SOIL SURVEY OF

Humacao Area of Eastern Puerto Rico

United States Department of Agriculture
Soil Conservation Service

In cooperation with
University of Puerto Rico
College of Agricultural Sciences

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in the period 1962–68. Soil names and descriptions were approved in 1969. Unless otherwise indicated, statements in the publication refer to conditions in the area in 1969. This survey was made cooperatively by the Soil Conservation Service and the University of Puerto Rico, College of Agricultural Sciences, Mayaguez Campus. It is part of the technical assistance furnished to the Noreste, Este, and Sudeste Soil Conservation Districts.

Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, woodlands, and wildlife areas; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of the Humacao Area are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the area in alphabetic order by map symbol and gives the capability classification and the woodland suitability group of each. It also shows the page where each soil is described.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the descriptions of the capability units and the woodland suitability groups.

Foresters and others can refer to the section "Use of the Soils for Woodland," where the soils of the county are grouped according to their suitability for trees.

Community planners and others can read about soil properties that affect the choice of sites for recreation areas in the section "Use of the Soils for Recreation Facilities."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers to the Humacao Area may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given on page 1.

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SOIL SURVEY OF THE HUMACAO AREA OF EASTERN PUERTO RICO

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THE HUMACAO AREA OF EASTERN PUERTO RICO is about 470,202 acres in size. It includes 16 municipalities and two offshore islands of Vieques and Culebra (fig. 1). Important cities are Humacao, the

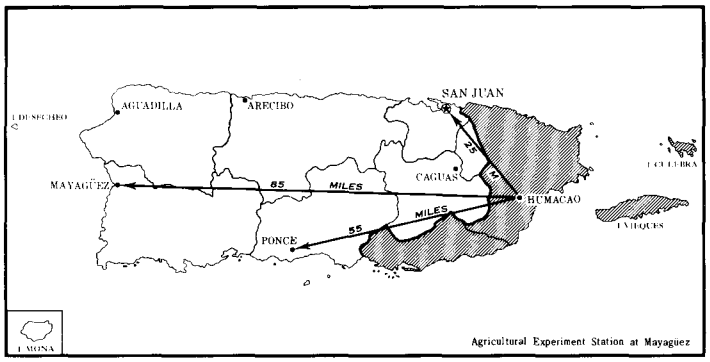

Figure 1.—**Location of the Humacao Area in Puerto Rico.**

more centrally located city in the area, Carolina, Fajardo, and Guayama. The area has three well-defined climatic regions. The southern part is semiarid, the northern and eastern parts are humid, and in the north central part there is a tropical rain forest where the annual precipitation is very high. Within these climatic regions are well-defined physiographic areas, such as the coastal plains and lowlands, inner valleys, nearly level river flood plains, and sloping to very steep uplands. Sugarcane is grown in the nearly level to sloping areas, and pasture and a variety of food crops are grown in the steeper uplands.

In 1970, 444,369 persons lived in the Humacao Area; in 1960, only 346,930 lived there. Much of the increase has been in the suburbs of the larger cities, especially Carolina, which is the closest township to San Juan. Land use is changing rapidly near San Juan.

The Guayanés River Watershed Project has been approved for this survey area. Two large petrochemical complexes and numerous light industries are established in the area. Public and private transportation link towns and the rural areas on an excellent network of state and municipal roads.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in the Humacao Area, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in areas nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Humacao and Fajardo, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Bajura clay, frequently flooded, is one of several phases within the Bajura series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the bound-

aries of the individual soils on aerial photographs. These photographs show buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Three such kinds of mapping units are shown on the soil map of the Humacao Area: soil complexes, soil associations, and undifferentiated soil groups.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Descalabrado-Rock land complex, 40 to 60 percent slopes, is an example.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one unit because the time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils, but the soils may differ greatly one from another. The name of an association consists of the names of the dominant soils, joined by a hyphen. Guayabota-Ciales-Picacho association, very steep, is an example.

An undifferentiated soil group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Descalabrado and Guayama soils, 20 to 60 percent slopes, eroded, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Rock land is a land type in the Humacao Area.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kind of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants and as building material, foundation, or covering for structures. They relate this behavior to properties of the soils. For example, if they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, they relate this to the slow permeability of the soil or its high water table. If they see that streets, road pavements, and foundations for houses are cracked on a named kind of soil, they relate that failure to the high shrink-swell potential of the soil. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consulting farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in the Humacao Area. A soil association is a landscape that has a distinctive pattern of soils in defined proportions. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association can occur in another but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in an area, who want to compare different parts of an area, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area or in planning engineering works, recreation facilities, and community developments. It is not a suitable map for planning the management of a farm or field or for selecting a site for a road or building or other structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in this survey have been grouped into two general kinds of landscapes for broad interpretative purposes. Each of the broad groups and their included soil associations are described in the following pages.

Soils of the Humid Areas

Nearly level to hilly soils that receive sufficient moisture for growing the common plants. Eight soil associations are in this group.

1. Swamps-Marshes association

Deep, very poorly drained soils on the coastal plains

This association is in level or nearly level, narrow strips adjacent to the ocean. The areas are slightly above sea level but are wet and, when the tide is high,

are covered or affected by salt water or brackish water. The high concentration of salt inhibits the growth of all vegetation except mangrove trees and, in small scattered patches, other salt-tolerant plants.

The association occupies about 4 percent of the survey area. Tidal swamps make up 85 percent of the association and Tidal flats and Salt water marshes make up 15 percent.

The soils are sandy or clayey and contain organic material from decaying mangrove trees. They are underlain by coral, shells, and marl at varying depths.

This association is not extensive and has no value for farming, but it serves as a feeding and breeding place for birds and crabs.

2. *Pandura-Rock land-Patillas association*

Shallow to deep, well-drained, steep and very steep soils on plutonic uplands

This association consists of brown-colored soils that formed in residual material that weathered from plutonic rocks, mainly quartz diorite and granodiorite. It occupies about 17 percent of the survey area.

Pandura soils make up about 49 percent of the association; Rock land, 19 percent; and Patillas soils, 12 percent. The rest is minor soils.

The Pandura soils are moderately deep and well drained and are underlain by granitic rocks. Rock land consists of areas where granitic boulders cover 50 to 70 percent of the land surface. The Patillas soils are moderately deep to saprolite, are well drained, and are underlain by partly weathered granitic rocks.

The minor soils are of the Vieques and Teja series. These soils are on side slopes.

The soils of this association are used mainly for food crops and native grasses. Steep slopes and shallow depth to bedrock are limitations for farming and for recreation and urban uses.

3. *Coloso-Toa-Bajura association*

Deep, moderately well drained to poorly drained, nearly level soils on flood plains

This association consists of nearly level soils that formed in fine textured and moderately fine textured sediment of mixed origin on flood plains. It occupies about 12 percent of the survey area.

Coloso soils make up about 18 percent of the association; Toa soils, 13 percent; Bajura soils, 10 percent; Maunabo soils, 8 percent; and Reilly soils, 7 percent. The remaining 44 percent consists of minor soils.

The Coloso soils are deep and somewhat poorly drained. The Toa soils are deep and moderately well drained. The Bajura soils and the Maunabo soils are deep and poorly drained. The Reilly soils are shallow to sand and gravel and are excessively drained; they lie adjacent to streams.

The minor soils are Talante, Vivi, Fortuna, Vega Alta, and Vega Baja soils. The Fortuna, Talante, Vivi, and Vega Baja soils are on flood plains, but the Vega Alta soils occupy slightly higher positions on terraces.

Soils of this association are the best soils for farming in the humid part of the survey area, though they are occasionally flooded. They are suited to many kinds of plants. Some of the soils have impeded drainage that can be corrected by a suitable drainage system. The soils have severe limitations for industrial and recreation uses because they are subject to flooding.

4. *Los Guineos-Humatas-Lirios association*

Deep, well drained and moderately well drained, gently sloping to very steep, acid soils on volcanic uplands

This association consists of soils that formed in medium-textured and fine-textured residual material derived from highly weathered intrusive and extrusive rocks. It occupies about 10 percent of the survey area.

Los Guineos soils make up about 40 percent of the association; Humatas soils, 30 percent; and Lirios soils, 14 percent. The remaining 16 percent consists of minor soils.

The Los Guineos soils are deep, moderately well drained, and moderately steep to very steep. They are on side slopes of strongly dissected uplands. The Humatas soils are deep, well drained, and steep to very steep. The Lirios soils are deep, well drained, and gently sloping to steep.

The minor soils are Limones, Ingenio, Jagueyes, and Aceitunas soils. The Limones, Ingenio, and Jagueyes soils are on side slopes and narrow ridgetops, and the Aceitunas soils are on foot slopes and terraces.

Soils of this association are used mainly as woodland and for crops. Food crops, such as plantains, tanniers, and yams, are the most important. Because the soils are gently sloping to very steep and subject to erosion, they have limitations for urban, farm, and recreation uses.

5. *Mabi-Rio Arriba-Cayagua association*

Deep, somewhat poorly drained and moderately well drained, nearly level to moderately steep soils on foot slopes, side slopes, terraces, and alluvial fans

This association consists of soils that formed in moderately coarse-textured to fine-textured sediment derived from intrusive and extrusive rocks. It occupies about 7 percent of the survey area.

Mabi soils make up about 29 percent of the association; Rio Arriba soils, 23 percent; and Cayagua soils, 15 percent. The remaining 33 percent consists of minor soils.

Mabi soils are deep, somewhat poorly drained, and nearly level to moderately steep. They lie on terraces and alluvial fans above the river flood plains. Rio Arriba soils also are on terraces and alluvial fans. They are deep, moderately well drained, and gently sloping to strongly sloping. Cayagua soils are deep, somewhat poorly drained, and gently sloping to moderately steep. They occupy side slopes and foot slopes.

The minor soils are Junquitos, Candelero, Via, Humacao, Fajardo, and Parcelas soils. The Junquitos soils are on foot slopes, and the Candelero, Via, Humacao, Fajardo, and Parcelas soils are on terraces.

The soils of this association are used for crops. Unfavorable drainage is the main limitation for farming. The shrink-swell potential limits recreation and urban uses of the soils.

6. *Caguabo-Mucara-Naranjito association*

Shallow and moderately deep, well-drained, sloping to very steep soils on volcanic uplands

This association consists of soils that formed in residual material that weathered from volcanic rocks. It occupies 19 percent of the survey area.

Caguabo soils make up about 42 percent of the association; Mucara soils, 19 percent; and Naranjito soils, 13 percent. The remaining 26 percent consists of minor soils.

The Caguabo soils are shallow, well drained, and moderately steep to very steep. They occupy side slopes of strongly dissected volcanic uplands. The Mucara soils are moderately deep, well drained, and strongly sloping to very steep. They also occupy side slopes of strongly dissected volcanic uplands. Naranjito soils are moderately deep, well drained, and steep to very steep. They are on dissected volcanic uplands.

The minor soils are Sabana, Daguao, and Yunes soils. The Sabana and Yunes soils are on side slopes, and the Daguao soils are on foot slopes and side slopes.

The soils of this association are used for pasture and food crops, such as tanniers, yams, plantains, bananas, and pigeonpeas. Steep slopes, the hazard of erosion, and depth to bedrock are the main limitations for farming and for recreation and urban uses.

7. *Los Guineos-Guayabota-Rock land association*

Shallow to deep, well-drained to poorly drained, strongly sloping to very steep soils on volcanic uplands of the tropical rain forest

This association consists of soils that formed in fine-textured residual material that weathered from intrusive and extrusive rocks. It occupies about 6 percent of the survey area.

Los Guineos and Yunque soils and Stony rock land together make up about 56 percent of the association; Guayabota, Ciales, and Picacho soils together, 27 percent; and Rock land, the remaining 17 percent.

The Los Guineos soils are deep, moderately well drained, and moderately steep to very steep. They are on side slopes of dissected uplands. The Yunque soils also are deep and moderately well drained. They lie on ridgetops and upper side slopes of strongly dissected uplands. Stony rock land is on the lower part of side slopes and along drainageways, where 90 to 100 percent of the surface is made up of grayish and bluish volcanic rocks.

The Guayabota soils are shallow, poorly drained soils on ridgetops and upper side slopes. The Ciales soils are deep and poorly drained. They occupy strongly dissected, moderately steep ridgetops and steep upper side slopes. The Picacho soils are deep, moderately well drained soils that are on upper side slopes. Rough stony land consists of the high, jagged mountain peaks and long, very steep side slopes. Rocks make up about 75 to 100 percent of the surface.

Rock land consists of areas where rock outcrops occupy 50 to 70 percent of the surface.

The soils of this association are used mainly as woodland, and some areas of virgin timber still remain. These soils have severe limitations for farm and urban uses because of very steep slopes, stoniness and rockiness, and high rainfall. They are suitable for recreation uses because of their high esthetic value.

8. *Catano-Aguadilla association*

Deep, excessively drained, nearly level to gently sloping soils on coastal plains

This association consists of soils that formed in a mixture of sand-sized fragments of shells and volcanic material and grains of quartz sand. It occupies about 2 percent of the survey area.

Catano soils make up about 53 percent of the association, and Aguadilla soils, 30 percent. The remaining 17 percent is minor soils.

The Catano soils are deep and excessively drained and lie close to sea level. The Aguadilla soils are deep, excessively drained, acid, and nearly level.

The minor soils are Meros soils and the land type Coastal beaches. These are along the coast, slightly above sea level.

Soils of this association are mainly in pasture and coconut trees. The available water capacity, organic-matter content, and fertility all are low, and these are the main limitations for farming. The soils have slight limitations for recreation uses.

Soils of the Dry Areas

Nearly level to hilly soils that receive limited rainfall and are deficient in moisture for growing the common plants. Three soil associations are in this group.

9. *Coamo-Guamani-Vives association*

Deep, well-drained, nearly level to strongly sloping soils on terraces and alluvial fans

This association consists of soils that formed in sediment derived from limestone and volcanic rocks. It occupies about 6 percent of the survey area.

Coamo soils make up 30 percent of the association; Guamani soils, 18 percent; and Vives soils, 17 percent. The remaining 35 percent consists of minor soils.

The Coamo soils are deep, well drained, and nearly level to strongly sloping. They are on terraces. The Guamani soils are shallow to sand and gravel, well drained, and nearly level. They occur on flood plains. The Vives soils are deep, well drained, and nearly level to strongly sloping. They are on flood plains, alluvial fans, and terraces.

The minor soils are Machete, Arenales, Pozo Blanco, and Vayas soils. The Vayas and Arenales soils are on river flood plains, the Pozo Blanco soils are on foot slopes, and the Machete soils are on alluvial fans and terraces.

Soils of this association are some of the best soils for farming in the semiarid part of the survey area, and they are used mainly for pasture and sugarcane. Low rainfall is a limitation, but if the soils are properly irrigated, many kinds of cultivated crops can be grown. Some of the soils in the association are suitable for urban and industrial uses, but others have severe limitations.

10. *Descalabrado-Guayama association*

Shallow, well-drained, strongly sloping to very steep soils on volcanic uplands

This association consists of soils that formed in moderately fine textured to fine textured residual material

derived from basic volcanic rocks. It occupies about 12 percent of the survey area.

Descalabrado soils make up about 41 percent of the association, and Guayama soils, 32 percent. The rest is small areas of Rock land and minor soils.

The Descalabrado and Guayama soils are shallow, well drained, and strongly sloping to very steep.

The soils of this association are used for pasture or are in brush. They have severe limitations for farming and for recreation and urban uses because they are shallow to bedrock, lack sufficient moisture, are steep, and are susceptible to erosion.

11. Jacana-Amelia-Fraternidad association

Moderately deep and deep, well drained and moderately well drained, nearly level to strongly sloping soils on terraces, alluvial fans, and foot slopes

This association consists of soils that formed in fine-textured sediment and gravelly sediment derived from limestone and volcanic rocks. It occupies about 5 percent of the survey area.

Jacana soils make up about 24 percent of the association; Amelia soils, 23 percent; and Fraternidad soils, 15 percent. The rest is minor soils.

The Jacana soils are moderately deep, well drained, and gently sloping to strongly sloping. They are on foot slopes. The Amelia soils are deep, well-drained, gently sloping to strongly sloping soils on foot slopes. The Fraternidad soils are deep, moderately well drained, and nearly level to strongly sloping. They are on terraces and alluvial fans.

The minor soils are Cartagena, Paso Seco, and Poncena soils on alluvial fans and terraces.

Soils of this association are used mainly for sugarcane and pasture. They have limitations for farm, recreation, and urban uses because of moderate slope, susceptibility to erosion, low rainfall, and high shrink-swell potential.

Descriptions of the Soils

This section describes each soil series in detail and then, briefly, each mapping unit in that series. Unless stated otherwise, what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface down to rock or other underlying material. Each series contains two descriptions of the profile. The first is brief and in terms familiar to a layman. The second is more detailed and is included for those who need to make thorough and precise studies of soils. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit. Color terms are for moist soil unless otherwise stated.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Coastal beaches, for example, does not belong to a soil series, but nevertheless, it is listed in alphabetic order along with the soil series.

Preceding the name of each mapping unit is a symbol that identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit and woodland suitability group in which the mapping unit has been placed. The capability unit and woodland suitability group of each mapping unit is also listed in the "Guide to Mapping Units" at the end of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*5*).[1]

Aceitunas Series

The Aceitunas series consists of deep soils that are well drained and moderately permeable. These soils formed in moderately fine textured and fine textured sediment. They are on foot slopes and terraces. Slopes are 5 to 12 percent. The climate is humid tropical. The average annual rainfall is 66 inches, and the average annual temperature is 77° F.

In a representative profile, the surface layer is dark reddish-brown, extremely acid silty clay loam about 10 inches thick. Below this layer, yellowish-red clay extends to a depth of 35 inches. It is underlain by yellowish-red, friable silty clay, which extends to a depth of more than 60 inches.

These soils have moderate available water capacity and shrink-swell potential and medium fertility. Runoff is medium. Most of the acreage is used for sugarcane, improved pasture, and food crops, but there are small areas in native pasture and brush.

Representative profile of Aceitunas silty clay loam, 5 to 12 percent slopes, 200 meters south and 8 meters west of kilometer marker 13.1 on Highway No. 31, Naguabo to Juncos:

Ap—0 to 10 inches, dark reddish-brown (5YR 3/3) silty clay loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; few fine roots; clay films along root channels; few, fine, black concretions; few pebbles 1 to 4 millimeters in diameter; few krotovinas; common root channels; extremely acid; abrupt, wavy boundary.

B21t—10 to 19 inches, yellowish-red (5YR 5/6) clay; moderate, medium, subangular blocky structure; firm, slightly sticky and slightly plastic; common fine roots; thin patchy clay films on root channels and ped surfaces; few krotovinas; few fine pebbles; few dark minerals; extremely acid; gradual, wavy boundary.

B22t—19 to 25 inches, yellowish-red (5YR 4/8) clay; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; few fine roots; thin patchy clay films; few fine pebbles; very strongly acid; clear, smooth boundary.

B23t—25 to 35 inches, yellowish-red (5YR 4/6) clay; weak, fine, subangular blocky structure; firm, slightly sticky and slightly plastic; common fine pores; few

[1] Italic numbers in parentheses refer to Literature Cited, p. 99

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

Mapping unit	Area	Extent
	Acres	*Percent*
Aceitunas silty clay loam, 5 to 12 percent slopes	2,920	0.6
Aguadilla loamy sand	2,100	.4
Aguadilla sandy loam, moderately wet	743	.2
Amelia gravelly clay loam, 2 to 5 percent slopes	1,961	.4
Amelia gravelly clay loam, 5 to 12 percent slopes, eroded	2,971	.6
Arenales sandy loam	407	.1
Arenales sandy loam, gravelly substratum	345	.1
Bajura silty clay, saline	253	(1)
Bajura clay, frequently flooded	5,170	1.1
Caguabo clay loam, 12 to 20 percent slopes, eroded	163	.1
Caguabo clay loam, 20 to 60 percent slopes, eroded	40,337	8.6
Candelero loam, 2 to 5 percent slopes	1,193	.2
Candelero loam, 5 to 12 percent slopes, eroded	3,149	.7
Cartagena clay	1,704	.4
Catano loamy sand	4,957	1.1
Cayagua sandy loam, 5 to 12 percent slopes, eroded	3,170	.7
Cayagua sandy loam, 12 to 20 percent slopes, eroded	1,393	.3
Coamo clay loam, 2 to 5 percent slopes	5,659	1.2
Coamo clay loam, 5 to 12 percent slopes	1,805	.4
Coastal beaches	1,094	.2
Cobbly alluvial land	3,824	.8
Coloso silty clay loam, occasionally flooded	7,892	1.7
Coloso silty clay	2,139	.4
Corcega sandy loam	1,210	.3
Daguao silty clay loam, deep variant, 2 to 12 percent slopes	237	(1)
Daguao clay, 20 to 40 percent slopes, eroded	826	.2
Descalabrado clay loam, 5 to 12 percent slopes, eroded	1,125	.2
Descalabrado clay loam, 20 to 40 percent slopes, eroded	12,741	2.7
Descalabrado and Guayama soils, 20 to 60 percent slopes, eroded	19,810	4.2
Descalabrado-Rock land complex, 40 to 60 percent slopes	12,462	2.6
Fajardo clay, 2 to 10 percent slopes	274	.1
Fajardo clay, 2 to 10 percent slopes, eroded	423	.1
Fortuna clay	2,044	.4
Fraternidad clay, 0 to 2 percent slopes	2,288	.5
Fraternidad clay, 2 to 5 percent slopes	777	.2
Guamani silty clay loam	4,849	1.1
Guayabota silty clay loam, 20 to 40 percent slopes, eroded	584	.1
Guayabota-Ciales-Picacho association, very steep	6,863	1.5
Guayama clay loam, moderately deep variant, 2 to 12 percent slopes, eroded	810	.2
Humacao loam, 2 to 5 percent slopes	885	.2
Humatas clay, 20 to 40 percent slopes, eroded	5,002	1.1
Humatas clay, 40 to 60 percent slopes, eroded	5,240	1.1
Humatas-Stony land complex, 40 to 60 percent slopes	1,786	.4
Ingenio silty clay loam, 20 to 40 percent slopes, eroded	1,210	.3
Jacana clay, 2 to 5 percent slopes	975	.2
Jacana clay, 5 to 12 percent slopes, eroded	4,167	.9
Jagueyes loam, 20 to 40 percent slopes, eroded	828	.2
Junquitos gravelly clay loam, 5 to 12 percent slopes	1,370	.3
Leveled clayey land	987	.2
Limones silty clay, 20 to 40 percent slopes, eroded	1,754	.4
Lirios clay loam, 3 to 10 percent slopes, eroded	509	0.1
Lirios silty clay loam, 20 to 40 percent slopes, eroded	5,132	1.1
Los Guineos silty clay loam, 12 to 20 percent slopes	354	.1
Los Guineos silty clay loam, 20 to 40 percent slopes, eroded	3,868	.8
Los Guineos silty clay loam, 40 to 60 percent slopes, eroded	14,233	3.1
Los Guineos-Yunque-Stony rock land association, steep	15,766	3.3
Mabi clay, 0 to 5 percent slopes	4,653	1.0
Mabi clay, 5 to 12 percent slopes, eroded	2,669	.6
Mabi clay, 12 to 20 percent slopes, eroded	541	.1
Machete loam, 0 to 2 percent slopes	1,049	.2
Machete loam, 2 to 5 percent slopes	1,333	.3
Made land	3,167	.7
Maunabo clay	4,215	.9
Mayo loam, 3 to 10 percent slopes	578	.1
Meros sand, 1 to 6 percent slopes	725	.1
Mucara silty clay loam, 12 to 20 percent slopes, eroded	1,891	.4
Mucara silty clay loam, 20 to 40 percent slopes, eroded	17,166	3.6
Naranjito silty clay loam, 20 to 40 percent slopes, eroded	5,979	1.3
Naranjito silty clay loam, 40 to 60 percent slopes, eroded	6,001	1.3
Pandura loam, 12 to 40 percent slopes, eroded	2,177	.5
Pandura loam, 40 to 60 percent slopes, eroded	23,353	5.0
Pandura-Very stony land complex, 40 to 60 percent slopes	14,845	3.2
Parcelas clay, 5 to 12 percent slopes, eroded	1,125	.2
Paso Seco clay, 0 to 5 percent slopes	1,157	.2
Patillas clay loam, 12 to 20 percent slopes, eroded	462	.1
Patillas clay loam, 20 to 40 percent slopes, eroded	3,272	.7
Pinones silty clay	1,215	.3
Poncena clay	3,233	.7
Pozo Blanco clay loam, 5 to 12 percent slopes, eroded	725	.1
Reilly soils	3,885	.8
Reparada clay	222	.1
Rio Arriba clay, 2 to 5 percent slopes	2,799	.6
Rio Arriba clay, 5 to 12 percent slopes, eroded	3,989	.8
Rock land	21,913	4.7
Rough stony land	3,964	.8
Sabana silty clay loam, 20 to 40 percent slopes, eroded	5,756	1.2
Sabana silty clay loam, 40 to 60 percent slopes, eroded	6,247	1.3
Salt water marsh	1,174	.2
Talante soils	3,332	.7
Teja gravelly sandy loam, 12 to 40 percent slopes	6,768	1.4
Tidal flats	1,513	.3
Tidal swamp	15,364	3.3
Toa silty clay loam	5,417	1.1
Utuado-Picacho-Stony rock land association, very steep	3,476	.7
Vayas silty clay loam, occasionally flooded	442	.1
Vayas silty clay, frequently flooded	1,398	.3
Vega Alta silty clay loam, 2 to 5 percent slopes	765	.2
Vega Alta silty clay loam, 5 to 12 percent slopes	739	.2

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

Mapping unit	Area	Extent	Mapping unit	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Vega Baja silty clay loam, 0 to 3 percent slopes	435	0.1	Vivi loam	1,421	0.3
Via silty clay loam, 3 to 10 percent slopes	1,470	.3	Wet alluvial land	3,722	.8
Vieques loam, 5 to 12 percent slopes	1,114	.2	Yunes silty clay loam, 20 to 60 percent slopes, eroded	2,943	.6
Vieques loam, 12 to 40 percent slopes, eroded	7,566	1.6	Urban, built-up, water areas, miscellaneous, etc.	26,816	5.7
Vives silty clay loam, high bottom	3,147	.7			
Vives clay, 0 to 2 percent slopes	1,646	.3	Total	470,202	100.0
Vives clay, 2 to 7 percent slopes	2,490	.5			

[1] Less than 0.1 percent.

patchy clay films; few pebbles; very strongly acid; clear, wavy boundary.

B3—35 to 60 inches, yellowish-red (5YR 4/8) silty clay; weak, fine, subangular blocky structure; friable, nonsticky and slightly plastic; few fine pores; very strongly acid.

The solum is more than 60 inches thick. The A horizon has a chroma of 3 to 4. The B2t horizon is 25 inches or more thick. It has weak or moderate, subangular blocky structure, and has value of 4 or 5 and chroma of 6 to 8.

The Aceitunas soils are on the same landscape as the Mabi and Rio Arriba soils. They are less plastic and have a lower shrink-swell potential than the Mabi and Rio Arriba soils.

AcC—Aceitunas silty clay loam, 5 to 12 percent slopes. This soil is on foot slopes and terraces. Included with it in mapping were small areas of Rio Arriba, Mabi, and Junquitos soils.

This soil has moderate limitations for farming because of slope and the hazard of erosion. Special conservation practices are required if the soil is clean cultivated. This soil is used for sugarcane, food crops, and pasture. If the soil is properly limed and fertilized, it is suited to most crops grown in the area. Capability unit IIIe–1.

Aguadilla Series

The Aguadilla series consists of deep soils that are excessively drained and rapidly permeable. These soils formed in sands of mixed origin. They are near sea level, and slopes are 0 to 2 percent. The climate is humid tropical. The average annual precipitation is 80 inches, and the average annual temperature is 77° F.

In a representative profile, the surface layer is dark-brown, very strongly acid loamy sand about 8 inches thick. The underlying material is brown, dark yellowish-brown, and grayish-brown, loose sand that extends to a depth of more than 50 inches.

These soils are low in available water capacity, shrink-swell potential, and natural fertility. Most of the acreage is used for coconut trees and pangolagrass, but a few areas are in native grasses and shrubs.

Representative profile of Aguadilla loamy sand, 4.8 kilometers east of town of Yabucoa, on the Riog farm, 30 meters north from farm road and 90 meters south from east end of sugar plantation:

Ap—0 to 8 inches, dark-brown (10YR 3/3) loamy sand; single grained; loose; many fine roots; very strongly acid; clear, smooth boundary.

C1—8 to 20 inches, brown (10YR 4/3) sand; single grained; loose; few fine roots; very strongly acid; clear, smooth boundary.

C2—20 to 40 inches, dark yellowish-brown (10YR 4/4) sand; single grained; loose; very strongly acid; gradual, smooth boundary.

C3—40 to 58 inches, grayish-brown (10YR 5/2) sand; single grained; loose; strongly acid.

The Ap horizon is 6 to 12 inches thick. The A horizon is sand, sandy loam, or loamy sand and has value of 3 to 4. The C horizon has value of 4 or 5 and chroma of 2, 3, or 4.

The Aguadilla soils are on the same landscape as Catano soils and Coastal beaches. Unlike the Catano soils, the Aguadilla soils are acid. Coastal beaches, a land type, have no horizon differentiation.

Ad—Aguadilla loamy sand. This nearly level soil is along the coast. It has the profile described as representative of the Aguadilla series. Included with this soil in mapping were small areas of Catano soils.

This soil has limitations for farming because of its available water capacity, low organic-matter content, and low fertility. It is not suited to cultivated crops, but it can be used for coconut trees and pasture. Capability unit VIs–3.

Ag—Aguadilla sandy loam, moderately wet. This nearly level soil is along the coast. The seasonal water table is close to the surface. Included with this soil in mapping were small areas of Catano loamy sand.

Low organic-matter content, low fertility, low available water capacity, and wetness are severe limitations for cultivated crops. The soil is better suited to pasture than to most other uses. Capability unit VIs–3.

Amelia Series

The Amelia series consists of deep soils that are well drained and moderately permeable. These soils formed in gravelly sediment derived from volcanic rocks. They are on alluvial fans and foot slopes. Slopes are 2 to 12 percent. The climate is semiarid tropical. The average annual precipitation is 30 to 40 inches, and the average temperature is 79° F.

In a representative profile, the surface layer is dark yellowish-brown, medium acid gravelly clay loam about 6 inches thick. Below this layer is brown, friable gravelly clay loam 7 inches thick. Dark-brown, friable gravelly clay is between depths of 13 and 22 inches. The

underlying material is strong-brown gravelly clay loam that extends to a depth of 46 inches.

These soils are low in available water capacity and fertility. Their shrink-swell potential is moderate. The soils are difficult to work, and most of their acreage is used for pasture and sugarcane. Some areas are in native pasture and brush.

Representative profile of Amelia gravelly clay loam, 5 to 12 percent slopes, eroded, in a cultivated field on Lot No. 505, 5 meters southwest of an Almacigo tree on this lot, Parcelas Las Ochenta, Salinas:

Ap—0 to 6 inches, dark yellowish-brown (10YR 3/4) gravelly clay loam, brown (7.5YR 5/4) when dry; massive parting to weak, fine, granular structure; very hard, friable, slightly sticky and slightly plastic; common fine roots; many gravel fragments ⅛ to 2 inches in diameter; medium acid; clear, wavy boundary.

B1—6 to 13 inches, brown (7.5YR 4/6) gravelly clay loam, dark yellowish brown (10YR 4/4) when dry; weak, fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many angular rock fragments ¼ to 2 inches in diameter and few rock fragments 4 to 16 inches in diameter; medium acid; clear, wavy boundary.

B2t—13 to 22 inches, dark-brown (7.5YR 4/4) gravelly clay, brown (7.5YR 5/4) when dry; moderate, medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine roots; many angular rock fragments ¼ to 3 inches in diameter; medium acid; clear, wavy boundary.

C—22 to 46 inches, strong-brown (7.5YR 5/6) gravelly clay loam; massive; hard, friable, slightly sticky; many angular rock fragments 1 to 3 inches in diameter; medium acid.

The solum ranges from 16 to 44 inches in thickness. The A horizon has hue of 10YR, 7.5YR, or 5YR, value of 3 or 4, and chroma of 2 to 4. The B horizon has hue of 10YR, 7.5YR, or 5YR, value of 3 or 4, and chroma of 4 to 6. It has weak or moderate, medium, subangular blocky structure and ranges from medium acid to neutral in reaction. The C horizon ranges from medium acid to mildly alkaline. The content of volcanic rock fragments averages 40 to 75 percent, by volume, throughout the soil profile.

The Amelia soils are on the same landscape as the Guayama, Descalabrado, and Jacana soils. The Amelia soils are deeper to bedrock than all those soils.

AmB—Amelia gravelly clay loam, 2 to 5 percent slopes. This soil is on foot slopes and alluvial fans in the semiarid part of the survey area. It has a thicker surface layer and is less affected by erosion than the soil described as representative of the Amelia series. Included with this soil in mapping were small areas of Jacana soils.

Low rainfall in the area and the soil's low available water capacity and low fertility are severe limitations for farming. This soil has been in native pasture and sugarcane. If the soil is irrigated, it is better suited to sugarcane than to most other uses. Capability units IVc–3 nonirrigated and IIIs–1 irrigated.

AmC2—Amelia gravelly clay loam, 5 to 12 percent slopes, eroded. This soil is on foot slopes in the semiarid part of the survey area. It has the profile described as representative of the Amelia series. Included with this soil in mapping were small areas of Guayama, Descalabrado, and Jacana soils.

This soil has severe limitations for farming because it has a low available water capacity, low fertility, and gravelly texture and because the climate is semiarid. Because of slope and the hazard of erosion, the soil requires special conservation practices. This soil has been in pasture and sugarcane. If it is irrigated, it is better suited to sugarcane than to most other uses. Capability unit IVe–8.

Arenales Series

The Arenales series consists of deep soils that are excessively drained and rapidly permeable. These soils formed in stratified, coarse-textured sediment derived from volcanic and limestone rocks. They are on flood plains and alluvial fans. Slopes are 0 to 2 percent. The climate is semiarid tropical. The average annual precipitation is 35 to 50 inches, and the average annual temperature is 79° F.

In a representative profile, the surface layer is very dark grayish-brown, mildly alkaline sandy loam about 8 inches thick. Below that is dark grayish-brown, very dark gray, and very dark grayish-brown, loose sand 34 inches thick. Gravel mixed with coarse sand is at a depth of 42 inches.

These soils are low in available water capacity and natural fertility. Runoff is slow. The soils are easily worked, and most of the acreage is used for sugarcane, but there are small areas in native pasture and brush.

Representative profile of Arenales sandy loam, near mango tree along farm road, 0.8 kilometers south and 15 meters west of kilometer marker 92.1 on Highway No. 1, near town of Salinas:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, fine, granular structure; very friable, nonsticky and nonplastic; many fine roots; common, fine, subrounded volcanic fragments; mildly alkaline; clear, wavy boundary.

C1—8 to 24 inches, very dark grayish-brown (10YR 3/2) and dark grayish-brown (10YR 4/2) loamy sand; single grained; loose, nonsticky and nonplastic; few fine roots; moderately alkaline; abrupt, smooth boundary.

IIC2—24 to 31 inches, very dark gray (10YR 3/1) and very dark grayish-brown (10YR 3/2) coarse sand; single grained; loose, nonsticky and nonplastic; moderately alkaline; abrupt, smooth boundary.

IIC3—31 to 42 inches, very dark grayish-brown (10YR 3/2) sand; single grained; loose, nonsticky and nonplastic; mildly alkaline; clear, smooth boundary.

IIIC4—42 to 50 inches, gravel mixed with coarse sand.

The Ap horizon ranges from 6 to 10 inches in thickness. It has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 or 3. The A horizon is neutral to mildly alkaline. The C horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 1 to 4.

The Arenales soils are on the same landscape as the Guamani soils. They have a coarser textured A horizon than the Guamani soils.

An—Arenales sandy loam. This nearly level soil is on flood plains and alluvial fans in the semiarid part of the survey area. It has the profile described as representative of the Arenales series. Included with this soil in mapping were small areas of Vives silty clay loam, high bottom; Arenales sandy loam, gravelly substratum; and Guamani soils.

This soil has severe limitations for farming because of its low available water capacity and rapid permeability. Also, rainfall in the area is low. If the soil is properly irrigated and fertilized, it is suited to sugarcane and pasture. Capability units VIc–1 nonirrigated and IVs–1 irrigated.

Ar—Arenales sandy loam, gravelly substratum. This

nearly level soil lies on river flood plains and alluvial fans. Its profile is similar to the one described as representative of the series, but gravel is at a depth of only 20 to 36 inches. Included with this soil in mapping were small areas of Guamani soils.

The rapid permeability and low available water capacity of the soil and the low rainfall in the area are severe limitations for farming. This soil has been used for sugarcane and pasture. If it is properly irrigated, it is suited to sugarcane. Capability units VIc–1 nonirrigated and IVs–1 irrigated.

Bajura Series

The Bajura series consists of deep soils that are poorly drained and slowly permeable. These soils formed in fine-textured sediment of mixed origin. They are on alluvial flood plains. Slopes are 0 to 2 percent. The climate is humid tropical. The average annual precipitation is 84 inches, and the average annual temperature is 78° F.

In a representative profile, the surface layer is very dark grayish-brown, mottled, slightly acid clay about 5 inches thick. Below this layer is very dark grayish-brown, dark-gray, very dark gray, black, and yellowish-brown, mottled, firm clay that extends to a depth of 60 inches.

These soils have a high available water capacity, high shrink-swell potential, and high natural fertility. Runoff is slow. These soils have been in sugarcane and pasture for many years.

Representative profile of Bajura clay, frequently flooded, 1.1 kilometers north of Land Authority office and 10 meters west of telephone pole along road, Colonia San Luis, Carolina:

Ap—0 to 5 inches, very dark grayish-brown (10YR 3/2) clay; few, fine, dark-gray (10YR 4/1) mottles; weak, fine, subangular blocky structure; very firm, slightly sticky and slightly plastic; common fine roots; few worm casts; slightly acid; clear, smooth boundary.

B1g—5 to 12 inches, very dark grayish-brown (10YR 3/2) clay; common, medium, distinct, dark-gray (5Y 4/1) and dark-brown (7.5YR 4/4) mottles; weak, coarse, subangular blocky structure; very firm, sticky and plastic; few fine roots; few pressure faces; slightly acid; clear, smooth boundary.

B2g—12 to 19 inches, dark-gray (10YR 4/1) clay; many, coarse, prominent, dark-brown mottles; weak, coarse, subangular blocky structure; firm, slightly sticky and plastic; few pressure faces; few worm casts; few krotovinas; slightly acid; clear, smooth boundary.

C1g—19 to 25 inches, very dark gray (10YR 3/1) clay; many, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; firm, slightly sticky and plastic; few pressure faces; slightly acid; clear, smooth boundary.

C2g—25 to 44 inches, black (10YR 2/1) clay; many, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; massive; firm, slightly sticky and plastic; slightly acid; clear, smooth boundary.

C3g—44 to 66 inches, yellowish-brown (10YR 5/6) clay; many, medium, prominent, dark-gray (2.5Y 4/0) mottles and few, fine prominent dark-gray (7.5YR 4/0) mottles; massive; firm, slightly sticky and plastic; slightly acid.

The solum is 16 to 24 inches thick. The Ap horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 2 or lower. It is silty clay or clay. The B horizon has hue of 10YR or 2.5Y, value of 3 to 6, and chroma of 2 or lower. It has weak, moderate or coarse, subangular blocky structure.

The Bajura soils occupy the same landscape as the Coloso, Corcega, and Fortuna soils. Unlike the Coloso and Corcega soils, the Bajura soils are poorly drained. The Bajura soils are not so acid as the Fortuna soils, and unlike Fortuna soils, they have pressure faces.

Ba—Bajura silty clay, saline. This nearly level soil is on alluvial flood plains close to seaboard mangrove swamps. Its profile is similar to the one described as representative of the series, but it is occasionally affected by salinity caused by high tides. Included with this soil in mapping were small areas of Tidal flats and Salt water marsh.

Because this soil is poorly drained, is not easily worked, has a high shrink-swell potential, and is affected by salt water. Its use for farming is limited. Frequent flooding and a seasonal high water table also limit the use of the soil for cultivated crops. Most of the acreage is in salt-tolerant plants. This soil is suited to pasture and wildlife habitat. Capability unit VIIw–1.

Bc—Bajura clay, frequently flooded. This nearly level soil is on alluvial flood plains. It occupies the farther areas from the river. It has the profile described as representative of the series. Included with this soil in mapping were some areas of Coloso silty clay.

Because this soil has slow permeability and a seasonal high water table, is subject to frequent flooding, and is difficult to work, it has severe limitations for farming (fig. 2). If the soil is drained and properly managed, it is suited to sugarcane, food crops, and pasture. Capability unit IIIw–1.

Caguabo Series

The Caguabo series consists of shallow soils that are well drained and moderately permeable. These soils formed in moderately fine textured residuum from partly weathered volcanic rocks. They are on side slopes. Slopes are 12 to 60 percent. The climate is humid tropical. The average annual precipitation is 80 inches, and the average annual temperature is 76° F.

In a representative profile, the surface layer is grayish-brown, slightly acid clay loam about 4 inches thick. The next layer, 5 inches thick, is dark-gray gravelly clay loam and 60 percent rock fragments. Below that is olive-gray gravelly clay loam that extends to a depth of 17 inches and is underlain by hard rock.

These soils have a moderate available water capacity, moderate shrink-swell potential, and medium natural fertility. Runoff is medium to rapid. The soils are susceptible to erosion, and they have been in pasture and brush for many years.

Representative profile of Caguabo clay loam, 20 to 60 percent slopes, eroded, 2.4 kilometers south of kilometer marker 17.4 on Highway No. 31, Juncos to Naguabo:

A1—0 to 4 inches, grayish-brown (10YR 5/2) clay loam; weak, fine, subangular blocky structure parting to granular; very hard, very firm, slightly sticky and slightly plastic; common fine roots; many fine volcanic rock fragments; few worm casts; slightly acid; abrupt, smooth boundary.

B—4 to 9 inches, dark-gray (10YR 4/1) gravelly clay loam; weak, medium, subangular blocky structure; very hard, very firm, slightly sticky and slightly plastic;

Figure 2.—**A field of sugarcane that is flooded on Bajura clay, frequently flooded.**

few fine roots; few fine pores; rock fragments make up 60 percent, by volume, of soil mass; slightly acid; clear, wavy boundary.

C—9 to 17 inches, olive-gray (5Y 5/2) gravelly clay loam; common, medium, distinct, very dark grayish-brown (10YR 3/2) mottles and few, fine, distinct, reddish-yellow (7.5YR 7/8) mottles; massive; very hard, firm, slightly sticky and slightly plastic; few fine roots; many rock fragments; common, dark, weathered minerals; most of this horizon is saprolite; medium acid; gradual, wavy boundary.

R—17 inches, hard consolidated volcanic rock.

The solum is 6 to 11 inches thick. Some profiles have an Ap horizon that has value of 3 or 4 and chroma of 2 or 3. The amount of rock fragments in the B and C horizons ranges from 35 to 70 percent. Depth to consolidated volcanic rock ranges from 12 to 20 inches.

The Caguabo soils are on the same landscape as the Mucara and Sabana soils. They are shallower and coarser textured than the Mucara soils. The Caguabo soils are less acid than the Sabana soils, and unlike Sabana soils, they are gravelly.

CbD2—Caguabo clay loam, 12 to 20 percent slopes, eroded. This soil is on side slopes. Its profile is similar to the one described as representative of the Caguabo series, but the surface layer is slightly thicker. Included with this soil in mapping were small areas of Mucara and Sabana soils.

Shallowness to hard rock and medium runoff are severe limitations for cultivated crops. Conservation practices are needed to slow surface runoff. This soil has been used for food crops and pasture. It is suited to pasture and woodland. Capability unit VIs–2; woodland suitability group 3d5.

CbF2—Caguabo clay loam, 20 to 60 percent slopes, eroded. This soil is on ridgetops and side slopes in the volcanic uplands. It has the profile described as representative of the series. Included with this soil in mapping were small areas of Mucara and Sabana soils and Rock land.

Rapid to very rapid runoff, shallowness to hard rock, and steep slopes are severe limitations for farming. Conservation practices are needed to slow surface runoff. This soil has been used for native pasture. It is not suited to cultivated crops, but it is suited to pasture and woodland. Capability unit VIIs–1; woodland suitability groups 3d5 and 4d5.

Candelero Series

The Candelero series consists of deep soils that are somewhat poorly drained and slowly permeable. These

soils formed in moderately fine textured sediment derived from granitic rocks. They are on alluvial fans, terraces, and foot slopes. Slopes are 2 to 12 percent. The climate is humid tropical. The average annual precipitation is 87 inches, and the average annual temperature is 77° F.

In a representative profile, the surface layer is dark grayish-brown, extremely acid loam about 7 inches thick. The next layer is gray and yellowish-brown, mottled, very firm sandy clay loam 8 inches thick. Below that is greenish-gray and light greenish-gray, very firm sandy clay loam 19 inches thick. Underlying the material is friable sandy clay loam that is mottled with yellowish-brown and greenish-gray and extends to a depth of more than 60 inches.

These soils have a moderate available water capacity and shrink-swell potential. Runoff is medium. The soils are subject to occasional flooding. They have been in sugarcane, native pasture, and brush.

Representative profile of Candelero loam, 5 to 12 percent slopes, eroded, 87 meters southwest from kilometer marker 1.9 on Highway No. 905 and 10 meters northwest from farm road:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) loam; weak, fine, granular structure; very friable, slightly sticky and slightly plastic; few fine roots; few, fine, black mineral grains; few concretions 2 to 3 millimeters in diameter; extremely acid; clear, smooth boundary.

B1—7 to 11 inches, gray (10YR 6/1) and yellowish-brown (10YR 5/8) sandy clay loam; fine purplish mottles; weak, coarse, subangular blocky structure; very firm, slightly sticky and plastic; few roots; thin, discontinuous, gray (10YR 6/1) films on ped surfaces; black coatings on root channels; common fine quartz grains; extremely acid; clear, smooth boundary.

B21t—11 to 15 inches, gray (10YR 6/1) and yellowish-brown (10YR 5/6) sandy clay loam; weak, medium, subangular blocky structure; very firm, slightly sticky and plastic; few roots; thin, discontinuous, gray (10YR 6/1) films on ped surfaces; dark films on root channels; common fine quartz grains; few, fine, black mineral grains; many weathered feldspar and hornblende crystals; very strongly acid; gradual, smooth boundary.

B22tg—15 to 24 inches, greenish-gray (5GY 6/1) sandy clay loam; common, medium, distinct, brownish-yellow (10YR 6/6) mottles and few, fine, distinct, reddish-brown mottles; weak, coarse, subangular blocky structure; very firm, slightly sticky and plastic; few roots; thin, discontinuous, greenish-gray (5GY 6/1) films on ped surfaces; dark films on root channels; many fine quartz grains; many weathered feldspar and hornblende crystals; strongly acid; gradual, smooth boundary.

B23tg—24 to 34 inches, light greenish-gray (5GY 7/1) sandy clay loam; common, fine, distinct, greenish-gray mottles and common, medium, distinct, yellowish-brown (10YR 5/8) and grayish-brown (10YR 5/2) mottles; weak, coarse, prismatic structure; very firm, slightly sticky and slightly plastic; thin, discontinuous, light greenish-gray (5GY 7/1) films on ped surfaces, gray tends to run in vertical tongues; many fine quartz grains; few, fine, black mineral grains; many weathered feldspar and hornblende crystals; slightly acid; clear, smooth boundary.

C—34 to 64 inches, dark yellowish-brown (10YR 4/4) sandy clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles and common, fine distinct, greenish-gray mottles; massive; friable, slightly sticky; many fine quartz grains; many weathered feldspar crystals; common, fine, black mineral grains; slightly acid.

The solum is 25 to 42 inches thick. The Ap horizon has value of 3 to 4 and is very strongly acid or extremely acid. The upper part of the B horizon has value of 5 or 6. Few to many quartz grains are mixed throughout the profile.

The Candelero soils are on the same landscape as the Humacao, Parcelas, and Mayo soils. Unlike the Humacao and Parcelas soils, they have dominant low-chroma colors and a B2t horizon. The Candelero soils are less permeable than the Mayo soils, and they are somewhat poorly drained.

CdB—Candelero loam, 2 to 5 percent slopes. This soil is on terraces and alluvial fans. Its profile is similar to the one described as representative of the series, but the surface layer is 2 to 4 inches thicker. Included with this soil in mapping were some areas of Humacao and Mayo soils.

This soil has severe limitations for farming because it is slowly permeable, somewhat poorly drained, susceptible to flooding, and has a seasonal water table. Complex soil conservation practices and proper management are required to overcome these limitations. If the soil is properly drained, limed, and fertilized, it is suited to sugarcane and pasture. Capability unit IIIw–2.

CdC2—Candelero loam, 5 to 12 percent slopes, eroded. This soil is on alluvial fans and foot slopes. It has the profile described as representative of the Candelero series. Included with this soil in mapping were small areas of Mayo and Parcelas soils.

This soil has severe limitations for farming because it is somewhat poorly drained. If the soil is clean cultivated, it requires special conservation practices because it is susceptible to erosion. It has been used for sugarcane, native pasture, and brush. If the soil is properly limed, drained, and fertilized, it is suited to sugarcane and pasture. Capability unit IVe–1.

Cartagena Series

The Cartagena series consists of deep soils that are somewhat poorly drained, mildly alkaline, and slowly permeable. These soils formed in fine-textured sediment derived from volcanic rocks and limestone. They are on alluvial fans. Slopes are 0 to 5 percent. The climate is semiarid tropical. The average annual precipitation is 30 to 45 inches, and the average annual temperature is 79° F.

In a representative profile, the surface layer is dark-brown, mildly alkaline or neutral, mottled clay about 19 inches thick. Below that layer is dark yellowish-brown, firm, mottled silty clay that extends to a depth of 45 inches.

These soils have a high available water capacity and shrink-swell potential. Runoff is slow. The soils are difficult to work, and they have been in sugarcane, pasture, and brush for many years.

Representative profile of Cartagena clay, 46 meters north and 1.3 kilometers west of gasoline station on Highway No. 705, from kilometer marker 151.3 on Highway No. 3 to Central Aguirre, Salinas:

Ap—0 to 10 inches, dark-brown (10YR 3/3) clay; common, fine faint, dark-brown (7.5YR 4/4) and dark-gray (10YR 4/1) mottles; weak, medium, subangular blocky structure; firm, slightly sticky and slightly plastic; common roots; few, fine, dark concretions; few limestone fragments; common pressure faces; mildly alkaline; clear, smooth boundary.

AC—10 to 19 inches, dark-brown (10YR 4/3) clay; common,

fine, faint, dark-gray (10YR 4/1) mottles; massive; few roots; firm, slightly sticky and slightly plastic; common, fine, dark concretions; few pressure faces; few slickensides; neutral; clear, smooth boundary.

C1ca—19 to 31 inches, dark yellowish-brown (10YR 4/4) silty clay; common, fine, distinct, gray (5Y 5/1) mottles and few, fine, distinct, dark redddish-brown (5YR 3/4) mottles; massive; few roots; firm, slightly sticky and slightly plastic; common, fine, dark concretions; few limestone fragments; few pressure faces and slickensides; moderately alkaline; gradual, wavy boundary.

C2—31 to 45 inches, dark yellowish-brown (10YR 4/4) silty clay; common, fine, distinct, yellowish-brown (10YR 5/8) mottles; massive; firm, slightly sticky and slightly plastic; many or common very dark brown (10YR 2/2) stains; few seashell fragments; moderately alkaline.

The Ap horizon is 4 to 12 inches thick. It has value of 3 or 4 and chroma of 2 or 3.

The Cartagena soils are on the same landscape as the Fraternidad and Paso Seco soils. Unlike the Fraternidad soils, they are somewhat poorly drained. The Cartagena soils lack the gravelly horizons of the Paso Seco soils.

Ce—Cartagena clay. This nearly level to gently sloping soil is on alluvial fans. Included with it in mapping were small areas of Fraternidad soils.

This soil has severe limitations for farming because it is somewhat poorly drained, slowly permeable, and difficult to work. It has been in sugarcane. If the soil is properly drained and managed, it is suited to sugarcane and grasses. Capability units IIIc–1 nonirrigated and IIs–1 irrigated.

Catano Series

The Catano series consists of deep soils that are excessively drained and rapidly permeable. These soils formed in miscellaneous sands and sand-sized rock fragments. They are along the sea. Slopes are 0 to 2 percent. The climate is humid tropical. The average annual precipitation is 75 inches, and the average annual temperature is 78° F.

In a representative profile, the surface layer is dark-brown, moderately alkaline loamy sand about 8 inches thick. Below that layer is dark-brown, brown, and grayish-brown, loose sand that extends to a depth of 64 inches.

These soils have a low available water capacity, shrink-swell potential, and natural fertility. They have been in coconut trees, native pasture, and brush, but a few areas are in food crops.

Representative profile of Catano loamy sand, 30 meters east of Guayanes River delta and about 120 meters west of the coast, Yabucoa:

A1—0 to 8 inches, dark-brown (10YR 3/3) loamy sand; single grained; loose, nonsticky and nonplastic; moderately alkaline; clear, smooth boundary.

C1—8 to 18 inches, dark-brown (10YR 4/3) sand; single grained; loose, nonsticky and nonplastic; moderately alkaline; clear, smooth boundary.

C2—18 to 59 inches, brown (10YR 5/3) sand; single grained; loose, nonsticky and nonplastic; moderately alkaline; clear, smooth boundary.

C3—59 to 64 inches, grayish-brown (10YR 5/2) sand; loose, nonsticky and nonplastic; moderately alkaline.

The A horizon is 6 to 12 inches thick. It has value and chroma of 2 or 3. The C horizon has value of 4 or 5 and chroma of 2 or 3.

The Catano soils are on the same landscape as the Aguadilla soils and the land type Coastal beaches. The Catano soils, unlike the Aguadilla soils, are moderately alkaline. Coastal beaches are wave-reworked sands that are saturated with sea water or lack horizon differentiation.

Cf—Catano loamy sand. This nearly level soil is along the coast. Included with it in mapping were small areas of Aguadilla soils and Coastal beaches.

This soil is not suited to cultivated crops because of its low available water capacity, rapid permeability, and low fertility. It is used for coconut trees, cassava, pangolagrass, and Guineagrass. It is suitable for coconut trees, pasture, wildlife food and cover, and recreation. Capability unit VIs–1.

Cayagua Series

The Cayagua series consists of deep soils that are somewhat poorly drained and slowly permeable. These soils formed in residuum derived from coarse-textured plutonic rocks. They are on foot slopes. Slopes are 5 to 20 percent. The climate is humid tropical. The average precipitation is 80 to 90 inches, and the average annual temperature is 79° F.

In a representative profile, the surface layer is dark grayish-brown, strongly acid sandy loam about 4 inches thick. Below that layer is light brownish gray, mottled clay 16 inches thick. The next layer is yellowish-red sandy loam and light-gray clay 7 inches thick. The underlying material is yellowish-red sandy loam and light-gray clay to a depth of 36 inches. Yellowish-red and reddish-yellow, very friable sandy loam extends to a depth of 100 inches.

These soils have medium natural fertility. Runoff is slow. The soils have been in sugarcane and native pasture. A few areas are in pineapples.

