

SOIL SURVEY

DETAILED-RECONNAISSANCE

Manatee County, Florida



UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In Cooperation with
FLORIDA AGRICULTURAL EXPERIMENT STATION

How to Use THE SOIL SURVEY REPORT

THIS SURVEY of Manatee County will help you to plan the kind of farming that will protect your soils and provide good yields. It describes the soils; shows their location on a map; and tells what they will do under different kinds of management.

Find your Farm on the Map

In using this survey, start with the soil map, which consists of the sheets bound in the back of this report. These sheets, if laid together, make a large photographic map of the county as it looks from an airplane. You can see woods, fields, roads, the coast line, and many other landmarks on this map.

To find your farm on the large map, use the index to the map sheets. This is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located.

When you have found the map sheet for your farm, you will notice that boundaries of the soils have been outlined in red, and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they appear on the map.

Suppose you have found on your farm an area marked with the symbol Be. You learn the name of the soil this symbol represents by looking at the map legend. The symbol identifies Bradenton fine sand.

Learn About the Soils on Your Farm

Bradenton fine sand and all the other soils are described in the section, *Soil Series, Types, and Phases*. Soil scientists walked over the fields and through the woodlands.

They dug holes and examined surface soils and subsoils; measured slopes with a hand level; noted differences in growth of crops, woods, brush, or trees; and, in fact, recorded all the things about the soils that they believed might affect their suitability for farming.

The scientists talked with people who use the soils, studied experimental data, and placed each soil in a management group. A management group is a group of similar soils that need and respond to about the same kind of management. Bradenton fine sand is in management group 7. Turn to the section, *Use and Management of Soils*, and read what is said about soils of group 7. You will want to study the table, which tells you how much you can expect to harvest from this particular soil under two levels of management. In columns A are the yields to be expected under ordinary management, and in columns B are yields to be expected under improved management.

Make a Farm Plan

For the soils on your farm, compare your yields and farm practices with those given in this report. Then decide whether or not you need to change your methods. The choice, of course, must be yours. This survey will aid you in planning new methods, but it is not a plan of management for your farm or any other farm in the county.

If you find that you need help in farm planning, consult the local representative of the Soil Conservation Service or the county agricultural agent. Members of your State experiment station staff and others familiar with farming in your county will also be glad to help you.

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SOIL SURVEY OF MANATEE COUNTY, FLORIDA¹

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United States Department of Agriculture in Cooperation with the Florida Agricultural Experiment Station

MANATEE COUNTY has a favorable climate and many kinds of soils that offer many opportunities for a diversified agriculture. Truck crops and citrus fruit are the major crops. In recent years, the raising of gladiolus for cut flowers and bulbs has expanded. The cattle industry is being improved by better pasture management and the introduction of breeds adapted to

detail, by reconnaissance methods, those soils better suited to forestry or other less intensive use. The survey was completed in 1947. Unless otherwise specifically indicated, all management practices are those considered appropriate in 1947.

General Character of the Area

Location and Extent

Manatee County is centrally located in the western part of the peninsula of Florida (fig. 1). It is bounded on the west by the Gulf of Mexico, on the north by Hillsborough County, on the east by Hardee and De Soto Counties, and on the south by Sarasota County. Bradenton is the county seat and largest city. Distances from Bradenton to varying points in Florida are shown in figure 1. According to the U. S. Census for 1950, the county has an area of 701 square miles, or 448,640 acres.

Physiography, Relief, and Drainage

Physiographically, Manatee County lies within the Floridian section of the Coastal Plain province (3).³ Cooke (2) described Florida as consisting of five natural topographic divisions: (1) The Central Highlands, (2) the Tallahassee Hills, (3) the Marianna Lowlands, (4) the Western Highlands, and (5) the Coastal Lowlands. According to this classification, Manatee County consists almost entirely of Coastal Lowlands. The Coastal Lowlands are made up for the most part of nearly level plains that have emerged so recently from the sea that large areas have undergone little or no dissection. Different invasions of the sea left successive shorelines at about 100, 70, 42, and 25 feet above present sea level. The marine terraces corresponding to these Pleistocene shorelines have been named, respectively, Wicomico, Penhaloway, Talbot, and Pamlico.

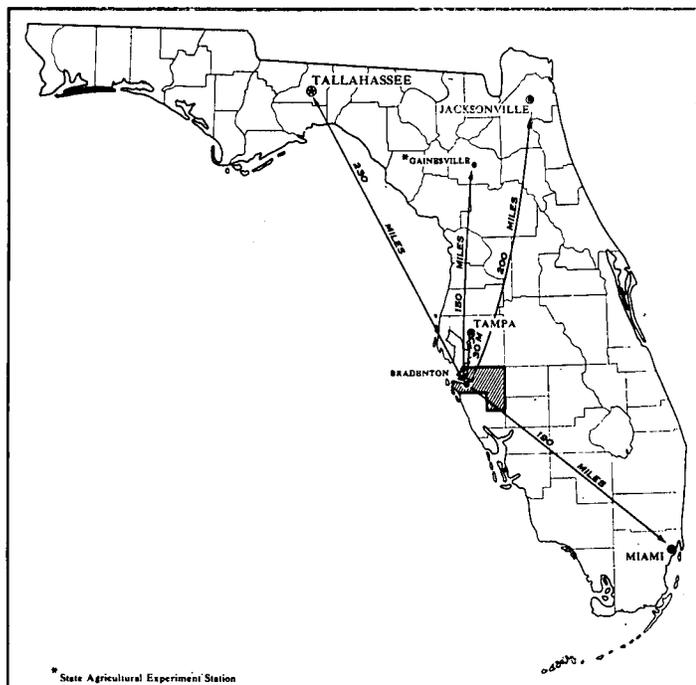


FIGURE 1. — Location of Manatee County in Florida.

the area. To aid farmers in determining the best uses for their land, the United States Department of Agriculture and the Florida Agricultural Experiment Station made this cooperative survey of the county. They mapped in detail the soils suitable for crops and in less

¹ Report by R. E. CALDWELL, Florida Agricultural Experiment Station.

² Fieldwork was done when the Soil Survey was a part of the Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration. Soil Survey was transferred to the Soil Conservation Service on November 15, 1952.

³ Numbers in italics refer to Literature Cited, p. 33.

Most areas of the county are level. Some areas in the central and northeastern parts, however, are gently rolling. The measured elevations range from slightly less than 150 feet in the northeastern tip to sea level along the gulf coast.

Manatee County has a fairly extensive drainage system. The Manatee River has its headwaters in the northeastern part of the county. It flows southwestward for several miles and then turns almost due west to flow into the Gulf of Mexico. It is joined by the Braden River just east of Bradenton. The Little Manatee River also has its origin in the northeastern corner of the county, but it flows in a northwesterly direction. It enters Hillsborough County near the central point of the county line between Hillsborough and Manatee Counties. The Myakka River starts in the far eastern part of the county and flows southwesterly through Myakka City and the Myakka River Valley State Park into Sarasota County. Numerous streams flow into each of these rivers. In addition, an extensive network of canals has been dug to drain some of the low areas.

Climate

The climate of Manatee County is oceanic and subtropical. Temperature in this locality is influenced by latitude, low elevation, winds that sweep across the peninsula, and proximity of the Gulf of Mexico. The area is therefore characterized by high relative humidity, short mild winters, and long warm summers. Rainfall is abundant throughout the year but is heaviest from June through September.

Manatee County is said to be "air-conditioned" because large bodies of water—the Gulf of Mexico and landlocked bays, rivers, and creeks—temper the atmosphere. These waterways give protection from frost during winter so that vegetables and all types of citrus fruits can be grown.

Normal monthly, seasonal, and annual temperature and precipitation compiled from records of the United States Weather Bureau Station at Bradenton are shown in table 1.

Temperatures above 95° F. occur frequently during summer. They are of short duration, however, because thunderstorms, which usually occur in the afternoon, bring about quick cooling. Days when temperatures fall below the freezing point are infrequent. They may occur about once or twice a year, and then generally in the eastern part of the county. Frost records kept at Bradenton over a 40-year period show that the latest killing frost in spring occurred on March 25, and the earliest killing frost in autumn, on November 18. There were 13 years with no killing frost in spring, and 21 years with none in autumn.

Some areas near the water are frost-free the year round. They are valuable for the growing of gladiolus for bulbs and cut flowers. Tomatoes, cabbage, peppers, escarole, lettuce, cucumbers, eggplant, and celery are also grown during the winter and are practically undamaged by frost. Grazing of native grasses and most of the improved pasture continues throughout the year. Shelter is not generally needed or provided for livestock. An occasional cold wave may cause the temperature to drop so low that the citrus groves are

TABLE 1.—*Temperature and precipitation at Bradenton, Manatee County, Fla.*

[Elevation, 10 feet]

Month	Temperature ¹			Precipitation ²			
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1944)	Wettest year (1912)	Average snowfall
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December	62.6	86	19	2.35	0.47	1.21	0
January	61.5	88	20	2.63	1.69	5.98	0
February	62.5	89	21	2.78	.27	1.95	(³)
Winter	62.2	89	19	7.76	2.43	9.14	(³)
March	66.2	91	30	2.34	4.83	1.86	0
April	70.7	93	37	2.31	1.90	1.13	0
May	75.6	97	45	3.06	2.30	3.84	0
Spring	70.8	97	30	7.71	9.03	6.83	0
June	79.8	100	55	6.90	3.10	25.62	0
July	80.8	99	61	9.73	5.75	9.03	0
August	81.2	98	62	9.58	3.09	6.45	0
Summer	80.6	100	55	26.21	11.94	41.10	0
September	80.0	98	56	7.64	2.37	16.65	0
October	74.5	96	39	3.39	3.38	5.61	0
November	67.2	90	27	1.89	.30	2.10	0
Fall	73.9	98	27	12.92	6.05	24.36	0
Year	71.8	100	19	54.60	29.45	81.43	0

¹ Average temperature based on a 72-year record, through 1955; highest temperature on a 61-year record and lowest on a 60-year record, through 1955.

² Average precipitation based on a 72-year record, through 1955; wettest and driest years based on a 72-year record, in the period 1869-1955; snowfall, based on a 22-year record, through 1952.

³ Trace.

"fired" to prevent damage to the trees and fruit. Temperatures of 28° F. or below occur about once or twice every 5 to 10 years, so that firing of the groves is seldom necessary.

The seasonal distribution of rainfall is usually good. There are some months, however, usually in the spring, in which crops are irrigated to prevent damage from drought. The average rainfall for June, July, and August over a 72-year period is 26.21 inches. The average rainfall for December, January, and February over this same period is 7.76 inches. Winter precipitation usually occurs in the form of slow steady drizzles.

During September and early October hurricanes are likely to form in the Caribbean Sea area. There is generally only one severe disturbance each year, however, and about one in every five strikes the peninsula of Florida. When a hurricane occurs, the accompanying rains do as much or more damage to the crops than the wind.

The mild winters have attracted tourists to this region in increasing numbers. Some stay to make permanent homes. Bradenton, the county seat, is a

well-known winter resort. Its population during the tourist season, which starts about the first of October and lasts until late April, is about double that in the summer months.

Water Supply

The city of Bradenton has a reservoir and modern filtration plant on the Braden River which furnishes an abundant supply of water. Most other communities rely on deep wells. In the rural sections, water for home use is pumped from wells by hand or by windmill, gasoline engine, or electric motor.

Water for livestock is plentiful in the many ponds, streams, canals, and rivers. In a few places windmills and wells are needed to furnish water for cattle, especially during dry periods. Artesian water is available in some areas in the western part of the country. When artesian wells are used, they furnish an adequate supply of water for present irrigation needs.

Four methods of irrigation are used for commercial production of crops in this important agricultural area. They are as follows:

Between the row.—This method consists of running water down the rows or furrows. Alternate rows are usually irrigated at one time, and the other rows are watered the next time. This method is used for all crops on practically all of the finer textured hammock land. In the citrus groves, the water is carried through pipes or hose to various parts of the orchard and is released into the shallow furrows.

Tile.—In this method hollow tile is placed in the ground and the water moves to the surface by capillary action. Little labor is required to irrigate a field in this manner. The tile is fairly costly to install, but it makes a permanent improvement on the land.

Seepage.—In this method of irrigation, small ditches are spaced throughout the field. When they are flooded, the water seeps laterally to the areas between them. This method is used commonly on Leon and Immokalee soils, which have a pan layer that restrains the downward movement of water.

Overhead.—In overhead irrigation, water is put under pressure and forced through pipes to sprinklers. The sprinklers are spaced at intervals to give complete coverage of the field. To obtain greater pressure usually only one line of sprinklers is used at a time. The line is moved progressively across the field as the water is needed. This system is used very successfully with cauliflower and gladiolus on Leon soils. Because most crops are not affected by salty water so quickly when overhead irrigation is used, this system is advantageous in localities where salt is getting into the water supply.

Land Use and Types of Farming

According to the United States Census of Agriculture in 1954, the average size of the 804 farms reported in the county was 384.5 acres. Land in farms aggregated 309,125 acres, or 68.9 percent of the 448,640 acres in the county. The farms reported 40,563 acres in cropland, 109,567 in pasture, 150,219 in woodland, and

8,776 acres in houselots, roads, wasteland, and other areas. Some areas are in forest or State parks and are used for recreational or other nonagricultural purposes. A considerable area is in shallow ponds, marshes, swamps, or coastal beach.

Most of the farms are located on the better soils of the hammock lands in the western part of the county. Vegetable farms are dominant in this area, although some citrus fruit is grown. Citrus groves are generally planted on the slightly higher, better drained soils, but citrus fruit can be grown on the lower hammock soils if canals are dug to provide better drainage. Other citrus-producing areas are near Parrish, Bethany, Oak Knoll, and Duette. Most of the cattle are grazed in the central, eastern, and southeastern parts of the county.

Soil Associations

Soil associations are well-defined groups of soils, not necessarily similar, that occur in close geographic association. They influence the type of agriculture and agricultural practices best suited to a general geographic area. Because of such a grouping, it is possible to make more generalized soil maps from detailed soil maps. A map of the county based on such a generalization is also useful for county-wide planning because it shows the general pattern of soils of the county.

General patterns of soils are shown on the colored soil association map in the back of the report. With the exception of one association that consists of miscellaneous land types in which the soil materials are so variable that they are not classified into soil series and types, the soils within each association have many similar important morphological characteristics. For the convenience of those interested in the possible uses of the different soils, each of the soil associations is described and the major soils within it are named. Each association as depicted on a small scale map also has a number of minor soil inclusions that may be quite different from the major soils of the association. The boundaries of the eight soil associations in the county are shown on the soil association map in the back of the report, and a description of each soil association follows.

1. Excessively to Moderately Well Drained, Deep, Sandy Soils

This association consists of soils of the St. Lucie, Lakewood, and Pomello series. They occur chiefly on the higher knolls and ridges throughout the eastern part of the county and in smaller areas on ridges nearer the coast. St. Lucie soils have, to depths greater than 42 inches, white, loose, incoherent sands beneath a thin light-gray surface soil. Lakewood soils have similar white sands to depths of 10 to 24 inches and are underlain by yellow to brownish-yellow sands. Neither St. Lucie nor Lakewood soils have a normal water table within 72 inches of the surface. Pomello soils are somewhat similar to the St. Lucie, but they have slightly more organic matter in their surface soils and

normally have a water table within 72 inches. Pomello soils usually have an organic pan at depths of 42 to 72 inches.

The native vegetation consists of sand pine and scrub oaks in the St. Lucie and Lakewood soils, and scrub oaks, longleaf pine, and saw-palmetto on the Pomello soils. The soils are low in organic matter and mineral plant nutrients and are very droughty, hence they are poorly suited to annual crops and citrus. Pasture grasses grow only sparsely unless intensively fertilized and irrigated. Little grazing is furnished by the native cover, although the scrubby growth furnishes some shade for livestock. During periods of high water, the higher areas of these soils sometimes furnish a place of refuge for animals. In the western part of the county, most areas of these soils have been developed into urban subdivisions. Here, under intensive management, the soils are suitable for citrus, mangoes, and other subtropical fruits.

2. Somewhat Excessively to Moderately Well Drained, Deep, Sandy Soils

This association contains chiefly soils of the Lakeland, Blanton, Orlando, and Huckabee series. These soils occur on level to gently undulating areas in all parts of the county. They have developed from thick deposits of unconsolidated sands. Lakeland soils generally have gray to brownish-gray surface horizons underlain by yellowish-brown to brownish-yellow subsoils. Blanton soils have gray surface soils and light-gray subsoils faintly mottled with pale yellow or white. Orlando soils are similar to the Lakeland and Blanton soils except that they have darker and thicker surface layers.

The native vegetation on these soils consists mostly of oaks and pine, with an undergrowth of native shrubs and grasses. The soils of this association are well suited to citrus and other subtropical fruits, general farm crops, improved pasture, and forest. Most areas are used for citrus groves or general farm crops.

3. Somewhat Poorly Drained Sandy Soils

This association consists principally of Scranton and Ona soils. It occurs in small areas scattered throughout the county. Scranton soils have very dark gray to black surface layers, 8 to 16 inches thick, that are underlain by light brownish-yellow to pale-yellow, faintly mottled fine sands. Ona soils are similarly colored but have a distinct brown, organic-stained layer, 5 to 7 inches thick, immediately below the surface layer.

Scranton and Ona soils occupy the somewhat poorly drained positions of the flat pine lands. Relief ranges from level to very gently sloping, so that the movement of water across the surface is negligible. Internal movement of water is only moderate because of the relatively high water table. If water is adequately controlled on these soils, they are well suited to citrus and other subtropical fruits, vegetables, truck crops, and improved pasture. Most of the larger areas are in cultivation.

4. Somewhat Poorly Drained Sandy Soils With Organic Pan

The soils of this association occupy large areas in the county. They occur in a typical pattern of level flatwoods, interspersed with wet spots, shallow ponds, and indistinct drainageways. The Leon and Immokalee soils are about equally extensive and dominate the association. There are also St. Johns soils and many small areas of the poorly drained Rutlege and Plummer soils that occur along narrow drainageways and on other low positions in the flatwoods. In the eastern part of the county, the association includes small areas of Pomello soils.

The Leon soils have gray surface layers, underlain by lighter colored sands and a dark organic pan at depths of 18 to 30 inches. The Immokalee and St. Johns soils are, in most respects, similar to the Leon soils, except that the Immokalee has organic pans below 30 inches and the St. Johns has a darker surface soil. Rutlege soils have a thick dark-gray to black surface soil, 8 or more inches thick, whereas the Plummer soils have surface soils that are gray only and not so thick. All of these soils are dominantly of a fine sand texture throughout and are strongly acid.

The native vegetation consists of pine, saw-palmetto, and wiregrass on the Leon, Immokalee, and St. Johns soils. Swamp or marsh vegetation occurs on the more poorly drained Plummer and Rutlege areas. Soils of this association are well suited to improved pastures, and many areas are now being developed for this use. Many of these soils are used as cutover, undeveloped range for cattle. In the western part of the county, truck farms and improved pasture are more common. The soils of this association have several characteristics that seriously limit their suitability for the commercial production of citrus fruit. Complete water-control systems are needed to provide drainage in wet seasons and irrigation in dry seasons.

5. Somewhat Poorly Drained Soils Derived From or Influenced by Calcareous Materials

This association consists principally of soils of the Bradenton, Ruskin, Parkwood, Keri, and Broward series. These soils occur on level to nearly level sites predominantly in the western and the extreme southeastern parts of the county. They have gray to dark-gray surface layers that range from 4 to 8 inches in thickness. Below the sandy surface layers, Bradenton soils have fine-textured subsoils that are underlain by marl, usually within 42 inches. Ruskin soils are similar to the Bradenton except that they are underlain by shell-marl instead of marl. Parkwood soils consist of sands overlying thick deposits of marl. Keri soils have marl layers, 8 to 14 inches thick, between layers of sand all occurring within 42 inches of the surface. Broward soils have thin sand mantles over limestone.

Under natural conditions these soils support a native vegetation of live oak, cabbage palmetto, pine, and other trees, and an undergrowth of saw-palmetto, vines, and grasses. These plants furnish fair grazing, some

forest products, and food and shelter for wildlife. The soils are well suited to more intensive use and, when cleared, make excellent improved pasture. With adequate water control and good management, most of these soils are suitable for citrus and truck crops. They require bedding and careful water control when used for citrus fruit.

6. Poorly to Very Poorly Drained Soils Underlain and Influenced by Calcareous Materials

This association consists of soils of the Pompano, Delray, Manatee, and Arzell series. These soils are underlain by calcareous materials and usually occur near areas of better drained soils that were derived from or influenced by alkaline materials. These soils are usually only slightly acid in their surface layers and neutral to alkaline in their subsoils. Pompano soils have gray surface layers and light-gray to pale-yellow fine sands to depths of 30 inches or more. Delray soils are similar but have thicker and darker surface horizons and are finer textured throughout their profiles. Arzell soils consist almost entirely of very light gray to white sands to depths greater than 30 inches.

Under natural conditions, the dominant soils in the association are covered with water during part of each year. Some of the areas have a native vegetation of water-tolerant grasses and small shrubs that provide fair to good grazing for cattle and a habitat for wildlife. Other areas have a dense growth of trees and bushes. If water is adequately controlled on these soils, primarily by drainage, they are suitable for cultivated crops and improved pastures.

7. Very Poorly Drained Organic Soils

The soils of this association occupy lower physiographic positions than any other soils in the county and are very wet or inundated throughout the year. The soils of the Terra Ceia series dominate this group. These soils were derived from thick accumulations of the organic remains of reeds, rushes, and other aquatic vegetation that have accumulated in shallow ponds. These soils occur near Parrish in the north-central part of the county and in the southeastern part, north of Myakka Park. The undeveloped areas consist mostly of fresh-water marshlands. Developed areas are excellent for truck crops and improved pasture. Good management and proper water control are essential for best use of these soils.

8. Miscellaneous Land Types

This association consists of Alluvial land, Coastal beach, Fresh water marsh, Fresh water swamp, Made land, Shallow ponds with grass, Shell mounds, Tidal marsh, and Tidal swamp. These land types consist of mixtures of soil materials that vary in color, texture, and composition. Coastal beach, Shell mounds, and Tidal swamp occur near the coast.

