United States Department of Agriculture

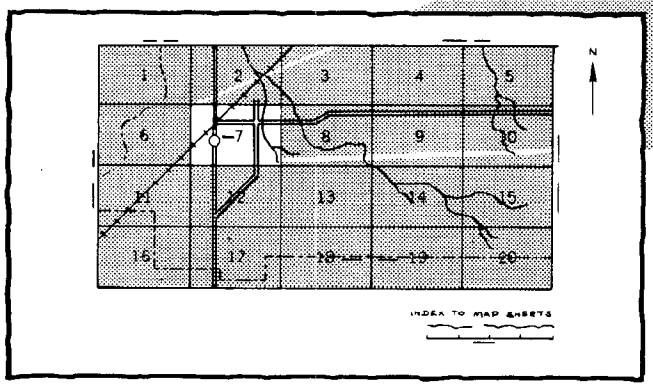
Soil Conservation Service

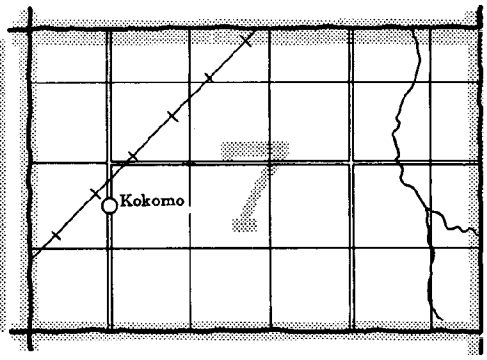
In cooperation with the Government of American Samoa

Soil Survey of American Samoa

HOW TO US

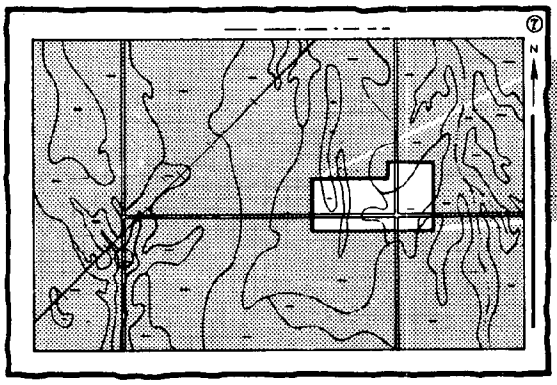
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

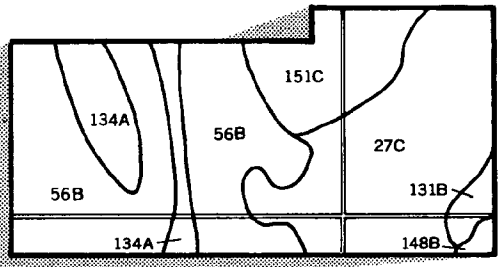




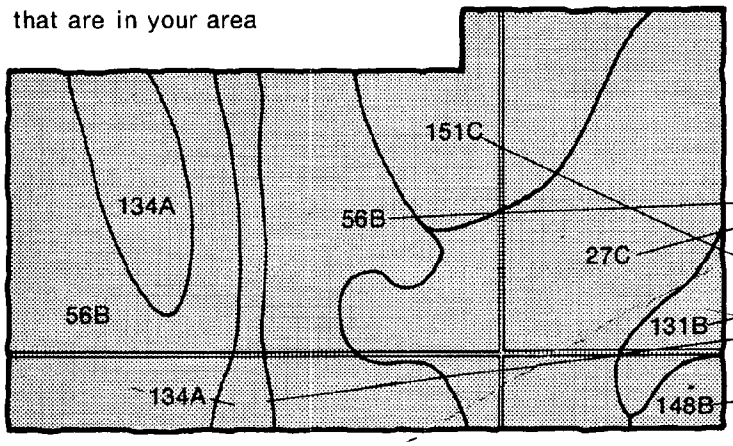
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.





4. List the map unit symbols that are in your area



Symbols

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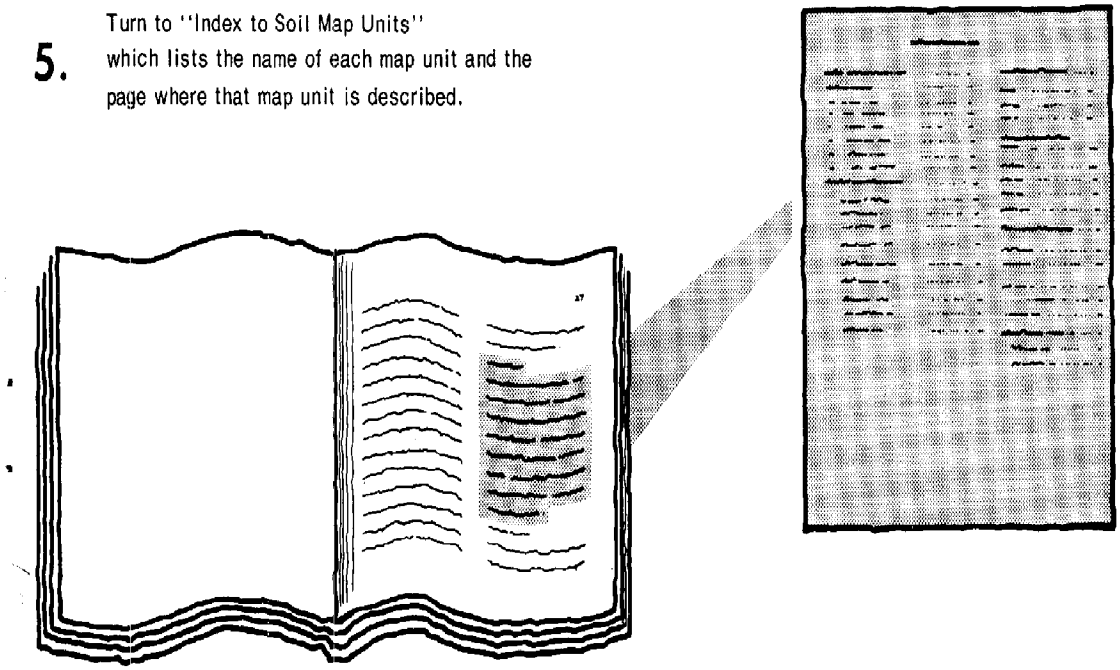
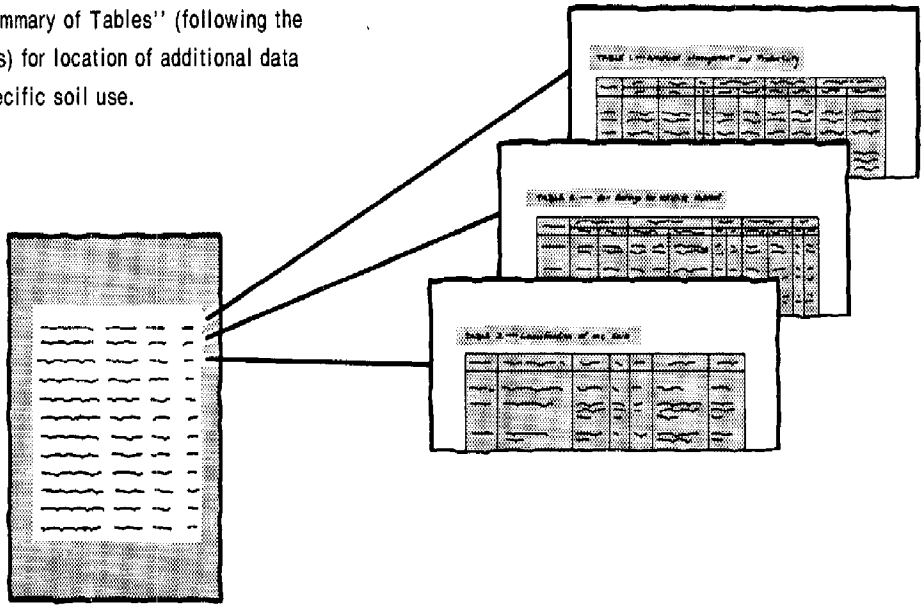
'HIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; for specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in 1981. Soil names and descriptions were approved in 1982. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1981. This survey was made by the Soil Conservation Service in cooperation with the Government of American Samoa.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Amanave on the island of Tutuila. In the foreground are steep Fagasa soils.

SOIL SURVEY OF AMERICAN SAMOA

E R R A T A

SOILS - Plate 3 entitled "SOILS - Eastern Tutuila" contains printing and color errors for 'Aunu'u Island, as follows:

a. The large area of mapping unit 16 should be blue instead of pale pink as shown.

b. The three small areas shown as mapping unit 16 should be mapping unit 6 and purple.

c. The small area of mapping unit 11 should be yellow instead of white as shown.

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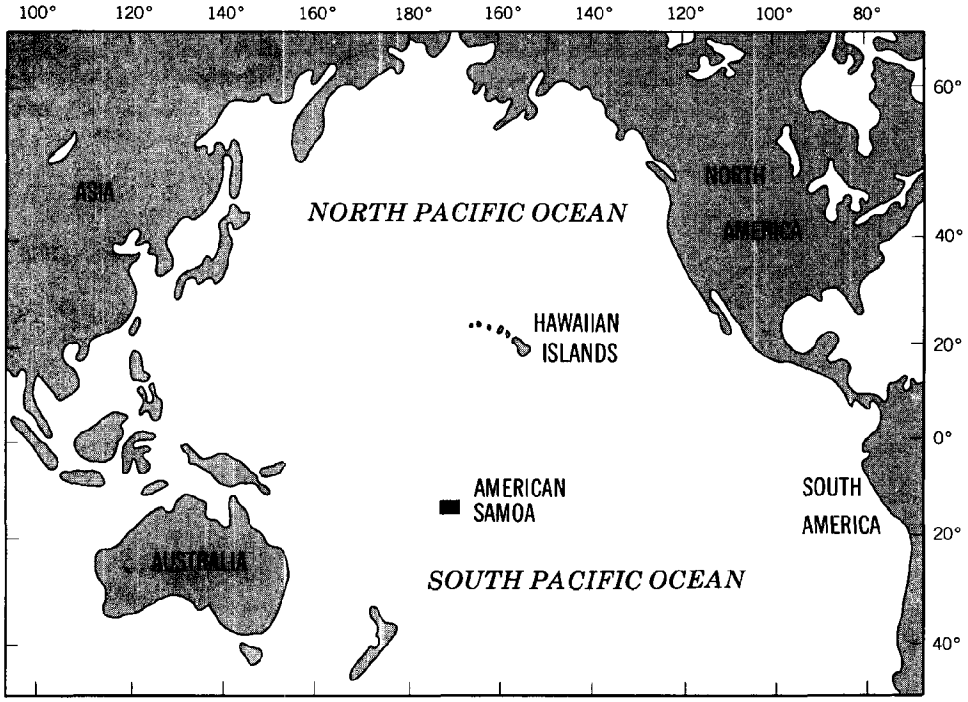
Preface

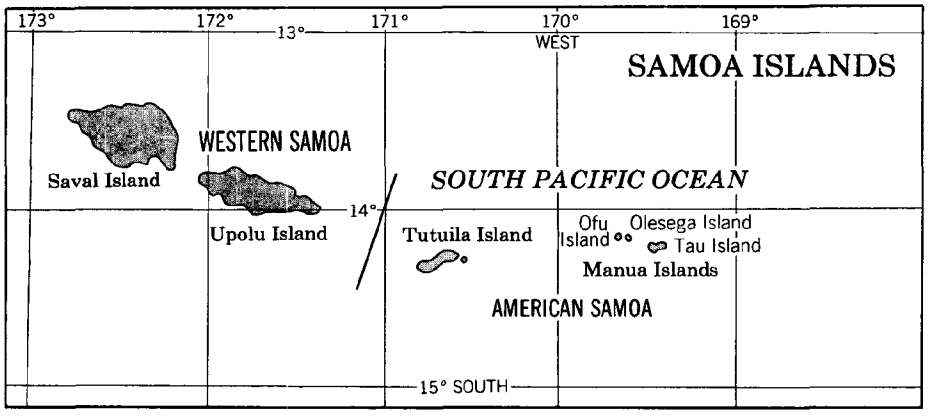
This soil survey contains information that can be used in land-planning programs in American Samoa. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the Honolulu, Hawaii, office of the Soil Conservation Service or the Department of Agriculture, Government of American Samoa.





Location of American Samoa in the South Pacific.

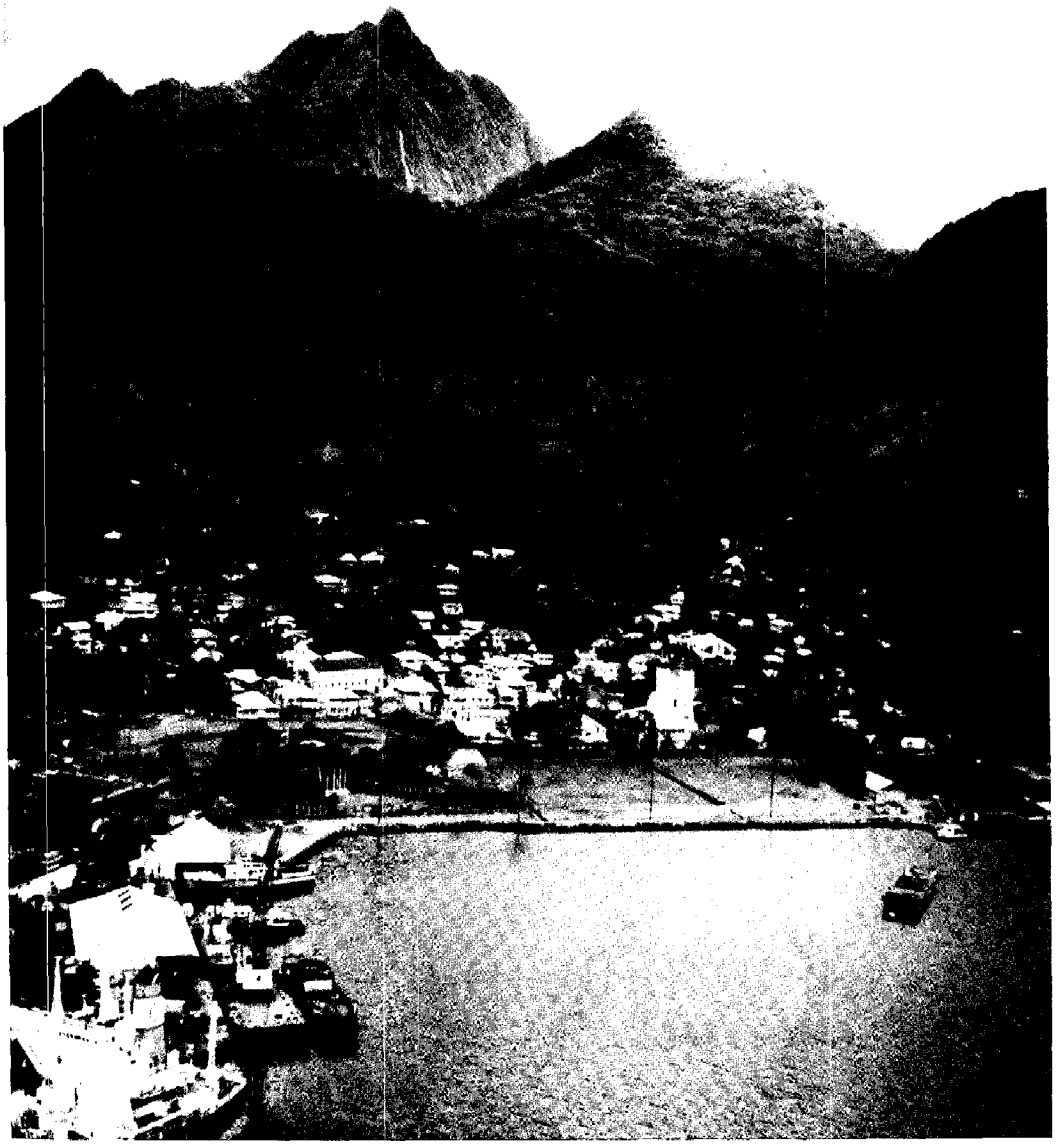


Figure 1.—Pago Pago, the capital, on the island of Tutuila. The area is in the Fagasa family-Lithic Hapludolls-Rock outcrop association, very steep.

Matafao Peak. From the mountain ridgetops the land slopes steeply to the ocean. There are many short streams and small valleys. Landslide scars are common on the mountainsides. On the southwestern part of the island is the plain, comprising about 5,000 acres. This area is underlain with recent lava and volcanic tuff, and cinder and ash cones are common.

Tau, the second largest island, covers 11,328 acres. It is about 6 miles long and 3 miles wide. Precipitous cliffs are along most of the perimeter of the island. The highest point is 3,056 feet at Lata Mountain. The interior of the island is not easily accessible because of the mountainous terrain and dense vegetation.

Ofu and Olosega are twin islands connected by a concrete bridge. These islands are remnants of a single

Soil Survey of American Samoa

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Fieldwork by Clarence L. Chavez and Michael W. Roybal,
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Department of Agriculture, Government of American Samoa

United States Department of Agriculture, Soil Conservation Service
In cooperation with the Government of American Samoa

AMERICAN SAMOA is composed of five volcanic islands in the South Pacific—Aunuu, Ofu, Olosega, Tau, and Tutuila Islands. American Samoa is about 2,300 miles southwest of Hawaii and 4,150 miles southwest of San Francisco. The total area is 48,768 acres, or 76.2 square miles. American Samoa, a territory of the United States, also includes the islands of Rose and Swains. These islands, however, are coral atoll islands and are not included in the survey area. The survey area makes up 98 percent of the territory of American Samoa (*1*). Pago Pago, the principal village and harbor on the main island of Tutuila, is the capital (fig. 1). The population of American Samoa in 1980 was about 32,395.

The islands in the survey area are characterized by rugged volcanic mountainsides, small valleys, and a narrow coastal fringe. The only sizable area that has gentle slopes is the plain between Nuuuli and Leone on Tutuila Island. The highest elevation is 3,056 feet on Tau Island. Lush vegetation grows throughout the islands because of high rainfall, tropical temperatures, and the fertility of the soils.

The economy of the islands is heavily dependent on two tuna canneries and the Government of American Samoa. More than half the labor force is employed by the canneries and the government.

Agriculture in the survey area is mainly subsistence farming. Most families grow some of their staple foods. Taro, bananas, breadfruit, and coconuts are the important crops.

The soils in the mountainous area are shallow to deep and are well drained. Slope is the major limitation for most uses of the soils in this area. About one-half the survey area has slopes of 70 percent or more.

The soils of the valleys and coastal fringe vary considerably. They are very poorly drained to somewhat excessively drained and are clayey to sandy. They are dominantly nearly level. Wetness, flooding, and soil texture are the main limitations of the soils in these areas.

The soils on the plain are well drained and are dominantly gently sloping. Depth to tuff or lava and stoniness are the major limitations of the soils in this area.

General Nature of the Survey Area

This section provides general information about the survey area. It discusses physiography, farming, and climate.

Physiography

Tutuila, the largest island in the survey area, is 33,920 acres. It is a narrow mountain range that extends from east to west and is about 20 miles long. It is 6 miles wide at the widest place but is only 0.75 mile wide at the central part, where Pago Pago Harbor cuts into the island. The highest point on the island is 2,142 feet at

volcano (5). The total area of Ofu is 1,792 acres and that of Olosega is 1,344 acres. Precipitous cliffs surround most of these islands. The highest point is 1,621 feet on Ofu and 2,095 feet on Olosega.

Aunuu is a 384-acre island 0.75 mile from the eastern end of Tutuila. It formed from a tuff cone that rises to an elevation of 280 feet. The interior of the cone contains a marsh. A broad, flat area of coral sand is on the western side of the island.

Farming

Land in American Samoa is owned jointly by village members. The matai, or chief, assigns land to be worked by village members.

Most farming is subsistence farming. Crops are produced for the immediate needs of the family or for use as gifts. The main crops are taro, bananas, breadfruit, and coconuts. Other crops commonly grown are cassava, giant taro, lime, papaya, pineapple, and yam. In most places the crops are intermixed. A few small commercial farms specialize in vegetables. Cucumbers, cabbage, green peas, green peppers, tomatoes, and eggplant are some of the crops grown. These farms supply the local markets and the fishing fleet based at Pago Pago.

In recent years, the economy of American Samoa has become more dependent on cash. Some crops, therefore, are sold at the local market.

Climate

Prepared by the National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

The survey area is characterized by a maritime climate with abundant rain and warm, humid days and nights. Table 1 gives data on rainfall and temperature for the survey area as recorded at Pago Pago Airport. Rainfall averages about 125 inches annually at the Pago Pago Airport, but it varies greatly over small distances because of topography. Rainfall at Pago Pago, which is less than 4 miles north of the airport and at the head of a hill-encircled harbor open to the prevailing wind, averages nearly 200 inches annually. Some areas receive more than 250 inches annually. In an average year there is a trace or more of rain at the airport on about 300 days and 0.10 inch or more on about 175 days.

The driest period is June through September (winter), and the wettest is December through March (summer). The seasonal rainfall may vary widely from year to year, however, and heavy showers and long, rainy periods can occur in any month; flooding can also occur. Some floods are associated with hurricanes and tropical storms, but flooding can occur at other times as well. As recorded at the airport on October 9, 1967, rainfall during an intense thunderstorm totaled 7.5 inches, causing extensive flooding on Tutuila.

The average annual temperature is near 80 degrees F at Pago Pago Airport, where the elevation is 12 feet. June, July, and August are the coolest months, and January, February, and March are the warmest. The mean annual temperature varies only about 3 degrees from year to year, but the mean daily temperature varies about 12 degrees. Temperatures in the afternoon ordinarily reach the upper 80's in summer and the middle 80's in winter, while temperatures at night fall to the middle 70's in summer and low 70's in winter.

The prevailing winds throughout the year are the easterly trade winds. They tend to be more directly from the east in December through March, and they are predominantly from the east-southeast and southeast during the rest of the year. The trade winds are less prevalent in summer than in winter.

About 25 to 30 thunderstorms occur in an average year, and they occur mainly during the rainy season. The survey area lies across the path of tropical disturbances that move into the area usually from the north, but occasionally from east or west. In January 1966, a tropical storm battered Pago Pago with wind gusts of more than 110 miles per hour and rainfall of 6 to 14 inches.

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas and their location and a discussion of their suitability, limitations, and management for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind or segment of the landscape. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept or model of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Individual soils on the landscape commonly merge into one another as their chacteristics gradually change. To construct an accurate map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While the soil survey was in progress, samples of some of the soils in the area were collected for laboratory analyses. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses and under different levels of management. Some interpretations were modified to fit local conditions, and some new interpretations were developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils or miscellaneous areas and some minor soils or miscellaneous areas. It is named for the major soils or miscellaneous areas. The soils or miscellaneous areas making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils or miscellaneous areas can be identified on the map. Likewise, areas that are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The general map units in this survey area are described in the following pages.

Map Unit Descriptions

1. Sogi-Iliili-Pavaiai

Shallow and moderately deep, well drained, nearly level to steep soils; on uplands

This map unit is in the southwestern part of Tutuila Island. It is mainly on low uplands. The unit is characterized by deposits of relatively young ash, cinders, and lava. Slope is 0 to 40 percent. Elevation is 0 to 900 feet. The mean annual rainfall is 120 to 200 inches, and the mean annual temperature is about 79 degrees F.

This unit makes up about 15 percent of the survey area. It is about 27 percent Sogi soils, 16 percent Iliili soils, and 12 percent Pavaiai soils. The remaining 45 percent is components of minor extent.

Sogi soils are on uplands. These soils are moderately deep to tuff and are well drained. They formed in volcanic ash. The soils are loamy to a depth of 21 inches. Below this, to a depth of 26 inches, the soils are sandy. Hard tuff is at a depth of 26 inches.

Iliili soils are on uplands that have complex slopes. These soils are shallow to lava and are well drained. They formed in volcanic ash and overlie lava flows. The soils are extremely stony and loamy throughout. Unweathered lava is at a depth of 9 inches.

Pavaiai soils are on uplands. These soils are moderately deep to lava and are well drained. They formed in volcanic ash and overlie lava flows. The surface layer is stony and loamy. The subsoil is very cobbly and loamy. Unweathered lava is at a depth of 38 inches.

Of minor extent in this unit are Tafuna, Oloava, and Puapua soils, Troporthents, and areas of Rock outcrop.

This unit is used mainly for subsistence farming and as homesites. It is also used for commercial vegetable farming and urban development.

The main limitations for subsistence farming and commercial vegetable farming are the hazard of water erosion and depth to bedrock. The main limitations for homesite and urban development are slope, depth to bedrock, and the stony surface layer.

2. Leafu-Ngedebus

Deep and very deep, somewhat poorly drained and somewhat excessively drained, nearly level and gently sloping soils; on valley floors and in low coastal areas

This map unit is along the coast of all the islands. Slope is 0 to 5 percent. Elevation is 0 to 250 feet. The mean annual rainfall is 125 to 250 inches, and the mean annual temperature is about 80 degrees F.

This unit makes up about 7 percent of the survey area. It is about 42 percent Leafu soils and 15 percent Ngedebus soils. The remaining 43 percent is components of minor extent.

Leafu soils are on valley floors. These soils are very deep and somewhat poorly drained. They formed in alluvium derived dominantly from basic igneous rock. The soils are dominantly clayey throughout. The subsoil is mottled below a depth of 19 inches.

Ngedebus soils are on nearly level coastal plains. These soils are very deep and somewhat excessively drained. They formed in coral sand derived from coral and sea shells. The soils are sandy throughout.

Of minor extent in this unit are very poorly drained Ngerungor Variant soils, well drained Aua soils, and areas of Urban land.

This unit is used for subsistence farming and for homesite and urban development. The main limitations are the hazard of flooding and wetness.

3. Fagasa family-Lithic Hapludolls-Rock outcrop

Shallow to deep, well drained, very steep soils, and Rock outcrop; on ridges and mountainsides

This map unit is on the mountain ranges of Tutuila, Ofu, and Olosega Islands. The unit is characterized by very steep mountainsides and deeply dissected drainageways. Slope is 70 to 130 percent. The vegetation is mainly tropical rain forest. Most areas are not easily accessible because of slope and the dense jungle vegetation. Elevation is near sea level to 2,100 feet. The mean annual rainfall is 150 to 250 inches, and the mean annual temperature is 75 to 80 degrees F.

This unit makes up about 55 percent of the survey area. It is about 55 percent Fagasa family soils, 18 percent Lithic Hapludolls, and 15 percent Rock outcrop. The remaining 12 percent is components of minor extent.

Fagasa family soils are on ridges and mountainsides. These soils are moderately deep and deep and are well drained. They formed in volcanic ash and residuum derived dominantly from basic igneous rock. The soils are clayey and are underlain by weathered bedrock at a depth of 20 to 60 inches.