Representative profile of Cayagua sandy loam, 5 to 12 percent slopes, eroded, 4.8 kilometers northwest of the town of Humacao, 135 meters west of kilometer marker 0.7 on Highway No. 935, 22 meters west of fence:

Ap—0 to 4 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, fine, granular structure; very friable, nonsticky and nonplastic; many fine roots; few medium iron concretions in lower part; strongly acid; abrupt, smooth boundary.

B21t—4 to 10 inches, light brownish-gray (10YR 6/2) clay; many, coarse, distinct, strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; very firm, slightly sticky and plastic; common fine roots; patchy clay films on ped surfaces and root channels; very strongly acid; clear, wavy boundary.

B22t—10 to 20 inches, light brownish-gray (10YR 6/2) clay; many, coarse, distinct, strong-brown (7.5YR 5/6) mottles and few, fine, distinct, red (2.5YR 5/6) mottles; weak, coarse, angular blocky structure; firm, slightly sticky and plastic; few fine roots; thin patchy clay films on ped surfaces and root channels; very strongly acid; clear, wavy boundary.

B3—20 to 27 inches, sixty percent yellowish-red (5YR 5/6) sandy loam; massive; friable, nonsticky and nonplastic; 40 percent light-gray (10YR 7/1) clay; massive; friable, nonsticky and plastic; few fine roots; very strongly acid; gradual, wavy boundary.

C1—27 to 36 inches, sixty percent yellowish-red (5YR 4/6) sandy loam; massive; friable, nonsticky and nonplastic; 40 percent light-gray (10YR 7/1) clay; massive; friable, nonsticky and plastic; quartz seams in the clayey sections; very strongly acid; gradual, wavy boundary.

C2—36 to 100 inches, yellowish-red (5YR 4/6) and reddish-yellow (7.5YR 6/6) sandy loam; massive; very friable, nonsticky and nonplastic; slightly acid.

The solum is 18 to 36 inches thick. The Ap horizon has value of 3 or 4 and chroma of 2 or 3. The B2t horizon is 12 to 20 inches thick and has value of 4 to 6. Mottles range from few to many and from fine to coarse; they are in shades of strong brown, light gray, and red. The B3 horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6.

The Cayagua soils are on the same landscape as the Candelero, Mayo, and Pandura soils. They occupy higher positions and are finer textured in the B2t horizon than the Candelero soils. The Cayagua soils occupy higher positions than the Mayo soils, and unlike Mayo soils, they are somewhat poorly drained. They occupy lower positions and are deeper than the Pandura soils.

CgC2—Cayagua sandy loam, 5 to 12 percent slopes, eroded. This soil is on foot slopes. It has the profile described as representative of the Cayagua series. Small areas of Candelero and Mayo soils were included with this soil in mapping.

This soil has moderate limitations for farming because it is somewhat poorly drained and is slowly permeable. It requires soil conservation practices and proper management. It has been planted to pineapples for many years. If the soil is properly limed and drained, it is suited to cultivated crops. If it is properly drained and cultivated, it is suited to sugarcane and pasture. Capability unit IIIe–2.

CgD2—Cayagua sandy loam, 12 to 20 percent slopes, eroded. This soil is on foot slopes. Its profile is similar to the one described as representative of the Cayagua series, but the surface layer is 2 or 3 inches thinner and this soil is more susceptible to erosion if it is clean cultivated. Included in mapping were small areas of Mayo and Pandura soils.

This soil has severe limitations for farming because it is moderately steep and somewhat poorly drained. If the soil is clean cultivated, it requires special conservation practices because it is susceptible to erosion. If the soil is properly drained, it is suited to cultivated crops. This soil is suited to sugarcane, pineapples, and pasture. Capability unit IVe–2.

Ciales Series

The Ciales series consists of deep soils that are poorly drained and slowly permeable in the upper part and well drained and moderately permeable in the lower part. These soils formed in fine-textured, highly weathered residuum of igneous rocks. They are on ridgetops and upper side slopes in the humid uplands. Slopes are 12 to 45 percent. The average annual precipitation is 185 inches, and the average annual temperature is 72° F.

In a representative profile, the surface layer is dark-brown, very strongly acid silty clay loam about 7 inches thick. The upper part of the subsoil, to a depth of 26 inches, is gray, very strongly acid clay that is mottled and friable. The lower part of the subsoil is reddish-yellow, very strongly acid, friable clay 7 inches thick. The underlying material is friable silty clay loam and silt loam of variegated colors of red, yellow, and brown that extends to a depth of 60 inches or more.

These soils have a moderate available water capacity and medium fertility. Runoff is medium to rapid. The soils have been in hardwood trees and tree ferns for many years.

In the Humacao Area of Eastern Puerto Rico, the Ciales soils are mapped only in an association with Guayabota and Picacho soils.

Representative profile of Ciales silty clay loam, 12 to 20 percent slopes, in an area of the Guayabota-Ciales-Picacho association, very steep, 17 meters west of kilometer marker 15.7 on Highway No. 191:

O1—1 to 0 inches, undecomposed and partially decomposed leaves and twigs.

A1—0 to 7 inches, dark-brown (10YR 3/3) silty clay loam; weak, fine, subangular blocky structure breaking to moderate, medium, granular; friable, slightly sticky and slightly plastic; many fine and medium roots; many fine quartz grains; very strongly acid; clear, smooth boundary.

B21tg—7 to 15 inches, gray (10YR 5/1) clay; common, fine, distinct, light yellowish-brown mottles and common, medium, distinct, yellowish-brown (10YR 5/8) mottles; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine and medium roots; thin patchy clay films on ped surfaces and along root channels; many fine quartz grains; very strongly acid; clear, smooth boundary.

B22tg—15 to 26 inches, gray (5Y 5/1) clay; common, medium, distinct, light yellowish-brown (2.5YR 6/4) mottles, few, medium, distinct, strong-brown (7.5YR 5/6) mottles, and common, medium, faint, gray (N 5/0) mottles; weak, coarse, subangular blocky structure; friable, slightly sticky and slightly plastic; few fine roots; patchy clay films on ped surfaces and along root channels; common worm casts; many fine quartz grains; very strongly acid; clear, smooth boundary.

B3—26 to 33 inches, reddish-yellow (7.5YR 6/8) clay; common, fine, distinct, gray and light yellowish-brown mottles; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; few fine roots; common fine quartz grains; very strongly acid; clear, smooth boundary.

C1—33 to 41 inches, reddish-yellow (5YR 6/6) silty clay loam; common, medium, faint, strong-brown (7.5YR 5/8) mottles; massive; friable, slightly sticky and slightly plastic; common fine quartz grains; very strongly acid; clear, smooth boundary.

C2—41 to 48 inches, yellowish-red (5YR 5/6) silt loam; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; massive; very friable, nonsticky and slightly plastic; many fine quartz grains; very strongly acid; clear, smooth boundary. About 40 percent of the soil mass of this horizon is saprolite.

C3—48 to 60 inches +, variegated colors of the saprolite; yellowish-red (5YR 5/6), strong-brown (7.5YR 5/8), yellowish-brown (10YR 5/8), and dark-red (7.5R 3/6) silty clay loam; massive; very friable, nonsticky and slightly plastic; common, fine, shiny flakes and quartz grains; very strongly acid.

The solum is 25 to 41 inches thick. The A horizon has hue of 10YR to 2.5 YR, value of 3 or less, and chroma of 1 to 3. It is dominantly silty clay loam. The B2t horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 2 or less. It is clay or silty clay and has weak, coarse or weak, medium, subangular blocky structure. Clay films range from thin patchy to thin continuous. The C horizon has dominant hue of 7.5YR or 5YR, value of 4 to 6, and chroma of 4 to 8. Reaction ranges from strongly acid to extremely acid throughout.

The Ciales soils occupy the same landscape as the Yunque, Picacho, Utuado, Guayabota, and Los Guineos soils. The Ciales soils, unlike the Yunque soils, have low chroma mottles in the B2t horizon. In contrast to the Picacho soils, they have dominant colors with chromas of 2 or less in the B2t horizon. They have a B2t horizon that the Utuado and Guayabota soils lack; they are finer textured than the Utuado soils and deeper than the Guayabota soils. Unlike

the Los Guineos soils, Ciales soils have low-chroma colors in the B2t horizon.

Coamo Series

The Coamo series consists of well-drained, moderately permeable soils that are moderately deep to stratified, coarse-textured materials. These soils formed in sediment derived from volcanic and limestone rocks. They are on alluvial fans or terraces. Slopes are 2 to 12 percent. The climate is semiarid. The average annual rainfall is 30 to 40 inches, and the average annual temperature is 79° F.

In a representative profile, the surface layer is very dark brown, slightly acid clay loam about 15 inches thick. Below that layer is dark-brown, firm clay and gravelly clay 23 inches thick. The underlying material is gravel and gravelly clay loam that extends to a depth of 48 inches.

These soils have a moderate available water capacity, moderate shrink-swell potential, and high natural fertility. Runoff is medium. The soils have been in food crops, sorghum, sugarcane, native pasture, and brush. If the soils are irrigated, they can be used for many kinds of food crops.

Representative profile of Coamo clay loam, 2 to 5 percent slopes, 2.7 kilometers south of kilometer marker 85.1 on Highway No. 1, Salinas to Cayey, Salinas:

A11—0 to 5 inches, very dark brown (10YR 2/2) clay loam, very dark grayish brown (10YR 3/2) when dry; weak, medium, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; few fine pebbles; slightly acid; diffuse, wavy boundary.

A12—5 to 15 inches, very dark brown (10YR 2/2) clay loam, very dark grayish brown (10YR 3/2) when dry; weak, coarse, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; few patchy clay films; few fine pebbles; slightly acid; clear, smooth boundary.

B2t—15 to 25 inches, dark-brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) when dry; weak, medium, subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; few fine lime splotches; common fine gravel; few discontinuous clay films along root channels and vertical cleavage plants; mildly alkaline; gradual, wavy boundary.

B3ca—25 to 38 inches, dark-brown (10YR 3/3) gravelly clay, dark brown (7.5YR 4/2) when dry; weak, medium, subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; moderately alkaline; ped surfaces coated with secondary lime; clear, smooth boundary.

IICca—38 to 48 inches, stratified gravel and gravelly clay loam; gravel ranges from ½ inch to 2 inches in diameter; common, fine, dark minerals; common fine lime splotches.

The solum is 31 to 57 inches thick. The A horizon has value of 2 or 3, and is slightly acid or neutral. The B horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 or 3. It is mildly alkaline or moderately alkaline. Depth to the ca horizon ranges from 21 to 37 inches. Depth to the gravelly horizon ranges from 31 to 57 inches.

The Coamo soils are on the same landscape as the Descalabrado, Jacana, and Amelia soils. The Coamo soils are deeper and occupy lower positions than the Descalabrado soils. They are deeper than the Jacana soils and lack the semiconsolidated volcanic rocks of those soils. In contrast to the Amelia soils, the Coamo soils lack gravelly sediment throughout the profile.

ClB—Coamo clay loam, 2 to 5 percent slopes. This soil is on alluvial fans and terraces in the semiarid part of the survey area. It has the profile described as representative of the series. Included with this soil in mapping were small areas of Vives silty clay loam, high bottom, and Paso Seco soils.

This soil has severe limitations for farming because rainfall is low. The soil is fertile, however, and if it is irrigated, it is suited to sugarcane, minor crops, sorghum, and pasture. Capability units IIIc–2 nonirrigated and IIe–1 irrigated.

ClC—Coamo clay loam, 5 to 12 percent slopes. This soil is on alluvial fans and terraces. Small areas of Jacana and Amelia soils were included with this soil in mapping.

Low rainfall and a high evaporation rate are severe limitations for cultivated crops. Conservation practices are needed to slow surface runoff. This soil has been used for sugarcane, pasture, and sorghum. If it is irrigated, it is suited to food crops, sugarcane, sorghum, and pasture. Capability unit IVe–3.

Coastal Beaches

Cm—Coastal beaches consists of narrow strips of light-colored beach sand along the coast. This wave-worked sand is saturated with seawater and contains many seashells and shell fragments throughout.

This land type has no value for farming. Most of it is devoid of vegetation, except for a few coconut palms and halophytic vegetation, such as uva playera (*Colobis ubifera*) and bejuco de playa (*Ipomoea prescaprae*). Capability unit VIIIs–1.

Cobbly Alluvial Land

Cn—Cobbly alluvial land is along the flood plains of streams and rivers. It consists of unconsolidated alluvium and about 70 percent, by volume, rock fragments that range from 3 to 10 inches in diameter.

This land type has severe limitations for farming because it has a low available water capacity and a high content of rock fragments. Some of the areas are used for grass. Capability unit Vs–1.

Coloso Series

The Coloso series consists of deep soils that are somewhat poorly drained and slowly permeable. These soils formed in moderately fine textured sediment of mixed origin. They are on river flood plains. Slopes are 0 to 2 percent. The climate is humid tropical. The average annual temperature is 78° F. Depth to the water table ranges from 24 to 48 inches.

In a representative profile, the surface layer is dark-brown, slightly acid silty clay loam about 9 inches thick. The next layer is dark grayish-brown, mottled silty clay loam 10 inches thick. The underlying layer is gray and yellowish-brown, mottled clay, silty clay, and silty clay loam that is firm and extends to a depth of 60 inches.

These soils have a high available water capacity, moderate shrink-swell potential, and high natural fertility. Runoff is slow. The soils have been in sugarcane for many years, and some areas are in native pasture and brush.

Representative profile of the Coloso series from an area of Coloso silty clay loam, occasionally flooded, 300

meters northeast, 515 meters northwest, and 6 meters northeast from kilometer marker 2.8 on Highway No. 925, Humacao:

Ap—0 to 9 inches, dark-brown (10YR 4/3) silty clay loam; common, medium, faint, dark grayish-brown mottles; weak, fine, subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common fine roots; common krotovinas; few, fine, dark concretions; common residue of burned sugarcane; slightly acid; abrupt, smooth boundary.

B—9 to 19 inches, dark grayish-brown (10YR 4/2) silty clay loam; common, fine, distinct, strong-brown (7.5YR 5/8) mottles and common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, fine, subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common worm casts; common, fine, dark minerals; worm channels coated with thin continuous clay films; few, fine, dead roots; slightly acid; clear, smooth boundary.

C1—19 to 27 inches, gray (10YR 5/1) silty clay loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles and few, fine, prominent, red (2.5YR 4/6) mottles; massive; hard, firm, slightly sticky and slightly plastic; few fine pores; common fine sand grains; few, fine, dead roots; few worm casts; slightly acid; clear, smooth boundary.

C2—27 to 32 inches, yellowish-brown (10YR 5/6) silty clay; common, medium, distinct, grayish-brown (10YR 5/2) mottles; massive; hard, firm, slightly sticky and slightly plastic; few fine pores; common worm casts with thin layer of clay films; few, fine, dead roots; slightly acid; clear, smooth boundary.

IIC3—32 to 43 inches, gray (10YR 5/1) clay; few, medium, distinct, dark-brown (10YR 4/3) mottles; weak, fine, subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common fine to medium pores; few dark minerals; few, fine, dead roots; roots and worm channels coated with thick clay films; slightly acid; gradual, wavy boundary.

IIIC4—43 to 60 inches, gray (10YR 5/1) clay; few, fine, faint, dark-brown (10YR 4/3) mottles; massive; hard, firm, slightly sticky and slightly plastic; few, fine, dead roots; few fine pores; slightly acid.

The solum is 14 to 22 inches thick. The A horizon has value and chroma of 3 or 4. The Ap horizon is silty clay or silty clay loam. The B horizon has chroma of 2 or 3 and has weak, fine or medium, subangular blocky structure. The C horizon has a matrix color of gray and has yellowish-brown and gley mottles. It ranges from silty clay loam to clay.

The Coloso soils occupy the same landscape as the Bajura, Toa, Fortuna, Reilly, Talante, and Maunabo soils. Unlike all those soils, the Coloso soils are somewhat poorly drained. They are finer textured in the lower horizons than the Toa soils. The Coloso soils are finer textured than the Reilly and Talante soils, and unlike the Reilly soils, they are not underlain by sand and gravel.

Co—Coloso silty clay loam, occasionally flooded. This nearly level soil is on flood plains. It has the profile described as representative of the series. Small areas of Toa, Bajura, and Fortuna soils were included with this soil in mapping.

Occasional flooding, slow permeability, and a seasonal high water table are moderate limitations for farming. This soil requires soil and water conservation practices for proper cultivation. It has been used for sugarcane. If the soil is properly drained, it is suited to sugarcane and pasture. Capability unit IIw–1.

Cr—Coloso silty clay. This nearly level soil is on flood plains. Its profile is similar to the one described as representative of the series, but it lies at a higher elevation and is less subject to flooding. Included with this soil in mapping were small areas of Toa, Bajura, and Fortuna soils.

Because this soil is somewhat poorly drained, it has limitations for farming. Occasional flooding, slow permeability, and a seasonal high water table are limitations for cultivated crops. Careful management and water control practices are required to overcome these limitations. Most of the acreage of this soil is in sugarcane. If the soil is properly drained, it is suited to sugarcane and pasture. Capability unit IIw–1.

Corcega Series

The Corcega series consists of deep soils that are somewhat poorly drained and moderately permeable. These soils formed in moderately fine textured sediment of mixed origin over sand. They are on river flood plains. Slopes are 0 to 2 percent. The climate is humid tropical. The average annual precipitation is 80 inches, and the average annual temperature is 77° F.

In a representative profile, the surface layer is dark-brown, slightly acid sandy loam about 8 inches thick. Below that layer is dark-brown and dark-gray, mottled, firm, silty clay loam or sandy clay loam that extends to a depth of 32 inches. The underlying material is dark-gray, loose sand 18 inches thick.

These soils have a moderate available water capacity and high natural fertility. They are easily worked. Surface runoff is slow. These soils have been in sugarcane and pasture, and a few areas are in coconut trees.

Representative profile of Corcega sandy loam, 1 kilometer east of kilometer marker 2.0 on Highway No. 115:

Ap—0 to 8 inches, dark-brown (10YR 4/3) sandy loam; weak, medium, granular structure; firm, slightly sticky and slightly plastic; many fine roots; slightly acid; clear, smooth boundary.

B2—8 to 14 inches, dark-brown (10YR 4/3) silty clay loam; common, fine, prominent, yellowish-red (5YR 4/6) mottles and few, fine, distinct, light-gray (10YR 7/2) mottles; weak, fine, subangular blocky structure; firm, slightly sticky and slightly plastic; common fine roots; common, fine, black concretions; slightly acid; clear, smooth boundary.

B3—14 to 32 inches, dark-gray (10YR 4/1) sandy clay loam; common, fine, distinct, reddish-brown (5YR 4/3) mottles and common, fine, distinct, gray (10YR 5/1) mottles; weak, medium, subangular blocky structure; firm, slightly sticky and slightly plastic; common, fine, black concretions; few fine roots; slightly acid; clear, smooth boundary.

IIC—32 to 50 inches, dark-gray (10YR 4/1) sand; single grained; loose, nonsticky and nonplastic; slightly acid.

Thickness of the solum and depth to sandy horizons range from 24 to 40 inches. The Ap horizon has value of 3 or 4. The B2 horizon has chroma of 2 to 4. Few to common, yellowish-red, reddish-brown, light-gray, and gray mottles are in the B and C horizons. The C horizon has a hue of 10YR or 2.5Y and chroma of 1 or 2.

The Corcega soils are on the same landscape as the Coloso and Bajura soils and the land type Wet alluvial land. They are coarser textured throughout than the Coloso and Bajura soils. The Corcega soils occupy higher positions and are less affected by water during the year than Wet alluvial land.

Cs—Corcega sandy loam. This nearly level soil is on river flood plains. Included with it in mapping were small areas of Coloso and Bajura soils.

Frequent flooding and a seasonal water table are moderate limitations for farming. Soil and water conservation practices are needed for proper cultivation. This soil has been in sugarcane and pasture, and some

small areas are in coconut trees. If the soil is properly drained, it is suited to cultivated crops, sugarcane, and pasture. Capability unit IIw–5.

Daguao Variant

The Daguao variant consists of deep soils that are well drained and moderately slowly permeable. These soils formed in moderately fine textured residuum derived from volcanic rocks. They occupy foot slopes. Slopes are 2 to 12 percent. The climate is humid tropical. The average annual rainfall is 80 inches, and the average annual temperature is 79° F.

In a representative profile, the surface layer is dark-brown, medium acid silty clay loam about 11 inches thick. Below that layer is dark-brown and strong-brown, friable clay that extends to a depth of 35 inches. The underlying material is dark yellowish-brown, friable silty clay loam weathered saprolite that can be crushed between the fingers.

These soils have a high available water capacity, moderate shrink-swell potential, and medium natural fertility. They have been in food crops, sugarcane, pasture, and trees.

Representative profile of Daguao silty clay loam, deep variant, 2 to 12 percent slopes, 2 miles south of the town of Humacao, 900 feet south of Central Ejemplo, 990 feet along farm road, and 28 feet west of lone mahogany tree:

A1—0 to 11 inches, dark-brown (7.5YR 3/2) silty clay loam; weak, fine, subangular blocky structure; hard, friable, nonsticky and slightly plastic; many fine roots; few, fine, dark concretions; few, fine, angular rock fragments; medium acid; clear, wavy boundary.

B21t—11 to 23 inches, dark-brown (10YR 3/3) clay; weak, medium, subangular blocky structure; friable, slightly sticky and plastic; common fine roots; many, fine, dark concretions; few, thin, patchy clay films on ped surfaces; few, fine, weathered rock fragments; medium acid; clear, wavy boundary.

B22t—23 to 35 inches, strong-brown (7.5YR 5/8) clay; moderate, medium, subangular blocky structure; friable, sticky and plastic; few fine roots; many, fine, dark grains and concretions; thin patchy clay films on ped surfaces; few fine rock fragments; strongly acid; clear, smooth boundary.

C—35 to 45 inches, dark yellowish-brown (10YR 3/4) silty clay loam; massive; friable, nonsticky and slightly plastic; medium acid. (This horizon consists of highly weathered volcanic rock saprolite that can be crushed easily between the fingers.)

The solum is 28 to 44 inches thick. The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 2 to 4. It ranges from clay loam to silty clay loam and from weak subangular blocky to moderate granular in structure. The B2 horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 3 to 8. It is 20 to 28 inches thick and ranges from silty clay to clay in texture. Structure is weak or moderate subangular blocky, and clay films vary from thin patchy to thin continuous. The reaction is strongly acid or medium acid. Depth to consolidated rock is more than 40 inches.

The Daguao variant soils occupy the same landscape as the Daguao, Lirios, Naranjito, and Pandura soils. The Daguao variant soils have a thicker profile and are deeper to consolidated rock than the Daguao soils. They are browner and finer textured than the Lirios soils, and they lack the yellowish-red horizons of the Naranjito soils. The Daguao variant soils are finer textured and have a thicker solum than the Pandura soils.

DaC—Daguao silty clay loam, deep variant, 2 to 12 percent slopes. This soil is on foot slopes. Included with it in mapping were small areas of Naranjito and Lirios soils.

Moderately slow permeability and slope are moderate limitations for farming. If the soil is properly limed and fertilized, it is suited to food crops, sugarcane, and pasture. Capability unit IIIe–3; woodland suitability group 3d5.

Daguao Series

The Daguao series consists of moderately deep soils that are well drained and moderately slowly permeable. These soils formed in moderately fine textured to fine textured residuum derived from volcanic rocks. They are on foot slopes and mountain side slopes. Slopes are 2 to 60 percent. The climate is humid tropical. The average annual rainfall is 80 to 85 inches, and the average annual temperature is 79° F.

In a representative profile, the surface layer is very dark gray, strongly acid clay about 8 inches thick. Below that layer is dark yellowish-brown and yellowish-brown, firm clay that extends to a depth of 21 inches. The underlying material is saprolite of varying colors. Consolidated volcanic rock is at a depth of 34 inches.

These soils have a moderate available water capacity, moderate shrink-swell potential, and medium natural fertility and have been in crops, pasture, and trees.

Representative profile of Daguao clay, 20 to 40 percent slopes, eroded, 45 meters north of kilometer marker 0.55 on Highway No. 31 near its intersection with Highway No. 3:

Ap—0 to 8 inches, very dark gray (10YR 3/1) clay; weak, fine, granular structure; very firm, slightly sticky and plastic; strongly acid; gradual, wavy boundary.

B1—8 to 13 inches, dark yellowish-brown (10YR 4/4) clay; weak, coarse, subangular blocky structure; firm, slightly sticky and slightly plastic; thin discontinuous clay films; strongly acid; gradual, wavy boundary.

B2t—13 to 21 inches, yellowish-brown (10YR 5/4) clay; moderate, coarse, subangular blocky structure; firm, slightly sticky and slightly plastic; clay films on vertical ped surfaces and few clay films on horizontal ped surfaces; few partly weathered hornblende crystals; few pressure faces and small slickensides; strongly acid; clear, wavy boundary.

C—21 to 34 inches, variegated, yellowish-brown (10YR 5/6), yellowish-red (5YR 4/6), and dark greenish-gray (5GY 4/1) saprolite; many hornblende crystals.

R—34 inches +, dark greenish, consolidated volcanic rock.

The solum is 14 to 26 inches thick. The Ap horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. It ranges from silty clay loam to clay. The B2t horizon has value of 4 or 5 and chroma of 4 to 6. It has weak or moderate, medium or coarse, subangular blocky structure. Few to many rock fragments are scattered throughout the profile. Depth to consolidated rock ranges from 20 to 40 inches.

The Daguao soils are on the same landscape as the Lirios, Naranjito, and Pandura soils. The Daguao soils are finer textured than the Lirios soils and lack the red B2t horizon of those soils. They lack the yellowish-red horizons of the Naranjito soils. The Daguao soils are finer textured and have a thicker solum than the Pandura soils.

DcE2—Daguao clay, 20 to 40 percent slopes, eroded. This soil is on mountain side slopes. Small areas of Pandura, Lirios, and Naranjito soils were included with this soil in mapping.

This soil has severe limitations for cultivated crops because it is steep. Conservation practices must be used to control surface runoff. This soil is better suited to pasture and woodland than to most other uses. Capability unit VIe–1; woodland suitability group 3d5.

Descalabrado Series

The Descalabrado series consists of well-drained, moderately permeable soils that are shallow to consolidated volcanic rock. These soils formed in moderately fine textured residuum derived from volcanic rocks. Slopes are 5 to 60 percent. The climate is semiarid. The average annual rainfall is 30 to 35 inches, and the average annual temperature is 79° F.

In a representative profile, the surface layer is very dark grayish-brown, neutral clay loam about 6 inches thick. The next layer, 4 inches thick, is brown, friable clay loam with small volcanic rock fragments. Dark-brown, firm silty clay is between depths of 10 and 14 inches. The underlying material is olive-brown loam saprolite that extends to a depth of about 19 inches. It is underlain by weathered volcanic rock.

These soils have a moderate available water capacity, moderate shrink-swell potential, and medium natural fertility. Runoff is medium to rapid. The soils are susceptible to erosion, and they have been in pasture and brush for many years.

Representative profile of Descalabrado clay loam, 20 to 40 percent slopes, eroded, 1.4 kilometers north of kilometer marker 155.9 on Highway 3 and 45 meters northeast of a shack:

Ap—0 to 6 inches, very dark grayish-brown (10YR 3/3) clay loam; weak, fine, subangular blocky structure parting to moderate, medium, granular; friable, slightly sticky and slightly plastic; many fine roots; few small volcanic fragments; neutral; clear, smooth boundary.

B1—6 to 10 inches, brown (10YR 4/3) clay loam; moderate, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; many fine roots; few small volcanic fragments; neutral; clear, smooth boundary.

B2—10 to 14 inches, dark-brown (10YR 4/3) silty clay; moderate, fine and medium, subangular blocky structure; firm, nonsticky and slightly plastic; common fine roots; thin very dark grayish-brown (10YR 3/2) clay films; few small volcanic fragments; few dark worm casts; 10 to 15 percent saprolite; neutral; clear, smooth boundary.

C—14 to 19 inches, olive-brown (2.5Y 4/4) loam (saprolite); fracture planes of the original rock structure coated with dark-brown (10YR 3/3) clay or organic matter, or both.

R—19 inches, greenish-gray slightly weathered volcanic rock.

The solum is 7 to 15 inches thick. The A horizon has value and chroma of 2 and 3. The B2 horizon has value of 3 or 4 and chroma of 2 or 3. Depth to consolidated volcanic rock ranges from 10 to 20 inches.

The Descalabrado soils are on the same landscape as the Guayama and Jacana soils. Unlike the Guayama soils, the Descalabrado soils are neutral and lack red horizons. The Descalabrado soils are coarser textured and shallower than the Jacana soils.

DeC2—Descalabrado clay loam, 5 to 12 percent slopes, eroded. This soil is on mountain side slopes. It occupies lower positions and has a thicker surface layer than the soil having the profile described as representative of the Descalabrado series.

This soil has severe limitations for farming because it is shallow to rock and rainfall is low. It is suited to pasture. Capability unit IVs–2; woodland suitability group 3d5.

DeE2—Descalabrado clay loam, 20 to 40 percent slopes, eroded. This soil is on mountain side slopes and ridgetops in the semiarid volcanic uplands. It has the profile described as representative of the Descalabrado series. Included with this soil in mapping were small areas of Guayama soils and Rock land.

Steep slopes, shallowness to bedrock, rapid runoff, low rainfall, and the hazard of erosion are severe limitations for farming. This soil is limited to pasture grazing and wildlife food and cover. Stocking rates should be controlled to avoid overgrazing and control erosion. The soil has been in pasture and brush for many years. It is better suited to grazing than to most other uses. Capability unit VIIs–4; woodland suitability group 3d5.

DgF2—Descalabrado and Guayama soils, 20 to 60 percent slopes, eroded. This mapping unit is on the sides and tops of ridges in the volcanic uplands. It consists of Descalabrado and Guayama soils. The proportion of each soil varies from one mapped area to another, and some areas may be entirely Guayama soils.

The Guayama soils are not so steep as the Descalabrado soils. The Guayama soils have chert throughout the surface layer and subsoil in places.

Steep slopes, shallowness to bedrock, rapid runoff, low rainfall, and the hazard of erosion are severe limitations for farming. These soils have been in pasture and brush for many years. They are suitable for pasture and wildlife food and cover. Capability unit VIIs–4; woodland suitability group 4d5.

DrF—Descalabrado-Rock land complex, 40 to 60 percent slopes. This mapping unit is on mountain side slopes and ridgetops in the semiarid volcanic uplands. It consists of Descalabrado soils and Rock land in such intricate patterns that they cannot be shown separately at the scale used in mapping. The Descalabrado soils make up about 80 to 85 percent of the mapping unit, and Rock land makes up 15 to 20 percent.

The Descalabrado soils in this complex are similar to the soil having the profile described as representative of the Descalabrado series, but they are steeper.

Because the soils of this mapping unit are steep, shallow to rocks, and rocky, they have severe limitations for farming. They are suitable for pasture and wildlife food and cover. Capability unit VIIs–4; woodland suitability group 4d5.

Fajardo Series

The Fajardo series consists of deep soils that are somewhat poorly drained and slowly permeable. These soils formed in fine-textured sediment of mixed origin. They occupy alluvial fans and terraces. Slopes are 2 to 10 percent. The climate is humid tropical. The average yearly precipitation is 75 to 80 inches, and the average annual temperature is 78° F.

In a representative profile, the surface layer is dark grayish-brown, medium acid, mottled clay about 9 inches thick. Below that layer is yellowish-brown, red, and light-gray, very firm, mottled clay 27 inches thick.

This is underlain by very firm, mottled clay that has variegated colors and extends to a depth of 60 inches.

These soils have a high available water capacity, high shrink-swell potential, and medium natural fertility. Runoff is slow. The soils are not easily worked, and they have been in sugarcane for many years.

Representative profile of Fajardo clay, 2 to 10 percent slopes, on the Land Authority Farm, 165 meters south and 13 meters west of entrance to Luquillo Public Beach on Highway 3:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) clay, common, fine, faint, gray (10YR 5/1) mottles; weak, medium, subangular blocky structure to moderate, medium, granular; firm, slightly sticky and slightly plastic; many fine roots; few fine volcanic fragments; common, fine, black concretions; medium acid; abrupt, smooth boundary.

B21t—9 to 14 inches, yellowish-brown (10YR 5/6) clay; many, medium, distinct, greenish-gray (5GY 6/1) mottles and many, medium, prominent, red (2.5YR 4/6) mottles; moderate, medium, subangular blocky structure; very firm, sticky and plastic; common fine roots; thin continuous clay films on ped surfaces and root channels; common, fine, black concretions; slightly acid; gradual, smooth boundary.

B22t—14 to 25 inches, yellowish-brown (10YR 5/6) clay; many, medium, prominent, gray (5Y 6/1) and red (2.5YR 4/6) mottles; moderate, medium, subangular blocky structure; very firm, sticky and plastic; common fine roots; thin patchy clay films on ped surfaces and root channels; common slickensides and pressure faces; common, fine, black concretions; medium acid; gradual, smooth boundary.

B23t—25 to 36 inches, red (2.5YR 4/6) and light-gray (N 7/0) clay; common, medium, prominent, dark-red (2.5YR 3/6) and yellowish-brown (10YR 5/6) mottles; weak, medium, angular blocky structure; very firm, sticky and plastic; few fine roots; common slickensides and pressure faces; few, fine, dark concretions; medium acid; gradual, smooth boundary.

B24t—36 to 48 inches, variegated, yellowish-brown (10YR 5/6), gray (N 6/0), light bluish-gray (5B 7/1), and dark-red (2.5YR 3/6) clay; weak, fine, subangular blocky structure; very firm, sticky and plastic; medium acid; gradual, smooth boundary.

B25t—48 to 60 inches, gray (N 6/0) clay; many, medium, distinct dark-red (2.5YR 3/6), yellowish-brown (10YR 5/6), and light bluish-gray (5B 7/1) mottles; weak, fine, subangular blocky structure; very firm, sticky and plastic; medium acid.

The solum is more than 60 inches thick. The Ap horizon has chroma of 2 or 3. The B21t and B22t horizons have hue of 10YR or 7.5YR and value of 4 or 5. Structure is weak or moderate, subangular blocky. Clay films vary from thin patchy to thin continuous. The B22 horizon has variegated colors of gray, yellowish brown, and red in varying proportions. Mottles throughout the profile are common or many and are shades of gray, yellowish brown, red, and dark red. Slickensides range from few to common.

The Fajardo soils are on the same landscape as the Vega Baja and Vega Alta soils. In contrast to the Vega Baja soils, the Fajardo soils have pressure faces and slickensides in the B2t horizon. Unlike the Vega Alta soils, they are somewhat poorly drained.

FaC—Fajardo clay, 2 to 10 percent slopes. This soil occupies alluvial fans. It has the profile described as representative of the series. Small areas of Vega Baja and Vega Alta soils were included with this soil in mapping.

Frequent flooding, slow permeability, and a seasonal high water table are moderate limitations for farming. Careful management is required to improve the air and water relationship. This soil has been used for sugarcane. If the soil is drained and properly managed, it is suited to sugarcane and pasture. Capability unit IIw–2.

FaC2—Fajardo clay, 2 to 10 percent slopes, eroded. This soil is on alluvial fans. Its profile is similar to the one described as representative of the Fajardo series, but erosion has removed some of the dark grayish-brown clay surface layer and small rills have formed from rains. In some places plowing has mixed the surface layer with the subsoil. Included with this soil in mapping were small areas of Vega Alta soils.

Slow permeability, a seasonal high water table, and unfavorable workability are moderate limitations for farming. Soil conservation practices and proper management are needed to control erosion. This soil has been used for sugarcane for many years. If it is drained and properly managed, it is suited to sugarcane and pasture. Capability unit IIw–2.

Fortuna Series

The Fortuna series consists of deep soils that are poorly drained and slowly permeable. These soils formed in fine-textured sediment of mixed origin. They are on the flood plains. Slopes are 0 to 2 percent. The climate is humid tropical. The average annual precipitation is 80 inches, and the average annual temperature is 78° F.

In a representative profile, the surface layer is olive-gray, strongly acid clay about 5 inches thick. Below that is dark greenish-gray and greenish-gray, very firm clay that extends to a depth of 60 inches or more.

These soils have a high available water capacity, shrink-swell potential, and natural fertility. Runoff is slow. The soils are difficult to work. They have been in sugarcane, but a few areas are in native pasture and brush.

Representative profile of Fortuna clay, 2.0 kilometers south of the town of Maunabo and 10 kilometers northeast of the town of Humacao; 2.1 kilometers north of bridge over Anton Ruiz River on Highway 3, near an abandoned railroad:

Ap—0 to 5 inches, olive-gray (5Y 4/2) clay; few, fine, faint, greenish-gray (5Y 6/1) mottles and few, fine, distinct, strong-brown (7.5YR 5/8) mottles; massive; very firm, slightly sticky and slightly plastic; common fine roots; strongly acid; abrupt, smooth boundary.

B21g—5 to 9 inches, dark greenish-gray (5GY 4/1) clay; common, medium, distinct, strong-brown (7.5YR 5/8) mottles; massive; very firm, slightly sticky and plastic; common fine roots; few fine rock fragments; strongly acid; abrupt, smooth boundary.

B22g—9 to 18 inches, greenish-gray (5GY 5/1) clay; many, medium, distinct, yellowish-brown (10YR 5/8) mottles; weak, coarse, subangular blocky structure; very firm, slightly sticky and plastic; common fine roots; few, fine, black nodules; strongly acid; gradual, smooth boundary.

B3g—18 to 30 inches, greenish-gray (5GY 5/1) clay; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; weak, coarse, subangular blocky structure; very firm, slightly sticky and plastic; few fine roots; dark coatings in root channels; strongly acid; gradual, smooth boundary.

Cg—30 to 77 inches, greenish-gray (5GY 5/1) clay; many, coarse, distinct, yellowish-brown (10YR 5/8) mottles; massive; very firm, sticky and plastic; very strongly acid.

The solum is 22 to 45 inches thick. The Ap horizon has chroma of 2 or 3. The B horizon has value of 4 or 5 and chroma of 2 or less. Consistence is slightly sticky or sticky and generally is plastic.

The Fortuna soils are on the same landscape as the Maunabo, Bajura, and Toa soils. The Fortuna soils occupy lower positions than the Maunabo soils, and unlike those soils, they are fine textured in the lower horizons. They lack the pressure faces that are present in the Bajura soils and are more acid than those soils. In contrast to the Toa soils, the Fortuna soils are fine textured and poorly drained.

Fo—Fortuna clay. This nearly level soil is on river flood plains in the humid part of the survey area. Small areas of Maunabo and Bajura soils were included with this soil in mapping.

Slow permeability, poor workability, poor drainage, and a seasonal high water table are severe limitations for cultivated crops. Soil conservation practices and management are needed. This soil has been used for sugarcane. If the soil is properly drained, it is suited to sugarcane and pasture. Capability unit IIIw–4.

Fraternidad Series

The Fraternidad series consists of deep soils that are moderately well drained and slowly permeable. These soils formed in fine-textured sediment derived from limestone and volcanic rocks. They are on coastal plains. Slopes are 0 to 5 percent. The climate is semiarid. The average annual rainfall is 30 to 45 inches, and the average annual temperature is 79° F.

In a representative profile, the upper part of the surface layer is very dark grayish-brown, slightly acid clay, about 8 inches thick, and the lower part is brown clay 5 inches thick. Below that layer is dark yellowish-brown, firm clay that extends to a depth of about 50 inches.

These soils have a high available water capacity, high natural fertility, and very high shrink-swell potential. Surface runoff is slow. The soils are difficult to work, and they have been used for sugarcane and pasture for many years.

Representative profile of Fraternidad clay, 0 to 2 percent slopes, 3.2 kilometers north of kilometer marker 161.9 on Highway No. 3, and 42 meters north of an irrigation reservoir:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) clay; weak, medium, subangular blocky structure; hard, firm, slightly sticky and plastic; common roots; slightly acid; abrupt, smooth boundary.

A12—8 to 13 inches, brown (10YR 4/3) clay; pockets of very dark grayish-brown (10YR 3/2) clay; weak, medium subangular blocky structure; firm, slightly sticky and plastic; common pressure faces and slickensides; common small pores; common pebbles 1 to 3 millimeters in diameter; few dark minerals; slighly acid; clear, wavy boundary.

C1—13 to 18 inches, dark yellowish-brown (10YR 4/4) clay; weak, coarse, angular blocky structure; firm, slightly sticky and plastic; very few patchy clay films along vertical cleavage planes and root channels; common pressure faces and slickensides; neutral; clear, wavy boundary.

C2ca—18 to 31 inches, dark yellowish-brown (10YR 4/4) clay; massive; firm, slightly sticky and plastic; common fine pores; few dead roots; few pressure faces and slickensides; common lime splotches and limestone fragments; few pebbles; few dark minerals; few krotovinas; strongly alkaline; clear, wavy boundary.

C3—31 to 50 inches, dark yellowish-brown (10YR 4/4) clay; massive; firm, plastic; few fine pores; few pressure faces; few, soft, dark concretions; common dark stains; strongly alkaline.

The A horizon is 9 to 16 inches thick. It has value of 3 or 4 and chroma of 2 or 3. The C horizon has chroma of 3 or 4.

The Fraternidad soils are on the same landscape as the Paso Seco and Cartagena soils. Unlike the Paso Seco soils, the Fraternidad soils lack gravelly horizons at a depth of 20 to 37 inches. The Fraternidad soils are better drained than the Cartagena soils.

FrA—Fraternidad clay, 0 to 2 percent slopes. This soil is on alluvial fans and terraces in the semiarid coastal plains. It has the profile described as representative of the series. Included with this soil in mapping were small areas of Paso Seco and Cartagena soils.

Slow permeability, poor workability, and low rainfall are moderate limitations for farming. This soil has been used for food crops, sorghum, sugarcane, and pasture. Capability units IIIc–1 nonirrigated and IIs–1 irrigated.

FrB—Fraternidad clay, 2 to 5 percent slopes. This soil is on terraces in the coastal plains. Included with it in mapping were small areas of Paso Seco soils.

Slow permeability, poor workability, slope, and low rainfall are moderate limitations for farming. These limitations affect land leveling and irrigation. If the soil is properly irrigated, it is suited to sugarcane, sorghum, cut grasses, and pasture. Capability units IIIc–1 nonirrigated and IIs–1 irrigated.

Guamani Series

The Guamani series consists of deep soils that are well drained and rapidly permeable. These soils formed in moderately fine textured sediment over coarse sand, gravel, and cobbles derived from volcanic rock (fig. 3). They are on river flood plains. Slopes are 0 to 2 percent. The climate is semiarid. The average annual rainfall is 35 to 45 inches, and the average annual temperature is 79° F.

In a representative profile, the surface layer is very dark grayish-brown, slightly acid silty clay loam about 6 inches thick. Below that layer is brown, friable silty clay loam 14 inches thick. That material is underlain by sand, gravel, and cobbles.

These soils have a low available water capacity, medium runoff, and low shrink-swell potential. They are high in natural fertility and are easy to work. Runoff is medium. The soils have been used for sugarcane and pasture.

Representative profile of Guamani silty clay loam, 30 meters west of kilometer marker 144.3 on Highway No. 3, between Guayama and Salinas:

Ap—0 to 6 inches, very dark grayish-brown (10YR 3/2) silty clay loam; weak, fine, subangular blocky structure parting to fine, granular; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; fine pores; few, fine, subrounded rock fragments; slightly acid; gradual, smooth boundary.

B—6 to 20 inches, brown (10YR 4/3) silty clay loam; weak, fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; common fine pores; few rock fragments and gravel; slightly acid; abrupt, wavy boundary.

IIC—20 inches, sand, gravel, and cobbles that are 3 to 8 inches in diameter.

The solum is 15 to 20 inches thick. The Ap horizon has

Figure 3.—**An area of Guamani silty clay loam showing the underlying sand, gravel, and cobbles.**

value and chroma of 2 to 5. The B horizon has chroma of 2 or 3.

The Guamani soils occupy the same landscape as the Vives and Arenales soils. They have a thinner solum than the Vives soils, and they are rapidly permeable. Unlike the Arenales soils, the Guamani soils have a B horizon.

Gm—Guamani silty clay loam. This nearly level soil is on river flood plains. Included with it in mapping were small areas of Vives soils, high bottom, and Arenales soils.

This soil has severe limitations for crops because it is shallow and has a low available water capacity and because rainfall is low. Deep cuts cannot be made to level the soil; shallow gravelly strata limit the construction of irrigation channels and irrigation reservoirs. Controlled irrigation practices are needed for proper farm management. If the soil is irrigated, it is suited to sugarcane and pasture. Capability unit IVc–1 nonirrigated and IIIs–2 irrigated.

Guayabota Series

The Guayabota series consists of shallow soils that are poorly drained and slowly permeable. These soils formed in residuum of thin-bedded, dark bluish-gray siltstone. They are on side slopes in the volcanic uplands. Slopes are 20 to more than 60 percent. The climate is that of a tropical rain forest. The average annual rainfall is 185 inches, and the average annual temperature is 72° F.

In a representative profile, the surface layer is very dark gray, very strongly acid silty clay loam about 5 inches thick. Below that layer is mottled, dark olive-gray firm silty clay 9 inches thick. The underlying material is silty clay loam of varying colors that extends to a depth of 18 inches. It is underlain by hard siltstone.

These soils have a high available water capacity and moderate shrink-swell potential. Runoff is medium to rapid. The soils have been in native pasture and forest vegetation for many years, and most of the acreage is still in tropical forest.

Representative profile of Guayabota silty clay loam, 20 to 40 percent slopes, eroded, in the El Yunque National Forest, 90 meters northeast, and 30 meters south from kilometer marker 11.8 on Highway No. 191 to Glorieta Bohique:

A1—0 to 5 inches, very dark gray (5Y 3/1) silty clay loam; few, fine, reddish-brown mottles; weak, fine, subangular blocky structure; firm, slightly sticky and slightly plastic; many fine and medium roots; few fine and medium pores; very strongly acid; clear, smooth boundary.

B2—5 to 11 inches, dark olive-gray (5Y 3/2) silty clay; many, fine, distinct, dark reddish-brown mottles, common, medium, distinct, dark bluish-gray (5B 4/1) mottles, and few, medium, distinct, yellowish-

brown (10YR 5/8) mottles; weak, coarse, subangular blocky structure parting to weak, medium, subangular blocky; firm, slightly sticky and slightly plastic; common fine and medium roots; few fine pores; very strongly acid; gradual, smooth boundary.

B3—11 to 14 inches, dark olive-gray (5Y 3/2) silty clay, common, coarse, distinct, yellowish-brown (10YR 5/8) mottles, few, medium, distinct, yellowish-red (5YR 5/8) mottles, and few, fine, distinct, dark-gray mottles; weak, medium, subangular blocky structure; firm, slightly sticky and plastic; few pieces of weathered siltstone; extremely acid; abrupt, smooth boundary.

C—14 to 18 inches, variegated, dark bluish-gray (5B 4/1), dark greenish-gray (5G 4/1), and yellowish-red (5YR 4/8) silty clay loam; massive; friable, slightly sticky and slightly plastic; few fine and medium roots; few fine pores; about 50 percent saprolite; extremely acid; abrupt, smooth boundary.

R—18 inches, hard, dark bluish-gray and greenish-gray siltstone.

The solum is 10 to 15 inches thick. The A horizon has value of 2 or 3 and chroma of 2 or less. The B horizon has chroma of 2 or less and has weak, medium or coarse, subangular blocky structure. Reaction is strongly acid to extremely acid throughout the profile. Depth to hard siltstone ranges from 13 to 20 inches.

The Guayabota soils are on the same landscape as the Ciales, Yunque, Picacho, Los Guineos, and Utuado soils. They are shallower to hard rock than all those soils. The Guayabota soils lack the B2t horizons of the Ciales, Yunque, Picacho, and Los Guineos soils, and they are finer textured than the Utuado soils.

GuE2—Guayabota silty clay loam, 20 to 40 percent slopes, eroded. This soil occupies mountains in the upland rain forest. Included with it in mapping were small areas of Ciales, Yunque, Picacho, Los Guineos, and Utuado soils.

Steep slopes, poor drainage, shallowness, and the hazard of erosion are severe limitations for farming. Conservation practices are needed to slow surface runoff. This soil is not suited to cultivated crops. It is better suited to pasture and woodland than to most other uses. Capability unit VIIs–6; woodland suitability group 4d3.

GvF—Guayabota-Ciales-Picacho association, very steep. This mapping unit is on mountains in the rain forest. It occupies narrow, winding ridgetops where slopes range from 5 to 45 percent and side slopes where slopes range from 40 to 90 percent.

The composition of this unit is more variable than that of most other units in the survey area, but mapping has been controlled well enough to interpret for the expected use of the soils.

About 50 percent of this unit is Guayabota soils, and 20 percent is Ciales soils. Picacho soils make up 15 percent, and Rock land makes up 10 percent. Included in this mapping unit were small areas of better drained, clayey soils and a few areas of soils that are similar to the Guayabota soils but are deeper to hard rock.

The soils in this unit occur in a uniform pattern. The steeper Picacho soils and the less sloping Ciales soils are on the ridgetops and the Guayabota soils and Rock land are on the side slopes.

All of this mapping unit is in hardwood rain forest. Because of the very steep slopes, its use is limited to forest, recreation, habitat for wildlife, and water catchment. The soils in this unit are wet because of high rainfall, slow permeability, and a perched water table. Road stabilization is difficult since the soils are wet and susceptible to slippage. The soils are desirable for recreation uses because of their highly esthetic environment, but they have severe limitations for paths, trails, and roads because they are continuously wet and unstable. Capability unit VIIe–3; woodland suitability group 4d3.

Guayama Series

The Guayama series consists of shallow soils that are well drained and moderately permeable. These soils formed in moderately fine textured and fine textured residuum of volcanic rocks. They occupy side slopes and narrow ridgetops. Slopes are 12 to 60 percent. The average annual precipitation is 35 inches, and the average annual temperature is 79° F.

In a representative profile, the surface layer is dark reddish-brown, neutral clay loam about 5 inches thick. Below that layer is reddish-brown, friable gravelly clay 7 inches thick. The underlying layer is yellowish-red, firm gravelly clay loam. Volcanic rock is at a depth of 18 inches.

These soils have a moderate available water capacity, medium fertility, and moderate shrink-swell potential. Runoff is medium to rapid. The soils are somewhat difficult to work, and they have been in pasture for many years.

In this survey area, Guayama soils are mapped only in an undifferentiated group with Descalabrado soils.

Representative profile of Guayama clay loam, 20 to 40 percent slopes, in an area of Descalabrado and Guayama soils, 20 to 60 percent slopes, eroded, 17 meters north of kilometer marker 1.5 on Highway No. 303:

A1—0 to 5 inches, dark reddish-brown (5YR 3/4) clay loam; weak, fine, granular structure; soft, friable, slightly sticky and plastic; many fine roots; many, fine, subrounded volcanic rock fragments; neutral; clear, smooth boundary.

B2t—5 to 12 inches, reddish-brown (5YR 4/4) gravelly clay; moderate, fine, subangular blocky structure; soft, friable, sticky and plastic; common fine roots; thin patchy clay films on peds, and fragments coated with clay; many fine volcanic rock fragments; neutral; clear, smooth boundary.

C—12 to 18 inches, yellowish-red (5YR 4/6) gravelly clay loam; weak, fine, subangular blocky structure; soft, firm, slightly sticky and plastic; few fine roots; many fine volcanic rock fragments; neutral; gradual, irregular boundary.

R—18 to 20 inches, volcanic rock; secondary calcium carbonate is in rock cavities and fracture planes.

The solum is 6 to 15 inches thick. The A horizon has hue of 5YR or 7.5YR and value of 3 or 4. It is dominantly clay loam or gravelly clay loam. The B2t horizon has hue of 5YR or 2.5YR, value of 4 to 6, and chroma of 4 or higher. It is clay or gravelly clay and has weak or moderate, fine, subangular blocky structure. Clay films vary from thin patchy to thin discontinuous in the B2t horizon. The C horizon has a hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 4 to 8. It ranges from clay loam to gravelly clay loam. Reaction in all horizons ranges from slightly acid to mildly alkaline. Depth to semiconsolidated volcanic rock is less than 20 inches.

The Guayama soils are on the same landscape as the Guayama variant soils and the Descalabrado, Amelia, and Jacana soils. The Guayama soils are shallower to semiconsolidated volcanic rock than the Guayama variant soils, and they are not so red in the B2t horizon as those soils. Unlike the Descalabrado soils, Guayama soils have a reddish B2t horizon. The Guayama soils are shallower than the Amelia

soils. They are shallower to volcanic rock than the Jacana soils, and they lack pressure faces.

Guayama Variant

The Guayama variant consists of moderately deep soils that are well drained and moderately permeable. These soils formed in moderately fine textured and fine textured residuum of volcanic rocks. They are on lower side slopes and foot slopes. Slopes are 2 to 12 percent. The average annual precipitation is 35 inches, and the average annual temperature is 79° F.

In a representative profile, the surface layer is dark yellowish-brown, strongly acid clay loam about 8 inches thick. Below that layer is red clay that extends to a depth of 26 inches. It is friable in the upper 8 inches and firm in the lower 10 inches. The underlying material is semiconsolidated volcanic rock.

These soils have a moderate available water capacity, medium fertility, and moderate shrink-swell potential. Runoff is medium. The soils are somewhat difficult to work, and they have been in pasture for many years.

Representative profile of Guayama clay loam, moderately deep variant, 2 to 12 percent slopes, eroded, 14.4 kilometers north of kilometer marker 132.8 on Highway No. 3:

Ap—0 to 8 inches, dark yellowish-brown (10YR 3/4) clay loam; weak, fine, granular structure; friable, nonsticky and slightly plastic; many fine roots; common, fine, subrounded rock fragments; strongly acid; clear, smooth boundary.

B21t—8 to 16 inches, red (2.5YR 4/6) clay; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine roots; thin patchy clay films on ped surfaces and root channels; few, fine, subangular rock fragments; medium acid; clear, wavy boundary.

B22t—16 to 26 inches, red (2.5YR 5/6) clay; weak, medium, subangular blocky structure; firm, slightly sticky and slightly plastic; few fine roots; thin discontinuous clay films on ped surfaces; common, fine, black concretions; many, fine, angular rock fragments; slightly acid; clear, smooth boundary.

R—26 to 30 inches, semiconsolidated volcanic rock; can be dug with difficulty with a spade when moist.

Thickness of the solum and depth to semiconsolidated volcanic rock range from 20 to 34 inches. Reaction is strongly acid in the A horizon, and the acidity decreases with increasing depth. The A horizon has hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 3 or 4. The B2t horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 6 to 8. Angular and subangular rock fragments range from few to many and clay films range from thin patchy to thin discontinuous in the B2t horizon.

The Guayama variant soils are on the same landscape as the Guayama, Descalabrado, and Amelia soils. The Guayama variant soils are deeper to volcanic rock and have a redder B horizon than the Guayama and Descalabrado soils. They have a redder B horizon than the Amelia soils, and they lack gravelly layers.

GyC2—Guayama clay loam, moderately deep variant, 2 to 12 percent slopes, eroded. This soil is on the lower side slopes and foot slopes in the semiarid part of the survey area. Erosion has removed some of the dark yellowish-brown, clay loam surface layer, and in some places plowing has mixed this layer with the subsoil. Included with this soil in mapping were some small areas of Amelia, Guayama, and Descalabrado soils.

