

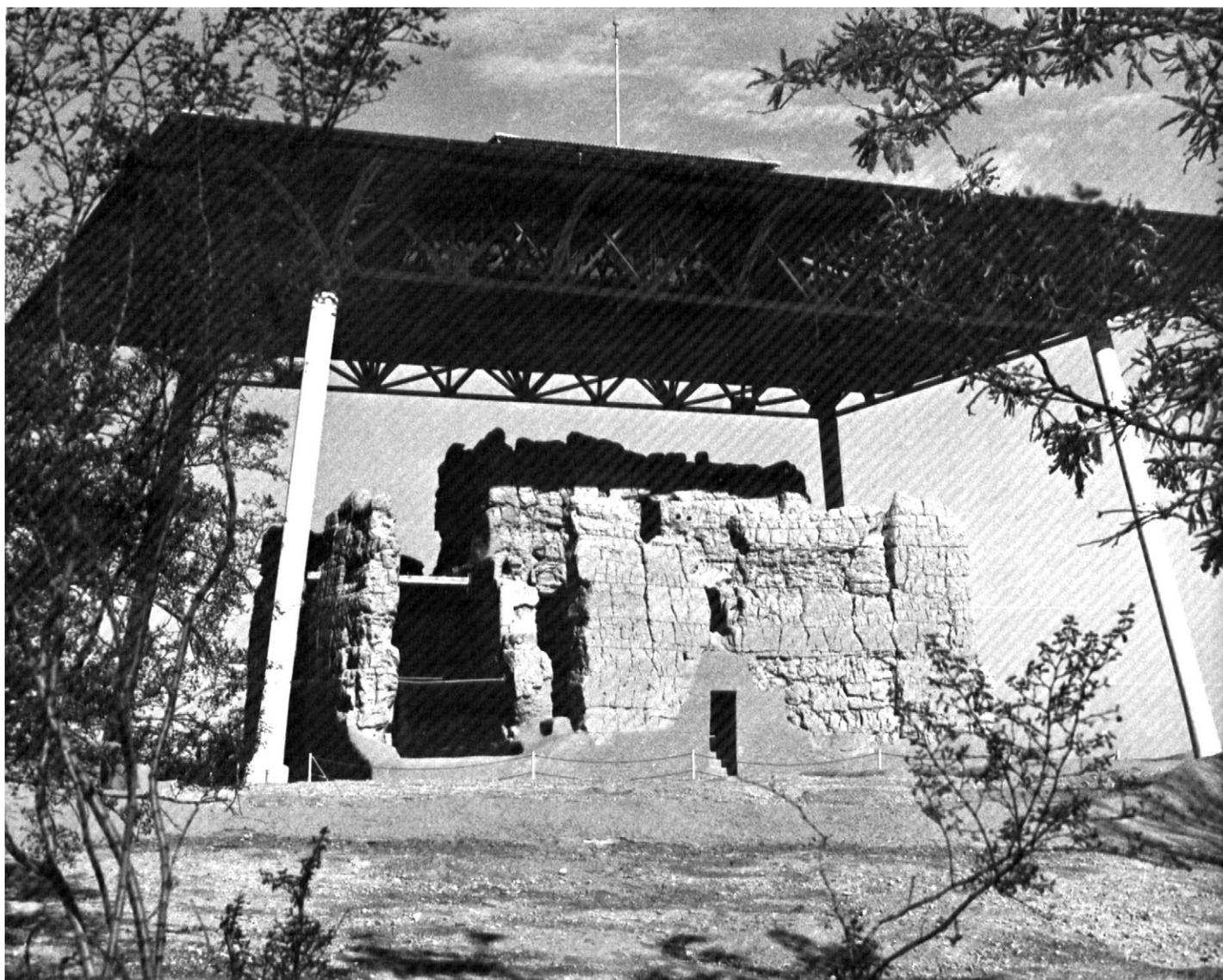


United States  
Department of  
Agriculture

Soil  
Conservation  
Service

In cooperation with  
Arizona Agricultural  
Experiment Station

# Soil Survey of Pinal County, Arizona, Western Part





# How To Use This Soil Survey

## General Soil Map

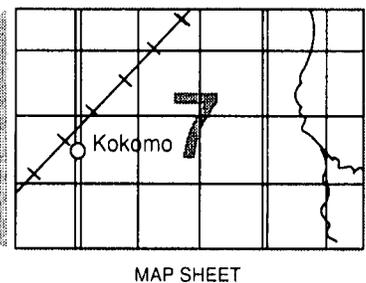
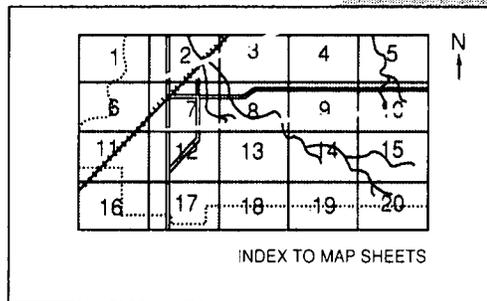
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

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.

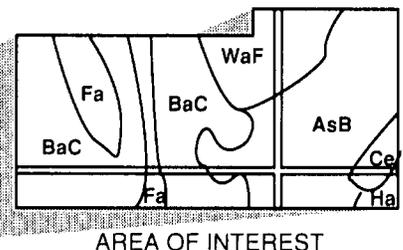
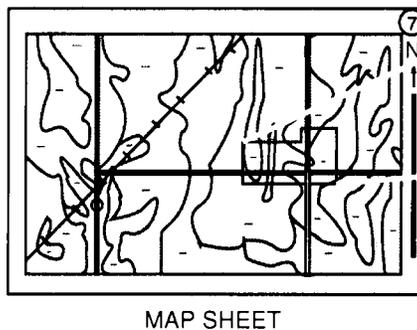
## Detailed Soil Maps

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.



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.



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.

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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 Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1983. Soil names and descriptions were approved in 1983. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1983. This survey was made cooperatively by the Soil Conservation Service and the Arizona Agricultural Experiment Station. It is part of the technical assistance furnished to the Eloy, Florence-Coolidge, and West Pinal National Resource Conservation Districts.

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 Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

**Cover: Casa Grande Monument, or the Great House, built by the Hohokam Indians about 1300 A.D. The adobe structure sits on Coolidge sandy loam, the same soil from which the adobe bricks were made.**

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# Foreword

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This soil survey contains information that can be used in land-planning programs in the 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.

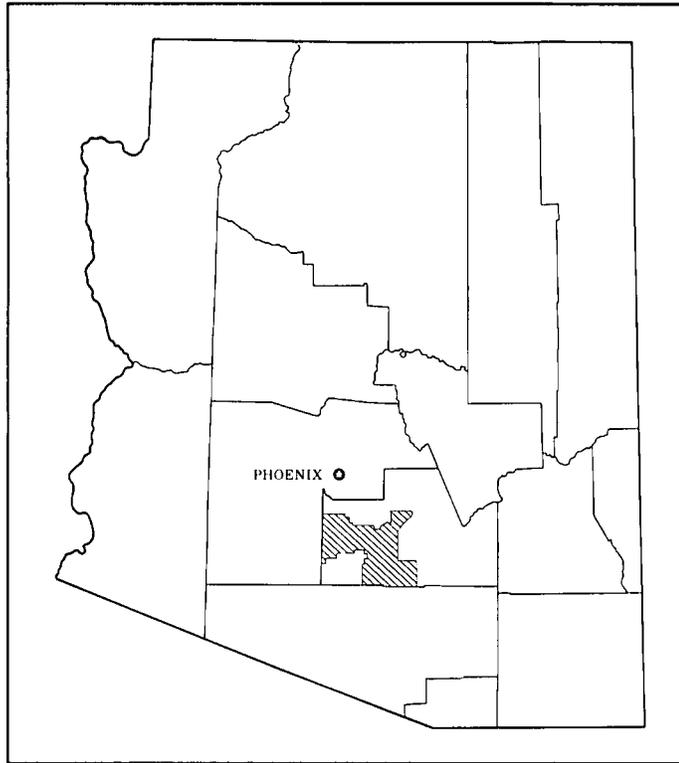
This soil survey is designed for many different users. Farmers, ranchers, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey 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 seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields.

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 Soil Conservation Service or the Cooperative Extension Service.



Donald W. Gohmert  
State Conservationist  
Soil Conservation Service



**Location of Pinal County, western part, In Arizona.**

# Soil Survey of Pinal County, Arizona, Western Part

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By Jon F. Hall, Soil Conservation Service

Fieldwork by Jon F. Hall, Donald J. Breckenfeld, Elmer D. Adams, Hayes C. Dye, and Donald F. White, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service,  
in cooperation with  
Arizona Agricultural Experiment Station

PINAL COUNTY, WESTERN PART, consists of cropland, rangeland, and potentially arable land of the Casa Grande Valley and parts of the Santa Cruz and Gila River Valleys that lie within Pinal County. These valleys are within the Basin and Range province. The survey area is bounded by the Gila River Indian Reservation on the north, Pima County on the south, Maricopa County on the west, and the Picacho Mountains and Florence-Casa Grande Canal on the east. The survey area has a land area of 937,020 acres, or 1,464 square miles.

Irrigated farming, some cattle ranching, feedlot operations, and copper mining are the most important industries. Irrigated farming is the largest industry. The main crops are cotton, small grain, and alfalfa.

Pinal County was formed in 1875 from parts of Maricopa and Pima Counties. The town of Florence, founded in 1866, was chosen as the county seat. It was a stage stop and an important trade center for mining. Coolidge was established in 1926, when the Coolidge Dam was under construction. Casa Grande, an important trading and shipping center, was established in 1919. Eloy was founded in 1903. It first was called Cotton City by early settlers, but later it was renamed Eloy. Arizola, a small station on the Southern Pacific Railroad line, was established in 1891. Red Rock was settled in 1881, and Picacho was an early stage stop on the road from Phoenix to Tucson. In 1916 Stanfield was the site of a one-room adobe school and a post office.

Two interstate highways and two major federal highways serve the area. They are Interstate 8, which runs from east to west, and Interstate 10, which runs from southeast to northwest. U.S. Highways 80 and 89

are near Florence and run generally from north to south.

The major state highways are 87 and 93, which run from north to south, and 84, which runs from east to west.

Two older surveys, "The Casa Grande Area" and "The Middle Gila Valley Area," were published in 1941 and 1920, respectively. These earlier surveys cover a part of the present survey. The present survey, however, updates the earlier surveys and provides additional information and larger maps that show the soils in greater detail.

Descriptions, names, and delineations of soils in this soil survey do not fully agree with those on soil maps for adjacent survey areas. Differences are the result of better knowledge of soils, modifications in series concepts, intensity of mapping, or the extent of soils within the survey area.

## Climate

Prepared by the National Climatic Data Center, Asheville, North Carolina.

Summers are hot and winters are cool in the survey area. Winter days are fairly warm, although the temperature drops below freezing most nights each winter. Rainfall is scant in most months but is heaviest in summer, when scattered thunderstorms develop in the moist air, which occasionally sweeps inland from the Gulf of Mexico. Snow cover in winter is not persistent and generally is confined to the higher elevations.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Casa Grande, Arizona, in the period 1951 to 1980. 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 53 degrees F and the average daily minimum temperature is 37 degrees. The lowest temperature on record, which occurred at Casa Grande on December 24, 1974, is 15 degrees. In summer the average temperature is 105 degrees. The highest recorded temperature, which occurred on June 27, 1979, is 119 degrees.

Growing degree days, shown in table 1, 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.

Of the total annual precipitation, 4 inches, or 45 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 3 inches. The heaviest 1-day rainfall during the period of record was 3.42 inches at Casa Grande on August 12, 1964. Thunderstorms occur about 23 days each year, and most occur late in summer.

Snowfall is rare. In 99 percent of the winters, there is no measurable snowfall. In 1 percent there is only a trace of snowfall, which usually is of short duration.

The average relative humidity in midafternoon is about 25 percent. Humidity is higher at night, and the average at dawn is about 50 percent. The sun shines 85 percent of the time possible in summer and 70 percent in winter. The prevailing wind is from the east. Average windspeed is highest, 7 miles per hour, in summer.

## 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 or segment of the landscape. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

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

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

While the soil survey was in progress, samples of some of the soils in the area were collected for laboratory analyses. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different

uses and under different levels of management. Some interpretations were modified to fit local conditions, and some new interpretations were developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records 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 state with a fairly high degree of probability that a given soil will be flooded in most years, but they cannot predict that flooding will always be at a specific level on the soil on a specific date.

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



# General Soil Map Units

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

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

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

The general map-units in this survey have been grouped into general kinds of landscape for broad interpretive purposes. Each of the broad groups and the map units in each group are described in the following pages.

## Map Unit Descriptions

### Soils on Flood Plains

This group consists of one map unit. It makes up about 8 percent of the survey area.

#### 1. Glenbar-Gilman-Trix

*Deep, well drained, nearly level, loamy soils; on flood plains*

This map unit is along the Santa Cruz River, Gila River, Greens Wash, Santa Rosa Wash, and the major intermittent tributaries. Slopes are 0 to 1 percent. The vegetation in areas not cultivated is mainly mesquite, cottonwood, and perennial and annual grasses and forbs. Elevation is 1,140 to 2,000 feet. The average

annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

This unit makes up about 8 percent of the survey area.

Glenbar and Gilman soils are deep and well drained. They formed in alluvium derived from mixed sources. These soils are loamy throughout and extend to a depth of 60 inches or more.

Trix soils are deep and well drained. They formed in alluvium deposited over older alluvium derived from mixed sources. These soils are loamy throughout and extend to a depth of 60 inches or more.

Of minor extent in this unit are Antho, Cashion, Gadsden, Ginland, Pimer, and Valencia soils.

This unit is used mainly as irrigated cropland. It is also used as rangeland and for homesite development.

If this unit is used as rangeland, the main limitation is the low precipitation.

If this unit is used for irrigated crops, it is limited mainly by the hazard of flooding. The risk of flooding can be reduced by the use of dikes and levees.

The main limitations for homesite development are the hazard of flooding and low soil strength.

### Soils on Stream Terraces

This group consists of one map unit. It makes up about 19 percent of the survey area.

#### 2. Marana-Sasco-Denure

*Deep, well drained and somewhat excessively drained, nearly level, loamy soils; on stream terraces*

This map unit is adjacent to the soils on flood plains along the major drainageways and tributaries. Slopes are 0 to 1 percent. The vegetation in areas not cultivated is creosotebush, cacti, mesquite, and annual grasses and forbs. Elevation is 1,140 to 3,200 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

This unit makes up about 19 percent of the survey area.

Marana and Sasco soils are deep and well drained. They formed in alluvium derived from mixed sources. These soils are loamy throughout and extend to a depth of 60 inches or more.

Denure soils are deep and somewhat excessively drained. They formed in alluvium derived from mixed sources. These soils are loamy throughout and extend to a depth of 60 inches or more.

Of minor extent in this unit are Dateland, Contine, Mohall, Rositas, and Saminiego soils.

This unit is used mainly for irrigated crops. It is also used as rangeland and for homesite development.

If this unit is used for irrigated crops, the main limitations are the hazard of flooding and susceptibility to gulying.

If this unit is used as rangeland, the main limitations are the low precipitation and susceptibility to gulying.

The main limitations for homesite development are the hazard of flooding, low soil strength, and susceptibility to gulying.

### Soils on Fan Terraces

This unit consists of three map units. It makes up about 46 percent of the survey area.

### 3. Mohall-Contine

*Deep, well drained, nearly level to gently sloping, loamy and clayey soils; on fan terraces*

This map unit is mainly west and south of Picacho Peak. Slopes range from 0 to 3 percent. The vegetation is mainly creosotebush, mesquite, cacti, shrubs, and annual grasses and forbs. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

This unit makes up about 15 percent of the survey area.

Mohall soils are deep and well drained. They formed in alluvium derived from mixed sources. These soils are loamy throughout and extend to a depth of 60 inches or more.

Contine soils are deep and well drained. They formed in alluvium derived from mixed sources. These soils are clayey to a depth of about 51 inches and are loamy below this depth.

Of minor extent in this unit are Casa Grande, Denure, Laveen, and Tremant soils.

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

If this unit is used for irrigated crops, the main limitation is the slow permeability of the Contine soils.

The Mohall soils are limited mainly by the hazard of wind erosion.

If this unit is used as rangeland, the main limitation is the low precipitation.

If this unit is used for homesite development, the main limitation is the shrink-swell potential.

### 4. Denure-Laveen-Dateland

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

This map unit is in the intermediate to lower position on fan terraces. Slopes range from 0 to 8 percent. The vegetation in areas not cultivated is creosotebush, paloverde, mesquite, cacti, and annual grasses and forbs. Elevation is 1,140 to 3,200 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

This unit makes up about 17 percent of the survey area.

Denure soils are deep and somewhat excessively drained. They formed in alluvium derived from mixed sources. These soils are loamy throughout and extend to a depth of 60 inches or more.