Coastal beach consists of dunelike ridges of light-gray to white fine sands mixed with various quantities of broken shells. It occurs on the gulf side of the larger islands and along areas of the mainland. The vegetation ranges from a few salt-tolerant grasses and an occasional cabbage palmetto to a rather thick growth of cabbage palmetto, live oak, cedar, myrtle, saw-palmetto, and various grasses. The soil has little or no agricultural value. Near the coast it is used for homesites and resorts.

Tidal marsh has a cover of salt-tolerant grasses and shrubs, whereas Tidal swamp has a dense growth of mangrove trees.

Alluvial land occurs along some of the larger streams and rivers and has a variable cover of hardwoods, shrubs, and grasses. It has little agricultural value because it is frequently inundated during the rainy seasons.

Shallow ponds with grass, Fresh water marsh, and Fresh water swamp occur throughout the county. They provide some grazing and water for livestock.

Made land includes those areas which have been filled in by man, mostly along the Manatee River near Bradenton and Palmetto. These small inextensive areas are used chiefly for building sites.

Soils of Manatee County

The parent material of the soils in Manatee County is predominantly unconsolidated marine sands. Marl beds, however, lie within a depth of 14 to 40 inches in many places. Organic accumulation, chiefly muck, is the major parent material in other places. The soils, with the exception of organic soils, have a sandy surface layer and are low in organic matter. Many are sandy to a depth of several feet. The soils of Manatee County are low in supply of plant nutrients; they are generally strongly acid, except where marl occurs within a few feet of the surface.

The St. Lucie and Lakewood fine sands are the light-colored, acid, very sandy, excessively drained soils at one extreme of the mineral soils, and soils of the Manatee series are the alkaline, poorly drained, dark clayey soils at the other extreme. Many of the soils have an organic pan (dark-colored layer) in the subsoil, or a layer of marl, rock, or iron concretions in the substratum.

The soils in the eastern part of the county in general are derived from thick beds of sand and clay. They are strongly acid and low in organic matter and plant nutrients. The most extensive soils in the eastern part are Leon and Immokalee fine sands, which occupy the flat pineland called flatwoods. The soils in the western and extreme southeastern parts are derived mostly from, or influenced by, calcareous (lime-bearing) materials. They are commonly referred to as "calcareous soils," although the surface layers are slightly to moderately acid in most places. Soils occurring in slight depressions, however, may be neutral or slightly alkaline in the surface layer if they receive water from surrounding calcareous areas.

Soil Series, Types, and Phases

In this section a short description of each of the series and miscellaneous land types in the county is given. Each series is followed by a more detailed account of its soil type or phase. Other soil types and phases in the series are also described and their relationship to the typical soil is shown. The relationship of the soil types and phases to the agriculture of the county is noted. The different soils are identified by the same symbols that are used on the soil map in the back of this report to show their location and distribution in the county.

The important characteristics of the major soil series, phases, and miscellaneous land types are shown in the supplement in the back of this report. The acreage and proportionate extent of the soils mapped are shown in table 2.

ALLUVIAL LAND

Alluvial land (Ac).—This miscellaneous land type consists of wet or swampy areas and riverwash. It occurs on the flood plains along the larger streams. The soil horizons in general are not well defined, and the texture, color, and consistence of the soil material varies so greatly that it is not practical to separate the component soils on a map of the scale used in this survey.

Alluvial land is widely distributed; the larger areas are in the central and eastern parts of the county. The land is not cultivated, because of its susceptibility to flooding, the wide differences in the soil material, and the cost of clearing.

The vegetation on Alluvial land consists mostly of a heavy stand of hardwoods, chiefly gum, oak, maple, hickory, bay, and magnolia. A scattered growth of slash pine occurs in the more open areas. These areas furnish some grazing and shade for livestock during seasons when the water table is high. Forest is probably the best use for most of this land type.

ARZELL SERIES

The Arzell series is poorly drained and occupies low positions in association with the St. Lucie, Plummer, and Pompano soils. The surface layer is light gray to nearly white and is underlain by white or pale-yellow sand. The profile shows little horizonation. The surface layer is lighter colored than that of the Plummer and Pompano soils. The Arzell soil is not so well drained and is more nearly level than St. Lucie soil. It has little agricultural value because of its low fertility.

Arzell fine sand (Ab).—This soil has developed in thick deposits of unconsolidated sands. It is in narrow bands around ponds or in low, flat, poorly drained areas that were once occupied by shallow water or by ponds filled with water grasses. The surface soil contains little organic matter and is light gray or nearly white. The native vegetation consists of prairie grasses and some slash pine.

Profile description:

- 0 to 1 inch, light-gray fine sand.
- 1 to 42 inches, white loose fine sand.

Most areas in the central and eastern parts of the county are in slight depressions in the flatwoods. Many of these have a dingy gray to brown stained

TABLE 2.—Approximate acreage and proportionate extent of soils mapped

Soil	Area	Extent
	<i>Acres</i>	<i>Percent</i>
Alluvial land	13,642	3.0
Arzell fine sand	703	.2
Blanton fine sand, brown layer phase	3,215	.7
Blanton fine sand, nearly level phase	2,359	.5
Blanton fine sand, undulating phase	168	(¹)
Braden fine sand	113	(¹)
Bradenton fine sand	5,121	1.1
Bradenton fine sand, deep phase	2,097	.5
Bradenton fine sand, thick surface phase	131	(¹)
Bradenton fine sand, thick surface deep phase	1,509	.3
Broward fine sand	1,244	.3
Broward fine sand, heavy substratum phase	1,888	.4
Broward fine sand, shallow phase	303	.1
Coastal beach	1,439	.3
Delray loamy fine sand	3,555	.8
Delray mucky loamy fine sand	305	.1
Fresh water marsh (unclassified soils)	7,185	1.6
Fresh water swamp (unclassified soils)	8,696	1.9
Huckabee-Kalmia fine sands	473	.1
Immokalee-Leon fine sands	60,848	13.6
Keri fine sand	480	.1
Lakeland fine sand, nearly level phase	3,458	.8
Lakeland fine sand, undulating phase	251	.1
Lakewood fine sand	481	.1
Leon fine sand, heavy substratum phase	13,795	3.1
Leon fine sand, light colored surface phase	17,863	4.1
Leon-Immokalee fine sands, gently sloping phases	1,873	.4
Leon-Immokalee fine sands, nearly level phases	167,663	37.4
Made land	635	.1
Manatee fine sandy clay loam	381	.1
Manatee fine sandy loam-loamy fine sand	2,582	.6
Manatee mucky loamy fine sand	595	.1
Ona fine sand	6,417	1.4
Orlando fine sand	554	.1
Parkwood fine sand	1,308	.3
Parkwood fine sand, shallow phase	407	.1
Plummer fine sand	5,260	1.2
Pompano fine sand	468	.1
Pompano-Delray fine sands	2,260	.5
Pomello fine sand	23,438	5.2
Ruskin fine sand	2,688	.6
Rutlege fine sand, gently sloping phase	5,029	1.1
Rutlege fine sand, nearly level phase	23,612	5.3
St. Johns-Leon fine sands	3,060	.7
St. Lucie fine sand	9,208	2.1
Scranton fine sand	1,132	.3
Shallow ponds with grass	23,710	5.3
Shell mounds	80	(¹)
Stough fine sand, dark surface phase	572	.1
Terra Ceia muck	123	(¹)
Tidal marsh	1,817	.4
Tidal marsh, high-lying phase	451	.1
Tidal swamp	6,894	1.5
Miscellaneous (urban areas, airports, etc.)	3,071	.7
Mine pits and dumps	35	(¹)
Water area	1,995	.4
Total	448,640	100.0

¹ Less than one-tenth of one percent.

layer, 8 to 10 inches thick, at depths of 20 to 30 inches. Below this is light-brown or gray sand that is lighter colored with depth. The soil is medium to strongly acid except in some places in the western part of the county. In these areas Arzell fine sand is in association with Broward, Keri, or Ruskin soils. These areas are underlain by calcareous material that causes the soil to be slightly acid to neutral.

Also mapped with this soil are a few areas having a

finer textured substratum at 24 to 42 inches. Areas of Charlotte fine sand, too small to be mapped separately, are also included with this soil. The Charlotte soil has a brownish-yellow or orange subsoil of fine sand. It is less acid than the Arzell soil.

Areas of Arzell fine sand in Manatee County are too small to be used extensively for agriculture. Most of this soil is in forest or unimproved pasture.

BLANTON SERIES

The Blanton series includes those sandy upland soils that have gray to light-gray surface layers and spotted pale-yellow and light-gray sandy subsoils. The soils have formed from thick deposits of unconsolidated acid sands and are associated with the St. Lucie, Pomello, Lakeland, and Leon soils. They have darker colored surface layers and are not so loose and dry as those of the St. Lucie and Pomello soils. The subsoil is grayer or less yellow than that of Lakeland soils. Blanton soils are better drained and lack the organic pan that is in soils of the Leon series.

Blanton fine sand, nearly level phase (Bb).—This soil occurs on the higher ridges in the county. Its native cover consists of bluejack or upland willow oak (4), smaller stands of pine, and an undergrowth of wire-grass and saw-palmetto. The relief ranges from level to gently undulating, and drainage is good. The largest areas are near Bethany; smaller areas are distributed throughout much of the county. This soil is strongly acid throughout. It is low in organic matter and plant nutrients. It is very rapidly permeable, and its capacity for holding a supply of moisture available to plants is low.

Profile description:

- 0 to 6 inches, gray to light brownish-gray loose fine sand; contains a small amount of organic matter.
- 6 to 42 inches, spotted pale-yellow and light-gray loose fine sand.

In mapping this soil in areas next to Lakeland fine sand, it was difficult to make a sharp delineation between the two soils, as they grade into one another. In a few places, there was little of the pale-yellow sand in the subsoil; in others, the subsoil was a light yellowish-gray sand with little or no spotting. In general, therefore, Blanton soils as mapped are those upland soils that are darker than those of the St. Lucie and Pomello series and are lighter than those of the Orlando and Scranton soils. They do not possess the strong yellow or brownish-yellow subsoil of the Lakeland soils.

In some areas near large streams where the vegetation is more dense, the hammocks are covered with growth of water and laurel oaks, other hardwood species, and various shrubs and vines.

Practically all of this soil in the western part of the county and large areas in the central and eastern parts are used for growing citrus and field crops. However, much of this soil occurs on knolls and ridges in the flatwoods, where it supports only a limited amount of grazing and shade for livestock.

This soil makes good response to proper fertilization and green-manure crops. Crotalaria, one of the best crops for improving the soil and increasing yields, is commonly used. Dolomitic limestone has been beneficial to citrus and some field crops.

Blanton fine sand, undulating phase (Bc).—This soil has stronger slopes than Blanton fine sand, nearly level phase. The gradients range from 2 to 8 percent. Most of this soil is on slopes of the ridges that border the larger streams and rivers. The most extensive areas are near Bethany and in the north-central part of the county along the Little Manatee River.

Blanton fine sand, brown layer phase (Bc).—This soil differs from Blanton fine sand, nearly level phase, in having a brown-stained subsoil and more live oak and scrub oak in the natural vegetation. It is very low in plant nutrients and is strongly acid.

Profile description:

- 0 to 8 inches, medium to light-gray loose fine sand.
- 8 to 14 inches, brown-stained fine sand, weakly cemented with organic matter. In places this layer is nearly a hardpan and may occur as deep as 24 inches below the surface.
- 14 to 24 inches +, pale-yellow loose fine sand grading into light-gray fine sand with depth.

A variation included in the mapping unit has a layer of lighter gray fine sand between the surface layer and the brown-stained layer. The presence of the lighter sand causes the profile to resemble somewhat Leon fine sand, light colored surface phase. However, the variation occurs on higher, better drained positions and has a heavier oak cover and a less compact organic layer than the Leon soil.

This soil is mostly in the eastern part of Manatee County. The largest areas are in unimproved pasture. Some acreage is used for citrus fruits and for general farming. It is fairly well suited to these uses but less so than the typical Blanton, Orlando, and Lakeland fine sands.

BRADEN SERIES

The soil of the Braden series occurs on stream terraces. It borders small streams or is on the point of land formed by two intersecting streams. It has a sandy clay loam subsoil that contains fragments of calcareous rock. The Braden soil is usually associated with Ruskin, Leon, and Immokalee soils but differs from them in occupying stream-terrace positions. In addition, the Braden soil lacks the definite shell-marl layer present in the Ruskin soil. It does not have the pan of organic-stained sand that is in the Leon and Immokalee soils.

Braden fine sand (Bd).—This soil is easily recognized because it occurs on stream terraces and has a native cover of pine, saw-palmetto, water and laurel oaks, and an occasional cabbage palmetto. The relief is nearly level to very gently sloping toward the stream. Drainage is imperfect to poor. The profile is acid in the surface layers and neutral to mildly alkaline in the finer textured subsoil. Most of this soil is in the south-central part of the county around the headwaters of the Braden River.

A representative profile:

- 0 to 4 inches, medium- to dark-gray fine sand.
- 4 to 12 inches, light- to medium-gray fine sand; some brown-stained fine sand around root channels.
- 12 to 20 inches, brownish-yellow fine sand, mottled or streaked with light-gray and light-brown fine sand.

20 to 32 inches, light-gray to pale-yellow loamy fine sand, mottled with streaks of orange-colored fine sand. This loamy layer is absent in places.

32 to 40 inches, mottled gray, brown, and brownish-yellow fine sandy loam to fine sandy clay; contains calcareous rock fragments; grades into brown and yellow fine sand.

The depth to the fine sandy loam or fine sandy clay layer ranges from 18 to 36 inches or more. This layer occurs most frequently at about 30 inches. The upper layers are also somewhat variable in color and thickness. The surface soil in some places is 3 to 6 inches thick, and the third layer in places is a brown fine sand that somewhat resembles an incipient pan layer.

Practically none of this soil is cultivated, mainly because it lies in the cooler parts of the county and is subject to occasional flooding. This is potentially as good a soil for agriculture as some of the thicker surface phases of the Bradenton soils, but it is used almost entirely as unimproved rangeland. It holds a good supply of water and would be excellent for improved pasture.

BRADENTON SERIES

The soils of the Bradenton series were derived from thin beds of sand and loamy fine sand that overlie sandy clay loam and clay loam materials that rest on marl. They are associated with Manatee, Parkwood, and Ruskin soils and are somewhat similar to the Sunniland soils as mapped farther south in Collier County.

Bradenton soils are lighter colored in the surface layer, better drained, and slightly higher than Manatee soils. They differ from the Parkwood soils in having a more acid surface layer, slightly better drainage, and a finer textured layer above the marl. Soils of the Bradenton series are slightly lower in position and are more brown in the lower profile than the Ruskin soil. They differ from the Sunniland soils in that they overlie marl instead of calcareous sandy clay loam.

Bradenton fine sand (Be).—This is one of the major hammock soils in the western part of Manatee County. Small areas occur in the extreme southeast, however. This soil occupies a slightly lower position than the surrounding flatwoods soils and is covered with a fairly thick hammock growth of live oak, ash, cabbage palmetto, and slash pine. The undergrowth consists of saw-palmetto, vines, and shrubs. Relief is level to nearly level. Surface drainage is slow, and internal drainage is medium to slow.

A representative profile in a virgin area near Bradenton:

- 0 to 6 inches, gray to dark-gray nearly loose fine sand; strongly acid.
- 6 to 12 inches, light-gray loose fine sand; strongly acid.
- 12 to 18 inches, grayish-brown to brown nearly loose fine sand becoming loamy at its lower limits; strongly acid.
- 18 to 26 inches, dark grayish-brown heavy fine sandy loam or light fine sandy clay loam; friable when moist, slightly plastic when wet, hard when dry; strongly acid.
- 26 to 36 inches, olive-gray friable fine sandy loam with many reddish-yellow and brownish-yellow mottles; slightly plastic when wet; slightly acid.
- 36 to 42 inches +, light-gray to white marl, with a texture of fine sandy loam or silt loam; very friable; mildly alkaline.

Depth to marl commonly ranges from 30 to 42 inches, but the combined thickness of the first three layers may range from 16 to 30 inches. This mapping unit therefore includes those soils of the Bradenton series that

have a slightly plastic horizon of fine sandy loam or fine sandy clay loam at less than 30 inches from the surface and marl within 42 inches of the surface. In places the surface soil is lighter in color than in the profile described because it contains less organic matter. Locally a 4- to 6-inch layer of brown fine sand, an incipient pan, lies just above the finer textured layer.

This soil and the other soils of the Manatee series make up most of the hammocks near Ellenton and Bradenton. Some of the oldest farms in the county are located in this area. Bradenton fine sand is one of the best soils in the county for growing truck crops because it requires less fertilizer than most soils under cultivation. Citrus trees also do very well if proper drainage is established. The groves may not live so long as those planted on the deeper sands because they are more subject to root rot. So far, a decline of groves has been noticed only on Terra Ceia Island where the trees are 50 to 70 years old.

The fine-textured layer in Bradenton fine sand is so close to the surface that it causes the sandy surface layer to become saturated more quickly in wet weather and to dry more quickly in droughts than the thicker surface layers of some other soils. This disadvantage can be overcome by providing ditches to carry off the excess water and by installing some system of irrigation for use during dry spells.

Bradenton fine sand, deep phase (Bf).—This soil differs from Bradenton fine sand in being slightly more acid and in having the marl at a greater depth than 42 inches. The surface characteristics of relief, drainage, and vegetation are the same, and the clay layer lies at similar depths. As mapped, however, this soil may contain small areas in which a brown-stained sandy layer overlies the clay subsoil and some in which the marl may be just within 42 inches, where it is near areas of the regular Bradenton fine sand.

Bradenton fine sand, thick surface phase (Bg).—This soil differs from Bradenton fine sand only in that the clay subsoil layer lies below 30 inches. In both soils marl occurs within 42 inches, but the marl is generally deeper in this soil than in Bradenton fine sand. Relief, drainage, and vegetation of the two soils are about the same. Where this soil is associated with Bradenton fine sand, it is usually slightly higher in elevation; it is on the outer edges of the hammocks between that soil and the soils of the flatwoods.

Its use and capabilities are about the same as those of the typical Bradenton fine sand, but it is slightly inferior for growing truck crops and somewhat better for citrus fruits. This soil is mainly in the western part of the county.

Bradenton fine sand, thick surface deep phase (Bh).—This is another of the variable transitional soils that lie between the lower hammocks and the flatwoods. The surface layer is thicker and the marl is deeper than that of the typical soil of the Bradenton series. The clay subsoil occurs at depths between 30 and 42 inches, and the marl is below 42 inches. Relief, drainage, and the native cover are similar to those of Bradenton fine sand. This soil occurs only in the western and extreme southeastern parts of the county.

A representative profile in a virgin area in the western part of the county:

0 to 6 inches, gray to dark-gray fine sand; strongly acid.
 6 to 14 inches, light-gray to medium-gray loose fine sand; strongly acid.
 14 to 23 inches, yellowish-brown to brownish-gray loose fine sand; strongly acid.
 23 to 38 inches, yellow to pale-yellow fine sand; medium acid.
 38 to 42 inches +, light-gray and brown mottled fine sandy clay loam; medium to slightly acid; neutral to mildly alkaline in the lower part near the marl or limestone which occurs at 60 inches or less.

In the southeast, this soil is generally more poorly drained, has slightly darker surface layers, and is less acid throughout the profile than in the western part of the county. In places the surface layer is neutral. The layer of fine sandy clay loam contains fragments of limestone or is underlain by a calcareous clay, in some places within 42 inches of the surface. In both sections of the county, the color, depth, and thickness of the layers vary somewhat; the fourth layer is absent in places. Locally, a brown layer occurs as the third layer. It ranges from a weakly cemented hardpan to a stained fine sand.

Most of this soil has never been cleared and is used as unimproved pasture. It is generally inferior to other Bradenton soils for truck crops, but it is about equally valuable for citrus fruits.

BROWARD SERIES

The soils of the Broward series have gray surface layers and brown to brownish-yellow subsoils that have developed from unconsolidated sands that overlie hard limestone. The surface soils and subsoils are strongly acid, except for a few inches above the limestone. The Broward soils are associated with Leon and Bradenton soils but differ in having hard limestone nearer the surface. Broward soils also lack the organic pan of Leon soils, and the subsoil is not so acid as that of the Leon soils. They do not have the thick layer of finer textured, slightly plastic materials that occur in Bradenton soils.

Broward fine sand (Bk).—This soil is mapped south and southwest of Bradenton and west of Oneco. Small areas occur on the east side of the Braden River, but most areas are nearer the coast. The relief is level or nearly level. This soil is slightly lower than the surrounding Leon soils and slightly higher than the Bradenton soils. Drainage is imperfect to poor. The plant cover consists of slash pine, an occasional cabbage palmetto, and some live oak, saw-palmetto, runner oak, and wiregrass.

A representative profile on the road to Cortez southwest of Bradenton:

0 to 6 inches, gray loose fine sand.
 6 to 12 inches, light-gray loose fine sand.
 12 to 24 inches, brown to brownish-yellow fine sand.
 24 inches +, hard limestone.

This soil is strongly acid to within a few inches of bedrock, where the reaction is slightly acid to neutral. The depth to limestone bedrock commonly ranges from 18 to 40 inches. In places a 1- to 2-inch layer of fine sandy loam or sandy clay loam overlies the limestone. This finer textured material is usually mottled with yellow and brown. The limestone is hard and pocketed and causes the many variations in this soil.

Most of this soil is in unimproved pasture, but some areas associated with Bradenton soils have been cleared

and are used for citrus fruits and truck crops. For the successful growing of citrus fruits, however, the underlying rock should be blasted or otherwise broken up before the trees are planted. Adequate drainage canals are also necessary.

This soil is used more for truck crops than for citrus groves, especially in areas near the coast that afford better protection from frost. If the land is used for vegetables, complete water control is needed.

Broward fine sand, shallow phase (Bm).—This soil usually borders ponds and swamps within areas of Broward fine sand, from which it differs chiefly in having the hard limestone at depths of 18 inches or less. In most places the average depth to bedrock is 12 inches. However, rock outcrops are common, especially near the rims of ponds and depressions. The exposed rock is noted on the soil maps by symbol. In its relief, drainage, and plant cover, this soil is similar to Broward fine sand. It occurs in a slightly lower topographic position, however.

