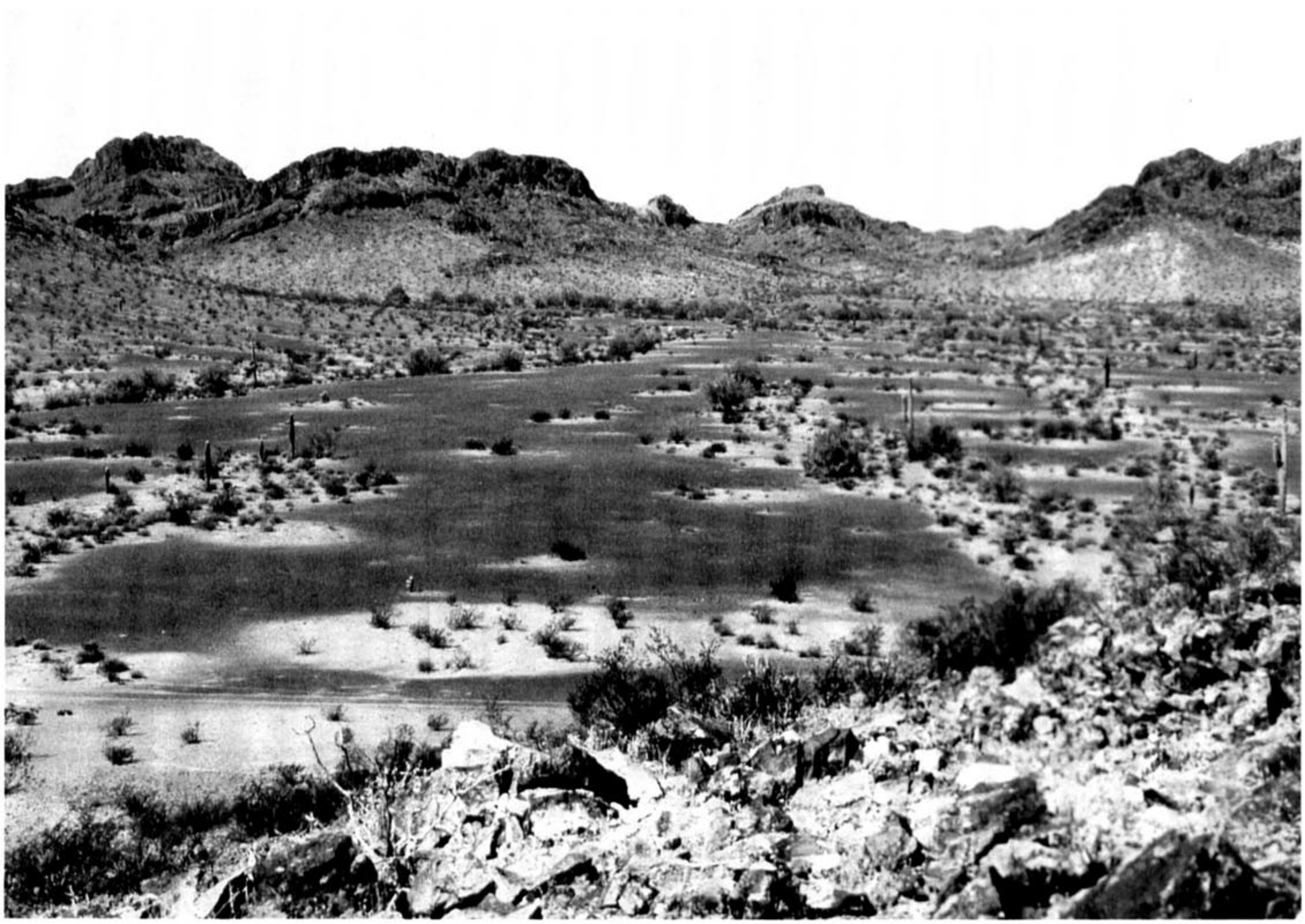
United States
Department of
Agriculture

Natural
Resources
Conservation
Service

In cooperation with
United States Department
of the Interior, Bureau of
Land Management and
Bureau of Indian Affairs;
and the Arizona
Agricultural Experiment
Station

Soil Survey of Gila Bend-Ajo Area, Arizona,
Parts of Maricopa and Pima Counties



How To Use This Soil Survey

General Soil Map

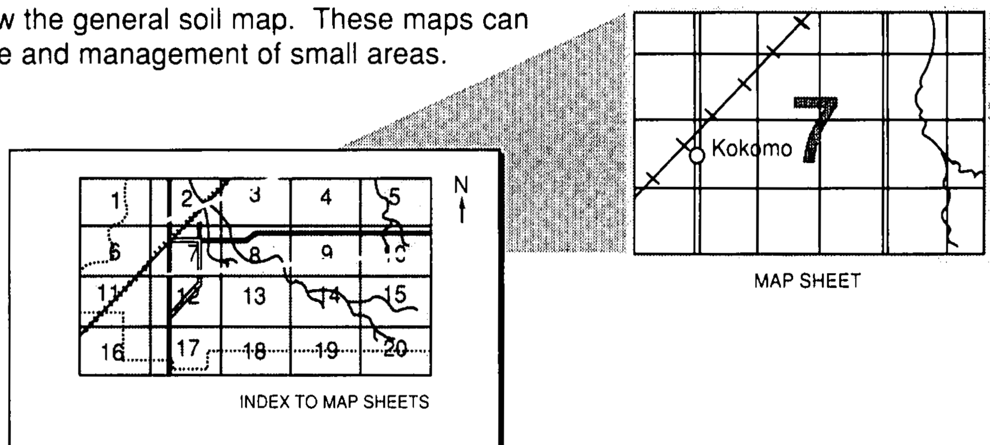
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

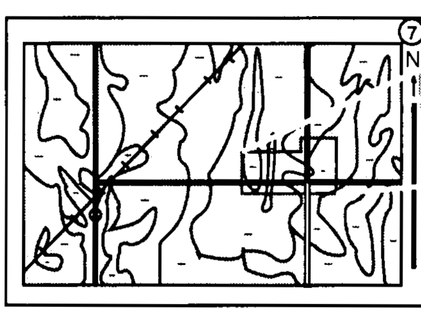
To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



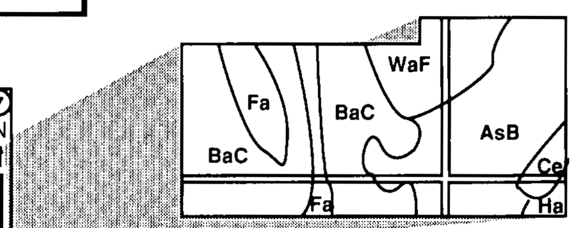
INDEX TO MAP SHEETS

MAP SHEET

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

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, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1984. Soil names and descriptions were approved in 1985. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1984. This survey was made cooperatively by the Natural Resources Conservation Service; the Arizona Agricultural Experiment Station; and the United States Department of the Interior, Bureau of Land Management and Bureau of Indian Affairs. The survey is part of the technical assistance furnished to the Gila Bend Natural Resource Conservation District and the Pima Natural Resource Conservation District.

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.

All programs and services of the Natural Resources Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: An area of Gunsight-Chuckawalla complex, 1 to 15 percent slopes, showing desert pavement on fan terraces. The Chuckawalla soil is in the dark areas under the desert pavement surface. The Gunsight soil is in the lighter colored areas. Hyder soils are on the hills and mountains in the foreground and background.

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Foreword

This soil survey contains information that can be used in land-planning programs in this survey area. 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, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

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

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 local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Michael Somerville
State Conservationist
Natural Resources Conservation Service

Soil Survey of Gila Bend-Ajo Area, Arizona, Parts of Maricopa and Pima Counties

By William W. Johnson, Jr.

Fieldwork by William W. Johnson, Jr., John D. Preston, Bruce E. Stoneman, Dennis W. Byrnes, John Kick, Steven Levine, and Rudy D. Schurig

United States Department of Agriculture, Natural Resources Conservation Service, in cooperation with the Arizona Agricultural Experiment Station and the United States Department of the Interior, Bureau of Land Management and Bureau of Indian Affairs

This survey area is in the southwestern part of Arizona (fig. 1). It has a total area of 1,432,320 acres. Of this total, 1,229,440 acres is in southwestern Maricopa County and 202,880 acres is in northwestern Pima County. The survey area is in the Western Range and Irrigated Region of the Sonoran Desert and Central Arizona sections of the Basin and Range province.

The Gila River is the main drainageway in the Gila Bend portion of the area. The Rio Cornez is the main drainageway in the Ajo portion. The area is characterized by flood plains, basin floors, stream terraces, alluvial fans, fan terraces, and steep, rocky mountains that rise abruptly from the fans. Elevation ranges from 420 feet where the Gila River leaves the survey area to more than 4,000 feet on the higher mountains.

Winters are mild in the survey area, but summers are hot and dry. The two main periods of rainfall are during the last half of summer and in early winter.

Most of the area is desert rangeland. Farming is the most important industry in the Gila Bend portion. The main crops are cotton, alfalfa, and small grain. Until recently, copper mining was the most important industry in the Ajo portion of the survey area.

An older survey, "Soil Survey of the Gila Bend Area, Arizona," was published in 1928. This earlier survey covers a part of the present survey. The present survey, however, updates the earlier survey and provides additional information and larger maps, which show the soils in greater detail.

General Nature of the Survey Area

This section provides brief information about the survey area. It describes settlement and development, transportation facilities, and climate.

Settlement and Development

The area in which the present-day community of Gila Bend is located was originally inhabited by the Hohokam Indians. After the disappearance of these Indians about A.D. 1400, the Gila River Route was not regularly traveled again until the period of Spanish Conquest. In 1774, Father Francisco Garces found an Indian rancheria in this area, which he called Santos Apostales San Simon y Judas (Granger, 1960).

Before and after the Mexican War (1846-1849), numerous United States military explorers and survey parties crossed the desert to California using the Gila River Route. The Mormon Battalion, an infantry unit, passed through just north of Gila Bend in 1847 marching on foot from Independence, Missouri, to San Diego, California. The battalion completed the trip in 182 days.

The first stagecoach transportation along the route began in the early 1850's. In 1858, Gila Ranch was built to serve as a time-table station for the Butterfield Overland Stage. The last trip of the Butterfield Stage was made in 1878, when railroad transportation had become available.

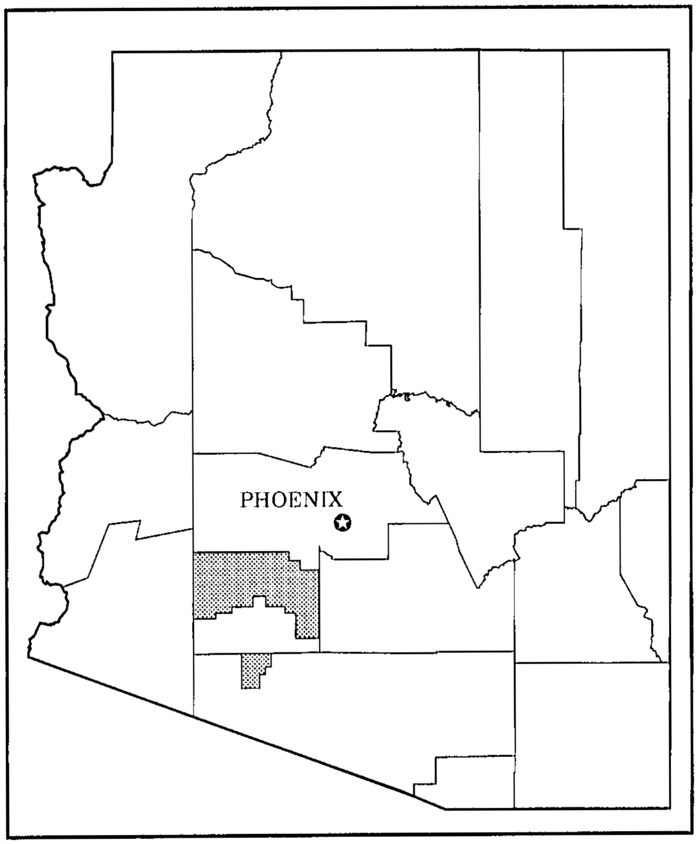

Figure 1.—Location of the Gila Bend-Ajo area in Arizona.

In the late 1840's, some white settlers were living at scattered locations near Gila Bend. It was not until 1865, however, that the first permanent white settlement was established at a site near the big bend of the Gila River. These settlers began raising grain for use by freighters. This site was eventually abandoned for one several miles south on higher ground along the newly completed railroad (Granger, 1960). Gila Bend's first post office was established in 1871, and the first schoolhouse, which was made of logs, was built in 1884. Articles of Incorporation were filed March 2, 1888.

Just north of town, the Gila Bend (Tohono O'odham) Indian Reservation was established on December 12, 1882. At one time it covered 22,391 acres, but it now consists of 10,297 acres (Granger, 1960). Because of a flowage easement when Painted Rock Dam was built, the only village on the Reservation (Sil Murk) was relocated by the U.S. Army Corps of Engineers. The new village was named San Lucy.

Also of historical interest is an area known as Agua Caliente, 35 miles west of Gila Bend. In 1744, Father Jacobo Sedelmayr, while exploring the Big Bend region of the Gila River, visited an Indian rancheria, which he called Santa Maria del Agua Caliente. On November 14, 1775, Father Francisco Garces again used the name Agua Caliente (hot water). In about 1865, the first white American to settle at Agua Caliente was King S. Woolsey. He noted a fact recorded by Sedelmayr many years earlier—that Indians made use of the warm water springs for medicinal purposes. They used the naturally saline water and soil to make mud to soothe their pains. By 1873, Agua Caliente had developed into a prominent health resort (Granger, 1960).

The mining town of Ajo is 44 miles south of Gila Bend in Pima County. "Ajo" means "garlic" in Spanish. Copper has been mined at Ajo since 1854. The Arizona Mining and Trading Company hauled the ore by horse and mule to Yuma and San Diego. The copper was transported from these ports in sailing ships around Cape Horn to Swansea, Wales, for smelting. The costs of these operations were ultimately too great, and the company failed in 1859. Intermittent attempts to exploit the ore deposits followed, but the lack of water and difficulties of transportation prevented success. Among the prospectors who persisted in these attempts were Tom Childs and Reuben Daniels. By the late 1890's, these men had acquired many claims in the area. It was only after 1917, when water sources had been developed and the railroad had been completed from Gila Bend to Ajo, that any large quantity of copper was produced. The Calumet and Arizona Mining Company operated the New Cornelia Mine until the company was purchased by Phelps Dodge Corporation in 1931. More than 400 million tons of ore have been mined from the ore body, which was originally estimated to contain only 30 million tons, making this one of the world's greatest copper mines (J.M. Roche, Phelps Dodge Corporation, personal communication).

Transportation Facilities

The only major Federal highway that serves the area is Interstate 8, which runs east and west through Gila Bend. State Route 85 runs north and south through Gila Bend and Ajo.

The Southern Pacific Railroad serves the Gila Bend portion of the survey area, and the Tucson, Cornelia, and Gila Bend Railroad serves the mine at Ajo.

No commercial airlines serve the area, but small general aviation airports are located at Gila Bend and Ajo.

Climate

Summers are long and very hot in the survey area. Winters are quite warm despite an occasional series of days when the nightly minimum temperature drops below freezing. Rainfall is scant throughout the year. Most of the ground is bare, and irrigation is required for all crops.

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Ajo and Gila Bend, Arizona, for the period 1951 to 1979. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 55 degrees at both Ajo and Gila Bend. The average daily minimum temperature is 43 degrees at Ajo and 39 degrees at Gila Bend. The lowest temperature on record, which occurred at Gila Bend on January 13, 1963, was 10 degrees. In summer, the average temperature is 89 degrees at Ajo and 91 degrees at Gila Bend. The average daily maximum temperature is about 104. The highest recorded temperature, which occurred at Gila Bend on July 10, 1958, was 121 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation ranges from 5 to 12 inches. Of this, 50 percent usually falls in April through September. The growing season for most crops falls within this period. The heaviest 1-day rainfall during the period of record was 3.80 inches at Ajo on August 28, 1951. Thunderstorms occur on about 25 days each year.

Snowfall is rare. In 90 percent of the winters, there is no measurable snowfall. In 10 percent, the snowfall, usually of short duration, is more than 1 inch. The heaviest 1-day snowfall on record was more than 2 inches.

The average relative humidity in midafternoon is about 20 percent. Humidity is higher at night, and the average at dawn is about 50 percent. The sun shines 90 percent of the time possible in summer and 80 percent in winter. The prevailing wind is from the east. Average windspeed is highest, 7 miles per hour, in spring. Strong, dry, dusty winds with gusts as much as 75 miles per hour occur at times in summer and winter.

How This Survey Was Made

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

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

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

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

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will be flooded in most years, but they cannot predict that the flooding will occur on a specific date.

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

This survey area was mapped at two levels of detail. At the more detailed level, map units are narrowly defined. Map unit boundaries were plotted and verified at closely spaced intervals. At the less detailed level, map units are broadly defined. Boundaries were plotted and verified at wider intervals. The detail of mapping was selected to meet the anticipated long-term use of the survey, and the map units were designed to meet the needs for that use. The irrigated area along the Gila River was mapped at a slightly more detailed level than areas of desert rangeland.

The descriptions, names, and delineations of the soils in this survey area do not fully agree with those of the soils in adjacent survey areas. Differences are the result of a better knowledge of soils, modifications in series concepts, or variations in the intensity of mapping or in the extent of the soils in the survey areas.

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, it consists of one or more major soils or miscellaneous areas and some minor soils or miscellaneous areas. It is named for the major soils or miscellaneous areas. The soils or miscellaneous areas making up one unit can occur in another but in a different pattern.

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

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

Soil Descriptions

1. Riverwash-Indio

Deep, well drained, nearly level, loamy soils and areas of Riverwash; on flood plains

This map unit is dominantly on the flood plain along the Gila River. It is characterized by the broad flood plain and channel of the Gila River. Slope is 0 to 1 percent. The vegetation is mainly mesquite, saltbush, arrowweed, and annual grasses. The channels are subject to scouring and commonly support little or no vegetation. Elevation ranges from 430 to 850 feet. The average annual precipitation is about 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free season is 260 to 320 days. Part of this unit is within the flood pool of Painted Rock Dam and is subject to long periods of flooding.

This unit makes up about 5 percent of the survey area.

Riverwash consists of stratified, coarse textured soil material in the channel and on the low flood plain of the Gila River.

Indio soils are on flood plains. These soils are deep and well drained. They formed in recent alluvium derived dominantly from mixed rocks. They are loamy and are saline-sodic in places.

Of minor extent in this unit are Agualt, Gadsden, Gilman, Glenbar, Kofa, Lagunita, Ripley, and Vint soils on flood plains; Carrizo, Cuerda, and Why soils on flood plains (washes) and on alluvial fans; Dateland and Denure soils on stream terraces; and Rositas soils on dunes.

This unit is used mainly as irrigated cropland or for pasture. Some areas are used as rangeland or for homesite development.

About 50 percent of this unit is suited to irrigated crops. The main management concerns are the hazard of flooding, the content of toxic salts, and droughtiness.

This unit is poorly suited to homesite development because of the flooding.

2. Mohall-Dateland

Deep, well drained, nearly level, loamy soils; on fan terraces and basin floors

This map unit is dominantly along the eastern edge of the survey area, in the Paloma Ranch area, and in the Valley of the Ajo. It is characterized by smooth topography and slight dissection by washes. Slope ranges from 0 to 7 percent. The vegetation is mainly creosotebush, white bursage, and paloverde. Elevation ranges from 500 to 2,100 feet. The average annual precipitation is about 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free season is 260 to 320 days.

This unit makes up about 13 percent of the survey area.

Mohall soils are on nearly level fan terraces and basin floors. These soils are deep and well drained. They formed in alluvium derived dominantly from mixed rocks. They are loamy and are underlain by a very limy layer at a depth of 20 to 40 inches.

Dateland soils are on nearly level fan terraces. These soils are deep and well drained. They formed in alluvium derived dominantly from mixed rocks. Typically, 5 to 15 percent of the surface is covered with pebbles. The soils are loamy.

Of minor extent in this unit are Coolidge, Denure, and Rillito soils on fan terraces; Tucson and Wellton soils on basin floors; Carrizo, Cuerda, and Why soils on alluvial fans and flood plains (washes); and areas that have a sandy surface layer and are on low dunes.

This unit is used mainly as rangeland or irrigated cropland. Some areas are used for homesite development.

This unit is well suited to irrigated crops. The main management concerns are the hazard of wind erosion, droughtiness, and the very limy layer.

This unit is well suited to homesite development. Few limitations affect this use.

3. Gunsight-Rillito-Denure

Deep, somewhat excessively drained, nearly level to moderately steep, gravelly to extremely gravelly, loamy soils; on fan terraces

This map unit is throughout the survey area. It is characterized by fan terraces deeply dissected by drainageways. Slope ranges from 1 to 25 percent. The vegetation is mainly creosotebush, white bursage, and paloverde. Elevation ranges from 450 to 2,600 feet. The annual precipitation is about 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free season is 260 to 320 days.

This unit makes up about 31 percent of the survey area.

Gunsight soils are on nearly level to moderately steep fan terraces. These soils are deep and somewhat excessively drained. They formed in alluvium derived dominantly from mixed rocks. Typically, 25 to 80 percent of the surface is covered with pebbles. The soils are extremely gravelly and loamy and are underlain by a very limy layer at a depth of 5 to 30 inches.

Rillito soils are on nearly level and gently sloping fan terraces. These soils are deep and somewhat excessively drained. They formed in alluvium derived dominantly from mixed rocks. Typically, 35 to 80 percent of the surface is covered with pebbles. The soils are gravelly and loamy and are underlain by a very limy layer at a depth of 5 to 40 inches.

Denure soils are on nearly level and gently sloping fan terraces. These soils are deep and somewhat excessively drained. They formed in alluvium derived dominantly from mixed rocks. Typically, 20 to 50 percent of the surface is covered with pebbles. The soils are gravelly and loamy throughout.

Of minor extent in this unit are Ajo, Cipriano, Comobabi, Pinamt, and Pompeii soils on fan terraces; Quilotosa soils on hills; Momoli soils on stream terraces; and Carrizo and Why soils on flood plains (washes) and alluvial fans.

This unit is used mainly as rangeland. The main limitations affecting all uses are the content of coarse fragments and the slope.

4. Wellton-Denure-Growler

Deep, well drained and somewhat excessively drained, nearly level and gently sloping, gravelly, loamy soils; on fan terraces

This map unit is in the Hyder area and in the area north and west of Gila Bend. It is characterized by intermittent desert pavement on the tops of fan terraces and slight dissection by washes. Slope ranges from 0 to 7 percent. The vegetation is mainly turkshead, creosotebush, white bursage, and paloverde. Elevation ranges from 550 to 800 feet. The average annual precipitation is about 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free season is 260 to 320 days. Part of this unit is within the flood pool of Painted Rock Dam and is subject to long periods of flooding.

This unit makes up about 7 percent of the survey area.

Wellton soils are on nearly level fan terraces and basin floors. These soils are deep and well drained. They formed in alluvium derived dominantly from mixed rocks. Typically, 1 to 60 percent of the surface is covered with pebbles. The soils are loamy and gravelly and are underlain by a very limy layer at a depth of 30 to more than 40 inches.

Denure soils are on nearly level and gently sloping fan terraces. These soils are deep and somewhat excessively drained. They formed in alluvium derived dominantly from mixed rocks. Typically, 5 to 50 percent of the surface is covered with pebbles. The soils are loamy and gravelly.

Growler soils are on nearly level fan terraces. These soils are deep and somewhat excessively drained. They formed in alluvium derived dominantly from mixed rocks. Typically, 85 to 100 percent of the surface is covered with darkly varnished, closely packed pebbles. The soils are loamy and gravelly and are underlain by a very limy layer at a depth of 10 to more than 40 inches. They are strongly salt and sodium affected.

Of minor extent in this unit are Dateland, Momoli, and Tremant soils on fan terraces; Ajolito, Cavelt, and Gunsight soils on stream terraces; Carrizo, Cuerda, and

Why soils on alluvial fans and on flood plains (washes); Harqua and Mohall soils on basin floors; and Rositas soils on dunes.

This unit is used mainly as irrigated cropland or rangeland. Some areas are used for homesite development.

This unit is moderately suited to irrigated crops. The main management concerns are droughtiness and the content of toxic salts.

This unit is well suited to homesite development. Few limitations affect this use.

5. Gunsight-Chuckawalla

Deep, somewhat excessively drained and well drained, nearly level to moderately steep, very gravelly and extremely gravelly, loamy soils; on fan terraces

This map unit is southeast of Gila Bend, north of Hyder, and around the Painted Rock Mountains. It is characterized by a dense desert pavement on the summits of fan terraces and by deeply dissected drainageways. Slope ranges from 1 to 25 percent. The vegetation is mainly turkshead, creosotebush, white bursage, and paloverde. Elevation ranges from 600 to 1,800 feet. The average annual precipitation is about 5 to 10 inches, the average air temperature is 70 to 74 degrees F, and the average frost-free season is 260 to 320 days.

This unit makes up about 6 percent of the survey area.

Gunsight soils are on nearly level to moderately steep fan terraces. These soils are deep and somewhat excessively drained. They formed in alluvium derived dominantly from mixed rocks. Typically, 40 to 70 percent of the surface is covered with pebbles. The soils are extremely gravelly and loamy and are underlain by a very limy layer at a depth of 5 to 24 inches.

Chuckawalla soils are on nearly level and gently sloping fan terraces. These soils are deep and well drained. They formed in alluvium derived dominantly from mixed rocks. Typically, 85 to 100 percent of the surface is covered with darkly varnished, closely packed pebbles. The soils are very gravelly and loamy and are underlain by a very limy layer at a depth of 7 to 13 inches. They are strongly salt and sodium affected.

Of minor extent in this unit are Growler and Rillito soils on fan terraces, Carrizo and Why soils on flood plains (washes) and alluvial fans, and Momoli soils on stream terraces.

This unit is used mainly as rangeland. Some areas are used for homesite development or as irrigated cropland.

This unit is moderately suited to homesite development. It is limited mainly by the slope.

This unit is generally unsuited to irrigated cropland. The main limitations are the slope, droughtiness, the very limy layer, and the content of toxic salts.

6. Cherioni-Hyder-Cipriano

Shallow and very shallow, somewhat excessively drained, nearly level to very steep, very gravelly and extremely gravelly, loamy soils; on volcanic mountains, hills, and basalt flows

This map unit is in the Gila Bend Mountains, the Painted Rock Mountains, and the Sentinel Lava Flows west of Gila Bend; in the Sand Tank Mountains east of Gila Bend; and in the Ajo, Batamote, and Sauceda Mountains surrounding Ajo. The unit is characterized by volcanic hills and mountains and associated lava flows that rise sharply from the desert floor. Slope ranges from 1 to 65 percent. The vegetation is mainly creosotebush, brittlebush, bush muhly, and annual grasses. Elevation ranges from 480 to 3,200 feet. The average annual precipitation is about 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free season is 260 to 320 days.

This unit makes up about 25 percent of the survey area.

Cherioni soils are on nearly level to strongly sloping basalt flows and summits of hills and mountains. These soils are shallow and very shallow and somewhat excessively drained. They formed in residuum and colluvium derived dominantly from basalt. Typically, 50 to 95 percent of the surface is covered with pebbles and cobbles. The soils are very gravelly and loamy. They are underlain by a hardpan at a depth of 5 to 18 inches and by basalt bedrock below the hardpan.

Hyder soils are on nearly level to very steep volcanic mountains and hills. These soils are shallow and very shallow and somewhat excessively drained. They formed in alluvium and colluvium derived dominantly from volcanic rock. Typically, 50 to 95 percent of the surface is covered with pebbles, cobbles, and stones. The soils are extremely gravelly and loamy. They are underlain by volcanic bedrock at a depth of 5 to 18 inches.

Cipriano soils are on nearly level to moderately steep volcanic mountains and hills. These soils are shallow and very shallow and somewhat excessively drained. They formed in alluvium and colluvium derived dominantly from basalt. Typically, 50 to 85 percent of the surface is covered with pebbles, cobbles, stones, and hardpan fragments. The soils are very gravelly and loamy. They are underlain by a hardpan at a depth of 6 to 20 inches.

Of minor extent in this unit are Akela, Garzona, and Winkel soils on mountains; Gachado soils on hills; Coolidge, Denure, and Gunsight soils on fan terraces; Carrizo soils on flood plains (washes); and areas of rock outcrop. Akela, Garzona, and Winkel soils are higher (elevation of 2,200 to 4,100 feet), more moist (average annual precipitation of 10 to 12 inches), and cooler (average annual temperature of 65 to 70 degrees F) than the major soils.

This unit is used mainly as rangeland. The main limitations affecting all uses are the depth to bedrock or to a hardpan, droughtiness, the content of coarse fragments, and the slope.

7. Quilotosa-Rock Outcrop-Momoli

Shallow to deep, somewhat excessively drained, nearly level to steep, very gravelly and extremely gravelly, loamy soils and areas of Rock outcrop; on fan terraces, granitic mountains, and hills

This map unit is in the eastern part of the survey area in the Maricopa Mountains, in the northwest corner of the survey area in the Gila Bend Mountains, and in the Ajo Mountains near Ajo. The unit is characterized by granitic mountains and hills that rise sharply from the nearly level desert floor. Slope ranges from 3 to 55 percent. The vegetation is mainly brittlebush, creosotebush, paloverde, and annual grasses. Elevation ranges from 800 to 2,800 feet. The average annual precipitation is about 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free season is 260 to 320 days.

This unit makes up about 13 percent of the survey area.

Quilotosa soils are on gently sloping to steep granitic mountains and hills. These soils are shallow and very shallow and somewhat excessively drained. They formed in alluvium and colluvium derived dominantly from granite and granite-gneiss. Typically, 45 to 95 percent of the surface is covered with pebbles, cobbles, stones, and boulders. The soils are extremely gravelly and loamy. They are underlain by weathered granite at a depth of 4 to 16 inches.

Rock outcrop consists of areas of exposed granite, granite-gneiss, and schist.

Momoli soils are on nearly level to strongly sloping fan terraces. These soils are deep and somewhat excessively drained. They formed in alluvium derived dominantly from mixed rocks. Typically, 35 to 85 percent of the surface is covered with pebbles, cobbles, and stones. The soils are very gravelly and loamy.

Of minor extent in this unit are Laposa, Schenco, and Vaiva soils on hills and mountains; Comobabi and Denure soils on fan terraces; and Carrizo soils on flood plains (washes).

This unit is used mainly as rangeland. Some areas are used for wildlife habitat or recreation. The main limitations affecting all uses are the depth to bedrock, droughtiness, large stones, and the slope.

Detailed Soil Map Units

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

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

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the underlying layers. They also can differ in slope, stoniness, salinity, 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, Indio silt loam, saline-sodic, is a phase of the Indio series.

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

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Denure-Coolidge complex, 1 to 3 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Momoli-Comobabi association, 5 to 15 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. The map unit Agualt and Ripley soils is an undifferentiated group in this survey area.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Table 4 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 or miscellaneous areas.

Soil Descriptions

1—Agualt and Ripley soils. This map unit is on the flood plains along the Gila River. The vegetation in areas that are not cultivated is mainly desert trees, shrubs, and annual grasses. Slope is 0 to 1 percent. Elevation ranges from 430 to 850 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

The pattern and proportion of these soils are highly variable. In some areas the unit is made up of only one of the soils. In general, the percentage of the Ripley soil is lowest and that of the Agualt soil is highest in the northern part of the survey area near Gillespie Dam. The percentage of the Ripley soil increases and the percentage of the Agualt soil decreases along the Gila River as it flows south and west toward Yuma County.

Included with these soils in mapping are small areas of Carrizo, Gilman, Indio, and Vint soils. Included areas make up about 20 percent of the map unit. The percentage varies from one area to another.

The Agualt soil is deep and well drained. It formed in recent alluvium derived from mixed rocks. Typically, the surface layer is pale brown very fine sandy loam about 13 inches thick. The upper 14 inches of the underlying material is pale brown very fine sandy loam that has thin strata of coarser textured material. The lower part to a depth of 60 inches or more is very pale brown fine sand and sand that have thin strata of finer textured material. In some places, thin lenses of gravel are in the upper part of the soil. In other places the surface layer is loam. This soil is nonsaline to slightly saline (electrical conductivity of 1 to 7 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches. The depth to sand ranges from 20 to 40 inches. In some areas in the flood pool behind Painted Rock Dam, the surface layer is silty clay loam.

Permeability is moderate to a depth of 20 to 40 inches in the Agualt soil and rapid below this depth. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderately high. This soil generally is subject to occasional periods of flooding; however, the risk of flooding is reduced by dams on the Gila River and its tributaries.

The Ripley soil is deep and well drained. It formed in recent alluvium derived dominantly from mixed rocks. Typically, the surface layer is pink silt loam about 2 inches thick. The upper 30 inches of the underlying material is light brown, stratified silt loam and very fine sandy loam. The lower part to a depth of 60 inches or more is pale brown and light brownish gray, stratified loamy fine sand and sand that have thin strata of finer or coarser textured material. In some areas the surface layer is very fine sandy loam. This soil is nonsaline to slightly saline (electrical conductivity of 1 to 8 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches. The depth to sand ranges from 20 to 40 inches.

Permeability is moderate to a depth of 20 to 40 inches in the Ripley soil and rapid below this depth. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderate. This soil generally is subject to occasional periods of flooding; however, the risk of flooding is reduced by dams on the Gila River and its tributaries.

This unit is used mainly for irrigated cotton, barley, or alfalfa hay. It is limited mainly by droughtiness, sand at moderate depths, and the hazard of flooding. The Agualt soil also is limited by the hazard of wind erosion.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of these soils. Leveling is needed for the efficient application of irrigation water. Keeping leveling cuts to a minimum helps to prevent exposing the sand. Applications of manure or gin trash are beneficial in leveled areas where sand is exposed. Water can be distributed by lined ditches or pipelines. Because this unit is droughty, applications of irrigation water should be light and frequent. In areas that are slightly saline, yields of some crops are limited and the growth of sensitive crops is restricted. Leaching is needed to prevent salt from building up in the soils, particularly if graded irrigation systems are used. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. Deep chiseling or subsoiling temporarily opens up the soil and allows water and salts to pass through. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned and cuts for leveling are made.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional long or very long periods of flooding. The vegetation in areas that have been recently flooded is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation generally becomes reestablished and the area may provide seasonal grazing for livestock. In irrigated areas, repairing ditches and releveling commonly are needed after periods of flooding. Root plowing to a depth of 12 to 18 inches is needed to remove the saltcedar.

The present vegetation in most areas is mainly mesquite, catclaw acacia, and creosotebush. The potential plant community is mainly mesquite, bush muhly, and threeawn. Major browse species are mesquite, desert saltbush, and fourwing saltbush. These species make up 30 percent of the plant community. Perennial grasses and forbs, including bush muhly and threeawn, make up 45 percent of the plant community. Annual grasses and forbs make up 10 percent.

This unit no longer benefits from the regular flooding of the Gila River because of protection provided by upstream structures on the Salt and Gila Rivers. The production of shrubs, grasses, and forbs on this unit resembles that on similar upland range sites. However, because the water table is at a depth of 20 to 40 feet, this unit can produce moderate stands that may consist of scattered very large trees or closely spaced shrubby trees.

Some areas of these soils produce sufficient forage for year-round use. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit the efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be applied. Fencing and developing water facilities can improve grazing or livestock management. These soils respond to improved grazing management in a reasonable length of time.

Livestock prefer this unit to most others in the survey area because of its accessibility and the availability of water. As a result, overgrazing and the subsequent deterioration of the vegetation are management concerns. Overgrazing increases the hazard of wind erosion and the formation of gullies.

These soils are well suited to desertic riparian herbaceous plants and moderately well suited to desertic riparian shrubs and trees. They are moderately well suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability classification is IIw, irrigated, and VIIw, nonirrigated. These soils are in the Loamy Bottom, 2-7" precipitation zone range site.

2—Agualt and Ripley soils, saline-sodic. This map unit is on the flood plains along the Gila River. The vegetation in areas that have not been cultivated is mainly desert trees, shrubs, and annual grasses. Slope is 0 to 1 percent. Elevation ranges from 430 to 850 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

The pattern and proportion of these soils are highly variable. In some areas the unit is made up of only one of the soils. In general, the percentage of the Ripley soil is lowest and that of the Agualt soil is highest in the northern part of the survey area near Gillespie Dam. The percentage of the Ripley soil increases and that of the Agualt soil decreases along the Gila River as it flows south and west toward Yuma County.

Included with these soils in mapping are small areas of Gilman, Glenbar, Indio, Lagunita, and Vint soils. Also included are soils that are similar to the Glenbar soils but have sand and gravel at a moderate depth. Included areas make up about 20 percent of the map unit. The percentage varies from one area to another.

The Agualt soil is deep and well drained. It formed in recent alluvium derived dominantly from mixed rocks.

Typically, the surface layer is pale brown very fine sandy loam about 13 inches thick. The upper 14 inches of the underlying material is pale brown, finely stratified very fine sandy loam that has thin strata of coarser textured material. The lower part to a depth of 60 inches or more is very pale brown fine sand and sand that have thin strata of finer textured material. In some areas the surface layer is loam. This soil is moderately or strongly saline (electrical conductivity of 8 millimhos per centimeter) in the upper 20 inches. In nonirrigated areas, a thin white crust of salt commonly is on the surface because water has moved upward and evaporated near the surface. Salt crystals are in the profile. The depth to sand ranges from 20 to 40 inches.

Permeability is moderate to a depth of 20 to 40 inches in the Aguailt soil and rapid below this depth. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderately high. This soil generally is subject to occasional periods of flooding; however, the risk of flooding is reduced by dams on the Gila River and its tributaries.

The Ripley soil is deep and well drained. It formed in recent alluvium derived dominantly from mixed rocks. Typically, the surface layer is pink silt loam about 2 inches thick. The upper 30 inches of the underlying material is light brown, stratified silt loam and very fine sandy loam. The lower part to a depth of 60 inches or more is pale brown, dominantly stratified loamy fine sand and light brownish gray sand that have thin strata of finer textured material. In some areas the surface layer is very fine sandy loam. In nonirrigated areas, a thin white crust of salt commonly is on the surface because water has moved upward and evaporated near the surface. Salt crystals are in the profile. This soil is moderately or strongly saline (electrical conductivity of 8 to 50 millimhos per centimeter) in the upper 20 inches. The depth to sand ranges from 20 to 40 inches.

Permeability is moderate to a depth of 20 to 40 inches in the Ripley soil and rapid below this depth. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderate. This soil generally is subject to occasional periods of flooding; however, the risk of flooding is reduced by dams on the Gila River and its tributaries.

This unit is used mainly as rangeland. Some areas are used for irrigated cotton, barley, or alfalfa hay.

These soils are limited mainly by droughtiness, sand at moderate depths, the content of toxic salts, and the hazard of flooding. The Aguailt soil also is limited by the hazard of wind erosion.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of these soils. Leveling is needed for the efficient application of irrigation water. Keeping leveling cuts to a minimum helps to prevent exposing the sand. Applications of manure or gin trash are beneficial in leveled areas where sand is exposed. Water can be distributed by lined ditches or pipelines. Because this unit is droughty, applications of irrigation water should be light and frequent. In the more sloping areas, irrigation streams can cause erosion. Erosion can be minimized by irrigating across the slope or by leveling. The salinity and sodicity restrict the choice of crops. Intensive management is needed to reduce the salinity and sodicity and to maintain productivity. Adding soil amendments and leaching reduce the content of toxic salts and sodium. Suitable soil amendments are sulfur, gypsum, and sulfuric acid. The kind and amount of amendments needed should be determined by soil tests. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. Deep chiseling or subsoiling temporarily opens up the soil and allows water and salts to pass through. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned and cuts for leveling are made.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional long or very long periods of flooding. The vegetation in areas that have been recently flooded is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation generally becomes reestablished and the area may provide seasonal grazing for livestock. In irrigated areas, repairing ditches and releveling commonly are needed after periods of flooding. Root plowing to a depth of 12 to 18 inches is needed to remove the saltcedar.

The present vegetation in most areas is mainly mesquite and saltbush. The potential plant community is mainly arrowweed, mesquite, desert saltbush, and fourwing saltbush. Major browse species are desert saltbush, mesquite, and fourwing saltbush. These species make up 55 percent of the plant community. Annual grasses and forbs make up 20 percent.

This unit no longer benefits from the regular flooding of the Gila River because of protection provided by upstream structures on the Salt and Gila Rivers. The production of shrubs, grasses, and forbs on this unit resembles that on similar upland range sites. However, because the water table is at a depth of 20 to 40 feet, this unit can produce moderate stands that may consist of scattered very large trees or closely spaced shrubby trees.

Some areas produce sufficient forage for year-round use. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. Fencing and developing water sources can improve grazing or livestock management. These soils respond to improved grazing management in a reasonable length of time.

Livestock prefer this unit to most others in the survey area because of its accessibility and the availability of water. As a result, overgrazing and the subsequent deterioration of the vegetation are management concerns. Overgrazing increases the hazard of wind erosion and the formation of gullies.

These soils are well suited to desertic riparian herbaceous plants and moderately well suited to desertic riparian shrubs and trees. They are poorly suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability classification is IIIs, irrigated, and VIIs, nonirrigated. These soils are in the Saline Bottom, 2-7" precipitation zone range site.

3—Ajo-Gunsight-Pompeii complex, 3 to 25 percent slopes. This map unit is on fan terraces and hills. The native vegetation is mainly desert trees and shrubs and cacti. Elevation ranges from 800 to 2,000 feet. The average annual precipitation is 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is 25 percent Ajo soil on gently sloping to moderately steep fan terraces, 25 percent Gunsight soil on fan terraces, and 25 percent Pompeii soil on gently sloping to moderately steep fan terraces and hills. The three soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Quilotosa soils on hills, Momoli and Pinamt soils on fan terraces, and Carrizo soils on flood plains (washes). Also included are soils that are similar to the Gunsight soil but have sandy textures and soils that are similar to the Pompeii soil but are moderately deep. Included areas make up about 25 percent of the map unit. The percentage varies from one area to another.

The Ajo soil is moderately deep and well drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 60 to 90 percent of the surface is covered with pebbles and cobbles. The surface layer is light reddish brown extremely gravelly sandy loam about 3 inches thick. The upper 5 inches of the subsoil is yellowish red very gravelly sandy clay loam. The next 9 inches is reddish brown very gravelly clay loam. The lower part of the subsoil, to a depth of about 32 inches, is yellowish red very gravelly sandy clay loam. The underlying material to a depth of 60 inches or more is an indurated hardpan. Depth to the hardpan ranges from 20 to 40 inches.

Permeability is moderately slow in the Ajo soil. Available water capacity is very low. Potential rooting depth is 20 to 40 inches. Runoff is moderately rapid, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is slight.

The Gunsight soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 60 to 90 percent of the surface is covered with pebbles and cobbles. The surface layer is very pale brown extremely gravelly sandy loam about 1 inch thick. The upper 5 inches of the subsoil is light gray very gravelly coarse sandy loam. The lower part of the subsoil, to a depth of about 46 inches, is very pale brown extremely gravelly coarse sandy loam. Below this is a buried subsoil of light brown very gravelly coarse sandy loam about 14 inches thick. A very limy layer is at a depth of 6 inches. Depth to the very limy layer ranges from 5 to 20 inches.

Permeability is moderate in the Gunsight soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight to severe. The hazard of wind erosion is slight.

The Pompeii soil is shallow and very shallow and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 60 to 90 percent of the surface is covered with pebbles, cobbles, and stones. The surface layer is light brown extremely gravelly coarse sandy loam about 3 inches thick. The subsoil is light brown very gravelly sandy loam about 6 inches thick. An indurated hardpan is at a depth of about 9 inches. Depth to the hardpan ranges from 6 to 20 inches.

Permeability is rapid in the Pompeii soil. Available water capacity is very low. Potential rooting depth is 6 to 20 inches. Runoff is rapid, and the hazard of water erosion is slight to severe. The hazard of wind erosion is slight.

This unit is used mainly as rangeland.

The present vegetation in most areas of the Ajo soil is mainly creosotebush, littleleaf paloverde, triangle bursage, and cacti. The potential plant community also is mainly creosotebush, littleleaf paloverde, triangle bursage, and cacti. Major browse species are littleleaf paloverde, white ratany, and ironwood. These species make up 20 percent of the plant community. Perennial grasses and forbs, including bush muhly and threeawn, make up 10 percent of the plant community. Annual grasses and forbs make up 10 percent.

The present vegetation in most areas of the Gunsight soil is mainly creosotebush, triangle bursage, white ratany, and cacti. The potential plant community is mainly creosotebush, white ratany, and triangle bursage. Major browse species are white bursage and white ratany. These species make up 15 percent of the plant community. Perennial grasses and forbs, including bush muhly and threeawn, make up 15 percent of the plant community. Annual grasses and forbs make up 5 percent.

The present vegetation in most areas of the Pompeii soil is mainly creosotebush, triangle bursage, white ratany, and cacti. The potential plant community is mainly creosotebush, littleleaf paloverde, and cacti. Major browse species are littleleaf paloverde, white ratany, and ironwood. These species make up 20 percent of the plant community. Perennial grasses and forbs, including bush muhly and threeawn, make up 10 percent of the plant community. Annual grasses and forbs make up 10 percent.

In areas where the average annual precipitation is less than 8 inches, the total vegetative production is about 50 to 100 pounds per acre less than is typical. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. These soils do not respond to improved grazing management in a reasonable length of time.

A high lime content, the low available water capacity, and competition from creosotebush contribute to the low production of forage in areas of these soils.

These soils are unsuited to irrigated crops. They are limited mainly by the slope, droughtiness, the very limy layer in the Gunsight soil, and depth to the hardpan in the Ajo and Pompeii soils.

These soils are very poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability classification is VIIs. The Ajo and Gunsight soils are in the Limy Slopes, 2-10" precipitation zone range site. The Pompeii soil is in the Limy Upland, 2-10" precipitation zone range site.

4—Akela-Rock outcrop complex, 15 to 65 percent slopes. This map unit is on mountains. Some areas of Rock outcrop are nearly vertical. The native vegetation is mainly desert trees, shrubs, cacti, and grasses. Elevation ranges from 2,200 to 3,500 feet. The average annual precipitation is 10 to 12 inches, the average annual air temperature is 65 to 70 degrees F, and the average frost-free period is 180 to 270 days.

This unit is 55 percent Akela soil and 40 percent Rock outcrop. The Akela soil is on moderately steep to very steep mountains and ridges, and the Rock outcrop is on the moderately steep to very steep upper mountains and ridges. The Akela soil and the Rock outcrop occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in mapping are small areas of Winkel soils on mountains near areas of basalt and areas of soils that are similar to the Akela soil but are more than 20 inches deep. Included areas make up about 5 percent of the map unit. The percentage varies from one area to another.

The Akela soil is very shallow and shallow and is well drained. It formed in residuum and colluvium derived dominantly from volcanic rocks. Typically, 50 to 90 percent of the surface is covered with stones, cobbles, and pebbles. The surface layer is light brown extremely gravelly sandy loam about 2 inches thick. The underlying material is brown extremely gravelly loam about 10 inches thick. Unweathered andesite is at a depth of about 12 inches. The depth to unweathered bedrock ranges from 4 to 20 inches.

Permeability is moderate in the Akela soil. Available water capacity is very low. Potential rooting depth is 4 to 20 inches. Runoff is rapid, and the hazard of water erosion is severe or very severe. The hazard of wind erosion is slight.

The Rock outcrop consists of andesite, rhyolite, and tuff.

This unit is used mainly as rangeland.

The present vegetation in most areas is mainly ironwood, paloverde, triangle bursage, and brittlebush. The potential plant community is mainly slender grama, littleleaf paloverde, triangle bursage, and bush muhly. Major browse species are littleleaf paloverde and jojoba. These species make up 20 percent of the plant community. Perennial grasses and forbs, including slim tridens, slender grama, and bush muhly, make up 35 percent of the plant community. Annual grasses and forbs make up 10 percent.

Some areas produce sufficient forage for year-round use. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. Fencing and developing water sources can improve grazing or livestock management. Cattle usually avoid areas of this unit unless their movement is restricted by fences. Because the stones and cobbles on the surface limit grazing, this unit responds rapidly to the use of appropriate grazing management systems.

This unit is unsuited to irrigated crops. It is limited mainly by droughtiness, the slope, and the depth to bedrock.

This unit is poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability classification of the Akela soil is VIIe, and that of the Rock outcrop is VIII. The Akela soil is in the Volcanic Hills, 10-12" precipitation zone range site. No range site is assigned for the Rock outcrop.

5—Carrizo-Dateland complex, 0 to 3 percent slopes. This map unit is on fan terraces and flood plains (washes). The native vegetation is mainly desert trees and shrubs and annual grasses. Elevation ranges from 1,400 to 2,000 feet. The average annual precipitation is 7 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is 45 percent Carrizo, bench, soil; 20 percent Dateland soil; and 20 percent Carrizo soil. The Carrizo, bench, soil is on the nearly level fan terraces; the Dateland soil is on the nearly level fan terraces between the gravel bars; and the Carrizo soil is on the nearly level flood plains (washes). The three soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Momoli soils on stream terraces, Denure soils in swales on fan terraces, and Why and Cuerda soils on flood pains (washes). Included areas make up about 15 percent of the map unit. The percentage varies from one area to another.

The Carrizo, bench, soil is deep and excessively drained. It formed in recent alluvium derived dominantly from mixed rocks. Typically, 45 to 85 percent of the surface is covered with pebbles and a few cobbles. The surface layer is brown extremely gravelly sandy loam about 5 inches thick. The underlying material, to a depth of about 49 inches, is light brown extremely gravelly loamy sand that has thin strata of finer textured material. Below this is a buried subsoil of yellowish red loam about 11 inches thick.

Permeability is very rapid in the Carrizo, bench, soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is very slight or slight. The hazard of wind erosion is slight.

The Dateland soil is deep and well drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 1 to 15 percent of the surface is covered with pebbles. The surface layer is light brown fine sandy loam about 3 inches thick. The upper 37 inches of the subsoil is reddish yellow very fine sandy loam. The lower 14 inches is reddish yellow gravelly coarse sandy loam. Below this is a buried subsoil of reddish yellow loam 6 or more inches thick. A very limy layer is at a depth of about 54 inches. Depth to the very limy layer ranges from 40 to 60 inches.

Permeability is moderate in the Dateland soil. Available water capacity is very high. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight or slight. The hazard of wind erosion is moderately high.

The Carrizo soil is deep and excessively drained. It formed in recent alluvium derived dominantly from mixed rocks. Typically, 40 to 80 percent of the surface is covered with pebbles and cobbles. The surface layer is light brown extremely gravelly sandy loam about 1 inch thick. The underlying material, to a depth of about 54 inches, is reddish yellow extremely gravelly sand and loamy sand that have thin strata of finer textured material. Below this is a buried subsoil of yellowish red very gravelly loamy sand 6 or more inches thick.

Permeability is very rapid in the Carrizo soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is very slight or slight. The hazard of wind erosion is slight. This soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. The occasional, very brief periods of flooding occur mainly in summer and winter.

This unit is used mainly as rangeland.

The present vegetation in most areas of the Carrizo, bench, soil is mainly creosotebush and annual grasses. The potential plant community is mainly creosotebush and triangle bursage. Major browse species are white bursage and white ratany. These species make up 10 percent of the plant community. Perennial grasses and forbs, including bush muhly, make up 5 percent of the plant community. Annual grasses and forbs make up 5 percent.

The present vegetation in most areas of the Dateland soil is mainly creosotebush and annual grasses. The potential plant community is mainly creosotebush, annual forbs, and annual grasses. Major browse species include white ratany. This species makes up 5 percent of the plant community. Perennial grasses and forbs, including bush muhly and big galleta, make up 10 percent of the plant community. Annual grasses and forbs make up 25 percent.

The present vegetation in most areas of the Carrizo soil is mainly paloverde, ironwood, triangle bursage, and annual grasses. The potential plant community is mainly shrubs, littleleaf paloverde, blue paloverde, and annual grasses. Major browse species are littleleaf paloverde, blue paloverde, and other shrubs. These species make up 50 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 25 percent of the plant community. Annual grasses and forbs make up 15 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. These soils do not respond to improved grazing management in a reasonable length of time.

A high lime content, the low available water capacity, and competition from creosotebush contribute to the low production of forage on the Carrizo, bench, and Dateland soils. Overgrazing increases the hazard of wind erosion in areas of the Dateland soil. Management of this unit should be geared to the Carrizo soil because most of the forage production is in areas of this soil. The periodic flooding increases the amount of forage available.

If this unit is used for irrigated crops, both of the Carrizo soils are limited mainly by droughtiness. The Carrizo soil in nearly level areas also is limited by the hazard of flooding. The Dateland soil is limited mainly by the hazard of wind erosion. The components of this map unit are so intricately intermingled, however, that finding an area of the Dateland soil large enough for development is difficult. It is generally more practical to select another unit for the development of cropland.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability classification of the Carrizo, bench, soil is VIIs; that of the Dateland soil is VIIe; and that of the Carrizo soil is VIIw. The Carrizo, bench, soil is in the Limy Upland (deep), 7-10" precipitation zone range site; the Dateland soil is in the Limy Fan, 7-10" precipitation zone range site; and the Carrizo soil is in the Sandy Bottom, 7-10" precipitation zone range site.

6—Carrizo-Momoli complex, 0 to 3 percent slopes. This map unit is on long, narrow flood plains (washes) and on fan terraces and alluvial fans in areas where washes emerge from the mountains. The native vegetation is mainly desert trees, shrubs, and cacti. Elevation ranges from 600 to 2,500 feet. The average annual precipitation is 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is 65 percent Carrizo soil and 25 percent Momoli soil. The Carrizo soil is on the nearly level alluvial fans and adjoining flood plains (washes). The Momoli soil is on the nearly level, higher fan terraces. The two soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Why and Lagunita soils on flood plains (washes) and alluvial fans and Denure and Carrizo, bench, soils on stream terraces. Also included are soils that are similar to the Carrizo soil but contain less sand and gravel. Included areas make up about 10 percent of the map unit. The percentage varies from one area to another.

The Carrizo soil is deep and excessively drained. It formed in recent alluvium derived dominantly from mixed rocks. Typically, 40 to 80 percent of the surface is covered with pebbles and cobbles. The surface layer is light brown extremely gravelly sandy loam about 1 inch thick. The underlying material, to a depth of about 54 inches, is reddish yellow extremely gravelly sand and loamy sand that have thin strata of finer textured material. Below this is a buried subsoil of yellowish red very gravelly loamy sand about 6 inches thick.

Permeability is very rapid in the Carrizo soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is very slight or slight. The hazard of wind erosion is slight. This soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. The occasional, very brief periods of flooding occur mainly in summer and winter.

The Momoli soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 45 to 75 percent of the surface is covered with pebbles. The surface layer is brown very gravelly sandy loam about 2 inches thick. The upper 8 inches of the subsoil is brown very gravelly sandy loam. The lower 50 inches or more is light brown very gravelly coarse sandy loam. In some places an indurated hardpan is at a depth of 50 to 60 inches.

Permeability is moderately rapid in the Momoli soil. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight or slight. The hazard of wind erosion is slight.

This unit is used mainly as rangeland.

The present vegetation in most areas of the Carrizo soil is mainly paloverde, ironweed, burrobrush, and cacti. The potential plant community is mainly littleleaf paloverde, wolfberry, ironwood, and annual grasses. Major browse species are littleleaf paloverde, ironwood, and wolfberry. These species make up 40 percent of the plant community. Perennial grasses and forbs, including bush muhly and big galleta, make up 20 percent of the plant community. Annual grasses and forbs make up 20 percent.

The present vegetation in most areas of the Momoli soil is mainly creosotebush, white bursage, cacti, and annual grasses. The potential plant community is mainly creosotebush, white bursage, annual grasses, and annual forbs. Major browse species are white bursage and white ratany. These species make up 15 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 10 percent of the plant community. Annual grasses and forbs make up 25 percent.

In areas where the average annual precipitation is more than 8 inches, total vegetative production is about 100 to 200 pounds per acre more than is typical. Forage plants and annuals make up a larger percentage of the total. Some of these areas produce sufficient forage for year-round use. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. These soils respond to improved grazing management in a reasonable length of time.

Most of the forage on this unit is produced in areas of the Carrizo soil. The periodic flooding increases the amount of forage available in areas of this soil.

This unit is unsuited to irrigated crops. It is limited mainly by droughtiness. The Carrizo soil also is limited by the flooding.

This unit is poorly suited to desertic riparian herbaceous plants and desertic riparian shrubs and trees for wildlife habitat.

The capability classification of the Carrizo soil is VIIw, and that of the Momoli soil is VIIs. The Carrizo soil is in the Sandy Bottom, 2-10" precipitation zone range site, and the Momoli soil is in the Limy Upland (deep), 2-10" precipitation zone range site.

7—Cherioni very cobbly fine sandy loam, 3 to 10 percent slopes. This map unit is on basalt flows. It also is on the summits of basalt hills and mountains. The native vegetation is mainly desert shrubs, cacti, and annual grasses. Elevation ranges from 1,000 to 2,800 feet. The average annual precipitation is 5 to 10 inches, the average annual temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

Included with this soil in mapping are small areas of basalt rock outcrop and soils that are similar to the Cherioni soil but contain less gravel throughout. Also included are small areas of Carrizo soils on flood plains (washes) that dissect areas of the unit. Included areas make up about 10 percent of the map unit. The percentage varies from one area to another.

The Cherioni soil is shallow and very shallow and somewhat excessively drained. It formed in residuum and colluvium derived dominantly from basalt. Typically, 40 to 80 percent of the surface is covered with varnished cobbles, pebbles, and hardpan fragments (fig. 2). The surface layer is reddish yellow very cobbly fine sandy loam about 2 inches thick. The underlying material, to a depth of about 10 inches, is brownish yellow very gravelly fine sandy loam. Below this is an indurated hardpan about 6 inches thick. Basalt is at a depth of about 16 inches. Depth to the indurated hardpan ranges from 5 to 18 inches. The depth to basalt ranges from 7 to 24 inches. In some areas the surface layer is very gravelly fine sandy loam.

Permeability is moderate. Available water capacity is very low. Potential rooting depth is 5 to 18 inches. Runoff is rapid, and the hazard of water erosion is moderate. The hazard of wind erosion is slight.

This unit is used mainly as rangeland.

The present vegetation in most areas is mainly creosotebush, buckhorn cholla, ocotillo, and annual grasses. The potential plant community is mainly creosotebush and white ratany. Major browse species are white bursage, range ratany, and white ratany. These species make up 15 percent of the plant community. Perennial grasses and forbs, including bush muhly, make up 10 percent of the plant community. Annual grasses and forbs make up 5 percent.

In areas where the average annual precipitation is more than 8 inches, total vegetative production is about 50 pounds per acre more than is typical. Forage plants and annuals make up a larger percentage of the total. Some of these areas produce sufficient forage for year-round use. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This soil does not respond to improved grazing management in a reasonable length of time.

A high lime content, the low available water capacity, and competition from creosotebush contribute to the low production of forage on this soil. The small included areas of Carrizo soils are more productive than the Cherioni soil. Periodic flooding increases the amount of forage available in these included areas. Management should be geared to the included areas because they produce most of the forage. The potential plant community on the Carrizo soils is mainly littleleaf paloverde, blue paloverde, annual grasses, and shrubs. The present vegetation in most areas is mainly littleleaf paloverde and annual grasses.

This unit is unsuited to irrigated crops. It is limited

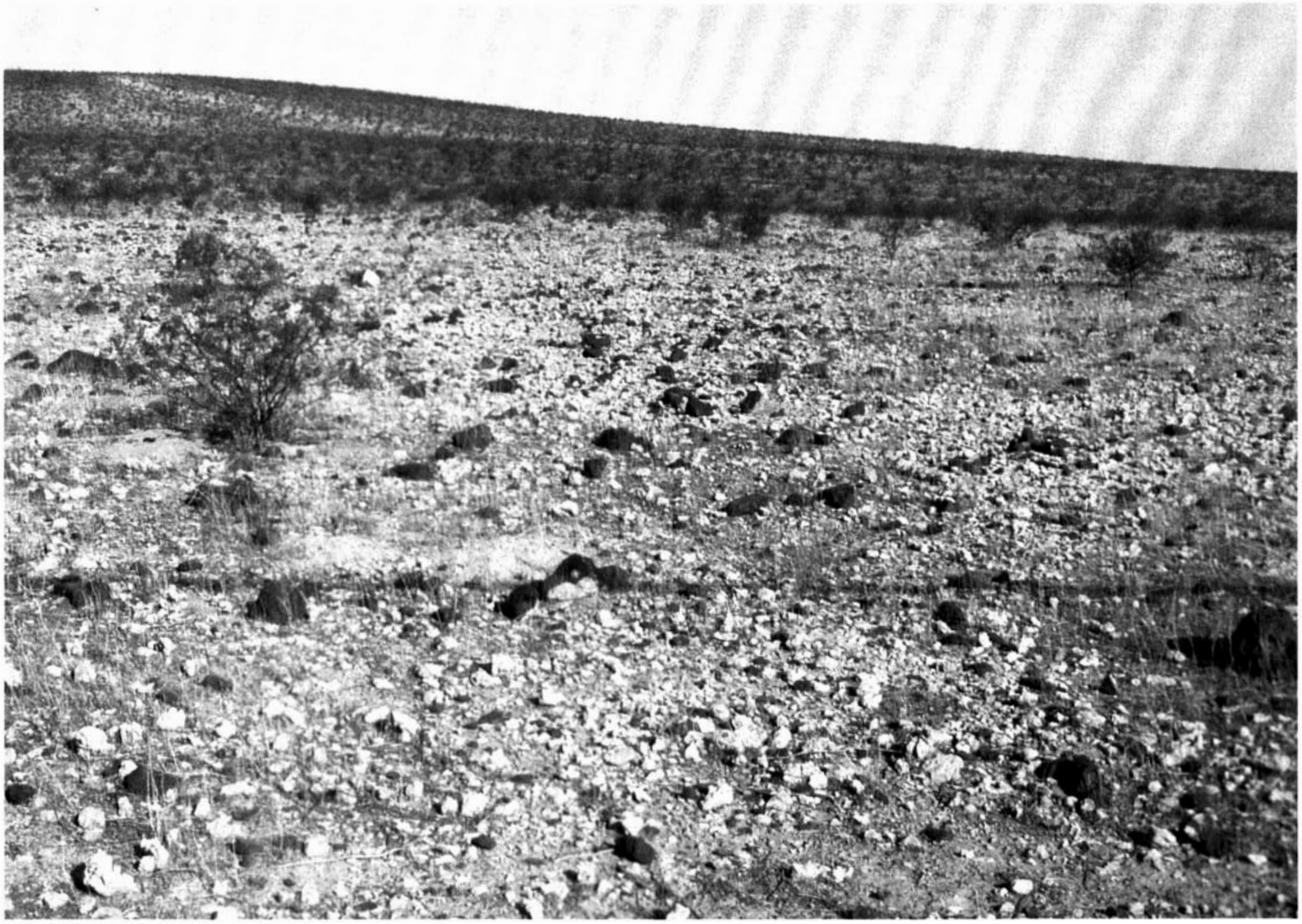

Figure 2.—A typical area of Cherioni very cobbly fine sandy loam, 3 to 10 percent slopes.

mainly by droughtiness, the slope, depth to the hardpan, and the depth to bedrock.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional, long or very long periods of flooding. The vegetation in areas that have been recently flooded is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation generally becomes reestablished and the area may provide seasonal grazing for livestock.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability classification is VIIs. This soil is in the Limy Upland, 2-10" precipitation zone range site.