Laveen soils are deep and well drained. They formed in alluvium derived from mixed sources. The surface layer is loamy. Below this to a depth of 60 inches or more the soils are loamy and have soft masses and concretions of lime.

Dateland soils are deep and well drained. They formed in alluvium derived from mixed sources. These soils are loamy throughout and extend to a depth of 60 inches or more.

Of minor extent in this unit are Coolidge, Gilman, Mohall, Tremant, and Valencia soils.

This unit is used as irrigated cropland and rangeland and for homesite development.

The main limitations for irrigated crops are the hazard of soil blowing, the moderate available water capacity of the Denure soils, and the high lime content of the Laveen soils. The main limitation for use as rangeland is the low precipitation. This unit has few limitations for homesite development.

### 5. Cipriano-Pinamt-Momoli

*Very shallow, shallow, and deep, well drained and somewhat excessively drained, nearly level to sloping, very gravelly, cobbly, and loamy soils; on fan terraces*

This map unit is on fan terraces that extend from the base of hillslopes and mountain slopes. Slopes range from 0 to 7 percent. The vegetation is mainly

creosotebrush, paloverde, ironwood, cacti, and annual grasses and forbs. Elevation is 1,740 to 2,500 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

This unit makes up about 14 percent of the survey area.

Cipriano soils are very shallow and shallow and are somewhat excessively drained. They formed in alluvium derived from basalt and andesite. From 20 to 30 percent of the surface is covered with cobbles and pebbles. The surface layer is cobbly and loamy. Below this to a depth of 8 inches the soils are very gravelly and loamy. A lime-silica cemented hardpan is at a depth of 8 to 20 inches.

Pinamt soils are deep and well drained. They formed in alluvium derived from mixed sources. From 40 to 70 percent of the surface is covered with desert varnished pebbles. The surface layer is very gravelly and loamy. Below this to a depth of 60 inches or more the soils are very gravelly and loamy.

Momoli soils are deep and somewhat excessively drained. They formed in alluvium derived from mixed sources. From 30 to 40 percent of the surface is covered with pebbles. These soils are very gravelly and loamy throughout and extend to a depth of 60 inches or more.

Of minor extent in this unit are Carrizo, Coolidge, Denure, Gunsight, and Tremant soils.

This map unit is used as rangeland.

The main limitation for use as rangeland is the low precipitation.

### **Soils on Relict Basin Floors**

This group consists of two map units. It makes up about 19 percent of the survey area.

### **6. Casa Grande-Mohall-Dateland**

*Deep, well drained, nearly level, loamy soils; on relict basin floors*

This map unit is in an area extending from Casa Grande to Coolidge and in an area south of the Sawtooth Mountains. Slopes are 0 to 1 percent. The vegetation in areas not cultivated is saltbush, creosotebush, mesquite, and annual grasses. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

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

Casa Grande, Mohall, and Dateland soils are deep and well drained. They formed in alluvium derived from

mixed sources. These soils are loamy throughout and extend to a depth of 60 inches or more.

Of minor extent in this unit are Ginland, La Palma, Laveen, and Toltec soils.

This unit is used mainly as irrigated cropland. It is also used as rangeland and for homesite development.

The main limitation for irrigated crops is the content of toxic salts in the Casa Grande soils and some of the Dateland soils.

The main limitation for use as rangeland is the low precipitation.

The main limitation for homesite development is the moderate shrink-swell potential of the Mohall and Casa Grande soils. The Dateland soils have few limitations for this use. The Casa Grande soils have a high content of toxic salts.

### **7. Toltec-Casa Grande-La Palma**

*Deep and moderately deep, well drained, nearly level, loamy soils; on relict basin floors*

This map unit extends from an area north of Eloy to an area just south of Coolidge. Slopes are 0 to 1 percent. The vegetation in areas not cultivated is saltbush, mesquite, and annual grasses. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

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

Toltec soils are deep and well drained. They formed in alluvium derived from mixed sources. These soils are loamy throughout and extend to a depth of 60 inches or more. They are moderately saline and strongly alkaline.

Casa Grande soils are deep and well drained. They formed in alluvium derived from mixed sources. They are loamy throughout and extend to a depth of 60 inches or more. These soils are moderately saline and strongly sodic.

La Palma soils are deep and well drained. They formed in alluvium derived from mixed sources. These soils are loamy and are underlain by a lime-cemented hardpan at a depth of 20 to 40 inches. They are moderately saline and strongly sodic.

Of minor extent in this unit are Dateland, Denure, Laveen, and Mohall soils.

This unit is used mainly as irrigated cropland. It is also used as rangeland and for homesite development.

The main limitation of this unit for irrigated crops is the content of toxic salts. The La Palma soils are also limited because of the moderate depth to a hardpan.

The main limitation for use as rangeland is the low precipitation.

The main limitations for homesite development are the shrink-swell potential, the content of toxic salts, and the depth to the cemented pan.

### **Soils on Hillslopes and Mountain Slopes**

This group consists of one map unit. It makes up about 7 percent of the survey area.

#### **8. Vaiva-Rock Outcrop-Cherioni**

*Very shallow and shallow, well drained and somewhat excessively drained, gently sloping to steep, very gravelly and extremely gravelly, loamy soils, and Rock outcrop; on hillslopes and mountain slopes*

This map unit is mainly in the Table Top, Sawtooth, and Palo Verde Mountains. Slopes range from 2 to 60 percent. The vegetation on this unit is mainly paloverde, cacti, and annual grasses and forbs. Elevation is 1,200 to 4,375 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

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

Vaiva soils are very shallow and shallow and are well drained. They formed in eolian material and in alluvium and colluvium derived from granite and gneiss. From 30 to 70 percent of the surface is covered with stones and pebbles. These soils are very gravelly and loamy to a depth of 4 to 20 inches. Weathered granite is at a depth of 4 to 20 inches.

Rock outcrop consists mainly of areas of exposed granite and basalt, but there are also small areas of exposed schist, rhyolite, granite-gneiss, and andesite.

Cherioni soils are on hillslopes and mountain slopes. These soils are very shallow and shallow and are somewhat excessively drained. They formed in eolian material and in alluvium and colluvium derived from basalt. From 40 to 65 percent of the surface is covered with cobbles, hardpan fragments, and pebbles. These soils are very gravelly and loamy to a depth of 5 to 20 inches. A silica-lime cemented hardpan is at a depth of 5 to 20 inches. Unweathered basalt is at a depth of 7 to 20 inches.

Of minor extent in this unit are Cipriano, Gunsight, Momoli, and Tremant soils.

Most areas of this unit are used as rangeland.

The main limitations for use as rangeland are the low

precipitation, limited thickness of the soils, steepness of slope, and rock fragments on the surface.

### **Warm Soils on Fan Terraces, Hillslopes, and Mountain Slopes**

This group consists of one map unit. It makes up about 1 percent of the survey area.

#### **9. Pajarito-Sonoita-Cellar**

*Deep, shallow, and very shallow, well drained and somewhat excessively drained, nearly level to steep, gravelly and very gravelly, loamy soils; on fan terraces, hillslopes, and mountain slopes*

This map unit is mainly in the southeastern corner of the survey area. Slopes range from 1 to 60 percent. The vegetation on this unit is mainly creosotebush, mesquite, cacti, and annual and perennial grasses and forbs. Elevation is 2,000 to 4,500 feet. The average annual precipitation is 6 to 12 inches, the average annual air temperature is 64 to 70 degrees F, and the average frost-free season is 180 to 240 days.

This unit makes up about 1 percent of the survey area.

Pajarito soils are on fan terraces. These soils are deep and well drained. They formed in alluvium derived from granite and other similar kinds of rock. These soils are gravelly and loamy throughout and extend to a depth of 60 inches or more.

Sonoita soils are on fan terraces. These soils are deep and well drained. They formed in alluvium derived dominantly from granite and other similar kinds of rock. These soils are gravelly and loamy throughout and extend to a depth of 60 inches or more.

Cellar soils are on hillslopes and mountain slopes. These soils are very shallow and shallow and are somewhat excessively drained. They formed in alluvium and colluvium derived dominantly from granite and granite-gneiss. From 15 to 30 percent of the surface is covered with stones and pebbles. These soils are very gravelly and loamy to a depth of 10 inches. Granite is at a depth of 4 to 20 inches.

Of minor extent in this unit are Akela soils and Rock outcrop.

This unit is used as rangeland.

The main limitation for use as rangeland is the low precipitation. Cellar soils are also limited by the steepness of slope and very shallow and shallow depth.

## Detailed Soil Map Units

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

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

Most included soils 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 behavior 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 segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but if intensive use of small areas is planned, onsite investigation to precisely define and locate the soils and miscellaneous areas is needed.

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

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

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

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

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or

miscellaneous areas are somewhat similar in all areas. Momoli-Carrizo complex, 1 to 8 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. Mohall-Denure association is an example.

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

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

Table 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.

## Map Unit Descriptions

**1—Akela-Rock outcrop complex, 10 to 60 percent slopes.** This map unit is on hillslopes and mountain slopes. Elevation is 2,000 to 3,000 feet. The average annual precipitation is 10 to 12 inches, the average annual air temperature is 64 to 68 degrees F, and the average frost-free period is 180 to 240 days.

This unit is 60 percent Akela very cobbly very fine sandy loam and 30 percent Rock outcrop. The components of this unit are intricately intermingled; however, a higher percentage of Rock outcrop is in areas near the hilltops.

Included in this unit are small areas of rubble land, very cobbly sandy loam in areas of highly fractured andesite, very cobbly clay loam in some saddles, and very cobbly loam on foot slopes. Also included are small areas of soils that are very shallow or shallow to a hardpan. Included areas make up about 10 percent of the total acreage.

The Akela soil is very shallow and shallow. It formed in eolian material and slope alluvium derived dominantly

from volcanic rock. Typically, 60 percent of the surface is covered with cobbles, stones, and subrounded basalt pebbles. The surface layer is light yellowish brown very cobbly very fine sandy loam about 2 inches thick. Below this is light yellowish brown very cobbly very fine sandy loam about 14 inches thick. Lime-coated basalt is at a depth of 16 inches.

Permeability of the Akela soil is moderate. 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. The hazard of soil blowing is slight.

Rock outcrop consists of exposed ledges and pinnacles of rhyodacite, basalt, and andesitic tuff.

This unit is used mainly as rangeland. It is also used for recreational development.

The potential native plant community on this unit consists of bush muhly, slim tridens, white brittlebush, and littleleaf paloverde. The present vegetation is paloverde, creosotebush, bursage, and bush muhly. Steepness of slope limits access for grazing by livestock in some areas.

The Rock outcrop provides nesting areas for birds of prey. This unit is very poorly suited to the production of desertic herbaceous plants and is poorly suited to the production of desertic shrubs and trees that provide habitat for wildlife.

If this unit is used for recreational development, the main limitations are steepness of slope, depth to rock, and rock fragments on the surface. Slope limits the use of areas of this unit mainly to a few paths and trails, which should extend across the slope. Less sloping areas in the unit can be used as campsites, picnic areas, and playgrounds.

The Akela soil is in capability subclass VII<sub>s</sub>. It is in the Basalt Hills, 10- to 12-inch p.z., range site. Rock outcrop is not assigned a land capability classification or a range site.

**2—Antho loamy fine sand.** This deep, somewhat excessively drained soil is on flood plains. It formed in alluvium derived from mixed sources. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is light brownish gray loamy fine sand about 4 inches thick. The next layer to a depth of 36 inches is fine sandy loam and sandy loam with thin strata of silty clay loam and loamy sand. Below this to a depth of 60 inches or more is loamy fine sand with thin strata of finer textured soil material.

Included in this unit are small areas of Gilman soils.

Included areas make up about 5 percent of the total acreage.

Permeability of this Antho soil is moderately rapid. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. The hazard of soil blowing is high. This unit is subject to occasional, brief periods of flooding in summer and winter.

This unit is used as irrigated cropland and rangeland.

If this unit is used for irrigated crops, it is limited mainly by the low available water capacity, the hazard of soil blowing, and the hazard of flooding. Surface, sprinkler, and trickle irrigation systems are suited to this unit. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the needs of the crop grown.

Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Keeping the soil surface moist also helps to control soil blowing and thus reduces the risk of damage to young seedlings. Properly designed and carefully installed channels, dikes, and levees can help to control flooding.

The potential native plant community on this unit is a diverse mixture of perennial grasses and forbs, desertic trees and shrubs, and annual grasses. The present vegetation is paloverde, ironwood, mesquite, creosotebush, and big sagebrush. Perennial grasses such as bush muhly, threeawn, slim tridens, and numerous annual grasses are also present. The most common perennial forbs present are globemallow, wirelettuce, fiddleneck, scorpion weed, hairy Bowlesia, and Indianwheat.

Continuous grazing and the absence of natural fires on this unit have led to an increase in woody plants. The amount of vegetation produced on the unit depends on the amount of moisture it receives from the seasonal floodwater. Channeling occurs when the native vegetation is depleted and reduces the area normally flooded. Plant production can be improved by removing the brush.

This map unit is in capability subclasses IIIw, irrigated, and IIw, nonirrigated. It is in the Sandy Bottom, 7- to 10-inch p.z., range site.

**3—Casa Grande fine sandy loam.** This deep, well drained soil is on relict basin floors. It formed in stream alluvium derived from mixed sources. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is light brown fine sandy

loam about 13 inches thick. Below this to a depth of 60 inches or more is reddish brown and pinkish gray, calcareous sandy clay loam. A layer of lime accumulation is at a depth of 4 to 18 inches.

Included in this unit are small areas of Coolidge, Dateland, Denure, Mohall, and Valencia soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Casa Grande soil is slow. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. This soil is moderately saline and strongly sodic.

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

If this unit is used for irrigated crops, it is limited mainly by the content of toxic salts, soil blowing, the moderate available water capacity, and the slow permeability. Intensive management is required to keep the salinity and sodicity of the soil to a minimum and to maintain soil productivity. The toxic salts have been leached, at least partially, to a depth of 3 to 5 feet in most cropland areas. In areas that are not cultivated or irrigated for a few years or are irrigated improperly, salts can move back into the upper part of the soil. The content of toxic salts can be reduced and maintained at a lower level by using a continuing management program that includes leaching, applying proper amounts of soil amendments, and returning crop residue to the soil.

Surface and trickle irrigation systems are suited to this unit. Because the soil in this unit has slow permeability, it should be leveled and the period of water application adjusted to permit a more uniform application and deeper infiltration of water. This results in more efficient use of irrigation water (fig. 1).

Maintaining crop residue on or near the surface reduces soil blowing, conserves moisture, and helps to maintain soil tilth and organic matter content. Keeping the soil surface moist helps to control soil blowing and thus reduces the risk of damage to young seedlings. If this unit is leveled, the cuts and fills in places are as much as 4 feet deep. This exposes the underlying layer, which has a high content of lime and sodium, and thus reduces the water intake rate and available water capacity and restricts the use of nutrients by plants.

This unit produces a fair amount of browse consisting mainly of salt-tolerant desertic shrubs. The potential native plant community is desert saltbush, fourwing saltbush, and numerous winter and summer annual grasses and forbs. The present vegetation is desert saltbush, seepweed, mound cactus, and Mediterraneangrass. An increase in



Figure 1.—Level basin furrow irrigation in an area of Casa Grande fine sandy loam.

Mediterranean grass, an introduced annual, and a decrease in the cool season annuals, native forbs, and grasses indicate site deterioration.

Because this unit is susceptible to soil blowing, care should be taken to manage grazing in order to leave enough vegetation to protect the soil surface.

If this unit is used for homesite development, the main limitations are the high content of toxic salts, moderate shrink-swell potential, and low soil strength. If buildings are constructed on this unit, overexcavating and backfilling the foundation with coarse textured soil material can reduce the possibility of structural damage caused by shrinking and swelling of the soil. Buildings

and roads should be designed to offset the effects of shrinking and swelling and the limited ability of the soil to support a load.

Construction of houses and access roads destroys the vegetation, brings large quantities of toxic salts to the surface, and leaves the soil susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as possible helps to control erosion. Plant cover is extremely difficult to establish. Good management includes fertilizing, seeding, and mulching. Measures such as wrapping steel pipes and using corrosion resistant concrete can be used to minimize deterioration of steel and concrete.

If this unit is used for septic tank absorption fields, the limitation of slow permeability can be reduced by increasing the size of the absorption field and by carefully designing and installing alternate systems.

This unit is poorly suited to the production of desert herbaceous plants, shrubs, and trees that provide habitat for wildlife. It is moderately well suited to the production of irrigated grain and seed crops and domestic grasses and legumes.

This unit is in capability subclasses IIIs, irrigated, and VIIs, nonirrigated. It is in the Saline Upland (loamy), 7- to 10-inch p.z., range site.