This soil has severe limitations for crops because rainfall is low. Slope and medium surface runoff are moderate limitations, and conservation practices are needed to reduce soil loss. This soil is suited to sugarcane, pasture, and woodland. Capability units IVc–2 nonirrigated and IIIe–4 irrigated; woodland suitability group 3d5.

Humacao Series

The Humacao series consists of deep soils that are well drained and moderately permeable. These soils formed in medium-textured and moderately fine textured sediment derived from granitic rocks. They occupy terraces above river flood plains. Slopes are 2 to 5 percent. The climate is humid tropical. The average annual rainfall is 85 to 90 inches, and the annual temperature is 78° F.

In a representative profile, the surface layer is dark-brown, strongly acid loam about 14 inches thick. The next layer, to a depth of 18 inches, is dark-brown, friable sandy clay loam. Below that layer is yellowish-brown, firm clay loam 13 inches thick. The underlying material is brown, friable clay loam that extends to a depth of 55 inches.

These soils have a moderate available water capacity. Surface runoff is slow. The soils are easily worked, and they have been in food crops and native pasture.

Representative profile of Humacao loam, 2 to 5 percent slopes, 0.2 kilometer south of kilometer marker 1.2 on Highway No. 908 and 3 meters west of farm road:

Ap—0 to 14 inches, dark-brown (7.5YR 3/2) loam; few, medium, distinct, dark-brown (10YR 4/3) mottles; weak, fine and medium, granular structure; friable, nonsticky and slightly plastic; many fine roots; few, fine, subrounded rock fragments; many fine quartz crystals; few, fine, dark minerals; strongly acid; clear, smooth boundary.

B2—14 to 18 inches, dark-brown (10YR 4/3) sandy clay loam with tongues of dark brown (7.5YR 3/2); weak, fine, subangular blocky structure; friable, nonsticky and slightly plastic; few fine roots; many, fine, subrounded rock fragments; common fine quartz crystals; common, fine, dark minerals; strongly acid; clear, smooth boundary.

C1—18 to 31 inches, yellowish-brown (10YR 5/4) clay loam; common, medium, faint, dark yellowish-brown (10YR 4/4) mottles; massive; firm, slightly sticky and slightly plastic; few fine roots; common fine quartz crystals; many, fine, subrounded, partially weathered rock fragments; few, fine, dark concretions; strongly acid; clear, smooth boundary.

C2—31 to 55 inches, yellowish-brown (10YR 5/6) clay loam; many, medium, prominent, dark-brown (10YR 3/3) mottles and common, medium, distinct, yellowish-red (5YR 5/8) mottles; massive; friable, slightly sticky and slightly plastic; few fine quartz crystals; many, fine, partially weathered rock fragments; common, medium, dark concretions; medium acid.

The solum is 12 to 28 inches thick. The A horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 or 3. The B horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 or 3. It has weak, fine or medium, subangular blocky structure. The C horizon has chroma of 4 to 6.

The Humacao soils occupy the same landscape as the Candelero and Vivi soils. They are better drained than the Candelero soils and lack their B2t horizon. The Humacao soils are finer textured in the C horizon than the Vivi soils, and unlike those soils, they are moderately permeable.

HmB—Humacao loam, 2 to 5 percent slopes. This soil is on terraces above the flood plains. Included with it in mapping were small areas of Candelero soils.

Proper management is needed to prevent soil loss. This soil is suited to cultivated crops, sugarcane, and pasture. Capability unit IIe–2.

Humatas Series

The Humatas series consists of deep soils that are well drained and moderately permeable. These soils formed in fine-textured residuum derived from basic volcanic rocks. They are on mountain side slopes and narrow ridgetops. Slopes are 20 to 60 percent. The climate is humid tropical. The average annual precipitation is 86 inches, and the average annual temperature is 76° F.

In a representative profile, the surface layer is brown to dark-brown, very strongly acid clay about 5 inches thick. Below that layer is yellowish-red and red clay and silty clay that extends to a depth of 38 inches. The underlying material is yellowish-red saprolite that is mottled with dark grayish brown and red. It extends to a depth of 60 inches.

These soils have a high available water capacity, medium natural fertility, and moderate shrink-swell potential. Surface runoff is medium to rapid. The soils are somewhat difficult to work. They have been in food crops, coffee trees, and pasture for many years.

Representative profile of Humatas clay, 20 to 40 percent slopes, eroded, 5.2 kilometers southwest, along paved road, from kilometer marker 2.7 on Highway No. 957 and 45 meters south, Palma Sola Ward, Canovanas:

A1—0 to 5 inches, brown to dark-brown (7.5YR 4/4) clay; weak, fine, subangular blocky structure parting to granular; friable, nonsticky and slightly plastic; many fine roots; very strongly acid; gradual, smooth boundary.

B21—5 to 10 inches, yellowish-red (5YR 4/6) clay; common, medium, faint, brown to dark-brown (7.5YR 4/4) mottles; weak to moderate, medium, subangular blocky structure; firm, nonsticky and slightly plastic; common fine roots; few fine pebbles, 1 to 2 millimeters; patchy clay films on peds; very strongly acid; clear, smooth boundary.

B22t—10 to 16 inches, red (2.5YR 4/6) clay; moderate, medium, subangular blocky structure; friable, nonsticky and plastic; few roots; thin continuous clay films on peds; very strongly acid; clear, smooth boundary.

B23t—16 to 27 inches, red (2.5YR 4/6) clay; weak, fine, subangular blocky structure; friable, nonsticky and plastic; few roots; common clay films; very strongly acid; clear, smooth boundary.

B3—27 to 38 inches, red (2.5YR 4/6) silty clay; common, fine, distinct, red (2.5YR 4/8), very pale brown (10YR 7/4), and strong-brown (7.5YR 5/6) mottles; weak, fine, subangular blocky structure; friable, nonsticky and slightly plastic; about 10 to 15 percent saprolite; very strongly acid; gradual, smooth boundary.

C—38 to 60 inches, yellowish-red (5YR 4/6) silty clay loam; few, fine, distinct, dark grayish-brown (10YR 4/2) and red (2.5YR 5/8) mottles; massive; friable, nonsticky and slightly plastic; about 80 percent saprolite; very strongly acid.

The solum is 23 to 50 inches thick. The A horizon has hue of 7.5YR or 5YR, value of 3 or 4, and chroma of 4 to 6. The B horizon ranges from 20 to 42 inches in thickness, and the B2t horizon from 14 to 30 inches. The B horizon has hue of 5YR or 2.5YR, value of 4 or 5, and chroma of 6 or more. The C horizon ranges from silty clay loam to clay loam.

The Humatas soils are on the same landscape as the Caguabo and Mucara soils. The Humatas soils are deeper and redder than the Caguabo and Mucara soils, and they have a B2t horizon.

HtE2—Humatas clay, 20 to 40 percent slopes, eroded. This soil is on side slopes and ridgetops in the humid volcanic uplands. It has the profile described as representative of the series. In some places plowing has mixed the surface layer with the subsoil. Included with this soil in mapping were small areas of Mucara and Caguabo soils.

Steep slopes, medium runoff, and the hazard of erosion limit this soil to occasional clean cultivation. Conservation practices and proper management are required to slow erosion. This soil has been used for coffee trees and pasture. If it is properly limed and managed, it is suited to occasional cultivated crops and to coffee trees, pasture, and woodland. Capability unit IVe–5; woodland suitability group 2c5.

HtF2—Humatas clay, 40 to 60 percent slopes, eroded. This soil occupies strongly dissected side slopes and narrow ridgetops in the humid volcanic uplands. It has a thinner surface layer than the soil described as representative of the series. Included with this soil in mapping were small areas of Mucara and Caguabo soils.

Steep slopes, rapid runoff, and the hazard of erosion are severe limitations for cultivated crops. The use of this soil is limited to pasture, woodland, and wildlife food and cover. Conservation practices are needed to slow runoff if the soil is used for food crops and coffee trees. Capability unit VIe–2; woodland suitability group 3r5.

HuF—Humatas-Stony land complex, 40 to 60 percent slopes. This mapping unit is on mountain side slopes and ridgetops in the humid volcanic uplands. Humatas clay and Stony land each make up 50 percent of this mapping unit. They occur in such intricate patterns that it is not feasible to map them separately. The areas of Stony land are covered with stones and boulders that range from 1 to 15 feet or more in diameter.

Very steep slopes, the hazard of erosion, rapid runoff, and boulders are severe limitations for cultivated crops. The soils of this complex are suitable for pasture, woodland, and wildlife food and cover. Capability unit VIIs–2; woodland suitability group 3r5.

Ingenio Series

The Ingenio series consists of deep soils that are well drained and moderately permeable. These soils formed in medium-textured and fine-textured residuum derived from highly weathered granitic rocks. They are on mountain side slopes and narrow ridgetops. Slopes are 20 to 40 percent. The climate is humid tropical. The average annual precipitation is 75 to 85 inches, and the average annual temperature is 78° F.

In a representative profile, the surface layer is yellowish-brown, very strongly acid silty clay loam about 7 inches thick. The next layer is red, friable clay and silty clay 33 inches thick. Below that, to a depth of 51 inches, is silty clay loam saprolite that has varying colors. Below this layer the saprolite is silt loam to a depth of 76 inches.

These soils have a moderate available water capacity and medium fertility. Runoff is medium to rapid. The

soils have been used for pasture. Most of the acreage is in native pasture, shrubs, and minor crops; small areas are in food crops.

Representative profile of Ingenio silty clay loam, 20 to 40 percent slopes, eroded, 4.9 kilometers southwest of Humacao and 1 kilometer southwest from Surillo School, Tejas Ward:

Ap—0 to 7 inches, yellowish-brown (10YR 5/4) silty clay loam; many, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; many fine roots; common fine quartz grains; few, fine, black grains; very strongly acid; clear, smooth boundary.

B21t—7 to 15 inches, red (2.5YR 5/6) silty clay; moderate, medium and coarse, prismatic structure; friable, slightly sticky and plastic; thin, continuous, yellowish-red (5YR 4/8) coatings on vertical ped surfaces and thin discontinuous coatings on horizontal ped surfaces; common fine roots; few fine pores; common fine quartz grains; few, fine, black grains; few krotovinas about 5 millimeters in diameter; very strongly acid; clear, smooth boundary.

B22t—15 to 31 inches, red (2.5YR 4/6) clay; moderate, medium and coarse, subangular blocky structure; friable, slightly sticky and slightly plastic; thin, continuous, reddish-brown (2.5YR 5/4) coatings on vertical ped surfaces and thin discontinuous coatings on horizontal ped surfaces; common fine roots; few fine pores; common fine quartz grains; few, fine, black grains; few krotovinas 2 to 5 millimeters in diameter; very strongly acid; gradual, smooth boundary.

B3—31 to 40 inches, red (2.5YR 4/6) silty clay; weak, medium and coarse, subangular blocky structure; very friable, nonsticky and slightly plastic; thin, discontinuous, reddish-brown (2.5YR 5/4) coatings on ped surfaces; common fine roots; common fine pores; common fine quartz grains; few, fine, black grains; few krotovinas 1 inch in diameter that have thick clay coatings; very strongly acid; clear, smooth boundary.

C1—40 to 51 inches, variegated, dusky red, yellow, and white silty clay loam, dark yellowish brown (10YR 4/4) crushed; massive; very friable, nonsticky and slightly plastic; common fine roots; few fine pores; common fine quartz grains; 50 percent saprolite; very strongly acid; gradual, smooth boundary.

C2—51 to 76 inches, variegated, dusky-red, yellow, yellowish-brown, and white silt loam saprolite; massive; very friable, nonsticky and slightly plastic; few dead roots with clay and organic coatings in root channels; very strongly acid.

The solum is 27 to 48 inches thick. The A horizon has hue of 10YR or 5YR, value of 4 or 5, and chroma of 3 or 4. The B2t horizon has hue of 5YR or 2.5YR, value of 4 or 5, and Chroma of 4 to 6. It is silty clay or clay. The C horizon has variegated colors of dusky red, yellow, brown, yellowish brown, and white.

The Ingenio soils are on the same landscape as the Lirios, Jagueyes, and Limones soils. The Ingenio soils have a thicker B2t horizon than the Lirios soils. They are redder and finer textured than the Jagueyes soils. The Ingenio soils are coarser textured throughout than the Limones soils.

InE2—Ingenio silty clay loam, 20 to 40 percent slopes, eroded. This soil is on mountain side slopes and ridgetops in the humid granitic uplands. Erosion has removed part of the original surface layer, and in most places the remaining part of that layer has been mixed with the subsoil. Included with this soil in mapping were small areas of Jagueyes and Limones soils.

Although this soil is used occasionally for cultivated crops, the steep slopes, rapid runoff, and the hazard of erosion are severe limitations. The soil is suited to pasture and woodland. Capability unit IVe–5; woodland suitability group 2o5.

Jacana Series

The Jacana series consists of moderately deep soils that are well drained and moderately slowly permeable. These soils formed in fine-textured sediment and residuum derived from basic volcanic rocks. They occupy foot slopes and low rolling hills. Slopes are 2 to 12 percent. The climate is semiarid. The average annual precipitation is 35 inches, and the average annual temperature is 79° F.

In a representative profile, the surface layer is very dark grayish-brown and dark-brown, medium acid clay about 5 inches thick. The next layer is dark-brown and dark yellowish-brown clay that extends to a depth of 21 inches. Partly weathered volcanic material is between depths of 21 and 26 inches; it is underlain by semiconsolidated volcanic rock.

These soils have high natural fertility and high shrink-swell potential. Surface runoff is medium. The soils are difficult to work. They have been in pasture for many years, and most of the acreage is still in pasture. Small areas are in sugarcane.

Representative profile of Jacana clay, 2 to 5 percent slopes, following farm roads 0.8 kilometer west of kilometer marker 92.1 on Highway No. 1, 3.2 kilometers north to southwestern corner of irrigation reservoir, then 0.2 kilometer west and 0.3 kilometer north to an irrigation channel and 9 meters north of the channel:

Ap—0 to 5 inches, very dark grayish-brown and dark-brown (10YR 3/2, 3/3) clay; weak, fine, subangular blocky structure parting to granular; friable, slightly sticky and slightly plastic; common fine roots; common, fine, subangular pebbles; few, fine, dark minerals; medium acid; gradual, smooth boundary.

B1—5 to 13 inches, dark-brown (10YR 3/3) clay; weak, medium and fine, subangular blocky structure; friable, slightly sticky and slightly plastic; few very dark grayish-brown (10YR 3/2) stains on ped surfaces; common fine roots; common, fine, subrounded pebbles; few, fine, dark minerals; neutral; abrupt, smooth boundary.

B2—13 to 21 inches, dark yellowish-brown (10YR 4/4) clay; weak, medium, subangular blocky structure; firm, slightly sticky and slightly plastic; few very dark grayish-brown (10YR 3/2) stains along root channels and ped surfaces; few patchy clay films; common pressure faces; common subrounded pebbles; few quartz grains; few, fine, dark minerals; neutral; abrupt, smooth boundary.

C—21 to 26 inches, partly weathered volcanic material.

R—26 inches +, semiconsolidated volcanic rock.

The solum is 16 to 28 inches thick. The Ap horizon has hue of 10YR or 7.5YR and value of 2 or 3. The B horizon has hue of 10YR or 7.5YR and value and chroma of 3 or 4. Pressure faces and slickensides range from few to many in the B2 horizon. Reaction ranges from medium acid to neutral. Depth to the partly weathered rock ranges from 20 to 36 inches.

The Jacana soils are on the same landscape as the Descalabrado, Coamo, and Amelia soils. The Jacana soils are thicker and finer textured than the Descalabrado soils. They are shallower than the Coamo soils and lack the stratified C horizon of those soils. The Jacana soils are finer textured and shallower than the Amelia soils, and they lack gravelly layers.

JaB—Jacana clay, 2 to 5 percent slopes. This soil is on foot slopes in the semiarid area. It has the profile described as representative of the Jacana series. Included with this soil in mapping were small areas of Coamo and Amelia soils.

Low rainfall is a severe limitation that restricts the use of this soil for farming. During years when rainfall is above average the soil is used for cultivated crops. If it is irrigated, the soil is suited to sugarcane, cut grasses, and pasture. Capability units IVc–2 nonirrigated and IIIs–3 irrigated; woodland suitability group 3d5.

JaC2—Jacana clay, 5 to 12 percent slopes, eroded. This soil occupies foot slopes and low rolling hills in the semiarid area. Its profile is similar to the one described as representative of the Jacana series, but some of the surface layer of dark grayish-brown clay has been removed by erosion, and in most places this layer has been mixed with the subsoil by plowing. Small areas of Descalabrado soils were included with this soil in mapping.

This soil has severe limitations for farming because of moderate slopes, the hazard of erosion, and poor workability. Also, rainfall is low in the area. Good management and conservation practices are required to slow surface runoff. This soil is suited to pasture, and it has been in pasture for many years. Capability unit IVe–4; woodland suitability group 3d5.

Jagueyes Series

The Jagueyes series consists of deep soils that are well drained and moderately permeable. These soils formed in residuum derived from highly weathered granitic rocks. They are on side slopes and narrow ridgetops. Slopes are 20 to 40 percent. The climate is humid tropical. The average annual rainfall is 75 to 85 inches, and the average annual temperature is 78° F.

In a representative profile, the surface layer is dark grayish-brown, very strongly acid loam about 8 inches thick. Below that layer is yellowish-brown sandy clay loam 6 inches thick. The next layer is yellowish-brown, yellow, and red, firm clay loam that extends to a depth of 37 inches. Below that layer is red, friable loam and sandy clay loam that extends to a depth of about 71 inches. It is underlain by saprolite.

These soils have a moderate available water capacity, medium natural fertility, and low shrink-swell potential. Surface runoff is medium. The soils have been used for food crops and pasture.

Representative profile of Jagueyes loam, 20 to 40 percent slopes, eroded, 7.5 kilometers southwest from Humacao and 7.7 kilometers north from Yabucoa, 445 meters west from junction of Highway No. 921 and farm road, 210 meters south of house and 150 meters northeast of mango trees, Tejas Ward, Yabucoa:

Ap—0 to 8 inches, dark grayish-brown (2.5Y 4/2) loam; weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; common fine roots; very strongly acid; clear, smooth boundary.

A3—8 to 14 inches, yellowish-brown (10YR 5/6) sandy clay loam; weak, medium, subangular blocky structure; soft, friable, slightly sticky and slightly plastic; common fine roots; few, medium, black concretions; common, fine, shiny grains; many fine quartz grains; very strongly acid; clear, smooth boundary.

B1—14 to 18 inches, yellowish-brown (10YR 5/8) sandy clay loam; weak, medium, subangular blocky structure; firm, slightly sticky and slightly plastic; strong-brown (7.5YR 5/6) and yellowish-brown (10YR 5/4) coatings on ped surfaces; common fine roots; thin patchy clay films; few, medium, black concretions; common, fine, black grains; many fine quartz grains; very strongly acid; clear, smooth boundary.

B21t—18 to 26 inches, yellow (10YR 7/6) clay loam; many, fine, distinct, dark-red (2.5YR 3/6) mottles and many, medium, distinct, red (2.5YR 4/8) mottles; moderate, medium, subangular blocky structure; firm, slightly sticky and slightly plastic; common fine roots; thin continuous clay films; few, medium, black concretions; few, fine, black grains; many fine quartz grains; many weathered feldspar grains; very strongly acid; clear, smooth boundary.

B22t—26 to 37 inches, yellow (10YR 7/6) and red (2.5YR 4/8) clay loam; few, fine, faint, brownish-yellow (10YR 6/8) mottles; weak, coarse, subangular blocky structure; firm, nonsticky and slightly plastic; few fine roots; thin discontinuous clay films; many fine quartz grains; few, fine, black grains; many weathered feldspar grains; very strongly acid; gradual, smooth boundary.

B3—37 to 52 inches, red (2.5YR 4/8) sandy clay loam; weak, medium, subangular blocky structure; friable, nonsticky and nonplastic; brownish-yellow (10YR 6/8) coatings; few fine roots; thin patchy clay films; many fine quartz grains; few, fine, black grains; very strongly acid; gradual, smooth boundary.

C1—52 to 71 inches, red (2.5YR 4/8) loam; massive; friable, nonsticky and slightly plastic; few, fine, black grains; many fine quartz grains; many, fine, weathered feldspar grains; 50 percent saprolite; very strongly acid; gradual, wavy boundary.

C2—71 to 95 inches, red (2.5YR 5/8) loam saprolite; massive; friable. nonsticky and slightly plastic; very strongly acid; gradual, smooth boundary.

C3—95 to 120 inches, red (2.5YR 5/6) sandy loam saprolite; massive; friable, nonsticky and slightly plastic; very strongly acid.

The solum is 39 to 66 inches thick. The A horizon has hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 2 to 6. It is loam, sandy loam, or sandy clay loam. The B horizon has hue of 10YR or 2.5YR, value of 4 to 7, and chroma of 6 to 8. It is clay loam or sandy clay loam and has weak to moderate, medium to coarse, subangular blocky structure. The C horizon is sandy loam to loam.

The Jagueyes soils occupy the same landscape as the Lirios, Ingenio, and Limones soils. The Jagueyes soils have a thicker solum than the Lirios soils, and they are coarser textured than the Ingenio and Limones soils.

JgE2—Jagueyes loam, 20 to 40 percent slopes, eroded. This soil is on narrow mountain ridgetops and side slopes in the humid plutonic uplands. Erosion has removed some of the dark grayish-brown loam surface layer, and in many places most of the plow layer is a mixture of the surface layer and the subsoil. Included with this soil in mapping were areas of Limones, Lirios, and Ingenio soils.

This soil has severe limitations for farming because of slope and the hazard of erosion. Steep slopes, medium runoff, and the hazard of erosion are severe limitations for cultivated crops. Conservation practices and proper management are required to slow surface runoff. This soil is used occasionally for food crops. If it is properly managed, it is suited to food crops, pasture, and woodland. Capability unit IVe–11; woodland suitability group 2o5.

Junquitos Series

The Junquitos series consists of moderately deep soils that are moderately well drained and moderately slowly permeable. These soils formed in alluvial and colluvial sediment derived from extrusive volcanic rocks and, to a small degree, in residuum from similar rocks. They are on foot slopes. Slopes are 5 to 12 percent. The climate is humid tropical. The average annual rainfall is 87 inches, and the average annual temperature is 79° F.

In a representative profile, the surface layer is brown to dark-brown, extremely acid gravelly clay loam about 7 inches thick. The next layer is yellowish-brown, mottled, firm clay 21 inches thick. The underlying material is brownish-yellow, mottled clay that extends to a depth of 35 inches. It is underlain by volcanic rock fragments.

These soils have a high available water capacity and moderate shrink-swell potential. Runoff is medium. The soils are difficult to work. They have been in pasture for many years, but some areas are in sugarcane.

Representative profile of Junquitos gravelly clay loam, 5 to 12 percent slopes, 1 kilometer north, 0.2 kilometer west, and 15 meters south of kilometer marker 81.3 on Highway No. 3, east of Humacao:

Ap—0 to 7 inches, brown to dark-brown (10YR 4/3) gravelly clay loam; massive; slightly hard, firm, nonsticky and slightly plastic; many fine roots; many, medium and coarse, angular and subrounded rock fragments; extremely acid; clear, smooth boundary.

B1—7 to 21 inches, yellowish-brown (10YR 5/8) clay; few, fine, distinct, red (2.5YR 5/8) mottles; weak, medium, subangular blocky structure; hard, firm, slightly sticky and plastic; few fine roots; few, fine, subrounded rock fragments; few, fine, dark concretions; strongly acid; clear, smooth boundary.

B2—21 to 28 inches, yellowish-brown (10YR 5/8) clay; few, fine, distinct, red (2.5YR 5/8) and light-gray (10YR 7/1) mottles; weak, fine, subangular blocky structure; hard, firm, slightly sticky and plastic; few, fine, patchy clay films; many, fine and medium, dark concretions; common, fine and medium, angular and subrounded rock fragments; slightly acid; clear, smooth boundary.

C1—28 to 35 inches, brownish-yellow (10YR 6/8) clay; many, coarse, prominent, red (2.5YR 5/8) mottles and common, medium, distinct, gray (10YR 5/1) mottles; massive; hard, firm, slightly sticky and plastic; many, fine, dark concretions; common, fine, subrounded, rock fragments; neutral; abrupt, smooth boundary.

IIC2—35 inches+, angular volcanic rock fragments.

The solum is 20 to 40 inches thick. The A horizon has value of 3 or 4 and chroma of 2 or 3. The content of volcanic rock fragments in the surface layer ranges from 30 to 40 percent. The B horizon has weak, fine or medium, subangular blocky structure. The C horizon has hue of 10YR or 7.5YR and value of 5 or 6. Mottles in the B and C horizons range from few to many and are shades of red and gray. Patchy clay films range from few to many, and dark concretions range from few to many and are fine or medium sized.

The Junquitos soils occupy the same landscape as the Rio Arriba, Mabi, Aceitunas, and Via soils. The Junquitos soils are shallower to rock fragments than the Rio Arriba soils. They are shallower and coarser textured than the Mabi soils, and their shrink-swell potential is not so high. The Junquitos soils are shallower than the Aceitunas soils and lack their reddish horizons. They are shallower and finer textured than the Via soils, and they are not so well drained as Via soils.

JuC—Junquitos gravelly clay loam, 5 to 12 percent slopes. This soil is on foot slopes in the humid volcanic uplands. Included with it in mapping were small areas of Rio Arriba, Mabi, and Via soils.

Slope and surface runoff are moderate limitations for farming. Proper management and conservation practices are needed to reduce erosion. If this soil is properly managed, it is suited to sugarcane and pasture. Capability unit IIIe–5.

Leveled Clayey Land

Leveled clayey land (Lc) consists of clayey soils that have different colors, plasticity, and mineralogy. These soils have been reworked by machinery during land leveling for construction. The original soils have been so disturbed that it is impossible to identify them. Generally, the soils in this mapping unit are deep to consolidated parent material.

This land type has severe limitations for farming because the soils have been disturbed. It is suitable for such nonfarm uses as foundations and sites for light industries.

Limones Series

The Limones series consists of deep soils that are moderately well drained and moderately permeable. These soils formed in fine-textured residuum of very highly weathered granitic rocks. They are on side slopes and narrow ridgetops. Slopes are 20 to 40 percent. The climate is humid tropical. The average annual rainfall varies from 75 to 85 inches, and the average annual temperature is 78° F.

In a representative profile, the surface layer is dark yellowish-brown, very strongly acid silty clay about 5 inches thick. Below that is dark yellowish-brown, yellowish-brown, and yellowish-red clay 35 inches thick. The underlying material is clay loam, clay, and silty clay loam saprolite that extends to a depth of 120 inches.

These soils have a high available water capacity and moderate to rapid runoff and are susceptible to erosion. They have been in pasture for many years, and there are small areas in food crops.

Representative profile of Limones silty clay, 20 to 40 percent slopes, 3 kilometers west of the town of Yabucoa and 30 meters north of kilometer marker 14.2 on Highway No. 182:

Ap—0 to 5 inches, dark yellowish-brown (10YR 4/4) silty clay; few, fine, distinct, strong-brown (7.5YR 5/8) and olive-gray (5Y 5/2) mottles; weak, fine and medium, subangular blocky structure; friable, nonsticky and plastic; common fine roots; red coatings along root channels; few fine quartz grains; very strongly acid; clear, smooth boundary.

B1—5 to 9 inches, dark yellowish-brown (10YR 4/4) clay; few, fine, faint, strong-brown (7.5YR 5/8) mottles; weak, fine, subangular blocky structure; friable, nonsticky and plastic; common fine roots; few, thin, patchy clay films; few fine quartz grains; few, fine, black grains; very strongly acid; clear, smooth boundary.

B21t—9 to 16 inches, yellowish-brown (10YR 5/6) clay; many, medium, distinct, red (2.5YR 4/8) mottles; moderate, medium and coarse, subangular blocky structure; firm, slightly sticky and plastic; common fine roots; thin, continuous, yellowish-brown

clay films on ped surfaces and root channels; common fine quartz grains; few, fine, black concretions; very strongly acid; clear, smooth boundary.

B22t—16 to 26 inches, yellowish-red (5YR 5/6) clay; moderate, medium and coarse, subangular blocky structure; firm, slightly sticky and plastic; common fine roots; thin, continuous, strong-brown clay films on ped surfaces, root, and worm channels; common fine quartz grains; few, fine, black grains; very strongly acid; gradual, smooth boundary.

B3—26 to 40 inches, yellowish-red (5YR 4/8) clay; weak, medium, subangular blocky structure; friable, slightly sticky and plastic; few fine roots; thin, patchy, strong-brown clay films on ped surfaces and root channels; few fine quartz grains; few, fine, black grains; about 20 percent saprolite; very strongly acid; gradual, smooth boundary.

C1—40 to 54 inches, red (2.5YR 4/8) clay loam saprolite; massive; friable, nonsticky and plastic; few fine roots; thin clay films along root channels; many weathered feldspar grains; many fine quartz grains; very strongly acid; gradual, smooth boundary.

C2—54 to 72 inches, variegated colors of the saprolite; red (2.5YR 4/8), rubbed, clay; massive; friable, nonsticky and plastic; few fine roots; many fine quartz grains; common, fine, soft, black grains; many weathered feldspar grains; very strongly acid; gradual, smooth boundary.

C3—72 to 96 inches, variegated colors of the saprolite; red (2.5YR 4/8), rubbed, silty clay loam; massive; friable, nonsticky and slightly plastic; many weathered feldspar grains; many fine quartz grains; very strongly acid.

C4—96 to 120 inches, variegated colors of the saprolite; red (2.5YR 4/8), rubbed, silty clay loam; massive friable, nonsticky and slightly plastic; many weathered feldspar grains; many fine quartz grains; very strongly acid.

The solum is 33 to 53 inches thick. The B2t horizon has hue of 10YR or 5YR, value of 4 or 5, and chroma of 4 to 8. Clay films vary from thin patchy to thin continuous. The C horizon ranges from clay loam to clay.

The Limones soils are on the same landscape as the Jagueyes and Ingenio soils. They are finer textured than the Jagueyes soils. Unlike the Ingenio soils, the Limones soils are moderately well drained and lack red colors in the solum.

LeE2—Limones silty clay, 20 to 40 percent slopes, eroded. This soil is on side slopes and narrow ridgetops in the humid plutonic uplands. Included with it in mapping were small areas of Ingenio and Jagueyes soils.

This soil is not suited to cultivated crops because of the hazard of erosion. Steep slopes, surface runoff, and the hazard of erosion are severe limitations for farming. If the soil is properly managed, it is suited to pasture and woodland. Capability unit IVe–5; woodland suitability group 2c5.

Lirios Series

The Lirios series consists of deep soils that are well drained and moderately permeable. These soils formed in fine-textured, very highly weathered residuum derived from granitic rocks. They are on foot slopes, side slopes, and hilltops. Slopes are 3 to 40 percent. The climate is humid tropical. The average annual rainfall is 80 to 90 inches, and the average annual temperature is 78° F.

In a representative profile, the surface layer is dark-brown, very strongly acid silty clay loam about 4 inches thick. Below that is red, friable clay and silty clay that extends to a depth of 23 inches. The underlying material is silty clay loam saprolite.

These soils have a high available water capacity. Surface runoff is moderate to rapid. The soils are susceptible to erosion. They have been in pasture for many years; few areas are in food crops.

Representative profile of Lirios silty clay loam, 20 to 40 percent slopes, eroded, 90 meters south of kilometer marker 11.9 on Highway No. 181, Barrio Guayabota, Municipality of Yabucoa:

Ap—0 to 4 inches, dark-brown (10YR 4/3) silty clay loam; weak, fine, subangular blocky structure; friable, nonsticky and slightly plastic; many fine roots; many fine quartz crystals; common, fine dark concretions; very strongly acid; abrupt, smooth boundary.

B2t—4 to 14 inches, red (2.5YR 4/8) clay; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine roots; thin patchy clay films on ped surfaces and root channels; common fine quartz crystals; few, fine, white flakes; very strongly acid; gradual, smooth boundary.

B3—14 to 23 inches, red (10R 4/6) silty clay; common, fine, distinct, reddish-yellow (5YR 6/6) mottles; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; few fine roots; thin patchy clay films on ped surfaces; common fine quartz crystals; many, fine, shiny, white flakes; very strongly acid; gradual, smooth boundary.

C—23 to 50 inches, variegated, red (10R 4/6), strong-brown (7.5YR 5/8), reddish-brown (5YR 4/3), and pink (5YR 7/3) silty clay loam saprolite; massive; friable, nonsticky and slightly plastic; many fine quartz crystals; many, fine, shiny flakes; very strongly acid.

The solum is 22 to 36 inches thick. The Ap horizon has hue of 10YR or 7.5YR and chroma of 3 or 4. It is silty clay loam to clay loam. The B horizon has hue of 5YR, 2.5YR, or 10R, value of 4 to 6, and chroma of 4 to 8. It is silty clay or clay and has weak or moderate, fine or medium, subangular blocky structure. Clay films vary from thin patchy to thin continuous. The C horizon has variegated colors of strong brown, reddish brown, pink, and red.

The Lirios soils are on the same landscape as the Jagueyes and Limones soils. They are finer textured than the Jagueyes soils and are better drained than the Limones soils.

LoC2—Lirios clay loam, 3 to 10 percent slopes, eroded. This soil is on hilltops and foot slopes in the humid uplands. It has a thicker surface layer than the soil described as representative of the series. Erosion has removed some of the original surface layer, and in some places plowing has mixed the remaining part of that layer with the subsoil. Included with this soil in mapping were some areas of Jagueyes and Limones soils.

This soil is suited to cultivated crops and pasture, but good management and conservation practices are required to control erosion. Capability unit IIIe–6; woodland suitability group 2c5.

LrE2—Lirios silty clay loam, 20 to 40 percent slopes, eroded. This soil is on mountain side slopes. It has the profile described as representative of the series. Erosion has removed some of the original surface layer, and in some places the saprolite is exposed.

Steep slopes, surface runoff, and the hazard of erosion are severe limitations for cultivated crops. Proper management and soil conservation practices are required to control erosion. If the soil is properly limed

and fertilized, it is suited to pasture and woodland. Capability unit IVe–5; woodland suitability group 2c5.

Los Guineos Series

The Los Guineos series consists of deep soils that are moderately well drained and moderately permeable. These soils formed in fine-textured residuum derived from highly weathered volcanic rocks. They are on mountain side slopes and narrow ridgetops. Slopes are 12 to 60 percent. The climate is humid tropical. The average annual precipitation is 100 inches, and the average annual temperature is 75° F.

In a representative profile, the surface layer is dark-brown, extremely acid silty clay loam about 5 inches thick. Below that is yellowish-brown and reddish-yellow very firm and firm clay 19 inches thick. The next layer is red, strong-brown, and reddish-yellow, very firm and firm clay. Clay saprolite is at a depth of 48 inches.

These soils have a high available water capacity and medium natural fertility. Runoff is medium to rapid. The soils are susceptible to erosion and are difficult to work. They have been in pasture, brush, and woodland for many years. Some areas are in abandoned coffee trees.

Representative profile of Los Guineos silty clay loam, 20 to 40 percent slopes, eroded, 350 meters southeast of kilometer marker 14.1 on Highway No. 179, Ward Carite, Guayama:

Ap—0 to 5 inches, dark-brown (10YR 4/3) silty clay loam; common, fine, distinct, yellowish-brown (10YR 5/8) mottles; weak, fine, granular structure; friable, slightly sticky and slightly plastic; few fine roots; extremely acid; clear, smooth boundary.

B21t—5 to 15 inches, yellowish-brown (10YR 5/6) clay; few, fine, yellowish-red (5YR 5/8) mottles; moderate, coarse, subangular blocky structure; very firm, slightly sticky and plastic; common fine roots; patchy clay films on ped surfaces and in root channels; extremely acid; numerous worm casts; gradual, smooth boundary.

B22t—15 to 24 inches, reddish-yellow (7.5YR 6/8) clay; ped interiors have common, medium, distinct, red (2.5YR 4/6) mottles; moderate, coarse, subangular blocky structure; firm, slightly sticky and plastic; thin continuous clay films on ped surfaces and patchy films in root channels; very strongly acid; gradual, wavy boundary.

B31—24 to 34 inches, red (2.5YR 4/6) and strong-brown (7.5YR 5/8) clay; weak, fine and medium, subangular blocky structure; very firm, slightly sticky and plastic; few fine roots; patchy clay films on vertical cleavage planes and in root channels; 20 percent saprolite; very strongly acid; gradual, wavy boundary.

B32—34 to 48 inches, red (2.5YR 4/6) and reddish-yellow (7.5YR 6/6) clay; weak, fine and medium, subangular blocky structure; firm, slightly sticky and plastic; few patchy clay films on vertical ped surfaces and in root channels; 40 percent saprolite; extremely acid; gradual, wavy boundary.

C—48 to 60 inches, mixed colors of the saprolite; red (2.5YR 4/6), brownish-yellow (10YR 6/6), very pale brown (10YR 7/4), and very dark brown (10YR 2/2) clay; massive; friable, slightly sticky and plastic; very strongly acid.

The solum is 36 to 58 inches thick. The Ap horizon has hue of 7.5YR or 10YR and chroma of 3 or 4. The B2t horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 6 or higher. It has moderate or strong, medium or coarse, subangular blocky structure. Reaction is strongly acid or extremely acid.

The Los Guineos soils are on the same landscape as the Ciales and Picacho soils. The Los Guineos soils are better drained than the Ciales soils. Unlike the Picacho soils, they lack low-chroma mottles in the B2t horizon.

LsD—Los Guineos silty clay loam, 12 to 20 percent slopes. This soil is on side slopes and ridgetops in the humid volcanic uplands. It has a thicker surface layer than the soil described as representative of the Los Guineos series. Small areas of Los Guineos soils, 20 to 40 percent slopes, eroded, Mucara soils, and Rock land were included with this soil in mapping.

Slopes, medium runoff, and the hazard of erosion are severe limitations for farming. These limitations restrict the choice of plants and require very careful management if the soil is clean cultivated. The high intensity of rainfall restricts the time of planting, tilling, and harvesting. Most of the acreage is in brush and tropical rain forest. This soil is suited to food crops, grass, and woodland. Capability unit IVe–5; woodland suitability group 2c3.

LsE2—Los Guineos silty clay loam, 20 to 40 percent slopes, eroded. This soil is on side slopes and ridgetops. It has the profile described as representative of the series. Included with it in mapping were small areas of moderately steep Los Guineos soils, Mucara soils, and Rock land.

Steep slopes, rapid runoff, and the hazard of erosion are severe limitations for clean cultivation. If the soil is occasionally clean cultivated, conservation practices and proper management are required to control erosion. If the soil is properly limed and managed, it is suited to coffee trees, pasture, and woodland. Capability unit VIe–2; woodland suitability group 2c3.

LsF2—Los Guineos silty clay loam, 40 to 60 percent slopes, eroded. This soil is on side slopes and ridgetops in the humid volcanic uplands. Included with it in mapping were small areas of Caguabo soils and Rock land.

Very steep slopes, rapid runoff, and the hazard of erosion are severe limitations for clean cultivation. This soil has been in abandoned coffee trees, pasture, and forest. It is suitable for pasture, woodland, and food and cover for wildlife. Capability unit VIIe–1; woodland suitability group 2r3.

LyF—Los Guineos-Yunque-Stony rock land association, steep. This mapping unit is on mountains in the rain forest. The soils occur in uniform patterns; the Los Guineos soils are on the mountain side slopes, and the Yunque soils are on the upper side slopes and ridgetops. Stony rock land is on the lower part of the side slopes and along drainageways. In these places, 90 to 100 percent of the surface is covered with grayish and bluish volcanic rocks. Slopes range from 25 to 65 percent on the side slopes, from 10 to 35 percent on the upper side slopes, and from 25 to 70 percent in areas of Stony rock land.

The composition of this mapping unit is more variable than that of most other mapping units in the survey area but has been controlled well enough to interpret for the expected use of the soils. About 50 percent is Los Guineos soils, 31 percent is Yunque soils, and 10 percent is Stony rock land. The rest consists of other soils, rocks, and boulders.

This mapping unit is in hardwood rain forest. Because of the very steep slopes, its use is limited to forest, recreation, habitat for wildlife, and water catch-

ment. Road stabilization is difficult because the soils are continuously wet and susceptible to slippage. Thus, the limitations for paths, roads, and trails are severe. Capability unit VIIe–3; woodland suitability group 3r3.

Mabi Series

The Mabi series consists of deep soils that are somewhat poorly drained and slowly permeable. These soils formed in sediment derived from volcanic rocks. They are on stream terraces, long foot slopes, and alluvial fans. Slopes are 0 to 20 percent. The climate is humid tropical. The average annual precipitation is 70 to 80 inches, and the average annual temperature is 78° F.

In a representative profile, the surface layer is dark-brown, very strongly acid clay about 6 inches thick. It is underlain by yellowish-brown, mottled, very firm clay that extends to a depth of 56 inches.

These soils have a high available water capacity, high natural fertility, and high shrink-swell potential. Runoff is medium to slow. The soils are difficult to work. They have been in pasture (fig. 4) and sugarcane. Some areas are in tobacco.

Representative profile of Mabi clay, 0 to 5 percent slopes, 9 meters south and 9 meters west of kilometer marker 14.7 on Highway No. 31, Naguabo to Juncos:

Ap—0 to 6 inches, dark-brown (10YR 4/3) clay; common, fine, faint, dark-red (2.5YR 3/6) mottles; weak, fine, subangular blocky structure; firm, slightly sticky and slightly plastic; common fine roots; common, medium and fine, black concretions; few krotovinas; clay films on root channels; very strongly acid; abrupt, wavy boundary.

AC—6 to 18 inches, yellowish-brown (10YR 5/6) clay; common, medium, distinct, light-gray (5Y 7/2) mottles; weak, coarse, angular blocky structure; very firm, sticky and plastic; common dead roots in root channels; few black concretions; slickensides and pressure faces; very strongly acid; gradual, wavy boundary.

C1—18 to 35 inches, yellowish-brown (10YR 5/8) clay; many, coarse, prominent, light greenish-gray (5GY 7/1) mottles; weak, coarse, angular blocky structure; very firm, sticky and plastic; common dead roots; common, fine and medium, black concretions; slickensides and pressure faces; strongly acid; clear, wavy boundary.

C2—35 to 56 inches, yellowish-brown (10YR 5/6) clay; many, coarse, prominent, light greenish-gray (5GY 7/1) mottles; weak, coarse, angular blocky structure; very firm, sticky and plastic; fine dead roots; many, medium, black concretions; common dark concretions; common dark streaks on ped surfaces; slightly acid.

The Ap horizon is 6 to 12 inches thick. It has value of 4 or less and chroma of 2 or more. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 4 or more. Low-chroma mottles are below the Ap horizon. Reaction ranges from very strongly acid in the surface horizon to slightly acid in the lower horizons.

The Mabi soils occupy the same landscape as the Mucara and Rio Arriba soils. They are at a lower elevation and are finer textured and deeper than the Mucara soils. Unlike the Rio Arriba soils, the Mabi soils lack a B2t horizon and are somewhat poorly drained.

MaB—Mabi clay, 0 to 5 percent slopes. This soil is on alluvial fans, foot slopes, and terraces below the vol-

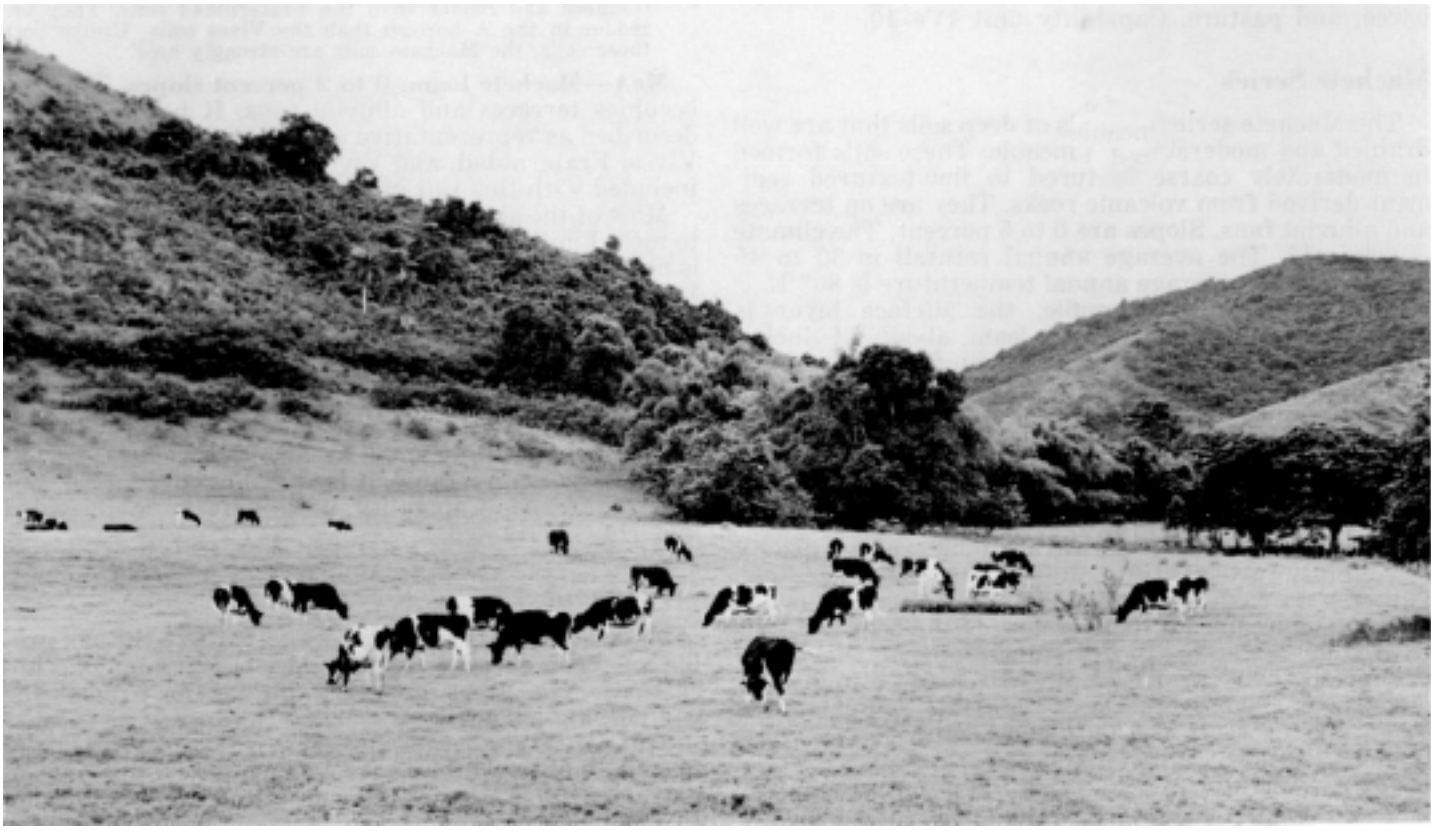

Figure 4.—**Pangolagrass pasture on Mabi soils. Steep Mucara soils are on the side slopes in the background.**

canic uplands. It has the profile described as representative of the series. Included with this soil in mapping were small areas of Rio Arriba soils.

This soil has moderate limitations for farming because of unfavorable workability and wetness. It is fertile and responds well to fertilizer but it needs careful management and drainage. The soil is suited to sugarcane, tobacco, and pasture. Capability unit IIw–3.

MaC2—Mabi clay, 5 to 12 percent slopes, eroded. This soil is on foot slopes and alluvial fans. Its profile is similar to the one described as representative of the Mabi series, but erosion has removed some of the dark-brown surface layer. In some places plowing has mixed the remaining part of the surface layer with some of the subsoil. Included with this soil in mapping were small areas of Rio Arriba soils.

This soil has moderate limitations for farming because it is somewhat poorly drained and difficult to cultivate. If it is properly managed and drained, the soil is suited to sugarcane, tobacco, and pasture. Capability unit IIIe–7.

MaD2—Mabi clay, 12 to 20 percent slopes, eroded. This soil is on foot slopes. It is steeper and better drained than the other Mabi soils. Erosion has removed some of the original dark-brown surface layer, and where the soil is plowed, the remaining part of that layer is mixed with some of the subsoil. In some places the yellowish-brown subsoil is exposed. Included with this soil in mapping were some areas of Mucara soils.

Slope, the hazard of erosion, and the difficulty of cultivation are severe limitations for farming. If the soil is properly managed, it is suited to sugarcane, tobacco, and pasture. Capability unit IVe–10.

Machete Series

The Machete series consists of deep soils that are well drained and moderately permeable. These soils formed in moderately coarse textured to fine-textured sediment derived from volcanic rocks. They are on terraces and alluvial fans. Slopes are 0 to 5 percent. The climate is semiarid. The average annual rainfall is 30 to 45 inches, and the average annual temperature is 80° F.

In a representative profile, the surface layer is reddish-brown, strongly acid loam about 14 inches thick. The next layer is reddish-brown friable clay loam to a depth of 20 inches. Below that layer is yellowish-red and reddish-brown clay and sandy clay loam 19 inches thick. Underlying that layer is reddish-brown and dark-brown, friable and very friable gravelly sandy clay loam and loamy sand that extends to a depth of 60 inches.

These soils have a moderate available water capacity and high natural fertility. Runoff is medium to slow. The soils are easily worked, and most of the acreage has been in sugarcane for many years. If the soils are irrigated, they are suited to cultivated crops.

Representative profile of Machete loam, 0 to 20 percent slopes, 800 meters east of Lafayette Sugar Central irrigation reservoir and 60 meters south of reservoir, 12 meters east of trail:

Ap—0 to 9 inches, reddish-brown (5YR 4/3) loam; weak, fine, granular structure; very friable, slightly sticky and slightly plastic; many fine roots; few, fine, black concretions; common fine sand grains; strongly acid; clear, smooth boundary.

A12—9 to 14 inches, reddish-brown (5YR 4/3) loam; weak, fine, granular structure; very friable, slightly sticky and slightly plastic; few fine roots; common medium and fine pores; common fine sand grains; strongly acid; clear, smooth boundary.

B1—14 to 20 inches, reddish-brown (5YR 4/4) clay loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; few fine roots; common medium and fine pores; thin patchy clay films; few, fine, black concretions; many fine sand grains; strongly acid; clear, smooth boundary.

B2t—20 to 32 inches, yellowish-red (5YR 4/6) clay; moderate, medium, subangular blocky structure; firm, slightly sticky and plastic; thin discontinuous clay films, more numerous on vertical ped surfaces and in root channels than on horizontal ped surfaces; few worm casts; few black concretions; many sand grains; strongly acid; clear, smooth boundary.

B3—32 to 39 inches, reddish-brown (5YR 4/4) sandy clay loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; few, thin, patchy clay films on peds and in root channels; few black concretions; many sand grains; few subrounded pebbles; strongly acid; abrupt, smooth boundary.

IIC1—39 to 45 inches, reddish-brown (5YR 4/3) gravelly sandy clay loam; massive; friable; strongly acid; abrupt, smooth boundary.

IIIC2—45 to 60 inches, dark-brown (7.5YR 4/4) loamy sand; massive; very friable; strongly acid.

The solum is 27 to 62 inches thick. The Ap horizon has hue of 5YR or 7.5YR and chroma of 3 or 4. The B horizon has hue of 7.5YR or 5YR and chroma of 4 to 6. The B2t horizon has weak or moderate, subangular blocky structure. The C horizon has reddish-brown and dark-brown colors. It ranges from gravelly sandy clay loam to loamy sand.

The Machete soils are on the same landscape as the Fraternidad and Vives soils. The Machete soils are coarser textured and redder than the Fraternidad soils. They are redder in the A horizon than the Vives soils. Unlike both those soils, the Machete soils are strongly acid.

McA—Machete loam, 0 to 2 percent slopes. This soil occupies terraces and alluvial fans. It has the profile described as representative of the series. Small areas of Vives, Fraternidad, and Vives, high bottom, soils were included with this soil in mapping.

Most of the acreage is in sugarcane. This soil is suited to most kinds of crops grown in the area, but irrigation is needed for successful crop production. Capability unit IIc–2 nonirrigated and I–1 irrigated.

McB—Machete loam, 2 to 5 percent slopes. This soil is on terraces and alluvial fans. It has a thinner surface layer than the soil described as representative of the Machete series. It occurs at a higher elevation than Machete loam, 0 to 2 percent slopes. Included with this soil in mapping were small areas of Vives soils.

If this soil is irrigated, it is suited to cultivated crops and sugarcane. Capability units IIIc–3 nonirrigated and IIe–3 irrigated.

Made Land

Made land (Md) consists of areas where the soil profile has been covered or destroyed by earthmoving operations. The areas generally have been graded for engineering purposes.

This land type is not suitable for agricultural uses. Because soil conditions are variable, it requires special management if lawns and trees are to be established. In some areas the hazards that affect engineering uses have been overcome, and the land type is used as sites for dwellings and light industries.

Maunabo Series

The Maunabo series consists of deep soils that are poorly drained and slowly permeable. These soils formed in fine-textured sediment derived from granitic rocks. They are on the river flood plains. Slopes are 0 to 2 percent. The climate is humid tropical. The average annual precipitation is 87 inches, and the average temperature is 79° F.

In a representative profile, the surface layer is light brownish-gray, mottled, strongly acid clay in the upper 4 inches and grayish-brown, mottled, very firm clay in the lower 6 inches. Below that is gray and greenish-gray, mottled clay and silty clay 29 inches thick. The underlying material is greenish-gray, very friable sandy loam that extends to a depth of 48 inches.

These soils are fertile and have a high available water capacity. Runoff is slow. The soils are difficult to work, and they have been in pasture and sugarcane for many years.

Representative profile of Maunabo clay 369 meters northeast of the intersection of Highway No. 905 and Highway No. 3:

Ap—0 to 4 inches, light brownish-gray (10YR 6/2) clay; few, fine, faint, strong-brown (7.5YR 5/6) mottles; massive; very firm, slightly sticky and plastic; common roots; few fine quartz grains; few, fine, black mineral grains; strongly acid; gradual, smooth boundary.

A12—4 to 10 inches, grayish-brown (10YR 5/2) clay; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; massive; very firm, slightly sticky and plastic; common roots; few fine pores; dark-colored old roots; small charcoal fragments; few, fine, black mineral grains; strongly acid; gradual, smooth boundary.

B1g—10 to 15 inches, gray (5Y 5/1) clay; common, medium, distinct, yellowish-red (5YR 5/8) mottles; weak, medium, subangular blocky structure; very firm, slightly sticky and plastic; common fine roots; dark coatings along root channels; few fine quartz grains; few, fine, black mineral grains; strongly acid; gradual, smooth boundary.

B2g—15 to 22 inches, gray (5Y 6/1) clay; common, medium, yellowish-brown (10YR 5/8) mottles; weak, coarse, subangular blocky structure; very firm, slightly sticky and plastic; dark coatings along root channels; fine roots; common fine pores; few fine quartz grains; strongly acid; gradual, smooth boundary.

B3g—22 to 39 inches, greenish-gray (5G 6/1) silty clay; many, medium, distinct, strong-brown (7.5YR 5/6) and dark-red (2.5YR 3/6) mottles; massive; very firm, slightly sticky and plastic; few roots; common fine quartz grains; common, fine, dark mineral grains; strongly acid; gradual, smooth boundary.

IICg—39 to 48 inches, greenish-gray (5BG 5/1) sandy loam; massive; very friable; many silvery flakes; strongly acid.