8—Cherioni-Coolidge complex, 1 to 15 percent slopes. This map unit is on basalt flows, hills, and fan terraces (fig. 3). The native vegetation is mainly desert shrubs, cacti, annual forbs, and grasses. Elevation ranges from 600 to 1,100 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is 60 percent Cherioni soils on basalt flows and on hillslopes and 25 percent Coolidge soil on fan terraces. The Cherioni soils are about 40 percent Cherioni extremely gravelly loam and 20 percent Cherioni extremely cobbly fine sandy loam. Cherioni extremely gravelly loam is on the nearly level, broad summits of basalt flows. Cherioni extremely cobbly fine sandy loam is on the gently sloping to strongly sloping side slopes of the basalt flows and hills. The Coolidge soil is on the nearly level fan terraces between the basalt flows. The Cherioni and Coolidge soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Denure soils on fan terraces, Cipriano soils on the side slopes of basalt hills, Rositas soils on dunes, Why soils on flood plains (washes), and areas of basalt rock outcrop. Included areas make up about 15 percent of the map unit. The percentage varies from one area to another.The Cherioni soils are shallow and very shallow and are somewhat excessively drained. They formed in residuum and colluvium derived dominantly from basalt. Typically, 60 to 95 percent of the surface is covered with varnished pebbles and pan fragments. The surface layer is dominantly light brown extremely gravelly loam about 2 inches thick. Below this is 4 inches of light

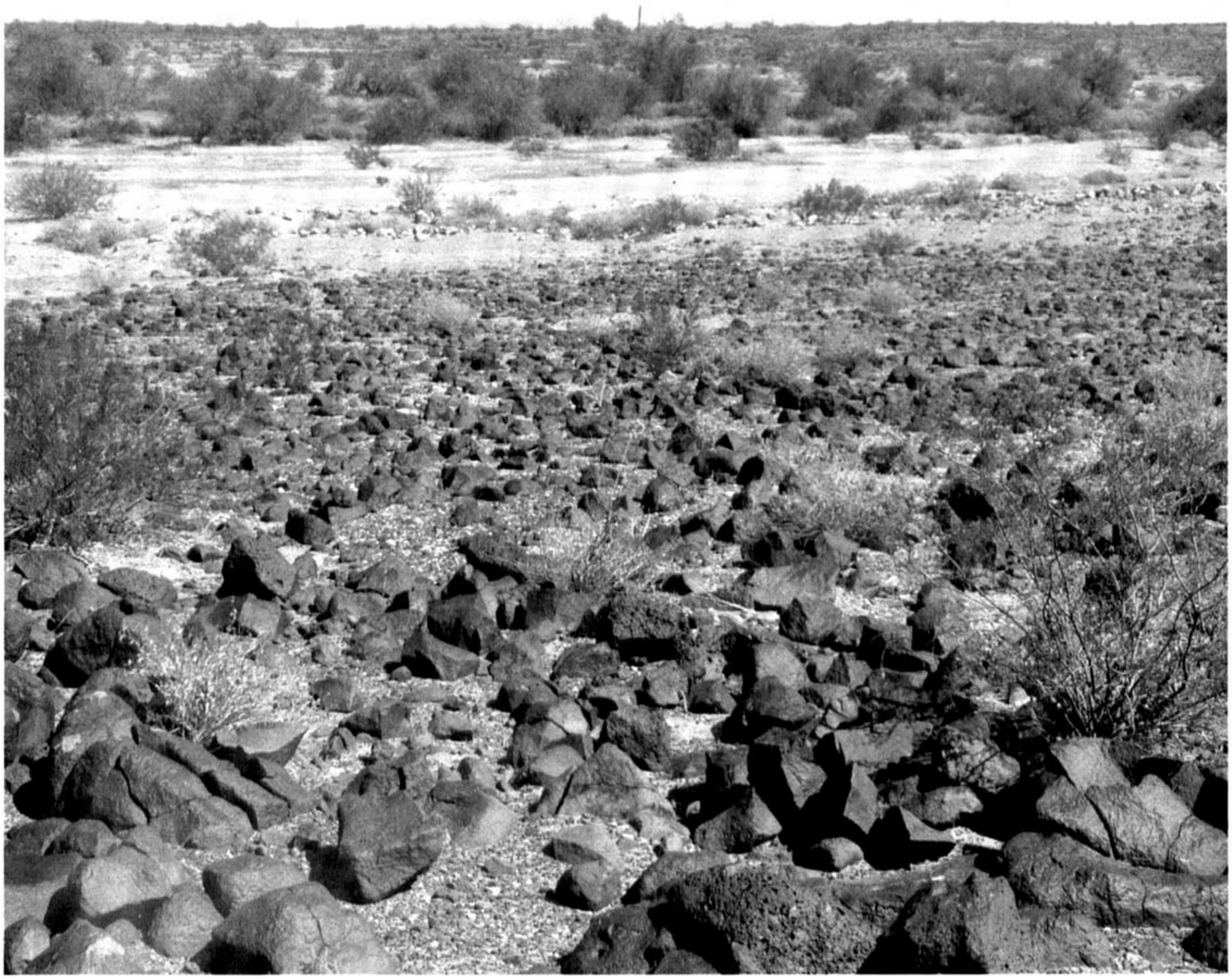

Figure 3.—An area of Cherioni-Coolidge complex, 1 to 15 percent slopes. The Cherioni soils are on the broad basalt flow, and the Coolidge soil is on low fan terraces in the background.

brown very gravelly fine sandy loam. The next layer is an indurated hardpan 2 inches thick. Basalt is at a depth of 8 inches. Depth to the indurated hardpan ranges from 5 to 18 inches. Depth to the basalt ranges from 7 to 24 inches. In about 20 percent of the areas, the surface layer is extremely cobbly fine sandy loam.

Permeability is moderate in the Cherioni soils. Available water capacity is very low. Potential rooting depth is 5 to 18 inches. Runoff is rapid, and the hazard of water erosion is slight to severe. The hazard of wind erosion is slight.

The Coolidge soil is deep and well drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 20 to 50 percent of the surface is covered with pebbles. The surface layer is light brown gravelly very fine sandy loam about 2 inches thick. The upper 19 inches of the underlying material is reddish yellow very fine sandy loam. The next 15 inches is gravelly sandy loam. The lower part of the underlying material to a depth of 60 inches or more is pink very gravelly sandy loam. A very limy layer is at a depth of about 36 inches. Depth to the very limy layer ranges from 21 to 40 inches.

Permeability is moderately rapid in the Coolidge soil. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The hazard of wind erosion is moderately high.

This unit is used mainly as rangeland.

The potential plant community and the present vegetation in most areas of Cherioni extremely gravelly loam consist mainly of turkshead.

The present vegetation in most areas of Cherioni extremely cobbly fine sandy loam is mainly creosotebush, white bursage, and diamond cholla. The potential plant community is mainly creosotebush, white bursage, and white ratany. Major browse species are white bursage, range ratany, and white ratany. These species make up 15 percent of the plant community. Perennial grasses and forbs, including bush muhly, make up 10 percent of the plant community. Annual grasses and forbs make up 5 percent.

The present vegetation in most areas of the Coolidge soil is mainly creosotebush, white ratany, and diamond cholla. The potential plant community is mainly creosotebush, white bursage, annual forbs, and annual grasses. Major browse species are white bursage and white ratany. These species make up 15 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 10 percent of the plant community. Annual grasses and forbs make up 20 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. These soils do not respond to improved grazing management in a reasonable length of time.

A high lime content, the limited available water capacity, and competition from creosotebush contribute to the low production of forage on this unit. The small included areas of Why and Rositas soils are more productive than the major soils. Management should be geared to these included areas. The potential plant community on the Why soils is mainly wolfberry, littleleaf paloverde, creosotebush, and annual forbs. The present vegetation in most areas is mainly creosotebush, littleleaf paloverde, and ironwood. Periodic flooding in areas of the Why soils increases the amount of forage available. The potential plant community on the Rositas soils is mainly big galleta and annual forbs. The present vegetation in most areas is mainly big galleta. Overgrazing increases the hazard of wind erosion in areas of the Why and Rositas soils.

This unit is unsuited to irrigated crops. The Cherioni soils are limited mainly by the depth to a hardpan, the depth to bedrock, the slope, and droughtiness. The Coolidge soil is limited by droughtiness and the hazard of wind erosion.

This unit is poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability classification is VIIs. Cherioni extremely cobbly fine sandy loam is in the Limy Upland, 2-7" precipitation zone range site, and the Coolidge soil is in the Limy Fan, 2-7" precipitation zone range site. Cherioni extremely gravelly loam is not assigned to a range site.

9—Cipriano-Hyder-Rock outcrop complex, 15 to 65 percent slopes. This map unit is on basalt hills and mountains (fig. 4). The native vegetation is mainly desert trees, cacti, shrubs, and grasses. Elevation ranges from 480 to 2,800 feet. The average annual precipitation is 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is 40 percent Cipriano soil, 15 percent Hyder soil, and 15 percent Rock outcrop. The Cipriano soil is on the moderately steep, lower colluvial hills and mountains. The Hyder soil and the Rock outcrop are on the moderately steep to very steep upper hills and mountains. Some areas of Rock outcrop are nearly vertical. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in mapping are small areas of Carrizo soils on flood plains (washes); Cherioni soils on summits and

Figure 4.—A typical landscape in an area of Cipriano-Hyder-Rock outcrop complex, 15 to 65 percent slopes. Talus slopes form distinctive stone stripes that are virtually devoid of vegetation.

the lower part of hills, intermingled with areas of Rock outcrop; Momoli soils on fan terraces; and rubble land on talus slopes. Included areas make up about 30 percent of the map unit. The percentage varies from one area to another. Also included are areas where elevation is higher than 2,800 feet.

The Cipriano soil is very shallow and shallow and is somewhat excessively drained. It formed in alluvium and colluvium derived dominantly from basalt rocks. Typically, 50 to 90 percent of the surface is covered with cobbles. The surface layer is light yellowish brown extremely cobbly sandy loam about 2 inches thick. The subsoil is reddish yellow very gravelly sandy loam about 8 inches thick. An indurated hardpan is at a depth of about 10 inches. Depth to the indurated hardpan ranges from 6 to 20 inches. In some areas the surface layer is extremely cobbly loam.

Permeability is moderate in the Cipriano soil. Available water capacity is very low. Potential rooting depth is 6 to 20 inches. Runoff is rapid, and the hazard of water erosion is very severe. The hazard of wind erosion is slight.

The Hyder soil is very shallow and shallow and is somewhat excessively drained. It formed in alluvium and colluvium derived dominantly from basalt rocks. Typically, 60 to 90 percent of the surface is covered with stones, cobbles, and pebbles. The surface layer is light brown extremely stony fine sandy loam about 2 inches thick. The subsoil is light brown extremely gravelly fine sandy loam about 3 inches thick. Unweathered basalt is at a depth of about 5 inches. The depth to unweathered bedrock ranges from 5 to 18 inches.

Permeability is moderate in the Hyder soil. Available water capacity is very low. Potential rooting depth is 5 to 18 inches. Runoff is rapid, and the hazard of water erosion is moderate or severe. The hazard of wind erosion is slight.

Rock outcrop consists of exposed areas of basalt. Runoff from these areas is rapid.

This unit is used mainly as rangeland.

The present vegetation in most areas of the Cipriano soil is mainly brittlebush, creosotebush, and paloverde. The potential plant community is mainly brittlebush, creosotebush, littleleaf paloverde, and buckhorn cholla. Major browse species are littleleaf paloverde, white bursage, and white ratany. These species make up 20 percent of the plant community, perennial grasses and forbs make up 10 percent, and annual grasses and forbs make up 10 percent.

The present vegetation in most areas of the Hyder soil is mainly brittlebush and paloverde. The potential plant community is mainly white bursage, littleleaf paloverde, brittlebush, and creosotebush. Major browse species are littleleaf paloverde, white bursage, and white ratany. These species make up 20 percent of the plant community, perennial grasses and forbs make up 10 percent, and annual grasses and forbs make up 10 percent.

In areas where the average annual precipitation is more than 8 inches, the total vegetative production is about 150 pounds per acre more than is typical and forage plants and annuals make up a larger percentage of the total. Some of these areas produce sufficient forage for year-round use. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional, long or very long periods of flooding. The vegetation in areas that have been recently flooded is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation generally becomes reestablished and the area may provide seasonal grazing for livestock.

This unit is unsuited to irrigated crops. It is limited mainly by droughtiness and the slope. The Cipriano soil also is limited by depth to the hardpan, and the Hyder soil is limited by large stones and the depth to bedrock.

This unit is poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability subclass of the Cipriano and Hyder soils is VIIe, and that of the Rock outcrop is VIII. The Cipriano and Hyder soils are in the Basalt Hills, 2-10" precipitation zone range site. The Rock outcrop is not assigned to a range site.

10—Cipriano-Momoli complex, 1 to 7 percent slopes. This map unit is on fan terraces dissected by shallow flood plains (washes) (fig. 5). The native vegetation is mainly desert trees, shrubs, cacti, and annual forbs and grasses. Elevation ranges from 1,000 to 2,000 feet. The average annual precipitation is 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is 60 percent Cipriano soil and 15 percent Momoli soil. The Cipriano soil is on nearly level and gently sloping summits and the upper sides of fan terraces. The Momoli soil is on the nearly level and gently sloping sides of fan terraces. The two soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Denure, Gunsight, and Rillito soils on fan terraces; Cherioni, Quilotosa, and Vaiva soils on low hills; and Carrizo soils on flood plains (washes). Included areas make up about 25 percent of the map unit. The percentage varies from one area to another.

The Cipriano soil is very shallow and shallow and is somewhat excessively drained. It formed in alluvium and colluvium derived dominantly from mixed rocks. Typically, 50 to 70 percent of the surface is covered with pebbles. The surface layer is light yellowish brown extremely gravelly sandy loam about 2 inches thick. Below this is about 8 inches of reddish yellow very gravelly sandy loam. An indurated hardpan is at a depth of about 10 inches. Depth to the indurated hardpan ranges from 6 to 20 inches. In some areas the surface layer is very cobbly sandy loam.

Permeability is moderate in the Cipriano soil. Available water capacity is very low. Potential rooting depth is 6 to 20 inches. Runoff is rapid, and the hazard of water erosion is slight. The hazard of wind erosion also is slight.

The Momoli soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 50 to 80 percent of the surface is covered with pebbles. The surface layer is light brown very gravelly sandy loam about 2 inches thick. The upper part of the subsoil is reddish yellow very gravelly sandy loam about 13 inches thick. The lower part to a depth of 60 inches or more is strong brown very gravelly coarse sandy loam. In some places an indurated hardpan is at a depth of 40 to 60 inches.

Permeability is moderately rapid in the Momoli soil. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The hazard of wind erosion also is slight.

This unit is used mainly as rangeland.

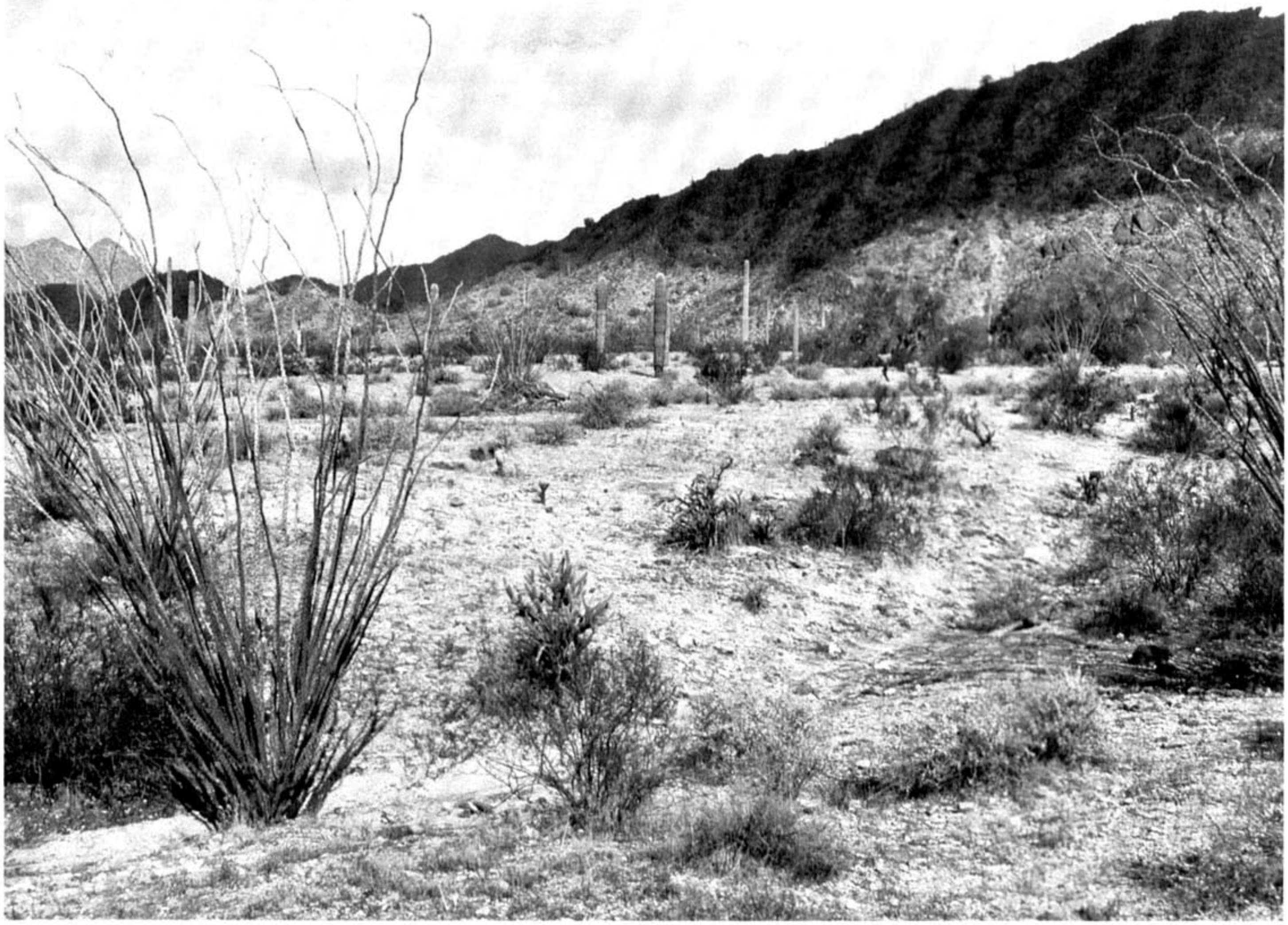

Figure 5.—An area of Cipriano-Momoli complex, 1 to 7 percent slopes, showing fan terraces and narrow stream terraces dissected by a shallow wash. Hardpan fragments are on the surface of the Cipriano soil. Quilotosa soils are on the mountains in the background.

The present vegetation in most areas of the Cipriano soil is mainly creosotebush, triangle bursage, saguaro, and ocotillo. The potential plant community is mainly creosotebush, triangle bursage, and white ratany. Major browse species are white ratany and white bursage. These species make up 15 percent of the plant community. Perennial grasses and forbs, including bush muhly, make up 5 percent of the plant community. Annual grasses and forbs make up 10 percent.

The present vegetation in most areas of the Momoli soil is mainly creosotebush, buckhorn cholla, triangle bursage, and saguaro. The potential plant community is mainly creosotebush, triangle bursage, white ratany, and annual forbs. White ratany is the major browse species. It makes up 10 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 10 percent of the plant community. Annual grasses and forbs make up 25 percent.

In areas where the average annual precipitation is less than 8 inches, the total vegetative production is about 50 to 100 pounds per acre less than is typical. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

A high content of lime, the low available water capacity, and competition from creosotebush contribute to the low production of forage on these soils. Large areas of this unit include smaller areas of the more productive Carrizo soils. Periodic flooding increases the amount of forage available in these included areas. Management of this unit should be geared towards these included areas because they produce most of the forage. The potential plant community on the Carrizo soils is mainly shrubs, littleleaf paloverde, blue paloverde, and annual grasses. The present vegetation in most areas is mainly ironwood, paloverde, triangle bursage, and ratany.

This unit is unsuited to irrigated crops. It is limited mainly by the slope and droughtiness. The Cipriano soil also is limited by depth to the hardpan.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability subclass is VIIs. The Cipriano soil is in the Limy Upland, 2-10" precipitation zone range site, and the Momoli soil is in the Limy Upland (deep), 2-10" precipitation zone range site.

11—Coolidge complex, 0 to 3 percent slopes. This map unit is on broad fan terraces that form basinlike areas between basalt flows. The native vegetation is mainly grasses, shrubs, cacti, and desert trees. Elevation ranges from 450 to 800 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 60 percent Coolidge gravelly very fine sandy loam and 30 percent Coolidge loamy fine sand. Coolidge gravelly very fine sandy loam is on nearly level fan terraces that have been deflated by wind erosion. Coolidge loamy fine sand is on nearly level coppice dunes in areas where blowing sand has accumulated around creosotebushes. These dunes are about 3 to 6 feet in diameter. The components of this map unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Denure soils on fan terraces and Rositas soils on dunes. These included soils make up about 10 percent of the map unit. The percentage varies from one area to another.

The Coolidge soils are deep and well drained. They formed in alluvium and eolian material derived dominantly from mixed rocks. Typically, 2 to 40 percent of the surface is covered with pebbles. The surface layer is light brown gravelly very fine sandy loam about 2 inches thick. The upper part of the subsoil is reddish yellow very fine sandy loam about 19 inches thick. The next part is gravelly sandy loam about 15 inches thick. The lower part to a depth of 60 inches or more is pink very gravelly sandy loam. A very limy layer is at a depth of about 36 inches. Depth to the very limy layer ranges from 21 to 40 inches. In about 30 percent of the areas, the surface layer and the upper part of the subsoil are loamy fine sand.

Permeability is moderately rapid. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight or slight. The hazard of wind erosion is moderately high in areas where the surface layer is gravelly very fine sandy loam and high in areas where the surface layer is loamy fine sand.

This unit is used mainly as rangeland.

The present vegetation in most areas of Coolidge gravelly very fine sandy loam is mainly creosotebush, triangle bursage, and annual grasses. The potential plant community is mainly creosotebush, white bursage, annual forbs, and annual grasses. Major browse species are white bursage and white ratany. These species make up about 15 percent of the plant community. Perennial grasses and forbs, including bush muhly and big galleta, make up 10 percent of the plant community. Annual grasses and forbs make up 20 percent.

The present vegetation in most areas of Coolidge loamy fine sand is mainly big galleta, creosotebush, and white bursage. The potential plant community is mainly big galleta, creosotebush, white bursage, and perennial forbs. Major browse species are white bursage and white ratany. These species make up about 25 percent of the plant community. Perennial grasses and forbs, including big galleta, make up 35 percent of the plant community. Annual grasses and forbs make up 20 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

The areas of Coolidge loamy fine sand provide nearly all of the forage and habitat for livestock and wildlife. Therefore, management should be geared to these areas. Overgrazing increases the hazard of wind erosion.

If this unit is used for irrigated crops, it is limited mainly by the hazard of wind erosion, droughtiness, and the very limy layer in the underlying material. A fast intake rate is an additional concern in areas of Coolidge loamy fine sand.

Furrow, border, and sprinkler irrigation systems are suitable in areas of this unit. Wind erosion can be controlled by returning crop residue to the soil and practicing minimum tillage. Onsite investigation is advisable before this unit is developed for irrigated crops.

The capability subclass is VIIs. Coolidge gravelly very fine sandy loam is in the Limy Fan, 2-7" precipitation zone range site, and Coolidge loamy fine sand is in the Limy Fan (sandy), 2-7" precipitation zone range site.

12—Cuerda-Why-Lagunita complex. This map unit is on alluvial fans. The vegetation in areas that have not been cultivated is mainly desert trees, shrubs, and annual grasses. Slope is 0 to 1 percent. Elevation ranges from 440 to 500 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 40 percent Cuerda soil, 25 percent Why soil, and 15 percent Lagunita soil. The three soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Agualt, Indio, and Ripley soils. These included soils make up about 20 percent of the map unit. The percentage varies from one area to another.

The Cuerda soil is deep and well drained. It formed in stratified alluvium derived dominantly from mixed rocks. Typically, as much as 5 percent of the surface is covered with pebbles. The surface layer is light brown, stratified loam about 5 inches thick. The upper part of the subsoil is light brown loam about 37 inches thick. The lower part to a depth of 60 inches or more is pink very gravelly loam. In some areas sand and gravel are below a depth of 40 inches. The soil is slightly or moderately saline and sodic (electrical conductivity of 4 to 16 millimhos per centimeter).

Permeability is moderate in the Cuerda soil. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderate. The soil is occasionally flooded during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. The occasional, very brief periods of flooding occur mainly in summer and winter.

The Why soil is deep and somewhat excessively drained. It formed in stratified alluvium derived dominantly from mixed rocks. Typically, as much as 10 percent of the surface is covered with pebbles. The surface layer is light brown, stratified sandy loam about 11 inches thick. The upper part of the subsoil is strong brown sandy loam about 20 inches thick. The lower part to a depth of 60 inches or more is strong brown and pink gravelly sandy loam. In some areas the surface layer is gravelly. In other areas sand and gravel are below a depth of 40 inches. The soil is nonsaline to moderately saline (electrical conductivity of 0.7 to 16.0 millimhos per centimeter).

Permeability is moderately rapid in the Why soil. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderately high. The soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. The occasional, very brief periods of flooding occur mainly in summer and winter.

The Lagunita soil is deep and excessively drained. It formed in stratified alluvium derived dominantly from mixed rocks. Typically, as much as 10 percent of the surface is covered with pebbles. The surface layer is pale brown, stratified loamy fine sand about 11 inches thick. The upper part of the underlying material, to a depth of about 50 inches, is light brownish gray, stratified sand. The lower part to a depth of 60 inches or more is light brownish gray very gravelly coarse sand. In some areas the surface layer is very fine sandy loam. The soil is nonsaline (electrical conductivity of less than 1 millimho per centimeter).

Permeability is rapid in the Lagunita soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is very slight. The hazard of wind erosion is high. The soil is subject to flooding during prolonged, high-intensity storms. The occasional, very brief periods of flooding occur mainly in summer and winter.

This unit is used mainly for irrigated cotton, small grain, or bermudagrass. It also is used as rangeland.

These soils are limited mainly by droughtiness and the hazard of flooding. The Cuerda and Why soils also are limited by the content of toxic salts. Wind erosion is a hazard in areas of the Lagunita and Why soils. The Lagunita soil also is limited by a fast intake rate.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of these soils. Leveling cuts are needed for the efficient application of irrigation water. Keeping leveling cuts to a minimum helps to prevent exposing the sand in areas of the Lagunita soil. Applications of manure or gin trash are beneficial in leveled areas where sand is exposed. Water can be distributed by lined ditches or pipelines. The hazard of wind erosion can be reduced by keeping the soils rough and cloddy if they are not protected by vegetation or crop residue. In the more sloping areas, irrigation streams can cause erosion. This hazard can be minimized by irrigating across the slope or by leveling to a more nearly level grade. The hazard of flooding can be reduced by using dikes and diversions. Strong salinity and sodicity restrict the choice of crops. Intensive management is needed to reduce the salinity and sodicity and to maintain productivity. Applying soil amendments and leaching reduce the content of toxic salts and sodium. Suitable soil amendments are sulfur, gypsum, and sulfuric acid. The kinds and amounts of amendments needed should be determined by soil tests. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. Deep chiseling or subsoiling temporarily opens up the soil and allows water and salts to pass through. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas of the Cuerda and Why soils is mainly mesquite, desert saltbush, and creosotebush. The potential plant community is mainly mesquite, desert saltbush, and annual grasses and forbs. Major browse species are desert saltbush and mesquite. These species make up about 70 percent of the plant community. Annual grasses and forbs make up 20 percent.

The present vegetation in most areas of the Lagunita soil is mainly annual grasses. The potential plant community is mainly mesquite big galleta and other shrubs. Major browse species are mesquite, desert saltbush, and blue paloverde. These species make up about 40 percent of the plant community. Perennial grasses and forbs, including big galleta, make up 40 percent of the plant community. Annual grasses and forbs make up 10 percent.

Periodic flooding increases the amount of forage available on this unit. Overgrazing increases the hazard of wind erosion and the likelihood of gullying. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. Fencing and developing water sources can improve grazing or livestock management. This unit responds to improved grazing management in a reasonable length of time.

This map unit no longer benefits from the regular flooding because of protection provided by flood-control structures. The production of shrubs, grasses, and forbs on these soils resembles that on similar upland range sites. Because of a seasonal high water table, however, these soils can produce moderate stands consisting of scattered very large trees or closely spaced shrubby trees.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional, long or very long periods of flooding. The vegetation in recently flooded areas is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation generally becomes reestablished and the area may provide seasonal grazing for livestock. In irrigated areas, repairing ditches and releveling are commonly needed after periods of flooding. Root plowing to a depth of 12 to 18 inches is needed to remove the saltcedar.

This unit is moderately well suited to desertic riparian herbaceous plants and desertic riparian shrubs and trees. It is moderately well suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass of the Cuerda and Why soils is IIIs, irrigated, and VIIs, nonirrigated. The capability subclass of the Lagunita soil is VIw, irrigated, and VIIw, nonirrigated. The Cuerda and Why soils are in the Saline Bottom, 2-7" precipitation zone range site, and the Lagunita soil is in the Sandy Bottom, 2-7" precipitation zone range site.

13—Dateland very fine sandy loam. This deep, well drained soil is on stream terraces. It formed in alluvium derived dominantly from mixed rocks. Slope is 0 to 1 percent. Elevation ranges from 500 to 1,400 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

Included with this soil in mapping are small areas of Aguilt, Denure, and Momoli soils. Also included are small areas of Carrizo soils on benches. Included soils make up about 23 percent of the map unit. The percentage varies from one area to another.

Typically, 1 to 15 percent of the surface of the Dateland soil is covered with pebbles. The surface layer is light brown very fine sandy loam about 10 inches thick. The upper 30 inches of the subsoil is reddish yellow very fine sandy loam. The lower 14 inches is reddish yellow gravelly coarse sandy loam. Below this to a depth of 60 inches or more is a buried subsoil of reddish yellow loam. The soil is nonsaline to slightly saline (electrical conductivity of 0.8 to 8.0 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is moderate. Available water capacity is very high. Potential rooting depth is 60 inches or more.

Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderate. The soil is subject to rare flooding.

This unit is used for irrigated cotton, small grain, or alfalfa hay. It has few limitations affecting irrigated crops.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of this soil. Leveling cuts are needed for the efficient application of irrigation water. In the more sloping areas, the amount of soil that must be moved in the process of leveling fields may be prohibitive. A graded system is more feasible in these areas. Leveling cuts can be made to a depth of about 40 inches. Water can be distributed by earth ditches, lined ditches, and pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. The included soils in washes are subject to flooding. Where these areas are adjacent to cropland that is not protected by dikes and diversions, the cropland also is subject to flooding. In slightly saline areas, yields of many crops are limited and the choice of plants is restricted. Leaching is needed to prevent salt from building up in the soil, particularly if graded irrigation systems are used. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional, long or very long periods of flooding. The vegetation in recently flooded areas is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation generally becomes reestablished and the area can provide seasonal grazing for livestock. In irrigated areas, repairing ditches and releveling are commonly needed after periods of flooding. Root plowing to a depth of 12 to 18 inches is needed to remove the saltcedar.

This soil is well suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability class is IIw, irrigated, and VIIw, nonirrigated.

14—Dateland-Cuerda complex, 0 to 3 percent slopes. This map unit is on fan terraces and flood plains (washes). The native vegetation is mainly desert trees, shrubs, cacti, annual grasses, and forbs. Elevation ranges from 600 to 1,700 feet. The average annual precipitation is 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 60 percent Dateland soil and 30 percent Cuerda soil. The Dateland soil is on nearly level fan terraces, and the Cuerda soil is on nearly level flood plains (washes). The two soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Denure and Mohall soils on fan terraces. These included soils make up about 10 percent of the map unit. The percentage varies from one area to another.

The Dateland soil is deep and well drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 1 to 15 percent of the surface is covered with pebbles. The surface layer is light brown fine sandy loam about 3 inches thick. The upper 35 inches of the subsoil is reddish yellow very fine sandy loam. The lower 16 inches is reddish yellow gravelly coarse sandy loam. Below this to a depth of 60 inches or more is a buried subsoil of reddish yellow loam.

Permeability is moderate in the Dateland soil. Available water capacity is high. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight or slight. The hazard of wind erosion is moderately high.

The Cuerda soil is deep and well drained. It formed in stratified alluvium derived dominantly from mixed rocks. Typically, 1 to 10 percent of the surface is covered with pebbles. The surface layer is light brown, stratified loam about 5 inches thick. The upper part of the subsoil is light brown loam about 37 inches thick. The lower part to a depth of 60 inches or more is pink very gravelly loam.

Permeability is moderate in the Cuerda soil. Available water capacity is high. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight or slight. The hazard of wind erosion is moderate. The soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. The occasional, very brief periods of flooding occur mainly in summer and winter.

This unit is used mainly as rangeland. It can be used for irrigated crops if water is made available.

The present vegetation in most areas of the Dateland soil is mainly creosotebush and annual grasses. The potential plant community is mainly creosotebush, white bursage, annual forbs, and annual grasses. Major browse species are white bursage and white ratany. These species make up 15 percent of the plant community. Perennial grasses and forbs, including big galleta, make up 5 percent of the plant community. Annual grasses and forbs make up 25 percent.

The present vegetation in most areas of the Cuerda soil is mainly mesquite, creosotebush, and annual grasses. The potential plant community is mainly big galleta, bush muhly, and shrubs. Perennial grasses and forbs, including big galleta, bush muhly, and threeawn, make up 75 percent of the plant community. Annual grasses and forbs make up 10 percent.

In areas where the average annual precipitation is more than 8 inches, the total vegetative production is about 100 to 200 pounds per acre more than is typical and forage plants and annuals make up a larger percentage of the total. Some of these areas produce sufficient forage for year-round use. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

The Cuerda soil provides most of the forage and habitat for livestock and wildlife on this unit. Periodic flooding increases the amount of forage available. Thus, management should be geared to this soil. Overgrazing increases the hazard of wind erosion on this unit. The Cuerda soil is subject to gully erosion if the natural drainage pattern is disturbed by roads or trails.

If this unit is used for irrigated crops, the main management concerns are the hazard of wind erosion on the Dateland soil and the occasional flooding in areas of the Cuerda soil. Furrow, border, and sprinkler irrigation systems are suitable in areas of these soils. Wind erosion can be controlled by returning crop residue to the soil and practicing minimum tillage. Onsite investigation is advisable before this unit is developed for irrigated crops.

This unit is moderately well suited to desertic herbaceous plants and desertic shrubs and trees. It is well suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass of the Dateland soil is IIe, irrigated, and VIIe, nonirrigated. The capability subclass of the Cuerda soil is IIw, irrigated, and VIIw, nonirrigated. The Dateland soil is in the Limy Fan, 2-10" precipitation zone range site, and the Cuerda soil is in the Loamy Bottom, 2-10" precipitation zone range site.

15—Dateland-Denure fine sandy loams, saline-sodic, 0 to 3 percent slopes. This map unit is on stream terraces adjacent to the Gila River. The native vegetation is mainly desert shrubs, trees, and annual forbs and grasses. Elevation ranges from 500 to 1,400 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 50 percent Dateland soil and 35 percent Denure soil. The two soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Mohall soils on fan terraces; Carrizo, bench, soils on stream terraces; and Carrizo and Why soils on flood plains (washes). Also included are small areas of soils that are similar to the Dateland and Denure soils but have sand and gravel at a moderate depth. Included areas make up about 15 percent of the map unit. The percentage varies from one area to another.

The Dateland soil is deep and well drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 1 to 15 percent of the surface is covered with pebbles. The surface layer is light brown fine sandy loam about 3 inches thick. The upper 37 inches of the subsoil is reddish yellow very fine sandy loam. The lower 14 inches is reddish yellow gravelly coarse sandy loam. Below this to a depth of 60 inches or more is a buried subsoil of reddish yellow loam. In some areas where low coppice dunes have accumulated at the base of mesquite trees, the surface layer is loamy fine sand. The soil is very slightly saline to strongly saline (electrical conductivity of 0.8 to 80.0 millimhos per centimeter).

Permeability is moderate in the Dateland soil. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is very slight or slight. The hazard of wind erosion is moderately high.

The Denure soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 1 to 15 percent of the surface is covered with pebbles. The surface layer is light brown fine sandy loam about 4 inches thick. The upper 37 inches of the subsoil is reddish yellow sandy loam. The lower 19 inches is pink gravelly sandy loam. A very limy layer is at a depth of about 41 inches. Depth to the very limy layer ranges from 40 to 60 inches. In some areas where low coppice dunes have accumulated at the base of mesquite trees, the surface layer is loamy fine sand. The soil is very slightly to strongly saline (electrical conductivity of 0.5 to 50.0 millimhos per centimeter).

Permeability is moderately rapid in the Denure soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight or slight. The hazard of wind erosion is moderately high.

This unit is used as rangeland. It can be used for irrigated crops. The soils are limited mainly by droughtiness, the hazard of wind erosion, and the content of toxic salts.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of these soils. Leveling cuts are needed for the efficient application of irrigation water. Leveling cuts can be made to a depth of about 40 inches. Water can be distributed by earth ditches, lined ditches, and pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. Because the soils are droughty, applications of irrigation water should be light and frequent. The hazard of wind erosion can be reduced by keeping the soils rough and cloddy if they are not protected by vegetation or crop residue. The included soils in washes are subject to flooding. Where these areas are adjacent to cropland that is not protected by dikes and diversions, the cropland also is subject to flooding. In most cultivated areas that have been irrigated, the content of toxic salts has been reduced through leaching. Because of the wide range of salinity levels, soil tests are needed. The choice of crops is restricted in areas where the soils are strongly saline and sodic. Intensive management is needed to reduce the salinity and sodicity and to maintain productivity. Applying soil amendments and leaching reduce the content of toxic salts and sodium. Suitable soil amendments are sulfur, gypsum, and sulfuric acid. The kinds and amounts of amendments needed should be determined by soil tests. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is strongly encouraged before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas is mainly desert saltbush, mesquite, and annual forbs and grasses. The potential plant community is mainly desert saltbush, fourwing saltbush, and wolfberry. Major browse species are desert saltbush, wolfberry, and fourwing saltbush. These species make up about 80 percent of the plant community. Annual grasses and forbs make up 15 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Also, overgrazing increases the hazard of wind erosion. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional, long or very long periods of flooding. The vegetation in recently flooded areas is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation generally becomes reestablished and the area can provide seasonal grazing for livestock. In irrigated areas, repairing ditches and releveling are commonly needed after periods of flooding. Root plowing to a depth of 12 to 18 inches is needed to remove the saltcedar.

This unit is moderately well suited to desertic herbaceous plants and desertic shrubs and trees. It is moderately well suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass of the Dateland soil is IIIs, irrigated, and VIIs, nonirrigated. The capability subclass of the Denure soil is IVs, irrigated, and VIIs, nonirrigated. Both soils are in the Saline Upland, 2-7" precipitation zone range site.

16—Denure sandy loam. This deep, somewhat excessively drained soil is on stream terraces. It formed in alluvium derived dominantly from mixed rocks. Slope is 0 to 1 percent. Elevation ranges from 500 to 1,400 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

Included with this soil in mapping are small areas of Dateland and Wellton soils and areas of soils that are similar to the Denure soil but are underlain by sand and gravel at a moderate depth. Included soils make up about 20 percent of the map unit. The percentage varies from one area to another.

Typically, 1 to 10 percent of the surface of the Denure soil is covered with pebbles. The surface layer is light brown sandy loam about 10 inches thick. The upper 31 inches of the subsoil is reddish yellow sandy loam. The lower 19 inches is pink sandy loam. A very limy layer is at a depth of about 41 inches. Depth to the very limy layer ranges from 40 to 60 inches. A buried subsoil is at a moderate depth in some areas. In places the surface layer is fine sandy loam. The soil is very slightly or slightly saline (electrical conductivity of 3.8 to 7.0 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is moderately rapid. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderately high. The soil is subject to rare flooding.

This unit is used for irrigated cotton, small grain, or alfalfa hay. It is limited mainly by droughtiness and the hazard of wind erosion.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of this soil. Leveling cuts are needed for the efficient application of irrigation water. In the more sloping areas, the amount of soil that must be moved if fields are leveled may be prohibitive. A graded system is more feasible in these areas. Leveling cuts can be made to a depth of about 40 inches. Water can be distributed by earth ditches, lined ditches, and pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. Because the soil is droughty, applications of irrigation water should be light and frequent. The hazard of wind erosion can be reduced by keeping the soil rough and cloddy if it is not protected by vegetation or crop residue. The included soils in washes are subject to flooding. Where these areas are adjacent to cropland that is not protected by dikes and diversions, the cropland also is subject to flooding. In areas that are slightly saline, yields of many crops are limited and the choice of plants is restricted. Leaching is needed to prevent salt from building up in the soil, particularly if graded irrigation systems are used. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional, long or very long periods of flooding. The vegetation in recently flooded areas is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation becomes reestablished and the area can provide seasonal grazing for livestock. In irrigated areas, repairing ditches and releveling are commonly needed after periods of flooding. Root plowing to a depth of 12 to 18 inches is needed to remove the saltcedar.

This soil is moderately well suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass is IIe, irrigated, and VIIe, nonirrigated.

17—Denure gravelly fine sandy loam, 1 to 3 percent slopes. This deep, somewhat excessively drained soil is on fan terraces. It formed in alluvium derived dominantly from mixed rocks. The vegetation in areas that have not been cultivated is mainly desert shrubs, annual forbs, and grasses. Elevation ranges from 500 to 1,400 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

Included with this soil in mapping are small areas of Momoli, Rillito, and Tremant soils on fan terraces; Carrizo, bench, soils on stream terraces; and Why soils on flood plains (washes). Also included are small areas of soils that are similar to the Denure soil but are underlain by sand and gravel at a moderate depth. Included soils make up about 30 percent of the map unit. The percentage varies from one area to another.

Typically, 15 to 35 percent of the surface of the Denure soil is covered with pebbles. The surface layer is light brown gravelly fine sandy loam about 4 inches thick. The upper 37 inches of the subsoil is reddish yellow gravelly sandy loam. The lower 19 inches is pink gravelly sandy loam. A very limy layer is at a depth of about 41 inches. Depth to the very limy layer ranges from 40 to 60 inches. A moderately fine textured buried subsoil is at a moderate depth in some areas. In a few areas that have not been cultivated, as much as 50 percent of the surface is covered with gravel. The soil is nonsaline to slightly saline (electrical conductivity of 0.5 to 5.0 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is moderately rapid. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight or slight. The hazard of wind erosion is moderately high.

This unit is used mainly for irrigated cotton, small grain, alfalfa, citrus, grapes, or jojoba. Some areas are used as rangeland. A portion of the town of Gila Bend is in areas of this unit.

This soil is limited mainly by droughtiness and the hazard of wind erosion.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of this soil. Leveling cuts are needed for the efficient application of irrigation water. In the more sloping areas, the amount of soil that must be moved if fields are leveled may be prohibitive. A graded system is more feasible in these areas. Leveling cuts can be made to a depth of about 40 inches. Water can be distributed by earth ditches, lined ditches, and pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. Because the soil is droughty, applications of irrigation water should be light and frequent. The included soils in washes are subject to flooding. Where these areas are adjacent to cropland that is not protected by dikes and diversions, the cropland also is subject to flooding. In areas that are slightly saline, yields of many crops are limited and the choice of plants is restricted. Leaching is needed to prevent salt from building up in the soil, particularly if graded irrigation systems are used. Leaching is especially critical in areas where the quality of the water is poor. Irrigation with water that is strongly affected by salts or sodium can result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas is mainly creosotebush and annual grasses. The potential plant community is mainly creosotebush, white bursage, annual forbs, and annual grasses. Major browse species are white bursage and white ratany. These species make up about 15 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 10 percent of the plant community. Annual grasses and forbs make up 25 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

This soil is well suited to homesite development. Few limitations affect this use.

This soil is poorly suited to desertic herbaceous plants and desertic shrubs and trees. It is moderately well suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass is IIIs, irrigated, and VIIs, nonirrigated. This soil is in the Limy Fan, 2-7" precipitation zone range site.

18—Denure-Carrizo, bench, gravelly fine sandy loams. This map unit is on fan terraces. The vegetation in areas that have not been cultivated is mainly desert shrubs, annual grasses, and annual forbs. Slope is 0 to 1 percent. Elevation ranges from 500 to 1,400 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 45 percent Denure soil and 30 percent Carrizo soil. The two soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Momoli and Tremant soils on fan terraces and Carrizo and Why soils on flood plains (washes). Also included are small areas of soils that are similar to the Denure soil but are underlain by sand and gravel at a moderate depth. Included areas make up about 25 percent of the map unit. The percentage varies from one area to another.

The Denure soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, the surface layer is light brown gravelly fine sandy loam about 10 inches thick. The upper 31 inches of the subsoil is reddish yellow gravelly sandy loam. The lower 19 inches is pink gravelly sandy loam. A very limy layer is at a depth of about 41 inches. Depth to the very limy layer ranges from 40 to 60 inches. In some areas the surface layer is very gravelly sandy loam. The soil is nonsaline to slightly saline (electrical conductivity of 0.6 to 7.4 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is moderately rapid in the Denure soil. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderately high.

The Carrizo soil is deep and excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, the surface layer is brown gravelly fine sandy loam about 10 inches thick. The underlying material to a depth of 60 inches or more is brown extremely gravelly loamy sand that has thin strata of finer textured material. In some areas the surface layer is very gravelly sandy loam. The soil is nonsaline to slightly saline (electrical conductivity of 0.5 to 7.0 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is very rapid in the Carrizo soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is very slight. The hazard of wind erosion is slight.

This unit is used mainly for irrigated cotton, small grain, alfalfa hay, citrus, or grapes. Some areas are used as rangeland.

These soils are limited mainly by droughtiness. The hazard of wind erosion is also a concern in areas of the Denure soil.

Graded furrow, graded border, sprinkler, and trickle irrigation systems are suitable in areas of these soils. The method used generally is governed by the crop. Leveling cuts are needed for the efficient application and removal of irrigation water in sloping areas. In the more sloping areas, the amount of soil that must be moved if fields are leveled may be prohibitive. A graded system is more feasible in these areas. Keeping leveling cuts to a minimum helps to prevent exposing the sand and gravel in areas of the Carrizo soil. Applications of manure or gin trash are beneficial in leveled areas where sand and gravel are exposed. Water can be distributed by lined ditches and pipelines. Because the soils are droughty, applications of irrigation water should be light and frequent. The included soils in washes are subject to flooding. Where these areas are adjacent to cropland that is not protected by dikes and diversions, the cropland also is subject to flooding. In areas that are slightly saline, yields of many crops are limited and the choice of plants is restricted. Leaching is needed to prevent salt from building up in the soil, particularly if graded irrigation systems are used. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas of the Denure soil is mainly creosotebush and annual grasses. The potential plant community is mainly creosotebush, white bursage, annual forbs, and annual grasses. Major browse species are white bursage and white ratany. These species make up about 15 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 10 percent of the plant community. Annual grasses and forbs make up 25 percent.

The present vegetation in most areas of the Carrizo soil is mainly creosotebush and turkshead. The potential plant community is mainly creosotebush, white bursage, and turkshead. Major browse species are white bursage and white ratany. These species make up about 15 percent of the plant community. Annual grasses and forbs make up 5 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees. It is poorly suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass of the Denure soil is IIIs, irrigated, and VIIs, nonirrigated. The capability subclass of the Carrizo soil is VIs, irrigated, and VIIs, nonirrigated. The Denure soil is in the Limy Fan, 2-7" precipitation zone range site, and the Carrizo soil is in the Limy Upland (deep), 2-7" precipitation zone range site.

19—Denure-Cavelt complex, 0 to 3 percent slopes. This map unit is on stream terraces grading toward the Gila River within the flood pool of Painted Rock Dam. The native vegetation is mainly desert shrubs, annual forbs, and grasses. The vegetation in areas that have been recently flooded is mainly phreatophytic shrubs. Elevation ranges from 600 to 661 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 55 percent Denure soil and 20 percent Cavelt soil. The two soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Coolidge, Harqua, Tucson, and Wellton soils. Also included are small areas of Rositas soils on sand dunes and areas of soils that are similar to the Denure soil but have a clay substratum. Included areas make up about 25 percent of the map unit. The percentage varies from one area to another.

The Denure soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, the surface layer is light brown fine sandy loam about 10 inches thick. The upper 31 inches of the subsoil is reddish yellow sandy loam. The lower 19 inches is pink gravelly sandy loam. A very limy layer is at a depth of about 41 inches. Depth to the very limy layer ranges from 40 to 60 inches. In some areas the surface layer is loamy fine sand. The soil is normally nonsaline to slightly saline (electrical conductivity of 1 to 4 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is moderately rapid in the Denure soil. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight to moderate. The hazard of wind erosion is moderately high. This soil is subject to rare or occasional, long or very long periods of flooding when water is stored behind Painted Rock Dam.

The Cavelt soil is moderately deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 5 to 25 percent of the surface is covered with fine pebbles. The surface layer is light brown gravelly sandy loam about 4 inches thick. The subsoil is pink gravelly loam about 23 inches thick. A lime-cemented hardpan is at a depth of about 27 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the surface layer is loamy fine sand. The soil is normally nonsaline to slightly saline (electrical conductivity of 1 to 4 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches. It also may be higher in areas that are flooded.

Permeability is moderate in the Cavelt soil. Available water capacity is very low. Potential rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is very slight or slight. The hazard of wind erosion is moderately high. The soil is subject to rare or occasional, long or very long periods of flooding when water is stored behind Painted Rock Dam.

Most areas of this unit are used as rangeland. A few areas are used as irrigated cropland.

These soils are limited mainly by droughtiness, the hazard of wind erosion, and the hazard of flooding. The Cavelt soil also is limited by the depth to a hardpan.

Leveling cuts made to a depth of 20 to 40 inches expose the hardpan in areas of the Cavelt soil. Because these soils are droughty, applications of irrigation water should be light and frequent. The hazard of wind erosion can be reduced by keeping the soils rough and cloddy if they are not protected by vegetation or crop residue. Because of recent flooding, a very dense stand of saltcedar has invaded most areas of this unit. Root plowing to a depth of 12 to 18 inches is needed to remove the trees. In areas that are slightly saline, yields of some crops are limited and the choice of plants is restricted. Leaching is needed to prevent salt from building up in the soil, particularly if graded irrigation systems are used. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas is mainly saltcedar. In areas that have not been flooded, the present vegetation is creosotebush and triangle bursage. This unit may provide seasonal grazing for livestock and habitat for wildlife between periods of flooding.

The capability subclass of the Denure soil is IIIw, irrigated, and VIIw, nonirrigated. The capability subclass of the Cavelt soil is VIw, irrigated, and VIIw, nonirrigated.

20—Denure-Coolidge complex, 1 to 3 percent slopes. This map unit is on nearly level fan terraces. The native vegetation is mainly desert shrubs, annual grasses, and forbs. Elevation ranges from 1,000 to 1,600 feet. The average annual precipitation is 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 55 percent Denure soil and 25 percent Coolidge soil. The two soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Carrizo, Cuerda, Mohall, occasionally flooded, and Why soils on flood plains (washes) and Dateland, Mohall, Momoli, and Rillito soils on fan terraces. Included areas make up about 20 percent of the map unit. The percentage varies from one area to another.

The Denure soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 20 to 50 percent of the surface is covered with pebbles. The surface layer is brown very gravelly sandy loam about 4 inches thick. The upper 5 inches of the subsoil is light brown sandy loam. The next 32 inches is reddish yellow gravelly sandy loam. The lower part of the subsoil to a depth of 60 inches or more is pink gravelly sandy loam. A very limy layer is at a depth of about 41 inches. Depth to the very limy layer ranges from 40 to 60 inches.

Permeability is moderately rapid in the Denure soil. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The hazard of wind erosion also is slight.

The Coolidge soil is deep and well drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 10 to 50 percent of the surface is covered with pebbles. The surface layer is light brown gravelly very fine sandy loam about 2 inches thick. The upper 19 inches of the subsoil is reddish yellow very fine sandy loam. The next 15 inches is reddish yellow gravelly sandy loam. The lower part of the subsoil to a depth of 60 inches or more is pink very gravelly sandy loam. A very limy layer is at a depth of 21 to 40 inches.

Permeability is moderately rapid in the Coolidge soil. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The hazard of wind erosion is moderately high.

This unit is used mainly as rangeland. It can be used for irrigated crops if water is made available.

The present vegetation in most areas is mainly creosotebush and annual grasses. The potential plant community is mainly creosotebush, white bursage, annual forbs, and annual grasses. Major browse species are white bursage and white ratany. These species make up about 15 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 10 percent of the plant community. Annual grasses and forbs make up 20 percent.

In areas where the average annual precipitation is more than 8 inches, the total vegetative production is about 100 pounds per acre more than is typical and forage plants and annuals make up a larger percentage of the total. Some of these areas produce sufficient forage for year-round use. Management measures that permit efficient use of annual forage and meet the needs of the perennial plants on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

A high content of lime, a low water-supplying capacity, and competition from creosotebush contribute to the low production of forage on these soils. Large areas of this unit include smaller areas of the more productive Carrizo, Cuerda, and Why soils. Periodic flooding increases the amount of forage available on these included soils. Management should be geared to these included areas because they produce most of the forage. The potential plant community on the Carrizo and Why soils is mainly littleleaf paloverde, ironwood, annual grasses, and shrubs. The present vegetation in most areas is mainly littleleaf paloverde, ironwood, and annual grasses. The potential plant community on the Cuerda soil is mainly big galleta, bush muhly, perennial grasses, and threeawn. The present vegetation in most areas is mainly creosotebush, white bursage, and annual grasses.

If this unit is used for irrigated crops, droughtiness is the main limitation. The Coolidge soil also is limited by a very limy layer in the underlying material and the hazard of wind erosion.

Furrow, border, sprinkler, and drip irrigation systems are suitable in areas of these soils. Leveling cuts are needed for the efficient application of irrigation water. If the very gravelly surface of the Denure soil is disturbed, the hazard of wind erosion is increased. Wind erosion can be controlled by returning crop residue to the soil and practicing minimum tillage. Onsite investigation is advisable before this unit is developed for irrigated crops.

This unit is poorly suited to desertic herbaceous plants and desertic shrubs and trees. It is moderately well suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass is IIIs, irrigated, and VIIs, nonirrigated. These soils are in the Limy Fan, 2-10" precipitation zone range site.

21—Denure-Rillito-Why complex, 1 to 5 percent slopes. This map unit is on fan terraces dissected by flood plains (washes) (fig. 6). The native vegetation is mainly desert shrubs, trees, cacti, and annual grasses. Elevation ranges from 500 to 1,800 feet. The average annual precipitation is 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is 40 percent Denure soil, 25 percent Rillito soil, and 15 percent Why soil. The Denure soil is on nearly level and gently sloping summits and sides of low fan terraces. The Rillito soil is on the slightly higher and more gravelly, nearly level and gently sloping summits and sides of fan terraces. The Why soil is on the nearly level flood plains (washes). The three soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Coolidge and Momoli soils on low fan terraces, Chuckawalla and Gunsight soils on the higher fan terraces, and Carrizo soils on flood plains (washes). Included areas make up about 20 percent of the map unit. The percentage varies from one area to another.

The Denure soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 20 to 50 percent of the surface is covered with pebbles. The surface layer is light brown very gravelly sandy loam about 4 inches thick. The upper 37 inches of the subsoil is reddish yellow gravelly sandy loam. The lower 19 inches is pink gravelly sandy loam. A very limy layer is at a depth of about 41 inches. Depth to the very limy layer ranges from 40 to 60 inches.

Permeability is moderately rapid in the Denure soil. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is slight.

The Rillito soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 35 to 80 percent of the surface

Figure 6.—An area of Denure-Rillito-Why complex, 1 to 5 percent slopes. The Denure soil is in the lower, darker colored areas, and the Rillito soil is in the slightly higher, lighter colored areas.

is covered with pebbles. The surface layer is light brown very gravelly sandy loam about 2 inches thick. The upper 7 inches of the subsoil is reddish yellow sandy loam. The next 13 inches is light brown gravelly fine sandy loam. The lower part of the subsoil, to a depth of about 42 inches, is pink gravelly sandy loam. Below this to a depth of 60 inches or more is a buried subsoil of reddish brown very gravelly sandy loam. A very limy layer is at a depth of about 22 inches. Depth to the very limy layer ranges from 20 to 40 inches. The soil is nonsaline to moderately saline (electrical conductivity of 0.2 to 13.7 millimhos per centimeter).

Permeability is moderately rapid in the Rillito soil. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The hazard of wind erosion also is slight.

The Why soil is deep and somewhat excessively drained. It formed in stratified alluvium derived dominantly from mixed rocks. Typically, 1 to 10 percent of the surface is covered with pebbles. The surface layer is light brown, stratified sandy loam about 11 inches thick. The upper 20 inches of the subsoil is strong brown sandy loam. The lower part to a depth of 60 inches or more is strong brown and pink gravelly sandy loam.

Permeability is moderately rapid in the Why soil. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The hazard of wind erosion is moderately high. The soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. The occasional, very brief periods of flooding occur mainly in summer and winter.

This unit is used mainly as rangeland.

The present vegetation in most areas of the Denure soil is mainly creosotebush and annual grasses. The potential plant community is mainly creosotebush, triangle bursage, annual forbs, and annual grasses. The major browse species is white ratany. This species makes up about 10 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 10 percent of the plant community. Annual grasses and forbs make up 25 percent.

The present vegetation in most areas of the Rillito soil is mainly creosotebush, buckhorn cholla, and annual grasses. The potential plant community is mainly creosotebush and triangle bursage. Major browse species are white bursage and white ratany. These species make up about 10 percent of the plant community. Perennial grasses and forbs, including bush muhly and threeawn, make up 15 percent of the plant community. Annual grasses and forbs make up 10 percent.

The present vegetation in most areas of the Why soil is mainly creosotebush, triangle bursage, paloverde, and ironwood. The potential plant community is mainly ironwood, littleleaf paloverde, shrubs, and perennial forbs. Major browse species are littleleaf paloverde, ironwood, and catclaw acacia. These species make up about 30 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 25 percent of the plant community. Annual grasses and forbs make up 15 percent.

The Why soil makes up only a small percentage of the unit, but it provides most of the forage for livestock and the habitat for wildlife. Periodic flooding increases the amount of forage available. Therefore, management should be geared to this soil. Overgrazing increases the hazard of wind erosion.

In areas where the average annual precipitation is less than 8 inches, the total vegetative production is about 50 to 200 pounds per acre less than is typical and forage plants and annuals make up a smaller percentage of the total. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

If this unit is used for irrigated crops, the main limitations are the slope and droughtiness. Also, the Rillito soil has a high content of toxic salts and a very limy layer in the underlying material. The occasional flooding and the hazard of wind erosion are management concerns in areas of the Why soil. Furrow, border, sprinkler, and drip irrigation systems are suitable in areas of these soils. If the gravelly surface of the Denure and Rillito soils is disturbed, the hazard of wind erosion is increased. Wind erosion can be controlled by returning crop residue to the soil and practicing minimum tillage. Onsite investigation is advisable before this unit is developed for irrigated crops.

This unit is poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability subclass of the Denure and Rillito soils is VIIs, nonirrigated. The capability subclass of the Why soil is VIIw, nonirrigated. The Denure soil is in the Limy Fan, 2-10" precipitation zone range site; the Rillito soil is in the Limy Upland (deep), 2-10" precipitation zone range site; and the Why soil is in the Sandy Bottom, 2-10" precipitation zone range site.

