United States
Department of
Agriculture

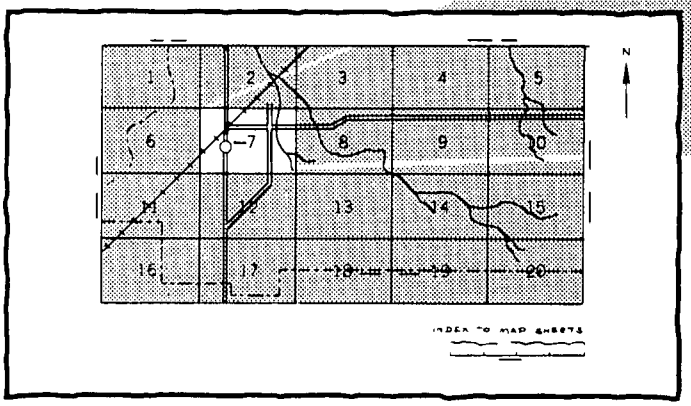
Soil
Conservation
Service

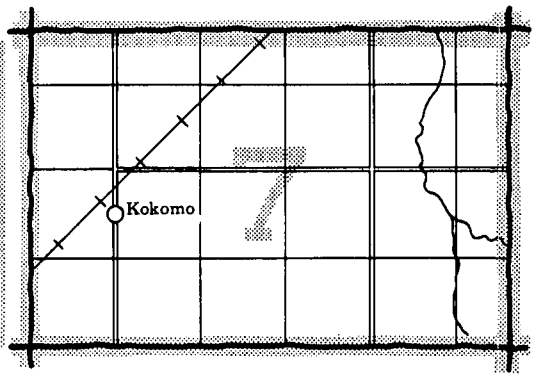
In Cooperation with
United States Department
of Agriculture, Forest
Service; United
States Department of the
Interior, Office of the
High Commissioner, Trust
Territory of the Pacific
Islands; and University of
Hawaii at Manoa, College
of Tropical Agriculture
and Human Resources

Soil Survey of Islands of Yap, Federated States of Micronesia

HOW TO USE

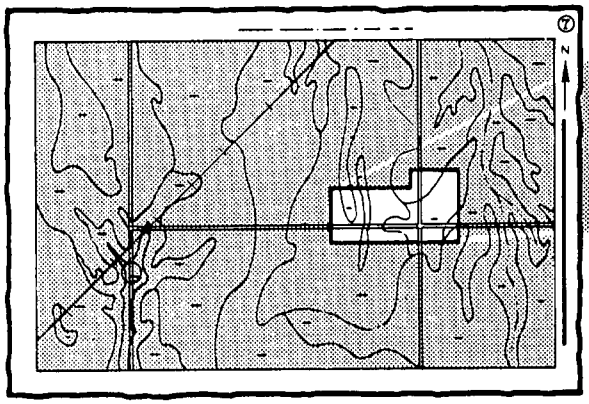
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

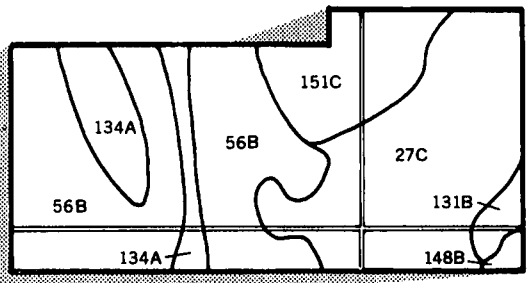




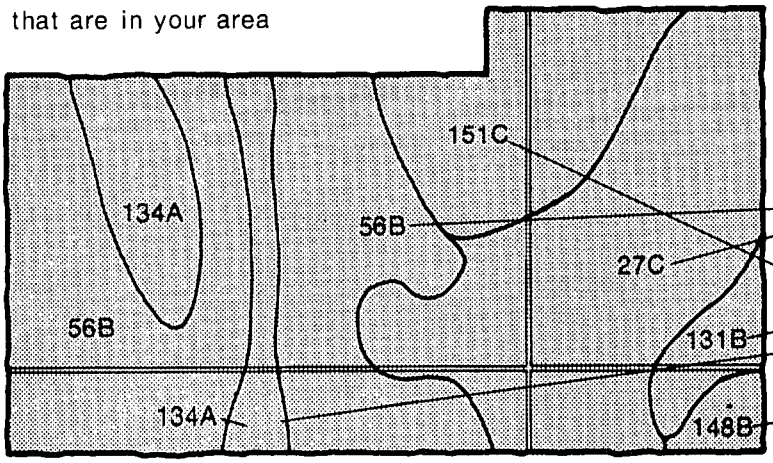
2. Note the number of the map sheet and turn to that sheet.

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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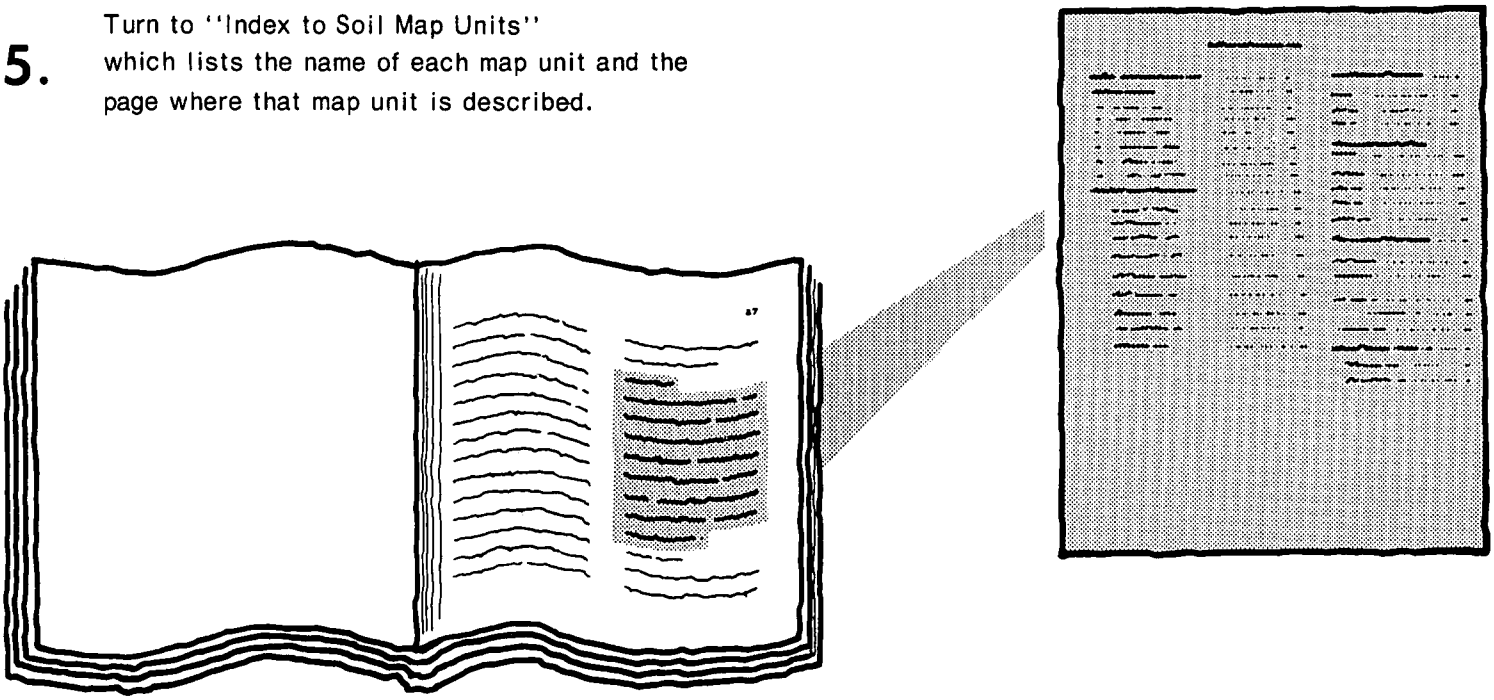
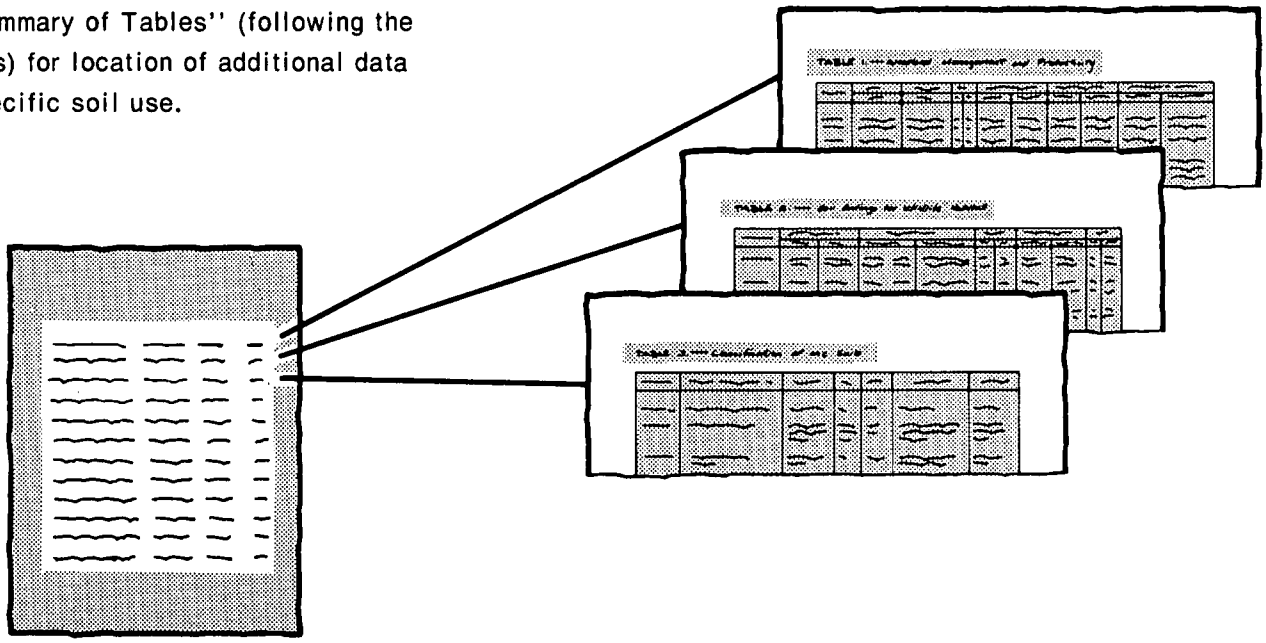
56B
131B
134A
148B
151C

THIS 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, the Agricultural Experiment Stations, 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 performed in 1980. Soil names and descriptions were approved in 1980. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1980. This survey was made cooperatively by the Soil Conservation Service and Forest Service; the United States Department of the Interior, Office of the High Commissioner, Trust Territory of the Pacific Islands; and the University of Hawaii at Manoa, College of Tropical Agriculture and Human Resources.

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: In the background are agricultural forest on Sonahnpil Variant soils and tropical forest on Weloy and Rumung soils.

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foreword

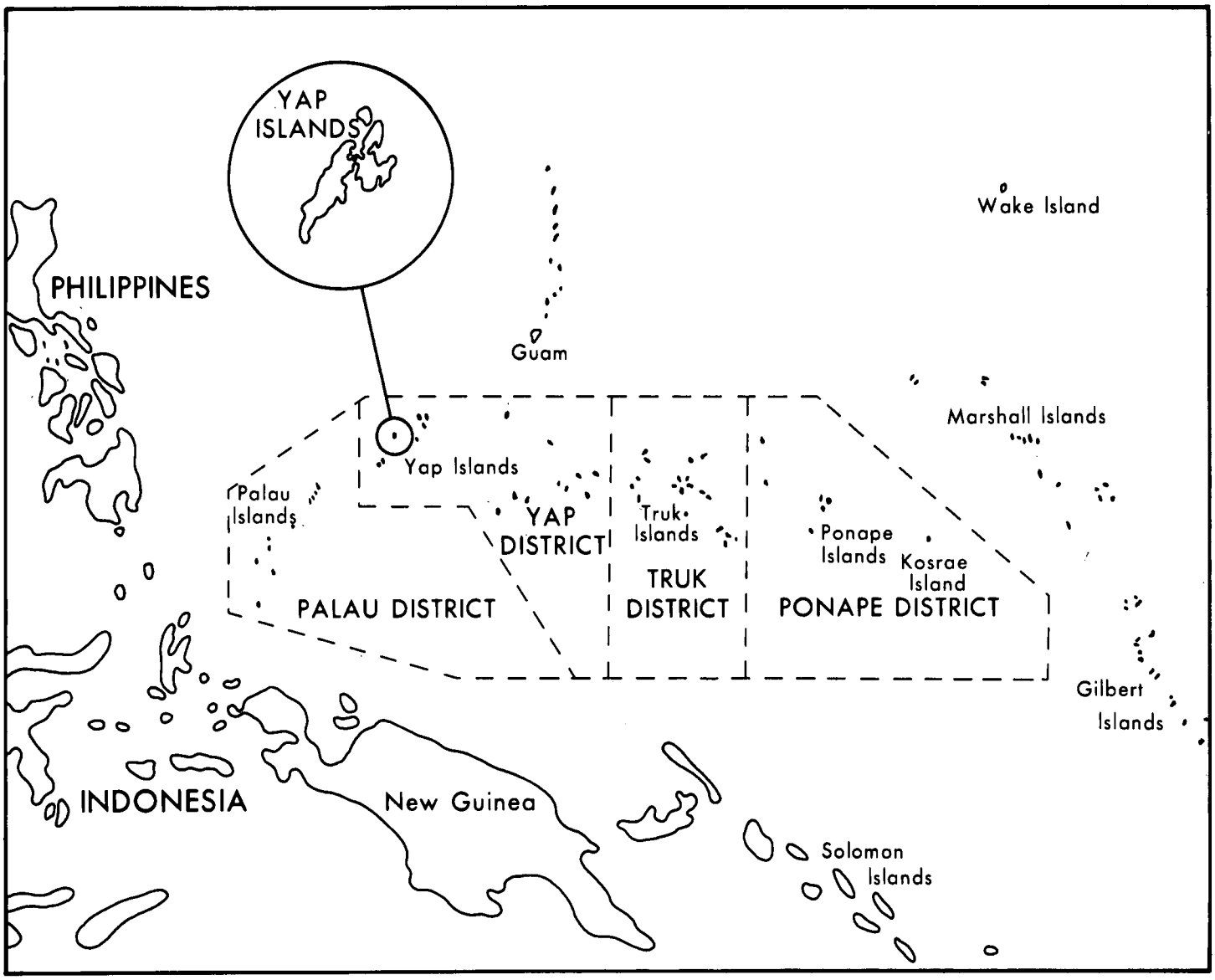
This soil survey contains information that can be used in land-planning programs in the Islands of Yap. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact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

This soil survey is designed for many different users. Farmers, ranchers, 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, and builders 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, 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, steep, shallow, 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 Yap State Department of Agriculture.

Jack P. Kanalz
State Conservationist, Hawaii
Soil Conservation Service



Location of the Islands of Yap, Federated States of Micronesia.

soil survey of
Islands of Yap
Federated States of Micronesia

By Christopher W. Smith, Soil Conservation Service

Fieldwork by Christopher W. Smith and Neil R. Babik,
Soil Conservation Service, with assistance from
John Pamm and others, Yap State Department of Agriculture

United States Department of Agriculture, Soil Conservation Service,
in cooperation with
United States Department of Agriculture, Forest Service;
United States Department of the Interior, Office of the
High Commissioner, Trust Territory of the Pacific Islands;
and University of Hawaii at Manoa, College of Tropical
Agriculture and Human Resources

The ISLANDS OF YAP, part of the Western Caroline Islands, is in the western part of the North Pacific Ocean. The survey area consists of Yap, Maap, Rumung, and Gagil Tamil Islands; Asor and Falalop Islands, within the Ulithi Atoll; and Fais Island. The islands of Yap, Maap, Gagil Tamil, and Rumung lie within a fringing reef system that is about 30 kilometers long and about 13 kilometers wide at its widest point. They are about 725 kilometers southwest of Guam and about 1,850 kilometers east-southeast of Manila in the Philippine Islands. Gagil Tamil is separated from Yap by a canal. The islands of Asor and Falalop are about 160 kilometers and the island of Fais about 225 kilometers east of the islands of Yap, Maap, Gagil Tamil, and Rumung. The survey area is about 130 square kilometers, or 11,280 hectares. Colonia, the capital, is on the east-central coast of Yap, the largest island. In 1980, the population of Yap was about 8,000.

The soils in the southern part of the island of Yap are mainly nearly level. They are on a dissected bench and are underlain by very soft volcanic breccia. The soils in the northern part are hilly and mountainous. They are underlain mainly by green, chlorite, and talc schist and amphibolite that are very hard to soft, but in a few areas they are underlain by weathered volcanic breccia. The soils in the northern and eastern parts of the island of Gagil Tamil are underlain by schist and conglomerate, and those in the southern part are on a highly dissected bench and are underlain by very soft volcanic breccia. The island of Maap is mostly hilly and is composed of schist and conglomerate with small, scattered areas of soft volcanic breccia. The coastline of the islands consists of rocky areas, sandy beaches, areas of alluvium, and peat soils that support mangrove forest vegetation.

Subsistence crop production is the main agricultural enterprise in the survey area. The major crops include cassava, taro, sweet potatoes, yams, bananas, and coconuts. Copra is produced intermittently, mainly on the coastal soils.

Soil scientists have determined that there are about 16 different kinds of soil in the survey area. The soils range widely in texture, natural drainage, depth, fertility, and other characteristics. The soils on the coral limestone

islands are nearly level, somewhat excessively drained, very deep, and sandy or are steep, well drained, shallow, and loamy and are associated with rock outcroppings. The upland soils are mostly nearly level to very steep, well drained or somewhat poorly drained, and fine textured. Most areas of these soils are well suited to the production of agricultural forest crops and to use as woodland. If careful management is used, these soils will also support a sustained yield of clean-tilled crops. The soils in some areas that are degraded or eroded can be reclaimed by reforestation.

The soils on bottom lands are level to nearly level, somewhat excessively drained to very poorly drained, and sandy, clayey, or mucky. They are mostly in small areas adjacent to the coast. The very poorly drained soils are well suited to the production of wetland taro. The somewhat excessively drained soils are well suited to the production of coconuts. Mangrove forests are in some areas along the coast.

A report entitled "Military Geology of Yap Islands, Caroline Islands," published in 1960, includes information on the soils in this survey area (*15*). The present survey updates this earlier report and provides additional information including crop suitability, management techniques, and larger maps that show the soils in greater detail.

climate

By the National Oceanic and Atmospheric Administration, United States Department of Commerce.

Between July and October the survey area is frequently under the influence of the intertropical convergence zone. During this period showers and light, variable winds dominate but are interspersed with heavier showers or thunderstorms and occasional strong, shifting winds. Thunderstorms are relatively infrequent, averaging two a month from August through December and 15 for the entire year.

Tropical cyclones affect this area much less often than they do areas in the Pacific Ocean further to the northwest. Most cyclones occur from June to December. Fully developed typhoons are uncommon near the area. Most of them pass to the north and then move westward to north-westward away from the area.

The survey area is under the influence of the northeast trade winds for 8 months of the year, November through June. From July through October the prevailing wind is southwesterly, with frequent periods of calm and of light, variable winds. This is also the wettest season, averaging more than 33 centimeters of rainfall per month. During February through April, the average monthly rainfall drops to less than 18 centimeters.

Temperature varies much less seasonally than between day and night. The average temperature of the warmest and coolest months differs by less than 1 degree C, as compared with a difference of nearly 7 degrees between the warmest and coolest times of the day.

Humidity is highest and clear skies are most frequent during the night and early in the morning. Cloudless days are rare. During May through December, morning fair weather clouds commonly build up late in the afternoon into towering cumulus clouds that give rise to showers in the evening and early the next morning. Visibility during such showers is seldom less than 5 miles.

Despite the relatively small size and low relief of the islands of Yap, Maap, Gagil Tamil, and Rumung, local differences in temperature, wind, humidity, and rainfall occur. Until March 1, 1968, when the office of the National Weather Service was moved to its present site, the station was on a narrow peninsula that projects southeastward into a reef- and shoreline-protected lagoon. The abruptness with which this peninsula rises from the lagoon is believed to have been responsible for recorded windspeeds considerably less than those observed in the open lagoon area. Since March 1968, observations have been taken at Yap Airfield in the southwestern part of the island. The exposure at this location, particularly with regard to the wind, is considered to be good.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, areas of savannah, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data

are assembled from other sources, such as test results, records, field experience, and local specialists.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, woodland managers, engineers, planners, developers and builders, and others.

The soil map and map units for the island of Fais were produced by interpreting the aerial photography of the island; by studying the results of fieldwork conducted on the islands of Anguar and Peleliu in Palau, which are similar to the island of Fais; and by discussing the characteristics of the island with Jesse Raglemar and John Lingmar of Fais and verifying the soil samples they collected.

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 and some minor soils. It is named for the major soils. The soils 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 can be identified on the map. Likewise, areas where the soils 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 11 map units in this survey have been grouped into four general kinds of landscape for broad interpretive purposes. Each of the broad groups and the map units in each group are described in the following pages.

map unit descriptions

upland soils underlain by volcanic material

This group consists of three map units. It makes up about 25 percent of this survey area. The soils in this group are level to steep. The vegetation is agricultural forest and deteriorated savannah.

The soils in this group are very deep and well drained. They formed in residuum derived dominantly from volcanic breccia and tuff.

This group is used for agricultural forest crops, homesites, and watershed.

1. Yap

Very deep, well drained, level to moderately steep soils; on dissected volcanic plateaus

This map unit is throughout the islands of Yap and Gagil Tamil. It is mainly on the top of dissected volcanic plateaus. Some areas are on side slopes in dissected areas. Slope is 0 to 30 percent. The vegetation on this unit is mainly agricultural forest.

This unit makes up about 14 percent of the survey area. It is about 80 percent Yap soils and 20 percent components of minor extent.

The Yap soils are on dissected volcanic plateaus. These soils are very deep and well drained. They formed in residuum derived dominantly from volcanic breccia and tuff. The surface is covered with a mat of forest litter. The surface layer is loamy, and the subsoil and substratum are clayey.

Of minor extent in this unit are Weloy, Rumung, and Gagil soils and very poorly drained Dechel soils.

This unit is used for farming and as homesites.

This unit is well suited to use as woodland and for agricultural forest crop production. The unit is poorly suited to the production of clean-tilled crops, which reduces soil fertility and the content of organic matter. If the unit is used as homesites and for roads, the main limitations are low soil strength, slope, and the hazard of erosion.

2. Gagil-Yap

Very deep, well drained, nearly level to steep soils; on hills and plateaus

This map unit is throughout the island of Gagil Tamil and in a small area of the island of Yap. It is mainly in areas on rounded hills that are subject to erosion, in drainageways on rounded hills, and on plateaus. Slope is 2 to 50 percent. The vegetation on the Gagil soils is mainly deteriorated savannah, and the vegetation on the Yap soils is mainly agricultural forest.

This unit makes up about 2 percent of the survey area. It is about 50 percent Gagil soils and 35 percent Yap soils. The remaining 15 percent is components of minor extent.

Gagil soils are mainly in areas on hillsides that are subject to erosion. These soils are very deep and well drained. They formed in residuum derived dominantly from volcanic breccia and tuff. The surface layer is loamy, the subsoil is clayey, and the substratum is loamy.

Yap soils are in drainageways and on plateaus. These soils are very deep and well drained. They formed in residuum derived dominantly from volcanic breccia and tuff. The surface is covered with a mat of forest litter. The surface layer is loamy, and the subsoil and substratum are clayey.

Of minor extent in this unit are Weloy soils and very poorly drained Dechel soils.

This unit is used as watershed, farmland, and homesites.

The Yap soils are well suited to moderately suited to agricultural forest crops and woodland, but the Gagil soils are poorly suited to these uses. If this unit is used as homesites and for roads, the main limitations are low soil strength, slope, and the hazard of erosion.

3. Gagil

Very deep, well drained, nearly level to steep soils; on dissected volcanic plateaus and hills

This map unit is on the island of Gagil Tamil. Slope is 2 to 50 percent. The vegetation is mainly deteriorated savannah.

This unit makes up about 9 percent of the survey area. It is about 85 percent Gagil soils and 15 percent components of minor extent.

The Gagil soils are on plateaus and hills. These soils are very deep and well drained. They formed in residuum derived dominantly from volcanic breccia and tuff. The surface layer is loamy, the subsoil is clayey, and the substratum is loamy.

Of minor extent in this unit are Weloy and Yap soils and very poorly drained Dechel soils.

This unit is used mainly as watershed.

This unit is poorly suited to farming, mainly because of very low soil fertility. If the unit is used as homesites and for roads, the main limitations are low soil strength, slope, and the hazard of erosion. The unit can be reforested.

upland soils underlain by schist

This group consists of two map units. It makes up about 49 percent of this survey area. The soils in this group are level to very steep. The vegetation in areas not cultivated is mainly tropical forest.

The soils in this group are shallow and moderately deep and are well drained and somewhat poorly drained. They formed in residuum derived dominantly from green, chlorite, and talc schist.

This group is used mainly as watershed and for farming. Some areas are used as woodland for village use.

4. Rumung-Weloy

Shallow and moderately deep, well drained, nearly level to very steep soils; on hills and mountains

This map unit is mainly on the hills and mountains of the islands of Yap and Rumung. Slope is 2 to 75 percent. The vegetation on this unit is mainly tropical forest. Some areas are under savannah vegetation.

This unit makes up about 39 percent of the survey area. It is about 45 percent Rumung soils and 35 percent Weloy soils. The remaining 20 percent is components of minor extent.

Rumung soils are on hills and mountains. These soils are shallow and well drained. They formed in residuum derived dominantly from green, chlorite, and talc schist. About 60 percent of the surface is covered with iron-coated schist gravel. The surface layer is gravelly and loamy. The subsoil is very gravelly and clayey. The substratum is extremely gravelly and clayey. Unweathered and weathered schist is at a depth of 48 centimeters.

Weloy soils are on hills and mountains. These soils are moderately deep and well drained. They formed in residuum derived dominantly from green, chlorite, and talc schist. The surface layer is gravelly and loamy, and the subsoil is gravelly and clayey. Weathered schist is at a depth of 56 centimeters.

Of minor extent in this unit are Yap soils and soils that are similar to the Weloy soils but are deeper, have a thicker surface layer, and have a higher or lower content of coarse fragments.

This unit is used mainly for farming and as watershed. Some areas are used as woodland for village use.

This unit is poorly suited to the production of clean-tilled crops, which reduces tilth and the content of organic matter. The unit is well suited to poorly suited to agricultural forest crops. The main limitations are slope and the hazard of erosion. The unit is well suited to moderately suited to use as woodland. If the unit is used as homesites and for roads, the main limitations are shallow depth to bedrock, slope, and the hazard of erosion.

5. Gitam

Moderately deep, somewhat poorly drained, level to strongly sloping soils; on toe slopes and upland plains

This map unit is throughout the islands of Yap, Maap, Gagil Tamil, and Rumung. Slope is 0 to 12 percent. The vegetation on this unit is mainly tropical forest and savannah.

This unit makes up about 10 percent of the survey area. It is about 85 percent Gitam soils and 15 percent components of minor extent.

Gitam soils are on toe slopes and plains. These soils are moderately deep and somewhat poorly drained. They formed in residuum derived dominantly from green, chlorite, and talc schist. From 10 to 80 percent of the surface is covered with gravel. The surface layer is very gravelly and loamy. The subsoil and substratum are clayey. Weathered schist is at a depth of 89 centimeters.

Of minor extent in this unit are well drained Weloy, Rumung, and Yap soils.

This unit is used for agricultural forest crops and as watershed.

This unit is poorly suited to clean-tilled crop production because of wetness and the high amount of coarse

fragments in the surface layer. The unit is suited to adapted agricultural forest crops. If the unit is used as homesites and for roads, the main limitations are wetness and low soil strength. Areas of the unit under savannah vegetation can be reforested.

soils on bottom lands

This group consists of five map units. It makes up about 24 percent of this survey area. The soils in this group are level to undulating. The vegetation is freshwater marsh, wetland taro, and agricultural forest.

The soils in this group are very deep and somewhat excessively drained to very poorly drained. They formed in alluvium and organic material.

This group is used for farming and as homesites.

6. Dechel

Very deep, very poorly drained, level and nearly level soils; on valley bottoms

This map unit typically is adjacent to the shore or is inland of beach deposits at or near the mouth of drainageways. Slope is 0 to 2 percent. The vegetation on this unit is mainly freshwater marsh and wetland taro. A few areas are under swamp forest.

This unit makes up about 5 percent of the survey area. It is about 80 percent Dechel soils and 20 percent components of minor extent.

Dechel soils are on valley bottoms. These soils are very deep and very poorly drained. They formed in alluvium derived dominantly from volcanic rock and schist. The surface is covered with a mat of organic material. The soils are clayey throughout.

Of minor extent in this unit are Mesei soils and moderately well drained Ngersuul Variant soils.

This unit is used for the production of wetland taro.

This unit is well suited to wetland taro production. The unit is poorly suited to most engineering uses because of wetness, the hazard of flooding, and low soil strength.

7. Ngedebus-Dublon Variant-Dublon

Very deep, somewhat excessively drained and somewhat poorly drained, level to undulating soils; adjacent to or near coastal beaches

This map unit is throughout the survey area. Slope is 0 to 4 percent. The vegetation is mainly agricultural forest.

This unit makes up about 3 percent of the survey area. It is about 35 percent Ngedebus soils, 30 percent Dublon Variant soils, and 25 percent Dublon soils. The remaining 10 percent is components of minor extent.

Ngedebus soils are adjacent to coastal beaches. These soils are very deep and somewhat excessively drained. They formed in alluvium derived dominantly from wind- and water-deposited coral sand. The soils are sandy throughout.