Thickness of the solum and depth to coarser textured material range from 28 to 50 inches. The Ap horizon has value of 5 or 6. The B horizon has hue of 5Y, 5G, or 5GY and value of 5 or 6. It has weak, medium or coarse, subangular blocky structure or is massive.

The Maunabo soils are on the same landscape as the Coloso, Talante, and Vivi soils. They are finer textured than all those soils. The Maunabo soils are more poorly drained and occupy lower positions than the Coloso soils. They are poorly drained, whereas the Vivi soils are well drained.

Me—Maunabo clay. This nearly level soil is on flood plains of the Maunabo and Guayanés Rivers. Included with it in mapping were small areas of Coloso and Talante soils.

This soil has severe limitations for farming because of poor drainage conditions. It requires a complex drainage system. Frequent flooding, slow permeability, and seasonal high water table are severe limitations for clean cultivation. These limitations require careful management and water control practices. Most areas of this soil are in sugarcane. If the soil is properly drained, it is suited to cultivated crops, sugarcane, and pasture. Capability unit IIIw–4.

Mayo Series

The Mayo series consists of deep soils that are well drained and rapidly permeable. These soils formed in coarse-textured sediment derived from plutonic rocks. They are on alluvial fans and terraces. Slopes are 3 to 10 percent. The climate is humid tropical. The average annual precipitation is 75 to 85 inches, and the average annual temperature is 77° to 80° F.

In a representative profile, the surface layer is very dark brown, very strongly acid loam about 8 inches thick. Below that is dark-brown and pale-brown, very friable and loose sandy loam and loamy sand that extends to a depth of 44 inches. It is underlain by brown, very friable sandy loam.

These soils have a low available water capacity and low shrink-swell potential. Runoff is medium. The soils are easily worked. They have been in sugarcane and pasture for many years; small areas are in food crops.

Representative profile of Mayo loam, 3 to 10 percent slopes, 4.2 kilometers north of the town of Yabucoa and 3.2 kilometers northwest of intersection of Highway No. 3, Este Soil Conservation District:

Ap—0 to 8 inches, very dark brown (10YR 2/2) loam; moderate, medium, granular structure; soft, very friable, nonsticky and nonplastic; common fine roots; very strongly acid; clear, smooth boundary.

B—8 to 18 inches, dark-brown (10YR 3/3) sandy loam; weak, fine, subangular blocky structure; soft, very friable, nonsticky and nonplastic; few fine roots; common fine quartz grains; common, fine, partly weathered feldspar grains; common, fine, black concretions; very strongly acid; clear, smooth boundary.

C1—18 to 27 inches, dark-brown (10YR 4/3) sandy loam; massive; soft, very friable, nonsticky and nonplastic; few fine roots; many fine quartz grains; common, fine, partly weathered feldspar grains; few, fine, black concretions; very strongly acid; gradual, smooth boundary.

IIC2—27 to 34 inches, pale-brown (10YR 6/3) loamy sand; massive; loose, nonsticky and nonplastic; many fine quartz grains; few, fine, shiny flakes; many, fine, dark grains; very strongly acid; abrupt, smooth boundary.

IIIC3—34 to 44 inches, pale-brown (10YR 6/3) loamy sand; massive; loose, nonsticky and nonplastic; many fine quartz grains; few, fine, dark grains; common, fine, partly weathered feldspar grains; very strongly acid; abrupt, smooth boundary.

IIIC4—44 to 60 inches, brown (10YR 5/3) sandy loam; massive; very friable, nonsticky and nonplastic; many fine quartz grains; common, fine, black grains; common, fine, partly weathered feldspar grains; few, fine, black, shiny and flaky grains; strongly acid.

The solum is 14 to 26 inches thick. The A horizon has chroma of 2 or 3 and ranges from sandy loam to loam. The B horizon has chroma of 3 or 4. The C horizon has value of 4, 5, or 6 and chroma of 3 or 4. The B and C horizons range from sandy loam to loam. Reaction ranges from strongly acid to very strongly acid.

The Mayo soils occupy the same landscape as the Pandura, Teja, Candelero, and Maunabo soils. They are deeper than the Pandura and Teja soils. The Mayo soils are better drained and coarser textured than the Candelero and Maunabo soils, and they are at a higher elevation than the Maunabo soils.

MlC—Mayo loam, 3 to 10 percent slopes. This soil is on alluvial fans and terraces along the Guayanes Valley. Included with it in mapping were small areas of Candelero soils.

This soil has moderate limitations for farming. If the soil is clean cultivated, conservation practices are needed to control erosion. The soil is easily worked, has a low available water capacity, and responds well to lime and fertilizer. It is suited to food crops, sugarcane, and pasture. Capability unit IIIe–10.

Meros Series

The Meros series consists of deep soils that are excessively drained and rapidly permeable. These soils formed in fine sandy sediment derived from sand-sized volcanic rock fragments, seashells, and coral. They are on benches along the coast slightly above sea level. Slopes are 1 to 6 percent. The climate is semiarid tropical. The average annual precipitation is 35 to 40 inches, and the average annual temperature is 79° F.

In a representative profile, the surface layer is very dark grayish-brown, neutral fine sand in the upper 8 inches and very dark brown fine sand in the lower 6 inches. The underlying material is very dark grayish-brown, dark yellowish-brown, black, and olive-brown, loose sand that extends to a depth of 60 inches.

These soils have a very low available water capacity and very low fertility. Runoff is slow. The soils have been in pasture and coconut trees for many years.

Representative profile of Meros sand, 1 to 6 percent slopes, 45 meters north of kilometer marker 93.8 on Highway No. 1:

A11—0 to 8 inches, very dark grayish-brown (10YR 3/2) fine sand; single grained; loose, nonsticky and nonplastic; many fine roots; common, fine, black minerals; neutral; clear, smooth boundary.

A12—8 to 14 inches, very dark brown (10YR 2/2) fine sand; single grained; loose, nonsticky and nonplastic; few fine roots; many, fine, black minerals; neutral; clear, smooth boundary.

C1—14 to 22 inches, very dark grayish-brown (2.5Y 3/2) fine sand; single grained; loose, nonsticky and nonplastic; few fine roots; neutral; clear, smooth boundary.

C2—22 to 40 inches, dark yellowish-brown (10YR 4/4) and black (10YR 2/1) sand; single grained; loose, nonsticky and nonplastic; mildly alkaline; clear, smooth boundary.

C3—40 to 50 inches, olive-brown (2.5Y 4/4) sand; single grained; loose, nonsticky and nonplastic; mildly alkaline; clear, smooth boundary.

C4—50 to 60 inches, very dark grayish-brown (2.5Y 3/2) sand; single grained; loose, nonsticky and nonplastic; moderately alkaline.

The A horizon is 12 to 20 inches thick. It has value and chroma of 2 or 3. The C horizon has hue of 10YR to 2.5Y, value of 3 or 4, and chroma of 2 to 4. Reaction ranges from neutral to moderately alkaline.

The Meros soils are on the same landscape as Coastal beaches and Tidal flats. Coastal beaches consist of miscellaneous sandy material that has been reworked by wave action. Tidal flats consist of miscellaneous materials that are covered by seawater of high tide.

MrB—Meros sand, 1 to 6 percent slopes. This soil is along the coast at an elevation in the semiarid area. Included with it in mapping were small areas of Coastal beaches and Tidal flats.

This soil is not suited to cultivated crops. Low available water capacity, very low fertility, and rapid permeability are severe limitations, and rainfall is low. The soil is suitable for pasture, coconut trees, and wildlife food and cover. Capability unit VIIs–7.

Mucara Series

The Mucara series consists of moderately deep soils that are well drained and moderately permeable. These soils formed in residuum derived from basic volcanic rocks. They are on side slopes and ridgetops of strongly dissected volcanic uplands. Slopes are 12 to 40 percent. The climate is humid tropical. The average annual precipitation is 75 to 80 inches, and the average annual temperature is 76° F.

In a representative profile, the surface layer is very dark grayish-brown, medium acid silty clay loam about 6 inches thick. Below that layer is very dark grayish-brown and yellowish-brown, firm silty clay 7 inches thick. The next layer is light olive-brown, firm silty clay loam that extends to a depth of 32 inches. It is underlain by semiconsolidated volcanic rock.

These soils are fertile and have high available water capacity and moderate shrink-swell potential. Runoff is medium to rapid. The soils are somewhat difficult to work. They have been used mainly for pasture, coffee trees, and food crops, but some areas are in sugarcane.

Representative profile of Mucara silty clay loam, 20 to 40 percent slopes, eroded, 45 meters southwest of kilometer marker 1.2 on Highway No. 449, Ward Paso Seco, Naguabo:

A1—0 to 6 inches, very dark grayish-brown (10YR 3/2) silty clay loam; weak, fine, subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common fine roots; few fine pores; common fine rock fragments; few worm casts; medium acid; abrupt, smooth boundary.

B2—6 to 9 inches, very dark grayish-brown (10YR 3/2) silty clay, inside color of peds is very dark grayish-brown (2.5Y 3/2); weak, medium, subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few fine roots; few fine pores; few patchy clay films along cleavage planes; common, fine, angular rock fragments; few worm casts; medium acid; clear, smooth boundary.

B3—9 to 13 inches, yellowish-brown (10YR 5/4) silty clay; weak, medium, subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few dead roots; common, fine, weathered rock fragments; few dark minerals; few patchy clay films along cleavage planes; root channels coated with dark brown (10YR 3/3); medium acid; clear, smooth boundary.

C1—13 to 18 inches, light olive-brown (2.5Y 5/4), crushed, sticky and slightly plastic; common dark minerals; common, fine, dead roots; few fine pores; many fine rock fragments weathered in place; medium acid; gradual, smooth boundary.

C2—18 to 32 inches, pale-yellow (2.5Y 7/4) clay loam; massive; hard, firm, slightly sticky and slightly plastic; most of this horizon is saprolite; common dark minerals; slightly acid; gradual, wavy boundary.

R—32 inches, semiconsolidated volcanic rock.

The solum is 10 to 20 inches thick. The A horizon has hue of 10YR or 2.5Y and chroma of 2 or 3. The B horizon

has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 2 to 4. It is silty clay or clay and has weak, medium or coarse, subangular blocky structure. Reaction is slightly acid or medium acid.

The Mucara soils occupy the same landscape as the Caguabo, Sabana, Naranjito, and Humatas soils. The Mucara soils are deeper to rock than the Caguabo and Sabana soils, and they have a thicker solum than the Caguabo soils. They lack red colors and are less acid than the Naranjito and Humatas soils, and they are shallower than the Humatas soils.

MuD2—Mucara silty clay loam, 12 to 20 percent slopes, eroded. This soil is on side slopes in the humid volcanic uplands. It has a thicker surface layer than the soil described as representative of the Mucara series. Erosion has removed some of the original surface layer of this soil, and in places that have been cultivated intensely, plowing has mixed the remaining part of that layer with some of the subsoil. Small rills and shallow gullies are common. Included with this soil in mapping were small areas of Caguabo, Naranjito, and Sabana soils and Rock land.

Slope, medium runoff, the hazard of erosion, and depth to rock are severe limitations for farming. This soil is somewhat difficult to work, and it requires very careful management if it is clean cultivated. It has been used for food crops, coffee trees, and native pasture. Capability unit IVe–6; woodland suitability group 3d5.

MuE2—Mucara silty clay loam, 20 to 40 percent slopes, eroded. This soil is on side slopes and ridgetops in the humid volcanic uplands. It has the profile described as representative of the series. As a result of past cultivation, erosion has removed part of the original surface layer, and in some places the yellowish-brown subsoil is exposed. Included with this soil in mapping were areas of Caguabo and Sabana soils and Rock land.

This soil is not suited to clean-cultivated crops. Slopes, rapid runoff, depth to volcanic rock, and the hazard of erosion are severe limitations for farming. This soil has been cultivated occasionally to pigeonpeas, tobacco, and food crops. It is better suited to pasture and woodland than to most other uses. Capability unit VIe–4; woodland suitability group 3d5.

Naranjito Series

The Naranjito series consists of moderately deep soils that are well drained and moderately permeable. These soils formed in moderately fine textured residuum weathered from volcanic rocks. They are in strongly dissected volcanic uplands. Slopes are 20 to 60 percent. The climate is humid tropical. The average annual precipitation is 75 to 100 inches, and the average annual temperature is 79° F.

In a representative profile, the surface layer is dark-brown, extremely acid silty clay loam about 7 inches thick. Below that is yellowish-red, yellowish-brown, red, and light olive-brown clay and clay loam. Hard rock is at a depth of 38 inches.

These soils have a high available water capacity, moderate shrink-swell potential, and medium fertility. Runoff is rapid to very rapid, and the soils are susceptible to erosion. They have been in food crops and pasture for many years.

Representative profile of Naranjito silty clay loam, 20 to 40 percent slopes, eroded, 1.6 kilometers east from junction of Highway No. 924 and Highway No. 927 and 450 meters northwest from Highway No. 927, Ward Mambiche, Humacao:

Ap—0 to 7 inches, dark-brown (10YR 3/3) silty clay loam; weak, fine, subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; common roots; thin clay films on root channels; few ¼- to 1-inch volcanic rock fragments; extremely acid; clear, smooth boundary.

B21t—7 to 20 inches, yellowish-red (5YR 4/6) clay; weak, fine, subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; thin, patchy, dark-brown (10YR 3/3) clay films; few krotovinas; many, angular, ⅛- to 2-inch volcanic rock fragments; very strongly acid; gradual, smooth boundary.

B22t—20 to 30 inches, yellowish-red (5YR 4/6, 5YR 4/8) and yellowish-brown (10YR 5/4) clay; weak, fine, subangular blocky structure; very hard, firm, slightly sticky and plastic; thin dark-brown (10YR 3/3) clay films; few krotovinas; thin clay films along root channels and worm holes; many, angular, ⅛- to 2-inch volcanic rock fragments; about 40 percent, by volume, is saprolite; very strongly acid; gradual, smooth boundary.

C—30 to 38 inches, yellowish-red (5YR 4/6), red (2.5YR 4/6), and light olive-brown (2.5Y 5/4) clay loam; weak, fine, subangular blocky structure; hard, firm, slightly sticky and plastic; common, fine, dark concretions; many, angular, ⅛- to 3-inch rock fragments; about 40 percent is saprolite; very strongly acid; abrupt, smooth boundary.

R—38 inches, semiconsolidated volcanic rock.

The solum is 23 to 40 inches thick. The Ap horizon has chroma of 3 or 4. The B horizon has hue of 5YR or 2.5YR, value of 4 or 5, and chroma of 6 to 8. Rock fragments scattered throughout the profile range from few to many and from ⅛ inch to 3 inches in size. Reaction ranges from extremely acid to strongly acid.

The Naranjito soils are on the same landscape as the Caguabo, Sabana, Mucara, and Humatas soils. The Naranjito soils are deeper and more acid than the Caguabo soils. They are deeper to semiconsolidated rock than the Sabana soils and are more acid than the Mucara soils. The Naranjito soils are shallower to rock than the Humatas soils.

NaE2—Naranjito silty clay loam, 20 to 40 percent slopes, eroded. This soil is on side slopes in the humid uplands. It has the profile described as representative of the series. As a result of past cultivation, most of the original surface layer has been removed by erosion. Included with this soil in mapping were small areas of Mucara, Caguabo, and Humatas soils.

This soil is used occasionally for cultivated crops. Steep slopes, the hazard of erosion, and rapid runoff are severe limitations that make the soil unsuited to cultivated crops, however, and limit its use to pasture and woodland. Capability unit VIe–1; woodland suitability group 2c5.

NaF2—Naranjito silty clay loam, 40 to 60 percent slopes, eroded. This soil is on mountain side slopes and ridgetops in the humid volcanic uplands. It has a thinner surface layer than the soil described as representative of the series. Included with this soil in mapping were small areas of Mucara, Caguabo, and Humatas soils.

Very steep slopes, the hazard of erosion, and very rapid runoff are severe limitations for clean-cultivated crops. This soil is suitable for pasture, woodland, and wildlife food and cover. Capability unit VIIe–1; woodland suitability group 3r5.

Pandura Series

The Pandura series consists of moderately deep soils that are well drained and have moderately rapid permeability. These soils formed in residuum derived from partly weathered plutonic rocks, mainly quartz diorite and granodiorite. They are on side slopes of dissected uplands. Slopes range from 12 to 60 percent. The climate is humid tropical. The average annual precipitation is 75 to 85 inches, and the average annual temperature is 78° F.

In a representative profile, the surface layer is dark-brown, strongly acid loam about 3 inches thick. The next layer is dark grayish-brown, friable loam 4 inches thick. Below that is light olive-brown, friable sandy loam that extends to a depth of 19 inches. It is underlain by partly weathered rock.

These soils have a low available water capacity. Runoff is medium to very rapid, and the soils are highly susceptible to erosion. Most of the acreage is in pasture and brush, but some areas are in food crops.

Representative profile of Pandura loam, 12 to 40 percent slopes, eroded, 45 meters northeast of kilometer marker 23.9 on Highway No. 181:

Ap—0 to 3 inches, dark-brown (10YR 3/3) loam; weak, fine, granular structure; friable, slightly sticky and slightly plastic; many fine roots; many fine quartz grains; many worm casts; strongly acid; clear, smooth boundary.

B2—3 to 7 inches, dark grayish-brown (10YR 4/2) loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; many fine roots; thin patchy clay films on ped surfaces; many fine quartz grains; many worm casts; many, fine, dark-colored, highly weathered minerals; strongly acid; gradual, smooth boundary.

C1—7 to 15 inches, light olive-brown (2.5Y 5/4) sandy loam; massive; friable, nonsticky and nonplastic; few fine roots; many fine quartz grains; medium acid; gradual, wavy boundary.

C2—15 to 19 inches, light olive-brown (2.5Y 5/4) sandy loam; massive; friable, nonsticky and nonplastic; very few fine roots; slightly acid; gradual, wavy boundary.

C3—19 to 35 inches, partly weathered rock.

The solum is 6 to 14 inches thick. The A horizon has hue of 10YR, value of 2 or 3, and chroma of 2 or 3. The B horizon has hue of 10YR, value of 3 or 4, and chroma of 2 to 4. It ranges from loam to sandy loam and has weak subangular blocky to weak granular structure. The C horizon has hue of 2.5Y, value of 5 or 6, and chroma of 2 to 4. It ranges from strongly acid to slightly acid.

The Pandura soils are on the same landscape as the Teja, Mayo, Limones, Ingenio, Lirios, and Jagueyes soils. Pandura soils are finer textured and deeper to granitic rocks than Teja soils, and, unlike those soils, they have a B horizon. They are shallower and have a thinner solum than the Mayo soils. The Pandura soils are shallower and coarser textured than the Limones, Ingenio, Lirios, and Jagueyes soils; they have a thinner solum than all those soils and lack their red colors.

PaE2—Pandura loam, 12 to 40 percent slopes, eroded. This soil is on the sides and tops of ridges in the west-central part of the survey area. It has the profile described as representative of the Pandura series. Erosion has removed most of the original surface layer, and where the soil is clean cultivated, tillage has mixed the remaining part of that layer with some of the subsoil. In some areas the subsoil is exposed. Included with this soil in mapping were small areas of Teja, Lirios, Jagueyes, and Ingenio soils.

Slope, shallowness, and the hazard of erosion are severe limitations for cultivated crops. This soil is occasionally used for food crops, and it has been in pasture. It is better suited to pasture, woodland, and wildlife food and cover than to most other uses. Capability unit VIe–3; woodland suitability group 2o5.

PaF2—Pandura loam, 40 to 60 percent slopes, eroded. This soil is on side slopes and ridgetops in highly dissected, humid uplands. It has a thinner surface layer than the soil described as representative of the Pandura series. Most of the original surface layer has been removed by erosion, and in some areas the subsoil is exposed. Small areas of Teja and Lirios soils and Rock land were included with this soil in mapping.

This soil is not suited to clean-cultivated crops, and it has severe limitations for cultivated crops because it is steep, shallow, and susceptible to erosion. Proper management and conservation practices are required if this soil is cultivated. This soil has been in pasture and brush. It is better suited to pasture, woodland, and wildlife food and cover than to most other uses. Capability unit VIIe–2; woodland suitability group 3r5.

PdF—Pandura-Very stony land complex, 40 to 60 percent slopes. This mapping unit is on side slopes and ridgetops in the humid granitic uplands. It consists of Pandura soils and Very stony land in such intricate patterns that they cannot be shown separately at the scale used in mapping. The Pandura soils make up about 30 to 40 percent of the mapping unit, and Very stony land 40 to 50 percent. The remaining area consists of soils that are too variable to be classified.

The soils of this mapping unit are not suited to clean-cultivated crops, and because they are steep, rocky, and shallow, they have severe limitations for cultivated crops. They are suitable for pasture and wildlife food and cover. Capability unit VIIs–5; woodland suitability group 4d5.

Parcelas Series

The Parcelas series consists of deep, moderately well drained soils that have moderately slow permeability. These soils formed in fine-textured sediment derived from plutonic materials. They are on foot slopes, alluvial fans, and terraces. Slopes are 5 to 12 percent. The climate is humid tropical. The average annual precipitation is 80 to 90 inches, and the average annual temperature is 77° F.

In a representative profile, the surface layer is dark-brown, extremely acid clay about 7 inches thick. Below that is dark reddish-brown and dark-brown, firm clay 24 inches thick. The underlying material is yellowish-brown clay and clay loam that extends to a depth of 60 inches.

These soils have a high available water capacity and high shrink-swell potential. Runoff is medium. The soils are difficult to work and are susceptible to erosion. Most areas have been in sugarcane and pasture, but some areas are in food crops.

Representative profile of Parcelas clay, 5 to 12 percent slopes, eroded, 300 meters south of kilometer marker 3.6 on Highway No. 901, Barrio Nuevo, municipality of Yabucoa:

Ap—0 to 7 inches, dark-brown (7.5YR 3/2) clay; weak,

fine, subangular blocky structure; firm, slightly sticky and plastic; many fine roots; extremely acid; clear, wavy boundary.

B1—7 to 17 inches, dark reddish-brown (5YR 3/3) clay; weak, medium, subangular blocky structure; firm, sticky and plastic; common fine roots; extremely acid; clear, smooth boundary.

B2—17 to 31 inches, dark-brown (7.5YR 4/4) clay; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; weak, medium, subangular blocky structure; firm, sticky and plastic; few fine roots; few small slickensides and pressure faces; extremely acid; clear, smooth boundary.

C1—31 to 44 inches, yellowish-brown (10YR 5/6) clay; massive; firm, slightly sticky and plastic; very fine roots; few small slickensides and pressure faces; strongly acid; clear, smooth boundary.

C2—44 to 60 inches, yellowish-brown (10YR 5/8) clay loam; massive; friable, slightly sticky and plastic; strongly acid.

The solum is 22 to 37 inches thick. The Ap horizon has hue of 7.5YR or 10YR and value and chroma of 2 or 3. The B horizon has hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 4 or higher. It has weak, medium or coarse subangular blocky structure. The C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8. Slickensides and pressure faces range from few to common. Reaction ranges from strongly acid to extremely acid.

The Parcelas soils occupy the same landscape as the Mayo, Pandura, Teja, and Candelero soils. The Parcelas soils are finer textured than the Mayo and Pandura soils, and unlike the Pandura soils, they have slickensides and pressure faces. They are on lower slopes and are deeper than the Teja soils. The Parcelas soils are better drained than the Candelero soils, and they have pressure faces and slickensides.

PeC2—Parcelas clay, 5 to 12 percent slopes, eroded. This soil is on foot slopes and terraces. Erosion has removed some of the original surface layer, and where the soil is cultivated, the plow layer is a mixture of the remaining dark-brown surface layer and the reddish-brown subsoil. Included with this soil in mapping were small areas of Candelero and Mayo soils.

This soil has moderate limitations for clean-cultivated crops because of slope, drainage, the hazard of erosion, and high clay content. If the soil is clean cultivated, careful management and conservation practices are required. If it is properly drained and limed, the soil is suited to sugarcane, pasture, cut grasses, and food crops. Capability unit IIIe–7.

Paso Seco Series

The Paso Seco series consists of deep soils that are moderately well drained and slowly permeable. These soils formed in fine-textured sediment of mixed origin that overlies gravelly, medium-textured sediment. They are on terraces and alluvial fans on the coastal plains. Slopes are 0 to 5 percent. The climate is semiarid tropical. The average annual precipitation is 30 to 40 inches, and the average annual temperature is 79° F.

In a representative profile, the surface layer is dark-brown, neutral or mildly alkaline clay about 13 inches thick. The next layer is brown to dark-brown, firm clay 6 inches thick. It is underlain by brown to dark-brown gravelly clay and gravelly loam that extends to a depth of 50 inches.

These soils have a high available water capacity and high shrink-swell potential and are difficult to work. They have been mainly in sugarcane, pasture, and brush, but some areas are in cut grasses.

Representative profile of Paso Seco clay, 0 to 5 percent slopes, 9 meters north of farm road that borders the main irrigation canal, 0.2 kilometer west of Colonia house, and 0.9 kilometer south of Highway No. 3 at kilometer marker 185.2, Colonia Sabater, Aguirre:

Ap—0 to 5 inches, dark-brown (7.5YR 3/2) clay; weak, fine. subangular blocky structure; friable, slightly sticky and slightly plastic; few roots; common pebbles; few black minerals; neutral; gradual, smooth boundary.

A12—5 to 13 inches, dark-brown (7.5YR 3/2) clay; weak, medium, subangular blocky structure; firm, slightly sticky and plastic; few pores; few roots; common pressure faces; few black stains along root channels and ped surfaces; common pebbles; few, small, soft, black concretions; mildly alkaline; abrupt, wavy boundary.

C1—13 to 19 inches, brown to dark-brown (7.5YR 4/4) clay; weak, medium, angular blocky structure; firm, slightly sticky and plastic; very dark grayish-brown coatings along root channels and ped surfaces; common slickensides and pressure faces; mildly alkaline; clear, wavy boundary.

C2—19 to 38 inches, brown to dark-brown (7.5YR 4/4) gravelly clay; massive; firm, slightly sticky and plastic; mildly alkaline; clear, wavy boundary.

IIC3—38 to 50 inches, brown to dark-brown (10YR 4/3) gravelly loam; massive; friable, nonsticky and nonplastic; neutral.

The A horizon is 8 to 18 inches thick. It has hue of 10YR or 7.5YR and value and chroma of 2 or 3. The C horizon has hue of 10YR or 7.5YR and value and chroma of 3 or 4. Slickensides are common or many. Depth to gravelly horizons is 20 to 37 inches. Reaction is neutral to mildly alkaline.

The Paso Seco soils are on the same landscape as the Fraternidad, Jacana, Amelia, and Coamo soils. The Paso Seco soils are shallower to gravelly horizons than the Fraternidad soils. Unlike the Jacana soils, they lack a B horizon and are not underlain by volcanic rocks. The Paso Seco soils are neutral to mildly alkaline, whereas the Amelia soils are neutral to medium acid. Unlike the Coamo soils, the Paso Seco soils lack a B2t horizon and have pressure faces and slickensides.

PlB—Paso Seco clay, 0 to 5 percent slopes. This soil is on terraces and alluvial fans in the semiarid part of the survey area. Included with it in mapping were small areas of Fraternidad and Amelia soils.

The soil's high shrink-swell potential and poor workability are limitations for farming, and the climate in the area is adverse. This soil commonly has been used for pasture. If irrigated, the soil is suited to sugarcane, pasture, and cut grasses. Capability units IIIc–1 nonirrigated and IIs–1 irrigated.

Patillas Series

The Patillas series consists of deep soils that are well drained and moderately permeable. These soils formed in residuum that weathered from intrusive volcanic rocks. They are on side slopes in dissected uplands. Slopes are 12 to 40 percent. The climate is humid tropical. The average annual precipitation is 60 to 70 inches, and the average annual temperature is 79° F.

In a representative profile, the surface layer is dark-brown, strongly acid clay loam about 8 inches thick. The next layer is reddish-brown, friable clay loam that extends to a depth of 19 inches. Below that is yellowish-red sandy loam saprolite.

These soils have a moderate available water capacity. Runoff is medium to rapid, and the soils are susceptible

to erosion. They have been used for pasture and food crops for many years, and some areas are used for sugarcane.

Representative profile of Patillas clay loam, 20 to 40 percent slopes, eroded, 1.8 kilometers east from kilometer marker 162.2 on Highway No. 3 and 1.25 kilometers southeast from Highway 757, in the vicinity of Patillas:

A1—0 to 8 inches, dark-brown (10YR 3/3) clay loam; weak, fine, subangular blocky structure parting to moderate, medium, granular; friable, nonsticky and slightly plastic; common fine roots; few fine pores; few, fine, black minerals; few fine quartz crystals; common, fine, subrounded rock fragments; strongly acid; clear, smooth boundary.

B2t—8 to 19 inches, reddish-brown (5YR 4/4) clay loam; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; few fine roots; common fine pores; thin patchy clay films; few fine quartz grains; common, fine, subrounded rock fragments; few weathered feldspar fragments; strongly acid; clear, wavy boundary.

C—19 to 48 inches, yellowish-red (5YR 4/6) sandy loam; massive; friable, nonsticky and nonplastic; coatings of finer textured material from B2t horizon on fracture planes; very strongly acid; this horizon consists of weathered plutonic rock (saprolite).

The solum is 15 to 24 inches thick. The A horizon has hue of 10YR or 7.5YR and value and chroma of 3 or 4. The B2t horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. It ranges from silty clay loam to clay loam and has weak, fine or medium, subangular blocky structure. The C horizon has hue of 7.5YR or 5YR and value and chroma of 4 to 6. It is sandy loam or loamy sand. Quartz crystals vary from few to common. Reaction is strongly acid or very strongly acid.

The Patillas soils are on the same landscape as the Limones, Pandura, and Lirios soils. The Patillas soils are coarser textured and have a thinner solum than the Limones soils. They are finer textured than the Pandura soils, and unlike those soils, they have a B2t horizon. They have a thinner solum than the Lirios soils.

PmD2—Patillas clay loam, 12 to 20 percent slopes, eroded. This soil is on side slopes in the humid plutonic uplands. It has a thicker surface layer than the soil described as representative of the Patillas series. Because this soil has been used intensively for food crops and tobacco, most of its surface layer has been eroded, and in some areas the reddish-brown subsoil is exposed. Included with this soil in mapping were small areas of Pandura, Limones, and Lirios soils.

Slope and the hazard of erosion are severe limitations for farming. This soil is used occasionally for cultivated crops and has been used for pasture and food crops for many years. Good management and conservation practices are needed if the soil is cultivated. If it is properly limed and managed, the soil is suited to sugarcane, food crops, pasture, and woodland. Capability unit IVe–7; woodland suitability group 2o5.

PmE2—Patillas clay loam, 20 to 40 percent slopes, eroded. This soil is on side slopes in the humid uplands. It has the profile described as representative of the series. Included with this soil in mapping were small areas of Pandura and Lirios soils and Rock land.

Slope and the hazard of erosion are severe limitations for clean cultivation. Conservation practices are needed if the soil is cultivated. This soil has been used for food crops, tobacco, and pasture for many years. It is better suited to pasture and woodland than to most other uses. Capability unit VIe–3; woodland suitability group 2o5.

Picacho Series

The Picacho series consists of deep, moderately well drained soils that have moderately slow permeability. These soils formed in fine textured and moderately fine textured residuum that weathered from igneous rocks. They are on upper side slopes and ridgetops in the humid uplands. Slopes range from 20 to 50 percent. The average annual precipitation is 185 inches, and the average annual temperature is 72° F.

In a representative profile, the surface layer is dark yellowish-brown, very strongly acid silty clay loam about 9 inches thick. Below that layer is yellowish-brown and strong-brown, mottled clay that is very strongly acid and firm and extends to a depth of 28 inches. The next layer is reddish-yellow, very strongly acid, firm clay 7 inches thick. The upper part of the underlying material is yellowish-red, very strongly acid, friable clay loam and silty clay loam that extends to a depth of 65 inches. The lower part is saprolite of variegated colors that extends to a depth of more than 72 inches.

These soils have a moderate available water capacity and medium fertility. Runoff is medium to rapid. The soils have been in hardwood trees and tree ferns for many years.

In this survey area, Picacho soils are mapped only in associations with Guayabota and Ciales soils and with Utuado soils and Stony rock land.

Representative profile of Picacho silty clay loam, 20 to 40 percent slopes, in an area of the Guayabota-Ciales-Picacho association, very steep, 42 meters south and 17 meters east of kilometer marker 15.7 on Highway No. 191:

A1—0 to 9 inches, dark yellowish-brown (10YR 4/4) silty clay loam; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; many fine to coarse roots; few fine pores; common, fine, silvery flakes; few, fine, dark minerals and quartz grains; very strongly acid; clear, smooth boundary.

B21t—9 to 19 inches, yellowish-brown (10YR 5/4) clay; common, fine, distinct, gray and yellowish-red mottles; weak, coarse and medium, subangular blocky structure; firm, slightly sticky and slightly plastic; few fine pores coated with brown; thin patchy clay films on ped surfaces and in root channels; few krotovinas, ⅜ inch in diameter; common fine quartz grains; few, fine, dark minerals and silvery flakes; very strongly acid; clear, wavy boundary.

B22t—19 to 28 inches, strong-brown (7.5YR 5/8) clay; common. fine, distinct, olive-gray mottles; weak, coarse and medium, subangular blocky structure; firm, slightly sticky and plastic; few fine and medium roots; few fine pores; thin patchy clay films on ped surfaces and in root channels; many coated quartz grains; common, fine, dark minerals; few, fine, silvery flakes; few krotovinas; very strongly acid; gradual, smooth boundary.

B3—28 to 35 inches, reddish-yellow (7.5YR 6/8) clay; weak, fine and medium, subangular blocky structure; firm, slightly sticky and plastic; few fine pores; thin patchy clay films on ped surfaces and in root channels; common fine quartz grains and silvery flakes; few krotovinas; very strongly acid; clear, smooth boundary.

C1—35 to 48 inches, yellowish-red (5YR 5/6) clay loam; weak, coarse and medium, subangular blocky structure; friable, nonsticky and slightly plastic; few fine roots; few fine pores coated with dark material; many silvery flakes and coated quartz grains; very strongly acid; clear, smooth boundary.

C2—48 to 65 inches, yellowish-red (5YR 4/6) silty clay

loam; few, fine, faint, red mottles; weak, coarse, subangular blocky structure; friable, nonsticky and slightly plastic; few fine roots; few fine pores; many silvery flakes; many fine quartz grains; few, fine, dark minerals; very strongly acid; gradual, smooth boundary.

C3—65 to 72 inches +, mottled very pale brown (10YR 8/3), reddish-yellow (7.5YR 6/8, 5YR 6/8), and red (10YR 4/8) loam saprolite; massive; very friable, nonsticky and nonplastic; many silvery flakes and quartz grains; very strongly acid.

The solum is 26 to 46 inches thick. The A horizon has hue of 10YR or 7.5YR and value and chroma of 3 or 4. It is clay loam, silty clay loam, or clay. The B horizon has dominant hue of 10YR, 7.5YR, or 5YR, value of 4 to 6, and chroma of 4 to 8. It is clay or silty clay. Gray mottles are common in the upper part of the B horizon but decrease as depth increases. The B2t horizon has weak or moderate, medium or coarse, subangular blocky structure. The C horizon is loam, clay loam, or silty clay loam. The C1 and C2 horizons have hue of 5YR or 2.5YR, value of 4 to 6, and chroma of 4 to 8. The C3 horizon has variegated colors of the saprolite. Reaction is very strongly acid or extremely acid throughout the profile.

The Picacho soils are on the same landscape as the Los Guineos, Ciales, Guayabota, and Utuado soils. Unlike the Los Guineos soils, the Picacho soils have low-chroma mottles in the B2t horizon. Unlike the Ciales soils, they lack dominant gray colors in the B2t horizon. The Picacho soils are deeper than the Guayabota soils and finer textured than the Utuado soils, and they have a B2t horizon that those soils lack.

Pinones Series

The Pinones series consists of deep soils that are poorly drained and very slowly permeable. These soils formed in fine-textured sediment of mineral origin that overlies decomposed and partly decomposed organic layers. They are on coastal lowlands. Slopes are 0 to 2 percent. The climate is humid tropical. The average annual precipitation is 80 to 90 inches, and the average temperature is 78° F.

In a representative profile, the surface layer is very dark grayish-brown, very strongly acid silty clay about 4 inches thick. The next layer is dark-gray, mottled, firm silty clay 14 inches thick. The underlying material is dark reddish-brown organic materials that extend to a depth of 58 inches.

These soils have a high available water capacity, high natural fertility and high shrink-swell potential. They are difficult to work, and most of the acreage is in sugarcane, pasture, and cut grasses.

Representative profile of Pinones silty clay, 1 mile northeast of Central Pasto Viejo, 100 feet west of main farm road on unimproved secondary road, and 30 feet north of unimproved road:

AP—0 to 4 inches, very dark grayish-brown (10YR 3/2) silty clay; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; weak, fine, subangular blocky structure; friable, slightly sticky and plastic; many fine roots; very strongly acid; abrupt, smooth boundary.

B21—4 to 13 inches, dark-gray (10YR 4/1) silty clay; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; firm, slightly sticky and plastic; common fine roots; very strongly acid; clear, smooth boundary.

B22—13 to 18 inches, dark-gray (10YR 4/1) silty clay; many, coarse, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; firm, slightly sticky and plastic; few fine roots; very strongly acid; clear, smooth boundary.

IIC—18 to 58 inches, dark reddish-brown (5YR 3/2), very strongly acid organic materials consisting of well-decomposed muck.

Thickness of the solum and depth to organic material range from 15 to 30 inches. The A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 3 or less. The B horizon has hue of 10YR or 5Y, value of 4 to 6, and chroma of 1 or less. It is silty clay or clay and has weak, medium or coarse, subangular blocky structure. Yellowish-brown or strong-brown mottles are common or many. Reaction is strongly acid or very strongly acid.

The Pinones soils are on the same landscape as the Maunabo, Coloso, and Fortuna soils. Unlike all those soils, the Pinones soils have an organic layer. They are more poorly drained and more acid than the Coloso soils.

Pn—Pinones silty clay. This nearly level soil is on coastal lowlands. Included with it in mapping were areas of Tidal swamp.

Poor drainage, frequent flooding, and a seasonal high water table are severe limitations for farming. Careful management and drainage can help overcome these limitations. This soil has been used for sugarcane and pasture. If it is properly drained, it is suited to cultivated crops, sugarcane, pasture, and cut grasses. Capability unit IVw–1.

Poncena Series

The Poncena series consists of deep soils that are moderately well drained, calcareous, and slowly permeable. These soils formed in fine-textured sediment derived from volcanic rocks and limestone. They are on terraces and alluvial fans. Slopes are 0 to 2 percent. The climate is semiarid tropical. The average annual precipitation is 35 to 50 inches, and the average annual temperature is 79° F. Depth to the water table ranges from 30 to 60 inches.

In a representative profile, the surface layer is about 7 inches thick. In the upper part it is very dark clay, and in the lower part it is dark-gray, mottled clay. Below this layer is dark-gray and dark greenish-gray, firm, mottled clay that extends to a depth of 41 inches.

These soils have a high available water capacity and high shrink-swell potential. Runoff is medium. The soils are fertile but difficult to work. Most of the acreage is used for sugarcane and pasture.

Representative profile of Poncena clay, 0.5 kilometer south of kilometer marker 163.0 on Highway No. 3, near the town of Salinas:

Ap—0 to 2 inches, very dark gray (10YR 3/1) clay; weak, fine, granular structure; friable, slightly sticky and slightly plastic; many fine roots; few fine volcanic pebbles; few sea shells; calcareous; clear, smooth boundary.

AC—2 to 7 inches, dark-gray (5Y 4/1) clay; common, fine, distinct, brown to dark-brown (7.5YR 4/4) mottles; weak, medium, subangular blocky structure; firm, slightly sticky and slightly plastic; common roots; few pressure faces; few fine volcanic pebbles; limestone fragments; few sea shells; calcareous; clear, smooth boundary.

C1—7 to 14 inches, dark-gray (5Y 4/1) clay; many, medium, distinct, brown to dark-brown (7.5YR 4/4) mottles and few, fine, distinct, gray (5Y 5/1) mottles; massive; firm, slightly sticky and plastic; few roots; many fine volcanic pebbles; calcareous; clear, smooth boundary.

C2g—14 to 25 inches, dark greenish-gray (5GY 4/1) clay; common, fine, distinct, brown to dark-brown (10YR 4/3) mottles; massive; firm, slightly sticky and plastic; few pressure faces and slickensides; com-

mon lime splotches; common sea shell fragments; calcareous; clear, smooth boundary.

C3g—25 to 41 inches, dark-gray (5Y 4/1) clay; common, medium, distinct, olive-brown (2.5Y 4/4) and greenish-gray (5G 5/1) mottles; massive; firm, slightly sticky and plastic; common seashell fragments; few volcanic pebbles; common lime splotches; calcareous.

The A horizon is 2 to 12 inches thick. The C horizon has hue of 10YR, 5Y, 5GY, or 2.5Y, value of 3 to 5, and chroma of 1 or 2. Mottles are few or common and fine or medium-sized and are in shades of brown, dark brown, olive brown, greenish gray, and gray. Reaction is neutral to strongly acid.

The Poncena soils occupy the same landscape as the Vayas and Cartagena soils. They are better drained than the Vayas soils, and unlike those soils, they have pressure faces and slickensides. The Poncena soils are better drained and have lower chroma than the Cartagena soils.

Po—Poncena clay. This nearly level soil is on coastal plains in the semiarid part of the survey area. Included with it in mapping were areas of Cartagena and Vayas soils.

Low rainfall in the area and the soil's slow permeability, high shrink-swell potential, and seasonal high water table are severe limitations for farming. This soil has been used for sugarcane. If drained, irrigated, and properly managed, it is suited to cultivated crops, sugarcane, and pasture. Capability units IIIc–1 nonirrigated and IIs–1 irrigated.

Pozo Blanco Series

The Pozo Blanco series consists of deep soils that are well drained and moderately permeable. These soils formed in medium-textured to moderately fine textured sediment derived from limestone or residuum weathered from volcanic rocks. They are on foot slopes and, to a minor extent, in the residual uplands. Slopes are 5 to 12 percent. The climate is semiarid. The average annual rainfall is 35 to 45 inches, and the average annual temperature is 79° F.

In a representative profile, the surface layer is very dark grayish-brown, mildly alkaline clay loam about 7 inches thick. The next layer is brown clay loam 8 inches thick. Below that is pink, friable, very strongly alkaline silt loam 12 inches thick. That layer is underlain by very pale brown, friable, strongly alkaline silt loam and gravelly clay loam that extends to a depth of 58 inches.

These soils have a moderate available water capacity, medium natural fertility, and moderate shrink-swell potential. Most of the acreage is used for sugarcane and pasture.

Representative profile of Pozo Blanco clay loam, 5 to 12 percent slopes, eroded, 525 meters southwest from a gas station at north entrance of Central Aguirre, Salinas:

A1—0 to 7 inches, very dark grayish-brown (10YR 3/2) clay loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common rock fragments 1 to 5 millimeters in diameter; mildly alkaline; abrupt, smooth boundary.

B—7 to 15 inches, brown (7.5YR 5/4) clay loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common rock fragments 2 to 10 millimeters in diameter; moderately alkaline; clear, smooth boundary.

C1ca—15 to 27 inches, pink (7.5YR 8/4) silt loam; massive; friable, nonsticky and slightly plastic; few dead roots; common rock fragments 2 to 20 millimeters in diameter; very strongly alkaline; clear, smooth boundary.

C2—27 to 47 inches, very pale brown (10YR 7/3) silt loam; massive; very friable, nonsticky and slightly plastic; few dead roots; common pores; strongly alkaline; clear, smooth boundary.

C3—47 to 58 inches, very pale brown (10YR 7/4) gravelly clay loam; massive; friable, nonsticky and slightly plastic; many rock fragments; strongly alkaline.

The solum is 10 to 20 inches thick. The A horizon has value of 2 or 3. The B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It has weak, medium or fine, subangular blocky structure. The C horizon has hue of 7.5YR or 10YR, value of 7 or 8, and chroma of 3 or 4. Reaction ranges from neutral to very strongly alkaline.

The Pozo Blanco soils are on the same landscape as the Fraternidad soils. The Pozo Blanco soils are coarser textured than the Fraternidad soils, and unlike those soils, they have a B horizon and lack pressure faces and slickensides.

PrC2—Pozo Blanco clay loam, 5 to 12 percent slopes, eroded. This soil is on foot slopes in the semiarid part of the survey area. Included with it in mapping were areas of Fraternidad soils.

This soil has severe limitations for farming because of slope. It requires careful management and conservation practices if it is used for clean-cultivated crops. If the soil is properly managed, it is suited to sugarcane, pasture, cut grasses, and woodland. Capability unit IVe–3; woodland suitability group 2o2.

Reilly Series

The Reilly series consists of excessively drained, rapidly permeable soils that are shallow to sand and gravel. These soils formed in stratified material, dominantly gravel and sand but partly medium-textured and moderately coarse textured sediment. They are adjacent to the streams on river flood plains. Slopes are 0 to 2 percent. The climate is humid tropical. The average annual precipitation is 70 inches, and the average annual temperature is 77° F.

In a representative profile, the surface layer is dark-brown, medium acid sandy loam about 9 inches thick. Below that is dark-brown, very friable loamy sand and dark yellowish-brown, yellowish-brown, brown, and pale-brown, loose sand that extends to a depth of 62 inches.

These soils have a low available water capacity and low natural fertility and are easily worked. Most of the acreage is used for pasture, but small areas are in sugarcane.

Representative profile of Reilly sandy loam, 0 to 2 percent slopes, in an area of Reilly soils, 8 meters north and 90 meters west of kilometer marker 97.8 on Highway No. 3:

Ap—0 to 9 inches, dark-brown (10YR 3/3) sandy loam; massive; friable, nonsticky and nonplastic; medium acid; clear, smooth boundary.

C1—9 to 19 inches, dark-brown (7.5YR 4/4) loamy sand; massive; very friable, nonsticky and nonplastic; medium acid; clear, smooth boundary.

IIC2—19 to 35 inches, dark yellowish-brown (10YR 4/4) coarse sand; massive; loose; slightly acid; clear, smooth boundary.

IIIC3—35 to 50 inches, yellowish-brown (10YR 5/4) medium sand; massive; loose; slightly acid; clear, smooth boundary.

IVC4—50 to 58 inches, brown (10YR 5/3) coarse sand; massive; loose; slightly acid; clear, smooth boundary.

VC5—58 to 62 inches, pale-brown (10YR 6/3) coarse sand; massive; loose; slightly acid.

The A horizon is 7 to 16 inches thick. The A and C horizons have hue of 10YR or 7.5 YR, value of 3 to 6, and chroma of 2 to 4. The C1 horizon is loamy sand, sand, or gravelly sand. Below the C1 horizon, sand and gravel vary in proportion.

The Reilly soils are on the same landscape as the Toa, Coloso, Vivi, Maunabo, and Talante soils. The Reilly soils are coarser textured than all those soils, and unlike those soils, they are excessively drained.

Re—Reilly soils. These nearly level soils are adjacent to the streams on the flood plains in the humid part of the survey area. Included with them in mapping were small areas of Toa, Coloso, and Talante soils.

These soils have severe limitations for cultivated crops, because of the hazard of flooding, low available water capacity, and low fertility. They are suited to pasture. Capability unit IVs–3.

Reparada Series

The Reparada series consists of poorly drained soils that are underlain by organic material. Permeability is very slow. These soils formed in fine-textured sediment of mixed origin that overlies decomposed organic soil material. They are on coastal lowlands. Slopes are 0 to 2 percent. The climate is semiarid tropical. The average annual precipitation is 30 to 40 inches, and the average annual temperature is 79° F.

In a representative profile, the surface layer is very dark brown, mildly alkaline, mottled clay about 8 inches thick. Below that is very dark gray, firm, mottled clay about 8 inches thick. Below that is very dark gray, firm, mottled clay that extends to a depth of 18 inches. It is underlain by black organic material.

These soils have a high available water capacity, high natural fertility, and high shrink-swell potential. They are difficult to work and have been used for native pasture and sugarcane for many years.

Representative profile of Reparada clay 0.2 kilometer south and 0.2 kilometer east of kilometer marker 131.6 on Highway No. 3, 0.6 kilometer south on dirt road, 12 meters east of road, 75 meters north of coconut grove:

Ap—0 to 8 inches, very dark brown (10YR 2/2) clay; common, medium, distinct, dark-brown (7.5YR 4/4) mottles and few, medium, distinct, dark reddish-brown (2.5YR 2/4) mottles; weak, medium, subangular blocky structure; firm, slightly sticky and slightly plastic; common fine roots; very dark gray coatings on ped surfaces; mildly alkaline; gradual, smooth boundary.

B2g—8 to 18 inches, very dark gray (N 3/0) clay; many, coarse, prominent, dark greenish-gray (5G 4/1) mottles; massive; firm, slightly sticky and slightly plastic; few fine roots; few partly decomposed plant residues; mildly alkaline; gradual, smooth boundary.

IIC—18 to 60 inches, black (10YR 2/1), decomposed, mildly alkaline organic material.

Thickness of the solum and depth to organic layers range from 12 to 22 inches. The A horizon has hue of 10YR to 2.5Y, value of 2 or 3, and chroma of 2 or less. Mottles range from few to common and are in shades of brown and red. The B horizon has hue of 2.5Y or N and has weak, subangular blocky structure or is massive. Reaction ranges from neutral to moderately alkaline.

The Reparada soils are on the same landscape as the Poncena soils. The Reparada soils have an organic layer whereas the Poncena soils do not.

Rp—Reparada clay. This nearly level soil is on coastal lowlands in the semiarid part of the survey area. Included with it in mapping were areas of Poncena soils.

This soil has severe limitations for cultivated crops because it has very slow permeability, poor drainage, and a seasonal water table and is difficult to work. If the soil is properly drained, it is suited to sugarcane and pasture. Capability unit IVw–2.

Rio Arriba Series

The Rio Arriba series consists of deep, moderately well drained soils. Permeability is moderately slow. These soils formed in fine-textured sediment of mixed origin. They are on alluvial fans and terraces above the river flood plains. Slopes are 2 to 12 percent. The climate is humid tropical. The average annual precipitation is 65 inches, and the average annual temperature is 77° F.

In a representative profile, the surface layer is brown to dark-brown, very strongly acid clay about 5 inches thick. The next layer is yellowish-brown and very pale brown, firm clay 21 inches thick. The layer below that is mottled, firm clay that has variegated colors and extends to a depth of 56 inches.

These soils have a high available water capacity and high shrink-swell potential. Runoff is slow to medium. The soils are somewhat difficult to work. They have been used for food crops, sugarcane, and pasture for many years.

Representative profile of Rio Arriba clay, 2 to 5 percent slopes, 0.5 kilometer south and 9 meters west of intersection of Highway No. 31 and Highway No. 924, Barrio Mambiche, Naguabo:

Ap—0 to 5 inches, brown (10YR 5/3) to dark-brown (10YR 4/3) clay; few, fine, faint, brown (10YR 5/3) mottles; weak, fine to medium, subangular blocky structure; firm, slightly sticky and slightly plastic; common fine roots; many, fine to medium, dark concretions; few worm casts; very strongly acid; abrupt, smooth boundary.

B21t—5 to 16 inches, yellowish-brown (10YR 5/8) clay; weak, medium, subangular blocky structure; firm, slightly sticky; slightly plastic; and few fine roots; few fine pores and krotovinas; many, thin, patchy clay films on vertical cleavage planes; common, fine to medium, dark concretions; very strongly acid; clear, wavy boundary.

B22t—16 to 26 inches, very pale brown (10YR 7/4) clay; weak, medium, subangular blocky structure; firm, sticky and plastic; few fine roots; peds coated with thin continuous clay films; few, fine to medium, dark concretions; some concretions coated with red (2.5YR 4/6); few worm casts; strongly acid; gradual, wavy boundary.

C1—26 to 39 inches, variegated light-gray (5Y 7/1), gray (5Y 6/1), brownish-yellow (10YR 6/6), and dark-red (10R 3/6) clay; massive; firm, sticky and plastic; few, fine, dead roots; few pores; common pressure faces and slickensides; few waterworn pebbles; few fine concretions; very strongly acid; clear, smooth boundary.

C2—39 to 56 inches, variegated brownish-yellow (10YR 6/6), light-gray (5Y 7/1), gray (5Y 6/1), and dark-red (10R 3/6) clay; massive; firm, sticky and plastic; few, fine, dead roots; common pressure faces and slickensides; few subrounded pebbles; very strongly acid.

The solum is 20 to 42 inches thick. The Ap horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. The B horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 4 to 8. It has weak or moderate, subangular blocky structure.

The Rio Arriba soils are on the same landscape as the Mabi, Aceitunas, and Via soils. The Rio Arriba soils have a B2t horizon that the Mabi soils lack. They have a higher shrink-swell potential than the Aceitunas soils. The Rio Arriba soils are finer textured than the Via soils, and unlike those soils, they have pressure faces and slickensides.

RrB—Rio Arriba clay, 2 to 5 percent slopes. This soil is on alluvial fans and terraces. It has the profile described as representative of the series. Included with this soil in mapping were areas of Mabi and Aceitunas soils.

This soil has moderate limitations for farming because of slope, the hazard of erosion, and workability. Careful management and conservation practices can help overcome these limitations. The soil is suited to sugarcane, food crops, cut grasses, and pasture. Capability unit IIs–2.

RrC2—Rio Arriba clay, 5 to 12 percent slopes, eroded. This soil is on alluvial fans and terraces. Its profile is similar to the one described as representative of the series, but most of the original surface layer has been removed by erosion, and the plow layer is a mixture of the remaining part of that layer and the yellowish-brown subsoil. In some places the present surface layer is subsoil material. Included with this soil in mapping were areas of Mabi and Via soils.

This soil has moderate limitations for farming because of the hazard of erosion, slope, and workability. If it is properly limed and fertilized, it is suited to sugarcane and pasture. Capability unit IIIe–7.

Rock Land

Rock land (Rs) consists of areas where rock crops out on 50 to 70 percent of the surface. Loose stones also are common on the surface. Very shallow soil material lies between the outcrops and stones. This land type is in the mountainous part of the survey area. Slopes are 60 to 70 percent. The vegetation is brush.

Rock land has little value for farming or engineering uses. Its use is restricted mainly to wildlife habitat. Capability unit VIIIs–2.

Rough Stony Land

Rough stony land (Ru) consists of the high, jagged mountain peaks and long, very steep side slopes in the rain forest. Rocks and boulders cover 75 to 90 percent of the surface. The areas are inaccessible, so the soils have not been classified. Scattered observations indicate that the soils are clayey and poorly drained on the smoother slopes and somewhat poorly drained on the very steep side slopes. Nearly continuous rainfall is favorable for mosses and ferns.

Very steep slopes, stoniness, and rockiness are severe limitations for crops and pasture and for nonfarm uses such as highway location, foundations for low buildings, septic tank filter fields, and sewage lagoons. This land type has scenic value, but the very steep slopes, rockiness, and stoniness are severe limitations for paths, trails, intensive play areas, campsites, and picnic areas. The use of this land type is limited to forest, habitat for wildlife, and water catchment. Capability unit VIIIs–2.

Sabana Series

The Sabana series consists of shallow soils that are well drained and moderately permeable. These soils formed in fine-textured residuum derived from partly weathered volcanic rocks. They are on mountain side slopes and ridgetops. Slopes are 20 to 60 percent. The climate is humid tropical. The average annual precipitation is 80 to 90 inches, and the average annual temperature is 78° F.