22—Denure-Why complex, 1 to 5 percent slopes. This map unit is on fan terraces and flood plains (washes). The native vegetation is mainly desert trees, shrubs, cacti, and grasses. Elevation ranges from 1,200 to 2,000 feet. The average annual precipitation is 5 to 10 inches, the average annual air temperature is 70 to

74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 60 percent Denure soil and 20 percent Why soil. The Denure soil is on nearly level and gently sloping fan terraces, and the Why soil is on nearly level and gently sloping flood plains (washes). The two soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Momoli and Rillito soils on fan terraces and Cuerda soils on flood plains (washes). Included areas make up about 20 percent of the map unit. The percentage varies from one area to another.

The Denure soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 20 to 50 percent of the surface is covered with pebbles. The surface layer is light brown very gravelly sandy loam about 4 inches thick. The upper 37 inches of the subsoil is reddish yellow gravelly sandy loam. The lower 19 inches is pink gravelly sandy loam. A very limy layer is at a depth of about 41 inches. Depth to the very limy layer ranges from 40 to 60 inches. The surface layer is typically noncalcareous, but in some places it is calcareous.

Permeability is moderately rapid in the Denure soil. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is slight.

The Why soil is deep and somewhat excessively drained. It formed in stratified alluvium derived dominantly from mixed rocks. Typically, 5 to 10 percent of the surface is covered with pebbles. The surface layer and the underlying material are light brown, stratified sandy loam about 11 inches thick. The next layer is a buried subsoil. The upper 20 inches of the buried subsoil is strong brown sandy loam. The lower part to a depth of 60 inches or more is strong brown, pink, and reddish yellow gravelly sandy loam.

Permeability is moderately rapid in the Why soil. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is moderately high. The soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. The occasional, very brief periods of flooding occur mainly in summer and winter.

This unit is used mainly as rangeland. It can be used for irrigated crops if water is made available.

The present vegetation in most areas of the Denure soil is mainly creosotebush and annual grasses. The potential plant community is mainly creosotebush, bush muhly, big galleta, and annual grasses. The major browse species is white ratany. This species makes up about 20 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 30 percent of the plant community. Annual grasses and forbs make up 20 percent.

The present vegetation in most areas of the Why soil is mainly ironwood, creosotebush, white bursage, and annual grasses. The potential plant community is mainly big galleta, bush muhly, littleleaf paloverde, and ironwood. Major browse species are littleleaf paloverde, ironwood, and catclaw acacia. These species make up about 30 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 25 percent of the plant community. Annual grasses and forbs make up 15 percent.

Periodic flooding increases the amount of forage available on the Why soil. Therefore, management should be geared to this soil. Overgrazing increases the hazard of wind erosion.

In areas where the average annual precipitation is less than 8 inches, the total vegetative production is about 100 to 200 pounds per acre less than is typical and forage plants and annuals make up a smaller percentage of the total. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

If this unit is used for irrigated crops, the main limitations are the slope and droughtiness. If the very gravelly surface of the Denure soil is disturbed, the hazard of wind erosion is increased. The Why soil also is limited by flooding and the hazard of wind erosion.

Furrow, border, and sprinkler irrigation systems are suitable in areas of these soils. Leveling cuts are needed for the efficient application and removal of irrigation water in sloping areas. Wind erosion can be controlled by returning crop residue to the soil and practicing minimum tillage. Onsite investigation is advisable before this unit is developed for irrigated crops.

This unit is moderately well suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability subclass of the Denure soil is VIIs, and that of the Why soil is VIIw. The Denure soil is in the Sandy Loam Upland, 2-10" precipitation zone range site, and the Why soil is in the Sandy Bottom, 2-10" precipitation zone range site.

23—Dumps-Pits association. This map unit consists of areas where surface mining has left exposed andesite, rhyolite, granite, and other related rocks. Large areas of mine spoil, such as tailings ponds and mine dumps, make up a large percentage of this unit. Also in this unit is a large, very deep, open pit mine where most of the present excavations are being made. Included in this unit are slag dumps, waste ponds, the smelter, mine buildings, and roads.

Natural fertility is very low. The areas tend to be excessively drained. Steep slopes, stones, boulders, and the hazard of wind erosion are all problems to be overcome in reclamation. Response to management is low. This land type increases in extent as mining continues.

24—Gadsden clay loam, 0 to 3 percent slopes. This map unit is on flood plains at the headwater of Vekol Wash. The native vegetation is mainly desert trees and grasses. Elevation ranges from 2,000 to 2,100 feet. The average annual precipitation is 7 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

Included with this soil in mapping are small areas of Glenbar soils. These soils make up about 10 percent of the map unit. The percentage varies from one area to another.

The Gadsden soil is deep and well drained. It formed in recent alluvium derived dominantly from mixed rocks. Typically, 1 to 5 percent of the surface is covered with pebbles. The surface layer is light reddish brown clay loam about 4 inches thick. The upper 49 inches of the underlying material is yellowish red and reddish brown silty clay loam. The lower part to a depth of 60 inches is light reddish brown clay loam. In some areas the surface layer is loam or silt loam.

Permeability is slow. Available water capacity is very high. Potential rooting depth is 60 inches or more. Runoff is moderately rapid, and the hazard of water erosion is very slight or slight. The hazard of wind erosion is moderate. The soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. The occasional, very brief periods of flooding occur mainly in summer and winter.

This soil is used as rangeland. It can be used for irrigated crops if water is made available. The main limitations are the slow permeability and the hazard of flooding.

The present vegetation in most areas is mainly tobosa and mesquite. The potential plant community is mainly tobosa, perennial forbs, and annual grasses. Major browse species are perennial forbs. These species make up about 10 percent of the plant community. Perennial grasses and forbs, including tobosa and vine mesquite, make up 70 percent of the plant community. Annual grasses and forbs make up 15 percent.

Some areas produce sufficient forage for year-round use. Management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. Fencing and developing water sources can improve grazing or livestock management. This soil does not respond to improved grazing management in a reasonable length of time.

Livestock prefer this unit to most others in the survey area because of its accessibility and the availability of water. As a result, overgrazing and the subsequent deterioration of the vegetation are management concerns. The periodic flooding increases the amount of forage available.

This unit is moderately well suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability subclass is VIIw. This soil is in the Clay Bottom, 7-10" precipitation zone range site.

25—Gadsden and Kofa silty clay loams, saline-sodic. This map unit is on flood plains in the vicinity of Agua Caliente Hot Springs. The vegetation in areas that have not been cultivated is mainly desert trees, shrubs, and annual grasses. Slope is 0 to 1 percent. Elevation ranges from 430 to 500 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 50 percent Gadsden soil and 30 percent Kofa soil. The two soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Glenbar, Indio, Lagunita, Ripley, and Vint soils. Included areas make up about 20 percent of the map unit. The percentage varies from one area to another.

The Gadsden soil is deep and well drained. It formed in recent alluvium derived dominantly from mixed rocks. Typically, the surface layer is grayish brown silty clay loam about 4 inches thick. The upper 9 inches of the underlying material is grayish brown, stratified silty clay. The next 16 inches is grayish brown, stratified silty clay loam. The lower part of the underlying material to a depth of 60 inches or more is light brownish gray and light brown, stratified silty clay loam. In some areas the surface layer is silt loam. In nonirrigated areas a thin white crust of salt commonly is on the surface because water has moved upward and evaporated near the surface. Salt crystals commonly are in the profile. The soil is moderately or strongly saline and sodic (electrical conductivity of 10 to 18 millimhos per centimeter).

Permeability is slow in the Gadsden soil. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is moderately rapid, and the hazard of water erosion is very slight. The hazard of wind erosion is moderate. The soil generally is subject to occasional periods of flooding, but the risk of flooding is reduced by dams on the Gila River and its tributaries.

The Kofa soil is deep and well drained. It formed in recent alluvium derived dominantly from mixed rocks. Typically, the surface is covered with a thin white crust of salt. The surface layer is brown silty clay loam about 3 inches thick. The upper 18 inches of the underlying material is brown, stratified silty clay and silty clay loam. The lower part to a depth of 60 inches or more is pale brown and light brownish gray loamy fine sand, fine sand, and gravelly sand that have thin strata of finer textured material. In some areas the surface layer is silt loam. Salt crystals commonly are throughout the profile. The soil is strongly saline and sodic (electrical conductivity of 16 to 46 millimhos per centimeter). The depth to sand ranges from 20 to 40 inches.

Permeability in the Kofa soil is slow to a depth of 20 to 40 inches and rapid below this depth. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is moderately rapid, and the hazard of water erosion is very slight. The hazard of wind erosion is moderate. The soil generally is subject to occasional periods of flooding, but the risk of flooding is reduced by dams on the Gila River and its tributaries.

This unit is used for bermudagrass and barley. It also is used as rangeland.

These soils are limited mainly by a slow intake rate, the slow permeability, droughtiness, the hazard of flooding, and the content of toxic salts. The Kofa soil also is limited by the depth to sand.

Furrow, border, basin, and drip irrigation systems are suitable in areas of these soils. Leveling cuts are needed for the efficient application of irrigation water. Sprinkler systems are poorly suited because of the slow intake rate. Leveling cuts made to a depth of 20 to 40 inches generally expose sand in areas of the Kofa soil. Water can be distributed by earth ditches, lined ditches, and pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. Permeability can be maintained or improved by adding organic matter to the soil and by growing deep-rooted plants. Deep chiseling and subsoiling also can be used, but the beneficial effect of these practices is only temporary. Deep chiseling or subsoiling temporarily opens up the soil and allows water and salts to pass through.

Strong salinity and sodicity restrict the choice of crops. Intensive management is needed to reduce the salinity and sodicity and to maintain productivity. Applying soil amendments and leaching reduce the content of toxic salts and sodium. Suitable soil amendments are sulfur, gypsum, and sulfuric acid. The kinds and amounts of amendments needed should be determined by soil tests. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. The very dense subsurface layers limit root development and increase the risk of soil compaction. Even with a very high level of management, roots do not develop as well as in soils that have better soil structure. All tillage practices, including ripping, should be performed when the soils are dry. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas is mainly mesquite, saltbush, and saltcedar. The potential plant community is mainly mesquite, iodinebush, and desert saltgrass. Major browse species are mesquite and wolfberry. These species make up about 70 percent of the plant community. Perennial grasses and forbs, including desert saltgrass, make up 5 percent of the plant community. Annual grasses and forbs make up 5 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. Fencing and developing water sources can improve grazing or livestock management. This unit responds to improved grazing management in a reasonable length of time.

Livestock prefer this unit to most others in the survey area because of its accessibility and the availability of water. As a result, overgrazing and the subsequent deterioration of the vegetation are management concerns.

This unit no longer benefits from the regular flooding of the Gila River because of the protection provided by upstream structures on the Salt and Gila Rivers. It does, however, benefit from runoff moisture received from adjacent soils. Also, the water table at a depth of 30 to 50 feet allows this unit to produce dense stands of mesquite.

These soils are very poorly suited to desertic riparian herbaceous plants but are well suited to desertic riparian shrubs and trees. They are very poorly suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass is IVs, irrigated, and VIIw, nonirrigated. These soils are in the Saline Bottom, 2-7" precipitation zone range site.

26—Garzona-Rock outcrop-Winkel complex, 15 to 65 percent slopes. This map unit is on mountains. The native vegetation is mainly desert trees and shrubs, cacti, and grasses. Elevation ranges from 2,800 to 4,100 feet. The average annual precipitation is 10 to 12 inches, the average annual air temperature is 65 to 70 degrees F, and the average frost-free period is 180 to 270 days.

This unit is about 45 percent Garzona soil, 20 percent Rock outcrop, and 20 percent Winkel soil. The Garzona soil is on the moderately steep to very steep upper and middle parts of mountains. The Rock outcrop is on the moderately steep to very steep upper part of the mountains and on ridges. The Winkel soil is on the moderately steep or steep lower part of the mountains. Some small areas of Rock outcrop are nearly vertical. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in mapping are small areas of Akela soils and rubble land on the middle and upper parts of mountains. Included areas make up about 15 percent of the map unit. The percentage varies from one area to another.

The Garzona soil is shallow and somewhat excessively drained. It formed in colluvium and residuum derived dominantly from basalt rocks. Typically, 75 to 90 percent of the surface is covered with stones, cobbles, and pebbles. The surface layer is light brown extremely stony loam about 2 inches thick. The upper 4 inches of the subsoil is brown very gravelly loam. The lower 9 inches is brown extremely cobbly loam. Unweathered basalt is at a depth of about 15 inches. The depth to unweathered bedrock ranges from 12 to 20 inches.

Permeability is moderate in the Garzona soil. Available water capacity is very low. Potential rooting depth is 12 to 20 inches. Runoff is rapid, and the hazard of water erosion is moderate or severe. The hazard of wind erosion is slight.

Rock outcrop consists of exposed areas of basalt. Runoff from these areas is rapid.

The Winkel soil is shallow and somewhat excessively drained. It formed in colluvium derived dominantly from basalt rocks. Typically, 50 to 85 percent of the surface is covered with stones, cobbles, and pebbles. The surface layer is light yellowish brown extremely stony loam about 2 inches thick. The subsoil is light yellowish brown extremely cobbly loam about 13 inches thick. An indurated hardpan is at a depth of about 15 inches. Depth to the indurated hardpan ranges from 10 to 20 inches.

Permeability is moderate in the Winkel soil. Available water capacity is very low. Potential rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is moderate or severe. The hazard of wind erosion is slight.

This unit is used mainly as rangeland.

The present vegetation in most areas of the Garzona soil is mainly paloverde, cacti, and annual grasses. The potential plant community is mainly bush muhly, littleleaf paloverde, slender janusia, and annual grasses. Major browse species are littleleaf paloverde, Mormon tea, wolfberry, and twinberry. These species make up 25 percent of the plant community. Perennial grasses and forbs, including bush muhly, slender janusia, and Arizona cottontop, make up 40 percent of the plant community. Annual grasses and forbs make up 15 percent.

The present vegetation in most areas of the Winkel soil is mainly creosotebush, cacti, paloverde, and annual grasses. The potential plant community is mainly slim tridens, creosotebush, and bush muhly. Major browse species are twinberry and white ratany. These species make up about 10 percent of the plant community. Perennial grasses and forbs, including slim tridens, bush muhly, and slender janusia, make up 55 percent of the plant community.

Some areas produce sufficient forage for year-round use. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. Fencing and developing water sources can improve grazing or livestock management. This unit responds to improved grazing management in a reasonable length of time.

Unless restricted by fences, cattle usually avoid areas of this unit. Because stones and cobbles on the surface limit grazing, the unit responds rapidly to the use of appropriate grazing management systems.

This unit is unsuited to irrigated crops. It is limited mainly by the slope, the large stones, and droughtiness. The Garzona soil also is limited by the depth to bedrock, and the Winkel soil is limited by the depth to a hardpan.

This unit is moderately well suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability subclass of the Garzona and Winkel soils is VIIe. The capability class of the Rock outcrop is VIII. The Garzona soil is in the Volcanic Hills, 10-12" precipitation zone range site, and the Winkel soil is in the Basalt Hills, 10-12" precipitation zone range site. The Rock outcrop is not assigned to a range site.

27—Gilman very fine sandy loam. This deep, well drained soil is on the flood plains along the Gila River. It formed in recent alluvium derived dominantly from mixed rocks. The vegetation in areas that have not been cultivated is mainly desert trees and shrubs. Slope is 0 to 1 percent. Elevation ranges from 500 to 850 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

Included with this soil in mapping are small areas of Agualt, Indio, Glenbar, and Vint soils. Also included are small areas of Gilman soils that have a high content of toxic salts. Included areas make up about 25 percent of the map unit. The percentage varies from one area to another.

Typically, the surface layer of the Gilman soil is light brown very fine sandy loam about 10 inches thick. The underlying material to a depth of 60 inches or more is light brown, stratified very fine sandy loam and loam. In some areas the surface layer is fine sandy loam. In other areas sand and gravel are below a depth of 40 inches. The soil is nonsaline to slightly saline (electrical conductivity of 1.1 to 8.0 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches. In some areas in the flood pool behind Painted Rock Dam, the surface layer is silty clay loam.

Permeability is moderate. Available water capacity is very high. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderate. The soil generally is subject to occasional periods of flooding, but the risk of flooding is reduced by dams on the Gila River and its tributaries.

This soil is used for irrigated cotton or small grain. It also is used as rangeland. It is limited mainly by the hazard of flooding.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of this soil. The method used is generally governed by the crop. Leveling cuts are needed for the efficient application and removal of irrigation water in sloping areas. Leveling cuts can be made to a depth of about 40 inches. Water can be distributed by earth ditches, lined ditches, and pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. In the more sloping areas, irrigation streams can cause erosion. This risk can be minimized by irrigating across the slope or by leveling to a more nearly level grade. In areas that are slightly saline, yields of many crops are limited and the choice of plants is restricted. Leaching is needed to prevent salt from building up in the soil, particularly if graded irrigation systems are used. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas is mainly mesquite. The potential plant community is mainly big galleta and bush muhly. The major browse species is mesquite. This species makes up 10 percent of the plant community. Perennial grasses and forbs, including big galleta, bush muhly, and threeawn, make up 75 percent of the plant community. Annual grasses and forbs make up 10 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. Fencing and developing water sources can improve grazing or livestock management. The soil responds to improved grazing management in a reasonable length of time.

This unit no longer benefits from the regular flooding of the Gila River because of protection provided by upstream structures on the Salt and Gila Rivers. The production of shrubs, grasses, and forbs on this unit resembles that on similar upland range sites. Because of a water table at a depth of 20 to 40 feet, however, this soil can produce moderate stands of scattered very large trees or closely spaced shrubby trees.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional, long or very long periods of flooding. The vegetation in recently flooded areas is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation becomes reestablished and the area may provide seasonal grazing for livestock. In irrigated areas, repairing ditches and releveling are commonly needed after periods of flooding. Root plowing to a depth of 12 to 18 inches is needed to remove the saltcedar.

This unit is moderately well suited to desertic riparian herbaceous plants and desertic riparian shrubs and trees. It is moderately well suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass is IIw, irrigated, and VIIw, nonirrigated. This soil is in the Loamy Bottom, 2-7" precipitation zone range site.

28—Gilman very fine sandy loam, saline-sodic. This deep, well drained soil is on the flood plains along the Gila River. It formed in recent alluvium derived dominantly from mixed rocks. The vegetation in areas that have not been cultivated is mainly desert trees, shrubs, and annual grasses. Slope is 0 to 1 percent. Elevation ranges from 500 to 850 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

Included with this soil in mapping are small areas of Agualt and Indio soils. These soils make up about 25 percent of the map unit. The percentage varies from one area to another.

Typically, the surface layer of the Gilman soil is light brown, stratified very fine sandy loam about 5 inches thick. The underlying material to a depth of 60 inches or more is light brown, stratified very fine sandy loam and loam. In some areas the surface layer is fine sandy loam. In other areas sand and gravel are below a depth of 40 inches. In nonirrigated areas, a thin white crust of salt commonly is on the surface because water has moved upward and evaporated near the surface. The soil is moderately or strongly saline and sodic (electrical conductivity of 9 to 20 millimhos per centimeter). In some areas in the flood pool behind Painted Rock Dam, the surface layer is silty clay loam.

Permeability is moderate. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderate. The soil is generally subject to occasional periods of flooding, but the risk of flooding is reduced by dams on the Gila River and its tributaries.

This soil is used mainly for irrigated cotton or small grain. It also is used as rangeland. It is limited mainly by droughtiness, the content of toxic salts, and the hazard of flooding.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of this soil. Leveling cuts are needed for the efficient application of irrigation water. Leveling cuts can be made to a depth of about 40 inches. Water can be distributed by earth ditches, lined ditches, and pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. In the more sloping areas, irrigation streams can cause erosion. This risk can be minimized by irrigating across the slope or by leveling to a more nearly level grade. Strong salinity and sodicity restrict the choice of crops. Intensive management is needed to reduce the salinity and sodicity of the soil and to maintain productivity. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. Deep chiseling or subsoiling temporarily opens up the soil and allows water and salts to pass through. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas is mainly mesquite, saltbush, and saltcedar. The potential plant community is mainly desert saltbush, mesquite, and fourwing saltbush. Major browse species are mesquite, desert saltbush, and fourwing saltbush. These species make up about 65 percent of the plant community. Annual grasses and forbs make up 20 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. Fencing and developing water sources can improve grazing or livestock management. The soil responds to improved grazing management in a reasonable length of time.

Livestock prefer this unit to most others in the survey area because of its accessibility and the availability of water. As a result, overgrazing and the subsequent deterioration of the vegetation are management concerns. Overgrazing increases the hazard of wind erosion and the likelihood of gullying.

This unit no longer benefits from the regular flooding of the Gila River because of protection provided by upstream structures on the Salt and Gila Rivers. The production of shrubs, grasses, and forbs on this unit resembles that on similar upland range sites. Because of a water table at a depth of 20 to 40 feet, however, this unit can produce moderate stands of scattered very large trees or closely spaced shrubby trees.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional, long or very long periods of flooding. The vegetation in recently flooded areas is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation becomes reestablished and the area may provide seasonal grazing for livestock. In irrigated areas, repairing ditches and releveling are commonly needed after periods of flooding. Root plowing to a depth of 12 to 18 inches is needed to remove the saltcedar.

This soil is moderately well suited to desertic riparian herbaceous plants and desertic riparian shrubs and trees. It is poorly suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass is IIIs, irrigated, and VIIs, nonirrigated. This soil is in the Saline Bottom, 2-7" precipitation zone range site.

29—Glenbar silty clay loam. This deep, well drained soil is on the flood plains along the Gila River. It formed in recent alluvium derived dominantly from mixed rocks. The vegetation in areas that have not been cultivated is mainly desert trees and shrubs and annual grasses. Slope is 0 to 1 percent. Elevation ranges from 430 to 850 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

Included with this soil in mapping are small areas of Gadsden, Gilman, and Indio soils. Also included are small areas of Glenbar soils that have a high content of toxic salts. Included areas make up about 20 percent of the map unit. The percentage varies from one area to another.

Typically, the surface layer of the Glenbar soil is brown silty clay loam about 10 inches thick. The upper 30 inches of the underlying material is brown and light brown, stratified silt loam and silty clay loam. The lower part to a depth of 60 inches or more is light brown loam. In some areas the surface layer is silt loam. The soil is nonsaline to slightly saline (electrical conductivity of 0.7 to 7.0 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is moderately slow. Available water capacity is very high. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderate. The soil generally is subject to occasional periods of flooding, but the risk of flooding is reduced by dams on the Gila River and its tributaries.

This soil is used mainly for irrigated cotton, small grain, or alfalfa hay. It is limited mainly by the hazard of flooding.

Furrow, border, basin, and drip irrigation systems are suitable in areas of this soil. Sprinkler systems are not suitable because of a slow intake rate. Leveling cuts are needed for the efficient application of irrigation water. Leveling cuts can be made to a depth of about 40 inches. Water can be distributed by earth ditches, lined ditches, and pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. In areas that are slightly saline, yields of many crops are limited and the choice of plants is restricted. Leaching is needed to prevent salt from building up in the soil, particularly if graded irrigation systems are used. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. The dense subsurface layers limit root development and increase the risk of soil compaction. All tillage practices, including ripping, should be performed when the soil is dry. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas is mainly mesquite, wolfberry, and grey thorn. The potential plant community is mainly mesquite, wolfberry, and bush muhly. Major browse species are mesquite and wolfberry. These species make up 60 percent of the plant community. Perennial grasses and forbs, including bush muhly and threeawn, make up 20 percent of the plant community. Annual grasses and forbs make up 10 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. Fencing and developing water sources can improve grazing or livestock management. This unit responds to improved grazing management in a reasonable length of time.

This unit no longer benefits from the regular flooding of the Gila River because of protection provided by upstream structures on the Salt and Gila Rivers. It does, however, benefit from runoff moisture received from adjacent soils. Also, the water table at a depth of 30 to 50 feet allows this unit to produce dense stands of mesquite.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional, long or very long periods of flooding. The vegetation in recently flooded areas is mainly phreatophytic trees and shrubs,

Figure 7.—An area of Glenbar silty clay loam, saline-sodic, in the flood pool behind Painted Rock Dam. The deep cracks formed in recently deposited sediment as it dried.

principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation becomes reestablished and the area may provide seasonal grazing for livestock. In irrigated areas, repairing ditches and releveling are commonly needed after periods of flooding. Root plowing to a depth of 12 to 18 inches is needed to remove the saltcedar.

This unit is well suited to desertic riparian herbaceous plants and desertic riparian shrubs and trees. It is well suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass is IIw, irrigated, and VIIw, nonirrigated. This soil is in the Loamy Bottom, 2-7" precipitation zone range site.

30—Glenbar silty clay loam, saline-sodic. This deep, well drained soil is on the flood plains along the Gila River (fig. 7). It formed in recent alluvium derived dominantly from mixed rocks. The vegetation in areas that have not been cultivated is mainly desert trees and shrubs and annual grasses. Slope is 0 to 1 percent. Elevation ranges from 430 to 850 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

Included with this soil in mapping are small areas of

Gadsden, Gilman, and Indio soils. These soils make up about 20 percent of the map unit. The percentage varies from one area to another.

Typically, the surface layer of the Glenbar soil is brown silty clay loam about 20 inches thick. The upper 38 inches of the underlying material is brown, stratified silt loam and silty clay loam. The lower part to a depth of 60 inches or more is light brown loam. In some areas the surface layer is silt loam. In nonirrigated areas a thin white crust of salt commonly is on the surface because water has moved upward and evaporated near the surface. Salt crystals commonly are in the profile. The soil is moderately or strongly saline and sodic (electrical conductivity of 8 to 18 millimhos per centimeter).

Permeability is moderately slow. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderate. The soil generally is subject to occasional periods of flooding, but the risk of flooding is reduced by dams on the Gila River and its tributaries.

This soil is used mainly for irrigated cotton, bermudagrass, or barley. It also is used as rangeland. It is limited mainly by droughtiness, the content of toxic salts, and the hazard of flooding.

Furrow, border, basin, and drip irrigation systems are suitable in areas of this soil. Sprinkler systems are poorly suited because of a slow intake rate. Leveling cuts are needed for the efficient application of irrigation water. Leveling cuts can be made to a depth of about 40 inches. Water can be distributed by earth ditches, lined ditches, and pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. The strong salinity and sodicity restrict the choice of crops. Intensive management is needed to reduce the salinity and sodicity of the soil and to maintain productivity. Applying soil amendments and leaching reduce the content of toxic salts and sodium. Suitable soil amendments are sulfur, gypsum, and sulfuric acid. The kinds and amounts of amendments needed should be determined by soil tests. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. Deep chiseling or subsoiling temporarily opens up the soil and allows water and salts to pass through. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. The dense subsurface layers limit root development and increase the risk of soil compaction. All tillage practices, including ripping, should be performed when the soil is dry. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas is mainly seepweed, mesquite, and iodinebush. The potential plant community is mainly seepweed, black greasewood, and iodinebush. Major browse species are seepweed, Torrey wolfberry, and mesquite. These species make up about 85 percent of the plant community. Annual grasses and forbs make up 10 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. Fencing and developing water sources can improve grazing or livestock management. This unit responds to improved grazing management in a reasonable length of time.

This soil no longer benefits from the regular flooding of the Gila River because of protection provided by upstream structures on the Salt and Gila Rivers. It does, however, benefit from runoff moisture received from adjacent soils. Also, the water table at a depth of 30 to 50 feet allows this soil to produce dense stands of mesquite.

Livestock prefer this unit to most others in the survey area because of its accessibility and the availability of water. As a result, overgrazing and the subsequent deterioration of the vegetation are management concerns. Overgrazing increases the hazard of wind erosion and the likelihood of gullying.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional, long or very long periods of flooding. The vegetation in recently flooded areas is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation becomes reestablished and the area may provide seasonal grazing for livestock. In irrigated areas, repairing ditches and releveling are commonly needed after periods of flooding. Root plowing to a depth of 12 to 18 inches is needed to remove the saltcedar.

This soil is moderately well suited to desertic riparian herbaceous plants and desertic riparian shrubs and trees. It is poorly suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass is IIIs, irrigated, and VIIs, nonirrigated. This soil is in the Saline Bottom, 2-7" precipitation zone range site.

31—Growler-Momoli complex, 1 to 3 percent slopes. This map unit is on fan terraces. The native vegetation is mainly desert shrubs, cacti, annual grasses, and forbs. Elevation ranges from 500 to 800 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 40 percent Growler soil and 35 percent Momoli soil. The two soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Chuckawalla and Gunsight soils on fan terraces and Carrizo and Why soils on flood plains (washes). Also included are small areas of soils that are similar to the Growler soil but have a subsoil of very gravelly sand and soils that are similar to the Why soils but have more gravel throughout the profile. Included soils make up about 25 percent of the map unit. The percentage varies from one area to another.

The Growler soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 85 to 100 percent of the surface is covered with darkly varnished, interlocked pebbles. The surface layer is light brown extremely gravelly fine sandy loam about 1 inch thick. The upper 1 inch of the subsoil is light reddish brown gravelly loam. The next 5 inches is light reddish brown fine sandy loam. The lower part of the subsoil, to a depth of 15 inches, is light brown gravelly sandy loam. Below this is a buried subsoil. The upper 28 inches of the buried subsoil is yellowish red gravelly sandy loam and light brown very gravelly sandy loam. The next 12 inches is brown extremely gravelly loamy sand. The lower part of the buried subsoil to a depth of 60 inches or more is reddish brown very gravelly sand. In some areas a very limy layer is below a depth of 20 inches. The soil is strongly saline (electrical conductivity of 8 to 56 millimhos per centimeter). In cultivated areas that have been leveled and irrigated, the desert pavement has been incorporated into the soil and the toxic salts have been reduced through leaching.

Permeability is moderately rapid in the Growler soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is moderately rapid, and the hazard of water erosion is slight. The hazard of wind erosion also is slight.

The Momoli soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 35 to 60 percent of the surface is covered with pebbles. The surface layer is light brown very gravelly sandy loam about 2 inches thick. The upper 13 inches of the subsoil is reddish yellow very gravelly sandy loam. The lower part to a depth of 60 inches or more is strong brown very gravelly coarse sandy loam. The soil is nonsaline to moderately saline (electrical conductivity of 0.4 to 11.6 millimhos per centimeter); however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is moderately rapid in the Momoli soil. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The hazard of wind erosion also is slight.

This unit is used mainly as rangeland. Some areas are used for irrigated crops. The soils are limited mainly by droughtiness and the content of toxic salts. A portion of the town of Gila Bend is in this unit.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of these soils. Leveling cuts are needed for the efficient application of irrigation water. In the more sloping areas, the amount of soil that must be moved if fields are leveled may be prohibitive. A graded system is more feasible in these areas. Leveling cuts made to a depth of 20 to 40 inches generally expose a very limy layer in areas of the Growler soil. Some sensitive crops may become chloritic because of the very limy layer. Applications of sulfur, manure, or gin trash are beneficial in leveled areas where cuts have exposed the very limy layer. Water can be distributed by lined ditches and pipelines. Because the soils are droughty, applications of irrigation water should be light and frequent. The included soils in washes are subject to flooding. In areas where these soils are adjacent to cropland that is not protected by dikes and diversions, the cropland also is subject to flooding. The strong salinity and sodicity restrict the choice of crops. Intensive management is needed to reduce the salinity and sodicity of the soils and to maintain productivity. Applying soil amendments and leaching reduce the content of toxic salts and sodium. Suitable soil amendments are sulfur, gypsum, and sulfuric acid. The kinds and amounts of amendments needed should be determined by soil tests. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. Deep chiseling or subsoiling temporarily opens up the soil and allows water and salts to pass through. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present and potential vegetation in most areas of the Growler soil is mainly turkshead. The present vegetation in most areas of the Momoli soil is mainly creosotebush, white bursage, cacti, and annual grasses. The potential plant community is mainly creosotebush, annual forbs, white bursage, and annual grasses. Major browse species are white bursage and white ratany. These species make up about 15 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 10 percent of the plant community. Annual grasses and forbs make up 25 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional, long or very long periods of flooding. The vegetation in recently flooded areas is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation becomes reestablished and the area may provide seasonal grazing for livestock. In irrigated areas, repairing ditches and releveling are commonly needed after periods of flooding. Root plowing to a depth of 12 to 18 inches is needed to remove the saltcedar.

Except for the areas in the flood pool of Painted Rock Dam, this unit is well suited to homesite development. Few limitations affect this use.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees. It is poorly suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass is IVs, irrigated, and VIIs, nonirrigated. The Growler soil is not assigned to a range site. The Momoli soil is in the Limy Upland (deep), 2-7" precipitation zone range site.

32—Growler-Wellton complex, 1 to 3 percent slopes. This map unit is on fan terraces. The vegetation in areas that have not been cultivated is mainly desert shrubs and annual forbs and grasses. Elevation ranges from 500 to 800 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 50 percent Growler soil and 35 percent Wellton soil. The two soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with this soil in mapping are small areas of Denure, Mohall, Momoli, and Tremant soils on fan terraces and Mohall, occasionally flooded, and Why soils on flood plains (washes). Included soils make up about 15 percent of the map unit. The percentage varies from one area to another.

The Growler soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 85 to 100 percent of the surface is covered with darkly varnished, interlocked pebbles. The surface layer is light brown extremely gravelly fine sandy loam about 1 inch thick. The upper 1 inch of the subsoil is light reddish brown gravelly loam. The lower 5 inches is light reddish brown fine sandy loam. The next layer is about 15 inches of light brown gravelly sandy loam. Below this is a buried subsoil. The upper 28 inches of the buried subsoil is yellowish red gravelly sandy loam and light brown very gravelly sandy loam. The next 12 inches is brown extremely gravelly loamy sand. The lower part of the buried subsoil to a depth of 60 inches or more is reddish brown very gravelly sand. In some areas a very limy layer is below a depth of 20 inches. The soil is strongly saline and sodic (electrical conductivity of 16 to 90 millimhos per centimeter). In cultivated areas that have been leveled and irrigated, the desert pavement has been incorporated into the soil and the toxic salts have been reduced through leaching.

Permeability is moderate in the Growler soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is moderately rapid, and the hazard of water erosion is slight. The hazard of wind erosion also is slight.

The Wellton soil is deep and well drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 35 to 60 percent of the surface is covered with pebbles and pan fragments. The surface layer is light brown very gravelly fine sandy loam about 3 inches thick. The upper 52 inches of the subsoil is light brown and light reddish brown fine sandy loam and gravelly loam. The lower 5 or more inches is yellowish red gravelly clay loam. In some areas the surface layer is very gravelly sandy loam. In some areas a very limy layer is below a depth of 20 inches. The soil is nonsaline to moderately saline (electrical conductivity of 1.1 to 10.4 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is moderate in the Wellton soil. Available water capacity also is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The hazard of wind erosion also is slight.

This unit is used mainly for irrigated cotton, alfalfa, small grain, or jojoba. It also is used as rangeland. The soils are limited mainly by droughtiness and the content

Figure 8.—A drip irrigation system on the Growler soil, in an area of Growler-Wellton complex, 1 to 3 percent slopes. Note the concentration of salts and sodium in a circular pattern around each emitter.

of toxic salts. A portion of the town of Gila Bend is in this unit.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of these soils (fig. 8). Leveling cuts are needed for the efficient application of irrigation water. In the more sloping areas, the amount of soil that must be moved if fields are leveled may be prohibitive. A graded system is more feasible in these areas. Leveling cuts made to a depth of 20 to 40 inches generally expose the very limy layer. Some sensitive crops may become chloritic because of the very limy layer. Applications of sulfur, manure, or gin trash are beneficial in leveled areas where cuts have exposed the very limy layer. Water can be distributed by earth ditches, lined ditches, or pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. Because the soils are droughty, applications of irrigation water should be light and frequent. The strong salinity and sodicity restrict the choice of crops. Intensive management is needed to reduce the salinity and sodicity of the soils and to maintain productivity. Applying soil amendments and leaching reduce the content of toxic salts and sodium. Suitable soil amendments are sulfur, gypsum, and sulfuric acid. The kinds and amounts of amendments needed should be determined by soil tests. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. Deep chiseling or subsoiling temporarily opens up the soil and allows water and salts to pass through. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The potential and present vegetation in most areas of the Growler soil is mainly turkshead. The present vegetation in most areas of the Wellton soil is mainly creosotebush and annual grasses. The potential plant community is mainly creosotebush, white bursage, annual grasses, and annual forbs. Major browse species are white bursage and white ratany. These species make up about 15 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 10 percent of the plant community. Annual grasses and forbs make up 15 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

This unit is well suited to homesite development. Few limitations affect this use.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees. It is poorly suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass of the Growler soil is IVs, irrigated, and VIIs, nonirrigated. The capability subclass of the Wellton soil is IIIs, irrigated, and VIIs, nonirrigated. The Growler soil is not assigned to a range site. The Wellton soil is in the Limy Fan, 2-7" precipitation zone range site.

33—Gunsight-Ajolito extremely gravelly sandy loams, 1 to 15 percent slopes. This map unit is on stream terraces along the Gila River. The native vegetation is mainly desert shrubs and trees, cacti, and annual forbs and grasses. Elevation ranges from 450 to 700 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 55 percent Gunsight soil and 35 percent Ajolito soil. The Gunsight soil is mainly on the gently sloping to strongly sloping sides of the stream terraces. A few small areas are on the nearly level and gently sloping summits of the stream terraces where there is no desert pavement. The Ajolito soil is on the nearly level and gently sloping summits of stream terraces where there is a darkly varnished, closely packed desert pavement. The Gunsight and Ajolito soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Ajo soils on fan terraces, Carrizo, bench, soils on the summits of stream terraces, Momoli soils on low stream terraces, and Carrizo soils on flood pains (washes). Included soils make up about 10 percent of the map unit. The percentage varies from one area to another.

The Gunsight soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 40 to 70 percent of the surface is covered with water-rounded pebbles and cobbles. The surface layer is very pale brown extremely gravelly sandy loam about 1 inch thick. The upper 5 inches of the subsoil is light gray very gravelly sandy loam. The lower part, to a depth of about 46 inches, is very pale brown extremely gravelly coarse sandy loam. Below this to a depth of 60 inches or more is a buried subsoil of light brown very gravelly coarse sandy loam. A very limy layer is at a depth of 6 inches. Depth to the very limy layer ranges from 5 to 20 inches. The soil is nonsaline (electrical conductivity of 0.66 to 1.28 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is moderate in the Gunsight soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is slight.

The Ajolito soil is shallow and very shallow and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 80 to

100 percent of the surface is covered with darkly varnished, interlocked, water-rounded pebbles. The surface layer is light brown extremely gravelly sandy loam about 1 inch thick. The upper 4 inches of the subsoil is light reddish brown very gravelly fine sandy loam. The lower 9 inches is light reddish brown very gravelly coarse sandy loam. An indurated hardpan is at a depth of about 14 inches. Depth to the hardpan ranges from 6 to 20 inches. The soil is nonsaline (electrical conductivity of 0.68 to 0.84 millimho per centimeter) in the upper 14 inches; however, salinity may be considerably higher in the surface crust and directly above the pan.

Permeability is moderately rapid in the Ajolito soil. Available water capacity is very low. Potential rooting depth is 6 to 20 inches. Runoff is rapid, and the hazard of water erosion is slight. The hazard of wind erosion also is slight.

This unit is used mainly as rangeland. It also is used as a source of gravel.

The present vegetation in most areas of the Gunsight soil is mainly creosotebush, triangle bursage, and buckhorn cholla. The potential plant community is mainly creosotebush, white bursage, and triangle bursage. Major browse species are white bursage and white ratany. These species make up about 10 percent of the plant community. Perennial grasses and forbs, including bush muhly, make up 5 percent of the plant community. Annual grasses and forbs make up 5 percent. The potential and present vegetation in most areas of the Ajolito soil is mainly turkshead.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

A high content of lime, a low water-supplying capacity, and competition from creosotebush contribute to the low production of forage on this unit. Large areas of this unit include smaller areas of the more productive Carrizo soils. Periodic flooding increases the amount of forage available on the Carrizo soils. Management should be geared to these included areas because they produce most of the forage. The potential plant community on the Carrizo soils is mainly littleleaf paloverde, ironwood, annual grasses, and shrubs. The present vegetation in most areas is mainly littleleaf paloverde, ironwood, and annual grasses.

This unit is unsuited to irrigated crops. If it is used for irrigated crops, the main limitations are the slope and droughtiness. The Ajolito soil also is limited by the depth to a hardpan, and the Gunsight soil is limited by the very limy layer. Also, disturbing the desert pavement on the Ajolito soil increases the hazard of wind erosion.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional, long or very long periods of flooding. The vegetation in recently flooded areas is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation becomes reestablished and the area may provide seasonal grazing for livestock.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability subclass is VIIs. The Gunsight soil is in the Limy Upland (deep), 2-7" precipitation zone range site. The Ajolito soil is not assigned to a range site.

34—Gunsight-Chuckawalla complex, 1 to 15 percent slopes. This map unit is on fan terraces dissected by narrow flood plains (washes). The native vegetation is mainly desert shrubs and trees, cacti, and annual forbs and grasses. Elevation ranges from 600 to 1,800 feet. The average annual precipitation is 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 40 percent Gunsight soil and 35 percent Chuckawalla soil (fig. 9). The Gunsight soil is mainly on the gently sloping to strongly sloping sides of the fan terraces. A few small areas are on the nearly level and gently sloping summits of the fan terraces where there is no desert pavement. The Chuckawalla soil is on the nearly level and gently sloping summits of fan terraces where there is a darkly varnished, closely packed desert pavement. The Gunsight and Chuckawalla soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Denure and Comobabi soils on the summits of fan terraces, Rillito soils on side slopes of the fan terraces, Momoli soils on stream terraces, and Carrizo and Why soils on flood plains (washes). Included soils make up about 25 percent of the map unit. The percentage varies from one area to another.

The Gunsight soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 40 to 70 percent of the surface is covered with pebbles and cobbles. The surface layer is very pale brown extremely gravelly sandy loam about 1 inch thick. The upper 5 inches of the subsoil is light gray very gravelly sandy loam. The

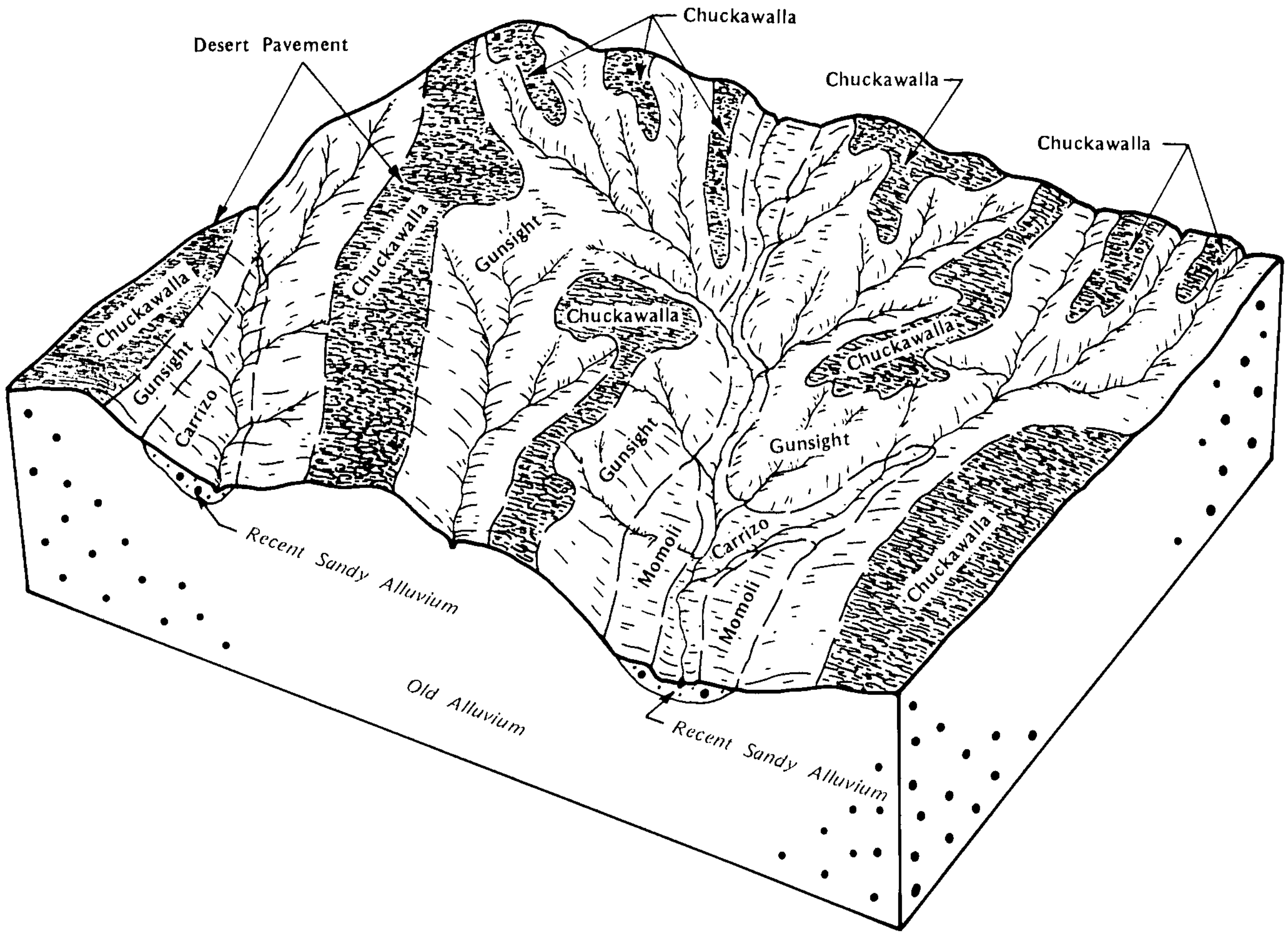

Figure 9.—A typical area of Gunsight-Chuckawalla complex, 1 to 15 percent slopes.

lower part, to a depth of about 46 inches, is very pale brown extremely gravelly coarse sandy loam. Below this to a depth of 60 inches or more is a buried subsoil of light brown very gravelly coarse sandy loam. A very limy layer is at a depth of 6 inches. Depth to the very limy layer ranges from 5 to 20 inches.

Permeability is moderate in the Gunsight soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is slight.

The Chuckawalla soil is deep and well drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 85 to 100 percent of the surface is covered with darkly varnished, closely packed pebbles. The surface layer is light brown extremely gravelly loam about 1 inch thick. The upper 9 inches of the subsoil is reddish brown and yellowish red, moderately and strongly saline gravelly loam and very gravelly sandy clay loam. The lower 8 inches is pink, strongly saline very gravelly coarse sandy loam. Below this to a depth of 60 inches or more is a buried subsoil of pink, strongly saline very gravelly coarse sandy loam. A very limy layer is at a depth of about 10 inches. Depth to the very limy layer ranges from 7 to 13 inches.

Permeability is moderate in the Chuckawalla soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is moderately rapid, and the hazard of water erosion is slight. The hazard of wind erosion also is slight.

This unit is used mainly as rangeland. A small acreage is used as irrigated cropland. Part of the town of Gila Bend is in this unit.

The present vegetation in most areas of the Gunsight soil is mainly creosotebush and buckhorn cholla. The potential plant community is mainly creosotebush, white bursage, and white ratany. Major browse species are white bursage and white ratany. These species make up about 10 percent of the plant community. Perennial grasses and forbs, including bush muhly, make up 5 percent of the plant community. Annual grasses and forbs make up 5 percent. The potential and present vegetation in most areas of the Chuckawalla soil is mainly turkshead.

In areas where the average annual precipitation is more than 8 inches, the total vegetative production is about 50 pounds per acre more than is typical and forage plants and annuals make up a larger percentage of the total. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

A high content of lime, a low water-supplying capacity, and competition from creosotebush contribute to the low production of forage on this unit. The strongly saline nature of the Chuckawalla soil also is a factor in the low forage production. Large areas of this unit include smaller areas of the more productive Carrizo and Why soils. Periodic flooding increases the amount of forage available on these soils. Management should be geared to these included areas because they produce most of the forage. The potential plant community on the Carrizo and Why soils is littleleaf paloverde, ironwood, annual grasses, and shrubs. The present vegetation in most areas is mainly littleleaf paloverde, ironwood, and annual grasses.

This unit is generally unsuited to irrigated crops. If it is used for irrigated crops, the main limitations are droughtiness, the slope, and the very limy layer. The Chuckawalla soil also is limited by the content of toxic salts. Also, if the desert pavement on the Chuckawalla soil is disturbed, the hazard of wind erosion is increased.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional, long or very long periods of flooding. The vegetation in recently flooded areas is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation becomes reestablished and the area may provide seasonal grazing for livestock.

This unit is moderately well suited to homesite development. It is limited mainly by the slope in areas of the Gunsight soil.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat. It is very poorly suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass is VIIs, irrigated and nonirrigated. The Gunsight soil is in the Limy Upland (deep), 2-10" precipitation zone range site. The Chuckawalla soil is not assigned to a range site.

35—Gunsight-Cipriano complex, 1 to 15 percent slopes. This map unit is on fan terraces dissected by narrow flood plains (washes). The native vegetation is mainly annual forbs and grasses, cacti, and shrubs. Desert trees are along the washes. Elevation ranges from 1,000 to 2,600 feet. The average annual precipitation is 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 50 percent Gunsight soil and 25 percent Cipriano soil. The Gunsight soil is on nearly level to strongly sloping summits and sides of fan terraces, and the Cipriano soil is on nearly level and gently sloping summits of fan terraces. The two soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Rillito soils on summits and sides of high fan terraces, Denure and Momoli soils on low fan terraces, and Carrizo soils on flood plains (washes). Included soils make up about 25 percent of the map unit. The percentage varies from one area to another.

The Gunsight soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 50 to 75 percent of the surface is covered with pebbles and cobbles. The surface layer is very pale brown extremely cobbly sandy loam about 1 inch thick. The upper 5 inches of the subsoil is light gray very gravelly sandy loam. The lower part, to a depth of about 46 inches, is very pale brown extremely gravelly coarse sandy loam. Below this to a depth of 60 inches or more is a buried subsoil of light brown very gravelly coarse sandy loam. A very limy layer is at a depth of 5 to 20 inches. In some areas the surface layer is very cobbly. In the Sauceda Mountains area, the soil is cooler than is typical for the survey area.

Permeability is moderate in the Gunsight soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is slight.

The Cipriano soil is very shallow and shallow and is somewhat excessively drained. It formed in alluvium and colluvium derived dominantly from mixed rocks. Typically, 50 to 90 percent of the surface is covered with pebbles. The surface layer is light yellowish brown extremely gravelly sandy loam about 2 inches thick. The subsoil is reddish yellow very gravelly sandy loam about 8 inches thick. An indurated hardpan is at a depth of about 10 inches. Depth to the indurated hardpan ranges from 6 to 20 inches. In some areas the surface layer is very cobbly or extremely cobbly. In the Sauceda Mountains area, the soil is cooler than is typical for the survey area.

Permeability is moderate in the Cipriano soil. Available water capacity is very low. Potential rooting depth is 6 to 20 inches. Runoff is rapid, and the hazard of water erosion is slight. The hazard of wind erosion also is slight.

This unit is used mainly as rangeland.

The present vegetation in most areas of the Gunsight soil is mainly creosotebush and white bursage. The potential plant community is mainly creosotebush, white bursage, and white ratany. Major browse species are white bursage and white ratany. These species make up about 10 percent of the plant community. Perennial grasses and forbs, including bush muhly, make up 5 percent of the plant community. Annual grasses and forbs make up 5 percent.

The present vegetation in most areas of the Cipriano soil is mainly creosotebush and white bursage. The potential plant community is mainly creosotebush, white bursage, and white ratany. Major browse species are white bursage and white ratany. These species make up about 20 percent of the plant community. Perennial grasses and forbs, including bush muhly, make up 5 percent of the plant community. Annual grasses and forbs make up 10 percent.

In areas where the average annual precipitation is more than 8 inches, the total vegetative production is about 50 pounds per acre more than is typical and forage plants and annuals make up a larger percentage of the total. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

A high content of lime, a low water-supplying capacity, and competition from creosotebush contribute to the low production of forage on this unit. Large areas of this unit include smaller areas of the more productive Carrizo soils. Periodic flooding increases the amount of forage available on these soils. Management should be geared to these included areas because they produce most of the forage. The potential plant community on the Carrizo soils is mainly shrubs, littleleaf paloverde, blue paloverde, and annual grasses. The present vegetation in most areas is mainly ironwood, paloverde, and triangle bursage.

This unit is unsuited to irrigated crops. It is limited mainly by the slope and droughtiness. The Cipriano soil also is limited by the depth to a hardpan, and the Gunsight soil is limited by the very limy layer.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional, long or very long periods of flooding. The vegetation in recently flooded areas is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation becomes reestablished and the area may provide seasonal grazing for livestock.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability subclass is VIIs. The Gunsight soil is in the Limy Upland (deep), 2-10" precipitation zone range site, and the Cipriano soil is in the Limy Upland, 2-10" precipitation zone range site.

36—Gunsight-Pinamt complex, 1 to 15 percent slopes. This map unit is on fan terraces dissected by narrow flood plains (washes). The native vegetation is mainly desert shrubs, cacti, and annual grasses. Elevation ranges from 800 to 2,300 feet. The average annual precipitation is 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 45 percent Gunsight soil and 35 percent Pinamt soil. The Gunsight soil is on the nearly level and gently sloping summits of fan terraces and the gently sloping to strongly sloping sides of fan terraces. The Pinamt soil is on the nearly level and gently sloping summits of fan terraces. The two soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Chuckawalla, Cipriano, Momoli, and Rillito soils on fan terraces and Carrizo soils on flood plains (washes). Included soils make up about 20 percent of the map unit. The percentage varies from one area to another.

The Gunsight soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 45 to 85 percent of the surface is covered with pebbles and cobbles. The surface layer is very pale brown extremely gravelly sandy loam about 1 inch thick. The upper 5 inches of the subsoil is light gray very gravelly sandy loam. The lower part, to a depth of about 46 inches, is very pale brown extremely gravelly coarse sandy loam. Below this to a depth of 60 inches or more is a buried subsoil of light brown very gravelly coarse sandy loam. A very limy layer is at a depth of 6 inches. Depth to the very limy layer ranges from 5 to 24 inches.

Permeability is moderate in the Gunsight soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is slight.

The Pinamt soil is deep and well drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 45 to 85 percent of the surface is covered with pebbles and cobbles. The surface layer is light brown very gravelly loam about 3 inches thick. The upper 14 inches of the subsoil is yellowish red and red very gravelly clay loam. The next 11 inches is yellowish red extremely gravelly sandy clay loam. The lower part of the subsoil to a depth of 60 inches or more is pink extremely gravelly sandy loam. A very limy layer is at a depth of about 28 inches. Depth to the very limy layer ranges from 18 to 36 inches.

Permeability is moderately slow in the Pinamt soil. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is slight.

This unit is used mainly as rangeland.

The present vegetation in most areas of the Gunsight soil is mainly creosotebush, buckhorn cholla, ocotillo, and annual grasses. The potential plant community is mainly creosotebush, white bursage, and white ratany. Major browse species are white bursage and white ratany. These species make up about 10 percent of the plant community. Perennial grasses and forbs, including bush muhly, make up 5 percent of the plant community. Annual grasses and forbs make up 5 percent.

The present vegetation in most areas of the Pinamt soil is mainly creosotebush, buckhorn cholla, ocotillo, and annual grasses. The potential plant community is mainly creosotebush, white bursage, and annual grasses. Major browse species are white bursage and white ratany. These species make up about 10 percent of the plant community. Annual grasses and forbs make up 25 percent.

In areas where the average annual precipitation is more than 8 inches, the total vegetative production is about 50 pounds per acre more than is typical and forage plants and annuals make up a larger percentage of the total. Some of these areas produce sufficient forage for year-round use. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

A high content of lime, a low water-supplying capacity, and competition from creosotebush contribute to the low production of forage on this unit. Large areas of this unit include smaller areas of the more productive Carrizo soils. Periodic flooding increases the amount of forage available on these soils. Management should be geared to these included areas because they produce most of the forage. The potential plant community on the Carrizo soils is mainly littleleaf paloverde, blue paloverde, annual grasses, and shrubs. The present vegetation in most areas is mainly ironwood, paloverde, and annual grasses.

This unit is unsuited to irrigated crops. It is limited mainly by droughtiness, the very limy layer, and the slope.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability subclass is VIIs. These soils are in the Limy Upland (deep), 2-10" precipitation zone range site.

37—Gunsight-Rillito-Carrizo complex, 1 to 15 percent slopes. This map unit is on fan terraces dissected by narrow flood plains (washes). The native vegetation is mainly annual forbs and grasses, cacti, and shrubs. Desert trees are along the washes. Elevation ranges from 800 to 2,000 feet. The average annual precipitation is 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 45 percent Gunsight soil, 35 percent Rillito soil, and 15 percent Carrizo soil. The Gunsight soil is on nearly level summits and the gently sloping to strongly sloping sides of fan terraces. The Rillito soil is on the nearly level summits of fan terraces. The Carrizo soil is on level flood plains (washes). The three soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Chuckawalla, Cipriano, Coolidge, and Denure soils on fan terraces, Momoli soils on stream terraces, and Why soils on flood plains (washes). Included soils make up about 10 percent of the map unit. The percentage varies from one area to another.

The Gunsight soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 60 to 80 percent of the surface is covered with pebbles and cobbles. The surface layer is very pale brown extremely gravelly sandy loam about 1 inch thick. The upper 5 inches of the subsoil is light gray very gravelly sandy loam. The lower part, to a depth of about 46 inches, is very pale brown extremely gravelly coarse sandy loam. Below this to a depth of 60 inches or more is a buried subsoil of light brown very gravelly coarse sandy loam. A very limy layer is at a depth of 6 inches. Depth to the very limy layer ranges from 5 to 20 inches.

Permeability is moderate in the Gunsight soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is slight.

The Rillito soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 50 to 75 percent of the surface is covered with pebbles. The surface layer is light brown very gravelly sandy loam about 2 inches thick. The upper 7 inches of the subsoil is reddish yellow sandy loam. The next 13 inches is light brown gravelly fine sandy loam. The lower part of the subsoil, to a depth of about 42 inches, is pink gravelly sandy loam. Below this is a buried subsoil of reddish brown very gravelly sandy loam about 18 or more inches thick. A very limy layer is at a depth of about 22 inches. Depth to the very limy layer ranges from 5 to 22 inches.

Permeability is moderately rapid in the Rillito soil. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The hazard of wind erosion also is slight.

The Carrizo soil is deep and excessively drained. It formed in recent alluvium derived dominantly from mixed rocks. Typically, 40 to 80 percent of the surface is covered with pebbles and cobbles. The surface layer is light brown extremely gravelly sandy loam about 1 inch thick. The underlying material, to a depth of about 54 inches, is reddish yellow extremely gravelly sand and loamy sand that have thin strata of finer textured material. Below this is a buried subsoil of yellowish red very gravelly loamy sand about 6 inches thick.

Permeability is very rapid in the Carrizo soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion also is slight. The soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. The occasional, very brief periods of flooding occur mainly in summer and winter.

This unit is used mainly as rangeland. A few areas in and around Ajo are used as homesites.

The present vegetation in most areas of the Gunsight and Rillito soils is mainly creosotebush. The potential plant community is mainly creosotebush, white bursage, and white ratany. Major browse species are white bursage and white ratany. These species make up about 10 percent of the plant community. Perennial grasses and forbs, including bush muhly, make up 5 percent of the plant community. Annual grasses and forbs make up 10 percent.

The present vegetation in most areas of the Carrizo soil is mainly ironwood, paloverde, and white bursage. The potential plant community is mainly littleleaf paloverde, ironwood, and desertthorn. Major browse species are littleleaf paloverde, catclaw acacia, and ironwood. These species make up about 30 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 20 percent of the plant community. Annual grasses and forbs make up 20 percent.

In areas where the average annual precipitation is more than 8 inches, the total vegetative production is about 50 to 200 pounds per acre more than is typical and forage plants and annuals make up a larger percentage of the total. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

A high content of lime, a low water-supplying capacity, and competition from creosotebush contribute to the low production of forage on the Gunsight and Rillito soils. The Carrizo soil makes up only a small percentage of the unit but provides most of the forage for livestock and the habitat for wildlife. Periodic flooding increases the amount of forage available on the Carrizo soil. Therefore, management should be geared to this soil. Suitable range management involves implementing a planned grazing system that includes fencing, deferred grazing, and developing water for livestock.

The Gunsight soil is moderately suited or well suited to homesite development. Where slopes are less than 8 percent, it has few limitations affecting septic tank absorption fields, dwellings, and local roads and streets. Where slopes are more than 8 percent, the slope is a moderate limitation. The Rillito soil is well suited to homesite development. It has few limitations. The Carrizo soil is poorly suited to homesite development. It is limited mainly by the hazard of flooding, a poor filtering capacity, and the instability of cutbanks.

This unit is unsuited to irrigated crops. It is limited mainly by the slope and droughtiness. The Gunsight and Rillito soils also are limited by the very limy layer, and the Carrizo soil is limited by the hazard of flooding.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional, long or very long periods of flooding. The vegetation in recently flooded areas is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation becomes reestablished and the area may provide seasonal grazing for livestock.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability subclass of the Gunsight and Rillito soils is VIIs, and that of the Carrizo soil is VIIw. The Gunsight and Rillito soils are in the Limy Upland (deep), 2-10" precipitation zone range site, and the Carrizo soil is in the Sandy Bottom, 2-10" precipitation zone range site.

38—Harqua fine sandy loam, 0 to 3 percent slopes. This deep, well drained soil is on basin floors grading toward the Gila River within the flood pool of Painted Rock Dam. It formed in alluvium derived dominantly from mixed rocks. The native vegetation is mainly desert shrubs, annual forbs, and annual grasses. The vegetation in areas that have been recently flooded is mainly phreatophytic shrubs. Elevation ranges from 600 to 661 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

Included with this soil in mapping are small areas of Cavelt, Denure, Mohall, Rositas, and Tremant soils. Also included are small areas of soils that are similar to the Harqua soil but have sand at a moderate depth. Included soils make up about 25 percent of the map unit. The percentage varies from one area to another.