Lithic Hapludolls are on very steep to nearly vertical mountainsides. These soils are shallow and well drained. They formed in colluvium and residuum derived dominantly from basic igneous rock. The soils are cobbly and clayey and are underlain by weathered bedrock at a depth of 15 inches.

Rock outcrop is exposed areas of igneous bedrock. It is on very steep to nearly vertical mountainsides.

Of minor extent in this unit are Aua and Oloava soils.

Most areas of this unit are used as woodland and for wildlife habitat. A few areas are used for subsistence farming.

The main limitations to use as woodland are slope, the hazard of erosion, plant competition, and rock outcrops.

This unit provides habitat for wild pigs, fruit bats, and birds.

4. Pavaiai-Ofu Variant-Sogi Variant

Moderately deep and deep, well drained, sloping to steep soils; on uplands and mountainsides

This map unit is in the western and northwestern parts of Tau Island and on Aunuu Island. Slope is 6 to 50 percent. Elevation is 0 to 600 feet. The mean annual rainfall is 175 to 230 inches, and the mean annual temperature is about 79 degrees F.

This unit makes up about 5 percent of the survey area. It is about 63 percent Pavaiai soils, 17 percent Ofu Variant soils, and 17 percent Sogi Variant soils. The remaining 3 percent is components of minor extent.

Pavaiai soils are on uplands. These soils are moderately deep to lava bedrock and are well drained. They formed in volcanic ash underlain by lava flows. The surface layer is stony and loamy. The subsoil is extremely gravelly and loamy. Unweathered lava is at a depth of 30 inches.

Ofu Variant soils are on uplands and mountainsides. These soils are deep and well drained. They formed in volcanic ash. The surface layer is clayey. The subsoil is clayey in the upper part and loamy in the lower part. Below this, to a depth of 60 inches or more, there is highly weathered tuff that crushes to loamy material.

Sogi Variant soils are on mountainsides. These soils are moderately deep to lava bedrock and are well drained. They formed in volcanic ash. The soils are clayey throughout. Unweathered lava is at a depth of 30 inches.

Of minor extent in this unit are areas of Rock outcrop.

This unit is used for subsistence farming, homesites, woodland, and wildlife habitat. The main limitation to use for subsistence farming is the hazard of water erosion. The main limitations to use as woodland are the hazards of water erosion and windthrow and plant competition.

This unit provides habitat for wild pigs, fruit bats, and birds.

5. Olotania family

Moderately deep and deep, well drained, moderately steep and steep soils; on mountainsides

This map unit is in the central part of Tau Island. Slope is 15 to 40 percent. The vegetation on this unit is mainly tropical rain forest consisting of broadleaf trees and an understory of tree ferns, ground ferns, and shrubs. Most areas are not easily accessible because of the dense jungle vegetation. Elevation is 900 to 3,000 feet. The mean annual rainfall is 200 to 300 inches, and the mean annual temperature is about 76 degrees F.

This unit makes up about 12 percent of the survey area. Soils of the Olotania family make up about 85 percent of this unit. The remaining 15 percent is components of minor extent.

Olotania family soils are on mountainsides. These soils are moderately deep and deep and are well drained. They formed in volcanic ash and cinders. The soils are loamy to a depth of 25 inches. Below this, to a depth of 60 inches or more, the soils are highly weathered cinders that crush to loamy material.

Of minor extent in this unit are soils that are similar to the Olotania family soils but are shallow to bedrock, areas of Rock outcrop, and soils that have slopes of as much as 70 percent.

This unit is used as woodland and as habitat for wildlife. The main limitations to use as woodland are the hazard of water erosion and plant competition.

This unit provides habitat for wild pigs, fruit bats, and birds.

6. Rock outcrop-Hydrandepts-Dystrandepts

Rock outcrop, and shallow and moderately deep, well drained, very steep soils; on mountainsides and cliffs

This map unit is in the northern, southern, and eastern parts of Tau Island. The unit is characterized by very steep, rocky mountainsides and cliffs. Slope is 70 to 130 percent. The vegetation is mainly tropical rain forest. Most areas are not easily accessible because of slope and the dense jungle vegetation. Elevation is near sea level to 3,000 feet. The mean annual rainfall is 175 to 300 inches, and the mean annual temperature is 74 to 80 degrees F.

This unit makes up about 6 percent of the survey area. It is about 35 percent Rock outcrop, 30 percent Hydrandepts, and 25 percent Dystrandepts. The remaining 10 percent is components of minor extent.

Rock outcrop is exposed areas of bedrock. It is on very steep to nearly vertical mountainsides.

Hydrandepts are on mountainsides. These soils are shallow and moderately deep and are well drained. They formed in volcanic ash. The soils are loamy and are underlain by weathered bedrock at a depth of 10 to 40 inches.

Dystrandepts are on mountainsides. These soils are shallow and moderately deep and are well drained. They formed in volcanic ash. The soils are loamy and are underlain by unweathered bedrock at a depth of 10 to 40 inches.

Of minor extent in this unit are areas of colluvium at the base of the cliffs and areas of landslides.

This unit is used as woodland and as habitat for wildlife. The main limitations to use as woodland are slope, the hazard of erosion, plant competition, and depth to bedrock.

This unit provides habitat for wild pigs, fruit bats, and birds.

Detailed Soil Map Units

The map units delineated on the detailed maps at the back of this survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the maps, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit is given under "Use and management of the soils."

A map unit delineation on a map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some "included" areas that belong to other taxonomic classes.

Most included soils and miscellaneous areas have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, included soils. They may or may not be mentioned in the map unit descriptions. Other included soils, however, have properties and behavior divergent enough to affect use or to require different management. These are contrasting, or dissimilar, included soils. They generally are in small areas and cannot be mapped separately because of the scale used. The included areas of contrasting soils or miscellaneous areas are mentioned in the map unit descriptions. A few included areas may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of included areas in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but if intensive use of small areas is planned, onsite investigation is needed to precisely define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying layers, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying layers. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Pavaiai stony clay loam, 6 to 12 percent slopes, is one of several phases in the Pavaiai series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes or associations.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Puapua-Rock outcrop complex, 40 to 100 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Fagasa

family-Lithic Hapludolls-Rock outcrop association, very steep, is an example.

Most map units include small scattered areas of soils or miscellaneous areas other than those for which the map unit is named. Some of these included areas have properties that differ substantially from those of the major soils or miscellaneous areas. Such differences could significantly affect use and management of the map unit. The included soils as well as miscellaneous areas are identified in each map unit description. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example. Miscellaneous areas are shown on the maps. Some that are too small to be shown are identified by a special symbol on the maps.

This survey was mapped at two levels of detail. At the most detailed level, map units are narrowly defined. This means that map unit boundaries were plotted and verified at closely spaced intervals. At the less detailed level, map units are broadly defined. Boundaries were plotted and verified at wider intervals. The broadly defined units are indicated by asterisks in the map legend. The detail of mapping was selected to meet the anticipated long-term use of the survey, and the map units were designed to meet the needs for that use.

Table 2 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils and miscellaneous areas.

Map Unit Descriptions

1—Aua very stony silty clay loam, 15 to 30 percent slopes. This very deep, well drained soil is on moderately steep and steep talus slopes. It formed in colluvium and alluvium derived dominantly from basic igneous rock. The natural vegetation is mainly mixed forest. Elevation is near sea level to 650 feet. The mean annual rainfall is 150 to 250 inches, and the mean annual temperature is about 79 degrees F.

Typically, the surface layer is dark brown very stony silty clay loam 7 inches thick. The upper 11 inches of the subsoil is dark brown stony clay loam, and the lower 42 inches is dark brown and very dark grayish brown very stony clay loam. In some areas the surface layer is very stony clay loam or very stony silty clay.

Included in this unit are small areas of Fagasa silty clay in very steeply sloping areas and Leafu silty clay on valley floors. Also included are small areas of soils near Pago Pago that are similar to this Aua soil but have highly weathered rock fragments in the subsoil and small areas of Aua soils that are wet because of seepage. Included areas make up about 15 percent of the total acreage.

Permeability of this Aua soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for subsistence farming and as homesites. Taro, bananas, breadfruit, and coconuts are the main crops.

This unit is moderately suited to the the production of subsistence crops. The main limitations are the hazard of water erosion and stoniness. Erosion can be controlled by use of crop residue, mulch, and cross-slope farming. Stones interfere with planting, weeding, and other farming operations. Soil fertility can be maintained by fertilizing, rotating crops, or adding organic material to the soil in the form of crop residue, mulch, or compost.

This unit is poorly suited to homesite development. The main limitations are slope and the hazard of water erosion. Seepage is also a limitation in some places. Access roads should be designed to control surface runoff and help stabilize cut slopes. Preserving the existing plant cover helps to control erosion. Only the part of the site that is used for construction should be disturbed.

2—Aua very stony silty clay loam, 30 to 60 percent slopes. This very deep, well drained soil is on talus slopes. It formed in colluvium and alluvium derived dominantly from basic igneous rock. The natural vegetation is mainly mixed forest. Elevation is near sea level to 650 feet. The mean annual rainfall is 150 to 250 inches, and the mean annual temperature is about 79 degrees F.

Typically, the surface layer is dark brown very stony silty clay loam 7 inches thick. The upper 11 inches of the subsoil is dark brown stony clay loam, and the lower 42 inches is dark brown and very dark grayish brown very stony clay loam. In some areas the surface layer is very stony clay loam.

Included in this unit are small areas of Fagasa silty clay. Also included are small areas of Aua soils that are wet because of seepage and small areas of soils near Pago Pago that are similar to this Aua soil but have highly weathered rock fragments in the subsoil. Included areas make up about 15 percent of the total acreage.

Permeability of this Aua soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is severe.

This unit is used mainly for subsistence farming and as homesites. Taro, bananas, breadfruit, and coconuts are the main crops. Some areas are used as a source of wood for fuel, woodcrafting, and other local uses.

This unit is poorly suited to the production of subsistence crops. The main limitations are slope, the hazard of water erosion, and stoniness. Steepness of

slope makes cultivation hazardous. Where feasible, the soil should be maintained in permanent vegetation to reduce erosion. Stones interfere with planting and harvesting of root crops. Areas used for subsistence farming should be managed so that disturbance of the soil is minimal. The soil should be protected with a cover of crop residue, mulch, or weeds.

This unit is poorly suited to homesite development. The main limitations are slope and the hazard of water erosion. A few areas are affected by seepage. Access roads should be designed to control surface runoff and to help stabilize cut slopes. Preserving the existing plant cover helps to control erosion. Only the part of the site that is used for construction should be disturbed.

This unit is moderately suited to a wide variety of climatically adapted trees. The main concerns in producing and harvesting trees are the hazard of water erosion, slope, and stoniness. The steepness of slope limits the kind of equipment that can be used in forest management. Careful management is needed to minimize the risk of water erosion.

3—Fagasa-Ofu silty clays, 30 to 60 percent slopes. This map unit is on mountainsides. The natural vegetation is mainly mixed forest. Elevation is near sea level to 800 feet. The mean annual rainfall is 150 to 200 inches, and the mean annual temperature is about 79 degrees F.

This unit is about 50 percent Fagasa silty clay and 35 percent Ofu silty clay. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Aua very stony silty clay loam on talus slopes and soils that have slopes of as little as 20 percent. Included areas make up about 15 percent of the total acreage.

The Fagasa soil is moderately deep and well drained. It formed in residuum derived dominantly from basic igneous rock. Typically, the surface layer is very dark grayish brown silty clay 5 inches thick. The subsurface layer is dark brown cobbly silty clay 7 inches thick. The underlying material is dark brown silty clay 17 inches thick over weathered bedrock. Weathered bedrock is at a depth of 29 inches. Depth to bedrock ranges from 20 to 40 inches. In some areas the surface layer is clay.

Permeability of the Fagasa soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium to rapid, and the hazard of water erosion is moderate to severe.

The Ofu soil is deep and well drained. It formed in residuum derived dominantly from basic igneous rock. Typically, the surface layer is dark brown silty clay 16 inches thick. The subsoil is dark brown silty clay to a depth of 60 inches or more.

Permeability of the Ofu soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium to rapid, and the hazard of water erosion is moderate to severe.

This unit is used mainly for subsistence farming. Taro, bananas, breadfruit, and coconuts are the main crops. Some areas are used as a source of wood for fuel, woodcrafting, and other local uses.

This unit is moderately suited to the production of subsistence crops. It is limited mainly by slope and the hazard of water erosion. Erosion can be controlled by use of crop residue, mulch, and cross-slope farming. Soil fertility can be maintained by fertilizing, rotating crops, or adding organic material to the soil in the form of crop residue, mulch, or compost.

This unit is well suited to a wide variety of climatically adapted trees. The main concerns in producing and harvesting trees are the hazards of water erosion and plant competition. Minimizing the risk of erosion is essential in harvesting trees. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected by constructing water bars and by seeding cuts and fills. Competing vegetation can be controlled by properly preparing the site and by spraying, cutting, or girdling to eliminate unwanted weeds, brush, or trees.

4—Fagasa family-Lithic Hapludolls-Rock outcrop association, very steep. This map unit is on ridges and mountainsides. Slope is 70 to 130 percent. The natural vegetation is mainly tropical rain forest. Elevation is near sea level to 2,100 feet. The mean annual rainfall is 150 to 250 inches, and the mean annual temperature is 75 to 80 degrees F. Fog and cloud cover are common at the higher elevations.

This unit is broadly defined and mapped because its rugged topography limits accessibility and use. The soils in the unit were examined only in a few places, and mapping was done mainly by photo interpretation.

This unit is about 50 percent Fagasa family soils, 20 percent Lithic Hapludolls, and 15 percent Rock outcrop. The Fagasa family soils are on very steep side slopes, and the Lithic Hapludolls and the areas of Rock outcrop are on very steep to nearly vertical side slopes.

Included in this unit are small areas of Dystrandepts in the Aoloaufou area and Aua very stony silty clay loam on talus slopes. Also included are common areas of landslides. Included areas make up about 15 percent of the total acreage.

The Fagasa family soils are moderately deep and deep and are well drained. These soils formed in volcanic ash and residuum derived from basic igneous rock. No single profile of Fagasa family soils is typical, but one commonly observed in the survey area has a surface layer of dark brown silty clay 12 inches thick. The subsoil is dark brown clay loam about 5 inches thick. The substratum to a depth of 31 inches is dark brown sandy clay loam. Weathered bedrock is at a depth

of 31 inches. Depth to bedrock ranges from 20 to 60 inches or more. In some areas the surface layer is clay.

Permeability of the Fagasa family soils is moderately rapid. Available water capacity is moderate. Effective rooting depth is 20 to 60 inches or more. Runoff is very rapid, and the hazard of water erosion is very severe.

Lithic Hapludolls are shallow and well drained. These soils formed in colluvium and residuum derived from basic igneous rock. No single profile of Lithic Hapludolls is typical, but one commonly observed in the survey area has a surface layer of dark brown cobbly silty clay 5 inches thick. The subsurface layer is dark brown very cobbly silty clay 4 inches thick. The substratum is clay loam 6 inches thick over weathered bedrock. Depth to weathered bedrock ranges from 4 to 20 inches.

Permeability of the Lithic Hapludolls is moderately rapid. Available water capacity is low. Effective rooting depth is 4 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

Rock outcrop is exposed areas of bedrock. It supports little vegetation. In places, trees and shrubs grow in cracks and on ledges.

This unit is used mainly as woodland and for wildlife habitat. Most areas support rain forest and are not used as commercial woodland. The areas of woodland are used as a source of wood for fuel, woodcrafting, and other local uses. The wildlife habitat mainly supports wild pigs, fruit bats, and birds. Small areas of Fagasa family soils at low elevations are used for subsistence farming. Areas where slopes are as much as 80 percent have been cleared of forest vegetation and planted mainly to taro. When production decreases, these areas are allowed to return to forest and new areas are cleared.

Most of this unit is moderately suited to a wide variety of climatically adapted trees; however, areas where slopes are more than 100 percent are poorly suited to trees. The main concerns in producing and harvesting trees are slope, the areas of Rock outcrop, and the hazards of water erosion and plant competition. The steepness of slope limits the kinds of equipment that can be used in forest management. Careful management is needed to minimize the risk of water erosion. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected by constructing water bars and by seeding cuts and fills. Competing vegetation can be controlled by properly preparing the site and by spraying, cutting, or girdling to eliminate unwanted weeds, brush, or trees.

If this unit is used for subsistence farming, the steepness of slope makes cultivation hazardous. Where feasible, the soil should be maintained in permanent vegetation to reduce erosion. Areas used for subsistence farming should be managed so that disturbance of the soil is minimal. The soil should be protected with a cover of crop residue, mulch, or weeds.

5—Iliili extremely stony mucky clay loam, 3 to 15 percent slopes. This shallow, well drained soil is on uplands. It formed in volcanic ash and is underlain by lava. Slopes are irregular because of the underlying lava flow. In some places there are short side slopes as steep as 20 percent. The natural vegetation is mainly mixed forest. Elevation is near sea level to 200 feet. The mean annual rainfall is 120 to 160 inches, and the mean annual temperature is about 80 degrees F.

Typically, 65 percent of the surface is covered with rock fragments and 1 inch of black, decomposed organic material. The surface layer is very dark grayish brown extremely stony mucky clay loam 5 inches thick. The subsoil is very dark grayish brown extremely stony clay loam 4 inches thick. Lava is at a depth of 9 inches. Depth to bedrock ranges from 8 to 20 inches. In some areas the surface layer is extremely stony mucky silty clay loam.

Included in this unit is Sogi clay loam in areas that are less than 6 acres.

Permeability of this Iliili soil is rapid. Available water capacity is low. Effective rooting depth is 8 to 20 inches. Runoff is slow, and the hazard of water erosion is slight.

Most areas of this unit are used for subsistence farming and as homesites. A few areas are used for pasture.

This unit is poorly suited to root crops and other crops that require cultivation and is moderately suited to orchard crops. It is limited mainly by the stony surface layer and depth to bedrock. Breadfruit, bananas, and papaya can be grown.

This unit is poorly suited to homesite development. The main limitations are the stony surface layer and depth to bedrock. The soil is difficult to excavate for homesites, but it provides a stable building foundation. Community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

6—Insak mucky sandy loam. This moderately deep, very poorly drained soil is in coastal depressional areas. It formed in coral sand and organic matter. Slope is 0 to 2 percent. The natural vegetation is mainly marsh plants. Elevation is near sea level to 20 feet. The mean annual rainfall is 150 to 175 inches, and the mean annual temperature is about 80 degrees F.

Typically, the surface layer is black mucky sandy loam 11 inches thick. The next layer is very dark gray mucky loamy sand 6 inches thick. The substratum is white and light gray sand 9 inches thick over coral. Coral is at a depth of 26 inches. Depth to bedrock ranges from 20 to 40 inches. In some areas the surface layer is mucky loamy sand.

Permeability is rapid. Available water capacity is low. Effective rooting depth is 20 to 40 inches for water-tolerant plants but is limited to depths between 5 and 15 inches for non-water-tolerant plants. Runoff is ponded to

slow, and the hazard of water erosion is slight. A water table is at a depth of 10 to 20 inches. Unprotected areas are frequently flooded.

This unit is used for wetland taro and wildlife habitat.

This unit is well suited to wetland taro. Dikes and drainage ditches are used to control the water level and periodic flooding. Mulch can be used to control weeds. The unit is poorly suited to crops that do not tolerate wetness.

7—Insak Variant clay loam. This deep, very poorly drained soil is in coastal depressional areas near the village of Tau. It formed in fine textured alluvium deposited over coral sand. Slope is 0 to 2 percent. The natural vegetation is mainly marsh plants. Elevation is near sea level to 20 feet. The mean annual rainfall is 175 to 200 inches, and the mean annual temperature is about 80 degrees F.

Typically, the surface layer is very dark grayish brown clay loam 5 inches thick. The next layer is very dark grayish brown silty clay loam 8 inches thick. The subsoil is very dark grayish brown silty clay 31 inches thick. It has reddish brown mottles and black concretions and stains. The substratum to a depth of 60 inches or more is light gray coral sand. In some areas the surface layer is loam or silty clay loam.

Included in this unit are small areas of soils that are similar to this Insak soil but are in higher lying areas and have a water table below a depth of 20 inches.

Permeability of this Insak Variant soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is more than 60 inches for water-tolerant plants but is limited to depths between 5 and 15 inches for non-water-tolerant plants. Runoff is slow, and the hazard of water erosion is slight. A water table is at a depth of 6 to 20 inches. This soil is subject to occasional, brief periods of flooding.

This unit is used for wetland taro and wildlife habitat.

This unit is well suited to wetland taro. Dikes and drainage ditches are needed to control the water level and flooding. Mulch can be used to control weeds. The unit is poorly suited to crops that do not tolerate wetness.

8—Leafu silty clay, 0 to 3 percent slopes. This very deep, somewhat poorly drained soil is on valley floors. It formed in fine textured alluvium derived dominantly from basic igneous rock. The natural vegetation is mainly mixed forest and grasses. Elevation is near sea level to 250 feet. The mean annual rainfall is 150 to 250 inches, and the mean annual temperature is about 79 degrees F.

Typically, the surface layer is dark brown silty clay loam 4 inches thick. The subsurface layer is dark brown silty clay 9 inches thick. The upper 6 inches of the subsoil is dark brown very fine sandy loam, and the lower 25 inches is dark brown and very dark brown, mottled silty clay. The substratum to a depth of 60 inches or more is dark brown, mottled silty clay. In some areas the surface layer is stony silty clay.

Included in this unit are small areas of poorly drained soils that have a water table at a depth of less than 36 inches. These soils are along streams and in depressional areas and are adjacent to soils underlain by hard volcanic tuff or pahoehoe lava.

Permeability of this Leafu soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is more than 60 inches for water-tolerant plants but is limited to depths between 36 and 60 inches for non-water-tolerant plants. Runoff is slow, and the hazard of water erosion is slight. A high water table is at a depth of 36 to 60 inches or more. This soil is subject to occasional, brief periods of flooding during prolonged, heavy rainfall.

Most areas of this unit are used for subsistence farming and as homesites. A few areas are used for commercial vegetable farming and pasture. Among the subsistence crops grown are taro, bananas, breadfruit, and coconuts. The vegetable crops include beans, cucumbers, eggplant, peppers, and cabbage (fig. 2).

This unit is moderately suited to the production of subsistence crops. It is limited mainly by the hazard of flooding and wetness. The risk of flooding can be reduced by the use of dikes and diversions. Proper row arrangement, field ditches, and vegetated outlets are needed to remove excess water on the surface. The water table builds up during the rainy period and generally limits the suitability of the soil for deep-rooted crops. Soil fertility can be maintained by fertilizing, rotating crops, or adding organic material to the soil in the form of crop residue, mulch, or compost.

This unit is poorly suited to homesite development. The main limitation is the hazard of flooding. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Excess water can be removed by using suitably designed drainage ditches.

9—Leafu stony silty clay, 0 to 3 percent slopes. This very deep, somewhat poorly drained soil is on valley floors. It formed in fine textured alluvium derived dominantly from basic igneous rock. The natural vegetation is mainly mixed forest and grasses. Elevation is near sea level to 250 feet. The mean annual rainfall is 150 to 250 inches, and the mean annual temperature is about 79 degrees F.

Typically, the surface layer is dark brown stony silty clay 13 inches thick. The subsoil is dark brown, mottled stony silty clay 31 inches thick. The substratum to a depth of 60 inches or more is dark brown, mottled silty clay. In some areas the surface layer is nonstony.

Included in this unit are small areas of poorly drained soils that have a water table at a depth of less than 36 inches. These soils are along streams and in

Figure 2.—Vegetable crops on Leafu silty clay, 0 to 3 percent slopes.

depressional areas and are adjacent to soils underlain by hard volcanic tuff or pahoehoe lava.

Permeability of this Leafu soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is more than 60 inches for water-tolerant plants but is limited to depths between 36 and 60 inches for non-water-tolerant plants. Runoff is slow, and the hazard of water erosion is slight. A high water table is at a depth of 36 to 60 inches or more. This soil is subject to occasional, brief periods of flooding during prolonged, heavy rainfall.

Most areas of this unit are used for subsistence farming and as homesites. A few areas are used for commercial vegetable farming and pasture. Among the subsistence crops grown are taro, bananas, breadfruit, and coconuts. The vegetable crops include beans, cucumbers, eggplant, peppers, and cabbage.

This unit is moderately suited to the production of subsistence crops. It is limited mainly by the hazard of flooding and wetness. The risk of flooding can be reduced by the use of dikes and diversions. Proper row arrangement, field ditches, and vegetated outlets are needed to remove excess water on the surface. The water table builds up during the rainy period and generally limits the suitability of the soil for deep-rooted crops. Stones interfere with planting, weeding, and other farming operations. Soil fertility can be maintained by fertilizing, rotating crops, or adding organic material to the soil in the form of crop residue, mulch, or compost.

This unit is poorly suited to homesite development. The main limitations are the hazard of flooding. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Excess water can be removed by using suitably designed drainage ditches.

10—Mesei Variant peat. This very deep, very poorly drained organic soil is in closed depressional areas or basins. It formed in organic material derived from reeds, ferns, and other marsh plants. Slope is 0 to 1 percent. This soil is commonly covered with water. The natural vegetation is mainly marsh plants. Elevation is near sea

level to 20 feet. The mean annual rainfall is 150 to 175 inches, and the mean annual temperature is about 80 degrees F.

Typically, the surface layer is black and very dark brown peat 12 inches thick. The next layer is dark brown mucky peat 12 inches thick. The underlying material to a depth of 60 inches or more is very dark brown muck.

Included in this unit are small areas of open water.

Permeability of this Mesei Variant soil is rapid. Available water capacity is high. Effective rooting depth is 60 inches or more for water-tolerant plants. Runoff is ponded to slow, and the hazard of water erosion is slight. The water table is commonly about 12 inches above the surface.

This unit is used for wildlife habitat.

11—Ngedebus mucky sand. This deep, somewhat excessively drained soil is on coastal plains. It formed in coral sand derived from coral and sea shells. Slope is 0 to 2 percent. The natural vegetation is mainly tropical coastal forest. Elevation is near sea level to 15 feet. The mean annual rainfall is 150 to 200 inches, and the mean annual temperature is about 80 degrees F.

Typically, the surface layer is black mucky sand 12 inches thick. The substratum to a depth of 60 inches or more is gray to very pale brown sand. In some areas the surface layer is sand or loamy sand.

Included in this unit are small areas of sandy beaches that are commonly less than 50 feet wide.

Permeability of this Ngedebus soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. A water table is at a depth of 42 inches or more. The soil is subject to occasional, very brief periods of flooding.

This unit is used mainly for subsistence farming. Taro, bananas, breadfruit, and coconuts are the main crops. Some areas are used as a source of wood for fuel, woodcrafting, and other local uses.