**4—Casa Grande clay loam.** This deep, well drained soil is on relict basin floors. It formed in stream alluvium derived from mixed sources. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is light brown clay loam about 13 inches thick. Below this to a depth of 60 inches or more is reddish brown and pinkish gray, calcareous sandy clay loam. A layer of lime accumulation is at a depth of 4 to 18 inches.

Included in this unit are small areas of Mohall and Trix soils. Also included are small areas of soils that have a surface layer of silty clay loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Casa Grande soil is slow. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight. This soil is moderately saline and strongly sodic.

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

If this unit is used for irrigated crops, it is limited mainly by the content of toxic salts, the moderate available water capacity, and the slow permeability. Surface and trickle irrigation systems are suited to this unit. Intensive management is needed to keep the salinity and sodicity of the soil below the minimum needed to maintain soil productivity. In most cropland areas, the toxic salts have been leached, at least partially, to a depth of 3 to 5 feet. If the soil is not cultivated or irrigated for a few years or is irrigated improperly, salts can move back into the upper part of the soil. The content of toxic salts can be reduced and maintained at a lower level by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil.

Because the soil in this unit has slow permeability, it

should be leveled and the period of water application adjusted to permit a more uniform application and deeper infiltration of water. This results in a more efficient use of irrigation water.

Maintaining crop residue on or near the surface reduces soil blowing and helps to maintain soil tilth and organic matter content. If this soil is leveled, the cuts and fills in places will be as much as 4 feet deep. This exposes the underlying layer, which has a high content of lime and sodium, and thus reduces the water intake rate, increases the sodium content near the surface, and restricts the use of nutrients by plants.

This unit produces a fair amount of browse consisting mainly of salt-tolerant desert shrubs. The potential native plant community on this unit is desert saltbush, fourwing saltbush, and a sparse understory of annual grasses and forbs. The present vegetation is desert saltbush, seepweed, mesquite, and hedgehog cactus.

If this unit is used for homesite development, the main limitations are the high content of toxic salts, moderate shrink-swell potential, and low soil strength. If buildings are constructed on this unit, overexcavating and backfilling the foundation with coarse textured soil material can reduce the possibility of structural damage caused by shrinking and swelling of the soil. Buildings and roads should be designed to offset the effects of toxic salts, shrinking and swelling, and the limited ability of the soil to support a load.

Construction of houses and access roads destroys the vegetation and leaves the soil susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as possible helps to control erosion. Plant cover is extremely difficult to establish but can be established and maintained by properly leaching, fertilizing, adding soil amendments, seeding, and mulching. Measures such as wrapping steel pipes and using corrosion resistant concrete can be used to minimize deterioration of steel and concrete.

If this unit is used for septic tank absorption fields, the limitation of slow permeability can be reduced by increasing the size of the absorption field and by carefully designing and installing alternate systems.

This unit is poorly suited to the production of desert herbaceous plants, shrubs, and trees that provide habitat for wildlife. It is moderately well suited to the production of irrigated grain and seed crops and domestic grasses and legumes.

This unit is in capability subclasses IIIs, irrigated, and VIIs, nonirrigated. It is in the Saline Upland (loamy), 7- to 10-inch p.z., range site.

**5—Cashion clay.** This deep, well drained soil is on flood plains. It formed in recent fine textured stream alluvium derived from mixed sources. Slope is 0 to 1

percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is grayish brown clay about 12 inches thick. The next 22 inches is grayish brown clay that is stratified in the lower 12 inches. Below this to a depth of 60 inches or more is light brownish gray silt loam with thin strata of finer and coarser textured soil material. This soil has an organic matter content of 1 percent or more to a depth of 22 to 30 inches. Depth to the contrasting loamy soil material mainly ranges from 24 to 38 inches, but in a few areas it is at a depth of as little as 14 inches.

Included in this unit are small areas of Gadsden, Glenbar, Pimer, and Trix soils. Also included are small areas of soils that have a surface layer of silty clay. Included areas make up about 10 percent of the total acreage.

Permeability of this Cashion soil is slow. Available water capacity is high. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight. This soil is subject to occasional, brief periods of flooding in summer and winter.

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

If this unit is used for irrigated crops, it is limited mainly by the slow water intake rate, the slow permeability, and the hazard of flooding. Surface and trickle irrigation systems are suited to this unit. Because the soil has slow permeability, it should be leveled and the period of water application adjusted to permit a more uniform application and deeper infiltration of water. Returning crop residue to the soil or regularly adding other organic material improves fertility, reduces crusting, and increases the water intake rate. Tillage can also be improved by returning crop residue to the soil. Properly designed and carefully installed dikes, channels, and levees can be used to help control flooding.

The potential native plant community on this unit is dominantly perennial grasses with scattered shrubs and cacti. The present vegetation is mesquite, bermudagrass, globemallow, and annual grasses and forbs.

This unit is moderately well suited to the production of desertic riparian herbaceous plants suitable as wildlife habitat. It is moderately well suited to the production of irrigated grain and seed crops and domestic grasses and legumes.

This unit is in capability subclasses IIIw, irrigated, and VIIw, nonirrigated. It is in the Clay Bottom, 7- to 10-inch p.z., range site.

**6—Cellar-Rock outcrop complex, 5 to 60 percent slopes.** This map unit is on hillslopes and mountain slopes. Elevation is 2,000 to 4,500 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is 62 to 70 degrees F, and the average frost-free period is 180 to 240 days.

This unit is 55 percent Cellar very gravelly sandy loam and 35 percent Rock outcrop. The Cellar soil is on back slopes of granite hills. Rock outcrop commonly is in the higher lying areas. 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 soils that have a surface layer of cobbly sandy loam, very cobbly sandy loam, or very gravelly loam. Included areas make up about 10 percent of the total acreage.

The Cellar soil is very shallow and shallow and is somewhat excessively drained. It formed in slope alluvium derived from granite, gneiss, and related rock. Typically, 35 to 60 percent of the surface is covered with pebbles, and in some areas there are cobbles. The surface layer is yellowish brown very gravelly sandy loam about 1 inch thick. The next layer is yellowish brown very gravelly sandy loam about 4 inches thick. Below this is soft weathered granite about 3 inches thick. Unweathered granite is at a depth of 8 inches.

Permeability of the Cellar soil is moderately rapid. Available water capacity is very low. Potential rooting depth is 4 to 20 inches. Runoff is medium to rapid, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

Rock outcrop consists of exposed areas of granite.

This unit is used as rangeland.

The potential native plant community on this unit is desertic shrubs with an understory of perennial and annual grasses and forbs. The present plant community consists of littleleaf paloverde, brittlebush, buckwheat, bricklebush, slim tridens, threeawn, and other forbs, grasses, cacti, and shrubs.

This unit is well suited to the production of desertic herbaceous plants, shrubs, and trees that provide habitat for wildlife.

The Cellar soil is in capability subclass VIIe and in the Granitic Hills, 10- to 12-inch p.z., range site. Rock outcrop is not assigned a land capability classification or a range site.

**7—Cherioni-Rock outcrop complex, 5 to 60 percent slopes.** This map unit is on hillslopes and mountain slopes. Elevation is 1,200 to 4,375 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

This unit is 55 percent Cherioni very cobbly very fine

sandy loam and 25 percent Rock outcrop. The Cherioni soil is on back slopes and foot slopes, and Rock outcrop is on the higher parts of the hills. 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 Cipriano soils on back slopes and foot slopes and Gunsight soils intermingled with Cipriano soils on the lower slopes. Also included are small areas of Vaiva soils. Included areas make up more than 20 percent of the total acreage. The percentage varies from one area to another.

The Cherioni soil is very shallow and shallow and is somewhat excessively drained. It formed in very cobbly slope alluvium derived dominantly from basalt. Typically, 40 to 65 percent of the surface is covered with cobbles, hardpan fragments, and pebbles. The surface layer is light brown very cobbly very fine sandy loam about 1 inch thick. The next layer is brown and light brown very gravelly very fine sandy loam about 7 inches thick. Below this is a silica- and lime-cemented hardpan about 2 inches thick. Basalt is at a depth of 10 inches. Depth to the silica- and lime-cemented hardpan ranges from 5 to 20 inches. Depth to rock ranges from 6 to 20 inches.

Permeability of the Cherioni soil is moderate. Available water capacity is very low. Potential rooting depth is 5 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

Rock outcrop consists of exposed areas of basalt and andesite.

Most areas of this unit are used as rangeland.

The potential native plant community on this unit is desertic shrubs and a small percentage of perennial grasses. The present vegetation is white brittlebush, littleleaf paloverde, triangle bursage, a variety of cacti, and numerous perennial and annual forbs.

In years of good precipitation in winter and summer, a significant amount of annual forage is produced. Use of the vegetation on this unit for grazing by livestock is limited by the steepness of slope and the cobbles on the surface.

This unit is moderately well suited to the production of desertic herbaceous plants, shrubs, and trees that provide habitat for wildlife.

The Cherioni soil is in capability subclass VIIe. It is in the Basalt Hills, 7- to 10-inch p.z., range site. Rock outcrop is not assigned a land capability classification or a range site.

#### **8—Cipriano cobbly loam, 1 to 8 percent slopes.**

This very shallow and shallow, somewhat excessively

drained soil is on fan terraces. It formed in very gravelly or cobbly fan alluvium derived from mixed sources. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, 15 to 35 percent of the surface is covered with cobbles and pebbles. The surface layer is brown cobbly loam about 2 inches thick. Below this is light brown very gravelly loam about 7 inches thick. An indurated, silica- and lime-cemented hardpan is at a depth of 9 inches. The depth to the hardpan ranges from 8 to 20 inches.

Included in this unit are small areas of Gunsight, Momoli, and Pinamt soils. Also included are small areas of soils that have a surface layer of very gravelly loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Cipriano soil is moderate. Available water capacity is very low. Potential rooting depth is 8 to 20 inches. Runoff is medium, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used mainly as rangeland.

The potential native plant community on this unit is shrubs and cacti. The present vegetation is creosotebush, bursage, fluffgrass, threeawn, a number of annual grasses, and forbs. A variety of perennial trees, shrubs, half-shrubs, succulents, and woody vines are also present. The plant community has changed very little since the introduction of livestock grazing. The production of forage is limited by the thickness of the soil, the high content of lime in the soil, the very low available water capacity, and the low precipitation. Small areas of more productive included soils are along the drainageways.

This unit is poorly suited to the production of desertic herbaceous plants, shrubs, and trees that provide habitat for wildlife.

This unit is in capability subclass VIIs. It is in the Limy Upland, 7- to 10-inch p.z., range site.

**9—Contine clay loam.** This deep, well drained soil is on fan terraces. It formed in fine textured fan alluvium derived from mixed sources. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

Typically, the surface layer is strong brown clay loam about 12 inches thick. The subsoil is yellowish red and light brown clay 39 inches thick. Below this to a depth of 60 inches or more is light brown, strongly alkaline

clay loam. Common soft masses of lime are present below a depth of about 26 inches.

Included in the unit are small areas of Mohall, Trix, and Ginland soils. Also included are areas that are moderately sodic. Included areas make up about 15 percent of the total acreage.

Permeability of this Contine soil is slow. Available water capacity is moderately high. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight. The high content of clay reduces penetration and distribution of roots in the subsoil.

This unit is used as irrigated cropland and rangeland.

If this unit is used for irrigated crops, it is limited mainly by the slow permeability, dense subsoil, and the moderately high available water capacity. Surface and trickle irrigation systems are suited to this unit. Because of the slow permeability of the soil in this unit, the application of water should be regulated so that it does not stand on the surface and damage the crops. Returning crop residue to the soil or regularly adding other organic material improves fertility, reduces crusting, and increases the water intake rate. Tillth can also be improved by returning crop residue to the soil. Tillage should be kept to a minimum. Leveling the soil permits more efficient use of irrigation water. If this unit is leveled for irrigation water management, the cuts and fills are as much as 5 feet deep, which can expose less desirable calcareous and sodic soil material.

The potential native plant community on this unit is tobosa, bush muhly, big galleta, threeawn, and other perennial grasses. An overstory of desertic trees and shrubs and an understory of annual forbs and grasses are also part of the potential plant community. The present vegetation community is creosotebush, triangle bursage, annual forbs, and grasses.

This unit is moderately well suited to the production of desertic herbaceous plants, shrubs, and trees. It is also moderately well suited to the production of irrigated grain and seed crops and domestic grasses and legumes.

This unit is in capability subclasses IIIs, irrigated, and VIIs, nonirrigated. It is in the Clay Loam Upland, 7- to 10-inch p.z., range site.

**10—Contine clay.** This deep, well drained soil is on relict basin floors. It formed in fine textured fan alluvium derived from mixed sources. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is strong brown clay about 12 inches thick. The subsoil is yellowish red and

light brown clay 39 inches thick. Below this to a depth of 60 inches or more is light brown, strongly alkaline clay loam. Common soft masses of lime are present below a depth of about 26 inches.

Included in this unit are small areas of Ginland, Mohall, and Trix soils. Also included are soils that are moderately sodic. Included areas make up about 10 percent of the total acreage.

Permeability of this Contine soil is slow. Available water capacity is moderately high. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight. Penetration and distribution of roots are reduced by the dense subsoil. The subsoil is slightly sodic in the lower part.

This unit is used for irrigated crops and as rangeland.

If this unit is used for irrigated crops, it is limited mainly by the slow water intake rate, dense subsoil, the moderately high available water capacity, the content of toxic salts, and the slow permeability. Surface and trickle irrigation systems are suited to this unit. The slope of the fields and the period and amount of water applied should be adjusted to permit adequate infiltration of water and leaching of salts. Returning crop residue to the soil or regularly adding other organic material improves fertility, reduces crusting, and increases the water intake rate. Tillth can also be improved by returning crop residue to the soil. If the unit is leveled for irrigation water management, the cuts and fills in places are as much as 5 feet deep, which can expose less desirable calcareous and sodic soil material.

The potential native plant community on this unit is mixed grasses, desertic shrubs, and cacti. Tobosa is dominant if the range is in good or excellent condition. The present vegetation on this unit consists of triangle bursage, creosotebush, and cacti. The unit commonly supports little vegetation when it is in poor condition.

This unit is moderately well suited to the production of desertic herbaceous plants, shrubs, and trees; irrigated grain and seed crops; and domestic grasses and legumes.

This unit is in capability subclasses IIIs, irrigated, and VIIs, nonirrigated. It is in the Clay Upland, 7- to 10-inch p.z., range site.

**11—Coolidge sandy loam.** This deep, somewhat excessively drained soil is on fan terraces and stream terraces. It formed in fan and stream alluvium derived from mixed sources. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is light brown sandy loam about 7 inches thick. The subsoil is light brown sandy loam 12 inches thick. The next layer is pink, pinkish white, and light brown sandy loam about 25 inches thick. Below this to a depth of 60 inches or more is light brown sandy clay loam. Many soft masses of lime are at a depth of 14 to 60 inches. A layer of lime accumulation is at a depth of 14 to 30 inches.

Included in this unit are small areas of Denure, Gunsight, Laveen, and Valencia soils and Coolidge soils that have a surface layer of fine sandy loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Coolidge soil 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 slight. The hazard of soil blowing is moderate. The subsoil is slightly saline and moderately sodic or strongly sodic.

This unit is used for irrigated crops, rangeland, and homesite development.

If this unit is used for irrigated crops, it is limited mainly by the moderate available water capacity and soil blowing. Surface, sprinkler, and trickle irrigation systems are suited to this unit. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the needs of the crop grown. If the soil is leveled for irrigation water management, the cuts and fills in places will be as much as 5 feet deep and the high lime and strongly sodic underlying layers will be exposed. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Keeping the soil surface moist helps to control soil blowing and thus reduces the risk of damage to young seedlings.

The potential native plant community on this unit is a mixture of desert shrubs and cacti and a small percentage of annual and perennial grasses and forbs. The present vegetation is creosotebush, triangle bursage, annual grasses, and forbs.

This unit is limited for homesite development by the high content of lime and toxic salts. Construction of houses and access roads in places destroys the vegetation and leaves the soil surface unprotected and highly susceptible to soil blowing. Plant cover can be established and maintained through proper fertilizing, seeding, mulching, and shaping of the slopes. Measures such as wrapping steel pipes or providing cathodic protection can be used to minimize corrosion of steel. Buildings and roads should be designed to offset the limited ability of the soil in this unit to support a load. There is a potential for settlement, but it can be

minimized by compacting the building site before construction is begun. Settlement can be reduced by diverting water away from buildings. This prevents the wetting of the calcareous underlying layers.

This unit is poorly suited to the production of desert herbaceous plants, shrubs, and trees. It is poorly suited to the production of irrigated grain and seed crops and domestic grasses and legumes.

This unit is in capability subclasses IIs, irrigated, and VIIs, nonirrigated. It is in the Limy Fan, 7- to 10-inch p.z., range site.