This shallow soil is hard to cultivate and is used largely for unimproved pasture.

Broward fine sand, heavy substratum phase (Bl).—This soil differs from Broward fine sand in having a brownish-yellow fine sandy clay layer 4 to 8 inches thick over the hard limestone. This layer ranges from brown to mottled yellow, gray, and brown. Where this soil is associated with Leon soils, a brown organic pan lies just above the sandy clay layer. The depth to limestone is variable but averages about 30 inches.

This soil is generally in unimproved pasture, but small areas are in market gardens. The finer textured layer makes it slightly superior to Broward fine sand for improved pasture and vegetables.

COASTAL BEACH

Coastal beach (Ca).—This mapping unit consists of dunelike ridges of loose, gray to white, fine sand mixed with various quantities of broken shells. It is on the gulf side of the larger islands and keys and in places along the mainland. The most extensive areas are on Anna Maria and Longboat Keys, where the width of the belt ranges from a few hundred yards to 2 miles.

The native plant cover consists of salt-tolerant grasses. An occasional palmetto occurs in areas near the Gulf of Mexico. Included with this miscellaneous soil type, and marked on the map by symbol Ca2, is an area further inland that has a heavy growth of cabbage palmetto, some saw-palmetto, live oak, red-cedar, myrtle, bracken, and various grasses. A brown layer stained with organic matter often occurs in this soil profile.

Coastal beach is not suited to agriculture because of its very sandy nature and the prevalence of salt spray. It is used for homesites and resorts.

DELRAY SERIES

The Delray series consists of poorly to very poorly drained soils that have dark surface layers and heavy-textured subsoils. The subsoils are neutral to alkaline in reaction. Soils of the Delray series are associated with soils of the Arzell, Pompano, Plummer, Rutlege, and Manatee series. They have darker surface layers than those of the Arzell, Pompano, and Plummer soils.

They are slightly better drained and not so fine textured as soils of the Manatee series. The subsoils of the Delray series are neutral to alkaline, whereas those of the Rutlege series are acid.

Delray loamy fine sand (Dc).—This soil usually occurs in large shallow depressions that have been drained by ditches and canals. In most places it lies between soils of the Pompano series, which are above it, and soils of the Manatee series, which are in a lower position. Relief is level to very gently sloping. Drainage is poor to very poor. The original plant cover probably consisted of sawgrass, but the few remaining areas not under cultivation are generally in grasses, bonnets, lilies, and some willow and elder bushes. This soil occurs only in the western and extreme southeastern parts of the county in association with other soils derived from or influenced by calcareous materials.

A representative profile:

- 0 to 10 inches, dark-gray to black loamy fine sand; contains considerable organic matter; medium to slightly acid.
- 10 to 32 inches, gray loamy fine sand, in places streaked with brown or brownish-yellow fine sand; medium to slightly acid.
- 32 to 40 inches, gray fine sandy loam to fine sandy clay loam, mottled with brown and yellow fine sand; neutral in reaction.
- 40 inches +, gray fine sandy clay loam; mildly alkaline; marl or shell may occur between 42 and 60 inches.

This soil lies on calcareous material; otherwise it is the equivalent of Rutlege soils, which are strongly acid throughout the profile. Soils of the Delray series are less acid in the surface layer than Rutlege soils and are neutral to mildly alkaline in the subsoil. The surface soils are always dark and range from 8 to 16 inches or more in depth. The fine-textured layer is at depths of 30 to 42 inches, although a few small areas are mapped in which this layer is closer to the surface.

This is one of the best soils in the county for truck crops. The principal vegetables grown are tomatoes, lettuce, cabbage, string beans, and celery. Celery does particularly well in the Pearce sawgrass area in the western part of the county near the Sarasota County line. Most crops produce good yields with less fertilizer than is generally applied on many soils. The chief problem is to control water on the land. In southeastern Manatee County, Delray loamy fine sand is as good or better than most soils of the area for improved pasture, even with little or no improvement except drainage.

Delray mucky loamy fine sand (Db).—This soil is similar to Delray loamy fine sand except that it has more organic matter in the surface layer. It occurs in slightly lower topographic positions, usually in areas that were once shallow ponds, and is surrounded by soils that developed from or were influenced by calcareous materials. The largest areas are near the Pearce Canal in the sawgrass area and in the extreme southeastern corner of the county.

As mapped in the county, this soil has about the same profile variations as Delray loamy fine sand. In most places, however, the surface soil is a little thicker, averaging between 12 and 16 inches. Shell or marl often occurs within 42 inches of the surface.

This soil has much the same uses as Delray loamy fine sand, but it is better for crops because it contains

more organic matter. It is the principal soil used for celery. Yields of tomatoes, lettuce, cabbage, and sweet corn are excellent on this soil.

FRESH WATER MARSH

Fresh water marsh (unclassified soils) (Fc).—This mapping unit includes large areas of marsh that are damp the year round and are covered with fresh water during most of the rainy summer months. These areas were covered originally with sawgrass. They were drained and subsequently burned, however, and the plant cover now consists chiefly of bonnets, waterlilies, various prairie grasses, and occasional clumps of buttonbush, willow, and elder. The areas are all high in organic matter, and in some places they consist of layers of peat several feet thick.

Included with this miscellaneous land type are some soils that resemble those of the Rutlege series and various peats, peaty mucks, and mucks. In places where adequate drainage has been installed so that the land can be used for agriculture, the various soil units were mapped separately.

Very little of this marshland is cultivated; it is generally used for pasture. Where it is not flooded, it provides some excellent land for grazing. If drained, it should be valuable for growing many kinds of truck crops.

FRESH WATER SWAMP

Fresh water swamp (unclassified soils) (Fb).—This unit as mapped in Manatee County includes all low-lying forested areas that are covered with water most of the year. Several large areas are south and east of Parrish, and many small areas are well distributed in all parts of the county. Fresh water swamp (unclassified soils) varies considerably within short distances in texture, color, and organic-matter content, and in composition and thickness of the various layers. Because the areas are usually covered with water, it would not be practicable to separate the highly variable materials into soil types and phases. Some of the soils occurring in these areas are Rutlege fine sand, Plummer fine sand, peat, and peaty muck.

The native vegetation consists chiefly of bay, gum, ash, swamp maple, and water oak; some cypress and an occasional slash pine occur. A thick undergrowth of vines, briars, and water-loving plants has developed. Very few of the areas of Fresh water swamp are used for agriculture, but they have some value for forest or for grazing livestock during dry spells.

HUCKABEE SERIES

The soils of the Huckabee series border the larger streams and rivers in the county. They have developed from sediments washed from acid soils in higher positions. The gray to brownish-gray sandy surface layer is underlain by yellowish-brown to brownish-yellow sandy subsoil that becomes somewhat finer textured with depth. The Huckabee soils are associated with and are somewhat similar to the soils of the associated Lakeland and Kalmia series. They differ from the Lakeland soils by being on stream terraces and from Kalmia soils in having coarser textured subsoils.

Huckabee-Kalmia fine sands (Hc).—In mapping the terrace soils along the streams and rivers, it was found

that depth to the finer textured layer varies considerably. In many places this layer is below 30 inches, whereas in others it is less than 30 inches from the surface. Because 30 inches is the point at which a separation is made between the Huckabee and Kalmia soils, and also because the heavier textured layer is generally a fine sandy loam, these soils are mapped as a complex of Huckabee and Kalmia soils. The complex consists predominantly of Huckabee soils, which are mixed with smaller areas of Kalmia soils.

The distinguishing features of this complex are its position on the landscape and its association with certain other soils. It always occurs on terraces, usually near acid upland soils that have shades of yellow in their lower profiles. The relief is nearly level to undulating. Some slopes have gradients up to 3 percent. This complex is moderately well drained—both external and internal drainage are medium. It is strongly acid throughout the profile.

The native vegetation consists of longleaf and slash pines and a few oaks and an undergrowth of saw-palmetto, prairieclover, runner oak, and wiregrass. Generally areas of this complex are narrow and border the Manatee and Little Manatee Rivers and their tributaries in the central part of the county.

A representative profile of Huckabee fine sand in a virgin area along the Manatee River:

- 0 to 4 inches, light brownish-gray nearly loose fine sand.
- 4 to 12 inches, yellowish-brown nearly loose fine sand.
- 12 to 24 inches, brownish-yellow fine sand.
- 24 to 32 inches, brownish-yellow to yellow loamy fine sand.
- 32 to 42 inches, brownish-yellow to yellow fine sandy loam, mottled or spotted with yellowish red or reddish yellow.

The surface soil ranges from 2 to 8 inches in thickness and may be gray, brownish gray, or dark gray in color. The finer textured fine sandy loam layer occurs at depths ranging from 24 to 42 inches. In a few places it is even deeper. Locally a layer of white fine sand occurs at about 40 inches, or just below the fine sandy loam. Its position would indicate that the soil materials were deposited in layers.

A small area is in field crops and some citrus fruits. The rest is in unimproved pasture or abandoned fields where the incoming grasses have made rapid growth and formed good grazing land. This complex is fairly good for citrus fruits, certain field crops, and some truck crops. Practically all areas in Manatee County are in such narrow strips or are so far from hard-surfaced roads that they are not valuable for agriculture.

IMMOKALEE SERIES

The soils of the Immokalee series have developed from unconsolidated sands on flat poorly drained surfaces of the flatwoods areas. They are closely related to the Leon soils; they have positions, drainage, vegetation, and profiles that are similar. Immokalee soils are more poorly drained than the Leon soils, however, and are usually more level. In addition, an organic-stained layer is in Immokalee soils, usually at depths of 30 to 42 inches, whereas a cemented organic pan layer is in Leon soils.

The Immokalee soils occur in association with soils of the Broward, Plummer, Arzell, and Pompano series. They lack the rock or hard limestone substratum of the

Broward soils and are more acid and slightly better drained than the Plummer, Arzell, and Pompano soils.

Immokalee-Leon fine sands (10a).—Immokalee fine sand and Leon fine sand were mapped as a complex where their areas were so intermingled that it was not practicable to show them separately on a map of the size used in this survey. The complex consists of large areas of Immokalee fine sand and small inclusions of Leon fine sand. The relief is dominantly level or nearly level, but there are some very gently undulating areas and a few slight depressions. Drainage is poor, and in places water stands on the surface during the rainy season.

The native cover consists of slash pine, saw-palmetto, a few bushes of bitter gallberry, wiregrass, and other grasses. Large areas of this complex are in Manatee County, mostly in the eastern part.

A representative profile of Immokalee fine sand in a virgin area:

- 0 to 6 inches, medium-gray loose fine sand containing a small amount of organic matter; medium to strongly acid.
- 6 to 34 inches, light-gray to almost white loose fine sand; medium to strongly acid.
- 34 to 38 inches, dark-brown fine sand, stained and weakly cemented with organic matter; strongly acid.
- 38 to 42 inches +, brown fine sand grading through yellowish-brown and brownish-yellow to a pale-yellow or light-gray loose fine sand; medium to strongly acid.

A typical profile of Leon fine sand is described elsewhere in this report.

Slight variations from the described profile occur from place to place. In places the surface layer is 3 to 8 inches thick and is dark gray, especially when moist. The organic-stained layer also varies considerably in depth below the surface and in degree of hardness. At some places it occurs at a depth of less than 30 inches. In these places it is usually more compact than elsewhere and closely resembles the Leon soils. In most places, however, it lies between 30 and 42 inches and is fairly soft.

Another variation was noted in mapping this soil. Near Manhattan a finer textured horizon occurs about 40 inches below the surface and in most places is a mottled gray, brown, and yellow fine sandy loam. Because of the depth of this horizon, it was not practicable to set up a mapping unit consisting of the soil in which this horizon occurs. The presence of this horizon affects the overlying soil and makes it slightly better than the typical Immokalee fine sand for production of truck crops and vegetables.

Most areas of Immokalee-Leon fine sands are in forest or unimproved rangeland. Although most of the trees were removed from large areas during past timber operations, small pine trees are now becoming established. Other large acreages have been cleared and planted to improved pasture grasses for grazing cattle. Immokalee soils are slightly better than Leon soils for this purpose because they hold a better supply of moisture available to plants and have more organic matter in their darker and deeper surface layers.

Wherever it is economically feasible to do so, the land should be cleared and put into improved pasture. The uncleared areas should be protected from fire to promote natural reforestation. Improved pasture is generally the best use for most soils in the flatwoods.

KERI SERIES

The soil of the Keri series has developed from layers of fine sand and marl over sands. It occurs in positions similar to those of other soils in the flatwoods. Relief is nearly level to undulating, and drainage is imperfect to poor. The native vegetation consists of an open stand of slash pine, saw-palmetto, wiregrass, and scattered cabbage palmetto. The Keri soil is associated with soils of the Leon, Broward, and Bradenton series. It has a layer of marl in the profile but lacks the organic pan of the Leon soils. It overlies marl, instead of hard limestone as in the Broward soils, and lacks the finer textured layer above the marl that is in Bradenton soils.

Keri fine sand (Ka).—The marl layer occurs in Keri fine sand at depths below that of typical Keri soils previously mapped in the State. This soil differs from Broward soils in that it is underlain by 2 to 12 inches of marl or a yellow sand rather than a thick bed of hard limestone. All areas are in the western part of the county. Most of the larger areas are south of the Manatee River and east of Oneco.

A representative profile in a virgin area:

- 0 to 4 inches, gray nearly loose fine sand.
- 4 to 12 inches, light-gray loose fine sand.
- 12 to 18 inches, brown to yellowish-brown fine sand.
- 18 to 24 inches, yellowish-brown fine sand, somewhat loamy where this layer is mixed with the underlying marly material.
- 24 to 32 inches, soft whitish marl that usually contains numerous shell fragments.
- 32 to 42 inches +, yellow fine sand.

The reaction of this soil depends somewhat on the water table. In general, however, the upper layers are strongly acid, the marl stratum is strongly alkaline, and the deeper sands are about neutral and become slightly acid with increasing depth.

The profiles of Keri fine sand are variable in color and thickness of the layers. As mapped, the surface soil may be 3 to 6 inches deep and gray to dark gray. The brown layer in areas next to Leon soils is sometimes darker than typical and has almost the consistency of a hardpan. Locally, there are a few inches of a finer textured material just above the marl layer. The marl layer is the greatest variable—it ranges from 2 or 3 inches to 12 inches or more in thickness. It occurs at 20- to 42-inch depths and often contains a fair quantity of broken shells.

Practically all of this soil is in open range, but a small acreage is in truck crops. It has much the same uses and potentialities as the deeper phases of Bradenton soils. It should produce good yields of tomatoes, eggplant, and peppers.

LAKELAND SERIES

The soils of the Lakeland series have developed from thick deposits of unconsolidated sands. Until 1947 they were included with the Norfolk series. The Norfolk series is now restricted to soils having finer textured materials within 30 inches of the surface, and the Lakeland series consists of those soils where this finer textured layer is below 30 inches.

Lakeland soils are also related to and associated with soils of the St. Lucie, Lakewood, Pomello, and Blanton series. They have darker surface layers and a looser

consistence than the St. Lucie, Lakewood, and Pomello soils. They have stronger yellow or brownish-yellow subsurface layers than Blanton soils.

Lakeland fine sand, nearly level phase (lb).—This soil is most easily recognized on sandy upland areas by the strong stand of turkey oak (*Quercus laevis*). In addition to turkey oak, the native vegetation consists of pine, bluejack or upland willow oak, a few scattered saw-palmetto, and various grasses. External and internal drainage is good, and the relief ranges from nearly level to gently rolling. This soil is strongly acid. The largest acreage is near Bethany, but other major areas are southeast of Bradenton and in the north-central part of the county near the Little Manatee River.

Profile description:

- 0 to 4 inches, medium-gray nearly loose fine sand; contains some organic matter.
- 4 to 12 inches, pale-olive to pale-yellow loose fine sand.
- 12 to 42 inches +, brownish-yellow to yellow loose fine sand.

Because of their close relationship, this soil and Blanton fine sands are difficult to map separately in areas where they are adjacent. In a few scattered areas the surface layer of Lakeland fine sand, nearly level phase, is darker gray, usually tinged with brown, and 8 to 10 inches thick. In such places the subsurface soils are paler yellow. The whole profile represents a transitional soil about halfway between Orlando and Lakeland soils. Typical is a description of a profile on Bethany road about a half mile northeast of Sullivan Bridge.

A heavy hammock phase of Lakeland soil occurs along areas of the larger streams and rivers, mainly along the loops of the Little Manatee in the north-central part of the county. On this hammocky soil the cover is chiefly water and laurel oaks and a few other hardwoods, with a heavy undergrowth of shrubs and vines. These areas are indicated on the map by the symbol lb2.

In a few small areas a similar soil occurs that has a thick scrub growth of sand pine, rosemary, a few live oak, and an undergrowth of cactus, briers, shrubs, and vines. This type of vegetation is also indicated on the map by the symbol lb2. In Manatee County, therefore, soils included with Lakeland fine sand, nearly level phase, may have sandy surface layers that are light gray, gray, or brownish gray and upper and lower subsoils that are dominantly yellow or brownish-yellow sands. Their native cover is also variable.

Probably a fourth of Lakeland fine sand, nearly level phase, is cultivated. Most of it is in citrus fruits, although corn, peanuts, sugarcane, watermelons, and sweetpotatoes are grown on a smaller scale. Citrus fruits make the best use of this soil because the trees thrive and the climate is particularly favorable.

Lakeland fine sand, undulating phase (lc).—This soil is similar to Lakeland fine sand, nearly level phase, except that most of its slopes are stronger than 2 percent. A few range up to 10 percent or more, although most gradients are 5 percent or less. The larger areas are located near Bethany where the upland soils slope toward the Manatee River.

Very little of this soil is used for agriculture, although its capabilities are about the same as those for Lakeland fine sand, nearly level phase. Because it is located on stronger slopes and is subject to some erosion, the surface layer is usually thinner. Trees furnish shade for livestock and the grasses supply some grazing. The land could be put to better use if planted to citrus fruits or to corn, peanuts, chufas, and watermelons.

LAKWOOD SERIES

The soil of the Lakewood series has developed from thick deposits of unconsolidated sands. It consists of an inch or two of light-gray sand over several inches of loose white sand. At 10 to 20 inches the loose white sand overlies brownish-yellow or deep-yellow loose incoherent sand that extends to a depth of 5 feet or more. Lakewood soil occurs in association with St. Lucie, Lakeland, Blanton, and Pomello soils. It differs from St. Lucie, Blanton, and Pomello soils in having a brownish-yellow subsurface layer and a lighter colored surface layer. It is more droughty throughout the profile than Blanton, Pomello, or Lakeland soils.

Lakewood fine sand (lg).—This soil lies on high sandy ridges adjacent to St. Lucie soils. Soils of both series have the same native scrub vegetation of sand pine, rosemary, occasional saw-palmetto, dwarf live oak, cactus, and a few grasses and shrubs. The relief ranges from nearly level to undulating. Drainage is excessive, and the soil is strongly acid. Most of this soil lies on the higher knolls and ridges in the eastern section of the county. Some areas, however, are in the western part in Palma Sola and along the Tamiami Trail south of Bolees Creek.

A representative profile:

- 0 to 2 inches, light-gray loose fine sand that contains a small amount of organic matter.
- 2 to 16 inches, white loose fine sand.
- 16 to 42 inches +, yellow to brownish-yellow loose fine sand.

Some variation from the typical vegetation was noted in mapping this soil. Near the Little Manatee River, the growth in places consists almost entirely of a dense stand of dwarf live oak. In the Whitfield Estates, in the extreme southwestern part of the county, some scrub hickory occurs among the regular scrub cover.

In the east, this soil is used for unimproved pasture. Grazing is very poor, but the trees furnish shade for livestock and the knolls are a place of refuge for cattle during high water. In the west, the agricultural value of Lakewood fine sand depends chiefly on its location. In the Palma Sola area some of it is used for citrus fruits and somewhat less for mangoes. This is a very poor soil for agriculture and ranks only slightly better than the St. Lucie soil.

LEON SERIES

The soils of the Leon series have developed from moderately thick beds of unconsolidated sands under the influence of a high water table. They occur in the flatwoods, chiefly in the east, but smaller areas are scattered throughout the county. Leon soils are associated with soils of the St. Lucie, Pomello, Blanton, St. Johns, Immokalee, Broward, and Plummer series.

Leon soils are distinguished by the cemented organic pan layer in their profile. They are more poorly drained than the St. Lucie, Pomello, and Blanton soils but are better drained and have lighter colored surface soils than St. Johns soils. The pan in the Leon soils is more compact and nearer the surface than that in the Immokalee soils. The Leon soils are better drained than the Broward and Plummer soils and have an organic pan. They lack the rock substratum of the Broward soils. Leon soil is strongly acid, except in areas of the heavy substratum phase. Here the reaction in the more clayey part may be only slightly acid. Where Leon soil is adjacent to calcareous soils, some of the clayey substrata are mildly alkaline.

Leon-Immokalee fine sands, nearly level phases (lg).—In mapping Leon fine sands, a number of smaller areas of Immokalee fine sand were included. Because the two intermingled soils are similar in position, drainage, vegetation, profile, and use, it was not practical to map them separately. This complex was therefore mapped as Leon-Immokalee fine sands.

This soil complex covers a larger acreage than any other soil in the county. It is the dominant soil of the flatwoods. The relief is level to nearly level; a few gradients are as steep as 2 percent. Surface drainage is slow to very slow; internal drainage is very slow.

The native vegetation consists of slash pine, some longleaf pine, a few scrub oaks, and a thick undergrowth of saw-palmetto, runner oak, wiregrass, and some bitter gallberry. This soil complex is widely distributed in the county.

A representative profile of Leon fine sand in a virgin area:

- 0 to 4 inches, medium-gray fine sand.
- 4 to 20 inches, light-gray to almost white loose fine sand.
- 20 to 22 inches, brownish-black pan layer consisting of fine sand and an accumulation of organic matter and cementing materials; hardness of this layer varies with its moisture content, and it is hardest when dry.
- 22 to 26 inches, dark-brown to brown fine sand and an accumulation of partially cemented organic matter; grades to a lighter brown near the lower limits.
- 26 to 42 inches +, light-brown, yellow, or light-gray fine sand; lighter in color with depth.