This unit is moderately suited to the production of subsistence crops. It is limited mainly by low available water capacity and low soil fertility. Crops that are tolerant of drought are best suited because the available moisture is not adequate for good growth of most other plants. Soil fertility can be maintained by fertilizing, rotating crops, or adding organic material to the soil in the form of crop residue, mulch, or compost.

12—Ngedebus Variant extremely cobbly sand, 0 to 5 percent slopes. This deep, excessively drained soil is on coastal plains. It is in small narrow strips inland of beaches. The soil formed in rubble and sand derived from coral and sea shells. The natural vegetation is mainly tropical coastal forest. Elevation is near sea level to 15 feet. The mean annual rainfall is 150 to 200 inches, and the mean annual temperature is about 80 degrees F.

Typically, the surface layer is black extremely cobbly sand 15 inches thick. It has a high content of organic matter. The substratum to a depth of 60 inches or more is pale brown extremely cobbly sand. In some areas the surface layer is extremely stony sand.

Included in this unit are small areas of sandy beaches, commonly less than 50 feet wide.

Permeability of this Ngedebus Variant soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. The soil is subject to occasional, very brief periods of flooding.

Most areas of this unit are used for wildlife habitat. A few scattered areas support plantings of coconuts. The unit is limited for most uses mainly by the high content of coral fragments throughout the soil.

13—Ngerungor Variant mucky peat. This deep, very poorly drained organic soil is in coastal swamps. It formed in organic material derived dominantly from decomposing mangrove roots and litter. Slope is 0 to 1 percent. This soil is commonly covered with water. The natural vegetation is mainly mangrove forest. Elevation is near sea level to 20 feet. The mean annual rainfall is 125 to 225 inches, and the mean annual temperature is about 80 degrees F.

Typically, the surface layer is very dark grayish brown mucky peat 4 inches thick. The next layer is very dark brown peat 17 inches thick. The underlying material to a depth of 60 inches or more is very dark brown mucky peat.

Included in this unit are small areas of very poorly drained mineral soils.

Permeability of this Ngerungor Variant soil is rapid. Available water capacity is high. Effective rooting depth is 40 to 60 inches or more for water-tolerant plants. Runoff is ponded to very slow, and the hazard of water erosion is slight. The water table fluctuates with the tide between about 12 inches above the soil surface and 12 inches below the surface.

This unit is used mainly for wildlife habitat. Small areas have been filled and are used for homesite and urban development.

14—Ofu silty clay, 15 to 40 percent slopes. This deep, well drained soil is on mountainsides. It formed in volcanic ash and residuum derived from basic igneous rock. The natural vegetation is mainly mixed forest. Elevation is 50 to 1,500 feet. The mean annual rainfall is 150 to 225 inches, and the mean annual temperature is 77 to 80 degrees F.

Typically, the surface layer is dark reddish brown silty clay 16 inches thick. The upper 29 inches of the subsoil is dark brown silty clay loam, and the lower 15 inches is dark brown silty clay. In some areas a substratum of dark brown silty clay or silty clay loam is at a depth of 30 to 60 inches or more.

Included in this unit are small areas of soils that are similar to this Ofu soil but are moderately deep. Also included are small areas of steeper soils. Included areas make up about 10 percent of the total acreage.

Permeability of this Ofu soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for subsistence farming. Taro, bananas, breadfruit, and coconuts are the main crops. Some areas are used as a source of wood for fuel, woodcrafting, and other local uses.

This unit is well suited to the production of subsistence crops. It is limited mainly by the hazard of water erosion. Erosion can be controlled by use of crop residue, mulch, and cross-slope farming. Soil fertility can be maintained by fertilizing, rotating crops, or adding organic material to the soil in the form of crop residue, mulch, or compost.

15—Ofu silty clay, 40 to 70 percent slopes. This deep, well drained soil is on mountainsides. It formed in volcanic ash and residuum derived from basic igneous rock. The natural vegetation is mainly mixed forest. Elevation is 50 to 1,500 feet. The mean annual rainfall is 150 to 225 inches, and the mean annual temperature is 77 to 80 degrees F.

Typically, the surface layer is dark reddish brown silty clay 10 inches thick. The upper 9 inches of the subsoil is dark reddish brown silty clay loam, and the lower 18 inches is reddish brown silty clay loam. The substratum is reddish brown silty clay loam to a depth of 60 inches or more. In some areas the surface layer is stony silty clay. Depth to weathered bedrock ranges from 40 to 60 inches or more.

Included in this unit are small areas of soils that are similar to this Ofu soil but are moderately deep. Also included are small areas of soils that are moderately steep. Included areas make up about 20 percent of the total acreage.

Permeability of this Ofu soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 40 to 60 inches or more. Runoff is medium to rapid, and the hazard of water erosion is severe.

This unit is used mainly as woodland. Most areas support rain forest and are not used as commercial woodland. The areas of woodland are used as a source of wood for fuel, woodcrafting, and other local uses. The unit also provides wildlife habitat mainly for wild pigs, fruit bats, and birds.

16—Ofu Variant silty clay, 6 to 20 percent slopes. This deep, well drained soil is on uplands. It formed in volcanic ash and other volcanic material. The natural vegetation is mainly mixed forest. Elevation is near sea level to 500 feet. The mean annual rainfall is 175 to 200 inches, and the mean annual temperature is about 79 degrees F.

Typically, the surface layer is dark brown silty clay 8 inches thick. The upper 6 inches of the subsoil is dark brown silty clay, and the lower 14 inches is dark yellowish brown clay loam. The substratum to a depth of 60 inches or more is highly weathered tuff that crushes easily to sandy loam.

Included in this unit are small areas of soils that are similar to this Ofu Variant soil but have fragmented rock at a depth of 24 to 36 inches and have bedrock at a depth of more than 50 inches.

Permeability of this Ofu Variant soil is moderately rapid. Available water capacity is moderate to high. Effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

Most areas of this unit are used for subsistence farming. A few areas are used for vegetable farming. Some areas are used as a source of wood for fuel, woodcrafting, and other local uses. The main subsistence crops grown are taro, bananas, breadfruit, and coconuts. The vegetable crops include head cabbage, chinese cabbage, cucumbers, beans, radishes, and peppers (fig. 3).

This unit is well suited to the production of subsistence crops. It has few limitations.

This unit is moderately suited to vegetable crops. It is limited mainly by the hazard of water erosion. All tillage should be on the contour or across the slope. The risk of sheet and rill erosion on the steeper slopes can be reduced by use of gradient terraces and contour farming. Tilth and fertility can be improved by returning crop residue to the soil. Regular applications of complete fertilizer are needed for continuous cropping.

17—Ofu Variant silty clay, 20 to 40 percent slopes. This deep, well drained soil is on uplands. It formed in volcanic ash and pyroclastic material. The natural vegetation is mainly mixed forest. Elevation is near sea level to 500 feet. The mean annual rainfall is 175 to 200 inches, and the mean annual temperature is about 79 degrees F.

Typically, the surface layer is dark brown silty clay 8 inches thick. The upper 6 inches of the subsoil is dark brown silty clay, and the lower 14 inches is dark yellowish brown clay loam. The substratum to a depth of 60 inches or more is highly weathered tuff that crushes easily to sandy loam.

Included in this unit are small areas of soils that are similar to this Ofu Variant soil but have fragmented rock at a depth of 24 to 36 inches and have bedrock at a depth of more than 50 inches.

Permeability of this Ofu Variant soil is moderately rapid. Available water capacity is moderate to high. Effective rooting depth is 60 inches or more. Runoff is medium to rapid, and the hazard of water erosion is moderate to severe.

Figure 3.—Head cabbage on Ofu Variant silty clay, 6 to 20 percent slopes.

Most areas of this unit are used as woodland. A few areas are used for subsistence farming. The main crops are taro, bananas, breadfruit, and coconuts.

This unit is well suited to a variety of climatically adapted trees. The main concerns in producing and harvesting trees are the hazard of water erosion and plant competition. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected by constructing water bars and by seeding cuts and fills. Competing vegetation can be controlled by properly preparing the site and by spraying, cutting, or girdling to eliminate unwanted weeds, brush, or trees.

This unit is moderately suited to the production of subsistence crops. It is limited mainly by the hazard of water erosion. Erosion can be controlled by use of crop residue, mulch, and cross-slope farming. Soil fertility can be maintained by fertilizing, rotating crops, or adding organic material to the soil in the form of crop residue, mulch, or compost.

18—Ofu Variant-Rock outcrop complex, 40 to 70 percent slopes. This map unit is on mountainsides. The natural vegetation is mainly mixed forest. Elevation is near sea level to 500 feet. The mean annual rainfall is 175 to 200 inches, and the mean annual temperature is about 80 degrees F.

This unit is about 65 percent Ofu Variant silty clay and 25 percent Rock outcrop.

Included in this unit are small areas of a soil that is similar to this Ofu Variant soil but has bedrock at a depth of less than 20 inches. Included areas make up about 10 percent of the total acreage.

The Ofu Variant soil is deep and well drained. It formed in volcanic ash and, in some places, from other volcanic material. Typically, the surface layer is dark brown silty clay 8 inches thick. The upper 6 inches of the subsoil is dark brown silty clay, and the lower 6 inches is dark yellowish brown clay loam. The substratum to a depth of 60 inches or more is highly weathered tuff that crushes easily to sandy loam.

Permeability of the Ofu Variant soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is severe.

Rock outcrop is exposed areas of tuff. It supports little vegetation; however, in some places, trees and shrubs grow in cracks and on ledges.

This unit is used as woodland and for wildlife habitat. Most areas support rain forest and are not used as commercial woodland. The areas of woodland are used as a source of wood for fuel, woodcrafting, and other local uses. The wildlife habitat mainly supports wild pigs, fruit bats, and birds.

19—Oloava silty clay loam, 6 to 12 percent slopes. This very deep, well drained soil is on uplands. It formed in volcanic ash and cinders. The natural vegetation is mainly mixed forest. Elevation is 400 to 1,500 feet. The mean annual rainfall is 175 to 230 inches, and the mean annual temperature is about 78 degrees F.

Typically, the surface layer is dark brown silty clay loam 9 inches thick. The upper 5 inches of the subsoil is dark brown clay loam, and the lower 3 inches is dark brown gravelly silt loam. The substratum to a depth of 60 inches or more is weathered cinders that crush to very gravelly sandy loam. Depth to weathered cinders commonly is 12 to 40 inches but ranges from 12 to 60 inches or more.

Included in this unit are small areas of Oloava soils that have slopes of 12 to 25 percent.

Permeability of this Oloava soil is moderately rapid above the cinders and very rapid through the cinders. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

This unit is used mainly for subsistence farming and as homesites. Taro and bananas are the main crops. Some areas are used as a source of wood for fuel, woodcrafting, and other local uses.

This unit is well suited to the production of subsistence crops. It has few limitations. Soil fertility can be maintained by fertilizing, rotating crops, or adding organic material to the soil in the form of crop residue, mulch, or compost.

This unit is moderately suited to homesite development. The main limitations are slope and the hazard of contaminating ground water. Cuts needed to provide essentially level building sites can expose loose cinders. Effluent from onsite sewage disposal systems may contaminate ground water because of the poor filtration in the cinders.

20—Oloava silty clay loam, 12 to 25 percent slopes. This very deep, well drained soil is on uplands. It formed in volcanic ash and cinders. The natural vegetation is mainly mixed forest. Elevation is 400 to 1,500 feet. The mean annual rainfall is 175 to 230 inches, and the mean annual temperature is about 78 degrees F.

Typically, the surface layer is dark brown silty clay loam 9 inches thick. The upper 5 inches of the subsoil is dark brown clay loam, and the lower 3 inches is dark brown gravelly silt loam. The substratum to a depth of 60 inches or more is weathered cinders that crush to very gravelly sandy loam. Depth to weathered cinders commonly is 12 to 40 inches but ranges from 12 to 60 inches or more.

Included in the steeper areas of this unit are soils that are similar to this Oloava soil but are more than 60 inches deep to cinders.

Permeability of this Oloava soil is moderately rapid above the cinder layer and very rapid through the cinders. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

This unit is used mainly for subsistence farming and as homesites. Taro and bananas are the main crops. Some areas are used as a source of wood for fuel, woodcrafting, and other local uses.

This unit is suited to the production of subsistence crops. It has few limitations. Erosion can be controlled by use of crop residue, mulch, and cross-slope farming. Soil fertility can be maintained by fertilizing, rotating crops, or adding organic material to the soil in the form of crop residue, mulch, or compost.

This unit is moderately suited to poorly suited to homesite development. The main limitations are slope and the hazard of contaminating ground water. Cuts needed to provide essentially level building sites can expose loose cinders. Effluent from onsite sewage disposal systems may contaminate ground water because of the poor filtration in the cinders.

21—Oloava silty clay loam, 40 to 100 percent slopes. This very deep, well drained soil is on mountainsides and cinder cones. It formed in volcanic ash and cinders. The natural vegetation is mainly mixed forest. Elevation is 400 to 1,500 feet. The mean annual

rainfall is 175 to 230 inches, and the mean annual temperature is about 78 degrees F.

Typically, the surface layer is dark brown silty clay loam 6 inches thick. The upper 5 inches of the subsoil is dark brown clay loam, and the lower 3 inches is dark brown gravelly silt loam. The substratum to a depth of 60 inches or more is weathered cinders that crush to very gravelly sandy loam. Depth to weathered cinders ranges from 12 to 30 inches.

Included in this unit are small areas of Rock outcrop and exposed cinders. Also included are small areas of Oloava soils that have slopes of 10 to 20 percent.

Permeability of this Oloava soil is moderately rapid above the cinder layer and very rapid through it. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is severe.

This unit is used mainly as woodland and for wildlife habitat. Most areas support rain forest and are not used as commercial woodland. The areas of woodland are used as a source of wood for fuel, woodcrafting, and other local uses. The wildlife habitat mainly supports wild pigs, fruit bats, and birds. A few areas of the unit are used for subsistence farming. Some cinder cones are mined for cinders that are used for road construction and landfill.

This unit is moderately suited to a wide variety of climatically adapted trees. The main concerns in producing and harvesting trees are slope, the hazard of water erosion, and plant competition. The steepness of slope limits the kinds of equipment that can be used in forest management. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected by constructing water bars and by seeding cuts and fills. Competing vegetation can be controlled by properly preparing the site and by spraying, cutting, or girdling to eliminate unwanted weeds, brush, or trees.

This unit is poorly suited to the production of subsistence crops. The steepness of slope makes cultivation hazardous. Where feasible, the soil should be maintained in permanent vegetation to reduce erosion. Areas used for subsistence farming should be managed so that disturbance of the soil is minimal. The soil should be protected with a cover of crop residue, mulch, or weeds.

22—Olotania family, 15 to 40 percent slopes. This map unit is on mountainsides. The natural vegetation is mainly tropical rain forest consisting of broadleaf trees and an understory of tree ferns, ground ferns, and shrubs. Most areas are not easily accessible because of the dense jungle vegetation. Elevation is 900 to 3,000 feet. The mean annual rainfall is 200 to 300 inches, and the mean annual temperature is about 76 degrees F. Fog and cloud cover are common.

This unit is broadly defined and mapped because the area's rugged topography limits accessibility and use. The soils in the unit were examined only in a few places, and mapping was done mainly by photo interpretation.

The Olotania family soils formed in volcanic ash and cinders under high rainfall. They are well drained. No single profile of Olotania family soils is typical, but one commonly observed in the survey area has a surface layer of dark brown silty clay loam about 8 inches thick. The subsoil is dark yellowish brown silty clay loam 17 inches thick. The subsoil feels smeary when moist. When it dries completely, it turns to hard sand- and gravel-sized aggregates that do not attain the same consistency when remoistened. The substratum to a depth of 60 inches or more is weathered volcanic cinders. Weathered cinders are at a depth of 20 to 60 inches or more.

Included in this unit are small areas of soils that are similar to the Olotania family soils but have unweathered bedrock at a depth of 20 inches or less. Also included are small areas of Rock outcrop and soils that have slopes of as much as 70 percent and are along drainageways and on ridges, cinder cones, and volcanic craters.

Permeability of the Olotania family soils is moderately rapid. Available water capacity is moderate to high. Effective rooting depth is 60 inches or more. Runoff is medium to rapid, and the hazard of water erosion is moderate to severe.

This unit is used as woodland and for wildlife habitat. Most areas support rain forest and are not used as commercial woodland. The areas of woodland are used as a source of wood for fuel, woodcrafting, and other local uses. The wildlife habitat mainly supports wild pigs, fruit bats, and birds.

This unit is well suited to a variety of climatically adapted trees. The main concerns in producing and harvesting trees are the hazard of water erosion, plant competition, and low soil strength. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected by constructing water bars and by seeding cuts and fills. Competing vegetation can be controlled by properly preparing the site and by spraying, cutting, or girdling to eliminate unwanted weeds, brush, or trees. The low soil strength limits the kind of equipment that can be used in forest management. Conventional equipment may get bogged when the soil is wet.

23—Pavalai stony clay loam, 6 to 12 percent slopes. This moderately deep, well drained soil is on uplands. It formed in volcanic ash and is underlain by lava. The natural vegetation is mainly mixed forest. Elevation is near sea level to 900 feet. The mean annual rainfall is 150 to 200 inches, and the mean annual temperature is about 79 degrees F.

Typically, the surface layer is very dark grayish brown stony clay loam 7 inches thick. The subsurface layer is very dark grayish brown clay loam 5 inches thick. The subsoil is dark brown very cobbly sandy loam 26 inches thick. Lava is at a depth of 20 to 40 inches. In some areas the surface layer is stony silty clay loam. Most areas are stony in the surface layer, but scattered small areas are very stony or nonstony.

Included in this unit are small areas of Iliili extremely stony mucky clay loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Pavaiai soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

Most areas of this unit are used for subsistence farming and as homesites. A few areas are used for commercial vegetable farming. Among the subsistence crops grown are taro, bananas, breadfruit, and coconuts. Small areas are used for production of vegetables including beans, cucumbers, eggplant, peppers, and cabbage. Some areas are used as a source of wood for fuel, woodcrafting, and other local uses.

This unit is moderately suited to the production of subsistence crops. It is limited mainly by stones, depth to rock, and the hazard of water erosion. In most places the content of stones in the surface layer is not great enough to significantly affect planting or other farming operations. Erosion can be controlled by use of crop residue, mulch, and cross-slope farming. Soil fertility can be maintained by fertilizing, rotating crops, or adding organic material to the soil in the form of crop residue, mulch, or compost.

This unit is moderately suited to homesite development. It is limited mainly by stones, depth to rock, and slope. Access roads should be designed to control surface runoff and to help stabilize cut slopes.

24—Pavaiai stony clay loam, 12 to 25 percent slopes. This moderately deep, well drained soil is on uplands. It formed in volcanic ash and is underlain by lava. The natural vegetation is mainly mixed forest. Elevation is near sea level to 900 feet. The mean annual rainfall is 150 to 200 inches, and the mean annual temperature is about 79 degrees F.

Typically, the surface layer is very dark grayish brown stony clay loam 7 inches thick. The subsurface layer is very dark grayish brown clay loam 5 inches thick. The subsoil is dark brown very cobbly sandy loam 26 inches thick. Lava is at a depth of 20 to 40 inches. In some areas the surface layer is stony silty clay loam. Most areas are stony in the surface layer, but scattered small areas are very stony or nonstony.

Included in this unit is Rock outcrop. Also included are small areas of soils that are similar to this Pavaiai soil but are less than 20 inches deep to bedrock.

Permeability of this Pavaiai soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

Most areas of this unit are used for subsistence farming and as homesites. A few areas are used for commercial vegetable farming. Among the subsistence crops grown are taro, bananas, breadfruit, and coconuts. Small areas are used for production of vegetables including beans, cucumbers, eggplant, peppers, and cabbage. Some areas are used as a source of wood for fuel, woodcrafting, and other local uses.

This unit is moderately suited to the production of subsistence crops. It is limited mainly by depth to rock, stones, slope, and the hazard of water erosion. In most places the content of stones in the surface layer is not great enough to significantly affect planting or other farming operations. Erosion can be controlled by use of crop residue, mulch, and cross-slope farming. Soil fertility can be maintained by fertilizing, rotating crops, or adding organic material to the soil in the form of crop residue, mulch, or compost.

This unit is moderately suited to homesite development. It is limited mainly by depth to rock, stones, and slope. Access roads should be designed to control surface runoff and to help stabilize cut slopes.

25—Pavaiai stony clay loam, 25 to 40 percent slopes. This moderately deep, well drained soil is on uplands. It formed in volcanic ash and is underlain by lava. The natural vegetation is mainly mixed forest. Elevation is near sea level to 900 feet. The mean annual rainfall is 150 to 200 inches, and the mean annual temperature is about 79 degrees F.

Typically, the surface layer is very dark grayish brown stony clay loam 10 inches thick. The upper 6 inches of the subsoil is very dark grayish brown extremely gravelly sandy loam, and the lower 14 inches is extremely gravelly very fine sandy loam. Lava is at a depth of 30 inches. In some areas the surface layer is stony silty clay loam. In most areas the surface layer is stony, but in small scattered areas, it is very stony, extremely stony, or nonstony.

Included in this unit is Rock outcrop. Also included are small areas of soils that are similar to this Pavaiai soil but are less than 20 inches deep to bedrock.

Permeability of this Pavaiai soil is moderately rapid. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium to rapid, and the hazard of water erosion is moderate to severe.

This unit is used for subsistence farming, woodland, and wildlife habitat. Among the subsistence crops grown are taro, bananas, breadfruit, and coconuts. The areas of woodland are a source of wood for fuel, woodcrafting, and other local uses. The wildlife habitat mainly supports wild pigs, fruit bats, and birds.

This unit is moderately suited to the production of subsistence crops. It is limited mainly by depth to rock, stones, and the hazard of water erosion. In most places the content of stones in the surface layer is not great enough to significantly affect planting or other farming operations. Soil fertility can be maintained by fertilizing, rotating crops, or adding organic material to the soil in the form of crop residue, mulch, or compost.

This unit is well suited to a variety of climatically adapted trees. It is limited mainly by the hazards of water erosion and plant competition. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected by constructing water bars and by seeding cuts and fills. Competing vegetation can be controlled by properly preparing the site and by spraying, cutting, or girdling to eliminate unwanted weeds, brush, or trees.

26—Puapua-Rock outcrop complex, 40 to 100 percent slopes. This map unit is in areas associated with cinder cones and craters. The natural vegetation is mainly mixed forest. Elevation is near sea level to 400 feet. The mean annual rainfall is 120 to 160 inches, and the mean annual temperature is about 80 degrees F.

This unit is about 50 percent Puapua clay loam and 30 percent Rock outcrop. The Puapua soil is on very steep side slopes, and Rock outcrop is on crater rims, ridgetops, and sides of small gullies. The components of the unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Sogi clay loam on moderately steep, convex side slopes and small areas of cinders and stony pyroclastic material. Included areas make up about 20 percent of the total acreage.

The Puapua soil is shallow to tuff and is well drained. It formed in volcanic ash. Typically, the surface layer is dark brown clay loam 11 inches thick. The substratum is dark brown sandy loam 5 inches thick over hard tuff. Depth to hard tuff ranges from 10 to 20 inches.

Permeability of the Puapua soil is moderately rapid above the tuff and is slow through it. Available water capacity is low. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is severe.

Rock outcrop is exposed areas of lava and hard volcanic tuff.

Most areas of this unit are used as woodland and for wildlife habitat. A few areas are used for subsistence farming. The main crops are taro, bananas, breadfruit, and coconuts. Most areas support rain forest and are not used as commercial woodland. The areas of woodland are used as a source of wood for fuel, woodcrafting, and other local uses. The wildlife habitat mainly supports wild pigs, fruit bats, and birds.

This unit is moderately suited to a wide variety of climatically adapted trees. The main concerns in producing and harvesting trees are slope, the hazard of water erosion, and the areas of Rock outcrop. The steepness of slope limits the kinds of equipment that can be used in forest management. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected by constructing water bars and by seeding cuts and fills. The areas of Rock outcrop can interfere with operations involving use of equipment.

This unit is poorly suited to the production of subsistence crops because of slope and the areas of Rock outcrop. The steepness of slope makes cultivation hazardous. Where feasible, the soil should be maintained in permanent vegetation to reduce erosion. Areas used for subsistence farming should be managed so that disturbance of the soil is minimal. The soil should be protected with a cover of crop residue, mulch, or weeds.

27—Rock outcrop-Hydrandepts-Dystrandepts association, very steep. This map unit is on mountainsides and cliffs. Slope is 70 to 130 percent. The natural vegetation is mainly tropical rain forest. Most areas are not easily accessible because of the steepness of slope and the dense jungle vegetation. Elevation is near sea level to 3,000 feet. The mean annual rainfall is 175 to 300 inches, and the mean annual temperature is 74 to 80 degrees F. Fog and cloud cover are common at the higher elevations.

This unit is broadly defined and mapped because the area's rugged topography limits accessibility and use. The soils in the unit were examined only in a few places, and mapping was done mainly be photo interpretation.

This unit is about 35 percent Rock outcrop, 30 percent Hydrandepts, and 25 percent Dystrandepts. Rock outcrop is on very steep and nearly vertical side slopes, Hydrandepts are on very steep side slopes at higher elevations, and Dystrandepts are on very steep side slopes at lower elevations.

Included in this unit are small areas of colluvium consisting of boulders, stones, and soil material deposited at the base of cliffs and steep mountainsides. These areas have slopes of 30 to 45 percent. Also included are small areas of landslides. The included areas make up about 10 percent of the total acreage.

Rock outcrop is exposed areas of bedrock. In most places, trees and shrubs grow in cracks and on ledges. There is little or no soil material except in cracks and on ledges. The soil material, where present, is commonly gravelly and ranges from silty clay loam to sandy loam.

Hydrandepts formed in volcanic ash under high rainfall. These soils are well drained and are mostly shallow or moderately deep to bedrock. They commonly are silty clay loam. The subsoil feels smeary when moist. When it dries completely, it turns to hard sand- and gravel-sized aggregates that do not attain the same consistency when remoistened.

Dystrandepts formed in volcanic ash and receive less rainfall than the Hydrandepts. They are well drained and

are mostly shallow or moderately deep to bedrock. They commonly are clay loam or silty clay loam and have a stony surface layer.

This unit is used as woodland and for wildlife habitat. Most areas support rain forest and are not used as commercial woodland. The areas of woodland are used as a source of wood for fuel, woodcrafting, and other local uses. The wildlife habitat mainly supports wild pigs, fruit bats, and birds.