**12—Cuerda fine sandy loam.** This deep, well drained soil is on alluvial fans. It formed in fan alluvium derived from mixed sources. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is pale brown fine sandy loam about 9 inches thick. The next layer is pale brown and light brown very fine sandy loam 21 inches thick. Below this to a depth of 60 inches or more is light brown loam within strata of finer and coarser textured soil material. Common accumulations of lime are in the root channels and pores below a depth of about 30 inches.

Included in this unit are small areas of Casa Grande, Denure, Mohall, Trix, Valencia, and Why soils. Also included are small areas of soils that have a surface layer of gravelly sandy loam. Included areas make up about 10 percent of the total acreage.

Permeability of this Cuerda soil is moderate. Available water capacity is moderately high. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. This unit is subject to occasional, very brief periods of flooding in summer and winter.

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

The potential native plant community on this unit is a diverse mixture of perennial grasses and forbs, desert trees and shrubs, and annual grasses. The present vegetation consists of paloverde, ironwood, mesquite, creosotebush, and big sagebrush. Perennial grasses such as bush muhly, threeawn, and slim tridens and numerous annual grasses are also present. Among the most common perennial forbs present are globemallow, wirelettuce, fiddleneck, scorpion weed, hairy Bowlesia, and Indianwheat.

If this unit is used for irrigated crops, the main limitations are the hazards of flooding and soil blowing and the moderately high available water capacity. Surface, sprinkler, and trickle irrigation systems are

suiting to this unit. Maintaining crop residue on or near the surface reduces soil blowing and helps to maintain soil tilth and organic matter content. Keeping the soil surface moist helps to control soil blowing and thus reduces the risk of damage to young seedlings. Leveling the soil permits more efficient use of irrigation water. Properly designed and carefully installed diversions, dikes, channels, and levees can help to control flooding.

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

This unit is in capability subclasses IIw, irrigated, and VIIw, nonirrigated. It is in the Sandy Bottom, 7- to 10-inch p.z., range site.

**13—Dateland fine sandy loam.** This deep, well drained soil is on fan terraces and stream terraces. It formed in fan and stream alluvium derived from mixed sources. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is light yellowish brown fine sandy loam about 2 inches thick. The subsoil is light yellowish brown and strong brown fine sandy loam 13 inches thick. The next layer is strong brown very fine sandy loam 25 inches thick. The substratum to a depth of 60 inches or more is strong brown sandy loam.

Included in this unit are small areas of Antho, Denure, Gilman, and Valencia soils. Included areas make up about 10 percent of the total acreage.

Permeability of this Dateland soil is moderate. Available water capacity also is moderate. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. Areas of this unit on stream terraces are subject to rare periods of flooding during high-intensity summer storms and prolonged winter rains.

This unit is used for irrigated crops, rangeland, and homesite development.

If this unit is used for irrigated crops, it is limited mainly by the moderate available water capacity and the hazard of soil blowing. Surface, trickle, and sprinkler irrigation systems are suited to this unit. A cropping system that includes crop rotation and the incorporation of crop residue or other organic material into the soil helps to maintain soil tilth and fertility, helps to conserve moisture, reduces soil blowing, and increases the available water capacity. Leveling the soil permits more

efficient use of irrigation water. Areas subject to flooding can be protected by construction of properly designed dikes, diversions, or levees.

The potential native plant community on this unit is desertic shrubs, cacti, and a small percentage of annual and perennial grasses and forbs. The present vegetation is creosotebush, triangle bursage, annual grasses, and forbs.

If this unit is used for homesite development, the main limitation is the hazard of flooding. Protection from flooding can be provided by the use of diversions, dikes, or channels to divert the water. Construction of houses and access roads destroys the vegetation and leaves the surface unprotected and highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as possible helps to control soil blowing. Measures such as wrapping steel pipes and providing cathodic protection can be used to minimize corrosion of steel.

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

This unit is in capability class I, irrigated, and subclass VIIc, nonirrigated. It is in the Limy Fan, 7- to 10-inch p.z., range site.

**14—Dateland fine sandy loam, saline.** This unit is on relict basin floors. It formed in stream alluvium derived from mixed sources. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is light brown fine sandy loam about 2 inches thick. The subsoil is strong brown fine sandy loam 13 inches thick. The next layer is strong brown very fine sandy loam 25 inches thick. The substratum to a depth of 60 inches or more is strong brown sandy loam. The soil is moderately saline and strongly sodic throughout.

Included in this unit are small areas of Casa Grande soils. Included areas make up about 5 percent of the total acreage.

Permeability of this Dateland soil is moderate. Available water capacity is high. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. The content of toxic salts is high.

This unit is used for irrigated crops, rangeland, and homesite development.

If this unit is used for irrigated crops, it is limited

mainly by the content of toxic salts, the hazard of soil blowing, and the low available water capacity. Surface and drip irrigation systems are suited to this unit. Intensive management is needed to reduce the salinity and sodicity of the soil to the minimum needed to maintain soil productivity. In most cropland areas of this unit, the toxic salts have been leached, at least partially, to a depth of 3 to 5 feet. The content of toxic salts can be reduced and maintained at a lower level by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. A cropping system that includes crop rotation and the incorporation of crop residue or other organic material into the soil helps to maintain soil tilth and fertility, conserves moisture, reduces soil blowing, and increases the available water capacity. Leveling the soil permits more efficient use of irrigation water. If this soil is leveled for irrigation water management, the cuts and fills in places are as much as 5 feet deep. This exposes the underlying layers, which have a high content of lime, salts, and sodium, and thus reduces the water intake rate and restricts the use of nutrients by plants.

The potential native plant community is desert saltbush, fourwing saltbush, and numerous winter and summer annual grasses and forbs. The present vegetation is desert saltbush, seepweed, mound cactus, and Mediterraneangrass.

This unit is limited for homesite development by the high content of toxic salts. Construction of homes and access roads in places destroys the vegetation and leaves the surface unprotected and highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as possible helps to control soil blowing. Selection of salt-tolerant vegetation is critical for the establishment of lawns, shrubs, and trees. Measures such as wrapping steel pipes or using cathodic protection and chemically resistant concrete can minimize the corrosion of steel and concrete.

This unit is poorly suited to the production of desert herbaceous plants, shrubs, and trees that provide habitat for wildlife. It is also well suited to the production of irrigated grain and seed crops and domestic grasses and legumes.

This unit is in capability subclasses IIs, irrigated, and VIIs, nonirrigated. It is in the Saline Upland (loamy), 7- to 10-inch p.z., range site.

**15—Denure very gravelly sandy loam, 1 to 8 percent slopes.** This deep, somewhat excessively drained soil is on fan terraces. It formed in fan alluvium derived from mixed sources. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is light brown very gravelly sandy loam about 8 inches thick. The next 46 inches is light brown sandy loam and fine sandy loam. Below this to a depth of 60 inches or more is reddish brown sandy clay loam. Soft masses of lime are below a depth of about 19 inches.

Included in this unit are about 5 percent Tremant soils on the higher end of fan terraces and lower ridges, 5 percent Mohall soils on the lower end of fan terraces, and 2 percent Carrizo soils on flood plains.

Permeability of this Denure soil 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 slight. The hazard of soil blowing is slight.

This unit is used as rangeland.

The potential native plant community is a mixture of desert shrubs and trees with an understory of perennial grasses. The present vegetation is littleleaf paloverde, triangle bursage, white bursage, ratany, creosotebush, bush muhly, and a variety of cacti, annual grasses, and forbs.

This unit is poorly suited to the production of desert herbaceous plants, shrubs, and trees that provide habitat for wildlife.

This unit is in capability subclass VIIc, nonirrigated. It is in the Sandy Loam Upland, 7- to 10-inch p.z., range site.

**16—Denure sandy loam, 1 to 3 percent slopes.**

This deep, somewhat excessively drained soil is on fan terraces. It formed in fan alluvium derived from mixed sources. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is light brown sandy loam about 2 inches thick. The next 52 inches is light brown sandy loam and fine sandy loam. Below this to a depth of 60 inches or more is reddish brown sandy clay loam. This layer is 5 to 30 percent pebbles. A few soft masses of lime are below a depth of about 19 inches.

Included in this unit are small areas of Coolidge, Dateland, Momoli, and Valencia soils. Also included are small areas of soils that have a surface layer of gravelly sandy loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Denure soil 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 slight. The hazard of soil blowing is moderate.

This unit is used mainly as rangeland. It is also used for irrigated crops and homesite development.

The potential native plant community on this unit is desertic shrubs and cacti and a small percentage of annual and perennial grasses and forbs. The present vegetation is creosotebush, triangle bursage, and annual grasses and forbs.

If this unit is used for irrigated crops, it is limited mainly by the slope, the hazard of soil blowing, and the moderate available water capacity. Surface, sprinkler, and trickle irrigation systems are suited to this unit. If furrow or corrugation methods are used, the application of water should be on the contour or across the slope. Leveling the soil permits more efficient use of irrigation water. To avoid overirrigating and leaching of plant nutrients, applications of water should be adjusted to the available water capacity, the water intake rate, and the needs of the crop. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Keeping the soil surface moist helps to control soil blowing and thus reduces the risk of damage to young seedlings.

This soil has few limitations for homesite development. Construction of houses and access roads in places exposes soil material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as possible helps to control soil blowing. Plant cover can be established and maintained through proper fertilizing, seeding, mulching, and shaping of the slopes. Measures such as wrapping steel pipes and providing cathodic protection can be used to minimize the corrosion of steel.

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

This unit is in capability subclasses IIs, irrigated, and VIIs, nonirrigated. It is in the Limy Fan, 7- to 10-inch p.z., range site.

**17—Denure fine sandy loam, 0 to 1 percent slopes.** This deep, somewhat excessively drained soil is on stream terraces. It formed in stream alluvium derived from mixed sources. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is light brown fine sandy loam about 2 inches thick. The next 52 inches is light brown sandy loam and fine sandy loam. Below this to a depth of 60 inches or more is reddish brown sandy clay loam. Soft masses of lime are below a depth of about 19 inches.

Included in this unit are small areas of Coolidge,

Dateland, Gilman, and Valencia soils and small areas of soils that have a surface layer of sandy loam. Included areas make up about 15 percent of the total acreage.

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

This unit is used mainly for irrigated crops, rangeland, and homesite development.

If this unit is used for irrigated crops, it is limited mainly by the moderate available water capacity and the hazard of soil blowing. Surface, trickle, and sprinkler irrigation systems are suited to this unit. Leveling fields permits more efficient use of irrigation water. Applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the needs of the crop. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Keeping the soil surface moist helps to control soil blowing and thus reduces the risk of damage to young seedlings.

The potential native plant community on this unit is desertic shrubs and cacti and a small percentage of annual and perennial grasses and forbs. The present vegetation is creosotebush, triangle bursage, and annual grasses and forbs.

This unit has few limitations for homesite development. Construction of houses and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as possible helps to control soil blowing. Plant cover can be established and maintained by properly fertilizing, seeding, and mulching. Measures such as wrapping steel pipes and providing cathodic protection can be used to minimize the corrosion of steel.

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

This unit is in capability subclasses IIs, irrigated, and VIIs, nonirrigated. It is in the Limy Fan, 7- to 10-inch p.z., range site.

**18—Denure clay loam, 0 to 1 percent slopes.** This deep, somewhat excessively drained soil is on stream terraces. It formed in stream alluvium derived from mixed sources. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is light yellowish brown clay loam about 15 inches thick. The next 39 inches is light brown sandy loam and fine sandy loam. Below this to a depth of 60 inches or more is reddish brown sandy clay loam. Soft masses of lime are below a depth of about 19 inches. The clay loam texture of the surface layer has developed as a result of the accumulation of silt and clay carried in the irrigation water.

Included in this unit are small areas of Gilman, Marana, and Sasco soils. Included areas make up about 5 percent of the total acreage.

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

This unit is used for irrigated crops.

If this unit is used for irrigated crops, it is limited mainly by the moderate available water capacity. Surface, trickle, and sprinkler irrigation systems are suited to this unit. Applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the needs of the crop. Leveling the soil permits more efficient use of irrigation water. If land leveling cuts are to be made, onsite investigation is needed. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content.

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

This unit is in capability subclasses IIs, irrigated, and VIIs, nonirrigated. It is in the Limy Fan, 7- to 10-inch p.z., range site.

**19—Dumps-Pits association.** This unit is on a gently sloping fan terrace northwest of Casa Grande. The deposits of material have nearly level to gently sloping tops and very steep side slopes. They are deep and well drained. Elevation ranges from 1,350 to 1,500 feet.

This unit is about 59 percent stony, unprocessed overburden; 29 percent chemically treated mine tailings, or slickens; 11 percent open pit mine; and 1 percent slag dumps.

Dumps are characterized by the stony, unprocessed overburden that has been dumped near a pit mine. It consists of rock fragments blasted out of a pit mine to expose copper-bearing ore. The areas of chemically treated mine tailings are sedimentation basins for smelter wastes that are easily transported by water. This material resembles reddish brown sandy loam. The open pit mine is characterized by a series of benches

50 to 75 feet high in copper-ore producing rock. It is about 500 feet deep and 0.5 mile in diameter at the top. The slag dumps are areas where molten smelter refuse has been dumped. The refuse resembles solid black rock.

This unit is used for mining. The limited water supplying capacity of the material, the very steep slopes, the content of toxic chemicals, and the proximity of mining activities severely restrict this unit for other uses.

Overburden material and mine tailings should be investigated for stability and settlement before they are used as building sites. The low acidity of the material is also a concern. The overburden material and crushed slag can be used to fill in low areas to be used as sites for homes, streets, railroads, and flood control dikes.

This unit is not assigned a land capability classification or a range site.

**20—Gadsden clay.** This deep, well drained soil is on flood plains. It formed in fine textured stream alluvium derived from mixed sources. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is brown clay about 13 inches thick. The next 29 inches is brown clay. Below this to a depth of 60 inches or more is brown silty clay loam. The organic matter content is 1 percent to a depth of about 60 inches.

Included in this unit are small areas of Cashion, Pimer, and Ginland soils. Also included are small areas of soils that have a surface layer of silty clay. In the area south of the Casa Grande Mountains are soils that are similar to this Gadsden soil but have a high content of toxic salts. The included areas make up about 15 percent of the total acreage.

Permeability of this Gadsden soil is slow. Available water capacity is high. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight. This soil is occasionally flooded for brief periods in summer and winter. Penetration and distribution of roots are reduced by the dense clay at a depth of less than 60 inches.

This unit is used mainly for irrigated crops. Only small isolated areas are used as rangeland.

If this unit is used for irrigated crops, it is limited mainly by the slow water intake rate, the slow permeability, the density of the soil, and the hazard of flooding. Surface and trickle irrigation systems are suited to this unit. Because of the slow water intake rate and slow permeability of the soil in this unit, the period

of water application should be adjusted to permit adequate infiltration of water. Returning crop residue to the soil or regularly adding other organic material improves fertility, reduces crusting, and increases the water intake rate. Subsoiling when the soil is dry helps to loosen the dense substratum. Tillage can also be improved by returning crop residue to the soil. Properly designed and carefully installed channels, dikes, and levees can help to control flooding.

This unit is well suited to the production of irrigated grain and seed crops, irrigated domestic grasses and legumes, and desertic riparian herbaceous plants, shrubs, and trees.

This unit is in capability subclasses IIIw, irrigated, and VIIw, nonirrigated. It is in the Clay Bottom, 7- to 10-inch p.z., range site.

**21—Gilman fine sandy loam.** This deep, well drained soil is on flood plains and alluvial fans. It formed in stream alluvium derived from mixed sources. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is light yellowish brown fine sandy loam about 14 inches thick. Below this to a depth of 60 inches or more is pale brown very fine sandy loam and sandy loam with thin strata of finer and coarser textured soil material.

Included in this unit are small areas of Antho, Dateland, Denure, and Valencia soils. In areas near Toltec and La Palma and within 5 miles of the Sawtooth Mountains, the soils have a high content of toxic salts. Included areas make up about 15 percent of the total acreage.

Permeability of this Gilman soil is moderate. Available water capacity is moderately high. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. This soil is occasionally flooded for brief periods in summer and winter.

This unit is used mainly for irrigated crops. Some small areas are used as rangeland and for homesite development.

If this unit is used for irrigated crops, the main limitations are the hazards of flooding and soil blowing. Surface, trickle, and sprinkler irrigation systems are suited to this unit. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tillage and organic matter content. Keeping the soil surface moist helps to control soil blowing and thus reduces the risk of damage to young seedlings. Leveling the soil permits more efficient use of irrigation water. Properly designed and carefully

installed channels, dikes, and levees can help to control flooding.

The potential native plant community on this unit is a diverse mixture of perennial grasses and forbs, desertic trees and shrubs, and annual grasses. The present vegetation is paloverde, ironwood, mesquite, creosotebush, and big sagebrush. Perennial grasses such as bush muhly, threeawn, and slim tridens and numerous annual grasses are also present. Among the most common perennial forbs are globemallow, wirelettuce, fiddleneck, scorpion weed, hairy Bowlesia, and Indianwheat.