Dublon Variant soils are on coastal flats adjacent to Ngedebus soils. These soils are very deep and somewhat poorly drained. They formed in alluvium derived dominantly from volcanic rock and coral sand. The soils are loamy throughout.

Dublon soils are in coastal areas adjacent to the shore or to areas of the Ngedebus soils. These soils are very deep and somewhat poorly drained. They formed in alluvium derived dominantly from wind- and water-deposited coral sand. The soils are sandy throughout.

Of minor extent in this unit are very poorly drained, organic Ilachetomel soils.

This unit is used as homesites and for coconut production and subsistence farming.

This unit is well suited to moderately suited to coconut production. If the unit is used as homesites, the main limitation is the hazard of flooding.

8. Sonahnpil Variant-Ngersuul Variant

Very deep, somewhat poorly drained and moderately well drained, level to gently rolling soils; in narrow inland valleys, on fans near the coast, and on flood plains

This map unit is throughout the islands of Yap, Gagil Tamil, and Rumung. Slope is 0 to 8 percent. The vegetation is mainly agricultural forest.

This unit makes up about 3 percent of the survey area. It is about 55 percent Sonahnpil Variant soils and 25 percent Ngersuul Variant soils. The remaining 20 percent is components of minor extent.

Sonahnpil Variant soils are on flood plains between uplands and the coast. These soils are very deep and somewhat poorly drained. They formed in alluvium. The surface layer is extremely gravelly and loamy. Below this the soils are stratified loamy, clayey, and mucky material that is very gravelly and extremely gravelly.

Ngersuul Variant soils are in narrow inland valleys and on fans near the coast. These soils are very deep and moderately well drained. The upper 18 centimeters of the surface layer is loamy and very gravelly, and the lower 40 centimeters is clayey. The subsoil is clayey.

Of minor extent in this unit are the very poorly drained Dechel soils and soils that are similar to the Ngersuul Variant and Sonahnpil Variant soils but are better drained, are poorly drained, or have a higher or lower content of coarse fragments.

This unit is used for agricultural forest crops and as homesites.

This unit is well suited to moderately suited to agricultural forest crops. The unit is poorly suited to most engineering uses because of the hazard of flooding and low soil strength and the high water table of the Sonahnpil Variant soils.

9. Ngedebus-Ngedebus Variant

Very deep, somewhat excessively drained, level to undulating soils; adjacent to beaches and in the interior of atoll islands

This map unit is on the islands of Fais, Falalop, and Asor. Slope is 0 to 6 percent. The vegetation is mainly coconut trees, agricultural forest, and atoll forest.

This unit makes up about 1 percent of the survey area. It is about 50 percent Ngedebus soils and 40 percent Ngedebus Variant soils. The remaining 10 percent is components of minor extent.

Ngedebus soils are adjacent to coastal beaches on the island of Fais and throughout the islands of Falalop and Asor. These soils are very deep and somewhat excessively drained. They formed in alluvium derived dominantly from wind- and water-deposited coral sand. The soils are sandy throughout.

Ngedebus Variant soils are adjacent to coastal beaches and in the interior of the islands of Falalop and Asor. These soils are very deep and somewhat excessively drained. They formed in alluvium derived dominantly from wind- and water-deposited coral sand, gravel, and cobbles. The soils are sandy and extremely cobbly throughout.

Of minor extent in this unit are small areas of shallow organic soils that have a lense of freshwater at the surface and are used for wetland taro production, soils that have coral bedrock at a depth of 150 centimeters or less, and coastal beaches.

This unit is well suited to coconut production. If the unit is used as homesites, the main limitations are the hazard of flooding during high-intensity storms and the hazard of ground water contamination as a result of seepage from onsite waste disposal systems.

10. Ilachetomel

Very deep, very poorly drained, level and nearly level soils; in the intertidal zone adjacent to the shoreline

This map unit is scattered along the shoreline on the islands of Yap, Gagil Tamil, and Rumung. Slope is 0 to 1 percent. The vegetation is mainly mangrove forest.

This unit makes up about 12 percent of the survey area. It is about 75 percent Ilachetomel soils and 25 percent components of minor extent.

The Ilachetomel soils are in the intertidal zone adjacent to the shoreline. These soils are very deep and very poorly drained. They formed in organic material derived dominantly from mangrove roots and litter. The soils are peat and mucky peat throughout. These soils are flooded by seawater during high tide.

Of minor extent in this unit are small areas of soils that are mucky peat, peaty loamy sand, and mucky silt loam.

This unit is used as woodland for village use.

This unit is well suited to the production of mangrove forest species.

soils on high limestone islands

This group consists of one map unit. It makes up about 2 percent of this survey area. The soils in this group are level to extremely steep. The vegetation in areas not cultivated is mainly forest.

The soils in this group are shallow and well drained. They formed in residuum derived dominantly from coral limestone.

This group is used mainly for subsistence farming and as watershed. Some areas are used as woodland for village use. A few areas have been mined for phosphate.

11. Rock outcrop-Peleliu

Rock outcrop and shallow, well drained, level to very steep soils; on a raised coral limestone plateau and on hills

This map unit is on uplands on the island of Fais. Slope is 0 to 75 percent. The vegetation is mainly forest.

This unit makes up about 2 percent of the survey area. It is about 65 percent Rock outcrop and 25 percent Peleliu soils. The remaining 10 percent is components of minor extent.

Rock outcrop consists of flat areas that have been strip-mined for phosphate or of hilly to very steep, jagged, irregularly shaped areas of exposed limestone.

Peleliu soils are between the areas of Rock outcrop and on hills. These soils are shallow and well drained. They formed in residuum derived dominantly from coral limestone. From 75 to 100 percent of the surface is covered with cobbles and stones. The surface layer is loamy and extremely cobbly. The subsoil is loamy and very gravelly. Unweathered coral limestone is at a depth of 30 centimeters.

Of minor extent in this unit are soils that are similar to the Peleliu soils but are sandy.

This unit is used mainly for subsistence farming. Some areas are used as woodland for village use. The unit is poorly suited to most agricultural uses because of the shallow rooting depth and droughtiness.

detailed soil map units

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

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil 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 material, 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 material. They also can differ in slope, 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, Gagil silty clay loam, 2 to 6 percent slopes, is one of several phases in the Gagil series.

Some map units are made up of two major soils. These map units are called soil complexes.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Rumung-Weloy complex, 12 to 30 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description.

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

Table 1 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.

map unit descriptions

500—Dechel mucky silt loam, 0 to 2 percent slopes. This very deep, very poorly drained soil is on valley bottoms near sea level. It is in areas where water cannot drain freely into streams or the ocean. The soil formed in alluvium underlain by volcanic material and schist. Areas are long and narrow or irregular in shape and are 1 to 22 hectares in size. The vegetation in areas not cultivated is mainly freshwater marsh. Swamp forest is in a few areas.

Typically, the surface is covered with a mat of undecomposed and partially decomposed grasses and sedges 10 centimeters thick. The surface layer is dark gray mucky silt loam 10 centimeters thick. The upper 92 centimeters of the underlying material is olive gray, greenish gray, and dark greenish gray silty clay loam, the next 17 centimeters is dark greenish gray very gravelly silty clay loam, and the lower part to a depth of 168 centimeters is dark grayish brown silty clay loam.

Included in this unit are small areas of soils that are similar to this Dechel soil but are on dikes and levees that are better drained and support banana plants and coconut trees. Also included are small areas of Mesei soils and soils that are similar to Mesei soils but have a silt loam or silty clay loam substratum at a depth of less than 64 centimeters and areas of soils under swamp forest that typically have a water table at a depth of less than 10 centimeters. Included areas make up about 10 percent of the total hectarage.

Permeability of the Dechel soil is moderately slow. The effective rooting depth for water tolerant plants is more than 150 centimeters. Runoff is very slow or ponded, and the hazard of water erosion is slight. This soil is subject to frequent, brief periods of flooding and

deposition throughout the year. A high water table is 10 centimeters above the surface to 25 centimeters below the surface year-round.

This unit is used for the production of wetland taro.

This unit is well suited to the production of wetland taro. Maintaining a thick layer of organic material and proper fertilization increase the yields.

This unit is poorly suited to most engineering uses because of wetness, the hazard of flooding, and low soil strength. Roads constructed on the unit need large volumes of base material to compensate for the low strength of the soil.

This unit is well suited to ponds and reservoirs. Placing dam cores in contact with suitable material may be difficult because of the great depth of saturated alluvium in many areas.

501—Dublon loamy fine sand, 0 to 4 percent slopes. This very deep, somewhat poorly drained soil is on beaches. It formed in water- and wind-deposited sand derived dominantly from coral reefs. Areas are long and narrow in shape and are 2 to 28 hectares in size. The vegetation is mainly coconut trees and agricultural forest.

Typically, the surface layer is dark brown loamy fine sand 23 centimeters thick. The next layer is pale brown loamy fine sand 33 centimeters thick. The upper 20 centimeters of the underlying material is white and light gray sand, and the lower part to a depth of 150 centimeters or more is extremely gravelly coarse sand.

Included in this unit are small areas of Ngedebus and Dublon Variant soils. Also included are small areas of soils that are similar to this Dublon soil but have a water table at a depth of less than 38 centimeters. Included areas make up about 10 percent of the total hectarage.

Permeability of the Dublon soil is rapid. Effective rooting depth is 150 centimeters or more for water tolerant plants but is limited to depths between 38 and 90 centimeters for plants that are not water tolerant. Runoff is very slow, and the hazard of water erosion is slight. A high water table is at a depth of 38 to 90 centimeters year-round. Areas of this soil that are closest to the shore may be affected by sodium from saltwater. The soil is subject to occasional, very brief periods of flooding and deposition during high-intensity storms.

This unit is used for production of coconuts and subsistence agricultural forest crops and as homesites.

This unit is poorly suited to subsistence clean-tilled crop production and moderately suited to subsistence agricultural forest crop production. The main limitations are the hazard of flooding, low soil fertility, and wetness. Crop damage should be expected periodically because of saltwater flooding during high-intensity storms. The limitation of low soil fertility can be overcome by the use of compost and fertilizer. If clean-tilled crops are grown, use of mulch and crop rotation also helps to overcome the limitation of low soil fertility.

This unit is moderately suited to certain woodland species such as *Calophyllum inophyllum*.

If this unit is used for coconut production, the main limitation is low soil fertility. This limitation can be overcome by the use of small, frequent applications of complete fertilizer with micronutrients.

This unit is poorly suited to homesite development. The main limitations are wetness and the hazard of flooding.

502—Dublon Variant sandy clay loam, 0 to 4 percent slopes. This very deep, somewhat poorly drained soil is on coastal flats between the uplands and the coast. It formed in alluvium derived dominantly from wave-deposited coral sand, volcanic rock, and schist. Slopes are nearly level to gently undulating. Areas are long and narrow in shape and are 2 to 16 hectares in size. The vegetation is agricultural forest.

Typically, the surface layer is very dark grayish brown sandy clay loam 23 centimeters thick. The upper 45 centimeters of the underlying material is dark grayish brown sandy clay loam, and the lower part to a depth of 150 centimeters or more is dark grayish brown coarse sandy loam.

Included in this unit are small areas of Dechel, Dublon, Ngedebus, and Ngersuul Variant soils. The Dechel and Ngersuul Variant soils are near the landward edge of the unit, and the Ngedebus and Dublon soils are near the seaward edge of the unit. Also included are small areas of soils that are similar to this Dublon Variant soil but are shallower or deeper to a water table. Included areas make up about 25 percent of the total hectarage.

Permeability of the Dublon Variant soil is moderate. Effective rooting depth is 150 centimeters or more for water tolerant plants but is limited to depths between 30 and 120 centimeters for plants that are not water tolerant. Runoff is very slow, and the hazard of water erosion is slight. A high water table is at a depth of 30 to 120 centimeters year-round. This soil is subject to runoff and to very brief periods of flooding by waves and by runoff from adjacent uplands, particularly during the typhoon season.

This unit is used for subsistence agricultural forest crop production and as homesites.

This unit is poorly suited to subsistence clean-tilled crop production and moderately suited to subsistence agricultural forest crop production. If the unit is used for subsistence clean-tilled crops, the main limitations are low soil fertility, the hazard of flooding, and wetness. Using compost, fertilizer, and mulch and planting crops in hills or mounds in areas where depth to the water table is shallowest help to overcome these limitations. If the unit is used for subsistence agricultural forest crops, the main limitations are the hazard of flooding and wetness.

This unit is moderately suited to woodland species adapted to wetness such as *Calophyllum inophyllum* and *Eucalyptus*.

This unit is poorly suited to homesite development. The main limitations are wetness, low soil strength, and the hazard of flooding. If roads and buildings are constructed on the unit, the limitation of low soil strength can be overcome by using an adequate amount of crushed coral or basalt ballast. Allow the soil material to dry sufficiently before filling and compacting areas of this unit.

Septic tank absorption fields do not function properly on this unit because of flooding and wetness.

503—Gagil extremely gravelly loam, 2 to 12 percent slopes. This very deep, well drained soil is on plains and broad ridges of dissected old volcanic plateaus. It formed in residuum derived dominantly from volcanic breccia and tuff. Slopes are plane or slightly convex. Areas are irregular in shape and are 4 to 40 hectares in size. The vegetation is deteriorated savannah.

Typically, the surface layer is dark brown extremely gravelly loam 10 centimeters thick. The upper 20 centimeters of the subsoil is strong brown extremely gravelly clay loam and yellowish red very gravelly clay, and the lower 48 centimeters is yellowish red silty clay. The substratum to a depth of 150 centimeters or more is mottled, yellowish red, strong brown, and dark red, highly weathered volcanic breccia that crushes easily to silty clay.

Included in this unit are small areas of Yap silty clay loam under forest vegetation in concave areas, Gagil silty clay loam in drainageways, and soils that have slopes of less than 2 percent or more than 12 percent. Also included are small areas of gullied land. Included areas make up about 10 percent of the total hectarage.

Permeability of the Gagil soil is moderately rapid. Effective rooting depth is 150 centimeters or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

This unit is used as watershed.

This unit is poorly suited to the production of subsistence clean-tilled crops and very poorly suited to subsistence agricultural forest crops. If the unit is used for subsistence clean-tilled crops, the main limitations are droughtiness of the surface layer, very low soil fertility, and the hazard of erosion in the steeper areas. These limitations can be minimized by mulching, avoiding burning, rotating crops, and adding lime, compost, and fertilizer. Crops should be planted in furrows because of the droughty surface layer.

This unit is moderately suited to woodland species adapted to very low soil fertility. Planting tree seedlings so that the root zone is below the droughty surface layer reduces the hazard of wilting. Reforestation is needed.

This unit is well suited to homesite development. Preserving the existing plant cover during construction helps to control erosion. If roads and buildings are constructed on the unit, the limitation of low soil strength can be overcome by using an adequate amount of crushed coral or basalt ballast. Allow the soil material to dry sufficiently before filling and compacting areas of this unit.

504—Gagil silty clay loam, 2 to 6 percent slopes. This very deep, well drained soil is on low-lying foothills and broad ridges. It formed in residuum derived dominantly from volcanic breccia and tuff. Slopes are plane or slightly convex. Areas are irregular in shape and are 2 to 140 hectares in size. The vegetation is deteriorated savannah.

Typically, the surface layer is dark brown silty clay loam 10 centimeters thick. The subsoil is yellowish red silty clay 35 centimeters thick. The substratum to a depth of 150 centimeters or more is strong brown and dusky red, highly weathered volcanic breccia that crushes easily to silty clay loam.

Included in this unit are small areas of Yap silty clay loam under forest vegetation and poorly drained soils in drainageways. Also included are small, exposed areas of soft, weathered volcanic rock. Included areas make up about 5 percent of the total hectarage.

Permeability of the Gagil soil is moderately rapid. Effective rooting depth is 150 centimeters or more. Runoff is slow, and the hazard of water erosion is slight.

This unit is used as watershed.

This unit is poorly suited to the production of subsistence clean-tilled crops and very poorly suited to subsistence agricultural forest crops. If the unit is used for subsistence clean-tilled crops, the main limitation is very low soil fertility. This limitation can be minimized by mulching, avoiding burning, rotating crops, and adding lime, compost, and fertilizer.

This unit is moderately suited to woodland species adapted to very low soil fertility. Reforestation is needed.

This unit is well suited to homesite development. If roads and buildings are constructed on the unit, the limitation of low soil strength can be overcome by using an adequate amount of crushed coral or basalt ballast. Allow the soil material to dry sufficiently before filling and compacting areas of this unit.

505—Gagil silty clay loam, 6 to 12 percent slopes. This very deep, well drained soil is on the sides of highly dissected old volcanic plateaus. It formed in residuum derived dominantly from volcanic breccia and tuff. Slopes are plane or slightly convex. Areas are irregular in shape and are 1 to 16 hectares in size. The vegetation is deteriorated savannah.

Typically, the surface layer is dark brown silty clay loam 10 centimeters thick. The subsoil is yellowish red silty clay 35 centimeters thick. The substratum to a

depth of 150 centimeters or more is strong brown and dusky red, highly weathered volcanic breccia that crushes easily to silty clay loam.

Included in this unit are small areas of Yap silty clay loam under forest vegetation and poorly drained soils in drainageways. Also included are small exposed areas of soft, weathered volcanic rock and a few small areas of soils that have slopes of less than 6 percent or more than 12 percent. Included areas make up about 5 percent of the total hectarage.

Permeability of the Gagil soil is moderately rapid. Effective rooting depth is 150 centimeters or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

This unit is used as watershed.

This unit is poorly suited to the production of subsistence clean-tilled crops and very poorly suited to subsistence agricultural forest crops. If the unit is used for subsistence clean-tilled crops, the main limitations are very low soil fertility and the hazard of erosion. These limitations can be minimized by mulching, avoiding burning, rotating crops, and adding lime, compost, and fertilizer. All tillage should be on the contour or across the slope.

This unit is moderately suited to woodland species tolerant of very low soil fertility. Reforestation is needed.

This unit is well suited to homesite development. Preserving the existing plant cover during construction helps to control erosion. If roads and buildings are constructed on the unit, the limitation of low soil strength can be overcome by using an adequate amount of crushed coral or basalt ballast. Allow the soil material to dry sufficiently before filling and compacting areas of this unit.

506—Gagil silty clay loam, 12 to 30 percent slopes. This very deep, well drained soil is on the sides of highly dissected old volcanic plateaus. It formed in residuum derived dominantly from volcanic breccia and tuff. Slopes are convex. Areas are irregular in shape and are 2 to 20 hectares in size. The vegetation is deteriorated savannah.

Typically, the surface layer is dark brown silty clay loam 10 centimeters thick. The subsoil is yellowish red silty clay 35 centimeters thick. The substratum to a depth of 150 centimeters or more is strong brown and dusky red, highly weathered volcanic breccia that crushes easily to silty clay loam.

Included in this unit are small areas of Yap silty clay loam under forest vegetation, Rumung and Weloy soils, and poorly drained soils in drainageways. Also included are small, exposed areas of soft, weathered volcanic rock and a few small areas of soils that have slopes of less than 12 precent or more than 30 percent. Included areas make up about 10 percent of the total hectarage.

Permeability of the Gagil soil is moderately rapid. Effective rooting depth is 150 centimeters or more. Runoff is medium to rapid, and the hazard of water erosion is moderate.

This unit is used as watershed.

This unit is poorly suited to the production of subsistence clean-tilled crops and very poorly suited to subsistence agricultural forest crops. If the unit is used for subsistence clean-tilled crops, the main limitations are very low soil fertility and the hazard of erosion. These limitations can be minimized by mulching, avoiding burning, rotating crops, contour stripcropping, and adding lime, compost, and fertilizer.

This unit is moderately suited to woodland species tolerant of very low soil fertility. Reforestation is needed.

This unit is poorly suited to homesite development. The main limitation is slope. Preserving the existing plant cover during construction helps to control erosion. If roads and buildings are constructed on the unit, the limitation of low soil strength can be overcome by using an adequate amount of crushed coral or basalt ballast. Allow the soil material to dry sufficiently before filling and compacting areas of this unit. Septic tank filter fields should be located in the less sloping areas.

507—Gagil silty clay loam, 30 to 50 percent slopes. This very deep, well drained soil is on the sides of highly dissected old volcanic plateaus. It formed in residuum derived dominantly from volcanic breccia and tuff. Slopes are convex. Areas are irregular in shape and are 1 to 25 hectares in size. The vegetation is deteriorated savannah.

Typically, the surface layer is dark brown silty clay loam 10 centimeters thick. The subsoil is yellowish red silty clay 35 centimeters thick. The substratum to a depth of 150 centimeters or more is strong brown and dusky red volcanic breccia that crushes easily to silty clay loam.

Included in this unit are small areas of Yap silty clay loam under forest vegetation and poorly drained soils in drainageways. Also included are small, exposed areas of soft, weathered volcanic rock and a few small areas of soils that have slopes of less than 30 percent or more than 50 percent. Included areas make up about 15 percent of the total hectarage.

Permeability of the Gagil soil is moderately rapid. Effective rooting depth is 150 centimeters or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as watershed.

This unit is poorly suited to the production of subsistence clean-tilled crops and very poorly suited for subsistence agricultural forest crops. If the unit is used for subsistence clean-tilled crops, the main limitations are very low soil fertility, slope, and the hazard of erosion. These limitations can be minimized by mulching, avoiding burning, rotating crops, and adding lime, compost, and fertilizer.

This unit is moderately suited to woodland species adapted to very low soil fertility. Reforestation is needed.

This unit is poorly suited to homesite development. The main limitation is slope. Preserving the existing plant cover during construction helps to control erosion. If roads and buildings are constructed on the unit, the limitation of low soil strength can be overcome by using an adequate amount of crushed coral or basalt ballast. Allow the soil material to dry sufficiently before filling and compacting areas of this unit.

508—Gitam very gravelly silty clay loam, 0 to 2 percent slopes. This moderately deep, somewhat poorly drained soil is on toe slopes and upland plains. It formed in residuum derived dominantly from green, chlorite, and talc schist. Slopes are plane or slightly concave. Areas are irregular in shape and are 2 to 15 hectares in size. The vegetation is mainly tropical forest and brush. Cleared areas support savannah vegetation.

Typically, 10 to 80 percent of the surface is covered with gravel. The surface layer is dark brown very gravelly silty clay loam 15 centimeters thick. The subsoil is mottled, yellowish brown silty clay 21 centimeters thick. The substratum to a depth of 89 centimeters is greenish gray silty clay. Soft, weathered schist is at a depth of 64 to 100 centimeters.

Included in this unit are small areas of Weloy, Rumung, and Yap soils and soils that have slopes of more than 2 percent. Also included are small areas of soils that are similar to this Gitam soil but are 102 centimeters to more than 150 centimeters deep to bedrock. Included areas make up about 15 percent of the total hectarage.

Permeability of the Gitam soil is very slow. Effective rooting depth is 64 to 100 centimeters for water tolerant plants but is limited to depths between 30 and 75 centimeters for plants that are not water tolerant. Runoff is very slow, and the hazard of water erosion is slight. Water is perched above the bedrock year-round during most years. Some areas have been ditched and bedded. Areas under forest vegetation tend to be more fertile than areas under savannah vegetation.

This unit is used mainly for the production of subsistence agricultural forest and clean-tilled crops and as homesites. It is also used for wetland taro in small excavated areas.

This unit is poorly suited to subsistence clean-tilled crop production and moderately suited to subsistence agricultural forest crop production. If the unit is used for subsistence clean-tilled crops, the main limitations are wetness, the high content of coarse fragments, droughtiness of the surface layer, and low soil fertility. These limitations can be overcome by installing drainage ditches, mulching, raking aside surface gravel, adding compost and fertilizer, and rotating crops, and avoiding burning. If the unit is used for subsistence agricultural forest crops, the main limitation is wetness. This limitation can be overcome by planting tree species adapted to the wet subsoil.

This unit is well suited to certain woodland species adapted to wetness. These species include *Calophyllum inophyllum* and *Eucalyptus*. Reforestation is needed in areas of this unit under savannah vegetation.

This unit is poorly suited to homesite development. The main limitations are wetness, low soil strength, and very slow permeability. If roads and buildings are constructed on the unit, the limitation of low soil strength can be overcome by using an adequate amount of crushed coral or basalt ballast. Allow the soil material to dry sufficiently before filling and compacting areas of this unit. Using drain tiles or graveled ditches and placing pier and post foundations on bedrock reduce the hazard of differential settling.

Septic tank absorption fields do not function properly on this unit. The main limitations are wetness and depth to rock. Use of raised bed filter fields helps to overcome these limitations.

This unit is well suited to ponds and reservoirs.

509—Gitam very gravelly silty clay loam, 2 to 6 percent slopes. This moderately deep, somewhat poorly drained soil is on toe slopes and upland plains. It formed in residuum derived dominantly from green, chlorite, and talc schist. Slopes are plane or slightly concave. Areas are irregular in shape and are 8 to 50 hectares in size. The vegetation is mainly tropical forest and brush. Cleared areas support savannah vegetation.

Typically, 10 to 80 percent of the surface is covered with gravel. The surface layer is dark brown very gravelly silty clay loam 15 centimeters thick. The subsoil is mottled, yellowish brown silty clay 21 centimeters thick. The substratum to a depth of 89 centimeters is greenish gray silty clay. Soft, weathered schist is at a depth of 60 to 100 centimeters.

Included in this unit are small areas of Weloy, Rumung, and Yap soils and soils that have slopes of less than 2 percent or more than 6 percent. Also included are small areas of soils that are similar to this Gitam soil but are less than 100 centimeters or more than 150 centimeters deep to bedrock. Included areas make up about 15 percent of the total hectarage.

Permeability of the Gitam soil is very slow. Effective rooting depth is 60 to 100 centimeters for water tolerant plants but is limited to depths between 30 and 60 centimeters for plants that are not water tolerant. Runoff is slow, and the hazard of water erosion is slight. Water is perched above the bedrock year-round during most years. Some areas have been ditched and bedded. Areas of the soil under forest vegetation tend to be more fertile than those under savannah vegetation.

This unit is used mainly for the production of subsistence agricultural forest and clean-tilled crops and as homesites. It is also used for wetland taro in small excavated areas.

This unit is poorly suited to subsistence clean-tilled crop production and moderately suited to subsistence

agricultural forest crop production. If the unit is used for subsistence clean-tilled crops, the main limitations are wetness, the high content of coarse fragments, droughtiness of the surface layer, and low soil fertility. Installing drainage ditches along the contour, mulching, raking aside surface gravel, using compost and fertilizer, rotating crops, and avoiding burning help to overcome these limitations. If the unit is used for subsistence agricultural forest crops, the main limitation is wetness. This limitation can be overcome by planting tree species adapted to the wet subsoil.

This unit is well suited to certain woodland species adapted to wetness. These species include *Calophyllum inophyllum* and *Eucalyptus*. Reforestation is needed in areas of this unit under savannah vegetation.

This unit is poorly suited to homesite development. The main limitations are wetness, low soil strength, and very slow permeability. If roads and buildings are constructed on the unit, the limitation of low soil strength can be overcome by using an adequate amount of crushed coral or basalt ballast. Allow the soil material to dry sufficiently before filling and compacting areas of this unit. Using drain tiles or graveled ditches and placing pier and post foundations on the bedrock reduce the hazard of differential settling.

Septic tank absorption fields do not function properly on this unit. The main limitations are wetness and depth to rock. Use of raised bed filter fields helps to overcome these limitations.

This unit is well suited to ponds and reservoirs.

510—Gitam very gravelly silty clay loam, 6 to 12 percent slopes. This moderately deep, somewhat poorly drained soil is on toe slopes and upland plains. It formed in residuum derived dominantly from green, chlorite, and talc schist. Slopes are slightly concave. Areas are irregular in shape and are 2 to 15 hectares in size. The vegetation is mainly tropical forest and brush. Cleared areas support savannah vegetation.

Typically, 10 to 80 percent of the surface is covered with gravel. The surface layer is dark brown very gravelly silty clay loam 15 centimeters thick. The subsoil is mottled, yellowish brown silty clay 21 centimeters thick. The substratum to a depth of 89 centimeters is greenish gray silty clay. Soft, weathered schist is at a depth of 64 to 100 centimeters.

Included in this unit are small areas of Weloy, Rumung, and Yap soils and soils that have slopes of less than 6 percent or more than 12 percent. Also included are small areas of soils that are similar to this Gitam soil but are less than 64 centimeters or more than 100 centimeters deep to bedrock. Included areas make up about 15 percent of the total hectarage.

Permeability of the Gitam soil is very slow. Effective rooting depth is 64 to 100 centimeters for water tolerant plants but is limited to depths between 30 and 75 centimeters for plants that are not water tolerant. Runoff is medium, and the hazard of water erosion is moderate. Water is perched above the bedrock year-round during most years. Some areas have been ditched and bedded. Areas of this unit under forest vegetation tend to be more fertile than those under savannah vegetation.

This unit is used mainly for subsistence agricultural forest and clean-tilled crops and as homesites. It is also used for wetland taro in small excavated areas.

This unit is poorly suited to subsistence clean-tilled crop production and moderately suited to subsistence agricultural forest crop production. If the unit is used for subsistence clean-tilled crops, the main limitations are wetness, the high content of coarse fragments, droughtiness of the surface layer, low soil fertility, and the hazard of erosion. Installing drainage ditches along the contour, mulching, adding compost and fertilizer, rotating crops, and avoiding burning help to overcome these limitations. All tillage should be on the contour or across the slope.

If the unit is used for subsistence agricultural forest crops, the main limitation is wetness. This limitation can be overcome by planting tree species adapted to wetness.

This unit is moderately suited to certain adapted woodland species. The main limitations are wetness and the hazard of erosion. Adapted woodland species include *Calophyllum inophyllum* and *Eucalyptus*. Clearcutting should be avoided. Reforestation is needed in areas of this unit under savannah vegetation.