Large areas of this unit are moderately suited to a wide variety of climatically adapted trees. The steeper areas, however, are poorly suited to trees. The main concerns in producing and harvesting trees are slope, the hazard of water erosion, and plant competition. The steepness of slope limits the kinds of equipment that can be used in forest management. Careful management is needed to minimize the risk of water erosion. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected by constructing water bars and by seeding cuts and fills. Competing vegetation can be controlled by properly preparing the site and by spraying, cutting, or girdling to eliminate unwanted weeds, brush, or trees.

28—Sogi-Puapua clay loams, 0 to 6 percent slopes. This map unit is on uplands. The natural vegetation is mainly mixed forest. The elevation ranges from near sea level to 400 feet. The mean annual rainfall is 120 to 160 inches, and the mean annual temperature is about 80 degrees F.

This unit is about 50 percent Sogi clay loam and 35 percent Puapua clay loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of tuff outcrops, mainly on knolls and ridgetops, and soils that are similar to the Sogi soil but have tuff at a depth of 40 inches or more and are mainly on convex side slopes. Also included are small, low-lying areas that are ponded for short periods after heavy rains. Included areas make up about 15 percent of the total acreage.

The Sogi soil is moderately deep to tuff and is well drained. It formed in volcanic ash and is underlain by hard volcanic tuff. Typically, the surface layer is dark brown clay loam 10 inches thick. The subsoil is dark brown clay loam 11 inches thick. The substratum is very dark grayish brown loamy sand 5 inches thick over hard tuff. Depth to hard tuff ranges from 20 to 40 inches.

Permeability of the Sogi soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight.

The Puapua soil is shallow to tuff and is well drained. It formed in volcanic ash and is underlain by hard volcanic tuff. Typically, the surface layer is very dark brown clay loam 11 inches thick. The substratum is dark brown sandy loam 5 inches thick over hard tuff. Depth to hard tuff ranges from 10 to 20 inches.

Permeability of the Puapua soil is moderately rapid above the underlying tuff and is slow through it. Available water capacity is low. Effective rooting depth is 10 to 20 inches. Runoff is slow, and the hazard of water erosion is slight.

Most areas of this unit are used for subsistence farming and as homesites. A few areas are used for commercial vegetable farming (fig. 4). The main subsistence crops grown are taro, bananas, breadfruit, and coconuts. The vegetable crops include cucumbers, beans, cabbage, peppers, eggplant, and tomatoes.

This unit is moderately suited to the production of subsistence and vegetable crops. The main limitation is the depth to rock. The soils in this unit become droughty during periods of dry weather, and crops may suffer from lack of moisture. Deep-rooted crops are restricted by the depth to rock in some areas. Erosion can be controlled by use of crop residue, mulch, and cross-slope farming. Soil fertility can be maintained by fertilizing, rotating crops, or adding organic material to the soil in the form of crop residue, mulch, or compost.

This unit is poorly suited to homesite development. It is limited mainly by the depth to rock. Because of this restrictive layer, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall.

29—Sogi-Puapua clay loams, 6 to 20 percent slopes. This map unit is on uplands. It is characterized by many small drainageways and ridges in most places. The natural vegetation is mainly mixed forest. Elevation is near sea level to 400 feet. The mean annual rainfall is 120 to 160 inches, and the mean annual temperature is about 80 degrees F.

This unit is about 45 percent Sogi clay loam and 40 percent Puapua clay loam. Generally, the Sogi soil is on convex side slopes and in the more gently sloping areas, and the Puapua soil is on concave side slopes, on knolls and ridgetops, and in drainageways. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of tuff outcrops, mainly on knolls and ridgetops, and soils that are similar to the Sogi soil but have tuff at a depth of 40 inches or more and are mainly on convex side slopes. Also included are small areas of steeper soils along drainageways. Included areas make up about 15 percent of the total acreage.

The Sogi soil is moderately deep to tuff and is well drained. It formed in volcanic ash and is underlain by hard volcanic tuff. Typically, the surface layer is dark brown clay loam 10 inches thick. The subsoil is dark brown clay loam 11 inches thick. The substratum is very dark grayish brown loamy sand 5 inches thick over hard tuff. Depth to hard tuff ranges from 20 to 40 inches.

Figure 4.—Cultivation in an area of Sogi-Puapua clay loams, 0 to 6 percent slopes.

Permeability of the Sogi soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

The Puapua soil is shallow to tuff and is well drained. It formed in volcanic ash and is underlain by hard volcanic tuff. Typically, the surface layer is very dark brown clay loam 11 inches thick. The substratum is dark brown sandy loam 5 inches thick over hard tuff. Depth to hard tuff ranges from 10 to 20 inches.

Permeability of the Puapua soil is moderately rapid above the underlying tuff and is slow through it. Available water capacity is low. Effective rooting depth is 10 to 20 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

Most areas of this unit are used for subsistence farming and as homesites. A few areas are used for commercial vegetable farming. The main subsistence crops grown are taro, bananas, breadfruit, and coconuts. The vegetable crops include cucumbers, beans, cabbage, peppers, eggplant, and tomatoes.

This unit is moderately suited to subsistence crops and vegetable crops. It is limited mainly by the depth to rock and the hazard of water erosion. Erosion can be controlled by use of crop residue, mulch, and cross-slope farming. Soil fertility can be maintained by fertilizing, rotating crops, or adding organic material to the soil in the form of crop residue, mulch, or compost. Deep-rooted crops are restricted by the depth to rock in some areas. This unit is poorly suited to homesite development. It is limited mainly by the depth to rock and slope. Because of the restrictive layer, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall.

30—Sogi-Puapua clay loams, 20 to 40 percent slopes. This map unit is in drainageways and on mountainsides. The natural vegetation is mainly mixed forest. Elevation is near sea level to 400 feet. The mean annual rainfall is 120 to 160 inches, and the mean annual temperature is about 80 degrees F.

This unit is about 45 percent Sogi clay loam and 40 percent Puapua clay loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of tuff outcrops mainly on knolls and ridgetops and on sides of drainageways, and soils that are similar to the Sogi soil but have tuff at a depth of 40 inches or more and are mainly the deeper soils on convex side slopes. Also included are small areas of Sogi and Puapua soils in moderately sloping areas. Included areas make up about 15 percent of the total acreage.

The Sogi soil is moderately deep to tuff and is well drained. It formed in volcanic ash and is underlain by hard volcanic tuff. Typically, the surface layer is dark brown clay loam 10 inches thick. The subsoil is dark brown clay loam 5 inches thick. The substratum is dark brown and very dark brown loamy sand 12 inches thick over hard tuff. Depth to hard tuff ranges from 20 to 40 inches.

Permeability of the Sogi soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium to rapid, and the hazard of water erosion is moderate to severe.

The Puapua soil is shallow to tuff and is well drained. Typically, the surface layer is very dark brown clay loam 11 inches thick. The substratum is dark brown sandy loam 5 inches thick over hard tuff. Depth to hard tuff ranges from 10 to 20 inches.

Permeability of the Puapua soil is moderately rapid above the underlying tuff and is slow through it. Available water capacity is low. Effective rooting depth is 10 to 20 inches. Runoff is medium to rapid, and the hazard of water erosion is moderate to severe.

This unit is used for subsistence farming. Taro, bananas, breadfruit, and coconuts are the main crops.

This unit is moderately suited to the production of subsistence crops. It is limited mainly by the depth to rock and the hazard of water erosion. Erosion can be controlled by use of crop residue, mulch, and cross-slope farming. Soil fertility can be maintained by fertilizing, rotating crops, or adding organic material to the soil in the form of crop residue, mulch, or compost. Deep-rooted crops are restricted by the depth to rock in some areas.

31—Sogi Variant-Pavaiai association, 15 to 50 percent slopes. This map unit is on mountainsides. The natural vegetation is mainly tropical rain forest. Elevation is 150 to 600 feet. The mean annual rainfall is 175 to 230 inches, and the mean annual temperature is 79 degrees F.

This unit is broadly defined and mapped because the rugged topography limits accessibility and use. The soils in the unit were examined only in a few places, and mapping was done mainly by photo interpretation.

This unit is about 50 percent Sogi Variant silty clay and 40 percent Pavaiai stony clay loam. The Sogi Variant soil generally is upslope of the Pavaiai soil.

Included in this unit are small areas of Rock outcrop along drainageways and on knolls and soils that are shallow to bedrock. The included areas make up about 10 percent of the total acreage.

The Sogi Variant soil is well drained and moderately deep to bedrock. It formed in volcanic ash. Typically, the surface layer is dark brown silty clay 8 inches thick. The subsoil is dark brown silty clay 22 inches thick over pahoehoe lava. Depth to bedrock ranges from 28 to 40 inches. In many places the surface layer is stony silty clay.

Permeability of the Sogi Variant soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 28 to 40 inches. Runoff is medium to

rapid, and the hazard of water erosion is moderate to severe.

The Pavaiai soil is moderately deep and well drained. It formed in volcanic ash and is underlain by lava. Typically, the surface layer is very dark grayish brown stony clay loam 10 inches thick. The subsoil is very dark grayish brown extremely gravelly sandy loam and extremely gravelly very fine sandy loam 20 inches thick. Lava is at a depth of 30 inches. Depth to bedrock ranges from 20 to 40 inches. In most areas the surface layer is stony or very stony.

Permeability of the Pavaiai soil is moderately rapid. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium to rapid, and the hazard of water erosion is moderate to severe.

Most areas of this unit are used as woodland and for wildlife habitat. A few areas are used for subsistence farming. The main crops are taro, bananas, breadfruit, and coconuts. Most areas support rain forest and are not used as commercial woodland. The areas of woodland are used as a source of wood for fuel, woodcrafting, and other local uses. The wildlife habitat mainly supports wild pigs, fruit bats, and birds.

This unit is moderately suited to a wide variety of climatically adapted trees. The main concerns in producing and harvesting trees are the hazards of water erosion and windthrow and plant competition. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected by constructing water bars and by seeding cuts and fills. Trees are subject to windthrow because of limited rooting depth. Species that can resist windthrow should be selected. Competing vegetation can be controlled by properly preparing the site and by spraying, cutting, or girdling to eliminate unwanted weeds, brush, or trees.

This unit is moderately suited to the production of subsistence crops. The Sogi Variant soil is limited mainly by stones in the surface layer and the hazard of water erosion. The Pavaiai soil is limited mainly by stones throughout the surface layer and subsoil and the hazard of water erosion. Stones interfere with planting, weeding, and other farming operations. Erosion can be controlled by use of crop residue, mulch, and cross-slope farming.

32—Tafuna extremely stony muck, 3 to 15 percent slopes. This deep, well drained soil is on lava flows. It is characterized by a thin organic soil overlying fragmental aa lava. The natural vegetation is mainly mixed forest. Elevation is near sea level to 150 feet. The mean annual rainfall is 120 to 175 inches, and the mean annual temperature is 80 degrees F.

Typically, the surface layer is black extremely stony muck 9 inches thick. It overlies very dark grayish brown and dark brown extremely stony muck 9 inches thick. The underlying material to a depth of 43 inches or more is fragmental aa lava. Depth to bedrock is mainly 40 to 60 inches or more. In some areas bedrock is at a depth of 24 to 40 inches.

Included in this unit are small areas of Iliili extremely stony mucky clay loam and small areas of soils that are less than 10 inches deep to pahoehoe lava. Included areas make up about 20 percent of the total acreage.

Permeability of this Tafuna soil is very rapid. Available water capacity is very low. Effective rooting depth is variable. Roots can penetrate through the fragmental aa lava and through cracks in the underlying bedrock. Runoff is very slow, and the hazard of water erosion is slight.

This unit is used for urban development and subsistence farming. Breadfruit and bananas are the main subsistence crops. Undisturbed areas are in mixed forest and support a number of large tree species.

This unit is poorly suited to urban development because of stones and depth to rock. The bedrock provides good, stable foundations for structures. The stones interfere with site development and excavation for foundations.

This unit is poorly suited to cultivated crops because of the stones throughout the soil. Orchard crops such as breadfruit, coconuts, and papaya, however, do not require cultivation and thus can be grown.

33—Troporthents, 0 to 6 percent slopes. These soils are at the Pago Pago Airport and in the surrounding industrial and residential areas. They consist of areas that have been altered by cutting, filling, and smoothing (fig. 5). Elevation is near sea level to 75 feet. The mean annual rainfall is 120 to 150 inches, and the mean annual temperature is about 80 degrees F.

Included in this unit are small areas of Tafuna extremely stony muck, Iliili extremely stony mucky clay loam, Rock outcrop, and Urban land.

Troporthents are well drained. They consist mainly of a mixture of sand, gravel, cobbles, and some fine textured material. Some filled areas consist of coral, coral sand, cinders, or other material. The underlying material is fragmental aa lava or bedrock.

Permeability of the Troporthents is slow to moderately rapid. Available water capacity is low. Effective rooting depth is variable. Runoff is slow to medium, and the hazard of water erosion is slight.

This unit is used for homesite and urban development. It is moderately suited to these uses. The main limitation is depth to bedrock. The unit provides a firm foundation for structures. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

34—Urban land-Aua-Leafu complex, 0 to 30 percent slopes. This map unit is on coastal plains, valley floors, and adjacent mountain foot slopes. Slope is mainly 0 to 6 percent but ranges to 30 percent on the

Figure 5.—Troporthents, 0 to 6 percent slopes, are very stony. They are a good foundation for structures.

mountain foot slopes. The natural vegetation is mainly mixed forest. Elevation is near sea level to 200 feet. The mean annual rainfall is 150 to 220 inches, and the mean annual temperature is about 80 degrees F.

This unit is 45 to 60 percent Urban land, 20 to 40 percent Aua very stony silty clay loam, and 10 to 15 percent Leafu silty clay. The percentages vary from one area to another. The Aua soils are on mountain foot slopes, and the Leafu soils are on coastal plains and valley floors. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of poorly drained soils along streams, soils underlain by volcanic tuff, and narrow strips of stony or sandy beaches. Included areas make up about 15 percent of the total acreage.

Urban land consists of areas covered by streets, buildings, and other structures that obscure or alter the soils so that identification is not feasible. Slopes are 0 to 30 percent.

The Aua soil is very deep and well drained. It formed in colluvium and alluvium derived dominantly from basic igneous rock. Slopes are 6 to 30 percent. Typically, the surface layer is dark brown very stony silty clay loam 7 inches thick. The subsoil to a depth of 60 inches or more is dark brown and dark grayish brown stony and very stony clay loam. In many places the soil has been cut, filled, and smoothed.

Permeability of the Aua soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

The Leafu soil is very deep and somewhat poorly drained. It formed in fine textured alluvium derived dominantly from basic igneous rock. Slopes are 0 to 6 percent. Typically, the surface layer is dark brown silty clay loam and silty clay 13 inches thick. The subsoil and substratum to a depth of 60 inches or more are dark brown very fine sandy loam and clay.

Permeability of the Leafu soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion is slight. This soil is subject to occasional, brief periods of flooding during prolonged, heavy rainfall.

Most areas of this unit are used as homesites. A few areas are used for subsistence farming.

This unit is poorly suited to homesite development. The main limitations are the slope of the Aua soil and the hazard of flooding on the Leafu soil. Only the part of the site that is used for construction should be disturbed. Access roads should be designed to control surface runoff and to help stabilize cut slopes. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

35—Urban land-Ngedebus complex. This map unit is on coastal plains. Slope is 0 to 5 percent. Elevation is sea level to 15 feet. The mean annual rainfall is 120 to 160 inches, and the mean annual temperature is about 80 degrees F.

This unit is 40 to 60 percent Urban land and 30 to 50 percent Ngedebus sand. The percentages vary from one area to another.

Included in this unit are small areas of poorly drained soils adjacent to streams and narrow strips of sandy beaches.

Urban land consists of areas covered by streets, buildings, and other structures that obscure or alter the soils so that identification is not feasible. Much of the area has been leveled and filled with coral fragments, sand, cinders, and other material.

The Ngedebus soil is very deep and somewhat excessively drained. It formed in sand derived dominantly from coral and sea shells. Typically, the surface layer is light brownish gray and brown sand 4 inches thick. The underlying material to a depth of 60 inches or more is pale brown and light yellowish brown sand.

Permeability of the Ngedebus soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. In some places this soil is subject to occasional, brief periods of flooding during prolonged, heavy rainfall or during high tide.

This unit is used mainly as homesites and for recreation. It is also a source of sand for construction.

This unit is moderately suited to homesite development in areas protected from flooding and is poorly suited in unprotected areas. Selection of adapted vegetation is critical for the establishment of lawns, shrubs, trees, and vegetable gardens. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This unit is well suited to beach type recreation.

Prime Farmland

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to producing food, feed, forage, fiber, and oilseed crops. It must either be used for producing food or fiber or be available for these uses. It has the soil quality, length of growing season, and moisture supply needed to economically produce a sustained high yield of crops when it is managed properly. Prime farmland produces the highest yields with minimal energy and economic resources, and farming it results in the least disturbance of the environment.

Prime farmland commonly has an adequate and dependable supply of moisture from precipitation or irrigation. It also has a favorable temperature and length of growing season and an acceptable level of acidity or alkalinity. It has few if any rock fragments and is permeable to water and air. Prime farmland is not excessively eroded or saturated with water for long periods and is not flooded during the growing season.

About 420 acres, or less than 1 percent, of the survey area meets the soil requirements for prime farmland. The areas of prime farmland are at Aoloaufou on Tutuila, near Tau Farm on Tau, and on Aunuu. The crops grown are taro, bananas, breadfruit, coconuts, and small amounts of vegetables.

The following map units meet the soil requirements for prime farmland if they are not in urban use. This list does not constitute a recommendation for a particular land use. The extent of each map unit is shown in table 2. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units."

16 Ofu Variant silty clay, 6 to 20 percent slopes
19 Oloava silty clay loam, 6 to 12 percent slopes

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops; as woodland; as sites for buildings, sanitary facilities, roads, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops

General management needed for crops is suggested in this section. The crops best suited to the soils, including some not commonly grown in the survey area, are identified.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units."

According to the Census of Agriculture, in 1980 American Samoa had 4,000 acres in crops. About 85 percent of the farms produce crops for subsistence. In 1979, about 1,400 acres was planted to taro (fig. 6). Other crops include bananas, breadfruit, coconuts, papaya, cassava, citrus fruit, and vegetables. The acreage of most crops has decreased over the past 10 years, but the acreage of taro has remained stable. In recent years there has been interest in vegetable production for market.

The arable soils in the survey area are mostly medium acid to neutral. Many of the soils, such as the Sogi, Puapua, Leafu, and Aua soils, have sufficient calcium and favorable soil reaction for plant growth. Most crops respond to nitrogen, phosphate, and potash. The application of fertilizer and lime should be based on the results of soil tests, the crops grown, and expected yields.

The warm temperatures and high rainfall in the survey area are well suited to most of the crops commonly grown. In addition, a variety of vegetables such as beans, broccoli, cabbage, corn, cucumbers, lettuce, onions, radishes, spinach, and tomatoes can be grown (*6*). Vegetables, however, can be damaged by high-intensity rains and by insects and disease.

Many soil factors affect use of the land for crop production. Steepness of slope, stoniness, restricted rooting depth, wetness, and the hazard of erosion are the important factors in the survey area.

The technology for subsistence farming is simple (*3*). The main agricultural implements are the bush knife, axe, and oso, a thick, pointed digging stick. Small patches of forest land are cleared with the bush knife and axe. A hole about 1 foot deep is made in the soil with the oso, and the plant is placed in the hole. Except for the holes, there is little soil disturbance. Plantings can be made year-round to insure continuous production.

Weeding is important because the warm tropical climate induces rapid weed growth. Weeds are cut with the bush knife or pulled by hand. The crops generally are not fertilized, and irrigation is not needed because of abundant rainfall. When production decreases, the land is turned to fallow and a new area is cleared for planting.

This type of farming is well adapted to the steep lands in the survey area. There is little soil disturbance to create erosion. The soil is protected most of the time by a cover of weeds or mulch. Generally, areas that have slopes of more than 50 percent should be kept in

Figure 6.—Taro on Ililli extremely stony mucky clay loam, 3 to 15 percent slopes.

permanent vegetation. If these areas are used for crops, only tree crops should be grown.

Organic matter is an important source of nitrogen for crops. It is especially important in subsistence farming because commercial fertilizer is not used. The soils in the survey area have a high organic matter content. The nutrients needed for plant growth are replenished by organic matter from decaying plants and animals. The organic matter content and fertility of the soils can be maintained by leaving crop residue and mulch on the surface.

Soil erosion is a major hazard in steep areas of cropland. It reduces productivity of the soil and results in pollution of streams and coastal waters. Erosion control practices can be used to protect the soil, reduce runoff, increase infiltration, and safely remove excess water.

Use of minimum tillage, cover crops, mulch, and crop residue is common in subsistence farming. The land is cleared and planted with hand implements, which results in minimal soil disturbance. Weeds can be left and used as a soil cover or can be cut or pulled and used as a mulch. Plant parts from the harvested crops can be left in the field for protection and improvement of the soil.

Other practices that help to control erosion are cross-slope or contour farming and using a cropping system that rotates crops and includes extended periods when the soil is covered. Terraces and diversions can be used to reduce runoff and remove excess water. They are suitable where the soils are deep and slopes are not too steep.

Woodland

Most of the land in the survey area is covered with dense forest vegetation (fig. 7). Even areas used for subsistence farming revert to forest within a short time.

The forests are typical of moist, tropical areas. They consist of broadleaf trees and an understory of tree ferns, ground ferns, shrubs, and vines. Mangrove forests occupy small areas of coastal wetlands.

Figure 7.—Forest vegetation on Olotania family, 15 to 40 percent slopes.

The forests in the survey area provide posts and timber for construction of houses, logs for canoes, and wood for handicrafts and fuel. Bark is used for tapa cloth, and leaves of pandanus are used for floor mats and baskets. There is no commercial woodland in the

area. Management and development of the forests is difficult because of communal land ownership.

A 1964 report stated that management for timber crops is feasible on about 12,000 acres of forest land in the survey area. Another 10,000 acres of forest land is on steep slopes that restrict forest management. An estimated 50 million board feet or more of sawtimber is available from a variety of tree species. Some species have good growth form and wood quality (*4*).

More land is in woodland today than in 1964 because the land used for coconuts at that time has reverted to forest in many areas of Tau, Ofu, and Olosega.

The woodland in the survey area has an important function for watershed protection and soil conservation. The steeper areas should remain in permanent cover.

Recreation

The survey area has many areas of scenic, geologic, and historic interest. The lush vegetation, rugged mountains, and winding coastline offer opportunities for sightseeing, hiking, nature study, picnicking, and camping. The coastal waters, in addition, offer opportunities for swimming, fishing, and boating. Most of the land, including the shoreline areas, is claimed by the villagers, however, and public access is limited.

The information in this section can be used to select sites and plan for parks, paths and trails, and other recreational facilities.

The soils of the survey area are rated in table 3 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 3, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 3 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 5 and interpretations for dwellings without basements and for local roads and streets in table 4.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for

planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 4 shows the degree and kind of soil limitations that affect shallow excavations, dwellings without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer; stone content; soil texture; and slope. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings and dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the

surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 5 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 5 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 5 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage because of rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 5 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

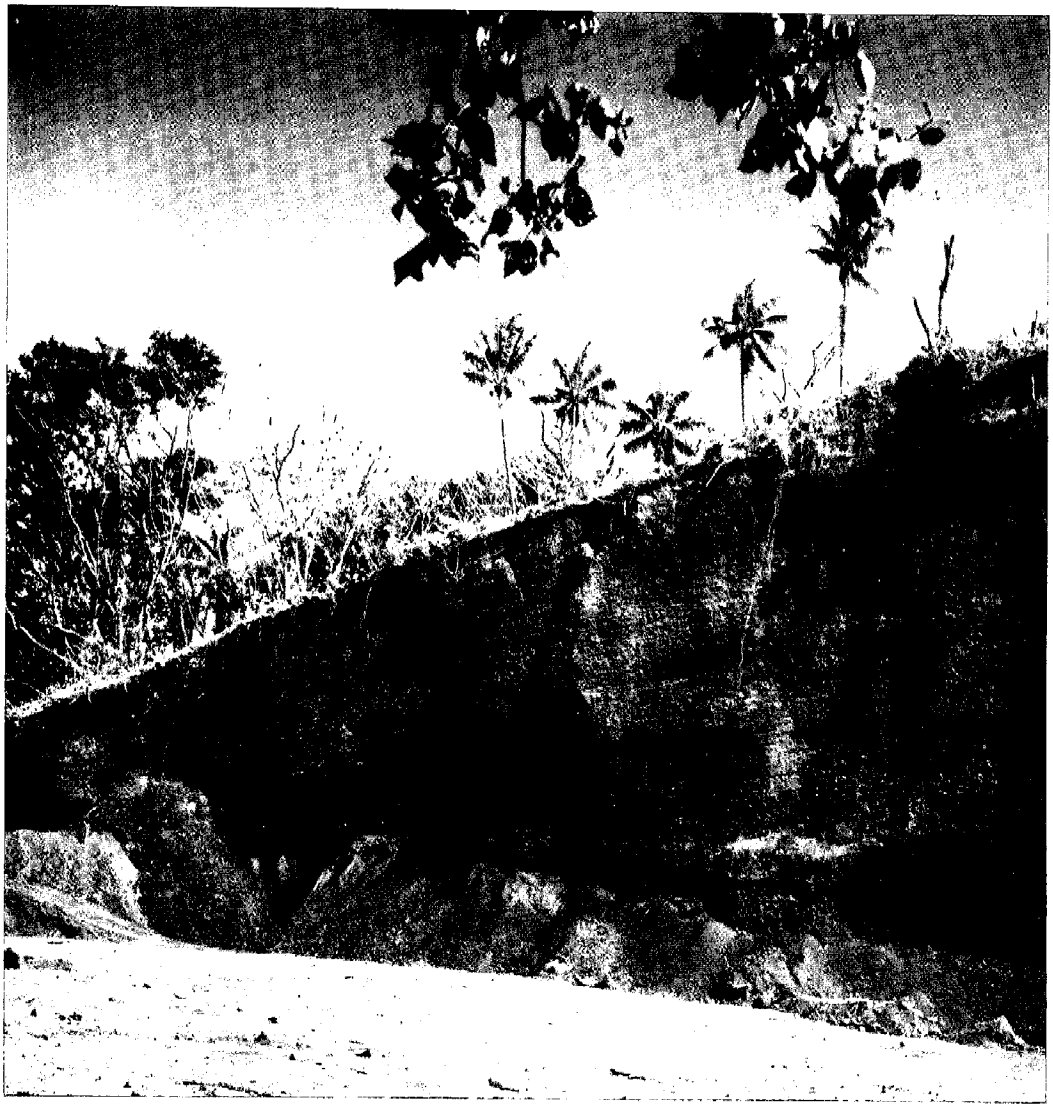

Figure 8.—Oloava soils are a good source of cinders for road construction and other uses.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 6 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material (fig. 8). Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil

layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 6, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 7 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable

material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement, permeability, depth to a high water table or depth of standing water if the soil is subject to ponding, slope, susceptibility to flooding, and subsidence of organic layers. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 8 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Taxonomic units and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The Unified system is further refined in tropical soils to take into consideration the dominant mineralogy and particle-size classes of the soil. The mineralogy classes used are A = Ashy, K = Kaolinitic, a = Oxidic, and T = Thixotropic. These mineralogy classes are indicated by a dash (-) following the standard Unified classes; for example, MH-K and CL-T. One or all of the mineralogy classes are used in the CL, ML, MH, and OH Unified classes.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 9 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, very fine sand, sand, and organic matter (up to 4 percent) and on soil structure and permeability. The estimates are modified by the presence of rock fragments. Values of K range from 0.02 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 9, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 10 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall is not considered flooding.