If this unit is used for homesite development, the main limitation is the hazard of flooding. Properly designed and carefully installed channels, dikes, and levees can be used to help control flooding.

Construction of houses and access roads in places exposes material that is susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as possible helps to control soil blowing. Plant cover can be established and maintained by properly fertilizing, seeding, and mulching. Measures such as wrapping steel pipes or using cathodic protection can be used to minimize the corrosion of steel.

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

This unit is in capability subclasses IIw, irrigated, and VIIw, nonirrigated. It is in the Loamy Bottom, 7- to 10-inch p.z., range site.

**22—Gilman clay loam.** This deep, well drained soil is on flood plains. It formed in stream alluvium derived from mixed sources. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is pale brown clay loam about 12 inches thick. Below this to a depth of 60 inches or more is pale brown very fine sandy loam and sandy loam with thin strata of finer and coarser textured soil material.

Included in this unit are small areas of Antho, Glenbar, and Pimer soils and small areas of soils that have a surface layer of very fine sandy loam and silt loam. Near Maricopa, Toltec, and La Palma and near the Sawtooth Mountains are areas of soils that are similar to this Gilman soil but have a high content of toxic salts. Included areas make up about 5 percent of the total acreage.

Permeability of this Gilman soil is moderate.

Available water capacity is high. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight. This unit is occasionally flooded in summer and winter for brief periods.

This unit is used for irrigated crops, rangeland, and homesite development.

If this unit is used for irrigated crops, the main limitation is the hazard of flooding. Surface and trickle irrigation systems are suited to this unit. Maintaining crop residue on or near the surface reduces runoff and helps to maintain soil tilth and organic matter content. Leveling the soil permits more efficient use of irrigation water. Properly designed and carefully installed channels, dikes, and levees can help to control flooding.

The potential native plant community on this unit is a diverse mixture of perennial grasses and forbs and annual grasses, forbs, and shrubs. The present vegetation is creosotebush, mesquite, globemallow, bush muhly, and a variety of annual grasses and forbs.

If this unit is used for homesite development, the main limitation is the hazard of flooding. Properly designed and carefully installed dikes and levees can be used to help control flooding. Measures such as wrapping steel pipes or providing cathodic protection can be used to minimize the corrosion of steel.

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

This unit is in capability subclasses 1lw, irrigated, and 7llw, nonirrigated. It is in the Loamy Bottom, 7- to 10-inch p.z., range site.

**23—Ginland clay.** This deep, well drained soil is on flood plains. It formed in fine textured stream alluvium deposited over older alluvium derived from mixed sources. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is brown clay about 13 inches thick. The subsurface layer is brown clay about 11 inches thick. Below this to a depth of 60 inches or more is strong brown and reddish yellow sandy clay loam. In some areas sandy clay loam is at a depth of 10 to 20 inches. Common soft masses of lime are below a depth of 26 to 40 inches.

Included in this unit are small areas of Cashion, Gadsden, Glenbar, and Trix soils. Also included are small areas of soils that have a surface layer of silty clay loam, clay loam, or silty clay. Included areas make

up about 5 percent of the total acreage.

Permeability of this Ginland soil is slow. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight. This soil is occasionally flooded for brief periods in summer and winter. It is nonsaline or slightly saline and slightly sodic or moderately sodic.

This unit is used for irrigated crops.

If this unit is used for irrigated crops, it is limited mainly by the slow water intake rate, the content of toxic salts, the slow permeability, and the hazard of flooding. Surface irrigation systems are suited to this unit. Because of the slow permeability of the soil in this unit, the period of water application should be adjusted to permit adequate infiltration of water. Returning crop residue to the soil or regularly adding other organic material improves fertility, reduces crusting, and increases the water intake rate. Tilth can also be improved by returning crop residue to the soil. Properly designed and carefully installed dikes and levees can help to control flooding. Applying enough water to leach salts and using soil amendments reduce the effect of the toxic salts.

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

This unit is in capability subclasses 1llw, irrigated, and 7llw, nonirrigated. It is not assigned a range site.

**24—Glenbar clay loam.** This deep, well drained soil is on flood plains. It formed in stream alluvium derived from mixed sources. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is light yellowish brown clay loam about 13 inches thick. Below this to a depth of 60 inches or more are light yellowish brown silt loam and silty clay loam and thin strata of finer and coarser textured soil material.

Included in this unit are small areas of Gilman, Pimer, and Trix soils. Also included are small areas of soils that have a surface layer of loam or silty clay loam. In the vicinity of Maricopa and the area between the Casa Grande and Sawtooth Mountains are small areas of soils that have a high content of toxic salts. Included areas make up about 15 percent of the total acreage.

Permeability of this Glenbar soil is moderately slow. Available water capacity is high. Potential rooting depth

is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight. This soil is occasionally flooded for brief periods in summer and winter.

This unit is used for irrigated crops, rangeland, and homesite development.

If this unit is used for irrigated crops, the main limitation is the hazard of flooding. Surface and trickle irrigation systems are suited to this unit. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Leveling the soil improves the efficiency of irrigation water management. Properly designed and carefully installed channels, dikes, and levees help to control flooding.

The potential native plant community on this unit is a mixture of perennial grasses and forbs, annual grasses and forbs, and scattered shrubs. The present vegetation is creosotebush, mesquite, globemallow, bush muhly, and a variety of annual grasses and forbs.

If this unit is used for homesite development, the main limitations are the hazard of flooding, the moderately slow permeability, and low soil strength. Properly designed and carefully installed channels, dikes, and levees can be used to help control flooding.

If this unit is used for septic tank absorption fields, the limitation of moderately slow permeability can be reduced by increasing the size of the absorption field. Constructing roads on raised, well compacted, coarse textured material and providing adequate side drains and culverts help to protect the roads from damage as a result of low soil strength. Measures such as wrapping steel pipes or providing cathodic protection can be used to minimize corrosion of steel.

Construction of houses and access roads in places exposes material that is highly susceptible to erosion. Preserving the existing plant cover or revegetating disturbed areas around construction sites as soon as possible helps to control erosion.

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

This unit is in capability subclasses 1lw, irrigated, and 7llw, nonirrigated. It is in the Loamy Bottom, 7- to 10-inch p.z., range site.

**25—Gunsight-Cipriano complex, 1 to 8 percent slopes.** This map unit is on fan terraces. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

This unit is 50 percent Gunsight very gravelly fine sandy loam and 40 percent Cipriano cobbly loam. The Gunsight soil is on the lower end of the terraces, and the Cipriano soil is on the higher end of the terraces. 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 about 2 percent Rock outcrop on mountain foot slopes, 5 percent Momoli soils on the lower end of fans and below the Gunsight soils, and 3 percent Carrizo soils along washes.

The Gunsight soil is deep and somewhat excessively drained. It formed in very gravelly fan alluvium derived from mixed sources. Slope is 2 to 6 percent. Typically, the surface layer is light brown very gravelly fine sandy loam about 3 inches thick. The next layer is pink gravelly loam 9 inches thick. Below this to a depth of 60 inches or more is calcareous, light brown very gravelly loam. The depth to a layer of lime accumulation ranges from 10 to 20 inches.

Permeability of the Gunsight soil 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 slight. The hazard of soil blowing is slight. This soil is slightly saline throughout and is moderately sodic or strongly sodic below a depth of 30 inches.

The Cipriano soil is very shallow and shallow and is somewhat excessively drained. It formed in very gravelly and cobbly fan alluvium derived from mixed sources. Slope is 1 to 8 percent. Typically, 10 to 20 percent of the surface is covered with cobbles and pebbles. The surface layer is very pale brown cobbly loam about 2 inches thick. Below this is light brown very gravelly loam about 7 inches thick. An indurated silica-cemented hardpan is at a depth of 9 inches. The depth to the hardpan ranges from 8 to 20 inches.

Permeability of the Cipriano soil is moderate. Available water capacity is very low. Potential rooting depth is 8 to 20 inches. Runoff is medium, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as rangeland.

The potential native plant community on this unit is shrubs and cacti. The present vegetation is creosotebush, bursage, fluffgrass, threeawn, a number of annual grasses, and forbs. Various perennial trees, shrubs, half-shrubs, succulents, and woody vines are also present.

The soils in this unit are poorly suited to the production of desertic herbaceous plants, shrubs, and trees that provide habitat for wildlife.

This map unit is in capability subclass VII. It is in the Limy Upland, 7- to 10-inch p.z., range site.

**26—Gunsight-Pinamt complex, 1 to 8 percent slopes.** This map unit is on fan terraces. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

This unit is 57 percent Gunsight very gravelly fine sandy loam and 30 percent Pinamt very gravelly loam. The Gunsight soil is on the lower end of the fan terraces, and the Pinamt soil is on the higher end of the fan terraces. 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 about 5 percent Coolidge soils on the lower end of the fan terraces, 3 percent Tremant soils on the higher end of the fan terraces, and 5 percent Momoli soils adjacent to the washes.

The Gunsight soil is deep and somewhat excessively drained. It formed in very gravelly fan alluvium derived from mixed sources. Slope is 1 to 5 percent. Typically, the surface layer is light brown very gravelly fine sandy loam about 3 inches thick. The next layer is pink gravelly loam 9 inches thick. Below this to a depth of 60 inches or more is calcareous, light brown very gravelly loam. The depth to a layer of lime accumulation ranges from 10 to 20 inches.

Permeability of the Gunsight soil 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 slight. The hazard of soil blowing is slight. This soil is slightly saline throughout and is moderately sodic or strongly sodic below a depth of 30 inches.

The Pinamt soil is deep and well drained. It formed in alluvium derived from mixed sources. Slope is 1 to 8 percent. Typically, 30 to 60 percent of the surface is covered with desert-varnished pebbles. The surface layer is light brown very gravelly loam about 2 inches thick. The subsoil is yellowish red, reddish brown, and light reddish brown very gravelly clay loam and very gravelly sandy clay loam about 21 inches thick. Below this to a depth of 60 inches or more is light brown extremely gravelly sandy loam and very gravelly sandy loam. Soft masses of lime are present beginning at a depth of about 7 inches.

Permeability of the Pinamt soil 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 slight. The hazard of soil blowing is slight.

This unit is used as rangeland.

The potential native plant community on the Gunsight soil is desert shrubs, cacti, and a sparse stand of annual and perennial grasses and forbs. Triangle

bursage and creosotebush are the dominant plants currently growing on this soil. The Pinamt soil has a slightly higher potential for producing perennial grasses, desert shrubs, and cacti than does the Gunsight soil. The present vegetation on the Pinamt soil is triangle bursage, creosotebush, paloverde, brittlebush, and fluffgrass.

The high lime content of the soils and the low precipitation are the main limitations for forage production on this unit.

The soils in this unit are poorly suited to the production of desert herbaceous plants, shrubs, and trees that provide habitat for wildlife.

This map unit is in capability subclass VIIIs. It is in the Limy Upland, 7- to 10-inch p.z., range site.

**27—La Palma fine sandy loam.** This moderately deep, well drained soil is on relict basin floors. It formed in loamy eolian material and stream alluvium derived from mixed sources. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is pale brown fine sandy loam about 3 inches thick. The next layer is pink, pinkish white, and pinkish gray, very strongly alkaline loam and clay loam 25 inches thick. An indurated lime-cemented hardpan is at a depth of 28 inches. Depth to the hardpan ranges from 20 to 40 inches.

Included in this unit are small areas of Casa Grande, Laveen, and Toltec soils and small areas of soils that have a surface layer of clay loam or loam. Included areas make up about 5 percent of the total acreage.

Permeability of this La Palma soil is slow. Available water capacity is low. Potential rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. It is moderately sodic or strongly sodic and slightly saline or moderately saline.

This unit is used for irrigated crops, rangeland, and homesite development.

If this unit is used for irrigated crops, it is limited mainly by the restricted rooting depth, the hazard of soil blowing, the low available water capacity, and the content of toxic salts. Surface, sprinkler, and trickle irrigation systems are suited to this unit. To avoid overirrigating and to provide for leaching of toxic salts, applications of irrigation water should be adjusted to the available water capacity, the leaching requirement, the water intake rate, and the needs of the crop grown. Because of the depth to the hardpan and the slow permeability of the soil, the application of water should be regulated so that water does not stand on the

surface and damage the crops. Where feasible, deep ripping of the cemented pan reduces the limitation of restricted rooting depth. Intensive management is needed to reduce the salinity and alkalinity of the soil and to maintain productivity. The content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Leveling the soil permits more efficient use of irrigation water. If land leveling cuts are to be made, onsite investigation is needed.

The potential native plant community on this unit is desert saltbush, fourwing saltbush, and a sparse understory of annual grasses and forbs. The present vegetation is desert saltbush, seepweed, mesquite, and hedgehog cactus.

If this unit is used for homesite development, the main limitations are the depth to a cemented pan, the content of toxic salts, the moderate shrink-swell potential, and low soil strength. Excavation for building sites is limited by the depth to the cemented pan. Because of the increased cost of excavating the cemented pan, buildings that are designed with minimal requirements for excavation are better suited to this unit. Landscaping should be designed to drain surface water away from buildings. This can reduce the possibility of damage caused by the moderate shrink-swell potential, salt content, and low soil strength. Tile drains constructed around the foundation are needed in some places where excess water becomes perched above the cemented pan.

Buildings and roads should be designed to offset the effects of shrinking and swelling and the limited ability of the soil to support a load. Backfilling foundations with well compacted, coarse textured soil material can reduce the adverse effects that shrinking and swelling and low soil strength can have on buildings and roads. Wrapping steel pipes or using cathodic protection and chemically resistant concrete can minimize corrosion of steel and concrete.

If this unit is used for septic tank absorption fields, the limitations of the depth to the cemented pan and the slow permeability are difficult to overcome. Placing tile drains below the pan and in more permeable soil material helps to overcome these limitations.

Construction of buildings and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as possible helps to control soil blowing. Plant cover can be established and maintained through proper fertilizing, seeding, and mulching.

This unit is poorly suited to the production of desert herbaceous plants, shrubs, and trees that provide habitat for wildlife. It is moderately well suited to the production of irrigated grain and seed crops and domestic grasses and legumes.

This unit is in capability subclasses IIIs, irrigated, and VIIs, nonirrigated. It is in the Saline Upland (loamy), 7- to 10-inch p.z., range site.

**28—Laveen loam.** This deep, well drained soil is on stream terraces and fan terraces. It formed in stream and fan alluvium derived from mixed sources. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is light brown loam about 15 inches thick. The next layer is pink, calcareous loam about 15 inches thick. The next layer is pinkish gray, limy very fine sandy loam about 12 inches thick. Below this to a depth of 60 inches or more is pink, limy gravelly fine sandy loam. A layer of lime accumulation is at a depth of 14 to 30 inches.

Included in this unit are small areas of Coolidge, Gilman, and Toltec soils. Also included are small areas of soils that have a surface layer of fine sandy loam, very fine sandy loam, or clay loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Laveen soil is moderate. Available water capacity is moderately high. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight. This soil is slightly saline throughout and is moderately sodic below a depth of 30 inches.

This unit is used for irrigated crops, rangeland, and homesite development.

If this unit is used for irrigated crops, the main limitations are the moderately high available water capacity, the moderate content of toxic salts, and the high content of lime. Surface, trickle, and sprinkler irrigation systems are suited to this unit. The content of lime can cause a nutrient imbalance in some plants, which results in iron chlorosis. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. To avoid overirrigating and to provide for leaching of toxic salts, applications of irrigated water should be adjusted to the available water capacity, the leaching requirement, the water intake rate, and the needs of the crop grown. Soil amendments applied according to soil tests reduce the effects of toxic salts.

The potential native plant community is desert shrubs and cacti and a small percentage of annual and perennial grasses and forbs. The present vegetation is

creosotebush, triangle bursage, and annual grasses and forbs.

If this unit is used for homesite development, the main limitations are the potential for settlement as a result of the wetting of the limy underlying layer and content of toxic salts. The possibility of settlement can be reduced by compacting the building site before construction and by diverting water away from buildings. Measures such as use of corrosion resistant concrete and wrapping and providing cathodic protection for steel pipes can be used to minimize the corrosive effects of the salts. Construction of houses and access roads in places exposes material that is highly susceptible to soil blowing. Preserving the existing plant cover and revegetating disturbed areas during construction help to control erosion and soil blowing. Lawn grasses, shrubs, and trees that are not sensitive to lime-induced chlorosis are well suited to use in landscaping. An annual application of iron chelates helps to reduce chlorosis caused by the high lime content.

This unit is poorly suited to the production of desertic herbaceous plants, shrubs, and trees that provide habitat for wildlife. It is well suited to the production of irrigated grain and seed crops and domestic grasses and legumes.

This unit is in capability class I, irrigated, and subclass VIIc, nonirrigated. It is in the Limy Fan, 7- to 10-inch p.z., range site.