Typically, the surface layer of the Harqua soil is brown fine sandy loam about 6 inches thick. The upper 4 inches of the subsoil is yellowish red fine sandy loam. The lower 10 inches is light reddish brown clay loam. Below this is a buried subsoil. The upper 11 inches of the buried subsoil is reddish brown silty clay loam, and the lower 39 inches is reddish brown silty clay. The substratum to a depth of 60 inches or more is light brownish gray loamy fine sand. A layer that has a very high content of gypsum is at a depth of about 20 inches. The depth to this layer ranges from 15 to 40 inches. In some areas the surface layer is loam. Salt crystals commonly are in the profile. The soil is normally very slightly to moderately saline (electrical conductivity of 2.6 to 12.1 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is slow. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is moderately rapid, and the hazard of water erosion is very slight or slight. The hazard of wind erosion is moderately high. The soil is subject to occasional, long or very long periods of flooding when water is stored behind Painted Rock Dam.

This soil is used mainly for irrigated cotton, small grain, or safflower. It also is used as rangeland. It is limited mainly by the hazard of wind erosion, the slow permeability, the hazard of flooding, and the content of toxic salts and sodium.

Furrow, border, basin, sprinkler, and trickle irrigation systems are suitable in areas of this soil. Leveling cuts are needed for the efficient application of irrigation water. In the more sloping areas, the amount of soil that must be moved in leveling a field may be prohibitive. A graded system is more feasible in these areas. Keeping leveling cuts to a minimum helps to prevent exposing the clayey subsoil. Applications of manure or gin trash are beneficial in leveled areas where cuts have exposed the clayey subsoil. Water can be distributed by lined ditches or pipelines. Earth ditches are not desirable because soils that have a high content of gypsum are generally unstable and blowouts may occur. Soils high in gypsum also are corrosive to concrete. A sulfate-resistant cement should be used in the construction of lined ditches. The hazard of wind erosion can be reduced by keeping the soil rough and cloddy if it is not protected by vegetation or crop residue. Permeability can be maintained or improved by adding organic matter to the soil and by growing deep-rooted plants. Deep chiseling and subsoiling also can be used, but the beneficial effect of these practices is only temporary. Deep chiseling or subsoiling temporarily opens up the soil and allows water and salts to pass through. Because of recent flooding, a very dense stand of saltcedar has invaded most areas of this unit. Root plowing to a depth of 12 to 18 inches is needed to remove the trees. The salinity and sodicity of the soil restrict the choice of crops. Intensive management is needed to reduce the salinity and sodicity and to maintain productivity. Applying soil amendments and leaching reduce the content of toxic salts and sodium. Suitable soil amendments are sulfur, gypsum, and sulfuric acid. The kinds and amounts of amendments needed should be determined by soil tests. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas is mainly saltcedar and arrowweed. In areas that have not been flooded, the present vegetation is creosotebush, triangle bursage, and annual grasses. This unit may provide seasonal grazing for livestock and habitat for wildlife between periods of flooding.

The capability subclass is IVw, irrigated, and VIIw, nonirrigated.

39—Harqua-Cavelt complex, 1 to 10 percent slopes. This map unit is on basin floors and stream terraces grading toward the Gila River within the flood pool of Painted Rock Dam. The native vegetation is mainly desert shrubs, annual forbs, and annual grasses. The vegetation in areas that have been recently flooded is mainly phreatophytic shrubs. Elevation ranges from 600 to 661 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 40 percent Harqua soil and 40 percent Cavelt soil. The Harqua soil is on nearly level basin floors, and the Cavelt soil is on nearly level to strongly sloping stream terraces. The two soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Denure, Tucson, and Wellton soils. Also included are small areas of hardpan outcrops. Included areas make up about 20 percent of the map unit. The percentage varies from one area to another.

The Harqua soil is deep and well drained. It formed in alluvium derived dominantly from mixed rocks. Typically, the surface layer is brown loam about 6 inches thick. The upper 4 inches of the subsoil is yellowish red loam. The lower 10 inches is light reddish brown clay loam. Below this is a buried subsoil. The upper 11 inches of the buried subsoil is reddish brown silty clay loam. The lower part, to a depth of 50 inches, is reddish brown silty clay. The substratum to a depth of 60 inches or more is light brownish gray loamy fine sand. A layer that has a very high content of gypsum is at a depth of about 20 inches. The depth to this layer ranges from 15 to 40 inches. In some areas the surface layer is gravelly or very gravelly. Salt crystals commonly are in the profile. The soil is very slightly to moderately saline (electrical conductivity of 2.6 to 12.1 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches. Also, it may be higher in areas that are flooded.

Permeability is slow in the Harqua soil. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is moderately rapid, and the hazard of water erosion is slight or moderate. Flooded areas have been subject to intense wave action and have severely eroded spots. The hazard of wind erosion is moderate. The soil is subject to occasional, long or very long periods of flooding when water is stored behind Painted Rock Dam.

The Cavelt soil is shallow and very shallow and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 40 to 55 percent of the surface is covered with gravel-sized pan fragments. The surface layer is light brown gravelly sandy loam about 4 inches thick. The subsoil also is light brown gravelly sandy loam. It is about 9 inches thick. An indurated hardpan is at a depth of about 13 inches. Depth to the indurated hardpan ranges from 5 to 20 inches. The soil is nonsaline (electrical conductivity of 1 millimho per centimeter) in the upper 20 inches. Salinity may be higher in areas that are flooded.

Permeability is moderate in the Cavelt soil. Available water capacity is very low. Potential rooting depth is 5 to 20 inches. Runoff is rapid, and the hazard of water erosion is slight or moderate. The steeper slopes in flooded areas have been subject to intense wave action and have severely eroded spots. The hazard of wind erosion is moderate. The soil is subject to occasional, long or very long periods of flooding when water is stored behind Painted Rock Dam.

Most areas of this unit are used as rangeland. A few areas are used for irrigated crops.

This unit is generally unsuited to irrigated crops. The Harqua soil is limited mainly by the slow permeability, the hazard of flooding, and the content of toxic salts and sodium. The Cavelt soil is limited mainly by droughtiness, the slope, the depth to a hardpan, and the hazard of flooding.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of these soils. Leveling cuts are needed for the efficient application and removal of irrigation water in sloping areas. In the more sloping areas, the amount of soil that must be moved in leveling a field may be prohibitive. A graded system is more feasible in these areas. Keeping leveling cuts to a minimum helps to prevent exposing the clayey subsoil in areas of the Harqua soil and the hardpan in areas of the Cavelt soil. Applications of manure or gin trash are beneficial in leveled areas where cuts have exposed the clayey subsoil. Water can be distributed by lined ditches or pipelines. Earth ditches are not desirable because the Harqua soil has a high content of gypsum. This soil is generally unstable, and blowouts may occur. Soils high in gypsum also are corrosive to concrete. A sulfate-resistant cement should be used in the construction of lined ditches. Because the Cavelt soil is droughty, applications of irrigation water should be light and frequent. The hazard of wind erosion can be reduced by keeping the soils rough and cloddy if they are not protected by vegetation or crop residue. Permeability can be maintained or improved by adding organic matter to the soil and by growing deep-rooted plants. Deep chiseling and subsoiling also can be used, but the beneficial effect of these practices is only temporary. Deep chiseling or subsoiling temporarily opens up the soil and allows water and salts to pass through. In the more sloping areas, irrigation streams can cause erosion. This risk can be minimized by irrigating across the slope or by leveling to a more nearly level grade. Because of recent flooding, a very dense stand of saltcedar has invaded most areas of this unit. Root plowing to a depth of 12 to 18 inches is needed to remove the trees. The high salinity and sodicity restrict the choice of crops. Intensive management is needed to reduce the salinity and sodicity and to maintain productivity. Applying soil amendments and leaching reduce the content of toxic salts and sodium. Suitable soil amendments are sulfur, gypsum, and sulfuric acid. The kinds and amounts of amendments needed should be determined by soil tests. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. Deep chiseling or subsoiling may be needed. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas is mainly saltcedar and arrowweed. In areas that have not been flooded, the present vegetation is creosotebush, triangle bursage, and annual grasses. As the water subsides in areas that have been flooded, shrubs die out in a short time. If no further flooding occurs, the native vegetation generally becomes reestablished and the area may provide seasonal grazing for livestock and habitat for wildlife.

The capability subclass of the Harqua soil is IVw, irrigated, and VIIw, nonirrigated. The capability subclass of the Cavelt soil is VIw, irrigated, and VIIw, nonirrigated.

40—Hyder-Gachado-Gunsight extremely gravelly sandy loams, 1 to 25 percent slopes. This map unit is on hills and fan terraces. The native vegetation is mainly desert shrubs and trees, annual grasses, and cacti. Elevation ranges from 1,000 to 2,200 feet. The average annual precipitation is 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 35 percent Hyder soil, 29 percent Gachado soil, and 15 percent Gunsight soil. Hyder and Gachado soils are on nearly level to moderately steep hills, and the Gunsight soil is on the nearly level and gently sloping summits and sides of fan terraces. The three soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Cherioni and Vaiva soils and rock outcrop on hills, Chuckawalla soils on fan terraces, and Carrizo soils on flood plains (washes). Included areas make up about 21 percent of the map unit. The percentage varies from one area to another.

The Hyder soil is very shallow and shallow and is somewhat excessively drained. It formed in alluvium and colluvium derived dominantly from andesite, rhyolite, and related volcanic rocks. Typically, 50 to 95 percent of the surface is covered with pebbles. The surface layer is light brown extremely gravelly sandy loam about 1 inch thick. The subsoil is light brown extremely gravelly sandy loam about 6 inches thick. Unweathered volcanic rock is at a depth of about 7 inches. The depth to unweathered bedrock ranges from 5 to 18 inches.

Permeability is moderate in the Hyder soil. Available water capacity is very low. Potential rooting depth is 5 to 18 inches. Runoff is rapid, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is slight.

The Gachado soil is very shallow and shallow and is well drained. It formed in residuum and colluvium derived dominantly from volcanic rocks. Typically, 50 to 95 percent of the surface is covered with pebbles and cobbles. The surface layer is brown extremely gravelly sandy loam about 1 inch thick. The upper 5 inches of the subsoil is yellowish red very gravelly sandy clay loam. The lower part is yellowish red very gravelly clay loam about 8 inches thick. Unweathered andesite bedrock is at a depth of about 14 inches. The depth to unweathered bedrock ranges from 5 to 20 inches.

Permeability is moderately slow in the Gachado soil. Available water capacity is very low. Potential rooting depth is 5 to 20 inches. Runoff is rapid, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is slight.

The Gunsight soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 25 to 75 percent of the surface is covered with pebbles and cobbles. The surface layer is very pale brown extremely gravelly sandy loam about 1 inch thick. The upper 5 inches of the subsoil is light gray very gravelly sandy loam. The lower part, to a depth of about 46 inches, is very pale brown extremely gravelly coarse sandy loam. Below this is a buried subsoil of light brown very gravelly coarse sandy loam about 14 or more inches thick. A very limy layer is at a depth of 6 inches. Depth to the very limy layer ranges from 5 to 30 inches.

Permeability is moderate in the Gunsight soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is slight.

This unit is used mainly as rangeland.

The present vegetation in most areas of the Hyder soil is mainly creosotebush, white bursage, brittlebush, and paloverde. The potential plant community is mainly creosotebush, littleleaf paloverde, cacti, and brittlebush. Major browse species are littleleaf paloverde, white bursage, and white ratany. These species make up about 25 percent of the plant community. Perennial grasses and forbs make up 5 percent of the plant community, and annual grasses and forbs make up 10 percent.

The present vegetation in most areas of the Gachado soil is mainly white bursage and creosotebush. The potential plant community is mainly white bursage, shrubs, and littleleaf paloverde. Major browse species are white bursage, littleleaf paloverde, and white ratany. These species make up about 45 percent of the plant community. Perennial grasses and forbs, including threeawn, Mormon tea, and bush muhly, make up 25 percent of the plant community. Annual grasses and forbs make up 5 percent.

The present vegetation in most areas of the Gunsight soil is mainly creosotebush and white bursage. The potential plant community is mainly creosotebush, white bursage, and white ratany. Major browse species are white bursage and white ratany. These species make up about 10 percent of the plant community. Perennial grasses and forbs, including bush muhly, make up 5 percent of the plant community. Annual grasses and forbs make up 5 percent.

In areas where the average annual precipitation is more than 8 inches, the total vegetative production is about 50 to 100 pounds per acre more than is typical and forage plants and annuals make up a larger percentage of the total. Some of these areas produce sufficient forage for year-round use. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

A high content of lime, a low water-supplying capacity, and competition from creosotebush contribute to the low production of forage on the Gunsight soil.

This unit is unsuited to irrigated crops. It is limited mainly by droughtiness, the slope, and the depth to bedrock in areas of the Hyder and Gachado soils and by droughtiness, the very limy layer, and the slope in areas of the Gunsight soil.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability subclass is VIIs. The Hyder soil is in the Limy Hills, 2-10" precipitation zone range site; the Gachado soil is in the Shallow Upland, 2-10" precipitation zone range site; and the Gunsight soil is in the Limy Upland (deep), 2-10" precipitation zone range site.

41—Indio silt loam. This deep, well drained soil is on flood plains along the Gila River. It formed in recent alluvium derived dominantly from mixed rocks. The vegetation in areas that have not been cultivated is mainly desert trees and shrubs. Slope is 0 to 1 percent. Elevation ranges from 430 to 850 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

Included with this soil in mapping are small areas of Gilman, Glenbar, Ripley, and Vint soils. Also included are small areas of Indio soils that have a high content of toxic salts. Included soils make up about 25 percent of the map unit. The percentage varies from one area to another.

Typically, the surface layer of the Indio soil is light brown silt loam about 12 inches thick. The upper 40 inches of the underlying material is light brown, stratified silt loam and very fine sandy loam. The next 6 inches is pale brown, stratified loam and silt loam. The lower part of the underlying material to a depth of 60 inches or more is light brown loamy sand. In some areas the surface layer is very fine sandy loam. The soil is nonsaline to slightly saline (electrical conductivity of 0.5 to 8.0 millimhos per centimeter) in the upper 20 inches; however, salinity can be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is moderate. Available water capacity is very high. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderate. The soil generally is subject to occasional periods of flooding, but the risk of flooding is reduced by dams on the Gila River and its tributaries.

This soil is used mainly for irrigated cotton, bermudagrass, or barley. It also is used as rangeland. It is limited mainly by the hazard of flooding.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of this soil. Leveling cuts are needed for the efficient application of irrigation water. Leveling cuts can be made to a depth of about 40 inches. Water can be distributed by earth ditches, lined ditches, and pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. The soil is subject to piping at field borders and benches. In areas that are slightly saline, yields of some crops are limited and the choice of plants is restricted. Leaching is needed to prevent salt from building up in the soil, particularly if graded irrigation systems are used. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas is mainly mesquite, arrowweed, and creosotebush. The potential plant community is mainly mesquite, annual forbs, and grasses. The major browse species is mesquite. This species makes up about 35 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 25 percent of the plant community. Annual grasses and forbs make up 20 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. Overgrazing increases the hazard of wind erosion and the likelihood of gullying. Fencing and developing water sources can improve grazing or livestock management. This unit responds to improved grazing management in a reasonable length of time.

This soil no longer benefits from the regular flooding of the Gila River because of protection provided by upstream structures on the Salt and Gila Rivers. The production of shrubs, grasses, and forbs on this soil resembles that on similar upland range sites. Because of a water table at a depth of 20 to 40 feet, however, this soil can produce moderate stands of scattered very large trees or closely spaced shrubby trees.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional, long or very long periods of flooding. The vegetation in recently flooded areas is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation becomes reestablished and the area may provide seasonal grazing for livestock. In irrigated areas, repairing ditches and releveling are commonly needed after periods of flooding. Root plowing to a depth of 12 to 18 inches is needed to remove the saltcedar.

This soil is moderately well suited to desertic riparian herbaceous plants and desertic riparian shrubs and trees. It is moderately well suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass is IIw, irrigated, and VIIw, nonirrigated. This soil is in the Loamy Bottom, 2-7" precipitation zone range site.

42—Indio silt loam, saline-sodic. This deep, well drained soil is on flood plains along the Gila River. It formed in recent alluvium derived dominantly from mixed rocks. The vegetation in areas that have not been cultivated is mainly desert trees, shrubs, and annual grasses. Slope is 0 to 1 percent. Elevation ranges from 430 to 850 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

Included with this soil in mapping are small areas of Gilman, Glenbar, and Ripley soils. These soils make up about 25 percent of the map unit. The percentage varies from one area to another.

Typically, the surface layer of the Indio soil is light brown silt loam about 12 inches thick. The upper 40 inches of the underlying material is light brown, stratified very fine sandy loam and silt loam. The next 6 inches is pale brown, stratified very fine sandy loam and silt loam. The lower part of the underlying material to a depth of 60 inches or more is light brown loamy sand. In nonirrigated areas a thin white crust of salt commonly is on the surface because water has moved upward and evaporated near the surface. In some areas in the flood pool behind Painted Rock Dam, the surface layer is silty clay loam.

Permeability is moderate. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderate. The soil generally is subject to occasional periods of flooding, but the risk of flooding is reduced by dams on the Gila River and its tributaries.

This soil is used mainly for irrigated cotton, bermudagrass, or barley. It also is used as rangeland. It is limited mainly by droughtiness, the content of toxic salts, and the hazard of flooding.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of this soil. Leveling cuts are needed for the efficient application of irrigation water. Leveling cuts can be made to a depth of about 40 inches. Water can be distributed by earth ditches, lined ditches, and pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. This soil is subject to piping at field borders and on benches. The strong salinity and sodicity restrict the choice of crops. Intensive management is needed to reduce the salinity and sodicity and to maintain productivity. Applying soil amendments and leaching reduce the content of toxic salts and sodium. Suitable soil amendments are sulfur, gypsum, and sulfuric acid. The kinds and amounts of amendments needed should be determined by soil tests. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. Deep chiseling or subsoiling temporarily opens up the soil and allows water and salts to pass through. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas is mainly mesquite, iodinebush, and saltcedar. The potential plant community is mainly Torrey seepweed, iodinebush, and Torrey wolfberry. Major browse species are seepweed, wolfberry, and mesquite. These species make up 65 percent of the plant community. Annual grasses and forbs make up 10 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. Fencing and developing water sources can improve grazing or livestock management. This unit responds to improved grazing management in a reasonable length of time.

Livestock prefer this unit to most others in the survey area because of its accessibility and the availability of water. As a result, overgrazing and the subsequent deterioration of the vegetation are management concerns. Overgrazing increases the hazard of wind erosion and the likelihood of gullying.

This unit no longer benefits from the regular flooding of the Gila River because of protection provided by upstream structures on the Salt and Gila Rivers. The production of shrubs, grasses, and forbs on this unit resembles that on similar upland range sites. Because of a water table at a depth of 20 to 40 feet, however, this unit can produce moderate stands of scattered very large trees or closely spaced shrubby trees.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional, long or very long periods of flooding. The vegetation in recently flooded areas is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation becomes reestablished and the area may provide seasonal grazing for livestock. In irrigated areas, repairing ditches and releveling are commonly needed after periods of flooding. Root plowing to a depth of 12 to 18 inches is needed to remove the saltcedar.

This soil is moderately well suited to desertic riparian herbaceous plants and desertic riparian shrubs and trees. It is very poorly suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass is IIIs, irrigated, and VIIs, nonirrigated. This soil is in the Saline Bottom, 2-7" precipitation zone range site.

43—Lagunita-Vint complex. This map unit is on flood plains along the Gila River. The vegetation in areas that have not been cultivated is mainly desert trees, shrubs, and annual grasses. Slope is 0 to 1 percent. Elevation ranges from 430 to 850 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 50 percent Lagunita soil and 35 percent Vint soil. The two soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used. The Lagunita soil is closer to the Gila River channel on the natural levee. The Vint soil is farther from the channel.

Included with these soils in mapping are small areas of Agualt, Carrizo, and Ripley soils. These included soils make up about 15 percent of the map unit. The percentage varies from one area to another.

The Lagunita soil is deep and excessively drained. It formed in recent alluvium derived dominantly from mixed rocks. Typically, the surface layer is pale brown, stratified loamy sand about 11 inches thick. The upper part of the underlying material, to a depth of about 50 inches, is light brownish gray, stratified sand. The lower part to a depth of 60 inches or more is light brownish gray very gravelly coarse sand. In some areas the surface layer is loamy sand. The soil is nonsaline or very slightly saline (electrical conductivity of 0.3 to 2.2 millimhos per centimeter) in the upper 20 inches. In some areas in the flood pool behind Painted Rock Dam, the surface layer is silty clay loam.

Permeability is rapid in the Lagunita soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is very slight. The hazard of wind erosion is high. The soil generally is subject to occasional periods of flooding, but the risk of flooding is reduced by dams on the Gila River and its tributaries.

The Vint soil is deep and excessively drained. It formed in recent alluvium derived dominantly from mixed rocks. Typically, the surface layer is pale brown loamy fine sand about 30 inches thick. The underlying material to a depth of 60 inches or more is pale brown and light brownish gray, stratified loamy fine sand, fine sand, and sand that have thin strata of finer textured material. In some areas the surface layer is silt loam. The soil is nonsaline to slightly saline (electrical conductivity of 0.4 to 2.8 millimhos per centimeter) in the upper 20 inches. In some areas in the flood pool behind Painted Rock Dam, the surface layer is silty clay loam.

Permeability is moderately rapid in the Vint soil. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is high. The soil generally is subject to occasional periods of flooding, but the risk of flooding is reduced by dams on the Gila River and its tributaries.

This unit is used mainly as rangeland. It also is used for irrigated cotton, barley, or alfalfa hay. It is limited mainly by droughtiness, a fast intake rate, the hazard of wind erosion, and the hazard of flooding.

Sprinkler and drip irrigation systems are suitable in areas of these soils. Surface irrigation systems are poorly suited because of the fast intake rate. Applications of manure or gin trash are beneficial in leveled areas where sand is exposed. Water can be distributed by lined ditches or pipelines. Because the soils are droughty, applications of irrigation water should be light and frequent. The hazard of wind erosion can be reduced by keeping the soils rough and cloddy if they are not protected by vegetation or crop residue. In areas that are slightly saline, yields of some crops are limited and the choice of plants is restricted. Leaching is needed to prevent salt from building up in the soil, particularly if graded irrigation systems are used. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas of the Lagunita soil is mainly arrowweed and saltcedar. The potential plant community is mainly Fremont cottonwood, arrowweed, and mesquite. Major browse species are mesquite, quailbush, and catclaw acacia. These species make up about 25 percent of the plant community. Perennial grasses and forbs make up 15 percent of the plant community, and annual grasses and forbs make up 10 percent.

The present vegetation in most areas of the Vint soil is mainly mesquite and arrowweed. The potential plant community is mainly big galleta, mesquite, and desert saltbush. Major browse species are mesquite, desert saltbush, and fourweed saltbush. These species make up about 35 percent of the plant community. Perennial grasses and forbs, including big galleta, make up 30 percent of the plant community. Annual grasses and forbs make up 20 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. Fencing and developing water sources can improve grazing or livestock management. This unit responds to improved grazing management in a reasonable length of time.

This map unit still benefits from the regular flooding of the Gila River. Vegetation grows on the banks of the river channel and on bars within the channel. The conditions necessary for the natural reproduction of cottonwood and willow occur regularly in areas of these soils.

Livestock prefer this unit to most others in the survey area because of its accessibility and the availability of water. As a result, overgrazing and the subsequent deterioration of the vegetation are management concerns. Overgrazing increases the hazard of wind erosion and the likelihood of gullying.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional, long or very long periods of flooding. The vegetation in recently flooded areas is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation becomes reestablished and the area may provide seasonal grazing for livestock. In irrigated areas, repairing ditches and releveling are commonly needed after periods of flooding. Root plowing to a depth of 12 to 18 inches is needed to remove the saltcedar.

This unit is very poorly suited to irrigated grain and seed crops and irrigated domestic grasses and legumes. It is well suited to riparian shrubs and trees for wildlife habitat.

The capability subclass of the Lagunita soil is VIw, irrigated, and VIIw, nonirrigated. The capability subclass of the Vint soil is IVw, irrigated, and VIIw, nonirrigated. Both soils are in the Sandy Bottom, 2-7" precipitation zone range site.

44—Mohall fine sandy loam. This deep, well drained soil is on basin floors and fan terraces. It formed in alluvium derived dominantly from mixed rocks. The native vegetation is mainly desert shrubs, annual forbs, and annual grasses. Slope is 0 to 1 percent. Elevation ranges from 700 to 820 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

Included with this soil in mapping are small areas of Mohall, occasionally flooded, soils on flood plains (washes); Growler and Tremant soils on fan terraces; and Tucson and Wellton soils on relict basin floors. Also included are small areas of Mohall soils that have a high content of toxic salts. Included soils make up about 25 percent of the map unit. The percentage varies from one area to another.

Typically, 1 to 15 percent of the surface of the Mohall soil is covered with fine pebbles. The surface layer is light brown fine sandy loam about 10 inches thick. The upper 26 inches of the subsoil is light brown loam and yellowish red clay loam. The lower 24 inches is pink and light reddish brown clay loam. A very limy layer is at a depth of about 24 inches. Depth to the very limy layer ranges from 20 to 40 inches. In places the surface layer is loam or very fine sandy loam. In some uncultivated areas the surface layer is gravelly. The soil is nonsaline to slightly saline (electrical conductivity of 0.7 to 7.5 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is moderately slow. Available water capacity is high. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderately high.

This soil is used mainly for irrigated cotton or small grain. It also is used as rangeland. It is limited mainly by the hazard of wind erosion.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of this soil. Leveling cuts are needed for the efficient application of irrigation water. In the more sloping areas, the amount of soil that must be moved if fields are leveled may be prohibitive. A graded system is more feasible in these areas. Leveling cuts made to a depth of 20 to 40 inches generally expose the very limy layer. Some sensitive crops may become chloritic because of this layer. Applications of sulfur, manure, or gin trash are beneficial in leveled areas where cuts have exposed the very limy layer. Water can be distributed by earth ditches, lined ditches, and pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. Because of the limited available water capacity in the surface layer, light and frequent applications of irrigation water are needed when plants are young. The hazard of wind erosion can be reduced by keeping the soil rough and cloddy if it is not protected by vegetation or crop residue. In areas that are slightly saline, yields of many crops are limited. Leaching is needed to prevent salt from building up in the soil, particularly if graded irrigation systems are used. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas is mainly creosotebush. The potential plant community is mainly creosotebush, white bursage, annual forbs, and annual grasses. The major browse species is white bursage. This species makes up about 5 percent of the plant community. Perennial grasses and forbs make up 10 percent of the plant community, and annual grasses and forbs make up 20 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. Overgrazing increases the hazard of wind erosion. This unit does not respond to improved grazing management in a reasonable length of time.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees. It is moderately well suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass is IIe, irrigated, and VIIe, nonirrigated. This soil is in the Limy Fan, 2-7" precipitation zone range site.

45—Mohall loam. This deep, well drained soil is on basin floors. It formed in alluvium derived dominantly from mixed rocks. The native vegetation is mainly desert shrubs and annual grasses. Slope ranges from 0 to 1 percent. Elevation ranges from 700 to 800 feet.

The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

Included with this soil in mapping are small areas of Tremant, Tucson, and Wellton soils. These soils make up about 25 percent of the map unit. The percentage varies from one area to another.

Typically, the surface layer of the Mohall soil is brown loam about 15 inches thick. The upper 21 inches of the subsoil is light brown loam and yellowish red clay loam. The lower 26 inches is pink and light reddish brown clay loam. A very limy layer is at a depth of about 24 inches. Depth to the very limy layer ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam. In places at the lower end of some fields that have been irrigated with sediment-laden water, the surface layer is dark brown clay loam. The soil is nonsaline to slightly saline (electrical conductivity of 0.5 to 3.2 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is moderately slow. Available water capacity is very high. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderate.

This soil is used mainly for irrigated cotton, safflower, or small grain. It also is used as rangeland. Few limitations affect the use of this soil for irrigated crops.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of this soil. The method used generally is governed by the crop. Leveling cuts are needed for the efficient application and removal of irrigation water in sloping areas. In the more sloping areas, the amount of soil that must be moved if fields are leveled may be prohibitive. A graded system is more feasible in these areas. Leveling cuts made to a depth of 20 to 40 inches generally expose a very limy layer. Some sensitive crops may become chloritic because of this layer. Applications of sulfur, manure, or gin trash are beneficial in leveled areas where cuts have exposed the very limy layer. Water can be distributed by earth ditches, lined ditches, or pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. In areas that are slightly saline, yields of some crops are limited and the choice of plants is restricted. Leaching is needed to prevent salt from building up in the soil, particularly if graded irrigation systems are used. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas is mainly creosotebush and annual grasses. The potential plant community is mainly creosotebush, white bursage, annual forbs, and annual grasses. The major browse species is white bursage. This species makes up 5 percent of the plant community. Perennial grasses and forbs make up 10 percent of the plant community, and annual grasses and forbs make up 20 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. Overgrazing increases the hazard of wind erosion. This unit does not respond to improved grazing management in a reasonable length of time.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees. It is well suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability classification is I, irrigated, and VIIc, nonirrigated. This soil is in the Limy Fan, 2-7" precipitation zone range site.

46—Mohall loam, occasionally flooded. This deep, well drained soil is in depressions along ephemeral drainageways on basin floors. It formed in alluvium covered with a thin mantle of recent alluvium derived dominantly from mixed rocks. The native vegetation is mainly desert shrubs, trees, and grasses. Slope is 0 to 1 percent. Elevation ranges from 700 to 900 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

Included with this soil in mapping are small areas of Wellton soils on fan terraces, Mohall soils on fan terraces that are not subject to occasional flooding, and Why soils on flood plains (washes). Included soils make up about 15 percent of the map unit. The percentage varies from one area to another.

Typically, 1 to 10 percent of the surface of the Mohall soil is covered with pebbles. The surface layer is light brown, finely stratified loam about 1 inch thick. The subsurface layer to a depth of 13 inches is light brown loam. The upper 23 inches of the subsoil is light brown loam and yellowish red clay loam. The lower 24 inches is pink and light reddish brown clay loam. A very limy layer is at a depth of about 37 inches. Depth to the very limy layer ranges from 24 to 40 inches. In some areas the surface layer is very fine sandy loam. The soil is nonsaline (electrical conductivity of 0.2 to 1.4 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is moderately slow. Available water capacity is very high. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderate. The soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. The occasional, very brief periods of flooding occur mainly in summer and winter.

This soil is used as rangeland. It can be used for irrigated crops. It is limited mainly by the hazard of flooding.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of this soil. The method used generally is governed by the crop. Leveling cuts are needed for the efficient application and removal of irrigation water in sloping areas. In the more sloping areas, the amount of soil that must be moved if fields are leveled may be prohibitive. A graded system is more feasible in these areas. Leveling cuts made to a depth of 20 to 40 inches generally expose a very limy layer. Some sensitive crops may become chloritic because of this layer. Applications of sulfur, manure, or gin trash are beneficial in leveled areas where cuts have exposed the very limy layer. Water can be distributed by earth ditches, lined ditches, and pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. The hazard of wind erosion can be reduced by keeping the soil rough and cloddy if it is not protected by vegetation or crop residue. In the more sloping areas, irrigation streams can cause erosion. This risk can be minimized by irrigating across the slope or by leveling to a more nearly level grade. The hazard of flooding can be reduced by installing dikes and diversions. In areas that are slightly saline, yields of many crops are limited and the choice of plants is restricted. Leaching is needed to prevent salt from building up in the soil, particularly if a graded irrigation system is used. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas is mainly creosotebush, annual grasses, mesquite, and big galleta. The potential plant community is mainly bush muhly, big galleta, and annual forbs. Perennial grasses and forbs, including big galleta and bush muhly, make up about 75 percent of the plant community. Annual grasses and forbs make up 15 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. Fencing and developing water sources can improve grazing or livestock management. This unit responds to improved grazing management in a reasonable length of time.

Periodic flooding increases the amount of forage available on this soil. Overgrazing increases the hazard of wind erosion and the likelihood of gullying.

This unit is moderately well suited to desertic riparian herbaceous plants and desertic riparian shrubs and trees for wildlife habitat.

The capability subclass is VIIw, nonirrigated. This soil is in the Loamy Bottom, 2-7" precipitation zone range site.

47—Mohall clay loam. This deep, well drained soil is on basin floors. It formed in alluvium derived dominantly from mixed rocks. Slope is 0 to 1 percent. Elevation ranges from 700 to 800 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

Included with this soil in mapping are small areas of Tremant, Tucson, and Wellton soils. These soils make up about 20 percent of the map unit. The percentage varies from one area to another.

Typically, the surface layer of the Mohall soil is dark brown clay loam about 15 inches thick. The upper 21 inches of the subsoil is light brown loam and yellowish red clay loam. The lower 24 inches is pink and light reddish brown clay loam. A very limy layer is at a depth of about 24 inches. Depth to the very limy layer ranges from 20 to 40 inches. The dark brown color and heavy surface texture of this soil are the result of irrigating with sediment-laden water. In some areas the surface layer is loam. The soil is nonsaline to slightly saline (electrical conductivity of 1.4 to 6.0 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is moderately slow. Available water capacity is very high. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderate.

This soil is used for irrigated cotton or small grain. It has few limitations affecting irrigated crops. It is limited mainly by a moderately slow intake rate.

Furrow, border, basin, and drip irrigation systems are suitable in areas of this soil. The method used generally is governed by the crop. Sprinkler systems are poorly suited because of the moderately slow intake rate. Leveling cuts are needed for the efficient application of irrigation water in sloping areas. Leveling cuts made to a depth of 20 to 40 inches generally expose the very limy layer. Some sensitive crops may become chloritic because of this layer. Applications of sulfur, manure, or gin trash are beneficial in leveled areas where cuts have exposed the very limy layer. Water can be distributed by earth ditches, lined ditches, and pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. In areas that are slightly saline, yields of some crops are limited and the choice of plants is restricted. Leaching is needed to prevent salt from building up in the soil, particularly in graded areas that are irrigated. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

This unit is well suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability classification is I, irrigated, and VIIc, nonirrigated.

48—Mohall complex, 0 to 3 percent slopes. This map unit is on broad basin floors and adjoining fan terraces. The native vegetation is mainly desert trees and shrubs, cacti, and annual grasses. Elevation ranges from 600 to 2,100 feet. The average annual precipitation is 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 50 percent Mohall soil and 30 percent Mohall, occasionally flooded, soil. The Mohall soil is on nearly level basin floors and fan terraces. The Mohall, occasionally flooded, soil is in nearly level depressional areas along ephemeral drainageways. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Coolidge, Dateland, and Denure soils on fan terraces and Cuerda and Why soils on flood plains (washes). These included soils make up about 20 percent of the map unit. The percentage varies from one area to another.

The Mohall soil is deep and well drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 1 to 10 percent of the surface is covered with pebbles. The surface layer is light brown sandy loam about 3 inches thick. The upper 10 inches of the subsoil is brown sandy loam. The lower 30 inches is brown and light brown sandy clay loam. The substratum to a depth of 60 inches or more is pink gravelly sandy loam. A very limy layer is at a depth of about 22 inches. Depth to the very limy layer ranges from 20 to 40 inches.

Permeability is moderately slow in the Mohall soil. Available water capacity is high. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight or slight. The hazard of wind erosion is moderately high.

The Mohall, occasionally flooded, soil is deep and well drained. It formed in alluvium that has a thin mantle of recent alluvium derived dominantly from mixed rocks. Typically, 1 to 10 percent of the surface is covered with pebbles. The surface layer is light brown, finely stratified sandy loam about 1 inch thick. The subsurface layer, to a depth of about 13 inches, is light brown sandy loam. The upper 24 inches of the subsoil is yellowish red and reddish brown sandy clay loam. The lower 23 inches is light reddish brown sandy clay loam. A very limy layer is at a depth of about 37 inches. Depth to the very limy layer ranges from 24 to 40 inches.

Permeability is moderately slow in the Mohall, occasionally flooded, soil. Available water capacity is high. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight or slight. The hazard of wind erosion is moderately high. The soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. The occasional, very brief periods of flooding occur mainly in summer and winter.

This unit is used mainly as rangeland. It can be used for irrigated crops if water is made available.

The present vegetation in most areas of the Mohall soil is mainly mesquite and creosotebush. The potential plant community is mainly big galleta, white bursage, annual forbs, and annual grasses. The major browse species is white bursage. This species makes up about 25 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 45 percent of the plant community. Annual grasses and forbs make up 25 percent.

The present vegetation in most areas of the Mohall, occasionally flooded, soil is mainly mesquite, white bursage, and creosotebush. The potential plant community is mainly big galleta and annual forbs. Perennial grasses and forbs, including big galleta and bush muhly, make up 75 percent of the plant community. Annual grasses and forbs make up 15 percent.

In areas where the average annual precipitation is more than 8 inches, the total vegetative production is about 50 to 200 pounds per acre more than is typical and forage plants and annuals make up a larger percentage of the total. Some of these areas produce sufficient forage for year-round use. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

The Mohall, occasionally flooded, soil provides most of the forage for livestock and habitat for wildlife in this unit. The periodic flooding increases the amount of forage available. Therefore, management should be geared to this soil. Overgrazing increases the hazard of wind erosion on this unit.

If this unit is used for irrigated crops, the main management concern is the hazard of wind erosion. Also, protection from flooding is needed in the areas that are subject to occasional flooding.

Furrow, border, and sprinkler irrigation systems are suitable in areas of these soils. Leveling cuts are needed for the efficient application of irrigation water. Wind erosion can be controlled by returning crop residue to the soil and by practicing minimum tillage. Onsite investigation is advisable before this unit is developed for irrigated crops.

This unit is poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability subclass of the Mohall soil is VIIe, and that of the Mohall, occasionally flooded, soil is VIIw. The Mohall soil is in the Sandy Loam Upland, 2-10" precipitation zone range site, and the Mohall, occasionally flooded, soil is in the Loamy Bottom, 2-10" precipitation zone range site.

49—Momoli-Carrizo extremely gravelly sandy loams, 1 to 10 percent slopes. This map unit is on fan terraces in intermountain canyons dissected by numerous flood plains (washes) (fig. 10). The native vegetation is mainly desert shrubs and trees, cacti, and annual grasses. Elevation ranges from 1,200 to 2,100 feet. The average annual precipitation is 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 50 percent Momoli soil and 25 percent Carrizo soil. The Momoli soil is on the gently sloping to strongly sloping summits and side slopes of fan terraces, and the Carrizo soil is on nearly level and gently sloping, narrow flood plains (washes) dividing the fan terraces. The two soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Pinamt and Rillito soils on fan terraces, Vaiva soils on low hills, and Why soils on flood plains (washes). Included soils make up about 25 percent of the map unit. The percentage varies from one area to another.

The Momoli soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from granite and gneiss. Typically, 45 to 75 percent of the surface is covered with pebbles. The surface layer is light brown extremely gravelly sandy loam about 2 inches thick. The upper 13 inches of the subsoil is reddish yellow very gravelly sandy loam. The lower 45 inches or more is strong brown very gravelly coarse sandy loam.

Permeability is moderately rapid in the Momoli soil. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is slight.

The Carrizo soil is deep and excessively drained. It formed in recent alluvium derived dominantly from granite and gneiss. Typically, 40 to 80 percent of the surface is covered with pebbles and cobbles. The surface layer is light brown extremely gravelly sandy loam about 1 inch thick. The underlying material, to a depth of about 54 inches, is reddish yellow extremely gravelly sand and loamy sand that have thin strata of finer textured material. Below this is a buried subsoil of yellowish red very gravelly loamy sand about 6 inches thick.

Permeability is very rapid in the Carrizo soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is slight. The soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. The occasional, very brief periods of flooding occur mainly in summer and winter.

This unit is used mainly as rangeland.

The present vegetation in most areas of the Mohall soil is mainly creosotebush, saguaro, buckhorn cholla,

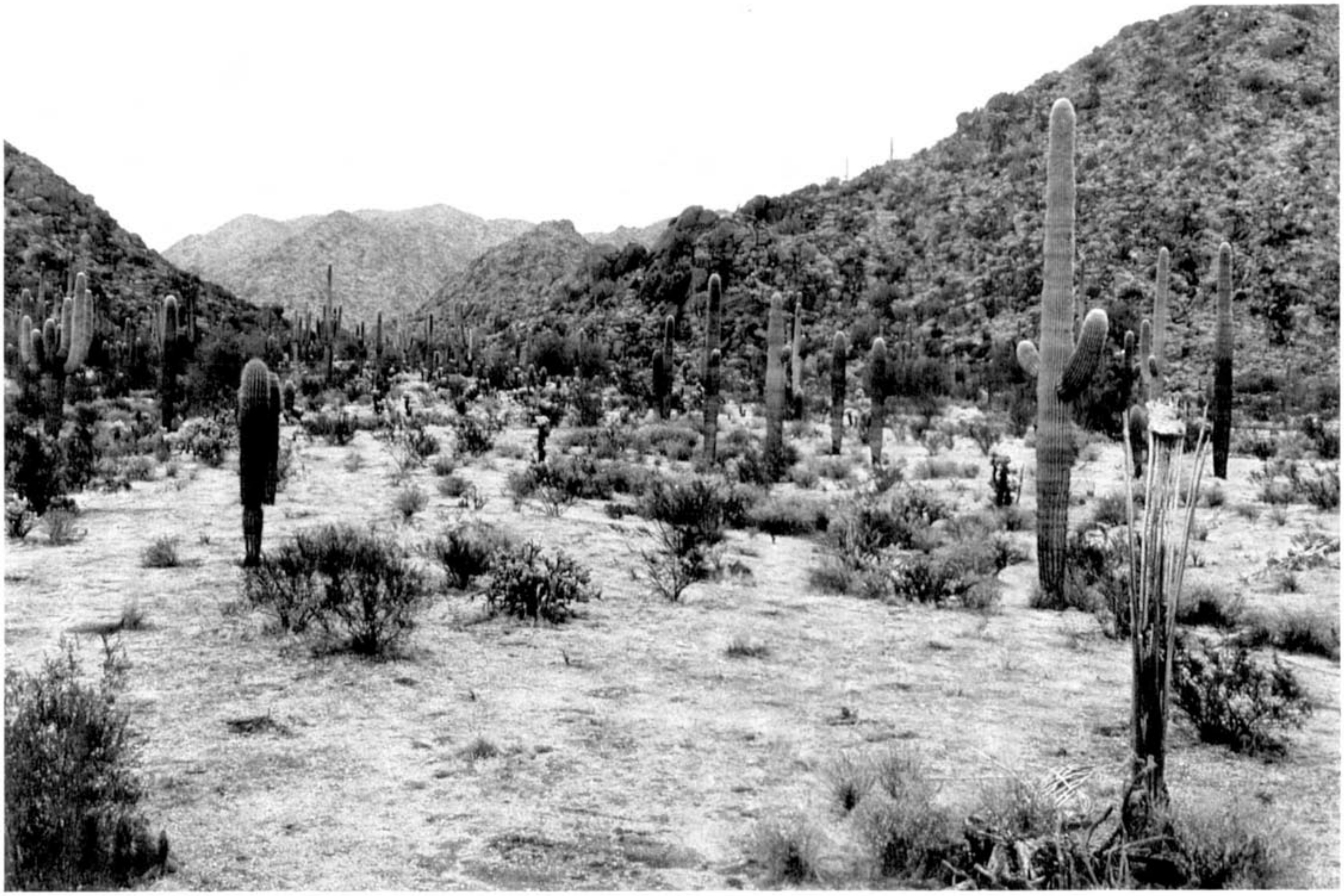

Figure 10.—A typical area of Momoli-Carrizo extremely gravelly sandy loams, 1 to 10 percent slopes.

and triangle bursage. The potential plant community is mainly triangle bursage, white ratany, bush muhly, and big galleta. Major browse species are white ratany and littleleaf paloverde. These species make up about 20 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 30 percent of the plant community. Annual grasses and forbs make up 20 percent.

The present vegetation in most areas of the Carrizo soil is mainly ironwood, paloverde, and shrubs. The potential plant community is mainly littleleaf paloverde and blue paloverde. Major browse species are paloverde and catclaw acacia. These species make up about 30 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 25 percent of the plant community. Annual grasses and forbs make up 15 percent.

In areas where the average annual precipitation is less than 8 inches, the total vegetative production is about 100 to 200 pounds per acre less than is typical. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

Periodic flooding increases the amount of forage available on the Carrizo soil. Therefore, management should be geared to this soil.

This unit is unsuited to irrigated cropland. It is limited mainly by the slope and droughtiness. The Carrizo soil also is limited by the hazard of flooding.

This unit is poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability subclass of the Momoli soil is VIIs, and that of the Carrizo soil is VIIw. The Momoli soil is in the Sandy Loam Upland, 2-10" precipitation zone range site, and the Carrizo soil is in the Sandy Bottom, 2-10" precipitation zone range site.

50—Momoli-Carrizo, bench, very gravelly sandy loams, 1 to 3 percent slopes. This map unit is on fan terraces. The vegetation in areas that have not been cultivated is mainly desert shrubs, annual grasses, and forbs. Elevation ranges from 500 to 1,400 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 50 percent Momoli soil and 30 percent Carrizo soil. The two soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Denure, Growler, and Tremant soils on fan terraces and Carrizo soils on flood plains (washes). Also included are small areas of soils that are similar to the Denure soils but are underlain by sand and gravel at a moderate depth. Included areas make up about 20 percent of the map unit. The percentage varies from one area to another.

The Momoli soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 35 to 60 percent of the surface is covered with pebbles and a few cobbles. The surface layer is light brown very gravelly sandy loam about 2 inches thick. The upper 13 inches of the subsoil is reddish yellow very gravelly sandy loam. The lower 45 inches is strong brown very gravelly coarse sandy loam. In a few areas that have not been cultivated, as much as 80 percent of the surface is covered with gravel. The soil is very slightly or slightly saline in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is moderately rapid in the Momoli soil. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The hazard of wind erosion also is slight.

The Carrizo soil is deep and excessively drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 35 to 60 percent of the surface is covered with pebbles and a few cobbles. The surface layer is brown very gravelly sandy loam about 5 inches thick. The underlying material to a depth of 60 inches or more is brown extremely gravelly loamy sand that has thin strata of finer textured material. In a few areas that have not been cultivated, as much as 80 percent of the surface is covered with gravel. The soil is very slightly or slightly saline in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is very rapid in the Carrizo soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion also is slight.

This unit is used mainly as rangeland. It also is used for irrigated cotton or jojoba. It is limited mainly by droughtiness.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of these soils. Leveling cuts are needed for the efficient application of irrigation water. In the more sloping areas, the amount of soil that must be moved if fields are leveled may be prohibitive. A graded system is more feasible in these areas. Keeping leveling cuts to a minimum helps to prevent exposing the sand and gravel in areas of the Carrizo soil. Applications of manure or gin trash are beneficial in leveled areas where sand and gravel are exposed. Water can be distributed by lined ditches or pipelines. Because the soils are droughty, applications of irrigation water should be light and frequent. The included soils in washes are subject to flooding. Where these areas are adjacent to cropland that is not protected by dikes and diversions, the cropland also is subject to flooding. In areas that are slightly saline, yields of some crops are limited and the choice of plants is restricted. Leaching is needed to prevent salt from building up in the soil, particularly if graded irrigation systems are used. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas of the Mohall soil is mainly creosotebush and annual grasses. The potential plant community is mainly creosotebush, white bursage, annual forbs, and annual grasses. Major browse species are white bursage and white ratany. These species make up about 15 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 10 percent of the plant community. Annual grasses and forbs make up 25 percent.

The present vegetation in most areas of the Carrizo soil is mainly creosotebush and turkshead. The potential plant community is mainly creosotebush, white bursage, and turkshead. Major browse species are white bursage and white ratany. These species make up about 15 percent of the plant community. Annual grasses and forbs make up 5 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit responds to improved grazing management in a reasonable length of time.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees. It is very poorly suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass of the Momoli soil is IVs, irrigated, and VIIs, nonirrigated. The capability subclass of the Carrizo soil is VIs, irrigated, and VIIs, nonirrigated. Both soils are in the Limy Upland (deep), 2-7" precipitation zone range site.

51—Momoli-Comobabi association, 5 to 15 percent slopes. This map unit is on fan terraces flanking granitic mountains. The native vegetation is mainly desert shrubs and trees, cacti, and annual grasses. Elevation ranges from 1,200 to 2,100 feet. The average annual precipitation is 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 50 percent Momoli soil and 25 percent Comobabi soil. The Momoli soil is in the higher areas on gently sloping to strongly sloping fan terraces near the mountains, and the Comobabi soil is in the lower areas.

Included with these soils in mapping are small areas of Gunsight and Pinamt soils on the higher part of the fan terraces, Cipriano soils on the lower part of the fan terraces, Quilotosa and Vaiva soils and rock outcrop at the foot of the mountains, and Carrizo soils on flood plains (washes). Also included are areas of soils that are moderately deep over a hardpan. Included areas make up about 25 percent of the map unit. The percentage varies from one area to another.

The Momoli soil is deep and somewhat excessively drained. It formed in alluvium and colluvium derived dominantly from granite and gneiss. Typically, 50 to 85 percent of the surface is covered with cobbles, pebbles, and a few stones. The surface layer is light brown extremely cobbly loam about 2 inches thick. The subsoil to a depth of 60 inches or more is strong brown extremely cobbly sandy loam.

Permeability is moderately rapid in the Momoli soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is slight.

The Comobabi soil is shallow and very shallow and is well drained. It formed in alluvium derived dominantly from granite and gneiss. Typically, 50 to 90 percent of the surface is covered with cobbles and pebbles. The surface layer is light brown extremely cobbly fine sandy loam about 1 inch thick. The upper 9 inches of the subsoil is yellowish red extremely cobbly sandy loam. The lower 9 inches is yellowish red extremely cobbly sandy clay loam. An indurated hardpan is at a depth of about 19 inches. Depth to the indurated hardpan ranges from 7 to 20 inches.

Permeability is moderately slow in the Comobabi soil. Available water capacity is very low. Potential rooting depth is 7 to 20 inches. Runoff is rapid, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is slight.

This unit is used mainly as rangeland.

The present vegetation in most areas of the Momoli soil is mainly creosotebush, triangle bursage, paloverde, and buckhorn cholla. The potential plant community is mainly creosotebush, triangle bursage, white ratany, and bush muhly. Major browse species are white ratany and littleleaf paloverde. These species make up about 10 percent of the plant community. Perennial grasses and forbs, including bush muhly and big galleta, make up 35 percent of the plant community. Annual grasses and forbs make up 10 percent.

The present vegetation in most areas of the Comobabi soil is mainly creosotebush, triangle bursage, paloverde, and buckhorn cholla. The potential plant community is mainly triangle bursage, littleleaf paloverde, buckhorn cholla, and bush muhly. Major browse species are littleleaf paloverde and ironwood. These species make up about 15 percent of the plant community. Perennial grasses and forbs, including bush muhly and big galleta, make up 30 percent of the plant community. Annual grasses and forbs make up 10 percent.

In areas where the average annual precipitation is less than 8 inches, the total vegetative production is about 100 pounds per acre less than is typical. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

A high content of lime, a low water-supplying capacity, and competition from creosotebush contribute to the low production of forage on this unit.

This unit is unsuited to irrigated crops. It is limited mainly by large stones, droughtiness, and the slope.

The Comobabi soil also is limited by the depth to a hardpan.

This unit is poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability subclass is VIIs. The Momoli soil is in the Limy Upland (deep), 2-10" precipitation zone range site, and the Comobabi soil is in the Limy Upland, 2-10" precipitation zone range site.

52—Pits. This unit is composed of areas where the upper layers of soil material have been removed for construction purposes, mainly roads and highways. Depth of the excavations ranges from 3 to 20 feet below the natural surface. Edges of the pits are steeply sloping to nearly vertical.

Included in mapping are small areas of undisturbed soils, spoil piles, and screening dumps.

53—Quilotosa-Momoli-Carrizo complex, 1 to 15 percent slopes. This map unit is on low granite hills and fan terraces dissected by flood plains (washes). The native vegetation is mainly desert trees, shrubs, cacti, and annual grasses. Elevation ranges from 1,000 to 2,500 feet. The average annual precipitation is 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 40 percent Quilotosa soil, 20 percent Momoli soil, and 15 percent Carrizo soil. The Quilotosa soil is on gently sloping to strongly sloping hills, the Momoli soil is on nearly level and gently sloping fan terraces between the hills, and the Carrizo soil is on and along nearly level and gently sloping flood plains (washes) that dissect the hills and fan terraces. The three soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Vaiva soils and granite rock outcrop on low hills; Cipriano and Comobabi soils on high fan terraces near hills; and Gunsight, Pinamt, and Rillito soils on fan terraces. Included areas make up about 25 percent of the map unit. The percentage varies from one area to another.

The Quilotosa soil is very shallow and shallow and is somewhat excessively drained. It formed in alluvium and colluvium derived dominantly from granite and gneiss. Typically, 45 to 75 percent of the surface is covered with pebbles, cobbles, and stones. The surface layer is pale brown extremely gravelly coarse sandy loam about 2 inches thick. The upper 4 inches of the underlying material is brown extremely gravelly coarse sandy loam. The next 8 inches is light yellowish brown extremely gravelly coarse sandy loam. The lower part of the underlying material is weathered granite about 9 inches thick. Unweathered granite is at a depth of about 19 inches. The depth to weathered bedrock ranges from 6 to 15 inches. The depth to unweathered bedrock ranges from 10 to 20 inches.

Permeability is moderately rapid in the Quilotosa soil. Available water capacity is very low. Potential rooting depth is 6 to 15 inches. Runoff is rapid, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is slight.

The Momoli soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from granite and gneiss. Typically, 45 to 75 percent of the surface is covered with pebbles. The surface layer is light brown very gravelly sandy loam about 2 inches thick. The upper 13 inches of the subsoil is reddish yellow very gravelly sandy loam. The lower 45 inches or more is strong brown very gravelly coarse sandy loam.

Permeability is moderately rapid in the Momoli soil. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is slight.

The Carrizo soil is deep and excessively drained. It formed in recent alluvium derived dominantly from granite and gneiss. Typically, 40 to 80 percent of the surface is covered with pebbles and cobbles. The surface layer is light brown extremely gravelly sandy loam about 1 inch thick. The underlying material, to a depth of about 54 inches, is reddish yellow extremely gravelly sand and loamy sand that have thin strata of finer textured material. Below this is a buried subsoil of yellowish red very gravelly loamy sand about 12 or more inches thick.

Permeability is very rapid in the Carrizo soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is slight. The soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. The occasional, very brief periods of flooding occur mainly in summer and winter.

This unit is used mainly as rangeland. A few areas in and around Ajo are used as homesites.

The present vegetation in most areas of the Quilotosa soil is mainly creosotebush, ironwood, paloverde, and cacti. The potential plant community is mainly white bursage, littleleaf paloverde, and shrubs. Major browse species are white bursage and littleleaf paloverde. These species make up about 60 percent of the plant community. Perennial grasses and forbs, including threeawn and bush muhly, make up 15 percent of the plant community.

The present vegetation in most areas of the Momoli soil is mainly creosotebush, ocotillo, paloverde, and cacti. The potential plant community is mainly creosotebush, white bursage, annual forbs, and big galleta. Major browse species are white bursage and white ratany. These species make up about 30 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 25 percent of the plant community. Annual grasses and forbs make up 25 percent.

The present vegetation in most areas of the Carrizo soil is mainly paloverde, ironwood, burrobrush, and wolfberry. The potential plant community is mainly littleleaf paloverde, ironwood, and desertthorn. Major browse species are littleleaf paloverde, ironwood, and catclaw acacia. These species make up about 30 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 20 percent of the plant community. Annual grasses and forbs make up 20 percent.

In areas where the average annual precipitation is more than 8 inches, the total vegetative production is about 75 to 200 pounds per acre more than is typical and forage plants and annuals make up a larger percentage of the total. Some of these areas produce sufficient forage for year-round use. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

The Quilotosa and Momoli soils produce most of the perennial forage in this unit. Management should be geared to these soils.

This unit is unsuited to irrigated cropland. It is limited mainly by the slope and droughtiness. The Quilotosa soil also is limited by the depth to bedrock, and the Carrizo soil is limited by the hazard of flooding.

This unit is poorly suited to homesite development. The Quilotosa soil is limited mainly by the depth to bedrock, and the Carrizo soil is limited by the hazard of flooding. The Momoli soil has only slight limitations affecting homesite development. Because of the pattern of the soils in the map unit, however, finding an area of the Momoli soil large enough for homesite development is difficult. Selecting a site in another area is generally more practical.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability subclass of the Quilotosa and Momoli soils is VIIs, and that of the Carrizo soil is VIIw. The Quilotosa soil is in the Shallow Upland, 2-10" precipitation zone range site; the Momoli soil is in the Sandy Loam Upland, 2-10" precipitation zone range site; and the Carrizo soil is in the Sandy Bottom, 2-10" precipitation zone range site.

54—Quilotosa-Rock outcrop complex, 15 to 55 percent slopes. This map unit is on mountains of granite that is mixed with gneiss in some areas (fig. 11). The native vegetation is mainly trees, cacti, shrubs, and grasses. Elevation ranges from 1,000 to 2,800 feet. The average annual precipitation is 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 60 percent Quilotosa soil and 25 percent Rock outcrop. The Quilotosa soil and Rock outcrop are on moderately steep or steep mountains. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in mapping are small areas of Vaiva soils on the more stable mountains and Laposa and Schenco soils on mountains. Included soils make up about 15 percent of the map unit. The percentage varies from one area to another.

The Quilotosa soil is very shallow and shallow and is somewhat excessively drained. It formed in alluvium and colluvium derived dominantly from granite and gneiss. Typically, 50 to 90 percent of the surface is covered with pebbles, cobbles, stones, and boulders. The surface layer is pale brown extremely stony coarse sandy loam about 2 inches thick. The upper 4 inches of the subsoil is brown extremely gravelly coarse sandy loam. The lower 8 inches is light yellowish brown extremely gravelly coarse sandy loam. The underlying material is soft, weathered granite about 5 inches thick. Unweathered granite is at a depth of about 19 inches. The depth to weathered bedrock ranges from 6 to 15 inches. The depth to unweathered bedrock ranges from 10 to 20 inches.

Permeability is moderately rapid in the Quilotosa soil. Available water capacity is very low. Potential rooting depth is 6 to 15 inches. Runoff is rapid, and the hazard of water erosion is moderate or severe. The hazard of wind erosion is slight.

Rock outcrop consists of exposed areas of granite and gneiss. Runoff from these areas is rapid.

This unit is used mainly as rangeland.

The present vegetation in most areas is mainly brittlebush, paloverde, and triangle bursage. The potential plant community is mainly triangle bursage, littleleaf paloverde, brittlebush, and shrubs. Major browse species are littleleaf paloverde and shrubs. These species make up 30 percent of the plant community. Perennial grasses and forbs, including slim

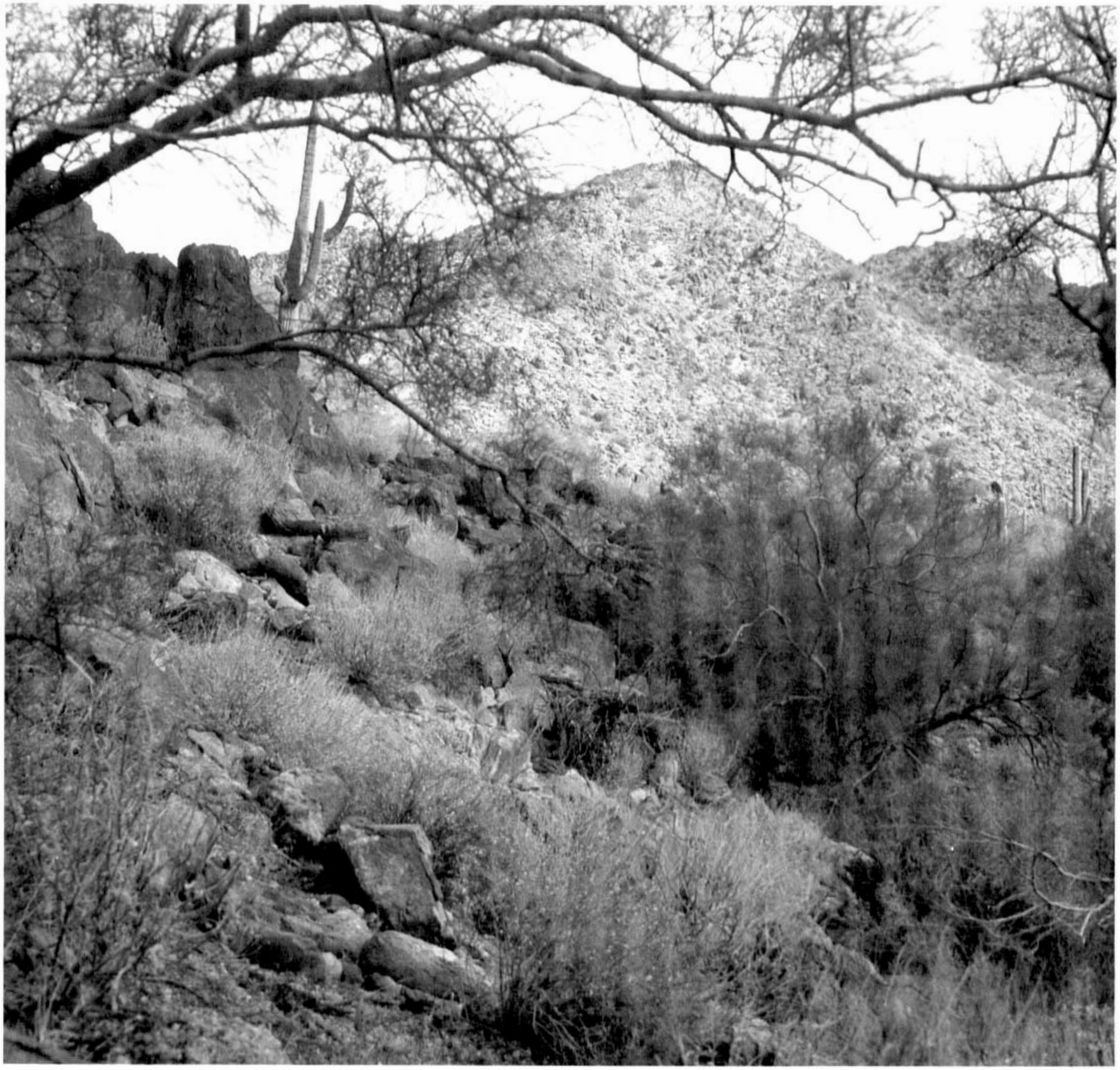

Figure 11.—A typical landscape in an area of Quilotosa-Rock outcrop complex, 15 to 55 percent slopes.

tridens, bush muhly, and big galleta, make up 30 percent of the plant community. Annual grasses and forbs make up 10 percent.