Table 10 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, no more than once in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table is the highest level of a saturated zone in the soil in most years. The depth to a high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 10 are the depth to the high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 10.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An *artesian* water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*8*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 11 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquent (*Aqu*, meaning aquic moisture regime, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Tropaquents (*Trop*, meaning tropical temperature regime, plus *aquents*, the suborder of the Entisols that have an aquic moisture regime)

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Tropaquents.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is sandy, carbonatic, isohyperthermic Typic Tropaquents.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Taxonomic Units and Their Morphology

In this section, each taxonomic unit recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each unit. A pedon, a small three-dimensional area of soil, that is typical of the units in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*7*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*8*). Following the pedon description is the range of important characteristics of the soils in the taxonomic unit.

The map units of each taxonomic unit are described in the section "Detailed Soil Map Units."

Aua Series

The Aua series consists of very deep, well drained soils on talus slopes. These soils formed in colluvium and alluvium derived from basic igneous rock. Slope is 6 to 60 percent. Elevation is near sea level to 650 feet. The mean annual rainfall is 150 to 250 inches, and the mean annual temperature is about 79 degrees F.

Taxonomic class: Clayey-skeletal, mixed, isohyperthermic Typic Hapludolls.

Typical pedon: Aua very stony silty clay loam; on a 35-percent talus slope on a roadside. When described, the soil was moist throughout. Colors are for moist soil

unless otherwise stated. Textures are apparent field textures.

A—0 to 7 inches; dark brown (7.5YR 3/2) very stony silty clay loam, dark brown (7.5YR 4/4) dry; strong medium and fine subangular blocky structure; extremely hard, friable, slightly sticky and slightly plastic; many roots; many pores; 25 percent stones, 5 percent cobbles, and 10 percent pebbles; neutral (pH 6.6); clear smooth boundary.

Bw1—7 to 18 inches; dark brown (7.5YR 3/3) stony clay loam, dark brown (7.5YR 4/2) dry; moderate medium and fine subangular blocky structure; extremely hard, firm, very sticky and very plastic; many roots; many very fine and common fine pores; 20 percent stones, 5 percent cobbles, and 5 percent pebbles; neutral (pH 6.6); gradual smooth boundary.

Bw2—18 to 39 inches; dark brown (7.5YR 3/3) very stony clay loam, dark brown (7.5YR 4/2) dry; moderate medium and fine subangular blocky structure; extremely hard, firm, very sticky and very plastic; many roots; many very fine and fine pores; 20 percent stones, 10 percent cobbles, and 10 percent pebbles; neutral (pH 6.6); clear smooth boundary.

Bw3—39 to 60 inches; very dark grayish brown (10YR 3/2) and dark brown (7.5YR 3/2) very stony clay loam, dark brown (7.5YR 3/2) dry; moderate fine and very fine subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; few roots; many very fine and common fine pores; 30 percent stones, 10 percent cobbles, and 10 percent pebbles; slightly acid (pH 6.3).

Type location: Tutuila Island, American Samoa; at Aua, 0.8 mile from coast highway on road to Afono; about 200 feet west of road; lat. 14°16'22" S. and long. 170°39'20" W.

Range in characteristics: Thickness of the solum is 35 to 60 inches or more. A C horizon is in some pedons. The profile is 5 to 30 percent stones, 5 to 15 percent cobbles, and 5 to 20 percent gravel. It averages 35 to 50 percent rock fragments between depths of 10 and 40 inches. The profile is slightly acid or neutral.

The A horizon has hue of 5YR to 10YR, value of 2 or 3 when moist and 3 or 4 when dry, and chroma of 2 or 3 when moist or dry. The fine earth fraction is silty clay loam, silty clay, or clay loam.

The B horizon has hue of 5YR to 10YR, value of 3 or 4, and chroma of 2 or 3 when moist or dry. The fine earth fraction commonly is clay loam but ranges to silty clay loam or clay.

Fagasa Series

The Fagasa series consists of moderately deep, well drained soils on ridges and mountainsides. These soils formed in residuum derived from basic igneous rock. Slope is 30 to 60 percent. Elevation is near sea level to 2,100 feet. The mean annual rainfall is 150 to 250 inches, and the mean annual temperature is 75 to 80 degrees F.

Taxonomic class: Fine, halloysitic, isohyperthermic Typic Hapludolls.

Typical pedon: Fagasa silty clay; on a 60-percent slope in an area of a taro and banana plantation. When described, the soil was moist throughout. Colors are for moist soil unless otherwise stated. Textures are apparent field textures.

A1—0 to 5 inches; very dark grayish brown (10YR 3/2) silty clay, very dark grayish brown (10YR 3/2) dry; moderate fine and medium subangular blocky structure; very hard, firm, sticky and plastic; many roots; many pores; 10 percent cobbles; medium acid (pH 6.0); clear wavy boundary.

A2—5 to 12 inches; dark brown (7.5YR 3/2) cobbly silty clay, dark brown (7.5YR 3/2) dry; moderate fine and medium subangular blocky structure; very hard, firm, very sticky and very plastic; many roots; many very fine and common fine pores; 10 percent stones, 20 percent cobbles; medium acid (pH 6.0); clear wavy boundary.

BC—12 to 29 inches; dark brown (7.5YR 3/2) silty clay, dark brown (7.5YR 4/4) dry; moderate fine and very fine subangular blocky structure; very hard, firm, very sticky and very plastic; medium acid (pH 5.8); 30 percent weathered igneous rock; gradual wavy boundary.

Cr—29 inches; weathered igneous rock.

Type location: Tutuila Island, American Samoa; at Pago Pago, 2.2 miles from coast highway on road to Fagasa; about 100 feet upslope from road; lat. 14°17'28" S. and long. 170°42'31" W.

Range in characteristics: The solum is 20 to 30 inches thick. A Bw horizon is in some pedons. Paralithic contact is at a depth of 20 to 40 inches. The profile is 0 to 15 percent stones, 0 to 20 percent cobbles, and 0 to 20 percent pebbles. It averages less than 35 percent rock fragments between depths of 10 and 40 inches. The profile is medium acid or slightly acid.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4 when dry, and chroma of 2 or 3 when moist or dry. It commonly is silty clay but is clay in some pedons.

The BC horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 to 4 when moist or dry. It is silty clay or clay loam.

Fagasa Family

The Fagasa family consists of moderately deep and deep, well drained soils on ridges and mountainsides. These soils formed in volcanic ash and residuum derived dominantly from basic igneous rock. Slope is 70 to 130

percent. Elevation is near sea level to 2,100 feet. The mean annual rainfall is 150 to 250 inches, and the mean annual temperature is 75 to 80 degrees F.

Taxonomic class: Fine, halloysitic, isohyperthermic Typic Hapludolls.

Reference pedon: Fagasa family; on a 100-percent slope in a forested area. When described, the soil was moist throughout. Colors are for moist soil unless otherwise stated. Textures are apparent field textures.

A1—0 to 7 inches; dark brown (7.5YR 3/2) silty clay, dark brown (7.5YR 3/2) dry; strong fine subangular blocky structure; very hard, firm, very sticky and very plastic; many roots; many pores; 2 percent pebbles; medium acid (pH 6.0); clear wavy boundary.

A2—7 to 12 inches; dark brown (7.5YR 3/2) silty clay, dark brown (7.5YR 4/3) dry; strong fine subangular blocky structure; very hard, firm, very sticky and very plastic; many roots; many pores; 4 percent stones and 4 percent pebbles; medium acid (pH 6.0); clear smooth boundary.

Bw—12 to 17 inches; dark brown (7.5YR 3/2) clay loam, dark brown (7.5YR 4/3) dry; strong fine and medium subangular blocky structure; hard, friable, sticky and plastic; few roots; many very fine and few fine pores; 15 percent pebbles; medium acid (pH 6.0); clear smooth boundary.

C1—17 to 31 inches; variegated dark brown (7.5YR 3/2, 4/4, 4/2) sandy clay loam, dark brown (7.5YR 4/3, 4/4) dry; highly weathered rock that can be crushed easily; medium acid (pH 6.0); abrupt wavy boundary.

R—31 inches; bedrock.

Type location: Tutuila Island, American Samoa; on Matautu Ridge, near Pago Pago; about 1,200 feet west of Tulutulu Point, near ridgetop on north side; lat. 14°17'56" S. and long. 170°40'38" W.

Range in characteristics: Bedrock is at a depth of 20 to 60 inches. The solum is 8 to 25 inches thick. Some pedons do not have a Bw horizon. The profile is 0 to 35 percent stones, cobbles, and pebbles. Some pedons have few moderately thick clay films.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist or dry, and chroma of 2 or 3 when moist or dry. It commonly is silty clay but is clay loam in some pedons.

The B horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist or dry, and chroma of 2 or 3 when moist or dry. It is silty clay or clay loam.

The C horizon has hue of 7.5YR or 10YR. It is silty clay to sandy clay loam.

Iliili Series

The Iliili series consists of shallow, well drained soils on uplands. These soils formed in volcanic ash and are underlain by lava. Slope is 3 to 15 percent. Elevation is near sea level to 200 feet. The mean annual rainfall is 120 to 160 inches, and the mean annual temperature is about 80 degrees F.

Taxonomic class: Medial-skeletal, isohyperthermic Lithic Dystrandepts.

Typical pedon: Iliili extremely stony mucky clay loam; on a 3-percent slope in an area of a taro plantation. When described, the soil was moist throughout. Colors are for moist soil unless otherwise stated. Textures are apparent field textures.

Op—1 inch to 0; black (10YR 2/1) extremely stony muck, very dark gray (10YR 3/1) dry; strong very fine granular structure; extremely hard, firm, nonsticky and nonplastic; many roots; many pores; 20 percent stones, 15 percent cobbles, and 30 percent pebbles; many decomposing leaves and twigs on surface; neutral (pH 7.1); clear smooth boundary.

Ap—0 to 5 inches; very dark grayish brown (10YR 3/2) extremely stony mucky clay loam, very dark grayish brown (10YR 3/2) dry; strong fine and very fine subangular blocky structure; very hard, slightly firm, slightly sticky and slightly plastic; many roots; many pores; 20 percent stones, 15 percent cobbles, and 30 percent pebbles; neutral (pH 7.1); clear smooth boundary.

B—5 to 9 inches; very dark grayish brown (10YR 3/2) extremely stony clay loam, dark yellowish brown (10YR 4/4) dry; moderate fine and very fine subangular blocky structure; friable, slightly sticky and slightly plastic; many roots; many pores; 20 percent stones, 15 percent cobbles, and 30 percent pebbles; neutral (pH 7.0); gradual irregular boundary.

2R—9 inches; lava.

Type location: Tutuila Island, American Samoa; about 1 mile northeast of Iliili; lat. 14°21'22" S. and long. 170°44'10" W.

Range in characteristics: The thickness of the solum and depth to lava range from 8 to 20 inches. Some pedons do not have an O horizon. Some pedons have a C horizon of loose, fragmental lava. The profile is medium acid to neutral.

The A horizon has hue of 7.5YR or 10YR, and it has chroma of 2 or 3 when moist or dry. It is extremely stony and mucky clay loam or silty clay loam.

The B horizon has hue of 7.5YR or 10YR, and it has chroma of 2 to 4 when moist or dry. It is extremely stony clay loam or silty clay loam.

Insak Series

The Insak series consists of moderately deep, very poorly drained soils in coastal depressional areas. These soils formed in coral sand and organic matter. Slope is 0 to 2 percent. Elevation is sea level to 20 feet. The mean

annual rainfall is 150 to 175 inches, and the mean annual temperature is about 80 degrees F.

Taxonomic class: Sandy, carbonatic, isohyperthermic Typic Tropaquents.

Typical pedon: Insak mucky sandy loam; on a 1-percent slope in a wetland taro patch. When described, the water table was at a depth of 16 inches, and the soil was moist above the water table. Colors are for moist soil unless otherwise stated. Textures are apparent field textures.

Ap—0 to 11 inches; 85 percent black (10YR 2/1) and 15 percent very pale brown (10YR 8/3, 7/3) mucky sandy loam when moist or dry; massive; friable, slightly sticky and nonplastic; many roots; 2 percent gravel-sized coral fragments; many sand grains and shell fragments; slightly effervescent; mildly alkaline (pH 7.5); clear wavy boundary.

AC—11 to 17 inches; very dark gray (10YR 3/2) mucky loamy sand, white (10YR 8/2) and very dark grayish brown (10YR 3/2) dry; massive; friable, slightly sticky and nonplastic; few roots; 5 percent gravel-sized coral fragments and 1 percent gravel-sized tuff fragments; strongly effervescent; mildly alkaline (pH 7.6); abrupt smooth boundary.

C—17 to 26 inches; white (10YR 8/1) and light gray (10YR 7/2) sand, light gray (10YR 7/1) dry; single grain; loose, nonsticky and nonplastic; 5 to 10 percent gravel-sized coral fragments; strongly effervescent; mildly alkaline (pH 7.5); clear wavy boundary.

2R—26 inches; coral limestone; pockets of coral sand similar to that of the C horizon.

Type location: Aunuu Island, American Samoa; about 1/4 mile east of town, in a wetland taro patch; lat. 14°17'17" S. and long. 170°33'15" W.

Range in characteristics: These soils are saturated and have a fluctuating water table at a depth of 10 to 20 inches. Coral is at a depth of 20 to 40 inches.

The A horizon has value of 2 to 8 when moist or dry, and it has chroma of 1 to 3 when moist or dry.

The C horizon has value of 7 or 8 when moist or dry, and it has chroma of 1 or 2 when moist or dry. It is sand or loamy sand.

Insak Variant

The Insak Variant consists of deep, very poorly drained soils in coastal depressional areas. These soils formed in fine textured alluvium over coral sand. Slope is 0 to 2 percent. Elevation is sea level to 20 feet. The mean annual rainfall is 175 to 200 inches, and the mean annual temperature is about 80 degrees F.

Taxonomic class: Fine, mixed, isohyperthermic Cumulic Haplaquolls.

Typical pedon: Insak Variant clay loam; on a 1-percent slope in a wetland taro patch. When described, the water table was at a depth of 14 inches and the soil was moist above the water table. Colors are for moist soil unless otherwise stated. Textures are apparent field textures.

A1—0 to 5 inches; very dark grayish brown (10YR 3/2) clay loam; moderate fine subangular blocky structure; friable, slightly sticky and slightly plastic; common roots; many very fine and fine pores; few coral sand grains; 2 percent gravel-sized coral fragments; neutral (pH 7.0); clear wavy boundary.

A2—5 to 13 inches; very dark grayish brown (10YR 3/2) silty clay loam; strong fine and very fine subangular blocky structure; friable, sticky and plastic; common roots; many very fine and fine pores; 2 percent gravel-sized coral fragments; neutral (pH 7.0); clear smooth boundary.

B1—13 to 25 inches; very dark grayish brown (10YR 3/2) silty clay; few fine faint reddish brown (5YR 5/4) mottles; moderate fine and medium subangular blocky structure; friable, sticky and plastic; few roots; many very fine and fine pores and common medium pores; 3 percent gravel-sized rock fragments; few black manganese concretions and stains; gradual smooth boundary.

B2—25 to 44 inches; very dark grayish brown (10YR 3/2) silty clay; common medium faint reddish brown (5YR 5/4) mottles; moderate fine and medium subangular blocky structure; firm, sticky and plastic; common black manganese concretions and stains; neutral (pH 7.0); abrupt smooth boundary.

2C—44 to 60 inches; light gray (10YR 7/1) sand; single grain; loose, nonsticky and nonplastic; 3 percent gravel-sized coral fragments; strongly effervescent; moderately alkaline.

Type location: Tau Island, American Samoa; at Tau Village, north of post office and 300 feet east of road; lat. 14°14'00" S. and long. 169°30'49" W.

Range in characteristics: The solum is 30 to 48 inches thick. The profile is 0 to 8 percent gravel-sized coral fragments. The water table is between depths of 6 and 20 inches.

The A horizon has value of 2 or 3 when moist or dry, and it has chroma of 1 or 2 when moist or dry. It is clay loam, loam, or silty clay loam.

The B horizon has value of 2 or 3 when moist or dry, and it has chroma of 2 or 3 when moist or dry.

The C horizon has value of 5 to 8, and it has chroma of 1 to 3 when moist or dry. It is sand or loamy sand.

Leafu Series

The Leafu series consists of very deep, somewhat poorly drained soils on valley floors. These soils formed in fine textured alluvium derived from basic igneous rock. Slope is 0 to 6 percent. Elevation is near sea level to 250 feet. The mean annual rainfall is 150 to 250 inches,

and the mean annual temperature is about 79 degrees F.

Taxonomic class: Very-fine, mixed, isohyperthermic Cumulic Hapludolls.

Typical pedon: Leafu silty clay; on a 1-percent slope in an area of a taro, banana, and coconut plantation. When described, the soil was moist throughout. Colors are for moist soil unless otherwise stated. Textures are apparent field textures.

Ap1—0 to 4 inches; dark brown (7.5YR 3/2) silty clay loam, dark brown (7.5YR 3/2) dry; moderate fine and medium subangular blocky structure; very hard, firm, sticky and plastic; common roots; many very fine pores and few medium pores; 1/2-inch-thick layer of very fine sandy loam at base of horizon; medium acid (pH 5.9); clear wavy boundary.

Ap2—4 to 13 inches; dark brown (7.5YR 3/3) silty clay, reddish brown (5YR 4/3) dry; weak fine and medium subangular blocky structure; very hard, firm, very sticky and very plastic; common roots; many very fine pores and few fine and medium pores; medium acid (pH 5.9); clear smooth boundary.

Bw1—13 to 19 inches; dark brown (7.5YR 3/2) very fine sandy loam, dark yellowish brown (10YR 4/4) dry; weak fine and medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; common roots; many very fine pores; strata of sand; slightly acid (pH 6.1); clear smooth boundary.

Bw2—19 to 36 inches; dark brown (7.5YR 3/3) silty clay, dark grayish brown (10YR 4/2) dry; common medium distinct strong brown (7.5YR 4/6) mottles; weak and moderate fine and medium subangular blocky structure; very hard, friable, very sticky and very plastic; common roots; many very fine and few medium pores; medium acid (pH 6.0); clear smooth boundary.

Bw3—36 to 44 inches; very dark brown (10YR 2/2) silty clay, very dark brown (10YR 2/2) dry; common medium distinct strong brown (7.5YR 4/6) mottles; moderate fine and medium subangular blocky structure; very hard, firm, very sticky and very plastic; few roots; few very fine pores and few fine and medium pores; 5 percent pebbles; slightly acid (pH 6.1); clear smooth boundary.

C—44 to 60 inches; dark brown (7.5YR 3/2) silty clay, dark brown (7.5YR 4/4) dry; common medium distinct strong brown (7.5YR 4/6) mottles; massive; extremely hard, firm, very sticky and very plastic; many very fine and fine pores and few medium pores; medium acid (pH 6.0).

Type location: Tutuila Island, American Samoa; at Leone, 0.7 mile north of highway and 30 feet east of valley road; lat. 14°29'14" S. and long. 170°46'41" W.

Range in characteristics: The solum is 30 to 60 inches thick. The profile is 0 to 15 percent stones, 0 to 25 percent cobbles, and 0 to 25 percent pebbles. It is slightly acid to medium acid. A water table is at a depth of 3 to 5 feet.

The A horizon has hue of 5YR to 10YR, value of 3 or 4 when dry, and chroma of 2 or 3 when moist or dry. The fine earth fraction is silty clay loam or silty clay.

The B horizon has hue of 5YR to 10YR, value of 2 or 3 when moist and 2 to 4 when dry, and chroma of 2 or 3 when moist and 2 to 4 when dry. The fine earth fraction commonly is silty clay or clay. Thin lenses of coarser material are in some pedons.

The C horizon has hue of 5YR to 10YR, value of 2 to 4 when moist and 4 to 6 when dry, and chroma of 2 to 4 when moist or dry.

Mesei Variant

The Mesei Variant consists of very deep, very poorly drained organic soils in closed depressional areas and in basins. These soils formed in organic material derived from reeds, ferns, and other marsh plants. Slope is 0 to 1 percent. Elevation is near sea level to 20 feet. The mean annual rainfall is 150 to 175 inches, and the mean annual temperature is about 80 degrees F.

Taxonomic class: Euic, isohyperthermic Sapric Tropofibrists.

Typical pedon: Mesei Variant peat; in a nearly level area in a marsh. When described, the water table was 12 inches above the soil surface. The soil was wet throughout. Colors are for moist soil unless otherwise stated.

Oi1—0 to 12 inches; black (10YR 2/1) and very dark brown (10YR 2/2) peat, very dark grayish brown (10YR 3/2) dry; dominantly roots of ferns and reeds; 95 percent fiber, 60 percent when rubbed; color is 10YR 8/2 in pyrophosphate solution; very strongly acid (pH 4.9 in calcium chloride); clear smooth boundary.

Oi2—12 to 24 inches; dark brown (7.5YR 3/3, 3/4) mucky peat; dominantly roots and stems of ferns and reeds; 60 percent fiber, 45 percent when rubbed; color is 10YR 8/3 in pyrophosphate solution; very strongly acid (pH 4.8 in calcium chloride); clear smooth boundary.

Oa—24 to 60 inches; very dark brown (10YR 2/2) muck; friable, slightly sticky and nonplastic; 20 percent fiber, 8 percent when rubbed; color is 10YR 7/4 in pyrophosphate solution; strongly acid (pH 5.3 in calcium chloride).

Type location: Aunuu Island, American Samoa; at the south end of Faimulivai Marsh; lat. 14°17'21" S. and long. 170°33'00" W.

Range in characteristics: Depth to bedrock is more than 60 inches. The profile is strongly acid or very strongly acid. The water table is commonly about 12 inches above the surface. The profile has hue of 10YR

or 7.5YR, value of 2 or 3, and chroma of 1 to 4 when moist or dry. The Oi horizon is peat or mucky peat.

Ngedebus Series

The Ngedebus series consists of very deep, somewhat excessively drained, calcareous soils on coastal plains. These soils formed in sandy marine deposits derived from coral and sea shells. Slope is 0 to 5 percent. Elevation is sea level to 15 feet. The mean annual rainfall is 125 to 200 inches, and the mean annual soil temperature is about 80 degrees F.

Taxonomic class: Carbonatic, isohyperthermic Typic Tropopsamments.

Typical pedon: Ngedebus mucky sand; on a 1-percent slope in an area of grassland. When described, the soil was moist throughout. Colors are for moist soil unless otherwise stated.

A—0 to 12 inches; light brownish gray and brown (10YR 6/2, 5/3) mucky sand, light gray (10YR 7/2) dry; single grain; loose; strongly effervescent; mildly alkaline (pH 7.6); clear smooth boundary.

C—12 to 60 inches; pale brown and light yellowish brown (10YR 6/3, 6/4) sand, light gray (10YR 7/2) dry; single grain; loose; 5 percent coral fragments; strongly effervescent; mildly alkaline (pH 7.7).

Type location: Tutuila Island, American Samoa; at Aoa Bay, 50 feet inland from central part of bay; lat. 14°16'05" S. and long. 170°35'13" W.

Range in characteristics: Bedrock is at a depth of 60 inches or more. The water table is at a depth of 60 inches or more. The profile is 0 to 15 percent gravel-sized coral rock fragments. It is mildly alkaline or moderately alkaline.

The A horizon has value of 2 to 6 when moist and 2 to 7 when dry, and it has chroma of 1 to 3 when moist or dry. It is sand, loamy sand, or mucky sand.

The C horizon has value of 5 to 8 when moist or dry, and it has chroma of 1 to 4 when moist and 1 to 3 when dry.

Ngedebus Variant

The Ngedebus Variant consists of deep, excessively drained soils on coastal plains. These soils formed in rubble and sand derived from coral and sea shells. Slope is 0 to 5 percent. Elevation is sea level to 15 feet. The mean annual rainfall is about 150 to 200 inches, and the mean annual temperature is about 80 degrees F.

Taxonomic class: Sandy-skeletal, carbonatic isohyperthermic Typic Troporthents.

Typical pedon: Ngedebus Variant extremely cobbly sand; on a 1-percent slope in a coastal area of forest. When described, the soil was moist throughout. Colors are for moist soil unless otherwise stated.

A—0 to 15 inches; 85 percent black (10YR 2/1) and 15 percent very pale brown (10YR 8/3, 7/3) extremely cobbly sand, very dark gray (10YR 3/1) dry; massive; very hard, friable, nonsticky and nonplastic; 50 percent coral pebbles and 30 percent coral cobbles; strongly effervescent; mildly alkaline (pH 7.7); clear smooth boundary.

C—15 to 60 inches; pale brown (10YR 6/3) extremely cobbly sand, pinkish gray (7.5YR 7/2) dry; single grain; loose; 40 percent coral pebbles and 25 percent coral cobbles; strongly effervescent; mildly alkaline (pH 7.8).

Type location: Tau Island, American Samoa; in the southeastern part of the island at Tufu Point, 100 feet north of road; lat. 14°15'42" S. and long. 169°25'27" W.

Range in characteristics: Bedrock is at a depth of 60 inches or more. The control section is 35 to 90 percent rock fragments. The profile is neutral or mildly alkaline.

The A horizon has hue of 7.5YR or 10YR, value of 2 to 8, and chroma of 1 to 3 when moist or dry. The fine earth fraction is sand, loamy sand, or mucky sand.

The C horizon has hue of 7.5Y or 10YR, value of 5 to 8, and chroma of 1 to 3 when moist or dry. The fine earth fraction is sand or loamy sand.

Ngerungor Variant

The Ngerungor Variant consists of deep, very poorly drained organic soils in coastal swamps. These soils formed in organic material derived dominantly from decomposing mangrove roots and litter. Slope is 0 to 1 percent. Elevation is sea level to 20 feet. The mean annual rainfall is 125 to 225 inches, and the mean annual temperature is about 80 degrees F.

Taxonomic class: Euic, isohyperthermic Typic Tropohemists.