**29—Marana silty clay loam.** This deep, well drained soil is on stream terraces. It formed in stream alluvium derived from mixed sources. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is yellowish brown silty clay loam about 2 inches thick. Below this to a depth of 60 inches or more is brown silty clay loam.

Included in this unit are small areas of Saminiego and Sasco soils. Also included are areas that are dissected by gullies. Included areas make up about 10 percent of the total acreage.

Permeability of this Marana soil is moderately slow. Available water capacity is high. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. This soil is subject to rare, very brief periods of flooding in summer and winter.

This unit is used for irrigated crops, rangeland, and homesite development.

If this unit is used for irrigated crops, it has few limitations. Surface and trickle irrigation systems are suited to this unit. Crop rotation and the incorporation of

crop residue into the soil or the regular addition of other organic material improve fertility, reduce crusting, and increase the water intake rate and available water capacity. Leveling the soil permits more efficient use of irrigation water.

The potential native plant community on this unit is perennial grasses and forbs, annual grasses and forbs, and shrubs. The present vegetation is creosotebush, mesquite, globemallow, bush muhly, and a variety of annual grasses and forbs.

Forage production can be improved by using erosion control measures, managing brush, fencing, and developing watering facilities. This unit responds well to management practices, such as deferred grazing and planned grazing systems.

If this unit is used for homesite development, the main limitations are the hazard of flooding, the moderate shrink-swell potential, and low soil strength. Properly designed and carefully installed diversions, dikes, and levees can be used to help control flooding. All structures are subject to piping. Buildings and roads should be designed to offset the effects of shrinking and swelling and the limited ability of the soil to support a load. Overexcavating and backfilling the foundation of buildings with suitable coarse textured fill material can reduce structural damage caused by shrinking and swelling and low soil strength. Designing buildings and landscaping so that runoff water is drained away from the foundation also reduces damage caused by shrinking and swelling and low soil strength. Measures such as wrapping steel pipes and providing cathodic protection can be used to minimize corrosion of steel.

If this unit is used for septic tank absorption fields, the limitation of moderately slow permeability can be reduced by increasing the size of the absorption field.

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

This unit is in capability class I, irrigated, and subclass VIIc, nonirrigated. It is in the Loamy Upland, 7- to 10-inch p.z., range site.

**30—Mohall sandy loam.** This deep, well drained soil is on fan terraces and relict basin floors. It formed in fan alluvium derived from mixed sources. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is light brown sandy loam about 16 inches thick. The subsoil is light brown sandy clay loam 27 inches thick. The substratum to a depth of

60 inches or more is pink sandy loam. Soft masses of lime are in the lower part of the subsoil.

Included in this unit are small areas of Casa Grande, Denure, Laveen, and Valencia soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Mohall soil is moderately slow. Available water capacity is high. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

This unit is used as irrigated cropland, as rangeland, and for homesite development.

If this unit is used for irrigated crops, soil blowing is the only limitation. Surface, sprinkler, and trickle irrigation systems are suited to this unit. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Keeping the soil surface moist helps to control soil blowing and reduces the risk of damage to young seedlings. Leveling the soil permits more efficient use of irrigation water. If this unit is leveled for irrigation water management, the cuts and fills in places are as much as 5 feet deep, which exposes a layer that has a high content of lime below a depth of about 20 inches and is slightly sodic below a depth of 4 feet.

The potential native plant community on this unit is desertic shrubs and trees with an understory of perennial grasses. The present vegetation is littleleaf paloverde, triangle bursage, white bursage, ratany, creosotebush, bush muhly, and a variety of cacti and annual grasses and forbs.

If this unit is used for homesite development, the main limitations are the moderately slow permeability, the shrink-swell potential, and low soil strength. Buildings and roads should be designed to offset the effects of shrinking and swelling and the limited ability of the soil to support a load. Overexcavating and backfilling the foundation of buildings with suitable coarse textured fill material can reduce structural damage caused by shrinking and swelling and low soil strength. Designing buildings and landscaping so that runoff water is drained away from the foundation also reduces damage from shrinking and swelling and low soil strength. Measures such as wrapping steel pipes and providing cathodic protection can be used to minimize corrosion of steel.

If this soil is used for septic tank absorption fields, the limitation of moderately slow permeability can be reduced by increasing the size of the absorption field.

Construction of houses and access roads in places exposes soil material that is highly susceptible to soil blowing. Preserving the existing plant cover during construction helps to control erosion. Revegetating

disturbed areas around construction sites as soon as possible helps to control soil blowing. Plant cover can be established and maintained through proper fertilizing, seeding, and mulching.

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

This unit is in capability class I, irrigated, and subclass VIIc, nonirrigated. It is in the Sandy Loam Upland, 7- to 10-inch p.z., range site.

**31—Mohall loam.** This deep, well drained soil is on fan terraces. It formed in fan alluvium derived from mixed sources. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is light brown loam about 18 inches thick. The next layer is light brown clay loam about 26 inches thick. Below this to a depth of 60 inches or more is pink sandy loam. Soft masses of lime are in the lower part of the subsoil.

Included in this unit are small areas of Casa Grande and Trix soils. Included areas make up about 15 percent of the total acreage.

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

This unit is used for irrigated crops, as rangeland, and for homesite development.

If this unit is used for irrigated crops, it has few limitations. Surface and trickle irrigation systems are suited to this unit. Maintaining crop residue on or near the surface reduces runoff and helps to maintain soil tilth and organic matter content. Leveling the soil permits more efficient use of irrigation water. If this soil is leveled for irrigation water management, the cuts and fills in places are as much as 5 feet deep. This exposes a layer that has a high content of lime below a depth of about 20 inches and soil that is slightly sodic below a depth of 4 feet.

The potential native plant community is an overstory of desertic trees and shrubs with an understory of perennial and annual grasses and forbs. The present vegetation is creosotebush, triangle bursage, mesquite, bush muhly, and a variety of cacti and annual grasses and forbs.

If this unit is used for homesite development, the main limitations are the moderately slow permeability,

the shrink-swell potential, and low soil strength. Buildings and roads should be designed to offset the effects of shrinking and swelling and the limited ability of the soil to support a load. Overexcavating and backfilling the foundation of buildings with suitable coarse textured fill material can reduce structural damage caused by shrinking and swelling and low soil strength. Designing buildings and landscaping so that runoff water is drained away from the foundation also reduces damage caused by shrinking and swelling and low soil strength. Measures such as wrapping steel pipes and providing cathodic protection can be used to minimize corrosion of steel.

If this unit is used for septic tank absorption fields, the limitation of moderately slow permeability can be reduced by increasing the size of the absorption field.

Construction of houses and access roads in places exposes soil material that is highly susceptible to soil blowing. Preserving the existing plant cover during construction helps to control erosion. Revegetating disturbed areas around construction sites as soon as possible helps to control soil blowing. Plant cover can be established and maintained through proper fertilizing, seeding, and mulching.

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

This unit is in capability class I, irrigated, and subclass VIIc, nonirrigated. It is in the Loamy Upland, 7- to 10-inch p.z., range site.

**32—Mohall clay loam.** This deep, well drained soil is on fan terraces and relict basin floors. It formed in fan alluvium derived from mixed sources. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is light brown clay loam about 16 inches thick. The next layer is light brown sandy clay loam 27 inches thick. Below this to a depth of 60 inches or more is sandy loam. Soft masses of lime are in the lower part of the subsoil and in the substratum.

Included in this unit are small areas of Casa Grande and Trix soils. Included areas make up about 10 percent of the total acreage.

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

This unit is used for irrigated crops, rangeland, and homesite development.

If this unit is used for irrigated crops, it has few limitations. Surface and trickle irrigation systems are suited to this unit. Maintaining crop residue on or near the surface reduces runoff and helps to maintain soil tilth and organic matter content. Leveling the soil permits more efficient use of irrigation water. If this unit is leveled for irrigation water management, the cuts and fills are as much as 5 feet deep in some areas, which exposes a layer that has a high content of lime below a depth of about 20 inches.

The potential native plant community is desertic trees and shrubs with an understory of perennial and annual grasses and forbs. The present vegetation is creosotebush, triangle bursage, mesquite, bush muhly, and a variety of cacti and annual grasses and forbs.

If this unit is used for homesite development, the main limitations are the moderately slow permeability, the shrink-swell potential, and low soil strength.

Buildings and roads should be designed to offset the effects of shrinking and swelling and the limited ability of the soil to support a load. Overexcavating and backfilling the foundation of buildings with suitable coarse textured fill material can reduce structural damage caused by shrinking and swelling and low soil strength. Designing buildings and landscaping so that runoff water is drained away from the foundation also reduces damage caused by shrinking and swelling and low soil strength. Measures such as wrapping steel pipes and providing cathodic protection can be used to minimize corrosion of steel.

If this unit is used for septic tank absorption fields, the limitation of moderately slow permeability can be reduced by increasing the size of the absorption field.

Construction of houses and access roads in places exposes soil material that is susceptible to soil blowing. Preserving the existing plant cover during construction helps to control erosion. Revegetating disturbed areas around construction sites as soon as possible helps to control soil blowing. Plant cover can be established and maintained through proper fertilizing, seeding, and mulching.

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

This unit is in capability class I, irrigated, and subclass VIIc, nonirrigated. It is in the Clay Loam Upland, 7- to 10-inch p.z., range site.

**33—Mohall-Denure association.** This map unit is on fan terraces. Elevation is 1,140 to 2,000 feet. Slope is 1

to 3 percent. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

This unit is 45 percent Mohall sandy loam and 45 percent Denure sandy loam.

Included in this unit is about 10 percent Carrizo and Valencia soils along drainageways.

The Mohall soil is deep and well drained. It formed in fan alluvium derived from mixed sources. Typically, the surface layer is light brown sandy loam about 16 inches thick. The next layer is light brown sandy clay loam about 27 inches thick. Below this to a depth of 60 inches or more is pink sandy loam. Soft masses of lime are at a depth of 24 to 40 inches.

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

The Denure soil is deep and somewhat excessively drained. It formed in fan alluvium derived from mixed sources. Typically, the surface layer is light brown sandy loam about 2 inches thick. The next 52 inches is light brown sandy loam and fine sandy loam. Below this to a depth of 60 inches or more is reddish brown sandy clay. The lower layer is 5 to 30 percent pebbles. Soft masses of lime are below a depth of about 19 inches.

Permeability of the Denure soil 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 slight. The hazard of soil blowing is moderate.

This unit is used as rangeland.

The potential native plant community is desertic shrubs and trees with an understory of perennial grasses. The present vegetation is littleleaf paloverde, triangle bursage, white bursage, ratany, creosotebush, bush muhly, and a variety of cacti and annual grasses and forbs.

This unit is moderately well suited to the production of desertic herbaceous plants, shrubs, and trees that provide habitat for wildlife.

This map unit is in capability subclass VIIc. It is in the Sandy Loam Upland, 7- to 10-inch p.z., range site.

**34—Momoli-Carrizo complex, 1 to 8 percent slopes.** This map unit is on fan terraces and flood plains. Elevation is 1,140 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

This unit is 60 percent Momoli very gravelly fine sandy loam and 20 percent Carrizo very gravelly fine

sandy loam. The Momoli soil is on the fan terraces, and the Carrizo soil is on the flood plains. 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 about 13 percent Antho, Dateland, and Denure soils on the lower end of fans, 4 percent Pinamt soils on the higher end of terraces, and 3 percent Tremant soils near the Pinamt soils on the higher end of terraces.

The Momoli soil is deep and somewhat excessively drained. It formed in very gravelly fan alluvium derived from mixed sources. Slope is 1 to 8 percent. Typically, 15 to 30 percent of the surface is covered with fine pebbles. The surface layer is light brown very gravelly fine sandy loam about 2 inches thick. The next layer is very gravelly sandy loam about 32 inches thick. Below this to a depth of 60 inches or more is light brown very gravelly loamy sand.

Permeability of the Momoli soil is moderately rapid. 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 soil blowing is slight. This soil is slightly saline.

The Carrizo soil is deep and excessively drained. It formed in very gravelly, coarse textured stream and fan alluvium derived from mixed sources. Slope is 1 to 5 percent. Typically, 30 to 50 percent of the surface is covered with fine pebbles. The surface layer is light yellowish brown very gravelly fine sandy loam about 5 inches thick. Below this to a depth of 60 inches or more is light yellowish brown and brown very gravelly coarse sand and extremely gravelly coarse sand.

Permeability of the Carrizo soil is very rapid. 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 soil blowing is slight. The soil is subject to occasional, brief periods of flooding in summer and winter.

This unit is used mainly as rangeland.

The potential native plant community on the Momoli soil is desertic shrubs, cacti, and annual and perennial grasses and forbs (fig. 2). The present vegetation on this soil is creosotebush, paloverde, triangle bursage, various cacti, seasonal grasses, and forbs.

Along the numerous small drainageways, the Carrizo soil produces desertic trees, shrubs, and a thick understory of perennial grasses and forbs. Dominant plants along the drainageways include ironwood, littleleaf paloverde, wolfberry, globemallow, threeawn, and a wide variety of annual and perennial grasses and forbs. The Carrizo soil receives runoff from adjacent areas, which increases its productivity.

The Momoli soil is well suited to the production of desertic herbaceous plants, shrubs, and trees that



Figure 2.—Typical area of Momoli very gravelly fine sandy loam in the Momoli-Carrizo complex, 1 to 8 percent slopes.

provide habitat for wildlife. The Carrizo soil is well suited to the production of desertic riparian herbaceous plants, shrubs, and trees.

The Momoli soil is in capability subclass VIIc, and the Carrizo soil is in capability subclass VIIw. The Momoli soil is in the Limy Fan, 7- to 10-inch p.z., range site, and the Carrizo soil is in the Sandy Bottom, 7- to 10-inch p.z., range site.

**35—Pajarito-Sonoita complex.** This map unit is on fan terraces. Slope is 1 to 3 percent. Elevation is 2,000 to 3,600 feet. The average annual precipitation is 10 to 12 inches, the average annual air temperature is 64 to 68 degrees F, and the average frost-free period is 180 to 240 days.

This unit is 50 percent Pajarito gravelly sandy loam and 30 percent Sonoita sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of soils that have a surface layer of gravelly fine sandy loam or sandy

loam. Also included are small areas of sandy alluvial soils in drainageways. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Pajarito soil is deep and somewhat excessively drained. It formed in fan alluvium derived from mixed sources. Typically, the surface layer is light yellowish brown gravelly sandy loam about 2 inches thick. The next 21 inches is light brown fine sandy loam and gravelly fine sandy loam over light yellowish brown gravelly loam 8 inches thick. Below this to a depth of 60 inches or more is light yellowish brown loam.

Permeability of the Pajarito soil 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 moderate. The hazard of soil blowing is moderate.

The Sonoita soil is deep and somewhat excessively drained. It formed in fan alluvium derived from mixed sources. Typically, the surface layer is light yellowish brown sandy loam about 2 inches thick. The subsoil is

strong brown sandy loam and strong brown and light brown loam 42 inches thick. The substratum to a depth of 60 inches or more is light brown sandy clay loam. This soil is moderately alkaline and noneffervescent in the upper 16 inches and is slightly effervescent below this depth.

Permeability of the Sonoita soil is moderately rapid. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

This unit is used as rangeland.

The potential native plant community is Arizona cottontop, sand dropseed, and grama. The present vegetation is paloverde, creosotebush, mesquite, burroweed, triangle bursage, and annual grasses and forbs.

This unit is well suited to the production of desertic herbaceous plants suitable for wildlife habitat. It is moderately well suited to the production of desertic shrubs and trees.

This map unit is in capability subclass VII<sub>s</sub>. The Pajarito soil is in the Deep Sandy Loam, 10- to 12-inch p.z., range site, and the Sonoita soil is in the Sandy Loam Upland, 10- to 12-inch p.z., range site.

**36—Pimer silty clay.** This deep, well drained soil is on flood plains. It formed in recent alluvium derived from mixed sources. Elevation is 1,140 to 2,000 feet. Slope is 0 to 1 percent. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is grayish brown silty clay about 15 inches thick. The next 12 inches is grayish brown silty clay loam. Below this to a depth of 60 inches or more is pale brown silt loam. Thin strata of finer and coarser textured soil material are common below a depth of 15 inches.

Included in this unit are small areas of Cashion, Gilman, and Glenbar soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Pimer soil is moderately slow. Available water capacity is high. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight. This soil is subject to occasional, brief periods of flooding in summer and winter.

This unit is used for irrigated crops and as rangeland.

If this unit is used for irrigated crops, it is limited mainly by the slow water intake rate, the moderately slow permeability, and the hazard of flooding. Surface and trickle irrigation systems are suited to this unit. Because of the slow water intake rate and moderately

slow permeability of the soil in this unit, the period of water application should be adjusted to permit adequate infiltration of water. Returning crop residue to the soil or regularly adding other organic material improves fertility, reduces crusting, and increases the water intake rate. Leveling the soil permits more efficient use of irrigation water. Properly designed and carefully installed dikes and levees can help to control flooding.