This unit is poorly suited to homesite development. The main limitations are wetness, low soil strength, and very slow permeability. If roads and buildings are constructed on this unit, the limitation of low soil strength can be overcome by using an adequate amount of crushed coral or basalt ballast. Allow the soil material to dry sufficiently before filling and compacting areas of this unit.

511—Ilachetomel peat, 0 to 1 percent slopes. This very deep, very poorly drained soil is in the intertidal area adjacent to the shoreline. It formed in decomposing roots and litter derived dominantly from mangrove trees. Areas are irregular in shape and are 1 to 116 hectares in size. The vegetation is mangrove forest.

Typically, the surface layer is black peat 20 centimeters thick. The next layer is very dark grayish brown peat 21 centimeters thick. Below this to a depth of 150 centimeters or more is very dark grayish brown peat and mucky peat.

Included in this unit are small areas of shallow and moderately deep peaty loamy sand on the lagoon side of the unit and very deep mucky silt loam on the landward side. Included areas make up about 25 percent of the total hectarage. The percentage varies from one area to another.

Permeability of this Ilachetomel soil is rapid. Effective rooting depth for saltwater tolerant plants is 150

centimeters or more. Runoff is very slow, and the hazard of water erosion by wave action is severe. The frequency, depth, and duration of tidal water floods and the salinity of the water vary greatly. Some areas of the soil near the lagoon are submerged year-round, and areas near the island are submerged only during high tide.

This unit is used as woodland and for wildlife habitat.

This unit is well suited to use as woodland. Suitable tree species are *Rhizophora mucronata*, *Rhizophora apiculata*, *Sonneratia alba*, *Lumnitzera littorea*, *Bruguiera gymnorhiza*, and *Xylocarpus granatum*. *Rhizophora mucronata* is used for firewood and produces a good quality charcoal; *Sonneratia alba* and *Bruguiera gymnorhiza* are used for posts; *Lumnitzera littorea* is used for cut timber and posts; and *Xylocarpus granatum* is used for handicrafts and decorations. The main concerns in harvesting timber are the hazards of erosion and soil degradation. Harvesting to the edge of the lagoon results in erosion by wave action.

This unit is poorly suited to onsite waste disposal systems because of wetness and the hazard of flooding, and the risk of contamination of the lagoon, resulting in a health hazard to swimmers and consumers of seafood taken from the area.

This unit is poorly suited to roads because of low soil strength, wetness, and daily periods of flooding. These limitations can be overcome by placing crushed coral or basalt ballast down to the bedrock and by elevating the surface of the road to about 1 meter above the mean high tide level.

512—Mesei mucky peat, 0 to 1 percent slopes. This very deep, very poorly drained soil is on valley bottoms near sea level. It is in areas where water cannot drain freely into streams or the ocean. The soil formed in deposits of organic material overlying alluvium derived dominantly from volcanic rock and schist. Areas are long and narrow or irregular in shape and are 1 to 18 hectares in size. The vegetation is mainly freshwater marsh.

The surface layer is dark brown mucky peat 12 centimeters thick. The next layer is very dark grayish brown mucky peat 74 centimeters thick. Below this to a depth of 150 centimeters or more is dark gray silt loam.

Included in this unit are small areas of soils on dikes and levees that are better drained and support banana plants and coconut trees. Also included are small areas of Dechel soils and soils that are similar to this Mesei soil but are silt loam or silty clay loam at a depth of 100 centimeters or more. Included areas make up about 10 percent of the total hectarage.

Permeability of the Mesei soil is moderately slow. The effective rooting depth for water tolerant plants is more than 150 centimeters. Runoff is very slow or ponded, and the hazard of water erosion is slight. This soil is subject to frequent, brief periods of flooding year-round. A high water table is 30 centimeters above the surface to 15 centimeters below the surface year-round.

Most areas of this unit are used for wildlife habitat. A few areas are used for the production of wetland taro.

This unit is well suited to the production of wetland taro. Yields can be increased by proper fertilization.

This unit is poorly suited to most engineering uses because of wetness, the hazard of flooding, and low soil strength. Roads constructed on the unit need large volumes of base material to compensate for the low strength of the soil.

This unit is well suited to ponds and reservoirs. Keying in dam cores to suitable material may be difficult because of the great depth of saturated alluvium in some areas.

513—Ngedebus sand, 0 to 4 percent slopes. This very deep, somewhat excessively drained soil is adjacent to coastal beaches and in the interior of atoll islands. It formed in water- and wind-deposited coral sand. Slopes are slightly convex or hummocky. Areas are irregular or long and narrow in shape and are 2 to 20 hectares in size. The vegetation is atoll forest and agricultural forest.

Typically, the surface layer is mixed grayish brown and very pale brown sand 46 centimeters thick. The underlying material to a depth of 150 centimeters or more is pale yellow and very pale brown sand and coarse sand.

Included in this unit are small areas of Ngedebus Variant soils and soils that are similar to this Ngedebus soil but do not have a dark-colored surface layer. Also included are small areas of Dublon soils in depressional areas and soils that have slopes of more than 4 percent. Included areas make up about 15 percent of the total hectarage.

Permeability of the Ngedebus soil is rapid. Effective rooting depth is 150 centimeters or more. Runoff is very slow, and the hazard of water erosion is slight. A water table is at a depth of 100 to 150 centimeters or more. Areas of the soil that are closest to the shore may be affected by sodium from saltwater. The soil is subject to occasional periods of flooding by saltwater.

This unit is used mainly for coconut production and subsistence farming. Some areas are used as woodland for village use. A few areas are used for homesite development and as recreational sites.

This unit is poorly suited to subsistence clean-tilled crop production. It is moderately suited to most subsistence agricultural forest crop production but is well suited to coconut production. If the unit is used for crops, the main limitations are low soil fertility and droughtiness. These limitations can be overcome by adding large quantities of compost and fertilizer.

If this unit is used for the production of coconuts, nitrogen and potassium should be added to the soil. A sufficient amount of potassium increases the number of

coconuts per tree and the copra content. Broadcast application of potassium fertilizer is the most efficient method. A good source of potassium is ashes from wood and coconut husks. A legume cover crop, seeded between the trees, provides some nitrogen. The soil in this unit commonly is also low in iron, zinc, and manganese. Annual additions of ferrous, zinc, and manganese sulfate by trunk injection or spot placement in the root zone may be needed.

This unit is well suited to use as woodland. Trees are subject to windthrow during typhoons, especially in areas adjacent to beaches.

This unit is poorly suited to homesite development. The main limitation is the hazard of flooding during typhoons. This limitation can be reduced by building structures on a raised foundation.

This unit is well suited to use as roadfill and as a source of sand.

This unit is poorly suited to septic tank absorption fields. The main limitation is poor filtration, which may result in contamination of ground water.

514—Ngedebus Variant very gravelly loamy sand, 0 to 6 percent slopes. This very deep, somewhat excessively drained soil is on beach deposits, some of which are raised. It formed in water- and wind-deposited coral sand, gravel, and cobbles. Areas are irregular in shape and are 8 to 132 hectares in size. The vegetation is agricultural forest and some atoll forest.

Typically, the surface layer is mixed very dark brown and pale brown very gravelly loamy sand 12 centimeters thick. The subsurface layer is mixed dark brown and brown extremely cobbly loamy sand 24 centimeters thick. The underlying material to a depth of 150 centimeters or more is mixed pinkish gray and brown extremely cobbly loamy sand.

Included in this unit are small areas of Ngedebus soils, soils that have coral bedrock at a depth of 150 centimeters or less, soils that have a high water table, soils near the airstrip on the island of Falalop that are peaty muck and have been developed for the production of wetland taro, and narrow cobbly beaches. Included areas make up about 15 percent of the total hectarage.

Permeability of the Ngedebus Variant soil is rapid. Effective rooting depth is 150 centimeters or more. Runoff is very slow, and the hazard of water erosion is slight. This soil is subject to erosion and deposition during typhoons. Areas of the soil closest to the shore may be affected by sodium and other salts from saltwater.

This unit is used mainly for copra production and subsistence farming. Some areas are used as woodland for village use.

This unit is very poorly suited to subsistence clean-tilled crop production and moderately suited to subsistence agricultural forest crop production. The main limitations are the high content of coarse fragments, low soil fertility, and low available water capacity.

If this unit is used for the production of coconuts, nitrogen and potassium should be added to the soil. A sufficient amount of potassium increases the number of coconuts per tree and the copra content. Broadcast application of potassium fertilizer is the most efficient method. A good source of potassium is ashes from wood and coconut husks. A legume cover crop, seeded between the trees, provides some nitrogen. The soil in this unit commonly is also low in iron, zinc, and manganese. Annual additions of ferrous, zinc, and manganese sulfate by trunk injection or spot placement in the root zone may be needed. Excavation for the planting of coconut trees is difficult and time-consuming because of the high content of coarse fragments.

This unit is moderately suited to use as woodland.

This unit is poorly suited to homesite development because of the high content of coarse fragments and the hazard of flooding during typhoons. Because of the hazard of flooding, buildings should be constructed on a raised foundation. Coarse fragments on the surface and in the soil make excavation difficult.

This unit is poorly suited to septic tank absorption fields. The main limitations are the high content of coarse fragments, which makes excavation difficult, and poor filtration, which may result in contamination of ground water.

515—Ngersuul Variant silty clay loam, 2 to 8 percent slopes. This very deep, moderately well drained soil is in narrow inland valleys and on fans near the coast. It formed in alluvium derived dominantly from schist. Slopes are undulating. Areas are irregular in shape and are 1 to 20 hectares in size. The vegetation is agricultural forest.

Typically, the surface is covered with a mat of forest litter 2 centimeters thick. The surface layer is dark grayish brown silty clay loam 18 centimeters thick. The subsurface layer is olive brown and olive very gravelly clay 58 centimeters thick. The subsoil is strong brown and greenish gray clay 63 centimeters thick. The substratum to a depth of 160 centimeters or more is strong brown and greenish gray silty clay.

Included in this unit are small areas of Dechel soils at the lower elevations and soils that are similar to this Ngersuul Variant soil but are somewhat poorly drained. Also included are small areas of soils that are less than 35 percent coarse fragments throughout. Included areas make up about 25 percent of the total hectarage.

Permeability of the Ngersuul Variant soil is very slow. Effective rooting depth is 160 centimeters or more. Runoff is very slow, and the hazard of water erosion is slight. This soil is subject to rare periods of flooding year-round during heavy storms.

Most areas of this unit are used for subsistence agricultural forest crop production. A few areas are used

as homesites. Wetland taro is produced in small excavated areas.

This unit is poorly suited to subsistence clean-tilled crop production and well suited to subsistence agricultural forest crop production. The main limitations are low soil fertility and the hazard of flooding. Adding compost and fertilizer and mulching help to overcome the limitation of low soil fertility. All tillage should be on the contour or across the slope.

This unit is well suited to use as woodland. The main limitation is low soil fertility.

This unit is poorly suited to homesite development. The main limitations are low soil strength and the hazard of flooding. If roads and buildings are constructed on the unit, the limitation of low soil strength can be overcome by using an adequate amount of crushed coral or basalt ballast. Allow the soil material to dry sufficiently before filling and compacting areas of this unit.

Septic tank absorption fields do not function properly on this unit because of the very slow permeability. Increasing the size of the absorption field helps to overcome this limitation. Place leach lines on the contour, and avoid using pit leaching wherever possible.

516—Peleliu extremely cobbly silt loam, 0 to 8 percent slopes. This shallow, well drained soil is on the raised coral limestone island of Fais. It formed in residuum derived dominantly from coral limestone. Slopes are level to undulating. Areas are irregular or long and narrow in shape. The vegetation is mainly forest. Cleared areas support sparse grasses and woody shrubs.

Typically, 75 to 100 percent of the surface is covered with cobbles and stones. The surface layer is very dark grayish brown extremely cobbly silt loam 12 centimeters thick. The subsoil is dark brown very gravelly loam 18 centimeters thick. Coral limestone is at a depth of 30 centimeters. Bedrock is at a depth of 25 to 50 centimeters.

Included in this unit are small areas of soils that are similar to this Peleliu soil but are less than 25 centimeters or more than 50 centimeters deep to bedrock and are less than 35 percent coarse fragments. Also included are small areas of soils that have slopes of more than 8 percent and small areas of limestone rock outcroppings.

Permeability of the Peleliu soil is moderately rapid. Effective rooting depth is 25 to 50 centimeters. Runoff is slow, and the hazard of water erosion is slight.

This unit is used mainly for subsistence agricultural forest crops. Some areas used as woodland for village use.

This unit is poorly suited to most crops. The main limitations are the shallow rooting depth and coarse fragments on the surface and in the soil. The shallow rooting depth reduces the yield of deep-rooted crops. Cobbles and gravel on the surface impede cultivation. Garden plots may be improved by clearing loose cobbles, adding topsoil, and adding compost and commercial fertilizer. Fertilizer should be added frequently in small quantities so that losses by leaching are minimized.

This unit is moderately suited to use as woodland. The main limitations are the shallow rooting depth and low available water capacity. Trees are subject to windthrow because of the shallow rooting depth.

This unit is poorly suited to homesite development. The main limitation is the shallow depth to bedrock, which makes excavation difficult. The unit is well suited to foundations and footings. Seepage from onsite sewage disposal systems installed in excavations in the bedrock or in raised beds may contaminate ground water.

517—Peleliu-Rock outcrop complex, 15 to 75 percent slopes. This map unit is in the higher lying areas of the raised coral limestone island of Fais. Areas are irregular in shape and are as much as 69 hectares in size. The vegetation is mainly forest. Cleared areas support various legumes and woody shrubs.

This unit is 60 percent Peleliu soils and 25 percent Rock outcrop.

Included in this unit are small areas of soils that are similar to this Peleliu soil but are less than 25 centimeters or more than 50 centimeters deep to bedrock and are less than 35 percent coarse fragments, or are very gravelly sand.

The Peleliu soil is shallow and well drained. It formed in residuum derived dominantly from coral limestone. Typically, 75 to 100 percent of the surface is covered with cobbles and stones. The surface layer is very dark grayish brown extremely cobbly silt loam 12 centimeters thick. The subsoil is dark brown very gravelly loam 18 centimeters thick. Coral limestone is at a depth of 30 centimeters. Depth to limestone ranges from 25 to 50 centimeters.

Permeability of the Peleliu soil is moderately rapid. Effective rooting depth is 25 to 50 centimeters. Runoff is slow to rapid, and the hazard of water erosion is moderate to high.

Rock outcrop is mostly hilly to very steep, jagged, and irregularly shaped areas of exposed coral limestone and small amounts of silt and clay that have been cemented by secondary carbonates. In most areas the limestone is porous and fractured, which allows roots to penetrate into the rock.

This unit is used mainly as watershed and for subsistence farming and phosphate mining. Some areas are used as woodland for village use.

This unit is poorly suited to most crops. The main limitations are the shallow rooting depth, coarse fragments on the surface and in the soil, and the areas of Rock outcrop. The shallow rooting depth reduces the yield of deep-rooted crops. Cobbles and gravel on the

surface and the areas of Rock outcrop impede cultivation. Garden plots may be improved by clearing loose cobbles, adding topsoil, and adding compost and commercial fertilizer. Fertilizer should be added frequently in small quantities to reduce losses by leaching.

This unit is poorly suited to use as woodland. The main limitations are shallow rooting depth, slope, and restricted available water capacity.

This unit is poorly suited to homesite development. The main limitation is the shallow depth to bedrock, which makes excavation difficult. The unit is well suited to foundations and footings. Seepage from onsite sewage disposal systems installed in excavations in the bedrock or in raised beds may contaminate ground water.

518—Rock outcrop, phosphate strip mine. This map unit is in the raised, central part of the island of Fais that formerly was used for phosphate mining. Slope is nearly level. The vegetation consists of sparse stands of grasses and shrubs.

The Rock outcrop consists of hard, fractured, and porous phosphate rock and coral limestone. The fractures are less than 3 centimeters wide, 1 meter apart, and 0.5 meter deep. Sandy or loamy soil material that varies in content of organic matter is in the fractures.

This unit may be reclaimed for farming by ripping the exposed rock with heavy equipment, rolling and crushing the fragments to a mixture of sand- and gravel-sized particles, and adding large amounts of compost. Small, frequent applications of commercial fertilizer that contains trace elements but no phosphorus are also needed.

When crushed to a powder, the phosphate rock may be suitable for use as fertilizer without further processing. The suitability can be determined by testing samples of the material for its citrate solubility.

519—Rumung-Weloy complex, 12 to 30 percent slopes. This map unit is on low-lying foothills. Slopes are convex. Areas are irregular in shape and are 2 to 100 hectares in size. The vegetation is mainly tropical forest. Cleared areas support savannah vegetation.

This unit is 45 percent Rumung gravelly silt loam and 35 percent Weloy gravelly silty clay loam.

Included in this unit are about 10 percent Gitam soils in the more nearly level areas. Also included are small areas of severely eroded soils on ridgetops, Rock outcrop that is mostly in grassland areas, poorly drained alluvial soils in drainageways, soils that have slopes of less than 12 percent or more than 30 percent, and Yap soils. Included areas make up about 20 percent of the total hectarage. The percentage varies from one area to another.

The Rumung soil is shallow and well drained. It formed in residuum derived dominantly from green, chlorite, and talc schist. Typically, 50 to 70 percent of the surface is covered with iron-coated schist gravel. The surface layer is dark brown gravelly silt loam 10 centimeters thick. The subsoil is strong brown very gravelly clay 18 centimeters thick. The substratum to a depth of 48 centimeters is pale olive extremely gravelly clay. Hard and soft, pale green schist is at a depth of 48 centimeters. Depth to bedrock is 25 to 50 centimeters. In some areas the surface layer is gravelly clay loam, gravelly silty clay loam, or very gravelly silt loam.

Permeability of the Rumung soil is moderate. Effective rooting depth is 25 to 50 centimeters. Runoff is medium to rapid, and the hazard of water erosion is moderate to high.

The Weloy soil is moderately deep and well drained. It formed in residuum derived dominantly from green, chlorite, and talc schist. Typically, the surface is covered with a mat of undecomposed and partially decomposed forest litter 3 centimeters thick. The surface layer is very dark grayish brown gravelly silty clay loam 10 centimeters thick. The subsurface layer is dark brown very gravelly clay loam 23 centimeters thick. The subsoil is yellowish brown and dark yellowish brown very gravelly clay 23 centimeters thick. Hard and soft, light olive brown and grayish green schist is at a depth of 56 centimeters. Bedrock is at a depth of 50 to 62 centimeters.

Permeability of the Weloy soil is moderate. Effective rooting depth is 50 to 62 centimeters. Runoff is medium to rapid, and the hazard of water erosion is moderate to high. Areas of this unit under savannah vegetation generally are lower in organic matter content and fertility than areas under forest vegetation.

Most areas of this unit are used mainly as watershed. Some areas are used as woodland for village use. A few areas are used for subsistence clean-tilled crop production.

This unit is poorly suited to subsistence clean-tilled crop production and well suited to subsistence agricultural forest crop production. If the unit is used for subsistence clean-tilled crops, the main limitations are the hazards of erosion and soil degradation, low soil fertility, the large amount of coarse fragments, and the shallow rooting depth and droughtiness of the Rumung soil. Mulching, avoiding burning, adding compost and fertilizer, and rotating crops reduce erosion and increase fertility. All tillage should be on the contour or across the slope. If the unit is used for subsistence agricultural forest crops, competition from understory vegetation should be reduced and all residue should be returned to the soil.

This unit is moderately suited to use as woodland. The main limitations are low soil fertility, slope, the hazard of erosion, and the shallow rooting depth and droughtiness

of the Rumung soil. Reforestation is needed in areas under savannah vegetation.

This unit is poorly suited to homesite development. The main limitations are the depth to hard rock, slope, the hazard of erosion, and low soil strength. Preserving the existing plant cover during construction helps to control erosion. If roads and buildings are constructed on the unit, the limitation of low soil strength can be overcome by using adequate crushed coral or basalt ballast. Allow the soil material to dry sufficiently before filling and compacting areas of this unit.

This unit is very poorly suited to septic tank absorption fields because of the depth to rock and slope.

520—Rumung-Weloy complex, 30 to 50 percent slopes. This map unit is on mountains and hills. Slopes are convex. Areas are irregular in shape and are 2 to 40 hectares in size. The vegetation is mainly tropical forest. Cleared areas support savannah vegetation.

This unit is 45 percent Rumung gravelly silt loam and 35 percent Weloy gravelly silty clay loam.

Included in this unit are small areas of Yap and Gitam soils in depressional areas, soils that have slopes of less than 30 percent, Weloy soils that have a thicker surface layer, soils that are similar to the Rumung and Weloy soils but do not have a clayey subsoil, and soils that have been ditched and bedded. Also included are a few areas of soils that have a lower or higher content of coarse fragments than is typical for the Rumung and Weloy soils. Included areas make up about 20 percent of the total hectarage. The percentage varies from one area to another.

The Rumung soil is shallow and well drained. It formed in residuum derived dominantly from green, chlorite, and talc schist. Typically, 50 to 70 percent of the surface is covered with iron-coated schist gravel. The surface layer is dark brown gravelly silt loam 10 centimeters thick. The subsoil is strong brown very gravelly clay 18 centimeters thick. The substratum to a depth of 48 centimeters is pale olive extremely gravelly clay. Hard and soft, pale green schist is at a depth of 48 centimeters. Bedrock is at a depth of 25 to 50 centimeters.

Permeability of the Rumung soil is moderate. Effective rooting depth is 25 to 50 centimeters. Runoff is rapid, and the hazard of water erosion is high.

The Weloy soil is moderately deep and well drained. It formed in residuum derived dominantly from green, chlorite, and talc schist. Typically, the surface is covered with a mat of undecomposed and partially decomposed forest litter 2 centimeters thick. The surface layer is very dark grayish brown gravelly silty clay loam 10 centimeters thick. The subsurface layer is dark brown very gravelly clay loam 23 centimeters thick. The subsoil is yellowish brown and dark yellowish brown very gravelly clay 23 centimeters thick. Hard and soft, light olive brown and grayish green schist is at a depth of 56 centimeters. Depth to bedrock is 50 to 62 centimeters.

Permeability of the Weloy soil is moderate. Effective rooting depth is 50 to 62 centimeters. Runoff is rapid, and the hazard of water erosion is high. Areas of this unit under savannah vegetation generally are lower in organic matter content and fertility than areas under forest vegetation.

Most areas of this unit are used as watershed. Some areas are used as woodland for village use. A few areas are used for subsistence clean-tilled crop production.

This unit is poorly suited to subsistence clean-tilled crop production and well suited to subsistence agricultural forest crop production. If the unit is used for subsistence clean-tilled crops, the main limitations are the hazards of erosion and soil degradation, low soil fertility, the high content of coarse fragments, and the shallow rooting depth and droughtiness of the Rumung soil. Mulching, avoiding burning, adding compost and fertilizer, rotating crops, and contour stripcropping reduce erosion and increase fertility. If the unit is used for subsistence agricultural forest crops, competition from understory vegetation should be reduced and all residue should be returned to the soil.

This unit is poorly suited to use as woodland. The main limitations are the shallow rooting depth and droughtiness of the Rumung soil, low soil fertility, slope, and the hazard of erosion. Reforestation is needed in areas under savannah vegetation.

This unit is poorly suited to homesite development. The main limitations are the shallow depth to hard rock in the Rumung soil, slope, the hazard of erosion, and low soil strength. Preserving the existing plant cover during construction helps to control erosion. If roads and buildings are constructed on this unit, the limitation of low soil strength can be overcome by using an adequate amount of crushed coral or basalt ballast. Allow the soil material to dry sufficiently before filling and compacting areas of this unit.

This unit is very poorly suited to septic tank absorption fields because of slope and depth to rock.

521—Rumung-Weloy complex, 50 to 75 percent slopes. This map unit is on mountains and hills. Slopes are convex. Areas are irregular in shape and are 2 to 34 hectares in size. The vegetation is mainly tropical forest. Cleared areas support savannah vegetation.

This unit is 50 percent Rumung gravelly silt loam and 30 percent Weloy gravelly silty clay loam.

Included in this unit are small areas of Weloy soils that have a thicker surface layer, soils that are similar to the Rumung and Weloy soils but do not have a clayey subsoil, and soils that have been ditched and bedded. Also included are a few areas of soils that have a lower or higher content of coarse fragments than is typical of the Rumung and Weloy soils. Included areas make up about 20 percent of the total hectarage. The percentage varies from one area to another.

The Rumung soil is shallow and well drained. It formed in residuum derived dominantly from green, chlorite, and talc schist. Typically, 50 to 70 percent of the surface is covered with iron-coated schist gravel. The surface layer is dark brown gravelly silt loam 10 centimeters thick. The subsoil is strong brown very gravelly clay 18 centimeters thick. The substratum to a depth of 48 centimeters is pale olive extremely gravelly clay. Hard and soft, pale green schist is at a depth of 48 centimeters. Bedrock is at a depth of 25 to 50 centimeters. In some areas the surface layer is gravelly clay loam, gravelly silty clay loam, or very gravelly silt loam.

Permeability of the Rumung soil is moderate. Effective rooting depth is 25 to 50 centimeters. Runoff is very rapid, and the hazard of water erosion is very high.

The Weloy soil is moderately deep and well drained. It formed in residuum derived dominantly from green, chlorite, and talc schist. Typically, the surface is covered with a mat of undecomposed and partially decomposed forest litter 2 centimeters thick. The surface layer is very dark grayish brown gravelly silty ciay loam 10 centimeters thick. The subsurface layer is dark brown very gravelly clay loam 23 centimeters thick. The subsoil is yellowish brown and dark yellowish brown very gravelly clay 23 centimeters thick. Hard and soft, light olive brown and grayish green schist is at a depth of 56 centimeters. Bedrock is at a depth of 50 to 62 centimeters.

Permeability of the Weloy soil is moderate. Effective rooting depth is 50 to 62 centimeters. Runoff is very rapid, and the hazard of water erosion is very high. Areas of this unit under savannah vegetation generally are eroded and are lower in organic matter content and fertility than areas under forest vegetation.

Most areas of this unit are used mainly as watershed. Some areas are used as woodland for village use. A few areas are used for subsistence clean-tilled crop production.

This unit is poorly suited to subsistence clean-tilled crop production and moderately suited to subsistence forest crop production. If the unit is used for subsistence clean-tilled crops, the main limitations are slope, the hazards of erosion and soil degradation, low soil fertility, the high content of coarse fragments, and the shallow rooting depth and droughtiness of the Rumung soil. Mulching, adding compost and fertilizer, avoiding burning, and rotating crops reduce erosion and increase fertility. If the unit is used for subsistence agricultural forest crops, the main limitations are slope and the hazard of erosion. The risk of erosion can be reduced by clearing only small areas prior to planting seedlings. Competition from understory vegetation should be reduced, and all residue should be returned to the soil.

This unit is poorly suited to use as woodland. The main limitations are the droughtiness of the Rumung soil, low soil fertility, slope, and the hazard of erosion. Reforestation is needed in areas of this unit under savannah vegetation.

This unit is poorly suited to homesite development. The main limitations are the shallow depth to hard rock in the Rumung soil, slope, and the hazard of erosion.

This unit is very poorly suited to septic tank absorption fields. The main limitations are slope and depth to rock.

522—Sonahnpil Variant extremely gravelly silt loam, 0 to 4 percent slopes. This very deep, somewhat poorly drained soil is on flood plains between the uplands and the coast. It formed in alluvium. Slopes are nearly level to gently undulating. Areas are long and narrow or irregular in shape and are 2 to 20 hectares in size. The vegetation is mainly agricultural forest.

Typically, the surface layer is very dark gray extremely gravelly silt loam 15 centimeters thick. The next 31 centimeters is olive brown extremely gravelly silty clay. Below this is a buried surface layer of dark grayish brown very gravelly silt loam about 18 centimeters thick. The next layer is a buried substratum of light olive brown extremely gravelly silty clay about 17 centimeters thick. Below this to a depth of 158 centimeters or more is dark gray very gravelly mucky silt loam.

Included in this unit are small areas of Dechel soils in the lower lying areas and soils that are similar to this Sonahnpil Variant soil but are poorly drained, moderately well drained, or well drained. Also included are small areas of Ngersuul Variant and Dublon Variant soils. Included areas make up about 15 percent of the total hectarage.

Permeability of the Sonahnpil Variant soil is moderate. Effective rooting depth is 158 centimeters or more for water tolerant plants but is limited to depths between 75 and 125 centimeters for plants that are not water tolerant. Runoff is very slow, and the hazard of water erosion is slight. A water table is at a depth of 75 to 125 centimeters. This soil is subject to occasional, very brief periods of flooding, especially during typhoons.

Most areas of this unit are used for subsistence agricultural forest crop production. A few areas are used as sites for villages.

This unit is poorly suited to clean-tilled crop production because of wetness and the high content of coarse fragments. It is moderately suited to the production of coconuts and well suited to the production of bananas.

This unit is well suited to water tolerant woodland species such as *Calophyllum inophyllum* and *Eucalyptus*.

This unit is poorly suited to homesite development. The main limitations are wetness, low soil strength, and the hazard of flooding. If roads and buildings are constructed on the unit, the limitation of low soil strength can be overcome by using adequate crushed coral or basalt ballast. Allow the soil material to dry sufficiently before filling and compacting areas of this unit.

Septic tank absorption fields do not function properly on this unit because of wetness and the hazard of flooding.

523—Tabecheding Variant silty clay loam, 0 to 4 percent slopes. This very deep, poorly drained soil is flood plains. It formed in alluvium derived dominantly from volcanic breccia and tuff. Slopes are nearly level to undulating. Areas are irregular in shape and are 2 to 30 hectares in size. The vegetation is wetland savannah.

Typically, the surface layer is mottled, very dark brown silty clay loam 20 centimeters thick. The subsurface layer is mottled, grayish brown silty clay loam 13 centimeters thick. The underlying material to a depth of 150 centimeters or more is mottled, light brownish gray silty clay.