Typical pedon: Ngerungor Variant mucky peat; on a 1-percent slope in a mangrove swamp. When described at low tide, the water table was 6 inches above the soil surface. Colors are for moist soil unless otherwise stated.

Oi1—0 to 4 inches; very dark grayish brown (10YR 3/2) mucky peat, very dark grayish brown (10YR 3/2) dry; massive; soft; many coral sand grains; 40 percent rubbed fiber; color is 10YR 8/2 in pyrophosphate solution; neutral (pH 7.2 in calcium chloride); clear smooth boundary.

Oi2—4 to 21 inches; very dark brown (10YR 2/2) peat, very dark grayish brown (10YR 3/2) dry; massive; soft; few coral sand grains; 45 percent rubbed fiber; color is 10YR 8/2 in pyrophosphate solution; neutral (pH 6.9 in calcium chloride); gradual smooth boundary.

Oe1—21 to 39 inches; very dark brown (10YR 2/2) mucky peat, very dark grayish brown (10YR 3/2)

dry; massive; soft; few coral sand grains; 30 percent rubbed fiber; color is 10YR 8/2 in pyrophosphate solution; medium acid (pH 5.9 in calcium chloride); clear smooth boundary.

Oe2—39 to 60 inches; very dark brown (10YR 2/2) mucky peat, very dark grayish brown (10YR 3/2) dry; massive; soft; few coral sand grains; 10 percent pebbles; hemic material that is 20 percent fiber when rubbed; color is 10YR 8/2 in pyrophosphate solution; medium acid (pH 5.7 in calcium chloride).

Type location: Tutuila Island, American Samoa; at Masefau, about 1,100 feet inland on the northern side of the valley; lat. 14°15'40" S. and long. 170°37'56" W.

Range in characteristics: The water table fluctuates with the tide between about 12 inches above the soil surface and 12 inches below the surface. The profile has value of 2 or 3 when moist, and it has chroma of 1 or 2 when moist or dry. The Oi horizon is mucky peat or peat. The Oe horizon is mucky peat or muck.

Ofu Series

The Ofu series consists of deep, well drained soils on mountainsides. These soils formed in volcanic ash and residuum derived from basic igneous rock. Slope is 15 to 70 percent. Elevation is 50 to 1,500 feet. The mean annual rainfall is 150 to 225 inches, and the mean annual temperature is 77 to 80 degrees F.

Taxonomic class: Fine, halloysitic, isohyperthermic Typic Hapludolls.

Typical pedon: Ofu silty clay; on a 19-percent, convex slope in an area of a banana and coconut plantation (fig. 9). When described, the soil was moist throughout. Colors are for moist soil unless otherwise stated. Textures are apparent field textures.

Ap—0 to 16 inches; dark reddish brown (5YR 3/3) silty clay, dark reddish brown (5YR 3/3) dry; strong medium and fine subangular blocky structure; very hard, friable, very sticky and very plastic; common very fine and fine roots and few medium roots; common very fine and fine pores; neutral (pH 6.9); clear smooth boundary.

Bw1—16 to 31 inches; dark brown (7.5YR 4/3) silty clay loam, dark reddish brown (5YR 3/4) dry; moderate medium subangular blocky structure; very hard, friable, sticky and plastic; few very fine and fine roots; many very fine and fine pores; neutral (pH 6.8); gradual smooth boundary.

Bw2—31 to 45 inches; dark brown (7.5YR 4/4) silty clay loam, dark reddish brown (5YR 3/3) dry; moderate medium subangular blocky structure; very hard, friable, sticky and plastic; few very fine and fine roots; many very fine and fine pores; neutral (pH 6.8); clear smooth boundary.

Bw3—45 to 60 inches; dark brown (7.5YR 4/4) silty clay, dark reddish brown (5YR 3/4) dry; moderate medium subangular blocky structure; firm, very sticky and very plastic; few fine roots; common very fine and fine pores; neutral (pH 6.9).

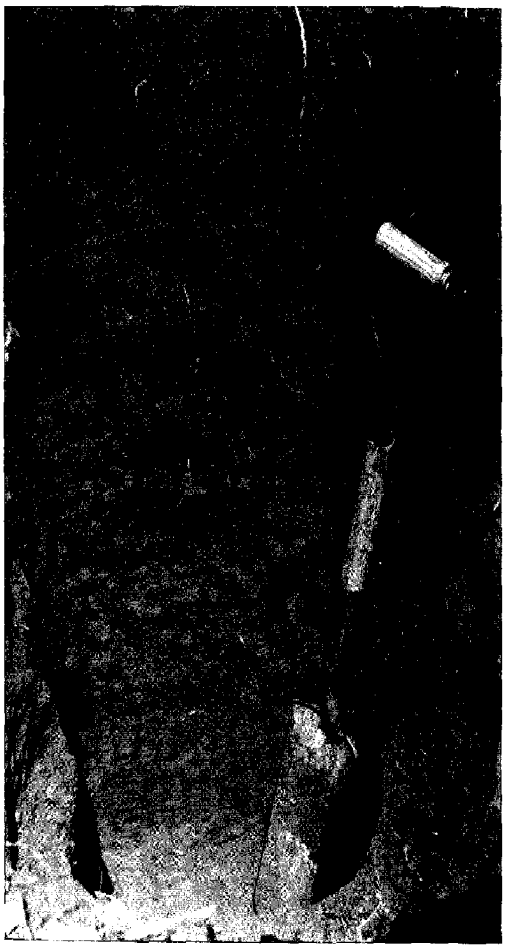

Figure 9.—Profile of Ofu silty clay, 15 to 40 percent slopes.

Type location: Ofu Island, American Samoa; near Alaufau, about 0.25 mile east-northeast of village; lat. 14°10'13" S. and long. 169°40'34" W.

Range in characteristics: The solum is 24 to 60 inches thick. The profile is 0 to 10 percent cobbles and 0 to 10 percent pebbles. It is medium acid to neutral.

The A horizon has hue of 5YR or 7.5YR, value of 2 or 3, and chroma of 2 or 3 when moist or dry.

The upper part of the B horizon has hue of 5YR or 7.5YR, and the lower part has hue of 2.5YR to 10YR. The B horizon has value of 3 or 4, and it has chroma of 3 to 6 when moist or dry. It is silty clay or silty clay loam.

The C horizon, where present, has hue of 2.5YR to 7.5YR, and it has chroma of 3 to 6 when moist or dry.

Ofu Variant

The Ofu Variant consists of deep, well drained soils on uplands and mountainsides. These soils formed in volcanic ash and pyroclastic material. Slope is 6 to 70 percent. Elevation is near sea level to 500 feet. The mean annual rainfall is 175 to 200 inches, and the mean annual temperature is about 79 degrees F.

Taxonomic class: Very-fine, mixed, isohyperthermic Typic Hapludolls.

Typical pedon: Ofu Variant silty clay; on a 12-percent, convex slope on Tau Farm banana plantation. When described, the soil was moist throughout. Colors are for moist soil unless otherwise stated. Textures are apparent field textures.

Ap—0 to 8 inches; dark brown (10YR 3/3) silty clay, dark brown (7.5YR 3/2) dry; weak fine and very fine subangular blocky structure; extremely hard, firm, very sticky and very plastic; many roots; many very fine and fine pores; neutral (pH 6.6); clear wavy boundary.

Bw—8 to 14 inches; dark brown (7.5YR 3/3) silty clay, dark brown (7.5YR 3/3) dry; moderate fine and very fine subangular blocky structure; very hard, friable, very sticky and very plastic; many roots; common very fine and fine pores; 10 percent weathered tuff fragments; 3 percent stones; medium acid (pH 6.0); clear wavy boundary.

BC—14 to 28 inches; dark yellowish brown (10YR 3/4) highly weathered tuff that easily crushes to clay loam, dark brown (7.5YR 3/3) dry; weak fine and medium subangular blocky structure; very hard, friable, sticky and plastic; common roots; many very fine and common fine pores; slightly acid (pH 6.1); abrupt wavy boundary.

2C—28 to 63 inches; variegated yellowish brown (10YR 5/4), black (10YR 2/1), and reddish brown (5YR 4/4) highly weathered tuff that crushes easily to sandy loam; very hard, very firm, nonsticky and nonplastic; common thin dark yellowish brown (10YR 4/4) coatings on faces of tuff fragments; slightly acid (pH 6.3).

Type location: Tau Island, American Samoa; on Tau Farm, about 400 feet east of office; lat. 14°13'48" S. and long. 169°30'20" W.

Range in characteristics: The solum is 25 to 36 inches thick. Bedrock is at a depth of 60 inches or more. The solum is 0 to 15 percent gravel-sized rock fragments. The profile is neutral to medium acid.

The A horizon has hue of 7.5YR or 10YR, and it has value and chroma of 2 or 3 when moist or dry.

The Bw horizon has hue of 7.5YR or 10YR, and it has value and chroma of 2 or 3 when moist or dry. It commonly is silty clay, but it is clay in some pedons.

The C horizon is variegated. It has hue of 5YR to 10YR, value of 2 to 7, and chroma of 1 to 8 when moist or dry. It is sandy loam or clay loam.

Oloava Series

The Oloava series consists of very deep, well drained soils on uplands. These soils formed in volcanic ash and cinders. Slope is 6 to 100 percent. Elevation is 400 to 1,500 feet. The mean annual rainfall is 175 to 230 inches, and the mean annual temperature is about 78 degrees F.

Taxonomic class: Medial over cindery, isohyperthermic Typic Dystrandepts.

Typical pedon: Oloava silty clay loam; on a 19-percent, convex slope along a road. When described, the soil was moist throughout. Colors are for moist soil unless otherwise stated. Textures are apparent field textures.

A—0 to 9 inches; dark brown (7.5YR 3/3) silty clay loam; strong fine and medium subangular blocky structure; very hard, friable, sticky and plastic; many roots; common very fine and few fine pores; 3 percent weathered cinders; common wormholes; dries to very hard, sand-sized aggregates; strongly acid (pH 5.3); clear wavy boundary.

Bw—9 to 14 inches; dark brown (7.5YR 3/3) clay loam; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; weakly smeary; many roots; common very fine pores; 3 percent weathered cinders; strongly acid (pH 5.3); clear wavy boundary.

2BC—14 to 17 inches; dark brown (10YR 3/2) gravelly silt loam; weak fine and very fine granular structure; friable, slightly sticky and slightly plastic; moderately smeary; many roots; many very fine pores; 30 percent weathered cinders; strongly acid (pH 5.4); clear wavy boundary.

2C—17 to 60 inches; black (10YR 2/1) weathered cinders that crush to variegated reddish brown (5YR 4/4), yellowish brown (10YR 5/6), and black (10YR 2/1) very gravelly sandy loam; firm, slightly sticky and nonplastic; moderately smeary; few roots; many pores; 55 percent hard cinders; strongly acid (pH 5.2).

Type location: Tutuila Island, American Samoa; at Aoloaufou, near end of road and 300 feet south of farmer's house; lat. 14°18'41" S. and long. 170°46'23" W.

Range in characteristics: Soft, weathered cinders are at a depth of 12 to 40 inches. The profile is slightly acid to strongly acid.

The A horizon has hue of 7.5YR, value of 2 or 3, and chroma of 2 or 3 when moist or dry. It is 0 to 3 percent gravel-sized cinders.

The upper part of the B horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 2 or 3 when moist or dry. It is clay loam or silty clay loam and is 3 to 10 percent gravel-sized cinders.

Olotania Family

The Olotania family consists of deep and moderately deep, well drained soils on mountainsides. These soils formed in volcanic ash and cinders. Slope is 15 to 40 percent. Elevation is 900 to 3,000 feet. The mean annual rainfall is 200 to 300 inches, and the mean annual temperature is about 76 degrees F.

Taxonomic class: Thixotropic, isohyperthermic Typic Hydrandepts.

Reference pedon: Olotania family silty clay loam; on a 34-percent slope in an area of tropical rain forest. When described, the soil was moist throughout. Colors are for moist soil unless otherwise stated. Textures are apparent field textures.

A—0 to 8 inches; dark brown (7.5YR 3/2) silty clay loam, dark brown (7.5YR 3/2) dry; weak fine and medium subangular blocky structure; extremely hard, friable, sticky and slightly plastic; weakly smeary; many roots; many very fine and common fine pores; few weathered cinders; medium acid (pH 6.0); clear smooth boundary.

Bw—8 to 25 inches; dark yellowish brown (10YR 3/4) silty clay loam, dark yellowish brown (10YR 3/4) dry; weak medium subangular blocky structure; very hard, friable, sticky and slightly plastic; moderately smeary; many roots; many very fine and few fine pores; 20 percent highly weathered cinders that are easily crushed; slightly acid (pH 6.5); abrupt smooth boundary.

2C—25 to 60 inches; stratified, variegated black (10YR 2/1), brown (10YR 4/3), and dark reddish brown (2.5YR 3/4) weathered cinders that crush to clay loam, sandy loam, and silty clay loam, dark yellowish brown (10YR 3/4), brownish yellow (10YR 6/6), and reddish yellow (7.5YR 6/6) dry; massive and weak medium subangular blocky structure; very hard, friable, sticky and slightly plastic; few roots; few fine and very fine pores; slightly acid (pH 6.4).

Type location: Tau Island, American Samoa; about 0.5 mile west-northwest of Olomanu Crater; lat. 14°14'31" S. and long. 169°29'25" W.

Range in characteristics: The solum is 20 to 40 inches thick. The solum is slightly acid to strongly acid, and the C horizon is slightly acid or neutral. Depth to bedrock ranges from 20 inches to more than 60 inches.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 2 or 3 when moist or dry.

The B horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist and 3 to 5 when dry, and chroma of 3 or 4 when moist and 3 to 6 when dry. It is slightly smeary or moderately smeary. It dries irreversibly to dark, angular, gravel-sized aggregates that are very hard.

The C horizon is variegated. It has hue of 2.5YR to 10YR, value of 2 to 4 when moist and 3 to 7 when dry, and chroma of 1 to 4 when moist and 4 or 6 when dry.

Pavaiai Series

The Pavaiai series consists of moderately deep, well drained soils on uplands. These soils formed in volcanic ash and are underlain with lava. Slope is 6 to 40 percent. Elevation is near sea level to 900 feet. The mean annual rainfall is 150 to 200 inches, and the mean annual temperature is about 79 degrees F.

Taxonomic class: Medial-skeletal, isohyperthermic Typic Dystrandepts.

Typical pedon: Pavaiai stony clay loam; on an 8-percent slope along a road. When described, the soil was moist throughout. Colors are for moist soil unless otherwise stated. Textures are apparent field textures.

A1—0 to 7 inches; very dark grayish brown (10YR 3/2) stony clay loam, very dark grayish brown (10YR 3/2) dry; strong fine and very fine subangular blocky structure; hard, friable, sticky and plastic; many very fine and fine roots; many very fine and fine pores; 2 percent pebbles and 10 percent stones; slightly acid (pH 6.2); clear smooth boundary.

A2—7 to 12 inches; very dark grayish brown (10YR 3/2) clay loam, dark brown (10YR 4/3) dry; weak fine and medium subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine and fine roots; many very fine and few fine pores; 2 percent pebbles; medium acid (pH 6.0); gradual smooth boundary.

Bw1—12 to 26 inches; dark brown (10YR 3/3) very cobbly sandy loam, dark yellowish brown (10YR 3/4) dry; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many very fine and few fine pores; 5 percent pebbles, 25 percent cobbles, and 15 percent stones; slightly acid (pH 6.2); abrupt smooth boundary.

Bw2—26 to 38 inches; dark brown (10YR 3/3) very cobbly sandy loam, dark yellowish brown (10YR 3/4) dry; weak fine and medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; many very fine and few fine pores; 5 percent pebbles, 35 percent cobbles, and 15 percent stones; slightly acid (pH 6.3); abrupt smooth boundary.

2R—38 inches; pahoehoe lava.

Type location: Tutuila Island, American Samoa; at Mapusagafou, 0.4 mile north of Pavaiai intersection on cut at M&J Enterprise; lat. 14°21'4" S. and long. 170°45'4" W.

Range in characteristics: The thickness of the solum and depth to bedrock range from 20 to 40 inches. The control section is 35 to 55 percent rock fragments. The profile is medium acid to neutral.

The A horizon has value of 2 or 3 when moist and 3 or 4 when dry, and it has chroma of 2 or 3 when moist or dry. It commonly is stony clay loam but is stony silty clay loam in some pedons. Rock fragment content is 5 to 35 percent.

The B horizon has value of 2 or 3 when moist and 3 or 4 when dry, and it has chroma of 2 or 3 when moist and 3 or 4 when dry. The fine earth fraction commonly is sandy loam or sandy clay loam, but the range includes silty clay loam, clay loam, and very fine sandy loam. Rock fragment content ranges from 40 to 60 percent.

Puapua Series

The Puapua series consists of shallow, well drained soils on uplands. These soils formed in volcanic ash and are underlain by hard tuff. Slope is 0 to 100 percent. Elevation is near sea level to 400 feet. The mean annual rainfall is 120 to 160 inches, and the mean annual temperature is about 80 degrees F.

Taxonomic class: Medial, isohyperthermic Lithic Eutrandepts.

Typical pedon: Puapua clay loam; on a 20-percent side slope in an area of a taro and breadfruit plantation. When described, the soil was moist throughout. Colors are for moist soil unless otherwise stated. Textures are apparent field textures.

Ap—0 to 11 inches; very dark brown (10YR 2/2) clay loam, brown (10YR 4/3) dry; strong very fine and fine subangular blocky structure; slightly hard, firm, sticky and plastic; many very fine and fine roots; many very fine and fine pores; less than 3 percent tuff fragments; neutral (pH 6.6); gradual smooth boundary.

C—11 to 16 inches; dark brown (7.5YR 3/2) sandy loam, yellowish brown (10YR 5/6) dry; weak fine granular structure; slightly hard, loose, slightly sticky and nonplastic; common very fine roots; many very fine pores; some fragments of volcanic tuff; slightly acid (pH 6.5); abrupt smooth boundary.

2R—16 inches; fine-grained tuff.

Type location: Tutuila Island, American Samoa; about 1 mile west-southwest of Futiga; lat. 14°21'14" S. and long. 170°46'14" W.

Range in characteristics: Depth to tuff ranges from 10 to 20 inches. The A horizon has hue of 7.5YR or 10YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist and 3 to 6 when dry. The C horizon has hue of 5YR to 10YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 1 to 4 when moist and 3 to 8 when dry.

Sogi Series

The Sogi series consists of moderately deep, well drained soils on uplands. These soils formed in volcanic ash and are underlain by hard tuff. Slope is 0 to 40 percent. Elevation is near sea level to 400 feet. The mean annual rainfall is 120 to 160 inches, and the mean annual temperature is about 80 degrees F.

Taxonomic class: Medial, isohyperthermic Udic Eutrandepts.

Typical pedon: Sogi clay loam; on a 1-percent slope in a cultivated field. When described, the soil was moist throughout. Colors are for moist soil unless otherwise stated. Textures are apparent field textures.

Ap—0 to 10 inches; dark brown (7.5YR 3/2) clay loam, yellowish brown (10YR 5/4) dry; strong very fine subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; many fine and very fine pores; slightly acid (pH 6.4); gradual wavy boundary.

Bw—10 to 21 inches; dark brown (7.5YR 3/2) clay loam, yellowish brown (10YR 5/6) dry; strong medium and fine subangular blocky structure; friable, sticky and plastic; few very fine roots; many very fine pores; neutral (pH 6.6); abrupt wavy boundary.

2C—21 to 26 inches; very dark grayish brown (10YR 3/2) loamy sand, brown (10YR 4/3) dry; single grain; soft, loose, nonsticky and nonplastic; neutral (pH 6.8); abrupt wavy boundary.

2R—26 inches; very dark brown (10YR 2/2) tuff.

Type location: Tutuila Island, American Samoa; on Taputimu Farm, about 200 feet southwest of office and 70 feet south of boundary fence; lat. 14°21'36" S. and long. 170°46'34" W.

Range in characteristics: Depth to tuff ranges from 20 to 40 inches. The A horizon has hue of 7.5YR or 10YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist and 3 to 6 when dry.

The B horizon has hue of 7.5YR or 10YR, value of 2 or 3 when moist, and chroma of 2 to 4 when moist. The lower part of the B horizon is sandy clay loam in some pedons.

The C horizon has hue of 5YR to 10YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 1 to 4 when moist and 3 to 8 when dry. It commonly is loamy sand, sandy loam, or sand.

Sogi Variant

The Sogi Variant consists of moderately deep, well drained soils on mountainsides. These soils formed in volcanic ash and are underlain by pahoehoe lava. Slope is 15 to 50 percent. Elevation is 150 to 600 feet. The mean annual rainfall is 200 to 230 inches, and the mean annual temperature is about 79 degrees F.

Taxonomic class: Very-fine, mixed, isohyperthermic Typic Hapludolls.

Typical pedon: Sogi Variant silty clay; on a 19-percent slope in an area of tropical rain forest. When described, the soil was moist throughout. Colors are for moist soil unless otherwise stated. Textures are apparent field textures.

A—0 to 8 inches; dark brown (10YR 3/3) silty clay, dark brown (10YR 3/2) dry; strong fine and very fine subangular blocky structure; very hard, firm, very sticky and very plastic; many very fine and fine roots; many very fine and common fine pores; 1 percent pebbles; neutral (pH 7.0); clear smooth boundary.

Bw1—8 to 19 inches; dark brown (10YR 3/3) silty clay, dark brown (10YR 3/3) dry; moderate fine and medium subangular blocky structure; very hard, friable, very sticky and very plastic; many very fine and fine roots; many very fine and common fine pores; 2 percent pebbles; 5 percent highly weathered rock fragments that crush easily; neutral (pH 6.9); clear wavy boundary.

Bw2—19 to 30 inches; dark brown (7.5YR 3/2) silty clay, dark brown (7.5YR 3/3) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, friable, very sticky and very plastic; weakly smeary; many fine and very fine roots; many very fine and common fine pores; 3 percent pebbles; 3 percent highly weathered rock fragments that are easily crushed; neutral (pH 7.0); abrupt wavy boundary.

2R—30 inches; pahoehoe lava.

Type location: Tau Island, American Samoa; near Amouli, about 0.25 mile northeast of Moso Point; lat. 14°15'51" S. and long. 169°29'38" W.

Range in characteristics: Thickness of the solum and depth to bedrock range from 28 to 40 inches. The profile is slightly acid or neutral. The solum has hue of 7.5YR or 10YR, and it has value and chroma of 2 or 3 when moist or dry. The surface layer is 0 to 35 percent rock fragments.

Tafuna Series

The Tafuna series consists of deep, well drained, extremely stony organic soils on uplands. These soils formed in an accumulation of organic matter over fragmental aa lava. Slope is 3 to 15 percent. Elevation is near sea level to 150 feet. The mean annual rainfall is 120 to 175 inches, and the mean annual temperature is about 80 degrees F.

Taxonomic class: Euic, isohyperthermic Typic Tropofolists.

Typical pedon: Tafuna extremely stony muck; on a 6-percent slope along a road. When described, the soil was moist throughout. Colors are for moist soil unless otherwise stated.

O1—0 to 9 inches; black (10YR 2/1) extremely stony muck, black (10YR 2/1) dry; weak fine and very fine subangular blocky structure; very hard, firm, nonsticky and nonplastic; many roots; many pores; 20 percent stones, 30 percent cobbles, and 35 percent pebbles; slightly acid (pH 6.3); diffuse wavy boundary.

O2—9 to 18 inches; 60 percent very dark grayish brown (10YR 3/2) and 40 percent dark brown (10YR 3/3) extremely stony muck, 60 percent dark brown (10YR 4/4) and 40 percent dark yellowish brown (10YR 4/3) dry; strong fine and very fine granular structure; very hard, firm, nonsticky and nonplastic; many very fine and fine roots; many very fine pores; 20 percent stones, 30 percent cobbles, and 35 percent pebbles; neutral (pH 6.6); diffuse wavy boundary.

2C—18 to 43 inches; fragmental aa lava with little soil material from above horizon; gradual wavy boundary.

R—43 inches; lava.

Type location: Tutuila Island, American Samoa; from the central part of Tafunafou, 0.3 mile west on gravel road and 200 feet south of mechanic's shop; lat. 14°20'08" S. and long. 170°44'06" W.

Range in characteristics: Depth to lava ranges from 40 to 60 inches or more. The O horizon has hue of 7.5YR to 10YR. It is slightly acid or neutral.

Formation of the Soils

Soil is a natural, three-dimensional body on the earth's surface that supports or is capable of supporting plants. Physical and chemical processes have determined its morphology. These processes have resulted from the interaction of five factors—parent material, climate, living organisms, topography, and time. Differences between soils can be traced to differences in one or more of these factors. The five soil-forming factors and their influence on soil formation in the survey area are discussed in this section.

Parent Material

Parent material is the unconsolidated, partly weathered rock in which soils form. To a large extent, parent material determines the mineralogy and chemical and physical properties of soils. The soils in the survey area formed in material derived from basic igneous rock, mainly basalt and small amounts of andesite and trachyte; in volcanic ash and cinders; and in colluvium and alluvium (*5*). A few of the soils formed in organic material and coral sand.

Basic igneous rock weathers to clayey soils, such as the Fagasa soils. Volcanic ash and cinders weather to loamy soils, such as the Oloava soils. Colluvium is on foot slopes at the base of the steeper uplands. It is mostly silty clay loam and silty clay material and has stones, cobbles, and gravel. The stony Aua soils are examples of soils that formed in colluvium. Alluvium is water-deposited sediment on bottom lands. It ranges from silty clay to fine sand. Because fresh deposits are laid down by floodwater, the soils that formed in alluvium are young. Leafu soils are examples. The Ngerungor Variant soils formed in organic deposits, and the Ngedebus soils formed in coral sand.

Climate

Climate has a strong influence on soil formation in the survey area. The high rainfall and warm temperatures are favorable for rapid weathering of rock, decomposition of organic matter, and formation of soils. Leaching of soluble material, such as calcium carbonate, is also rapid because of the high rainfall; therefore, some of the soils in the area are low in content of bases and nutrients. Many of the soils, however, have high base saturation. This may be true because the parent material is of recent origin or because the soil is shallow or stony and the bases are constantly being replenished.

Living Organisms

Living organisms, including man, affect soil formation. The changes plants and animals bring about depend on the kind of life processes peculiar to each. Grasses and trees send fibrous roots into the upper few feet of the soil. They loosen the soil and improve soil structure and tilth. They obtain nutrients from deeper horizons and contribute soluble minerals, such as calcium, iron, phosphorus, nitrogen, and sulfur, when they die and decay.