The potential native plant community is perennial grasses, shrubs, and cacti. The present vegetation is mesquite, bermudagrass, globemallow, and annual grasses and forbs.

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

This unit is in capability subclasses II<sub>w</sub>, irrigated, and VII<sub>w</sub>, nonirrigated. It is in the Clay Bottom, 7- to 10-inch p.z., range site.

**37—Pinamt-Momoli complex, 1 to 8 percent slopes.** This map unit is on fan terraces. Elevation is 1,200 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

This unit is 50 percent Pinamt very gravelly loam and 30 percent Momoli very gravelly fine sandy loam. The Pinamt soil is on the higher part of fan terraces, and the Momoli soil is on the lower part of fan terraces. 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 Carrizo soils along drainageways and Mohall and Tremant soils on the lower terraces. Included areas make up about 20 percent of the total acreage.

The Pinamt soil is deep and well drained. It formed in very gravelly fan alluvium derived from mixed sources. Slope is 1 to 8 percent. Typically, 40 to 70 percent of the surface is covered with desert varnished pebbles. The surface layer is light brown very gravelly loam about 2 inches thick. The subsoil is yellowish red and light reddish brown very gravelly clay loam and very gravelly sandy clay loam 21 inches thick. Below this to a depth of 60 inches or more is light brown very gravelly sandy loam and extremely gravelly sandy loam. Soft masses of lime are at a depth of about 10 inches.

Permeability of the Pinamt soil 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 slight. The hazard of soil blowing is slight.

The Momoli soil is deep and somewhat excessively drained. It formed in very gravelly fan alluvium derived from mixed sources. Slope is 1 to 5 percent. Typically, 30 to 40 percent of the surface is covered with pebbles. The surface layer is light brown very gravelly fine sandy loam about 2 inches thick. The next 32 inches is light brown very gravelly sandy loam. Below this to a depth of 60 inches or more is light brown very gravelly loamy sand.

Permeability of the Momoli soil is moderately rapid. 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 soil blowing is slight.

This unit is used mainly as rangeland.

The potential native plant community on the Pinamt soil is perennial grasses, desertic shrubs, and cacti. The present vegetation is triangle bursage, creosotebush, paloverde, brittlebush, fluffgrass, and buckhorn cholla.

The potential native plant community on the Momoli soil is desertic shrubs, cacti, and annual and perennial grasses and forbs. The present vegetation is creosotebush, triangle bursage, white bursage, bush muhly, and annual grasses and forbs.

This unit is poorly suited to the production of desertic herbaceous plants, shrubs, and trees that provide habitat for wildlife.

This map unit is in capability subclass VII. The Pinamt soil is in the Limy Upland, 7- to 10-inch p.z., range site, and the Momoli soil is in the Limy Fan, 7- to 10-inch p.z., range site.

**38—Pits.** This map unit consists of borrow pits or areas where the upper part of the soil has been removed. Some areas were used as a source of fill material during the construction of Interstate Highways 8 and 10. Fill material from these pits was also used for the Pinal Air Park and some local building sites. The borrow pits are 3 to 45 feet deep and 5 to 95 acres in size.

Some of the borrow pits are deep enough to be used as sites for sanitary landfills; however, geology of the site and the condition of the ground water must be considered.

This unit provides some wildlife habitat in areas where the pits intercept runoff from the surrounding areas. These areas are intermittently filled with water, which provides better growing conditions for grasses, shrubs, and trees that can be used as cover and food for wildlife.

Some of the shallower pits have been used for livestock watering tanks in areas of rangeland. These borrow pits receive tailwater runoff intermittently from

the surrounding areas or water from natural drainageways is diverted into them.

Areas of this unit can be graded or filled and reclaimed for farming or for urban use.

This unit is not assigned a land capability classification or a range site.

**39—Quilotosa-Rock outcrop complex, 5 to 60 percent slopes.** This map unit is on hillslopes and mountain slopes. Elevation is 1,200 to 3,200 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

This unit is 50 percent Quilotosa extremely stony loam and 35 percent Rock outcrop. The Quilotosa soil is on the less sloping parts of granite hills. The Rock outcrop is in the steeper areas and on the higher peaks. 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 Carrizo soils in washes, Denure soils on the lower end of fans, and Momoli soils on the lower slopes and above the Denure soils. Also included are Vaiva soils in small pockets on benches and behind rocks, where the slopes are more stable. Included areas make up about 15 percent of the total acreage.

The Quilotosa soil is very shallow and shallow and is somewhat excessively drained. It formed in eolian material and in slope alluvium derived dominantly from granite and gneiss. Typically, 50 to 80 percent of the surface is covered with pebbles, cobbles, stones, and boulders. The surface layer is pale brown extremely stony loam about 2 inches thick. The next 8 inches is brown extremely gravelly sandy loam. Below this to a depth of 18 inches is soft, weathered granite. Unweathered granite is at a depth of 18 inches.

Permeability of the Quilotosa soil is moderately rapid. Available water capacity is very low. Potential rooting depth is 4 to 20 inches. Runoff is medium, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

Rock outcrop consists of exposed areas of granite with small areas of schist and rhyolite.

Most areas of this unit are used as rangeland.

The potential native plant community is desertic shrubs with an understory of perennial and annual grasses and forbs. The present vegetation is littleleaf paloverde, brittlebush, slim tridens, threeawn, and other forbs, grasses, cacti, and shrubs.

This unit is poorly suited to the production of desertic herbaceous plants suitable for wildlife habitat. It is moderately well suited to the production of desertic shrubs and trees.

The Quilotosa soil is in capability subclass VII<sub>s</sub> and in the Granitic Hills, 7- to 10-inch p.z., range site. Rock outcrop is not assigned a land capability classification or a range site.

**40—Rositas loamy fine sand.** This deep, somewhat excessively drained soil is on dunes. It formed in eolian sand derived from mixed alluvium. Elevation is 1,140 to 2,000 feet. Slope is 1 to 3 percent. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is light brown loamy fine sand about 2 inches thick. Below this to a depth of 60 inches or more is light brown loamy sand.

Included in this unit are small areas of Antho and Gilman soils. Also included are a few small areas of soils that have a surface layer of fine sandy loam or sandy loam. Included areas make up about 5 percent of the total acreage.

Permeability of this Rositas soil is rapid. Available water capacity is low. Potential rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

This unit is used as rangeland and irrigated cropland.

The potential native plant community is a mixture of perennial and annual grasses, forbs, and desertic shrubs. Big galleta is the dominant plant.

If this unit is used for irrigated crops, it is limited mainly by the low available water capacity and the hazard of soil blowing. Trickle or sprinkler irrigation systems are best suited to this unit. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the needs of the crop. Maintaining crop residue on or near the surface reduces soil blowing and helps to maintain soil tilth and organic matter content. Keeping the soil surface moist helps to control soil blowing and thus reduces the risk of damage to young seedlings.

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

This unit is in capability subclasses III<sub>s</sub>, irrigated, and VII<sub>s</sub>, nonirrigated. It is in the Sandy Upland, 7- to 10-inch p.z., range site.

**41—Saminiego silty clay loam.** This deep, well drained soil is on stream terraces. It formed in fine textured stream alluvium deposited over older alluvium

derived from mixed sources. Elevation is 1,140 to 2,000 feet. Slope is 0 to 1 percent. The average annual precipitation is 7 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is brown silty clay loam about 2 inches thick. The subsoil is dark brown and dark grayish brown clay about 28 inches thick. The substratum to a depth of 60 inches or more is brown silty clay loam.

Included in this unit are small areas of Gadsden, Glenbar, Pimer, and Sasco soils. Also included are small areas of soils that have a surface layer of silty clay, clay loam, or clay. Included areas make up about 5 percent of the total acreage.

Permeability of this Saminiego soil is slow. Available water capacity is moderately high. Potential rooting depth is 60 inches or more. Runoff is slow or very slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight. This soil is subject to rare, very brief periods of flooding in summer and winter. Penetration and distribution of roots are reduced by the relatively dense subsoil and abrupt textural change at a depth of about 30 inches.

This unit is used for irrigated crops and as rangeland.

If this unit is used for irrigated crops, it is limited mainly by the slow water intake rate, the dense subsoil, and the slow permeability. Surface and trickle irrigation systems are suited to this unit. Because of the slow permeability, the soil should be leveled and the period of water application adjusted to permit a more uniform application and deeper infiltration of water. Returning crop residue to the soil or regularly adding other organic material improves fertility, reduces crusting, and increases the water intake rate. Tilth can also be improved by returning crop residue to the soil.

The potential native plant community is perennial grasses with shrubs and cacti. The present vegetation is mesquite, bermudagrass, globemallow, annual grasses, and forbs.

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

This unit is in capability subclasses III<sub>s</sub>, irrigated, and VII<sub>s</sub>, nonirrigated. It is in the Clay Upland, 7- to 10-inch p.z., range site.

**42—Sasco silt loam.** This deep, well drained soil is on stream terraces. It formed in silty stream alluvium derived from mixed sources. Elevation is 1,100 to 2,000 feet. Slope is 0 to 1 percent. The average annual

precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is dark yellowish brown silt loam about 2 inches thick. The next layer is pale brown silt loam about 45 inches thick. Below this to a depth of 60 inches or more is brown clay loam.

Included in this unit are small areas of Gadsden, Gilman, Glenbar, Marana, and Saminiego soils. Also included are areas of soils that have a surface layer of very fine sandy loam and severely gullied areas near Greene Canal. Included areas make up about 15 percent of the total acreage.

Permeability of this Sasco soil is moderately slow. Available water capacity is high. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. This soil has very low strength and pipes readily. It is subject to rare, very brief periods of flooding in summer and winter.

This unit is used mainly as irrigated cropland. Some areas are also used as rangeland.

If this unit is used for irrigated crops, it is limited by the hazard of soil blowing and very low soil strength. Surface, sprinkler, and trickle irrigation systems are suited to this unit. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Keeping the soil surface moist helps to control soil blowing and thus reduces the risk of damage to young seedlings. If this unit is leveled for irrigation water management, the cuts and fills will be as much as 5 feet deep, which in places will expose less desirable soil material. Berms more than 12 inches high are subject to piping and are very difficult to maintain.

The potential native plant community on this unit is perennial grasses and forbs and annual grasses, forbs, and shrubs. The present vegetation is creosotebush, mesquite, globemallow, bush muhly, and a variety of annual grasses and forbs.

This unit is moderately well suited to the production of desert herbaceous plants, shrubs, and trees that provide habitat for wildlife. It is moderately well suited to the production of irrigated grain and seed crops and domestic grasses and legumes.

This unit is in capability class I, irrigated, and subclass VIIC, nonirrigated. It is in the Loamy Upland, 7- to 10-inch p.z., range site.

**43—Toltec fine sandy loam.** This deep, well drained soil is on relict basin floors. It formed in eolian material and stream alluvium derived from mixed sources. Elevation is 1,140 to 2,000 feet. Slope is 0 to 1 percent. The average annual precipitation is 6 to 8 inches, the

average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is pale brown fine sandy loam about 12 inches thick. The next layer is calcareous, light brown fine sandy loam and very fine sandy loam about 24 inches thick. Below this to a depth of 60 inches or more is calcareous extremely gravelly and very gravelly fine sandy loam. The soil is strongly alkaline below a depth of about 24 to 36 inches. Many masses and nodules of lime are below a depth of 24 inches.

Included in this unit are small areas of Casa Grande, Coolidge, La Palma, Laveen, and Mohall soils. Also included are small areas of soils that have a high content of toxic salts. In a few places the limy layer is strongly cemented. Included areas make up about 10 percent of the total acreage.

Permeability of this Toltec soil is moderate. Available water capacity also is moderate. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. This soil is slightly saline or moderately saline and is slightly sodic or moderately sodic.

This unit is used for irrigated crops, rangeland, and homesite development.

If this unit is used for irrigated crops, it is limited mainly by soil blowing, the content of rock fragments, the moderate available water capacity, and the content of toxic salts. Surface, sprinkler, and trickle irrigation systems are suited to this unit. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the toxic salt content, the water intake rate, and the needs of the crop grown. Intensive management is needed to reduce the content of toxic salts and to maintain productivity. The content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Leveling the soil permits more efficient use of irrigation water. If land leveling cuts are to be made, onsite investigation is needed.

The potential native plant community is desert saltbush, fourwing saltbush, and a sparse understory of annual grasses and forbs. The present vegetation is desert saltbush, seepweed, mesquite, and hedgehog cactus.

Livestock watering facilities are very important in grazing management. Forage production is greatest in spring. Periodic rest during this time and proper use of the dominant plants help to maintain or improve plant vigor and the range condition.

If this unit is used for homesite development, the main limitations are settling as a result of the leaching of carbonates and content of toxic salts. The possibility of settlement can be minimized by compacting the building site before construction is begun. Settlement can also be reduced by diverting water away from buildings. This prevents solution and leaching of lime from the substratum.

Wrapping steel pipes or providing cathodic protection and using chemically resistant concrete helps to minimize corrosion of steel and concrete.

If this unit is used for septic tank absorption fields, the limitation of moderate permeability can be reduced by increasing the size of the absorption field.

Construction of houses and access roads in places exposes soil material that is highly susceptible to blowing. Revegetating disturbed areas around construction sites as soon as possible helps to control soil blowing. Plant cover can be established and maintained through proper fertilizing, seeding, and mulching.

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

This unit is in capability subclasses IIIs, irrigated, and VIIs, nonirrigated. It is in the Saline Upland (loamy), 7- to 10-inch p.z., range site.

**44—Tremant-Denure complex.** This map unit is on fan terraces. Elevation is 1,200 to 2,000 feet. Slope is 1 to 3 percent. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

This unit is 45 percent Tremant gravelly loam and 35 percent Denure sandy loam.

Included in this unit are small areas of Mohall soils on low fan terraces above areas of the Denure soil, Pinamt soils on high fan terraces above areas of the Tremant soils, Momoli soils adjacent to drainageways, and Valencia soils in drainageways. Included areas make up about 20 percent of the total acreage.

The Tremant soil is deep and well drained. It formed in gravelly fan alluvium derived from mixed sources. Typically, 30 to 50 percent of the surface is covered with fine pebbles. The surface layer is light brown gravelly loam 2 inches thick. The next layer is brown loam 3 inches thick over brown and light brown gravelly clay loam 31 inches thick. Below this to a depth of 60 inches or more is light brown gravelly sandy clay loam. Soft masses of lime are below a depth of about 5 inches.

Permeability of the Tremant soil 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 slight. The hazard of soil blowing is slight. This soil is slightly saline.

The Denure soil is deep and somewhat excessively drained. It formed in fan alluvium derived from mixed sources. Typically, the surface layer is light brown sandy loam about 2 inches thick. The next 52 inches is light brown sandy loam and fine sandy loam. Below this to a depth of 60 inches or more is reddish brown sandy clay loam that is 5 to 30 percent pebbles. Soft masses of lime are below a depth of about 19 inches.

Permeability of the Denure soil 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 slight. The hazard of soil blowing is moderate.

This unit is used as rangeland.

The potential native plant community is desertic shrubs, cacti, and an intermittent understory of perennial and annual grasses and forbs. Triangle bursage and creosotebush are the dominant plants.

This unit is poorly suited to the production of desertic herbaceous plants suitable for wildlife habitat and moderately suited to the production of desertic shrubs and trees.

This unit is in capability subclass VIIs. It is in the Limy Fan, 7- to 10-inch p.z., range site.

**45—Trix clay loam.** This deep, well drained soil is on flood plains. It formed in stream alluvium deposited over older alluvium derived from mixed sources. Elevation is 1,140 to 2,000 feet. Slope is 0 to 1 percent. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is brown clay loam about 15 inches thick. The next layer is brown clay loam 9 inches thick. The next layer is light reddish brown sandy clay loam 10 inches thick. Below this to a depth of 60 inches or more is light reddish brown and pink clay loam. Soft masses of lime are below a depth of about 24 inches.

Included in this unit are small areas of Casa Grande, Ginland, Glenbar, and Mohall soils that have a surface layer of silty clay loam and areas of soils, around Maricopa and to the south and east of the Casa Grande Mountains, that have a high content of toxic salts. Included areas make up about 10 percent of the total acreage.

Permeability of this Trix soil is moderately slow. Available water capacity is high. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of

water erosion is slight. The hazard of soil blowing is slight. This unit is subject to occasional, brief periods of flooding in summer and winter. It is slightly sodic or moderately sodic and nonsaline or slightly saline.

This unit is used mainly for irrigated crops (fig. 3). It is also used as rangeland and for some homesite development.

If this unit is used for irrigated crops, the main limitations are the hazard of flooding and, in some places, the content of toxic salts. Surface and trickle irrigation systems are suited to this unit. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Leveling the soil permits more efficient use of irrigation water. The effects of high salt or sodium content can be reduced by adding soil amendments and applying excess water for leaching. If the soil is leveled for irrigation water management, the

cuts and fills in places are as much as 5 feet deep. Therefore, an onsite investigation should be made to see if the soil material in the substratum is suitable. Properly designed and carefully installed dikes and levees can be used to help control flooding.