Included in this unit are small areas of Mesei and Dechel soils in the lower lying, very poorly drained areas. Also included are small areas of soils that have slopes of more than 4 percent and soils that have a water table at a depth of less than 15 centimeters or more than 45 centimeters. Included areas make up about 15 percent of the total hectarage.

Permeability of the Tabecheding Variant soil is moderate. Effective rooting depth is 150 centimeters for water tolerant plants but is limited to depths between 15 and 45 centimeters for plants that are not water tolerant. Runoff is slow, and the hazard of water erosion is slight. A high water table typically is at a depth of 15 to 45 centimeters. This soil is subject to frequent, very brief periods of flooding and ponding during high-intensity storms.

This unit is used as watershed.

This unit is poorly suited to subsistence clean-tilled crop production and very poorly suited to agricultural forest crop production. It is poorly suited to the production of wetland taro. If the unit is used for subsistence clean-tilled crops, the main limitations are wetness, the hazard of flooding, very low soil fertility, and acidity. Installing drainage ditches, using small, frequent applications of compost and fertilizer that contains micronutrients, and adding lime help to overcome these limitations. If wetland taro is produced, additions of lime and large amounts of green manure and installation of water management structures such as levees are needed.

This unit is poorly suited to homesite development. The main limitations are wetness and the hazard of flooding. Roads constructed on the unit need thick layers of coral or schist ballast to offset the low strength of the soil. Excess water can be removed by using shallow drainage ditches and diversions.

524—Typic Troporthents, severely eroded. These very deep, well drained soils are on deeply dissected and actively eroding uplands. They formed in residuum derived from volcanic breccia and some tuff. Slope is 15 to 100 percent or more. Slopes are complex. Areas are irregular in shape and are 2 to 26 hectares in size. Most areas support little if any vegetation because of the very strong acidity and very low fertility of the soils. A few areas support sparse stands of *Gleichenia linearis* and *Pandanus.*

Typic Troporthents are variegated strong brown, white, and dusky red volcanic breccia and tuff saprolite to a depth of 150 centimeters or more. They commonly have red, olive gray, and yellowish brown spots and streaks. The saprolite crushes easily to silty clay loam or silty clay. The soils are very strongly acid throughout.

Included in this unit are small areas of Gagil silty clay loam and Gagil extremely gravelly loam on plateaulike remnants that have not been eroded. Also included are areas of moderately well drained to poorly drained, freshly eroded saprolite and areas of Tabecheding Variant soils. Included areas make up about 15 percent of the total hectarage.

Permeability of Typic Troporthents is highly variable but generally is moderately rapid. If the soils are properly prepared, effective rooting depth is 150 centimeters or more. Runoff is rapid to very rapid, and the hazard of water erosion is very high. These soils characteristically granulate upon heating and cooling and wetting and drying and sluff off side slopes, depositing sediment in the lagoon.

This unit is poorly suited to most uses. It can be reclaimed and stabilized with careful management. Gullying can be reduced by placing check dams at the head of gullies. These dams can be constructed of old automobile and truck tires. Sluffing of side slopes can be reduced by planting spreading varieties of *Casuarina*. Fertilizing and liming are desirable. If the unit is revegetated, it is essential that wildfires be prevented.

525—Typic Troporthents-Urban land complex, 0 to 1 percent slopes. This map unit is mainly in areas adjacent to the ocean in Colonia. Areas are long and narrow or irregular in shape and are 2 to 10 hectares in size.

This unit is 40 percent Typic Troporthents and 60 percent Urban land.

Included in this unit are small areas of Weloy soils.

Typic Troporthents consist of nearly level areas filled with crushed coral, clayey soil material, and schist rock fragments. The soil material has been removed in a few areas, exposing hard schist rock. The properties of these soils are quite variable because of the material used for fill.

Urban land consists of areas covered by structures such as buildings and roads.

This unit is used mainly for urban and homesite development and as a source of roadfill.

This unit is moderately suited to use as a source of roadfill.

This unit is poorly suited to roads in areas where clayey material is the dominant fill material. The main limitations are low soil strength and the slow permeability of some areas. These limitations can be reduced by using an adequate amount of crushed coral or basalt ballast.

This unit is well suited to homesite and urban development in areas where coral and schist gravel and cobbles are the dominant fill material. The main limitation is the rapid permeability of some areas. The unit is poorly suited to onsite waste disposal systems because of the hazard of tidal water contamination.

526—Weloy-Rumung complex, 2 to 12 percent slopes. This map unit is on low-lying foothills. Slopes are slightly convex. Areas are irregular in shape and are 2 to 18 hectares in size. The vegetation is mainly tropical forest. Cleared areas support savannah vegetation.

This unit is 55 percent Weloy gravelly silty clay loam and 25 percent Rumung gravelly silt loam.

Included in this unit are small areas of Yap and Gitam soils in depressional areas and on toe slopes, Weloy soils that have a thicker surface layer, soils that are similar to the Rumung and Weloy soils but do not have a clayey subsoil, and soils that have been ditched and bedded. Also included are small areas of soils that have a lower or higher content of coarse fragments than is typical of the Rumung and Weloy soils. Included areas make up about 20 percent of the total hectarage. The percentage varies from one area to another.

The Weloy soil is moderately deep and well drained. It formed in residuum derived dominantly from green, chlorite, and talc schist. Typically, the surface is covered with a mat of undecomposed and partially decomposed forest litter 2 centimeters thick. The surface layer is very dark grayish brown gravelly silty clay loam 10 centimeters thick. The subsurface layer is dark brown very gravelly clay loam 23 centimeters thick. The subsoil is yellowish brown and dark yellowish brown very gravelly clay 23 centimeters thick. Hard and soft, light olive brown and grayish green schist is at a depth of 56 centimeters. Bedrock is at a depth of 50 to 100 centimeters.

Permeability of the Weloy soil is moderate. Effective rooting depth is 50 to 100 centimeters. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

The Rumung soil is shallow and well drained. It formed in residuum derived dominantly from green, chlorite, and talc schist. Typically, 50 to 70 percent of the surface is covered with iron-coated schist gravel. The surface layer is dark brown gravelly silt loam 10 centimeters thick. The subsoil is strong brown very gravelly clay 18 centimeters thick. The substratum to a depth of 48 centimeters is pale olive extremely gravelly clay. Hard and soft, pale green schist is at a depth of 48 centimeters. Bedrock is at a depth of 25 to 50 centimeters.

Permeability of the Rumung soil is moderate. Effective rooting depth is 25 to 50 centimeters. Runoff is medium, and the hazard of water erosion is moderate. Areas of this unit under savannah vegetation generally are lower in organic matter content and fertility than areas under forest vegetation.

Most areas of this unit are used mainly as watershed. Some areas are used as woodland for village use. A few areas are used for subsistence clean-tilled crop production.

This unit is poorly suited to subsistence clean-tilled crop production and well suited to subsistence agricultural forest crop production. If the unit is used for subsistence clean-tilled crops, the main limitations are the hazard of erosion, low soil fertility, the high content of coarse fragments, and the shallow rooting depth and droughtiness of the Rumung soil. Mulching, adding compost and fertilizer, avoiding burning, and rotating crops reduce erosion and increase fertility. All tillage should be on the contour or across the slope. If the unit is used for subsistence agricultural forest crops, competition from understory vegetation should be reduced and all residue should be returned to the soil.

This unit is moderately suited to use as woodland. The main limitations are low soil fertility, the hazard of erosion, and the depth to rock and droughtiness of the Rumung soil. Reforestation is needed in areas of this unit under savannah vegetation.

This unit is poorly suited to homesite development. The main limitations are depth to hard rock in the Rumung soil and low soil strength. If roads and buildings are constructed on the unit, the limitation of low soil strength can be overcome by using an adequate amount of crushed coral or basalt ballast. Allow the soil material to dry sufficiently before filling and compacting areas of this unit.

Because of the depth to rock, septic tank absorption fields should be constructed in a raised bed of suitable material.

527—Yap silty clay loam, 0 to 2 percent slopes. This very deep, well drained soil is on low-lying broad ridges. It formed in residuum derived dominantly from volcanic breccia and tuff. Slopes are slightly convex. Areas are irregular in shape and are 2 to 30 hectares in size. The vegetation is agricultural forest.

Typically, the surface is covered with a mat of undecomposed and partially decomposed forest litter 5 centimeters thick. The surface layer is dark brown silty clay loam 50 centimeters thick. The subsoil is strong brown silty clay 40 centimeters thick. The subtratum to a depth of 150 centimeters or more is strong brown and white silty clay.

Included in this unit are small areas of Gitam soils and soils that are similar to this Yap soil but are less than 50 centimeters or more than 100 centimeters deep to the substratum. Also included are small areas of Yap soils

that have been ditched and bedded, soils that have slopes of more than 2 percent, and soils that have slower permeability in the subsoil than does this Yap soil. Included areas make up about 10 percent of the total hectarage.

Permeability of the Yap soil is moderately rapid. Effective rooting depth is 150 centimeters or more. Runoff is very slow, and the hazard of water erosion is slight. If the forest vegetation is removed and the area is kept cleared for extended periods without proper management, this soil will become degraded by losing organic matter and by leaching of nutrients.

This unit is used mainly as watershed and homesites and for subsistence agricultural forest crops such as bananas, Polynesian chestnuts, mangoes, papayas, citrus fruit, and coconuts. Some areas are used as woodland for village use. A few areas have been cleared and are used for subsistence clean-tilled crops such as dryland taro, cassava, sweet potatoes, yams, pineapples, and sugarcane.

This unit is poorly suited to subsistence clean-tilled crop production and well suited to subsistence agricultural forest crop production. If the unit is used for subsistence clean-tilled crops, the main limitations are the hazard of soil degradation and low soil fertility. These limitations can be overcome by mulching, avoiding burning, adding compost and fertilizer, and rotating crops. If the unit is used for subsistence agricultural forest crops, competition from understory vegetation should be reduced and all residue should be returned to the soil.

This unit is well suited to use as woodland. The main limitation is low soil fertility. This limitation can be overcome by reducing plant competition, by using small, frequent applications of commercial fertilizer with micronutrients, and by returning all residue to the soil.

This unit is well suited to homesite development. If roads and buildings are constructed on the unit, the limitation of low soil strength can be overcome by using an adequate amount of crushed coral or basalt ballast. Allow the soil material to dry sufficiently before filling and compacting areas of this unit.

528—Yap silty clay loam, 2 to 6 percent slopes. This very deep, well drained soil is on low-lying broad ridges. It formed in residuum derived dominantly from volcanic breccia and tuff. Slopes are slightly convex. Areas are irregular in shape and are 6 to 34 hectares in size. The vegetation is agricultural forest.

Typically, the surface is covered with a mat of undecomposed and partially decomposed forest litter 5 centimeters thick. The surface layer is dark brown silty clay loam 50 centimeters thick. The subsoil is strong brown silty clay 40 centimeters thick. The substratum to a depth of 150 centimeters or more is strong brown and white silty clay.

Included in this unit are small areas of Gitam soils and soils that are similar to this Yap soil but are less than 50 centimeters or more than 100 centimeters deep to the substratum. Also included are small areas of Yap soils that have been ditched and bedded, soils that have slopes of less than 2 percent or more than 6 percent, and soils that have slower permeability than does this Yap soil. Included areas make up about 10 percent of the total hectarage.

Permeability of the Yap soil is moderately rapid. Effective rooting depth is 150 centimeters or more. Runoff is slow, and the hazard of water erosion is slight. If this soil is cleared and left barren for extended periods without proper management, it will become degraded by loss of organic matter and leaching of nutrients.

This unit is used mainly as watershed and homesites and for subsistence agricultural forest crops such as bananas, Polynesian chestnuts, mangoes, papayas, citrus fruit, and coconuts. Some areas are used as woodland for village use. A few areas have been cleared and are used for subsistence clean-tilled crops such as dryland taro, cassava, sweet potatoes, yams, pineapples, and sugarcane.

This unit is poorly suited to subsistence clean-tilled crop production and well suited to subsistence agricultural forest production. If the unit is used for subsistence clean-tilled crops, the main limitations are the hazard of soil degradation and low soil fertility. These limitations can be overcome by the mulching, avoiding burning, adding compost and fertilizer, and rotating crops. If the unit is used for subsistence agricultural forest crops, competition from understory vegetation should be reduced and all residue should be returned to the soil.

This unit is well suited to use as woodland. The main limitation is low soil fertility. This limitation can be overcome by reducing competition from understory vegetation, by using small, frequent applications of commercial fertilizer with micronutrients, and by returning all residue to the soil.

This unit is well suited to homesite development. If roads and buildings are constructed on the unit, the limitation of low soil strength can be overcome by using an adequate amount of crushed coral or basalt ballast. Allow the soil material to dry sufficiently before filling and compacting areas of this unit.

529—Yap silty clay loam, 6 to 12 percent slopes. This very deep, well drained soil is on low-lying broad ridges. It formed in residuum derived dominantly from volcanic breccia and tuff. Slopes are slightly convex. Areas are irregular in shape and are 2 to 22 hectares in size. The vegetation is agricultural forest.

Typically, the surface is covered with a mat of undecomposed and partially decomposed forest litter 5 centimeters thick. The surface layer is dark brown silty clay loam 50 centimeters thick. The subsoil is strong

brown silty clay 40 centimeters thick. The substratum to a depth of 150 centimeters or more is strong brown and white silty clay.

Included in this unit are small areas of Gitam soils and soils that are similar to this Yap soil but are less than 50 centimeters or more than 100 centimeters deep to the substratum. Also included are small areas of Yap soils that have been ditched and bedded, soils that have slopes of less than 6 percent or more than 12 percent, and soils that have slower permeability than does this Yap soil. Included areas make up about 10 percent of the total hectarage.

Permeability of the Yap soil is moderately rapid. Effective rooting depth is 150 centimeters or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

This unit is used as watershed and homesites and for subsistence agricultural forest crops such as bananas, Polynesian chestnuts, mangoes, papayas, citrus fruit, and coconuts. Some areas are used as woodland for village use. A few areas have been cleared and are used for subsistence clean-tilled crops such as dryland taro, cassava, sweet potatoes, yams, pineapples, and sugarcane.

This unit is poorly suited to subsistence clean-tilled crop production and well suited to subsistence agricultural forest crop production. If the unit is used for subsistence clean-tilled crops, the main limitations are the hazard of soil degradation, low soil fertility, and the hazard of erosion. These limitations can be overcome by mulching, avoiding burning, adding compost and fertilizer, and rotating crops. All tillage should be on the contour or across the slope. If the unit is used for subsistence agricultural forest crops, competition from understory vegetation should be reduced and all residue should be returned to the soil.

This unit is well suited to use as woodland. The main limitations are low soil fertility and the hazard of erosion. These limitations can be overcome by reducing competition from understory vegetation, by using small, frequent applications of commercial fertilizer with micronutrients, and by returning all residue to the soil. A cover crop should be established at the time of planting to protect the soil until a tree canopy is established.

This unit is well suited to homesite development. Preserving the existing plant cover during construction helps to control erosion. If roads and buildings are constructed on the unit, the limitation of low soil strength can be overcome by using adequate crushed coral or basalt ballast. Allow the soil material to dry sufficiently before filling and compacting areas of this unit.

530—Yap silty clay loam, 12 to 30 percent slopes. This very deep, well drained soil is on low-lying broad ridges. It formed in residuum derived dominantly from very soft volcanic breccia and tuff. Slopes are convex. Areas are long and narrow or irregular in shape and are 2 to 20 hectares in size. The vegetation is agricultural forest.

Typically, the surface is covered with a mat of undecomposed and partially decomposed forest litter 5 centimeters thick. The surface layer is dark brown silty clay loam 50 centimeters thick. The subsoil is strong brown silty clay 40 centimeters thick. The substratum to a depth of 150 centimeters or more is strong brown and white silty clay.

Included in this unit are small areas of soils that are similar to this Yap soil but are less than 50 centimeters or more than 100 centimeters deep to the substratum. Also included are small areas of soils that have slopes of less than 12 percent or more than 30 percent and soils that have slower permeability than does this Yap soil. Included areas make up about 15 percent of the total hectarage.

Permeability of the Yap soil is moderately rapid. Effective rooting depth is 150 centimeters or more. Runoff is medium to rapid, and the hazard of water erosion is moderate. If this soil is cleared and left barren for extended periods without proper management, it will become degraded by loss of organic matter and leaching of nutrients.

This unit is used as watershed and for subsistence agricultural forest crops such as bananas, Polynesian chestnuts, mangoes, papayas, citrus fruit, and coconuts. Some areas are used as woodland for village use.

This unit is poorly suited to subsistence clean-tilled crop production and well suited to subsistence agricultural forest production. If the unit is used for subsistence clean-tilled crops, the main limitations are the hazard of soil degradation, low soil fertility, and the hazard of erosion. These limitations can be overcome by mulching, avoiding burning, adding compost and fertilizer, rotating crops, and contour stripcropping. All tillage should be on the contour or across the slope. If the unit is used for subsistence agricultural forest crops, competition from understory vegetation should be reduced and all residue should be returned to the soil.

This unit is moderately suited to use as woodland. The main limitations are low soil fertility, slope, and the hazard of erosion. Reducing competition from understory vegetation, using small, frequent applications of commercial fertilizer with micronutrients, and returning all residue to the soil increase fertility and reduce erosion. A cover crop should be established at the time of planting to protect the soil until a tree canopy is established.

This unit is poorly suited to homesite development. Preserving the existing plant cover during construction helps to control erosion. If roads and buildings are constructed on the unit, the limitation of low soil strength can be overcome by using an adequate amount of crushed coral or basalt ballast. Allow the soil material to dry sufficiently before filling and compacting areas of this unit. Septic tank filter fields should be placed in the less sloping areas.

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, 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 and pasture; as woodland; and as sites for buildings, sanitary facilities, roads and other transportation systems, and parks and other recreation facilities. 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 or wetness can cause difficulty in excavation.

Health officials, public works 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

Miles Grabau, assistant professor of biology, Northwest Missouri State University, provided the discussion on composting.

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."

Crops.—The soils in this survey area, as in other tropical environments, have special limitations that must be considered in order to obtain good yields over an extended period of time. Poor management practices can lead to severe damage to the soils, and reclamation may not be economically feasible. Only a small percentage of the soils in the area are used for the production of crops; however, enough crops for local use and export can be produced if the land is carefully managed. Table 2 gives the suitability of many crops for specified map units in the area (*2, 4, 6, 7, 8, 9, 11, 16*).

The soils in the survey area that are under forest, such as the Yap and Weloy soils, are the most fertile. The main reason for this is the presence of large amounts of organic matter, which provides nutrients for plants. As fallen leaves and branches rot, organic matter and nutrients are returned to the soil. Before these nutrients can be leached through the soil and lost, roots absorb them and the process begins again. In this way, the forest land soils become more fertile with each cycle (*10*). In addition, the forest canopy and layer of litter provide protection from erosion. The canopy also provides shade, which keeps the temperature lower and reduces the droughtiness of the surface layer. If the forest cover is removed, the organic matter content of the soil is reduced, nutrients are lost through oxidation and leaching, and the soil becomes less productive. These factors result in soil degradation and thus should be considered when determining the type of crops to be grown and the management systems to be used. In the following paragraphs suitable management practices for crop production are discussed.

Subsistence agricultural forest crop production generally is the least damaging to the soil and requires the least human and monetary resources. Agricultural forest crops include food and wood crops. Soils under mature forest are best suited to agricultural forest crops.

If agricultural forest crops are grown, undesirable woodland species should be removed. Burning, however, should be avoided. Seeds, seedlings, cuttings, and suckers should then be planted. A desirable mixture of vegetation in an established planting might include breadfruit, coconut, mango, and Polynesian chestnut as well as adapted timber species. Desirable understory vegetation might include banana, plantain, pineapple,

yams, and certain dryland taro species tolerant of shade, such as *Alocasia*. After planting, little care is required. Volunteer undesirable understory vegetation should be slashed, and the cuttings should be concentrated around desirable vegetation. Applying commercial fertilizer normally is not necessary. Many small areas, mainly of the Rumung and Weloy soils, have been excavated and developed for the planting of wetland taro. These areas can be improved by large applications of green manure. All crop residue should be returned to the soil.

If subsistence agricultural forest crops are grown in an area of savannah, heavy additions of green manure, compost, and other organic fertilizer are necessary to insure a good survival rate of the plantings. Continued applications of fertilizer may be necessary until the canopy is established. Grasses should only be cleared from areas around plantings. Grasses growing between the plantings should be trimmed, and the cuttings should be concentrated around the trees. The application of lime to the Gagil soils may be beneficial to some crops such as coconuts.

Subsistence clean-tilled crop production is common in this survey area. Crops commonly grown are cassava, sweet potatoes, sugarcane, dryland taro, and vegetable crops such as Chinese cabbage, onions, eggplant, and tomatoes. Wetland taro is grown mainly on the Dechel soils and, to a small extent, on the Mesei soils. The main limitations for clean-tilled crop production are loss of the surface layer by erosion, loss of organic matter by exposure of the surface layer to sunlight, and loss of fertility through leaching and erosion.

Using adequate amounts of compost and other organic fertilizer, returning all crop residue to the soil, rotating crops, and applying lime help to overcome fertility problems. In general, fresh organic fertilizers should be used on the Dechel and Mesei soils. Use of compost, which contains nitrate, is not desirable on these soils because the nitrate may be converted to a gas and be lost to the atmosphere. Tilling on the contour, contour stripcropping, and mulching reduce the hazard of erosion. An adequate amount of mulch helps to shade and cool the soil, which reduces the loss of organic matter and reduces growth of weeds. If garden plots are abandoned, they should be seeded with a suitable ground cover.

Most areas of the upland soils in the survey area have been cultivated at some time. Ditches and planting beds are used in most of these areas. The planting beds usually are rectangular and are about 3 to 10 meters wide and 6 to 15 meters long. The planting beds are constructed mainly to thicken the surface layer and thus provide greater effective rooting depth and increased fertility. On the Gitam soils, the elevated beds place the rooting zone at a greater depth above the water table.

If planting beds are used, ditches should be placed only on the contour or in less sloping areas to allow water to runoff slowly from the hillsides. If ditches are not on the contour in the steeper areas, water flows rapidly downslope, creating a greater hazard of erosion. Contour ditches may be installed slightly closer together in the steeper areas to obtain adequate topsoil for the beds.

In many areas of the Gitam soils that are under savannah vegetation, the soil surface is covered with as much as 80 percent iron concretions and iron-coated schist pebbles. If tilled into the soil, these concretions and pebbles reduce the available water capacity of the surface layer and increase the hazard of seedlings wilting, especially during the dry season. Therefore, they should be raked aside before tilling the soil.

Land-clearing methods.—If forested areas are cleared for subsistence clean-tilled crop production, use of the following procedures conserves the nutrients stored in the vegetation and conserves the organic material. Slash all understory vegetation. Girdle the trees and allow time for the leaves to drop. The forest litter on the soil surface should either be allowed to remain in place or should be raked and composted and returned to the garden later. If clean-tilled crops are grown in the steeper areas, it is preferable to leave a litter mulch on the soil surface. Woody material should be cut for use as firewood.

If areas of savannah are cleared for subsistence clean-tilled crops, two basic methods are suitable. These methods maintain the content of organic matter and the fertility of the soil. The first method requires cutting the grass by hand down to the soil surface, composting the cuttings, and then returning the compost to the garden. The second method requires tethering goats or cattle in the proposed garden area until the vegetation has been eaten down far enough so that the soil can be turned. This method eliminates the need for labor to clear the land and adds manure to the soil. Because the animals trample the manure and the dry grass at the base of the plant into the soil, the organic material is decomposed by the time of planting.

Burning vegetation to clear land should be avoided wherever possible. If vegetation is burned, some nutrients remain in the ashes but many that are essential to plant growth are lost. Among those that are lost are nitrogen, sulfur, and phosphorus. The organic matter that could have been added to the soil is also lost.

Soil fertility.—In most of the soils on uplands, the upper 10 centimeters contains the most nutrients for plant growth. Because the most fertile layer is so thin, it is very important to control erosion.

The Gagil soils are high in content of aluminum that is available to plants. This aluminum can be toxic to certain plants, such as Chinese cabbage and tomatoes, and generally results in stunted growth and poor root development. Most of the plants that are native to tropical areas, however, are adapted to soils high in content of aluminum. Examples of these are tapioca,

yams, pineapple, sweet potatoes, sugarcane, and black pepper.

Soils that are low in content of calcium and high in content of aluminum can be improved by the addition of calcium silicate or lime. The best source of lime is dolomite, which contains a large amount of magnesium and calcium. Dolomite, however, should not be added to the Gitam, Rumung, and Weloy soils because these soils are naturally high in content of magnesium. Lime should be added to these soils only if there is an imbalance between the proportion of calcium to magnesium.

Agricultural lime, quicklime, and slaked lime are also excellent sources of calcium. Because of the low cost and availability, coral sand and rubble are good sources of lime in the survey area. The coral sand should be very fine, and the coral rubble should be crushed. The smaller the particle size, the more quickly the calcium carbonate and other compounds will dissolve in the soil, become available to the plants, and raise the soil reaction to a more suitable level.

For the Yap and Gagil soils, the reaction should not be raised to levels higher than about 6.2. Apply about 2 to 3 tons of lime per hectare. The lime should be incorporated into the surface layer and the upper part of the subsoil before planting if feasible. Reaction should be tested after harvesting to determine if further applications of lime are needed. After the reaction has been raised to the desired level, additional applications need not be made for as long as 5 years or more. The content of calcium and magnesium is adequate in the Ngedebus and Ngedebus Variant soils. These soils have the least ability to hold nutrients of any of the soils in the survey area; therefore, maintaining a high content of organic matter is very important.

Applications of commercial fertilizer generally should be small and frequent because of the high rainfall, which causes loss by leaching. Phosphorus, however, should be applied in a band or pocket a few inches below the seed or seedling at the time of planting. This prevents the phosphorus from combining with iron or calcium and becoming unavailable to plants.

Deposits of nodular and rock phosphate have been mined on the island of Fais. If the phosphate has a high enough citrate solubility, it can be crushed to a powder and used as fertilizer.

Composting.—Fresh, green plant material and dry plants should not be added directly to the soil at or near planting time. Instead, the plant material should be piled up and left to decay for as long as 6 months. The compost pile should be located near a source of fresh material and in an area free of standing water and not subject to flooding if feasible. A shady spot is desirable; however, if the compost is placed under trees, the roots of the trees should be kept out of the pile. It may be necessary to partially cover the pile to keep it from becoming too wet because of the high rainfall. Banana and coconut leaves are a good cover because they allow air to penetrate the pile and also provide shade. Generally, piles about 2 to 3 meters wide and 1.2 to 1.5 meters high are best. The size and shape should be maintained by a fence. Tree logs 1 to 3 centimeters in diameter and 3 to 4 meters long make good fencing. A fence 60 centimeters high is adequate.

Almost any kind of plant material can be used for composting. Legumes are the most desirable because of their high content of nitrogen. Plants growing on fertile soils contain more nutrients in their leaves, stems, and roots than do plants growing on less fertile soils. Adding a liberal amount of high-quality commercial fertilizer to the pile is beneficial. If commercial fertilizer is not available or is too expensive, manure and sea animals or snails can be substituted. If a sufficient quantity of commercial fertilizer or animal waste is used in the composting process, the total time required to produce a usable compost will be reduced and the compost will be richer in nutrients.

In this survey area, the compost can be applied to the soil after about 6 months or less if the following method is used. Place enough plant material on the pile to make a layer about 0.3 meter thick after packing by trampling. Next apply commercial fertilizer, manure, sea animals, or snails and some coral sand and old compost or rich topsoil. The old compost or topsoil acts as a source of bacteria and fungi to start the decaying process. Repeat the steps until the pile is as high as desired. Finally, top with banana or coconut leaves or other suitable cover. Green, freshly cut plant material is higher in content of nutrients and decays faster than brown, dry plant material. If dry plant material must be used, it should not be covered until it has been wetted.

If the compost pile has been made properly it will heat up in a few days. The internal temperature will likely rise to about 49 degrees C. This can be checked by inserting a metal rod into the pile. If it is too hot to comfortably hold, the temperature is correct. As the composting process slows down, the temperature will drop.

After about 3 months the pile cools and thus needs to be turned for decay to continue. The undecayed parts of the pile, the top and sides, should then be placed on the bottom. The rest of the pile should be loosened to add air. Once the entire pile has been turned over, it should be covered again. The temperature will rise as before, and the decaying process will start again. By the end of the next 3 months, the temperature will again be down and the decaying process will have gone far enough so that the compost can be added to the garden. At the time the pile is turned, a new pile should be started so that an almost continuous supply of compost can be maintained.

Because of the amount of time and energy used in its production, compost should be used wisely. Since compost spread on the surface of the garden might be mostly wasted, it is best to place the compost in narrow deep rows or mix it into the upper 15 centimeters of the

soil. A well organized garden should have permanent beds or rows, and compost should be added to them at the time of each planting. Soil rich in compost is loose and needs little if any preparation before planting.

woodland management and productivity

Virgin forest once covered most of the survey area. Some areas have been cleared, but the majority of the land is still covered with dense heterogeneous tropical forest. The soils under tropical forest are capable of producing a relatively high, sustained yield of timber if properly managed. The potential for supplying the timber needs of the survey area is good.

About 3,723 hectares, or about 33 percent of the survey area, is woodland on the Rumung and Weloy soils. Mangrove forest, which makes up about 1,295 hectares, or 9 percent of the survey area, borders part of the area. All of the woodland is private land except a small area of government land at the weather and navigational stations. The largest areas of woodland are in general map units 4 and 10. The areas of forest on the Rumung and Weloy soils are mainly in unit 4, and the areas of mangrove forest are mainly in unit 10.

The most common trees in areas of Rumung and Weloy soils on uplands are *Artocarpus altilis*, *Calophyllum inophyllum*, *Campnosperma brevipetiolata*, *Inocarpus fagifer*, and *Pterocarpus carolinensis*. Introduced species that are suitable for planting and that have potential for timber production are *Albizzia*, *Adenanthera pavonina*, and *Eucalyptus*.