Bacteria, fungi, and other micro-organisms decompose dead plants, breaking down the organic matter into stable humus. Some bacteria in nodules on the roots of certain legumes remove nitrogen from the air. When these bacteria die, the nitrogen becomes available in the soil. Earthworms, insects, and small burrowing animals affect soil formation by mixing and working the organic and mineral matter. The mixing speeds soil development and makes the soil more friable. By clearing and tilling the land and mixing horizons, man has also affected the soil.

Most soils in the survey area have a high organic matter content. The organic matter makes the soil darker in color and improves its fertility, tilth, and permeability.

Topography

Topography influences soil formation through its effect on runoff, drainage, erosion, and vegetation. In the more steeply sloping areas, runoff is more rapid and the hazard of erosion is greater. Steeply sloping soils generally have good drainage, which affects the kind of plants that can grow on them. The Fagasa and Ofu soils are examples of steep soils. In level or depressional areas, little runoff and soil erosion occur. Some areas are ponded and are subject to soil deposition. The soils in these areas commonly are poorly drained and support water-tolerant plants. The Insak soils are examples of nearly level soils in depressional areas.

Time

The length of time that parent material has been subjected to the effects of climate and living organisms and modified by topography is an important factor in soil formation. The soils in the survey area are relatively young, although many are highly weathered. The Tafuna soils, which formed in young lava, exhibit minimal soil development. They have been forming only long enough for organic matter to accumulate in the surface layer. The Sogi and Puapua soils are subject to high rainfall; however, they still have high base saturation because they formed in young volcanic ash. Other soils such as the Ofu soils have a well developed Bw horizon, which indicates greater soil development and age.

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Glossary

Aa lava. A type of lava flow that has a rough, fragmental surface. It is a blocky lava consisting of clinkers and scoria and is characteristic of oceanic shield volcanoes and continental plateau eruptions.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Canopy. The leafy crown of trees or shrubs. (See crown.)

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

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.

Clay skin. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay film.

Coarse fragments. Mineral or rock particles larger than 2 millimeters in diameter.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Very cobbly soil material is 35 to 60 percent of these rock fragments, and extremely cobbly soil material is more than 60 percent.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of oil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

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.—Readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—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; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cropping system. Growing crops using a planned system of rotation and management practices.

Cross-slope farming. Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, 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 classes of natural soil drainage are recognized:
Excessively drained.—These soils have very high and high hydraulic conductivity and low water holding capacity. They are not suited for crop production unless irrigated.
Somewhat excessively drained.—These soils have high hydraulic conductivity and low water holding capacity. Without irrigation only a narrow range of crops can be grown, and yields are low.
Well drained.—These soils have intermediate water holding capacity. They retain optimum amounts of moisture, but they are not wet close enough to the surface or long enough during the growing season to adversely affect yields.
Moderately well drained.—These soils are wet close enough to the surface for long enough that planting or harvesting operations or yields of some field crops are adversely affected unless artificial drainage is provided. Moderately well drained soils commonly have a layer with low hydraulic conductivity, a wet layer relatively high in the profile, additions of water by seepage, or some combination of these.
Somewhat poorly drained.—These soils are wet close enough to the surface or long enough that planting or harvesting operations or crop growth is markedly restricted unless artificial drainage is provided. Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, a wet layer high in the profile, additions of water through seepage, or a combination of these.
Poorly drained.—These soils commonly are so wet at or near the surface during a considerable part of the year that field crops cannot be grown under natural conditions. Poorly drained conditions are caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these.
Very poorly drained.—These soils are wet to the surface most of the time. These soils are wet enough to prevent the growth of important crops (except rice) unless artificially drained.

Drainage, surface. Runoff, or surface flow of water, from an area.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the

building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature; for example, fire that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foothill. A steeply sloping upland that has relief of as much as 1,000 feet (or 300 meters) and fringes a mountain range or high-plateau escarpment.

Foot slope. The inclined surface at the base of a hill.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

Hard rock. Rock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual.* The major horizons of mineral soil are as follows:
O horizon.—An organic layer of fresh and decaying plant residue.
A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.
B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.
E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.
C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the number 2 precedes the letter C.
R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet

and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Light textured soil. Sand and loamy sand.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded 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 of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Mountain. A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides and considerable bare-rock surface. A mountain can occur as a single, isolated mass or in a group forming a chain or range.

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Pahoehoe lava. A type of lava flow that has a glassy, smooth, and billowy or undulating surface. It is characteristic of Hawaii. It commonly is a basaltic and porous type of lava.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

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

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saprolite (soil science). Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soft rock. Rock that can be excavated using trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and 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.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 6 to 15 inches (15 to 38 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. 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 without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the E horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Talus. Rock fragments of any size or shape, commonly coarse and angular, derived from and lying at the base of a cliff or very steep, rocky slope. The accumulated mass of such loose, broken rock formed chiefly by falling, rolling, or sliding.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

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."

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topography. The configuration of a surface including its relief and the position of its natural and man-made features.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Tuff. A compacted deposit that is 50 percent or more volcanic ash and dust.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Tables

TABLE 1.--RAINFALL AND TEMPERATURE

[Recorded at Pago Pago Airport. Rainfall was recorded in the period 1960-80. Temperature was recorded in the period 1964-66]

	Mean monthly rainfall	Temperature		
		Mean daily	Maximum daily	Minimum daily
	In	°F	°F	°F
January---	12.83	80.8	86.7	74.9
February--	11.89	80.8	86.8	74.8
March-----	11.77	80.9	87.0	74.8
April-----	11.90	80.7	86.6	74.7
May-------	11.16	79.9	85.3	74.5
June------	7.94	79.6	84.3	74.8
July------	6.77	78.8	83.4	74.1
August----	7.36	78.7	83.5	73.9
September-	6.68	79.4	84.5	74.2
October---	11.37	79.9	84.9	74.8
November--	11.07	80.4	85.7	75.0
December--	14.00	80.6	86.1	75.0
Annual--	124.74	80.0	85.4	74.6

TABLE 2.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Aunuu	Ofu	Olosega	Tau	Tutuila	Total-- Area	Total-- Extent
		Acres	Acres	Acres	Acres	Acres	Acres	Pct
1	Aua very stony silty clay loam, 15 to 30 percent slopes	0	0	0	0	209	209	0.4
2	Aua very stony silty clay loam, 30 to 60 percent slopes	0	104	97	0	1,985	2,186	4.5
3	Fagasa-Ofu silty clays, 30 to 60 percent slopes	0	0	0	0	1,288	1,288	2.6
4	Fagasa family-Lithic Hapludolls-Rock outcrop association, very steep	0	437	596	0	19,790	20,823	42.7
5	Ililili extremely stony mucky clay loam, 3 to 15 percent slopes	0	0	0	156	1,224	1,380	2.8
6	Insak mucky sandy loam	28	5	8	0	0	41	0.1
7	Insak Variant clay loam	0	0	0	23	0	23	*
8	Leafu silty clay, 0 to 3 percent slopes	0	0	0	0	550	550	1.1
9	Leafu stony silty clay, 0 to 3 percent slopes	0	0	0	0	397	397	0.8
10	Mesei Variant peat	33	0	0	0	0	33	0.1
11	Ngedebus mucky sand	51	62	0	7	0	120	0.2
12	Ngedebus Variant extremely cobbly sand, 0 to 5 percent slopes	11	0	32	114	7	164	0.3
13	Ngerungor Variant mucky peat	43	0	0	0	123	166	0.3
14	Ofu silty clay, 15 to 40 percent slopes	0	385	236	0	0	621	1.3
15	Ofu silty clay, 40 to 70 percent slopes	0	764	332	0	0	1,096	2.2
16	Ofu Variant silty clay, 6 to 20 percent slopes	42	0	0	178	0	220	0.5
17	Ofu Variant silty clay, 20 to 40 percent slopes	57	0	0	50	0	107	0.2
18	Ofu Variant-Rock outcrop complex, 40 to 70 percent slopes	83	0	0	106	0	189	0.4
19	Oloava silty clay loam, 6 to 12 percent slopes	0	0	0	0	415	415	0.9
20	Oloava silty clay loam, 12 to 25 percent slopes	0	0	0	0	552	552	1.1
21	Oloava silty clay loam, 40 to 100 percent slopes	0	0	0	0	904	904	1.9
22	Olotania family, 15 to 40 percent slopes	0	0	0	5,844	0	5,844	12.0
23	Pavaiai stony clay loam, 6 to 12 percent slopes	0	0	0	142	577	719	1.5
24	Pavaiai stony clay loam, 12 to 25 percent slopes	0	0	0	220	318	538	1.1
25	Pavaiai stony clay loam, 25 to 40 percent slopes	0	0	0	856	0	856	1.8
26	Puapua-Rock outcrop complex, 40 to 100 percent slopes	0	0	0	0	436	436	0.9
27	Rock outcrop-Hydrandepts-Dystrandepts association, very steep	0	0	0	2,617	0	2,617	5.4
28	Sogi-Puapua clay loams, 0 to 6 percent slopes	0	0	0	0	950	950	1.9
29	Sogi-Puapua clay loams, 6 to 20 percent slopes	0	0	0	0	819	819	1.7
30	Sogi-Puapua clay loams, 20 to 40 percent slopes	0	0	0	0	278	278	0.6
31	Sogi Variant-Pavaiai association, 15 to 50 percent slopes	0	0	0	919	0	919	1.9
32	Tafuna extremely stony muck, 3 to 15 percent slopes	0	0	0	42	884	926	1.9
33	Troporthents, 0 to 6 percent slopes	0	0	0	0	1,055	1,055	2.2
34	Urban land-Aua-Leafu complex, 0 to 30 percent slopes	0	0	0	0	891	891	1.8
35	Urban land-Ngedebus complex	36	35	43	54	268	436	0.9
	Total	384	1,792	1,344	11,328	33,920	48,768	100.0

* Less than 0.1 percent.

TABLE 3.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1 Aua	Severe: slope.	Severe: slope.	Severe: large stones, slope, small stones.	Moderate: large stones, slope.	Severe: large stones, slope.
2 Aua	Severe: slope.	Severe: slope.	Severe: large stones, slope, small stones.	Severe: slope.	Severe: large stones, slope.
3*: Fagasa	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: too clayey, slope.	Severe: slope, too clayey.
Ofu	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: too clayey, slope.	Severe: slope, too clayey.
4*: Fagasa	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: too clayey, slope.	Severe: slope, too clayey.
Lithic Hapludolls.					
Rock outcrop.					
5 Ililli	Severe: large stones, small stones, depth to rock.	Severe: large stones, small stones, depth to rock.	Severe: large stones, slope, small stones.	Severe: large stones.	Severe: small stones, large stones, thin layer.
6 Insak	Severe: flooding, ponding, excess salt.	Severe: ponding, excess salt.	Severe: ponding, flooding, excess salt.	Severe: ponding.	Severe: excess salt, ponding, flooding.
7 Insak Variant	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
8, 9 Leafu	Severe: flooding, too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
10 Mesei Variant	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.	Severe: ponding, flooding, excess humus.
11 Ngedebus	Severe: flooding, too sandy.	Severe: too sandy.	Severe: small stones.	Severe: too sandy.	Moderate: droughty, flooding.
12 Ngedebus Variant	Severe: flooding, large stones.	Severe: flooding, large stones.	Severe: flooding, large stones.	Severe: flooding, large stones.	Severe: flooding, large stones.
13 Ngerungor Variant	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.	Severe: ponding, flooding, excess humus.

See footnote at end of table.

TABLE 3.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
14, 15---------- Ofu	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: too clayey, slope.	Severe: slope, too clayey.
16---------- Ofu Variant	Severe: too clayey.	Severe: too clayey.	Severe: slope, too clayey.	Severe: too clayey.	Severe: too clayey.
17---------- Ofu Variant	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: too clayey, slope.	Severe: slope, too clayey.
18*: Ofu Variant----------	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: too clayey, slope.	Severe: slope, too clayey.
Rock outcrop.					
19---------- Oloava	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: droughty, slope.
20---------- Oloava	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
21---------- Oloava	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
22*---------- Olotania	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
23---------- Pavaiai	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: large stones.	Moderate: large stones, slope, thin layer.
24---------- Pavaiai	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: large stones, slope.	Severe: slope.
25---------- Pavaiai	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
26*: Puapua----------	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, thin layer.
Rock outcrop.					
27*: Rock outcrop.					
Hydrandepts.					
Dystrandepts.					
28*: Sogi----------	Slight----------	Slight----------	Moderate: slope, depth to rock.	Slight----------	Moderate: thin layer.
Puapua----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Severe: thin layer.

See footnote at end of table.

TABLE 3.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
29*:					
Sogi	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope, thin layer.
Puapua	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight	Severe: thin layer.
30*:					
Sogi	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Puapua	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, thin layer.
31*:					
Sogi Variant	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: too clayey, slope.	Severe: slope, too clayey.
Pavaiai	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
32 Tafuna	Severe: large stones, excess humus.	Severe: large stones, excess humus.	Severe: large stones, slope, excess humus.	Severe: large stones, excess humus.	Severe: large stones, excess humus.
33*. Troporthents					
34*: Urban land.					
Aua	Severe: slope.	Severe: slope.	Severe: large stones, slope, small stones.	Moderate: large stones, slope.	Severe: large stones, slope.
Leafu	Severe: flooding, too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
35*: Urban land.					
Ngedebus	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 4.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1, 2---------- Aua	Severe: large stones, slope.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope.	Severe: large stones, slope.
3*:					
Fagasa----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, too clayey.
Ofu----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, too clayey.
4*:					
Fagasa----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, too clayey.
Lithic Hapludolls.					
Rock outcrop.					
5---------- Iliili	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock.	Severe: small stones, large stones, thin layer.
6---------- Insak	Severe: depth to rock, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding.	Severe: excess salt, ponding, flooding.
7---------- Insak Variant	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding.	Severe: wetness.
8, 9---------- Leafu	Moderate: too clayey, wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: too clayey.
10---------- Mesei Variant	Severe: excess humus, ponding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding, low strength.	Severe: wetness.	Severe: ponding, flooding, excess humus.
11---------- Ngedebus	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
12---------- Ngedebus Variant	Severe: cutbanks cave, large stones.	Severe: flooding, large stones.	Severe: flooding, large stones.	Severe: flooding, large stones.	Severe: flooding, large stones.
13---------- Ngerungor Variant	Severe: excess humus, ponding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding, low strength.	Severe: wetness, flooding, low strength.	Severe: ponding, flooding, excess humus.
14, 15---------- Ofu	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, too clayey.

See footnote at end of table.

TABLE 4.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
16---------- Ofu Variant	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: too clayey.
17---------- Ofu Variant	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, too clayey.
18*: Ofu Variant------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, too clayey.
Rock outcrop.					
19---------- Oloava	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
20, 21---------- Oloava	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
22*---------- Olotania	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
23---------- Pavaiai	Severe: depth to rock.	Moderate: slope, depth to rock, large stones.	Severe: slope.	Moderate: depth to rock.	Moderate: large stones, slope, thin layer.
24, 25---------- Pavaiai	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Moderate: depth to rock.	Severe: slope.
26*: Puapua----------	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: depth to rock.	Severe: slope, thin layer.
Rock outcrop.					
27*: Rock outcrop.					
Hydrandepts.					
Dystrandepts.					
28*: Sogi----------	Moderate: depth to rock.	Slight----------	Slight----------	Moderate: depth to rock.	Moderate: thin layer.
Puapua----------	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Severe: thin layer.
29*: Sogi----------	Moderate: depth to rock, slope.	Moderate: slope.	Severe: slope.	Moderate: depth to rock.	Moderate: slope, thin layer.
Puapua----------	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: slope.	Severe: depth to rock.	Severe: thin layer.
30*: Sogi----------	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: depth to rock.	Severe: slope.

See footnote at end of table.

TABLE 4.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
30*:					
Puapua	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: depth to rock.	Severe: slope, thin layer.
31*:					
Sogi Variant	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, too clayey.
Pavaiai	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Moderate: depth to rock.	Severe: slope.
32 Tafuna	Severe: large stones.	Severe: large stones.	Severe: slope, large stones.	Severe: large stones.	Severe: large stones, excess humus.
33*. Troporthents					
34*: Urban land.					
Aua	Severe: large stones, slope.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope.	Severe: large stones, slope.
Leafu	Moderate: too clayey, wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: too clayey.
35*: Urban land.					
Ngedebus	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 5.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "moderate," "severe," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1, 2---------- Aua	Severe: slope, large stones.	Severe: seepage, slope, large stones.	Severe: seepage, slope, large stones.	Severe: seepage, slope.	Poor: large stones, slope.
3*: Fagasa----------	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, too clayey, slope.
Ofu----------	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
4*: Fagasa----------	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, too clayey, slope.
Lithic Hapludolls.					
Rock outcrop.					
5---------- Iliili	Severe: depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, seepage, large stones.	Severe: depth to rock.	Poor: area reclaim.
6---------- Insak	Severe: flooding, depth to rock, ponding.	Severe: seepage, depth to rock, flooding.	Severe: flooding, depth to rock, seepage.	Severe: flooding, depth to rock, seepage.	Poor: area reclaim, seepage, ponding.
7---------- Insak Variant	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: too clayey, hard to pack, wetness.
8---------- Leafu	Severe: flooding, wetness.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: too clayey, hard to pack.
9---------- Leafu	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: too clayey, hard to pack.
10---------- Mesei Variant	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess humus.
11---------- Ngedebus	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage.	Poor: seepage, too sandy.

See footnote at end of table.

TABLE 5.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
12---------- Ngedebus Variant	Severe: flooding, poor filter, large stones.	Severe: seepage, flooding, large stones.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: seepage, too sandy, large stones.
13---------- Ngerungor Variant	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess humus.
14, 15---------- Ofu	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
16---------- Ofu Variant	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: too clayey, slope.
17---------- Ofu Variant	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
18*: Ofu Variant--------	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
Rock outcrop.					
19---------- Oloava	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: seepage, small stones.
20, 21---------- Oloava	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: seepage, small stones, slope.
22*---------- Olotania	Severe: depth to rock, poor filter, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, slope.
23---------- Pavaiai	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim, large stones.
24, 25---------- Pavaiai	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, large stones, slope.
26*: Puapua----------	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, slope.
Rock outcrop.					
27*: Rock outcrop.					
Hydrandepts.					
Dystrandepts.					

See footnote at end of table.

TABLE 5.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
28*:					
Sogi	Severe: depth to rock, poor filter.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim.
Puapua	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim.
29*:					
Sogi	Severe: depth to rock, poor filter.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim.
Puapua	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim.
30*:					
Sogi	Severe: depth to rock, poor filter, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, slope.
Puapua	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, slope.
31*:					
Sogi Variant	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, too clayey, slope.
Pavaiai	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, large stones, slope.
32--- Tafuna	Severe: poor filter, large stones.	Severe: seepage, slope, excess humus.	Severe: depth to rock, seepage, large stones.	Severe: seepage.	Poor: seepage, small stones.
33*. Troporthents					
34*: Urban land.					
Aua	Severe: slope, large stones.	Severe: seepage, slope, large stones.	Severe: seepage, slope, large stones.	Severe: seepage, slope.	Poor: large stones, slope.
Leafu	Severe: flooding, wetness.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: too clayey, hard to pack.

See footnote at end of table.

TABLE 5.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
35*: Urban land.					
Ngedebus	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage.	Poor: seepage, too sandy.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1, 2---------- Aua	Fair: large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: large stones, area reclaim, slope.
3*: Fagasa----------	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones, slope.
Ofu----------	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
4*: Fagasa----------	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones, slope.
Lithic Hapludolls.				
Rock outcrop.				
5---------- Ililli	Poor: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
6---------- Insak	Poor: area reclaim, wetness.	Improbable: thin layer.	Improbable: thin layer.	Poor: small stones, excess salt, wetness.
7---------- Insak Variant	Fair: wetness.	Probable----------	Improbable: too sandy.	Poor: thin layer, wetness.
8---------- Leafu	Fair: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
9---------- Leafu	Fair: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, large stones, area reclaim.
10---------- Mesei Variant	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
11---------- Ngedebus	Good----------	Probable----------	Probable----------	Poor: too sandy, small stones, area reclaim.
12---------- Ngedebus Variant	Poor: large stones.	Improbable: large stones.	Improbable: large stones.	Poor: large stones.
13---------- Ngerungor Variant	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.

See footnote at end of table.

TABLE 6.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
14, 15---------- Ofu	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
16---------- Ofu Variant	Good----------	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
17---------- Ofu Variant	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
18*: Ofu Variant---------- Rock outcrop.	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
19---------- Oloava	Good----------	Probable----------	Probable----------	Poor: small stones, area reclaim.
20---------- Oloava	Fair: slope.	Probable----------	Probable----------	Poor: small stones, area reclaim, slope.
21---------- Oloava	Poor: slope.	Probable----------	Probable----------	Poor: small stones, area reclaim, slope.
22*---------- Olotania	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
23---------- Pavaiai	Poor: area reclaim.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: large stones.
24, 25---------- Pavaiai	Poor: area reclaim.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: large stones, slope.
26*: Puapua---------- Rock outcrop.	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
27*: Rock outcrop. Hydrandepts. Dystrandepts.				
28*: Sogi---------- Puapua---------- 	Poor: area reclaim. Poor: area reclaim, thin layer.	Improbable: excess fines. Improbable: excess fines.	Improbable: excess fines. Improbable: excess fines.	Fair: area reclaim. Poor: area reclaim.

See footnote at end of table.

TABLE 6.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
29*:				
Sogi	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, slope.
Puapua	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
30*:				
Sogi	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Puapua	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
31*:				
Sogi Variant	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
Pavaiai	Poor: area reclaim.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: large stones, slope.
32--- Tafuna	Poor: large stones.	Improbable: small stones, large stones.	Improbable: large stones.	Poor: excess humus, large stones, area reclaim.
33*. Troporthents				
34*: Urban land.				
Aua	Fair: large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: large stones, area reclaim, slope.
Leafu	Fair: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
35*: Urban land.				
Ngedebus	Good	Probable	Probable	Poor: too sandy.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Terraces and diversions	Grassed waterways
1, 2---------- Aua	Severe: seepage, slope.	Severe: large stones.	Deep to water----	Slope, large stones, rooting depth.	Large stones, slope, droughty.
3*: Fagasa----------	Severe: seepage, slope.	Severe: thin layer.	Deep to water----	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
Ofu----------	Severe: seepage, slope.	Slight----------	Deep to water----	Slope----------	Slope.
4*: Fagasa----------	Severe: seepage, slope.	Severe: thin layer.	Deep to water----	Slope, depth to rock.	Slope, depth to rock.
Lithic Hapludolls.					
Rock outcrop.					
5---------- Ililil	Severe: depth to rock, slope.	Severe: large stones, thin layer.	Deep to water----	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
6---------- Insak	Moderate: depth to rock.	Severe: seepage, ponding, excess salt.	Ponding, depth to rock, flooding.	Depth to rock, ponding, too sandy.	Wetness, excess salt, droughty.
7---------- Insak Variant	Severe: seepage.	Severe: wetness.	Flooding----------	Wetness----------	Wetness.
8---------- Leafu	Severe: seepage.	Moderate: wetness, low strength.	Deep to water----	Favorable--------	Favorable.
9---------- Leafu	Severe: seepage.	Moderate: wetness, large stones, low strength.	Deep to water----	Large stones-----	Large stones.
10---------- Mesei Variant	Severe: seepage.	Severe: wetness.	Ponding, flooding.	Ponding----------	Wetness.
11---------- Ngedebus	Severe: seepage.	Severe: seepage, piping.	Deep to water----	Too sandy, soil blowing.	Droughty.
12---------- Ngedebus Variant	Severe: seepage.	Severe: seepage, large stones.	Deep to water----	Large stones, too sandy.	Large stones, droughty.
13---------- Ngerungor Variant	Severe: seepage.	Severe: excess humus, wetness.	Ponding, flooding.	Ponding----------	Wetness.
14, 15---------- Ofu	Severe: seepage, slope.	Slight----------	Deep to water----	Slope----------	Slope.

See footnote at end of table.

TABLE 7.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Terraces and diversions	Grassed waterways
16, 17---------- Ofu Variant	Severe: seepage, slope.	Slight----------	Deep to water----	Slope----------	Slope.
18*: Ofu Variant------- Rock outcrop.	Severe: seepage, slope.	Slight----------	Deep to water----	Slope----------	Slope.
19, 20, 21--------- Oloava	Severe: seepage, slope.	Severe: seepage.	Deep to water----	Slope----------	Slope, droughty.
22*---------- Olotania	Severe: seepage, slope.	Severe: excess humus, hard to pack.	Deep to water----	Slope, depth to rock.	Slope, depth to rock.
23, 24, 25-------- Pavaiai	Severe: seepage, slope.	Moderate: thin layer.	Deep to water----	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
26*: Puapua---------- Rock outcrop.	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water----	Slope, depth to rock.	Slope, depth to rock.
27*: Rock outcrop. Hydrandepts. Dystrandepts.					
28*: Sogi---------- Puapua---------- 	Severe: seepage. Severe: depth to rock.	Severe: thin layer. Severe: thin layer.	Deep to water---- Deep to water----	Depth to rock---- Depth to rock----	Depth to rock. Depth to rock.
29*, 30*: Sogi---------- Puapua---------- 31*: Sogi Variant----- Pavaiai----------	Severe: seepage, slope. Severe: depth to rock, slope. Severe: seepage, slope. Severe: seepage, slope.	Severe: thin layer. Severe: thin layer. Moderate: thin layer. Moderate: thin layer.	Deep to water---- Deep to water---- Deep to water---- Deep to water----	Slope, depth to rock. Slope, depth to rock. Slope, depth to rock. Slope, large stones, depth to rock.	Slope, depth to rock. Slope, depth to rock. Slope, depth to rock. Large stones, slope, depth to rock.
32---------- Tafuna	Severe: seepage, slope.	Severe: large stones.	Deep to water----	Slope, large stones.	Large stones, slope, droughty.
33*. Troporthents					

See footnote at end of table.