In areas where the average annual precipitation is less than 8 inches, the total vegetative production is about 75 pounds per acre less than is typical. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. Fencing and developing water sources can improve grazing or livestock management. This unit responds to improved grazing management in a reasonable length of time.

Because boulders, stones, and cobbles on the surface limit grazing, this unit responds rapidly to the use of appropriate grazing management systems.

This unit is unsuited to irrigated crops. It is limited mainly by the depth to bedrock, droughtiness, the large stones, and the slope.

This unit is poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability classification of the Quilotosa soil is VIIe, and that of the Rock outcrop is VIII. The Quilotosa soil is in the Granitic Hills, 2-10" precipitation zone range site. The Rock outcrop is not assigned to a range site.

55—Riverwash. This map unit is in the channel of the Gila River and on the adjacent low flood plain (fig. 12). The native vegetation is mainly widely spaced riparian trees and shrubs. Most areas are devoid of vegetation. Elevation ranges from 430 to 750 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

The soil material is stratified and coarse textured. Portions of this unit in the flood pool of Painted Rock Dam have a layer of fine textured alluvium on the surface.

This unit is frequently flooded. Areas in the flood pool of Painted Rock Dam are subject to very long periods of inundation. The hazard of water erosion is severe, and the hazard of wind erosion is very high.

This unit is used mainly as rangeland. It also is a source of sand and gravel.

The capability class is VIII. No range site is assigned.

56—Rock outcrop-Hyder complex, 25 to 65 percent slopes. This map unit is on volcanic hills and mountains. The native vegetation is mainly cacti, annual grasses, and shrubs. Elevation ranges from 1,200 to 2,500 feet. The average annual precipitation is 5 to 10 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 40 percent Rock outcrop and 35 percent Hyder soil. The Rock outcrop and the Hyder soil are on steep or very steep hills and mountains. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Cherioni, Gachado, and Laposa soils on hills and mountains; Gunsight and Momoli soils on fan terraces; and Carrizo soils on flood plains (washes). Included soils make up about 25 percent of the map unit. The percentage varies from one area to another.

Rock outcrop consists of exposed areas of andesite, rhyolite, and related volcanic rocks (fig. 13). Runoff from these areas is rapid.

The Hyder soil is very shallow and shallow and is somewhat excessively drained. It formed in alluvium and colluvium derived dominantly from andesite, rhyolite, and related volcanic rocks. Typically, 50 to 90 percent of the surface is covered with pebbles. The surface layer is light brown extremely gravelly sandy loam about 1 inch thick. The underlying material is light brown extremely gravelly sandy loam about 6 inches thick. Unweathered volcanic rock is at a depth of 7 inches. The depth to unweathered bedrock ranges from 5 to 18 inches.

Permeability is moderate in the Hyder soil. Available water capacity is very low. Potential rooting depth is 5 to 18 inches. Runoff is rapid, and the hazard of water erosion is severe. The hazard of wind erosion is slight.

This unit is used mainly as rangeland.

The present vegetation in most areas is mainly creosotebush, brittlebush, and paloverde. The potential plant community is mainly white bursage, creosotebush, annual forbs, and perennial grasses. Major browse species are white bursage, shrubby buckwheat, and white ratany. These species make up about 30 percent of the plant community. Perennial grasses and forbs, including bush muhly, make up 25 percent of the plant community. Annual grasses and forbs make up 15 percent.

In areas where the average annual precipitation is more than 8 inches, the total vegetative production is about 100 pounds per acre more than is typical and forage plants and annuals make up a larger percentage of the total. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management practices that permit efficient use of annual forage and meets the needs of the perennial plants and the animals on the range should be used. Fencing and developing water sources can improve grazing or livestock management. This unit responds to improved grazing management in a reasonable length of time.

This unit is unsuited to irrigated crops. It is limited mainly by the slope, the depth to bedrock, and droughtiness.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional, long or very long periods of flooding. The vegetation in recently flooded areas is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters

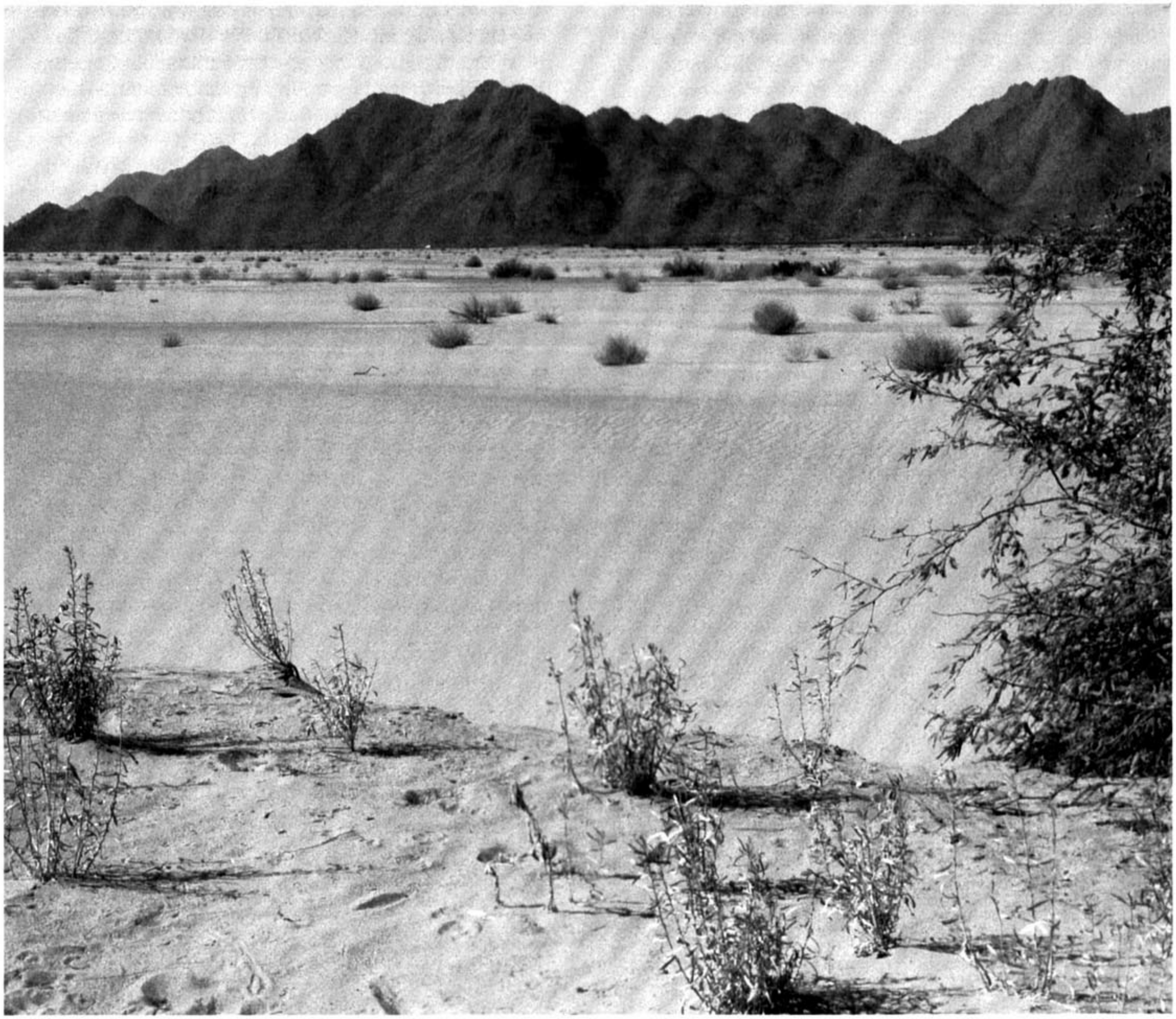

Figure 12.—An area of Riverwash in the major channel of the Gila River. Quilotosa soils are on the mountains in the background.

subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation becomes reestablished and the area may provide seasonal grazing for livestock.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability classification of the Rock outcrop is VIII, and that of the Hyder soil is VIIe. The Hyder soil is in the Volcanic Hills, 2-10" precipitation zone range site. The Rock outcrop is not assigned to a range site.

57—Rositas-Denure loamy fine sands, 1 to 10 percent slopes. This map unit is on sand dunes and stream terraces. The native vegetation is mainly grasses, desert shrubs, and trees. Elevation ranges from 500 to 800 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 40 percent Rositas soil and 30 percent Denure soil. The Rositas soil is on nearly level to strongly sloping, large dunes. The Denure soil is in nearly level and gently sloping areas between dunes on stream terraces. The two soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Coolidge soils; soils, on sand dunes, that are similar to the Rositas soil but have a very limy layer; Gunsight and Wellton soils between the sand dunes; and Carrizo and Why soils on flood plains (washes). Included soils make up about 30 percent of the map unit. The percentage varies from one area to another.

The Rositas soil is deep and somewhat excessively drained. It formed in eolian soil material derived dominantly from mixed rocks. Typically, the surface layer is light brown loamy fine sand about 3 inches thick. The upper 45 inches of the underlying material is light brown loamy fine sand and loamy sand. The lower part to a depth of 60 inches or more is light reddish brown sandy loam.

Permeability is rapid in the Rositas soil. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is high.

The Denure soil is deep and somewhat excessively drained. It formed in eolian soil material and alluvium derived dominantly from mixed rocks. Typically, 1 to 10

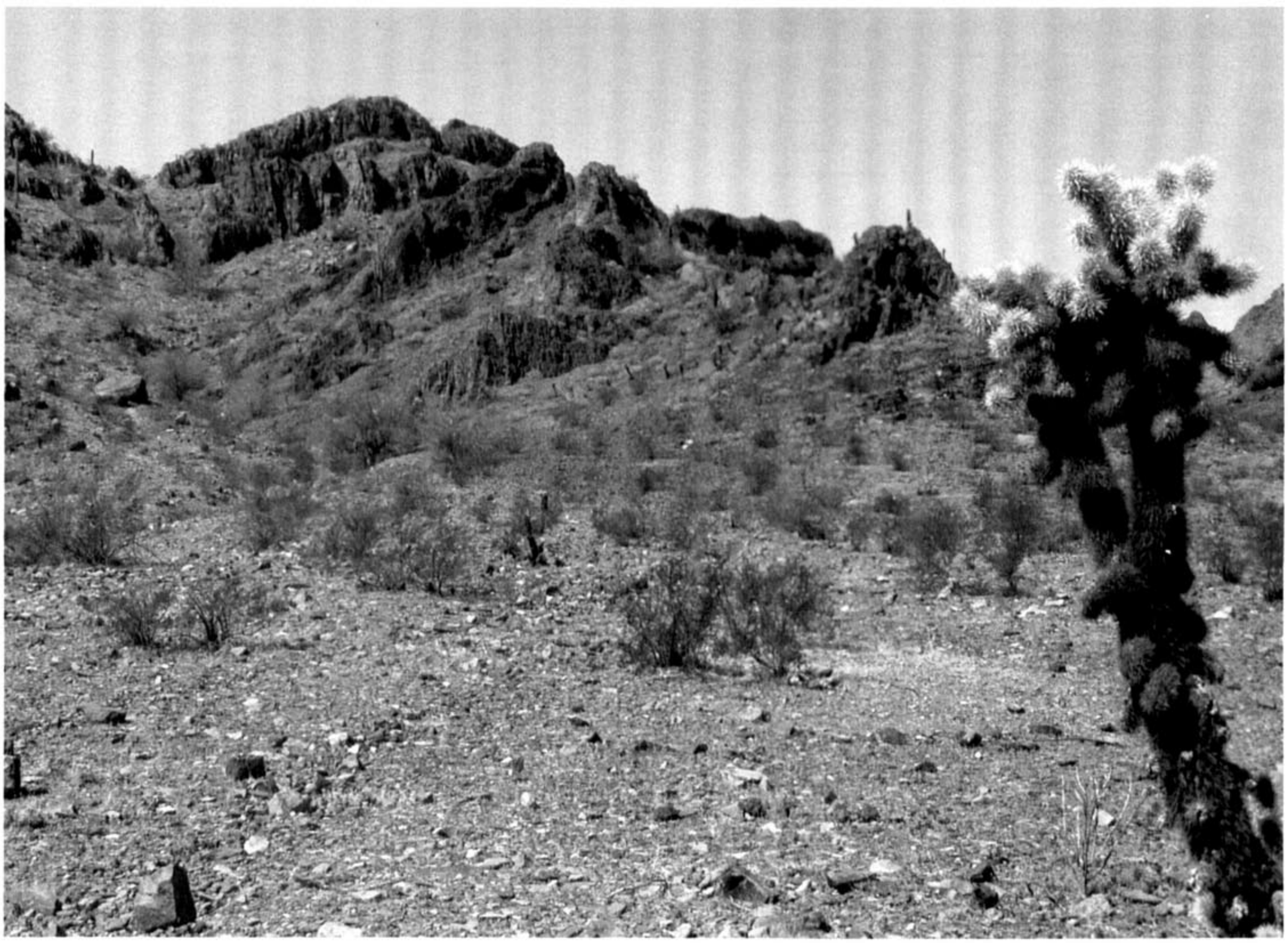

Figure 13.—An area of Rock outcrop-Hyder complex, 25 to 65 percent slopes, showing steep slopes and volcanic rocks. Gunsight soils are on the fan terrace in the foreground.

percent of the surface is covered with fine pebbles. The surface layer is light brown loamy fine sand about 17 inches thick. The upper 26 inches of the subsoil is light reddish brown sandy loam. The lower part to a depth of 60 inches or more is pink sandy loam. A very limy layer is at a depth of about 43 inches. Depth to the very limy layer ranges from 40 to 60 inches. In some places the surface layer and the upper part of the underlying material are fine sandy loam.

Permeability is moderately rapid in the Denure soil. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is high.

This unit is used mainly as rangeland.

The present vegetation in most areas of the Rositas soil is mainly big galleta, creosotebush, white bursage, and desert saltbush. The potential plant community is mainly big galleta and annual forbs. The major browse species is white bursage. This species makes up about 5 percent of the plant community. Perennial grasses and forbs, including big galleta and Mormon tea, make up 55 percent of the plant community. Annual grasses and forbs make up 30 percent.

The present vegetation in most areas of the Denure soil is mainly creosotebush and desert saltbush. The potential plant community is mainly big galleta, creosotebush, white bursage, and annual forbs. Major browse species are white bursage and white ratany. These species make up about 25 percent of the plant community. Perennial grasses and forbs, including big galleta and Mohave threeawn, make up 40 percent of the plant community. Annual grasses and forbs make up 20 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

This unit is very susceptible to wind erosion. Intensive management is needed to maintain the plant cover.

This unit is unsuited to irrigated cropland. It is limited mainly by the slope, a fast intake rate, droughtiness, and the hazard of wind erosion.

This unit is moderately well suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability subclass is VIIs. The Rositas soil is in the Sandy Upland, 2-7" precipitation zone range site, and the Denure soil is in the Limy Fan (sandy), 2-7" precipitation zone range site.

58—Schenco-Laposa-Rock outcrop complex, 10 to 55 percent slopes. This map unit is on schist hills and mountains. The native vegetation is mainly desert shrubs, cacti, and annual grasses. Elevation ranges from 1,600 to 2,800 feet. The average annual precipitation is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 35 percent Schenco soil, 20 percent Laposa soil, and 20 percent Rock outcrop. The Schenco soil is on the upper part of moderately steep or steep mountains. The Laposa soil is on the lower part of strongly sloping to moderately steep hills and mountains. The areas of Rock outcrop are dominantly on the upper part of steep mountains. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in mapping are small areas of Quilotosa and Vaiva soils on mountains, Gunsight and Momoli soils on high intermountain fan terraces, and Carrizo soils on flood plains (washes) that dissect the fan terraces. Also included are areas where elevation is higher than 2,800 feet. Included areas make up about 25 percent of the map unit. The percentage varies from one area to another.

The Schenco soil is shallow and well drained. It formed in alluvium and colluvium derived dominantly from schist. Typically, 50 to 90 percent of the surface is covered with schist channers. The surface layer is brown extremely channery sandy loam about 1 inch thick. The upper 6 inches of the subsoil is yellowish red very channery sandy clay loam. The lower 5 inches is pink very channery loam. Below this is about 9 inches of weathered schist. Unweathered schist is at a depth of about 21 inches. The depth to unweathered bedrock ranges from 21 to 30 inches.

Permeability is moderate in the Schenco soil. Available water capacity is very low. Potential rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is moderate or severe. The hazard of wind erosion is slight.

The Laposa soil is moderately deep and somewhat excessively drained. It formed in alluvium and colluvium derived dominantly from schist. Typically, 35 to 70 percent of the surface is covered with schist channers. The surface layer is brown extremely channery sandy loam about 1 inch thick. The upper 14 inches of the subsoil is light brown very channery sandy loam. The lower part, to a depth of about 23 inches, is light brown very channery fine sandy loam. Below this is about 10 inches of weathered schist. Unweathered schist is at a depth of about 33 inches. The depth to weathered bedrock ranges from 20 to 36 inches. The depth to unweathered bedrock ranges from 30 to 45 inches.

Permeability is moderate in the Laposa soil. Available water capacity is very low. Potential rooting depth is 20 to 36 inches. Runoff is moderately rapid, and the hazard of water erosion is moderate or severe. The hazard of wind erosion is slight.

Rock outcrop consists of exposed areas of schist. Runoff from these areas is rapid.

This unit is used mainly as rangeland.

The present vegetation in most areas of the Schenco soil is mainly brittlebush, creosotebush, cacti, and annual grasses. The potential plant community is mainly littleleaf paloverde, brittlebush, triangle bursage, and bush muhly. Major browse species are littleleaf paloverde, white ratany, and narrowleaf ditaxis. These species make up about 35 percent of the plant community. Perennial grasses and forbs, including bush muhly, make up 20 percent of the plant community. Annual grasses and forbs make up 10 percent.

The present vegetation in most areas of the Laposa soil is mainly creosotebush, ocotillo, and annual grasses. The potential plant community is mainly creosotebush, littleleaf paloverde, brittlebush, and cacti. Major browse species are littleleaf paloverde and white ratany. These species make up about 20 percent of the plant community. Perennial grasses and forbs, including bush muhly, make up 5 percent of the plant community. Annual grasses and forbs make up 10 percent.

In areas where the average annual precipitation is less than 8 inches, the total vegetative production is about 100 pounds per acre less than is typical. The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

This unit is unsuited to irrigated crops. It is limited mainly by the slope, the depth to bedrock, and droughtiness.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability classification of the Schenco and Laposa soils is VIIe, and that of the Rock outcrop is VIII. The Schenco soil is in the Schist Hills, 2-10" precipitation zone range site, and the Laposa soil is in the Limy Hills, 2-10" precipitation zone range site. The Rock outcrop is not assigned to a range site.

59—Tremant gravelly fine sandy loam. This deep, well drained soil is on fan terraces. It formed in alluvium derived dominantly from mixed rocks. The vegetation in areas that have not been cultivated is mainly desert shrubs and annual grasses. Slope is 0 to 1 percent. Elevation ranges from 500 to 800 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

Included with this soil in mapping are small areas of Coolidge, Denure, Growler, Mohall, Momoli, and Wellton soils. Also included are areas of Tremant soils that have a high content of toxic salts. Included soils make up about 20 percent of the map unit. The percentage varies from one area to another.

Typically, 15 to 35 percent of the surface of the Tremant soil is covered with pebbles. The surface layer is light brown gravelly fine sandy loam about 1 inch thick. The upper 7 inches of the subsoil is light reddish brown fine sandy loam. The next part is reddish yellow gravelly loam about 33 inches thick. The lower part to a depth of 60 inches or more is reddish yellow clay loam. In places the surface layer is sandy loam. In some areas that have not been cultivated, the surface is very gravelly. The soil is nonsaline to moderately saline (electrical conductivity of 0.8 to 12.4 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches. In some areas a very limy layer is below a depth of 20 inches.

Permeability is moderately slow. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderately high.

This unit is used mainly for irrigated cotton, small grain, alfalfa hay, citrus, or grapes. It also is used as rangeland. It is limited mainly by the content of toxic salts and droughtiness.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of this soil. Leveling cuts are needed for the efficient application of irrigation water. In the more sloping areas, the amount of soil that must be moved if fields are leveled may be prohibitive. A graded system is more feasible in these areas. Leveling cuts can be made to a depth of about 40 inches. Water can be distributed by earth ditches, lined ditches, and pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. In areas that are slightly or moderately saline, yields of some crops are limited and the choice of plants is restricted. Leaching is needed to prevent salt from building up in the soil, particularly if graded irrigation systems are used. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas is mainly creosotebush and annual grasses. The potential plant community is mainly creosotebush, white bursage, annual grasses, and annual forbs. Major browse species are white bursage and white ratany. These species make up about 15 percent of the plant community. Perennial grasses and forbs, including bush muhly and big galleta, make up 10 percent of the plant community. Annual grasses and forbs make up 20 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees. It is poorly suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass is IIIs, irrigated, and VIIs, nonirrigated. This soil is in the Limy Fan, 2-7" precipitation zone range site.

60—Tucson loam. This deep, well drained soil is on basin floors. It formed in alluvium derived dominantly from mixed rocks. Elevation ranges from 700 to 800 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

Included with this soil in mapping are small areas of Denure, Mohall, and Tremant soils. These soils make up about 20 percent of the map unit. The percentage varies from one area to another.

Typically, 1 to 15 percent of the surface of the Tucson soil is covered with pebbles. The surface layer is light brown loam about 12 inches thick. The upper 5 inches of the subsoil is light brown loam. The lower part to a depth of 60 inches or more is brown and light brown clay loam. A very limy layer is at a depth of about 17 inches. Depth to the very limy layer ranges from 6 to 20 inches. In places the surface layer is fine sandy loam. In some areas at the lower end of some fields that have been irrigated with sediment-laden water, the surface layer is dark brown clay loam. The soil is nonsaline to moderately saline (electrical conductivity of 1.8 to 11.0 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is moderately slow. Available water capacity is very high. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderate.

This soil is used for irrigated cotton, safflower, or small grain. It is limited mainly by the very limy layer.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of this soil. Leveling cuts are needed for the efficient application of irrigation water. In the more sloping areas, the amount of soil that must be moved if fields are leveled may be prohibitive. A graded system is more feasible in these areas. Keeping leveling cuts to a minimum helps to prevent exposing the very limy layer. Sensitive crops suffer from iron chlorosis because of the very limy layer. Applications of sulfur, manure, or gin trash are beneficial in leveled areas where cuts have exposed the very limy layer. Water can be distributed by earth ditches, lined ditches, and pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. In areas that are slightly saline, yields of some crops are limited and the choice of plants is restricted. Leaching is needed to prevent salt from building up in the soil, particularly if graded irrigation systems are used. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

This unit is moderately well suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass is IIs, irrigated, and VIIs, nonirrigated.

61—Vaiva-Quilotosa extremely gravelly sandy loams, 3 to 25 percent slopes. This map unit is on granitic hills. The native vegetation is mainly desert shrubs and trees, annual grasses, and cacti. Elevation ranges from 1,600 to 2,200 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 50 percent Vaiva soil and 25 percent Quilotosa soil. These soils are on gently sloping to moderately steep hills. They occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of rock outcrop on hills; Gunsight, Momoli, and Pinamt soils on small fan terraces between hills; and Carrizo soils on flood plains (washes) that dissect the hills and fan terraces. Included areas make up about 25 percent of the map unit. The percentage varies from one area to another.

The Vaiva soil is very shallow and shallow and is somewhat well drained. It formed in alluvium and colluvium derived dominantly from granite and gneiss rocks. Typically, 50 to 85 percent of the surface is covered with pebbles. The surface layer is light brown extremely gravelly sandy loam about 2 inches thick. The subsoil is yellowish red very gravelly sandy clay loam about 4 inches thick. The underlying material is weathered and fractured granite and gneiss about 13 inches thick. Unweathered granite and gneiss is at a depth of about 19 inches. The depth to weathered bedrock ranges from 4 to 16 inches. The depth to unweathered bedrock ranges from 7 to 20 inches.

Permeability is moderate in the Vaiva soil. Available water capacity is very low. Potential rooting depth is 4 to 16 inches. Runoff is rapid, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is slight.

The Quilotosa soil is very shallow and shallow and is somewhat excessively drained. It formed in alluvium and colluvium derived dominantly from granite and gneiss. Typically, 60 to 90 percent of the surface is covered with pebbles, cobbles, and stones. The surface layer is pale brown extremely gravelly sandy loam about 2 inches thick. The upper 4 inches of the underlying material is brown extremely gravelly sandy loam. The next 8 inches is light yellowish brown extremely gravelly sandy loam. The lower part of the underlying material is weathered granite about 5 inches thick. Unweathered granite is at a depth of about 19 inches. The depth to weathered bedrock ranges from 6 to 15 inches. The depth to unweathered bedrock ranges from 9 to 20 inches.

Permeability is moderately rapid in the Quilotosa soil. Available water capacity is very low. Potential rooting depth is 6 to 15 inches. Runoff is rapid, and the hazard of water erosion is slight or moderate. The hazard of wind erosion is slight.

This unit is used mainly as rangeland.

The present vegetation in most areas of the Vaiva soil is mainly creosotebush, white bursage, brittlebush, and paloverde. The potential plant community is mainly white bursage, ratany, Mormon tea, and littleleaf paloverde. Major browse species are white bursage, littleleaf paloverde, and narrowleaf ditaxis. These species make up about 55 percent of the plant community. Perennial grasses and forbs make up 5 percent of the plant community, and annual grasses and forbs make up 10 percent.

The present vegetation in most areas of the Quilotosa soil is mainly creosotebush, brittlebush, cholla, and ocotillo. The potential plant community is mainly creosotebush, littleleaf paloverde, and cacti. Major browse species are littleleaf paloverde, white bursage, and white ratany. These species make up about 25 percent of the plant community. Annual grasses and forbs make up 10 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

This unit is unsuited to irrigated crops. It is limited mainly by droughtiness, the slope, and the depth to bedrock.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability subclass is VIIs. The Vaiva soil is in the Shallow Upland, 2-7" precipitation zone range site, and the Quilotosa soil is in the Limy Hills, 2-7" precipitation zone range site.

62—Vaiva-Quilotosa extremely stony sandy loams, 25 to 55 percent slopes. This map unit is on hills and mountains of sandstone and conglomerate. The native vegetation is mainly desert trees, shrubs, and cacti. Elevation ranges from 800 to 1,500 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 70 percent Vaiva soil and 20 percent Quilotosa soil. The Vaiva soil is on steep or very steep, stable hills and mountains. The Quilotosa soil is on steep or very steep, active hills and mountains. The two soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Gunsight soils on small fan terraces and rock outcrop in drainageways. Included areas make up about 10 percent of the map unit. The percentage varies from one area to another.

The Vaiva soil is very shallow and shallow and is somewhat well drained. It formed in alluvium and colluvium derived dominantly from sandstone and conglomerate. Typically, the surface layer is light brown extremely stony sandy loam about 2 inches thick. The subsoil is yellowish red and red extremely gravelly sandy clay loam about 7 inches thick. Weathered conglomerate is at a depth of about 9 inches. Unweathered conglomerate is at a depth of about 21 inches. The depth to unweathered bedrock is more than 20 inches. The depth to weathered bedrock ranges from 8 to 21 inches. In some areas the surface layer is calcareous.

Permeability is moderate in the Vaiva soil. Available water capacity is very low. Potential rooting depth is 8 to 21 inches. Runoff is rapid, and the hazard of water erosion is severe. The hazard of wind erosion is slight.

The Quilotosa soil is shallow and somewhat excessively drained. It formed in colluvium derived dominantly from sandstone and conglomerate. Typically, 90 to 95 percent of the surface is covered with stones, cobbles, and pebbles. The surface layer is light brown extremely stony sandy loam about 2 inches thick. The subsoil is yellowish red extremely gravelly sandy loam about 8 inches thick. Weathered conglomerate is at a depth of about 10 inches. Unweathered conglomerate is at a depth of about 21 inches. The depth to weathered bedrock ranges from 10 to 21 inches. The depth to unweathered bedrock is more than 20 inches. In some areas the surface layer is calcareous.

Permeability is moderately rapid in the Quilotosa soil. Available water capacity is very low. Potential rooting depth is 10 to 21 inches. Runoff is rapid, and the hazard of water erosion is severe. The hazard of wind erosion is slight.

This unit is used mainly as rangeland.

The present vegetation in most areas of the Vaiva soil is mainly creosotebush, brittlebush, buckhorn cholla, and paloverde. The potential plant community is mainly littleleaf paloverde, white brittlebush, narrowleaf ditaxis, and white bursage. Major browse species are littleleaf paloverde, narrowleaf ditaxis, and white bursage. These species make up about 45 percent of the plant community. Perennial grasses and forbs, including desert globemallow, make up 10 percent of the plant community. Annual grasses and forbs make up 5 percent.

The present vegetation in most areas of the Quilotosa soil is mainly creosotebush, brittlebush, buckhorn cholla, and paloverde. The potential plant community is mainly littleleaf paloverde, white bursage, and white brittlebush. Major browse species are littleleaf paloverde and white bursage. These species make up about 35 percent of the plant community. Perennial grasses and forbs, including bush muhly and threeawn, make up 20 percent of the plant community. Annual grasses and forbs make up 10 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit does not respond to improved grazing management in a reasonable length of time.

This unit is unsuited to irrigated crops. The main limitations are the depth to bedrock, droughtiness, and the slope.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability subclass is VIIe. Both soils are in the Granitic Hills, 2-7" precipitation zone range site.

63—Vint very fine sandy loam. This deep, excessively drained soil is on flood plains along the Gila River. It formed in recent alluvium derived dominantly from mixed rocks. The vegetation in areas that have not been cultivated is mainly desert trees, shrubs, and annual grasses. Slope is 0 to 1 percent. Elevation ranges from 430 to 850 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

Included with this soil in mapping are small areas of Indio, Lagunita, and Ripley soils. These soils make up about 25 percent of the map unit. The percentage varies from one area to another.

Typically, the surface layer of the Vint soil is pale brown very fine sandy loam about 7 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray loamy fine sand, fine sand, and sand that have thin strata of finer textured material. In some areas the surface layer is loamy fine sand. The soil is nonsaline to slightly saline (electrical conductivity of 1.0 to 7.5 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is moderately rapid. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderately high. This soil generally is subject to occasional periods of flooding, but the risk of flooding is reduced by dams on the Gila River and its tributaries.

This unit is used mainly as rangeland. It also is used for irrigated cotton, barley, or alfalfa hay. It is limited mainly by droughtiness, the hazard of flooding, and the hazard of wind erosion.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of this soil. Keeping leveling cuts to a minimum helps to prevent exposing the sand. Applications of manure or gin trash are beneficial in leveled areas where sand is exposed.

Water can be distributed by earth ditches, lined ditches, and pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. Because the soil is droughty, applications of irrigation water should be light and frequent. The hazard of wind erosion can be reduced by keeping the soil rough and cloddy if it is not protected by vegetation or crop residue. In areas that are slightly saline, yields of some crops are limited and the choice of plants is restricted. Leaching is needed to prevent salt from building up in the soil, particularly if graded irrigation systems are used. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas is mainly paloverde, arrowweed, and mesquite. The potential plant community is mainly big galleta, mesquite, and desert saltbush. Major browse species are mesquite, desert saltbush, and fourwing saltbush. These species make up about 30 percent of the plant community. Perennial grasses and forbs, including big galleta, make up 30 percent of the plant community. Annual grasses and forbs make up 20 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit responds to improved grazing management in a reasonable length of time.

Livestock prefer this unit to most others in the survey area because of its accessibility and the availability of water. As a result, overgrazing and the subsequent deterioration of the vegetation are management concerns. Overgrazing increases the hazard of wind erosion and the likelihood of gullying.

This soil no longer benefits from the regular flooding of the Gila River because of protection provided by flood-control structures, such as Painted Rock Dam. The production of shrubs, grasses, and forbs on this soil resembles that on similar upland range sites. Because of a water table at a moderate depth, however, the soil can produce moderate stands of scattered very large trees or closely spaced shrubby trees.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional, long or very long periods of flooding. The vegetation in recently flooded areas is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation becomes reestablished and the area may provide seasonal grazing for livestock. In irrigated areas, repairing ditches and releveling are commonly needed after periods of flooding. Root plowing to a depth of 12 to 18 inches is needed to remove the saltcedar.

This unit is moderately well suited to desertic riparian herbaceous plants and desertic riparian shrubs and trees. It is very poorly suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass is IVw, irrigated, and VIIw, nonirrigated. This soil is in the Sandy Bottom, 2-7" precipitation zone range site.

64—Wellton loam. This deep, well drained soil is on basin floors and fan terraces. It formed in alluvium derived dominantly from mixed rocks. The native vegetation is mainly desert shrubs, annual forbs, and annual grasses. Slope is 0 to 1 percent. Elevation ranges from 700 to 750 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

Included with this soil in mapping are small areas of Mohall and Tucson soils. These soils make up about 25 percent of the map unit. The percentage varies from one area to another.

Typically, 1 to 15 percent of the surface of the Wellton soil is covered with pebbles. The surface layer is light brown loam about 10 inches thick. The upper 45 inches of the subsoil is light brown and light reddish brown gravelly loam. The lower part to a depth of 60 inches or more is yellowish red gravelly clay loam. In places the surface layer is fine sandy loam or gravelly loam. In some areas at the lower end of some fields that have been irrigated with sediment-laden water, the surface layer is dark brown clay loam. In some places a very limy layer is below a depth of 20 inches. The soil is nonsaline to slightly saline (electrical conductivity of 0.3 to 6.0 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is moderate. Available water capacity also is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderate.

This unit is used mainly for irrigated cotton or small grain. It also is used as rangeland. It is limited mainly by droughtiness.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of this soil. Leveling cuts are needed for the efficient application of irrigation water. In the more sloping areas, the amount of soil that must be moved if fields are leveled may be prohibitive. A graded system is more feasible in these areas. Leveling cuts can be made to a depth of about 40 inches. Water can be distributed by earth ditches, lined ditches, and pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. In areas that are slightly saline, yields of some crops are limited and the choice of plants is restricted. Leaching is needed to prevent salt from building up in the soil, particularly if graded irrigation systems are used. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas is mainly creosotebush, annual forbs, and grasses. The potential plant community is mainly creosotebush, white bursage, and white ratany. Major browse species are white bursage and white ratany. These species make up about 15 percent of the plant community. Perennial grasses and forbs, including bush muhly and big galleta, make up about 10 percent of the plant community. Annual grasses and forbs make up 15 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. Overgrazing increases the hazard of wind erosion. This unit responds to improved grazing management in a reasonable length of time.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees. It is moderately well suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass is IIs, irrigated, and VIIs, nonirrigated. This soil is in the Limy Fan, 2-7" precipitation zone range site.

65—Wellton complex. This map unit is on fan terraces. The native vegetation is mainly desert shrubs, annual forbs, and annual grasses. Slope is 0 to 1 percent. Elevation ranges from 720 to 760 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 60 percent Wellton very gravelly fine sandy loam and 20 percent Wellton loamy fine sand. The two soils occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping are small areas of Mohall, occasionally flooded, soils on flood plains (washes) and Growler and Mohall soils on fan terraces. Included areas make up about 20 percent of the map unit.

The Wellton soil is deep and well drained. It formed in alluvium derived dominantly from mixed rocks. Typically, 35 to 60 percent of the surface is covered with pebbles and pan fragments. The surface layer is light brown very gravelly fine sandy loam about 3 inches thick. The upper part of the subsoil is light brown fine sandy loam about 7 inches thick. The next 45 inches is light brown and light reddish brown gravelly loam. The lower part of the subsoil to a depth of 60 inches or more is yellowish red gravelly clay loam. In 20 percent of the mapped areas, the surface layer is loamy fine sand. In places the surface layer is very gravelly loam, gravelly fine sandy loam, gravelly loam, or fine sandy loam. In some areas a very limy layer is below a depth of 20 inches. The soil is nonsaline to slightly saline (electrical conductivity of 0.5 to 4.8 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is moderate. Available water capacity also is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is slight in areas of Wellton very gravelly fine sandy loam and high in areas of Wellton loamy fine sand.

This unit is used mainly as rangeland. It can be used for irrigated crops. It is limited mainly by droughtiness. Wellton loamy fine sand also is limited by the hazard of wind erosion and a fast intake rate.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of these soils. The method used generally is governed by the crop. Leveling cuts are needed for the efficient application and removal of irrigation water in sloping areas. In the more sloping areas, the amount of soil that must be moved if fields are leveled may be prohibitive. A graded system is more feasible in these areas. Leveling cuts can be made to a depth of about 40 inches. Water can be distributed by earth ditches, lined ditches, and pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. Because of the limited available water capacity in the surface layer, light and frequent applications of irrigation water are needed when plants are young. The hazard of wind erosion can be reduced by keeping the soils rough and cloddy if they are not protected by vegetation or crop residue. The included areas in washes are subject to flooding. Where these areas are adjacent to cropland that is not protected by dikes and diversions, the cropland also is subject to flooding. In areas that are slightly saline, yields of some crops are limited and the choice of plants is restricted. Leaching is needed to prevent salt from building up in the soil, particularly if graded irrigation systems are used. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas of Wellton very gravelly fine sandy loam is mainly creosotebush and white bursage. The potential plant community is mainly creosotebush, white bursage, and white ratany. Major browse species are white bursage and white ratany. These species make up about 10 percent of the plant community. Annual grasses and forbs make up 5 percent.

The present vegetation in most areas of Wellton loamy fine sand is mainly big galleta, creosotebush, white bursage, and annual grasses. The potential plant community is mainly big galleta, creosotebush, white bursage, and annual forbs. Major browse species are white bursage and white ratany. These species make up about 25 percent of the plant community. Perennial grasses and forbs, including big galleta, make up 20 percent of the plant community. Annual grasses and forbs make up 20 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. Overgrazing increases the hazard of wind erosion in areas of Wellton loamy fine sand. This unit responds to improved grazing management in a reasonable length of time.

This unit is very poorly suited to desertic herbaceous plants and desertic shrubs and trees for wildlife habitat.

The capability subclass of Wellton very gravelly fine sandy loam is IIs, irrigated, and VIIs, nonirrigated. The capability subclass of Wellton loamy fine sand is IIIe, irrigated, and VIIe, nonirrigated. Wellton very gravelly fine sandy loam is in the Limy Upland (deep), 2-7" precipitation zone range site, and Wellton loamy fine sand is in the Limy Fan (sandy), 2-7" precipitation zone range site.

66—Why gravelly fine sandy loam. This deep, somewhat excessively drained soil is on alluvial fans and flood plains (washes). It formed in stratified alluvium derived dominantly from mixed rocks. The native vegetation is mainly desert shrubs, annual forbs, and annual grasses. Slope is 0 to 1 percent. Elevation ranges from 500 to 1,400 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

Included with this soil in mapping are small areas of Momoli soils on fan terraces and small areas of soils that are similar to the Why soil but contain more gravel throughout. Also included, on flood plains (washes), are Carrizo soils; Mohall, occasionally flooded, soils; and soils that are similar to the Why soil but have sand and gravel at a moderate depth. Included soils make up about 25 percent of the map unit. The percentage varies from one area to another.

Typically, 15 to 35 percent of the surface of the Why soil is covered with pebbles. The surface layer is light brown, stratified gravelly fine sandy loam about 11 inches thick. The upper 20 inches of the subsoil is strong brown sandy loam. The lower part to a depth of 60 inches or more is strong brown and pink gravelly sandy loam. The soil is nonsaline to moderately saline (electrical conductivity of 0.5 to 13.6 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is moderately rapid. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight. The hazard of wind erosion is moderately high. The soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. The occasional, very brief periods of flooding occur mainly in summer and winter.

This unit is used as rangeland. It can be used for irrigated crops. It is limited mainly by droughtiness, the hazard of flooding, and the hazard of wind erosion.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of this soil. The method used generally is governed by the crop. Leveling cuts are needed for the efficient application and removal of irrigation water in sloping areas. In the more sloping areas, the amount of soil that must be moved if fields are leveled may be prohibitive. A graded system is more feasible in these areas. Leveling cuts can be made to a depth of about 40 inches. Water can be distributed by earth ditches, lined ditches, and pipelines. Lining ditches with concrete or installing pipelines helps to prevent the loss of water and improves the management of irrigation water. Because the soil is droughty, applications of irrigation water should be light and frequent. The risk of flooding can be reduced by installing dikes and diversions. In areas that are slightly saline, yields of many crops are limited and the choice of plants is restricted. Leaching is needed to prevent salt from building up in the soil, particularly if graded irrigation systems are used. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas is mainly creosotebush, triangle bursage, paloverde, and ironwood. The potential plant community is mainly littleleaf paloverde, creosotebush, and desertthorn. Major browse species are littleleaf paloverde, catclaw acacia, and blue paloverde. These species make up about 30 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 20 percent of the plant community. Annual grasses and forbs make up 15 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit responds to improved grazing management in a reasonable length of time. Periodic flooding increases the amount of forage available. Overgrazing increases the hazard of wind erosion and the likelihood of gullying.

This unit is moderately well suited to desertic riparian herbaceous plants and desertic riparian shrubs and trees. It is poorly suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass is IIIw, irrigated, and VIIw, nonirrigated. This soil is in the Sandy Bottom, 2-7" precipitation zone range site.

67—Why-Carrizo complex, 0 to 3 percent slopes. This map unit is on alluvial fans and flood plains (washes). The native vegetation is mainly desert trees, shrubs, and cacti. Elevation ranges from 500 to 1,400 feet. The average annual precipitation is 5 to 7 inches, the average annual air temperature is 70 to 74 degrees F, and the average frost-free period is 260 to 320 days.

This unit is about 30 percent Why soil and 25 percent Carrizo soil. About 20 percent of the unit is made up of a soil that is similar to the Why soil but has sand and gravel at a moderate depth. The Why soil is on alluvial fans, and the Carrizo soil is on adjoining flood plains (washes). The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Denure, Growler, and Momoli soils on fan terraces; areas, on flood plains (washes), of Momoli, occasionally flooded, soils, Cuerda soils, and soils that are similar to the Cuerda soils but have sand and gravel at a moderate depth; and small areas of soils that are similar to the Why soil but have more gravel throughout and soils that are similar to the Carrizo soil but have less gravel throughout. Included areas make up about 25 percent of the map unit. The percentage varies from one area to another.

The Why soil is deep and somewhat excessively drained. It formed in stratified alluvium derived dominantly from mixed rocks. Typically, 15 to 35 percent of the surface is covered with pebbles. The surface layer is light brown, stratified sandy loam about 11 inches thick. The upper 20 inches of the subsoil is strong brown sandy loam. The lower part to a depth of 60 inches or more is strong brown and pink gravelly sandy loam. The soil is nonsaline to slightly saline (electrical conductivity of 0.6 to 8.0 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is moderately rapid in the Why soil. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is very slight or slight. The hazard of wind erosion is moderately high. The soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. The occasional, very brief periods of flooding occur mainly in summer and winter.

The Carrizo soil is deep and excessively drained. It formed in recent alluvium derived dominantly from mixed rocks. Typically, 50 percent of the surface is covered with pebbles. The surface layer is light brown, stratified very gravelly sandy loam about 9 inches thick. The underlying material, to a depth of about 40 inches, is light brown very gravelly coarse sand and loamy coarse sand that have thin strata of finer textured material. Below this is a buried subsoil of strong brown very gravelly loamy coarse sand and coarse sand 20 or more inches thick. The soil is nonsaline to slightly saline (electrical conductivity of 0.3 to 6.0 millimhos per centimeter) in the upper 20 inches; however, salinity may be considerably higher in the surface crust and below a depth of 20 inches.

Permeability is very rapid in the Carrizo soil. Available water capacity is very low. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is very slight or slight. The hazard of wind erosion is slight. The soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. The occasional, very brief periods of flooding occur mainly in summer and winter.

This unit is used mainly as irrigated cropland. A few areas are used as rangeland or as homesites. The soils are limited mainly by droughtiness and the hazard of flooding. The Why soil also is limited by the hazard of wind erosion.

Furrow, border, basin, sprinkler, and drip irrigation systems are suitable in areas of these soils. Leveling cuts are needed for the efficient application of irrigation water. In the more sloping areas, the amount of soil that must be moved if fields are leveled may be prohibitive. A graded system is more feasible in these areas. Keeping leveling cuts to a minimum helps to prevent exposing the sand and gravel in areas of the Carrizo soil. Applications of manure or gin trash are beneficial in leveled areas where sand and gravel are exposed. Water can be distributed by lined ditches or pipelines. Because the soils are droughty, applications of irrigation water should be light and frequent. The hazard of wind erosion can be reduced by keeping the soils rough and cloddy if they are not protected by vegetation or crop residue. The risk of flooding can be reduced by installing dikes and diversions. In areas that are slightly saline, yields of many crops are limited and the choice of plants is restricted. Leaching is needed to prevent salt from building up in the soil, particularly if graded irrigation systems are used. Leaching is especially critical in areas where the quality of the water is poor. Irrigating with water that is strongly affected by salts or sodium may result in a concentration of these substances in the soil over a period of time. The condition of the soil can be maintained or improved by returning crop residue to the soil and by keeping tillage to a minimum. Onsite investigation is advisable before irrigation systems are planned or cuts for leveling are made.

The present vegetation in most areas of the Why soil is mainly creosotebush, desert saltbush, paloverde, and ironwood. The potential plant community is mainly littleleaf paloverde, creosotebush, big galleta, and desertthorn. Major browse species are littleleaf paloverde, ironwood, and catclaw acacia. These species make up about 30 percent of the plant community. Perennial grasses and forbs, including big galleta and bush muhly, make up 20 percent of the plant community. Annual grasses and forbs make up 15 percent.

The present vegetation in most areas of the Carrizo soil is mainly paloverde, ironwood, burrobrush, and cacti. The potential plant community is mainly littleleaf paloverde, ironwood, creosotebush, and desertthorn. Major browse species are littleleaf paloverde, ironwood, and catclaw acacia. These species make up about 30 percent of the plant community. Perennial grasses and forbs, including big galleta, make up 15 percent of the plant community. Annual grasses and forbs make up 20 percent.

The major management concern is the utilization of the ephemeral range as it becomes available. Grazing management measures that permit efficient use of annual forage and meet the needs of the perennial plants and the animals on the range should be used. This unit responds to improved grazing management in a reasonable length of time. Periodic flooding increases the amount of forage available. Overgrazing increases the hazard of wind erosion and the likelihood of gullying.

A portion of this unit is within the flood pool of Painted Rock Dam and is subject to occasional, long or very long periods of flooding. The vegetation in recently flooded areas is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. As the floodwaters subside, these shrubs die out in a short time. If no further flooding occurs, the native vegetation becomes reestablished and the area may provide seasonal grazing for livestock. In irrigated areas, repairing ditches and releveling are commonly needed after periods of flooding. Root plowing to a depth of 12 to 18 inches is needed to remove the saltcedar.

This unit is poorly suited to homesite development. It is limited mainly by the hazard of flooding, the instability of cutbanks for shallow excavations, and a poor filtering capacity, which affects septic tank absorption fields.

This unit is moderately well suited to desertic riparian herbaceous plants and desertic riparian shrubs and trees. It is very poorly suited to irrigated grain and seed crops and irrigated domestic grasses and legumes for wildlife habitat.

The capability subclass of the Why soil is IIIw, irrigated, and VIIw, nonirrigated. The capability subclass of the Carrizo soil is VIw, irrigated, and VIIw, nonirrigated. Both soils are in the Sandy Bottom, 2-7" precipitation zone range site.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pastureland, forest land, or other land, but it is not urban or built-up land or water areas. The soil qualities, growing season, and moisture supply are those needed for the soil to economically produce sustained high yields of crops when proper management, including water management, and acceptable farming methods are applied. In general, prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content, and few or no rocks. It is permeable to water and air. It is not excessively erodible or saturated with water for long periods, and it either is not frequently flooded during the growing season or is protected from flooding. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

About 157,592 acres, or nearly 11.1 percent of the survey area, would meet the requirements for prime farmland if an adequate and dependable supply of irrigation water were available.

A recent trend in land use in some parts of the survey area has been the loss of some prime farmland to urban and industrial uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed at the end of this section. This list does not constitute a recommendation for a particular land use. On some soils included in the list, measures that overcome a hazard or limitation, such as flooding, wetness, and droughtiness, are needed. Onsite evaluation is needed to determine whether or not the hazard or limitation has been overcome by corrective measures. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

The map units that meet the requirements for prime farmland are:

1	Agualt and Ripley soils
13	Dateland very fine sandy loam
14	Dateland-Cuerda complex, 0 to 3 percent slopes
16	Denure sandy loam
17	Denure gravelly fine sandy loam, 1 to 3 percent slopes
20	Denure-Coolidge complex, 1 to 3 percent slopes
27	Gilman very fine sandy loam
29	Glenbar silty clay loam
41	Indio silt loam
44	Mohall fine sandy loam
45	Mohall loam
47	Mohall clay loam
59	Tremant gravelly fine sandy loam
60	Tucson loam
64	Wellton loam
66	Why gravelly fine sandy loam

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 to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral 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 rangeland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the 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 the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

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

Health officials, highway 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.

Irrigated Crops

Smith W. Covey and Stephen G. Smarik, district conservationists, Natural Resources Conservation Service, helped prepare this section.

General management needed for irrigated crops is suggested in this section. The major crops grown in the area are identified, the system of land capability classification used by the Natural Resources Conservation Service is explained, and the estimated yields of the main crops are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

History of Irrigated Farming

The area along the Gila River was first farmed in the 1860's. The Gila River Ditch Company came into existence in 1871. In 1882, G.W. Webb constructed 16 miles of canal in the area. He envisioned a fruit-producing settlement similar to Riverside, California. Construction on Wolfey's Canal (also referred to as the Peoria Canal and the Gila Bend Canal) began on May 16, 1891.

Many attempts were made to dam the Gila River below the mouth of the Hassayampa River. In 1906, owners of the Enterprise Ranch built a dam of earth and brush to divert water into the Enterprise Canal, which had been constructed in 1886. Frank A. Gillespie of Oklahoma constructed a concrete dam at this location in 1921 (Granger, 1960). This dam still stands where the Gila River enters at the northern boundary of the survey area.

By the late 1920's, approximately 16,000 acres was under cultivation in the vicinity of the Enterprise Ranch and Theba, part of the Gila Water Company project. Cotton and alfalfa were the principal crops. Short staple varieties of Acala and Mebane yielded an average of 0.7 bale per acre and a maximum of 1.0 bale per acre. Alfalfa was commonly cut twice in the spring, after which the fields were allowed to dry and the crop to go to seed. After the seed had been harvested in the fall, the land was again irrigated and cattle and sheep pastured through the winter on the new growth. This system resulted in average yields of 2½ tons of hay and 75 to 80 pounds of seed per acre. The better irrigated lands were valued as high as $125 or more per acre, and raw lands with potential for irrigation were valued at $20 to $25 per acre (Youngs and others, 1928).

Irrigated Farming and Water Quality

Farming is the foundation of the economy in the Gila Bend area. Cotton is still the principal crop. Acreages of alfalfa and small grain vary from year to year. In the Hyder area, small acreages of citrus and grapes also are grown. Approximately 88,000 acres is currently irrigated in the survey area. When commodity prices are high, as much as 100,000 acres is irrigated.

Most of the land is irrigated either by graded furrows or by graded borders. Some of the alluvial soils along the river are irrigated by level furrows or level borders. Nearly 2,000 acres is currently being irrigated by trickle irrigation on the Paloma Ranch west of Gila Bend.

Ground water in the Hyder area contains a large amount of sodium chloride. The total of dissolved solids ranges from 590 to 9,630 ppm, and water temperature ranges from 77 to 104 degrees F. Because of the high or very high levels of sodium and salinity, the water is classified as acceptable or poor for agricultural use. Several of the water samples analyzed contained excessive amounts of boron and lithium (Weist, 1965).

Ground water in the Gila Bend area ranges from 937 to 4,940 ppm total dissolved solids. It also contains high concentrations of sodium and boron. Water temperature ranges from 74 to 85 degrees F (Heindl and Armstrong, 1963).

All of the crops presently grown in the survey area must be irrigated. The major crops grown are alfalfa, cotton, barley, wheat, and grain sorghum. Jojoba also is being developed for commercial production because of the high-quality oil extracted from its beans.

Soil Management

The physical condition of the soil limits or enhances its ability to produce a profitable crop. In some cases, continued loss of topsoil through erosion can severely limit production. Unless proper techniques are used, irrigating with saline-sodic water can also reduce the productive capacity of the soils because the accumulation of salts results in a toxic level of concentration within the root zone.

A soil is in good condition when water, air, plant roots, and micro-organisms can move freely in and through the root zone of the soil. Such soil has good tilth and no compacted layers. Management that involves numerous tillage operations, single crop production, and excessive use of heavy equipment can harm soil tilth and create compacted layers.

Good soil condition also is highly dependent on the return or addition of adequate amounts of organic matter to the soil. The soils of the survey area are subject to high temperatures, which cause rapid oxidation and loss of organic matter. The content of organic matter is typically less than 1 percent.

The hazard of erosion generally does not seriously affect the production of irrigated crops in the survey area. The dry climate does not produce enough precipitation to create serious erosion problems on the long, flat slopes that are farmed in the valleys, and windstorms are generally of short duration. Erosion can occur in localized areas of concentrated water flow or during dust storms associated with frequent summer thunderstorms. Protecting the seedling crops against the abrasive forces of the wind helps to maintain plant vigor.

Wind erosion is a potential hazard on many of the soils in the survey area. A conservation cropping system, crop residue management, and conservation tillage are needed. Establishing windbreaks, mulching, and planting cover crops also help to control wind erosion in the areas that are more susceptible to this hazard.

Cultural Conservation Practices

Erosion is less likely to occur on soils that are in good physical condition. Precipitation readily enters soils that have good tilth. Thus, the runoff rate and the hazard of water erosion are reduced. A high content of organic matter also helps to bind soil particles together, making it harder for them to be dislodged and transported by the wind.

The vegetative cover provided by crops protects the soil from wind erosion and water erosion. Plant cover reduces "splash erosion," which is a term describing erosion caused by the impact of raindrops on the surface. Because the raindrops are intercepted by the plants, the energy of their impact is significantly reduced and the precipitation is allowed to enter the soil. Plant cover also reduces wind velocity at the surface, thus reducing the hazard of wind erosion. Conservation practices that maintain or improve soil condition are those that add organic matter to the soil and that minimize tillage. The most common of these practices are conservation cropping systems, crop residue management, and minimum tillage.

A conservation cropping system involves growing crops in rotations or growing combinations of crops, or both. It also includes the cultural and management practices needed for crop production. Such a system generally results in an economic return and maintains or improves soil condition. Using a good cropping system maintains or improves the physical condition of the soil by maintaining the content of organic matter. A system of crop rotation helps to control weeds, nematodes, insects, and diseases by breaking reproductive cycles or allowing the use of different pesticides. Including high-residue crops in the rotation helps to maintain the content of organic matter. Small grain and grain sorghum, for example, produce large amounts of residue per unit of yield. Vegetables produce only small amounts of crop residue.

Crop residue management is the practice of returning plant residue to the soil. Residue that is high in cellulose, such as wheat straw, may require additional nitrogen fertilizer to aid in decomposition. Additions of nitrogen fertilizer also provide adequate nitrogen for growing crops by offsetting nitrogen that is not available for plant use during the biological breakdown of cellulose. If high-residue crops cannot be economically grown, organic material produced elsewhere can be applied to the soil. Mulching is commonly used to maintain good soil condition. Manure and gin trash are common sources of organic material. The mulch is generally incorporated into the surface layer.

Minimum tillage may be necessary to avoid creating or amplifying soil-related limitations and hazards. This practice limits tillage operations to those that are properly timed, that are essential to the production of a crop, and that do not damage the soil. Limiting tillage minimizes the deterioration of soil structure, helps to prevent soil compaction and the formation of tillage pans, and improves soil aeration, permeability, and tilth.

Commonly, soils that have compacted layers must be mechanically renovated by ripping or subsoiling, which shatters the compacted zones. After these layers or zones are broken up, however, conservation cropping systems, crop residue management, and minimum tillage are needed to maintain good soil condition.

Windbreaks are strips of trees and shrubs established around field boundaries. They form barriers that effectively reduce the velocity of the wind in the field they protect. Windbreaks also help to maintain a better environment for early crop growth. Grain harvesting may also be improved because the windbreaks help to prevent lodging. Irrigation is required for the tree species used in windbreaks. If not properly managed, the trees also tend to use soil moisture from adjacent areas of cropland.

Structural Conservation Practices

The structural practices most commonly needed in the survey area are diversions and waterways. These structures can be expensive to install, but they are generally necessary to protect the resource base.

A diversion is a constructed channel, with a supporting ridge on the lower side, constructed across a slope. It diverts water from areas of excess runoff to sites where the water can be used or disposed of without creating an erosion problem. These diversions are needed to protect fields from flooding in areas where storm flows occur frequently. Most fields in the survey area are protected by some type of diversion, but the runoff is not always released on sites where erosion can be controlled.

Waterways are necessary if no safe outlet exists for a diversion. A waterway is a natural or constructed channel that is shaped or graded and that transports storm flows at a velocity that does not cause erosion. These channels should be kept clear of all brush that reduces the flow capacity. Irrigation is needed on grassed waterways installed in the survey area to maintain a suitable stand of vegetation. These areas may also be used as pasture or hayland or to provide food and cover for wildlife.

Management of Soil Salinity

The chemical properties of soils affect land use limitations and hazards. These limitations can be overcome through special management practices. Calcium carbonate, soluble salts, and sodium are the most common limiting features that affect the soils in the survey area.

Calcium carbonate.—Some soils have high concentrations of calcium carbonate (lime) at varying depths. A high content of lime can adversely affect crop production by reducing the available water capacity of the soil or by chemically preventing the availability of some plant nutrients. Sensitive crops, such as grain sorghum, may show evidence of reduced growth or chlorosis if grown in areas of soils affected by calcium carbonate. If the concentrations of calcium carbonate are exposed during land leveling activities, special treatment is needed. Such treatment may include applications of sulfur, manure, or gin trash. Onsite investigation is necessary to diagnose and treat problems associated with calcium carbonate.

Soluble salts.—Most plant nutrients are available to plants in the form of salts. However, different plant species have different salt-tolerance levels. Bermudagrass and barley are relatively tolerant of large amounts of salt, but citrus, grapes, and many vegetable crops are sensitive to small amounts of salt.

Because of the wide range in salinity of many soils in the survey area, electrical conductivity of 8 millimhos per centimeter was chosen as the break point between two phases of the same series, for example, Indio silt loam and Indio silt loam, saline-sodic. Yields of cotton are reduced when the limit of 8 millimhos per centimeter is exceeded. Cotton was used as the benchmark crop for this purpose because of its importance in the survey area.

Soluble salts are present to some degree in all irrigation water and soils. When soils are irrigated, salts are added to the soil. As water is removed from the soil by plants or by evaporation, these added salts are left behind, thereby increasing the salt concentration in the soil. Some soils are naturally saline and require reclamation before they can be productive (Longnecker and Lyerly, 1974).

Salts are generally removed from the soil by leaching them below the root zone (Longnecker and Lyerly, 1974). Ideally, as water moves through the soil, the accumulated salts are dissolved and move with the water below the effective root zone. Any restrictive zone in the soil profile, however, such as a claypan, a hardpan, or a plowpan, restricts the movement of water through the soil and inhibits the leaching process. Clayey soils are difficult to reclaim because of their slow permeability. Incorporating organic matter into the soil, ripping, or subsoiling can temporarily open the soil so that water can leach the soluble salts from the root zone.

Sodium.—Soils may become sodic through continued irrigation with water that has a high sodium content or with water that is low in calcium and magnesium. Some soils in the survey area are sodic by nature. Water penetration can be adversely affected by high levels of sodium because of soil dispersion. Dispersion of the clay particles significantly reduces the rate that water enters the soil and results in poor soil condition.

Soil amendments are generally necessary to reclaim sodic soils. Amendments can improve water movement into and through the soil by chemically exchanging excess sodium with calcium (Longnecker and Lyerly, 1974). The typical amendment either contains soluble calcium or dissolves calcium already present in the soil. The most common soil amendments used are gypsum (calcium sulfate) and sulfuric acid. Soil amendments are effective in correcting permeability problems caused by excessive sodium, but they do not improve permeability that is restricted by dense layers in the soil (Hoffman).

Amendments added to poor-quality irrigation water also can improve the ratio of sodium to calcium (Ayers and Westcot, 1976) and help to prevent a buildup of excess sodium in the soil. Amending a sodic soil by adding amendments to irrigation water is not practical, however. Adding amendments to the water corrects water-quality problems but not soil-related problems.