This soil is strongly to very strongly acid throughout the profile. The organic pan layer is more acid than the other horizons.

Mapped with this soil complex, but differentiated from it by symbol lg4, is a "treeless phase" of Leon-Immokalee fine sands. It is similar to the typical soil except that a growth of pine is lacking. Possibly some physical factor, present in the past, adversely affected tree growth, or the land may have been so poorly drained before definite channels were cut that it was too wet for pine. This theory is partially substantiated by the fact that a pine stand occurs in the same general area but is nearer the streams or drainage channels where the water had a chance to run off. Here the soil is somewhat drier.

Numerous variations occur among Leon-Immokalee fine sands, nearly level phases. The depth to the hard-pan ranges from about 12 to 30 inches but averages about 20 inches. The thickness and hardness of this pan layer are also quite variable. In some places it is not hard or compact, which would indicate that this

layer is in the process of formation or disintegration. In a few places more than one hardpan layer occurs. They were probably caused by a change in the water table. The color of the surface soil ranges from light gray to dark gray, but it is lighter near the better drained soils and darker adjacent to St. Johns and Rutledge soils.

Leon-Immokalee fine sands, nearly level phases, is one of the most promising soils for agriculture in the county. Most of it remains in unimproved pasture, however. In areas where the saw-palmetto cover is not too dense, some of this soil complex is being planted to bermuda, carpet, bahia, and other grasses. The yields are very encouraging. The grasses have done particularly well in the eastern part of the county where the chief livestock-producing areas are located. By improving the pasture, the carrying capacity of the land is increased and better animals are produced. A small amount of this soil complex is used for farming in this section. Sweetpotatoes are the chief crop.

This soil complex is most useful, however, in the western part of the county where large acreages are planted to tomatoes, beans, eggplant, and peppers. Other crops, such as bulbs, potatoes, and sweet corn, are grown in increasing volume. Many farmers state that Leon fine sand is one of the best soils in the county for growing tomatoes and gladiolus. The reasons given are that the land can be cleared cheaply, and the lay of the land and the water table favor proper control of soil moisture by a system of drainage and irrigation. In addition, it occurs in large areas in reasonably frost-free regions where truck crops and gladiolus can be grown throughout the winter.

Leon-Immokalee fine sands, gently sloping phases (lf).—This soil complex occurs on stronger slopes than Leon-Immokalee fine sands, nearly level phases. Otherwise it is similar and is used in the same way. This complex occurs along the main drainage channels and is much more variable than Leon-Immokalee fine sands, nearly level phases.

Leon fine sand, light colored surface phase (le).—This soil occurs within areas of Leon-Immokalee soils heretofore described, but it occupies higher, better drained positions. It is also transitional between the Leon fine sands and the ridge soils. The vegetation is similar to that of the typical Leon-Immokalee fine sands, although it is not so heavy in places. Where this soil is associated with soils of the Blanton series, the plant cover also includes a scattering of scrub live oak. The relief varies from nearly level to gently undulating. Drainage is good to imperfect. The slopes usually average between 1 and 2 percent. Leon fine sand, light colored surface phase, is strongly acid. Most areas of these soils are located in the central and eastern parts of the county.

This soil has a lighter colored surface layer and an organic pan at greater depth than the typical Leon fine sand. The surface soil is a light gray to a very light gray fine sand about 1 to 3 or 4 inches thick. The underlying leached layer, an almost white to white fine sand, overlies the organic pan. Depth to the pan ranges from 24 to 40 inches. The pan and the succeeding lower layers are similar to those of the typical Leon soil profile.

Practically none of this soil is cultivated, because it is dry and infertile. Like Pomello fine sand, it is used mainly for forest and unimproved pasture. Some areas are planted to improved grasses if they occur in small patches in an area of the more favorable Leon-Immokalee fine sands, nearly level phases.

Leon fine sand, heavy substratum phase (ld).—This soil differs from the typical Leon fine sand in that it is underlain by a mottled gray, brown, and yellow fine sandy clay layer at 3 to 4 feet. There is no appreciable difference in elevation, but usually this soil is slightly lower than Leon fine sand. Relief is level to nearly level, and drainage is imperfect to poor. Most areas of this soil are in the western part of Manatee County.

This soil has vegetation similar to that of Leon-Immokalee fine sands, except for an occasional cabbage palmetto and a few live oaks. It has the same variations in the surface soil and depth to and hardness of the pan as the typical Leon fine sand. Along some of the tributaries of the Braden, Manatee, and Little Manatee Rivers, this soil differs slightly in occupying a terracelike position. Here it has good to imperfect drainage, a slightly lighter colored surface layer, and a variable substratum. The substratum ranges from a mottled yellow and orange loamy fine sand to the more common gray, brown, and yellow mottled fine sandy clay.

In general, this soil is slightly better for agriculture than Leon-Immokalee fine sands. In the east it is used mostly for unimproved pasture, but small areas are in improved pasture and forest. Nearer the coast, however, the crops grown are much like those produced on Leon-Immokalee fine sands. This soil responds to improved truck-crop practices and pasture-improvement programs.

MADE LAND

Made land (Mc).—This miscellaneous land type occurs mainly along the Manatee River near Bradenton and Palmetto, where soil was dredged from the river to fill the marshes along its banks. Made land is inextensive in this county. It has little agricultural value and is used chiefly for homesites.

MANATEE SERIES

The soils of the Manatee series have developed from thin beds of sands and clays that overlie marl. The surface layers are always dark; they contain a fair supply of organic matter and range in texture from loamy fine sand to fine sandy clay loam. Manatee soils occupy the lower drainageways and depressions of the calcareous hammocks. They are associated with soils of the Bradenton, Parkwood, and Delray series, but they occur in lower, more poorly drained positions and have darker surface layers than the Bradenton soils. Manatee soils are more poorly drained than the Parkwood soils and have a finer-textured layer above the marl that is lacking in the Parkwood soils. They are finer textured and have marl at shallower depths than the Delray soils.

Manatee fine sandy loam-loamy fine sand (Mc).—This soil commonly occurs in the wet depressions among the large hammocks in the western part of the county. The surface soil is fine sandy loam in some places and

loamy fine sand in others. Relief is level to nearly level. Drainage is somewhat poor to very poor; external and internal drainage are slow.

The native cover consists of a swamp growth of hardwoods, mostly ash and maple, a few oaks, and some cabbage palmetto. Some areas lack this hammock vegetation but support a prairie growth of water-loving plants, such as bonnets, pickerelweed, lilies, ferns, and various grasses, and occasionally willow and myrtle. The prairie areas are included with this soil but are indicated on the map by a special symbol (Mc3) to show their plant cover. Most areas of this soil are in the western part of Manatee County, but small acreages are in the southeast.

A representative profile in a virgin area of the western part of the county:

- 0 to 12 inches, very dark gray to black fine sandy loam; high organic-matter content; slightly acid to neutral.
- 12 to 26 inches, gray fine sandy clay, mottled with brown and yellow in places; neutral in reaction.
- 26 inches +, light-gray to white marl; strongly alkaline.

The texture of the surface layer varies from loamy fine sand to fine sandy loam. The color ranges from dark gray to black, depending on the amount of organic matter present. The depth and thickness of the different layers also vary. The sandy clay layer, however, is always within 30 inches of the surface, and the marl is usually within 42 inches.

When ditches and drains are properly constructed, this soil is very good for truck crops. Cabbage, lettuce, endive, beans, and tomatoes are the chief crops. Citrus fruits have been planted to some extent, but they normally do not grow well, even after drainage is provided. The main disadvantage in bringing new land into production is the cost of clearing and of providing adequate drains. Even after drains are installed, crops are sometimes damaged by standing water after heavy rains.

Manatee fine sandy clay loam (Mb).—This soil occurs in fairly small depressions within areas of Manatee fine sandy loam, from which it differs mainly in having a finer textured surface layer. Relief is nearly level and drainage is very poor.

The principal native vegetation consists of a swamp growth of ash and maple. In some areas there is a prairie growth of sawgrass, pickerelweed, various weeds and grasses, and an occasional swamp maple. The prairie growth is shown on the map by symbol Mb3. This soil developed in the same areas as other Manatee soils.

A representative profile in a virgin area southeast of Bradenton:

- 0 to 14 inches, black fine sandy clay loam that contains considerable organic matter; slightly acid to neutral; moderately plastic when wet, very hard when dry, and tending to crack; commonly called gumbo.
- 14 to 24 inches, dark-gray fine sandy clay; neutral to mildly alkaline.
- 24 inches +, light-gray marl; strongly alkaline.

This soil varies chiefly in thickness of the surface layer (10 to 16 or 18 inches) and in depth to marl (usually 20 to 40 inches).

This soil is used for growing vegetables if it occurs in small areas within large tracts of Bradenton soils or with other soils of the Manatee series. The soil

occurs in low positions, and vegetables are sometimes damaged by floods. Even when ditches are placed at frequent intervals, drainage is slow because of the fine texture of the surface soil and subsoil. This is a very fertile soil, however, and excellent yields can be obtained. Truck crops, especially the leafy vegetables, produce excellent yields where the soil is properly drained and otherwise well managed.

Manatee mucky loamy fine sand (Md).—This soil has developed in areas where ponds were once filled with sawgrass. Subsequently, the ponds have been drained by large ditches and canals. This is one of the best soils in the county for truck crops. It differs from other Manatee soils chiefly by having more organic matter and less of the fine mineral particles in the surface layer. Relief is level to nearly level, and drainage is poor.

In the past the native vegetation consisted of sawgrass and a few elder and willow bushes. After the ponds were drained, the uncultivated areas were burned. As a result, most areas are now covered with lilies, bonnets, rushes, sedges, and various reeds and grasses. Some sawgrass and willow and elder bushes remain. Little of this soil occurs in Manatee County; the larger areas are near Parrish.

A representative profile in a cultivated field about a mile west of Parrish:

- 0 to 14 inches, dark-gray to black mucky loamy fine sand; medium acid.
- 14 to 26 inches, gray and brown mottled fine sandy clay loam; mildly alkaline.
- 26 inches +, light-gray to whitish marl; strongly alkaline.

The surface layer is 10 to 18 inches thick. The finer textured layer (4 to 16 inches thick) may be a fine sandy loam or a fine sandy clay loam. The marl may range from several inches to a foot or more in thickness and may occur at depths ranging from 18 to 36 inches.

Much of this soil is cultivated and planted to truck crops similar to those produced on Manatee fine sandy loam-loamy fine sand. This soil has slightly better production, however, because it is easier to clear and has a higher supply of organic matter. Drainage is the chief problem, as on all other soils of the Manatee series. If the water level is controlled, excellent yields can be obtained from most truck crops.

MINE PITS AND DUMPS

Mine pits and dumps are areas in which large excavations were made during the process of mining for phosphate. The refuse was left on the adjoining land. Several such areas are in the western part of Manatee County, the largest being around the fuller's earth plant east of Ellenton. They are indicated on the soil map.

ONA SERIES

The soil of the Ona series has developed on level, poorly drained surfaces in areas of the flatwoods. It is closely associated with soils of the Scranton, Leon, St. Johns, and Rutlege series. The Ona soil differs from the Scranton soil in having a feebly cemented organic layer; from the Leon in having a thicker and darker surface layer; from the St. Johns in having a very weak pan layer and in lacking the leached horizon

underlying the surface layer; and from the Rutlege soils by being better drained and in having a slightly lighter colored surface layer.

Ona fine sand (Oa).—This soil is mainly on level or nearly level sites, but very slight slopes occur in places. The drainage is imperfect to poor. The soil is strongly acid throughout its entire depth. The vegetation consists of pine, runner oak, wiregrass, and saw-palmetto, and a few bitter gallberry. The soil is fairly well distributed in the county; the largest acreages are in the eastern part.

A representative profile in a virgin area near Waterbury townsite:

- 0 to 8 inches, medium-gray to dark-gray fine sand.
- 8 to 14 inches, dark-brown soft organic layer; contains particles of fine sand feebly cemented with organic matter.
- 14 to 20 inches, light yellowish-brown fine sand.
- 20 to 42 inches +, brownish-yellow fine sand that grades into a pale-yellow slightly loamy fine sand at its lower limits.

Ona fine sand commonly occurs between areas of Scranton fine sand and Leon fine sand. It may also occur between areas of Leon and Rutlege soils, but these transitional places are usually too narrow to be delineated separately on the map. The greatest variation is in the surface layer, which ranges from a medium gray to a very dark gray fine sand. Where this soil is adjacent to Leon soils, an inch or two of a lighter gray fine sand may lie above the organic layer. This soil is closely related to Scranton fine sand and possesses most of its qualities and characteristics.

Ona fine sand is used for growing citrus and truck crops. It is almost as good for agriculture as the Scranton soils. Areas not in cultivation are mostly in unimproved pasture. Small areas are in improved pasture or forest. The pasture grasses do exceedingly well. This is one of the best soils in the county, and its best use is for truck crops. Citrus fruits do well if sufficient drainage is provided.

ORLANDO SERIES

In Manatee County, the Orlando soil occupies well-drained upland areas that have dark gray to very dark gray surface layers. It has developed from thick beds of unconsolidated acid sands and is closely associated with soils of the Lakeland, Blanton, and Scranton series. Orlando soil has deeper and darker surface layers than the Lakeland and Blanton soils. It lacks the bright-yellow or brownish-yellow subsurface layers of the Lakeland soils and is better drained than the Scranton soil.

Orlando fine sand (Ob).—This soil is characterized by a dark-surface soil similar to that of the Blanton. However, it more nearly resembles the Scranton soil in other profile features. It differs from the Scranton mainly in position and drainage. It occurs in areas that have level to gently rolling topography. Slopes range from 0 to 2 percent. Drainage is good. Runoff is medium to slow, and internal drainage is rapid. This soil is strongly acid.

The native vegetation consists principally of long-leaf and slash pines, turkey oak, upland willow oak, live oak, and wiregrass. Areas of this soil are scattered throughout the county; the largest acreage is near Parrish.

A representative area from an orange grove near Parrish:

- 0 to 12 inches, dark-gray fine sand; contains a considerable quantity of organic matter.
- 12 to 26 inches, brownish-gray fine sand.
- 26 to 42 inches +, pale-yellow fine sand.

The 8- to 14-inch surface layer is somewhat lighter in color where it adjoins other well-drained upland soils. In the Bethany area, Orlando fine sand is not so dark as the soil of the typical profile, but it does have surface soil thick enough to place it in the Orlando series.

More than half of this soil is cultivated; most of it is in citrus fruits. Orlando fine sand is one of the best all-purpose, well-drained soils in the county. Under the same fertilization and management practices it will produce the same crops as Lakeland and Blanton soils, but it produces somewhat higher yields. The good yields probably result from the high content of organic matter. The organic matter holds a better supply of nutrients and moisture available to the plants.

PARKWOOD SERIES

The soils of the Parkwood series have developed from thin beds of sands and loamy fine sands over marl. They are closely related to soils of the Bradenton, Ruskin, and Manatee series. The Parkwood soils occur in slightly lower positions and are less acid than the Bradenton and Ruskin soils. Furthermore, they lack the clayey substratum layer over marl that is present in those soils. Parkwood soils are better drained and have lighter colored and coarser textured surface soils than Manatee soils, but they lack the finer textured substratum layer over the marl.

Parkwood fine sand (Pa).—This is one of the best hammock soils in Manatee County. It is easily recognized in its native state by the abundant growth of cabbage palmetto. It occupies a position slightly lower than the flatwoods and is imperfectly to poorly drained.

The original cover, in addition to cabbage palmetto, consists of a few live oak, slash pine, vines, and shrubs. Like other soils overlying calcareous materials, Parkwood fine sand occurs only in the western and extreme southeastern parts of the county.

A representative profile in the western part of the county:

- 0 to 8 inches, medium-gray to dark-gray nearly loose fine sand; slightly acid to neutral.
- 8 to 20 inches, light-gray loose fine sand, splotched with brown fine sand in places; neutral to mildly alkaline.
- 20 inches +, unweathered white marl; strongly alkaline.

The surface layer is generally somewhat darker in the southeastern part of the county than in the western part. A few areas have a very dark gray to black loamy fine sand surface soil. Most of these areas are in slightly lower positions in drainageways or around the edges of ponds. The marl ranges in depth from 16 to 30 inches and in texture from a soft limestone to a fine sandy loam or silt loam.

Locally, marly fine sand occurs below the surface and extends to 42 inches or more. In these areas hard marl or limestone may be at 36 inches. Because these areas are so small, they are mapped with Parkwood fine sand. Where this soil is next to soils of the Brad-

enton or Manatee series, a few inches of a finer textured material is commonly over the marl.

Truck crops have excellent yields on Parkwood fine sand when the soil is properly drained and irrigated. Citrus fruits have been planted with various results. Some success with this crop is possible, although the soil is generally too shallow to marl for good root development. In the southeastern part of the county very little of this soil has been cultivated. Here most of it is under native cover that provides some grazing and shade for livestock.

Parkwood fine sand, shallow phase (Pb).—This soil has all the characteristics of Parkwood fine sand, but it is more shallow to marl. Marl occurs at less than 18 inches from the surface, but the average depth is from 8 to 12 inches. Because this marly material lies near the surface, it is often turned up in plowing. It gives the surface layer a strongly alkaline reaction. This soil is good for truck crops, and some citrus fruits are planted. It is not so desirable for these crops as the typical Parkwood fine sand.

PLUMMER SERIES

The Plummer series consists of unconsolidated acid sands. It is characterized by a gray, loose, sand surface soil overlying a lighter colored sand subsoil. The depth of the sand to finer textured materials is commonly 4 feet or more, but it may be 3 feet. Relief is prevailing level or nearly level. Drainage is poor to very poor when the water table is high. The Plummer soil is associated with Leon, Immokalee, Arzell, and Rutlege soils, and it occurs in slightly lower depressions and drainageways in the flatwoods. It is more poorly drained than the Leon and Immokalee soils and lacks an organic pan layer. It has darker colored surfaces than soils of the Arzell series, but the surface layers are lighter colored than those of the Rutlege soils. The Plummer soil is more strongly acid than Pompano soils.

Plummer fine sand (Pc).—This soil occurs in drainageways and as narrow bands around some of the ponds within the flatwoods area. It has a cover of slash pine, wiregrass, and a sparse low growth of saw-palmetto. The relief is level or nearly level, and drainage is poor to very poor. A high water table prevents the movement of water through the profile. The soil is strongly acid throughout its entire depth.

Other vegetation on this soil includes water oak, gallberry, myrtle, broomsedge, rushes, and some cypress. Plummer fine sand is widely distributed in Manatee County; the larger areas occur in the central and eastern parts.

A representative profile:

- 0 to 6 inches, medium-gray fine sand.
- 6 to 42 inches +, light-gray fine sand; has, in places, a 4- to 10-inch layer of brown, organic-stained fine sand, usually at a depth of 24 inches or more.

Most of the areas mapped consist of fine sand to a depth greater than 42 inches. Locally, however, some areas have, at depths between 30 and 42 inches, a finer textured layer that ranges from a fine sandy loam to a fine sandy clay. In a very few places this layer is closer to the surface. Practically all of these areas have been mapped in ponds. They may include

profiles of Arzell or Rutlege soils too small in extent to be delineated separately on the map.

The vegetation on areas around the undrained and drained ponds differs slightly from that on an area having the typical profile described. This native growth near ponds consists of prairie grasses.

Very little of Plummer fine sand is cultivated. Most areas are in forest, improved pasture, or unimproved rangeland. This soil usually produces a heavier stand of grass than soils of the flatwoods because it holds a better supply of moisture available to plants and has a sparser growth of saw-palmetto. Improved pasture is suited to this soil. On areas with prairie vegetation, improved pasture grasses can be established with very little effort.

POMELLO SERIES

The Pomello series consists of well-drained, light-colored soils in transition zones between the higher scrub oak and pine lands and the lower flatwoods. It has developed from thick beds of unconsolidated sands and is associated with soils of the St. Lucie, Blanton, and Leon series. The soil of the Pomello series has a lighter colored surface layer than Leon and Blanton soils but is not so dry as the St. Lucie soil.

Pomello fine sand (Pf).—This soil occurs on the higher, better drained ground within areas of Leon and Immokalee soils. It is transitional between those soils and the excessively drained St. Lucie soil. Relief ranges from nearly level to gently sloping. The slopes usually average 1 to 2 percent; a few gradients are stronger than 2 percent. Drainage is good to excessive because the loose and open soil is in a fairly high position. The soil is strongly acid.

The native vegetation consists of pine, scrub live oak, saw-palmetto, and some wiregrass and runner oak. This soil is widely distributed over the county.

A representative profile in a virgin area near the center of the county:

- 0 to 2 inches, light-gray to almost white, loose fine sand.
- 2 to 24 inches +, white, loose, incoherent fine sand.

Where this soil is closely associated with Leon fine sand, light colored surface phase, it is practically impossible to separate them on a map of the size used in this survey. The only difference between the two soils is that a hardpan layer occurs within 42 inches of the surface of the Leon soil. In some local areas, largely near Little Manatee River, the vegetation consists almost entirely of scrub live oak. These areas are not extensive and are mapped as Pomello fine sand.

None of this soil is cultivated in the eastern part of the county. A small acreage has been put into improved pasture where it occurs with soils of the lower flatwoods. Most of Pomello fine sand, however, remains in unimproved range. In the west, small areas that occur as knolls and ridges in the larger fields of the Leon and Immokalee fine sands are planted to vegetables and bulbs. Pomello fine sand has somewhat higher water and fertilizer requirements than those two soils, but fair yields can be obtained if the Pomello soil is properly managed. Some areas are used for citrus fruits, but the suitability of this soil for this crop ranks between that of the St. Lucie and Blanton soils.

POMPANO SERIES

The soils of the Pompano series are best described as the alkaline equivalent of the acid Plummer soil. The Pompano soils have developed from or have been influenced by calcareous materials. Their subsoils range from slightly acid to mildly alkaline. They have gray surface soils, lighter gray subsurface layers, and, in places, a subsoil finer textured than the overlying layers. Pompano soils are associated with Keri, Ruskin, Bradenton, and Delray soils. They are more poorly drained than the Keri and have a lighter colored surface layer than the Delray soils.