Because the forests on uplands generally are a mixture of several species, thinning of undesirable vegetation and hand planting of nursery stock commonly are needed to improve a stand. Clearing of undesirable competing vegetation is necessary periodically. Fertilization improves the production of most species. Trees in exposed areas such as on ridgetops are subject to windthrow during typhoons.

To minimize harvesting costs, trees should be cut for timber where they are felled. The main equipment needed is a portable mill and chainsaw. The lumber then can be taken to the shore or road on foot and transported to market by boat or truck, which eliminates the need for heavy equipment and logging roads. Production can be sufficient to provide a good source of income.

Land reclamation by reforestation is needed on the Gagil soils, the Typic Troporthents, severely eroded, and in areas of the Gitam, Rumung, and Weloy soils under savannah vegetation. All of these soils, except the Gitam soils, can be reforested with *Calophyllum*, *Campnosperma*, *Eucalyptus grandis*, or *Casuarina*. Gitam soils are less suited to the planting of *Campnosperma* and *Casuarina* because of wetness.

The use of trees for biomass fuel for the production of steam-generated electricity may be feasible in this survey area. Tests should be performed to select the most suitable species for this use in the area (*3*).

Further information on management of woodland can be obtained from the Yap State Department of Forestry and the offices of the Forest Service and Soil Conservation Service in Honolulu, Hawaii.

Table 3 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The species listed in the table are given by scientific name because the English common name is not available for all species. The English common names that are known are:

Scientific name	Common name
Adenanthera pavonina	red sandlewood tree
Albizzia	none
Artocarpus altilis	breadfruit
Bruguiera gymnorhiza	oriental mangrove
Calophyllum inophyllum	alexandrian laurel
Campnosperma brevipetiolata	campnosperma
Cocos nucifera	coconut
Eucalyptus	eucalyptus
Ficus benghalensis	banyan
Inocarpus fagifer	none
Lumnitzera littorea	lumnitzera
Mangifera indica	mango
Pterocarpus carolinensis	none
Rhizophora apiculata	mangrove
Rhizophora mucronata	rhizophora
Semecarpus venenosus	none
Serianthes kanehirae yapensis	none
Sonneratia alba	sonneratia
Trichosperma ikutai	none
Xylocarpus granatum	xylocarpus

In table 3, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *windthrow hazard* are based on soil

characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that a few trees may be blown down by normal winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

Ratings of *plant competition* indicate the degree to which undesirable plants are expected to invade where there are openings in the tree canopy. The invading plants compete with native plants or planted seedlings. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; *severe* indicates that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed to control undesirable plants.

The *common trees* are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suited to the soils and to commercial wood production.

recreation

Recreation sites in the survey area are mainly in areas of Ngedebus soils in the northern part of the island of Tomil and at the southern end of the island of Yap. They are used primarily for picnicking. These areas are subject to flooding during typhoons. Because of their esthetic value, the areas make desirable sites for vacation huts. The hazard of flooding, however, should be taken into consideration when designing structures. Structures should be built on raised post foundations.

Septic tank filter fields are poorly suited to the Ngedebus soils because of the hazard of contamination of adjacent saltwater and freshwater wells. Alternative methods of waste disposal should be used.

The soils of the survey area are rated in table 4 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 areas suitable for waste disposal. 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 4, 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 4 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 6 and interpretations for dwellings without basements and for local roads and streets in table 5.

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. 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, boulders, or rock outcroppings 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, boulders, or rock outcroppings 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 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 150 to 180 centimeters. 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 150 to 180 centimeters 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, shrink-swell potential, 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, 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 5 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 150 to 180 centimeters 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, 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 150 to 180 centimeters 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 180 centimeters. 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 100 centimeters, 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 6 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 6 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 61 and 183 centimeters 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 120 centimeters 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 effectively filter the effluent. 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 60 to 120 centimeters. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 6 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 30 to 60 centimeters 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 due to 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 6 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 180 centimeters. 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 generally are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

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 7 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. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 150 to 180 centimeters.

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 180 centimeters high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 150 to 180 centimeters. 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 150 centimeters 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 90 centimeters. 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 30 to 90 centimeters. 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 30 centimeters. They may have layers of suitable material, but the material is less than 90 centimeters 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 7, 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 90 centimeters thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as weathered schist, 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 100 centimeters 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 100 centimeters. 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 50 to 100 centimeters 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 50 centimeters 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 8 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 150 centimeters. 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 6 meters 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 150 centimeters. 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 150 centimeters 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 or to a cemented pan, 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 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 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 testing. 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 (*13*).

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 Hawaii. 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 9 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 150 to 180 centimeters.

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 "Soil series 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 a soil contains particles coarser than sand, 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 (*1*).

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 76 millimeters 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. A letter K indicates soils dominated by the clay mineral tubular halloysite and an O indicates soils that are oxidic. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

Rock fragments larger than 76 millimeters 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 76 millimeters in diameter based on an oven-dry 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 10 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. 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 centimeters of water per centimeter 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. 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.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

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, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 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 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 10, the estimated content of organic matter of the plow layer 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 and by adding green manure and compost. 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 11 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 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 and water in swamps and marshes are not considered flooding.

Table 11 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 of once in 2 years; and *frequent* that it occurs on an average of 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 11 are the depth to the high water table 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 11.

Only saturated zones within a depth of about 180 centimeters 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 150 centimeters. 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.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence results from either dessication and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. Table 11 shows the expected initial subsidence, which usually is a result of drainage, and annual subsidence, which usually is a result of oxidation.

Not shown in the table is subsidence caused by an imposed surface load or by the withdrawal of ground water throughout an extensive area as a result of lowering the water table.

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 (*14*). 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. In table 12, the soils of the survey area are classified according to the system. 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 water, 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 Fluvaquents (*Fluv*, meaning on a flood plain, plus *aquent*, 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 *Tropic* identifies the subgroup that has a warm climate that varies little in mean summer and winter temperatures. An example is Tropic Fluvaquents.

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 very fine, mixed, nonacid, isohyperthermic Tropic Fluvaquents.

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.

soil series and their morphology

In this section, each soil series 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 series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*12*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*14*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

Soil reaction (pH) was determined by use of a portable pH meter and hydrogen ion electrode. Dilution was 1:1. In addition, the pH was determined after diluting the soil sample 1:1 with 1 Normal potassium chloride solution. The difference between the pH values is negative, zero, or positive and corresponds to the net charge on the colloid (*5*). While none of the soils in this survey area have a net positive charge, the information is presented in the series for comparison with other soils in tropical areas.

The map units of each soil series are described in the section "Detailed soil map units."

Dechel series

The Dechel series consists of very deep, very poorly drained soils on valley floors. These soils formed in alluvium derived from volcanic rock and schist. Slope is 0 to 2 percent. The mean annual rainfall is about 370 centimeters, and the mean annual temperature is about 27 degrees C.

Taxonomic class: Very fine, mixed, nonacid, isohyperthermic Tropic Fluvaquents.

Typical pedon: Dechel mucky silt loam; in a level area of hydrophytic grasses and sedges. When described (11/29/79), the water table was at the soil surface. Colors are for moist soil. All textures are apparent field textures.

O1—10 centimeters to 0; undecomposed and partially decomposed mat of grass and sedge litter.

A1—0 to 10 centimeters; dark gray (5Y 4/1) mucky silt loam; massive; slightly sticky and nonplastic; many very fine and fine roots; common very fine and fine tubular pores; strongly acid (pH 5.1 in 1:1 water); abrupt smooth boundary. (10 to 30 centimeters thick)

C1—10 to 28 centimeters; olive gray (5Y 4/2) silty clay loam; areas of yellowish red (5YR 5/6) oxidized material surrounding pores and a few small specks of bluish gray (5B 5/1); weak fine and medium subangular blocky structure; slightly sticky and slightly plastic; common very fine and fine roots and few medium roots; many very fine and fine tubular and interstitial pores and few medium tubular pores; strongly acid (pH 5.5 in 1:1 water); abrupt smooth boundary. (5 to 25 centimeters thick)

C2g—28 to 61 centimeters; greenish gray (5GY 5/1) silty clay loam; common olive (5Y 4/3) organic coatings on ped faces and lining pores and areas of yellowish red (5YR 5/6) oxidized material surrounding pores; weak medium subangular blocky structure; sticky and slightly plastic; many very fine and fine tubular and interstitial pores and common medium tubular pores; approximately 2 percent rounded and subrounded ferritic concretions 2 to 7 millimeters in diameter; medium acid (pH 5.9 in 1:1 water); clear wavy boundary. (30 to 100 centimeters thick)

C3g—61 to 102 centimeters; dark greenish gray (5GY 4/1) silty clay loam; few small specks of dark bluish gray (5B 4/1); massive; sticky and slightly plastic; many very fine and fine roots and common medium roots; many very fine and fine tubular and interstitial pores and few medium tubular pores; approximately 12 percent irregular, solid ferritic concretions 2 to 15 millimeters in diameter and one 6-by-9-centimeters, irregular, solid ferritic concretion; medium acid (pH 5.9 in 1:1 water); abrupt smooth boundary. (40 to 80 centimeters thick)

IIC4g—102 to 109 centimeters; dark greenish gray (5GY 4/1) very gravelly silty clay loam; massive; sticky and slightly plastic; few very fine roots; few very fine and fine tubular pores; approximately 40 percent irregular ferritic concretions 2 to 15 millimeters in diameter and 5 percent rounded and subrounded basalt cobbles 7.5 to 24 centimeters in diameter; medium acid (pH 5.6 in 1:1 water); clear smooth boundary. (0 to 15 centimeters thick)

IIIC5—109 to 168 centimeters; dark grayish brown (2.5Y 4/2) silty clay loam; massive; sticky and slightly plastic; few very fine roots; few very fine and fine tubular pores; approximately 2 percent rounded and subrounded ferritic concretions 2 to 7 millimeters in diameter; strongly acid (pH 5.1 in 1:1 water).

Type location: Airai Municipality, Babelthuap Island, Palau, Western Caroline Islands; about 595 meters along main road southeast of T intersection of main road and road leading to Nekken. Turn northeast and head 37 miles along trail and up small escarpment to first small, nearly level area of ancient manmade terrace and then northwest 73 meters; lat. 7°22'3" N. and long. 134°32'28.1" E.

Range in characteristics: Depth to the water table ranges from 10 centimeters above the mineral soil surface to about 25 centimeters below. The O1 horizon ranges from 0 to 10 centimeters in thickness. In areas of forest vegetation, the O1 horizon typically is absent and the water table is rarely above the surface. Soil depth is more than 150 centimeters. The *n* value throughout the soil is assumed to be more than 0.7 except in very gravelly strata.

The A horizon has moist color in hue of 10YR, 2.5Y, 5Y, 5G, or 5GY, value of 3, 4, or 5, and chroma of 1 or 2. The apparent field texture is silt loam, silty clay loam, or mucky silt loam. Organic-carbon content ranges from 8 to 13 percent. Reaction in 1:1 water is strongly acid to neutral.

The C horizon has moist color in hue of 10YR, 2.5Y, 5Y, or 5GY, value of 3, 4, or 5, and chroma of 1 or 2. The apparent field texture is silt loam or silty clay loam. The amount of clay, as measured by the product of 2.5 times the 15-bar water percentage, is more than 80 percent. Some pedons have thin strata containing 20 to 50 percent pebble-sized schist or ferritic and gibbsitic concretions and 2 to 10 percent ironstone or basalt cobbles. A few pedons contain strata of hemic or sapric material in the lower part of the substratum. Reaction in 1:1 water is strongly acid to neutral.

Dublon series

The Dublon series consists of very deep, somewhat poorly drained soils on coastal strands. These soils formed in water- and wind-deposited coral sand. Slope is 0 to 4 percent. The mean annual rainfall is about 350

centimeters, and the mean annual temperature is about 27 degrees C.

Taxonomic class: Carbonatic, isohyperthermic Aquic Tropopsamments.

Typical pedon: Dublon loamy fine sand; in a coconut grove. When the soil was described (8/28/80), the water table was at a depth of 43 centimeters. Colors are for moist soil.

A1—0 to 23 centimeters; dark grayish brown (10YR 4/2) loamy fine sand; very pale brown (10YR 8/3) uncoated sand grains; massive; very friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; many very fine tubular and interstitial pores; violently effervescent; mildly alkaline (pH 7.4 in 1:1 water); clear smooth boundary. (10 to 100 centimeters thick)

AC—23 to 56 centimeters; pale brown (10YR 6/3) loamy fine sand; very pale brown (10YR 8/3) uncoated sand grains; massive; very friable, nonsticky and nonplastic; common very fine and fine roots and few medium roots; many very fine interstitial pores and common very fine and fine tubular pores; violently effervescent; slight odor of sulfur; mildly alkaline (pH 7.6 in 1:1 water); clear wavy boundary. (15 to 36 centimeters thick)

C1—56 to 69 centimeters; white (2.5Y 8/2) coarse sand; single grain; loose; few very fine, fine, and medium roots; many very fine and fine interstitial pores; violently effervescent; mildly alkaline (pH 7.7 in 1:1 water); abrupt wavy boundary. (10 to 100 centimeters thick)

C2—69 to 76 centimeters; light gray (2.5Y 7/2) sand; single grain; loose; few very fine and fine roots; many very fine interstitial pores; violently effervescent; moderately alkaline (pH 8.0 in 1:1 water); abrupt wavy boundary. (0 to 50 centimeters thick)

IIC3—76 to 150 centimeters; light gray (5Y 7/2) extremely gravelly coarse sand; single grain; loose; few very fine and fine roots; many very fine and fine and few medium interstitial pores; violently effervescent; about 70 percent coral fragments 2 to 45 millimeters in diameter; moderately alkaline (pH 8.0 in 1:1 water).

Type location: Island of Moen, Truk State, Federated States of Micronesia; about 61 meters north of the end of the Moen municipal dump road and then 18 meters east; lat. 7°25'16.1" N. and long. 151°50'42.6" E.

Range in characteristics: The depth to the water table ranges from 38 to 90 centimeters. The depth to the gravelly part of the substratum ranges from 50 centimeters to more than 150 centimeters.

The A horizon has moist color of 10YR 3/2, 4/2, or 5/2 or of 2.5Y 4/2. The uncoated sand grains have color of 10YR 8/2, 8/3, or 8/4. The A horizon is loamy fine sand or loamy sand and has 0 to 15 percent coral pebbles. The AC horizon has moist color of 10YR 6/2, 6/3, or 7/2. It is loamy fine sand, loamy sand, or sand and has 0 to 15 percent coral pebbles. Some pedons do not have the odor of sulfur.

The C horizon has moist color of 2.5Y 6/2, 7/2, or 8/2, of 10YR 8/2 or 8/3, or of 5Y 7/2 or 8/2. It is stratified coarse sand, sand, fine sand, and loamy sand. Some pedons do not have strata of very gravelly or extremely gravelly sand or coarse sand. The gravelly or extremely gravelly strata have 35 to 75 percent coral pebbles 2 millimeters to 7 centimeters in diameter. This horizon is mildly alkaline or moderately alkaline.

Dublon Variant

The Dublon Variant consists of very deep, somewhat poorly drained soils on coastal flats. These soils formed in alluvium derived from coral sand and in alluvium washed from upland soils derived from volcanic rock or schist. Slope is 0 to 4 percent. The mean annual rainfall is about 30 centimeters, and the mean annual temperature is about 27 degrees C.

Taxonomic class: Fine-loamy, carbonatic, isohyperthermic Typic Tropofluvents.

Typical pedon: Dublon Variant sandy clay loam; in a level area of a coconut grove. When described (5/26/80), the soil was moist throughout and had a freshwater table at a depth of 38 centimeters. Colors are for moist soil.

A1—0 to 23 centimeters; very dark grayish brown (10YR 3/2) sandy clay loam; massive; friable, slightly sticky and slightly plastic; many very fine, fine, medium, and coarse roots; many very fine and fine tubular pores; slightly effervescent; approximately 10 percent shell and coral fragments 2 to 40 millimeters in size; mildly alkaline (pH 7.5 in 1:1 water); clear smooth boundary. (20 to 38 centimeters thick)

C1—23 to 68 centimeters; dark grayish brown (2.5Y 4/2) sandy clay loam; common fine faint grayish brown (2.5Y 5/2) mottles, many medium faint light olive brown (2.5Y 5/4) mottles, and common fine distinct strong brown (7.5YR 4/6) mottles; massive; friable, sticky and slightly plastic; many very fine, fine, medium, and coarse roots; many very fine tubular pores; slightly effervescent; approximately 2 percent shell fragments 2 to 40 millimeters in size; freshwater standing at 38 centimeters below soil surface; common crab burrows filled with soil material from the A horizon; neutral (pH 7.3 in 1:1 water); clear smooth boundary. (45 to 150 centimeters thick)

IIC2—68 to 150 centimeters; dark grayish brown (2.5Y 4/2) coarse sandy loam; massive; slightly sticky and slightly plastic; few very fine and fine roots; many very fine interstitial pores; strongly effervescent; neutral (pH 6.8 in 1:1 water).

Type location: Gagil Municipality, Yap Island, Yap State, Federated States of Micronesia; in the abandoned village site of Gatchpar, about 40 meters south of the stone money bank; lat. 9°32'24.5" N. and long. 138°11'20.5" E.

Range in characteristics: The profile is more than 150 centimeters thick. Depth to freshwater ranges from 30 to 120 centimeters. The profile in 1:1 water is neutral or mildly alkaline.

The A horizon has moist color of 10YR 2/1 or 3/2 or of 2.5Y 3/2. It has an apparent field texture of sandy loam, loam, sandy clay loam, or clay loam. The horizon is 2 to 15 percent coarse fragments 2 to 76 millimeters in size and 0 to 5 percent coral, shell, and schist pebbles and cobbles 76 to 150 millimeters in size.

The C horizon has moist color of 10YR 4/2, 4/3, 4/4, 5/4, 5/6, or 6/4 or of 2.5Y 4/2, 5/4, or 6/4. It has an apparent field texture of stratified loamy sand, coarse sandy loam, and sandy clay loam. Clay content averages more than 18 percent in the control section. The C horizon is 2 to 15 percent coarse fragments 2 to 76 millimeters in size and 0 to 15 percent coral, shell, and schist pebbles and cobbles 76 to 254 millimeters in size. Some pedons have a few coral stones and boulders in the lower part of the C horizon.

Gagil series

The Gagil series consists of very deep, well drained soils on uplands. These soils formed in highly weathered volcanic breccia and tuff. Slope is 2 to 50 percent. The mean annual rainfall is about 310 centimeters, and the mean annual temperature is about 27 degrees C.

Taxonomic class: Clayey, oxidic, isohyperthermic Tropeptic Haplorthox.

Typical pedon: Gagil silty clay loam; on a 15-percent, convex slope in an area of deteriorated savannah. When described (4/16/80), the soil was moist throughout. Colors are for moist soils unless otherwise noted. All textures are apparent field textures.

A1—0 to 10 centimeters; dark brown (7.5YR 4/4) silty clay loam, brown (7.5YR 5/4) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many very fine tubular and interstitial pores; approximately 2 percent subrounded quartzlike sand grains; few dark brown (7.5YR 4/4) wormcasts; strongly acid (pH 5.2 in 1:1 water); clear wavy boundary. (10 to 15 centimeters thick)

B21—10 to 20 centimeters; yellowish red (5YR 4/6) silty clay; moderate medium angular blocky structure parting to moderate fine angular blocky; firm, slightly sticky and plastic; few very fine and fine roots; many very fine tubular and interstitial pores; many thin waxy coatings on faces of peds and lining pores; very few vesicular gibbsite concretions 5 to 10 millimeters in size; strongly acid (pH 5.1 in 1:1 water); gradual wavy boundary. (10 to 23 centimeters thick)

B22—20 to 45 centimeters; yellowish red (5YR 4/6) silty clay; moderate medium angular blocky structure parting to moderate fine angular blocky; firm, slightly sticky and plastic; few very fine and fine roots; many very fine and fine tubular and interstitial pores and few medium tubular pores; many thin waxy coatings on faces of peds and lining pores; very few vesicular gibbsite concretions 5 to 10 millimeters in size; approximately 2 percent moderately hard saprolitic pebbles 5 to 20 millimeters in size; strongly acid (pH 5.3 in 1:1 water); clear wavy boundary. (16 to 25 centimeters thick)

C—45 to 150 centimeters; variegated strong brown (7.5YR 4/6) and dusky red (10R 3/3) silty clay loam, many spots and streaks of dark greenish gray (5BG 4/1), olive gray (5Y 5/2), yellowish brown (10YR 5/4), and red (10R 5/6); fractured rock structure; firm, slightly sticky and slightly plastic; many very fine and common fine tubular pores following fractures; strongly acid (pH 5.4 in 1:1 water).

Type location: Tomil Municipality, Yap Island, Yap State, Federated States of Micronesia; from intersection of road to Faniff and road to Gatil Tamil, head 500 meters east-northeast on road to Gagil Tamil, then about 50 meters south of road; lat. 9°33'19" N. and long. 138°8'3" E.

Range in characteristics: The thickness of the solum ranges from 40 to 56 centimeters.

The A horizon has moist color in hue of 5YR or 7.5YR and chroma and value of 3 or 4. The apparent field texture is silty clay loam, silty clay, or extremely gravelly loam. The horizon is 0 to 10 percent solid spheroidal iron concretions 2 to 5 millimeters in size. Organic matter content ranges from 0.5 to 4.0 percent. Reaction in 1:1 water is strongly acid to slightly acid.

The B2 horizon has moist color of 5YR 4/4, 4/6, 4/8, or 5/8 or of 7.5YR 5/8. The apparent field texture is silty clay loam, silty clay, or clay. The amount of clay, as measured by the product of 2.5 times the 15-bar water percentage, is 55 to 90 percent. The horizon is 0 to 5 percent solid spheroidal iron concretions 2 to 50 millimeters in diameter. Reaction in 1:1 water is very strongly acid to medium acid.

The C horizon has moist variegated colors in hue of 10R, 2.5YR, 7.5YR, 10YR, 5Y, or 5BG, value of 3 to 8, and chroma of 1 to 8. It has an apparent field texture of

silty clay loam, silty clay, or clay. The amount of clay, as measured by the product of 2.5 times the 15-bar water percentage, is 35 to 80 percent. Reaction in 1:1 water is very strongly acid to medium acid.

Gitam series

The Gitam series consists of moderately deep, somewhat poorly drained soils on toe slopes and plains. These soils formed in material derived from schist. Slope is 0 to 30 percent. The mean annual rainfall is about 310 centimeters, and the mean annual temperature is about 27 degrees C.

Taxonomic class: Fine, mixed, isohyperthermic Aquic Tropudalfs.

Typical pedon: Gitam very gravelly silty clay loam; on a 4-percent, slightly convex, south-by-southeast-facing slope in an area of deteriorated savannah. When described (4/8/80), the soil was moist throughout and had a perched water table at a depth of 46 centimeters. Colors are for moist soil. Approximately 30 percent of the surface is covered with pebble-sized iron concretions and iron-coated angular and subangular schist fragments.

A1—0 to 15 centimeters; dark brown (7.5YR 3/2) very gravelly silty clay loam; strong very fine granular structure; friable, slightly sticky and slightly plastic; many very fine and fine roots and common medium and coarse roots; many very fine interstitial pores; approximately 10 percent small iron-coated subangular schist pebbles and 50 percent spherical solid iron concretions 2 to 10 millimeters in diameter; medium acid (pH 6.0 in 1:1 water); clear smooth boundary. (13 to 30 centimeters thick)

B2—15 to 36 centimeters; yellowish brown (10YR 5/4) silty clay; many fine distinct reddish yellow (7.5YR 7/6) mottles and many fine prominent greenish gray (5GY 6/1) mottles; strong medium subangular blocky structure; firm, sticky and plastic; many very fine and fine roots and few medium and coarse roots; many very fine and fine tubular pores, few medium tubular pores, and few very fine and fine interstitial pores; approximately 4 percent subangular iron-coated schist pebbles 1 to 7 centimeters in diameter in the upper 6 centimeters and 13 percent spherical solid iron concretions 2 to 10 millimeters in diameter in the lower part; medium acid (pH 5.8 in 1:1 water); clear irregular boundary. (16 to 56 centimeters thick)

C1—36 to 89 centimeters; lithochromic greenish gray (5GY 6/1) silty clay; common medium prominent strong brown (7.5YR 4/6) mottles and few thin black (7.5YR 2/0) manganese stains on faces of peds; strong medium and coarse subangular blocky structure; firm, slightly sticky and plastic; common very fine and fine and few coarse vertical roots; many very fine tubular and interstitial pores and common fine and medium tubular pores; many pressure faces; medium acid (pH 5.8 in 1:1 water); abrupt irregular boundary. (4 to 26 centimeters thick)

C2r—89 centimeters; greenish gray (5GY 6/1) saprolitic amphibilite schist that crushes easily to silty clay; schistose structure at an 80-degree tilt; firm, slightly sticky and slightly plastic; common moderately thick strong brown (7.5YR 4/6) iron stains and black (7.5YR 2/1) manganese stains coating fractures that are less than 2 millimeters wide and are 1 to 5 centimeters apart; strongly acid (pH 5.2 in 1:1 water).

Type location: Ruul Municipality, Yap Island, Yap State, Federated States of Micronesia; about 755 meters northeast of intersection of main road and airport road, along main road; there about 40 meters north by northwest of road; lat. 9°29'46.87" N. and long. 138°04'55.2" E.

Range in characteristics: From 10 to 80 percent of the surface is covered with small, iron-coated schist pebbles. Depth to a perched water table ranges from 30 to 75 centimeters. Depth to a paralithic contact ranges from 64 to 100 centimeters. Thickness of the solum ranges from 36 to 89 centimeters.

The A horizon has moist color of 7.5YR 3/2, of 10YR 3/3 or 3/4, or of 2.5Y 3/2, 4/2, or 4/4. It is silty clay loam or clay loam and is gravelly or very gravelly. It is 10 to 55 percent spherical solid iron concretions 2 to 20 millimeters in diameter and is 2 to 10 percent subangular iron-coated schist pebbles 1 to 10 centimeters in diameter. Reaction in 1:1 water is medium acid or slightly acid.

The B horizon has moist color of 10YR 5/4, 5/8, or 6/8, of 2.5Y 4/4, or of 5Y 4/3 or 6/4. It has few to many distinct mottles of 7.5YR 5/6, of 10YR 5/8, of 5Y 5/1 or 5/2, or of 5GY 6/1. It is silty clay or clay. Clay content ranges from 35 to 50 percent. This horizon is 0 to 10 percent spherical solid iron concretions 2 to 10 millimeters in diameter and 2 to 10 percent subangular iron-coated schist pebbles 1 to 10 centimeters in diameter. Pebble content averages less than 15 percent. Reaction in 1:1 water is medium acid or slightly acid.

The C horizon has moist lithochromic color of 5Y 5/1, 5G 6/2, or 5GY 6/1.

Ilachetomel series

The Ilachetomel series consists of very deep, very poorly drained organic soils in the intertidal zone

adjacent to the shoreline. These soils formed in decomposing mangrove roots and litter. Slope is 0 to 2 percent. The mean annual rainfall is about 370 centimeters, and the mean annual temperature is about 27 degrees C.

Taxonomic class: Euic, isohyperthermic Typic Sulfihemists.

Typical pedon: Ilachetomel peat; in a level area of mangrove forest. When described (12/6/79), the soil was wet throughout. Because of the fluctuating tide, the water table was 10 centimeters above the soil surface. Colors are for moist soil.

Oi1—0 to 20 centimeters; black (10YR 2/1) fibric material, about 70 percent fiber rubbed; weak fine and medium subangular blocky structure; many very fine and fine roots and few medium roots; common very fine interstitial pores; moderate odor of sulfur; slightly acid (pH 6.0 in calcium chloride); clear smooth boundary. (10 to 25 centimeters thick)

Oi2—20 to 41 centimeters; very dark grayish brown (10YR 3/2) fibric material, about 70 percent fiber rubbed; weak fine and medium subangular blocky structure; many very fine and fine roots and few medium roots; common very fine interstitial pores; slight odor of sulfur; common medium and coarse decomposing roots; slightly acid (pH 6.0 in calcium chloride); gradual smooth boundary. (10 to 100 centimeters thick)

Oi3—41 to 81 centimeters; very dark grayish brown (10YR 3/2) fibric material, about 55 percent fiber rubbed; weak fine and medium subangular blocky structure; many very fine and fine roots, few medium roots, and common coarse roots; common very fine interstitial pores; slight odor of sulfur; common medium and coarse decomposing roots; medium acid (pH 5.6 in calcium chloride); gradual smooth boundary. (0 to 100 centimeters thick)

Oi4—81 to 150 centimeters; very dark grayish brown (10YR 3/2) hemic material, about 42 percent fiber rubbed; weak medium and coarse subangular blocky structure; many very fine and fine roots, few medium roots, and common coarse roots; common very fine interstitial pores; slightly acid (pH 5.8 in calcium chloride).

Type location: Aimeliik Municipality, Babelthuap Island, Palau, Western Caroline Islands; about 27 meters west of first landing up channel through mangroves leading to the Dabador area in Aimeliik, then about 5 meters north into mangroves; lat. 7°24'11" N. and long. 134°129'8.2" E.

Range in characteristics: The sea level fluctuates between about 30 centimeters above the surface and 30 centimeters below the surface. Areas closer to the lagoon are submerged longer than areas closer to land. The organic material ranges from fibric to sapric throughout the profile. Typically, the surface tier has the highest content of fiber when rubbed. Depth to sulfidic material ranges from 100 centimeters to more than 150 centimeters. Nonaerated samples of the soil are medium acid or slightly acid in calcium chloride.

The upper 10 to 25 centimeters of the profile has moist color of 7.5YR 2/1, 3/1, or 3/2, of 10YR 2/1, 3/1, or 3/2, or of 2.5Y 2/1, 3/1, or 3/2.