Salinity or sodicity varies from one area to another within a map unit or field, and testing of suspect soils is needed to define the extent of the problem. Treatment of saline-sodic conditions can be very expensive. Agricultural experts should be consulted before treatment needs are determined for specific conditions.

Water Management

Water is the most critical natural resource in the survey area. Because there are no significant sources of impounded surface water available for irrigation, irrigation water is supplied by underground aquifers. Pumping lifts currently range from 75 to 600 feet. Water quality varies from good to very poor. Some well water has excessive amounts of salt, sodium, or bicarbonates.

Presently, ground water is being pumped more rapidly than it is being recharged in the survey area. The careful use of irrigation water is critical if crop production is to continue, and waste of irrigation water should be avoided.

Several types of irrigation systems are presently in use throughout the survey area. Each type of system has its applications and its advantages and disadvantages. The agricultural producer should evaluate each field in terms of soils, crops, and quantity and quality of irrigation water and should select the type of irrigation system that is best adapted to a given set of conditions.

Level basin and level furrow irrigation systems are two of the most efficient methods of irrigation used in the survey area. These methods apply a known amount of water to a given area as rapidly as possible. Water penetrates evenly over the entire irrigated area. Leaching can be achieved more effectively and more uniformly with level systems, and soils that are in poor physical condition can be more easily wetted.

The level system is adapted to use for all of the commonly grown crops. It can be installed on most deep soils with slopes of 0.5 percent or less. It is best adapted to soils having an intake rate of 1 inch per hour or less. Level systems have some disadvantages. For example, varying rates of water intake within a field can distort the uniformity of water distribution. Coarse textured soils that take in water rapidly limit the length of an irrigation run. Also, steep slopes or shallow soils limit field or bench width.

Land leveling is necessary when level irrigation systems are installed. The development of laser-controlled earthmoving equipment has greatly improved the construction of these systems. All slopes, ridges, and depressions in a field must be eliminated for the efficient operation of a level system. Detailed onsite investigation is needed prior to land leveling to locate problem soils that may be shallow or too sandy and that will create problems with water distribution after cuts and fills are made.

Installing graded border and graded furrow irrigation systems requires less alteration of the land surface than installing level systems. Graded systems are commonly used where deep cuts made for land leveling would expose poor soil material. In these systems, water is applied at a rate that slightly exceeds the intake rate of the soil. Land leveling is necessary to eliminate irregularities in slope. The amount of water applied, the application time, and the rate of water intake must be monitored during irrigation applications. A tailwater (runoff) recovery system saves water by allowing runoff to be reused. Leaching or replacing soil moisture in soils that are in poor physical condition can be difficult if graded surface irrigation systems are used.

Sprinkler systems are most suitable in areas of moderately coarse textured and coarse textured soils that readily take water. However, these systems can be installed and used with a minimum of landforming. The high evaporation rates that are characteristic of the survey area reduce the application efficiency of sprinkler systems. Consequently, sprinkler systems have been used only on a very limited basis in the survey area. These systems must be properly designed so that crops can be irrigated often enough to avoid crop stress. Portable sprinkler systems are commonly used during germination of vegetable crops, but once the crop is established, surface irrigation systems are used.

The use of drip or trickle irrigation systems is increasing in the survey area. These systems are the most efficient of all irrigation systems in delivering a specific amount of water to the crop. They can be installed with almost no disturbance of the topsoil.

Drip systems are relatively expensive to install because of the need for water filtration and underground pipelines. In common with other highly efficient irrigation systems, they require a high level of management for proper operation. Because this technology is relatively new in the area, some management requirements of the system may not yet be recognized. Proper design and installation of the system are essential if the desired results are to be obtained.

Selection of the proper irrigation systems depends on economics, the soils, and the crops to be grown, but all irrigation systems must be well managed if they are to operate efficiently. Crops may be overirrigated or underirrigated if the proper amount of water needed is not determined.

Several methods of measuring the flow of irrigation water are available. It is possible to measure the amount of water being applied at the well, in the ditch, or in the furrows.

Moisture available in the soil may be estimated by the "feel" of the soil or measured by one of several devices that measure soil moisture or crop canopy temperature. Regular monitoring of soil moisture levels helps the manager to know when fields need irrigating again. Proper scheduling of irrigation applications improves crop yields.

Principal Crops and Estimated Yields

A wide variety of crops are grown in the survey area. In this section, the management practices used to grow five of the most important crops in the survey area are described. Jojoba is not discussed because needed cultural treatment is still in the research and development stage.

Alfalfa (Medicago sativa) is an important part of most cropping systems and is grown for profit and to improve the soils. The crop is grown throughout the year and can be harvested all year. The crop that follows alfalfa benefits from the ability of alfalfa to fix nitrogen.

Varieties of alfalfa grown in the area are nondormant cultivars. The characteristics of this group include a lack of cold tolerance and little or no winter dormancy, quick recovery after cutting, erect stems, and purple flowers (University of Arizona, 1977). The cultivars include Mesa-Sirsa, El-Unico, Sonora-70, Hayden, Moapa-69, UC Salton, and UC-Cargo (University of Arizona, 1977). An important local characteristic is resistance to the spotted alfalfa aphid and to downy mildew.

Eight to ten hay cuttings are normally made each year. Although hay can be harvested throughout the year, hay cut from December through February dries slowly, thus lowering the quality of the hay produced. To utilize the winter growth, sheep from the northern part of the state are usually trucked in to winter on alfalfa.

Yields of more than 10 tons per acre per year are produced most easily on medium textured and moderately fine textured soils.

The average annual consumptive use of water for alfalfa is about 80 inches per acre per year (Erie and others, 1981). The crop is normally irrigated with level basin or graded border irrigation systems. Proper management of any irrigation system is needed to prevent stand depletion. Water standing over the crown for more than 12 hours will kill the plant (University of Arizona, 1977).

A stand of alfalfa is normally grown for 3 or 4 years and is followed by small grain, sorghum, or cotton.

Cotton (Gossipium hirsutum and G. barbadense) is the principal income-producing crop on most farms. Several commercial varieties of G. hirsutum, which is commonly known as short staple or upland cotton, are grown in the survey area. G. barbadense, commonly known as extra long staple or Pima cotton, is an extra long staple Egyptian cotton (Walter E. Parsons, Natural Resources Conservation Service, personal communication).

Most cotton is planted in April when mean soil temperatures are more than 60 degrees F.

Graded furrow and level furrow irrigation systems are the most widely used for cotton. Level basin, sprinkler, and drip systems also are used to some extent in the survey area. The average annual consumptive use of water by cotton is about 41 inches per acre per year (Erie and others, 1981).

Cotton is picked from September through December in most years.

Barley (Hordeum vulgare) and *wheat* (Triticum aestivum) are the winter small grain crops most commonly grown in the area. These crops are planted in rotation with cotton, on newly leveled land, and as intercrops in orchards. The large amounts of crop residue produced by small grain add needed organic matter to the soil. Barley is more tolerant of high salinity levels than wheat and is better adapted for reclamation of saline soils (Dennis and others, 1976 and 1978).

Barley and wheat are adapted to most irrigated soils in the survey area. Variety selection depends on specific site and market conditions. Information on varieties can be obtained from the local office of the Cooperative Extension Service.

Small grain is usually grown in level basins or graded borders, but other types of irrigation systems can be used to supply the needs of these crops. The average annual consumptive use of water is about 25 inches per acre per year for barley and 26 inches per acre per year for wheat (Erie and others, 1981). The peak period of water use occurs in March and April. Small grain is harvested in May and June.

Grain sorghum (Sorghum vulgare) is grown in rotation with most irrigated crops in the survey area. Short- and long-season types are grown. Grain sorghum may be harvested for grain or ensiled for livestock feed. Grain sorghum is not well adapted to soils that have a limy or sodic surface layer. It develops an iron chlorosis under these conditions. Yields can be significantly reduced under severe chloritic conditions.

The average annual consumptive use of water by grain sorghum is about 25 inches per acre per year (Erie and others, 1981).

Grain sorghum may be planted from May through July. Pest control is more critical for late crops than for long-season crops. The short-season types, which are planted in June and July and harvested in October and November, can be used to double-crop behind crops harvested in spring.

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; effective management of irrigation water; and harvesting that ensures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland or for engineering purposes (USDA, 1961).

In the capability system, soils generally are grouped at three levels—capability class, subclass, and unit.

Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use. There are no class V soils in this survey area.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIs. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c* shows that the chief limitation is climate that is very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Rangeland

Daniel G. Robinett, range conservationist, Natural Resources Conservation Service, prepared this section.

Rangeland makes up about 1,344,320 acres in the survey area. In spite of the extreme aridity of the area, it has quite a long history of use as rangeland, especially along the Gila River. The more remote and drier valleys, away from the river, were not developed for grazing until the late 1800's or early 1900's.

Cattle and horses were introduced into Papago country, south of the survey area, in the early 1700's by Father Kino (Bryan, 1925). By 1775, there were several Indian rancherias on the lower Gila River near present-day Gila Bend, Oatman Flats, and Agua Caliente. The villages had livestock; the animals were descendants of those introduced by Kino and grazed the flood plains along the Gila River (Ross, 1923).

Grazing by livestock was probably confined to the river bottom until the Gadsden Purchase in 1853. Until the late 1800's, further introductions of livestock were confined to the stock used by the American miners and prospectors coming into the region. It was not until the turn of the century that ranching on a larger scale, by American cattlemen, was initiated in the drier valleys of the survey area.

In the area around Ajo, Thomas Childs, Sr., was ranching just east of town in 1890. Rueb Daniels had also established a ranch at Bates Wells in 1890. He ranched in this area and up Cuerda de Lena until 1920, when drought forced him to remove his livestock. The Childs family watered their cattle at the Batamote well and at two wells drilled by the New Cornelia Copper Company. With the drilling of the Burro Gap well in 1920, the Childs range expanded into the country between the Batamote and Sauceda Mountains. By 1920, this portion of the survey area was largely used for grazing. Ranches had been established near Ajo, in the Gunsight Mountains, at Bates Wells, and at Pozo Redondo.

In the eastern portion of the survey area, development of the dry valleys did not begin until about 1910. In 1910 and 1912, W.P. Beloat drilled five wells in Rainbow Valley along Waterman Wash. Three of the wells produced stockwater. The southernmost of these watered stock that grazed in the area north of Mobile. In the Little Rainbow Valley, Carl Arnold established ranching in 1900 with the construction of Gibson Tank. The only water at this time in the Vekol Valley consisted of two temporary charcos. One of these was at the northern end of the valley on the south side of the Haley Hills. The other was at the southern end of the valley just west of Table Top Mountain in the Vekol Arroyo. Natural water occurred in the Sand Tank Mountains at Sand Tanks and Mesquite Tank. By 1917, there was a small ranch at the dug well near Mesquite Tank and another at Stouts Well on the northeast side of Squaw Tits Peak. Papago cattle used the southern end of the Vekol Valley in wet periods when the charco there had water. A description of the Vekol Valley in 1920 is as follows:

> The headwaters of the valley were an adobe flat extending about 10 miles to the north. This flat had no trees and was covered with galleta (tobosa grass). Deposition was occurring in this area. At the point of the southern charco the main stream entered a shallow trench from 100 to 300 feet wide, covered with thick mesquite. The stream channel was further incised 5 to 10 feet deep and 10 to 20 feet wide. This arrangement continued north for about 10 miles and then faded out and dumped its water onto a broad flat that narrowed through the gap in the Booth and Haley Hills, then spread out again and ran over grassy flats around Mobile and finally drained off into the Waterman Wash.
>
> The present channel of the Vekol which turns east, south of the Haley hills is a later development. After the construction of Coolidge Dam on the Gila River in 1922, the perennial flow of the river through the Gila River Indian Reservation was terminated. In an attempt to bring another source of water on to the west end of the reservation the Indians diverted the course of the Vekol floodwaters to the east onto the old flood plains of Santa Cruz. Over the years the floodwaters cut the present channel (Bryan, 1925).

Later development for ranching came in this area in the 1930's with the establishment of several ranches in the Vekol Valley and use of the ranges southwest of the Maricopa Mountains (Jack Norris, Bureau of Land Management, personal communication).

The entire length of the Gila River through the survey area was well settled with farms and ranches by 1920. In 1919, A.H. Stout drilled a well in Quilotosa Wash, south of Gila Bend, and established a ranch and farm there. Little of the land west of Stout's ranch and south of the Gila River was used for grazing at this time (Bryan, 1925).

The northwestern portion of the survey area was brought into use for grazing purposes in the late 1800's. John Montgomery's Flower Pot Cattle Company, headquartered at the mouth of the Hassayampa River, ranged largely north of the survey area, but the stock watered at Woolsey Tank in the Gila Bend Mountains and Galleta Well on the Centennial Wash flood plain. Later in the early 1920's, the Gable-Ming clan controlled most of this part of the survey area (Ross, 1923).

Ranching continued to be an important industry in the survey area during these early days. As the years progressed, more water sources were developed in the form of dirt tanks and represos and drilled wells. All of the early ranches were cow ranches, and grazing of very large numbers of steers during lush winter-spring seasons was common during and after World War II. With the advent of the Taylor Grazing Act and subsequent establishment of the Maricopa Grazing District Board in 1936, adjudication of grazing allotments continued until 1950. Fencing of allotments started in 1936. Much of the original boundary fencing was done by Civilian Conservation Corps crews. Fencing of allotment boundaries is still in progress through the adjudication process. Today much of the area is unfenced and consists of waterless valley areas and rugged mountain ridges (Jack Norris, Bureau of Land Management, personal communication).

Some of the ranches in the survey area are several hundred sections in size. Others, especially along the Gila River, are as small as 15 to 20 sections. Some ranches still run a base herd of mother cows. Some are strictly pasture operations that run cattle in the winter-spring period. Although carrying capacities of this type of rangeland are very low for year-long cow operations, they can be very high in years of good spring growth for a period of 3 or 4 months.

Proper range management requires a knowledge of the potential of specific soils in a given climatic area to produce vegetation. Comparing the actual condition of the soil with that soil's potential for producing good rangeland vegetation helps in the planning of management systems.

A range site is a specific kind of rangeland that produces a characteristic natural plant community. The range sites in this survey area have been described within broad areas, or zones, having similar elevations, temperature ranges, and precipitation. The precipitation map shows the three zones in this survey area (fig. 14).

Zone 1, which makes up most of the survey area, has an average annual rainfall of less than 8 inches and an average annual soil temperature of more than 72 degrees F. Most of the precipitation falls in the winter-spring period. Summer rainfall is very erratic, and in some years the area has no summer rainfall. Soils in this zone are very calcareous, and the potential plant communities are dominated by desert trees and shrubs. Characteristic species include creosotebush, littleleaf paloverde, smoketree, white bursage, brittlebush, and big galleta.

Zone 2 has an average annual precipitation of 8 to 10 inches. The average annual soil temperature is more than 72 degrees F. About half of the precipitation falls in the winter-spring period and half in the summer. The winter rains are the more dependable, while summer rains are spotty. Soils in this zone are generally calcareous, at least below the surface layer. Potential plant communities are dominated by desert trees, shrubs, and cacti. Characteristic species include littleleaf paloverde, ironwood, creosotebush, saguaro,

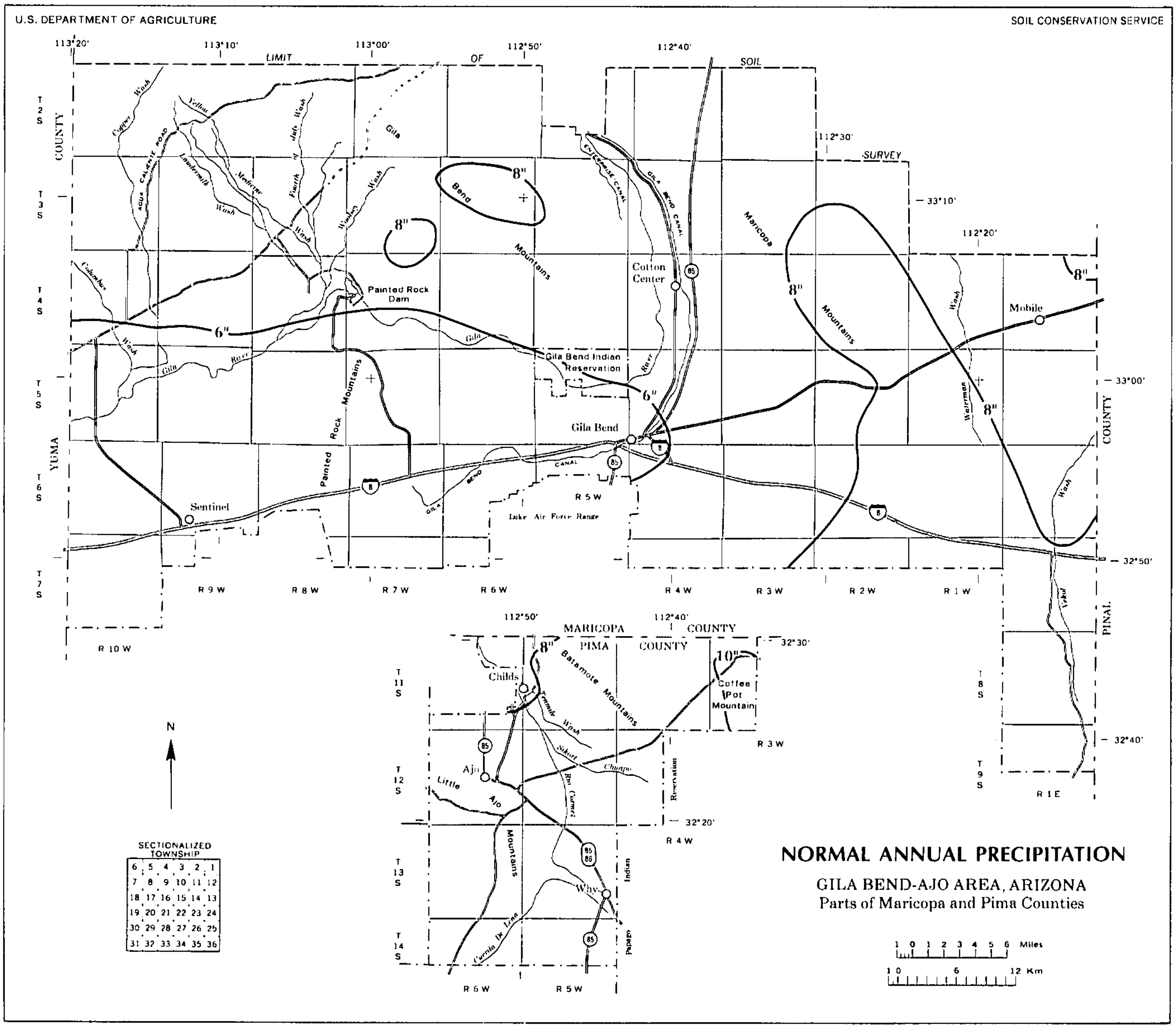

Figure 14.—Normal annual precipitation in the survey area.

buckhorn cholla, triangle bursage, big galleta, bush muhly, and globemallow.

Annual forb species are very important on almost all of the range sites in zones 1 and 2. Both winter and summer annuals grow on these sites. The common species are Indianwheat, filaree, bull filaree, sixweeks fescue, Mediterraneangrass, fiddleneck, hollyhocks, and desert lupine. In good spring seasons these annual species can produce several hundred pounds of feed per acre on the deeper, better suited soils.

Zone 3 has an average annual precipitation of 10 to 12 inches, half of which occurs in the winter-spring season and half in the summer rainy season. The average annual soil temperature is 65 to 69 degrees F. Precipitation in both winter and summer is fairly dependable in this zone. Soils in this zone are calcareous in some phases and not in others. Potential plant communities are dominated by desert trees and shrubs and an understory of perennial grasses and forbs. Characteristic species include littleleaf paloverde, catclaw acacia, whitethorn, jojoba, guajillo, bush muhly, threeawn, Arizona cottontop, slim tridens, and Rothrock grama.

Much of the information used in defining the range sites in the survey area was developed by studying areas of the same kinds of soils in ungrazed locations both within and adjacent to the survey area. Most of the area on the Barry M. Goldwater Air Force Range, which adjoins the southern boundary of the area, has not been grazed by domestic stock. Much of the potential plant community data for range sites in zones 1 and 2 were developed from studies of the soils on this bombing range.

Table 6 shows, for nearly all of the soils in the survey area, the range site and the total annual production of vegetation in favorable, normal, and unfavorable years. Only those soils that are used as rangeland or are suited to use as rangeland are listed. Explanation of the column headings in table 6 follows.

A range site is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and depth to the water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

The range sites in the survey area that need improvement are mainly the Bottom sites and the Sandy Upland site. Large valley areas of relatively unproductive Limy Upland range sites commonly include a small percentage of Sandy Bottom or Loamy Bottom sites. Even though the Bottom sites make up only 10 to 15 percent of the area, grazing management should be geared toward their improvement as they provide the majority of the habitat for both domestic stock and wildlife. The Bottom range sites present a management problem. Because of the extra runoff water they receive, the fine textures of the soils, and a lack of gravel or rock cover, the soils erode easily when the protective plant cover is depleted. Livestock use these areas as travel routes and concentrate in them because of the availability of water, good forage production, shade, and protection.

The Sandy Upland sites also are a management problem. Because they are easily traversed and produce palatable browse and perennial grass forage, they are favored by livestock. As the plant cover is depleted, the soils are very susceptible to wind erosion.

Grazing management in the survey area is generally limited because of the low carrying capacities of the range. On cow ranches, deferred grazing can be accomplished by turning water developments on and off. On the stocker ranches the range can be improved by bringing cattle on during the spring, when the annual forage plants make seed, and taking the animals off when the grazing pattern changes from the annuals to browse and grass.

Many grazing management methods and the facilities needed to implement them have proven effective elsewhere in Arizona but are not feasible in this area because of the very low carrying capacities and the size of the land areas used for ranching.

Recreation

Recreational activities in the survey area include hunting, fishing, camping, picnicking, hiking, sightseeing, target shooting, and rockhounding. Driving off-road vehicles is also popular. There are few developed recreational areas in the survey area. These include local parks at Gila Bend and Ajo, Painted Rocks State Park, and the Buckeye Hills Recreation Area, which is a county park. Painted Rocks State Park offers facilities for picnicking and sightseeing. The Buckeye Hills Recreation Area offers facilities for picnicking, sightseeing, hiking, and target shooting. The Bureau of Land Management and the Boy Scouts of America maintain a portion of the old Butterfield State Route east of Gila Bend. Markers designate spots of historical importance and different types of local vegetation. On land administered by the Bureau of Land Management, hunting and four-wheel driving are the most common types of recreation.

The soils of the survey area are rated in table 7 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. 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 recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 7, 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 a combination of these measures.

The information in table 7 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 9 and interpretations for dwellings without basements and for local roads and streets in table 8.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have gentle 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. Steep slopes and stones or boulders can greatly increase the cost of constructing campsites.

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

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

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

Wildlife

John C. York, biologist, helped prepare this section.

The kinds and combinations of wildlife that inhabit an area depend on the ability of the area to produce vegetation. Determining the factors that limit or hamper the production of vegetation is a purpose of this soil survey.

Kinds, numbers, and mixes of animals on the desert are determined by evolution, weather, and climate, provided there is a suitable soil on which to grow usable vegetation. Animal numbers fluctuate with moisture in the survey area because vegetation fluctuates with moisture. The kinds of animals are relatively fixed (barring human interference), and the mixes are determined by kinds and amounts of vegetation.

Each map unit is rated for its suitability to produce vegetation. This rating is based on limiting factors, including moisture, stoniness, depth to bedrock, salinity or alkalinity, and depth to a hardpan or other limiting layer. Such factors determine the kinds of vegetation that can be produced in a specific map unit and what management problems might be involved.

Vegetative elements of wildlife habitat vary across the survey area. Each map unit is rated for its ability to produce some or all of the following—desertic riparian shrubs, trees, and vines; desertic herbaceous plants; desertic riparian herbaceous plants; desertic shrubs, trees, and vines; grain and seed crops (irrigated); domestic grasses and legumes (irrigated); riparian shrubs, trees, and vines; and riparian herbaceous plants.

Not all soils were rated for each element. Some elements do not apply to all soils. Levels of suitability are assigned for each applicable vegetative element. These levels are expressed as follows:

Well suited means that soil properties are such that vegetation can easily be improved, managed, or created. Soil limitations are moderate, and some management will be necessary to maintain the soil and vegetation.

Moderately well suited means that soil properties are such that vegetation can be improved, managed, or created. Soil limitations are moderate, and management will be necessary to maintain the soil and vegetation.

Poorly suited means that limitations affecting vegetation for wildlife are severe. Managing the resource is possible, but creating vegetation (for example, through planting) may be very difficult. Successful management is questionable.

Very poorly suited means that soil properties are such that it is impractical to attempt to create or improve vegetation. Failure is highly probable. In some cases, however, very poorly suited soils might be managed successfully.

Many rating systems rate units in relation to other similar units. This rating system, however, applies only to this survey area and cannot be compared to any other survey area unless the resource areas are the same.

In general, the Clay Bottom, Sandy Bottom, and Loamy Bottom range sites have been rated moderately well suited or well suited. Saline Bottom sites are rated poorly suited or very poorly suited. Bottom sites are rated higher because of the potential for flooding and extra moisture. Extra moisture provides more opportunities for management on these sites. The rough, broken, rocky, basaltic and volcanic mountains and hills are rated well suited to poorly suited. Management can improve this habitat because of the protection from drying, the microhabitats created by the rock, and the protection from grazing offered by the rock. The Sandy sites are rated poor but can be moderately well suited or well suited, depending on rainfall in winter and early spring. Good winter rains can produce very heavy vegetative growth. If little or no rain falls, however, these sites produce no vegetation. Almost all range sites and map units are limited in some way by the amount of moisture they receive. The very poorly suited map units are usually very dry, rocky, saline, and shallow and have a hardpan. Any significant management of the vegetation is generally not practical.

The following lists indicate the variety of wildlife species that inhabit the survey area (Cockrum, 1960; Olin, 1970; Phillips and others, 1964; Stebbins, 1966). Actual collecting sites are listed where known. For mammals, "within range" means that the survey area is within the known range of the animal. The reptiles are reported according to the habitat in which they would most likely be found. The birds are reported according to documented sightings. It is highly likely that many birds frequenting the survey area have not been reported (Phillips and others, 1964).

Mammals

Bats.—California leaf-nosed (within range); long-nosed (within range); Yuma myotis (Gila Bend); cave myotis (Alamo Canyon, Ajo Mountains); western pipistrelle (Gila Bend, Ajo, Gunsight, Bates Well); Brazilian free-tailed (Bates Well); and greater mastiff (within range).

Hares and rabbits.—Antelope jackrabbit (west of Quitovaquita); black-tailed jackrabbit (within range); and desert cottontail (within range).

Squirrels and allies.—Rock squirrel (Alamo Canyon, Ajo Mountains); white-tailed antelope squirrel (10 miles north of Ajo, Gila Bend); round-tailed ground squirrel (Gunsight, 10 miles north of Ajo, Bates Well); Growler pocket gopher (Ajo, Bates Well); and Cervinus pocket gopher (Gila Bend).

Kangaroo rats and pocket mice.—Taylor's pocket mouse (Gila Bend, Bates Well, Gunsight, Copper Mountain, Valley of the Ajo); Price's pocket mouse (Gila Bend, Crater Mountain); rock pocket mouse (Gila Bend, Crater Mountain); banner-tailed kangaroo rat (Gunsight, Valley of the Ajo, Crater Mountain); Merriam's kangaroo rat (Gunsight, Growler Mine, 4 miles north of Copper Mountain, Copper Mountain); and desert kangaroo rat (10 miles north of Ajo, Bates Well, Gila Bend).

Native rats and mice.—Southern grasshopper mouse (within range); western harvest mouse (within range); cactus mouse (10 miles south of Gila Bend, Crater Mountains, Ajo); deer mouse (Gila Bend area); white-throated wood rat (9 miles east of Papago Well, Agua Dulce, Valley of the Ajo, Growler Mine); and desert wood rat (10 miles north of Ajo, Bates Well, Gila Bend).

Dogs and allies.—Coyote (statewide; Ajo area, Bates Well); kit fox (within range); and gray fox (within range, Bates Well).

Raccoons and allies.—Ringtail (within range); raccoon (along the Gila River).

Weasels, skunks, and allies.—Badger (statewide); spotted skunk (within range); and striped skunk (statewide).

Cats.—Bobcat (statewide); mountain lion (mountains in the survey area).

Javelinas.—Javelina (Sand Tank Mountains, Sauceda Mountains, Coffee Pot Mountain).

Deer and allies.—Mule deer (Ajo, Ajo Mountains, Sauceda Mountains); Coue's white-tailed deer (within range).

Antelope.—Sonoran pronghorned antelope (within range).

Bighorn sheep.—Desert bighorn sheep (Sierra del Ajo, Batamote Mountains, Sauceda Mountains, Coffee Pot Mountains)

Reptiles and Amphibians

Geckos.—Desert gecko (rocky, low areas and hills).

Lizards.—Chuckawalla (rocky, hilly areas with creosote); desert iguana (creosotebush plains); leopard lizard (arid, creosotebush plains); Clark's spiny lizard (Ajo and adjacent mountains); desert spiny lizard (creosotebush areas); tree lizard (riparian areas of mesquite and saltcedar thickets); Arizona brush lizard (mesquite, catclaw, and paloverde trees); desert side-blotched lizard (sandy, rocky washes); desert horned lizard (creosote, cactus arid plains); regal horned lizard (rocky washes, canyons with mesquite and older trees and brush); and Gila monster (almost everywhere, but likes moisture—canyons, washes, irrigated areas).

Snakes.—Western blind snake (rocky hillsides); Mexican boa (rocky brushlands, oases and other damp areas); Pima leaf-nosed snake (upland desert burrower); clouded leaf-nosed snake (sandy, gravelly plains, burrower); western black racer (wide range, avoids heavy vegetative growth); Ajo Mountain whipsnake (semiarid mountain slopes, rocky mountain stream courses); desert patch-nosed snake (dry creosote plains to low mountain slopes, along stream courses); Sonora gopher snake (climber, burrower, wide range); Arizona glossy snake (desert shrubs, burrower); Yuma kingsnake (very wide range; eats other snakes); western long-nosed snake (burrower, wide range); checkered gartersnake (springs, seeps, rivers); western ground snake (riparian areas, areas of sandy soil with subsurface moisture, arrowweed, mesquite); banded sand snake (very good sandy swimmer in creosote/paloverde desert); western shovel-nosed snake (prefers sandy soil, burrower); Sonora shovel-nosed snake (prefers rockier soil than the western shovel-nosed snake); rattlesnakes (very wide range, several species); and Sonora sidewinder (areas of fine, windblown sand).

Toads and frogs.—Western spadefoot toad (washes, flood plains, playas, low areas in desert); Couch's spadefoot toad (creosote desert, arid areas); Great Plains toad (creosote desert, burrower); Sonoran green toad (mesquite grassland, creosotebush desert); Colorado River toad (wide range, mainly in areas of mesquite and creosote along washes); burrowing tree frog (nocturnal burrowing frog of mesquite grasslands, the nearest of which is the Quijotoa Valley); and leopard frog (Gila River or other areas of permanent water).

Tortoise.—Desert tortoise (wide range; large land tortoise, burrowing vegetarian).

Birds

Pigeons and doves.—Band-tailed pigeon (Ajo to Growler Mountains, as transients); white-winged dove (throughout the survey area); mourning dove (throughout the survey area); ground dove (Gila River, farms, mesquite bottoms); and Inca dove (cities and towns in the survey area).

Cuckoos.—Roadrunner (nearly everywhere in the area).

Owls.—Common screech owl (common on deserts in summer); ferruginous owl (Gila Bend area); elf owl (common in the Ajo area); burrowing owl (Gila Bend area); long-eared owl (Bates Well, Ajo area); and short-eared owl (Gila Bend area).

Goat suckers.—Lesser nighthawk (Gila Bend, southwest side of the Papago Reservation).

Hummingbirds.—Costa's hummingbird (best adapted of the desert hummers; common in all of the mountains and foothills in the area); rufous hummingbird (spring migrant through the area); and calliope hummingbird (spring migrant, seen at Papago Well).

Woodpeckers.—Gila woodpeckers (all mountains and foothills in the area); flickers (in saguaro areas).

Flycatchers.—Arizona crested flycatcher (Ajo area); least flycatcher (western part of the survey area); and western flycatcher (Ajo and adjacent mountains).

Larks.—Horned lark (pink race, throughout the Gila Bend area).

Swallows.—Tree swallow (near springs and seeps in the area); bank swallow (along the Gila River).

Wrens.—Cactus wren (common in all areas of mesquite and cholla).

Mockingbirds and thrashers.—Mockingbird (Gila Bend area); Bendire's thrasher (Gila Bend, Ajo, Ajo Mountains); curve-billed thrasher (throughout the area); LeConte's thrasher (open creosotebush desert areas); and Crissal thrasher (along the Gila River).

Thrushes.—Many thrushes winter throughout southern Arizona. The kind depends on the exact location and the time of winter.

Warblers, gnatcatchers, and kinglets.—Blue-gray gnatcatcher (Ajo, Ajo Mountains, and surrounding hills in winter); black-tailed gnatcatcher (throughout the area, year-round).

Silky flycatchers.—Phainopepla (throughout the area in paloverde and mesquite trees in winter; attracted to mistletoe berries on trees).

Wood warblers.—Lucy's warbler (along the Gila River); yellow-breasted chat (along the Gila River). Many warblers are transients throughout the survey area.

Weaver finches.—English sparrow (throughout the area).

Meadowlarks.—Western meadowlark (from Growler Valley to the Ajo area in spring, if good annual vegetation is present); yellow-headed blackbird (Gila River, near springs and seeps; seen at Bates Well); Scott's oriole (from the Gila Bend area to Organ Pipe National Monument, in early spring); rusty blackbird (near water in western parts of the survey area); and red-eyed cowbird (throughout the area in mountain canyons).

Grosbeaks and buntings.—Cardinal (Bates Well north to Gila Bend in brushy sites); Pyrrhuloxia (Ajo region, Growler Valley north to Gila Bend); common grosbeak (Growler Mountains to Gila Bend); blue grosbeak (along the Gila River); and varied bunting (foothill canyons around the Ajo area).

Finches and goldfinches.—While not common, several goldfinches and finches are transients throughout the survey area; brown towhee (Ajo to Papago Well); Abert's towhee (Gila River, a riparian bird); chipping sparrow (Gila River in winter); black-chinned sparrow (Ajo Mountains and vicinity); Scott's sparrow (Ajo Mountains and vicinity); Cassin's sparrow (Growler, Ajo Mountains north to Gila Bend); desert sparrow (throughout deserts in the area); and juncos of many kinds (throughout the survey area, in winter).

Vultures, hawks, and falcons.—Turkey vulture (from Sells west to Ajo, then north through Gila Bend); black vulture (fairly common along the Gila River); red-tailed hawk (common throughout the area); Audubon's caracara (Gila Bend area); sharpshinned hawk (winter visitor); and sparrow hawk (winter visitor).

Quail.—Gambel's quail (Gila Bend area).

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. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

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

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

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

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to the 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 kinds 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 evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and 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 8 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, 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, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and 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 without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, and shrinking and swelling can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, 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, potential for frost action, 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 or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand or clay in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 9 shows the degree and 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 9 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

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

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

Table 9 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, and large stones.

Excessive seepage resulting from rapid permeability in 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. Slope, bedrock, and cemented pans 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 should be considered.

The ratings in table 9 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

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

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

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as the 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 10 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 5 or 6 feet.

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

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

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

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

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 10, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

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

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

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

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

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

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

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high 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 11 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 for 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 irrigation.

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

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

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

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

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, soil reaction, and soil condition.

Soil Properties

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

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

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

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, 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 12 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "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 the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (ASTM, 1993) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1986).

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

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection. There are no highly organic soils in this survey area.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

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

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

The estimates of grain-size distribution, liquid limit, and plasticity index are generally 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 13 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.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

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 and septic tank absorption fields.

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

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

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 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 wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are very highly erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are moderately highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are moderately erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

8. Soils that are subject to only a slight hazard of wind erosion because of coarse fragments on the surface or because of surface wetness.

Soil and Water Features

Table 14 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 infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

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

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

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

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

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 14 gives the estimated frequency of flooding. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year).

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 little or no horizon development.

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.

A portion of the survey area is subject to occasional, long or very long periods of flooding when water is impounded behind Painted Rock Dam. This earthfill flood-control structure was built in 1959. It is 4,796 feet long and 181 feet high. The potential reservoir, should the dam fill to the spillway crest, would cover 53,200 areas with a volume of 2,491,700 acre-feet (U.S. Army Corps of Engineers, 1961).

During a major flood on March 7, 1980, the water level rose to 648 feet above mean sea level, which was 13 feet below the spillway. The water covered 44,300 acres with a volume of 1,854,000 acre-feet. The peak inflow during this flood was more than 170,000 cubic feet per second, compared to a design inflow peak of 300,000 cubic feet per second. The design outflow peak is 22,500 cubic feet per second, but because of downstream considerations the peak release has never exceeded 5,000 cubic feet per second and is usually much less (Troy Leatherwood, U.S. Army Corps of Engineers, personal communication).

The vegetation in recently flooded areas is mainly phreatophytic trees and shrubs, principally saltcedar and arrowweed. A cap of silty clay loam covered the lowest portion of the flood pool. This cap ranged from a few inches to several feet in thickness and cracked deeply after drying. Portions of the riverbank and shoreline have been eroded during periods of rising and falling water levels.

Above the flood pool, the recent flooding has resulted in channel widening and underbank cutting. The river ran bank full during the flood of February 16, 1980. This flood measured 178,000 cubic feet per second at Gillespie Dam. Other recent floods were 92,900 cubic feet per second on March 3, 1978; 125,000 cubic feet per second on December 20, 1978; and 89,100 cubic feet per second on October 5, 1983. An estimated 250,000 cubic feet per second occurred during the flood of February 1891 (Anderson and White, 1979).

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is 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.

A *cemented pan* is a cemented or indurated subsurface layer within a depth of 5 feet. Such a pan causes difficulty in excavation. Pans are classified as thin or thick. A thin pan is less than 3 inches thick if continuously indurated or less than 18 inches thick if discontinuous or fractured. Excavations can be made by trenching machines, backhoes, or small rippers. A thick pan is more than 3 inches thick if continuously indurated or more than 18 inches thick if discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed in excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, 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 results in a severe hazard of corrosion. 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 (USDA, 1975). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 15 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven 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 Fluvent (*Fluv*, meaning flood plain, 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 Torrifluvents (*Torri*, meaning hot and dry, plus *fluvent*, the suborder of the Entisols that formed in sediment on flood plains).

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

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, 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 coarse-loamy, mixed (calcareous), hyperthermic Typic Torrifluvents.

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 underlying material can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. Characteristics of the soil and the material in which it formed are identified for each 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" (USDA, 1951). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (USDA, 1975). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

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

Agualt Series

The Agualt series consists of deep, well drained soils on flood plains. These soils formed in recent alluvium derived dominantly from mixed rocks. Slope is 0 to 1 percent. Elevation is 430 to 850 feet. The mean annual precipitation is about 5 to 7 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are coarse-loamy over sandy or sandy-skeletal, mixed (calcareous), hyperthermic Typic Torrifluvents.

Typical pedon of Agualt very fine sandy loam, in an area of Agualt and Ripley soils, about 1,250 feet south and 700 feet east of the northwest corner of sec. 5, T. 5 S., R. 4 W.

Ap1—0 to 5 inches; pale brown (10YR 6/3) very fine sandy loam, dark brown (10YR 3/3) moist; weak thin platy structure; soft, very friable; common very fine roots; few very fine tubular pores; violently effervescent; nonsaline (ECe 0.1 mmho/cm); about 1 percent pebbles; mildly alkaline (pH 7.8); clear smooth boundary.

Ap2—5 to 13 inches; pale brown (10YR 6/3) very fine sandy loam, dark brown (10YR 3/3) moist; massive; soft, very friable; few very fine roots; few very fine tubular pores; violently effervescent; very slightly saline (ECe 2.0 mmhos/cm); mildly alkaline (pH 7.8); clear smooth boundary.

C1—13 to 27 inches; pale brown (10YR 6/3), stratified very fine sandy loam, dark yellowish brown (10YR 3/4) moist; massive; soft, very friable; few very fine roots (more abundant at the lower boundary); few very fine tubular pores; violently effervescent; very slightly saline (ECe 2.8 mmhos/cm); mildly alkaline (pH 7.6); abrupt smooth boundary.

2C2—27 to 38 inches; very pale brown (10YR 7/3), stratified sand, brown (10YR 4/3) moist; single grain; loose; few very fine roots; many very fine irregular pores; slightly effervescent; nonsaline (ECe 0.9 mmho/cm); about 10 percent fine water-rounded pebbles; mildly alkaline (pH 7.6); clear smooth boundary.

2C3—38 to 60 inches; very pale brown (10YR 7/3), stratified fine sand, dark brown (10YR 3/3) moist; massive; loose; common very fine irregular pores; strongly effervescent; nonsaline (ECe 0.07 mmho/cm); about 1 percent fine water-rounded pebbles; mildly alkaline (pH 7.6).

Depth to the coarse textured horizon ranges from 20 to 40 inches. The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 dry and 3 to 5 moist, and chroma of 2 to 4 dry or moist. The C horizon has colors similar to those of the A horizon. The upper part commonly has very thin strata of coarser or finer soil material. The texture in the strongly contrasting lower part ranges from sand to loamy sand, and the content of gravel ranges to as much as 35 percent. Electrical conductivity ranges from 1 to more than 8 millimhos per centimeter. The sodium adsorption ratio is typically less than 13 but is greater than 13 in some pedons.

Ajo Series

The Ajo series consists of moderately deep, well drained soils on fan terraces. These soils formed in alluvium derived dominantly from mixed rocks. Slope ranges from 3 to 25 percent. Elevation is 800 to 2,000 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are loamy-skeletal, mixed, hyperthermic Petrocalcic Paleargids.

Typical pedon of Ajo extremely gravelly sandy loam, in an area of Ajo-Gunsight-Pompeii complex, 3 to 25 percent slopes, about 1,300 feet south and 300 feet west of the northeast corner of sec. 9, T. 6 S., R. 2 W.

About 65 percent of the surface is covered with pebbles and a few cobbles.

A—0 to 3 inches; light reddish brown (5YR 6/4) extremely gravelly sandy loam, reddish brown (5YR 5/3) moist; weak fine granular structure; slightly hard, very friable; many very fine roots; common very fine tubular pores; about 60 percent pebbles and 5 percent cobbles; noneffervescent; moderately alkaline (pH 8.0); abrupt wavy boundary.

BAt—3 to 8 inches; yellowish red (5YR 5/6) very gravelly sandy clay loam, yellowish red (5YR 4/6) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores; clay films occurring as colloidal stains; few fine lime filaments; slightly effervescent; about 50 percent pebbles; moderately alkaline (pH 8.0); clear wavy boundary.

Btk—8 to 17 inches; reddish brown (5YR 5/4) very gravelly clay loam, yellowish red (5YR 5/6) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; common very fine tubular pores; common moderately thick clay films on faces of peds; many small soft masses of lime; strongly effervescent; about 50 percent pebbles and 5 percent cobbles; moderately alkaline (pH 8.2); gradual wavy boundary.

BCtk—17 to 32 inches; yellowish red (5YR 5/6) very gravelly sandy clay loam, yellowish red (5YR 4/6) moist; moderate fine subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; few very fine tubular pores; common thin clay films on faces of peds; many small soft masses of lime and thin filaments of lime; strongly effervescent;

about 55 percent pebbles; moderately alkaline (pH 8.0); abrupt wavy boundary.

2Ckm—32 to 60 inches; indurated, lime-cemented hardpan.

About 60 to 90 percent of the surface is covered with pebbles and cobbles. Depth to the petrocalcic horizon ranges from 20 to 40 inches. The A horizon is 2 to 6 inches thick. It has hue of 7.5YR or 5YR, value of 4 to 6, and chroma of 3 or 4. The thickness of the B horizon ranges from 18 to 37 inches. This horizon is sandy loam, sandy clay loam, or clay loam and has 40 to 80 percent coarse fragments by volume. It has hue of 5YR or 2.5YR, value of 4 or 5, and chroma of 4, 6, or 8.

Ajolito Series

The Ajolito series consists of shallow and very shallow, somewhat excessively drained soils on stream terraces. These soils formed in alluvium derived dominantly from mixed rocks. Slope ranges from 1 to 5 percent. Elevation is 450 to 700 feet. The mean annual precipitation is about 5 to 7 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are loamy-skeletal, mixed, hyperthermic, shallow Petrocalcic Paleargids.

Typical pedon of Ajolito extremely gravelly sandy loam, in an area of Gunsight-Ajolito extremely gravelly sandy loams, 1 to 15 percent slopes, about 1,900 feet west and 2,400 feet south of the northeast corner of sec. 6, T. 5 S., R. 6 W.

About 90 percent of the surface is covered with rounded, darkly varnished pebbles and pan fragments.

A—0 to 1 inch; light brown (7.5YR 6/4) extremely gravelly sandy loam, dark brown (7.5YR 4/4) moist; weak very fine granular structure; soft, very friable; many very fine vesicular pores; violently effervescent; nonsaline (ECe 0.9 mmho/cm); about 75 percent rounded pebbles; mildly alkaline (pH 7.6); abrupt smooth boundary.

Btk1—1 to 5 inches; light reddish brown (5YR 6/4) very gravelly fine sandy loam, yellowish red (5YR 6/4) moist; weak medium subangular blocky structure; soft, very friable; common very fine roots; common very fine tubular pores; few distinct clay films on faces of peds; common thin lime filaments and thin lime coatings on pebbles; violently effervescent; nonsaline (ECe 0.5 mmho/cm); about 40 percent rounded pebbles; mildly alkaline (pH 7.6); clear smooth boundary.

Btk2—5 to 14 inches; light reddish brown (5YR 6/4) very gravelly coarse sandy loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; soft, very friable; few fine roots; common very fine tubular pores; few distinct clay films on faces of peds; thick lime coatings on pebbles; violently effervescent; very slightly saline (ECe 3.7 mmhos/cm); about 50 percent rounded pebbles; mildly alkaline (pH 7.8); abrupt smooth boundary.

2Bkm—14 to 32 inches; lime-cemented, indurated hardpan.

About 85 to 100 percent of the surface is covered with darkly varnished, water-rounded pebbles. Depth to the petrocalcic horizon ranges from 6 to 20 inches. The thickness of the B horizon ranges from 5 to 19 inches. This horizon is sandy loam, fine sandy loam, coarse sandy loam, or loam and has 30 to 50 percent rounded pebbles by volume. Some horizons have thin strata of very gravelly coarse sand. These strata have hue of 5YR or 7.5YR and value and chroma of 4 to 6. Most pedons are nonsaline, but some pedons are strongly saline.

Akela Series

The Akela series consists of shallow and very shallow, well drained soils on mountains. These soils formed in colluvium and residuum derived dominantly from volcanic rocks, such as andesite, rhyolite, and tuff. Slope ranges from 15 to 65 percent. Elevation is 2,200 to 3,500 feet. The mean annual precipitation is about 10 to 12 inches, the mean annual air temperature is 65 to 70 degrees F, and the frost-free season is 180 to 270 days.

The Akela soils in this survey area are taxadjuncts because they are noncalcareous throughout most of the control section. They are classified as loamy-skeletal, mixed (calcareous), thermic Lithic Torriorthents.

Typical pedon of Akela extremely gravelly sandy loam, in an area of Akela-Rock outcrop complex, 15 to 65 percent slopes; in an unsectionalized area about 4,600 feet east and 20,500 feet north of the southwest corner of T. 11 S., R. 3 W.

About 10 percent of the surface is covered with cobbles, and 80 percent is covered with pebbles.

A—0 to 2 inches; light brown (7.5YR 6/4) extremely gravelly sandy loam, dark brown (7.5YR 4/4) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; about 80 percent pebbles and 10 percent cobbles; mostly noneffervescent but has pockets that are strongly effervescent; mildly alkaline (pH 7.4); clear smooth boundary.

C—2 to 12 inches; brown (7.5YR 5/4) extremely gravelly loam, dark brown (7.5YR 4/4) moist; massive; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; about 50 percent pebbles and 10 percent cobbles; mostly noneffervescent but has pockets that are strongly effervescent; mildly alkaline (pH 7.6); abrupt smooth boundary.

2R—12 to 16 inches; hard, unweathered andesite that has lime in a few fractures.

About 50 to 90 percent of the surface is covered with pebbles, cobbles, and stones. The content of rock fragments averages more than 35 percent throughout the control section. The depth to lithic contact is 4 to 20 inches. The A horizon is 1 to 3 inches thick. It has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 or 4. The C horizon is sandy loam, fine sandy loam, or loam and is 35 to 90 percent cobbles and pebbles. It has colors similar to those of the A horizon.

Carrizo Series

The Carrizo series consists of deep, excessively drained soils on flood plains (washes), alluvial fans, and on fan terraces (relict gravel bars). These soils formed in recent alluvium derived dominantly from mixed rocks. Slope ranges from 0 to 5 percent. Elevation is 500 to 2,500 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are sandy-skeletal, mixed, hyperthermic Typic Torriorthents.

Typical pedon of Carrizo very gravelly sandy loam, in an area of Why-Carrizo complex, 0 to 3 percent slopes, about 600 feet north and 400 feet west of the southeast corner of sec. 28, T. 3 S., R. 4 W.

About 50 percent of the surface is covered with pebbles.

A—0 to 9 inches; light brown (7.5YR 6/4), stratified very gravelly sandy loam, brown (7.5YR 4/4) moist; weak fine granular structure; soft, very friable; few very fine roots; common very fine tubular pores; violently effervescent; about 50 percent pebbles; mildly alkaline (pH 7.4); abrupt smooth boundary.

C—9 to 19 inches; light brown (7.5YR 6/4), stratified very gravelly coarse sand, brown (7.5YR 5/4) moist; single grain; loose; common very fine roots; many very fine irregular pores; violently effervescent; about 50 percent pebbles; mildly alkaline (pH 7.4); abrupt wavy boundary.

Ck—19 to 40 inches; light brown (7.5YR 6/4), stratified very gravelly loamy coarse sand, brown (7.5YR 4/4) moist; massive; soft, loose; few very fine roots; many very fine irregular pores; violently effervescent; about 35 percent pebbles that have accumulations of lime; mildly alkaline (pH 7.4); abrupt wavy boundary.

2Btkb—40 to 47 inches; strong brown (7.5YR 5/6) very gravelly loamy coarse sand, brown (7.5YR 5/4) moist; massive; soft, loose; few very fine roots; many very fine irregular pores; few thin clay films occurring as colloidal stains and as bridges between mineral grains; violently effervescent; about 40 percent lime-coated pebbles; mildly alkaline (pH 7.4); clear wavy boundary.

2Btb—47 to 60 inches; strong brown (7.5YR 5/6) very gravelly coarse sand, brown (7.5YR 5/4) moist; massive; soft, loose; many very fine irregular pores; few thin clay films occurring as colloidal stains and as bridges between mineral grains; mostly slightly effervescent but has pockets that are noneffervescent; about 40 percent pebbles; mildly alkaline (pH 7.4).

About 1 to 80 percent of the surface is covered with pebbles and cobbles. The content of coarse fragments ranges from 1 to 80 percent throughout the control section but averages more than 35 percent. The A horizon is 1 to 9 inches thick. It has been scoured away in some pedons. It is gravelly fine sandy loam, very gravelly sandy loam, or extremely gravelly sandy loam. It has hue of 10YR or 7.5YR, value of 6 or 7, and chroma of 2, 4, or 6. The C horizon is stratified sandy loam, loamy sand, or sand. It has colors similar to those of the A horizon. The buried Bt horizon occurs between depths of 40 and 60 inches.

Cavelt Series

The Cavelt series consists of shallow and very shallow, somewhat excessively drained soils on stream terraces. These soils formed in alluvium derived dominantly from mixed rocks. Slope ranges from 1 to 10 percent. Elevation is 600 to 661 feet. The mean annual precipitation is 5 to 7 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are loamy, mixed, hyperthermic, shallow Typic Paleorthids.

Typical pedon of Cavelt gravelly sandy loam, in an area of Harqua-Cavelt complex, 1 to 10 percent slopes, about 1,700 feet west and 50 feet south of the northeast corner of sec. 11, T. 5 S., R. 7 W.

About 50 percent of the surface is covered with gravel-sized pan fragments.

A—0 to 4 inches; light brown (7.5YR 6/4) gravelly sandy loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; soft, very friable; few fine roots; few very fine tubular pores; violently effervescent; about 25 percent pebbles; moderately alkaline (pH 8.4); clear smooth boundary.

Bk—4 to 13 inches; light brown (7.5YR 6/4) gravelly sandy loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; soft, very friable; common very fine roots; common very fine tubular pores; colloidal stains on faces of peds; common small masses of lime; violently effervescent; about 15 percent pebbles; moderately alkaline (pH 8.4); abrupt irregular boundary.

2Bkm—13 to 43 inches; indurated hardpan of lime-cemented fine sand that has pockets of loose fine sand.

About 25 to 55 percent of the surface is covered with pebbles and pan fragments. Depth to the petrocalcic horizon is 5 to 20 inches. The A horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 4 to 6. The thickness of the B horizon ranges from 4 to 19 inches. This horizon is sandy loam or fine sandy loam and has 5 to 30 percent pebbles and pan fragments by volume. It has colors similar to those of the A horizon. Some pedons have buried horizons that have moderately fine textures. Some pedons are strongly saline.

The Cavelt soil in Denure-Cavelt complex, 0 to 3 percent slopes, is deeper than is defined as the range for the series. This difference, however, does not significantly affect the use and management of the soil.

Cherioni Series

The Cherioni series consists of shallow and very shallow, somewhat excessively drained soils on basalt flows, hills, and mountains. These soils formed in residuum and colluvium derived dominantly from basalt. Slope ranges from 1 to 15 percent. Elevation is 600 to 2,800 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are loamy-skeletal, mixed, hyperthermic, shallow Typic Durorthids.

Typical pedon of Cherioni very cobbly fine sandy loam, 3 to 10 percent slopes, about 1,000 feet east and 1,500 feet north of the southwest corner of sec. 31, T. 2 S., R. 5 W.

About 45 percent of the surface is covered with cobbles, pebbles, and duripan fragments.

A—0 to 2 inches; reddish yellow (7.5YR 6/6) very cobbly fine sandy loam, light brown (7.5YR 6/4) moist; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; few very fine roots; many very fine irregular pores; violently effervescent; about 45 percent cobbles and pebbles; moderately alkaline (pH 8.4); abrupt wavy boundary.

Bk1—2 to 6 inches; brownish yellow (10YR 6/6) very gravelly fine sandy loam, light yellowish brown (10YR 6/4) moist; massive; soft, very friable, slightly sticky and slightly plastic; few very fine roots; many very fine irregular pores; violently effervescent; about 45 percent pebbles; moderately alkaline (pH 8.4); abrupt wavy boundary.

Bk2—6 to 10 inches; brownish yellow (10YR 6/6) very gravelly fine sandy loam, light yellowish brown (10YR 6/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; many very fine irregular pores; violently effervescent; about 55 percent pebbles; moderately alkaline (pH 8.4); abrupt wavy boundary.

2Bkqm—10 to 16 inches; hardpan cemented with silica and lime; abrupt wavy boundary.

3R—16 to 20 inches; basalt.

About 40 to 95 percent of the surface is covered with pebbles, cobbles, and hardpan fragments and as much as 15 percent stones. The content of rock fragments ranges from 30 to 95 percent throughout the control section and averages more than 35 percent. The indurated hardpan is at a depth of 5 to 18 inches. Basalt bedrock is at a depth of 7 to 24 inches. The A horizon is very cobbly fine sandy loam, extremely gravelly loam, or extremely cobbly fine sandy loam. It has hue of 7.5YR or 10YR, value of 6, and chroma of 4 to 6. The B horizon is fine sandy loam or sandy loam. It has colors similar to those of the A horizon. The lower part of the B horizon has as much as 30 percent pan fragments.

Chuckawalla Series

The Chuckawalla series consists of deep, well drained soils on fan terraces that have desert pavements. These soils formed in alluvium derived dominantly from mixed rocks. Slope ranges from 1 to 5 percent. Elevation is 600 to 1,800 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are loamy-skeletal, mixed, hyperthermic Typic Haplargids.

Typical pedon of Chuckawalla extremely gravelly loam, in an area of Gunsight-Chuckawalla complex, 1 to 15 percent slopes, about 1,200 feet south and 1,100 feet west of the northeast corner of sec. 36, T. 5 S., R. 4 W.

About 85 percent of the surface is covered with darkly varnished, closely packed pebbles and cobbles (desert pavement).

A—0 to 1 inch; light brown (7.5YR 6/4) extremely gravelly loam, brown (7.5YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; many very fine tubular pores; slightly effervescent; very slightly saline (ECe 1.0 mmho/cm); slightly sodic (SAR 6); about 60 percent pebbles; strongly alkaline (pH 8.6); abrupt smooth boundary.

Bt1—1 to 6 inches; reddish brown (5YR 5/4) gravelly loam, yellowish red (5YR 4/6) moist; moderate fine subangular blocky structure; slightly hard, very friable, sticky and plastic; common fine roots; many very fine tubular pores; few thin clay films on faces of peds; strongly effervescent; moderately saline (ECe 11.9 mmhos/cm); slightly sodic (SAR 10); about 20 percent pebbles; moderately alkaline (pH 8.2); clear smooth boundary.

Bt2—6 to 10 inches; yellowish red (5YR 5/6) very gravelly sandy clay loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; slightly hard, very friable, sticky and slightly plastic; common fine roots; many very fine tubular pores; few thin clay films on faces of peds; slightly effervescent; strongly saline (ECe 38.4 mmhos/cm); slightly sodic (SAR 12); about 42 percent pebbles; moderately alkaline (pH 8.0); abrupt wavy boundary.

Bk—10 to 18 inches; pink (7.5YR 7/4) very gravelly coarse sandy loam, light brown (7.5YR 6/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; many very thin coatings of lime on undersides of pebbles and cobbles; violently effervescent; strongly saline (ECe 31.3 mmhos/cm); slightly sodic (SAR 9); fine tubular pores; about 44 percent pebbles and few cobbles; moderately alkaline (pH 7.9); abrupt wavy boundary.

2Btkb1—18 to 35 inches; pink (5YR 7/4) very gravelly coarse sandy loam, light reddish brown (5YR 6/4) moist; massive; hard, very friable; many very fine tubular pores; few thin clay films; thin coatings of lime on the undersides of pebbles; violently effervescent; strongly saline (ECe 28.4 mmhos/cm); slightly sodic (SAR 10); about 39 percent pebbles; moderately alkaline (pH 7.9); gradual wavy boundary.

2Btkb2—35 to 49 inches; pink (5YR 7/4) very gravelly coarse sandy loam, light reddish brown (5YR 6/4) moist; massive; hard, very friable; many very fine tubular pores; few thin clay films; thin coatings of lime on the undersides of pebbles; violently effervescent; strongly saline (ECe 26.8 mmhos/cm); slightly sodic (SAR 11); about 38 percent pebbles; moderately alkaline (pH 7.9); abrupt wavy boundary.

2Bk—49 to 61 inches; pink (7.5YR 7/4), weakly cemented very gravelly coarse sandy loam, light brown (7.5YR 6/4) moist; massive; very hard; violently effervescent; strongly saline (ECe 28.9 mmhos/cm); moderately sodic (SAR 13); about 53 percent pebbles.

About 85 to 100 percent of the surface is covered with darkly varnished, closely packed pebbles. A calcic horizon is at a depth of 10 to 18 inches. The A horizon is ½ inch to 10 inches thick. It has chroma of 4 to 6. The Bt horizon is sandy loam, silt loam, loam, or sandy clay loam and has 5 to 50 percent pebbles. It has hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 4 to 8. The Bk horizon is sand or loamy sand and has 35 to 65 percent pebbles. It has hue of 7.5YR or 5YR, value of 5 to 7, and chroma of 4 to 6. Depth to the buried Bt horizon ranges from 10 to more than 40 inches. The sodium adsorption ratio ranges from 5 to 17. Electrical conductivity ranges from 1 to 38 millimhos per centimeter but is typically greater than 16 millimhos per centimeter throughout most of the profile.

Cipriano Series

The Cipriano series consists of shallow and very shallow, somewhat excessively drained soils on fan terraces, hills, and mountains. These soils formed in alluvium and colluvium derived dominantly from mixed rocks. Slope ranges from 1 to 25 percent. Elevation is 480 to 2,800 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are loamy-skeletal, mixed, hyperthermic, shallow Typic Durorthids.

Typical pedon of Cipriano extremely gravelly sandy loam, in an area of Cipriano-Momoli complex, 1 to 7 percent slopes; about 2,475 feet north and 1,600 feet west of the southeast corner of sec. 26, T. 4 S., R. 3 W.

About 60 percent of the surface is covered with granitic gravel.

A—0 to 2 inches; light yellowish brown (10YR 6/4) extremely gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; weak fine granular structure; slightly hard, very friable; many very fine roots; common very fine tubular pores; about 60 percent fine pebbles; noneffervescent; moderately alkaline (pH 8.0); clear wavy boundary.

Bk—2 to 10 inches; reddish yellow (7.5YR 6/6) very gravelly sandy loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, very friable; many very fine roots; common very fine tubular pores; about 45 percent fine pebbles and pan fragments partially coated with lime; violently effervescent; moderately alkaline (pH 8.4); abrupt wavy boundary.

2Bkqm—10 to 14 inches; hardpan cemented with silica and lime.