In a representative profile, the surface layer is very dark gray, strongly acid silty clay loam about 4 inches thick. The next layer is dark grayish-brown, mottled silty clay 8 inches thick. Below that layer is yellowish-red, mottled clay 6 inches thick. It is underlain by consolidated rock.

These soils have a moderate available water capacity and moderate shrink-swell potential. Runoff is rapid to very rapid. Most of the acreage is used for pasture and woodland, and some areas are in brush.

Representative profile of Sabana silty clay loam, 20 to 40 percent slopes, eroded, 2.4 kilometers north on Highway No. 925 from its junction with Highway No. 3, 45 meters north of Parcelas Junquitos:

Ap—0 to 4 inches, very dark gray (10YR 3/1) silty clay loam; moderate, medium, granular structure; firm, slightly sticky and slightly plastic; common fine roots; common fine volcanic fragments; strongly acid; clear wavy boundary.

B1—4 to 12 inches, dark grayish-brown (10YR 4/2) silty clay; common, medium, prominent, strong-brown (7.5YR 5/6) mottles; weak, fine, subangular blocky structure; firm, slightly sticky and slightly plastic; few fine roots; few fine pores; occasional thin clay films; few, fine, volcanic rock fragments; strongly acid; smooth boundary.

B2—12 to 18 inches, yellowish-red (5YR 5/6) clay; many, coarse, prominent, dark-brown (7.5YR 4/4) mottles; weak, medium, subangular blocky structure; firm, slightly sticky and slightly plastic; few fine roots; few fine pores; few, thin, patchy clay films; common, fine, volcanic rock fragments; strongly acid; abrupt, smooth boundary.

R—18 inches, consolidated volcanic rock.

Thickness of the solum and depth to volcanic rock ranges from 10 to 20 inches. The Ap horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 1 or 2. Coarse fragments are few or common. The B2 horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. It has weak, fine or medium, subangular blocky structure.

The Sabana soils occupy the same landscape as the Caguabo, Mucara, and Naranjito soils. They are more acid than the Caguabo soils and lack their gravelly B horizon. The Sabana soils are shallower to hard rock than the Mucara and Naranjito soils, and they have a thinner solum than the Naranjito soils.

SaE2—Sabana silty clay loam, 20 to 40 percent slopes, eroded. This soil is on side slopes in the humid part of the survey area. It has the profile described as representative of the series. Erosion has removed some of the original surface layer, and in some places the subsoil is exposed. Included with this soil in mapping were areas of Caguabo, Mucara, and Naranjito soils.

This soil is not suited to clean-cultivated crops. Steep slopes, depth to volcanic rocks, rapid runoff, and the hazard of erosion are severe limitations for farm-

ing. The soil is suited to pasture and woodland. Capability unit VIIs–1; woodland suitability group 3d5.

SaF2—Sabana silty clay loam, 40 to 60 percent slopes, eroded. This soil is on side slopes and ridgetops in the humid volcanic uplands. Its profile is similar to the one described as representative of the Sabana series, but erosion has removed most of the surface layer. In some places the subsoil is exposed. Included with this soil in mapping were small areas of Caguabo soils.

This soil is not suited to clean-cultivated crops. It has severe limitations for farming because of steep slopes, the hazard of erosion, very rapid runoff, and shallowness to rock. It is suited to woodland and pasture. Capability unit VIIs–1; woodland suitability group 4d5.

Salt Water Marsh

Salt water marsh (Sm) consists of wet, periodically flooded areas that are covered mainly by grass, cattails, brush, or other herbaceous plants. It is occasionally flooded by salty water from adjacent mangrove swamps. During periods when rainfall is intense, rivers and streams drain into Salt water marsh and cause the water table to fluctuate. The soil material varies widely in texture.

This land type has severe limitations for farming because it is wet and salty. Expensive drainage systems are required to reclaim it. It is suitable for wildlife food and cover. Capability unit VIIIw–1.

Talante Series

The Talante series consists of deep soils that are poorly drained and moderately permeable. These soils formed in medium-textured to coarse-textured sediment that derived from granitic rocks. They are on flood plains. Slopes are 0 to 2 percent. The climate is humid tropical. The average annual precipitation is 87 inches, and the average annual temperature is 79° F. Depth to the water table ranges from 15 to 30 inches.

In a representative profile, the surface layer is about 10 inches thick. In the upper part it is dark-brown, very strongly acid, mottled clay loam, and in the lower part it is grayish-brown, mottled sandy clay loam. The next layer is brown, friable loam 8 inches thick. The layer below that is dark-brown and gray loamy sand and coarse sand that extends to a depth of 58 inches.

These soils have a moderate available water capacity and low shrink-swell potential. They are subject to flooding and difficult to work. Runoff is slow. The soils have been in pasture and sugarcane for many years.

Representative profile of Talante clay loam, 0 to 2 percent slopes, in an area of Talante soils, 1000 meters northeast of Central Roig and 180 meters north of Guayanes River:

Ap—0 to 4 inches, dark-brown (10YR 4/3) clay loam; many, medium, distinct, gray (10YR 5/1) and dark-brown (7.5YR 4/4) mottles; weak, fine, subangular blocky structure parting to granular; friable, slightly plastic; very strongly acid; clear, smooth boundary.

A1g—4 to 10 inches, grayish-brown (10YR 5/2) sandy clay loam; many, medium, prominent, dark-gray (5Y 4/1) and yellowish-red (5YR 4/8) mottles; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; many mica flakes; strongly acid; clear, smooth boundary.

B2g—10 to 18 inches, brown (10YR 5/3) loam; medium, prominent, gray (5Y 5/1) and dark-brown (7.5YR 4/4) mottles; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; strongly acid; clear, smooth boundary.

IIC1g—18 to 40 inches, mixed dark-brown (7.5YR 4/4) and gray (5Y 5/1) loamy sand; massive; very friable, nonsticky and nonplastic; strongly acid; clear, smooth boundary.

IIIC2g—40 to 58 inches, gray (2.5YR 5/1) coarse sand; many; medium, prominent, yellowish-brown (10YR 5/6) mottles; single grained; loose; strongly acid.

The solum is 14 to 38 inches thick. The A horizon has value of 3 or 4 and chroma of 2 or 3. Mottles are in shades of brown, yellowish red, and gray. The B horizon has value of 4 or 5 and chroma of 2 or 3. It ranges from loam to sandy loam and has gray, dark-brown, and brown mottles. Reaction is strongly acid or very strongly acid.

The Talante soils are on the same landscape as the Coloso, Maunabo, Reilly, and Vivi soils. The Talante soils are more poorly drained than the Coloso soils, and they are coarser textured than the Coloso and Maunabo soils. They are finer textured than the Reilly soils, and unlike these soils, they are poorly drained. Unlike the Vivi soils, the Talante soils are poorly drained and have low-chroma mottles.

Ta—Talante soils. These nearly level soils are on flood plains. Included with them in mapping were small areas of Maunabo, Coloso, and Reilly soils.

These soils have severe limitations for farming because of flooding, a seasonal water table, and poor drainage. If the soils are properly drained, they are suited to sugarcane, cut grasses, and pasture. Capability unit IIIw–3.

Teja Series

The Teja series consists of shallow soils that are well drained and rapidly permeable. These soils formed in gravelly residuum derived from granitic rocks. They are on mountain side slopes and ridgetops. Slopes are 12 to 40 percent. The climate is humid tropical. The average annual precipitation is 80 to 90 inches, and the average annual temperature is 78° F.

In a representative profile, the surface layer is dark-brown, very strongly acid gravelly sandy loam about 6 inches thick. Below that layer is dark-brown and yellowish-brown, loose gravelly sandy loam 8 inches thick. This is underlain by hard rock.

These soils have a low available water capacity and are somewhat difficult to work. Runoff is medium to rapid. Most of the acreage is in pasture and woodland.

Representative profile of Teja gravelly sandy loam, 12 to 40 percent slopes, 8 meters south of kilometer marker 2.7 on Highway No. 906:

A1—0 to 6 inches, dark-brown (10YR 3/3) gravelly sandy loam; weak, fine, granular structure; very friable, nonsticky and nonplastic; common fine roots; many fine quartz grains; very strongly acid; clear, smooth boundary.

C—6 to 14 inches, dark-brown (10YR 4/3) and yellowish-brown (10YR 5/4) gravelly sandy loam; single grained; loose, nonsticky and nonplastic; few fine roots; about 40 percent, by volume, angular rock fragments; very strongly acid; abrupt, smooth boundary.

R—14 to 20 inches, hard, coarse-grained plutonic rock.

The A horizon is 4 to 10 inches thick. It has value and chroma of 2 or 3. The C horizon has value of 4 or 5 and chroma of 3 or 4. Depth to consolidated plutonic rock ranges

from 10 to 20 inches. Reaction is strongly acid or very strongly acid.

The Teja soils are on the same landscape as the Pandura, Mayo, Daguao, and Candelero soils. The Teja soils are shallower and coarser textured than the Pandura soils. They are shallower than the Mayo soils and lack their B horizon. The Teja soils are shallower and coarser textured and have a thinner solum than the Daguao soils. They are shallower, coarser textured, and better drained than the Candelero soils.

TeE—Teja gravelly sandy loam, 12 to 40 percent slopes. This soil is on side slopes and ridgetops. Included with it in mapping were small areas of Pandura soils and Rock land.

This soil is not suited to cultivated crops, and it has severe limitations for farming because of slope, shallowness, and the hazard of erosion. It is suited to woodland and pasture. Capability unit VIIs–1; woodland suitability group 4d5.

Tidal Flats

Tidal flats (Tf) consists of low areas, slightly above sea level, that are affected by seawater during high tide. Because of the high concentration of salt, only salt-tolerant plants grow in these areas. Occasional barren spots that have visible salt accumulation are common. The soil material varies widely in texture.

This land type has severe limitations for farming because of salinity. It is suitable for wildlife food and cover. Capability unit VIIIw–1.

Tidal Swamp

Tidal swamp (Ts) consists of areas that are covered with a thick growth of mangrove trees and are under salty water most of the year. These areas are along the seacoast and inlets. The sandy or clayey soils are light colored and saline and contain organic material from decaying mangrove trees. They are underlain by coral, shells, and marl at varying depths.

This land type is not extensive and has no value for farming, but it serves as a feeding and breeding place for birds, oysters, and crabs. Some of the mangrove trees are used for making charcoal. The land type has very severe limitations for nonfarm uses, and reclamation is expensive. Capability unit VIIIw–1.

Toa Series

The Toa series consists of deep soils that are moderately well drained and moderately permeable. These soils formed from moderately fine textured and fine textured alluvial sediment of mixed origin. They are on river flood plains. Slopes are 0 to 2 percent. The climate is humid tropical. The average annual precipitation is 82 inches, and the average annual temperature is 78° F.

In a representative profile, the surface layer is dark-brown, medium acid silty clay loam about 10 inches thick. The next layer is dark grayish-brown, mottled silty clay loam 6 inches thick. Below this layer is grayish-brown and dark-brown, friable, mottled clay loam that extends to a depth of 60 inches or more.

These soils have a moderate available water capacity and high fertility and are easily worked. They have been in sugarcane and pasture for many years, and some small areas are in food crops.

Representative profile of Toa silty clay loam, 6 meters west of railroad bridge and 6 meters south, near main office of Colonia Santa Rosa, Naguabo:

Ap—0 to 10 inches, dark-brown (10YR 3/3) silty clay loam; moderate, medium, granular structure; friable, nonsticky and slightly plastic; medium acid; clear, smooth boundary.

B—10 to 16 inches, dark grayish-brown (10YR 4/2) silty clay loam; common, medium, distinct, yellowish-red (5YR 5/6) mottles; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; medium acid; clear, smooth boundary.

C1—16 to 60 inches, grayish-brown (10YR 5/2) clay loam; many, fine, faint, dark-brown (10YR 4/3) mottles; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; thin lenses of sand and gravel fragments, 2 to 3 inches in diameter, at a depth of 30 inches; medium acid; clear, smooth boundary.

C2—60 to 70 inches, dark-brown (7.5YR 4/4) clay loam; many, fine, distinct, gray and brown mottles; massive; friable, nonsticky and slightly plastic; common fine sand grains; common gravel fragments.

The solum is 12 to 28 inches thick. The A horizon has value and chroma of 2 or 3. The B horizon has chroma of 2 to 4 and weak, fine or medium, subangular blocky structure. The C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. Reaction is slightly acid or medium acid.

The Toa soils occupy the same landscape as the Bajura, Fortuna, Coloso, and Reilly soils. The Toa soils are better drained and coarser textured throughout than the Bajura and Fortuna soils. They are coarser textured in the lower horizons and better drained than the Coloso soils. The Toa soils are finer textured than the Reilly soils and lack their underlying sand and gravel.

Tt—Toa silty clay loam. This nearly level soil is on river flood plains in the humid coastal plains. Included with it in mapping were areas of Coloso, Fortuna, and Bajura soils.

This soil is suited to cultivated crops and can be used for food crops, sugarcane, grasses, and pasture (fig. 5). It needs ordinary management and practices that help to maintain fertility and good tilth. Capability unit I–2.

Utuado Series

The Utuado series consists of deep, well-drained soils that have moderately rapid permeability. These soils formed in moderately fine textured or medium-textured, highly weathered residuum derived from igneous rock. They are on mountain side slopes in the plutonic uplands. Slopes are 40 to 100 percent. The average annual precipitation is 185 inches, and the average annual temperature is 72° F.

In a representative profile, the surface layer is dark-brown, very strongly acid clay loam about 5 inches thick. Below that is yellowish-brown, very strongly acid, friable clay loam 13 inches thick. Yellowish-brown, very friable loam is between depths of 18 and 23 inches. The underlying material is pale-brown and very pale brown, very friable sandy loam that extends to a depth of 72 inches or more.

These soils have a moderate to low available water capacity and medium fertility. Runoff is rapid. The soils have been in hardwood trees, sierra palms, and tree ferns for many years.

Representative profile of Utuado clay loam, 40 to 60

Figure 5.—**A recently plowed field on Toa silty clay loam. This soil has high fertility and is easy to work. It is suited to most cultivated crops.**

percent slopes, in an area of the Utuado-Picacho-Stony rock land association, very steep, 25 meters southeast of kilometer marker 21.0 on Highway No. 191:

A1—0 to 5 inches, dark-brown (10YR 3/3) clay loam; moderate, medium, granular structure; friable, slightly sticky and slightly plastic; many fine, medium, and large roots; few fine quartz grains; very strongly acid; gradual, smooth boundary.

B2—5 to 18 inches, yellowish-brown (10YR 5/6) heavy clay loam; weak, coarse, subangular blocky structure breaking to weak, fine, subangular blocky; friable, slightly sticky and slightly plastic; common fine roots; common fine pores; very thin patchy clay films; few fine quartz grains; few, fine, dark minerals; very strongly acid; gradual, wavy boundary.

B3—18 to 23 inches, yellowish-brown (10YR 5/4) loam; very weak, coarse, subangular blocky structure; very friable, slightly sticky and slightly plastic; few fine and medium roots; common fine pores; common fine quartz grains; very strongly acid; gradual, wavy boundary.

C1—23 to 36 inches, pale-brown (10YR 6/3) sandy loam; massive breaking to very weak, coarse, subangular blocky structure; very friable, nonsticky and nonplastic; many fine quartz grains; many, flaky, shiny minerals; common, fine, dark minerals; very strongly acid; diffuse, wavy boundary.

C2—26 to 52 inches, very pale brown (10YR 7/3) sandy loam; common, fine, distinct, dark-brown mottles; massive breaking to very weak, coarse, subangular blocky structure; very friable, nonsticky and nonplastic; many fine quartz grains; many, flaky, shiny minerals; many, fine, dark minerals; very strongly acid; diffuse, wavy boundary.

C3—52 to 72 inches+, very pale brown (10YR 7/3) sandy loam; many, fine, distinct, dark-brown, brown, and yellowish-brown mottles; massive; very friable, nonsticky and nonplastic; very strongly acid.

The solum is 18 to 31 inches thick. The A horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 to 4. It ranges from loam to clay loam. The B horizon has hue of 10YR or 7.5 YR, value of 4 to 6, and chroma of 4 to 8. It ranges from clay loam or sandy clay loam to loam and has weak or very weak, fine to coarse, subangular blocky structure. The C horizon has hue of 10YR or 7.5YR, value of 4 to 7, and chroma of 2 to 6. It ranges from sandy loam to loam. Quartz grains vary from few to many throughout the profile. Reaction ranges from strongly acid to extremely acid.

The Utuado soils are on the same landscape as the Ciales, Yunque, Los Guineos, and Picacho soils. Unlike the Ciales, Yunque, and Los Guineos soils, the Utuado soils lack a B2t horizon; they are coarser textured than the Yunque and Los Guineos soils. The Utuado soils are coarser textured than the Picacho soils and lack their low-chroma mottles.

UpF—Utuado-Picacho-Stony rock land association, very steep. This mapping unit is on mountains in the rain forest. It occupies narrow upper side slopes where slopes range from 20 to 50 percent, mid side slopes where slopes range from 50 to 100 percent, and lower side slopes adjacent to drainageways where slopes range from 30 to 100 percent.

The composition of this unit is more variable than that of most other units in the survey area but has been controlled well enough to interpret for the expected use of the soils. About 40 percent of this unit is Utuado soils, 26 percent is Picacho soils, and 19 percent is Stony rock land. The remaining area is minor soils that vary in texture and color.

The soils of this unit occur in uniform patterns; the Picacho soils are on the upper side slopes and the Utuado soils are on the mid side slopes. Stony rock land is on the lower part of the side slopes adjacent to the drainageways. Gray and bluish volcanic rocks cover 90 to 100 percent of the surface, and loose fragments that range from 6 to 60 inches in diameter are at the base of the rock cliffs.

All of this mapping unit is in hardwood trees. Because of the very steep slopes, its use is limited to forest, habitat for wildlife, and water catchment. The soils are desirable for recreation because of their scenic value, but they have severe limitations for paths,

trails, and roads because they are continuously wet and are susceptible to slippage in roadbanks. Capability unit VIIs–3; woodland suitability group 3r3.

Vayas Series

The Vayas series consists of deep soils that are poorly drained and slowly permeable. These soils formed in fine-textured sediment of mixed origin. They are on weakly dissected river flood plains. Slopes are 0 to 2 percent. The climate is semiarid tropical. The average annual precipitation is 30 to 40 inches, and the average annual temperature is 79° F. Depth to the water table ranges from 30 to 60 inches.

In a representative profile, the surface layer is very dark grayish-brown, neutral silty clay about 8 inches thick. Below that is very dark grayish-brown, firm, mottled silty clay 5 inches thick. Brown, friable, mottled silty clay and silty clay loam are between depths of 13 and 30 inches. These are underlain by olive-brown, friable, mottled silt loam and fine sandy loam that extends to a depth of 54 inches.

These soils have a high available water capacity and high natural fertility. They are difficult to work and have been in sugarcane and pasture for many years.

Representative profile of Vayas silty clay, frequently flooded, 24 meters south of farm railroad track, and 0.2 kilometer west of Josefa Machinery Shop within the Hacienda Josefa:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) silty clay; few, fine, faint, very dark gray (5Y 3/1) mottles; massive parting to weak, coarse, subangular blocky structure; friable, slightly sticky and slightly plastic; few fine roots; few pebbles; black stains along root channels; neutral; gradual, smooth boundary.

B—8 to 13 inches, very dark grayish-brown (10YR 3/2) silty clay; common, fine, distinct, dark-gray (5Y 3/2) and dark yellowish-brown (10YR 4/4) mottles; weak, medium and coarse, subangular blocky structure; firm, slightly sticky and slightly plastic; clay coatings along root channels and pores; few pores; few pebbles; black stains along root channels; neutral; abrupt, smooth boundary.

C1—13 to 21 inches, brown (10YR 4/3) silty clay; many, fine, distinct, olive-gray (5Y 5/2) and dark yellowish-brown (10YR 4/2) mottles; massive; friable, slightly sticky and slightly plastic; few pores; dead roots; black stains and coatings along root channels; mildly alkaline; clear, smooth boundary.

C2—21 to 30 inches, brown (10YR 4/3) silty clay loam; many, fine, distinct, olive-gray (5Y 4/2) and dark-brown (7.5YR 4/4) mottles; massive; friable, slightly sticky and slightly plastic; few pores; few clay coatings along root channels; mildly alkaline; clear, smooth boundary.

C3—30 to 44 inches, olive-brown (2.5Y 4/4) silt loam; common, fine, distinct, olive (5Y 4/3) mottles; massive; friable, nonsticky and nonplastic; mildly alkaline; clear, smooth boundary.

C4—44 to 54 inches, olive-brown (2.5Y 4/4) fine sandy loam; common, fine, distinct, olive (5Y 4/3) mottles; massive; friable, nonsticky and nonplastic; mildly alkaline.

The solum is 12 to 18 inches thick. The A horizon has value and chroma of 2 or 3. The B horizon has value of 3 or 4 and chroma of 2 or less. It has gray, dark-gray, and dark yellowish-brown mottles. It is silty clay or clay and has weak, fine to coarse, subangular blocky structure. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4. Reaction is neutral to moderately alkaline.

The Vayas soils are on the same landscape as the Vives, Cartagena, and Poncena soils. Unlike the Vives soils, they are poorly drained and have low-chroma mottles. The Vayas soils lack the high shrink-swell potential of the Cartagena and Poncena soils, and unlike the Poncena soils, they are poorly drained and have a B horizon.

Va—Vayas silty clay loam, occasionally flooded. This nearly level soil is on alluvial flood plains in the semiarid part of the survey area. Included with it in mapping were small areas of Cartagena soils.

Slow permeability, poor drainage, the hazard of flooding, and poor workability are moderate limitations for farming. If the soil is properly drained and managed, it is suited to sugarcane, cut grasses, and pasture. Capability units IIw–4 nonirrigated and IIw–4 irrigated.

Vc—Vayas silty clay, frequently flooded. This nearly level soil is on river flood plains. It has the profile described as representative of the series. Included with this soil in mapping were areas of Cartagena and Vives soils.

The hazard of flooding, poor drainage, slow permeability, and poor workability are moderate limitations for farming. If the soil is properly drained and managed, it is suited to sugarcane, cut grasses, and pasture. Capability units IIw–4 nonirrigated and IIw–4 irrigated.

Vega Alta Series

The Vega Alta series consists of deep soils that are well drained and moderately permeable. These soils formed in fine-textured, red, brown, and gray coastal plain sediment that is rich in iron. They are on coastal plains and terraces. Slopes are 2 to 12 percent. The climate is humid tropical. The average annual precipitation is 76 inches, and the average annual temperature is 77° F.

In a representative profile, the surface layer is dark yellowish-brown, strongly acid silty clay loam about 9 inches thick. Below this layer is yellowish-brown and red, firm or very firm clay 19 inches thick. The next layer is red, yellowish-brown, and light-gray, firm clay that extends to a depth of 60 inches.

These soils have a moderate available water capacity and medium fertility. They are somewhat difficult to work. Runoff is slow to medium. Most of the acreage is used for sugarcane, cut grasses, and pasture, but there are small areas in food crops and brush.

Representative profile of Vega Alta silty clay loam, 2 to 5 percent slopes, 15 meters west of trail and 0.3 kilometer north from kilometer marker 2.1 on Highway No. 194, municipality of Fajardo:

A1—0 to 9 inches, dark yellowish-brown (10YR 4/4) silty clay loam, light yellowish brown (10YR 6/4), dry; weak, medium, subangular blocky structure; firm, nonsticky and slightly plastic; common fine roots; strongly acid; clear, smooth boundary.

B21t—9 to 20 inches, mixed yellowish-brown (10YR 5/4) and red (2.5YR 4/6) clay; weak, fine to medium, subangular blocky structure; firm, slightly sticky and slightly plastic; common pores; common fine roots; common clay films on ped surfaces and pores; about 5 percent, by volume, is plinthite; few black concretions; very strongly acid; clear, smooth boundary.

B22t—20 to 28 inches, mixed red (10YR 4/8) and yellowish-brown (10YR 5/4, 5/6) clay; moderate, medium, subangular blocky structure; very firm, slightly

sticky and plastic; many clay films on ped surfaces; about 5 percent, by volume, is plinthite; few shale fragments; few pores; very strongly acid; clear, wavy boundary.

B23t—28 to 60 inches, mixed red (10R 4/8), yellowish-brown (10YR 5/8), and light-gray (10YR 7/1) clay; weak, medium, subangular blocky structure; firm, slightly sticky and slightly plastic; few clay films on ped surfaces; about 5 percent, by volume, is plinthite; few shale fragments; very strongly acid.

The solum is more than 60 inches thick. The A horizon has hue of 10YR or 7.5YR and value and chroma of 4 to 6. The B2t horizon has hue of 2.5YR, 7.5YR, 10R, or 10YR, value of 4 to 7, and chroma of 1 to 8. It has weak or moderate, fine or medium, subangular blocky structure. Plinthite makes up 5 to 10 percent of the B2t horizon. Reaction is strongly acid or very strongly acid.

The Vega Alta soils occupy the same landscape as the Vega Baja and Fajardo soils. The Vega Alta soils are better drained than those soils, and they contain plinthite.

VeB—Vega Alta silty clay loam, 2 to 5 percent slopes. This soil is on coastal plains and terraces in the humid part of the survey area. It has the profile described as representative of the series. Included with this soil in mapping were areas of Vega Baja and Fajardo soils.

This soil has moderate limitations for farming because of the hazard of erosion. If it is properly managed, the soil is suited to food crops, sugarcane, and pasture. Capability unit IIe–4.

VeC—Vega Alta silty clay loam, 5 to 12 percent slopes. This soil is on coastal plains and terraces in the humid part of the survey area. Included with it in mapping were small areas of Fajardo and Vega Baja soils.

This soil has moderate limitations for farming because of slope and the hazard of erosion. If proper management and conservation practices are used, the soil is suited to sugarcane, cut grasses, and pasture. Capability unit IIIe–8.

Vega Baja Series

The Vega Baja series consists of deep soils that are somewhat poorly drained and slowly permeable. These soils formed in fine-textured, mixed sediment. They are on coastal plains and alluvial fans. Slopes are 0 to 3 percent. The climate is humid tropical. The average annual precipitation is 76 inches, and the average annual temperature is 77° F.

In a representative profile, the surface layer is brown to dark-brown, slightly acid silty clay loam about 12 inches thick. Below that is dark grayish-brown, firm, mottled silty clay 11 inches thick. The underlying material is yellowish-brown, firm, mottled clay that extends to a depth of 48 inches.

These soils have a high available water capacity and medium fertility. Runoff is slow. The soils are difficult to work and have been in sugarcane and pasture for many years.

Representative profile of Vega Baja silty clay loam, 0 to 3 percent slopes, 0.9 kilometer west from kilometer marker 0.8 on Highway No. 976, 90 meters southwest from Land Authority Office, Colonia San Pedro, Fajardo, and 38 meters south from junction of farm roads:

Ap—0 to 12 inches, brown to dark-brown (10YR 4/3) silty clay loam; weak, fine, subangular blocky structure parting to granular; friable, slightly sticky and slightly plastic; slightly acid; abrupt, wavy boundary.

B2t—12 to 23 inches, dark grayish-brown (10YR 4/2) silty clay; common, medium, distinct, brownish-yellow (10YR 6/6) mottles and few, distinct, red (2.5YR 4/8) mottles; weak, medium, subangular blocky structure; firm, slightly sticky and slightly plastic; common black concretions; medium acid; abrupt, wavy boundary.

C1—23 to 30 inches, yellowish-brown (10YR 5/8) clay; common, medium, distinct, gray (2.5Y 5/0) mottles; few, fine, distinct, red (2.5YR 4/6) mottles; and common, fine, prominent, dark-gray (2.5Y 4/0) mottles; massive; firm, slightly sticky and plastic; common black concretions; slightly acid; abrupt, wavy boundary.

C2—30 to 48 inches, yellowish-brown (10YR 5/8) clay; common, medium, prominent, greenish-gray (5BG 6/1) mottles; massive; firm, slightly sticky and slightly plastic; few gravel fragments; few black concretions; medium acid.

The solum is 14 to 32 inches thick. The A horizon has value and chroma of 3 or 4. The B horizon has chroma of 2 or 3. Black concretions range from few to many. Reaction is slightly acid or medium acid.

The Vega Baja soils are on the same landscape as the Vega Alta, Coloso, Bajura, and Toa soils. Unlike the Vega Alta soils, the Vega Baja soils are somewhat poorly drained and lack red colors. They have a B2t horizon that the Coloso soils lack. The Vega Baja soils are not so poorly drained as the Bajura soils and lack their high shrink-swell potential. They are finer textured than the Toa soils, and unlike those soils, they are somewhat poorly drained.

VgA—Vega Baja silty clay loam, 0 to 3 percent slopes. This soil is on coastal plains and alluvial fans in the humid part of the survey area. Included with it in mapping were small areas of Coloso, Bajura, and Toa soils.

This soil has moderate limitations for farming because it is somewhat poorly drained and is susceptible to flooding. If it is properly drained and managed, the soil is suited to sugarcane, cut grasses, and pasture. Capability unit IIw–1.

Via Series

The Via series consists of deep soils that are well drained and moderately permeable. These soils have formed in moderately fine textured sediment that is underlain by coarse-textured, gravelly or cobbly sediment. They are on terraces. Slopes are 3 to 10 percent. The climate is humid tropical. The average temperature is 78° F.

In a representative profile, the surface layer is dark grayish-brown, strongly acid silty clay loam about 8 inches thick. Below that layer is reddish-brown and yellowish-red, firm clay loam 39 inches thick. The underlying material is dark-brown, firm gravelly clay loam that extends to a depth of 62 inches.

These soils have a moderate available water capacity, and high fertility. They are easy to work. Runoff is slow. Most of the acreage is used for sugarcane and pasture, but some areas are used for food crops.

Representative profile of Via silty clay loam, 3 to 10 percent slopes, 0.7 kilometer west of kilometer marker 21.9 on Highway No. 3 and 1,050 meters east of schoolhouse:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silty clay loam, brown (10YR 5/3), dry; weak, fine, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many fine roots; fine

dark concretions; few worm casts; few cobbles and pebbles at contact with B horizon; strongly acid; abrupt, smooth boundary.

B21t—8 to 23 inches, reddish-brown (5YR 4/4) clay loam; weak, medium, subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; common fine roots; few, thin, patchy clay films on vertical ped surfaces; many, fine, dark mineral grains; common fine rock fragments; slightly acid; clear, smooth boundary.

B22t—23 to 47 inches, yellowish-red (5YR 4/8) clay loam; weak, medium, subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; few fine roots; thin patchy clay films; common, fine, dark minerals; many fine and medium rock fragments; slightly acid; gradual, wavy boundary.

IIC—47 to 62 inches, dark-brown (7.5YR 4/4) gravelly clay loam; structureless; hard, firm, slightly sticky; more than 70 percent, by volume, coarse fragments; medium acid.

Thickness of the solum and depth to the gravelly horizons range from 30 to 60 inches. The Ap horizon has hue of 10YR or 5YR, value of 4 or 5, and chroma of 2 or 3. The B horizon has hue of 7.5YR or 5YR and chroma of 4 to 8. It has weak, fine or medium, subangular blocky structure. Reaction in the B2t horizon is slightly acid or medium acid.

The Via soils occupy the same landscape as the Rio Arriba, Mabi, and Junquitos soils. They are coarser textured than the Rio Arriba and Mabi soils and lack their high shrink-swell potential. Unlike the Junquitos soils, the Via soils lack low-chroma mottles in the B horizon.

VlC—Via silty clay loam, 3 to 10 percent slopes. This soil is on terraces in the humid part of the survey area. Included with it in mapping were small areas of Rio Arriba, Junquitos, and Mabi soils.

This soil is suited to food crops, sugarcane, and pasture. Good management and conservation practices should be used to control erosion. Capability unit IIIe–9.

Vieques Series

The Vieques series consists of moderately deep, well-drained soils that have moderately rapid permeability. These soils formed in partly weathered granitic rocks. They are on side slopes and ridgetops in the dry uplands. Slopes are 5 to 40 percent. The climate is semiarid tropical. The average annual precipitation is 35 inches, and the average annual temperature is 78° F.

In a representative profile, the surface layer is dark-brown, slightly acid loam about 5 inches thick. Below that layer is brown to dark-brown, friable sandy clay loam 10 inches thick. The underlying material is yellowish-brown, loose gravelly coarse sand 23 inches thick. Consolidated granitic rock is at a depth of 38 inches.

These soils have a low available water capacity and medium fertility, and they are susceptible to erosion. They have been in native pasture and brush, but some areas are used for sugarcane.

Representative profile of Vieques loam, 12 to 40 percent slopes, eroded, 30 meters southwest from kilometer marker 1.6 on Highway No. 993, island of Vieques:

A1—0 to 5 inches, dark-brown (10YR 3/3) loam; weak, fine, granular structure; soft, friable, nonsticky and nonplastic; common fine roots; slightly acid; clear, smooth boundary.

B—5 to 15 inches, brown to dark-brown (7.5YR 4/4) sandy clay loam; weak, coarse, subangular blocky structure; slightly hard, friable, nonsticky and slightly plastic; few fine roots; krotovinas filled with material from A1 horizon; common rock fragments that vary from 2 to 5 millimeters in size; neutral; gradual, wavy boundary.

C—15 to 38 inches, yellowish-brown (10YR 5/4) gravelly coarse sand, 60 percent coarse fragments of partially weathered plutonic rocks.

R—38 inches, consolidated granitic rock.

The solum is 12 to 20 inches thick. The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 3 or 4. The B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It has weak, medium or coarse, subangular blocky structure. The C horizon has value of 4 or 5 and chroma of 4 to 6. Depth to consolidated granitic rock is 32 to 50 inches. Reaction is slightly acid to mildly alkaline.

The Vieques soils are on the same landscape as the Descalabrado, Coamo, and Guayama soils. The Vieques soils are deeper to rock than the Descalabrado soils, and they are coarser textured than the Coamo soils. The Vieques soils lack the red colors of the Guayama soils.

VmC—Vieques loam, 5 to 12 percent slopes. This soil is on side slopes on the island of Vieques. Its profile is similar to the one described as representative of the series, but its surface layer is 1 or 2 inches thicker. Included with this soil in mapping were areas of Guayama and Descalabrado soils.

This soil has severe limitations for farming because of low rainfall and the hazard of erosion. It is not irrigated. The soil has been in sugarcane and pasture that has low carrying capacity. Capability unit IVe–9; woodland suitability group 3d5.

VmE2—Vieques loam, 12 to 40 percent slopes, eroded. This soil is on side slopes and ridgetops on the island of Vieques. It has the profile described as representative of the series. Most of the original surface layer has been eroded. Included with this soil in mapping were small areas of Guayama and Descalabrado soils.

This soil has severe limitations for farming because it is steep and susceptible to erosion. It is suited to pasture and wildlife habitat. Capability unit VIe–5; woodland suitability group 3d5.

Vives Series

The Vives series consists of deep soils that are well drained and moderately permeable. These soils formed in moderately fine textured sediment of mixed origin. They are on river flood plains and on alluvial fans and terraces above the present river flood plains. Slopes are 0 to 7 percent. The climate is semiarid tropical. The average annual precipitation is 25 to 45 inches, and the average annual temperature is about 79° F.

In a representative profile, the surface layer is very dark grayish-brown, neutral, mottled clay about 9 inches thick. The next layer is yellowish-red and reddish-brown clay loam that has fine rock fragments and is 23 inches thick. The underlying material is brown, friable clay loam that extends to a depth of 50 inches.

These soils have a high available water capacity and high natural fertility. They are easily worked, and they have been in sugarcane for many years.

Representative profile of Vives clay, 2 to 7 percent slopes, 1.4 kilometers north of kilometer marker 150.8 on Highway No. 3:

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) clay; few, medium, prominent, reddish-brown (5YR

4/4) mottles; weak, fine, subangular blocky structure; firm, slightly sticky and plastic; many fine roots; many fine rock fragments; many fine charcoal pieces; neutral; abrupt, wavy boundary.

B2—9 to 23 inches, yellowish-red (5YR 4/6) clay loam; weak, medium, subangular blocky structure; firm, slightly sticky and plastic; common fine roots; few fine pores; many fine rock fragments; many dark coatings in root channels; neutral; clear, wavy boundary.

B3—23 to 32 inches, reddish-brown (5YR 4/4) clay loam; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; few fine roots; few fine pores; few fine rock fragments; neutral; clear, wavy boundary.

C1—32 to 43 inches, brown (7.5YR 4/4) clay loam; massive; friable, nonsticky and slightly plastic; many, fine, subrounded rock fragments; neutral; clear, smooth boundary.

C2—43 to 50 inches, brown (7.5YR 4/4) clay loam; massive; friable, nonsticky and slightly plastic; many lime splotches; calcareous; moderately alkaline.

The solum is 20 to 40 inches thick. The A horizon has hue of 10YR or 7.5YR and value and chroma of 2 to 4. The B2 horizon has hue of 5YR or 7.5YR and chroma of 4 to 6. It ranges from clay loam to clay and has weak, fine or medium, subangular blocky structure. Clay films are few and patchy. The C horizon has hue of 7.5YR or 5YR and chroma of 4 to 6. Reaction is slightly acid to moderately alkaline.

The Vives soils are on the same landscape as the Machete and Amelia soils. They lack the B2t horizon of the Machete soils. Unlike the Amelia soils, the Vives soils lack the large amount of gravel in the profile.

Vs—Vives silty clay loam, high bottom. This nearly level soil is on river flood plains in the semiarid part of the survey area. Included with it in mapping were areas of Arenales and Guamani soils.

This soil has moderate limitations for farming because rainfall is low. Most of the acreage is in sugarcane. If the soil is properly irrigated and managed, it is suited to many kinds of crops and to sugarcane and pasture. Capability units IIc–1 nonirrigated and I–3 irrigated.

VvA—Vives clay, 0 to 2 percent slopes. This soil is on alluvial fans and terraces in the semiarid part of the survey area. Included with it in mapping were small areas of Machete soils and other Vives soils.

This soil has moderate limitations for farming because rainfall is low. Most of the acreage is planted to sugarcane. The soil is suited to sugarcane, food crops, and pasture. Capability units IIc–1 nonirrigated and I–3 irrigated.

VvB—Vives clay, 2 to 7 percent slopes. This soil is on alluvial fans and terraces in the semiarid part of the survey area. It has the profile described as representative of the series. Included with this soil in mapping were small areas of Machete and Amelia soils.

This soil has moderate limitations for farming because of low rainfall, slope, and the hazard of erosion. If it is irrigated, the soil is suited to many kinds of food crops and to sugarcane. Capability units IIIc–2 nonirrigated and IIe–1 irrigated.

Vivi Series

The Vivi series consists of deep soils that are well drained and rapidly permeable. These soils formed in moderately coarse textured and medium-textured, stratified sediment derived from plutonic rocks. They are on the river flood plains. Slopes are 0 to 2 percent. The climate is humid tropical. The average annual precipitation is 80 to 90 inches, and the average annual temperature is 78° F.

In a representative profile, the surface layer is very dark grayish-brown, very strongly acid loam about 7 inches thick. The next layer is dark grayish-brown, friable loam 7 inches thick. Below this layer is dark-brown, dark grayish-brown, and very dark grayish-brown, friable to loose very fine sandy loam, loam, coarse sand, and sandy loam that extends to a depth of 60 inches.

These soils have a moderate available water capacity and are easily worked. Runoff is slow. The soils have been in sugarcane for many years, and some areas are in pasture.

Representative profile of Vivi loam, 300 meters north of kilometer marker 4.3 on Highway No. 901:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) loam; weak, fine, granular structure; very friable, nonsticky and nonplastic; many fine roots; many fine quartz crystals; very strongly acid; clear, smooth boundary.

B—7 to 14 inches, dark grayish-brown (10YR 4/2) loam; weak, medium, subangular blocky structure; friable, nonsticky and nonplastic; common fine roots; many fine quartz crystals; strongly acid; clear, smooth boundary.

C1—14 to 20 inches, dark-brown (10YR 3/3) very fine sandy loam; massive; friable, nonsticky and nonplastic; few fine roots; many fine quartz crystals; strongly acid; clear, smooth boundary.

C2—20 to 30 inches, very dark grayish-brown (10YR 3/2) loam; massive; friable, nonsticky and nonplastic; many fine quartz crystals; strongly acid; clear, smooth boundary.

C3—30 to 36 inches, dark grayish-brown (10YR 4/2) coarse sand; single grained; loose, nonsticky and nonplastic; many fine quartz crystals; strongly acid; clear, smooth boundary.

C4—36 to 60 inches, dark grayish-brown (10YR 4/2) sandy loam; common, medium, distinct, dark-brown (7.5YR 4/4) mottles; massive; very friable, nonsticky and slightly plastic; many fine quartz grains; strongly acid.

The solum is 10 to 22 inches thick. The Ap horizon has value and chroma of 2 or 3. The B horizon has chroma of 2 or 3 and has weak, fine or medium, subangular blocky structure. The C horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 or 3. Reaction is strongly acid or very strongly acid.

The Vivi soils are on the same landscape as the Maunabo, Coloso, Talante, and Reilly soils. They are coarser textured and better drained than the Maunabo, Coloso, and Talante soils. The Vivi soils are deeper to sand and gravel than the Reilly soils, and unlike those soils, they have a B horizon.

Vw—Vivi loam. This nearly level soil is on river flood plains in the humid part of the survey area. Small areas of Reilly and Coloso soils were included with it in mapping.

This soil has moderate limitations for farming because it is rapidly permeable. It has been planted to sugarcane. If the soil is properly managed and irrigated, it is suited to food crops and sugarcane. Capability unit IIs–3.

Wet Alluvial Land

Wet alluvial land (Wa) consists of lagoonlike areas or depressions on the flood plains of the river and streams that drain the humid part of the survey area.

The water table is at or near the surface most of the year. During rainy periods the areas are covered with water. The soils range from loam to clay in texture.

Because of the high water table, lack of outlets, and high cost of reclamation, this land type is not suited to cultivated crops and is of little value for pasture, but it provides good habitat for wildlife. Capability unit VIIIw–2.

Yunes Series

The Yunes series consists of shallow soils that are well drained, strongly acid, and moderately permeable. These soils formed in very gravelly residuum of shaly sedimentary rocks. They are on side slopes and ridgetops in strongly dissected uplands. Slopes are 20 to 60 percent. The climate is humid tropical. The average annual precipitation is 76 inches, and the average annual temperature is 77° F.

In a representative profile, the surface layer is dark reddish-brown silty clay loam about 2 inches thick. Below this layer is dark-brown, friable gravelly silty clay loam that extends to a depth of 16 inches. It is underlain by bedded, fragmental shale.

These soils have a low available water capacity, are susceptible to erosion, and are difficult to work. They have been in native pasture and brush for many years.

Representative profile of Yunes silty clay loam, 20 to 60 percent slopes, eroded, 1 kilometer east of District Hospital, Bermudez Farm, municipality of Fajardo:

A1—0 to 2 inches, dark reddish-brown (5YR 3/2) silty clay loam; moderate, medium, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine shale fragments; strongly acid; abrupt, smooth boundary.

B2—2 to 11 inches, dark-brown (7.5YR 3/2) gravelly silty clay loam; weak, medium, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; 60 percent, by volume, is shale fragments; strongly acid; abrupt, smooth boundary.

B3—11 to 16 inches, dark-brown (7.5YR 4/4) gravelly silty clay loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; 80 percent, by volume, is shale fragments; strongly acid; abrupt, smooth boundary.

C—16 inches, bedded, fragmental, mixed light-red (2.5YR 6/8), strong-brown (7.5YR 5/8), and pink (7.5YR 7/4) shale; thickness of beds is from 1 to 4 inches; this material can be dug with difficulty with a spade when moist.

Thickness of the solum and depth to fragmental shale range from 10 to 20 inches. The A horizon has hue of 5YR or 7.5YR and value and chroma of 2 or 3. The B horizon has hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 2 to 4. It ranges from gravelly silty clay loam to gravelly clay loam. Reaction is strongly acid or very strongly acid.

The Yunes soils occupy the same landscape as the Caguabo soils. Unlike the Caguabo soils, the Yunes soils are strongly acid and lack hard rock.

YuF2—Yunes silty clay loam, 20 to 60 percent slopes, eroded. This soil is on side slopes and ridgetops in the humid, mountainous part of the survey area.

This soil is not suited to clean-cultivated crops. Slope, shallowness, and the hazard of erosion are severe limitations that limit its use for pasture and wildlife. Capability unit VIIs–1; woodland suitability group 4d5.

Yunque Series

The Yunque series consists of deep soils that are moderately well drained and moderately permeable. These soils formed in fine-textured, highly weathered residuum of volcanic rocks. They are on upper side slopes and ridgetops in strongly dissected uplands. Slopes are 10 to 35 percent. The average annual precipitation is 185 inches, and the average annual temperature is 72° F.

In a representative profile, the surface layer is dark yellowish-brown, very strongly acid silty clay about 8 inches thick. Yellowish-brown, firm and friable clay is between depths of 8 and 51 inches. Below this layer is yellowish-red, friable clay that has red and reddish-yellow mottles and extends to a depth of more than 68 inches.

These soils have a high available water capacity and medium fertility. Runoff is medium. The soils have been in hardwood trees and tree ferns for many years.

In this survey area, the Yunque soils are mapped only in an association with Los Guineos soils and Stony rock land.

Representative profile of Yunque silty clay, 12 to 20 percent slopes, in an area of the Los Guineos-Yunque-Stony rock land association, steep, 25 meters southeast from kilometer marker 11.9 on Highway No. 186:

A1—0 to 8 inches, dark yellowish-brown (10YR 4/4) silty clay; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; many fine roots; few fine pores; few, fine, dark minerals; few fine rock fragments; few krotovinas; very strongly acid; clear, smooth boundary.

B21t—8 to 20 inches, yellowish-brown (10YR 5/6) clay; few, fine, faint, yellowish-red mottles; weak, medium, subangular blocky structure; firm, sticky and slightly plastic; common fine roots; few fine pores; thin continuous clay films; few, fine, coated rock fragments; few krotovinas; very strongly acid; gradual, smooth boundary.

B22t—20 to 38 inches, yellowish-brown (10YR 5/8) clay; few, fine, faint, yellowish-red mottles; weak, medium, subangular blocky structure breaking to weak, fine, subangular blocky; firm, sticky and slightly plastic; few fine roots; few fine pores; thin continuous clay films; few, fine, coated rock fragments; few krotovinas; few dark minerals; very strongly acid; gradual, smooth boundary.

B23t—38 to 51 inches, yellowish-brown (10YR 5/8) clay; many, medium, distinct, red (2.5YR 4/8) mottles; weak, medium, subangular blocky structure; friable, sticky and slightly plastic; few pores; few, thin, patchy clay films; few dark concretions; very strongly acid; clear, smooth boundary.

B3—51 to 68 inches+, yellowish-red (5YR 4/8) clay; common, distinct, red (2.5YR 4/8) and reddish-yellow (7.5YR 6/8) mottles; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; few pores; very few, thin, patchy clay films; few dark minerals; strongly acid.

The solum is more than 60 inches thick. The A horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 to 4. It is silty clay loam or silty clay. The B2 horizon has dominant hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 4 to 8. It is silty clay or clay and has weak or moderate, fine or medium, subangular blocky structure. Clay films vary from thick continuous to thin patchy. The B3 horizon has hue of 5YR, 7.5YR, or 2.5YR, value of 4 to 6, and chroma of 6 to 8. It is silty clay or clay. Mean annual soil temperature at a depth of 20 inches is 66° to 72° F., and the difference between mean summer and mean winter soil temperatures is less than 9° F. Reaction is very strongly acid or strongly acid.

The Yunque soils are on the same landscape as the Utuado, Ciales, Picacho, and Los Guineos soils. The Yunque soils are finer textured than the Utuado soils, and unlike those soils they have a B2t horizon. They lack the low-chroma mottles in the B2t horizon of the Ciales and Picacho soils. The Yunque soils have a thicker B2t horizon than the Los Guineos soils.

Use and Management of the Soils

In this section the system of capability grouping used by the Soil Conservation Service is explained and the capability units in the Humacao Area are described. Estimated yields for the principal crops and pasture grasses under two levels of management are given. Management of the soils for woodland is also discussed. Information about the soil properties and limitations that affect engineering practices and recreation uses is given, mainly in tables.

Capability Grouping

Some readers, particularly those who farm on a large scale, may find it practical to use and manage alike some of the different kinds of soil on their farm. These readers can make good use of the capability classification system, a grouping that shows, in a general way, the suitability of soils for most kinds of farming.

The grouping is based on limitations of soils when used for field crops, the risk of damage when they are farmed, and the way the soils respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops that require special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations for forest trees or for engineering.

In the capability system, soils are grouped at three levels; the class, the subclass, and the unit. The classes, subclasses, and units in the Humacao Area are described in the list that follows. The capability unit for each soil is listed in the "Guide to Mapping Units" and at the end of the mapping unit description in the section "Descriptions of the Soils."

Class I. Soils that have few limitations that restrict their use.
- (No subclasses)
  - Unit I–1. Deep, nearly level, well-drained, strongly acid, medium-textured soils; on stream terraces and alluvial fans in the semiarid area.
  - Unit I–2. Deep, nearly level, moderately well drained, medium acid, moderately fine textured soils; on river flood plains in the humid area.
  - Unit I–3. Deep, nearly level, well-drained, neutral, fine textured and moderately fine textured soils; on stream terraces and alluvial fans in the semiarid area.

Class II. Soils that have moderate limitations that reduce the choice of plants or require moderate conservation practices.
- Subclass IIe. Soils subject to moderate erosion if they are not protected.
  - Unit IIe–1. Deep, gently sloping, well-drained, neutral and slightly acid, fine textured and moderately fine textured soils; on stream terraces and alluvial fans in the semiarid area.
  - Unit IIe–2. Deep, gently sloping, well-drained, strongly acid, medium-textured soils; on stream terraces in the humid area.
  - Unit IIe–3. Deep, gently sloping, well-drained, strongly acid, medium-textured soils; on stream terraces and alluvial fans in the semiarid area.
  - Unit IIe–4. Deep, gently sloping, well-drained, strongly acid, moderately fine textured soils; on coastal plains and terraces in the humid area.
- Subclass IIw. Soils that have moderate limitations because of excess water.
  - Unit IIw–1. Deep, nearly level to gently sloping, somewhat poorly drained, slightly acid, moderately fine textured and fine textured soils; on river flood plains, coastal plains, and alluvial fans in the humid area.
  - Unit IIw–2. Deep, gently sloping to strongly sloping, somewhat poorly drained, medium acid, fine-textured soils; on alluvial fans and terraces in the humid area.
  - Unit IIw–3. Deep, nearly level to gently sloping, somewhat poorly drained, very strongly acid, fine-textured soils, on alluvial fans, foot slopes, and terraces in the humid area.
  - Unit IIw–4. Deep, nearly level, poorly drained, neutral, fine textured and moderately fine textured soils; on river flood plains in the semiarid area.
  - Unit IIw–5. Deep, nearly level, somewhat poorly drained, slightly acid, moderately coarse textured soils that are underlain by sand; in the humid area.
- Subclass IIs. Soils that have moderate limitations because of tilth or low available water capacity.
  - Unit IIs–1. Deep, nearly level to gently sloping, moderately well drained and somewhat poorly drained, mildly alkaline to slightly acid, fine-textured soils that have expansive clays; on coastal plains, alluvial fans, and terraces in the semiarid area.
  - Unit IIs–2. Deep, gently sloping, moderately well drained, very strongly acid, fine-textured soils; on alluvial fans and terraces in the humid area.
  - Unit IIs–3. Deep, nearly level, well-drained, very strongly acid, medium-textured soils; on river flood plains in the humid area.
- Subclass IIc. Soils limited by lack of water.
  - Unit IIc–1. Deep, nearly level, well-drained, neutral, moderately fine textured soils; on

flood plains, alluvial fans, and terraces in the semiarid area.

Unit IIc–2. Deep, nearly level, well-drained, strongly acid, medium-textured soils; on stream terraces and alluvial fans in the semiarid area.

Class III. Soils that have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Subclass IIIe. Soils subject to severe erosion if they are cultivated and not protected.

Unit IIIe–1. Deep, strongly sloping, well-drained, very strongly acid, fine-textured soils; on terraces and foot slopes in the humid area.

Unit IIIe–2. Deep, strongly sloping, somewhat poorly drained, strongly acid, moderately coarse textured soils; on foot slopes and side slopes in the humid area.

Unit IIIe–3. Moderately deep, gently sloping to strongly sloping, well-drained, strongly acid, moderately fine textured soils; on foot slopes in the humid area.

Unit IIIe–4. Moderately deep, gently sloping to strongly sloping, well-drained, strongly acid, moderately fine textured soils; on foot slopes in the semiarid area.

Unit IIIe–5. Moderately deep, strongly sloping, moderately well drained, strongly acid, moderately fine textured, gravelly soils; on foot slopes in the humid area.

Unit IIIe–6. Deep, gently sloping to strongly sloping, well-drained, very strongly acid, moderately fine textured soils; on hilltops and foot slopes in the humid area.

Unit IIIe–7. Deep, strongly sloping, moderately well drained to somewhat poorly drained, very strongly acid, and extremely acid, fine-textured soils; on foot slopes, alluvial fans, and terraces in the humid area.

Unit IIIe–8. Deep, strongly sloping, well-drained, strongly acid, moderately fine textured soils; on coastal plains and terraces in the humid area.

Unit IIIe–9. Deep, gently sloping to strongly sloping, well-drained, strongly acid, moderately fine textured soils that are underlain by gravelly clay loam; on terraces in the humid area.

Unit IIIe–10. Deep, gently sloping to strongly sloping, well-drained, very strongly acid, medium-textured soils that are underlain by coarser textured material; on stream terraces and alluvial fans in the humid area.

Subclass IIIw. Soils that have severe limitations because of excess water.

Unit IIIw–1. Deep, nearly level, poorly drained, slightly acid, fine-textured soils; on flood plains in the humid area.

Unit IIIw–2. Deep, gently sloping, somewhat poorly drained, extremely acid, medium-textured soils; on terraces and alluvial fans in the humid area.

Unit IIIw–3. Deep, nearly level, poorly drained, very strongly acid, moderately fine textured soils that are underlain by sand; on flood plains in the humid area.

Unit IIIw–4. Deep, nearly level, poorly drained, strongly acid, fine-textured soils; on flood plains in the humid area.

Subclass IIIs. Soils that have severe limitations because of poor workability, gravel, shallowness to rock, or low available water capacity.

Unit IIIs–1. Deep, gently sloping, well-drained, medium acid, moderately fine textured, gravelly soils; on foot slopes and alluvial fans in the semiarid area.

Unit IIIs–2. Deep, nearly level, well-drained, moderately fine textured, slightly acid, friable soils that are underlain by cobbles, gravel, and sand; on flood plains in the semiarid area.

Unit IIIs–3. Moderately deep, gently sloping, well-drained, medium acid, fine-textured soils; on foot slopes in the semiarid area.

Subclass IIIc. Soils severely limited by lack of water.

Unit IIIc–1. Deep, nearly level to gently sloping, moderately well drained to somewhat poorly drained, mildly alkaline to slightly acid, fine-textured soils that have expansive clays throughout; on coastal plains, terraces, and alluvial fans.