Mesei series

The Mesei series consists of very deep, very poorly drained soils on bottom lands. These soils formed in deposits of organic material overlying alluvial sediment. Slope is 0 to 1 percent. The mean annual rainfall is about 370 centimeters, and the mean annual temperature is about 27 degrees C.

Taxonomic class: Very fine, mixed, euic, isohyperthermic Terric Troposaprists.

Typical pedon: Mesei muck; in a level area supporting wetland taro and hydrophytic grasses and sedges. When described (3/6/80), the soil was saturated throughout. The water table was 25 centimeters above the soil surface. Colors are for moist soil. Texture for the C horizon is apparent field texture.

Oa1—0 to 12 centimeters; dark brown (7.5YR 3/2) muck; about 30 percent fiber; massive; nonsticky and slightly plastic; many very fine and fine roots and common medium roots; many very fine and fine tubular pores; color is 10YR 7/2 in pyrophosphate solution; very strongly acid (pH 4.5 in calcium chloride); clear smooth boundary. (10 to 30 centimeters thick)

Oa2—12 to 40 centimeters; very dark grayish brown (10YR 3/2) muck; about 24 percent fiber, 4 percent rubbed; weak coarse subangular blocky structure; nonsticky and slightly plastic; many very fine and fine roots and common medium roots; many very fine and fine tubular pores; color is 10YR 6/3 in pyrophosphate solution; strongly acid (pH 5.3 in calcium chloride); gradual wavy boundary. (20 to 50 centimeters thick)

Oa3—40 to 86 centimeters; very dark grayish brown (10YR 3/2) muck; about 29 percent fiber, 1 percent rubbed; weak medium and coarse subangular blocky structure; nonsticky and slightly plastic; many very fine and fine roots; many very fine and fine tubular pores and common fine interstitial pores; color is 10YR 6/3 in pyrophosphate solution; strongly acid (pH 5.4 in calcium chloride); abrupt smooth boundary. (30 to 50 centimeters thick)

IICg—86 to 150 centimeters; dark gray (10YR 4/1) silt loam; massive; slightly sticky and slightly plastic; common very fine roots; many very fine and fine tubular pores; about 5 percent plant fibers 1 to 15 millimeters in diameter; slightly acid (pH 6.2 in 1:1 water); abrupt smooth boundary. (50 to 85 centimeters thick)

IIIOe1—150 to 188 centimeters; black (10YR 2/1) hemic material; about 76 percent fiber, 48 percent rubbed; weak medium subangular blocky structure; friable, nonsticky and nonplastic; many very fine tubular pores; color is 10YR 8/1 in pyrophosphate solution; strongly acid (pH 5.4 in calcium chloride).

Type location: Babelthuap Island, Palau, Western Caroline Islands; about 585 meters along the main road southeast of T intersection of main road and road leading to Nekken; turn northeast and proceed 20 meters along trail; site is 10 meters northwest of trail; lat. 7°22'2.5" N. and long. 134°32'28" E.

Range in characteristics: Thickness of the organic tiers above a mineral layer ranges from 65 to 100 centimeters. The water table ranges from 30 centimeters above the surface to 15 centimeters below the surface. Rubbed fiber content throughout the surface and subsurface tiers ranges from 0 to 20 percent. Some pedons have strata that are as much as 15 percent mineral silt and clay.

The Oa horizon is hemic or sapric material. It has hue of 7.5YR or 10YR, value of 2 to 4, and chroma of 1 to 3. Reaction in calcium chloride is very strongly acid or strongly acid.

The IIC horizon is silt loam or silty clay loam. It has hue of 10YR, 2.5YR, or 5Y, value of 4 to 6, and chroma of 0 to 2. It is 0 to 10 percent coarse fragments. Reaction in 1:1 water is medium acid or slightly acid. The *n* value is more than 0.7.

Ngedebus series

The Ngedebus series consists of very deep, somewhat excessively drained soils adjacent to coastal beaches and within interiors of atoll islands. These soils formed in water- and wind-deposited coral sand. Slope is 0 to 4 percent. The mean annual rainfall is about 370 centimeters, and the mean annual temperature is about 27 degrees C.

Taxonomic class: Carbonatic, isohyperthermic Typic Tropopsamments.

Typical pedon: Ngedebus sand; on a 2-percent, east-by-southeast-facing, convex slope in an area of casuarina forest. When described (10/30/79), the soil was moist throughout. Colors are for moist soil.

A1—0 to 46 centimeters; 50 percent grayish brown (10YR 5/2) sand mixed with 50 percent very pale brown (10YR 7/3) uncoated sand; single grain; loose; common very fine, fine, medium, and coarse roots; many very fine interstitial pores; mixed by land crabs to include lenses of pale yellow (2.5Y 8/4) sand; strongly effervescent; mildly alkaline (pH 7.7 in 1:1 water); clear wavy boundary. (10 to 50 centimeters thick)

C1—46 to 81 centimeters; pale yellow (2.5Y 8/4) sand; single grain; loose; many very fine interstitial pores; strongly effervescent; moderately alkaline (pH 7.9 in 1:1 water); clear smooth boundary. (35 to 100 centimeters thick)

C2—81 to 150 centimeters; very pale brown (10YR 8/4) coarse sand; single grain; loose; many very fine interstitial pores; about 4 percent coarse coral fragments 5 to 20 millimeters by 20 to 40 millimeters in size; freshwater table at a depth of 122 centimeters; strongly effervescent; moderately alkaline (pH 8.0 in 1:1 water).

Type location: Peleliu Municipality, Peleliu Island, Palau, Western Caroline Islands; about 1.25 kilometers north-northeast of Peleliu Village on main road and 1 kilometer south from the first road junction, then about 5 meters east of roadway; lat. 7°2'36" N. and long. 134°16'35" E.

Range in characteristics: Depth to the freshwater table ranges from 100 centimeters to more than 150 centimeters.

The A horizon has moist color of 10YR 2/1, 2/2, 3/1, 3/2, 3/3, 4/2, 4/3, 5/2, 5/3, or 7/3 or of 2.5Y 3/2. An AC horizon, present in some pedons, has moist color of 10YR 6/1, 6/2, or 7/2. It is sand, fine sand, or loamy sand and is gravelly in some pedons. The A horizon is 0 to 20 percent pebbles and 0 to 10 percent cobbles. Reaction in 1:1 water ranges from neutral to moderately alkaline.

The C horizon has moist color of 10YR, 7.5YR, or 2.5Y, value of 6 to 8, and chroma of 2 to 4. It is stratified fine sand, sand, or coarse sand and is gravelly in some pedons. Pebble content ranges from 0 to 25 percent. Cobble content ranges from 0 to 15 percent. Coarse fragment content averages less than 35 percent within the particle-size control section. Reaction in 1:1 water ranges from mildly alkaline to strongly alkaline.

Ngedebus Variant

Ngedebus Variant consists of very deep, somewhat excessively drained soils adjacent to rubbly coastal beaches and within interiors of atoll islands. These soils formed in water- and wind-deposited coral rubble and sand. Slope is 2 to 6 percent. The mean annual rainfall is about 370 centimeters, and the mean annual temperature is about 27 degrees C.

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

Typical pedon: Ngedebus Variant extremely cobbly loamy sand; on a 5-percent, convex, southeast-facing slope in an area of casuarina forest. When described (2/26/80), the soil was moist throughout. Colors are for moist soil unless otherwise noted.

O1—6 centimeters to 0; dark reddish brown (5YR 2/2) partially decomposed leaves and other organic material, dark reddish gray (5YR 4/2) dry; neutral (pH 6.7 in 1:1 water); abrupt wavy boundary. (9 to 10 centimeters thick)

A1—0 to 12 centimeters; mixed 85 percent very dark brown (10YR 2/2) and 15 percent pale brown (10YR 6/3) extremely cobbly loamy sand, dark grayish brown (10YR 4/2) and very pale brown (10YR 7/3) dry, respectively; weak very fine granular structure and single grain; very friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots and few coarse roots; many very fine interstitial pores; slightly effervescent; approximately 30 percent cobbles and 50 percent gravel; neutral (pH 7.3 in 1:1 water); clear wavy boundary. (5 to 30 centimeters thick)

A12—12 to 36 centimeters; mixed 60 percent dark brown (7.5YR 4/2) and 40 percent brown (7.5YR 5/2) extremely cobbly loamy sand; single grain; loose; common very fine, fine, and medium roots; many very fine interstitial pores; strongly effervescent; approximately 30 percent cobbles and 50 percent gravel; mildly alkaline (pH 7.0 in 1:1 water); gradual wavy boundary. (10 to 30 centimeters thick)

C—36 to 150 centimeters; mixed 70 percent pinkish gray (7.5YR 6/2) and 30 percent brown (7.5YR 5/2) extremely cobbly loamy sand; single grain; loose; few very fine, fine, and medium roots; many very fine interstitial pores; strongly effervescent; approximately 30 percent cobbles and 50 percent gravel; mildly alkaline (pH 7.5 in 1:1 water).

Type location: Angaur Municipality, Angaur Island, Palau, Western Caroline Islands; 1.2 kilometers southwest of the south end of Angaur airstrip, along the coast road, and 30 meters southeast of the roadway; lat. 6°52'35.5" N. and long. 134°8'24.5" E.

Range in characteristics: The profile is more than 150 centimeters thick. It is 35 to 50 percent pebbles and 0 to 50 percent cobbles throughout. Total coarse fragment content ranges from 35 to 90 percent throughout. Reaction in 1:1 water is neutral to moderately alkaline throughout the profile.

The A horizon is 25 to 50 centimeters thick. It has moist color of 10YR 2/2, 3/2, 4/2, or 4/3 or of 7.5YR 3/2 or 4/2 and includes partially coated sand grains in colors of 10YR 6/2, 6/3, 7/2, or 7/3 or of 7.5YR 5/2 or 6/2. The A horizon is sand or loamy sand and is very gravelly, extremely gravelly, very cobbly, or extremely cobbly.

The C horizon has hue of 7.5YR or 10YR, value of 4 to 8, and chroma of 2 to 4. It is loamy sand or sand and is very gravelly, extremely gravelly, very cobbly, or extremely cobbly.

Ngersuul Variant

The Ngersuul Variant consists of very deep, moderately well drained soils in narrow inland valleys and on fans near the coast. These soils formed in alluvium washed from upland soils derived from schist. Slope is 2 to 8 percent. The mean annual rainfall is about 310 centimeters, and the mean annual temperature is about 27 degrees C.

Taxonomic class: Very fine, mixed, isohyperthermic Fluventic Dystropepts.

Typical pedon: Ngersuul Variant silty clay loam; in a sloping area of agricultural forest. When described (5/27/80), the soil was moist throughout. Colors are for moist soil.

O1—1.5 centimeters to 0; undecomposed and partially decomposed forest litter.

A11—0 to 18 centimeters; dark grayish brown (2.5Y 4/2) silty clay loam; moderate fine subangular blocky structure; friable, slightly sticky and slightly plastic; many very fine, fine, medium, and coarse roots; many very fine and fine tubular and interstitial pores; about 5 percent iron-coated pebbles 1 to 2 centimeters in diameter; strongly acid (pH 5.3 in 1:1 water); clear smooth boundary. (10 to 20 centimeters thick)

A12—18 to 38 centimeters; olive brown (2.5Y 4/4) very gravelly clay; moderate very fine subangular blocky structure; firm, sticky and plastic; many very fine, fine, medium, and coarse roots; many very fine and fine tubular and interstitial pores; about 50 percent iron-coated pebbles 1 to 2 centimeters in diameter; medium acid (pH 5.8 in 1:1 water); clear smooth boundary. (10 to 20 centimeters thick)

A13b—38 to 58 centimeters; olive (5Y 4/3) very gravelly clay; moderate fine subangular blocky structure; firm, sticky and plastic; common very fine, fine, medium, and coarse roots; many very fine and fine tubular and interstitial pores; many thin and moderately thick coatings on faces of peds and lining pores; about 60 percent iron-coated pebbles 1 to 2 centimeters in diameter; slightly acid (pH 6.2 in 1:1 water); abrupt wavy boundary. (10 to 20 centimeters thick)

B2tb—58 to 86 centimeters; strong brown (7.5YR 5/8) clay; many greenish gray (5GY 6/1) mottles; moderate medium prismatic structure parting to strong fine angular blocky; firm, sticky and very plastic; common very fine, fine, and coarse roots; many very fine tubular and interstitial pores and many fine and medium tubular pores; continuous thin coatings on faces of peds and lining pores; about 2 percent iron-coated pebbles 1 to 2 centimeters in diameter; medium acid (pH 6.0 in 1:1 water); gradual wavy boundary. (12 to 30 centimeters thick)

B3tb—86 to 122 centimeters; strong brown (7.5YR 5/8) clay; many greenish gray (5GY 6/1) mottles; moderate medium prismatic structure parting to strong fine angular blocky; firm, sticky and very plastic; common very fine, fine, and coarse roots; many very fine tubular and interstitial pores and many fine and medium tubular pores; common thin coatings on faces of peds and lining pores; slightly acid (pH 6.4 in 1:1 water); gradual wavy boundary. (15 to 40 centimeters thick)

C1b—122 to 160 centimeters; strong brown (7.5YR 5/8) saprolitic greenschist that crushes easily to silty clay; many greenish gray (5GY 6/1) mottles; schistose structure; friable, slightly plastic; few very fine, fine, and medium roots; slightly acid (pH 6.4 in 1:1 water); abrupt irregular boundary. (25 to 42 centimeters thick)

R—160 centimeters; 75 percent greenish gray (5GY 6/1), hard, slightly weathered greenschist with 25 percent strong brown (7.5YR 5/8) mottles; iron and manganese stains coating fracture faces; schistose structure.

Type location: Fanif Municipality, Yap Island, Yap State, Federated States of Micronesia; about 90 meters from the shore just to the inland side of the main trail; lat. 9°31'6.2" N. and long. 138°04'42.4" E.

Range in characteristics: Soil depth is more than 150 centimeters.

The A horizon ranges from 20 to 65 centimeters in thickness. It has moist color of 10YR 2/2, 3/1, 3/2, or 4/2, of 2.5Y 3/2, 4/2, or 4/3, or of 5Y 4/2 or 4/3. It is silt loam or silty clay loam and is gravelly or very gravelly in the lower part of some pedons.

The buried B and C horizons have color of 7.5YR 5/6 or 5/8, of 10YR 5/6 or 5/8, of 2.5Y 4/4, 5/4, or 5/6, of 5Y 4/4 or 6/4, or of 5GY 6/1. They are silty clay or clay and are gravelly in some pedons. Gravel content averages less than 35 percent. Some pedons do not have a buried soil that contains an argillic horizon.

Peleliu series

The Peleliu series consists of shallow, well drained soils on raised coral limestone islands. These soils formed in residuum derived from coral limestone. Slope is 0 to 150 percent. The mean annual rainfall is about 370 centimeters, and the mean annual temperature is about 27 degrees C.

Taxonomic class: Clayey-skeletal, oxidic, isohyperthermic Lithic Eutropepts.

Typical pedon: Peleliu extremely cobbly silt loam; in a level area of "limestone" forest. When described (10/31/79), the soil was moist throughout. Colors are for moist soil unless otherwise noted. All textures are apparent field textures.

O1—1 centimeter to 0; undecomposed leaf litter and twigs. (0 to 4 centimeters thick)

A1—0 to 12 centimeters; very dark grayish brown (10YR 3/2) extremely cobbly silt loam, grayish brown (10YR 5/2) dry; moderate very fine and fine granular structure; friable, slightly sticky and slightly plastic; many very fine, fine, medium, and coarse roots; many very fine and fine interstitial pores; approximately 35 percent pebble-sized and 30 percent cobble-sized coral limestone fragments; common thin organic stains coating pebbles and cobbles; neutral (pH 7.1 in 1:1 water); clear wavy boundary. (8 to 15 centimeters thick)

B2—12 to 30 centimeters; dark brown (7.5YR 3/4) very gravelly loam; moderate very fine and fine subangular blocky structure; friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots and few coarse roots; approximately 35 percent pebble-sized and 25 percent cobble-sized coral limestone fragments; common thin and moderately thick clay films and organic stains coating pebbles and cobbles; neutral (pH 7.2 in 1:1 water); abrupt irregular boundary. (15 to 40 centimeters thick)

R—30 centimeters; white (10YR 8/1) hard coral limestone; massive; crystal structure apparent in freshly exposed face.

Type location: Peleliu Municipality, Peleliu Island, Palau, Western Caroline Islands; about 643 meters west of the southwestern end of Honeymoon beach, then 30 meters south of the main road; lat. 6°59'50" N. and long. 134°15'36" E.

Range in characteristics: Depth to a lithic contact and thickness of the solum range from 25 to 50 centimeters.

The A horizon has moist color of 10YR 3/1, 3/2, or 3/3 and dry color of 10YR 5/1, 5/2, or 5/3. It is 25 to 50 percent limestone pebbles 2 to 76 millimeters in size and 25 to 35 percent limestone cobbles 7.6 to 25 centimeters in size. Reaction in 1:1 water is neutral or mildly alkaline. This horizon is slightly effervescent or noneffervescent.

The B2 horizon has moist color of 7.5YR 3/4, 4/6 or 5/6 or of 10YR 4/4 or 4/6. It has an apparent field texture of very gravelly or extremely gravelly loam or

very cobbly or extremely cobbly loam. Clay content, as measured by the product of 2.5 times the 15-bar water percentage, is more than 45 percent. It is 25 to 50 percent limestone pebbles 2 to 76 millimeters in size and 15 to 35 percent limestone cobbles 7.6 to 25 centimeters in size. Reaction in 1:1 water is neutral or mildly alkaline. This horizon is slightly effervescent or noneffervescent.

Rumung series

The Rumung series consists of shallow, well drained soils on uplands. These soils formed in residuum derived from green, chlorite, and talc schist. Slope is 2 to 75 percent. The mean annual rainfall is about 310 centimeters, and the mean annual temperature is about 27 degrees C.

Taxonomic class: Clayey-skeletal, mixed, isohyperthermic Lithic Tropudalfs.

Typical pedon: Rumung gravelly silt loam; on a 19-percent, northeast-facing, convex slope in an area of deteriorated savannah. When described (4/15/80), the soil was dry in the upper 5 centimeters of the profile. Colors are for moist soil unless otherwise noted. About 60 percent of the surface is covered with iron-coated chlorite schist and amphibolite pebbles 2 to 50 millimeters in size.

A1—0 to 10 centimeters; dark brown (10YR 3/3) gravelly silt loam, brown (10YR 5/3) dry; strong very fine granular structure; hard, very friable, slightly sticky and slightly plastic; many very fine and medium roots; many very fine interstitial pores and common very fine tubular pores; approximately 25 percent subangular chlorite schist fragments 2 to 5 centimeters in size; slightly acid (pH 6.4 in 1:1 water); clear wavy boundary. (8 to 20 centimeters thick)

B2—10 to 28 centimeters; strong brown (7.5YR 5/8) very gravelly clay; many fine distinct light olive brown (2.5Y 5/4) mottles; moderate medium and coarse subangular blocky structure; firm, slightly sticky and plastic; common very fine and fine roots and few coarse roots; many very fine and fine tubular pores, few medium tubular pores, and common fine interstitial pores; approximately 40 percent subrounded hard chlorite schist and amphibolite fragments measuring 20 to 60 millimeters along the long axis; medium acid (pH 6.0 in 1:1 water); clear wavy boundary. (10 to 40 centimeters thick)

C—28 to 48 centimeters; pale olive (5Y 6/4) extremely gravelly clay; moderate medium and coarse subangular blocky structure; firm, slightly sticky and plastic; few very fine roots; common very fine tubular pores; approximately 80 percent hard chlorite schist and amphibolite fragments measuring 20 to 60 millimeters along the long axis; medium acid (pH 5.7 in 1:1 water); abrupt irregular boundary. (0 to 25 centimeters thick)

R—48 centimeters; pale green (5G 6/2) uptilted highly fractured chlorite schist and amphibolite; contains interlayered crystals of olivine; approximately 25 percent of the horizon is weathered.

Type location: Weebey Municipality, Yap Island, Yap State, Federated States of Micronesia; about 1.3 kilometers north of the village of Okau by road and about 3.2 kilometers east on the over-island road above a small rock quarry south of the road, about 38 meters south of the road; lat. 9°32'38.26" N. and long. 138°06'17.59" E.

Range in characteristics: Depth to bedrock ranges from 25 to 50 centimeters. Thickness of the solum ranges from 18 to 50 centimeters.

The A horizon has hue of 10YR or 2.5Y, value of 2, 3, or 4, and chroma of 2 or 3. It is dominantly gravelly silt loam but ranges to gravelly clay loam, gravelly silty clay loam, or very gravelly silt loam. The A horizon is 15 to 40 percent moderately hard and hard schist pebbles 2 to 76 millimeters in size and 0 to 15 percent cobbles 8 to 15 centimeters in size. Reaction in 1:1 water is medium acid or slightly acid.

The B horizon has moist color in hue of 10YR, 7.5YR, or 5Y, value of 4 or 5, and chroma of 3 to 8. It is clay loam, silty clay loam, silty clay, or clay and is very gravelly. The B horizon is 0 to 10 percent pebbles 8 to 15 centimeters in size. Reaction in 1:1 water is strongly acid to slightly acid.

The C horizon has moist color in hue of 5Y, 2.5Y, or 5G, value of 4, 5, or 6, and chroma of 2 to 6. It is extremely gravelly clay loam or extremely gravelly clay. The C horizon is 50 to 85 percent pebbles 2 to 76 centimeters in size and 10 to 20 percent cobbles 8 to 15 centimeters in size. Total coarse fragment content ranges from 60 to 90 percent. Reaction in 1:1 water is strongly acid to slightly acid.

Sonahnpil Variant

The Sonahnpil Variant consists of very deep, somewhat poorly drained soils on coastal bottom lands. These soils formed in alluvium. Slope is 0 to 4 percent. The mean annual rainfall is about 310 centimeters, and the mean annual temperature is about 27 degrees C.

Taxonomic class: Clayey-skeletal, mixed, isohyperthermic Fluvaquentic Eutropepts.

Typical pedon: Sonahnpil Variant extremely gravelly silt loam; in a level area of agricultural forest. When described (5/27/80), the soil was moist throughout and had a water table at a depth of 34 centimeters. Colors are for moist soil. All textures are apparent field textures.

A11—0 to 15 centimeters; very dark gray (10YR 3/1) extremely gravelly silt loam; strong very fine and fine granular structure; very friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; many very fine and fine tubular and interstitial pores; about 60 percent pebbles 2 to 76 millimeters in diameter and 10 percent cobbles 76 to 100 millimeters in diameter; slightly acid (pH 6.4 in 1:1 water); clear wavy boundary. (10 to 20 centimeters thick)

C1—15 to 46 centimeters; olive brown (2.5Y 4/4) extremely gravelly silty clay; few reddish yellow (7.5YR 6/8) mottles; moderate fine and medium subangular blocky structure; firm, sticky and plastic; many very fine and fine roots and common medium roots; many very fine tubular and interstitial pores; about 60 percent gravel 2 to 76 millimeters in diameter and 10 percent cobbles 76 to 100 millimeters in diameter; neutral (pH 6.8 in 1:1 water); clear wavy boundary. (20 to 75 centimeters thick)

A12b—46 to 64 centimeters; dark grayish brown (2.5Y 4/2) very gravelly silt loam; strong fine subangular blocky structure; friable, slightly sticky and slightly plastic; common very fine, fine, medium and few coarse roots; many very fine and fine tubular and common very fine interstitial pores; about 40 percent by volume gravel 2 to 76 millimeters in diameter and 10 percent cobbles 76 to 100 millimeters in diameter; neutral (pH 7.1); clear wavy boundary. (0 to 25 centimeters thick)

C2b—64 to 81 centimeters; light olive brown (2.5Y 5/4) extremely gravelly silty clay; many fine distinct strong brown (7.5YR 5/6) mottles; moderate fine and medium subangular blocky structure; firm, sticky and plastic; common very fine, fine, and medium roots and few coarse roots; many very fine and fine tubular pores and few very fine interstitial pores; common thin grayish brown (2.5Y 5/2) coatings on faces of peds and lining pores; many manganese stains on coarse fragments and faces of peds; about 55 percent pebbles 2 to 76 millimeters in diameter and 10 percent cobbles 76 to 100 millimeters in diameter; neutral (pH 7.1 in 1:1 water); abrupt wavy boundary. (10 to 75 centimeters thick)

IIA13b—81 to 158 centimeters; dark gray (2.5Y 4/1) very gravelly mucky silt loam; weak coarse subangular blocky structure; very friable, slightly sticky and slightly plastic; few very fine, fine, and medium roots; many very fine tubular pores; about 45 percent pebbles 2 to 76 millimeters in diameter; neutral (pH 7.2 in 1:1 water).

Type location: Dugor Village, Weloy Municipality, Yap Island, Yap State, Federated States of Micronesia; from intersection of main road and overland road, head northwest about 80 meters on road, then turn right 90 degrees and proceed about 15 meters; lat. 9°31'57.9" N. and long. 138°06'56.7" E.

Range in characteristics: The profile is more than 150 centimeters thick. The water table is at a depth of 75 to 125 centimeters.

The A horizon ranges from 10 to 20 centimeters in thickness. It has moist color of 10YR 2/2, 3/1, 3/2, or 4/1. The horizon has an apparent field texture of silt loam or silty clay loam and is very gravelly or extremely gravelly. It is 35 to 65 percent gravel 2 to 76 millimeters in size and 0 to 20 percent cobbles 8 to 15 centimeters in size. Reaction in 1:1 water ranges from medium acid to neutral. Some profiles do not have a buried A horizon.

The C horizon has moist lithochromic color of 2.5Y 4/4 or 5/4 or of 5Y 4/3 or 4/4, and it has none to many mottles of 7.5YR 5/6 or 6/8, of 10YR 5/6, or of 5Y 5/1 or 4/4. The horizon has an apparent field texture of silty clay loam, silty clay, or clay and is very gravelly or extremely gravelly. It is 35 to 65 percent gravel 2 to 76 millimeters in size and 0 to 20 percent cobbles 8 to 15 centimeters in size. Reaction ranges from slightly acid to mildly alkaline.

The lower part of the substratum in some pedons consists of thin strata of coral loamy sand, sand, mucky mineral material, or muck.

Tabecheding Variant

The Tabecheding Variant consists of very deep, poorly drained soils on wet bottom lands. These soils formed in alluvium derived mainly from saprolitic volcanic breccia and tuff. Slope is 0 to 4 percent. The mean annual rainfall is about 310 centimeters, and the mean annual temperature is about 27 degrees C.

Taxonomic class: Very fine, halloysitic, acid, isohyperthermic Typic Sulfaquents.

Typical pedon: Tabecheding Variant silty clay loam; on a 1-percent, northwest-facing, plane slope in an area of wetland savannah. When described (5/22/80), the soil was moist throughout and had a water table at a depth of 15 centimeters. Colors are for moist soil. All textures are apparent field textures.

A1—0 to 20 centimeters; very dark brown (10YR 2/2) silty clay loam; few fine distinct brown (7.5YR 4/4) mottles; moderate fine granular structure; friable, sticky and slightly plastic; many very fine and fine roots; many very fine and fine interstitial pores; very strongly acid (pH 4.9 in 1:1 water); clear wavy boundary. (10 to 30 centimeters thick)

AC—20 to 33 centimeters; grayish brown (10YR 5/2) silty clay loam; many fine distinct strong brown (7.5YR 5/8) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; friable, sticky and slightly plastic; common very fine tubular and interstitial pores; very strongly acid (pH 4.7 in 1:1 water); clear wavy boundary. (0 to 20 centimeters thick)

C1—33 to 41 centimeters; light brownish gray (10YR 6/2) silty clay; many fine and medium distinct strong brown (7.5YR 5/8) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; friable, sticky and plastic; few very fine and fine roots; many very fine and fine tubular pores and common very fine interstitial pores; very strongly acid (pH 4.7 in 1:1 water); clear wavy boundary. (5 to 30 centimeters thick)

C2—41 to 150 centimeters; light gray (5Y 7/1) silty clay; many fine and medium prominent strong brown (7.5YR 5/8) mottles; massive; friable, sticky and plastic; few very fine roots; many very fine and fine tubular pores; very strongly acid (pH 4.7 in 1:1 water).

Type location: Gachaam Village, Tamil Municipality, Gagil Tamil Island, Yap State, Federated States of Micronesia; lat. 9°32'2.7" N. and long. 138°09'28.9" E.

Range in Characteristics: A water table is at a depth of 10 to 40 centimeters. The profile is more than 150 centimeters thick.

The A horizon has moist color of 5YR 3/2 or 4/2, of 7.5YR 3/2, 3/4, 4/4, or 4/2, or of 10YR 2/2, 3/2, 3/3, 4/2, 4/3, or 5/2. It has an apparent field texture of silty clay loam or silty clay.

The C horizon is mottled and has moist color of 5YR 5/3, 5/4, 6/3, or 6/4, of 7.5YR 7/4 or 5/8, or of 10YR 6/2 grading to 5Y 5/1, 6/1, 7/1, or 7/2. It has an apparent field texture of silty clay or clay.

Weloy series

The Weloy series consists of moderately deep, well drained soils on uplands. These soils formed in material weathered from hard and soft green, chlorite, and talc schist. Slope is 2 to 75 percent. The mean annual rainfall is about 310 centimeters, and the mean annual temperature is about 27 degrees C.

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

Typical pedon: Weloy gravelly silty clay loam; on a 53-percent, west-facing slope in an area of tropical forest. Colors are for moist soil. About 5 percent of the surface is covered with hard schist pebbles and cobbles.

O1—2 centimeters to 0; undecomposed and partially decomposed forest litter.