About 50 to 90 percent of the surface is covered with pebbles, cobbles, stones, and hardpan fragments. The content of gravel ranges from 40 to 65 percent throughout the profile. Depth to the indurated hardpan ranges from 6 to 20 inches. The A horizon is 1 to 3 inches thick. It is extremely cobbly sandy loam or extremely gravelly sandy loam. It has hue of 10YR, 7.5YR, or 5YR, value of 4 to 6, and chroma of 3 to 6. The B horizon is sandy loam, very fine sandy loam, fine sandy loam, or loam. It has colors similar to those of the A horizon.

In areas adjacent to the Sauceda Mountains, the Cipriano soil in Gunsight-Cipriano complex, 1 to 15 percent slopes, is cooler than is typical. This difference, however, does not significantly affect use and management of the soil.

Comobabi Series

The Comobabi series consists of shallow and very shallow, well drained soils on fan terraces. These soils formed in alluvium derived dominantly from mixed rocks. Slope ranges from 5 to 15 percent. Elevation is 1,200 to 2,100 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are loamy-skeletal, mixed, hyperthermic, shallow Typic Durargids.

Typical pedon of Comobabi extremely cobbly fine sandy loam, in an area of Momoli-Comobabi association, 5 to 15 percent slopes, about 850 feet north and 2,000 feet west of the southeast corner of sec. 25, T. 4 S., R. 3 W.

About 80 percent of the surface is covered with cobbles and pebbles.

A—0 to 1 inch; light brown (7.5YR 6/4) extremely cobbly fine sandy loam, brown (7.5YR 5/4) moist; weak fine granular structure; slightly hard, very friable; common fine roots; many very fine vesicular pores; slightly effervescent; about 40 percent cobbles and 30 percent pebbles; moderately alkaline (pH 8.4); gradual wavy boundary.

Bt—1 to 10 inches; yellowish red (5YR 5/6) extremely cobbly sandy loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly plastic; many very fine roots; common very fine irregular pores; few thin clay films on faces of peds and in pores; slightly effervescent; about 40 percent cobbles and 35 percent pebbles; mildly alkaline (pH 7.8); gradual wavy boundary.

Btk—10 to 19 inches; yellowish red (5YR 5/8) extremely cobbly sandy clay loam, yellowish red (5YR 5/6) moist; moderate fine subangular blocky structure; hard, friable, slightly sticky and plastic; many very fine roots; few very fine tubular pores; clay films occurring as colloidal stains and as bridges between sand grains; common fine masses and filaments of lime; violently effervescent; about 40 percent cobbles and 35 percent pebbles; moderately alkaline (pH 8.2); abrupt wavy boundary.

2Bkqm—19 to 27 inches; hardpan cemented with silica and lime.

About 50 to 90 percent of the surface is covered with cobbles and pebbles. The content of coarse fragments ranges from 60 to 80 percent throughout the profile. There are typically more cobbles than pebbles. Depth to the cemented hardpan ranges from 7 to 20 inches. The A horizon is 1 to 4 inches thick. It has hue of 7.5YR or 10YR and value and chroma of 4 to 6. The Bt horizon is loam, sandy clay loam, or sandy loam. It has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 5 to 8.

Coolidge Series

The Coolidge series consists of deep, well drained soils on fan terraces and coppice dunes. These soils formed in alluvium and eolian material derived dominantly from mixed rocks. Slope ranges from 0 to 3 percent. Elevation is 450 to 1,600 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are coarse-loamy, mixed, hyperthermic Typic Calciorthids.

Typical pedon of Coolidge gravelly very fine sandy loam, in an area of Denure-Coolidge complex, 1 to 3 percent slopes, about 50 feet north and 100 feet east of the southwest corner of sec. 2, T. 3 S., R. 2 W.

About 15 percent of the surface is covered with pebbles.

A—0 to 2 inches; light brown (7.5YR 6/4) gravelly very fine sandy loam, brown (7.5YR 5/4) moist; weak fine granular and thin platy structure; slightly hard, very friable; many very fine roots; many very fine tubular pores; about 15 percent pebbles; moderately alkaline (pH 8.2); abrupt wavy boundary.

Bw—2 to 21 inches; reddish yellow (7.5YR 6/6) very fine sandy loam, brown (7.5YR 5/4) moist; massive; soft, very friable; many very fine roots; common very fine tubular pores; violently effervescent; about

5 percent pebbles; moderately alkaline (pH 8.4); abrupt wavy boundary.

Bk1—21 to 36 inches; reddish yellow (7.5YR 6/6) gravelly sandy loam, strong brown (7.5YR 5/6) moist; massive; hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores; lime occurring as fillings in pores; colloidal stains and bridges between mineral grains; violently effervescent; about 15 percent pebbles; strongly alkaline (pH 8.8); clear wavy boundary.

Bk2—36 to 60 inches: pink (7.5YR 7/4) very gravelly sandy loam, brown (7.5YR 5/4) moist; massive; very hard, firm, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; common medium masses of lime; violently effervescent; about 35 percent pebbles; strongly alkaline (pH 8.8).

About 2 to 50 percent of the surface is covered with pebbles. The content of gravel between depths of 10 and 40 inches averages less than 15 percent. The calcic horizon is at a depth of 21 to 40 inches. The A horizon is 2 to 8 inches thick. It is gravelly very fine sandy loam or loamy fine sand. It has hue of 7.5YR or 10YR. The B horizon is dominantly sandy loam or fine sandy loam and has 5 to 25 percent pebbles.

Cuerda Series

The Cuerda series consists of deep, well drained soils on flood plains (washes) and alluvial fans. These soils formed in stratified alluvium derived dominantly from mixed rocks. Slope is 0 to 1 percent. Elevation is 440 to 1,700 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are coarse-loamy, mixed, hyperthermic Fluventic Camborthids.

Typical pedon of Cuerda loam, in an area of Dateland-Cuerda complex, 0 to 3 percent slopes, about 1,300 feet west and 2,600 feet south of the northeast corner of sec. 28, T. 12 S., R. 5 W.

About 5 percent of the surface is covered with pebbles.

A—0 to 5 inches; light brown (7.5YR 6/4), stratified loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; violently effervescent; about 2 percent pebbles; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bw—5 to 21 inches; light brown (7.5YR 6/4) loam, dark brown (7.5YR 4/4) moist; weak coarse subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; violently effervescent; about 2 percent pebbles; moderately alkaline (pH 8.2); gradual wavy boundary.

Bk1—21 to 42 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; few very fine lime fillings in pores; violently effervescent; about 10 percent pebbles; moderately alkaline (pH 8.4); clear wavy boundary.

Bk2—42 to 60 inches; pink (7.5YR 7/4) very gravelly loam, light brown (7.5YR 6/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; many soft masses of lime; violently effervescent; about 35 percent lime-coated pebbles; moderately alkaline (pH 8.4).

The content of gravel averages less than 15 percent throughout the profile. The A horizon is 2 to 10 inches thick. The A and B horizons have hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 6. The B horizon is loam, silt loam, or very fine sandy loam. In some pedons the upper part of the profile has thin layers of finer or coarser textured material. Electrical conductivity ranges from less than 1 millimho per centimeter to 23 millimhos per centimeter. The sodium adsorption ratio is greater than 13 in some pedons. Salt crystals occur in some pedons.

Dateland Series

The Dateland series consists of deep, well drained soils on fan terraces and stream terraces. These soils formed in alluvium derived dominantly from mixed rocks. Slope ranges from 0 to 3 percent. Elevation is 500 to 2,000 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are coarse-loamy, mixed, hyperthermic Typic Camborthids.

Typical pedon of Dateland fine sandy loam, in an area of Dateland-Cuerda complex, 0 to 3 percent slopes, about 1,950 feet south and 25 feet west of the northeast corner of sec. 11, T. 3 S., R. 2 W.

About 5 percent of the surface is covered with fine pebbles.

A—0 to 3 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 4/4) moist; moderate fine granular structure; slightly hard, very friable; many very fine roots; common very fine tubular pores; about 5 percent fine pebbles; moderately alkaline (pH 8.2); clear smooth boundary.

Bw—3 to 38 inches; reddish yellow (7.5YR 6/6) very fine sandy loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable; many very fine roots; common very fine tubular pores; violently effervescent; moderately alkaline (pH 8.4); clear smooth boundary.

Bk—38 to 54 inches; reddish yellow (7.5YR 6/6) gravelly coarse sandy loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable; common very fine roots; common very fine tubular pores; few patchy coatings of lime on the undersides of pebbles; violently effervescent; about 20 percent fine pebbles; moderately alkaline (pH 8.4); clear smooth boundary.

2Btkb—54 to 60 inches; reddish yellow (5YR 6/6) loam, yellowish red (5YR 5/6) moist; moderate fine subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; few thin clay films on faces of peds; few masses of lime; violently effervescent; about 5 percent fine pebbles; moderately alkaline (pH 8.0).

About 0 to 15 percent of the surface is covered with pebbles. The A horizon is 1 to 5 inches thick. It is very fine sandy loam or fine sandy loam. It has hue of 7.5YR and value and chroma of 4 to 6. The B horizon is dominantly loam or very fine sandy loam, but in some pedons it has thin horizons of finer or coarser textured material. It has colors similar to those of the A horizon. Some pedons have a buried horizon below a depth of 50 inches. This horizon is loam, sandy loam, or sandy clay loam. It has hue of 5YR, value of 4 to 7, and chroma of 3 to 6. The sodium adsorption ratio is greater than 13 in some pedons. Electrical conductivity ranges from less than 1 millimho per centimeter to 80 millimhos per centimeter.

Denure Series

The Denure series consists of deep, somewhat excessively drained soils on fan terraces and stream terraces. These soils formed in alluvium and eolian soil material derived dominantly from mixed rocks. Slope ranges from 0 to 7 percent. Elevation is 500 to 2,000 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are coarse-loamy, mixed, hyperthermic Typic Camborthids.

Typical pedon of Denure very gravelly sandy loam, in an area of Denure-Coolidge complex, 1 to 3 percent slopes, about 800 feet east and 100 feet south of the northwest corner of sec. 11, T. 3 S., R. 2 W.

About 40 percent of the surface is covered with fine pebbles.

A—0 to 4 inches; brown (7.5YR 5/4) very gravelly sandy loam, dark brown (7.5YR 4/4) moist; weak fine granular structure; slightly hard, very friable; many very fine roots; many very fine tubular pores; noneffervescent, nonsaline (ECe 1.07 mmhos/cm); 40 percent fine pebbles; moderately alkaline (pH 8.2); clear wavy boundary.

Bw1—4 to 9 inches; light brown (7.5YR 6/4) sandy loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, very friable; many very fine roots; many very fine tubular pores; strongly effervescent; nonsaline (ECe 0.16 mmho/cm); 15 percent fine pebbles; moderately alkaline (pH 8.3); gradual wavy boundary.

Bw2—9 to 31 inches; reddish yellow (7.5YR 6/6) gravelly sandy loam, strong brown (7.5YR 4/6) moist; massive; slightly hard, very friable, slightly sticky; many very fine roots; many very fine tubular pores; violently effervescent; nonsaline (ECe 0.18 mmho/cm); 20 percent fine pebbles; moderately alkaline (pH 8.2); gradual wavy boundary.

Bk1—31 to 41 inches; reddish yellow (7.5YR 6/6) gravelly sandy loam, strong brown (7.5YR 5/6) moist; massive; slightly hard, very friable; many very fine roots; many very fine tubular pores; thin coatings of lime on the undersides of pebbles; violently effervescent; very slightly saline (ECe 2.42 mmhos/cm); 25 percent fine pebbles; moderately alkaline (pH 8.3); clear wavy boundary.

Bk2—41 to 60 inches; pink (7.5YR 7/4) gravelly sandy loam, brown (7.5YR 5/4) moist; massive; hard, very friable, slightly sticky and slightly plastic; few fine roots; many very fine tubular pores; many small masses of lime; violently effervescent; slightly saline (ECe 4.13 mmhos/cm); 35 percent fine pebbles; moderately alkaline (pH 8.2).

About 15 to 50 percent of the surface is covered with pebbles. The content of gravel in the control section ranges from 5 to 40 percent and averages less than 25 percent by volume. The A horizon is 2 to 6 inches thick. It is sandy loam, fine sandy loam, gravelly fine sandy loam, very gravelly sandy loam, or loamy fine sand. It has hue of 7.5YR, value of 5 or 6, and chroma of 4 to 6. The B horizon is 40 or more inches thick. It is sandy loam or fine sandy loam. In some pedons it has thin layers of coarser or finer textured material. It has hue of 7.5YR or 5YR, value of 5 to 7, and chroma of 4 to 6. Electrical conductivity ranges from less than 1 millimho to 50 millimhos per centimeter. The sodium adsorption ratio is more than 13 in some pedons.

Gachado Series

The Gachado series consists of very shallow and shallow, well drained soils on hills. These soils formed in residuum and colluvium derived dominantly from volcanic rocks. Slope ranges from 1 to 25 percent. Elevation is 1,000 to 2,200 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are loamy-skeletal, mixed, hyperthermic Lithic Haplargids.

Typical pedon of Gachado extremely gravelly sandy loam, in an area of Hyder-Gachado-Gunsight extremely gravelly sandy loams, 1 to 25 percent slopes; about 1,320 feet east and 2,400 feet north of the southwest corner of sec. 16, T. 2 S., R. 7 W.

About 90 percent of the surface is covered with pebbles.

A—0 to 1 inch; brown (7.5YR 5/4) extremely gravelly sandy loam, brown (7.5YR 4/4) moist; weak fine granular structure; soft, very friable; many very fine roots; many very fine irregular pores; noneffervescent; about 90 percent pebbles; mildly alkaline (pH 7.6); abrupt wavy boundary.

Bt1—1 to 6 inches; yellowish red (5YR 4/6) very gravelly sandy clay loam, yellowish red (5YR 5/6) moist; weak medium subangular blocky structure; soft, friable, sticky and plastic; many very fine roots; many very fine irregular pores; noneffervescent; thin patch clay films on mineral grains; about 50 percent pebbles; mildly alkaline (pH 7.6); abrupt wavy boundary.

Bt2—6 to 14 inches; yellowish red (5YR 4/6) very gravelly clay loam, yellowish red (5YR 5/6) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine roots; common very fine tubular pores; thin patchy clay films staining mineral grains and occurring as bridges; slightly effervescent; about 35 percent pebbles and 5 percent cobbles; mildly alkaline (pH 7.8); abrupt wavy boundary.

R—14 to 18 inches; andesite.

About 50 to 95 percent of the surface is covered with pebbles and cobbles. The content of coarse fragments is more than 35 percent throughout the profile. The depth to hard volcanic rock is 5 to 20 inches. The A horizon is 1 to 2 inches thick. It has hue of 7.5YR, value of 5 or 6, and chroma of 4. The B horizon is sandy clay loam or clay loam and has 35 percent pebbles and cobbles. It has hue of 2.5YR, 7.5YR, or 5YR, value of 4 or 5, and chroma of 6.

Gadsden Series

The Gadsden series consists of deep, well drained soils on flood plains. These soils formed in recent alluvium derived from mixed rocks. Slope ranges from 0 to 3 percent. Elevation is 430 to 2,100 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soil are fine, montmorillonitic (calcareous), hyperthermic Vertic Torrifluvents.

Typical pedon of Gadsden silty clay loam, in an area of Gadsden and Kofa silty clay loams, saline-sodic, about 0.5 mile south and west of Agua Caliente, Arizona; 2,500 feet east and 2,000 feet north of the southwest corner of sec. 19, T. 5 S., R. 10 W.

The surface is covered with a crust of curled silty clay loam about 1 millimeter thick.

An1—0 to 1 inch; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; strong thick platy structure; very hard, very firm, very sticky and plastic; many very fine tubular pores; strongly effervescent; few small salt crystals; very slightly saline (ECe 1.7 mmhos/cm); strongly alkaline (pH 8.8); abrupt wavy boundary.

An2—1 to 4 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; strong medium subangular blocky structure; very hard, very firm, very sticky and plastic; many very fine roots; many very fine tubular pores; strongly effervescent; few small salt crystals; very slightly saline (ECe 3.0 mmhos/cm); strongly alkaline (pH 8.8); abrupt wavy boundary.

Cknz1—4 to 13 inches; grayish brown (10YR 5/2), stratified silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; many very fine roots; many very fine tubular pores; common small masses and filaments of lime; strongly effervescent; common small salt crystals; moderately saline (ECe 11.8 mmhos/cm); strongly sodic (SAR 59); many organic stains in old root channels; strongly alkaline (pH 8.6); gradual smooth boundary.

Cknz2—13 to 29 inches; grayish brown (10YR 5/2), stratified silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure; very hard, extremely firm, very sticky and plastic; common very fine roots; many very fine tubular pores; common small slickensides; many small masses and filaments of lime; common small salt crystals; moderately saline (ECe 11.7 mmhos/cm); strongly sodic (SAR 77); many organic stains in old root channels; strongly alkaline (pH 8.8); gradual smooth boundary.

Cknz3—29 to 43 inches; light brownish gray (2.5YR 6/2), stratified silty clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, very firm, sticky and plastic; few very fine roots; many very fine tubular pores; common small masses and filaments of lime; moderately saline (ECe 11.8 mmhos/cm); strongly sodic (SAR 135); many organic stains in root channels; moderately alkaline (pH 8.2); gradual smooth boundary.

Cknz4—43 to 61 inches; light brown (7.5YR 6/4), stratified silty clay loam, brown (7.5YR 4/4) moist; massive; slightly hard, friable, sticky and plastic; few very fine roots; many very fine tubular pores; few small masses of lime; moderately saline (ECe 14.0 mmhos/cm); many organic stains in root channels; moderately alkaline (pH 8.0).

When dry, these soils have cracks ½ inch wide or wider to a depth of 20 inches. Calcium carbonate equivalent is less than 10 percent. The content of clay averages more than 35 percent in the 10- to 40-inch control section. The A horizon is silty clay loam or clay loam. It has hue of 7.5YR or 10YR. Electrical conductivity ranges from less than 2 to more than 8 millimhos per centimeter. The sodium adsorption ratio is less than 13 in some pedons.

Garzona Series

The Garzona series consists of shallow, somewhat excessively drained soils on mountains. These soils formed in colluvium and residuum derived dominantly from basalt rocks. Slope ranges from 15 to 65 percent. Elevation is 2,800 to 4,100 feet. The mean annual precipitation is 10 to 12 inches, the mean annual air temperature is 65 to 70 degrees F, and the frost-free season is 180 to 270 days.

These soils are loamy-skeletal, mixed, thermic Lithic Camborthids.

Typical pedon of Garzona extremely stony loam, in an area of Garzona-Rock outcrop-Winkel complex, 15 to 65 percent slopes; in an unsectionalized area about 7,300 feet east and 20,700 feet north of the southwest corner of T. 11 S., R. 3 W.

About 80 percent of the surface is covered with stones, cobbles, and gravel.

A—0 to 2 inches; light brown (7.5YR 6/4) extremely stony loam, dark brown (7.5YR 4/4) moist; weak fine granular structure; soft, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; noneffervescent; about 65 percent pebbles; mildly alkaline (pH 7.4); clear wavy boundary.

BA—2 to 6 inches; brown (7.5YR 5/4) very gravelly loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; noneffervescent; about 5 percent cobbles and 40 percent pebbles; mildly alkaline (pH 7.4); clear wavy boundary.

Bw—6 to 15 inches; brown (7.5YR 5/4) extremely cobbly loam, dark brown (7.5YR 4/4) moist; weak fine granular structure; soft, very friable, sticky and plastic; few very fine roots; many very fine irregular pores; thin clay films occurring as coatings and bridges; noneffervescent; about 10 percent stones, 50 percent cobbles, and 15 percent pebbles; mildly alkaline (pH 7.4); abrupt wavy boundary.

2R—15 to 19 inches; basalt.

About 75 to 90 percent of the surface is covered with stones, cobbles, and pebbles. The content of rock fragments is more than 45 percent throughout the profile. The depth to unweathered basalt is 12 to 20 inches. The A horizon is 1 to 3 inches thick. It has hue of 7.5YR, value of 5 or 6, and chroma of 3 or 4. The Bw horizon is loam or clay loam. It has hue of 7.5YR, value of 4 to 6, and chroma of 3 or 4.

Gilman Series

The Gilman series consists of deep, well drained soils on flood plains. These soils formed in recent alluvium derived dominantly from mixed rocks. Slope is 0 to 1 percent. Elevation is 500 to 850 feet. The mean annual precipitation is about 5 to 7 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are coarse-loamy, mixed (calcareous), hyperthermic Typic Torrifluvents.

Typical pedon of Gilman very fine sandy loam, saline-sodic, about 2,200 feet north and 100 feet west of the southeast corner of sec. 14, T. 4 S., R. 8 W.

About 1 percent of the surface is covered with rounded pebbles.

A—0 to 5 inches; light brown (7.5YR 6/4), stratified very fine sandy loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine irregular pores; violently effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

C—5 to 18 inches; light brown (7.5YR 6/4), stratified very fine sandy loam, dark brown (7.5YR 4/4) moist; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; violently effervescent; moderately alkaline (pH 8.4); clear smooth boundary.

Cz1—18 to 40 inches; light brown (7.5YR 6/4), stratified loam, dark brown (7.5YR 4/4) moist; massive; soft, very friable, slightly sticky and slightly plastic; few very fine roots; many very fine irregular pores; violently effervescent; moderately saline (ECe 12.8 mmhos/cm); moderately alkaline (pH 8.0); clear smooth boundary.

Cz2—40 to 60 inches; light brown (7.5YR 6/4), stratified very fine sandy loam, dark brown (7.5YR 4/4) moist; massive; soft, very friable, slightly sticky and slightly plastic; few very fine roots; many very fine irregular pores; violently effervescent; moderately saline (ECe 13.0 mmhos/cm); moderately alkaline (pH 8.0).

The content of gravel is less than 15 percent throughout the profile. The A horizon is 2 to 10 inches thick. The A and C horizons have hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 6. The C horizon is stratified loam, fine sandy loam, and very fine sandy loam. It commonly has thin layers of finer or coarser textured material. Electrical conductivity ranges from less than 1 millimho per centimeter to more than 20 millimhos per centimeter. The sodium adsorption ratio is greater than 13 in some pedons. Salt crystals occur in some pedons.

Glenbar Series

The Glenbar series consists of deep, well drained soils on flood plains. These soils formed in recent alluvium derived dominantly from mixed rocks. Slope is 0 to 1 percent. Elevation is 430 to 2,100 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are fine-silty, mixed (calcareous), hyperthermic Typic Torrifluvents.

Typical pedon of Glenbar silty clay loam, saline-sodic, 1,200 feet east and 2,300 feet south of the northwest corner of sec. 6, T. 5 S., R. 10 W.

Anyz—0 to 2 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 3/4) moist; moderate coarse prismatic structure; slightly hard, friable, sticky and plastic; many very fine irregular pores; violently effervescent; few small salt crystals; strongly saline (ECe 95.9 mmhos/cm); strongly sodic (SAR 161); less than 1 percent pebbles; many silt coatings on faces of peds; few small gypsum crystals; moderately alkaline (pH 8.2); abrupt smooth boundary.

Cnyz1—2 to 6 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and plastic; few fine roots; many very fine irregular pores; violently effervescent; few small salt crystals; strongly saline (ECe 70.4 mmhos/cm); strongly sodic (SAR 80); common silt coatings on faces of peds; few large gypsum crystals; mildly alkaline (pH 7.8); clear smooth boundary.

Cnyz2—6 to 12 inches; brown (7.5YR 5/4), finely stratified silt loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; many very fine irregular pores; violently effervescent; few small salt crystals; strongly saline (ECe 112.0 mmhos/cm); few silt coatings in root channels; few large gypsum crystals; mildly alkaline (pH 7.8); abrupt smooth boundary.

Cnyz3—12 to 14 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 3/4) moist; moderate medium subangular blocky structure; slightly hard, firm, sticky and plastic; few very fine roots; many very fine irregular pores; violently effervescent; many small salt crystals; strongly saline (ECe 51.1 mmhos/cm); strongly sodic (SAR 65); many silt coatings in pores and on faces of peds; few large gypsum crystals; mildly alkaline (pH 7.8); abrupt smooth boundary.

Cnyz4—14 to 32 inches; brown (7.5YR 5/4), finely stratified silt loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine irregular pores; violently effervescent; common salt crystals; strongly saline (ECe 42.3 mmhos/cm); strongly sodic (SAR 61); few silt coatings in pores; few small gypsum crystals; moderately alkaline (pH 8.0); abrupt smooth boundary.

Cnz1—32 to 40 inches; light brown (7.5YR 6/4), finely stratified silt loam, dark brown (7.5YR 4/4) moist; massive; soft, very friable, slightly sticky and slightly plastic; few very fine roots; many very fine irregular pores; violently effervescent; moderately saline (ECe 13.0 mmhos/cm); few silt coatings in pores; moderately alkaline (pH 8.0); clear smooth boundary.

Cnz2—40 to 60 inches; light brown (7.5YR 6/4), finely stratified loam, dark brown (7.5YR 4/4) moist; massive; soft, friable, slightly sticky and slightly plastic; few very fine roots; many very fine irregular pores; violently effervescent; moderately saline (ECe 10.0 mmhos/cm); few silt coatings in pores; moderately alkaline (pH 8.2).

Less than 1 percent of the surface is covered with pebbles. The A horizon is 2 to 10 inches thick. It has hue of 5YR, 7.5YR, or 10YR and value of 5 or 6. The C horizon has hue of 5YR, 7.5YR, or 10YR, value of 5 or 6, and chroma of 4 to 6. It is dominantly silt loam and silty clay loam, but the range includes loam and clay loam. Some pedons do not have gypsum crystals. Some pedons have small masses of lime in the lower part. The sodium adsorption ratio ranges from less than 13 to more than 100. Electrical conductivity ranges from less than 1 millimho per centimeter to more than 100 millimhos per centimeter.

Growler Series

The Growler series consists of deep, somewhat excessively drained soils on fan terraces and stream terraces. These soils formed in alluvium derived from mixed rocks. Slope ranges from 1 to 3 percent. Elevation is 500 to 800 feet. The mean annual precipitation is about 5 to 7 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are coarse-loamy, mixed, hyperthermic Typic Haplargids.

Typical pedon of Growler extremely gravelly fine sandy loam, in an area of Growler-Momoli complex, 1 to 3 percent slopes, about 1,600 feet north and 2,000 feet east of the southwest corner of sec. 30, T. 5 S., R. 4 W.

About 95 percent of the surface is covered with varnished gravel.

A—0 to 1 inch; light brown (7.5YR 6/4) extremely gravelly fine sandy loam, brown (7.5YR 5/4) moist; weak very fine granular structure; soft, very friable; many very fine irregular pores; strongly effervescent; very slightly saline (ECe 2.5 mmhos/cm); about 80 percent pebbles; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bt—1 to 2 inches; light reddish brown (5YR 6/4) gravelly loam, yellowish red (5YR 5/6) moist; strong medium subangular blocky structure; slightly hard, very friable, sticky and slightly plastic; few very fine roots; many very fine vesicular pores; common thin clay films on faces of peds; violently effervescent; nonsaline (ECe 0.5 mmho/cm); about 15 percent pebbles; strongly alkaline (pH 8.8); abrupt smooth boundary.

Btkz1—2 to 7 inches: light reddish brown (5YR 6/4) fine sandy loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky; few very fine roots; many very fine irregular pores; common thin clay films on faces of peds; few small masses of lime; violently effervescent; strongly saline (ECe 32.0 mmhos/cm); about 10 percent pebbles; moderately alkaline (pH 8.0); clear smooth boundary.

Btkz2—7 to 15 inches; light brown (7.5YR 6/4) gravelly sandy loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky; few very fine roots; common very fine tubular pores; few thin clay films on faces of peds; common medium masses of calcium carbonate; violently effervescent; strongly saline (ECe 50.0 mmhos/cm); about 25 percent pebbles; moderately alkaline (pH 7.9); gradual smooth boundary.

2Btkz3—15 to 26 inches; yellowish red (5YR 5/6) gravelly sandy loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky; few very fine roots; common very fine tubular pores; few thin clay films on faces of peds; few small masses of lime; violently effervescent; strongly saline (ECe 34.0 mmhos/cm); about 20 percent pebbles; moderately alkaline (pH 8.0); clear smooth boundary.

2BCtkz—26 to 43 inches; light brown (7.5YR 6/4) very gravelly sandy loam, brown (7.5YR 5/4) moist; massive; very hard, firm; common very fine tubular pores; few thin clay films in pores; many medium hard masses of lime; violently effervescent (10 percent calcium carbonate); strongly saline (ECe 28.0 mmhos/cm); about 40 percent pebbles; moderately alkaline (pH 8.0); clear smooth boundary.

3Btkz1—43 to 55 inches; brown (7.5YR 5/4) extremely gravelly loamy sand, brown (7.5YR 4/4) moist; massive; hard, friable; many very fine irregular pores; bridging and colloidal stains on mineral grains; many medium hard masses of lime; violently effervescent; strongly saline (ECe 24.0 mmhos/cm); about 75 percent pebbles; moderately alkaline (pH 8.0); abrupt smooth boundary.

3Btkz2—55 to 60 inches; reddish brown (5YR 5/4) very gravelly sand, yellowish red (5YR 5/6) moist; massive; hard, friable; many very fine tubular pores; few distinct clay films in pores; common small hard masses of calcium carbonate; noneffervescent with pockets that are violently effervescent; moderately saline (ECe 12.0 mmhos/cm); about 40 percent pebbles; moderately alkaline (pH 7.9).

About 85 to 100 percent of the surface is covered with darkly varnished, closely packed pebbles. A calcic horizon is at a depth of 10 to more than 40 inches. The A horizon is 1 to 3 inches thick. It has hue of 7.5YR or 10YR and value of 6 or 7. The Bt horizon is loam, sandy loam, silt loam, or sandy clay loam and averages 10 to 18 percent clay. The content of coarse fragments in the Bt horizon ranges from 5 to 40 percent and averages less than 35 percent. Electrical conductivity ranges from less than 1 millimho per centimeter to more than 70 millimhos per centimeter, but it typically is more than 16 millimhos per centimeter throughout most of the profile. The sodium adsorption ratio is greater than 13 in most pedons.

Gunsight Series

The Gunsight series consists of deep, somewhat excessively drained soils on fan terraces and stream terraces. These soils formed in alluvium derived dominantly from mixed rocks. Slope ranges from 1 to 25 percent. Elevation is 450 to 2,600 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are loamy-skeletal, mixed, hyperthermic Typic Calciorthids.

Typical pedon of Gunsight extremely gravelly sandy loam, in an area of Gunsight-Rillito-Carrizo complex, 1 to 15 percent slopes, about 1,300 feet north and 500 feet west of the southeast corner of sec. 35, T. 3 S., R. 4 W.

About 80 percent of the surface is covered with gravel and cobbles.

A—0 to 1 inch; very pale brown (7.5YR 7/3) extremely gravelly sandy loam, yellowish brown (10YR 5/4) moist; weak fine granular structure; soft, friable; many very fine roots; many very fine vesicular pores; violently effervescent; about 80 percent pebbles; strongly alkaline (pH 8.6); abrupt wavy boundary.

Bk1—1 to 6 inches; light gray (10YR 7/2) very gravelly sandy loam, light yellowish brown (10YR 6/4) moist; massive; slightly hard, firm; many very fine roots; common very fine tubular pores; few small masses and nodules of lime; violently effervescent; about 50 percent pebbles; moderately alkaline (pH 8.4); clear wavy boundary.

Bk2—6 to 46 inches; very pale brown (10YR 7/3) extremely gravelly coarse sandy loam, yellowish brown (10YR 5/4) moist; massive; hard, firm; common very fine roots; common fine irregular pores; many small masses and nodules of lime; many small hardpan fragments; violently effervescent; about 70 percent pebbles and 5 percent cobbles; moderately alkaline (pH 8.2); clear broken boundary.

2Btkb—46 to 60 inches; light brown (7.5YR 6/4) very gravelly coarse sandy loam, brown (7.5YR 4/4) moist; massive; hard, firm; few medium roots; many very fine irregular pores; clay films bridging sand grains; about 55 percent gravel; moderately alkaline (pH 8.2).

About 25 to 90 percent of the surface is covered with pebbles and cobbles. The content of rock fragments in the control section, mostly pebbles, ranges from 20 to 80 percent and averages more than 35 percent. A calcic horizon is between depths of 5 and 30 inches. The A horizon is 1 to 3 inches thick. It is extremely gravelly sandy loam or extremely cobbly sandy loam. It has hue of 10YR or 7.5YR, value of 4 to 7, and chroma of 3 or 4. The Bk horizon is coarse sandy loam, sandy loam, or fine sandy loam. It has hue of 7.5YR or 10YR, value of 4 to 7, and chroma of 2 to 6. Depth to the buried subsoil ranges from 40 to more than 60 inches. The sodium adsorption ratio is less than 13. Electrical conductivity is less than 16 millimhos per centimeter.

In areas adjacent to the Sauceda Mountains, the Gunsight soil in Gunsight-Cipriano complex, 1 to 15 percent slopes, is cooler than is typical. This difference, however, does not significantly affect use and management of the soil.

Harqua Series

The Harqua series consists of deep, well drained soils on basin floors. These soils formed in alluvium derived dominantly from mixed rocks. Slope ranges from 0 to 10 percent. Elevation is 600 to 800 feet. The mean annual precipitation is 5 to 7 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

The Harqua soils in this survey area are taxadjuncts because they have a silty clay subhorizon in the lower part of the control section. They are classified as fine-loamy, mixed, hyperthermic Typic Haplargids.

Typical pedon of Harqua fine sandy loam, 0 to 3 percent slopes, about 1,000 feet north and 1,350 feet west of the southeast corner of sec. 7, T. 5 S., R. 6 W.

Ap—0 to 6 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; soft, very friable; many very fine roots; common very fine tubular pores; violently effervescent; slightly saline (ECe 4.5 mmhos/cm); moderately sodic (SAR 20); about 5 percent pebbles; moderately alkaline (pH 8.3); clear smooth boundary.

Btknz—6 to 10 inches; yellowish red (5YR 5/6) fine sandy loam, reddish brown (5YR 5/4) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; few distinct clay films in pores and on faces of peds; common small soft masses of lime; violently effervescent (13 percent calcium carbonate); slightly saline (ECe 6.0 mmhos/cm); moderately sodic (SAR 19); about 5 percent pebbles; moderately alkaline (pH 7.9); clear smooth boundary.

Btkn—10 to 20 inches; light reddish brown (5YR 6/4) clay loam, yellowish red (5YR 5/6) moist; moderate medium subangular blocky structure; slightly hard, firm, sticky and plastic; many very fine roots; many very fine tubular pores; many distinct clay films on faces of peds; many medium masses of lime; violently effervescent (16 percent calcium carbonate); very slightly saline (ECe 2.6 mmhos/cm); moderately sodic (SAR 28); few small yellow masses of sulfur; strongly alkaline (pH 8.6); clear smooth boundary.

2Btknyz1—20 to 31 inches; reddish brown (5YR 5/4) silty clay loam, yellowish red (5YR 5/6) moist; moderate fine subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; common very fine tubular pores; common distinct clay films on faces of peds; few small masses of lime; violently effervescent; moderately saline (ECe 12.1 mmhos/cm); moderately sodic (SAR 25); few very fine gypsum crystals; few iron-manganese stains on faces of peds; moderately alkaline (pH 7.9); clear smooth boundary.

2Btknyz2—31 to 50 inches; reddish brown (5YR 4/4) silty clay, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; common very fine tubular pores; few distinct clay films on faces of peds; slightly effervescent; moderately saline (ECe 11.4 mmhos/cm); moderately sodic (SAR 25); many medium gypsum crystals in masses; few medium iron-manganese stains on faces of peds; moderately alkaline (pH 7.9); abrupt wavy boundary.

3Ctnz—50 to 60 inches; light brownish gray (10YR 6/2) loamy fine sand, pale brown (10YR 6/3) moist; massive; soft, very friable; many very fine irregular pores; few distinct clay films in pores; slightly effervescent; slightly saline (ECe 4.8 mmhos/cm); strongly sodic (SAR 33); about 1 percent rounded pebbles; moderately alkaline (pH 8.1).

About 5 to 40 percent of the surface is covered with pebbles and pan fragments. Depth to the buried B horizon ranges from 10 to 40 inches. Some pedons are strongly saline-sodic. The depth to gypsum ranges from 15 to 40 inches. The A horizon is loam or fine sandy loam. It contains 5 to 20 percent pebbles and pan fragments by volume. It is commonly 2 to 6 inches thick. It has hue of 7.5YR or 10YR and value and chroma of 4 to 6. The upper part of the B horizon is sandy loam, fine sandy loam, or clay loam. It contains 5 to 10 percent pebbles by volume. It is 10 to more than 30 inches thick. It has hue of 7.5YR or 5YR, value of 5 to 7, and chroma of 3 to 6. The buried 2B horizon is silt loam, silty clay loam, silty clay, clay loam, or clay. It is typically 20 or more inches thick. It has hue of 5YR, value of 4 to 7, and chroma of 4 to 6. The 3C horizon is loamy fine sand or fine sand. The sand is cemented with lime in some pedons.

Hyder Series

The Hyder series consists of shallow and very shallow, somewhat excessively drained soils on hills and mountains. These soils formed in colluvium and alluvium derived dominantly from volcanic rocks, such as andesite, rhyolite, and basalt. Slope ranges from 1 to 65 percent. Elevation is 480 to 2,800 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are loamy-skeletal, mixed (calcareous), hyperthermic Lithic Torriorthents.

Typical pedon of Hyder extremely gravelly sandy loam, in an area of Hyder-Gachado-Gunsight extremely gravelly sandy loams, 1 to 25 percent slopes; in an unsectionalized area about 1,600 feet north and 16,900 feet west of the southeast corner of T. 2 S., R. 9 W.

About 95 percent of the surface is covered with pebbles.

A—0 to 1 inch; light brown (7.5YR 6/4) extremely gravelly sandy loam, dark brown (7.5YR 4/4) moist; weak fine granular structure; soft, very friable; common very fine roots; many very fine irregular pores; strongly effervescent; about 75 percent pebbles; mildly alkaline (pH 7.6); abrupt wavy boundary.

Bk—1 to 7 inches; light brown (7.5YR 6/4) extremely gravelly sandy loam, brown (7.5YR 5/4) moist; massive; soft, very friable; common very fine roots; many very fine irregular pores; thin continuous coatings of lime on the undersides of pebbles; violently effervescent; about 75 percent pebbles and cemented pan fragments; moderately alkaline (pH 8.2); abrupt wavy boundary.

2R—7 to 11 inches; rhyolite.

About 50 to 95 percent of the surface is covered with pebbles, cobbles, and stones. The content of rock fragments ranges from 40 to 75 percent throughout the profile. The depth to hard volcanic rock is 5 to 18 inches. The A horizon is 1 to 3 inches thick. It is extremely gravelly sandy loam or extremely stony fine sandy loam. The fine-earth part of the B horizon is sandy loam, fine sandy loam, or loam.

Indio Series

The Indio series consists of deep, well drained soils on flood plains. These soils formed in recent alluvium derived dominantly from mixed rocks. Slope is 0 to 1 percent. Elevation is 430 to 850 feet. The mean annual precipitation is about 5 to 7 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are coarse-silty, mixed (calcareous), hyperthermic Typic Torrifluvents.

Typical pedon of Indio silt loam, about 1,350 feet south and 75 feet east of the northwest corner of sec. 7, T. 5 S., R. 9 W.

A—0 to 12 inches; light brown (7.5YR 6/4) silt loam, brown (7.5YR 4/4) moist; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine irregular pores; violently effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

C—12 to 52 inches; light brown (7.5YR 6/4), stratified silt loam and very fine sandy loam, brown (7.5YR 4/4) moist; massive; soft, very friable, slightly sticky and slightly plastic; common fine roots; few very fine irregular pores; violently effervescent; very slightly saline (ECe 2.6 mmhos/cm); moderately alkaline (pH 8.2); abrupt smooth boundary.

Cz—52 to 58 inches; pale brown (10YR 6/3), stratified loam and silt loam, brown (10YR 4/3) moist; massive; soft, very friable, slightly sticky and slightly plastic; common fine roots; few very fine irregular pores; violently effervescent; common salt crystals; moderately alkaline (pH 8.0); abrupt smooth boundary.

2C—58 to 60 inches; light brown (7.5YR 6/4) loamy sand, brown (7.5YR 5/4) moist; single grain; loose; many very fine irregular pores; violently effervescent; moderately alkaline (pH 7.9).

The content of gravel is less than 1 percent throughout the profile. The A and C horizons have hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 2 to 4. The C horizon is stratified very fine sandy loam, silt loam, or silt. Some pedons have strata of sandy loam, loamy sand, loam, or silty clay loam less than 5 inches thick. Some pedons have salt crystals throughout the profile or have a white crust of salt on the surface. Electrical conductivity ranges from less than 1 millimho per centimeter to more than 100 millimhos per centimeter. The sodium adsorption ratio is greater than 13 in some pedons.

Kofa Series

The Kofa series consists of deep, well drained soils on flood plains. These soils formed in recent alluvium derived dominantly from mixed rocks. Slope is 0 to 1 percent. Elevation is 430 to 500 feet. The mean annual precipitation is about 5 to 7 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are clayey over sandy or sandy-skeletal, montmorillonitic (calcareous), hyperthermic Vertic Torrifluvents.

Typical pedon of Kofa silty clay loam, in an area of Gadsden and Kofa silty clay loams, saline-sodic, 850 feet south and 2,600 feet east of the northwest corner of sec. 29, T. 5 S., R. 10 W.

About 75 percent of the surface is covered with saltcedar litter and a thin, white crust of salt.

Anz—0 to 3 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; weak coarse subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; common very fine tubular pores; violently effervescent; many large salt crystals; strongly saline (ECe 160 mmhos/cm); mildly alkaline (pH 7.8); clear wavy boundary.

Cnz—3 to 21 inches; brown (10YR 5/3) silty clay that has few thin strata of silty clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; very hard, firm, very sticky and plastic; many very fine roots; many very fine tubular pores; violently effervescent; common small salt crystals; strongly saline (ECe 25 mmhos/cm); moderately alkaline (pH 8.2); abrupt smooth boundary.

2Cnyz—21 to 27 inches; pale brown (10YR 6/3), finely stratified loamy fine sand, dark brown (10YR 4/3) moist; fine black strata; soft, very friable; few very fine roots; many very fine irregular pores; violently effervescent; strongly saline (ECe 22.5 mmhos/cm); mildly alkaline (pH 7.8); abrupt smooth boundary.

2Cy—27 to 53 inches; pale brown (10YR 6/3), finely stratified fine sand, dark brown (10YR 4/3) moist; fine black strata; single grain; loose; few very fine roots; many very fine irregular pores; strongly effervescent; nonsaline (ECe 1.1 mmhos/cm); mildly alkaline (pH 7.6); abrupt smooth boundary.

2Cyz—53 to 60 inches; light brownish gray (10YR 6/2), finely stratified gravelly sand, dark brown (10YR 4/3) moist; fine black strata; single grain; loose; many very fine irregular pores; slightly effervescent; slightly saline (ECe 4.5 mmhos/cm); about 20 percent pebbles; mildly alkaline (pH 7.6).

Depth to the coarse textured horizon ranges from 20 to 40 inches. When dry, these soils have cracks ½ inch wide or wider to a depth of 20 inches. The A horizon is 2 to 4 inches thick. It has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 or 4. The C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 to 4. The upper part of the C horizon is silty clay loam or silty clay in some places. It has thin strata of coarser textured material. The lower part of the C horizon is loamy fine sand, sand, or gravelly sand. The sodium adsorption ratio is greater than 13 in most pedons.

Lagunita Series

The Lagunita series consists of deep, excessively drained soils on flood plains and alluvial fans. These soils formed in recent alluvium derived dominantly from mixed rocks. Slope is 0 to 1 percent. Elevation is 430 to 850 feet. The mean annual precipitation is about 5 to 7 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are mixed, hyperthermic Typic Torripsamments.

Typical pedon of Lagunita loamy sand, in an area of Lagunita-Vint complex, about 100 feet east and 2,600 feet south of the northwest corner of sec. 35, T. 2 S., R. 5 W.

A—0 to 11 inches; pale brown (10YR 6/3), stratified loamy sand, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable; many very fine roots; many very fine irregular pores; strongly effervescent; mildly alkaline (pH 7.4); abrupt wavy boundary.

C1—11 to 23 inches; light brownish gray (10YR 6/2), stratified sand, brown (10YR 5/3) moist; single grain; loose; many very fine roots; many very fine irregular pores; about 10 percent pebbles; slightly effervescent; neutral (pH 7.2); gradual smooth boundary.

C2—23 to 50 inches; light brownish gray (10YR 6/2), stratified sand, brown (10YR 5/3) moist; single grain; loose; many fine roots; many very fine irregular pores; about 2 percent pebbles; slightly effervescent; neutral (pH 7.2); abrupt smooth boundary.

C3—50 to 60 inches; light brownish gray (10YR 6/2), stratified very gravelly coarse sand, brown (10YR 4/3) moist; single grain; loose; few fine roots; many very fine irregular pores; about 40 percent pebbles; slightly effervescent; neutral (pH 7.2).

The content of gravel averages less than 10 percent in the upper 40 inches. The A horizon is loamy fine sand or loamy sand and contains 0 to 25 percent pebbles. It has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 to 4. The C horizon is dominantly loamy sand or sand and contains 1 to 55 percent pebbles and cobbles. It has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 3 or 4.

Laposa Series

The Laposa series consists of moderately deep, somewhat excessively drained soils on hills and mountains. These soils formed in alluvium and colluvium derived dominantly from schist. Slope ranges from 10 to 25 percent. Elevation is 1,600 to 3,200 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are loamy-skeletal, mixed, hyperthermic Typic Camborthids.

Typical pedon of Laposa extremely channery sandy loam, in an area of Schenco-Laposa-Rock outcrop complex, 10 to 55 percent slopes; in an unsectionalized area about 15,000 feet east and 7,800 feet north of the southwest corner of T. 2 S., R. 6 W.

About 60 percent of the surface is covered with channers.

A—0 to 1 inch; brown (7.5YR 5/4) extremely channery sandy loam, brown (7.5YR 4/4) moist; weak fine granular structure; soft, very friable; many very fine roots; many very fine irregular pores; effervescent; about 60 percent channers; moderately alkaline (pH 8.0); abrupt wavy boundary.

Bw—1 to 15 inches; light brown (7.5YR 6/4) very channery sandy loam, brown (7.5YR 4/4) moist; massive; soft, very friable; many very fine roots; many very fine irregular pores; strongly effervescent; about 50 percent channers; moderately alkaline (pH 8.2); clear wavy boundary.

Bk—15 to 23 inches; light brown (7.5YR 6/4) very channery fine sandy loam, brown (7.5YR 4/4) moist; massive; soft, very friable; many very fine roots; many very fine irregular pores; few small masses of lime; violently effervescent; about 50 percent channers; moderately alkaline (pH 8.4); clear wavy boundary.

2Cr—23 to 33 inches; weathered schist.

2R—33 to 37 inches; schist.

About 35 to 70 percent of the surface is covered with schist channers. The depth to paralithic contact ranges from 20 to 36 inches. The depth to lithic contact ranges from 30 to 45 inches. The A horizon is 1 to 2 inches thick. It has hue of 7.5YR and value and chroma of 4 to 6. The C horizon is sandy loam or fine sandy loam and contains 40 to 60 percent channers. It has colors similar to those of the A horizon. Some pedons do not have a Cr horizon.

Mohall Series

The Mohall series consists of deep, well drained soils on fan terraces and basin floors. These soils formed in alluvium derived dominantly from mixed rocks. Slope ranges from 0 to 3 percent. Elevation is 600 to 2,100 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are fine-loamy, mixed, hyperthermic Typic Haplargids.

Typical pedon of Mohall loam, about 600 feet west and 600 feet north of the southeast corner of sec. 4, T. 6 S., R. 6 W.

Ap1—0 to 6 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; violently effervescent; nonsaline (ECe 1.9 mmhos/cm); about 2 percent fine pebbles; moderately alkaline (pH 8.4); clear smooth boundary.

Ap2—6 to 15 inches; brown (7.5YR 5/4) loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine irregular pores; violently effervescent; slightly saline (ECe 6.0 mmhos/cm); about 2 percent fine pebbles; moderately alkaline (pH 8.2); abrupt smooth boundary.

Btk1—15 to 26 inches; light brown (7.5YR 6/4) loam, strong brown (7.5YR 5/6) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; few very fine tubular pores; colloid in bridges between mineral grains; few filaments and small soft masses of lime; violently effervescent (8 percent calcium carbonate); slightly saline (ECe 5.0 mmhos/cm); about 2 percent fine pebbles; moderately alkaline (pH 8.4); clear smooth boundary.

Btk2—26 to 36 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 5/6) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; few very fine roots; few very fine tubular pores; common thin clay films on faces of peds; common medium masses of lime; violently effervescent (22 percent calcium carbonate); slightly saline (ECe 4.0 mmhos/cm); about 5 percent pebbles; moderately alkaline (pH 8.4); clear wavy boundary.

Btk3—36 to 57 inches; pink (5YR 8/4) clay loam, pink (7.5YR 7/4) moist; moderate medium subangular blocky structure; slightly hard, firm, sticky and plastic; few very fine roots; few very fine irregular pores; common thin clay films on faces of peds; many medium masses of lime; violently effervescent (37 percent calcium carbonate); very slightly saline (ECe 2.9 mmhos/cm); about 10 percent fine pebbles; moderately alkaline (pH 8.4); gradual wavy boundary.

Btk4—57 to 60 inches; light reddish brown (5YR 6/4) clay loam, light reddish brown (5YR 6/4) moist; weak medium subangular blocky structure; slightly hard, firm, sticky and plastic; few very fine roots; few very fine irregular pores; few thin clay films on faces of peds; common medium masses of lime; violently effervescent (25 percent calcium carbonate); very slightly saline (ECe 3.1 mmhos/cm); about 5 percent fine pebbles; moderately alkaline (pH 8.2).

About 1 to 25 percent of the surface is covered with pebbles. Depth to the calcic horizon ranges from 20 to 40 inches. The A horizon is loam, clay loam, fine sandy loam, or sandy loam and has 1 to 10 percent pebbles. It has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 3 or 4. The Btk horizon is loam, clay loam, or sandy clay loam and has 0 to 10 percent pebbles. It has hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 4 to 6. Electrical conductivity ranges from 1 to 8 millimhos per centimeter.

Mohall loam, occasionally flooded, is in depressions along ephemeral drainageways and is subject to occasional, very brief periods of flooding. This characteristic is not typical for the series.

Momoli Series

The Momoli series consists of deep, somewhat excessively drained soils on fan terraces and stream terraces. These soils formed in alluvium and colluvium derived dominantly from mixed rocks. Slope ranges from 0 to 15 percent. Elevation is 500 to 2,500 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are loamy-skeletal, mixed, hyperthermic Typic Camborthids.

Typical pedon of Momoli very gravelly sandy loam, in an area of Quilotosa-Momoli-Carrizo complex, 1 to 15 percent slopes, about 2,050 feet north and 1,950 feet west of the southeast corner of sec. 13, T. 4 S., R. 3 W.

About 60 percent of the surface is covered with pebbles.

A—0 to 2 inches; light brown (7.5YR 6/4) very gravelly sandy loam, dark brown (7.5YR 4/4) moist; weak fine granular structure; soft, very friable; common very fine roots; common very fine irregular pores; noneffervescent; about 40 percent pebbles; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bw—2 to 15 inches; reddish yellow (7.5YR 6/6) very gravelly sandy loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, friable; many very fine roots; few fine tubular pores; slightly effervescent; about 35 percent pebbles; moderately alkaline (pH 8.2); clear wavy boundary.

Bk—15 to 60 inches; strong brown (7.5YR 5/6) very gravelly coarse sandy loam, brown (7.5YR 4/4) moist; massive; soft, friable; common very fine roots; common very fine tubular pores; few large masses of lime; violently effervescent; about 45 percent pebbles partially coated with lime; moderately alkaline (pH 8.4).

About 35 to 85 percent of the surface is covered with pebbles, cobbles, and stones. In the upper 40 inches, the content of pebbles and cobbles ranges from 30 to 90 percent and averages more than 35 percent. Typically, there are more pebbles than cobbles. The A horizon is 1 to 4 inches thick. It is extremely gravelly sandy loam, very gravelly sandy loam, or extremely cobbly loam and contains 45 to 90 percent pebbles and cobbles. It has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 or 4. The B horizon is fine sandy loam, coarse sandy loam, or sandy loam and contains 30 to 80 percent pebbles and cobbles. In some strata the texture ranges to loamy sand. The B horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 4 to 6. Electrical conductivity ranges from less than 1 millimho per centimeter to 12 millimhos per centimeter. The sodium adsorption ratio is less than 13.

Pinamt Series

The Pinamt series consists of deep, well drained soils on fan terraces. These soils formed in alluvium derived dominantly from mixed rocks. Slope ranges from 1 to 5 percent. Elevation is 800 to 2,300 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are loamy-skeletal, mixed, hyperthermic Typic Haplargids.

Typical pedon of Pinamt very gravelly loam, in an area of Gunsight-Pinamt complex, 1 to 15 percent slopes, about 1,200 feet west and 300 feet north of the southeast corner of sec. 29, T. 8 S., R. 1 E.

About 70 percent of the surface is covered with pebbles, and 5 percent is covered with cobbles.

A—0 to 3 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 5/4) moist; weak fine granular structure; soft, very friable, sticky and plastic; many very fine roots; many very fine vesicular pores; about 30 percent pebbles and 5 percent cobbles; moderately alkaline (pH 8.0); abrupt wavy boundary.

Btk1—3 to 9 inches; yellowish red (5YR 5/6) very gravelly clay loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; soft, very friable, sticky and plastic; many very fine roots; many very fine tubular pores; colloidal stains on mineral grains; strongly effervescent; about 25 percent pebbles and 10 percent cobbles; moderately alkaline (pH 8.4); clear wavy boundary.

Btk2—9 to 17 inches; red (2.5YR 4/6) very gravelly clay loam, dark red (2.5YR 3/6) moist; moderate fine subangular blocky structure; slightly hard, very friable, sticky and plastic; many very fine roots; common very fine tubular pores; clay films occurring as colloidal stains and bridging mineral grains; filaments and coatings of lime on pebbles; violently effervescent; about 25 percent pebbles and 10 percent cobbles; strongly alkaline (pH 8.6); clear wavy boundary.

Btk3—17 to 28 inches; yellowish red (5YR 5/6) extremely gravelly sandy clay loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; slightly hard, very friable, sticky and plastic; many very fine roots; common very fine tubular pores; clay films occurring as colloidal stains and bridging mineral grains; filaments and coatings of lime on pebbles and cobbles; violently effervescent; about 60 percent pebbles and 15 percent cobbles; strongly alkaline (pH 8.6); clear wavy boundary.

Bk—28 to 60 inches; pink (7.5YR 7/4) extremely gravelly sandy loam, brown (7.5YR 5/4) moist; massive; hard, firm, slightly sticky and slightly plastic; few fine roots; many very fine tubular pores; cemented with lime in some parts; violently effervescent; about 60 percent pebbles and 15 percent cobbles; moderately alkaline (pH 8.2).

About 45 to 85 percent of the surface is covered with pebbles and some cobbles. The content of gravel ranges from 30 to 70 percent throughout the profile and averages 45 to 65 percent. A calcic horizon is at a depth of 24 inches. Depth to the calcic horizon ranges from 18 to 36 inches. The A horizon is 2 to 4 inches thick. It has value and chroma of 4 to 6. The Bt horizon is loam, sandy clay loam, clay loam, or sandy loam. It has hue of 2.5YR, 5YR, or 7.5YR, value of 3 to 7, and chroma of 4 to 6.

Pompeii Series

The Pompeii series consists of shallow and very shallow, somewhat excessively drained soils on fan terraces and hills. These soils formed in alluvium derived from mixed rocks. Slope ranges from 3 to 25 percent. Elevation is 800 to 2,000 feet. The mean annual precipitation is 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are loamy-skeletal, mixed, hyperthermic, shallow Typic Paleorthids.

Typical pedon of Pompeii extremely gravelly coarse sandy loam, in an area of Ajo-Gunsight-Pompeii complex, 3 to 25 percent slopes, about 800 feet south and 2,600 feet east of the northwest corner of sec. 9, T. 7 S., R. 2 W.

About 65 percent of the surface is covered with pebbles, and 5 percent is covered with cobbles and stones.

A—0 to 3 inches; light brown (7.5YR 6/4) extremely gravelly coarse sandy loam, brown (7.5YR 4/4) moist; weak very fine granular structure; soft, very friable; common very fine roots; many very fine irregular pores; violently effervescent; about 75 percent pebbles; moderately alkaline (pH 8.0); clear wavy boundary.

B—3 to 9 inches; light brown (7.5YR 6/4) very gravelly sandy loam, brown (7.5YR 4/4) moist; weak very fine granular structure; soft, very friable; common very fine roots; many very fine irregular pores; few pan fragments; few thin discontinuous carbonate coatings on pebbles; violently effervescent; about 45 percent pebbles; moderately alkaline (pH 8.2); abrupt wavy boundary.

2Bkm—9 to 13 inches; lime-cemented hardpan that has a thin laminar cap.

About 60 to 90 percent of the surface is covered with pebbles, cobbles, and stones. The content of rock fragments ranges from 35 to 75 percent throughout the profile. Depth to the hardpan ranges from 6 to 20 inches. The B horizon is sandy loam or coarse sandy loam and contains 35 to 70 percent coarse fragments.

Quilotosa Series

The Quilotosa series consists of very shallow and shallow, somewhat excessively drained soils on hills and mountains. These soils formed in colluvium and alluvium derived dominantly from granite and gneiss but also from sandstone and conglomerate. Slope ranges from 3 to 55 percent. Elevation is 800 to 2,800 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are loamy-skeletal, mixed (calcareous), hyperthermic Lithic Torriorthents.

Typical pedon of Quilotosa extremely stony coarse sandy loam, in an area of Quilotosa-Rock outcrop complex, 15 to 55 percent slopes, about 1,000 feet east and 850 feet south of the northwest corner of sec. 25, T. 4 S., R. 3 W.

About 80 percent of the surface is covered with pebbles, cobbles, stones, and boulders.

A—0 to 2 inches; pale brown (10YR 6/3) extremely stony coarse sandy loam, yellowish brown (10YR 5/4) moist; weak fine granular structure; soft, very friable; many very fine roots; many very fine irregular pores; about 80 percent pebbles, cobbles, and stones; moderately alkaline (pH 8.0); abrupt wavy boundary.

Bw—2 to 6 inches; brown (10YR 5/3) extremely gravelly coarse sandy loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, very friable; many very fine roots; common very fine irregular pores; strongly effervescent; about 65 percent pebbles; moderately alkaline (pH 8.2); gradual wavy boundary.

Bk—6 to 14 inches; light yellowish brown (10YR 6/4) extremely gravelly coarse sandy loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, very friable; common very fine roots; common fine irregular pores; thin coatings of lime on some pebbles; violently effervescent; about 65 percent pebbles; moderately alkaline (pH 8.2); gradual wavy boundary.

2Cr—14 to 19 inches; weathered granite.

2R—19 to 23 inches; hard granite.

About 45 to 95 percent of the surface is covered with pebbles, cobbles, stones, and boulders. The depth to weathered bedrock is 4 to 16 inches. The depth to unweathered bedrock is 9 to 20 inches. The A horizon is 1 to 3 inches thick. It is extremely gravelly coarse sandy loam, extremely gravelly sandy loam, extremely stony coarse sandy loam, or extremely stony sandy loam and contains 60 to 90 percent rock fragments. It has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 or 4. The B horizon is sandy loam and contains 35 to 85 percent rock fragments. It has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 to 6.

The Quilotosa soil in Vaiva-Quilotosa extremely stony sandy loams, 25 to 55 percent slopes, formed in colluvium derived dominantly from sandstone and conglomerate and is deeper than 20 inches to the lithic contact. These differences, however, do not significantly affect use and management of the soil.

Rillito Series

The Rillito series consists of deep, somewhat excessively drained soils on fan terraces. These soils formed in alluvium derived dominantly from mixed rocks. Slope ranges from 1 to 5 percent. Elevation is 500 to 2,000 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are coarse-loamy, mixed, hyperthermic Typic Calciorthids.

Typical pedon of Rillito very gravelly sandy loam, in an area of Denure-Rillito-Why complex, 1 to 5 percent slopes, about 1,300 feet north and 100 feet west of the southeast corner of sec. 12, T. 5 S., R. 4 W.

About 40 percent of the surface is covered with pebbles and a few cobbles.

A—0 to 2 inches; light brown (7.5YR 6/4) very gravelly sandy loam, brown (7.5YR 5/4) moist; weak fine granular structure; slightly hard, very friable; common very fine roots; many very fine irregular pores; strongly effervescent; nonsaline (ECe 0.2 mmho/cm); about 35 percent pebbles and 5 percent cobbles; moderately alkaline (pH 8.2); clear smooth boundary.

Bw—2 to 9 inches; reddish yellow (7.5YR 6/6) sandy loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable, slightly sticky; many very fine roots; many very fine tubular pores; few small filaments of lime; violently effervescent; nonsaline (ECe 0.6 mmho/cm); slightly sodic (SAR 9); about 10 percent pebbles; moderately alkaline (pH 8.4); clear wavy boundary.

Bk1—9 to 22 inches; light brown (7.5YR 6/4) gravelly fine sandy loam, brown (7.5YR 5/4) moist; massive; hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; few small masses of lime; violently effervescent (15 percent calcium carbonate); slightly saline (ECe 7.8 mmhos/cm); moderately sodic (SAR 27); about 20 percent pebbles partially coated with lime; moderately alkaline (pH 8.2); gradual wavy boundary.