Pompano fine sand (Pd).—This soil usually borders large shallow ponds, some of which have been drained. It also occurs as smaller depressions and drainageways within soils of the calcareous regions. The relief is level to nearly level, and natural drainage is poor.

The native vegetation consists mostly of prairie-grasses and an occasional slash pine or cabbage palmetto. This soil is in the western and southeastern parts of the county in areas where calcareous soils predominate. The largest areas are in Pearce drain or border the eastern rim of the Tatum flats.

A representative profile from the Pearce sawgrass area:

- 0 to 6 inches, medium-gray fine sand; medium to slightly acid.
- 6 to 12 inches, light-gray fine sand; medium to slightly acid.
- 12 to 36 inches, yellowish-brown and gray fine sands; medium to slightly acid.
- 36 to 42 inches, light brownish-gray fine sandy loam to fine sandy clay loam; neutral to mildly alkaline; marl or shell may occur between depths of 40 to 60 inches.

This soil, as mapped, includes a few small areas in which the finer textured horizon lies at shallower depths. In other areas this layer occurs below 42 inches. In all places, however, the soil is less acid than the Plummer soil and lies within or adjacent to other calcareous soils.

In the southeastern part of the county, Pompano fine sand is used as unimproved pasture and provides good grazing. In the western part the only extensive acreage is in the Pearce sawgrass area, where it is used for truck crops. Farmers consider it a poor soil, probably because it is not so productive as Delray soils that occur in the same vicinity. Under proper management, however, it should produce good yields.

Pompano-Delray fine sands (Pe).—This soil complex occurs along some of the more or less definite drainage channels and around some of the larger ponds in the central and eastern parts of Manatee County. The soils of the Pompano and Delray series are so intricately mixed in these areas that an accurate separation is not possible on a map of the size used in this report. However, the Pompano predominate. The relief is very gently sloping or level, and drainage is imperfect to poor.

The vegetation consists of slash pine, water and live oaks, saw-palmetto, runner oak, gallberry, and wiregrass. None of this soil complex is cultivated. Practically all of it is in unimproved pasture and furnishes good grazing. With good management, Pompano-Delray fine sands would make excellent pasture.

RUSKIN SERIES

The soil of the Ruskin series is restricted to the Gulf Coastal Plain of west-central Florida. It was derived from beds of unconsolidated sands and clays that overlie shell marl. The surface layers are gray to dark gray and overlie succeeding layers of light-gray and brown to brownish-yellow fine sands. The subsoil is a gray and brownish-yellow mottled fine sandy clay over shell marl. Ruskin soil is associated with soils of the Leon and Immokalee series and is closely related to the Bradenton soils. It differs from the Leon and Immokalee soils in lacking an organic pan and in having marl at shallow to medium depths. It occupies slightly higher positions and is somewhat more yellow in the lower profile than the Bradenton soils.

Ruskin fine sand (Ra).—This soil has much the same relief, drainage, and vegetation as the more acid soils of the flatwoods, although the cover includes a scattered growth of cabbage palmetto. This soil is slightly lower than other flatwoods soils, and consequently it is imperfectly to poorly drained.

The natural vegetation consists of slash pine, saw-palmetto, wiregrass, cabbage palmetto, and a few oaks. Ruskin fine sand occurs in widely separated areas; the larger acreages are in the watershed of the Braden River. One area is southeast of Myakka City along the road to Arcadia.

A representative profile in a virgin area:

- 0 to 6 inches, gray nearly loose fine sand; medium acid.
- 6 to 18 inches, light-gray loose fine sand; medium acid.
- 18 to 22 inches, brown fine sand; medium acid; layer may be absent.
- 22 to 30 inches, brownish-yellow to yellow fine sand; slightly acid.
- 30 to 36 inches, mottled light-gray and brownish-yellow fine sandy loam or fine sandy clay loam; slightly acid to neutral.
- 36 inches +, white and yellow mixture of shell and marl; strongly alkaline.

The thickness of the sand layers over the mottled sandy loam ranges from 18 to about 34 inches and that of the finer textured layer ranges from 4 to 10 inches. The depth to the shell and marl ranges from 24 to 42 inches.

Much of this soil is used for range, largely because most areas lie inland where there is more danger from frost than along the coast. Nevertheless, with proper water control, fertilization, and other good management, it is suitable for tomatoes, peppers, eggplant, and many other truck crops.

RUTLEGE SERIES

The Rutlege series consists of acid sandy soils with dark surface layers. These soils occur in low very poorly drained areas. They have developed from thick beds of acid sands and loamy sands in drainageways and around the edges of ponds. They are related to and occur in association with Leon, St. Johns, and Plummer soils. The Rutlege soils are more poorly drained and lack the organic pan of the Leon and St. Johns soils. They have darker and thicker surface layers than the Plummer soil.

Rutlege fine sand, nearly level phase (Rc).—This soil occurs in low, poorly drained areas having a native cover of slash pine, clumps of saw-palmetto, gallberry, and a good stand of various grasses—chiefly carpet-

grass. Other areas are located around the larger ponds or occupy entire sites of smaller intermittent ponds where a prairie growth of grasses and sedges is present. These prairie-growth areas are indicated on the soil map by a special symbol (Rc3) to show their different vegetation.

Relief is level to gently sloping, and drainage is very poor. Little runoff occurs. Internal drainage would be rapid, except for the high water table that is present most of the time. This soil is strongly acid. Small- to medium-sized areas are well-distributed over the central and eastern parts of the county.

Profile description:

- 0 to 10 inches, dark-gray to black fine sand with a high content of organic matter.
- 10 to 20 inches, medium-gray to light-gray loose fine sand.
- 20 to 42 inches +, light-gray loose fine sand.

Included with this soil are all those acid low-lying sandy soils that have 6 to 18 inches of dark-gray to black surface layers. The content of organic matter is variable, however, and small areas of mucky fine sand may be present. A brown-stained layer, which may contain iron concretions, often occurs in the profile, usually at its lower depths. Locally, a finer textured layer may be at about 40 inches.

Most of Rutlege fine sand, nearly level phase, is in unimproved pasture. Even when unimproved, this soil provides good grazing for livestock. Some small areas have been cleared, drained, and used for truck crops, which do very well if properly managed. This inherently good soil requires only adequate drainage to reclaim it for agriculture. Corn, truck crops, and pasture grasses should do well on it.

Rutlege fine sand, gently sloping phase (Rb).—This soil occurs on stronger slopes than Rutlege fine sand, nearly level phase. The gradients range from 2 to 5 percent and are even stronger in a few places. The areas occur along the larger streams. The profile resembles that of the typical profile described for the nearly level phase, except that a brown, soft organic layer occurs in many places at a depth of about 30 inches. Furthermore, a greater supply of organic matter is often present in the surface layer, which gives the soil a texture of a mucky fine sand or even a peaty muck. In places, the vegetation consists of a heavy growth of saw-palmetto, fern, and a few slash pines. In some areas a few bay trees are intermingled with the saw-palmetto and ferns.

Most of this soil is in unimproved pasture or range. Only small areas are under cultivation. This soil has about the same uses and will give about the same crop responses as Rutlege fine sand, nearly level phase. Slightly different management practices are needed on the slopes, however.

SCRANTON SERIES

The soil of the Scranton series has developed from thick beds of unconsolidated acid sands and loamy sands. It is characterized by a dark-gray surface layer and a pale-yellow subsurface layer. Scranton soil is somewhat related to and associated with soils of the Orlando, Ona, Rutlege, and Plummer series. It occurs in slightly lower positions and is more poorly drained than soils of the Orlando series. Scranton soil

lacks the weakly cemented organic layer that occurs just below the surface of the Ona soils, but it is better drained and has more brown and yellow sand in the subsurface layer than the Rutlege and Plummer soils.

Scranton fine sand (Sc).—This soil occupies positions similar to those occupied by Leon fine sand. Relief ranges from level to very gently sloping, and drainage is imperfect to poor. Runoff is slow, but internal drainage is medium. This soil is strongly acid throughout its entire depth.

The natural vegetation consists of slash and longleaf pines, prairieclover, wiregrass, and saw-palmetto. This soil occurs in small- to fair-sized areas scattered throughout the central and eastern parts of the county.

Profile description:

- 0 to 8 inches, dark-gray to dark brownish-gray fine sand with a high content of organic matter.
- 8 to 22 inches, brownish-yellow fine sand; less brown and more yellow at its lower limits.
- 22 to 42 inches +, pale-yellow fine sand, somewhat loamy at its lower limits.

Scranton fine sand varies somewhat, particularly in the depth of the surface layer and the color of the subsurface layer. The surface layer is lighter and thinner in areas near Lakeland or Blanton soils, but it is darker and thicker where it is adjacent to Orlando and Rutlege soils. The subsurface layer generally grades from brownish yellow to pale yellow, but in some areas it grades from a darker brown to yellow. In other places the deeper horizons are mottled yellow, brown, and gray. In these areas a finer textured layer usually lies close to the surface and mottling indicates that internal drainage is poor.

Probably more of this soil has been cleared and cultivated than any other soil in the county. It is used for citrus fruits and truck crops, and yields are excellent. In most places some artificial drainage is required, but under normal conditions drains can be installed at a comparatively small expense. The forested areas produce a good stand of pine. The cutover land would make excellent pasture.

SHALLOW PONDS WITH GRASS

Shallow ponds with grass (Sd).—This miscellaneous land type is made up of shallow bodies of water that have grasses and water-loving plants in them. During seasons of little rainfall, some of these areas are dry for short periods. For most of the year, however, they are covered with a few inches to 3 feet or more of water. They occupy more than 23,000 acres in the county.

The soils in these ponds are so variable that it is not feasible to separate them into types and phases. The surface layers range from light gray to black, and their content of organic matter also varies widely. The subsoils range from light-gray or almost white fine sand to dark-gray or black fine sandy clay. The soils in these areas commonly belong to the Plummer, Rutlege, and Arzell series; smaller areas of peat and peaty mucks occur.

The most extensive areas are in depressions in the flatwoods in the central and eastern parts of the county. These ponds are used to supply water for livestock and the grasses provide some grazing. Most of them are

difficult and expensive to drain adequately for cultivation.

SHELL MOUNDS

Shell mounds (Se).—This miscellaneous land type consists of large heaps of oyster, clam, and other shells. Probably the mounds were made by Indians. Most areas are small, although some cover as much as 10 acres and are 2 to 20 feet thick. They occur along the shores of bays and the mouths of rivers and are now covered by a fairly dense growth of trees and vines. One good-sized area borders McGill Bay on the lower part of Terra Ceia Island, and another is on the southern edge of Snead Island. The mounds occupy about 80 acres in all and have little agricultural value. Some of the material is used for surfacing roads.

ST. JOHNS SERIES

The soil of the St. Johns series occurs in the lower flatwoods and has a dark-gray surface and an organic pan in the subsoil. It differs from the Leon soils chiefly in having a thicker and darker surface layer. It has developed from unconsolidated sands and is poorly drained and strongly acid. The St. Johns soil is also associated with Immokalee, Plummer, and Rutlege soils. It has a darker surface and a more compact organic layer than the Immokalee or Ona soils. It has an organic pan that is lacking in the Plummer and Rutlege soils; it occurs in slightly higher positions, and is better drained.

St. Johns-Leon fine sands (So).—St. Johns fine sand is mapped with Leon fine sand as a complex because the two soils are so closely related and intermingled that it is not feasible to separate them on a map of the scale used in this survey. St. Johns fine sand is the dominant soil type in this mapping unit. Both soils are strongly acid and poorly drained. They occupy nearly level areas in the lower flatwoods.

The native cover consists of slash pine, saw-palmetto, gallberry, and wiregrass and other grasses. Most of this complex is around the headwaters of the Manatee River in the northeastern part of the county. In some places large areas lack the growth of pine but are otherwise similar.

A representative profile of St. Johns fine sand in a virgin area near Pineland:

0 to 8 inches, dark-gray fine sand;
8 to 16 inches, medium-gray to light-gray fine sand.
16 to 20 inches, dark-brown or black organic pan.
20 to 42 inches +, light-brown to brownish-yellow fine sand;
lighter in color with depth.

A profile description of Leon fine sand is given elsewhere in this report.

A few small areas of Rutlege soils are included. Some treeless areas, shown by symbol So4, are slightly lower and contain more dark soil than the typical St. Johns fine sand. The pan layer varies in thickness, depth from the surface, and hardness. In most places it occurs at depths of 10 to 20 inches.

Practically all of this soil complex is in unimproved range. It is somewhat better for range pasture than Leon and Immokalee soils. It supports pasture grasses better because its darker topsoil contains more organic matter and its higher water table supplies more mois-

ture. Because less saw-palmetto occurs on St. Johns soil, especially on the treeless areas, a better stand of grass can develop. Under proper management this soil could be used for pasture.

ST. LUCIE SERIES

The St. Lucie soil has developed from thick beds of unconsolidated sands and clays. The soil consists of white, loose, incoherent sands that extend from an inch or so below a light-gray surface layer to a depth of 5 feet or more. It occurs in association with Lakewood, Lakeland, Blanton, Pomello, and Leon soils. The subsoil lacks the brownish-yellow or yellow colors of the subsoils of the Lakeland, Lakewood, and Blanton series. The St. Lucie soil has a lighter colored surface, is more excessively drained, and has a more scrubby cover than the Pomello soil. It also has a lighter colored surface layer than the Leon soils and lacks the organic hardpan.

St. Lucie fine sand (Sb).—This soil occurs on the highest locations in the county. Its relief varies from gently rolling to nearly level. Surface drainage is medium to rapid; internal drainage is very rapid. This soil is very strongly acid.

The natural growth is chiefly sand pine, scrub oak, rosemary, saw-palmetto, pricklypear cactus, and a few other plants common to dry places. Small areas of this soil are scattered throughout the county, most of them in the east.

A representative profile:

0 to 1 inch, light-gray loose fine sand.
1 to 42 inches +, white very loose fine sand.

Practically all of this soil has its original cover. The soil is too low in fertility and too droughty for strong stands of plants to develop. Although it provides little grass for cattle, its vegetation furnishes some shade in summer and shelter during the rainy season.

In the Palma Sola area, where frost protection is afforded, several attempts have been made to cultivate a few small tracts. The yields were discouraging however. Some citrus fruit has been planted, but most of the groves have been abandoned. Mangoes were also grown, but the crops were not successful. Vegetables are rarely grown. Because this soil has extremely high requirements for irrigation and fertilizer, it is not suited to crop production under present conditions. Some of the sand has been used for manufacturing cement blocks.

STOUGH SERIES

The soil of the Stough series occurs on terraces that border the larger streams. It has developed from old alluvium but now occupies positions well above the normal overflow. The profile is characterized by its dominantly gray and brown color and the heavy-textured pan in the subsoil. Compared with the Kalmia and Huckabee soils, the Stough is less well drained; it has a mottled subsoil and more compact pan.

Stough fine sand, dark surface phase (Sf).—Most of this soil is in the central and eastern parts of the county. The relief is nearly level; slopes range from 0 to 2 percent. This soil is imperfectly to moderately well drained, although subject to runoff and seepage from the surrounding soils. Internal drain-

age is slow because of the fine-textured, compact layer in the profile. This soil is strongly acid. It has a natural cover consisting chiefly of oaks, some pine, saw-palmetto, and an occasional cabbage palmetto.

A representative profile taken from a virgin area along the Manatee River:

0 to 4 inches, dark-gray to brownish-gray fine sand.
 4 to 16 inches, gray and light-brown splotched fine sand.
 16 to 24 inches, gray and brown mottled fine sandy clay.
 24 to 39 inches, light brownish-gray fine sandy clay loam.
 39 to 42 inches +, light-gray loamy fine sand; contains streaks of light-brown fine sandy clay loam.

This soil varies in depth to the pan layer and in the texture of this layer. Depth to the compact layer ranges from 12 to about 36 inches, and its texture varies from a heavy fine sandy loam to a fine sandy clay. The horizons above and below this compact layer vary somewhat in color and depth; they are affected chiefly by the position of the clay layer within the profile. Most of this soil is in unimproved pasture and trees, to which uses it is probably best suited.

TERRA CEIA SERIES

Soil of the Terra Ceia series occurs on one of the lowest physiographic positions of any soil in the county. It is very poorly drained, and the relief is nearly level. It occurs in depressions in association with Bradenton and Manatee soils, but differs from them by having a greater amount of organic matter in the surface layer.

Terra Ceia muck (T_a).—The native vegetation consists chiefly of sawgrass. Some swamp hardwoods and cabbage palmetto occur. In the western part of the mainland, however, some areas are covered mostly with prairie grasses. Little of this soil occurs in the county. It is generally in the western part, but a few small areas are in the extreme southeast.

A representative profile:

0 to 18 inches, black muck consisting of a mixture of well-decomposed organic matter and mineral matter; the mineral matter makes up from 50 to 80 percent of the mixture; slightly acid to neutral.
 18 to 22 inches, very dark gray mucky fine sand; slightly acid to neutral.
 22 to 32 inches, black fine sandy clay loam; neutral to slightly alkaline.
 32 to 42 inches +, light-gray marl with streaks of dark-gray and light brownish-gray fine sandy clay.

As mapped in Manatee County, Terra Ceia muck includes all those low-lying muck soils that are underlain by a finer textured substratum, which, in turn, overlies marl. The depth of the surface layer varies considerably. In places a few inches of raw sawgrass peat have developed; most of these are on Terra Ceia Island. This peat layer would disappear quickly if the areas were drained and cultivated.

Terra Ceia muck occurs in such small individual areas that it is farmed only when the surrounding land is cultivated. If properly drained, these areas would be excellent for growing many kinds of vegetables and truck crops.

TIDAL SOILS

The Tidal soils consist of miscellaneous land types that are affected by tides in the Gulf of Mexico. They

occur along the coast, on the islands, and near the mouths of the larger streams.

Tidal marsh (T_b).—This miscellaneous land type occupies low-lying wet areas that are flooded or affected by salt water during high tide. The concentration of salt inhibits the growth of all except salt-tolerant plants. Tidal marsh therefore is not used for agriculture. It supports a growth of salt-loving weeds and grasses. To reclaim this land, expensive dikes and drains would be necessary. The most extensive areas occur along the Manatee and Braden Rivers.

Tidal marsh, high-lying phase (T_c).—This miscellaneous land type occupies those sand flats that commonly occur between the mangrove swamps and the higher, better drained soils. The flats are usually barren of vegetation. Where vegetation occurs, it is generally a sparse stand of grasses, an occasional cabbage palmetto, and a few slash pines. Because it is on slightly higher positions, this miscellaneous land type is better drained and not so marshy as Tidal marsh. It is subject to tidal overflow only during storms or other periods of extremely high water.

Where this land type occurs adjacent to or within farmed areas, small plots are used occasionally to square out a field. In some of the less salty places, the sand flats could be leached by flooding with well water. They might become productive within a few years. On the whole, these areas are not classified as agricultural land.

Tidal swamp (T_d).—This miscellaneous land type occupies those areas that are covered with a thick growth of mangroves and are inundated with water, especially at high tide. The surface soil usually consists of gray to brownish-gray fine sands, which overlie limestone or shell. There may be only a thin layer over the limestone and shell, or the depth to these materials may be 42 inches or more. Tidal swamp occurs along the eastern shore of Anna Maria and Longboat Keys, along the gulf coast of the mainland, and in a few places along the Braden and Manatee Rivers. It is not suited to agriculture.

Use and Management of Soils

The soils of Manatee County have been placed in 10 management groups. The characteristics common to the soils in each group, and the use and management to which each group is suited, are discussed in this section. The expected yields of the principal crops under management prevailing in the county are given in table 3.

Management groups

MANAGEMENT GROUP 1

The soils of management group 1 are as follows:

Lakewood fine sand.
 St. Lucie fine sand.

These are excessively drained soils of the sand pine and scrub oak ridges. They occur on the highest parts of the upland. They are very sandy, are extremely low in organic matter and plant nutrients, and have a

TABLE 3.—Estimated average acre yields of the principal crops on each soil¹ under prevailing management

Soil types and phases	Citrus fruits		Flow-ers	Truck crops						Permanent pasture Cow-acre-days ²	
	Or-anges	Grape-fruit	Glad-olius	Toma-toes	Cab-bage	Let-tuce	Pep-pers	Cu-cum-bers	Snap-beans		Water-melons
	Boxes	Boxes	Blooms	Bu.	Tons	Crates	Bushel crates	Bu.	Bushel hampers		Car-loads
Arzell fine sand.				200	5	135		135			125-225
Blanton fine sand, nearly level phase.	375	525								1/2	100-200
Blanton fine sand, undulating phase.	375	525								1/2	100-200
Blanton fine sand, brown layer phase.	300	400								1/2	100-200
Braden fine sand.				250	8	200	250	160	150		250-400
Bradenton fine sand.	300	425	25,000	350	10	250	325	200	175		250-400
Bradenton fine sand, deep phase.	300	425	25,000	300	9	225	300	175	150		225-400
Bradenton fine sand, thick surface phase.	325	450	22,500	250	9	225	300	175	150		225-375
Bradenton fine sand, thick surface deep phase.	300	425	20,000	225	8	200	250	150	125		200-350
Broward fine sand.	150	225	22,500	250	7	175	225	150	125		200-325
Broward fine sand, shallow phase.				250	6	150	200	150			200-325
Broward fine sand, heavy substratum phase.			25,000	300	8	200	250	160	150		200-350
Delray loamy fine sand.				375	11	275	225	160	200		400-600
Delray mucky loamy fine sand.				400	12	300	250		200		450-600
Huckabee-Kalmia fine sands.	325	425		225	5		175	125		1/2	150-250
Immokalee-Leon fine sands.			20,000	250	5	125	175	125			250-350
Keri fine sand.	300	400	20,000	300	8	200	250	160			250-375
Lakeland fine sand, nearly level phase.	400	550								1/2	100-200
Lakeland fine sand, undulating phase.	400	550								1/2	100-200
Lakewood fine sand.											
Leon-Immokalee fine sands, nearly level phases.			22,500	250	5	125	175	125			200-325
Leon-Immokalee fine sands, gently sloping phases.				250	5	125	175	125			200-325
Leon fine sand, light colored surface phase.	100	150									100-200
Leon fine sand, heavy substratum phase.			22,500	300	6	150	200	150	100		250-350
Manatee fine sandy loam-loamy fine sand.				375	11	275	225	150	200		400-600
Manatee fine sandy clay loam.				350	10	250	250		175		400-500
Manatee mucky loamy fine sand.				400	12	300	250		200		450-600
Ona fine sand.	350	450	20,000	300	8	200	225	160	125		250-400
Orlando fine sand.	500	650		300	7		200	150		1/2	150-300
Parkwood fine sand.	350	500	25,000	375	9	225	325	175	175		250-400
Parkwood fine sand, shallow phase.	200	300	22,500	350	8	200	300	160	160		225-400
Plummer fine sand.				250	7	175	175	150	100		275-425
Pomello fine sand.	100	150									100-200
Pompano fine sand.				250	8	200	200	150	125		300-450
Pompano-Delray fine sands.				300	9	225	225	150	150		325-475
Ruskin fine sand.	250	325	25,000	350	9	225	300	175	150		250-400
Rutlege fine sand, nearly level phase.				300	10	250	200	150	175		400-550
Rutlege fine sand, gently sloping phase.				275	9	225	175	150	175		400-550
Seranton fine sand.	500	650	22,500	350	9	225	250	175	150		300-450
St. Johns-Leon fine sands.			20,000	250	7	175	200	150			250-350
St. Lucie fine sand.											
Stough fine sand, dark surface phase.	200	300									150-250
Terra Ceia muck.									200		400-600

¹ Miscellaneous land types are not included in this table.