Unit IIIc–2. Deep, gently sloping, well-drained, moderately alkaline to slightly acid, fine textured and moderately fine textured soils; on alluvial fans and terraces.

Unit IIIc–3. Deep, gently sloping, well-drained, strongly acid, medium-textured soils; on stream terraces and alluvial fans.

Class IV. Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

Subclass IVe. Soils subject to very severe erosion if they are cultivated and not protected.

Unit IVe–1. Deep, strongly sloping, somewhat poorly drained, extremely acid, medium-textured soils; on alluvial fans and foot slopes in the humid area.

Unit IVe–2. Deep, moderately steep, somewhat poorly drained, strongly acid, moderately coarse textured soils; on foot slopes in the humid area.

Unit IVe–3. Deep, strongly sloping, well-drained, very strongly alkaline to slightly acid, moderately fine textured soils that are underlain by gravel or secondary lime; on alluvial fans, terraces, and foot slopes in the semiarid area.

Unit IVe–4. Moderately deep, strongly sloping, well-drained, medium acid, fine-textured soils; on foot slopes and low rolling hills in the semiarid area.

Unit IVe–5. Deep, moderately steep and steep, well drained and moderately well drained, very strongly acid and extremely acid, fine textured and moderately fine textured soils; on uplands in the humid area.

Unit IVe–6. Moderately deep, moderately

steep, well-drained, medium acid, moderately fine textured soils; on side slopes in the humid area.

Unit IVe–7. Deep, moderately steep, well-drained, strongly acid, moderately fine textured soils; on uplands in the humid area.

Unit IVe–8. Deep, strongly sloping, well-drained, medium acid, moderately fine textured, gravelly soils; on foot slopes in the semiarid area.

Unit IVe–9. Strongly sloping, well-drained, slightly acid, medium-textured soils that are shallow to sand and are underlain by hard rock at a depth of 32 to 50 inches; on semiarid uplands.

Unit IVe–10. Deep, moderately steep, somewhat poorly drained, very strongly acid, fine-textured soils; on foot slopes in the humid area.

Unit IVe–11. Deep, steep, well-drained, very strongly acid, medium-textured soils on humid uplands.

Subclass IVw. Soils that have very severe limitations because of excess water.

Unit IVw–1. Deep, nearly level, poorly drained, very strongly acid, fine-textured soils that are underlain by organic material at a depth of 15 to 30 inches; on coastal lowlands in the humid area.

Unit IVw–2. Deep, nearly level, poorly drained, mildly alkaline, fine-textured soils that are underlain by organic material at a depth of 12 to 22 inches; on coastal lowlands in the semiarid area.

Subclass IVs. Soils that have very severe limitations because of shallowness, gravel, poor tilth, low available water capacity, or permeability.

Unit IVs–1. Deep, nearly level, moderately alkaline, very friable, excessively drained, moderately coarse textured soils that are underlain by sand and gravel at a depth of 8 to 10 inches, and have a low available water capacity; on flood plains and alluvial fans in the semiarid area.

Unit IVs–2. Strongly sloping, well-drained, neutral, moderately fine textured soils that are shallow to hard rock; on side slopes in the semiarid area.

Unit IVs–3. Nearly level, excessively drained, medium acid, moderately coarse textured soils that are shallow to sand and gravel; on flood plains in the humid area.

Subclass IVc. Soils very severely limited by lack of water.

Unit IVc–1. Deep, nearly level, well-drained, moderately fine textured, slightly acid, friable soils that are underlain by cobbles, gravel, and sand at a depth of 12 to 20 inches; on flood plains in the semiarid area.

Unit IVc–2. Moderately deep, gently sloping to strongly sloping, strongly acid to neutral, well-drained, fine-textured and moderately fine textured soils; on foot slopes.

Unit IVc–3. Deep, gently sloping, well-drained, medium acid, moderately fine textured, gravelly soils; on foot slopes and alluvial fans in the semiarid area.

Class V. Soils that are subject to little or no erosion but that have other limitations, impractical to remove, that limit their use largely to pasture, woodland, or wildlife habitat.

Subclass Vs. Soils that have severe limitations because of excess stones.

Unit Vs–1. Nearly level, medium-textured, stony soils that contain about 70 percent, by volume, stones that range from 3 to 10 inches in diameter; on flood plains of streams and rivers.

Class VI. Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture, woodland, or wildlife food and cover.

Subclass VIe. Soils severely limited, chiefly by risk of erosion if a protective cover is not maintained.

Unit VIe–1. Moderately deep, steep, well-drained, strongly acid to extremely acid, fine textured and moderately fine textured soils; on humid uplands.

Unit VIe–2. Deep, steep and very steep, well drained and moderately well drained, moderately fine textured, very strongly acid soils; on uplands where rainfall is high.

Unit VIe–3. Deep, moderately steep to steep, well-drained, strongly acid, medium-textured to moderately fine textured soils; on humid uplands.

Unit VIe–4. Moderately deep, steep, well-drained, medium acid, moderately fine textured soils; on humid uplands.

Unit VIe–5. Moderately steep to steep, well-drained, medium-textured soils that are shallow to sand and are underlain by rock at a depth of 36 to 50 inches; on semiarid uplands.

Subclass VIs. Soils generally unsuitable for cultivation and limited for other uses by their low available water capacity or shallowness to gravel or hard rock.

Unit VIs–1. Deep, nearly level, excessively drained, moderately alkaline, coarse-textured soils that have a very low available water capacity; along the coast.

Unit VIs–2. Moderately steep, well-drained, slightly acid, moderately fine textured soils that are shallow to hard rock; on humid uplands.

Unit VIs–3. Deep, nearly level, excessively drained, very strongly acid, coarse-textured soils that have a low available water capacity; along the coast.

Subclass VIc. Soils severely limited by the lack of rainfall.

Unit VIc–1. Deep, nearly level, excessively drained, mildly alkaline, friable, moderately coarse textured soils that are underlain by gravel and sand at a depth of 8 to 10 inches and have a low available water capacity; on flood plains.

Class VII. Soils that have very severe limitations that

make them unsuitable for cultivation and restrict their use largely to pasture, woodland, or wildlife food and cover.

Subclass VIIe. Soils very severely limited, chiefly by risk of erosion unless protective cover is maintained.

Unit VIIe–1. Deep and moderately deep, very steep, well drained and moderately well drained, extremely acid, moderately fine textured soils; on humid uplands.

Unit VIIe–2. Very steep, strongly acid, well-drained, medium-textured soils that are moderately deep to weathered rock; on humid uplands.

Unit VIIe–3. Shallow and deep, steep and very steep, poorly drained and moderately well drained, strongly acid to extremely acid, moderately fine textured soils; in rain forest. There are rocks in some mapping units.

Subclass VIIw. Soils that have very severe limitations because of excess water.

Unit VIIw–1. Deep, nearly level, slightly acid, poorly drained, fine-textured, saline soils; on coastal lowlands.

Subclass VIIs. Soils very severely limited by shallowness, stoniness, or a low available water capacity.

Unit VIIs–1. Moderately steep to very steep, well-drained, moderately coarse textured to moderately fine textured soils that are shallow and moderately deep to hard rock; on humid uplands. Stones on the surface are common.

Unit VIIs–2. Deep, very steep, well-drained, very strongly acid, fine-textured soils; on humid uplands. About 50 percent of the unit consists of areas covered with stones and boulders.

Unit VIIs–3. Deep and moderately deep, steep and very steep, well drained and moderately well drained, very strongly acid, moderately fine textured soils; in rain forest. A large percent of the unit consists of stony rock land.

Unit VIIs–4. Steep to very steep, well-drained, neutral, moderately fine textured soils that are shallow to rock; on semiarid uplands.

Unit VIIs–5. Shallow and moderately deep, very steep, well-drained, strongly acid to slightly acid, medium-textured soils; on humid uplands. Boulders cover 40 to 50 percent of the surface.

Unit VIIs–6. Steep, poorly drained, very strongly acid, moderately fine textured soils that are shallow to hard rock; on humid uplands.

Unit VIIs–7. Deep, nearly level to gently sloping, excessively drained, neutral soils that are sandy throughout and have a very low available water capacity; along the coast.

Class VIII. Soils and landforms that have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife habitat, water supply, or esthetic purposes.

Subclass VIIIw. Extremely wet soils or marshes.

Unit VIIIw–1. This unit consists of extremely wet areas on coastal lowlands that are periodically flooded by seawater. Texture of the soil material ranges widely and includes organic material. Only mangrove trees and other salt-tolerant vegetation grow in these areas. Cost of reclamation is high.

Unit VIIIw–2. This unit consists of low lagoonlike areas on the flood plains of the rivers and streams that drain the humid part of the survey area. The water table is at or near the surface most of the year. Texture of the soils ranges from loam to clay.

Subclass VIIIs. Very shallow, stony or sandy soils, rock, or soil material that has no potential for agriculture.

Unit VIIIs–1. This unit consists of narrow strips of light-colored beach sands along the coast. The sands are excessively drained, and saltwater is at variable depths.

Unit VIIIs–2. This unit consists of the high, jagged mountain peaks and long, very steep side slopes in the rain forest and in the mountains. Rock outcrops, loose stones, and boulders cover about 50 to 90 percent of the surface.

Estimated Yields

The estimated average yields per acre of principal crops grown in the Humacao Area are shown in table 2, and those of the principal grasses are shown in table 3. In columns A are yields expected under management common in the survey area, and in columns B are yields to be expected under improved management.

The yields are based on research data, on long-term records compiled at the sugarmills, and on information obtained from farmers and other agricultural workers.

The yields under management common in the area are the average of yields obtained during the period of the survey. They include those obtained by a few farmers practicing improved management, a few practicing poor management, and many practicing average management. Average yields mainly reflect common management practices.

Improved management includes the following practices:

1. Application of fertilizer according to the results of soil tests.
2. Adequate preparation of the seedbed, including leveling and smoothing, if feasible.
3. Drainage and control of water if needed.
4. Use of improved crop varieties.
5. Effective use of irrigation water.
6. Cultivation within the proper moisture content and to the proper depth.
7. Control of weeds, insects, and other pests and of plant diseases.
8. Harvesting crops at the proper time.
9. Management of crop residue so that the burn-

ing of sugarcane residue and other crop residue is avoided.
10. Protection from overgrazing.

Use of the Soils for Woodland [2]

When Puerto Rico was colonized in the early 1500's, the island was completely covered by forests, but land clearing for farms was soon begun. By 1880, most of the forests had been cut. Some areas were not suitable for permanent cultivation and were abandoned when their fertility was lost. Later some of these areas were again cleared, cultivated, and abandoned. Land thus abandoned generally was taken over by inferior volunteer trees.

At present, about 15 percent of the Humacao Area is covered by forest, both commercial and noncommercial. This includes the Caribbean National Forest. Nearly half of this total requires timber stand improvement or reforestation.

Forest is an excellent use of the soils in the Humacao Area for the protection of soil and water resources. Forest cover can minimize floods, reduce the amount of soil material lost as sediment in rivers, and hold runoff into periods of dry weather. In using the soils for forest in the Humacao Area, some natural noncommercial forests need to be converted to commercial, other noncommercial forests need to be protected and left in their natural state, and trees need to be planted in some nonforested areas.

The soils of the Humacao Area have been placed in woodland suitability groups to assist owners in planning the use of their soils for wood crops. Each group is made up of soils that are suited to the same kinds of trees, that need about the same management where the vegetation on them is similar, and that have the same potential production.

Each woodland group is identified by a three-part symbol, such as 1o1, 2w1, or 3w3. The potential productivity of the soils in the group is indicated by the first number in the symbol: 1 indicates very high potential productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. These ratings are based on estimates of the productivity in board feet per acre per year of suitable tree species.

The second part of the woodland suitability group symbol is a lowercase letter. In this survey area, the letters *c*, *d*, *r*, and *o* are used. Except for the *o*, the letter indicates an important soil property that imposes a hazard or limitation in managing the soils of the group for trees. The letter *o* shows that the soils have few limitations that restrict their use for trees. The letter *c* means that the soils have limitations because of the kind or amount of clay in the upper part of the soil profile. The letter *d* stands for soils that have a restricted rooting depth. Soils that are shallow to hard rock or to layers in the soil that restrict roots are examples. The letter *r* shows that the main limitation is steep slopes and that there is a hazard of erosion and possibly limitations to the use of equipment. In this survey area, *r* is used if slopes are greater than 40 percent.

The last part of the symbol, another number, differentiates woodland suitability groups that have identical first and second parts in their identifying symbol. Soils in woodland suitability group 3w1, for example, require somewhat different management than soils in group 3w2.

In the Humacao Area, many thousands of acres of soils that can produce forest trees are not placed in woodland suitability groups, because they are prime areas for growing sugarcane and for other farm uses and they are not likely to be planted to forest.

Land types are not placed in woodland suitability groups, because they are not suitable for commercial forest. They are too rocky, too exposed to wind and sun, too steep, or infertile. Among these are Rock land, Rough stony land, Tidal swamp, Tidal flats, Cobbly alluvial land, Wet alluvial land, Coastal beaches, Leveled clayey land, and Salt water marsh. These areas are not suitable for planting trees, but the existing woodland cover should be protected.

Table 4 gives a brief description of the woodland suitability groups in the Humacao Area and lists suitable tree species and their potential productivity for each group. Also, each woodland suitability group is rated for various hazards and limitations that affect management. These ratings are *slight*, *moderate*, and *severe*, and they are explained in the following paragraphs.

Seedling mortality refers to the expected degree of mortality of naturally occurring or planted tree seedlings as influenced by kinds of soil or topographic conditions. Plant competition is assumed not to be a factor, and seed supplies are assumed to be adequate. A rating of *slight* indicates a loss of 0 to 25 percent of the seedlings; *moderate* indicates a loss of 25 to 50 percent; and *severe* indicates a loss of more than 50 percent.

Erosion hazard refers to the potential erodibility of the soil and the hazard it causes. A rating of *slight* means that no special techniques in management are required. *Moderate* means that some provision in management must be made to control accelerated erosion. Roads, skid trails, fire lanes, and landing construction require some special techniques. *Severe* means that special techniques in management and special attention to roads, skid trails, fire lanes, and landing construction and maintenance are necessary to minimize accelerated erosion.

Equipment limitations depend on soil characteristics that restrict or prohibit the use of harvesting equipment, either seasonally or continually. A rating of *slight* means that there are no restrictions in the kind of equipment or the time of year it is used. *Moderate* means that the use of equipment is restricted for 3 months of the year or less. *Severe* means that special equipment is needed and that its use is severely restricted for more than 3 months of the year.

Engineering Uses of the Soils [3]

This section is useful to planning commissions, town

[2] By ROBERT W. NOBLES, project leader, Cooperative Forestry Institute of Tropical Forestry, Forest Service, U.S. Department of Agriculture.

[3] PEDRO CATONI, engineer, Soil Conservation Service, helped prepare this section.

TABLE 2.—*Estimated average yields per acre of*

[Yields in A columns are those expected under management common in the survey area, and those in B columns are expected under be grown under the

Soil	Sugarcane					
	Spring		18-month cut		Ratoons	
	A	B	A	B	A	B
	Tons	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
Aceitunas silty clay loam, 5 to 12 percent slopes	40	50	50	60	35	45
Aguadilla loamy sand [1 2]						
Aguadilla sandy loam, moderately wet						
Amelia gravelly clay loam, 2 to 5 percent slopes	35	45	40	60	30	40
Amelia gravelly clay loam, 5 to 12 percent slopes, eroded	30	40	35	50	25	35
Arenales sandy loam	25	35	35	45	20	30
Arenales sandy loam, gravelly substratum	20	30	25	40	20	25
Bajura silty clay, saline						
Bajura clay, frequently flooded	35	45	40	50	25	35
Caguabo clay loam, 12 to 20 percent slopes, eroded						
Caguabo clay loam, 20 to 60 percent slopes, eroded						
Candelero loam, 2 to 5 percent slopes	35	45	40	55	30	40
Candelero loam, 5 to 12 percent slopes, eroded	30	40	35	50	25	35
Cartagena clay	40	55	45	65	30	40
Catano loamy sand [1 2]						
Cayagua sandy loam, 5 to 12 percent slopes, eroded	30	45	35	50	25	40
Cayagua sandy loam, 12 to 20 percent slopes, eroded						
Coamo clay loam, 2 to 5 percent slopes	30	45	25	55	25	40
Coamo clay loam, 5 to 12 percent slopes	25	40	30	50	20	30
Coastal beaches						
Cobbly alluvial land						
Coloso silty clay loam, occasionally flooded	40	60	45	60	35	45
Coloso silty clay	40	50	45	60	35	45
Corcega sandy loam	35	40	40	45	25	30
Daguao silty clay loam, deep variant, 2 to 12 percent slopes	35	45	40	55	25	35
Daguao clay, 20 to 40 percent slopes, eroded						
Descalabrado clay loam, 5 to 12 percent slopes, eroded						
Descalabrado clay loam, 20 to 40 percent slopes, eroded						
Descalabrado and Guayama soils, 20 to 60 percent slopes, eroded						
Descalabrado-Rock land complex, 40 to 60 percent slopes						
Fajardo clay, 2 to 10 percent slopes	35	45	40	55	25	35
Fajardo clay, 2 to 10 percent slopes, eroded	30	40	35	50	20	30
Fortuna clay	40	55	45	65	25	35
Fraternidad clay, 0 to 2 percent slopes	50	65	55	80	40	55
Fraternidad clay, 2 to 5 percent slopes	50	65	55	80	40	55
Guamani silty clay loam	30	40	35	45	25	30
Guayabota silty clay loam, 20 to 40 percent slopes, eroded						
Guayabota-Ciales-Picacho association, very steep						
Guayama clay loam, moderately deep variant, 2 to 12 percent slopes, eroded						
Humacao loam, 2 to 5 percent slopes	35	50	50	60	25	40
Humatas clay, 20 to 40 percent slopes, eroded						
Humatas clay, 40 to 60 percent slopes, eroded						
Humatas-Stony land complex, 40 to 60 percent slopes						
Ingenio silty clay loam, 20 to 40 percent slopes, eroded						
Jacana clay, 2 to 5 percent slopes	35	40	40	55	25	35
Jacana clay, 5 to 12 percent slopes, eroded	30	35	35	50	20	30
Jagueyes loam, 20 to 40 percent slopes, eroded						
Junquitos gravelly clay loam, 5 to 12 percent slopes	35	45	40	50	30	35
Leveled clayey land						
Limones silty clay, 20 to 40 percent slopes, eroded						
Lirios clay loam, 3 to 10 percent slopes, eroded						
Lirios silty clay loam, 20 to 40 percent slopes, eroded						
Los Guineos silty clay loam, 12 to 20 percent slopes						
Los Guineos silty clay loam, 20 to 40 percent slopes, eroded						
Los Guineos silty clay loam, 40 to 60 percent slopes, eroded						
Los Guineos-Yunque-Stony rock land association, steep						
Mabi clay, 0 to 5 percent slopes	40	50	45	60	35	45
Mabi clay, 5 to 12 percent slopes, eroded	35	45	40	55	30	35
Mabi clay, 12 to 20 percent slopes, eroded	35	45	40	55	30	35
Machete loam, 0 to 2 percent slopes	40	55	60	80	35	45
Machete loam, 2 to 5 percent slopes	40	55	60	80	35	45
Made land						

See footnotes at end of table.

principal crops under two levels of management

improved management. Dashes indicate that the crop is not commonly grown on the soil, is not well suited to the soil, or cannot management specified]

Tanniers		Plantains		Bananas		Yams		Tobacco		Sweet potatoes	
A	B	A	B	A	B	A	B	A	B	A	B
Cwt	*Cwt*	*Thousands*	*Thousands*	*Cwt*	*Cwt*	*Cwt*	*Cwt*	*Cwt*	*Cwt*	*Cwt*	*Cwt*
80	100	20	30	45	55	80	125	12	15	40	50
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	14	18	—	—
—	—	—	—	—	—	—	—	10	16	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
50	80	—	—	—	—	—	—	—	—	—	—
50	80	18	25	25	35	80	120	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
55	90	20	30	18	25	80	120	10	20	—	—
80	140	18	30	20	35	140	200	10	20	60	80
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	60	80
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	60	90
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
80	100	20	30	30	40	120	200	12	20	60	90
—	—	—	—	—	—	—	—	—	—	—	—
70	85	15	18	40	50	120	190	10	12	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	15	20	—	—
—	—	—	—	—	—	—	—	14	18	—	—
—	—	—	—	—	—	—	—	14	16	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—

TABLE 2.—*Estimated average yields per acre of principal*

Soil	Sugarcane					
	Spring		18-month cut		Ratoons	
	A	B	A	B	A	B
	Tons	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
Maunabo clay	35	45	45	60	30	40
Mayo loam, 3 to 10 percent slopes	30	40	40	50	25	35
Meros sand, 1 to 6 percent slopes [1]						
Mucara silty clay loam, 12 to 20 percent slopes, eroded	35	40	40	45	25	30
Mucara silty clay loam, 20 to 40 percent slopes, eroded						
Naranjito silty clay loam, 20 to 40 percent slopes, eroded						
Naranjito silty clay loam, 40 to 60 percent slopes, eroded						
Pandura loam, 12 to 40 percent slopes, eroded [2]						
Pandura loam, 40 to 60 percent slopes, eroded [2]						
Pandura-Very stony land complex, 40 to 60 percent slopes						
Parcelas clay, 5 to 12 percent slopes, eroded	35	45	40	55	30	40
Paso Seco clay, 0 to 5 percent slopes	50	70	60	80	40	50
Patillas clay loam, 12 to 20 percent slopes, eroded	35	40	40	50	25	30
Patillas clay loam, 20 to 40 percent slopes, eroded						
Pinones silty clay	30	40	40	50	25	30
Poncena clay	35	45	45	55	25	30
Pozo Blanco clay loam, 5 to 12 percent slopes, eroded	30	40	40	55	25	30
Reilly soils						
Reparada clay	30	40	40	50	25	30
Rio Arriba clay, 2 to 5 percent slopes	40	50	45	60	30	35
Rio Arriba clay, 5 to 12 percent slopes, eroded	35	45	40	55	25	30
Rock land						
Rough stony land						
Sabana silty clay loam, 20 to 40 percent slopes, eroded						
Sabana silty clay loam, 40 to 60 percent slopes, eroded						
Salt water marsh						
Talante soils	35	40	40	50	25	35
Teja gravelly sandy loam, 12 to 40 percent slopes						
Tidal flats						
Tidal swamp						
Toa silty clay loam	40	50	50	70	35	45
Utuado-Picacho-Stony rock land association, very steep						
Vayas silty clay loam, occasionally flooded	45	55	50	65	40	45
Vayas silty clay, frequently flooded	40	50	45	60	35	40
Vega Alta silty clay loam, 2 to 5 percent slopes	35	40	40	55	30	35
Vega Alta silty clay loam, 5 to 12 percent slopes	35	40	40	55	30	35
Vega Baja silty clay loam, 0 to 3 percent slopes	35	45	45	55	30	40
Via silty clay loam, 3 to 10 percent slopes	35	40	40	50	30	35
Vieques loam, 5 to 12 percent slopes	35	45	45	55	25	30
Vieques loam, 12 to 40 percent slopes, eroded						
Vives silty clay loam, high bottom	55	70	65	85	45	55
Vives clay, 0 to 2 percent slopes	45	60	60	80	35	45
Vives clay, 2 to 7 percent slopes	40	55	55	75	35	40
Vivi loam	35	45	50	60	30	40
Wet alluvial land						
Yunes silty clay loam, 20 to 60 percent slopes, eroded						

[1] This soil produces 8,000 coconuts under management common in the area and 10,000 coconuts under improved management.

and city managers, land developers, engineers, contractors, farmers, and others who need information about soils used as structural material or as foundation on which structures are built.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, drainage, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who–

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.

crops under two levels of management—Continued

Tanniers		Plantains		Bananas		Yams		Tobacco		Sweet potatoes	
A	B	A	B	A	B	A	B	A	B	A	B
Cwt	*Cwt*	*Thousands*	*Thousands*	*Cwt*	*Cwt*	*Cwt*	*Cwt*	*Cwt*	*Cwt*	*Cwt*	*Cwt*
70	90	16	20	40	50	90	110	14	18	60	80
										45	60
										50	70
										60	90
80	120	12	20	40	50	70	120	10	20		
								18	20	75	95

[3] This soil produces 30 hundred weights of cassava under management common in the area and 45 hundred weights under improved management.

3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the soils on which they are built, to help predict performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables. Table 5 shows estimated soil properties significant in engineering. Table 6 gives interpretations for various engineering uses. Table 7 shows the results of engineering laboratory tests on soil samples.

This information, along with the soil map and data

TABLE 3.—*Estimated average yields per acre of principal pasture grasses*

[Yields in A columns are those expected under management common in the survey area, and those in B columns are expected under improved management. Dashes indicate that the crop is not commonly grown on the soil, is not well suited to the soil, or cannot be grown under the management specified]

Soil	Stargrass and pangolagrass		Guineagrass		Paragrass		Merkergrass	
	A	B	A	B	A	B	A	B
	AUM [1]	*AUM* [1]	*AUM* [1]	*AUM* [1]	*AUM* [1]	*AUM* [1]	*AUM* [1]	*AUM* [1]
Aceitunas silty clay loam, 5 to 12 percent slopes	18	24			12	17	48	60
Aguadilla loamy sand	12	20					30	48
Aguadilla sandy loam, moderately wet	12	20					30	48
Amelia gravelly clay loam, 2 to 5 percent slopes			3	6				
Amelia gravelly clay loam, 5 to 12 percent slopes, eroded			3	6				
Arenales sandy loam								
Arenales sandy loam, gravelly substratum								
Bajura silty clay, saline								
Bajura clay, frequently flooded	18	24			18	24	48	60
Caguabo clay loam, 12 to 20 percent slopes, eroded	8	12						
Caguabo clay loam, 20 to 60 percent slopes, eroded	8	12						
Candelero loam, 2 to 5 percent slopes	18	24			18	24	50	60
Candelero loam, 5 to 12 percent slopes, eroded	18	24			18	24	50	60
Cartagena clay			3	6				
Catano loamy sand	12	20					30	48
Cayagua sandy loam, 5 to 12 percent slopes, eroded	18	24					50	60
Cayagua sandy loam, 12 to 20 percent slopes, eroded	18	24					50	60
Coamo clay loam, 2 to 5 percent slopes								
Coamo clay loam, 5 to 12 percent slopes								
Coastal beaches								
Cobbly alluvial land								
Coloso silty clay loam, occasionally flooded	18	24			18	24	48	60
Coloso silty clay	18	24			18	24	48	60
Corcega sandy loam	18	24			18	24	48	60
Daguao silty clay loam, deep variant, 2 to 12 percent slopes	18	24					40	60
Daguao clay, 20 to 40 percent slopes, eroded	15	21					30	45
Descalabrado clay loam, 5 to 12 percent slopes, eroded			3	4				
Descalabrado clay loam, 20 to 40 percent slopes, eroded			3	4				
Descalabrado and Guayama soils, 20 to 60 percent slopes, eroded			3	4				
Descalabrado-Rock land complex, 40 to 60 percent slopes			3	4				
Fajardo clay, 2 to 10 percent slopes	18	24					50	60
Fajardo clay, 2 to 10 percent slopes, eroded	18	24					50	60
Fortuna clay	18	24			18	24	48	60
Fraternidad clay, 0 to 2 percent slopes			3	6				
Fraternidad clay, 2 to 5 percent slopes			3	6				
Guamani silty clay loam								
Guayabota silty clay loam, 20 to 40 percent slopes, eroded	14	20					30	48
Guayabota-Ciales-Picacho association, very steep								
Guayama clay loam, moderately deep variant, 2 to 12 percent slopes, eroded			3	4				
Humacao loam, 2 to 5 percent slopes	18	24					48	60
Humatas clay, 20 to 40 percent slopes, eroded	15	21					30	45
Humatas clay, 40 to 60 percent slopes, eroded	15	21					30	45
Humatas-Stony land complex, 40 to 60 percent slopes								
Ingenio silty clay loam, 20 to 40 percent slopes, eroded	15	21					30	45
Jacana clay, 2 to 5 percent slopes			3	6				
Jacana clay, 5 to 12 percent slopes, eroded			3	6				
Jagueyes loam, 20 to 40 percent slopes, eroded	15	21					30	45
Junquitos gravelly clay loam, 5 to 12 percent slopes	18	24					48	60
Leveled clayey land								
Limones silty clay, 20 to 40 percent slopes, eroded	15	21						
Lirios clay loam, 3 to 10 percent slopes, eroded	18	24					40	60
Lirios silty clay loam, 20 to 40 percent slopes, eroded	15	21					30	45
Los Guineos silty clay loam, 12 to 20 percent slopes	14	20					30	48
Los Guineos silty clay loam, 20 to 40 percent slopes, eroded	14	20					30	48
Los Guineos silty clay loam, 40 to 60 percent slopes, eroded	14	20					30	48
Los Guineos-Yunque-Stony rock land association, steep								
Mabi clay, 0 to 5 percent slopes	18	24					48	60
Mabi clay, 5 to 12 percent slopes, eroded	18	24					48	60
Mabi clay, 12 to 20 percent slopes, eroded	18	24					48	60

See footnotes at end of table.

TABLE 3.—*Estimated average yields per acre of principal pasture grasses*—Continued

Soil	Stargrass and pangolagrass		Guineagrass		Paragrass		Merkergrass	
	A	B	A	B	A	B	A	B
	AUM[1]	*AUM*[1]	*AUM*[1]	*AUM*[1]	*AUM*[1]	*AUM*[1]	*AUM*[1]	*AUM*[1]
Machete loam, 0 to 2 percent slopes								
Machete loam, 2 to 5 percent slopes								
Made land								
Maunabo clay	18	24			18	24	48	60
Mayo loam, 3 to 10 percent slopes	18	24					48	60
Meros sand, 1 to 6 percent slopes								
Mucara silty clay loam, 12 to 20 percent slopes, eroded	18	24					48	60
Mucara silty clay loam, 20 to 40 percent slopes, eroded	8	12						
Naranjito silty clay loam, 20 to 40 percent slopes, eroded	15	21					30	45
Naranjito silty clay loam, 40 to 60 percent slopes, eroded	15	21					30	45
Pandura loam, 12 to 40 percent slopes, eroded	7	11					24	40
Pandura loam, 40 to 60 percent slopes, eroded	7	11					24	40
Pandura-Very stony land complex, 40 to 60 percent slopes								
Parcelas clay, 5 to 12 percent slopes, eroded	18	24					50	60
Paso Seco clay, 0 to 5 percent slopes			3	6				
Patillas clay loam, 12 to 20 percent slopes, eroded	18	24					40	60
Patillas clay loam, 20 to 40 percent slopes, eroded	15	21					30	45
Pinones silty clay	18	24			18	24	48	60
Poncena clay			3	6				
Pozo Blanco clay loam, 5 to 12 percent slopes, eroded			3	6				
Reilly soils	18	22					48	60
Reparada clay								
Rio Arriba clay, 2 to 5 percent slopes	18	24			12	17	48	60
Rio Arriba clay, 5 to 12 percent slopes, eroded	18	24			12	17	48	60
Rock land								
Rough stony land								
Sabana silty clay loam, 20 to 40 percent slopes, eroded	8	12						
Sabana silty clay loam, 40 to 60 percent slopes, eroded	8	12						
Salt water marsh								
Talante soils	18	24			18	24	48	60
Teja gravelly sandy loam, 12 to 40 percent slopes	14	20					30	48
Tidal flats								
Tidal swamp								
Toa silty clay loam	18	24					48	60
Utuado-Picacho-Stony rock land association, very steep								
Vayas silty clay loam, occasionally flooded								
Vayas silty clay, frequently flooded								
Vega Alta silty clay loam, 2 to 5 percent slopes	18	24			12	17	48	60
Vega Alta silty clay loam, 5 to 12 percent slopes	18	24			12	17	48	56
Vega Baja silty clay loam, 0 to 3 percent slopes	18	24			18	24	48	60
Via silty clay loam, 3 to 10 percent slopes	18	24					48	60
Vieques loam, 5 to 12 percent slopes								
Vieques loam, 12 to 40 percent slopes, eroded								
Vives silty clay loam, high bottom	18	24					48	60
Vives clay, 0 to 2 percent slopes	18	24					48	60
Vives clay, 2 to 7 percent slopes	18	24					48	60
Vivi loam	18	24					48	60
Wet alluvial land								
Yunes silty clay loam, 20 to 60 percent slopes, eroded	14	20					30	48

[1] AUM is animal-unit-months, a term used to express the carrying capacity of pasture. It is the number of months during the year that 1 acre will provide grazing for 1 animal unit (one cow, one horse, one mule, five hogs, or seven sheep) without damage to the pasture.

in other parts of this publication, can be used to make interpretations in addition to those given in tables 5 and 6, and it also can be used to make useful maps.

This information, however, does not eliminate the need for further investigation at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths of more than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil can include small areas of other kinds of soil that have strongly contrasting properties and different suitability or limitations for soil engineering.

Some of the terms used in this soil survey have special meaning to soil scientists. The Glossary defines many of the terms commonly used in soil science.

TABLE 4.—*Woodland management*

Woodland suitability group and map symbols	Potential productivity		Hazards and limitations that affect management		
	Suitable trees	Average yearly growth per acre	Seedling mortality	Erosion hazard	Equipment limitations
		Board feet			
Group 2c3. Moderately well drained, moderately fine textured, very strongly acid soils that are deep and have slopes of 12 to 40 percent; in a humid climate; at an elevation of more than 500 meters. LsD, LsE2.	Honduras pine Eucalyptus Kadam	1,400 2,000 1,800	Slight	Slight for LsD. Moderate for LsE2.	Moderate.
Group 2c5. Well drained and moderately well drained, fine textured and moderately fine textured, very strongly acid soils that are deep and moderately deep to tuffaceous and plutonic rocks and have slopes of 3 to 40 percent; in a humid climate; at an elevation of less than 500 meters. HtE2, LeE2, LoC2, LrE2, NaE2.	Honduras pine Teak Mahogany	1,100 on HtE2, LoC2, and LrE2. 1,200 on NaE2. 1,300 on LeE2. 250 on HtE2, LoC2, and LrE2. 300 on HtE2, LoC2, and LrE2.	Slight	Slight for LoC2. Moderate for HtE2, LeE2, LrE2, and NaE2.	Slight for LoC2. Moderate for HtE2, LeE2, LrE2, and NaE2.
Group 2r3. Moderately well drained, moderately fine textured, very strongly acid soils that are deep and have slopes of 40 to 60 percent; in a humid climate; at an elevation of more than 500 meters. LsF2.	Honduras pine Eucalyptus Kadam	1,300 2,000 1,800	Slight	Moderate	Severe.
Group 2o2. Well-drained, moderately fine textured, neutral to very strongly alkaline soils that are deep and have slopes of 5 to 12 percent; in a semiarid climate. PrC2.	Mahogany	500	Slight	Slight	Slight.
Group 2o5. Well-drained, medium-textured and moderately fine textured, strongly acid to very strongly acid soils that are deep and moderately deep to plutonic rock and have slopes of 12 to 40 percent; in a humid climate; at an elevation of less than 500 meters. InE2, JgE2, PaE2, PmD2, PmE2.	Honduras pine	1,100 on PaE2, PmD2, and PmE2. 1,200 on JgE2. 1,300 on InE2.	Slight	Slight for PmD2. Moderate for InE2, JgE2, PaE2, and PmE2.	Moderate.
Group 3d5. Well-drained, moderately fine textured and fine textured, neutral to strongly acid soils that are shallow and moderately deep to tuffaceous and plutonic rock and have slopes of 2 to 40 percent; some are underlain by coarse sand; in humid and semiarid climates; at an elevation of less than 500 meters. CbD2, DaC, DcE2, DeC2, DeE2, GyC2, JaB, JaC2, MuD2, MuE2, SaE2, VmC, VmE2.	Honduras pine Kadam Mahogany	800 on CbD2, and SaE2. 900 on DaC2, DcE2, MuD2, and MuE2. 1,400 on CbD2, MuD2, and MuE2. 300 on DeC2, DeE2, GyC2, VmC, and VmE2. 400 on JaB, JaC2, MuD2, and MuE2.	Slight for CbD2, DaC, DcE2, DeC2, DeE2, GyC2, JaB, JaC2, MuD2, MuE2, SaE2, and VmC. Moderate for VmE2.	Slight for CbD2, DaC, DeC2, GyC2, JaB, JaC2, MuD2, and VmC. Moderate for DcE2, DeE2, MuE2, SaE2, and VmE2.	Slight for DaC, DeC2, GyC2, JaB, JaC2, and VmC. Moderate for CbD2, DcE2, DeE2, MuD2, MuE2, SaE2, and VmE2.
Group 3r3. Well drained and moderately well drained, fine textured and moderately fine textured, very strongly acid soils that are deep to tuffaceous and plutonic rock and have slopes of 10 to 100 percent; some are underlain by sandy loam; in places there are rocks on the surface; in a humid climate; at an elevation of more than 500 meters. LyF, UpF.	Honduras pine	800	Severe	Severe	Severe.

TABLE 4.—*Woodland management*—Continued

Woodland suitability group and map symbols	Potential productivity		Hazards and limitations that affect management		
	Suitable trees	Average yearly growth per acre	Seedling mortality	Erosion hazard	Equipment limitations
		Board feet			
Group 3r5. Well-drained, medium-textured to fine-textured, slightly acid to very strongly acid soils that are deep and moderately deep to tuffaceous and plutonic rock and have slopes of 40 to 60 percent; some are underlain by sandy loam; others have rocks on the surface; in a humid climate; at an elevation of less than 500 meters. HtF2, HuF, NaF2, PaF2.	Honduras pine	800 on PaF2. 900 on HtF2, HuF, and NaF2.	Slight on HtF2, HuF, and NaF2. Moderate on PaF2.	Moderate on HtF2, HuF, and NaF2. Severe on PaF2.	Severe.
Group 4d3. Poorly drained and moderately well drained, fine textured and moderately fine textured, very strongly acid and extremely acid soils that are deep and shallow to hard siltstone and have slopes of 5 to more than 60 percent; some are underlain by loam; in tropical rain forest; at an elevation of more than 500 meters. GuE2, GvF.	Honduras pine	800	Moderate	Severe	Severe.
Group 4d5. Well-drained, medium-textured and moderately fine textured, neutral to very strongly acid soils that are shallow and moderately deep to tuffaceous and plutonic rock and have slopes of 12 to 60 percent; some are underlain by sandy loam; others have from 15 to 50 percent of the surface covered by rocks; in humid and semiarid climates; at an elevation of less than 500 meters. CbF2, DgF2, DrF, PdF, SaF2, TeE, YuF2.	Honduras pine Mahogany	600 on TeE. 700 on CbF2, PdF, SaF2, and YuF2. 700 on DgF2, and DrF.	Moderate on CbF2, SaF2, and YuF2. Severe on DgF2, DrF, PdF, and TeE.	Severe	Severe.

Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*7*) used by SCS engineers, the Department of Defense, and others and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*1*).

In the Unified system, soils are classified according to particle-size distribution, plasticity, liquid limit, and organic matter. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes, for example, CL–ML.

The AASHTO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHTO classification for tested soils, with group index numbers in parentheses, is shown in table 7; the estimated classification, without group index numbers, is given in table 5 for all the soils mapped in the survey area.

Soil properties significant in engineering

Several estimated soil properties significant in engineering are given in table 5. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the column headings in table 5.

Depth to bedrock is distance from the surface of the soil to the rock layer.

Depth to seasonal high water table is distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

Soil texture is described in table 5 in the standard

TABLE 5.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The as indicated in the first column of this table. The symbol

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification	
	Bedrock	Seasonal high water table			Unified	AASHTO
	Feet	*Feet*	*Inches*			
Aceitunas: AcC	>6	>6	0–60	Silty clay loam, clay, and silty clay.	MH	A–7
Aguadilla: Ad, Ag	>6	>6	0–8 8–58	Loamy sand Sand	SM SP	A–2–4 A–3
Amelia: AmB, AmC2	>6	>6	0–46	Gravelly clay loam and gravelly clay.	GC	A–6
Arenales: An, Ar	>6	>6	0–8 8–24 24–42 42–50	Sandy loam Loamy sand Sand Gravel	SM SM SP or SM GP	A–2, A–4 A–2 A–1 A–1
Bajura: Ba, Bc	>6	1½–2½	0–60	Clay	CH	A–7
Caguabo: CbD2, CbF2	1–1½	>6	0–17 17	Gravelly clay loam Hard rock.	CL	A–6
Candelero: CdB, CdC2	>6	2½–5	0–7 7–64	Loam Sandy clay loam	SM or SC SC	A–4 A–6
Cartagena: Ce	>6	2½–5	0–45	Clay and silty clay	CH	A–7
Catano: Cf	>6	>6	0–64	Sand	SP	A–1
Cayagua: CgC2, CgD2	>6	>6	0–4 4–20 20–100	Sandy loam Clay Sandy loam	SM MH SM–SC	A–2 A–7 A–2
Ciales Mapped only in an association with Guayabota and Picacho soils.	>6	>6	0–7 7–26 26–60	Silty clay loam Clay Clay and silty clay loam.	MH MH MH	A–7 A–7 A–7
Coamo: CIB, CIC	>6	>6	0–15 15–38 38–48	Clay loam Clay Gravelly clay loam	CL–ML MH–CH CL	A–6 A–7 A–6
Coastal beaches: Cm	>6	Wave action	0–60	Sand	SP	A–1
Cobbly alluvial land: Cn. Properties are too variable to be estimated.						
Coloso: Co, Cr	>6	2–4	0–27 32–60	Silty clay loam Clay	CL CH	A–7 A–7
Corcega: Cs	>6	1½–2½	8–14 14–32 32–50	Silty clay loam Sandy clay loam Sand	CL SC SP	A–7 A–2 A–1
Daguao, deep variant: ĐaC	2–3½	>6	0–35 35–45 45	Clay Saprolite. Hard rock.	MH, CH	A–7
Daguao: DcE2	2–3½	>6	0–21 21–34 34	Clay Saprolite. Hard rock.	MH, CH	A–7

See footnotes at end of table.

significant in engineering

soils in such mapping units may have different properties and limitations, and for this reason it is necessary to refer to other series
> means more than; the symbol < means less than]

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
						Inches per hour	*Inches per inch of soil*	*pH*			
100	100	90–100	75–95	70–80	20–30	0.6–2.0	0.10–0.15	4.5–5.0	Moderate	High	High.
100	100	50–75	15–30	[1] NP	[1] NP	6.0–20.0	0.03–0.05	4.5–5.5	Very low	Very low	High.
100	100	50–70	5–15	NP	NP	>20.0	<.03	4.5–6.0	Very low	Very low	High.
60–70	50–60	40–50	35–40	40–50	30–40	0.6–2.0	0.10–0.15	5.6–7.3	Moderate	Low	Moderate.
100	100	60–70	30–40	NP	NP	6.3–20.0	0.07–0.09	6.6–7.8	Very low	Very low	Low.
100	100	50–75	15–30	NP	NP	6.3–20.0	0.05–0.07	7.9–8.4	Very low	Very low	Low.
100	100	50–70	5–15	NP	NP	>20.0	0.03–0.05	7.4–8.4	Very low	Very low	Low.
25–50	25–50	13–35	2–5	NP	NP	>20.0	0.02–0.03	7.4–8.4	Very low	Very low	Low.
100	100	90–100	75–95	60–70	40–50	0.06–0.20	0.15–0.17	5.6–6.0	High	Very high	Moderate.
100	100	90–100	70–80	55–65	17–22	0.6–2.0	0.10–0.15	6.1–6.5	Moderate	Low	Low.
100	100	65–75	35–45	25–35	4–10	0.60–2.0	0.11–0.13	<4.5	Low	High	High.
100	100	80–90	35–50	25–35	15–25	0.06–0.20	0.13–0.15	4.5–5.5	Moderate	High	High.
100	100	90–100	75–95	50–70	40–45	0.06–0.20	0.15–0.18	6.6–8.4	Very high	Very high	Low.
100	100	50–70	5–15	NP	NP	>20.0	<.03	7.9–8.4	Very low	Very low	Low.
100	100	60–70	25–35	14–20	NP	2.0–6.0	0.03–0.05	4.5–5.5	Very low	Very high	Moderate.
100	100	90–100	75–95	70–80	30–40	0.06–0.20	0.15–0.20	4.5–5.5	Moderate	Very high	Moderate.
100	100	60–70	25–35	14–20	NP	6.0–20.0	0.05–0.10	4.5–5.5	Very low	Very high	Moderate.
100	100	95–100	85–95	70–80	27–32	0.6–2.0	0.10–0.12	4.5–5.0	Moderate	High	High.
100	100	90–100	75–95	80–90	35–45	0.06–0.2	0.09–0.11	4.5–5.0	Moderate.		
100	100	95–100	85–95	70–80	10–20	0.6–2.0	0.16–0.18	4.5–5.0	Moderate.		
100	100	90–100	70–80	30–50	10–20	0.6–2.0	0.10–0.15	5.1–5.5	Moderate	Moderate	Low.
100	100	90–100	75–95	60–75	28–35	0.6–2.0	0.10–0.15	7.4–8.4	High	Moderate	Low.
65–85	65–85	55–75	35–50	55–65	17–22	2.0–6.0	0.05–0.10	7.4–8.4	Low	Moderate	Low.
100	100	50–70	5–15	NP	NP	>20.0	<.03	6.6–8.4	Low	High	High.
100	100	45–100	85–95	40–50	25–35	0.06–0.20	0.15–0.20	6.1–6.5	Moderate	High	Moderate.
100	100	90–100	75–95	70–80	48–55	0.06–0.20	0.15–0.20		Moderate	High	Moderate.
100	90–100	85–95	75–85	40–50	25–35	0.6–2.0	0.12–0.14	5.6–6.5	Moderate	High	Moderate.
100	90–100	65–80	25–35	25–35	15–25	0.6–2.0	0.09–0.11	5.6–6.5	Low	High	Moderate.
100	100	50–70	5–15	NP	NP	6.0–20.0	0.03–0.05	5.6–6.5	Very low	High	Moderate.
100	100	90–100	75–95	50–60	25–30	0.2–0.6	0.10–0.15	4.5–5.5	High	Moderate	Moderate.
100	100	90–100	75–95	50–60	25–30	0.2–0.6	0.10–0.15	4.5–5.5	High	Moderate	Moderate.

TABLE 5.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification	
	Bedrock	Seasonal high water table			Unified	AASHTO
	Feet	*Feet*	*Inches*			
*Descalabrado: DeC2, DeE2, DgF2, DrF. For the Guayama part of DgF2, see the Guayama series. Properties of the Rock land part are too variable to be estimated.	1–1½	>6	0–10 10–14 14–19 19	Clay loam Silty clay Saprolite. Hardrock.	CL CH	A–6 A–7
Fajardo: FaC, FaC2	>6	>3½	0–60	Clay	CH	A–7
Fortuna: Fo	>6	2½–3	0–77	Clay	CH	A–7
Fraternidad: FrA, FrB	>6	>6	0–50	Clay	CH	A–7
Guamani: Gm[2]	>6	>6	0–20 20–50	Silty clay loam Sand and gravel	CL–ML GP	A–6 A–1
*Guayabota: GuE2, GvF For the Ciales and Picacho parts of GvF, see the Ciales and Picacho series.	1–1½	>6	0–18 18–20	Silty clay and silty clay loam. Hard siltstone.	MH	A–7
Guayama Mapped only in an undifferentiated group with Descalabrado soils.	1–1½	>6	0–5 5–18 18	Clay loam Gravelly clay and gravelly clay loam. Volcanic rock.	CL GC	A–6 A–6
Guayama, moderately deep variant: GyC2.	1½–2½	>6	0–8 8–26 26	Clay loam Clay Hardrock.	CL–ML MH	A–6 A–7
Humacao: HmB	>6	>6	0–18 18–55	Loam Clay loam	ML CL–ML	A–4 A–6
Humatas: HtE2, HtF2, HuF Properties of the Stony land part of HuF are too variable to be estimated.	>6	>6	0–60	Clay, silty clay and silty clay loam.	MH	A–7
Ingenio: InE2	>6	>6	0–40 40–110	Silty clay and clay Saprolite silty clay loam and silt loam.	MH CL–ML	A–7 A–4, A–7
Jacana: JaB, JaC2	1½–3	>6	0–26 26	Clay Bedrock.	CH	A–7
Jagueyes: JgE2	>6	>6	0–8 8–52 52–95	Loam Clay loam Loam	ML CL ML	A–4 A–6 A–6
Junquitos: JuC	1½–3	>6	0–7 7–35 35	Gravelly clay Clay Rock fragments.	GM GH	A–6 A–7
Leveled clayey land: Lc	>6	>6	0–60	Clay	MH	A–7
Limones: LeE2	>6	>6	0–72	Clay	MH	A–7
Lirios: LoC2, LrE2	>6	>6	0–23 23–50	Clay and silty clay Silty clay loam	MH ML	A–7 A–7

See footnotes at end of table.

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
						Inches per hour	*Inches per inch of soil*	*pH*			
100	100	90–100	70–80	30–50	10–20	0.6–2.0	0.10–0.15	6.1–7.3	Moderate	High	Low.
100	100	95–100	90–95	60–70	40–50	0.6–2.0	0.10–0.15	6.1–7.3	Moderate	High	Low.
100	100	90–100	75–95	60–105	60–70	0.06–0.20	0.15–0.20	5.1–6.0	High	Very high	Moderate.
100	100	90–100	75–95	70–80	42–50	0.06–0.20	0.15–0.20	4.5–5.5	High	Very high	Moderate.
100	100	90–100	75–95	50–90	30–60	0.06–0.20	0.15–0.18	6.1–7.8	Very high	Very high	Low.
100	100	95–100	85–95	40–45	15–20	0.6–2.0	0.12–0.14	6.1–7.9	Low	Low	Low.
				NP	NP	>20.0	<.05		Very low	Low	Low.
100	100	95–100	85–95	70–80	27–32	0.06–0.20	0.15–0.20	4.5–5.5	Moderate	Very high	Moderate.
100	100	90–100	70–80	30–50	10–20	0.6–2.0	0.10–0.15	5.1–6.5	Moderate	Moderate	Low.
40–65	40–65	25–50	15–20	30–40	10–20	0.6–2.0	0.10–0.15	5.1–6.5	Moderate.		
100	100	90–100	70–80	30–50	10–20	0.6–2.0	0.10–0.15	5.1–6.5	Moderate	Moderate	Low.
100	100	90–100	75–95	50–60	25–30	0.6–2.0	0.10–0.15	5.1–6.5	Moderate	Moderate	Low.
100	100	80–95	60–75	28–35	4–8	0.6–2.0	0.10–0.12	5.1–6.0	Low	Moderate	Moderate.
100	100	90–100	70–80	25–35	10–20	0.6–2.0	0.12–0.14	5.6–6.5	Moderate	Moderate	Moderate.
100	100	90–100	70–100	40–60	10–24	0.6–2.0	0.11–0.18	4.5–5.0	Moderate	Moderate	Moderate.
100	100	90–100	75–95	50–60	20–24	0.6–2.0	0.10–0.15	4.5–5.5	Moderate	High	Moderate.
100	100	90–100	65–75	40–50	10–20	2.0–6.0	0.08–0.12	4.5–5.0	Low	High	Moderate.
100	100	75–85	70–95	70–75	40–50	0.2–0.6	0.12–0.16	5.6–7.3	High	High	Low.
100	100	85–95	60–70	35–50	6–14	2.0–6.0	0.08–0.12	4.5–5.5	Very low	Low	Moderate.
100	100	90–100	70–80	35–45	15–25	0.6–2.0	0.10–0.14	4.5–5.5	Low	Low	Moderate.
100	100	85–95	60–75	40–50	10–15	2.0–6.0	0.08–0.12	4.5–5.5	Very low	Low	Moderate.
65–75	65–75	55–65	35–45	30–40	5–10	0.6–2.0	0.10–0.15	4.5–5.0	Moderate	High	Moderate.
95–100	95–100	85–95	70–90	60–75	28–35	0.2–0.6	0.13–0.16	5.1–6.5	High	High	Moderate.
100	100	90–100	75–95	80–90	35–45			4.0–6.5	Moderate.		
100	100	90–100	75–95	80–90	36–44	0.6–2.0	0.15–0.17	4.5–5.5	Moderate	Moderate	Moderate.
100	100	80–90	65–95	55–60	20–29	0.6–2.0	0.10–0.15	4.5–5.5	Moderate	High	High.
100	100	85–90	80–85	40–50	12–20	2.0–6.0	0.08–0.10	4.5–5.0	Low	High	High.

TABLE 5.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification	
	Bedrock	Seasonal high water table			Unified	AASHTO
	Feet	*Feet*	*Inches*			
*Los Guineos: LsD, LsE2, LsF2, LyF. For the Yunque part of LyF, see the Yunque series. Properties of the Stony rock land part of LyF are too variable to be estimated.	>6	>6	0–60	Clay	MH	A–7
Mabi: MaB, MaC2, MaD2	>6	>5	0–60	Clay	CH	A–7
Machete: McA, McB	>6	>6	0–20	Loam	ML	A–6
			20–32	Clay	MH	A–7
			32–45	Sandy clay loam	SC	A–6
			45–60	Loamy sand	SM	A–2
Made land: Md. Properties are too variable to be estimated.						
Maunabo: Me	>6	1½–3½	0–39	Clay and silty clay	CH	A–7
			39–48	Sandy loam	SM	A–2
Mayo: MlC	>6	>6	0–60	Sandy loam and loamy sand.	SM	A–2
Meros: MrB	>6	>6	0–60	Sand	SP	A–1
Mucara: MuD2, MuE2	2–3	>6	0–18	Silty clay loam, silty clay.	CH	A–7
			18–32	Saprolite.		
			32	Bedrock.		
Naranjito: NaE2, NaF2	2–3	>6	0–38	Silty clay loam, clay and clay loam.	MH	A–7
			38	Volcanic rock.		
Pandura: PaE2, PaF2, PdF. Properties of the Very stony land part of PdF are too variable to be estimated.	1–1½	>6	0–7	Loam	ML, SM	A–4
			7–19	Sandy loam	SM	A–2
			19–35	Weathered igneous rock (rippable).		
Parcelas: PeC2	>6	>6	0–60	Clay and clay loam	CH	A–7
Paso Seco: PlB	>6	>6	0–19	Clay	CH	A–7
			19–38	Gravelly clay	GC	A–2
			38–50	Gravelly loam	GM	A–1
Patillas: PmD2, PmE2	>6	>6	0–19	Clay loam	CL–ML	A–6
			19–48	Saprolite, sandy loam	SM	A–2
Picacho Mapped only in associations with Guayabota and Ciales soils and with Utuado soils and Stony rock land.	>6	>6	0–9	Silty clay loam	MH	A–7
			9–35	Clay	MH	A–7
			35–72	Clay loam, silty clay loam.	MH	A–7
Pinones: Pn	>6	1–2½	0–18	Silty clay	CH	A–7
			18–58	Organic material.		
Poncena: Po	>6	2½–5	0–41	Clay	CH	A–7
Pozo Blanco: PrC2	>6	>6	0–15	Clay loam	CL	A–6
			15–58	Silty soft limestone	CL	A–4

See footnotes at end of table.