Bk2—22 to 42 inches; pink (7.5YR 7/4) gravelly sandy loam, light brown (7.5YR 6/4) moist; massive; hard, firm, sticky and plastic; common very fine roots; many very fine tubular pores; common soft masses and nodules of lime; violently effervescent (20 percent calcium carbonate); moderately saline (ECe 13.7 mmhos/cm); moderately sodic (SAR 21); about 20 percent pebbles partially coated with lime; moderately alkaline (pH 8.0); clear wavy boundary.

2Btkb—42 to 60 inches; reddish brown (5YR 5/4) very gravelly sandy loam, reddish brown (5YR 4/4) moist; massive; very hard, firm, sticky and plastic; many very fine tubular pores; few clay films occurring as colloidal stains and bridging sand grains; few small masses of lime; strongly effervescent; moderately saline (ECe 9.8 mmhos/cm); moderately sodic (SAR 25); about 50 percent fine pebbles; moderately alkaline (pH 8.0).

The surface is covered with 35 to 80 percent pebbles. The content of gravel ranges from 10 to 50 percent in any one horizon and averages 15 to 35 percent in the control section. The depth to a calcic horizon ranges from 5 to 40 inches. The A horizon is 2 to 5 inches thick. It has hue of 7.5YR, value of 6 or 7, and chroma of 4. The B horizon is sandy loam, fine sandy loam, or loam. It has hue of 7.5YR, value of 6 or 7, and chroma of 4 to 6. Some pedons do not have a buried 2Btk horizon. The sodium adsorption ratio is less than 30. Electrical conductivity is less than 16 millimhos per centimeter.

Ripley Series

The Ripley series consists of deep, well drained soils on flood plains. These soils formed in recent alluvium derived dominantly from mixed rocks. Slope is 0 to 1 percent. Elevation is 430 to 850 feet. The mean annual precipitation is about 5 to 7 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free period is 260 to 320 days.

These soils are coarse-silty over sandy or sandy-skeletal, mixed (calcareous), hyperthermic Typic Torrifluvents.

Typical pedon of Ripley silt loam, in an area of Agualt and Ripley soils, saline-sodic, 1,100 feet east and 1,100 feet south of the northwest corner of sec. 32, T. 5 S., R. 10 W.

A—0 to 2 inches; pink (7.5YR 7/4) silt loam, brown (7.5YR 4/4) moist; weak fine granular structure; soft, very friable, slightly plastic; many very fine roots; many very fine irregular pores; violently effervescent; nonsaline (ECe 0.9 mmho/cm); mildly alkaline (pH 7.8); clear smooth boundary.

Czn—2 to 10 inches; light brown (7.5YR 6/4), finely stratified silt loam, brown (7.5YR 4/4) moist; weak medium subangular blocky structure; soft, very friable, slightly plastic; many very fine roots; common very fine irregular pores; violently effervescent; few fine salt crystals; very slightly saline (ECe 3.2 mmhos/cm); moderately sodic (SAR 18); mildly alkaline (pH 7.8); clear smooth boundary.

Cnz1—10 to 25 inches; light brown (7.5YR 6/4), finely stratified silt loam, brown (7.5YR 4/4) moist; massive; soft, very friable, slightly plastic; common very fine roots; common very fine irregular pores; violently effervescent; common fine salt crystals; moderately saline (ECe 14.9 mmhos/cm); moderately sodic (SAR 14); mildly alkaline (pH 7.8); clear wavy boundary.

Cnz2—25 to 32 inches; light brown (7.5YR 6/4), finely stratified very fine sandy loam, brown (7.5YR 4/4) moist; massive; soft, very friable; common very fine roots; common very fine irregular pores; violently effervescent; few fine salt crystals; moderately saline (ECe 15 mmhos/cm); moderately alkaline (pH 8.2); abrupt wavy boundary.

Cnz3—32 to 47 inches; pale brown (10YR 6/3), finely stratified loamy fine sand, dark brown (10YR 3/3) moist; single grain; loose; common very fine roots; many very fine irregular pores; violently effervescent; slightly saline (ECe 6.0 mmhos/cm); mildly alkaline (pH 7.8); abrupt wavy boundary.

Cnz4—47 to 52 inches; very dark grayish brown (10YR 3/2) clay, dark yellowish brown (10YR 3/4) moist; massive; very hard, very firm, very sticky and very plastic; many very fine roots; few very fine irregular pores; violently effervescent; many fine salt crystals; moderately saline (ECe 15.4 mmhos/cm); mildly alkaline (pH 7.8); abrupt wavy boundary.

Cnz5—52 to 56 inches; pale brown (10YR 6/3), finely stratified very fine sandy loam, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable; many very fine roots; many very fine irregular pores; violently effervescent; slightly saline (ECe 0.5 mmho/cm); mildly alkaline (pH 7.8); abrupt wavy boundary.

C—56 to 60 inches; light brownish gray (10YR 6/2), finely stratified sand, dark brown (10YR 3/3) moist; single grain; loose; many very fine irregular pores; strongly effervescent; mildly alkaline (pH 7.6).

The upper part of the C horizon is silt loam or very fine sandy loam. The lower part is loamy fine sand, loamy sand, or sand. Depth to the coarse textured layers ranges from 20 to 40 inches. The C horizon has thin strata of finer or coarser textured material. Electrical conductivity ranges from less than 1 millimho per centimeter to more than 50 millimhos per centimeter. The sodium adsorption ratio is less than 13 in some pedons.

Rositas Series

The Rositas series consists of deep, somewhat excessively drained soils on sand dunes. These soils formed in eolian soil material derived dominantly from mixed rocks. Slope ranges from 1 to 10 percent. Elevation is 500 to 800 feet. The mean annual precipitation is about 5 to 7 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are mixed, hyperthermic Typic Torripsamments.

Typical pedon of Rositas loamy fine sand, in an area of Rositas-Denure loamy fine sands, 1 to 10 percent slopes, about 3,000 feet north and 30 feet east of the southwest corner of sec. 6, T. 5 S., R. 9 W.

A—0 to 3 inches; light brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 4/4) moist; weak thin platy structure; soft, very friable; few very fine roots; many very fine irregular pores; strongly effervescent; few fine concretions; moderately alkaline (pH 8.2); gradual wavy boundary.

C1—3 to 29 inches; light brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 4/4) moist; massive; loose; few very fine roots; many very fine irregular pores; strongly effervescent; moderately alkaline (pH 8.0); gradual wavy boundary.

C2—29 to 48 inches; light brown (7.5YR 6/4) loamy sand, brown (7.5YR 4/4) moist; massive; soft, very friable; few very fine roots; many very fine irregular pores; strongly effervescent; moderately alkaline (pH 8.4); diffuse wavy boundary.

2C3—48 to 60 inches; light reddish brown (5YR 6/4) sandy loam, brown (7.5YR 4/4) moist; massive; soft, very friable; few very fine roots; many very fine irregular pores; strongly effervescent; about 1 percent gravel; moderately alkaline (pH 8.4).

The content of gravel is less than 2 percent throughout the profile. The soils have hue of 10YR to 5YR throughout. They have value of 5 to 7 and chroma of 4 to 6. They are loamy fine sand, loamy sand, or sand. The 2C horizon, if it occurs, is below a depth of 40 inches.

Schenco Series

The Schenco series consists of shallow, well drained soils on mountains. These soils formed in alluvium and colluvium derived dominantly from schist. Slope ranges from 20 to 55 percent. Elevation is 1,600 to 2,800 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are loamy-skeletal, mixed (calcareous), hyperthermic, shallow Typic Torriorthents.

Typical pedon of Schenco extremely channery sandy loam, in an area of Schenco-Laposa-Rock outcrop complex, 10 to 55 percent slopes; in an unsectionalized area about 15,400 feet east and 8,650 feet north of the southwest corner of T. 2 S., R. 6 W.

About 70 percent of the surface is covered with channers.

A—0 to 1 inch; brown (7.5YR 5/4) extremely channery sandy loam, dark brown (7.5YR 4/4) moist; weak fine granular structure; soft, very friable; many very fine roots; common very fine tubular pores; about 60 percent channers; moderately alkaline (pH 8.2); abrupt wavy boundary.

Bw—1 to 7 inches; yellowish red (5YR 5/6) very channery sandy clay loam, reddish brown (5YR 5/4) moist; massive; slightly hard, friable, sticky and plastic; many very fine roots; many very fine tubular pores; slightly effervescent; about 50 percent channers; moderately alkaline (pH 8.0); gradual irregular boundary.

Bk—7 to 12 inches; pink (7.5YR 7/4) very channery loam, light brown (7.5YR 6/4) moist; massive; soft, very friable, sticky and slightly plastic; common very fine roots; common very fine tubular pores; violently effervescent; about 35 percent channers coated with lime; strongly alkaline (pH 8.6); gradual broken boundary.

2Cr—12 to 21 inches; weathered schist.

2R—21 to 25 inches; hard schist.

About 50 to 90 percent of the surface is covered with schist channers. Channers make up 35 to 80 percent of the profile. The depth to weathered schist is 10 to 20 inches. Unweathered schist is at a depth of 21 to 30 inches. The A horizon is 1 to 2 inches thick. It has hue of 7.5YR, value of 5 or 6, and chroma of 4 to 6. The B horizon is sandy clay loam, loam, or sandy loam. It has hue of 7.5YR or 5YR, value of 4 to 7, and chroma of 4 to 6.

Tremant Series

The Tremant series consists of deep, well drained soils on fan terraces. These soils formed in alluvium derived dominantly from mixed rocks. Slope is 0 to 1 percent. Elevation is 500 to 800 feet. The mean annual precipitation is about 5 to 7 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are fine-loamy, mixed, hyperthermic Typic Haplargids.

Typical pedon of Tremant gravelly fine sandy loam, 1,400 feet west and 1,000 feet south of the northeast corner of sec. 30, T. 6 S., R. 7 W.

About 25 percent of the surface is covered with pebbles and a few pan fragments.

A—0 to 1 inch; light brown (7.5YR 6/4) gravelly fine sandy loam, brown (7.5YR 5/4) moist; moderate thick platy structure; soft, very friable; few very fine roots; few very fine irregular pores; violently effervescent; very slightly saline (ECe 0.6 mmho/cm); about 15 percent pebbles; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bw—1 to 8 inches; light reddish brown (5YR 6/4) fine sandy loam, reddish brown (5YR 5/4) moist; weak medium subangular blocky structure; soft, very friable; few very fine roots; many very fine irregular pores; violently effervescent; very slightly saline (ECe 0.5 mmho/cm); about 5 percent pebbles; moderately alkaline (pH 8.4); clear wavy boundary.

Btk1—8 to 16 inches; reddish yellow (5YR 6/6) gravelly loam, yellowish red (5YR 5/6) moist; weak medium subangular blocky structure; slightly hard, friable, slightly plastic; common very fine roots; many very fine tubular pores; clay bridges between mineral grains; few fine filaments and masses of calcium carbonate; violently effervescent (5 percent calcium carbonate); very slightly saline (ECe 1.0 mmho/cm); about 15 percent pebbles; moderately alkaline (pH 8.2); clear wavy boundary.

Btk2—16 to 22 inches; reddish yellow (5YR 6/6) gravelly loam, yellowish red (5YR 5/6) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; common clay bridges between mineral grains; common medium masses of calcium carbonate; violently effervescent (16 percent calcium carbonate); very slightly saline (ECe 2.4 mmhos/cm); about 30 percent pebbles; moderately alkaline (pH 8.2); clear wavy boundary.

Btk3—22 to 41 inches; reddish yellow (5YR 6/6) gravelly loam, yellowish red (5YR 5/6) moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; few very fine roots; many very fine tubular pores; many distinct clay films on faces of peds; many large masses of calcium carbonate; violently effervescent (22 percent calcium carbonate); very slightly saline (ECe 3.8 mmhos/cm); about 20 percent pebbles; moderately alkaline (pH 8.2); gradual wavy boundary.

Btk4—41 to 60 inches; reddish yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) moist; moderate fine subangular blocky structure; extremely hard, very firm, sticky and plastic; few very fine roots; many very fine tubular pores; many distinct clay films on faces of peds; common large masses of calcium carbonate; violently effervescent (30 percent calcium carbonate); slightly saline (ECe 4.0 mmhos/cm); about 10 percent pebbles; moderately alkaline (pH 8.4).

About 15 to 60 percent of the surface is covered with pebbles. In some places the surface gravel has desert varnish. Depth to the calcic horizon ranges from 14 to more than 30 inches. The A horizon is ½ inch to 18 inches thick. The Bt horizon has hue of 5YR or 7.5YR and value of 5 or 6. It is dominantly loam or clay loam, but the range includes sandy loam in the lower part. The content of pebbles in this horizon ranges from 10 to 30 percent but averages more than 15 percent in the upper 20 inches. Electrical conductivity ranges from less than 1 millimho per centimeter to 15 millimhos per centimeter.

Tucson Series

The Tucson series consists of deep, well drained soils on basin floors. These soils formed in alluvium derived dominantly from mixed rocks. Slope is 0 to 1 percent. Elevation is 700 to 800 feet. The mean annual precipitation is about 5 to 7 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are fine-loamy, mixed, hyperthermic Typic Haplargids.

Typical pedon of Tucson loam, 1,320 feet east of the southwest corner of sec. 14, T. 6 S., R. 7 W.

About 5 to 10 percent of the surface is covered with fine pebbles.

Ap1—0 to 8 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and plastic; common very fine roots; many very fine irregular pores; violently effervescent; nonsaline (ECe 1.8 mmhos/cm); about 5 percent fine pebbles; moderately alkaline (pH 8.2); clear wavy boundary.

Ap2—8 to 12 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; soft, friable, slightly sticky and plastic; common very fine roots; many very fine irregular pores; violently effervescent; nonsaline (ECe 1.6 mmhos/cm); about 2 percent fine pebbles; moderately alkaline (pH 8.2); clear wavy boundary.

Btk1—12 to 17 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and plastic; common very fine roots; many very fine irregular pores; clay bridges between mineral grains; few fine masses of calcium carbonate; violently effervescent (9 percent calcium carbonate); nonsaline (ECe 1.8 mmhos/cm); about 2 percent fine pebbles; moderately alkaline (pH 8.2); abrupt smooth boundary.

Btk2—17 to 23 inches; brown (7.5YR 5/4) clay loam, pink (7.5YR 7/4) moist; moderate coarse subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; common very fine tubular pores; few distinct clay films in pores and on faces of peds; many medium masses of calcium carbonate; violently effervescent (21 percent calcium carbonate); nonsaline (ECe 1.6 mmhos/cm); about 4 percent fine pebbles; moderately alkaline (pH 8.4); gradual smooth boundary.

Btk3—23 to 41 inches; light brown (7.5YR 6/4) clay loam, pink (7.5YR 7/4) moist; moderate coarse subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; many very fine tubular pores; common distinct clay films on faces of peds; many large masses of calcium carbonate; violently effervescent (26 percent calcium carbonate); nonsaline (ECe 1.2 mmhos/cm); about 4 percent fine pebbles; moderately alkaline (pH 8.2); gradual smooth boundary.

Btk4—41 to 60 inches; light brown (7.5YR 6/4) clay loam, light brown (7.5YR 6/4) moist; moderate coarse subangular blocky structure; hard, firm, slightly sticky and plastic; few very fine roots; many very fine tubular pores; few distinct clay films in pores and occurring as colloid in bridges between mineral grains; many medium masses of calcium carbonate; violently effervescent (20 percent calcium carbonate); nonsaline (ECe 1.0 mmho/cm); about 5 percent fine pebbles; moderately alkaline (pH 8.2).

Depth to the calcic horizon is 6 to 20 inches. About 1 to 15 percent of the surface is covered with pebbles. The A or Ap horizon is 3 to 20 inches thick. The Btk horizon is loam or clay loam and contains less than 15 percent pebbles. It has hue of 5YR or 7.5YR and value of 5 or 6.

Vaiva Series

The Vaiva series consists of very shallow and shallow, well drained soils on hills and mountains. These soils formed in alluvium and colluvium derived dominantly from granite and gneiss but also from sandstone and conglomerate. Slope ranges from 3 to 55 percent. Elevation is 800 to 2,200 feet. The mean annual precipitation is about 5 to 7 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are loamy-skeletal, hyperthermic Lithic Haplargids.

Typical pedon of Vaiva extremely gravelly sandy loam, in an area of Vaiva-Quilotosa extremely gravelly sandy loams, 3 to 25 percent slopes; in an unsectionalized area about 14,100 feet north and 15,400 feet west of the southeast corner of T. 2 S., R. 9 W.

About 80 percent of the surface is covered with pebbles.

A—0 to 2 inches; light brown (7.5YR 6/4) extremely gravelly sandy loam, brown (7.5YR 4/4) moist; weak very fine granular structure; soft, very friable; many very fine roots; many very fine irregular pores; slightly effervescent; about 80 percent pebbles; mildly alkaline (pH 7.6); abrupt smooth boundary.

Bt—2 to 6 inches; yellowish red (5YR 5/6) very gravelly sandy clay loam, yellowish red (5YR 4/6) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; clay films occurring as colloidal stains and as bridges between mineral grains; about 45 percent pebbles; mildly alkaline (pH 7.8); abrupt wavy boundary.

Cr—6 to 19 inches; weathered granite gneiss.

R—19 to 23 inches; unweathered granite gneiss.

About 50 to 90 percent of the surface is covered with pebbles, cobbles, and stones. The depth to weathered bedrock ranges from 4 to 16 inches. The depth to unweathered bedrock ranges from 7 to 20 inches. The A horizon is 1 to 4 inches thick. It is extremely gravelly sandy loam or extremely stony sandy loam. The Bt horizon is sandy loam or sandy clay loam. It has hue of 2.5YR or 5YR.

The Vaiva soil in Vaiva-Quilotosa extremely stony sandy loams, 25 to 55 percent slopes, formed in residuum derived dominantly from sandstone and conglomerate and is more than 20 inches deep to the lithic contact. These changes, however, do not significantly affect use and management.

Vint Series

The Vint series consists of deep, excessively drained soils on flood plains. These soils formed in recent alluvium derived from mixed rocks. Slope is 0 to 1 percent. Elevation is 430 to 850 feet. The mean annual precipitation is about 5 to 7 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free period is 260 to 320 days.

These soils are sandy, mixed, hyperthermic Typic Torrifluvents.

Typical pedon of Vint loamy fine sand, in an area of Lagunita-Vint complex, 1,300 feet north and 300 feet west of the southeast corner of sec. 8, T. 4 S., R. 4 W.

A—0 to 3 inches; pale brown (10YR 6/3), finely stratified loamy fine sand, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable; many very fine roots; many very fine irregular pores; violently effervescent; nonsaline (ECe 0.5 mmho/cm); mildly alkaline (pH 7.4); abrupt smooth boundary.

C1—3 to 10 inches; pale brown (10YR 6/3), finely stratified loamy fine sand, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable; many very fine roots; common very fine irregular pores; slightly effervescent; nonsaline (ECe 0.7 mmho/cm); neutral (pH 7.2); clear smooth boundary.

C2—10 to 23 inches; light brownish gray (10YR 6/2), finely stratified fine sand that has a few thin strata of very fine sandy loam, brown (10YR 4/3) moist; common black strata; single grain; loose; many very fine roots; many very fine irregular pores; slightly effervescent; nonsaline (ECe 0.4 mmho/cm); about 1 percent pebbles; neutral (pH 7.2); clear smooth boundary.

C3—23 to 45 inches; light brownish gray (10YR 6/2), finely stratified loamy fine sand, brown (10YR 4/3) moist; common thin black strata; single grain; loose; few fine roots; many very fine irregular pores; slightly effervescent; nonsaline (ECe 1.8 mmhos/cm); neutral (pH 7.2); abrupt smooth boundary.

C4—45 to 60 inches; light brownish gray (10YR 6/2), finely stratified sand, brown (10YR 4/3) moist; common thin black strata; single grain; loose; many very fine irregular pores; noneffervescent; nonsaline (ECe 0.3 mmho/cm); neutral (pH 7.2).

The A horizon is loamy fine sand or very fine sandy loam. It has hue of 10YR or 7.5YR, value of 6 or 7, and chroma of 3 or 4. The 10- to 40-inch control section is loamy fine sand, fine sand, or sand. The sand occurs in the lower part. The control section has thin strata of finer or coarser textured materials. It has hue of 10YR or 7.5YR, value of 6 or 7, and chroma of 3 or 4.

Wellton Series

The Wellton series consists of deep, well drained soils on fan terraces and basin floors. These soils formed in alluvium derived dominantly from mixed rocks. Slope ranges from 0 to 3 percent. Elevation is 500 to 800 feet. The mean annual precipitation is about 5 to 7 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are coarse-loamy, mixed, hyperthermic Typic Haplargids.

Typical pedon of Wellton very gravelly fine sandy loam, in an area of Wellton complex, 2,800 feet west and 2,100 feet south of the northeast corner of sec. 34, T. 6 S., R. 7 W.

About 50 percent of the surface is covered with fine pan fragments.

A—0 to 3 inches; light brown (7.5YR 6/4) very gravelly fine sandy loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky; common very fine roots; common very fine tubular pores; violently effervescent; nonsaline (ECe 1.0 mmho/cm); about 50 percent fine pan fragments; moderately alkaline (pH 8.2); clear wavy boundary.

Bw—3 to 10 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky; many very fine roots; common very fine tubular pores; violently effervescent; nonsaline (ECe 0.7 mmho/cm); about 10 percent pebbles and pan fragments; moderately alkaline (pH 8.2); clear wavy boundary.

Btk1—10 to 26 inches; light brown (7.5YR 6/4) gravelly loam, brown (7.5YR 5/4) moist; moderate coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; clay films occurring as colloidal stains and as bridges between mineral grains; common small masses and few nodules of lime; violently effervescent; very slightly saline (ECe 3.9 mmhos/cm); about 20 percent pebbles; moderately alkaline (pH 8.0); clear wavy boundary.

Btk2—26 to 55 inches; light reddish brown (5YR 6/4) gravelly loam, yellowish red (5YR 5/6) moist; weak medium subangular blocky structure; hard, firm, sticky and slightly plastic; few very fine roots; common very fine tubular pores; few thin clay films on faces of peds; many medium masses of lime; violently effervescent; very slightly saline (ECe 3.7 mmhos/cm); about 25 percent pebbles; mildly alkaline (pH 7.8); gradual smooth boundary.

Btk3—55 to 60 inches; yellowish red (5YR 5/6) gravelly clay loam, light reddish brown (5YR 6/4) moist; weak medium subangular blocky structure; very hard, firm, sticky and plastic; few very fine roots; common very fine tubular pores; few thin clay films on faces of peds; many medium masses of lime; violently effervescent; very slightly saline (ECe 2.8 mmhos/cm); 25 percent pebbles; mildly alkaline (pH 7.8).

About 1 to 60 percent of the surface is covered with pebbles. The A horizon is 1 to 5 inches thick. It has hue of 5YR or 7.5YR. It is very gravelly fine sandy loam, loam, or loamy fine sand and contains 1 to 60 percent pebbles. The Bt horizon has value of 5 to 7. It is dominantly gravelly loam, but the range includes fine sandy loam in the upper part and gravelly clay loam in the lower part, below a depth of 40 inches. The upper 20 inches of the Bt horizon averages less than 18 percent clay. Some pedons have a calcic horizon at a depth of 30 to more than 40 inches.

Why Series

The Why series consists of deep, somewhat excessively drained soils on flood plains (washes) and alluvial fans. These soils formed in stratified alluvium derived dominantly from mixed rocks. Slope ranges from 0 to 5 percent. Elevation is 500 to 2,000 feet. The mean annual precipitation is about 5 to 10 inches, the mean annual air temperature is 70 to 74 degrees F, and the frost-free season is 260 to 320 days.

These soils are coarse-loamy, mixed, hyperthermic Fluventic Camborthids.

Typical pedon of Why sandy loam, in an area of Denure-Why complex, 1 to 5 percent slopes, about 1,600 feet north and 25 feet west of the southeast corner of sec. 7, T. 6 S., R. 1 E.

About 10 percent of the surface is covered with fine pebbles.

A—0 to 4 inches; light brown (7.5YR 6/4), stratified sandy loam, dark brown (7.5YR 4/4) moist; massive; soft, very friable; many very fine roots; common very fine tubular pores; noneffervescent; about 2 percent fine pebbles; mildly alkaline (pH 7.8); abrupt wavy boundary.

C—4 to 11 inches; light brown (7.5YR 6/4), stratified sandy loam, brown (7.5YR 4/4) moist; massive; soft, very friable; many very fine roots; common very fine tubular pores; strongly effervescent; about 10 percent fine pebbles; moderately alkaline (pH 8.3); clear wavy boundary.

2Bwb1—11 to 31 inches; strong brown (7.5YR 5/6) sandy loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; slightly hard, very friable; many very fine roots; many very fine tubular pores; strongly effervescent; about 15 percent fine pebbles; moderately alkaline (pH 8.4); clear wavy boundary.

2Bwb2—31 to 37 inches; strong brown (7.5YR 5/6) gravelly sandy loam, strong brown (7.5YR 5/6) moist; weak medium subangular blocky structure; slightly hard, very friable; common very fine roots; many very fine tubular pores; strongly effervescent;

about 15 percent fine pebbles; moderately alkaline (pH 8.4); abrupt wavy boundary.

2Bkb1—37 to 53 inches; pink (7.5YR 7/4) gravelly sandy loam, light brown (7.5YR 6/4) moist; massive; hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; common masses of lime; violently effervescent; about 15 percent fine pebbles; moderately alkaline (pH 8.4); gradual smooth boundary.

2Bkb2—53 to 60 inches; reddish yellow (7.5YR 7/6) gravelly sandy loam, light brown (7.5YR 6/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; many very fine irregular pores; common masses of lime; violently effervescent; about 20 percent fine pebbles; moderately alkaline (pH 8.4).

The content of gravel ranges from 5 to 35 percent. Depth to the buried subsoil ranges from 10 to 30 inches. The A horizon is sandy loam or gravelly fine sandy loam. It has hue of 7.5YR, value of 4 to 7, and chroma of 2 to 4. The C horizon is dominantly sandy loam, but in some pedons it contains thin strata of finer or coarser textured material. It has colors similar to those of the A horizon. The 2B horizon is coarse sandy loam, sandy loam, or fine sandy loam. It has hue of 5YR or 7.5YR, value of 4 to 7, and chroma of 4 to 6. Electrical conductivity ranges from less than 1 millimho per centimeter to 23 millimhos per centimeter.

Winkel Series

The Winkel series consists of shallow, somewhat excessively drained soils on mountains. These soils formed in colluvium derived dominantly from basalt. Slope ranges from 15 to 45 percent. Elevation is 2,800 to 4,100 feet. The average annual precipitation is about 10 to 12 inches, the average annual air temperature is 65 to 70 degrees F, and the frost-free season is 180 to 270 days.

These soils are loamy-skeletal, mixed, thermic, shallow Typic Paleorthids.

Typical pedon of Winkel extremely stony loam, in an area of Garzona-Rock outcrop-Winkel complex, 15 to 65 percent slopes; in an unsectionalized area about 7,000 feet east and 21,000 feet north of the southwest corner of T. 11 S., R. 3 W.

About 45 percent of the surface is covered with stones, 15 percent is covered with cobbles, and 20 percent is covered with pebbles.

A—0 to 2 inches; light yellowish brown (10YR 6/4) extremely stony loam, dark brown (10YR 4/3) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; strongly effervescent; about 10 percent pebbles, 15 percent cobbles, and 35 percent stones; mildly alkaline (pH 7.6); clear wavy boundary.

Bk1—2 to 9 inches; light yellowish brown (10YR 6/4) extremely cobbly loam, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; violently effervescent; about 50 percent cobbles and 20 percent pebbles coated with lime; moderately alkaline (pH 7.9); gradual wavy boundary.

Bk2—9 to 15 inches; light yellowish brown (10YR 6/4) extremely cobbly loam, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; few fine filaments and small masses of lime; violently effervescent; about 50 percent cobbles and 20 percent pebbles coated with lime; moderately alkaline (pH 7.9); abrupt wavy boundary.

2Bkm—15 to 19 inches; lime-indurated hardpan.

About 50 to 85 percent of the surface is covered with pebbles, cobbles, and stones. The content of rock fragments is more than 35 percent throughout the profile. Depth to the lime-indurated hardpan is 10 to 20 inches. The A horizon is 1 to 3 inches thick. It has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 or 4. The B horizon is fine sandy loam or loam and has 35 to 75 percent pebbles and cobbles. It has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 4 to 6.

Formation of the Soils

John D. Preston, soil scientist, Natural Resources Conservation Service, assisted in writing this section.

This section describes the factors of soil formation and the major landforms in the survey area.

Factors of Soil Formation

Soil-forming processes act on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material; the climate under which the soil material accumulated and has existed since accumulation; the plant and animal life on and in the soil; relief, or lay of the land; and the length of time the forces of soil formation have acted on the material (Jenny, 1941).

Climate and plant and animal life are active forces of soil formation. As they act on the parent material, they slowly change the material into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material affects the kind of soil profile that forms. Finally, time is needed for changing parent material into a soil. Usually, a long time is needed for the formation of distinct horizons. The importance of each factor differs from place to place, and each modifies the effects of the other four. In some areas, one factor dominates the formation of a soil. Human activities, such as land leveling, cultivating, and applying fertilizer, also affect soil formation.

Climate

There are three major climatic zones in the survey area. These zones are explained in detail in the "Rangeland" section.

In today's arid climate, soil formation occurs slowly because of the small amount of precipitation and is limited to the formation of Entisols and some Camborthids.

It is generally accepted that the past climate was much cooler and more moist than the present. Haplargids, Calciorthids, Durorthids, Durargids, Paleorthids, and Paleargids formed during previous climates.

Living Organisms

Because of the dry climate, the native plant community of sparse shrubs and shallow-rooted annuals does not add a significant amount of organic matter to the surface layer of the soils in the survey area. These shrubs trap windblown sands and silts, however, creating coppice dunes at their base in localized areas.

Animals and insects affect soil formation in a minor way. Burrowing animals can degrade or even obliterate diagnostic horizons, such as calcic horizons, by mixing the soil.

Human activity has had a great effect on soil formation. Over the years, irrigation with sediment-laden water has created a surface layer of dark clay loam capping the original soil surface in several areas. This process is evident in the Paloma Ranch vicinity, formerly known as Theba. Cutting and filling associated with land leveling can affect soil depth, texture, and structure. Irrigation can increase or decrease salinity or sodicity levels in soils.

Parent Material

Soil forms in parent materials derived primarily from the physical weathering of rock. Although chemical processes may contribute to the formation of parent material to some extent by dissolving cementing agents that bind the rock crystals, physical weathering is the dominant force (Thompson and Troeh, 1978). Several processes, such as expansion and contraction from temperature fluctuations and physical movements, fracture and disintegrate rock.

Igneous rocks are the most extensive in the survey area. Metamorphic rocks are second in extent, and sedimentary rocks make up only a relatively small area.

Igneous rocks can be divided into two groups—intrusive and extrusive. The Precambrian granites are examples of intrusive igneous rocks, and the Cretaceous-Tertiary volcanics and Quaternary basalts are examples of extrusive igneous rocks.

Precambrian granites comprise most of the Maricopa Mountains, the Buckeye Hills, and the eastern part of the Gila Bend Mountains (ADOT, 1977). The fine-earth fraction of Quilotosa soils, which weathered from these rocks, has a high percentage of coarse sand.

Cretaceous volcanics are in the Gila Bend Mountains and Painted Rock Mountains (ADOT, 1977). Tertiary volcanics are in the Sauceda Mountains, near Ajo (ADOT, 1963). Hyder soils, which weathered from these rocks, are typically finer textured than the Quilotosa soils.

The Quaternary and Tertiary basalts are in the Gila Bend Mountains, the Batamote and Sauceda Mountains near Ajo, and the extensive lava flows near Sentinel (ADOT, 1963). The Sentinel Plain volcanic field has 15 low-aspect (diameter-to-height ratio of 40 or 50 to 1) lava cones that have very little pyroclastic material on them. These cones were created by effusion of relatively gas-free magma (Lynch, 1982). Drainage on the flow is generally in a youthful stage of development. Incipient radial drainage has started near some of the lava cones, but channels have not become incised (Armstrong and Yost, 1958).

Volcanic eruptions also produced cones and basalt flows that are associated with the three terraces formed by the Gila River as it deepened its valley. Some of the lava flows dammed the river temporarily. One of the lava flow dams, in the northern part of the Painted Rock Mountains, diverted the river around the southern end of these mountains (Babcock and others, 1948). This flow occurred about three million years ago (Eberly and Stanley, 1978).

The river was also dammed at the site of Gillespie Dam by a 6-million-year-old flow from Woolsey Peak to the west, which may have diverted the river through the Gila Bend Mountains (Eberly and Stanley, 1978; Babcock and others, 1948). Cherioni soils, which weathered from these basalt rocks, have a lime- and silica-cemented hardpan overlying the bedrock.

The two types of metamorphic rocks are schist and granitic gneiss. Precambrian schists occur in the southern Maricopa Mountains, the White Hills in the Vekol Valley, and the Gila Bend Mountains near the Webb Mountains. Precambrian granitic gneiss occurs in the northwestern part of the Gila Bend Mountains (ADOT, 1977). Schenco soils, which weathered from these rocks, are covered with a channery surface because of the platy nature of schist. The skeletal subsoil of these soils is also a result of the channers.

The only significant area of sedimentary rock is the Tertiary sandstone and fanglomerate that occur in the southeastern part of the Gila Bend Mountains (Eberly and Stanley, 1978). A smaller area occurs near Ajo at Locomotive Rock. These formations have been named the Locomotive Fanglomerate (Gilluly, 1946; Babcock and others, 1948). This correlation was questioned by Heindl, who named the outcrops near Gila Bend the Sil Murk formation (Heindl and Armstrong, 1963). The fanglomerate and interbedded rocks probably underlie many areas covered by volcanic rocks and alluvium. A well log near Gila Bend shows rocks below a depth of 1,000 feet that are similar (Babcock and others, 1948). The sandstones in this unit were observed in Red Rock Canyon in the southeastern part of the Gila Bend Mountains. The arkosic sandstone ranges from buff to red and suggests flood plain deposition in an area of low relief (Heindl and Armstrong, 1963). A sandstone layer more than 200 feet thick was observed in one place (Babcock and others, 1948). Soils that formed in these rocks are most similar to those that weathered from granitic rocks.

Disintegrated rock material that remains in place is called residuum. If the material is transported to another site by gravity, it is called colluvium or slope alluvium. Wind-transported material is called eolian material, and material transported by water is called alluvium. Most of the soils in the survey area formed in alluvium. Eolian material no doubt contributes to the remarkable similarity of the light brown (7.5YR 6/4) surface layer and the sandy loam or fine sandy loam surface textures in most of the typical pedons of the area.

Time

The soils in the survey area range in age from a few years to a few hundred thousand years or more. The youngest soils are Torrifluvents, such as Indio soils, which are less than a few hundred years old. Camborthids, such as Denure soils, are somewhat older. They formed during the mid or late Holocene and are less than 5,000 years old. Calciorthids, such as Gunsight soils, formed between 5,000 and 10,000 years ago during the mid or early Holocene. Haplargids, such as Mohall soils, formed during the late Pleistocene, about 10,000 to 250,000 years ago. Durargids, such as Comobabi soils, formed more than 250,000 years ago during the mid Pleistocene.

Relief

Relief can be characterized by slopes that are active, stable, and metastable. On active slopes (more than 45 percent), soil development is minimal and soils are shallow. Lithic Torriorthents are examples of soils on active slopes. Soils on stable slopes (less than 15 percent) generally have well expressed diagnostic horizons. The deep Typic Haplargids are examples. Soils on metastable slopes (15 to 45 percent) have characteristics intermediate between these extremes.

Local soil patterns are controlled mostly by relief.

Different soils form on mountains than on fan terraces or on flood plains. Soils on the same landform can have different characteristics, depending on the nature of the parent material and on the length of time they have been in place.

Major Landforms of the Survey Area

In this survey area, six major landforms were identified. These are flood plains and channels; stream terraces and dunes; alluvial fans and washes; basin floors; fan terraces; and hills and mountains. In this section the soil-forming factors (principally parent material, time, and relief) that interact on these landforms are described and related to the specific soils in the survey area.

1. Soils on Major Flood Plains and in Channels

These landforms developed in recent alluvium deposited by the Gila River.

Sandy and gravelly riverwash is typical of the material in the channels. The braided channels of the Gila River lie 5 to 15 feet below the flood plain in an inner valley about one-half mile wide (Babcock and others, 1948).

The sandy Lagunita and Vint soils are typical of soils on the first bottom or low flood plain. Lagunita soils are made up of coarser sand than the Vint soils and are nearer to the channel or the natural levee.

Loamy soils, such as Gilman and Indio soils, are typical of soils on the higher flood plain. Indio soils have a higher percentage of silt than the Gilman soils. The relative proportion of Indio soils compared to Gilman soils increases downstream. This fining downstream can be attributed in part to the reduced gradient in the river as it flows through the survey area. The section of the river from Gillespie Dam to the bend near Gila Bend falls 5.25 feet per mile, whereas the section from Painted Rock Dam to Agua Caliente falls only 4.0 feet per mile.

Glenbar soils also occur on the flood plain. They have more clay than the Gilman and Indio soils. They are in old backwaters, where slowly moving floodwater deposited finer sediments.

Agualt and Ripley soils are similar to Gilman and Indio soils but are underlain by sand at a moderate depth. They are in transitional areas between the Lagunita and Vint soils and the Gilman, Indio, and Glenbar soils.

Recent flooding and the subsequent storage of sediment-laden waters behind Painted Rock Dam have had some of the most recent and noticeable effects on soil formation. The flooding events during the period 1978 to 1980 deposited a mantle of fine textured sediments of varying thickness over the soils in the flood pool behind the dam. The subsequent flood in the fall of 1983 scoured this deposit away in places.

2. Soils on Stream Terraces and Dunes

These landforms border the present flood plain along the Gila River.

Denure and Dateland soils are the principal soils on the low stream terraces, and Rositas soils are on the dunes of these terraces. Denure and Dateland soils formed in moderately coarse textured and medium textured stream alluvium that has been in place long enough for a cambic horizon to form.

Rositas soils are on sand dunes on both sides of the river in the vicinity of Agua Caliente. They are deep, windblown sands whose origin was the sandy soils of the Gila River Channel.

Ajolito soils are on what has been called the middle terrace of the Gila River. Deposits of Quaternary water-rounded gravelly alluvium capping this terrace contain a bed of volcanic ash 1 to 2 feet thick produced during eruptions in the Gila Bend Mountains (Babcock and others, 1948). This terrace can best be observed along Watermelon Road northwest of Gila Bend. Upstream, in the Cotton Center area, only remnants of the terrace remain in the form of islands surrounded by fan alluvium.

3. Soils on Alluvial Fans and Minor Flood Plains (Washes)

These Holocene landforms occur throughout the survey area where washes exit the mountains and spread out. The water in the washes loses velocity and deposits sediment over the desert floor.

Carrizo soils are typical of soils on these landforms. The sandy-skeletal textures are typical because of the close proximity to the source of weathering.

Alluvial fans also form where washes that dissect the fan terraces spread out over the flood plain along the Gila River. Why and Cuerda soils are typical of soils on alluvial fans. Because they are farther from the source, they are moderately coarse textured and medium textured. These soils also occur on narrow flood plains adjacent to washes that dissect fan terraces.

4. Soils on Basin Floors

The basin floors are characterized by broad alluvial flats with ephemeral drainageways. This landform occurs primarily in the Paloma (Theba) area.

Mohall and Tucson soils are the principal soils on this landform. Mohall soils are deep and have argillic and calcic horizons. Tucson soils are similar to Mohall soils but have shallow calcic horizons in the upper part of the subsoil. The effects of human activity on soil

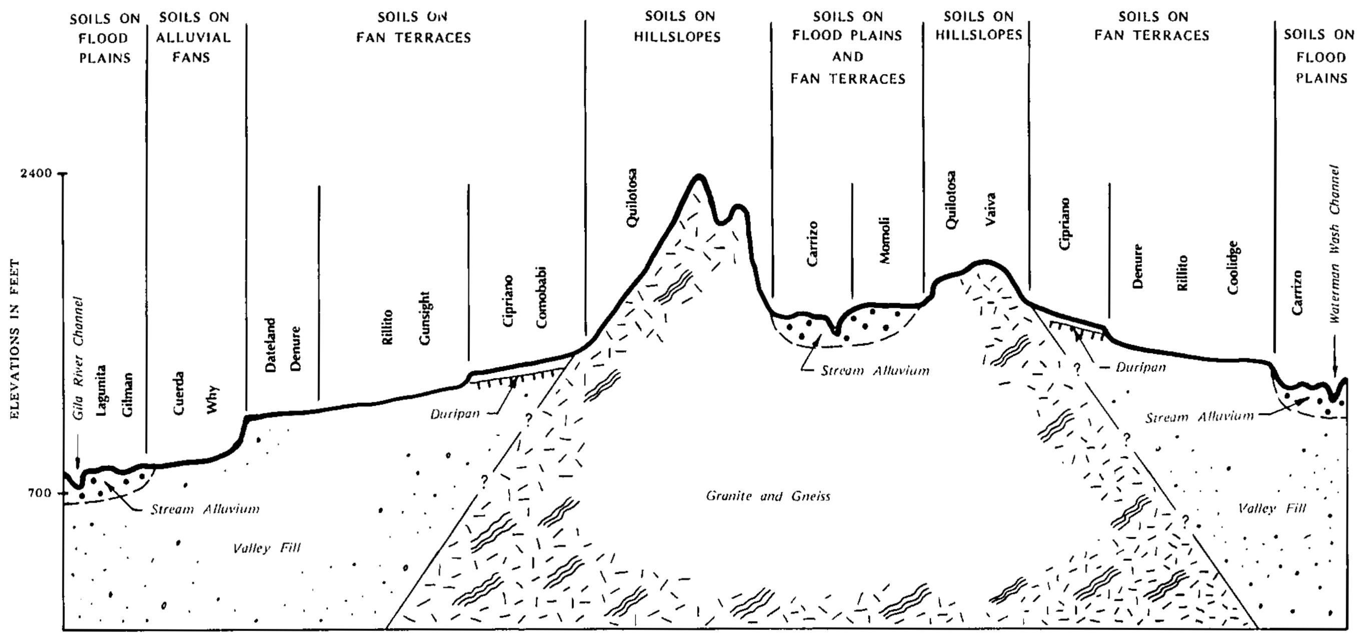

Figure 15.—An idealized soil-landscape profile of the Maricopa Mountains.

formation can be seen in this area. Loams and fine sandy loams are the dominant surface textures of Mohall soils in uncultivated areas, but dark clay loam has been deposited on fields that have been irrigated for many years with sediment-laden irrigation water.

Harqua soils are on a remnant relict basin floor. The reddish brown clays of the substratum are similar to those described by others as lake deposits (Heindl and Armstrong, 1963). Termination of lacustrine conditions and development of exterior drainage systems occurred between 10.5 and 6.0 million years ago. Drainageways through the area were well established by the late Pliocene and probably reached the Yuma area (Eberly and Stanley, 1978).

Only one minor closed basin system remains near the survey area. It is just outside the survey area, southwest of Sentinel. It probably formed when the Sentinel lava flows disrupted local drainage (Eberly and Stanley, 1978).

5. Soils on Fan Terraces

The fan terraces are broad coalescent plains that have been incised by washes. Soils on fan terraces formed during the mid or late Pleistocene.

The position of the fan terraces has influenced the soil properties and horizonation of the soils. Parent material on the upstream lithology has influenced the initial soil properties. A typical soil-landscape sequence consists of soils with duripans on the highest fan terraces, soils with calcic horizons in the intermediate positions, and soils with cambic horizons in the lowest positions (fig. 15).

Comobabi and Cipriano soils are on the highest fan terraces directly below the mountain front. Cipriano soils occur below both granite and basalt, and Comobabi soils are associated almost exclusively with granite. Both soils are shallow to a duripan, but Comobabi soils have an argillic horizon. They are on the higher part of the fan terraces. The argillic horizons of the Comobabi soils are similar to the buried paleosols that underlie many soils farther down the fan terraces. The argillic horizons of the Comobabi soils may have been partially truncated, deposited downslope, and subsequently covered with younger sediments.

Gunsight and Rillito soils are typical of soils in the intermediate positions on the fan terraces. These soils have calcic horizons at a shallow or moderate depth, but they have not been in place long enough for a hardpan to form.

Denure and Dateland soils are typical of soils on the lowest parts of the fan terraces. These soils show only redistribution and accumulation of carbonates (figs. 15 and 16).

The content of coarse fragments gradually decreases downslope from the source of weathering. This decrease is evident in Chuckawalla and Growler soils in areas of desert pavement on the fan terraces below volcanic mountains. Desert pavement is a concentration of pebbles, generally subrounded, armoring the surface of the soil. The pebbles generally have a black coating, called desert varnish or patina. Chuckawalla soils are on the highest part of the fan terrace. They are skeletal and provide the best example of desert pavement, particularly in the vicinity of the Painted Rock Mountains. The desert pavement in this area consists of closely packed pebbles that are heavily coated with a dark varnish or patina. Growler soils are on the lowest part of the fan terrace. They have fewer coarse fragments than the Chuckawalla soils, and the desert pavement is less well expressed.

The processes of desert paving and varnishing are still active today. Indian pottery shards and even 20th-century metallic artifacts can be found interlocked within the desert pavement and varnished on the upper side.

Soils in areas of desert pavement have a high content of salts and sodium. According to data from the National Soil Survey Laboratory, paved soils in this survey area typically have a sodium adsorption ratio ranging from 4 to 17. Also, they typically have electroconductivity readings from less than 1 millimho per centimeter to more than 38 millimhos per centimeter and total salts ranging from a trace to 1.5 percent. These salts have probably accumulated in desert pavement soils in much the same way that salts accumulate at the tops of seedbeds in irrigated cropland because of capillary rise and evaporation. The desert pavement then armors the soil profile and protects the salts from leaching by rainfall by shedding the rainwater to adjacent nonpaved areas.

6. Soils on Hills and Mountains

Quilotosa and Vaiva soils are typical of the soils on granite hills. Vaiva soils are redder than the Quilotosa soils and have argillic horizons. They typically occur on stable slopes, whereas Quilotosa soils are on metastable and active slopes.

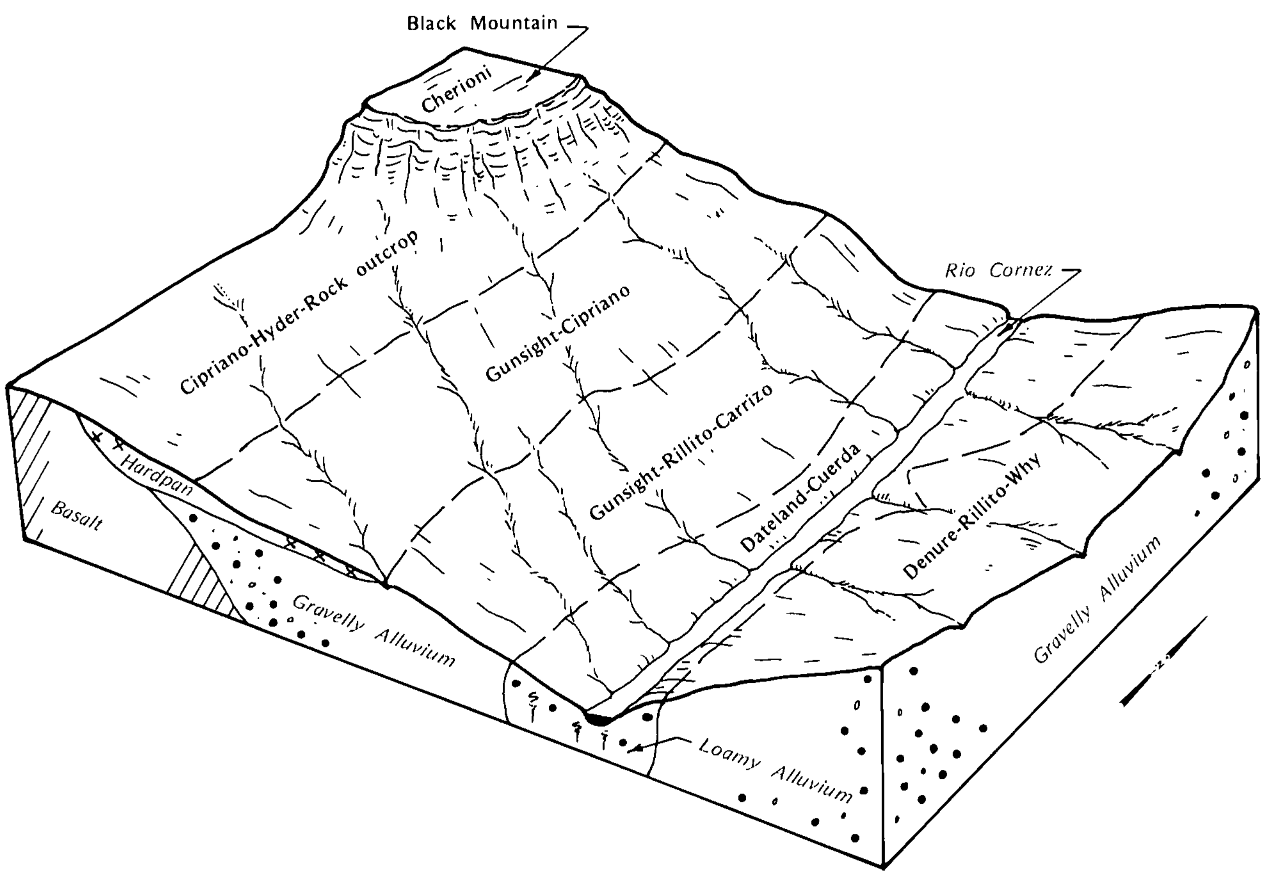

Figure 16.—Cross section of the Valley of the Ajo, from Black Mountain across Rio Cornez.

Hyder and Gachado soils are typical of soils on volcanic hills. These soils are shallow over bedrock and are skeletal. Gachado soils have an argillic horizon and are typically noncalcareous in the upper part of the profile. Gachado soils are typically on stable slopes, and Hyder soils are on the more active slopes.

Cherioni soils are the dominant soils that formed from lava flows. They are also dominant on mesa tops of the basalt mountains. These soils are shallow and skeletal and are underlain by a duripan that mantles basalt. Cipriano soils are on the lower colluvial basaltic slopes. They are similar to Cherioni soils but have a thicker shallow duripan and consequently are deeper over bedrock. Hyder soils are commonly on the more active upper part of slopes. They do not have a duripan. Winkel and Garzona soils are on the basaltic mountain slopes in the Sauceda Mountains near Ajo. Winkel soils are similar to Cipriano soils but are in a slightly cooler temperature regime. Also, they are underlain by petrocalcic horizons rather than a duripan. Garzona soils are similar to Hyder soils but are in a slightly cooler temperature regime and have cambic horizons.

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Glossary

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.

Alluvial fan. The fanlike deposit of a stream where it issues from a gorge upon a plain or of a tributary stream near or at its junction with its main stream.

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

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

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

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

Very low	0 to 3.5
Low	3.5 to 5.0
Moderate	5.0 to 7.5
High	7.5 to 10.0
Very high	more than 10.0

Bar and channel. The microrelief common to flood plains and relatively young alluvial terraces. With time, the microrelief becomes subdued as the higher bars erode into the channels. The ridgelike bars commonly consist of accumulations of coarse sediments, whereas the channels are finer textured. The relief between bar and channel is largely related to the competence of the stream.

Basin. A depressed area with no surface outlet or only limited surface outlet. Examples are closed depressions in lake basins or river basins.

Basin floor. A general term describing the nearly level and gently sloping bottom surface of an intermontane basin. Component landforms include playas, broad alluvial flats with ephemeral drainageways, and relict alluvial and lacustrine surfaces that rarely, if ever, are subject to flooding.

Basin-floor remnant. A flattish topped erosional remnant of any former landform of a basin floor that has been dissected following the incision of an axial stream.

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

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

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

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

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds directly beneath the solum, or it is exposed at the surface by erosion.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

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

Channery soil material. Soil material that is, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) along the longest axis. A single piece is called a channer.

Charco. A natural dirt water hole on a flood plain. It is shallow to deep and has been gouged out by floodwater. Typically, it contains water only during rainy seasons.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

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.

Climax plant community. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

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

Coarse textured soil. Sand or loamy sand.

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

Colluvium. Soil material or 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 establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

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

Concretions. Cemented bodies with crude internal symmetry organized around a point, a line, or a plane that typically takes the form of concentric layers visible to the naked eye. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up concretions. If formed in place, concretions of iron oxide or manganese oxide are generally considered a type of redoximorphic concentration.

Conglomerate. A coarse grained, clastic rock composed of rounded or subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.

Conservation cropping system. Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the effects of the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the "Soil Survey Manual."

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

Coppice dune. A small dune of fine grained soil material stabilized around shrubs or small trees.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

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.

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

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

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

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Deflation. The removal of material from the land surface by wind erosion.

Depth, soil. Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

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

Desert pavement. On a desert surface, a layer of gravel or larger fragments that was emplaced by upward movement of the underlying sediments or that remains after finer particles have been removed by running water or the wind.

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 wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained.* These classes are defined in the "Soil Survey Manual."

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

Dune. A mound, ridge, or hill of loose, windblown granular material (generally sand), either bare or covered with vegetation.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

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 human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

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 lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

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

Excess sodium (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Extrusive rock. Igneous rock derived from deep-seated molten matter (magma) emplaced on the earth's surface.

Fan terrace. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

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

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

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

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

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

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

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

Fluvial. Of or pertaining to rivers; produced by river action, as a fluvial plain.

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

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

Forb. Any herbaceous plant not a grass or a sedge.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Geomorphic surface. A geomorphic surface represents an episode in landscape development and consists of one or more landforms. A mappable part of the land surface that is defined in terms of morphology (relief, slope, aspect), origin (erosional, constructional), age (absolute, relative), and stability of component landforms.

Geomorphology. The science that treats the general configuration of the earth's surface; specifically, the study of the classification, description, nature, origin, and development of the landforms and their relationships to underlying structure and the history of geologic changes as recorded by these surface features.

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

Gravelly soil material. Material that is 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Ground water. Water filling all the unblocked pores of the material below the water table.

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 material and the more decomposed sapric material.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Holocene. The second epoch of the Quaternary Period of geologic time, extending from the end of the Pleistocene (about 10,000 to 12,000 years ago) to the present. Also, the corresponding time-stratigraphic subdivision (system) of earth materials.

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 uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the "Soil Survey Manual." The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

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.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Hummocky. Refers to a landscape of hillocks, separated by low sags, having sharply rounded tops and steep sides. Hummocky relief resembles rolling or undulating relief, but the tops of ridges are narrow and the sides are shorter and less even.

Hydrologic soil groups. Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

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.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and are less palatable to livestock.

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.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Intrusive. Denoting igneous rocks derived from molten matter (magmas) that invaded preexisting rocks and cooled below the surface of the earth.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Lacustrine deposit. Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.6 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.

Mesa. A broad, nearly flat topped and commonly isolated upland mass characterized by summit widths that are more than the heights of bounding erosional scarps.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

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

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mountain. A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides. A mountain can occur as a single, isolated mass or in a group forming a chain or range.

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Outcrop. That part of a geologic formation or structure that appears at the surface of the earth.

Paleosol. A soil that formed on a landscape of the past with distinctive morphological features resulting from a soil-forming environment that no longer exists at the site. The former pedogenic process was either altered because of external environmental change or interrupted by burial.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pediment. A gently sloping erosional surface developed at the foot of a receding hill or mountain slope. The surface may be essentially bare, exposing earth material that extends beneath adjacent uplands, or it may be thinly mantled with alluvium and colluvium, ultimately in transit from upland front to basin or valley lowland.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. In soil physics, the rate is referred to as "saturated hydraulic conductivity," which is defined in the "Soil Survey Manual." In line with conventional usage in the engineering profession and with traditional usage in published soil surveys, this rate of flow continues to be expressed as "permeability." Terms describing permeability, measured in inches per hour, are as follows:

Extremely slow	0.0 to 0.01 inch
Very slow	0.01 to 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

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.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Playa. The generally dry and nearly level lake plain that occupies the lowest parts of closed depressional areas, such as those on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation and runoff.

Pleistocene. The first epoch of the Quaternary Period of geologic time, following the Pliocene Epoch and preceding the Holocene (about 2 million to 10,000 years ago). Also, the corresponding time-stratigraphic subdivision (system) of earth material.

Pliocene. The last epoch of the Tertiary Period of geologic time, following the Miocene Epoch and preceding the Pleistocene Epoch (about 7 million to 2 million years ago). Also, the corresponding time-stratigraphic subdivision (system) of earth materials.

Pluvial lake. A lake formed in a period of exceptionally heavy rainfall; a lake formed in the Pleistocene Epoch during a time of glacial advance and now either extinct or existing as a remnant.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid or very rapid permeability, 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.

Potential native plant community. See Climax plant community.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use. Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

Quaternary. The second period of the Cenozoic Era of geologic time, extending from the end of the Tertiary Period (about 2 million years ago) to the present and comprising two epochs, the Pleistocene (Ice Age) and the Holocene (Recent). Also, the corresponding time-stratigraphic subdivision (system) of earth materials.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor on the basis of how much the present plant community has departed from the potential.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

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 degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	less than 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

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Represo. A small, shallow, dug pond, usually on a flood plain. It is 3 to 5 feet deep and generally has water only during rainy seasons.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Ridge. A long, narrow elevation of the land surface, typically sharp crested with steep sides and forming an extended upland between valleys. The term is used in areas of both hill and mountain relief.

Rill. A steep-sided channel resulting from accelerated erosion. A rill generally is a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 drawbar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

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.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Salinity. The concentration of dissolved salts in water. The term is used to indicate the existence of saline soils. The classes, in terms of millimhos per centimeter, are as follows:

Nonsaline	less than 2
Very slightly saline	2 to 4
Slightly saline	4 to 8
Moderately saline	8 to 16
Strongly saline	more than 16

Saltation. Particle movement by water or wind where particles skip or bounce along the streambed or soil surface.

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.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

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. Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Sedimentation. Solid clastic material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by water, wind, or mass wasting and has come to rest on the earth's surface either above or below sea level. Sedimentary deposits in a broad sense also include materials that have been precipitated from solution or emplaced by explosive volcanism and have not been subject to appreciable transport.

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. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil generally is silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey, classes for simple slopes are as follows:

Nearly level	0 to 3 percent
Gently sloping	3 to 7 percent
Strongly sloping	7 to 15 percent
Moderately steep	15 to 25 percent
Steep	25 to 55 percent
Very steep	55 percent and higher

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodic (alkali) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na^+ to Ca^{++} + Mg^{++}. The degrees of sodicity and their respective ratios are:

Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

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

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 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, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

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

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Stream terrace. One of a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream and representing the dissected remnants of an abandoned flood plain, streambed, or valley floor produced during a former stage of erosion or deposition.

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).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

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

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Tailwater. In hydraulics, the water directly downstream from a dam or similar structure.

Talus. Fragments of rock and other soil material accumulated by gravity at the foot of cliffs or steep slopes.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

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 generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Tertiary. The first period of the Cenozoic Era of geologic time, following the Mesozoic Era and preceding the Quaternary (from approximately 65 million to 2 million years ago). Also, the corresponding time-stratigraphic subdivision (system) of earth materials. Epoch or series subdivisions include, in order of increasing age, Pliocene, Miocene, Oligocene, Eocene, and Paleocene.

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 that is 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.

Topography. The relative position and elevation of the natural or manmade features of an area that describe the configuration of its surface.

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. Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley. An elongate, relatively large, externally drained depression of the earth's surface that is primarily developed by stream erosion.

Valley-border surfaces. A general grouping of valley-side geomorphic surfaces that occur in a stepped sequence graded to successively lower streambase levels produced by episodic valley entrenchment.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Valley-side alluvium. A concave "slopewash" deposit at the base of a hill, mountain, or terrace escarpment that may not include the alluvial toe slope of a pediment.

Varnish (desert). A surface stain or crust of brown or black manganese or iron oxide, typically with a glistening luster, that characterizes many exposed rock surfaces in the desert. It coats not only ledges or rock in place but also boulders and pebbles that are scattered over the surface of the ground.

Volcanic. Pertaining to the deep-seated, igneous processes by which magma and associated gases rise through the crust and are extruded onto the earth's surface and into the atmosphere. Also, the structures, rocks, and landforms produced by these processes.

Wash (dry wash). The broad, flat-floored channel of an ephemeral stream, commonly with very steep or vertical banks cut in alluvium.

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.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wildlife habitat vegetative elements. Descriptions of the various types of wildlife habitat elements are as follows:

Desertic riparian shrubs, trees, and vines.—Native or naturally established shrubs, trees, and vines that grow in and along the ephemeral and intermittent stream courses in the arid portions of the Southwest. They supply seeds, cover, foliage, fruits, and water to wildlife.

Desertic herbaceous plants.—Native or naturally established herbaceous plants used by wildlife for food and cover.

Desertic riparian herbaceous plants.—Mainly, herbaceous plants that grow in and along the ephemeral and intermittent stream courses in the arid portion of the Southwest. They are native or naturally established plants and are used by wildlife for food and cover.

Desertic shrubs, trees, and vines.—Native or naturally established trees, shrubs, and vines that produce buds, fruit, twigs, bark, or foliage that provide a substantial portion of food and cover for wildlife.

Grain and seed crops (irrigated).—Perennial or naturally reseeding grain and seed crops that are planted to provide food and cover for wildlife.

Domestic grasses and legumes (irrigated).—Irrigated perennial and naturally reseeding grasses and herbaceous legumes that are planted to provide food and cover for wildlife.

Riparian shrubs, trees, and vines.—Shrubs, trees, and vines growing along wet stream courses and impoundments. They supply cover and food for wildlife in the form of fruits, nuts, catkins, bark, leaves, and seeds.

Riparian herbaceous plants.—Native or naturally established herbaceous plants along wet stream courses and impoundments. They provide food and cover for wildlife.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.