A1—0 to 10 centimeters; very dark grayish brown (10YR 3/2) gravelly silty clay loam; strong very fine and fine granular structure; friable, slightly sticky and slightly plastic; many very fine and fine roots, common medium roots, and few coarse roots; many very fine tubular and interstitial pores and common fine tubular pores; approximately 25 percent subangular to subrounded, moderately hard and hard schist pebbles 2 to 50 millimeters in size and 5 percent soft cobbles 10 centimeters in size; medium acid (pH 5.7 in 1:1 water); gradual wavy boundary. (8 to 25 centimeters thick)

A3—10 to 33 centimeters; dark brown (10YR 3/3) very gravelly clay loam; strong medium and coarse subangular blocky structure parting to strong very fine subangular blocky; friable, sticky and plastic; few very fine and fine roots; many very fine and fine tubular and interstitial pores; approximately 40 percent moderately hard to hard, subangular to subrounded schist pebbles 1 to 8 centimeters in size; slightly acid (pH 6.2 in 1:1 water); clear wavy boundary. (10 to 25 centimeters thick)

B2t—33 to 56 centimeters; yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/4) very gravelly clay; moderate fine and medium angular blocky structure; firm, sticky and very plastic; few very fine, fine, and medium roots; common very fine tubular and interstitial pores; common thin coatings on faces of peds and lining pores; fingers varying from 8 centimeters in width at the top to 2 centimeters in width at the bottom extend to a depth of 45 centimeters; approximately 40 percent moderately hard to hard, subangular to subrounded schist pebbles 1 to 8 centimeters in size; slightly acid (pH 6.4 in 1:1 water); abrupt irregular boundary. (5 to 45 centimeters thick)

Cr—56 centimeters; light olive brown (2.5YR 5/6) weathered schist that crushes with difficulty to sandy clay loam and grayish green (5G 4/2) hard schist; black (2.5Y 2/0) manganese stains along fractures and dark yellowish brown (10YR 4/4) weathering rind; fractures in nearly vertical plane with one intrusion of hard schist 15 centimeters across; easily dug with spade; few fine and medium roots along fractures; common very fine and fine tubular pores following interstices; many thin coatings on faces of peds; weathered schist is slightly acid (pH 6.4 in 1:1 water).

Type location: Weloy Municipality, Yap Island, Yap State, Federated States of Micronesia; about 0.8 kilometer by road north of the village of Okau, then about 3 kilometers east on overland road and 30 meters south of road on trail through forest; lat. 9°32'36.38" N. and long. 138°6'12.46" E.

Range in characteristics: The thickness of the solum and the depth to bedrock range from 50 to 62 centimeters.

The A1 horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 2 or 3. It is gravelly silty clay loam, gravelly clay loam, gravelly silt loam, or very gravelly silt loam. It is 10 to 30 percent moderately hard and hard schist pebbles 2 to 76 millimeters in size. The horizon is 5 to 15 percent cobbles 8 to 15 centimeters in size. Reaction in 1:1 water is slightly acid or medium acid.

The B2t horizon has moist color in hue of 7.5YR, 10YR, or 5Y, value of 4 or 5, and chroma of 3 to 8. It is clay loam, silty clay, or clay and is gravelly or very gravelly. The horizon is 15 to 40 percent gravel 2 to 8 centimeters in size and 5 to 15 percent cobbles 8 to 15 centimeters in size. Total coarse fragment content ranges from 20 to 50 percent and averages more than 35 percent in the particle-size control section. Reaction in 1:1 water is medium acid or slightly acid.

Yap series

The Yap series consists of very deep, well drained soils on uplands. These soils formed in material derived from volcanic breccia and tuff. Slope is 0 to 30 percent. The mean annual rainfall is about 310 centimeters, and the mean annual temperature is about 27 degrees C.

Taxonomic class: Clayey, mixed, isohyperthermic Tropeptic Eutrorthox.

Typical pedon: Yap silty clay loam; on a 2-percent, slightly convex, north-facing slope in an area of agricultural forest. When described (1/3/80), the soil was moist throughout. Colors are for moist soil. All textures are apparent field textures.

O1—5 to 3 centimeters; undecomposed and partially decomposed forest litter. (0 to 5 centimeters thick)

O2—3 centimeters to 0; black (5YR 2.5/1) peat; weak very fine and fine subangular blocky structure; very friable, slightly sticky and slightly plastic; many very fine and few medium roots; many very fine tubular and interstitial pores; abrupt smooth boundary. (0 to 5 centimeters thick)

A1—0 to 50 centimeters; dark brown (7.5YR 4/4) silty clay loam; strong very fine and fine subangular blocky structure parting to strong very fine and fine granular; friable, slightly sticky and slightly plastic; many very fine roots and common fine and medium roots; many very fine interstitial pores and common very fine, fine, and medium tubular pores; approximately 2 percent subrounded iron concretions 1 to 5 centimeters in diameter and approximately 2 percent green schist fragments about 0.5 by 1 by 3 centimeters in size; medium acid (pH 5.8 in 1:1 water); abrupt wavy boundary. (8 to 50 centimeters thick)

B2—50 to 90 centimeters; strong brown (7.5YR 5/8) silty clay; many medium faint red (2.5YR 5/8) mottles; few faint distinct white (10YR 9/2) pseudomorphs of feldspar; strong medium and moderate very fine angular blocky structure; firm, sticky and plastic; few very fine, fine, and medium roots; many very fine interstitial pores and many very fine, fine, and medium tubular pores; many thin coatings on faces of peds and lining pores; slightly acid (pH 6.4 in 1:1 water); clear wavy boundary. (37 to 75 centimeters thick)

C—90 to 150 centimeters; variegated strong brown (7.5YR 5/8) and white (10YR 8/2) silty clay; few fine and medium distinct red (10R 4/8) mottles; moderate medium and coarse subangular blocky structure; firm, slightly sticky and slightly plastic; few very fine, fine, and medium roots; many very fine tubular pores following faces of peds; many thin strong brown (7.5YR 4/6) coatings and dark brown (7.5YR 3/4) stains on faces of peds and lining pores; slightly acid (pH 6.4 in 1:1 water).

Type location: Kanifay Municipality, Yap Island, Yap State, Federated States of Micronesia; about 225 meters west from intersection of Kanifay Church; take right fork and head north about 77 meters to houses, then head north by northwest on trail about 56 meters, turn north into forest, and proceed about 9 meters; lat. 9°28'23.91" N. and long. 138°03'30.41" R.

Range in characteristics: The solum is 45 to 125 centimeters thick.

The A horizon has moist color in hue of 2.5YR, 5YR, or 7.5YR, value of 3 or 4, and chroma of 2 to 4. It has an apparent field texture of silty clay loam or silty clay. The horizon is 0 to 5 percent schist fragments and iron concretions 2 to 50 millimeters in diameter. Reaction in 1:1 water is medium acid or slightly acid.

The B2 horizon has moist color in hue of 2.5YR, 5YR, or 7.5YR, value of 3, 4, or 5, and chroma of 4 to 8. It has an apparent field texture of silty clay loam, silty clay, or clay. The horizon is 0 to 5 percent schist fragments and spheroidal iron concretions 2 to 50 millimeters in diameter. Reaction in 1:1 water ranges from strongly acid to slightly acid.

The C horizon has moist, variegated colors in hue of 10R, 2.5YR, 7.5YR, 10YR, 5Y, or 5BG, value of 3 to 8, and chroma of 1 to 8. It has an apparent field texture of silty clay loam, silty clay, or clay. Reaction in 1:1 water ranges from strongly acid to slightly acid.

formation of the soils

Soil is the collection of natural bodies on the earth's surface, containing living matter that supports or is capable of supporting plants (*14*). It is a mixture of varying amounts of rocks and minerals, elements combined as salts or ions, organic matter, water, and air.

The processes involved in soil formation are complex, and the soil is constantly changing. There are five factors that interact with one another to form soil. They are 1) the physical and mineralogical composition of the parent material; 2) the climate under which the material has accumulated and has existed since accumulation; 3) the plant and animal life on and in the soil; 4) the relief, or lay of the land; and 5) the length of time the forces of soil formation have acted on the soil material.

Climate and plants and animals are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into soil. The effects of the climate and plants and animals are influenced by relief. The parent material also affects the kind of soil that is formed. Finally, time is needed for the changing of the parent material into a mature soil.

The five factors of soil formation are so closely interrelated in their effect on the soil that few generalizations can be made about the effect of any one factor unless conditions are specified for the other four.

This section describes the five major factors of soil formation and how these factors affect the soils in this survey area.

parent material

Parent material is the unconsolidated mass from which soil forms. It largely determines the chemical and mineralogical composition of the soil. The minerals in the parent material generally determine the kinds and amount of clay in the soil. Many of the upland soils in the area, such as the Yap and Gagil soils, formed in place from saprolitic material derived from extrusive volcanic rock such as tuff and tuffaceous breccia. These soils have a high content of tubular halloysite clay.

The Gitam, Rumung, and Weloy soils formed in place from green, chlorite, and talc schist. They are dominated by chloritic and montmorillonitic clay because of the high content of calcium and magnesium in the parent material. Other soils formed in alluvium washed from these upland soils. Still others formed in coral sand (for example, the Ngedebus soils) or in a combination of coral sand and alluvium washed from the uplands (for example, the Dublon Variant soils).

climate

Soil forms rapidly in this survey area because of the warm tropical climate. This warm climate is favorable throughout the year for rapid chemical and physical reactions and for the decomposition of organic material from plants and animals. Temperature and rainfall, which vary only slightly within the area, partially govern the rate of weathering of the rocks and the decomposition of minerals. They also influence leaching, eluviation, illuviation, and soil deterioration.

More specific information on the climate of the survey area is given in the section "Climate."

plants and animals

Plants, animals, fungi, and bacteria are important to soil formation. The changes they bring about depend mainly on the kinds of life processes peculiar to each.

Originally, most of the soils in the survey area were covered by dense tropical forest. Some areas were burned and cleared for cultivation and other uses. When these areas were left idle, savannah vegetation became dominant. Repeated burning and removal of the savannah vegetation further depleted the soils, so that now some areas support only deteriorated savannah vegetation. Burning clearly has altered the physical and chemical properties of the soils.

The vegetation generally determines the amount of organic matter in the soil, the color of the surface layer, and the amount of nutrients. Growing plants provide a cover that reduces erosion and helps to stabilize the surface so that soil-forming processes can continue. Plants recycle nutrients, and plant roots intercept many nutrients being released into the soil before they can be leached through the soil and lost. Leaves, twigs, and entire plants accumulate on the surface of the soil and then decompose as a result of micro-organisms, earthworms, and other forms of animal life acting on the soil. The plant roots leave pores and widen cracks in the rocks and thus permit more water to enter the soil. Also, the uprooting of trees influences soil formation by mixing the soil layers and loosening the underlying material.

Earthworms, ants, and many other burrowing animals are active in the survey area. They help to keep the soil

open and porous, mix the layers of the soil, mix organic matter into the soil, and help to break down the remains of plants. Earthworms and other small invertebrates feed on organic matter in the upper few centimeters of the soil. They slowly but continually mix the soil material and, in places, alter it chemically. Bacteria, fungi, and other micro-organisms hasten the weathering of rock minerals and the decay of organic matter.

relief

The shape of the land surface, the slope, and the depth of the water table have had a great influence on the formation of the soils in the survey area. Strongly sloping to steep soils, where runoff is moderate to rapid, generally are well drained and have a bright colored subsoil. Soils on toe slopes, such as the Gitam soils, receive runoff and lateral seepage from higher lying areas. The montmorillonitic and chloritic clay in these soils prevents free drainage, and the gentle slopes allow water to perch in the soils. Soils in bottom land areas, such as the Dechel soils, have a water table at or near the surface for long periods of time. These soils exhibit marked evidence of wetness in the form of mottles or solid gleyed colors.

time

A long period of time generally is needed for changes to take place in the parent material. The soils in the survey area range from those that exhibit little or no development to older soils that exhibit very pronounced development. The Ngedebus soils are examples of young soils, and the Yap, Gagil, and Gitam soils are examples of older soils.

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glossary

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.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Agricultural forest. A forest consisting of planted trees for producing food, such as bananas and breadfruit, mixed with other native non-food-producing trees.

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.

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 centimeters of water per centimeter of soil. The capacity, in centimeters, in a 150-centimeter profile or to a limiting layer is expressed as—

	Centimeters
Very low	0 to 7.5
Low	7.5 to 15
Moderate	15 to 22.5
High	22.5 to 30
Very high	More than 30

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 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.

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

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 7.5 to 25 centimeters in diameter.

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 soil 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 are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. Calcium carbonate and iron and aluminum oxides are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; 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 25 centimeters and 100 or 200 centimeters.

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.

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.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.
Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

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

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

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.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Excess sulfur (in tables). Excessive amount of sulfur in the soil. The sulfur causes extreme acidity if the soil is drained, and the growth of most plants is restricted.

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.

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

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 15 to 37.5 centimeters long.

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

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

Gathering. The collecting or gleaning of food and other raw material from the wild.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

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 2 millimeters to 7.5 centimeters in diameter. An individual piece is a pebble.

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

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

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

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 at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material.

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. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

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 A or B horizon. 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 Roman numeral II precedes the letter C.

Cr layer.—Weathered bedrock or saprolite, such as weathered igneous rock, that roots cannot enter except along fracture planes. The material can be dug with a spade.

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.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

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.

Intertropical convergence zone. The boundary area between the trade wind systems of the Northern Hemisphere and the Southern Hemisphere. It is an elongated band of disturbed weather that usually is broken rather than continuous. In the Pacific Ocean area, it generally is north of the equator in all seasons.

Large stones (in tables). Rock fragments 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.

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.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

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; *medium*, from 5 to 15 millimeters; and *coarse*, more than 15 millimeters.

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Mulch. A protective covering of organic materials on the surface of the soil.

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.

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.

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.)

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 1 square meter to 10 square meters, depending on the variability of the soil.

Percolation. The downward movement of water through 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 0.02 centimeter
Slow	0.02 to 0.5 centimeter
Moderately slow	0.5 to 1.5 centimeters
Moderate	1.5 to 5.0 centimeters
Moderately rapid	5.0 to 15.0 centimeters
Rapid	15.0 to 50 centimeters
Very rapid	more than 50 centimeters

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.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Pit leaching. A method of disposal of effluent from septic tanks whereby a deep pit is dug (about 2 meters in diameter and 5 meters deep) into the soft parent material and then backfilled with gravel. This method may be used where slopes are too steep for other absorption fields to function without the hazard of lateral seepage.

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.

Plinthite. The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents. It commonly appears as red mottles, usually in platy, polygonal, or reticulate patterns. Plinthite changes irreversibly to an ironstone hardpan or to irregular aggregates on repeated wetting and drying, especially if it is exposed also to heat from the sun. In a moist soil, plinthite can be cut with a spade. It is a form of laterite.

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.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

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.

Root zone. The part of the soil that can be penetrated by plant 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 swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damange 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 6.1 meters in 30.5 meters of horizontal

distance. In this survey the following slope classes are recognized:

	Percent
Nearly level	0 to 2
Gently sloping	2 to 6
Strongly sloping	6 to 12
Moderately steep	12 to 30
Steep	30 to 50
Very steep	50 to 75

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 7.5 centimeters in diameter. Small stones adversely affect the specified use of the soil.

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.

Soil degradation. The process whereby fertile soils under natural forest conditions are made less productive by the removal of the forest, frequent burning, and clean-till cultivation. This interrupts the recycling of nutrients and allows sunlight to heat and dry the surface layer and volitalize organic matter. Leaching of nutrients and erosion increases. Available water capacity of the soil is reduced.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sandL0.25 to 0.10	
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

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 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 25 to 60 centimeters in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind and water erosion.

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).

Subsidence. The settlement of organic soils, which results either from dessication and shrinkage or oxidation of organic material, or both, following drainage.

Subsistence farming. Farm operations that provide barely the living requirements of the operator and his family rather than an excess for sale on the market.

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 A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Suitability ratings. Ratings for the degree of suitability of soils for pasture, crops, woodland, and engineering uses. The ratings and the general criteria used for their selection are as follows:

Well suited.—The intended use may be initiated and maintained by using only the standard materials and methods typically required for that use. Good results can be expected.

Moderately suited.—The intended use has limitations that make special planning, design, or maintenance necessary.

Poorly suited.—The intended use is difficult or costly to initiate and maintain because of soil properties such as steep slopes, a high hazard of erosion, a high water table, low fertility, or a hazard of flooding. Major soil reclamation, special design, or intensive management practices are needed.

Very poorly suited—The intended use is very difficult or costly to initiate and maintain, and thus it generally should not be undertaken.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 10 to 25 centimeters. Frequently designated as the "plow layer," or the "Ap horizon."

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."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

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.

Water table. The upper limit of the soil or underlying rock that is wholly saturated with water.

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.--HECTARAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Hectares	Percent
500	Dechel mucky silt loam, 0 to 2 percent slopes	433	3.8
501	Dublon loamy fine sand, 0 to 4 percent slopes	115	1.0
502	Dublon Variant sandy clay loam, 0 to 4 percent slopes	170	1.5
503	Gagil extremely gravelly loam, 2 to 12 percent slopes	125	1.1
504	Gagil silty clay loam, 2 to 6 percent slopes	405	3.6
505	Gagil silty clay loam, 6 to 12 percent slopes	204	1.8
506	Gagil silty clay loam, 12 to 30 percent slopes	279	2.5
507	Gagil silty clay loam, 30 to 50 percent slopes	125	1.1
508	Gitam very gravelly silty clay loam, 0 to 2 percent slopes	65	0.6
509	Gitam very gravelly silty clay loam, 2 to 6 percent slopes	577	5.1
510	Gitam very gravelly silty clay loam, 6 to 12 percent slopes	453	4.0
511	Ilachetomel peat, 0 to 1 percent slopes	1,303	11.6
512	Mesei mucky peat, 0 to 1 percent slopes	79	0.7
513	Ngedebus sand, 0 to 4 percent slopes	208	1.8
514	Ngedebus Variant very gravelly loamy sand, 0 to 6 percent slopes	67	0.6
515	Ngersuul Variant silty clay loam, 2 to 8 percent slopes	111	1.0
516	Peleliu extremely cobbly silt loam, 0 to 8 percent slopes	75	0.7
517	Peleliu-Rock outcrop complex, 15 to 75 percent slopes	69	0.6
518	Rock outcrop, phosphate strip mine	101	0.9
519	Rumung-Weloy complex, 12 to 30 percent slopes	2,146	19.0
520	Rumung-Weloy complex, 30 to 50 percent slopes	1,127	10.0
521	Rumung-Weloy complex, 50 to 75 percent slopes	431	3.8
522	Sonahnpil Variant extremely gravelly silt loam, 0 to 4 percent slopes	202	1.8
523	Tabecheding Variant silty clay loam, 0 to 4 percent slopes	49	0.4
524	Typic Troporthents, severely eroded	107	1.0
525	Typic Troporthents-Urban land complex, 0 to 1 percent slopes	34	0.3
526	Weloy-Rumung complex, 2 to 12 percent slopes	585	5.2
527	Yap silty clay loam, 0 to 2 percent slopes	235	2.1
528	Yap silty clay loam, 2 to 6 percent slopes	759	6.7
529	Yap silty clay loam, 6 to 12 percent slopes	285	2.5
530	Yap silty clay loam, 12 to 30 percent slopes	356	3.2
	Total	11,280	100.0

TABLE 2.--SUITABILITY OF CROPS FOR SPECIFIED MAP UNITS

[A rating of 1 indicates that the crop is suited to the unit; 2, that the crop is suited if special management is used; and 3, that the crop is not suited. Slope and the hazard of erosion are not considered in ratings. Map units not rated are not suited to any of the crops specified]

Crop	Map units														
	500	501	502	504 505 506 507	508 509 510	512	513	514	515	516 517	519[1] 520 521 526	522	523	519[2] 520 521 526	527 528 529 530
Avocados	3	3	3	2	3	3	2	2	2	2	2	3	3	1	1
Bananas	3[3]	2	1	2	1	3[3]	2	2	1	2	2	1	2	1	1
Betelnuts	3[3]	2	1	2	1	3[3]	2[4]	2[4]	1	2	2	1	2	1	1
Breadfruit	3	2	2	2	2	3	2	2	1	2	2	2	3	1	1
Cacao	3	3	3	3	2	3	3	3	1	3	2	3	3	1	1
Cashews	3	2	2	2	2	3	2	2	1	2	1	2	3	1	1
Cassava	3	2	2	2	1	3	2	3	1	2	1	2	3	1	1
Chinese cabbage	3	2	2	2	1	3	2	3	1	2	2	2	3	2	1
Cinnamon	3	3	3	2	2	3	3	3	2	2	2	3	3	2	1
Citrus fruit	2	2	3	2	2	3	3	3	1	2	2	3	3	1	1
Clove	3	3	3	2	2	3	3	3	2	2	2	3	3	1	1
Coconuts	3	1	1	2	2	3	1	1	1	2	3	2	3	2	1
Coffee	3	3	3	3	3	3	3	3	1	3	2	3	3	2	2
Corn	3	2	2	2	1	3	2	3	1	2	2	2	3	2	1
Cucumbers	3	2	2	2	1	3	2	3	1	2	2	2	3	2	1
Eggplant	3	2	2	2	2	3	2	3	1	2	2	2	3	2	1
Green onions	3	2	2	2	1	3	2	3	1	2	2	2	3	2	1
Guava	3	3	3	2	2	3	3	3	2	2	2	2	3	1	1
Mangoes	3	2	2	2	2	3	3	3	1	2	2	2	3	1	1
Mangosteens	3	3	3	2	2	3	3	3	1	2	2	3	3	1	1
Nutmeg	3	3	3	2	2	3	3	3	2	2	2	3	3	1	1
Papayas	3	2	2	2	2	3	2	2	1	2	2	2	3	1	1
Pineapples	3	3	3	2	2	3	2	2	1	2	1	2	3	1	1

See footnotes at end of table.

TABLE 2.--SUITABILITY OF CROPS FOR SPECIFIED MAP UNITS--Continued

Crop	Map units														
	500	501	502	504 505 506 507	508 509 510	512	513	514	515	516 517	519[1] 520 521 526	522	523	519[2] 520 521 526	527 528 529 530
Polynesian chestnuts--	3[3]	2	1	2	1	3[3]	3	3	1	3	2[4]	1	3	1[4]	2[4]
Sugarcane----------	3	2	2	2	2	3	2	3	1	2	2	2	3	1	1
Sweet potatoes--------	3	2	2	2	1	3	2	3	1	2	2	2	3	1	1
Taro, dryland---------	3	2	2	2	1	3	2	2	1	2	2	2	3	1	1
Taro, wetland---------	1	2	2	3	2	1	3	3	3	3	3	2	2	3	3
Tea----------	3	3	3	2	3	3	3	3	2	3	3	3	3	3	1
Tomatoes----------	3	2	2	2	2	3	2	3	1	2	2	2	3	2	1
Yams----------	3	2	2	2	2	3	2	3	1	2	3	3	3	2	1

[1]Only the Rumung soil in these map units is used for crops.

[2]Only the Weloy soil in these map units is used for crops.

[3]The crop is better suited to adjacent soils.

[4]The crop is better suited to more moist soils.

TABLE 3.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available. Only scientific names of trees are listed in this table. Common names are given in the section "Woodland management and productivity"]

Soil name and map symbol	Management concerns				Common trees	Trees to plant
	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition		
511*---------- Ilachetomel	Severe	Moderate	Slight	Slight	Bruguiera gymnorhiza, Lumnitzera littorea, Sonneratia alba, Xylocarpus granatum, Rhizophora mucronata, Rhizophora apiculata.	(**)
519*:						
Rumung----------	Moderate	Moderate	Moderate	Severe	Artocarpus altilis, Calophyllum inophyllum, Cocos nucifera, Campnosperma brevipetiolata, Mangifera indica, Ficus benghalensis, Inocarpus fagifer, Pterocarpus carolinensis, Semecarpus venenosus, Trichosperma ikutai.	Adenanthera pavonina, Albizzia, Artocarpus altilis, Calophyllum inophyllum, Campnosperma brevipetiolata, Eucalyptus, Inocarpus fagifer, Pterocarpus carolinensis, Serianthes kanehirae yapensis.
Weloy----------	Moderate	Moderate	Moderate	Severe	Artocarpus altilis, Calophyllum inophyllum, Campnosperma brevipetiolata, Ficus benghalensis, Inocarpus fagifer, Mangifera indica, Pterocarpus carolinensis, Semecarpus venenosus, Trichosperma ikutai, Cocos nucifera.	Adenanthera pavonina, Artocarpus altilis, Calophyllum inophyllum, Campnosperma brevipetiolata, Eucalyptus, Inocarpus fagifer, Pterocarpus carolinensis, Serianthes kanehirae yapensis.
520*:						
Rumung----------	Moderate	Moderate	Moderate	Severe	Artocarpus altilis, Calophyllum inophyllum, Cocos nucifera, Campnosperma brevipetiolata, Mangifera indica, Ficus benghalensis, Inocarpus fagifer, Pterorcarpus carolinensis, Semecarpus venenosus, Trichosperma ikutai.	Adenanthera pavonina, Artocarpus altilis, Calophyllum inophyllum, Campnosperma brevipetiolata, Eucalyptus, Inocarpus fagifer, Pterocarpus carolinensis, Serianthes kanehirae yapensis.

See footnotes at end of table.

TABLE 3.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Management concerns				Common trees	Trees to plant
	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition		
520*:						
Weloy	Moderate	Moderate	Moderate	Severe	Artocarpus altilis, Calophyllum inophyllum, Campnosperma brevipetiolata, Ficus benghalensis, Inocarpus fagifer, Mangifera indica, Pterocarpus carolinensis, Semecarpus venenosus, Trichosperma ikutai, Cocos nucifera.	Adenanthera pavonina, Albizzia, Artocarpus altilis, Calophyllum inophyllum, Campnosperma brevipetiolata, Eucalyptus, Inocarpus fagifer, Pterocarpus carolinensis, Serianthes kanehirae.
521*:						
Rumung	Severe	Moderate	Moderate	Severe	Artocarpus altilis, Calophyllum inophyllum, Cocos nucifera, Campnosperma brevipetiolata, Mangifera indica, Ficus benghalensis, Inocarpus fagifer, Pterocarpus carolinensis, Semecarpus venenosus, Trichosperma ikutai.	Adenanthera pavonina, Artocarpus altilis, Calophyllum inophyllum, Campnosperma brevipetiolata, Eucalyptus, Inocarpus fagifer, Pterocarpus carolinensis, Serianthes kanehirae yapensis.
Weloy	Severe	Moderate	Moderate	Severe	Artocarpus altilis, Calohyllum inophyllum, Campnosperma brevipetiolata, Ficus benghalensis, Inocarpus fagifer Mangifera indica, Pterocarpus carolinensis, Semecarpus venenosus, Trichosperma ikutai.	Adenanthera pavonina, Albizzia, Artocarpus altilis, Calophyllum inophyllum, Campnosperma brevipetiolata, Eucalyptus, Inocarpus fagifer, Pterocarpus carolinensis, Serianthes kanehirae yapensis.
526*:						
Weloy	Slight	Moderate	Moderate	Severe	Artocarpus altilis, Calophyllum inophyllum, Campnosperma brevipetiolata, Ficus benghalensis, Inocarpus fagifer, Pterocarpus carolinensis, Semecarpus venenosus, Trichosperma ikutai, Cocos nucifera.	Adenanthera pavonina, Albizzia, Artocarpus altilis, Calophyllum inophyllum, Campnosperma brevipetiolata, Eucalyptus, Inocarpus fagifer, Pterocarpus carolinensis, Serianthes kanehirae yapensis.

See footnotes at end of table.

TABLE 3.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Management concerns				Common trees	Trees to plant
	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competi-tion		
526* Rumung	Slight	Moderate	Moderate	Severe	Artocarpus altilis, Calophyllum inophyllum, Cocos nucifera, Campnosperma brevipetiolata, Mangifera indica, Ficus benghalensis, Inocarpus fagifer, Pterocarpus carolinensis, Semecarpus venenosus, Trichosperma ikutai.	Adenanthera pavonina, Albizzia, Artocarpus altilis, Calophyllum inophyllum, Campnosperma brevipetiolata, Eucalyptus, Inocarpus fagifer, Pterocarpus carolinensis, Serianthes kanehirae yapensis.
527,528,529,530 Yap	Slight	Moderate	Moderate	Severe	Artocarpus altilis Calophyllum inophyllum, Campnosperma brevipetiolata, Ficus benghalensis, Inocarpus fagifer, Pterocarpus carolinensis, Semecarpus venenosus, Trichosperma ikutai, Cocos nucifera.	Adenanthera pavonina, Artocarpus altilis, Calophyllum inophyllum, Campnosperma brevipetiolata Eucalyptus, Inocarpus fagifer, Pterocarpus carolinensis, Serianthes kanehirae yapensis.

* See description of the map unit for composition and behavior characteristics of the map unit.

** This soil is not suited to planting of trees. Only natural regeneration is practiced.

TABLE 4.--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
500 Dechel	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.	Severe: ponding, flooding.
501 Dublon	Severe: flooding.	Moderate: wetness.	Moderate: slope, small stones, wetness.	Moderate: wetness.	Moderate: wetness, droughty, flooding.
502 Dublon Variant	Severe: flooding, wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
503 Gagil	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Severe: small stones.	Severe: small stones, droughty.
504 Gagil	Slight	Slight	Moderate: slope.	Slight	Slight.
505 Gagil	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
506 Gagil	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
507 Gagil	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
508, 509 Gitam	Severe: small stones, wetness.	Severe: small stones, percs slowly.	Severe: small stones, wetness.	Severe: small stones.	Severe: small stones.
510 Gitam	Severe: small stones, wetness.	Severe: small stones, percs slowly.	Severe: slope, small stones, wetness.	Severe: small stones.	Severe: small stones.
511* Ilachetomel	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus, excess salt.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.	Severe: excess salt, excess sulfur, ponding.
512 Mesei	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.	Severe: ponding, flooding, excess humus.
513 Ngedebus	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, flooding, too sandy.
514 Ngedebus Variant	Severe: flooding, small stones.	Severe: small stones.	Severe: small stones.	Slight	Severe: small stones, droughty.