² Cow-acre-days is a term used to express the carrying capacity of pasture land. It represents the number of days a year that 1 acre will graze a cow without injury to the pasture.

very small capacity for holding moisture. The vegetation is chiefly sand pine, scrub oak, rosemary, saw-palmetto, and cactus. The trees grow slowly and have little or no commercial value. These soils are not cultivated, and they have very little value for pasture.

With favorable weather and under management that includes the use of fertilizers, lime, and irrigation, some citrus fruit could be produced on selected areas of Lakewood soils. Many areas near the coast are suitable for building sites.

MANAGEMENT GROUP 2

The soils of management group 2 are as follows:

- Lakeland fine sand, nearly level phase.
- Lakeland fine sand, undulating phase.

- Blanton fine sand, brown layer phase.
- Blanton fine sand, nearly level phase.
- Blanton fine sand, undulating phase.
- Orlando fine sand.
- Huckabee-Kalmia fine sands.

These are well-drained sandy soils of the longleaf pine and blackjack oak lands. They occur on the uplands and stream terraces. They contain a little more clay or are not so deep to an underlying clay layer as the soils of management group 1. They are proportionately more responsive to good management, especially fertilization, and are more useful for cultivation. Cover crops are grown in the cultivated areas to increase the organic-matter content.

The Orlando soil is the most productive and is cultivated to the greatest extent. The Huckabee-Kalmia

fine sands are about as productive as the Orlando soil. Most of their acreage, however, lies in narrow strips along the larger streams and under a heavy hammock growth that makes clearing more expensive than for the other soils of management group 2.

Many areas of these soils have been cleared and planted to citrus and other subtropical fruits, suitable crops, and improved pasture. Other areas support a native growth of turkey, bluejack, and live oaks, pines, and a few shrubs and grasses. Under favorable weather conditions and good management, which includes liberal applications of fertilizers and lime when needed, good yields are obtained from citrus trees and suited crops. Most areas have relief favorable for good air drainage that makes damage from frost less likely. During part of the year, the undulating areas may be somewhat droughty for citrus and improved pasture. If water is available, the crops on these areas can be irrigated.

MANAGEMENT GROUP 3

The soils of management group 3 are as follows:

- Pomello fine sand.
- Leon fine sand, light colored surface phase.

These are well-drained to imperfectly drained soils of the high pine land. They are less favorable for cultivation than soils of group 2 because they are wetter during the rainy season and too droughty during the dry season for citrus crops or watermelons. Their surface layers are generally too dry for grasses. The soils are more favorable for plant growth than those of management group 1, but nevertheless they have a low agricultural value. The soils of this group have light-colored surface soils that are very low in organic matter. They have within the profile an organic brown-stained layer that is at least weakly cemented, although that of the Pomello is below a depth of 42 inches.

Most areas have a native cover of scrub live oak, runner oak, a few pines, and wiregrass and other grasses that furnish poor to fair grazing for cattle. Some areas have fair to good stands of trees. Under favorable weather conditions and good management, which includes liberal applications of fertilizers, liming, and adequate water control, pasture and citrus give fair returns.

MANAGEMENT GROUPS 4 AND 5

Management group 4 consists of imperfectly drained soils of the high pine land. They are as follows:

- Stough fine sand, dark surface phase.
- Scranton fine sand.
- Ona fine sand.

Management group 5 consists of imperfectly drained soils of the flat pine and palmetto land. They are as follows:

- Leon-Immokalee fine sands, nearly level phases.
- Leon-Immokalee fine sands, gently sloping phases.
- Leon fine sand, heavy substratum phase.
- Immokalee-Leon fine sands.
- St. Johns-Leon fine sands.

The soils of management group 4 are slightly better drained than are those of management group 5 and are better for the production of crops. They support a

better growth of pine and grasses and have less palmetto on them. Most of the acreage of both groups is used for grazing. A large acreage near the gulf coast is used for truck and flower crops during the winter. Some areas of group 4 soils are used for citrus fruits and general farm crops.

With adequate water control where needed, the Scranton, Ona, and Stough soils are suited to vegetables and truck crops, citrus and other subtropical fruits, and improved pasture. Under good management that includes fertilization and liming, these soils can be expected to produce high yields of crops and fruit. The natural vegetation consists of pine, bluejack and runner oaks, myrtle bushes, saw-palmetto, and wiregrass and other grasses. The cover provides fair unimproved range pasture for cattle. Pine trees make fair to good growth on these soils.

Under natural conditions, the Leon, Immokalee, and St. Johns soils are suited to range, improved pasture, and forest. Drainage and irrigation, although not essential, are beneficial for improved pasture. These soils are not generally suited to citrus, truck, or cultivated crops. However, under favorable weather conditions and good management that includes liberal applications of fertilizers and lime and adequate water control, they produce fair yields of suited crops. Adequate drainage is necessary for production of citrus fruits on these soils. The dominant native vegetation consists of pines, saw-palmetto, gallberry, runner oak, and various shrubs and grasses. Those areas that lack the pine trees are indicated on the map as a treeless phase.

MANAGEMENT GROUP 6

The soils of management group 6 are as follows:

- Keri fine sand.
- Ruskin fine sand.
- Broward fine sand.
- Broward fine sand, shallow phase.
- Broward fine sand, heavy substratum phase.
- Braden fine sand.

These are imperfectly drained soils of the flat pine and cabbage palmetto land. They have neutral to slightly alkaline subsoils underlain by marl or other calcareous clayey materials. In general, the surface soils are relatively dark and moderately to slightly acid. These soils are more desirable for pasture and truck crops than those of management group 5.

Under good management, including water control (primarily drainage) and fertilization, the soils of this management group produce fair to good yields of citrus crops. Under natural conditions these soils support a growth of pine, saw and cabbage palmetto, runner oak, gallberry, and wiregrass and other grasses that furnish fair grazing for livestock.

MANAGEMENT GROUP 7

The soils of management group 7 are as follows:

- Bradenton fine sand.
- Bradenton fine sand, deep phase.
- Bradenton fine sand, thick surface deep phase.
- Parkwood fine sand.
- Parkwood fine sand, shallow phase.

These are imperfectly drained soils of the low marl hammock land. They have neutral to alkaline subsoils

over marl. They have deeper and darker surface soils than the soils of management groups 1 to 6 and are slightly more poorly drained than the soils of management group 6. Their suitability for truck crops and the accessibility of most areas to transportation facilities have encouraged the clearing of a great part for cultivation. The initial cost of clearing the hammock vegetation, however, was an important deterrent to their agricultural development. Under natural conditions the soils of this group are too poorly drained for citrus crops. If adequately drained and properly managed, however, they should produce good yields of these crops.

Because these soils have a neutral to alkaline reaction somewhere in their profiles, special fertilizer and management practices are needed to improve the availability of some plant nutrients for crops. Under good management improved pasture does well on these soils.

MANAGEMENT GROUP 8

The soils of management group 8 are as follows:

- Arzell fine sand.
- Plummer fine sand.
- Rutlege fine sand, nearly level phase.
- Rutlege fine sand, gently sloping phase.

These are poorly to very poorly drained soils of the acid prairies and swamps. To a depth of about 30 inches they consist predominantly of acid sands. More clayey materials may be below this, which may be calcareous in many places. A great part of the acreage of these soils has a prairie or swamp vegetation, and practically all of it is along the lower drainageways and in seep areas of the acid upland soils. Most of these soils of management group 8 are used as unimproved pasture and provide good grazing. Small areas have been cleared and are used for truck crops.

With adequate water control and other good management practices, the soils are suitable for improved pasture, vegetable and truck crops, and forest.

MANAGEMENT GROUP 9

The following are soils of management group 9:

- Pompano fine sand.
- Pompano-Delray fine sands.
- Delray loamy fine sand.
- Delray mucky loamy fine sand.
- Manatee fine sandy loam-loamy fine sand.
- Manatee fine sandy clay loam.
- Manatee mucky loamy fine sand.
- Terra Ceia muck.

These are the poorly to very poorly drained soils of the wet prairies and swamps. They differ from those of group 8 chiefly in being less acid in the surface soils and neutral to strongly alkaline rather than acid in the subsoils. The Delray, Manatee, and Terra Ceia soils have thicker, darker colored surface soils than the Pompano soils. All of these soils are well suited to truck crops if adequate water control and good management practices are employed. However, adequate drainage is difficult to maintain in Terra Ceia muck, and Manatee fine sandy clay loam has unfavorable tilth.

During normal, relatively dry winter and spring seasons, many vegetable and truck crops and improved pasture are grown on these soils. Fairly high yields are obtained.

MANAGEMENT GROUP 10

Group 10 consists of miscellaneous land types. They are as follows:

- Alluvial land.
- Coastal beach.
- Fresh water marsh (unclassified soils).
- Fresh water swamp (unclassified soils).
- Made land.
- Shallow ponds with grass.
- Shell mounds.
- Tidal marsh.
- Tidal marsh, high-lying phase.
- Tidal swamp.

The land types of this management group are not suited to cultivation and have little value for pasture or forest. A great part of the acreage is very wet. The rest of the acreage, although drier, is for the most part so infertile that it does not support any substantial growth of useful plants.

Additional Facts About Manatee County

Settlement

The first white man known to have set foot in this part of Florida was Hernando De Soto, who landed on May 30, 1539, at what was later known as De Soto Point. In October 1856, Manatee County was created from Hillsborough County, which contained 5,000 square miles at that time. The town of Manatee, now a part of Bradenton, was the first county seat.

Manatee County was settled principally by people from Georgia, Virginia, and the Carolinas. Some came from New England, and a few came from the British islands off the southern coast of Florida.

Population

According to the 1950 census, Manatee County had a population of 34,704, an increase of 33 percent since 1940. Braidenton, now Bradenton, was established in 1878. In 1950 it had a population of 13,604, and Palmetto, across the Manatee River, had a population of 4,103. These two cities have about half the population in the county. Farming communities in this area are Parrish, Ellenton, Gillette, Rubonia, Terra Ceia, Palma Sola, Samoset, Oneco, and Tallevast. The fishing and resort communities of Anna Maria and Cortez are on the gulf. Most of the population is concentrated within 15 miles of the gulf coast. The population is unevenly distributed because settlements were made on the better hammock soils, which are in the western part. These are also near large bodies of water, which temper the climate and give better protection from frost.

Transportation and Markets

Two railroads, the Atlantic Coast Line and the Seaboard Air Line, provide adequate rail facilities. Two main highways, United States Highways Nos. 41 and 301, join in Palmetto. They continue southward in the

western part of the county. Other roads connect with points to the east. In addition, there are many miles of paved and graded roads, all well located with respect to accessibility to farming centers.

Bradenton is the principal rail center for shipment of produce. Other shipping centers for farm and citrus products are located at Palmetto, Parrish, and Ellenton. Farming centers are at Gillette and Rubonia, and vegetables and other farm crops are marketed at Palma Sola, Samoset, and Oneco. Myakka City is a trading center for the cattle-producing area in the southeastern part of the county.

An air line makes regular stops at the airport between Bradenton and Sarasota. Connections for other air travel can be made in Tampa, 30 miles north of Bradenton.

The Sunshine Skyway Bridge connects the northwestern corner of the county with St. Petersburg and saves many miles of travel around Tampa Bay. The Manatee River furnishes a waterway to the Gulf of Mexico and is navigable by small boats for many miles inland. Many boats from various sections of the country are anchored in the fine yacht basin at Bradenton.

The greatest amounts of agricultural products are shipped to northern and eastern markets by freight and express; smaller amounts go by boat and truck; and the rest is marketed locally or elsewhere in the State.

Industries and Occupations

Manatee County is noted primarily for its vegetable and citrus crops and for cattle production. A few industries have been established. A crate mill east of Bradenton, the farmers' market in Palmetto, and several large lumber yards employ many people. A large fuller's earth plant located just east of Ellenton has been in operation. A manufacturer of house trailers has started operations, and several marine railways build small boats for sportsmen and commercial fishermen. A preserving company at Palma Sola and a canning company at Palmetto can the guava fruit and guava products.

Social Facilities and Farm and Home Improvements

Educational facilities include grade and high schools. Children in rural areas are transported by bus to schools and towns in cities.

Churches of several denominations are located in the county, most of them in the Bradenton-Palmetto area. In 1947 there were several theaters, two hospitals, a public library, and two National Guard armories. A county auditorium, capable of seating 1,000 persons, is located in the Chamber of Commerce Building at the Bradenton pier.

The farm dwellings and barns are constructed mostly of wood. According to the 1954 Census of Agriculture, 676 farms had piped running water; 784 had electricity; and 471 had telephones. The better farms have installed modern plumbing and water systems. These home conveniences are mostly on farms in the western part of the county.

Agriculture

Land Use

The first settlement in Manatee County was made early in the nineteenth century in the town of Manatee, which became part of the city of Bradenton in 1944. Sugarcane was probably the first agricultural crop grown extensively in the area, but the industry dwindled with the outbreak of the Civil War. The raising of range cattle was important for a time, but then declined. It was superseded by the production of turpentine and rosin.

The growing of citrus crops attracted the attention of farmers late in the nineteenth century, and the first commercial grapefruit grove in the State was planted in Manatee County. Severe freezes in December 1885 and January 1886 damaged the citrus crop but did not kill the trees. Freezes in December and January of the 1894-95 season killed all of the young trees and set back the citrus industry.

A diversified agriculture developed along with the citrus industry. Truck crops, although influenced by supply and demand, have been increasingly grown throughout the years. Of these, tomatoes are the most extensively grown. More recently, the production of gladiolus for bulbs and cut flowers has increased. This crop now occupies almost as many acres as tomatoes.

The cattle industry is again becoming a major enterprise. The improvements in pasture and pasture grasses and the introduction of the Brahman breed for crossbreeding with the native cattle have largely accounted for the improvement of beef cattle. Some dairy cattle are raised, and dairy products are sold locally.

Crops

The acreage of principal field and truck crops and numbers of fruit trees in several census years are given in table 4. Vegetables and citrus fruits are the most important crops, both in acreage and value. The acreage in corn has greatly decreased. The principal crops grown in Manatee County are discussed individually, whereas the minor crops are grouped and mentioned only briefly.

Table 4.—*Acreage in principal field and truck crops and number of bearing fruit trees in stated years*

Crop	1929	1939	1949	1954
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>
Corn -----	747	1,041	182	36
Hay and forage -----	796	388	110	587
Flowers and flowering plants grown for sale in the open...	(¹)	(¹)	2,082	1,972
Vegetables:				
Potatoes -----	93	98	15	2
Sweetpotatoes -----	85	45	25	17
Other vegetables harvested for sale -----	4,958	5,869	4,447	4,558
	<i>Number²</i>	<i>Number²</i>	<i>Number²</i>	<i>Number</i>
Fruit trees:				
Orange ³ -----	130,611	132,248	224,025	219,312
Grapefruit -----	144,841	187,266	178,159	176,891

¹ No data available.

² Number in census year which is 1 year later than crop year given at head of column.

³ Including tangerine, satsuma, mandarin, etc.

Tomatoes.—This is the principal vegetable crop. The acreage is affected by market conditions and varies considerably from year to year. In 1954, 63 farms reported growing 2,111 acres of tomatoes, whereas in the 1941-42 season 6,000 acres were grown. The yield from unstaked plants is about half that from the staked ones.

Tomatoes are planted on most soil types in the western part of the county as a spring and a fall crop. The spring crop is the larger. Seedbeds for the spring crop are prepared in the latter part of December or early in January, and for the fall crop, about the middle of August. One-half pound of seed will produce enough plants for an acre of ground.

From the seedbed, the plants are set out in the fields in rows 4 feet apart and about 15 to 18 inches apart in the row. Commercial fertilizer is applied. Two applications are made—the first, about a week before setting the plants and, the second, as a sidedressing just before the first blooms appear. Tomatoes to be shipped are picked when the color begins to change from dark to light green. The fruit is then sorted, wrapped in paper, and crated at packing houses. For local markets, the tomatoes are left on the vine longer to improve their flavor.

Cabbage.—Acreages of cabbage ranged from 1,000 in the 1941-42 and 1944-45 seasons to 238 acres in 1954. Cabbage is one of the easiest truck crops to grow in Florida. It produces better yields on the heavier soil types. It requires more irrigation and fertilizer on the more sandy soils. The average yield is 8 to 10 tons per acre, although 20 tons have been grown on small areas of muck soils.

Cabbage is planted in seedbeds in October and transplanted to the fields when the plants are 4 to 6 inches high. The plants are usually set out in double rows with 36-inch middles, 15 to 18 inches apart in the rows. About 12 ounces of seed will produce enough plants for an acre of ground. About half of the fertilizer used is applied a week or 10 days before the plants are set in the field, and the remainder is added as a sidedressing

when the crop is about half grown. The crop is harvested 65 to 80 days after planting. For local and nearby markets, cabbage is collected in 40-pound sacks. For transportation to the northern markets, it is packed in standard cabbage crates or in hampers.

Lettuce.—Lettuce should be grown during the cool months, but in a warm soil. Lettuce was grown on 1,500 acres in the 1941-42 season. In 1954, 332 acres of lettuce and romaine were planted. In 1920 Florida supplied about a fifth of the lettuce grown in the United States. With the introduction of crisphead Iceberg lettuce, demand for the Florida crop dropped to about 0.5 of 1 percent. Early attempts to grow Iceberg lettuce in the State failed, but by 1937 Imperial varieties 847, 44, and 850 were developed. These varieties meet the demand for an Iceberg-type lettuce and are adapted to the soils and climate of Florida.

The moist, sandy loams and loamy sands of the Manatee and Delray series yield 200 to 300 crates to the acre. Each crate holds 4 to 6 dozen heads.

Lettuce seed is planted in seedbeds from the middle of September to January. Slightly more than ½ pound of seed will produce enough plants for an acre. When the plants are 2 to 3 inches high and have 4 leaves, they are set in double rows about 15 inches apart, with 30-inch middles. Fertilizer requirements vary with the type of soil. The organic soils do not require as much nitrogen but are more likely to need potassium. The sandier soils require more nitrogen. Practically all fertilizer is applied before the plants are set in the field. The crop is harvested about 85 days after planting. The heads are trimmed, graded, and packed in crates and shipped under ice to northern and eastern markets.

Cucumbers.—Cucumbers for table use and pickling are increasingly grown as a spring and fall crop. Although 100 acres were planted in the 1944-45 season, 438 acres were grown in 1954. This fluctuation results from the long rotations used to avoid diseases.

Cucumbers do well on almost any good soil but grow best on the sandy loams and loamy sands that have a relatively high water table. They are mostly planted directly in the field in rows 4 to 6 feet apart. Several seeds are planted in each hill. Planting takes place in September and October for the fall crop, and in February and March for the spring crop. Some growers broadcast about half the fertilizer used about 10 days before planting and the other half as a sidedressing. The cucumbers are picked when they are medium sized, well formed, and dark green over most of their length. Harvesting begins about 70 days after planting, and yields on the better soils average about 200 bushels an acre. The cucumbers are washed, graded, and packed in bushel baskets or hampers for shipment.

Peppers.—Sweet peppers and pimientos are grown in Manatee County. About 725 acres of peppers were grown in 1940, but only 102 acres in 1954. This fluctuation is the result of market demands for the crop. Average yields on 31 soils are shown in table 3. The yield from any one field may vary, as the plant has a long growing season and will produce fruit for 8 months if weather conditions are favorable.

Peppers are grown successfully on many soil types that have sufficient moisture without being water-

logged. One-half pound of seed will usually furnish enough plants for an acre. The seed is planted in seedbeds, and the plants are set out in the field 16 to 20 inches apart in rows that are 3 feet apart. A good commercial fertilizer is used in two applications—one-half 10 days before setting the plants in the field, and the rest about 40 days later. Additional sidedressings of nitrate of soda are sometimes made during the bearing season at 4- to 6-week intervals. The seed is planted in July and August for the fall crop and in January and February for the spring crop. Harvesting begins about 4 months after planting. The peppers are hand picked, graded, packed in the standard pepper crates, and shipped under refrigeration.

Beans.—Snap beans are increasing in importance as a fall and spring crop. During many of the seasons only 100 acres have been planted, but 402 acres were planted in 1954. Average yields range between 150 and 200 bushels per acre.

Beans can be grown on many kinds of soils but do best on the better grades of hammock and muck soils. They require an adequate supply of moisture, although the lower soils must be fairly well drained.

The seed is planted in rows 3 feet apart, with about 4 inches between hills in the row. The fertilizer is applied about a week before planting. The sandier soils require more fertilizer than the organic soils. Plantings are made in August and September for the fall crops and February and March for the spring crops. The beans are picked when the pods have reached mature size, but before they begin to ripen. Several pickings are usually necessary. After harvesting, the beans are sorted, packed in bushel hampers, and transported to the markets.