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
						Inches per hour	*Inches per inch of soil*	*pH*			
100	100	95–100	75–100	50–70	11–20	0.6–2.0	0.15–0.20	4.5–5.5	Moderate	High	High.
100	100	85–95	85–90	55–75	45–60	0.06–0.20	0.15–0.20	5.1–6.5	Very high	Very high	Moderate.
100	100	85–100	60–80	20–40	4–6	2.0–6.0	0.08–0.12	4.5–5.5	Low	Low	Moderate.
100	100	90–100	75–95	80–90	36–44	0.6–2.0	0.10–0.14	4.5–5.5	Moderate	Low	Moderate.
100	100	80–90	35–50	25–35	15–25	2.0–6.0	0.08–0.12	4.5–5.5	Low	Low	Moderate.
100	100	50–75	15–30	NP	NP	6.0–20.0	0.03–0.05	4.5–5.5	Very low	Low	Moderate.
100	100	90–100	75–95	70–80	48–55	0.06–0.20	0.15–0.17	4.5–5.5	High	Very high	Moderate.
100	100	60–70	25–35	NP	NP	6.0–20.0	0.03–0.05	4.5–5.5	Very low	Very low	Moderate.
100	100	50–75	15–35	14–20	NP	6.0–20.0	0.05–0.08	4.5–5.5	Very low	Very low	High.
100	100	50–70	5–15	NP	NP	>20.0	<.03	6.6–8.4	Very low	Low	Low.
100	100	90–100	80–90	60–75	28–35	0.6–2.0	0.15–0.17	5.6–6.5	High	High	Low.
100	100	90–100	75–95	50–60	20–24	0.6–2.0	0.15–0.18	4.5–5.5	Moderate	Moderate	Moderate.
100	100	80–95	35–75	35–40	6–12	2.0–6.0	0.08–0.12	5.1–5.5	Low	Low	Moderate.
100	100	60–70	25–35	14–20	NP	6.0–20.0	0.05–0.08	5.6–6.5	Very low	Low	Moderate.
100	100	90–100	75–95	60–90	55–70	0.2–0.6	0.15–0.20	4.5–5.5	High	High	Moderate.
90–100	90–100	80–90	65–85	50–90	30–60	0.06–0.20	0.15–0.18	6.6–7.8	Very high	High	Low.
40–65	40–65	25–50	15–20	50–90	30–60	0.20–0.60	0.10–0.15	6.6–7.8	High	High	Low.
40–65	40–65	25–50	10–15	NP	NP	6.0–20.0	0.03–0.05	6.6–7.8	Low	High	Low.
100	100	90–100	70–80	30–50	10–20	0.6–2.0	0.10–0.14	4.5–5.5	Moderate	Moderate	Moderate.
100	100	60–70	25–35	NP	NP	6.0–20.0	0.05–0.08	4.5–5.5	Low	Moderate	Moderate.
100	100	95–100	85–95	70–80	27–32	0.6–2.0	0.10–0.12	4.5–5.0	Moderate	High	High.
100	100	90–100	75–95	80–90	35–45	0.2–0.6	0.09–0.11	4.5–5.0	Moderate.		
100	100	90–100	80–95	70–80	10–20	0.6–2.0	0.16–0.18	4.5–5.0	Moderate.		
100	100	95–100	90–95	60–90	50–60	<.06	0.15–0.20	4.5–5.0	High	Very high	High.
100	100	90–100	75–95	50–70	40–60	0.06–0.20	0.15–0.20	6.6–8.4	Very high	High	Low.
100	100	90–100	70–80	30–50	10–20	0.6–2.0	0.10–0.15	7.4–7.8	Moderate	High	Low.
85–100	85–100	85–100	75–90	30–40	10–20	2.0–6.3	0.10–0.13	7.9–8.4	Low.		

TABLE 5.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification	
	Bedrock	Seasonal high water table			Unified	AASHTO
	Feet	*Feet*	*Inches*			
Reilly: Re	>6	2½–5	0–19	Sandy loam, loamy sand.	SM	A–2
			19–62	Sand and gravel	GP	A–1
Reparada: Rp	>6	1½–2½	0–18	Clay	CH	A–7
			18	Organic material.		
Rio Arriba: RrB, RrC2	>6	>5	0–56	Clay	CH	A–7
Rock land: Rs. Properties are too variable to be estimated.						
Rough stony land: Ru. Properties are too variable to be estimated.						
Sabana: SaE2, SaF2	1–1½	>6	0–18	Silty clay and clay	CH	A–7
			18	Hard rock.		
Salt water marsh: Sm. Properties are too variable to be estimated.						
Talante: Ta	>6	1½–2½	0–10	Clay loam, sandy clay loam.	CL–ML	A–6
			10–18	Loam	ML	A–4
			18–58	Loamy sand, sand	SM	A–1
Teja: TeE	1–1½	>6	0–14	Gravelly sandy loam	GM	A–2
			14	Hard rock.		
Tidal flats: Tf. Properties are too variable to be estimated.						
Tidal swamp: Ts. Properties are too variable to be estimated.						
Toa: Tt	>6	2½–5	0–60	Silty clay loam, clay loam.	CL	A–6
*Utuado: UpF For the Picacho part, see the Picacho series. Properties of the Stony rock land part are too variable to be estimated.	>6	>6	0–18	Clay loam	ML	A–6
			18–72	Sandy loam	SM	A–2, A–4
Vayas: Va, Vc	>6	2½–5	0–21	Silty clay	MH	A–7
			21–44	Silty clay loam	CL	A–7
Vega Alta: VeB, VeC	>6	>6	0–60	Clay, silty clay loam	MH	A–7
Vega Baja: VgA	>6	>5	0–12	Silty clay loam	CL	A–7
			12–48	Silty clay and clay	MH	A–7
Via: VIC	>6	>6	0–47	Silty clay loam, clay loam.	CL–ML	A–6
			47–62	Gravelly clay loam	CL	A–6
Vieques: VmC, VmE2	3–4	>6	0–15	Loam, sandy clay loam.	ML, SM	A–4
			15–38	Gravelly sand	GW	A–1
			38	Granitic rock.		

See footnotes at end of table.

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
						Inches per hour	*Inches per inch of soil*	*pH*			
100	100	50–75	15–30	NP	NP	6.0–20.0	0.03–0.05	5.6–6.5	Very low	Low	Low.
100	100	90–100	75–95	60–90	50–60	<.06	0.15–0.20	6.6–8.4	High	Very high	Low.
100	100	90–100	75–95	60–90	55–70	0.2–0.6	0.15–0.20	5.6–7.9	High	High	Low.
100	100	90–100	75–95	70–80	50–60	0.6–2.0	0.10–0.15	4.5–5.5	High	High	Moderate.
100	100	80–100	65–80	35–45	10–20	0.6–2.0	0.12–0.14	4.5–5.5	Low	High	Moderate.
100	100	85–95	60–75	30–40	4–10	2.0–6.0	0.08–0.10	4.5–5.5	Very low	High	Moderate.
100	100	50–80	5–35	NP	NP	6.0–20.0	<.03–0.05	4.5–5.5	Very low	High	Moderate.
100	100	60–70	25–35	NP	NP	6.0–20.0	<.03	4.5–5.5	Very low	Low	High.
100	100	90–100	70–95	40–50	25–35	0.6–2.0	0.10–0.15	5.6–7.3	Moderate	Moderate	Low.
100	100	90–100	70–80	30–50	10–20	0.6–2.0	0.10–0.14	4.5–5.5	Low	Moderate	Moderate.
100	100	60–70	30–40	NP	NP	6.0–20.0	0.07–0.09	4.5–5.5	Low	Low	High.
100	100	95–100	90–95	70–80	20–32	0.06–0.6	0.10–0.15	6.6–7.8	Moderate	High	High.
100	100	95–100	85–95	40–50	25–35	0.06–0.6	0.10–0.15	7.4–8.4	Moderate	High	High.
100	100	90–100	75–95	70–80	20–30	0.6–2.0	0.10–0.15	4.5–5.5	Moderate	High	Moderate.
100	100	95–100	85–95	40–50	25–35	0.06–0.20	0.10–0.15	4.5–6.0	Moderate	High	Moderate.
100	100	90–100	75–95	70–80	20–32	0.06–0.20	0.10–0.15	4.5–6.0	Moderate	High	Moderate.
100	100	90–100	70–85	40–45	15–20	0.6–2.0	0.10–0.15	4.0–4.5	Moderate	Moderate	High.
100	100	90–100	70–80	25–35	10–20	2.0–6.0	0.08–0.20	6.1–6.5	Moderate	Moderate	High.
100	100	80–95	35–75	30–40	4–10	2.0–6.0	0.07–0.10	5.1–7.9	Low	Low	Moderate.
				NP	NP	>20.0	<.03	5.1–7.9	Very low	Low	Moderate.

TABLE 5.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification	
	Bedrock	Seasonal high water table			Unified	AASHTO
	Feet	*Feet*	*Inches*			
Vives: Vs, VvA, VvB	>6	>6	0–9	Clay	CL	A–7
			9–50	Clay loam	CL–ML	A–6
Vivi: Vw	>6	>5	0–30	Loam	ML	A–4
			30–60	Sand, sandy loam	SM	A–2
Wet alluvial land: Wa. Properties are too variable to be estimated.						
Yunes: YuF2	1–1½	>6	0–16	Gravelly silty clay loam.	GC	A–6
			16	Mudstone.		

[1] NP means nonplastic.

terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used are defined in the Glossary of this soil survey.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from semisolid to plastic. If the moisture content is further increased, the material changes from plastic to liquid. The plastic limit is the moisture content at which the soil material changes from semisolid to plastic; and the liquid limit, from plastic to liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table 5, but in table 7 the data on liquid limit and plasticity index are based on tests of soil samples.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 5 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinkage and swelling of soils cause much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material having this rating.

Corrosivity, as used in table 5, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. Rate of corrosion of uncoated steel is related to soil properties such as drainage, texture, total acidity, and electrical conductivity of the soil material. Ratings of soils for corrosivity for concrete are based mainly on soil texture and acidity. Installations that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. A corrosivity rating of *low* means that there is a low probability of soil-induced corrosion damage. A rating of *high* means that there is a high probability of damage, so that protective measures for steel and more resistant concrete should be used to avoid or minimize damage.

Engineering interpretations of the soils

The estimated interpretations in table 6 are based on the engineering properties of soils shown in table 5, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of the Humacao Area. In table 6, ratings are used to summarize limitation or suitability of the soils for all listed purposes other than for pond reservoir areas, embankments, drainage for

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
						Inches per hour	*Inches per inch of soil*	*pH*			
100	100	90–100	75–95	40–45	22–28	0.6–2.0	0.12–0.16	5.1–7.3	Moderate	Moderate	Low.
100	100	90–100	70–80	30–40	10–20	0.6–2.0	0.10–0.15	6.6–7.9	Moderate	Moderate	Low.
100	100	80–95	60–75	25–35	4–7	2.0–6.0	0.07–0.10	4.5–5.5	Low	Low	High.
100	100	50–70	5–35	NP	NP	>20.0	<.03	4.5–5.5	Very low	Low	High.
60–80	55–75	50–70	35–50	25–35	10–20	0.6–2.0	0.07–0.10	4.5–5.5	Low	Moderate	Moderate.

[a] Coarse fraction greater than 3 inches is 5 to 15 percent.

crops and pasture, irrigation, and terraces and diversions. For these particular uses, table 6 lists those soil features not to be overlooked in planning, installation, and maintenance.

Soil limitations are indicated by the ratings slight, moderate, and severe. *Slight* means that soil properties generally are favorable for the rated use or, in other words, limitations are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means that soil properties are so unfavorable and so difficult to correct or overcome that major soil reclamation, special design, or intensive maintenance are required.

Soil suitability is rated by the terms *good*, *fair*, and *poor*, which have meanings approximately parallel to the terms slight, moderate, and severe.

Following are explanations of some of the columns in table 6.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material from a depth of 18 inches to 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope affects layout and construction and also the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Sewage lagoons are shallow ponds constructed to hold sewage, within a depth of 2 to 5 feet, long enough for bacteria to decompose the solids. A lagoon has a nearly level floor; its sides, or embankments, are of compacted soil material. The assumption is made that the embankment is compacted to medium density and the pond is protected from flooding. Properties that affect the pond floor are permeability, organic matter, and slope, and, if the floor needs to be leveled, depth to bedrock becomes important. The soil properties that affect the embankment are the engineering properties of the embankment material as interpreted from the Unified Soil Classification and the amount of stones, if any, that influence the ease of excavation and compaction of the embankment material.

Dwellings, as rated in table 6, are not more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to support load and resist settlement under load, and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Sanitary landfill is a method of disposing of refuse in dug trenches. The waste is spread in thin layers, compacted, and covered with soil. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of polluting ground water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated the ratings in table 6 apply only to a depth of about 6 feet, so a limitation of *slight* or *moderate* may not be valid if trenches are to be much deeper than that. For some soils, reliable predictions can be made to a depth of 10 to 15 feet; nevertheless, every site should be investigated before it is selected.

Local roads and streets, as rated in table 6, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions

TABLE 6.—*Interpretations of*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The as indicated in the first

Soil series and map symbols	Degree and kind of limitations for—					Suitability as a source of—
	Septic tank absorption fields	Sewage lagoons	Dwellings without basements	Sanitary landfill [1] (Trench type)	Local roads and streets	Road fill
Aceitunas: AcC	Slight where slope is 2 to 8 percent. Moderate where slope is 8 to 12 percent.	Moderate where slope is 2 to 7 percent; moderate permeability. Severe where slope is more than 7 percent.	Moderate: moderate shrink-swell potential.	Severe: clay texture.	Moderate: moderate shrink-swell potential.	Fair: fair traffic-supporting capacity.
Aguadilla: Ad, Ag	Slight [2]	Severe: very rapid permeability.	Slight	Severe: very rapid permeability.	Slight	Good
Amelia: AmB, AmC2	Slight where slope is 2 to 8 percent. Moderate where slope is 8 to 12 percent.	Moderate: moderate permeability.	Slight where slope is 2 to 8 percent. Moderate where slope is 8 to 12 percent.	Slight	Slight where slope is 2 to 8 percent. Moderate where slope is 8 to 12 percent.	Good
Arenales: An, Ar	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding; rapid permeability.	Moderate: subject to flooding.	Good
Bajura: Ba, Bc	Severe: subject to flooding; depth to water table is 1½ to 2½ feet.	Severe: depth to water table is 1½ to 2½ feet; subject to flooding.	Severe: high shrink-swell potential; subject to flooding.	Severe: subject to flooding; clay texture; poorly drained.	Severe: high shrink-swell potential; poorly drained; subject to flooding.	Poor: high shrink-swell potential; poorly drained.
Caguabo: CbD2, CbF2.	Severe: depth to hard rock is 1 to 1½ feet.	Severe: depth to hard rock is 1 to 1½ feet; slope.	Severe: depth to hard rock is 1 to 1½ feet; slope.	Severe: depth to hard rock is 1 to 1½ feet.	Severe: slope; depth to hard rock is 1 to 1½ feet.	Poor: limited thickness of material.
Candelero: CdB, CdC2	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: moderate shrink-swell potential.	Moderate: somewhat poorly drained.	Moderate: moderate shrink-swell potential; somewhat poorly drained.	Fair: fair traffic-supporting capacity; somewhat poorly drained.
Cartagena: Ce	Severe: slow permeability.	Slight	Severe: very high shrink-swell potential.	Severe: clay texture; plastic.	Severe: very high shrink-swell potential.	Poor: poor traffic-supporting capacity; very high shrink-swell potential.
Catano: Cf	Slight [2]	Severe: very rapid permeability.	Slight	Severe: very rapid permeability.	Slight	Good
Cayagua: CgC2, CgD2.	Severe: slow permeability.	Severe: rapid permeability in substratum.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Poor to a depth of 20 inches. Good below a depth of 20 inches.

See footnotes at end of table.

engineering properties of the soils

soils in such mapping units may have different properties and limitations, and for this reason it is necessary to refer to other series column of this table]

Suitability as a source of—Continued		Soil features affecting—				
Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Unsuited	Fair: silty clay loam surface layer; plastic.	Moderate permeability.	Medium compressibility; fair compaction characteristics.	Well drained	No unfavorable features.	No unfavorable features.
Good	Poor: sand throughout.	Very rapid permeability.	Poor slope stability; very rapid permeability.	Excessively drained.	Low available water capacity.	Poor soil stability.
Unsuited	Poor: gravelly	Moderate permeability.	No unfavorable features.	Well drained	No unfavorable features.	Gravelly soil; construction difficult.
Fair for sand. Good for gravel below a depth of 3 feet.	Fair: limited thickness of material.	Rapid permeability.	Rapid permeability; poor slope stability.	Excessively drained.	Low available water capacity.	Poor soil stability.
Unsuited	Poor: poorly drained; clay texture.	Seasonal high water table is at depth of 1½ to 2½ feet.	High compressibility; poor slope stability.	Slow permeability.	Need for drainage; high water table.	Dense clay subsoil.
Unsuited	Poor: limited thickness of material; coarse fragments.	Depth to hard rock is 1 to 1½ feet; seepage.	Limited thickness of material.	Well drained	Slope	Depth to hard rock is 1 to 1½ feet.
Unsuited	Good	Moderate permeability.	No unfavorable features.	Slow permeability.	Area of heavy rainfall.	Limited depth to unfavorable material.
Unsuited	Poor: high clay content.	Seasonal high water table.	High compressibility; poor slope stability.	Slow permeability.	Very slow intake rate.	Dense clay subsoil.
Good for sand	Poor: sand texture throughout.	Very rapid permeability.	Very rapid permeability; poor slope stability; low resistance to piping.	Excessively drained.	Low available water capacity.	Poor soil stability.
Unsuited	Poor: clay texture.	Rapid permeability in substratum.	Fair slope stability; slow permeability.	Slow permeability.	Area of heavy rainfall.	No unfavorable features.

TABLE 6.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitations for—					Suitability as a source of—
	Septic tank absorption fields	Sewage lagoons	Dwellings without basements	Sanitary landfill [1] (Trench type)	Local roads and streets	Road fill
Ciales Mapped only in an association with Guayabota and Picacho soils.	Severe: slope; slow permeability.	Severe: slope	Severe: slope; poorly drained.	Severe: poorly drained.	Severe: slope; poorly drained.	Poor: poorly drained.
Coamo: ClB, ClC	Slight	Severe: moderately rapid permeability in substratum.	Severe: high shrink-swell potential.	Severe: moderately rapid permeability in substratum.	Moderate: fair traffic-supporting capacity; high shrink-swell potential.	Fair: clay loam and clay texture; high shrink-swell potential.
Coastal beaches: Cm	Severe: water table at or near surface.	Severe: water table at or near surface; subject to flooding.	Severe: water table at or near surface; subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Good
Cobbly alluvial land: Cn.	Severe: cobbles; subject to flooding.	Severe: subject to flooding.	Severe: cobbles; subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Fair: cobbles
Coloso: Co, Cr	Severe: subject to flooding; depth to water table is 2 to 4 feet.	Severe: subject to flooding.	Severe: subject to flooding; somewhat poorly drained.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: somewhat poorly drained; fair traffic-supporting capacity.
Corcega: Cs	Severe: subject to flooding; depth to water table is 1½ to 2½ feet.	Severe: subject to flooding; rapid permeability below a depth of 32 inches.	Severe: subject to flooding.	Severe: subject to flooding.	Moderate: subject to flooding.	Fair: somewhat poorly drained; water table at a depth of 1½ to 2½ feet.
Daguao, deep variant: DaC.	Severe: slope; depth to hard rock is 2 to 3½ feet.	Severe: slope; depth to hard rock is 2 to 3½ feet.	Severe: slope	Severe: depth to hard rock is 2 to 3½ feet.	Severe: slope	Poor: slope
Daguao: DcE2	Severe: depth to hard rock is 3½ feet.	Severe: slope; depth to hard rock is 3½ feet.	Moderate: slope.	Severe: depth to hard rock is 2 to 3½ feet.	Severe: slope	Poor: slope
*Descalabrado: DeC2, DeE2, DgF2, DrF. For Guayama part of DgF2, see Guayama series. For Rock land part of DrF, see Rock land.	Severe: slope; depth to hard rock is 1 to 1½ feet.	Severe: slope; depth to hard rock is 1 to 1½ feet.	Severe: slope; depth to hard rock is 1 to 1½ feet.	Severe: slope; depth to hard rock is 1 to 1½ feet.	Severe: slope; depth to hard rock is 1 to 1½ feet.	Poor: limited thickness of material.
Fajardo: FaC, FaC2	Severe: slow permeability.	Severe: depth to water table is more than 3½ feet.	Severe: high shrink-swell potential.	Severe: clay texture; plastic.	Severe: high shrink-swell potential; poor traffic-supporting capacity.	Poor: high shrink-swell potential; poor traffic-supporting capacity.

See footnotes at end of table.

properties of the soils—Continued

Suitability as a source of—Continued		Soil features affecting—				
Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Unsuited	Poor: slope; silty clay, loam, and clay texture; poorly drained.	Slope	High compressibility; poor compaction characteristics.	Slow permeability.	Area of heavy rainfall.	Slope.
Unsuited	Fair: clay loam surface layer.	Moderately rapid permeability in substratum.	Medium compressibility; fair slope stability; medium resistance to piping.	Well drained	No unfavorable features.	Dense clay subsoil.
Good	Poor: soluble salts.	Rapid permeability.	Rapid permeability; low compressibility.	Excessively drained.	Permanent salinity.	Sand texture; very rapid permeability.
Unsuited	Poor: coarse fragments.	Coarse fragments; seepage.	Seepage; many cobbles.	Well drained	Many cobbles	Cobbles; hazard of slipping.
Unsuited	Fair: silty clay loam texture.	Seasonal high water table.	High compressibility; poor slope stability.	Slow permeability.	Need for drainage; high water table.	Dense clay subsoil.
Unsuited to a depth of 32 inches. Fair below a depth of 32 inches.	Fair: silty clay loam and sandy clay loam texture.	Rapid permeability below a depth of 32 inches; depth to seasonal high water table is 1½ to 2½ feet.	Poor slope stability; rapid permeability below a depth of 32 inches.	Need for drainage; high water table.	High water table; need for drianage.	Sandy substratum.
Unsuited	Poor: clay texture; slope.	No unfavorable features.	Limited thickness of borrow material; medium compressibility.	Well drained	Area of heavy rainfall.	Depth to hard rock is 2 to 3½ feet.
Unsuited	Poor: clay texture; slope.	No unfavorable features.	Limited thickness of borrow material; medium compressibility.	Well drained	Area of heavy rainfall.	Depth to hard rock is 3½ feet.
Unsuited	Poor: limited thickness of material; coarse fragments.	Depth to hard rock is 1 to 1½ feet.	Limited thickness of material.	Well drained	Slope	Depth to hard rock is 1 to 1½ feet.
Unsuited	Poor: clay texture.	Seasonal high water table.	High compressibility; poor slope stability.	Slow permeability.	High water table; need for drainage.	Dense clay subsoil.

TABLE 6.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitations for—					Suitability as a source of—
	Septic tank absorption fields	Sewage lagoons	Dwellings without basements	Sanitary landfill [1] (Trench type)	Local roads and streets	Road fill
Fortuna: Fo	Severe: subject to flooding; depth to water table is 2½ to 3 feet.	Severe: subject to flooding; depth to water table is 2½ to 3 feet.	Severe: subject to flooding; high shrink-swell potential; poorly drained.	Severe: subject to flooding; poorly drained; clay texture.	Severe: subject to flooding; high shrink-swell potential; poorly drained.	Poor: high shrink-swell potential; poorly drained.
Fraternidad: FrA, FrB	Severe: slow permeability.	Slight where slope is 0 to 2 percent. Moderate where slope is 2 to 5 percent.	Severe: very high shrink-swell potential.	Severe: clay texture.	Severe: very high shrink-swell potential.	Poor: very high shrink-swell potential; poor traffic-supporting capacity.
Guamani: Gm	Severe: subject to flooding.	Severe: very rapid permeability.	Severe: subject to flooding.	Severe: subject to flooding.	Moderate: subject to flooding.	Good
*Guayabota: GuE2, GvF. For Ciales and Picacho parts of GvF, see Ciales and Picacho series.	Severe: slope; depth to hard rock is 1 to 1½ feet.	Severe: slope; depth to hard rock is 1 to 1½ feet.	Severe: slope; poorly drained; depth to hard rock is 1 to 1½ feet.	Severe: depth to hard rock is 1 to 1½ feet.	Severe: depth to hard rock is 1 to 1½ feet; slope; poorly drained.	Poor: poorly drained; limited thickness of material; slope.
Guayama Mapped only in an undifferentiated group with Descalabrado soils.	Severe: slope; depth to bedrock is 1 to 1½ feet.	Severe: slope; depth to bedrock is 1 to 1½ feet.	Severe: slope; depth to bedrock is 1 to 1½ feet.	Severe: slope; depth to bedrock is 1 to 1½ feet.	Severe: slope; depth to bedrock is 1 to 1½ feet.	Poor: slope; depth to bedrock is 1 to 1½ feet.
Guayama, moderately deep variant: GyC2.	Severe: slope; depth to hard rock is 1½ to 2½ feet.	Severe: slope; depth to hard rock is 1½ to 2½ feet.	Severe: slope; depth to hard rock is 1½ to 2½ feet.	Severe: slope; depth to hard rock is 1½ to 2½ feet.	Severe: slope; depth to hard rock is 1½ to 2½ feet.	Poor: limited thickness of material.
Humacao: HmB	Moderate: moderate permeability.	Moderate: moderate permeability.	Slight	Slight	Slight	Fair: moderate shrink-swell potential; fair traffic-supporting capacity.
Humatas: HtE2, HtF2, HuF. Stony land part of HuF is too variable for interpretations to be made.	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Poor: poor traffic-supporting capacity.
Ingenio: InE2	Severe: slope	Severe: slope; moderately rapid permeability.	Severe: slope	Severe: moderately rapid permeability.	Severe: slope	Fair where slope is less than 25 percent. Poor where slope is more than 25 percent.

See footnotes at end of table.

properties of the soils—Continued

Suitability as a source of—Continued		Soil features affecting—				
Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Unsuited	Poor: clay texture; poorly drained.	Seasonal high water table.	High compressibility; poor slope stability.	Slow permeability.	High water table; need for drainage.	Dense clay subsoil.
Unsuited	Poor: clay texture.	No unfavorable features.	High compressibility; poor slope stability.	Slow permeability.	Very slow intake rate.	Dense clay subsoil.
Unsuited for sand. Fair for gravel below a depth of 20 inches.	Fair: silty clay loam texture.	Very rapid permeability.	Very rapid permeability.	Well drained	Low available water capacity; very rapid permeability.	Sandy and gravelly substratum.
Unsuited	Poor: slope; poorly drained.	Depth to hard rock is 1 to 1½ feet.	Limited thickness of material.	Slow permeability.	Area of heavy rainfall.	Slope.
Unsuited	Poor: slope	Slope	Shallowness to bedrock.	Well drained	Slope	Slope.
Unsuited	Poor: slope; coarse fragments.	Depth to hard rock is 1½ to 2½ feet.	Limited thickness of borrow material.	Well drained	Slope	Depth to hard rock is 1½ to 2½ feet.
Unsuited	Good	Moderate permeability.	Fair slope stability; moderate permeability.	Well drained	Area of heavy rainfall.	No unfavorable features.
Unsuited	Poor: clay texture.	Moderate permeability.	Moderate permeability; medium compressibility; fair slope stability.	Well drained	Area of heavy rainfall.	Slope.
Unsuited	Poor: slope	Moderately rapid permeability.	Fair slope stability; moderately rapid permeability.	Well drained	Area of heavy rainfall.	Slope.

TABLE 6.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitations for—					Suitability as a source of—
	Septic tank absorption fields	Sewage lagoons	Dwellings without basements	Sanitary landfill [1] (Trench type)	Local roads and streets	Road fill
Jacana: JaB, JaC2	Severe: depth to bedrock is 1½ to 3 feet.	Severe: depth to bedrock is 1½ to 3 feet.	Severe: high shrink-swell potential.	Severe: depth to bedrock is 1½ to 3 feet.	Severe: high shrink-swell potential; poor traffic-supporting capacity.	Poor: poor traffic-supporting capacity; high shrink-swell potential.
Jagueyes: JgE2	Severe: slope	Severe: slope	Severe: slope	Moderate where slope is less than 25 percent. Severe where slope is more than 25 percent.	Severe: slope	Fair where slope is less than 25 percent. Poor where slope is more than 25 percent.
Junquitos: JuC	Severe: moderately slow permeability.	Moderate where slope is 2 to 7 percent. Severe where slope is more than 7 percent.	Severe: high shrink-swell potential.	Severe: depth to bedrock is 1½ to 3 feet.	Severe: high shrink-swell potential; poor traffic-supporting capacity.	Poor: high shrink-swell potential.
Leveled clayey land: Lc.	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: clay texture.	Moderate: clay texture; moderate permeability.	Moderate: clay texture.	Fair: clay texture.
Limones: LeE2	Severe: slope	Severe: slope	Severe: slope	Moderate where slope is less than 25 percent. Severe where slope is more than 25 percent.	Severe: slope	Fair where slope is less than 25 percent; fair traffic-supporting capacity; moderate shrink-swell potential. Poor where slope is more than 25 percent.
Lirios: LoC2, LrE2	Slight where slope is less than 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.	Moderate where slope is 2 to 7 percent. Severe where slope is more than 7 percent.	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.	Slight where slope is 3 to 15 percent. Moderate where slope is 15 to 25 percent. Severe where slope is more than 25 percent.	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.	Fair where slope is less than 25 percent: fair traffic-supporting capacity. Poor where slope is more than 25 percent.
*Los Guineos: LsD, LsE2, LsF2, LyF. For Yunque part of LyF, see Yunque series. Stony rock land part of LyF is too variable for interpretations to be made.	Severe: slope	Severe: slope	Severe: slope	Severe: clay texture.	Severe: slope	Poor: poor traffic-supporting capacity; moderate shrink-swell potential.

See footnotes at end of table.

properties of the soils—Continued

Suitability as a source of—Continued		Soil features affecting—				
Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Unsuited	Poor: clay texture.	Depth to bedrock is 1½ to 3 feet.	High compressibility; limited thickness of material.	Well drained	Very low intake rate; slope.	Dense clay subsoil.
Unsuited	Fair: loam, clay loam and sandy clay loam texture.	Moderate permeability.	Medium compressibility; moderate permeability; fair slope stability.	Moderately well drained.	Area of heavy rainfall.	Slope.
Unsuited	Poor: clay texture.	Depth to bedrock is 1½ to 3 feet.	High compressibility; limited thickness of material.	Moderately slow permeability.	Area of heavy rainfall.	Dense clay subsoil.
Unsuited	Poor: clay texture.	No unfavorable features.	No unfavorable features.	Well drained	No unfavorable features.	No unfavorable features.
Unsuited	Poor: slope	Moderate permeability.	Medium compressibility; fair slope stability.	Moderate permeability.	Area of heavy rainfall.	Slope.
Unsuited	Fair where slope is less than 15 percent. Severe where slope is more than 15 percent.	Moderate permeability.	Medium compressibility; fair slope stability.	Well drained	Area of heavy rainfall.	Dense clay subsoil.
Unsuited	Poor: plastic clay.	Moderate permeability.	Medium compressibility; fair slope stability.	Moderate permeability.	Area of heavy rainfall.	Slope; dense clay subsoil.

TABLE 6.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitations for—					Suitability as a source of—
	Septic tank absorption fields	Sewage lagoons	Dwellings without basements	Sanitary landfill [1] (Trench type)	Local roads and streets	Road fill
Mabi: MaB, MaC2, MaD2.	Severe: slow permeability.	Severe: subject to flooding.	Severe: very high shrink-swell potential; subject to flooding; somewhat poorly drained.	Severe: clay texture throughout.	Severe: very high shrink-swell potential.	Poor: very high shrink-swell potential.
Machete: McA, McB	Slight	Severe: moderately rapid permeability.	Slight	Slight	Slight	Good
Made land: Md. Too variable for interpretations to be made.						
Maunabo: Me	Severe: subject to flooding; depth to water table is 1½ to 3½ feet.	Severe: subject to flooding; depth to water table is 1½ to 3½ feet.	Severe: poorly drained; subject to flooding; seasonal high water table; high shrink-swell potential.	Severe: subject to flooding.	Severe: poorly drained; subject to flooding; high shrink-swell potential.	Poor: poorly drained; high shrink-swell potential.
Mayo: MlC	Slight	Severe: rapid permeability.	Slight	Slight	Slight	Good
Meros: MrB	Slight [2]	Severe: very rapid permeability.	Slight	Severe: very rapid permeability.	Slight	Good
Mucara: MuD2, MuE2	Severe: slope; depth to bedrock is 2 to 3 feet.	Severe: slope; depth to bedrock is 2 to 3 feet.	Severe: slope	Severe: depth to bedrock is 2 to 3 feet.	Severe: slope	Poor: poor traffic-supporting capacity; high shrink-swell potential.
Naranjito: NaE2, NaF2.	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
Pandura: PaE2, PaF2, PdF. Very stony land part of PdF is too variable for interpretations to be made.	Severe: slope; depth to bedrock is 1 to 1½ feet.	Severe: slope; depth to bedrock is 1 to 1½ feet.	Severe: slope; depth to bedrock is 1 to 1½ feet.	Severe: depth to bedrock is 1 to 1½ feet.	Severe: depth to bedrock is 1 to 1½ feet.	Fair where slope is less than 25 percent. Poor where slope is more than 25 percent.
Parcelas: PeC2	Severe: moderately slow permeability.	Moderate where slope is 5 to 7 percent. Severe where slope is 7 to 12 percent.	Severe: high shrink-swell potential.	Severe: clay texture.	Severe: high shrink-swell potential; poor traffic-supporting capacity.	Poor: high shrink-swell potential.

See footnotes at end of table.

properties of the soils—Continued

Suitability as a source of—Continued		Soil features affecting—				
Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Unsuited	Poor: clay texture throughout.	No unfavorable features.	High compressibility; poor slope stability.	Slow permeability.	Area of heavy rainfall.	Dense clay subsoil.
Unsuited	Good	Moderately rapid permeability.	Medium resistance to piping; fair slope stability; moderately rapid permeability.	Well drained	No unfavorable features.	No unfavorable features.
Unsuited	Poor: poorly drained; clay texture.	Depth to water table is 1½ to 3½ feet; rapid permeability in substratum.	High compressibility.	Slow permeability.	Area of heavy rainfall.	Dense clay subsoil.
Unsuited	Good	Rapid permeability.	Low resistance to piping; poor slope stability.	Excessively drained.	Low available water capacity.	No unfavorable features.
Good for sand. Unsuited for gravel.	Poor: sand throughout.	Very rapid permeability.	Very rapid permeability; poor slope stability.	Excessively drained.	Low available water capacity.	Poor stability.
Unsuited	Poor: clay texture.	Moderate permeability; depth to bedrock is 2 to 3 feet.	High compressibility; thin layer of borrow material.	Well drained	Area of heavy rainfall.	Slope; depth to bedrock is 2 to 3 feet.
Unsuited	Poor: slope	Moderate permeability; depth to bedrock is 2 to 3 feet.	Limited thickness of material; medium compressibility.	Well drained	Area of heavy rainfall.	Slope.
Unsuited	Poor: slope	Rapid permeability; depth to bedrock is 1 to 1½ feet.	Limited thickness of material.	Well drained	Area of heavy rainfall.	Slope.
Unsuited	Poor: clay texture.	Moderately slow permeability.	High compressibility; poor slope stability.	Moderately slow permeability.	Area of heavy rainfall.	Dense clay subsoil.

TABLE 6.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitations for—					Suitability as a source of—
	Septic tank absorption fields	Sewage lagoons	Dwellings without basements	Sanitary landfill [1] (Trench type)	Local roads and streets	Road fill
Paso Seco: PlB	Severe: slow permeability.	Severe: rapid permeability in substratum.	Severe: very high shrink-swell potential.	Severe: clay texture.	Severe: very high shrink-swell potential.	Poor: very high shrink-swell potential; poor traffic-supporting capacity.
Patillas: PmD2, PmE2	Severe: slope.	Severe: slope.	Severe: slope.	Moderate where slope is less than 25 percent. Severe where slope is more than 25 percent.	Severe: slope.	Fair where slope is less than 25 percent. Poor where slope is more than 25 percent.
Picacho Mapped only in associations with Guayabota and Ciales soils and with Utuado soils and Stony rock land.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Pinones: Pn	Severe: subject to flooding; depth to water table is 1 to 2½ feet; very slow permeability.	Severe: depth to water table is 1 to 2½ feet; subject to flooding.	Severe: high shrink-swell potential; organic material below a depth of 18 inches.	Severe: subject to flooding; organic material below a depth of 18 inches; poorly drained.	Severe: high shrink-swell potential; subject to flooding; poorly drained; organic material below a depth of 18 inches.	Poor: high shrink-swell potential; poorly drained.
Poncena: Po	Severe: slow permeability.	Moderate: depth to water table is 2½ to 5 feet.	Severe: high shrink-swell potential.	Severe: clay texture; plastic.	Severe: high shrink-swell potential.	Poor: high shrink-swell potential.
Pozo Blanco: PrC2	Slight where slope is 5 to 8 percent. Moderate where slope is 8 to 12 percent.	Severe: moderately rapid permeability in substratum.	Slight where slope is 5 to 8 percent. Moderate where slope is 8 to 12 percent.	Slight	Moderate: fair traffic-supporting capacity.	Fair: fair traffic-supporting capacity.
Reilly: Re	Severe: subject to flooding.	Severe: rapid permeability; subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding; rapid permeability.	Severe: subject to flooding.	Good
Reparada: Rp	Severe: subject to flooding; depth to water table is 1½ to 2½ feet; very slow permeability.	Severe: depth to water table is 1½ to 2½ feet; subject to flooding.	Severe: poorly drained; depth to water table is 1½ to 2½ feet; organic material below a depth of 18 inches.	Severe: subject to flooding; organic material below a depth of 18 inches; poorly drained.	Severe: subject to flooding; poorly drained; organic material below a depth of 18 inches.	Poor: high shrink-swell potential.
Rio Arriba: RrB, RrC2.	Severe: moderately slow permeability.	Moderate where slope is 2 to 7 percent. Severe where slope is 7 to 12 percent.	Severe: high shrink-swell potential.	Severe: clay texture.	Severe: high shrink-swell potential; poor traffic-supporting capacity.	Poor: high shrink-swell potential; poor traffic-supporting capacity.

See footnotes at end of table.

properties of the soils—Continued

Suitability as a source of—Continued		Soil features affecting—				
Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Unsuited	Poor: clay texture.	Rapid permeability in substratum.	High compressibility; poor slope stability.	Slow permeability.	Very slow intake rate.	Dense clay subsoil.
Unsuited	Poor: slope	Rapid permeability in substratum.	Resistance to piping; rapid permeability in substratum.	Well drained	Area of heavy rainfall.	Slope.
Unsuited	Poor: slope; silty clay loam and clay texture.	Slope	Poor compaction characteristics; high compressibility.	Moderately well drained.	Area of heavy rainfall.	Slope.
Unsuited	Poor: poorly drained; silty clay texture.	Depth to water table is 1 to 1½ feet; organic material below a depth of 18 inches.	Limited thickness of borrow material.	High water table.	High water table; need for drainage.	Dense clay and organic subsoil.
Unsuited	Poor: clay texture.	Seasonal water table.	High compressibility; poor slope stability.	Slow permeability.	Very low intake rate.	Dense clay subsoil.
Unsuited	Fair: clay loam texture.	Moderately rapid permeability.	Medium resistance to piping; medium compressibility; fair slope stability.	Well drained	Slope	Limited depth to unfavorable material.
Unsuited for sand. Good for gravel.	Poor: coarse fragments.	Rapid permeability.	Limited thickness of borrow material; rapid permeability.	Excessively drained.	Low available water capacity.	Limited depth to coarse material.
Unsuited	Poor: clay texture; poorly drained.	Depth to water table is 1½ to 2½ feet; organic material below a depth of 18 inches.	Limited thickness of borrow material.	High water table.	High water table; need for drainage.	Limited depth to unfavorable material.
Unsuited	Poor: clay texture.	No unfavorable features.	High compressibility; poor slope stability.	Moderately slow permeability.	Very low intake rate.	Dense clay subsoil.

TABLE 6.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitations for—					Suitability as a source of—
	Septic tank absorption fields	Sewage lagoons	Dwellings without basements	Sanitary landfill [1] (Trench type)	Local roads and streets	Road fill
Rock land: Rs	Severe: rock at or near surface; slope.	Severe: rock at or near surface; slope.	Severe: rock at or near surface; slope.	Severe: rock at or near surface; slope.	Severe: rock at or near surface; slope.	Poor: slope; rock at or near surface.
Rough stony land: Ru.	Severe: rock at or near surface; slope.	Severe: rock at or near surface; slope.	Severe: rock at or near surface; slope.	Severe: rock at or near surface; slope.	Severe: rock at or near surface; slope.	Poor: rock at or near surface; slope.
Sabana: SaE2, SaF2	Severe: slope; depth to hard rock is 1 to 1½ feet.	Severe: slope; depth to hard rock is 1 to 1½ feet.	Severe: slope; depth to hard rock is 1 to 1½ feet; high shrink-swell potential.	Severe: depth to hard rock is 1 to 1½ feet.	Severe: slope; depth to hard rock is 1 to 1½ feet.	Poor: high shrink-swell potential; slope; limited thickness of material.
Salt water marsh: Sm.	Severe: water table at or near surface; subject to flooding.	Severe: water table at or near surface; subject to flooding.	Severe: water table at or near surface; subject to flooding.	Severe: water table at or near surface; subject to flooding.	Severe: subject to flooding.	Severe: poorly drained.
Talante: Ta	Severe: subject to flooding; depth to water table is 1½ to 2½ feet.	Severe: subject to flooding; depth to water table is 1½ to 2½ feet; rapid permeability in substratum.	Severe: subject to flooding; poorly drained.	Severe: subject to flooding; poorly drained.	Severe: poorly drained; subject to flooding.	Severe: poorly drained.
Teja: TeE	Severe: slope; depth to hard rock is 1 to 1½ feet.	Severe: slope; depth to hard rock is 1 to 1½ feet; rapid permeability.	Severe: slope; depth to hard rock is 1 to 1½ feet.	Severe: depth to hard rock is 1 to 1½ feet.	Severe: slope; depth to hard rock is 1 to 1½ feet.	Poor: limited thickness of material.
Tidal flats: Tf	Severe: water table at or near surface; subject to flooding.	Severe: water table at or near surface; subject to flooding.	Severe: water table at or near surface; subject to flooding.	Severe: water table at or near surface; subject to flooding.	Severe: subject to flooding.	Poor: poorly drained.
Tidal swamp: Ts. Too variable for interpretations to be made.						
Toa: Tt	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Moderate: subject to flooding.	Fair: silty clay loam surface layer.
*Utuado: UpF For Picacho part, see Picacho series. Stony rock land part is too variable for interpretations to be made.	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
Vayas: Va, Vc	Severe: subject to flooding; slow permeability; depth to water table is 2½ to 5 feet.	Severe: subject to flooding; depth to water table is 2½ to 5 feet.	Severe: subject to flooding; poorly drained; high shrink-swell potential.	Severe: poorly drained; subject to flooding; clay texture.	Severe: poorly drained; high shrink-swell potential; subject to flooding.	Poor: poorly drained; high shrink-swell potential.

See footnotes at end of table.

properties of the soils—Continued

Suitability as a source of—Continued		Soil features affecting—				
Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Unsuited	Poor: stoniness; slope.	Slope; rock at or near surface.	Shallowness to bedrock; many stones.	Well drained	Slope; stoniness	Limited depth to bedrock; stoniness.
Unsuited	Poor: stoniness; slope.	Slope; rock at or near surface.	Shallowness to bedrock; many stones.	Well drained	Slope; stoniness	Limited depth to bedrock; stoniness.
Unsuited	Poor: slope; silty clay and clay texture.	Depth to hard rock is 1 to 1½ feet.	Limited thickness of material.	Well drained	Slope	Slope; depth to hard rock is 1 to 1½ feet.
Unsuited	Poor: soluble salts; poorly drained.	Water table at or near surface.	Salinity	Water table at or near surface; salinity.	Need for drainage; salinity.	Concave slope.
Unsuited	Poor: poorly drained.	Rapid permeability in substratum.	Low resistance to piping; poor slope stability.	High water table	High water table; low available water capacity.	Limited depth to unfavorable material.
Unsuited	Poor: slope	Rapid permeability; depth to hard rock is 1 to 1½ feet.	Limited thickness of material.	Well drained	Area of heavy rainfall.	Slope; depth to hard rock is 1 to 1½ feet.
Unsuited	Poor: soluble salts; poorly drained.	Water table at or near surface.	Salinity	Water table at or near surface; salinity.	Permanent salinity.	Level; water table at or near surface.
Unsuited	Good	Moderate permeability.	Medium compressibility; fair slope stability.	Moderate permeability.	No unfavorable features.	No unfavorable features.
Unsuited	Poor: slope	Slope	High susceptibility to piping; fair compaction characteristics.	Well drained	Area of heavy rainfall.	Slope.
Unsuited	Poor: poorly drained; clay texture.	Seasonal high water table.	High compressibility; poor slope stability.	High water table	High water table; need for drainage.	Dense clay subsoil.

TABLE 6.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitations for—					Suitability as a source of—
	Septic tank absorption fields	Sewage lagoons	Dwellings without basements	Sanitary landfill [1] (Trench type)	Local roads and streets	Road fill
Vega Alta: VeB, VeC	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: moderate shrink-swell potential.	Severe: clay texture.	Moderate: moderate shrink-swell potential; fair traffic-supporting capacity.	Fair: moderate shrink-swell potential; fair traffic-supporting capacity.
Vega Baja: VgA	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding; somewhat poorly drained.	Severe: subject to flooding.	Severe: subject to flooding.	Fair: moderate shrink-swell potential; fair traffic-supporting capacity.
Via: VlC	Slight	Severe: moderately rapid permeability.	Moderate: moderate shrink-swell potential.	Slight	Moderate: moderate shrink-swell potential.	Fair: moderate shrink-swell potential; fair traffic-supporting capacity.
Vieques: VmC, VmE2	Severe: depth to hard rock is 3 to 4 feet.	Severe: depth to hard rock is 3 to 4 feet; very rapid permeability in substratum.	Moderate where slope is 5 to 15 percent. Severe where slope is more than 15 percent.	Severe: depth to hard rock is 3 to 4 feet.	Moderate where slope is 5 to 15 percent. Severe where slope is more than 15 percent.	Poor: limited thickness of material.
Vives: Vs, VvA, VvB	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Fair: moderate shrink-swell potential; fair traffic-supporting capacity.
Vivi: Vw	Severe: subject to flooding.	Severe: subject to flooding; rapid permeability.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Good
Wet alluvial land: Wa.	Severe: water table at or near surface; subject to flooding.	Severe: water table at or near surface; subject to flooding.	Severe: water table at or near surface; subject to flooding.	Severe: poorly drained; subject to flooding.	Severe: subject to flooding.	Poor: poorly drained.
Yunes: YuF2	Severe: slope; depth to hard rock is 1 to 1½ feet.	Severe: slope; depth to hard rock is 1 to 1½ feet.	Severe: slope; depth to hard rock is 1 to 1½ feet.	Severe: slope; depth to hard rock is 1 to 1½ feet.	Severe: slope; depth to hard rock is 1 to 1½ feet.	Poor: limited thickness of material.

[1] Onsite deep studies of the underlying strata, water tables, and hazards of aquifer pollution and drainage into ground water need to be made for landfills deeper than 5 or 6 feet.

properties of the soils—Continued

Suitability as a source of—Continued		Soil features affecting—				
Sand and gravel	Topsoil	Pond reservoir areas	Dikes, levees, and other embankments	Drainage for crops and pasture	Irrigation	Terraces and diversions
Unsuited	Poor: clay texture.	Moderate permeability.	Medium compressibility; fair slope stability.	Well drained	Slope	Dense clay subsoil.
Unsuited	Poor: clay texture.	Moderate permeability.	High compressibility; poor slope stability.	Slow permeability.	No unfavorable features.	Dense clay subsoil.
Unsuited	Fair: clay loam texture.	Moderately rapid permeability.	Medium resistance to piping; fair slope stability.	Well drained	Slope	No unfavorable features.
Unsuited	Fair where slope is less than 15 percent; limited thickness of material. Poor where slope is more than 15 percent.	Moderately rapid to very rapid permeability; depth to hard rock is 3 to 4 feet.	Limited thickness of borrow material; moderately rapid to very rapid permeability.	Well drained	Moderately rapid to very rapid permeability; slope.	No unfavorable features.
Unsuited	Fair: clay and clay loam texture.	Moderate permeability.	Medium compressibility; fair slope stability.	Well drained	No unfavorable features.	No unfavorable features.
Unsuited	Good	Rapid permeability.	Low resistance to piping; poor slope stability.	Well drained	Rapid permeability.	Limited depth to unfavorable material.
Unsuited	Poor: poorly drained.	No unfavorable features.	High compressibility; poor compaction characteristics.	Slow permeability; water table at or near surface.	Need for drainage.	Concave slope; water table at or near surface.
Unsuited	Poor: coarse fragments; slope; limited thickness of material.	Depth to hard rock is 1 to 1½ feet; seepage.	Limited thickness of material.	Well drained	Area of heavy rainfall.	Slope.

[2] Pollution is a hazard to water supplies.

TABLE 7.—*Engineering*

[Test performed by the Bureau of Public Roads in accordance with standard procedures of

Soil name and location	Parent material	Bureau of Public Roads report no.	Depth	Mechanical analysis [1]		
				Percentage passing sieve—		
				No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)
			Inches			
Candelero loam:						
30 feet west and 156 feet north from intersection of Highways No. 905 and 3 (345°). (Modal)	Old alluvium.	S–43069	0–7	100	70	38
		S–43071	7–50	100	67	37
Fortuna clay:						
1.5 miles northwest of bridge over Anton Ruiz River on Highway No. 3. (Modal)	Alluvium from volcanic rocks.	S–43072	0–5	100	99	94
		S–43073	9–30	100	100	98
Ingenio silty clay loam:						
0.6 mile southwest of Surillo School, on Highway No. 908, Tejas ward, Humacao. (Modal)	Granitic rocks.	S–43074	0–7	100	92	73
		S–43075	15–31	100	98	87
		S–43076	40–51	100	98	85
Jagueyes loam:						
281° and 1,484 feet from road junction with Highway No. 908. (Modal)	Granitic materials.	S–43083	0–8	100	80	33
		S–43085	8–71	100	82	60
Coloso silty clay:						
1.2 miles southeast of Central Roig, Yabucoa, and 30 feet east from intersection of farm roads. (Modal)	Alluvium.	S–43092	0–9	100	93	71
		S–43093	15–25	100	100	93
Limones silty clay loam:						
100 feet north of kilometer marker 14.2 on Highway No. 182. (Modal)	Granitic rocks.	S–43095	0–5	100	91	70
		S–43096	9–16	100	93	80
		S–43097	40–54	100	93	80
Mabi clay:						
800 feet north and 600 feet west of Gurabo Experiment Station Offices. (Modal)	Alluvium from volcanic rocks.	S–43124	0–7	100	98	90
		S–43125	15–24	100	99	96
		S–43126	38–53	100	99	95
Maunabo clay:						
40° 30′ and 1,562 feet from intersection of Highway No. 905 and Highway No. 3. (Modal)	Alluvium from granitic rocks.	S–43105	10–39	100	99	86
Mayo loam:						
336° and 6,406 feet from intersection of Highway No. 905 and Highway No. 3. (Modal)	Granitic materials.	S–43106	0–8	100	72	40
		S–43107	8–18	100	62	27
		S–43108	27–34	100	69	32
Pandura loam:						
339° 30′ and 7,109 feet from intersection of Highway No. 905 and Highway No. 3. (Modal)	Granitic rocks.	S–43112	0–5	100	73	38
		S–43113	5–12	100	69	30
		S–43114	12–28	100	65	27

[1] Mechanical analyses according to AASHTO Designation T 88 (*1*). Results obtained by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS procedure, the fine material is analyzed by the pipette method and material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soil.

for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Soil properties that most affect design and construction of roads and streets are load-supporting capacity, stability of the subgrade, and the workability and quantity of cut and fill material available. The AASHTO and Unified classifications of the soil material and the shrink-swell potential indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Road fill is soil material used in embankments for

test data

the American Association of State Highway and Transportation Officials (AASHTO) (*1*)]

Mechanical analysis [1]—Continued				Liquid limit	Plasticity index	Classification	
Percentage smaller than—							
0.05 mm	0.02 mm	0.005 mm	0.002 mm			Unified [2]	AASHTO [3]
35	25	16	13	27	6	SM–SC	A–4(1)
34	27	22	19	33	15	SC	A–6(2)
91	77	58	45	69	34	MH–CH	A–7–5(20)
96	86	68	57	82	48	CH	A–7–5(20)
72	67	52	40	63	24	MH	A–7–5(17)
85	74	50	35	56	22	MH	A–7–5(16)
82	67	40	27	46	14	ML	A–7–5(11)
31	29	25	21	30	11	SC	A–2–6(0)
59	53	37	26	39	13	CL–ML	A–6(6)
66	53	38	30	48	22	CL–ML	A–7–6(12)
88	76	52	38	59	27	MH–CH	A–7–5(19)
69	67	63	56	74	30	MH	A–7–5(18)
79	77	73	65	78	36	MH	A–7–5(20)
78	72	52	39	59	23	MH	A–7–5(17)
88	78	59	49	68	33	MH	A–7–5(20)
95	90	75	67	102	67	CH	A–7–5(20)
93	88	69	60	87	55	CH	A–7–5(20)
81	72	56	45	57	28	MH–CH	A–7–6(19)
36	28	19	14	31	6	SM	A–4(1)
24	21	14	10	[4] NP	[4] NP	SM	A–2–4(0)
28	23	15	11	NP	NP	SM	A–2–4(0)
34	28	18	14	30	8	SM–SC	A–4(1)
26	21	14	11	NP	NP	SM	A–2–4(0)
23	18	9	7	NP	NP	SM	A–2–4(0)

[2] Based on the Unified Soil Classification System (*7*).

[3] Based on AASHTO Designation M 145–49.

[4] NP means nonplastic.

roads. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 6 provide guidance about where to look for probable sources. A soil rated as a *good* or *fair* source generally has a layer of sand or gravel at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, and neither do they indicate quality of the deposit.

Topsoil is used for topdressing an area where vegeta-

tion is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as in preparing a seedbed; natural fertility of the material or plant response when fertilizer is added to the soil; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments affect suitability, and also considered in the ratings is damage that can result at the area from which topsoil is taken.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage and piping and that is of favorable stability, shrink-swell potential, shear strength, and compactibility. Stones or organic material in a soil are among factors that are unfavorable.

Drainage of cropland and pasture is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock or other layers that influence rate of water movement; depth to the water table; slope; stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, water erosion, or soil blowing; soil texture; content of stones; accumulation of salts and alkali; depth of root zone; rate of water intake at the surface; permeability below the surface layer and in fragipan or other layers that restrict movement of water; amount of water held available to plants; and need for drainage, or depth to water table or bedrock.

Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or to other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Soil test data

Table 7 contains engineering test data for some of the major soil series in the Humacao Area. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limit and plastic limit. The mechanical analyses were made by combined sieve and hydrometer methods.

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material, as has been explained for table 5.

Use of the Soils for Recreation Facilities

Knowledge of soils is necessary in planning, developing, and maintaining areas used for recreation. In table 8 the soils of the Humacao Area are rated according to limitations that affect their suitability for camp areas, playgrounds, picnic areas, and paths and trails.