TABLE 7.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Terraces and diversions	Grassed waterways
34*: Urban land.					
Aua	Severe: seepage, slope.	Severe: large stones.	Deep to water	Slope, large stones, rooting depth.	Large stones, slope, droughty.
Leafu	Severe: seepage.	Moderate: wetness, low strength.	Deep to water	Favorable	Favorable.
35*: Urban land.					
Ngedebus	Severe: seepage.	Severe: seepage, piping.	Deep to water	Too sandy, soil blowing.	Droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--ENGINEERING INDEX PROPERTIES

[The symbol > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Unified classification	Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
					4	10	40	200		
	In			Pct					Pct	
1, 2---------- Aua	0-7	Very stony silty clay loam.	MH-K	40-50	75-100	70-100	65-95	60-90	55-65	10-20
	7-18	Stony clay loam, stony silty clay, stony silty clay loam.	MH-K	25-35	75-100	70-100	65-95	50-90	50-60	10-20
	18-60	Very stony clay loam, very stony silty clay, very stony silty clay loam.	MH-K	40-60	70-90	65-90	60-90	55-90	50-65	10-20
3*:										
Fagasa----------	0-5	Silty clay-------	MH-K	0-15	75-90	75-90	70-90	65-90	50-70	10-20
	5-12	Cobbly silty clay	MH-K	15-35	70-90	70-90	65-90	60-90	50-70	10-20
	12-29	Clay loam, silty clay.	MH-K	0-10	85-100	75-90	70-85	65-90	50-70	10-20
	29	Weathered bedrock	---	---	---	---	---	---	---	---
Ofu----------	0-16	Silty clay-------	MH-K	0	100	100	95-100	95-100	55-75	20-30
	16-60	Silty clay, silty clay loam.	MH-K	0	100	100	95-100	95-100	55-75	20-30
4*:										
Fagasa----------	0-12	Silty clay-------	MH-K	0-15	75-100	75-100	70-95	65-90	50-70	10-20
	12-29	Silty clay-------	MH-K	0-15	75-80	75-80	70-75	65-70	50-70	10-20
	29	Weathered bedrock	---	---	---	---	---	---	---	---
Lithic Hapludolls.										
Rock outcrop.										
5----------	0-5	Extremely stony clay loam.	GM	45-55	60-80	40-60	35-55	30-50	40-50	5-15
Iliili	5-9	Extremely stony clay loam.	GM	45-55	60-80	40-60	35-55	30-50	40-50	5-15
	9	Unweathered bedrock.	---	---	---	---	---	---	---	---
6----------	0-11	Mucky sandy loam	SM, SP-SM	0-5	85-95	80-90	50-65	25-40	---	NP
Insak	11-26	Mucky loamy sand, gravelly loamy sand, loamy sand.	SM, SP-SM	0-5	65-95	60-90	30-70	10-30	---	NP
	26	Unweathered bedrock.	---	---	---	---	---	---	---	---
7----------	0-5	Clay loam--------	MH	0	95-100	90-100	80-100	65-80	50-60	10-20
Insak Variant	5-13	Silty clay loam	MH	0	90-100	90-100	85-100	75-95	60-70	10-20
	13-44	Silty clay-------	MH	0	100	100	95-100	95-100	55-75	20-30
	44-60	Sand, loamy sand	SP-SM, SM	0-5	85-100	80-100	45-60	5-20	---	NP
8----------	0-13	Silty clay-------	MH	0-5	100	100	95-100	95-100	55-65	10-20
Leafu	13-19	Very fine sandy loam.	ML	0-5	75-100	75-100	75-95	50-75	30-40	5-10
	19-60	Silty clay, clay	MH	0-5	100	100	95-100	95-100	65-75	10-30
9----------	0-13	Stony silty clay	MH	10-20	95-100	80-100	80-100	75-95	55-65	10-20
Leafu	13-60	Stony silty clay, stony clay.	MH	10-20	90-100	80-100	80-100	75-95	65-75	10-30
10----------	0-12	Peat----------	PT	0	---	---	---	---	---	NP
Mesei Variant	12-60	Mucky peat, muck	PT	0	---	---	---	---	---	NP

See footnote at end of table.

TABLE 8.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Unified classification	Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
					4	10	40	200		
	In			Pct					Pct	
11----------	0-12	Mucky sand-------	SP-SM, SM	0-5	85-100	80-100	45-60	5-15	---	NP
Ngedebus	12-60	Stratified sand to gravelly sand.	SP-SM, SM	0-25	70-100	65-100	30-80	5-35	---	NP
12----------	0-15	Extremely cobbly sand.	GP	50-65	35-50	25-45	15-30	0-5	---	NP
Ngedebus Variant	15-60	Stratified very gravelly loamy sand to extremely cobbly sand.	GP-GM, GM, SP-SM, SM	35-65	25-70	20-65	15-50	5-15	---	NP
13----------	0-4	Mucky peat-------	PT	0	---	---	---	---	---	NP
Ngerungor	4-21	Peat-------------	PT	0	---	---	---	---	---	NP
Variant	21-60	Mucky peat-------	PT	0	---	---	---	---	---	NP
14----------	0-16	Silty clay-------	MH-K	0	100	100	95-100	95-100	55-75	20-30
Ofu	16-45	Silty clay loam, silty clay.	MH-K	0	90-100	85-100	80-100	75-95	70-80	15-25
	45-60	Silty clay, silty clay loam.	MH-K	0	100	100	95-100	95-100	55-75	20-30
15----------	0-10	Silty clay-------	MH-K	0	100	100	95-100	95-100	55-75	20-30
Ofu	10-37	Silty clay loam, silty clay.	MH-K	0	90-100	85-100	80-100	75-95	70-80	15-25
	37-60	Silty clay, silty clay loam.	MH-K	0	100	100	95-100	95-100	55-75	20-30
16, 17----------	0-8	Silty clay-------	MH-K	0	100	100	95-100	95-100	55-75	20-30
Ofu Variant	8-14	Silty clay-------	MH-K	0	100	95-100	95-100	85-100	55-75	20-30
	14-28	Clay loam--------	MH-K	0	95-100	90-100	80-100	65-80	50-60	10-20
	28-60	Clay loam, sandy loam.	MH-K	0	95-100	90-100	80-100	65-80	50-60	10-20
18*:										
Ofu Variant-----	0-8	Silty clay-------	MH-K	0	100	100	95-100	95-100	55-75	20-30
	8-14	Silty clay-------	MH-K	0	100	95-100	95-100	85-100	55-75	20-30
	14-20	Clay loam--------	MH-K	0	95-100	90-100	80-100	65-80	50-60	10-20
	20-60	Clay loam, sandy loam.	MH-K	0	95-100	90-100	80-100	65-80	50-60	10-20
Rock outcrop.										
19, 20----------	0-9	Silty clay loam	ML-A	0	90-100	90-100	85-100	75-95	30-40	NP-5
Oloava	9-14	Clay loam, silty clay loam.	ML-A	0	90-100	90-100	80-100	75-95	30-40	NP-5
	14-17	Gravelly silt loam.	ML-A	0	75-85	75-85	60-70	55-65	25-35	NP-5
	17-60	Very gravelly sandy loam.	SM	0	65-75	40-50	30-40	15-25	---	NP
21----------	0-6	Silty clay loam	ML-A	0	90-100	90-100	85-100	75-95	30-40	NP-5
Oloava	6-11	Clay loam, silty clay loam.	ML-A	0	90-100	90-100	80-100	75-95	30-40	NP-5
	11-14	Gravelly silt loam.	ML-A	0	75-85	75-85	60-70	55-65	25-35	NP-5
	14-60	Very gravelly sandy loam.	SM	0	65-75	40-50	30-40	15-25	---	NP
22*----------	0-25	Silty clay loam	OH-T, MH-T	0	90-100	85-100	80-100	75-95	200-300	40-60
Olotania	25-35	Stratified silty clay loam to sandy loam.	MH-T, OH-T	0	85-100	75-95	70-90	60-80	80-100	10-20
	35	Weathered bedrock	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 8.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Unified classification	Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
					4	10	40	200		
	In			Pct					Pct	
23, 24----------	0-7	Stony clay loam	MH-A	20-30	95-100	90-100	80-100	60-70	65-75	10-20
Pavaiai	7-12	Clay loam--------	MH-A	0-5	95-100	90-100	80-100	60-70	65-75	10-20
	12-38	Very cobbly sandy loam, very cobbly sandy clay loam.	SM	50-60	80-100	80-90	60-85	25-45	55-75	NP-15
	38	Unweathered bedrock.	---	---	---	---	---	---	---	---
25----------	0-10	Stony clay loam	MH-A	20-30	95-100	90-100	80-100	60-70	65-75	10-20
Pavaiai	10-30	Extremely gravelly very fine sandy loam, extremely gravelly sandy loam.	GM, GP-GM	10-30	30-50	20-30	15-30	5-20	50-60	NP-5
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---
26*:										
Puapua----------	0-11	Clay loam--------	MH-A	0	95-100	90-100	80-100	65-80	65-75	10-20
	11-16	Sandy loam-------	SM	0	80-90	75-85	50-60	30-40	50-60	NP-10
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---
Rock outcrop.										
27*:										
Rock outcrop.										
Hydrandepts.										
Dystrandepts.										
28*, 29*:										
Sogi----------	0-21	Clay loam--------	MH-A	0	95-100	90-100	80-100	60-75	60-75	15-25
	21-26	Loamy sand, sandy loam, sand.	SM	0	100	100	40-60	10-30	---	NP
	26	Unweathered bedrock.	---	---	---	---	---	---	---	---
Puapua----------	0-11	Clay loam--------	MH-A	0	95-100	90-100	80-100	65-80	65-75	10-20
	11-16	Sandy loam-------	SM	0	80-90	75-85	50-60	30-40	50-60	NP-10
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---
30*:										
Sogi----------	0-15	Clay loam--------	MH-A	0	95-100	90-100	80-100	60-75	60-75	15-25
	15-27	Loamy sand, sandy loam, sand.	SM	0	100	100	40-60	10-30	---	NP
	27	Unweathered bedrock.	---	---	---	---	---	---	---	---
Puapua----------	0-11	Clay loam--------	MH-A	0	95-100	90-100	80-100	65-80	65-75	10-20
	11-16	Sandy loam-------	SM	0	80-90	75-85	50-60	30-40	50-60	NP-10
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---
31*:										
Sogi Variant----	0-8	Silty clay-------	MH-K	0	100	100	95-100	80-90	60-70	15-25
	8-30	Silty clay-------	MH-K	0	100	100	95-100	80-90	60-70	15-25
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 8.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Unified classification	Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
					4	10	40	200		
	In			Pct					Pct	
31*:										
Pavaiai	0-10	Stony clay loam	MH-A	20-30	95-100	90-100	80-100	60-70	65-75	10-20
	10-30	Extremely gravelly very fine sandy loam, extremely gravelly sandy loam.	GM, GP-GM	10-30	30-50	20-30	15-30	5-20	50-60	NP-5
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---
32	0-9	Extremely stony muck.	PT	50-70	---	---	---	---	---	NP
Tafuna	9-18	Extremely stony muck.	PT	50-70	---	---	---	---	---	NP
	18-43	Fragmental material.	GP	70-85	0-20	0-5	0-5	---	---	NP
	43	Unweathered bedrock.	---	---	---	---	---	---	---	---
33*.										
Troporthents										
34*:										
Urban land.										
Aua	0-7	Very stony silty clay loam.	MH-K	40-50	75-100	70-100	65-95	60-90	55-65	10-20
	7-18	Stony clay loam, stony silty clay, stony silty clay loam.	MH-K	25-35	75-100	70-100	65-95	50-90	50-60	10-20
	18-60	Very stony clay loam, very stony silty clay, very stony silty clay loam.	MH-K	40-60	70-90	65-90	60-90	55-90	50-65	10-20
Leafu	0-13	Silty clay	MH	0-5	100	100	95-100	95-100	55-65	10-20
	13-60	Silty clay, clay	MH	0-5	100	100	95-100	95-100	65-75	30-40
35*:										
Urban land.										
Ngedebus	0-4	Sand	SP-SM, SM	0-5	85-100	80-100	45-60	5-15	---	NP
	4-60	Stratified sand to gravelly sand.	SP-SM, SM	0-25	70-100	65-100	30-80	5-35	---	NP

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Moist bulk density	Permeability	Available water capacity	Soil reaction	Erosion factors		Organic matter
						K	T	
	In	G/cm³	In/hr	In/in	pH			Pct
1, 2	0-7	0.90-1.00	2.0-6.0	0.10-0.15	6.1-7.3	0.17	5	5-7
Aua	7-18	0.90-1.00	2.0-6.0	0.10-0.15	6.1-7.3	0.17		
	18-60	0.90-1.00	2.0-6.0	0.09-0.11	6.1-7.3	0.15		
3*:								
Fagasa	0-5	0.90-1.20	2.0-6.0	0.10-0.15	5.6-6.5	0.10	1	4-10
	5-12	0.90-1.20	2.0-6.0	0.10-0.15	5.6-6.5	0.15		
	12-29	0.90-1.20	2.0-6.0	0.10-0.15	5.6-6.5	0.10		
	29	---	---	---	---	----		
Ofu	0-16	0.90-1.00	2.0-6.0	0.10-0.15	5.6-7.3	0.10	5	8-12
	16-60	0.90-1.00	2.0-6.0	0.10-0.15	5.6-7.3	0.10		
4*:								
Fagasa	0-12	0.90-1.20	2.0-6.0	0.10-0.15	5.6-6.5	0.10	3	3-10
	12-29	0.90-1.20	2.0-6.0	0.10-0.15	5.6-6.5	0.10		
	29	---	---	---	---	----		
Lithic Hapludolls.								
Rock outcrop.								
5	0-5	0.30-0.40	6.0-20	0.10-0.13	5.6-7.3	0.05	1	10-16
Iliili	5-9	0.70-0.80	6.0-20	0.10-0.13	5.6-7.3	0.05		
	9	---	---	---	---	----		
6	0-11	1.10-1.30	6.0-20	0.10-0.12	7.4-8.4	0.05	3	15-25
Insak	11-26	1.10-1.40	6.0-20	0.08-0.10	7.4-8.4	0.05		
	26	---	---	---	---	----		
7	0-5	0.90-1.00	2.0-6.0	0.10-0.15	6.6-7.3	0.10	5	4-8
Insak Variant	5-13	0.90-1.00	2.0-6.0	0.10-0.15	6.6-7.3	0.10		
	13-44	0.90-1.00	2.0-6.0	0.10-0.15	6.6-7.3	0.10		
	44-60	1.10-1.30	>20	0.03-0.07	7.4-8.4	0.02		
8	0-13	0.90-1.00	2.0-6.0	0.13-0.15	5.6-6.5	0.17	5	4-8
Leafu	13-19	0.90-1.00	2.0-6.0	0.15-0.18	5.6-6.5	0.20		
	19-60	0.90-1.00	2.0-6.0	0.10-0.13	5.6-6.5	0.17		
9	0-13	0.90-1.00	2.0-6.0	0.13-0.15	5.6-6.5	0.17	5	4-8
Leafu	13-60	0.90-1.00	2.0-6.0	0.10-0.15	5.6-6.5	0.17		
10	0-12	0.30-0.35	6.0-20	0.20-0.30	4.5-5.0	0.05	5	60-80
Mesei Variant	12-60	0.30-0.35	6.0-20	0.20-0.30	4.5-5.5	0.05		
11	0-12	1.20-1.40	6.0-20	0.08-0.10	6.6-8.4	0.05	5	10-15
Ngedebus	12-60	1.50-1.70	6.0-20	0.04-0.07	7.4-9.0	0.10		
12	0-15	1.20-1.40	6.0-20	0.02-0.04	6.6-8.4	0.02	5	1-3
Ngedebus Variant	15-60	1.50-1.70	6.0-20	0.01-0.07	6.6-8.4	0.02		
13	0-4	0.30-0.40	6.0-20	0.20-0.30	6.6-7.3	0.05	5	40-60
Ngerungor Variant	4-21	0.30-0.40	6.0-20	0.20-0.30	6.6-7.3	0.05		
	21-60	0.30-0.40	6.0-20	0.20-0.30	5.6-6.0	----		
14	0-16	0.90-1.00	2.0-6.0	0.10-0.15	5.6-7.3	0.10	5	8-12
Ofu	16-45	0.90-1.00	2.0-6.0	0.10-0.15	5.6-7.3	0.10		
	45-60	0.90-1.00	2.0-6.0	0.10-0.15	5.6-7.3	0.10		
15	0-10	0.90-1.00	2.0-6.0	0.10-0.15	5.6-7.3	0.10	5	8-12
Ofu	10-37	0.90-1.00	2.0-6.0	0.10-0.15	5.6-7.3	0.10		
	37-60	0.90-1.00	2.0-6.0	0.10-0.15	5.6-7.3	0.10		

See footnote at end of table.

TABLE 9.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Moist bulk density	Permeability	Available water capacity	Soil reaction	Erosion factors		Organic matter
						K	T	
	In	G/cm³	In/hr	In/in	pH			Pct
16, 17----------	0-8	0.85-0.95	2.0-6.0	0.10-0.15	5.6-7.3	0.10	4	8-12
Ofu Variant	8-14	0.85-0.95	2.0-6.0	0.10-0.15	5.6-7.3	0.10		
	14-28	0.85-0.95	2.0-6.0	0.10-0.15	5.6-7.3	0.10		
	28-60	0.85-0.95	2.0-6.0	0.10-0.15	5.6-7.3	0.10		
18*:								
Ofu Variant------	0-8	0.85-0.95	2.0-6.0	0.10-0.15	5.6-7.3	0.10	4	8-12
	8-14	0.85-0.95	2.0-6.0	0.10-0.15	5.6-7.3	0.10		
	14-20	0.85-0.95	2.0-6.0	0.10-0.15	5.6-7.3	0.10		
	20-60	0.85-0.95	2.0-6.0	0.10-0.15	5.6-7.3	0.10		
Rock outcrop.								
19, 20----------	0-9	0.70-0.80	2.0-6.0	0.10-0.15	5.1-6.5	0.10	2	12-15
Oloava	9-14	0.70-0.80	2.0-6.0	0.10-0.15	5.1-6.5	0.10		
	14-17	0.70-0.80	6.0-20	0.05-0.08	5.1-6.5	0.10		
	17-60	0.90-1.10	>20	0.08-0.10	5.1-6.5	0.05		
21----------	0-6	0.70-0.80	2.0-6.0	0.10-0.15	5.1-6.5	0.10	2	12-15
Oloava	6-11	0.70-0.80	2.0-6.0	0.10-0.15	5.1-6.5	0.10		
	11-14	0.70-0.80	6.0-20	0.05-0.08	5.1-6.5	0.10		
	14-60	0.90-1.10	>20	0.08-0.10	5.1-6.5	0.05		
22*----------	0-25	0.70-0.80	2.0-6.0	0.15-0.17	5.1-6.0	0.05	5	16-25
Olotania	25-35	0.70-0.90	6.0-20	0.13-0.15	6.1-7.3	0.05		
	35	---	---	---	---	----		
23, 24----------	0-7	0.60-0.85	2.0-6.0	0.17-0.20	5.6-7.3	0.10	2	10-14
Pavaiai	7-12	0.60-0.85	2.0-6.0	0.22-0.25	5.6-7.3	0.10		
	12-38	0.60-0.85	2.0-6.0	0.09-0.11	5.6-7.3	0.05		
	38	---	---	---	---	----		
25----------	0-10	0.60-0.85	2.0-6.0	0.17-0.20	5.6-7.3	0.10	2	10-14
Pavaiai	10-30	0.60-0.85	2.0-6.0	0.04-0.06	5.6-7.3	0.02		
	30	---	---	---	---	----		
26*:								
Puapua----------	0-11	0.60-0.85	2.0-6.0	0.22-0.25	6.1-7.3	0.10	2	10-14
	11-16	0.60-0.85	2.0-6.0	0.18-0.20	6.1-7.3	0.10		
	16	---	---	---	---	----		
Rock outcrop.								
27*:								
Rock outcrop.								
Hydrandepts.								
Dystrandepts.								
28*, 29*:								
Sogi----------	0-21	0.60-0.85	2.0-6.0	0.22-0.25	6.1-7.3	0.10	2	4-10
	21-26	0.90-1.00	6.0-20	0.03-0.07	6.1-7.3	0.10		
	26	---	---	---	---	----		
Puapua----------	0-11	0.60-0.85	2.0-6.0	0.22-0.25	6.1-7.3	0.10	2	10-14
	11-16	0.60-0.85	2.0-6.0	0.18-0.20	6.1-7.3	0.10		
	16	---	---	---	---	----		
30*:								
Sogi----------	0-15	0.60-0.85	2.0-6.0	0.22-0.25	6.1-7.3	0.10	2	4-10
	15-27	0.90-1.00	6.0-20	0.03-0.07	6.1-7.3	0.10		
	27	---	---	---	---	----		
Puapua----------	0-11	0.60-0.85	2.0-6.0	0.22-0.25	6.1-7.3	0.10	2	10-14
	11-16	0.60-0.85	2.0-6.0	0.18-0.20	6.1-7.3	0.10		
	16	---	---	---	---	----		

See footnote at end of table.

TABLE 9.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Moist bulk density	Permeability	Available water capacity	Soil reaction	Erosion factors		Organic matter
						K	T	
	In	G/cm^3	In/hr	In/in	pH			Pct
31*:								
Sogi Variant-----	0-8	0.85-0.95	2.0-6.0	0.10-0.15	6.6-7.3	0.10	2	3-6
	8-30	0.85-0.95	2.0-6.0	0.10-0.15	6.6-7.3	0.10		
	30	---	---	---	---	-----		
Pavaiai----------	0-10	0.60-0.85	2.0-6.0	0.17-0.20	5.6-7.3	0.10	2	10-14
	10-30	0.60-0.85	2.0-6.0	0.04-0.06	5.6-7.3	0.02		
	30	---	---	---	---	-----		
32----------	0-9	0.10-0.20	>20	0.10-0.15	6.1-6.5	0.02	1	50-85
Tafuna	9-18	0.10-0.20	>20	0.10-0.15	6.1-7.3	0.02		
	18-43	1.10-1.30	>20	0.01-0.02	6.1-7.3	0.00		
	43	---	---	---	---	-----		
33*.								
Troporthents								
34*:								
Urban land.								
Aua----------	0-7	0.90-1.00	2.0-6.0	0.10-0.15	6.1-7.3	0.17	5	5-7
	7-18	0.90-1.00	2.0-6.0	0.10-0.15	6.1-7.3	0.17		
	18-60	0.90-1.00	2.0-6.0	0.09-0.11	6.1-7.3	0.15		
Leafu----------	0-13	0.90-1.00	2.0-6.0	0.13-0.15	5.6-6.5	0.17	5	4-8
	13-60	0.90-1.00	2.0-6.0	0.10-0.13	5.6-6.5	0.17		
35*:								
Urban land.								
Ngedebus---------	0-4	1.20-1.40	6.0-20	0.05-0.07	6.6-8.4	0.10	5	1-3
	4-60	1.50-1.70	6.0-20	0.04-0.07	7.4-9.0	0.10		

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "brief" and "apparent" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
1, 2---------- Aua	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low.
3*: Fagasa----------	C	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate.
Ofu----------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
4*: Fagasa----------	C	None---------	---	---	>6.0	---	---	20-60	Soft	Moderate	Moderate.
Lithic Hapludolls.											
Rock outcrop.											
5---------- Illill	D	None---------	---	---	>6.0	---	---	8-20	Hard	Moderate	Moderate.
6---------- Insak	D	Frequent----	Very long	Jan-Dec	0.5-2.0	Apparent	Jan-Dec	20-40	Hard	High-----	High.
7---------- Insak Variant	D	Occasional	Brief-----	Oct-Mar	0.5-2.0	Apparent	Oct-Mar	>60	---	Moderate	Moderate.
8, 9---------- Leafu	C	Occasional	Brief-----	Oct-May	3.0-5.0	Apparent	Oct-May	>60	---	Moderate	Moderate.
10**---------- Mesei Variant	D	Frequent----	Very long	Jan-Dec	+1-1.0	Apparent	Jan-Dec	>60	---	High-----	High.
11---------- Ngedebus	A	Occasional	Very brief	Jan-Dec	>3.5	Apparent	Jan-Dec	>60	---	High-----	Low.
12---------- Ngedebus Variant	A	Occasional	Very brief	Jan-Dec	>6.0	---	---	>60	---	High-----	Low.
13**---------- Ngerungor Variant	D	Frequent----	Long------	Jan-Dec	+1-1.0	Apparent	Jan-Dec	>60	---	High-----	High.
14, 15---------- Ofu	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
16, 17---------- Ofu Variant	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
18*: Ofu Variant------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
Rock outcrop.											

See footnotes at end of table.

TABLE 10.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
19---------- Oloava	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low.
20, 21---------- Oloava	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low.
22*---------- Olotania	A	None---------	---	---	>6.0	---	---	>20	Hard	Moderate	Moderate.
23, 24, 25-------- Pavaiai	C	None---------	---	---	>6.0	---	---	20-40	Hard	Moderate	Moderate.
26*: Puapua----------	D	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	Low.
Rock outcrop.											
27*: Rock outcrop.											
Hydrandepts.											
Dystrandepts.											
28*, 29*, 30*: Sog1----------	C	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	Low.
Puapua----------	D	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	Low.
31*: Sog1 Variant-----	C	None---------	---	---	>6.0	---	---	28-40	Hard	Moderate	Low.
Pavaiai----------	C	None---------	---	---	>6.0	---	---	20-40	Hard	Moderate	Moderate.
32---------- Tafuna	A	None---------	---	---	>6.0	---	---	40-60	Hard	Moderate	Low.
33*. Troporthents											
34*: Urban land.											
Aua----------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low.
Leafu----------	C	Occasional	Brief-----	Oct-May	3.0-5.0	Apparent	Oct-May	>60	---	Moderate	Moderate.
35*: Urban land.											
Ngedebus----------	A	Occasional	Very brief	Jan-Dec	>3.5	Apparent	Jan-Dec	>60	---	High-----	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

** In the "High water table--Depth" column, a plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

TABLE 11.--CLASSIFICATION OF THE SOILS

Soil name	Family
Aua	Clayey-skeletal, mixed, isohyperthermic Typic Hapludolls
Fagasa	Fine, halloysitic, isohyperthermic Typic Hapludolls
Ililli	Medial-skeletal, isohyperthermic Lithic Dystrandepts
Insak	Sandy, carbonatic, isohyperthermic Typic Tropaquents
Insak Variant	Fine, mixed, isohyperthermic Cumulic Haplaquolls
Leafu	Very-fine, mixed, isohyperthermic Cumulic Hapludolls
Mesei Variant	Euic, isohyperthermic Sapric Tropofibrists
Ngedebus	Carbonatic, isohyperthermic Typic Tropopsamments
Ngedebus Variant	Sandy-skeletal, carbonatic, isohyperthermic Typic Troporthents
Ngerungor Variant	Euic, isohyperthermic Typic Tropohemists
Ofu	Fine, halloysitic, isohyperthermic Typic Hapludolls
Ofu Variant	Very-fine, mixed, isohyperthermic Typic Hapludolls
Oloava	Medial over cindery, isohyperthermic Typic Dystrandepts
Olotania	Thixotropic, isohyperthermic Typic Hydrandepts
Pavaiai	Medial-skeletal, isohyperthermic Typic Dystrandepts
Puapua	Medial, isohyperthermic Lithic Eutrandepts
Sogi	Medial, isohyperthermic Udic Eutrandepts
Sogi Variant	Very-fine, mixed, isohyperthermic Typic Hapludolls
Tafuna	Euic, isohyperthermic Typic Tropofolists

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