Gladiolus.—The growing of gladiolus for bulbs and cut flowers is rapidly expanding. In 1945 about 1,500 acres were planted to this crop. Yields averaged about 25,000 blooms per acre.

Gladiolus does well on almost any good well-drained soil that contains an adequate supply of moisture. Because freedom from frost is essential, large plantings are made in the extreme western part of the county where the bays and river have a moderating effect on the temperature. The ground is plowed or disked and the bulbs are planted closely in rows 3 feet apart. From 40,000 to 50,000 bulbs are required for each acre. The plantings begin in August and continue at 7-day intervals until February, to provide a continuous supply of blooms. The first application of fertilizer is made about 10 days before planting; the other two are applied as sidedressings.

Harvesting of the blooms begins from 75 to 90 days after planting; the date depends on the variety and weather conditions. The flower stalks are cut just as the lowest blossom begins to open. After blooming, the plants mature in 1 to 2 months. The bulbs are then dug, cured, and stored until the next planting. The curing is done in any dry, well-ventilated place. The bulbs are placed in wooden trays with slats in the bottom so that air can circulate. After about 6 weeks of air-drying, the bulbs are stored at 35° to 45° F. to prevent premature sprouting.

Citrus crops.—The growing of citrus fruits ranks first in acreage and value of agricultural products in

Manatee County. According to the Florida State Marketing Bureau, for the 1944-45 season, there were 5,180 acres of grapefruit trees, 4,610 acres of oranges, and 117 acres of tangerines. This total of 9,907 acres of citrus fruits compares with 5,732 acres in vegetables during the same season.

Most citrus trees are purchased from commercial nurseries and are budded on sour-orange or rough-lemon rootstock. The sour-orange rootstock is used more in the western part of the county on the hammock and lower flatwoods soils, as these roots are more resistant to root rot. Citrus trees on rough-lemon rootstock do better on the higher, better drained sandy soils, since the roots go deeper and the trees are better able to resist drought.

Grapefruit varieties most commonly grown are the Duncan, Marsh Seedless, Royal, Thompson, and Seedless Pink. The spacings used in the groves are 15 by 30 feet, 20 by 30 feet, 25 by 25 feet, and 30 by 30 feet. The wide spacings have proved to be better and have been more generally used in the later plantings. The quantities of fertilizer vary with the size of the tree and fertility of the soil. Each tree is individually fertilized and receives from 2- to 30-pound applications in May or June. The fall application is made in November. From 20 to 25 pounds of fertilizer per tree is a good average on most producing groves. Yields of the fruit vary from one-half a box up to 20 or 25 boxes per tree. The average is near 7 boxes, or about 500 boxes per acre.

Varieties of oranges grown are classified as early, midseason, and late. The spacings are a little less than for grapefruit; 25 by 25 feet distances are suggested. The fertilizer and time of application are also the same, but the amount per tree is not so much. From 10 to 15 pounds is a good average for most producing groves. Yields in general are about one-half those of grapefruit, or about 250 boxes per acre.

The spraying and dusting schedules vary from grove to grove, according to conditions. A common practice is to apply, in January or February, a nutritional spray consisting of zinc and lime-sulfur. For groves on alkaline soils, manganese sulfate is included. Copper also has a nutritional value and is sometimes included when not needed for disease control. In most instances, however, copper is applied the latter part of April or early in May as a separate post-bloom spray for the control of melanose. Dusting with sulfur or the use of wettable sulfur sprays during summer and fall is recommended for control of the rust mite.

Minor crops.—Many other crops are grown in Manatee County, both for local consumption and shipment. Although individual crops occupy a comparatively small acreage, they reach a fairly large total investment and produce considerable income. These crops include hay and forage, strawberries, potatoes, sweet-potatoes, watermelons, squash, sugarcane or sorghum, sweet corn, okra, endive, escarole, celery, eggplant, turnips, and blackeyes and other green cowpeas. The tree fruits include papaya, guava, mango, persimmon, peach, pecan, plum, pear, and fig. Only 12 farms reported having grapevines in 1954. Other crops, usually grown in the family garden, are peanuts, chufas, velvetbeans, onions, English peas, beets, lima

beans, cauliflower, field peas, lemons, limes, tangelos, kumquats, and bananas.

Fertilizers and Rotations

Fertilizer materials most commonly used were nitrate of soda, nitrate of potash, superphosphate, hardwood ashes, and limestone. Other materials used were sulfate of ammonia, ammonium nitrate, cyanamid, castor pomace, sheep manure, muriate of potash, sulfate of potash, kainite, bonemeal, basic slag, and secondary plant foods. From one-third to one-half of the nitrogen in most mixtures is from organic sources.

Fertilization of each major crop produced in the county has been covered in the discussion of that crop and, in general, is in agreement with the recommendations of the Florida Agricultural Experiment Station. For truck crops, the common practice is to apply about one-half of the mixed fertilizer 1 to 2 weeks before planting, and the rest as a sidedressing when the crops are about half-grown or just before the bloom stage. In some cases the entire amount of mixed fertilizer is applied before planting, and this is followed by sidedressings of nitrate of soda during the stages of rapid growth.

In general, field crops are fertilized only lightly, or not at all. Corn is not fertilized when grown with peanuts, velvetbeans, or chufas. When corn or peanuts are grown alone, however, some farmers use a complete fertilizer in the row and also sidedress the corn with nitrate of soda. Tests by the Florida Agricultural Experiment Station show that zinc sulfate, applied at the rate of 12 pounds to the acre, has corrected white bud of corn and increased yields. The tests also showed increased yields, to a lesser extent, for cowpeas, velvetbeans, Pearl millet, crotalaria, and oats.

The programs for the fertilization of citrus fruits are varied and depend on the kind of soil, the age and size of the trees, the general condition of the grove, and the opinions of the individual growers.

The kind and amount of fertilizers used for the production of a crop depend primarily upon the requirements of that crop, but they also vary with the different types of soil. A dark-colored soil such as the Orlando, Scranton, Rutlege, Delray, Manatee, or Terra Ceia muck does not require so much nitrogen as a light-colored soil such as the Lakeland, Blanton, Pomello, or Arzell. The darker colored soils contain more organic matter than the lighter soils. This organic matter and the finer texture of some soils enable them to absorb and hold plant nutrients better and thereby retard loss by leaching. Potassium, in particular, is quickly lost from an open, porous, sandy soil.

Present practices in regard to crop rotation and the use of cover crops are varied. The system most widely used for citrus fruits is a combination of clean cultivation in the dry season with cover crops during the rainy summer season. Clean cultivation preserves moisture that would be used by weeds and grass. The surface mulch also reduces evaporation. At the beginning of the summer season, cultivation is discontinued, and a cover crop of crotalaria is sown or a growth of native

weeds and grasses is allowed to develop. This plant cover is maintained until October or November, when it is disked under to add organic matter to the soil. Some of the effects of these summer cover crops on crop yields and soil conditions have been studied and reported by the Florida Agricultural Experiment Station. The organic matter in the surface soil was not materially increased on the light sandy soils, but the continued use of cover crops was indicated as being necessary for the maintenance of soil productivity.

Some farmers use the space between young trees for the growing of vegetables. Where two or more vegetables are grown on the same farm, they are usually rotated. When only one crop is grown, the land lies idle or a cover crop is grown for 1 to 3 years before the crop is replanted. This practice is followed mainly to control plant diseases, but also to maintain the fertility of the soil. The cover crops most extensively used for soil improvement are beggarweed, cowpeas, sesbania, velvetbeans, oats, rye, and three varieties of crotalaria—*C./spectabilis*, *C./intermedia*, and *C./mucronata*. Of these, crotalaria and native weeds furnish the main summer cover; oats and rye are winter cover crops.

Pastures and Their Management

The grazing land in Manatee County is mostly in the central, eastern, and southeastern parts. Most of it is unimproved range, but in recent years an increased acreage has been put in improved pasture. Both range and improved pasture are in practically all parts of the county, but the largest areas are on the soils of the extensive pinelands. These soils of the flatwoods have level to very gently undulating relief, with scattered knolls of scrub oaks and sandy oak hammocks. Numerous intermittent water and grass ponds furnish water for livestock. Usually the ponds are ringed with a grassy prairie area that increases the grazing value of the flatwoods. The estimated average carrying capacities of the different types of unimproved range are as follows: Fresh-water marsh, 1 cow on 1 acre; sandy prairies, 1 cow on 3 acres; bottom land, 1 cow on 5 acres; low-marl hammocks, 1 cow on 8 acres; pine and cabbage palm land, 1 cow on 10 acres; flat pine land, 1 cow on 15 acres; and the scrub oak and sandy oak hammocks, 1 cow on about 30 acres.

Forage for grazing on the unimproved range consists mainly of wiregrass and a few other grasses and sedges, particularly broomsedge, bermudagrass, and carpetgrass. With the introduction of purebred stock and Federal aid for the improvement of pastures, most cattlemen have fenced their rangeland and are improving their pastures. The improved pastures are mostly planted to carpetgrass, but some Coastal bermudagrass and Pangolagrass are grown. Some acreages of the Pensacola strain of bahiagrass have been planted on the higher, more droughty sandy soils.

The marsh prairies are the best for pasture and furnish good grazing almost the year round. They are located largely in the extreme southeastern part of the county. Most of the sandy prairies are being converted into improved pasture by running heavy disks or rotary choppers over the land to eradicate the pal-

metto. This practice is carried out on many areas of the flatwoods soils. The carpetgrass can become established, especially if aided by the proper fertilizers. Studies have shown that most Florida soils are low or deficient in one or more of the mineral nutrients essential for rapid and normal plant growth. In the acid flatwoods soils, carpetgrass shows the greatest response to the addition of phosphate, but nitrogen, potash, and lime are also needed.

Many herds still graze over large acreages of unimproved range. On these areas the land is burned annually to improve the quality of the wiregrass. Usually, burning is done late in winter so that the wiregrass can put on new growth in spring. Thus wiregrass becomes very palatable and highly nutritious for about 90 days. It has been reported that where controlled burning was practiced annually, steers made about 33 percent greater gains than steers grazing on land that had not been burned for several years.

Livestock and Livestock Products

Census figures for 1954 on the number of livestock on farms are shown in table 5. Cattle are the most important livestock. A large percentage of the cattle raised are beef cattle of native stock and inferior type. They receive only the food that they are able to obtain on the open range. The more progressive cattlemen are improving the quality of their herds by the introduction of better breeding stocks. Purebred Brahman, Angus, and Hereford bulls are crossed with native cows to increase the size of the cattle and to develop greater resistance to high humidity and temperature. Rhoad and Black (9) found that the best stock for subtropical climate was obtained by crossing native cows to purebred Hereford bulls; crossing the first-generation heifer with Brahman bulls, and finally backcrossing the offspring with purebred Hereford bulls. Most of the beef cattle are shipped to other parts of the country for market. Some are sold at auction markets within the State.

TABLE 5.—Livestock of all ages on farms in stated years

Livestock on farms	1930	1940	1950	1954
	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>
Horses and colts.....	317	¹ 247	493	388
Mules and mule colts.....	559	¹ 410	194	73
Cattle and calves.....	4,550	¹ 10,108	17,643	31,145
Hogs and pigs.....	5,435	² 3,738	798	532
Chickens.....	¹ 22,508	² 16,033	² 23,647	² 30,521
Beehives.....	953	1,424	³ 968	(⁴)

¹ Over 3 months old.
² Over 4 months old.

³ In 1949.
⁴ Not reported.

The dairy cattle are mainly Jersey and Guernsey; their products are sold locally. The dairy farms are mainly in the western part of the county near the large population centers. The swine are mainly of common stock and are butchered for home consumption or sold at nearby auction. Sheep, goats, and chickens are kept by some farmers.

According to the 1954 census, 12,516 cattle and calves, 281 hogs and pigs, and 38,684 chickens were reported sold. Also reported sold were 1,102,707 gallons of milk and 273,740 dozen eggs.

Farm Power and Mechanical Equipment

The 1954 census reported 613 tractors on 366 farms, 624 trucks on 442 farms, and 772 automobiles on 618 farms. There were an estimated 834 farms in the county in 1954. The tractors are usually equipped for all tillage operations.

Also in 1954, 210 farms reported a total of 461 horses and mules. This total compares with 775 horses and mules on the 429 farms reporting in 1945. Replacements are raised on only a few of the farms. The decrease in work stock is attributed to a greater use of mechanized equipment.

Types of Farms

The chief sources of income for the farms in 1954 were vegetables, horticultural specialties, and fruits and nuts. The vegetable farms are mostly in the western third of the county where the better hammock soils predominate. Gladiolus are grown for bulbs and flowers on many of the farms producing horticultural specialties. They are produced largely on flat pine and cabbage palm land near the gulf coast, where there is less danger from frosts. Citrus fruits are widely grown over the county on many kinds of soils. In the western area, the groves are on the sandy oak hammock land, pine and cabbage palm land, flat pine land, and the low marl hammocks. In the central and eastern areas, most groves are confined to the soils of the sandy oak hammocks.

Farm Tenure

Census figures for 1954 show that full owners operated 670 farms; part owners, 74; managers, 19; and tenants, 41.

Of the 41 tenant farmers in 1954, 12 were cash tenants, 6 were share tenants, and 1 was a share-cash tenant. There were no croppers, but there were 22 unspecified tenants. In general, the share tenants furnish all the labor and the landlord furnishes shelter, farm implements, and sometimes the seed and fertilizer. The products raised are usually divided equally between the tenant and the landlord.

Farm Expenditures

The purchase of feed and fertilizer and the hiring of labor are among the chief expenses of operating a farm. According to the 1954 census, 588 farms reported buying commercial fertilizer, 156 reported buying lime, and 455 reported buying feed.

Many of the farms reported expenditures for hired labor. Most of the laborers are employed in harvesting the fruit and in planting and harvesting the vegetables.

Some are paid by the day and others by the amount harvested.

Forests

Forest Types

The forest of Florida has been roughly divided into five groups, as follows: (1) Longleaf-slash pinelands, (2) hardwood hammocks, (3) blackgum and cypress swamps, (4) longleaf-scrub oak ridges, and (5) sand pine scrubland. All of these forest types occur in Manatee County. In addition, minor areas of distinct forest types, such as the cabbage palmetto hammocks and scrubby hardwood growth, occur on many of the keys (8).

Longleaf-slash pinelands.—The longleaf-slash pine areas are the most extensive in Manatee County. Of the seven species of pine native to the State, longleaf and slash pines are the most valuable. They are dual-purpose pines because they yield naval stores of commercial value and also produce some of the finest lumber and other wood products. They commonly grow together in mixed stands on many of the soils in the flatwoods. On the low wet areas, however, slash pine is dominant, as the longleaf grows poorly under such conditions. Longleaf pine is better adapted to dry, sandy ridges. In general, slash pine is more useful than longleaf pine because it grows rapidly, yields more naval stores of a slightly better grade, and has seedlings that can be transplanted more easily.

Hardwood hammocks.—The hardwood hammocks probably rank next in importance. Among the most valuable trees of this group are the magnolia, sweetgum, white bay, black cherry, hammock hickory, ash, basswood, maple, and dogwood. Many other hardwoods having little or no commercial value are also present. The most common of these are the live, water, and laurel oaks. Elm, Carolina laurelcherry, beech, persimmon, and holly occur in lesser numbers.

Cypress swamps.—The cypress swamps in Manatee County are not extensive. They occur mostly in the north-central and eastern areas. The stands consist almost entirely of cypress with a few blackgum trees.

Longleaf-scrub oak ridges.—The longleaf-scrub oak ridges have been cleared of pine in many areas. Restocking this kind of land with pine species is difficult because the ridges are usually too dry for slash pine, and the seedlings of longleaf pine are difficult to transplant successfully. Even where seed trees have been left on the drier sandy soils, reforestation is fairly slow.

Sand pine scrubland.—Many sand pine scrub areas occur in the eastern part of the county. Sand pine is relatively unimportant for timber because the wood is fairly knotty and not durable, and the trees do not grow so large as other pines. The soils on which this pine grows are so dry and low in productivity that it would be inadvisable to plant more valuable species or to grow a cultivated crop.

All land areas not actually under cultivation can be classed as forest or grazing land. Much land is used for both purposes. Large areas have been cleared of

pine and are now being used as unimproved rangeland. It is the common practice to burn over these areas annually to provide a fresh growth of wiregrass for cattle. Under this system reforestation is obstructed and the land is not used to its fullest capacity.

Forest Management

The forests are understocked in most areas. For restocking the cutover areas, seedlings should be planted; natural reproduction should be advanced through the thinning of undesirable species; and dwarfed or crooked trees and shade trees should be pruned.

The Florida Agricultural Extension Service has suggested a program that combines timber growing with grazing. This system forms a basis for better land utilization (8) and also provides for the production of game, fish, and other wildlife.

Slash pine (6) is a good source of income in the county, and its planting and care are discussed in detail. It grows fast and produces turpentine gum at an early age while growing to timber size; its wood averages the heaviest, hardest, and strongest of all the commercial conifers in the United States.

Slash pine.—If seed trees are well distributed (6 or 8 per acre) and if time is not a factor, a slash-pine area will restock itself by natural reproduction. Fires should be kept out, however. Another method, used more frequently because it gets quicker results, is to plant pine seedlings. The seedlings may be obtained at a small cost from the Florida Forest Service at Tallahassee or from the nearest district forester. For best survival, the young trees should be planted in a fairly moist soil during December and January.

The Florida Forest Service (5) suggests spacings of 6 by 6 feet for erosion control, 8 by 8 feet for all purposes, 10 by 10 feet for early returns, and 12 by 12 feet for naval stores. The seedlings should be planted as soon as possible after they are received. The hole should be large enough to allow the roots to spread, and the soil should be firmly packed around it. A mulch of grass, straw, or loose soil scraped about the trees will prevent too rapid drying of the soil.

Thinning is necessary in many forests to avoid overcrowding. Proper thinning will hasten the production of a full crop of timber. Young trees should be set fairly close together to produce a straight, tall growth, with few side branches. The trees can be thinned so that the tops will come together in about 5 years.

Another general rule for thinning is to add 2 to the diameter of the trees in inches at breast height (d. b. h.). The resulting number gives the number of feet that should be about the average distance between trees. For example, if the trees average 6 inches d. b. h., add 2 to this number and the result will be 8. Thus the trees should be thinned so that they are 8 feet apart. The greater the diameter of the trees, the greater the spacings between them.

Pruning is more beneficial in open forests than in thick stands. As a slash pine grows, the lower limbs die and break off because they have not received enough sunlight. In close stands, the side limbs are shaded

earlier and break off sooner, and a new clear wood will form where the limb had been. If the tree stands in the open forest, the side limbs get much more light and live longer. Consequently, the trees are shorter and more knotty, and the lumber is of lower grade and value.

Other suggestions by the Florida Forest and Park Service (5) are to prune selected trees that are sound, straight, and even-spaced; that is, the trees more likely to make high-quality products. Cut the limbs close to the trunk so that they do not leave any stub. Prune no more than two-thirds of the total height of the tree, or no more than the lower one-third of the live crown or top. Prune a second time, if necessary, to produce at least one clear 16-foot log. Scatter the limb debris away from the base of the trees to prevent insect attack and to lessen the danger from fire.

Morphology and Genesis of Soils

Factors of Soil Formation

Soil is the product of forces of weathering and soil development acting on the parent material deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which that material accumulated and has since existed; (3) the plant and animal life in and on the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of development have acted on the soil material (12, 13).

Climate and vegetation change the parent material from an inert heterogeneous mass into a body that has a definite genetic morphology. The effect of these two factors on the parent material are accelerated, or retarded, to varying degrees by relief. Relief, in turn, affects runoff, the movement of water through the soil, the rate of natural erosion, the vegetation, and exposure to sun and wind.

The kind of parent material also affects the results of the forces of climate and vegetation. Parent material is important in determining internal soil conditions and the kinds of natural vegetation that grow on the soil.

Finally, time is a factor in the development of the soil into a body that is in equilibrium with its environment. The degree of such development depends not only upon time, but also on the rate at which the forces of climate and vegetation act, which, in turn, is affected by the relief and parent material.

Humic Gley, Ground-Water Podzol, and Low-Humic Gley soils are the principal great soil groups occurring in Manatee County. These are miscellaneous intrazonal soils and have relief that is usually low and flat. They have poor drainage and a high water table and are more or less waterlogged. In general the Humic Gley soils are dark in color and contain a noticeable amount of organic matter, whereas the Ground-Water Podzols and Low-Humic Gley soils are lighter in color and contain much less organic material. Other great soil groups in the county are Regosols, Bog soils, and Alluvial soils.

Parent material

According to a geological survey by Cooke (2), three geologic formations are at or near the surface in Manatee County: The Hawthorn formation, the Bone Valley formation, and Caloosahatchee marl. The Hawthorn formation consists chiefly of gray phosphatic sand and lenses of green or gray fuller's earth. Known exposures of this formation are confined to the western part of the county. Farther to the east the Hawthorn formation is overlain by the Bone Valley formation and by late Pleistocene sand. A light-gray to white fuller's earth has been mined near Ellenton, although these pits are now abandoned. According to Sellards and Gunter (10), the thickness of this fuller's earth varies from 7 feet to a thin film and is absent in some places. A compact, marly, fossiliferous limestone occurs under it, and a thin bed of Pleistocene terrace deposits lies over it unconformably.

The natural deposits of the Bone Valley formation are rare; therefore, descriptions of it are based almost entirely upon examinations of phosphate mines. Matson (7) describes the Bone Valley as "gray, brown, or mottled sand and phosphate conglomerate, in a sand matrix. The brown sands are locally cemented into a hard ferruginous sandstone, and slight induration is common." In the same report he says that the Bone Valley gravel consists of rounded pebbles of phosphate embedded in a matrix of sand or clay overlain by varying thicknesses of loose semi-indurated sand. The maximum thickness of this formation is probably more than 50 feet, but only about one-third of this thickness should be assigned to the phosphate. It is estimated by geologists that more than half of Manatee County is underlain by pebble phosphate richer than 55-percent bone phosphate of lime.

The Caloosahatchee marl consists mostly of sand and shells. In many places the shells comprise a large part of the deposits; in others, there are few or none. In fresh unweathered exposures of Caloosahatchee marl, the shells are commonly white or light gray. After the exposures are subjected to the oxidizing effects of weathering, however, the color changes to cream or yellow (2). Only a few feet of this formation is exposed anywhere, because it occurs in a generally level region. In Manatee County this marl region borders the Gulf of Mexico.