In table 8 the soils are rated as having slight, moderate, or severe limitations for the specified uses. For all of these ratings, it is assumed that a good cover of vegetation can be established and maintained. A limitation of *slight* means that soil properties are generally favorable and limitations are so minor that they easily can be overcome. A *moderate* limitation can be overcome or modified by planning, by design, or by special maintenance. A *severe* limitation means that costly soil reclamation, special design, intense maintenance, or a combination of these, is required.

Camp areas are used intensively for tents and small camp trailers and the accompanying activities of outdoor living. Little preparation of the site is required, other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils have mild slopes, good drainage, a surface free of rocks and coarse fragments, and are not subject to flooding during periods of heavy use; their surface is firm after rain but not dusty when dry.

Playgrounds are areas used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. The best soils have a nearly level surface free of coarse fragments and rock outcrops. They have good drainage and are not subject to flooding during periods of heavy use. Their surface is firm after rain but not dusty when dry. If grading and leveling are required, depth to rock is important.

Picnic areas are attractive natural or landscaped tracts that carry heavy foot traffic. Most of the vehicular traffic, however, is confined to access roads. The best soils are firm when wet but not dusty when dry, are not subject to flooding during the season of use, and do not have slopes or stones that can greatly increase the cost of leveling or of building access roads.

Paths and trails are used for local and cross-country travel by foot or horseback. Design and layout should require little or no cutting and filling. The best soils are at least moderately well drained, are firm when wet but not dusty when dry, are flooded not more than once during the season of use, have slopes of less than 15 percent, and have few or no rocks or stones on the surface.

Formation and Classification of the Soils

This section describes the five major factors of soil formation and tells how these factors have affected the soils of the Humacao Area. It also defines the system currently used for classifying soils and shows the classification of the soils in the area by series and higher categories.

Factors of Soil Formation

Soils are formed by the action of soil-forming processes on material deposited or accumulated by geologic

TABLE 8.—*Degree and kind of limitations of the soils for recreation facilities*

Soil series and map symbols	Camp areas	Picnic areas	Playgrounds	Paths and trails
Aceitunas: AcC	Moderate: silty clay loam surface layer.	Moderate: silty clay loam surface layer.	Moderate where slope is less than 7 percent: silty clay loam surface layer. Severe where slope is more than 7 percent.	Moderate: silty clay loam surface layer.
Aguadilla: Ad	Slight	Slight	Moderate: loamy sand surface layer.	Moderate: loamy sand surface layer.
Ag	Moderate: subject to flooding.	Slight	Slight	Slight.
Amelia: AmB, AmC2	Moderate: gravelly clay loam surface layer; coarse fragments on surface.	Moderate: gravelly clay loam surface layer; coarse fragments on surface.	Severe: coarse fragments on surface.	Moderate: gravelly clay loam surface layer; coarse fragments on surface.
Arenales: An, Ar	Moderate: subject to flooding.	Moderate: subject to flooding.	Moderate: subject to flooding.	Moderate: sandy loam surface layer; subject to flooding.
Bajura: Ba, Bc	Severe: poorly drained; subject to flooding; clay surface layer.	Severe: poorly drained; subject to flooding; clay surface layer.	Severe: poorly drained; subject to flooding; clay surface layer.	Severe: poorly drained; subject to flooding; clay surface layer.
Caguabo: CbD2, CbF2	Severe: slope	Severe: slope	Severe: slope; depth to hard rock is 1 to 1½ feet.	Moderate where slope is less than 25 percent. Severe where slope is more than 25 percent.
Candelero: CdB, CdC2	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate where slope is 2 to 6 percent: somewhat poorly drained; slow permeability. Severe where slope is more than 6 percent.	Moderate: somewhat poorly drained.
Cartagena: Ce	Severe: clay surface layer.	Severe: clay surface layer.	Severe: clay surface layer.	Severe: clay surface layer.
Catano: Cf	Slight	Slight	Moderate: sand surface layer.	Moderate: sand surface layer.
Cayagua: CgC2, CgD2	Moderate where slope is less than 15 percent: somewhat poorly drained; slow permeability. Severe where slope is more than 15 percent.	Moderate where slope is less than 15 percent: somewhat poorly drained. Severe where slope is more than 15 percent.	Moderate where slope is less than 6 percent: somewhat poorly drained; slow permeability. Severe where slope is more than 6 percent.	Moderate: somewhat poorly drained.
Coamo: ClB, ClC	Moderate: clay loam surface layer.	Moderate: clay loam surface layer.	Moderate where slope is less than 6 percent. Severe where slope is more than 6 percent.	Moderate: clay loam surface layer.
Coastal beaches: Cm	Severe: wave action	Severe: wave action	Severe: sandy wave action.	Severe: sandy.
Cobbly alluvial land: Cn	Severe: subject to flooding; coarse fragments.	Severe: subject to flooding; coarse fragments.	Severe: subject to flooding; coarse fragments.	Severe: subject to flooding; coarse fragments.
Coloso: Co, Cr	Moderate: somewhat poorly drained; subject to flooding; silty clay loam surface layer.	Moderate: somewhat poorly drained; subject to flooding; silty clay loam surface layer.	Moderate: somewhat poorly drained; subject to flooding; silty clay loam surface layer.	Moderate: somewhat poorly drained; subject to flooding; silty clay loam surface layer.

TABLE 8.—*Degree and kind of limitations of the soils for recreation facilities*—Continued

Soil series and map symbols	Camp areas	Picnic areas	Playgrounds	Paths and trails
Corcega: Cs	Severe: subject to flooding; depth to seasonal high water table is 1½ to 2½ feet; somewhat poorly drained.	Severe: subject to flooding; depth to seasonal high water table is 1½ to 2½ feet; somewhat poorly drained.	Severe: subject to flooding; depth to seasonal high water table is 1½ to 2½ feet; somewhat poorly drained.	Severe: subject to flooding; depth to seasonal high water table is 1½ to 2½ feet; somewhat poorly drained.
Daguao, deep variant: DaC.	Moderate: slope; silty clay loam surface layer.	Moderate: slope; silty clay loam surface layer.	Moderate where slope is less than 6 percent: silty clay loam surface layer. Severe where slope is more than 6 percent.	Moderate: silty clay loam surface layer.
Daguao: DcE2	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Descalabrado: DeC2, DeE2	Moderate where slope is less than 15 percent: clay loam surface layer. Severe where slope is more than 15 percent.	Moderate where slope is less than 15 percent: clay loam surface layer. Severe where slope is more than 15 percent.	Severe: slope; depth to hard rock is 1 to 1½ feet.	Moderate where slope is less than 25 percent; clay loam surface layer.
DgF2	Severe: slope	Severe: slope	Severe: slope; depth to rock is less than 20 inches.	Severe: slope.
DrF	Severe: slope; rockiness.	Severe: slope; rockiness.	Severe: slope; depth to bedrock is 10 to 20 inches; rockiness.	Severe: slope; rockiness.
Fajardo: FaC, FaC2	Severe: clay surface layer.	Severe: clay surface layer.	Severe: clay surface layer.	Severe: clay surface layer.
Fortuna: Fo	Severe: poorly drained; subject to flooding; clay surface layer.	Severe: poorly drained; subject to flooding; clay surface layer.	Severe: poorly drained; subject to flooding; clay surface layer.	Severe: poorly drained; subject to flooding; clay surface layer.
Fraternidad: FrA, FrB	Severe: clay surface layer.	Severe: clay surface layer.	Severe: clay surface layer.	Severe: clay surface layer.
Guamani: Gm	Moderate: silty clay loam surface layer.	Moderate: silty clay loam surface layer.	Moderate: silty clay loam surface layer.	Moderate: silty clay loam surface layer.
Guayabota: GuE2	Severe: slope	Severe: slope	Severe: slope; depth to hard rock is 1 to 1½ feet.	Moderate where slope is less than 25 percent. Severe where slope is more than 25 percent.
GvF	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Guayama, moderately deep variant: GyC2.	Moderate where slope is less than 15 percent: clay loam surface layer.	Moderate where slope is less than 15 percent: clay loam surface layer.	Moderate where slope is less than 6 percent. Severe where slope is more than 6 percent.	Moderate: clay loam surface layer.
Humacao: HmB	Slight	Slight	Slight	Slight.
Humatas: HtE2, HtF2	Severe: clay surface layer.	Severe: clay surface layer.	Severe: slope; clay surface layer.	Severe: clay surface layer.
HuF	Severe: slope; stoniness.	Severe: slope; stoniness.	Severe: slope; stoniness.	Severe: slope; stoniness.
Ingenio: InE2	Severe: slope	Severe: slope	Severe: slope	Moderate where slope is less than 25 percent. Severe where slope is more than 25 percent.

TABLE 8.—*Degree and kind of limitations of the soils for recreation facilities*—Continued

Soil series and map symbols	Camp areas	Picnic areas	Playgrounds	Paths and trails
Jacana: JaB, JaC2	Severe: clay surface layer.	Severe: clay surface layer.	Severe: clay surface layer.	Severe: clay surface layer.
Jagueyes: JgE2	Severe: slope	Severe: slope	Severe: slope	Moderate where slope is less than 25 percent. Severe where slope is more than 25 percent.
Junquitos: JuC	Severe: coarse fragments on surface.	Severe: coarse fragments on surface.	Severe: coarse fragments on surface.	Moderate: coarse fragments on surface; gravelly clay loam surface layer.
Leveled clayey land: Lc	Slight	Slight	Slight	Slight.
Limones: LeE2	Severe: slope	Severe: slope	Severe: slope	Moderate where slope is less than 25 percent. Severe where slope is more than 25 percent.
Lirios: LoC2, LrE2	Moderate where slope is less than 15 percent: silty clay loam surface layer. Severe where slope is more than 15 percent.	Moderate where slope is less than 15 percent: silty clay loam surface layer. Severe where slope is more than 15 percent.	Severe: slope	Moderate where slope is less than 25 percent. Severe where slope is more than 25 percent.
Los Guineos: LsD, LsE2, LsF2	Moderate where slope is less than 15 percent: silty clay loam surface layer. Severe where slope is more than 15 percent.	Moderate where slope is less than 15 percent: silty clay loam surface layer. Severe where slope is more than 15 percent.	Severe: slope	Moderate where slope is less than 25 percent. Severe where slope is more than 25 percent.
LyF	Severe: slope; rockiness.	Severe: slope; rockiness.	Severe: slope; rockiness.	Severe: slope; rockiness.
Mabi: MaB, MaC2, MaD2	Severe: clay surface layer.	Severe: clay surface layer.	Severe: clay surface layer.	Severe: clay surface layer.
Machete: McA, McB	Slight	Slight	Slight where slope is 0 to 2 percent. Moderate where slope is 2 to 5 percent.	Slight.
Made land: Md	Slight	Slight	Slight	Slight.
Maunabo: Me	Severe: poorly drained; clay surface layer.	Severe: poorly drained; clay surface layer.	Severe: poorly drained; clay surface layer.	Severe: poorly drained; clay surface layer.
Mayo: MlC	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 10 percent.	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 10 percent.	Moderate where slope is less than 6 percent. Severe where slope is more than 6 percent.	Slight.
Meros: MrB	Slight	Slight	Moderate: sand texture.	Moderate: sand texture.
Mucara: MuD2, MuE2	Moderate where slope is less than 15 percent: silty clay loam surface layer. Severe where slope is more than 15 percent.	Moderate where slope is less than 15 percent: silty clay loam surface layer. Severe where slope is more than 15 percent.	Severe: slope	Moderate where slope is less than 25 percent: silty clay loam surface layer. Severe where slope is more than 25 percent.
Naranjito: NaE2, NaF2	Severe: slope	Severe: slope	Severe: slope	Moderate where slope is less than 25 percent: silty clay loam surface layer. Severe where slope is more than 25 percent.

TABLE 8.—*Degree and kind of limitations of the soils for recreation facilities*—Continued

Soil series and map symbols	Camp areas	Picnic areas	Playgrounds	Paths and trails
Pandura: PaE2, PaF2	Moderate where slope is less than 15 percent. Severe where slope is more than 15 percent.	Moderate where slope is less than 15 percent. Severe where slope is more than 15 percent.	Severe: slope	Moderate where slope is less than 25 percent. Severe where slope is more than 25 percent.
PdF	Severe: slope; stoniness.	Severe: slope; stoniness.	Severe: slope; stoniness.	Severe: slope; stoniness.
Parcelas: PeC2	Severe: clay surface layer.	Severe: clay surface layer.	Severe: clay surface layer.	Severe: clay surface layer.
Paso Seco: PlB	Severe: clay surface layer.	Severe: clay surface layer.	Severe: clay surface layer.	Severe: clay surface layer.
Patillas: PmD2, PmE2	Moderate where slope is less than 15 percent: clay loam surface layer. Severe where slope is more than 15 percent.	Moderate where slope is less than 15 percent: clay loam surface layer. Severe where slope is more than 15 percent.	Severe: slope	Moderate where slope is less than 25 percent: clay loam surface layer. Severe where slope is more than 25 percent.
Pinones: Pn	Severe: poorly drained; silty clay surface layer.	Severe: poorly drained; silty clay surface layer.	Severe: poorly drained; silty clay surface layer.	Severe: poorly drained; silty clay surface layer.
Poncena: Po	Severe: clay surface layer.	Severe: clay surface layer.	Severe: clay surface layer.	Severe: clay surface layer.
Pozo Blanco: PrC2	Moderate: slope; clay loam surface layer.	Moderate: slope; clay loam surface layer.	Severe: slope	Moderate: clay loam surface layer.
Reilly: Re	Severe: subject to flooding; coarse fragments on surface.	Severe: subject to flooding; coarse fragments on surface.	Severe: subject to flooding; coarse fragments on surface.	Severe: subject to flooding; coarse fragments on surface.
Reparada: Rp	Severe: clay surface layer; poorly drained; very slow permeability.	Severe: clay surface layer; poorly drained.	Severe: clay surface layer; poorly drained; very slow permeability.	Severe: clay surface layer; poorly drained.
Rio Arriba: RrB, RrC2	Severe: clay surface layer.	Severe: clay surface layer.	Severe: clay surface layer.	Severe: clay surface layer.
Rock land: Rs	Severe: slope; rockiness.	Severe: slope; rockiness.	Severe: slope; rockiness.	Severe: slope; rockiness.
Rough stony land: Ru	Severe: slope; stoniness.	Severe: slope; stoniness.	Severe: slope; stoniness.	Severe: slope; stoniness.
Sabana: SaE2, SaF2	Severe: slope	Severe: slope	Severe: slope; depth to hard rock is 1 to 1½ feet.	Moderate where slope is less than 25 percent. Severe where slope is more than 25 percent.
Salt water marsh: Sm	Severe: wetness; subject to flooding.	Severe: wetness; subject to flooding.	Severe: wetness; subject to flooding.	Severe: wetness; subject to flooding.
Talante: Ta	Moderate: somewhat poorly drained; clay loam and sandy clay loam surface layer; subject to flooding.	Moderate: somewhat poorly drained; clay loam and sandy clay loam surface layer; subject to flooding.	Moderate: somewhat poorly drained; clay loam and sandy clay loam surface layer; subject to flooding.	Moderate: somewhat poorly drained; clay loam and sandy clay loam surface layer; subject to flooding.
Teja: TeE	Severe: slope; coarse fragments on surface.	Severe: slope; coarse fragments on surface.	Severe: slope; coarse fragments on surface; depth to hard rock is 1 to 1½ feet.	Severe: slope; coarse fragments on surface.
Tidal flats: Tf	Severe: wetness; subject to flooding.	Severe: wetness; subject to flooding.	Severe: wetness; subject to flooding.	Severe: wetness; subject to flooding.

TABLE 8.—*Degree and kind of limitations of the soils for recreation facilities*—Continued

Soil series and map symbols	Camp areas	Picnic areas	Playgrounds	Paths and trails
Tidal swamp: Ts	Severe: wetness; subject to flooding.	Severe: wetness; subject to flooding.	Severe: wetness; subject to flooding.	Severe: wetness; subject to flooding.
Toa: Tt	Moderate: silty clay loam surface layer.	Moderate: silty clay loam surface layer.	Moderate: silty clay loam surface layer.	Moderate: silty clay loam surface layer.
Utuado: UpF	Severe: slope; rockiness.	Severe: slope; rockiness.	Severe: slope; rockiness.	Severe: slope; rockiness.
Vayas: Va, Vc	Severe: poorly drained; subject to flooding; silty clay surface layer.	Severe: poorly drained; subject to flooding; silty clay surface layer.	Severe: poorly drained; subject to flooding; silty clay surface layer.	Severe: poorly drained; subject to flooding; silty clay surface layer.
Vega Alta: VeB, VeC	Moderate: silty clay loam surface layer.	Moderate: silty clay loam surface layer.	Moderate where slope is less than 6 percent: silty clay loam surface layer. Severe where slope is more than 6 percent.	Moderate: silty clay loam surface layer.
Vega Baja: VgA	Moderate: silty clay loam surface layer; subject to flooding; somewhat poorly drained.	Moderate: silty clay loam surface layer; subject to flooding; somewhat poorly drained.	Moderate: silty clay loam surface layer; subject to flooding; somewhat poorly drained.	Moderate: silty clay loam surface layer; subject to flooding; somewhat poorly drained.
Via: VlC	Moderate: silty clay loam surface layer.	Moderate: silty clay loam surface layer.	Moderate where slope is less than 6 percent: silty clay loam surface layer. Severe where slope is more than 6 percent.	Moderate: silty clay loam surface layer.
Vieques: VmC, VmE2	Moderate where slope is less than 15 percent. Severe where slope is more than 15 percent.	Moderate where slope is less than 15 percent. Severe where slope is more than 15 percent.	Severe: slope	Slight where slope is less than 15 percent. Moderate where slope is 15 to 25 percent. Severe where slope is more than 25 percent.
Vives: Vs, VvA, VvB	Severe: clay surface layer.	Severe: clay surface layer.	Severe: clay surface layer.	Severe: clay surface layer.
Vivi: Vw	Moderate: subject to flooding.	Slight	Slight	Slight.
Wet alluvial land: Wa	Severe: wetness; subject to flooding.	Severe: wetness; subject to flooding.	Severe: wetness; subject to flooding.	Severe: wetness; subject to flooding.
Yunes: YuF2	Severe: slope	Severe: slope	Severe: slope; depth to hard rock is 1 to 1½ feet.	Moderate where slope is less than 25 percent. Severe where slope is more than 25 percent.

forces. 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 the soil material has accumulated and has existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life are active factors of soil genesis. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of the climate and plant and animal life are conditioned by relief. The parent material also affects the kind of profile that can be formed and, in extreme cases, determines it almost entirely. Finally, time is needed for the changing of the parent material into a mature soil. The amount of time can be short or long, but some time is always required for soil horizons to form. Usually a long time is required for distinct horizons to develop.

The factors of soil formation are so closely interre-

lated in their effects on the soil that few generalizations can be made about the effect of any one unless conditions are specified for the other four.

Parent material

Parent material is the unconsolidated mass from which a soil forms. It largely determines the chemical and mineralogical composition of the soil. To a large extent, the minerals in the parent material determine the kinds and amount of clay in the soil. Many of the soils in the Humacao Area formed in place from material derived from intrusive and extrusive volcanic rocks.

Climate

A soil forms rapidly in the Humacao Area because of the warm tropical climate. This warm climate is favorable throughout the year for rapid chemical and physical reactions, for the decomposition of organic material from plants and animals, and for other soil-forming processes.

The variations in temperature are relatively small within the area, but rainfall varies from place to place, and this accounts for some differences in the soils. Roughly, the four climatic zones in the survey area are the southern part of the area, the central part, the northern part, and the tropical rain forest.

In the southern part, the climate is warm and dry. The average temperatures are 79.9° F. for the year, 76.8° for January, and 82.1° for July. The average annual rainfall is 24 to 45 inches.

In the central part, the climate is warm and humid. The average temperatures are 77.4° for the year, 73.0° for January, and 78.3° for July. The average annual rainfall is 70 to 90 inches.

In the northern part the climate is warm and subhumid. The average temperatures are 78.2° for the year, 74.0° for January, and 79.6° for July. The annual average rainfall is 60 to 80 inches.

In the tropical rain forest, the climate is warm and humid. The average temperatures are 74.1° for the year, 70.7° for January, and 76.5° for July. The average annual rainfall is 100 to 180 inches.

Temperature and rainfall govern the rate of weathering of rocks and the decomposition of minerals. They also influence leaching, eluviation, and illuviation. For example, the soils in the southern part of the survey area, where the climate is semiarid, are not so leached as soils in other parts of the area that originated from the same parent material but have lost bases and nutrients because of the amount of rainfall.

Plants and animals

Plants, animals, fungi, and bacteria are important to soil formation. The changes they bring about depend mainly on the kinds of life processes peculiar to each.

Originally, the Humacao Area was covered by a fairly dense tropical forest. A large part of the area was cleared for cultivation, and when it was later left idle, low brush and native pasture became dominant. Most of the original native vegetation has been destroyed or seriously disturbed, except in the rain forest, but its effect on soil formation is visible.

The vegetation is generally responsible for the amount of organic matter in the soil, the color of the surface layer, and the amount of nutrients. Growing plants provide a cover that helps to reduce erosion and stabilize the surface so that the soil-forming processes can continue. Leaves, twigs, and entire plants accumulate on the surface of forest soils and then decompose as a result of percolating water and of micro-organisms, earthworms, and other forms of animal life acting on the soil. The roots of plants widen cracks in the rocks and thus permit more water to enter the soil. Also, the uprooting of trees influences soil formation by mixing the soil layers and loosening the underlying material.

Earthworms, ants, and many other burrowing animals are extremely active in the Humacao Area and help to keep the soil open and porous. They mix the layers of the soil, mix organic matter into the soil, and help to break down the remains of plants. Earthworms and other small invertebrates feed on organic matter in the upper few inches of the soil. They slowly but continually mix the soil material and, in places, alter it chemically. Bacteria, fungi, and other micro-organisms hasten the weathering of rock minerals and the decay of organic matter.

Relief

The shape of the land surface, the slope, and the depth of the water table have had great influence on the formation of the soils in the survey area. Strongly sloping soils, where runoff is moderate to rapid, generally are well drained, have a bright-colored, unmottled subsoil, and are leached to a greater depth than wet soils in the same general area. About 64 percent of the soils in the Humacao Area are strongly sloping or steep. The more gently sloping soils, where runoff is slower, generally exhibit some evidence of wetness, such as mottling in the subsoil. In level areas or slight depressions, where the water table is at or near the surface for long periods of time, the soils show marked evidence of wetness.

Time

In the formation of soils, time is needed for changes to take place in the parent material, and this is usually a long time when measured in years.

The soils of the Humacao Area range from those that show little or no development to older soils that show pronounced development. Vives and Toa soils are examples of young soils that formed from sediment that washed from the hills and was deposited on river flood plains. Los Guineos and Humatas are two older soils of the uplands where the parent rock has weathered in place for a long time.

Classification of the Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and revised later (*4*). The system currently used by the National Cooperative Soil Survey was developed in the early sixties (*3*) and was adopted in 1965 (*6*). It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 9 shows the classification of each soil series of the Humacao Area by family, subgroup, and order, according to the current system. The six categories of the current system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soil. The two exceptions to this are the Entisols and Histosols, which occur in many different climates. Each order is named with a word of three or four syllables ending in *sol* (Ent-i-sol).

SUBORDER. Each order is divided into suborders primarily on the basis of those soil characteristics that seem to produce classes that have the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation. The names of suborders have two syllables. The last syllable indicates the order. An example is *Aquent* (*Aqu*, meaning water or wet, and *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated, those that have a pan that interferes with the growth of roots or movement of water, and thick, dark colored surface horizons. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark red and dark brown colors associated with basic rocks, and the like. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is Fluvaquents (*Fluv*, meaning river, *aqu* for wetness or water, and *ent*, from Entisols).

SUBGROUP. Great groups are divided into subgroups, one representing the central (typic) segment of the group, and others called intergrades that have properties of the group and also have one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Tropic Fluvaquents (Fluvaquents of the tropics.)

FAMILY. Soil families are established within a subgroup primarily on the basis of properties important to the growth of plants or the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for characteristics, such as texture and mineralogy, that are used to differentiate families (see table 9). An example is the fine, mixed, acid, isohyperthermic family of Tropic Fluvaquents.

SERIES. The series is a group of soils that have major horizons that, except for texture of the surface layer, are similar in important characteristics and in arrangement in the profile. They are given the name of a geographic location near the place where that series was first observed and mapped. An example is the Teja series.

The nomenclature for the classes in each of the four highest categories is, for the most part, connotative. The formative elements come chiefly from the classical languages. Many of the roots are familiar and thus help us to visualize the soil. For example, the Teja series is classified as a Lithic Troporthents. One can visualize that the Teja soils must have hard rock within 20 inches of the surface (lithic), are continually warm (trop), are the common ones (orth), and are in the Entisol order (Ent). The Teja soils are, in fact, shallow to hard granitic rock, occur in the tropics in humid climate, and are in the Entisol order.

The names are distinctive for the classes in each category, so that a name itself will indicate the category to which a given class belongs. Moreover, the names are designed so that each subgroup by its name is placed in the great group, suborder, and order with which it is identified. For example, the name Lithic Troporthents indicates a class in the subgroup. Furthermore, from the name one can identify the great group (Troporthents), the suborder (Orthents), and the order (Entisol).

Climate [4]

The Humacao Area has a tropical marine climate. The mean annual rainfall varies widely mainly because of the variation in topography and elevation. The area includes one of the driest sections of the island, the semiarid southern coastal plain, as well as the most rainy section, the tropical rain forest in the Luquillo Mountains.

The variation in mean annual temperatures is, as in

[4] By ROBERT J. CALVESBERT, Commonwealth climatologist, Environmental Science Services Administration, San Juan, Puerto Rico.

TABLE 9.—*Classification of the soil series*

Series	Family	Subgroup	Order
Aceitunas	Clayey, oxidic, isohyperthermic	Typic Palehumults	Ultisols.
Aguadilla	Mixed, isohyperthermic	Typic Tropopsamments	Entisols.
Amelia	Clayey-skeletal, mixed, isohyperthermic	Typic Haplustalfs	Alfisols.
Arenales	Mixed, isohyperthermic	Typic Ustipsamments	Entisols.
Bajura	Fine, mixed, nonacid, isohyperthermic	Vertic Tropaquepts	Inceptisols.
Caguabo	Loamy-skeletal, mixed, isohyperthermic	Lithic Eutropepts	Inceptisols.
Candelero	Fine-loamy, mixed, isohyperthermic	Aeric Tropaqualfs	Alfisols.
Cartagena	Fine, mixed, isohyperthermic	Udic Chromusterts	Vertisols.
Catano	Carbonatic, isohyperthermic	Typic Tropopsamments	Entisols.
Cayagua	Fine, mixed, isohyperthermic	Aeric Tropaqualfs	Alfisols.
Ciales	Clayey, mixed, isothermic	Aquic Tropohumults	Ultisols.
Coamo	Fine, mixed, isohyperthermic	Typic Argiustolls	Mollisols.
Coloso	Fine, mixed, nonacid, isohyperthermic	Aeric Tropic Fluvaquents	Entisols.
Corcega	Fine-loamy over sandy or sandy-skeletal, mixed, nonacid, isohyperthermic	Aeric Tropic Fluvaquents	Entisols.
Daguao	Clayey, mixed, isohyperthermic	Typic Tropohumults	Ultisols.
Descalabrado	Clayey, mixed, isohyperthermic	Lithic Vertic Ustropepts	Inceptisols.
Fajardo	Fine, mixed, isohyperthermic	Vertic Paleudalfs	Alfisols.
Fortuna	Fine, mixed, acid, isohyperthermic	Tropic Fluvaquents	Entisols.
Fraternidad	Very fine, montmorillonitic, isohyperthermic	Udic Chromusterts	Vertisols.
Guamani	Fine-loamy over sandy or sandy-skeletal, mixed, isohyperthermic	Fluventic Ustropepts	Inceptisols.
Guayabota	Clayey, mixed, acid, isothermic	Lithic Tropaquepts	Inceptisols.
Guayama	Clayey, mixed, isohyperthermic	Lithic Haplustalfs	Alfisols.
Humacao	Fine-loamy, mixed, isohyperthermic	Fluventic Eutropepts	Inceptisols.
Humatas	Clayey, kaolinitic, isohyperthermic	Typic Tropohumults	Ultisols.
Ingenio	Clayey, mixed, isohyperthermic	Orthoxic Tropudults	Ultisols.
Jacana	Fine, mixed, isohyperthermic	Vertic Ustropepts	Inceptisols.
Jagueyes	Fine-loamy, mixed, isohyperthermic	Orthoxic Tropudults	Ultisols.
Junquitos	Fine, mixed, isohyperthermic	Aquic Eutropepts	Inceptisols.
Limones	Clayey, kaolinitic, isohyperthermic	Epiaquic Orthoxic Tropohumults	Ultisols.
Lirios	Clayey over loamy, mixed, isohyperthermic	Typic Tropudults	Ultisols.
Los Guineos	Clayey, mixed, isothermic	Epiaquic Tropohumults	Ultisols.
Mabi	Fine, montmorillonitic, isohyperthermic	Vertic Eutropepts	Inceptisols.
Machete	Fine, mixed, isohyperthermic	Udic Haplustalfs	Alfisols.
Maunabo	Fine, mixed, acid, isohyperthermic	Typic Tropaquepts	Inceptisols.
Mayo	Coarse-loamy, mixed, isohyperthermic	Typic Dystropepts	Inceptisols.
Meros	Mixed, isohyperthermic	Typic Ustipsamments	Entisols.
Mucara	Clayey, montmorillonitic, isohyperthermic, shallow	Vertic Eutropepts	Inceptisols.
Naranjito	Clayey, mixed, isohyperthermic	Typic Tropohumults	Ultisols.
Pandura	Loamy, mixed, isohyperthermic, shallow	Typic Eutropepts	Inceptisols.
Parcelas	Fine, mixed, isohyperthermic	Vertic Dystropepts	Inceptisols.
Paso Seco	Clayey over loamy-skeletal, mixed, isohyperthermic	Udic Chromusterts	Vertisols.
Patillas	Fine-loamy, mixed, isohyperthermic	Dystropeptic Tropudults	Ultisols.
Picacho	Clayey, mixed, isothermic	Aquic Tropohumults	Ultisols.
Pinones	Fine, mixed, acid, isohyperthermic	Thapto-Histic Tropic Fluvaquents	Entisols.
Poncena	Fine, mixed, isohyperthermic	Udic Pellusterts	Vertisols.
Pozo Blanco	Loamy, carbonatic, isohyperthermic, shallow	Typic Calciustolls	Mollisols.
Reilly	Sandy-skeletal, mixed, isohyperthermic	Fluventic Hapludolls	Mollisols.
Reparada	Fine, mixed, nonacid, isohyperthermic	Thapto-Histic Tropic Fluvaquents	Entisols.
Rio Arriba	Fine, mixed, isohyperthermic	Vertic Paleudalfs	Alfisols.
Sabana	Clayey, mixed, isohyperthermic	Lithic Dystropepts	Inceptisols.
Talante	Coarse-loamy over sandy or sandy-skeletal, mixed, acid, isohyperthermic	Aeric Tropic Fluvaquents	Entisols.
Teja	Loamy-skeletal, mixed, acid, isohyperthermic	Lithic Troporthents	Entisols.
Toa	Fine, mixed, isohyperthermic	Fluventic Hapludolls	Mollisols.
Utuado	Fine-loamy, mixed, isothermic	Typic Humitropepts	Inceptisols.
Vayas	Fine, mixed, nonacid, isohyperthermic	Tropic Fluvaquents	Entisols.
Vega Alta	Clayey, mixed, isohyperthermic	Plinthic Tropudults	Ultisols.
Vega Baja	Fine, mixed, isohyperthermic	Aeric Tropaqualfs	Alfisols.
Via	Fine-loamy, mixed, isohyperthermic	Typic Tropudalfs	Alfisols.
Vieques	Fine-loamy over sandy or sandy-skeletal, mixed, isohyperthermic	Typic Ustropepts	Inceptisols.
Vives	Fine-loamy, mixed, isohyperthermic	Fluventic Ustropepts	Inceptisols.
Vivi	Coarse-loamy, mixed, isohyperthermic	Fluventic Eutropepts	Inceptisols.
Yunes	Loamy-skeletal, mixed, isohyperthermic, shallow	Typic Dystropepts	Inceptisols.
Yunque	Clayey, mixed, isothermic	Epiaquic Palehumults	Ultisols.

most of Puerto Rico, quite small. The area is under the influence of the easterly trade winds the year round and has a definite land and sea breeze pattern caused by the differential daytime heating and nighttime cooling of the land and sea.

Tropical storms and hurricanes occasionally strike directly, but more often they pass some distance away although their wind and rain affect the area for several days.

There are a number of microclimates in this eastern section of Puerto Rico, mainly as the result of a variety of rainfall patterns and, to a lesser extent, the variance in relative humidity, temperature, and evaporation. Temperature and precipitation data for five locations in the Humacao Area are given in table 10.

Mean annual rainfall ranges from 42 inches in the Aguirre area of the southern coast to 180 inches in the Luquillo rain forest. There is no dry season nor a wet season, but there is a relatively drier period, usually from December through April in the southern part of the area and from January through April in the northern part, and a period of heavier rainfall from May through November in the south and May through December in the north. There are two peak periods of heavier rains in May and October. Monthly totals range from 0.76 inch to 5.93 inches on the southern coast and from 2.87 to 10.87 inches in the eastern interior around Humacao.

Much of the rain falls in short, convective showers, but very heavy rains lasting several days are caused by the polar trough, locally called vaguada, that moves from west to east as a weakening cold front out of the continental mainland. These rains occur several times during winter and are usually accompanied by gusty winds. The easterly wave, a pressure trough moving from east to west, also can bring heavy rains over the southeastern part of the island late in spring and in summer. Finally, hurricanes and tropical storms can produce very heavy rains in the fall when moving directly over the area or passing offshore as far as 100 miles out to sea. Of the last 6 major hurricanes that have hit Puerto Rico since 1893, 5 have entered the island on the southeastern coast between Fajardo and Aguirre.

Under the effect of these three types of rainmakers, the area can receive as much as 10 inches of rain in a 24-hour period. On the average this happens about once every 10 years. On the average about 5.50 inches of rainfall in 24 hours occurs at least once a year somewhere in the area. Usually the heavier rainfalls cause some flooding.

Extreme droughts that have a devasting effect on agriculture and on the general economy occur in the area. Water supplies become low enough to require the rationing of irrigation water and the curtailing of use of water for human consumption from the reservoirs. In 1967, during the most severe drought on record, the southern coastal stations averaged only 19 inches of rain during the year, the southern slopes area averaged 38 inches, and the northern interior stations averaged 44 to 49 inches. These droughts usually last about 6 months to a year and half. Although no deïnite cycle of occurrence is indicated, a severe to extreme drought occurs about once every 10 to 12 years and several shorter dry spells occur in between.

Mean annual maximum temperatures in Humacao range from 82.0° F. in January to 88.2°in August. The mean annual minimum temperatures vary from 64.0° in January to 73.2° in June. The highest maximum temperature recorded during a 30-year period (1931 to 1960) was 95°, and the lowest minimum was 53°. The higher the elevation on the Luquillo Mountains, the narrower the daily temperature range. In the rain forest itself, the mean maximum temperature is 77° and the mean minimum is 64°. Normally the widest temperature ranges are in places between the higher terrain of the rain forest and the sea-level areas near the ocean where the water has a tempering effect on the daily temperatures.

The prevailing wind direction reflects the easterly trade winds. The section on the east coast, around Fajardo and the Roosevelt Roads Naval Air Station, receives a surface flow from a quadrant encompassing northeast to southeast about 75 percent of the time annually and as much as 95 percent of the time in July when the easterlies are at their strongest. The differential heating of the land and sea during the day tends to give a more northerly component to the flow on the northern side of the island and a more southerly component on the southern side. During the night a land breeze causes a prevailing southeasterly flow in the north and a prevailing northeasterly flow over the southern coast.

About 40 percent of the time, the windspeed is 8 to 12 miles per hour, about 30 percent of the time it is 7 miles per hour or less, and the rest of the time it is more than 12 miles per hour. Windbreaks are effective in some of the higher exposed areas and especially along the eastern and northern coasts where the wind has an open fetch across the sea. The highest windspeeds occur as hurricanes pass through the area. Windspeed as high as 165 miles per hour has been registered and 190 miles per hour estimated on the northern coast during the entry of Hurricane San Felipe in the Guayama area. Based on wind data kept at San Juan for a long period of time, it is estimated that hurricane winds of 75 miles per hour or more occur on the average of about once every 24 years.

Average evaporation rates are higher than the average rainfall as shown in table 11.

Hail is rare and occurs once or twice a year, usually in May or September, but only in the northern and interior parts of the area.

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TABLE 10.—*Temperature and rainfall data from selected stations*

Month	Temperature				Rainfall		
	Average daily maximum	Average daily minimum	Average monthly highest maximum	Average monthly lowest minimum	Average monthly total	One year in 10 will have—	
						Less than—	Equal to or more than—
	°F	°F	°F	°F	Inches	Inches	Inches
HUMACAO							
January	82.0	64.0	84.9	59.1	4.23	1.82	7.11
February	82.7	64.2	86.3	59.2	3.30	1.16	6.23
March	84.5	65.7	88.2	59.8	2.87	.85	5.43
April	85.8	68.5	89.0	64.4	5.22	1.51	9.92
May	86.2	71.5	89.4	66.3	10.26	4.79	16.79
June	87.1	73.2	89.8	69.3	9.53	4.84	14.90
July	87.5	72.9	90.1	69.5	8.65	4.42	13.52
August	88.2	72.4	91.4	69.3	9.41	6.12	13.04
September	87.8	71.7	91.3	67.9	10.87	6.47	15.81
October	87.3	70.4	90.7	66.8	9.96	6.16	14.21
November	85.2	68.1	88.7	63.1	8.16	3.08	14.36
December	82.8	65.5	86.5	60.2	5.59	2.27	9.60
Year	85.6	69.0	[1] 92.6	[2] 57.3	88.05	35.79	151.09
AGUIRRE							
January	85.9	68.0	88.9	63.6	1.07	0.26	2.13
February	85.7	67.9	88.8	63.5	1.29	.15	2.94
March	86.3	68.9	89.3	64.8	.76	.16	1.63
April	87.0	70.7	89.8	66.7	2.37	.38	6.54
May	88.1	72.8	90.9	68.5	4.94	1.93	8.53
June	89.0	74.2	91.4	70.8	4.73	1.78	8.31
July	89.8	74.5	92.8	71.3	4.17	1.26	8.34
August	90.5	74.6	94.4	71.3	5.28	2.56	8.37
September	90.5	73.8	93.5	69.8	5.93	1.74	9.92
October	90.1	73.3	93.4	69.3	5.77	1.09	10.26
November	89.1	71.7	92.3	67.9	4.36	.72	9.39
December	87.3	69.8	90.2	65.5	2.10	.35	4.50
Year	88.3	71.7	[1] 95.2	[2] 62.3	42.77	30.13	56.49
FAJARDO							
January	82.9	69.5	85.6	63.0	3.40	1.44	5.73
February	83.1	69.0	85.9	62.9	2.78	.57	5.73
March	83.9	69.9	87.0	62.9	2.32	.90	4.05
April	84.8	71.7	88.2	66.6	4.32	1.53	7.75
May	86.3	73.9	89.6	68.8	7.97	3.68	14.09
June	87.1	75.3	89.4	70.0	6.12	2.53	10.41
July	87.7	75.7	89.1	70.9	6.06	2.49	10.37
August	88.3	75.8	90.0	71.1	6.80	4.08	9.84
September	88.4	74.7	90.5	69.6	7.75	4.09	12.01
October	88.0	73.5	90.6	68.8	8.01	4.64	11.83
November	86.2	72.2	88.6	66.7	6.08	2.57	10.26
December	84.1	71.0	86.5	64.9	4.40	2.05	7.21
Year	85.9	72.7	[1] 91.6	[2] 60.9	66.01	33.53	103.50

illus. [Supplements issued in March 1967, September 1968, and April 1969]
(7) United States Department of Defense. 1968. Unified soil classification system for roads, airfields, embankments and foundations. MIL-STD-619B, 30 pp., illus.

Glossary

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvial fan. A fan-shaped deposit of sand, gravel, and fine material dropped by a stream where its gradient lessens abruptly.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

TABLE 10.—*Temperature and rainfall data from selected stations*—Continued

VIEQUES

Month	Temperature				Rainfall		
	Average daily maximum	Average daily minimum	Average monthly highest maximum	Average monthly lowest minimum	Average monthly total	One year in 10 will have—	
						Less than—	Equal to or more than—
	°F	°F	°F	°F	*Inches*	*Inches*	*Inches*
January	84.4	68.9	87.7	64.4	2.21	0.62	4.13
February	84.7	69.3	88.1	64.1	1.84	.41	3.86
March	85.7	68.9	88.7	64.5	1.55	.28	3.19
April	86.6	70.5	89.8	66.6	2.62	.72	5.88
May	87.8	73.3	90.5	68.5	3.46	1.09	6.45
June	88.9	74.5	91.2	69.9	3.87	1.39	6.88
July	89.6	74.8	92.0	70.8	3.60	1.24	6.54
August	90.2	75.0	92.8	70.8	4.67	2.27	7.52
September	89.2	74.7	92.2	70.0	5.76	2.18	10.09
October	88.8	73.9	91.1	69.8	5.57	1.76	10.41
November	87.5	72.4	90.5	67.4	4.52	1.72	7.93
December	85.6	70.2	88.5	65.4	3.20	.91	5.80
Year	87.4	72.2	[1] 93.8	[2] 62.5	42.88	31.70	54.00
CANOVANAS							
January	83.1	65.4	87.3	59.5	4.96	2.00	10.04
February	83.6	65.1	88.0	58.7	3.57	.90	7.05
March	84.9	65.8	89.1	59.5	2.82	.89	5.25
April	86.2	67.9	90.7	62.0	4.50	1.58	8.07
May	87.9	70.3	91.4	64.8	8.25	3.28	14.26
June	88.5	71.7	91.4	66.2	7.08	3.84	12.55
July	88.0	72.3	90.8	66.8	7.80	3.92	12.22
August	88.7	72.9	91.9	70.2	7.65	4.36	11.34
September	88.8	71.6	91.9	66.6	7.23	3.32	11.79
October	88.7	70.6	92.4	65.6	6.18	3.97	9.06
November	86.3	69.1	90.4	61.7	6.79	3.16	11.10
December	84.0	67.2	88.5	61.3	6.01	2.84	9.78
Year	86.6	69.2	[1] 93.5	[2] 57.9	72.84	57.59	88.59

[1] Average annual highest temperature.
[2] Average annual lowest temperature.

TABLE 11.—*Mean evaporation rates, in inches, for three locations*

Location	January	February	March	April	May	June	July	August	September	October	November	December	Annual
San Juan	5.82	6.01	7.88	7.93	7.50	7.36	8.06	7.66	6.43	5.91	5.34	5.69	81.59
Aguirre	5.26	5.75	7.41	7.60	7.72	7.69	8.02	7.84	6.54	6.04	5.06	4.92	79.85
Gurabo	3.84	4.48	5.68	6.16	6.09	6.28	6.21	6.04	5.25	4.94	3.82	3.71	62.50

Chert. A compact, siliceous rock formed of chalcedonic or opaline silica, or both, that is of organic or precipitated origin.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Drainage class (natural). Refers to the conditions of frequency

and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Leaching. The removal of soluble materials from soils or other material by percolating water.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Plutonic rock. A general term applied to the class of igneous rocks that have crystallized at great depths and are generally granitoid in texture.

Pressure faces. Structural faces that show more evidence of clay than the natural ped surfaces but that do not have clay films. Probably caused by the shrinking and swelling of the soil.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

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

Runoff (hydraulics). The part of the precipitation upon a drainage area that is discharged from the area in stream channels. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called groundwater runoff or seepage flow from ground water.

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; or contains harmful salts and has a highly alkaline reaction; or contains harmful salts and exchangeable sodium and is strongly alkaline in reaction. The salts, exchangeable sodium, and alkaline reaction occur in the soil in such location that the growth of most crop plants is less than normal.

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Saprolite. Disintegrated and somewhat decomposed but untransported rock.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on relatively steep slopes and in swelling clays, where there is marked change in moisture content.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand* (2.0 to 1.0

millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Upland (geology). Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowland along rivers.

Variant, soil. A soil having properties sufficiently different from those of other known soils to suggest establishing a new soil series, but a soil of such limited known area that creation of a new series is not believed to be justified.

Volcanic rock. The class of igneous rocks that have been poured out or ejected at or near the surface. The form is synonymous with extrusive rock and effusive rock.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Weathering. All physical and chemical changes produced in rocks at or near the earth's surface by atmospheric agents. These changes result in more or less complete disintegration and decomposition of the rock.

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GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and the description of the soil series to which the mapping unit belongs. The system of capability grouping is explained in the section that begins on page 49. The system of woodland suitability grouping is explained in the section that begins on page 53.

Map symbol	Mapping unit	Page	Capability unit Nonirrigated	Capability unit Irrigated	Woodland suitability group
			Symbol	Symbol	Symbol
AcC	Aceitunas silty clay loam, 5 to 12 percent slopes	7	IIIe-1	------	---
Ad	Aguadilla loamy sand	7	VIs-3	------	---
Ag	Aguadilla sandy loam, moderately wet	7	VIs-3	------	---
AmB	Amelia gravelly clay loam, 2 to 5 percent slopes	8	IVc-3	IIIs-1	---
AmC2	Amelia gravelly clay loam, 5 to 12 percent slopes, eroded	8	IVe-8	------	---
An	Arenales sandy loam	8	VIc-1	IVs-1	---
Ar	Arenales sandy loam, gravelly substratum	8	VIc-1	IVs-1	---
Ba	Bajura silty clay, saline	9	VIIw-1	------	---
Bc	Bajura clay, frequently flooded	9	IIIw-1	------	---
CbD2	Caguabo clay loam, 12 to 20 percent slopes, eroded	10	VIs-2	------	3d5
CbF2	Caguabo clay loam, 20 to 60 percent slopes, eroded	10	VIIs-1	------	3d5, 4d5
CdB	Candelero loam, 2 to 5 percent slopes	11	IIIw-2	------	---
CdC2	Candelero loam, 5 to 12 percent slopes, eroded	11	IVe-1	------	---
Ce	Cartagena clay	12	IIIc-1	IIs-1	---
Cf	Catano loamy sand	12	VIs-1	------	---
CgC2	Cayagua sandy loam, 5 to 12 percent slopes, eroded	13	IIIe-2	------	---
CgD2	Cayagua sandy loam, 12 to 20 percent slopes, eroded	13	IVe-2	------	---
ClB	Coamo clay loam, 2 to 5 percent slopes	14	IIIc-2	IIe-1	---
ClC	Coamo clay loam, 5 to 12 percent slopes	14	IVe-3	------	---
Cm	Coastal beaches	14	VIIIs-1	------	---
Cn	Cobbly alluvial land	14	Vs-1	------	---
Co	Coloso silty clay loam, occasionally flooded	15	IIw-1	------	---
Cr	Coloso silty clay	15	IIw-1	------	---
Cs	Corcega sandy loam	15	IIw-5	------	---
DaC	Daguao silty clay loam, deep variant, 2 to 12 percent slopes	16	IIIe-3	------	3d5
DcE2	Daguao clay, 20 to 40 percent slopes, eroded	16	VIe-1	------	3d5
DeC2	Descalabrado clay loam, 5 to 12 percent slopes, eroded	17	IVs-2	------	3d5
DeE2	Descalabrado clay loam, 20 to 40 percent slopes, eroded	17	VIIs-4	------	3d5
DgF2	Descalabrado and Guayama soils, 20 to 60 percent slopes, eroded	17	VIIs-4	------	4d5
DrF	Descalabrado-Rock land complex, 40 to 60 percent slopes	17	VIIs-4	------	4d5
FaC	Fajardo clay, 2 to 10 percent slopes	18	IIw-2	------	---
FaC2	Fajardo clay, 2 to 10 percent slopes, eroded	18	IIw-2	------	---
Fo	Fortuna clay	19	IIIw-4	------	---
FrA	Fraternidad clay, 0 to 2 percent slopes	19	IIIc-1	IIs-1	---
FrB	Fraternidad clay, 2 to 5 percent slopes	19	IIIc-1	IIs-1	---
Gm	Guamani silty clay loam	20	IVc-1	IIIs-2	---
GuE2	Guayabota silty clay loam, 20 to 40 percent slopes, eroded	21	VIIs-6	------	4d3
GvF	Guayabota-Ciales-Picacho association, very steep	21	VIIe-3	------	4d3
GyC2	Guayama clay loam, moderately deep variant, 2 to 12 percent slopes, eroded	22	IVc-2	IIIe-4	3d5
HmB	Humacao loam, 2 to 5 percent slopes	22	IIe-2	------	---
HtE2	Humatas clay, 20 to 40 percent slopes, eroded	23	IVe-5	------	2c5
HtF2	Humatas clay, 40 to 60 percent slopes, eroded	23	VIe-2	------	3r5
HuF	Humatas-Stony land complex, 40 to 60 percent slopes	23	VIIs-2	------	3r5
InE2	Ingenio silty clay loam, 20 to 40 percent slopes, eroded	24	IVe-5	------	2o5
JaB	Jacana clay, 2 to 5 percent slopes	25	IVc-2	IIIs-3	3d5
JaC2	Jacana clay, 5 to 12 percent slopes, eroded	25	IVe-4	------	3d5
JgE2	Jagueyes loam, 20 to 40 percent slopes, eroded	25	IVe-11	------	2o5
JuC	Junquitos gravelly clay loam, 5 to 12 percent slopes	26	IIIe-5	------	---
Lc	Leveled clayey land	26	------	------	---

Map symbol	Mapping unit	Page	Capability unit Nonirrigated	Capability unit Irrigated	Woodland suitability group
			Symbol	Symbol	Symbol
LeE2	Limones silty clay, 20 to 40 percent slopes, eroded	27	IVe-5	------	2c5
LoC2	Lirios clay loam, 3 to 10 percent slopes, eroded	27	IIIe-6	------	2c5
LrE2	Lirios silty clay loam, 20 to 40 percent slopes, eroded	27	IVe-5	------	2c5
LsD	Los Guineos silty clay loam, 12 to 20 percent slopes	28	IVe-5	------	2c3
LsE2	Los Guineos silty clay loam, 20 to 40 percent slopes, eroded	28	VIe-2	------	2c3
LsF2	Los Guineos silty clay loam, 40 to 60 percent slopes, eroded	28	VIIe-1	------	2r3
LyF	Los Guineos-Yunque-Stony rock land association, steep	28	VIIe-3	------	3r3
MaB	Mabi clay, 0 to 5 percent slopes	29	IIw-3	------	---
MaC2	Mabi clay, 5 to 12 percent slopes, eroded	30	IIIe-7	------	---
MaD2	Mabi clay, 12 to 20 percent slopes, eroded	30	IVe-10	------	---
McA	Machete loam, 0 to 2 percent slopes	30	IIc-2	I-1	---
McB	Machete loam, 2 to 5 percent slopes	30	IIIc-3	IIe-3	---
Md	Made land	30	------	------	--
Me	Maunabo clay	31	IIIw-4	------	---
MlC	Mayo loam, 3 to 10 percent slopes	32	IIIe-10	------	---
MrB	Meros sand, 1 to 6 percent slopes	32	VIIs-7	------	---
MuD2	Mucara silty clay loam, 12 to 20 percent slopes, eroded	33	IVe-6	------	3d5
MuE2	Mucara silty clay loam, 20 to 40 percent slopes, eroded	33	VIe-4	------	3d5
NaE2	Naranjito silty clay loam, 20 to 40 percent slopes, eroded	33	VIe-1	------	2c5
NaF2	Naranjito silty clay loam, 40 to 60 percent slopes, eroded	33	VIIe-1	------	3r5
PaE2	Pandura loam, 12 to 40 percent slopes, eroded	34	VIe-3	------	2o5
PaF2	Pandura loam, 40 to 60 percent slopes, eroded	34	VIIe-2	------	3r5
PdF	Pandura-Very stony land complex, 40 to 60 percent slopes	34	VIIs-5	------	4d5
PeC2	Parcelas clay, 5 to 12 percent slopes, eroded	35	IIIe-7	------	---
PlB	Paso Seco clay, 0 to 5 percent slopes	35	IIIc-1	IIs-1	---
PmD2	Patillas clay loam, 12 to 20 percent slopes, eroded	36	IVe-7	------	2o5
PmE2	Patillas clay loam, 20 to 40 percent slopes, eroded	36	VIe-3	------	2o5
Pn	Pinones silty clay	37	IVw-1	------	---
Po	Poncena clay	38	IIIc-1	IIs-1	---
PrC2	Pozo Blanco clay loam, 5 to 12 percent slopes, eroded	38	IVe-3	------	2o2
Re	Reilly soils	39	IVs-3	------	---
Rp	Reparada clay	39	IVw-2	------	---
RrB	Rio Arriba clay, 2 to 5 percent slopes	40	IIs-2	------	---
RrC2	Rio Arriba clay, 5 to 12 percent slopes, eroded	40	IIIe-7	------	---
Rs	Rock land	40	VIIIs-2	------	---
Ru	Rough stony land	40	VIIIs-2	------	---
SaE2	Sabana silty clay loam, 20 to 40 percent slopes, eroded	40	VIIs-1	------	3d5
SaF2	Sabana silty clay loam, 40 to 60 percent slopes, eroded	41	VIIs-1	------	4d5
Sm	Salt water marsh	41	VIIIw-1	------	---
Ta	Talante soils	41	IIIw-3	------	---
TeE	Teja gravelly sandy loam, 12 to 40 percent slopes	42	VIIs-1	------	4d5
Tf	Tidal flats	42	VIIIw-1	------	---
Ts	Tidal swamp	42	VIIIw-1	------	---
Tt	Toa silty clay loam	42	I-2	------	---
UpF	Utuado-Picacho-Stony rock land association, very steep	43	VIIs-3	------	3r3
Va	Vayas silty clay loam, occasionally flooded	44	IIw-4	IIw-4	---
Vc	Vayas silty clay, frequently flooded	44	IIw-4	IIw-4	---
VeB	Vega Alta silty clay loam, 2 to 5 percent slopes	45	IIe-4	------	---
VeC	Vega Alta silty clay loam, 5 to 12 percent slopes	45	IIIe-8	------	---
VgA	Vega Baja silty clay loam, 0 to 3 percent slopes	45	IIw-1	------	---
VlC	Via silty clay loam, 3 to 10 percent slopes	46	IIIe-9	------	---
VmC	Vieques loam, 5 to 12 percent slopes	46	IVe-9	------	3d5
VmE2	Vieques loam, 12 to 40 percent slopes, eroded	46	VIe-5	------	3d5
Vs	Vives silty clay loam, high bottom	47	IIc-1	I-3	---
VvA	Vives clay, 0 to 2 percent slopes	47	IIc-1	I-3	---

Map symbol	Mapping unit	Page	Capability unit Nonirrigated	Capability unit Irrigated	Woodland suitability group
			Symbol	Symbol	Symbol
VvB	Vives clay, 2 to 7 percent slopes	47	IIIc-2	IIe-1	---
Vw	Vivi loam	47	IIs-3	------	---
Wa	Wet alluvial land	47	VIIIw-2	------	---
YuF2	Yunes silty clay loam, 20 to 60 percent slopes, eroded	48	VIIs-1	------	4d5

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