See footnote at end of table.

TABLE 4.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
515 Ngersuul Variant	Severe: flooding, percs slowly.	Severe: percs slowly.	Severe: percs slowly, flooding.	Moderate: flooding.	Moderate: flooding.
516 Peleliu	Severe: large stones, small stones.	Severe: large stones, small stones.	Severe: large stones, small stones.	Severe: small stones.	Severe: small stones, large stones, droughty.
517*:					
Peleliu	Severe: slope, large stones, small stones.	Severe: slope, large stones, small stones.	Severe: large stones, slope, small stones.	Severe: slope, small stones.	Severe: small stones, large stones, droughty.
Rock outcrop.					
518*. Rock outcrop					
519*:					
Rumung	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Moderate: slope.	Severe: droughty, slope, thin layer.
Weloy	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.	Severe: slope.
520*, 521*:					
Rumung	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope.	Severe: droughty, slope, thin layer.
Weloy	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.	Severe: slope.
522 Sonahnpil Variant	Severe: flooding, small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones, large stones, droughty.
523 Tabecheding Variant	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
524. Typic Troporthents					
525*: Typic Troporthents.					
Urban land.					
526*:					
Weloy	Moderate: small stones.	Moderate: small stones.	Severe: slope, small stones.	Slight	Moderate: small stones, large stones.
Rumung	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight	Severe: droughty, thin layer.

See footnote at end of table.

TABLE 4.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
527 Yap	Slight	Slight	Slight	Slight	Moderate: droughty.
528 Yap	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
529 Yap	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
530 Yap	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 5.--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
500 Dechel	Severe: ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: low strength, ponding, wetness.	Severe: ponding, flooding.
501 Dublon	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: wetness, droughty, flooding.
502 Dublon Variant	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding.	Moderate: wetness, droughty.
503 Gagil	Moderate: too clayey.	Slight	Moderate: slope.	Severe: low strength.	Severe: small stones.
504 Gagil	Moderate: too clayey.	Slight	Moderate: slope.	Severe: low strength.	Slight.
505 Gagil	Moderate: too clayey, slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
506, 507 Gagil	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
508, 509 Gitam	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength.	Severe: small stones.
510 Gitam	Severe: wetness.	Severe: wetness.	Severe: wetness, slope.	Severe: low strength.	Severe: small stones.
511* Ilachetomel	Severe: excess humus, ponding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding, low strength.	Severe: low strength, wetness, flooding.	Severe: excess salt, excess sulfur, ponding.
512 Mesei	Severe: excess humus, ponding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding, low strength.	Severe: low strength, ponding, wetness.	Severe: ponding, flooding, excess humus.
513 Ngedebus	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding, too sandy.
514 Ngedebus Variant	Severe: cutbanks cave, large stones.	Severe: flooding, large stones.	Severe: flooding, large stones.	Severe: large stones.	Severe: small stones, droughty.
515 Ngersuul Variant	Moderate: too clayey.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding.
516 Peleliu	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, low strength.	Severe: small stones, large stones, droughty.

See footnote at end of table.

TABLE 5.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
517*:					
Peleliu	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock, low strength, slope.	Severe: small stones, large stones, droughty.
Rock outcrop.					
518*. Rock outcrop					
519*, 520*, 521*:					
Rumung	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope, thin layer.
Weloy	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
522 Sonahnpil Variant	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: small stones, large stones, droughty.
523 Tabecheding Variant	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness, flooding.
524. Typic Troporthents					
525*: Typic Troporthents.					
Urban land.					
526*:					
Weloy	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: low strength.	Moderate: small stones, large stones.
Rumung	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Moderate: depth to rock, shrink-swell.	Severe: droughty, thin layer.
527 Yap	Moderate: too clayey.	Slight	Slight	Severe: low strength.	Slight.
528 Yap	Moderate: too clayey.	Slight	Moderate: slope.	Severe: low strength.	Slight.
529 Yap	Moderate: too clayey, slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
530 Yap	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "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
500 Dechel	Severe: flooding, ponding, percs slowly.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Poor: hard to pack, ponding.
501 Dublon	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, small stones.
502 Dublon Variant	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
503 Gagil	Slight	Severe: seepage, slope.	Severe: seepage, too clayey.	Severe: seepage.	Poor: too clayey, hard to pack.
504 Gagil	Slight	Severe: seepage.	Severe: seepage, too clayey.	Severe: seepage.	Poor: too clayey, hard to pack.
505 Gagil	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too clayey.	Severe: seepage.	Poor: too clayey, hard to pack.
506, 507 Gagil	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope, too clayey.	Severe: seepage, slope.	Poor: too clayey, hard to pack, slope.
508, 509 Gitam	Severe: depth to rock, wetness, percs slowly.	Severe: depth to rock, wetness.	Severe: depth to rock, wetness.	Severe: depth to rock, wetness.	Poor: area reclaim, too clayey, hard to pack.
510 Gitam	Severe: depth to rock, wetness, percs slowly.	Severe: depth to rock, slope, wetness.	Severe: depth to rock, wetness.	Severe: depth to rock, wetness.	Poor: area reclaim, too clayey, hard to pack.
511* Ilachetomel	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess humus, excess salt.
512 Mesei	Severe: flooding, ponding, percs slowly.	Severe: seepage, flooding, excess humus.	Severe: flooding, ponding.	Severe: flooding, seepage, ponding.	Poor: hard to pack, ponding.
513 Ngedebus	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, too sandy.	Severe: flooding, seepage.	Poor: seepage, too sandy.
514 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, small stones.
515 Ngersuul Variant	Severe: percs slowly, flooding.	Severe: flooding.	Severe: too clayey, flooding.	Moderate: flooding.	Poor: too clayey, hard to pack.

See footnote at end of table.

TABLE 6.--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
516 Peleliu	Severe: depth to rock.	Severe: depth to rock, large stones.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim, small stones.
517*:					
Peleliu	Severe: depth to rock, slope.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, small stones, slope.
Rock outcrop.					
518*. Rock outcrop					
519*, 520*, 521*:					
Rumung	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
Weloy	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, too clayey, small stones.
522 Sonahnpil Variant	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, small stones.
523 Tabecheding Variant	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, wetness.
524. Typic Troporthents					
525*: Typic Troporthents.					
Urban land.					
526*:					
Weloy	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock, seepage.	Poor: area reclaim, too clayey, small stones.
Rumung	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
527, 528 Yap	Slight	Severe: seepage.	Severe: seepage, too clayey.	Severe: seepage.	Poor: too clayey, hard to pack.
529 Yap	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too clayey.	Severe: seepage.	Poor: too clayey, hard to pack.
530 Yap	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope, too clayey.	Severe: seepage, slope.	Poor: too clayey, hard to pack, slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--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
500 Dechel	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
501 Dublon	Fair: wetness.	Probable	Probable	Poor: area reclaim.
502 Dublon Variant	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
503 Gagil	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
504, 505 Gagil	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
506 Gagil	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
507 Gagil	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
508, 509, 510 Gitam	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
511* Ilachetomel	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, excess salt, wetness.
512 Mesei	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
513 Ngedebus	Good	Probable	Probable	Poor: too sandy, small stones.
514 Ngedebus Variant	Poor: large stones.	Improbable: large stones.	Improbable: large stones.	Poor: small stones, area reclaim.
515 Ngersuul Variant	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
516 Peleliu	Poor: area reclaim, low strength, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
517*:				
Peleliu	Poor: area reclaim, low strength, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Rock outcrop.				

See footnote at end of table.

TABLE 7.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
518*. Rock outcrop				
519*:				
Rumung	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Weloy	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
520*, 521*:				
Rumung	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Weloy	Poor: area reclaim, low strength, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
522 Sonahnpil Variant	Fair: large stones, wetness.	Probable	Probable	Poor: small stones, area reclaim.
523 Tabecheding Variant	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
524. Typic Troporthents				
525*: Typic Troporthents.				
Urban land.				
526*:				
Weloy	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Rumung	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
527, 528 Yap	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
529 Yap	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
530 Yap	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "moderate" and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
500 Dechel	Moderate: seepage.	Severe: hard to pack, ponding.	Ponding, flooding, subsides.	Ponding	Wetness, droughty.
501 Dublon	Severe: seepage.	Severe: seepage, piping, wetness.	Flooding, cutbanks cave.	Wetness, too sandy.	Wetness.
502 Dublon Variant	Moderate: seepage.	Severe: piping, wetness.	Flooding, cutbanks cave.	Wetness, too sandy.	Wetness, droughty.
503, 504 Gagil	Severe: seepage.	Severe: hard to pack.	Deep to water	Favorable	Droughty.
505, 506, 507 Gagil	Severe: seepage, slope.	Severe: hard to pack.	Deep to water	Slope	Slope.
508 Gitam	Moderate: depth to rock.	Severe: hard to pack.	Percs slowly, depth to rock.	Depth to rock, wetness.	Wetness, depth to rock.
509 Gitam	Moderate: depth to rock, slope.	Severe: hard to pack.	Percs slowly, depth to rock, slope.	Depth to rock, wetness.	Wetness, depth to rock.
510 Gitam	Severe: slope.	Severe: hard to pack.	Percs slowly, depth to rock, slope.	Slope, depth to rock, wetness.	Wetness, slope, depth to rock.
511* Ilachetomel	Severe: seepage.	Severe: excess humus, ponding, excess salt.	Ponding, flooding, subsides.	Ponding	Wetness, excess salt.
512 Mesei	Severe: seepage.	Severe: hard to pack, ponding.	Ponding, flooding, subsides.	Ponding	Wetness.
513 Ngedebus	Severe: seepage.	Severe: seepage.	Deep to water	Too sandy	Droughty.
514 Ngedebus Variant	Severe: seepage.	Severe: seepage, large stones.	Deep to water	Large stones, too sandy.	Large stones, droughty.
515 Ngersuul Variant	Moderate: slope.	Severe: piping, hard to pack.	Deep to water	Percs slowly	Percs slowly.
516 Peleliu	Severe: depth to rock.	Severe: seepage, large stones.	Deep to water	Large stones, depth to rock.	Large stones, droughty.
517*:					
Peleliu	Severe: depth to rock, slope.	Severe: seepage, large stones.	Deep to water	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Rock outcrop.					
518*. Rock outcrop					

See footnote at end of table.

TABLE 8.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
519*, 520*, 521*:					
Rumung	Severe: depth to rock, slope.	Severe: seepage, hard to pack.	Deep to water	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Weloy	Severe: slope.	Severe: seepage.	Deep to water	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
522 Sonahnpil Variant	Severe: seepage.	Severe: seepage, large stones.	Flooding, cutbanks cave.	Large stones, wetness, too sandy.	Large stones, droughty.
523 Tabecheding Variant	Moderate: seepage.	Severe: wetness.	Flooding	Wetness	Wetness.
524. Typic Troporthents					
525*: Typic Troporthents.					
Urban land.					
526*:					
Weloy	Moderate: seepage, depth to rock, slope.	Severe: seepage.	Deep to water	Large stones, depth to rock.	Large stones, depth to rock.
Rumung	Severe: depth to rock.	Severe: seepage, hard to pack.	Deep to water	Large stones, depth to rock.	Large stones.
527, 528 Yap	Severe: seepage.	Severe: hard to pack.	Deep to water	Favorable	Favorable.
529, 530 Yap	Severe: seepage, slope.	Severe: hard to pack.	Deep to water	Slope	Slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--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 > 76 mm	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	Cm			Pct					Pct	
500---------- Dechel	0-10	Mucky silt loam	OH, MH	0	100	100	90-100	70-100	75-100	10-20
	10-102	Silty clay loam	MH	0	100	100	90-100	85-100	65-75	15-20
	102-109	Very gravelly silty clay loam.	MH, GM	10-15	35-60	30-55	30-55	25-55	65-75	15-20
	109-168	Silty clay loam, silt loam.	MH	0	100	100	90-100	85-100	65-75	15-20
501---------- Dublon	0-56	Loamy fine sand	SM, SP-SM	0	80-100	75-100	60-75	20-30	---	NP-5
	56-150	Stratified loamy fine sand to extremely gravelly coarse sand.	SM, SP-SM, GP-GM, GM	0-5	25-100	20-100	10-70	5-15	---	NP
502---------- Dublon Variant	0-23	Sandy clay loam	SC	0-10	80-100	75-100	60-85	25-50	40-50	NP-10
	23-150	Stratified loamy sand to sandy clay loam.	SM, SC	0-25	90-100	75-100	50-90	20-40	30-50	10-20
503---------- Gagil	0-10	Extremely gravelly loam.	GP-GC, GM-GC, GC	2-30	20-35	10-25	10-25	5-20	20-30	5-15
	10-30	Extremely gravelly clay loam, very gravelly clay.	GM-GC, GC	20-30	25-35	15-30	15-30	10-30	20-30	5-15
	30-150	Clay, silty clay	MH	0-5	95-100	90-95	80-95	70-85	55-85	15-35
504, 505, 506, 507---------- Gagil	0-10	Silty clay loam	MH	0	90-100	85-100	80-100	75-95	70-80	15-25
	10-45	Silty clay-------	MH	0	95-100	95-100	90-100	80-95	75-85	20-30
	45-150	Silty clay, clay, silty clay loam.	MH	0	100	100	95-100	85-95	80-95	25-30
508, 509, 510---- Gitam	0-15	Very gravelly silty clay loam.	GM, SM	10-15	45-70	30-50	30-45	25-40	80-90	20-30
	15-36	Silty clay, clay	MH	0-5	85-100	75-95	70-95	55-90	95-105	50-60
	36-89	Silty clay-------	MH	0	100	100	95-100	90-95	60-70	25-35
	89	Unweathered bedrock.	---	---	---	---	---	---	---	---
511*---------- Ilachetomel	0-41	Peat----------	PT	0	---	---	---	---	---	NP
	41-150	Mucky peat-------	PT	0	---	---	---	---	---	NP
512---------- Mesei	0-86	Mucky peat-------	PT	0	---	---	---	---	---	NP
	86-150	Silt loam, silty clay loam.	MH	0	90-100	85-100	80-100	70-95	65-75	15-20
513---------- Ngedebus	0-46	Sand----------	SP-SM	0-5	85-95	80-90	56-70	5-10	---	NP
	46-150	Sand, coarse sand, fine sand.	SP-SM	0-5	85-95	75-90	40-60	5-10	---	NP
514---------- Ngedebus Variant	0-36	Very gravelly loamy sand.	GM	15-25	35-50	30-45	20-30	10-15	---	NP
	36-150	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
515---------- Ngersuul Variant	0-18	Silty clay loam	MH	0	90-100	85-100	80-100	70-95	55-65	5-15
	18-150	Stratified clay to very gravelly clay.	SM, MH	0	60-90	50-85	45-85	35-80	75-105	20-60

See footnote at end of table.

TABLE 9.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Unified classification	Fragments > 76 mm	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	Cm			Pct					Pct	
516---------- Peleliu	0-12	Extremely cobbly silt loam.	GM, GC	40-50	30-50	20-40	20-40	15-35	30-50	10-20
	12-30	Extremely gravelly loam, very cobbly loam, extremely cobbly loam.	GM	25-50	25-65	15-60	15-55	10-50	60-80	20-30
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---
517*: Peleliu---------	0-12	Extremely cobbly silt loam.	GM, GC	40-50	30-50	20-40	20-40	15-35	30-50	10-20
	12-30	Extremely gravelly loam, very cobbly loam, extremely cobbly loam.	GM	25-50	25-65	15-60	15-55	10-50	60-80	20-30
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---
Rock outcrop.										
518*. Rock outcrop										
519*, 520*, 521*: Rumung----------	0-10	Gravelly silt loam.	GM, MH, SM	0-15	50-100	50-75	45-75	40-70	75-85	15-25
	10-48	Very gravelly clay, extremely gravelly clay.	GM	0-25	25-50	20-45	20-45	15-40	85-95	25-35
	48	Unweathered bedrock.	---	---	---	---	---	---	---	---
Weloy----------	0-10	Gravelly silty clay loam.	GM, MH	10-15	60-85	55-80	50-80	45-80	75-85	20-30
	10-56	Very gravelly clay loam, very gravelly clay, gravelly clay.	GM	0-25	30-65	25-60	20-50	15-45	85-95	25-35
	56-79	Weathered bedrock	---	---	---	---	---	---	---	---
522---------- Sonahnpil Variant	0-15	Extremely gravelly silt loam.	GP-GM, GM	10-40	10-35	10-35	10-35	5-30	55-65	5-15
	15-81	Stratified very gravelly silt loam to extremely gravelly silty clay.	GP-GM, GM	10-40	20-40	10-35	10-35	5-30	65-75	5-20
	81-158	Stratified very gravelly silt loam to sand.	GP-GM, GM	10-25	20-50	10-35	10-30	5-20	60-70	NP-15
523---------- Tabecheding Variant	0-20	Silty clay loam	MH-K	0	100	100	95-100	85-95	100-115	20-40
	20-150	Silty clay loam, silty clay, clay.	MH-K	0	100	100	95-100	85-95	90-105	25-50
524. Typic Troporthents										
525*: Typic Troporthents.										
Urban land.										

See footnote at end of table.

TABLE 9.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Unified classification	Fragments > 76 mm	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	Cm			Pct					Pct	
526*:										
Weloy	0-10	Gravelly silty clay loam.	GM, MH	10-15	60-85	55-80	50-80	45-80	75-85	20-30
	10-56	Very gravelly clay loam, very gravelly clay.	GM	10-25	30-55	25-50	20-50	15-45	85-95	25-35
	56-79	Weathered bedrock	---	---	---	---	---	---	---	---
Rumung	0-10	Gravelly silt loam.	GM, MH	0-15	50-100	50-75	45-75	40-70	75-85	15-25
	10-48	Very gravelly clay, extremely gravelly clay.	GM, SM, MH	0-25	25-50	20-45	20-45	15-40	85-95	25-35
	48	Unweathered bedrock.	---	---	---	---	---	---	---	---
527, 528, 529, 530 Yap	0-50	Silty clay loam	MH	0	95-100	90-100	85-95	75-90	80-90	10-20
	50-90	Silty clay, silty clay loam, clay.	MH	0	95-100	90-100	85-100	80-90	75-85	20-30
	90-150	Silty clay, silty clay loam, clay.	MH	0	100	95-100	90-100	85-95	80-95	25-30

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > 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	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	Cm	G/cm^3	Cm/hr	Cm/cm	pH	Mmhos/cm				Pct
500---------- Dechel	0-10	0.50-0.90	5.0-15	0.15-0.25	5.1-7.3	<2	Low----------	0.15	5	12-18
	10-102	0.90-1.10	0.5-1.5	0.15-0.18	5.1-7.3	<2	Low----------	0.15		
	102-109	0.90-1.10	1.5-5.0	0.10-0.13	5.1-7.3	<2	Low----------	0.15		
	109-168	0.90-1.10	0.5-1.5	0.15-0.18	5.1-7.3	<2	Low----------	0.15		
501---------- Dublon	0-562	1.10-1.20	15-50	0.07-0.12	7.4-7.8	<2	Low----------	0.05	5	2-6
	56-150	1.10-1.40	15-50	0.05-0.09	7.4-8.4	<2	Low----------	0.05		
502---------- Dublon Variant	0-23	1.00-1.20	0.5-1.5	0.07-0.11	7.4-7.8	<2	Low----------	0.10	5	2-6
	23-150	1.10-1.40	1.5-5.0	0.05-0.08	6.6-7.8	<2	Low----------	0.10		
503---------- Gagil	0-10	0.90-1.10	15-50	0.05-0.08	6.1-6.5	<2	Low----------	0.05	5	1-2
	10-30	1.00-1.20	5.0-15	0.10-0.13	5.6-6.0	<2	Low----------	0.05		
	30-150	0.90-1.10	5.0-15	0.13-0.17	5.6-6.0	<2	Low----------	0.10		
504, 505, 506, 507---------- Gagil	0-10	0.80-1.00	5.0-15	0.13-0.15	5.1-6.0	<2	Low----------	0.15	5	1-4
	10-45	1.00-1.20	5.0-15	0.13-0.15	5.1-6.0	<2	Low----------	0.15		
	45-150	0.90-1.10	5.0-15	0.13-0.15	4.5-6.0	<2	Low----------	0.15		
508, 509, 510---- Gitam	0-15	0.90-1.10	0.2-0.5	0.10-0.15	5.6-6.5	<2	Low----------	0.10	3	1-4
	15-36	1.00-1.20	<0.2	0.13-0.16	5.6-6.5	<2	Moderate----	0.15		
	36-89	1.10-1.30	<0.2	0.13-0.16	5.6-6.0	<2	Moderate----	0.15		
	89	---	---	---	---	---	----------	----		
511*---------- Ilachetomel	0-41	0.05-0.09	15-50	0.20-0.30	5.6-6.0	>16	Low----------	0.05	1	70-90
	41-150	0.07-0.18	15-50	0.20-0.30	5.6-6.0	>16	Low----------	0.05		
512---------- Mesei	0-86	0.07-0.20	15-50	0.20-0.30	4.5-5.5	<2	Low----------	0.05	5	>99
	86-150	1.00-1.30	0.5-1.5	0.07-0.11	5.6-6.5	<2	Low----------	0.10		
513---------- Negedebus	0-46	1.20-1.40	15-50	0.05-0.07	7.4-8.4	<2	Low----------	0.10	5	<.5
	46-150	1.20-1.40	15-50	0.05-0.07	7.9-9.0	<2	Low----------	0.10		
514---------- Ngedebus Variant	0-36	1.20-1.40	15-50	0.04-0.06	6.6-8.4	<2	Low----------	0.05	5	1-3
	36-150	1.50-1.70	15-50	0.01-0.07	6.6-8.4	<2	Low----------	0.02		
515---------- Ngersuul Variant	0-18	0.70-0.90	15-50	0.15-0.18	5.1-5.5	<2	Low----------	0.10	5	2-6
	18-150	0.80-1.00	<0.2	0.03-0.16	5.6-6.5	<2	Moderate----	0.05		
516---------- Peleliu	0-12	0.70-0.90	15-50	0.10-0.13	6.6-7.8	<2	Low----------	0.05	1	5-8
	12-30	0.90-1.10	5.0-15	0.05-0.08	6.6-7.8	<2	Low----------	0.05		
	30	---	---	---	---	---	----------	----		
517*:										
Peleliu---------	0-12	0.70-0.90	15-50	0.10-0.13	6.6-7.8	<2	Low----------	0.05	1	5-8
	12-30	0.90-1.10	5.0-15	0.05-0.08	6.6-7.8	<2	Low----------	0.05		
	30	---	---	---	---	---	----------	----		
Rock outcrop.										
518*. Rock outcrop										
519*, 520*, 521*:										
Rumung----------	0-10	0.90-1.10	5.0-15	0.10-0.13	5.6-6.5	<2	Low----------	0.10	1	1-4
	10-48	1.00-1.20	1.5-5.0	0.10-0.13	5.1-6.5	<2	Moderate----	0.10		
	48	---	---	---	---	---	----------	----		
Weloy----------	0-10	0.90-1.10	5.0-15	0.12-0.15	5.6-6.5	<2	Low----------	0.10	2	2-6
	10-56	1.00-1.20	1.5-5.0	0.10-0.13	5.6-6.5	<2	Moderate----	0.10		
	56-79	---	---	---	---	---	----------	----		

See footnote at end of table.

TABLE 10.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	Cm	G/cm^3	Cm/hr	Cm/cm	pH	Mmhos/cm				Pct
522---------- Sonahnpil Variant	0-15	0.80-1.00	5.0-15	0.06-0.10	5.6-7.3	<2	Low---------	0.05	2	2-6
	15-81	0.80-1.20	1.5-5.0	0.06-0.12	6.1-7.8	<2	Low---------	0.05		
	81-158	0.70-1.50	1.5-50	0.06-0.12	6.1-7.8	<2	Low---------	0.10		
523---------- Tabecheding Variant	0-20	0.70-1.00	5.0-15	0.15-0.18	4.5-5.0	<2	Low---------	0.15	5	4-8
	20-150	0.70-1.00	1.5-5.0	0.15-0.18	4.5-5.0	<2	Low---------	0.17		
524. Typic Troporthents										
525*: Typic Troporthents.										
Urban land.										
526*: Weloy----------	0-10	0.90-1.10	5.0-15	0.12-0.15	5.6-6.5	<2	Low---------	0.10	2	2-6
	10-56	1.00-1.20	1.5-5.0	0.10-0.13	5.6-6.5	<2	Moderate----	0.10		
	56-79	---	---	---	---	---	----------	----		
Rumung----------	0-10	0.90-1.10	5.0-15	0.10-0.13	5.6-6.5	<2	Low---------	0.10	1	1-4
	10-48	1.00-1.20	1.5-5.0	0.10-0.13	5.1-6.5	<2	Moderate----	0.10		
	48	---	---	---	---	---	----------	----		
527, 528, 529, 530---------- Yap	0-50	0.80-1.00	5.0-15	0.10-0.18	5.6-6.5	<2	Low---------	0.10	5	2-8
	50-906	1.00-1.20	5.0-15	0.15-0.18	5.1-6.5	<2	Low---------	0.15		
	90-150	0.90-1.10	5.0-15	0.15-0.18	5.1-6.5	<2	Low---------	----		

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare" and "very brief" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table		Bedrock		Subsidence		Risk of corrosion	
		Frequency	Duration	Months	Depth	Months	Depth	Hard-ness	Ini-tial	Total	Uncoated steel	Concrete
					Cm		Cm		Cm	Cm		
500 Dechel	D	Frequent	Long	Jan-Dec	+10-25	Jan-Dec	>150	---	5-10	15-20	Moderate	Moderate.
501 Dublon	B	Occasional	Very brief	Jan-Dec	38-90	Jan-Dec	>150	---	---	---	Low	Low.
502 Dublon Variant	B	Occasional	Very brief	Jan-Dec	30-120	Jan-Dec	>150	---	---	---	High	Low.
503, 504, 505, 506, 507 Gagil	B	None	---	---	>180	---	>150	---	---	---	High	High.
508, 509, 510 Gitam	D	None	---	---	30-75	Jan-Dec	64-100	Soft	---	---	Moderate	Moderate.
511* Ilachetomel	D	Frequent	Long	Jan-Dec	+30-30	Jan-Dec	>150	---	10-20	>150	High	High.
512 Mesei	D	Frequent	Long	Jan-Dec	+30-15	Jan-Dec	>150	---	10-20	60-100	High	High.
513 Ngedebus	A	Occasional	Very brief	Jan-Dec	100-150	Jan-Dec	>150	---	---	---	High	High.
514 Ngedebus Variant	A	Occasional	Very brief	Jan-Dec	>180	---	>150	---	---	---	High	Low.
515 Ngersuul Variant	D	Rare	---	---	>180	---	>150	---	---	---	Moderate	Moderate.
516 Peleliu	D	None	---	---	>180	---	25-50	Hard	---	---	Moderate	Low.
517*:												
Peleliu	D	None	---	---	>180	---	25-50	Hard	---	---	Moderate	Low.
Rock outcrop.												
518*. Rock outcrop												
519*, 520*, 521*:												
Rumung	C	None	---	---	>180	---	25-50	Soft	---	---	Moderate	Moderate.
Weloy	C	None	---	---	>180	---	50-62	Hard	---	---	Moderate	Moderate.
522 Sonahnpil Variant	C	Occasional	Very brief	Jan-Dec	75-125	Jan-Dec	>150	---	---	---	High	Low.

See footnote at end of table.

TABLE 11.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table		Bedrock		Subsidence		Risk of corrosion	
		Frequency	Duration	Months	Depth	Months	Depth	Hard-ness	Ini-tial	Total	Uncoated steel	Concrete
					Cm		Cm		Cm	Cm		
523---------- Tabecheding Variant	D	Frequent----	Very brief	Jan-Dec	15-45	Jan-Dec	>150	---	---	---	High-----	High.
524. Typic Troporthents												
525*: Typic Troporthents.												
Urban land.												
526*:												
Weloy----------	C	None--------	---	---	>180	---	50-100	Hard	---	---	Moderate	Moderate.
Rumung----------	C	None--------	---	---	>180	---	25-50	Soft	---	---	Moderate	Moderate.
527, 528, 529, 530---------- Yap	B	None--------	---	---	>180	---	>150	---	---	---	Moderate	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Dechel	Very fine, mixed, nonacid, isohyperthermic Tropic Fluvaquents
Dublon	Carbonatic, isohyperthermic Aquic Tropopsamments
Dublon Variant	Fine-loamy, carbonatic, isohyperthermic Typic Tropofluvents
Gagil	Clayey, oxidic, isohyperthermic Tropeptic Haplorthox
Gitam	Fine, mixed, isohyperthermic Aquic Tropudalfs
Ilachetomel	Euic, isohyperthermic Typic Sulfihemists
Mesei	Very fine, mixed, euic, isohyperthermic Terric Troposaprists
Ngedebus	Carbonatic, isohyperthermic Typic Tropopsamments
Ngedebus Variant	Sandy-skeletal, carbonatic, isohyperthermic Typic Troporthents
Ngersuul Variant	Very fine, mixed, isohyperthermic Fluventic Dystropepts
Peleliu	Clayey-skeletal, oxidic, isohyperthermic Lithic Eutropepts
Rumung	Clayey-skeletal, mixed, isohyperthermic Lithic Tropudalfs
Sonahnpil Variant	Clayey-skeletal, mixed, isohyperthermic Fluvaqentic Eutropepts
Tabecheding Variant	Very fine, halloysitic, acid, isohyperthermic Typic Sulfaquents
Weloy	Clayey-skeletal, mixed, isohyperthermic Typic Argiudolls
Yap	Clayey, mixed, isohyperthermic Tropeptic Eutrorthox

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