Most of the soils in Florida have developed from noncalcareous sands and clays overlying deposits of limestone. The thickness of this mantle of sand and clay is quite variable in Manatee County. In the northeastern and central parts of the county it is comparatively thick, whereas in the southeastern and central parts it is so thin that the underlying limestones influence the characteristics of the soil. The Bradenton, Parkwood, Manatee, and Ruskin soils have been derived from or influenced by the underlying marls.

Climate

The subtropical climate of Manatee County, with its high relative humidity, short mild winters, long warm

summers, and abundant rainfall, affects the development of the soils in this region. The heavy rains on the higher, well-drained sandy areas percolate rapidly through the soil and transfer materials from one horizon to another, or even out of the soil completely.

Climate exerts its influence on soils directly and indirectly. Directly, it affects the type of weathering of the parent material; the collection and deposition of materials transported by water, wind, and gravity; and the percolation of water through the soil. Indirectly, it is responsible for the variation in the biologic forces, the shaping of land masses thrust up from the sea by movements of the earth's crust, and, to a certain extent, for the character of many rock formations (1).

The climate, along with relief, which includes drainage, influences the plant and animal life, which, in turn, exerts its own influence on the development of the soil profile.

Plant and animal life

Higher plants, micro-organisms, earthworms, and other forms of life occur on and in the soil and contribute to its morphology. The nature of these changes brought about by these organisms depends, among other things, on the kinds of life and the life processes peculiar to each.

Plant life has two important functions in the development of the soil profile. It furnishes organic matter for the soil and brings plant nutrients from the lower horizons to the upper ones (1). Trees and grasses deposit their dead leaves and trunks on the surface of the soil and thus furnish organic material to the surface layer. Their roots permeate the soil, making it more porous, and add organic material to lower layers. The deeper rooted plants bring up from the deeper layers a certain amount of plant nutrients that are returned to the surface of the soil when the leaves fall and the plants themselves decay.

Everything is not known about the micro-organisms, earthworms, and other population of the soil, but their influence on soil formation is probably equal to that of higher forms of life.

Relief

Relief is an important factor in soil formation. In Manatee County it is generally level, although areas in the central and northeastern parts are gently rolling. Gentle slopes are most favorable for the development of normal soils because the drainage is good and runoff is not excessive. Where the slopes are steeper, the soil material is more subject to removal by surface runoff. Level areas are conducive to poor drainage which, in Manatee County, gives rise to Low-Humic Gley, Humic Gley, Ground-Water Podzol, and Bog soils. The Ona, Leon, St. Johns, and Immokalee soils were developed from thick beds of sands in a level position under the vegetation of the flatwoods. They were also influenced by a high water table. In a lower position, the Humic Gley soils were formed. Where Humic Gley soils are over fairly thick beds of sands and clays,

the soils of the Rutlege and Plummer series have developed. If this sandy covering is shallow, the underlying marl, shell, and limestone tend to make the profile more alkaline, and soils of the Parkwood, Bradenton, Manatee, Pompano, and Delray series result. The Bog soils, consisting chiefly of mucks, are in the lowest physiographic positions. In these places the plant debris has accumulated, and as a result a large amount of organic matter is present.

Time

Parent material, climate, relief, and plant and animal life all need time in which to exert their influences on soil formation. In certain acid soils in humid regions, such as the soils present in most of Manatee County, profile development takes place in a fairly short time. A few hundred years might prove sufficient under these conditions. However, if lime occurs in the sandy material, or if the parent material is finer textured, the time required for development of a mature profile is much longer. These last-named conditions exist in areas in the western part of the county.

Soil Survey Methods and Definitions

The scientist who makes a soil survey examines soils in the field, classifies them in accordance with facts that he observes, and maps their boundaries on an aerial photograph or other map (11).

FIELD STUDY.—The soil surveyor bores or digs many holes to see what the soils are like. The holes are not spaced in a regular pattern; they are located according to the lay of the land. He crosses the land at intervals a quarter of a mile apart and sometimes much closer. In most soils such a boring or hole reveals several distinct layers, called horizons, which collectively are known as the soil profile. Each layer is studied to see how it differs from others in the profile and to learn the things about this soil that influence its capacity to grow plants.

Color is usually related to the amount of organic matter. The darker the surface soil, as a rule, the more organic matter it contains. Streaks and spots of gray, yellow, and brown in the lower layers generally indicate poor drainage and poor aeration.

Texture, or the content of sand, silt, and clay, is determined by the way the soil feels when rubbed between the fingers, and is later checked by laboratory analysis. Texture determines how well a soil retains moisture, plant nutrients, and fertilizer, and whether it is easy or difficult to cultivate.

Structure, which is the way the individual soil particles are arranged in larger grains, and the amount of pore space between grains, gives us clues to the ease or difficulty with which the soil is penetrated by plant roots and by moisture.

Consistence, or the tendency of the soil to crumble or to stick together, indicates whether it is easy or difficult to keep the soil open and porous under cultivation.

Other characteristics observed in the course of the

field study and considered in classifying the soil include the following: The depth of the soil over bedrock, cemented or compact layers, or loose gravel strata; the presence of gravel or stone in amounts that will interfere with cultivation; the steepness and pattern of slopes and the degree of erosion; the runoff of surface water, drainage through the soil, and occurrence of a high water table; the nature of the underlying rocks or other parent material from which the soil has developed; and acidity or alkalinity of the soil as measured by chemical tests.

Simple chemical tests show how acid the soil may be. The reaction of a soil is its degree of acidity or alkalinity expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality; higher values, alkalinity; and lower values, acidity. The degree of acidity or alkalinity is expressed in words and pH values as follows (11):

<i>pH</i>		<i>pH</i>	
Extremely acid -----	Below 4.5	Neutral -----	6.6-7.3
Very strongly acid ---	4.5-5.0	Mildly alkaline ---	7.4-7.8
Strongly acid -----	5.1-5.5	Moderately alkaline ---	7.9-8.4
Medium acid -----	5.6-6.0	Strongly alkaline ---	8.5-9.0
Slightly acid -----	6.1-6.5	Very strongly alkaline -----	9.1 and higher

CLASSIFICATION.—On the basis of the characteristics observed by the survey team or determined by laboratory tests, soils are classified into phases, types, and series. The soil type is the basic classification unit. A soil type may consist of several phases. Types that resemble each other in most of their characteristics are grouped into soil series.

Soil type.—Soils similar in kind, thickness, and arrangement of soil layers are classified as one soil type.

Soil phase.—Because of differences other than those of kind, thickness, and arrangement of layers, some soil types are divided into two or more phases. Slope variations, frequency of rock outcrops, degree of erosion, depth of soil over the substratum, type of drainage (natural or artificial), and presence of excess soluble salts are examples of characteristics that suggest dividing a soil type into phases.

The soil phase (or the soil type if it has not been subdivided) is the unit shown on the soil map. It is the unit that has the narrowest range of characteristics. Use and management practices therefore can be specified for the soil phase more easily than for soil series or yet broader groups that contain more variation.

Soil series.—Two or more soil types that differ in surface texture, but that are otherwise similar in kind, thickness, and arrangement of soil layers, are normally designated as a soil series. In a given area, however, it frequently happens that a soil series is represented by only one soil type. Each series is named for a place near which the soil was first mapped.

As an example of soil classification, consider the Blanton series. This series has only one type in Manatee County, which is subdivided into three phases:

<i>Series</i>	<i>Type</i>	<i>Phase</i>
Blanton-----	Fine sand-----	{ Nearly level phase. Undulating phase. Brown layer phase.

Miscellaneous land types.—Fresh stream deposits, or

rough, stony, and severely gullied areas that have little true soil are not classified into types and series; they are identified by descriptive names such as alluvial land, stony land, riverwash, and so on. Alluvial land, Coastal beach, Tidal marsh, and Tidal swamp are miscellaneous land types in Manatee County.

Soil complex.—When two or more soils are so intricately associated in small areas that it is not feasible to show them separately on the soil map, they are mapped together and called a soil complex. Leon-Immokalee fine sands, nearly level phases, is a complex of Leon fine sand and Immokalee fine sand.

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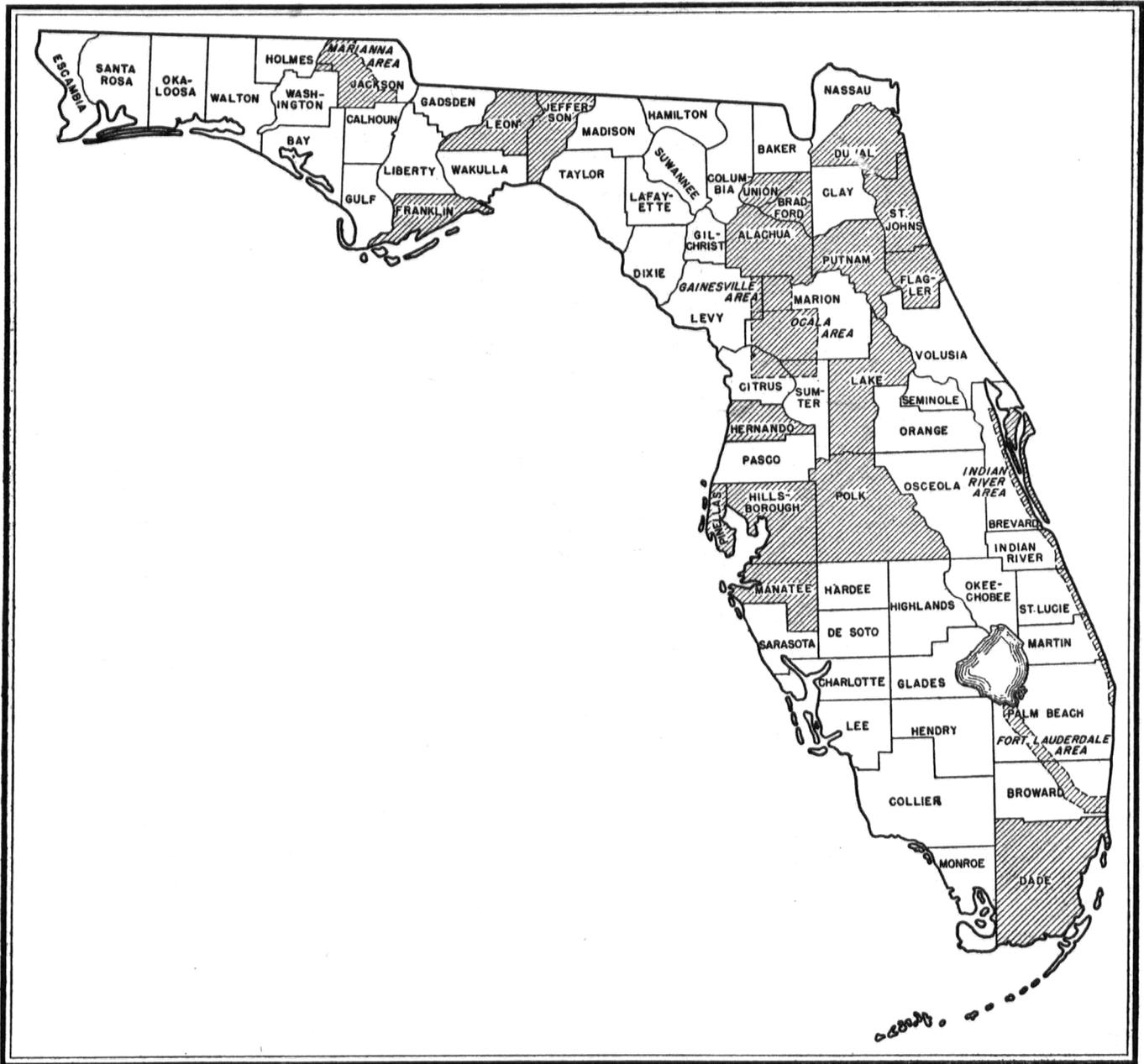
Supplement to soil map giving important characteristics of the soils

Soil types and phases	Map symbol	Parent material	Physiographic position	Natural drainage	Color and consistence of soil horizon		
					Surface soil	Lower layers	
Alluvial land -----	Ao	Variable -----	Alluvial bottoms	Variable -----	Variable -----	Variable -----	Variable.
Arzell fine sand -----	Ab	Acid or alkaline sand and clays.	Drainageways and depressions in uplands.	Poor -----	Light-gray fine sand.	White fine sand -----	May have heavier textured layer below 30 inches.
Blanton fine sand, nearly level phase	Bb	Acid sands -----	Upland -----	Good -----	Gray to light-brownish gray fine sand.	Spotted pale-yellow and light-gray fine sand.	
Blanton fine sand, undulating phase.	Bc	Acid sands -----	Upland -----	Good -----	Same -----	Same -----	
Blanton fine sand, brown layer phase.	Bo	Acid sands -----	Upland -----	Good -----	Medium- to light-gray fine sand.	Brown fine sand stained with organic matter.	Pale-yellow to light-gray fine sand.
Braden fine sand -----	Bd	Acid sands and clays over calcareous rock fragments.	River and stream terraces.	Imperfect -----	Medium- to dark-gray fine sand.	Light- to medium-gray fine sand over brownish-yellow fine sand.	Mottled gray, brown and brownish-yellow fine sandy loam to fine sandy clay containing calcareous rock fragments.
Bradenton fine sand -----	Be	Acid sands and clays over marl.	Upland -----	Imperfect -----	Gray to dark-gray fine sand.	Light-gray fine sand over grayish-brown to brown fine sand.	Fine sandy loam or light fine sandy clay loam over marl.
Bradenton fine sand, deep phase.	Bf	Same -----	Upland -----	Imperfect -----	Same -----	Same -----	Same.
Bradenton fine sand, thick surface phase.	Bg	Same -----	Upland -----	Imperfect -----	Same -----	Same -----	Same.
Bradenton fine sand, thick surface deep phase.	Bh	Same -----	Upland -----	Imperfect -----	Same -----	Light- to medium-gray fine sand over yellowish-brown or brownish-gray fine sand.	Light-gray and brown mottled fine sandy clay loam over marl.
Broward fine sand -----	Bk	Acid sands and clays over limestone.	Upland -----	Imperfect to poor.	Gray fine sand -----	Light-gray sands over brown to brownish-yellow fine sand.	Hard limestone below 18 inches.
Broward fine sand, shallow phase.	Bm	Same -----	Upland -----	Imperfect to poor.	Gray fine sand -----	Same -----	Hard limestone less than 18 inches.
Broward fine sand, heavy substratum phase.	Bl	Same -----	Upland -----	Imperfect to poor.	Gray fine sand -----	Same -----	Brownish-yellow fine sandy clay over hard limestone.
Coastal beach -----	Co	Mixed sands and shells.	Along coasts -----	Variable -----	Very light gray to white sands and shells.		
Delray loamy fine sand	Do	Neutral to alkaline sands and clays.	Shallow depressions in uplands.	Poor to very poor.	Dark-gray to black loamy fine sand.	Gray loamy fine sand	Gray fine sandy loam to fine sandy clay loam, neutral to mildly alkaline.
Delray mucky loamy fine sand.	Db	Same -----	Same -----	Same -----	Dark-gray to black mucky loamy fine sand.	Gray loamy fine sand	Same.
Fresh water marsh (unclassified soils).	Fa	Variable -----	Lowland -----	Ponded -----	Variable -----	Variable -----	Variable.
Fresh water swamp (unclassified soils).	Fb	Variable -----	Lowland -----	Ponded -----	Variable -----	Variable -----	Variable.

MANATEE COUNTY, FLORIDA

Soil types and phases	Map symbol	Parent material	Physiographic position	Natural drainage	Color and consistence of soil horizon		
					Surface soil	Lower layers	
Huckabee-Kalmia fine sands.	Ho	Acid sands and clays.	River terrace	Good	Light brownish-gray to yellowish-brown fine sand.	Brownish-yellow fine sand.	Brownish-yellow to yellow fine sandy loam below 30 inches. Kalmia soils have fine sandy loam within 30 inches.
Immokalee-Leon fine sands.	lo	Acid sands	Upland	Imperfect	Medium-gray fine sand (Immokalee).	Light-gray fine sand (Immokalee).	Dark-brown fine sand stained with organic matter (Immokalee).
Keri fine sand	Ko	Acid sands over marl.	Upland	Imperfect	Gray fine sand	Light-gray fine sand over brown to yellowish-brown fine sand.	Whitish marl underlain by sand.
Lakeland fine sand, nearly level phase.	lb	Acid sands	Upland	Good	Medium-gray fine sand.	Pale-olive to pale-yellow fine sand.	Brownish-yellow to yellow fine sand.
Lakeland fine sand; undulating phase.	lc	Acid sands	Upland	Good	Medium-gray fine sand.	Same	Same.
Lakewood fine sand	lo	Acid sands	Upland	Excessive	Light-gray fine sand	White fine sand	Yellow to brownish-yellow fine sand.
Leon-Immokalee fine sands, nearly level phases.	lg	Acid sands	Upland	Imperfect	Medium-gray fine sand (Leon).	Light-gray to almost white fine sand (Leon).	Brownish-black organic hardpan (Leon).
Leon-Immokalee fine sands, gently sloping phases.	lf	Acid sands	Upland	Imperfect	Medium-gray fine sand (Leon).	Same	Same.
Leon fine sand, light colored surface phase.	le	Acid sands	Upland	Good to imperfect.	Light-gray to very light gray fine sand.	Almost white to white fine sand.	Same.
Leon fine sand, heavy substratum phase.	ld	Acid sands and clays.	Upland	Imperfect to poor.	Light-gray fine sand	White fine sand	Organic hardpan over mottled fine sandy clay.
Made land	Mo	Variable	Variable	Variable	Variable	Variable	Variable.
Manatee fine sandy loam-loamy fine sand.	Mc	Alkaline sands and clays over marl.	Drainageways and depressions in uplands.	Poor to very poor.	Very dark gray to black fine sandy loam to loamy fine sand.	Gray fine sandy clay mottled with brown and yellow.	Light-gray to white marl.
Manatee fine sandy clay loam.	Mb	Same	Same	Very poor	Black fine sandy clay loam.	Dark-gray fine sandy clay.	Light-gray marl.
Manatee mucky loamy fine sand.	Md	Same	Same	Poor	Dark-gray to black mucky loamy fine sand.	Gray and brown mottled loamy fine sandy clay.	Light-gray to whitish marl.
Ona fine sand	Oo	Acid sands	Upland	Imperfect to poor.	Medium- to dark-gray fine sand.	Dark-brown organic fine sand.	Brownish-yellow to pale-yellow loamy fine sand.
Orlando fine sand	Ob	Acid sands	Upland	Good	Dark-gray fine sand over brownish-gray fine sand.	Pale-yellow fine sand	
Parkwood fine sand	Pa	Sands and loamy sands over marl.	Upland	Imperfect to poor.	Medium- to dark-gray fine sand.	Light-gray fine sand	White marl below 18 inches.
Parkwood fine sand, shallow phase.	Pb	Same	Upland	Imperfect to poor.	Medium- to dark-gray fine sand.	Light-gray fine sand	White marl within 18 inches.
Plummer fine sand	Pc	Acid sands	Drainageways and depressions in uplands.	Poor to very poor.	Medium-gray fine sand.	Light-gray to white fine sand.	May have heavier textured layer below 30 inches.
Pomello fine sand	Pf	Acid sands	Upland	Good to excessive.	Light-gray to almost white fine sand.	White fine sand	

Pompano fine sand	Pd	Alkaline sands	Drainageways and depressions in uplands.	Poor	Medium-gray fine sand.	Light-gray to yellowish-brown and gray fine sand.	Light brownish-gray fine sandy loam to fine sandy clay loam.
Pompano-Delray fine sands.	Pe	Alkaline sands	Drainageways	Imperfect to poor.	Medium-gray fine sand (Pompano).	Light-gray to yellowish-brown and gray fine sand (Pompano).	Light brownish-gray fine sandy loam to fine sandy clay loam (Pompano).
Ruskin fine sand	Ro	Sands and clays over shell-marl.	Upland	Imperfect	Gray fine sand	Light-gray fine sands over brownish-yellow sands.	Mottled light-gray and brownish-yellow fine sandy loam or fine sandy clay loam over shell-marl.
Rutlege fine sand, nearly level phase.	Rc	Acid sands	Drainageways and depressions in uplands.	Very poor	Dark-gray to black fine sand.	Medium- to light-gray fine sand.	May have heavier textured layer at about 40 inches.
Rutlege fine sand, gently sloping phase.	Rb	Acid sands	Same	Very poor	Dark-gray to black fine sand.	Medium- to light-gray fine sand.	Same.
Scranton fine sand	Sc	Acid sands	Upland	Imperfect to poor.	Dark-gray to dark brownish-gray fine sand.	Brownish-yellow to pale-yellow fine sand.	
Shallow ponds with grass.	Sd	Sands and clays	Depressions in uplands.	Ponded	Variable	Variable	Variable.
Shell mounds	Se	Sands and shells.	Upland	Good	Sands and shells		
St. Johns-Leon fine sands.	So	Acid sands	Upland	Poor	Dark-gray fine sand (St. Johns).	Light-gray fine sand (St. Johns).	Dark-brown or black organic hardpan (St. Johns).
St. Lucie fine sand	Sb	Acid sands	Upland	Excessive	Light-gray fine sand	White fine sand	
Stough fine sand, dark surface phase.	Sf	Acid sands and clays.	Stream and river terraces.	Imperfect	Dark-gray to brownish-gray fine sand.	Gray and light-brown spotted fine sand.	Gray and brown mottled fine sandy clay.
Terra Ceia muck	To	Organic sands and clays over marl.	Lowland	Very poor	Black muck	Very dark gray mucky fine sand.	Black fine sandy clay loam over light-gray marl.
Tidal marsh	Tb	Variable	Lowland	Ponded	Variable	Variable	Variable.
Tidal marsh, high-lying phase.	Tc	Variable	Lowland	Ponded	Variable	Variable	Variable.
Tidal swamp	Td	Variable	Lowland	Ponded	Variable	Variable	Variable.



Areas surveyed in Florida shown by shading.

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