The potential native plant community on this unit is perennial grasses and forbs and annual grasses, forbs, and shrubs. The present vegetation is creosotebush, mesquite, globemallow, bush muhly, and a variety of annual grasses and forbs.

If this unit is used for homesite development, the main limitations are the shrink-swell potential, low soil strength, and the hazard of flooding. If buildings are constructed on this unit, structural damage caused by shrinking and swelling can be minimized by overexcavating and backfilling the foundation with suitable coarse textured material and by diverting water away from buildings. Constructing roads on raised, well



Figure 3.—Cotton in an area of Trix clay loam.

compacted, coarse textured fill material and providing adequate side drains and culverts help to reduce the risk of flooding. If flooding is reduced, the damage to roads caused by low soil strength because of wetness is also reduced. Carefully designed and installed channels, ditches, dikes, or levees help to control flooding.

If this unit is used for septic tank absorption fields, the moderately slow permeability and the hazard of flooding are limitations. Increasing the size of the absorption field can reduce the effect of restricted permeability. Diversions, dikes, or levees can be used to reduce the risk of flooding.

Wrapping steel pipes or providing cathodic protection and using chemically resistant concrete helps to minimize corrosion of steel and concrete.

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

This unit is in capability subclasses IIw, irrigated, and VIIw, nonirrigated. It is in the Loamy Bottom, 7- to 10-inch p.z., range site.

**46—Vaiva-Rock outcrop complex, 2 to 15 percent slopes.** This map unit is on hillslopes and mountain slopes. Elevation is 1,200 to 2,000 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

This unit is 55 percent Vaiva very gravelly loam and 20 percent Rock outcrop. The Rock outcrop is in the steeper areas of the hillslopes. 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 Pinamt and Tremant soils on fan terraces and Momoli soils on the fan terraces below the Pinamt soils. Included areas make up about 25 percent of the total acreage.

The Vaiva soil is very shallow and shallow and is well drained. It formed in eolian material and in slope alluvium derived dominantly from granite and gneiss. Typically, 30 to 50 percent of the surface is covered with pebbles, cobbles, and stones. The surface layer is brown very gravelly loam about 4 inches thick. The subsoil is brown and light brown very gravelly sandy clay loam and extremely gravelly sandy clay loam about 12 inches thick. Granite is at a depth of 16 inches. Depth to rock ranges from 4 to 20 inches.

Permeability of the Vaiva soil is moderate. Available water capacity is very low. Potential rooting depth is 4 to 20 inches. Runoff is medium, and the hazard of

water erosion is slight. The hazard of soil blowing is slight.

Rock outcrop consists of exposed granite with small areas of schist and rhyolite.

Most areas of this unit are used as rangeland.

The potential native plant community on this unit is desertic shrubs with an understory of perennial and annual grasses and forbs. The present plant community is littleleaf paloverde, brittlebush, slim tridens, threawn, and other forbs, grasses, cacti, and shrubs.

This unit is poorly suited to the production of desertic herbaceous plants suitable for wildlife habitat. It is moderately well suited to the production of desertic shrubs and trees.

The Vaiva soil is in capability subclass VIIs. It is in the Shallow Upland, 7- to 10-inch p.z., range site. Rock outcrop is not assigned a land capability classification or a range site.

**47—Vaiva-Rock outcrop complex, 15 to 50 percent slopes.** This map unit is on hillslopes and mountain slopes. Elevation is 1,200 to 3,200 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

This unit is 50 percent Vaiva extremely stony sandy loam and 30 percent Rock outcrop. 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 Pinamt soils on fan terraces, Momoli soils on fan terraces below the Pinamt soils, and Tremant soils intermingled with the Pinamt soils on fan terraces. Included areas make up about 20 percent of the total acreage.

The Vaiva soil is very shallow and shallow and is well drained. It formed in eolian material and slope alluvium derived dominantly from granite and gneiss. Typically, 60 to 70 percent of the surface is covered with stones and cobbles. The surface layer is brown extremely stony sandy loam about 4 inches thick. The subsoil is brown and light brown very gravelly sandy clay loam and extremely gravelly sandy clay loam about 12 inches thick. Granite is at a depth of 16 inches. Depth to rock ranges from 4 to 20 inches.

Permeability of the Vaiva soil is moderate. Available water capacity is very low. Effective rooting depth is 4 to 20 inches. Runoff is medium, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

Rock outcrop consists of exposed granite with some small areas of schist and rhyolite.

Most areas of this unit are used as rangeland. The potential native plant community on this unit is

desertic shrubs with an understory of perennial and annual grasses and forbs. The present plant community is littleleaf paloverde, brittlebush, slim tridens, threeawn, forbs, grasses, cacti, and shrubs.

This unit is poorly suited to the production of desertic herbaceous plants suitable for wildlife habitat. It is moderately well suited to the production of desertic shrubs and trees.

The Vaiva soil is in capability subclass VIIc. It is in the Granitic Hills, 7- to 10-inch p.z., range site. Rock outcrop is not assigned a land capability classification or a range site.

**48—Valencia sandy loam.** This deep, well drained soil is on flood plains and alluvial fans. It formed in stream and fan alluvium deposited over older alluvium derived from mixed sources. Elevation is 1,140 to 2,000 feet. Slope is 0 to 1 percent. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is light yellowish brown sandy loam about 8 inches thick. The next 20 inches is light brown sandy loam. The next 18 inches is light reddish brown and reddish brown loam and sandy clay loam. Below this to a depth of 60 inches or more is pink sandy loam. Soft masses of lime are below a depth of about 17 inches.

Included in this unit are small areas of Casa Grande, Denure, Mohall, and Trix soils. Also included are small areas of soils that have a surface layer of fine sandy loam or gravelly sandy loam and small areas that have a high content of toxic salts in the subsoil. Included areas make up about 5 percent of the total acreage.

Permeability of this Valencia soil is moderately rapid to a depth of 28 inches and moderately slow below this depth. Available water capacity is moderately high. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. This soil is occasionally flooded for very brief periods in summer and winter. It is slightly sodic or moderately sodic and nonsaline or slightly saline.

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

The potential native plant community on this unit is desertic shrubs and trees with an understory of perennial grasses. The present vegetation is littleleaf paloverde, triangle bursage, white bursage, ratany, creosotebush, bush muhly, and a variety of cacti, annual grasses, and forbs.

If this unit is used for irrigated crops, it is limited mainly by slope and the hazard of flooding. Some areas are limited by high sodium or salt content. Surface,

trickle, and sprinkler irrigation systems are suited to this unit. Leveling permits more efficient use of irrigation water. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Keeping the soil surface moist helps to control soil blowing and thus reduces the risk of damage to young seedlings. Applying soil amendments and adding excess water for leaching reduce the content of toxic salts. If this unit is leveled for irrigation water management, the cuts and fills in places are as much as 5 feet deep, which exposes underlying layers that have a high content of lime or toxic salts. Properly designed and carefully installed dikes and levees help to control flooding.

This unit is well suited to the production of desertic riparian herbaceous plants, shrubs, and trees that are suitable for use as wildlife habitat. It is well suited to the production of irrigated grain and seed crops and domestic grasses and legumes.

This unit is in capability subclasses IIw, irrigated, and VIIw, nonirrigated. It is in the Sandy Bottom, 7- to 10-inch p.z., range site.

**49—Why sandy loam.** This deep, somewhat excessively drained soil is on alluvial fans and flood plains. It formed in stream and fan alluvium derived from mixed sources. Elevation is 1,140 to 2,000 feet. Slope is 0 to 1 percent. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free period is 240 to 325 days.

Typically, the surface layer is light yellowish brown sandy loam about 2 inches thick. Below this to a depth of 60 inches or more is light yellowish brown, light brown, and strong brown sandy loam. Soft accumulations of lime are in the root channels and pores and on the underside of pebbles below a depth of 15 inches.

Included in this unit are small areas of Casa Grande, Cuerda, Denure, Mohall, Trix, and Valencia soils. Also included are small areas of soils that have a surface layer of fine sandy loam or gravelly sandy loam. Included areas make up about 10 percent of the total acreage.

Permeability of the Why soil is moderately rapid. Available water capacity is moderate. Potential rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. This unit is occasionally flooded for very brief periods in summer and winter.

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

The potential native plant community is a diverse mixture of perennial grasses and forbs, desertic trees

and shrubs, and annual grasses. The present vegetation consists of paloverde, ironwood, mesquite, creosotebush, and big sagebrush. Perennial grasses, such as bush muhly, threeawn, and slim tridens, and numerous annual grasses are also present. Among the most common perennial forbs present are globemallow, wirelettuce, fiddleneck, scorpion weed, hairy Bowlesia, and Indianwheat.

If this unit is used for irrigated crops, the main limitations are the low available water capacity and the hazard of flooding. Surface, trickle, and sprinkler irrigation systems are suited to this unit. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Keeping the soil surface moist helps to control soil blowing and thus reduces the risk

of damage to young seedlings. Leveling the soil permits more efficient use of irrigation water. The amounts of water applied and the timing of applications should be adjusted to the available water capacity. Properly designed and carefully installed dikes, diversions, and levees can be used to help control flooding.

This unit is moderately well suited to the production of desertic riparian herbaceous plants, shrubs, and trees that provide habitat for wildlife. It is also moderately well suited to the production of irrigated grain and seed crops and domestic grasses and legumes.

This unit is in capability subclasses IIw, irrigated, and VIIw, nonirrigated. It is in the Sandy Bottom, 7- to 10-inch p.z., range site.

## Prime Farmland

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In this section, prime farmland is defined and discussed and the prime farmland soils in this survey area are listed.

Prime farmland is of major importance in meeting the Nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and federal levels, as well as individuals, must encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to producing food, seed, forage, fiber, and oilseed crops. Such soils have properties that are favorable for the economic production of sustained high yields of crops. The soils need only to be treated and managed using acceptable farming methods. Adequate moisture and a sufficiently long growing season are required. Prime farmland soils produce the highest yields with minimal inputs of energy and economic resources, and farming these soils results in the least damage to the environment.

Prime farmland soils may presently be in use as cropland, pasture, or woodland, or they may be in other uses. They either are used for producing food and fiber or are available for these uses. Urban or built-up land, public land, and water areas cannot be considered prime farmland. Urban or built-up land is any contiguous unit of land 10 acres or more in size that is used for such purposes as housing, industrial, and commercial sites, sites for institutions or public buildings, small parks, golf courses, cemeteries, railroad yards, airports, sanitary landfills, sewage treatment plants, and water control structures. Public land is land not available for farming in national forests, national parks, military reservations, and state parks.

Prime farmland soils commonly get an adequate and dependable supply of moisture from precipitation or irrigation. Temperature and length of growing season are favorable, and level of acidity or alkalinity is acceptable. The soils have few, if any, rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and

are not flooded during the growing season. The slope ranges mainly from 0 to 6 percent.

Soils that have a high water table, are subject to frequent flooding, or are droughty may qualify as prime farmland soils if the limitations are overcome by drainage, flood control, or irrigation. Onsite evaluation is necessary to determine the effectiveness of corrective measures. More information on the criteria for prime farmland soils can be obtained at the local office of the Soil Conservation Service.

A recent trend in land use has been the conversion of prime farmland to urban and industrial uses. The loss of prime farmland to other uses puts pressure on lands that are less productive than prime farmland.

About 706,796 acres, or nearly 76 percent of the survey area, would meet the requirements for prime farmland if an adequate and dependable supply of irrigation water were available.

The following map units meet the soil requirements for prime farmland when irrigated. On some soils included in the list, measures should be used to overcome a hazard or limitation, such as flooding, wetness, or droughtiness. The location of each map unit is shown on the detailed soil maps at the back of this publication. Soil qualities that affect use and management are described in the section "Detailed Soil Map Units." This list does not constitute a recommendation for a particular land use.

5	Cashion clay
9	Contine clay loam
10	Contine clay
11	Coolidge sandy loam
12	Cuerda fine sandy loam
13	Dateland fine sandy loam
17	Denure fine sandy loam, 0 to 1 percent slopes
18	Denure clay loam, 0 to 1 percent slopes
20	Gadsden clay
21	Gilman fine sandy loam
22	Gilman clay loam
23	Ginland clay
24	Glenbar clay loam
28	Laveen loam

29 Marana silty clay loam  
30 Mohall sandy loam  
31 Mohall loam  
32 Mohall clay loam  
36 Pimer silty clay

41 Saminiego silty clay loam  
42 Sasco silt loam  
45 Trix clay loam  
48 Valencia sandy loam  
49 Why sandy loam

# Use and Management of the Soils

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

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and 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 recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

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

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

Health officials, 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 and Pasture

By Gerardo R. Gonzalez, soil conservationist, Soil Conservation Service.

General management needed for irrigated crops and pasture is suggested in this section. The major crops or

pasture plants commonly grown in the survey area are identified; the system of land capability classification used by the Soil 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 "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 350,000 acres of irrigated cropland is in this survey area. All crops must be irrigated because insufficient moisture is supplied by rainfall.

This area has potential for producing a wide variety of food and fiber crops. The major crops currently grown are cotton, small grain, grain sorghum, and alfalfa hay. Other important crops are sugar beets, broccoli, lettuce, melons, citrus fruit, and pecans.

The source of water for irrigation is from wells and from the San Carlos Irrigation Project. Some water from the Central Arizona Project, which will carry water from the Colorado River, might be available when the project is completed. The main limitation for agriculture in the area is the limited supply of water. The availability of water from the Central Arizona Project, use of high efficiency irrigation systems, and careful management of available water can help to overcome this limitation.

The Arizona Groundwater Management Act, the Central Arizona Project water allocations, and the need to preserve the agricultural economics of the area all mandate more efficient use of water. This can be achieved with proper use of soil and water resources. Irrigation systems, water management, and soil management are necessary in areas of irrigated cropland. The kinds of irrigation used in this area are surface, trickle, and sprinkler systems. These systems are discussed in the following paragraphs:

*Surface irrigation systems.*—In surface systems a uniform surface grade, with or without tailwater recovery, is installed when the land is initially developed for irrigation. Slopes may or may not be uniform throughout the length of the run or across the field.

Typically, there is a slope from the upper end of the field to the lower end. An extra amount of water is needed to adequately wet the soil at the lower end of the field. This creates runoff, especially on soils that have a slow water intake rate. As the irrigation water supply becomes more limited or expensive, it is a common practice to stop applying water before the lower end of the field is adequately irrigated. This limits the amount of runoff, underirrigates the soil at the lower end of the field, and reduces crop yield.

A modified surface grade irrigation system is also used in some parts of this area. It differs from the traditional uniform surface grade system in that the upper part of the field is sloping and the lower part is flat. A farm road or field edge berm is constructed along the lower end of the field to block the ends of the furrows or borders and prevent runoff. This system commonly is used to eliminate runoff losses without the use of a tailwater recovery system; however, it is probably the most difficult to manage of any system because the flat part tends to be too wet and the upper, or sloping, end too dry.

In the surface irrigation systems, water is distributed by way of furrows and borders.

The furrow method commonly is used to irrigate cultivated row crops, such as cotton, sugar beets, grain sorghum, corn, and vegetables. Furrows can also be used to irrigate close-growing crops that are not cultivated, such as wheat and barley.

The border method is used to irrigate close-growing crops, such as alfalfa, pasture, small grain, and sudangrass, and tree crops, such as pecans and citrus fruit.

Surface irrigation systems may or may not be used with a method to recover tailwater runoff. Mismanagement of irrigation tailwater has given surface systems a bad name. Tailwater recovery should be considered with all surface systems. Tailwater recovery can improve irrigation application efficiency by 5 to 30 percent, depending on the management used. It can also save labor and energy. Irrigation designs generally include a way to collect, temporarily store, and then return tailwater to the distribution system.

Level basin irrigation systems (furrow and border) were recognized in the mid-1970's for their potential irrigation efficiency. With these surface irrigation systems, fields must be level to nearly level from end to end and side to side. Level basins are best suited where large volumes of irrigation water are available and soils are moderately fine to medium textured. If the systems are properly designed and managed, this range can be extended. Coarser textured soils, such as those of the Denure, Coolidge, and Carrizo series, have

a high water intake rate. These soils are not well suited to level basin systems.

*Sprinkler irrigation systems.*—These systems are designed so that water is applied directly to the soil by way of pipelines and spray or impact nozzles. Very little water runoff should occur when the system is properly designed and operated. There are several types of sprinkler systems—periodic move, continuous move, and fixed. In this area sprinkler systems are best suited to soils that have a high water intake rate, generally sandy texture, and low to variable available water capacity. Limitations are determined by the type of equipment used, the supply and quality of water, and the crops grown. Sprinkler systems can be harmful to some crops if water that has a high content of toxic salts is used. Leaf damage is one of the first signs. High temperature, low humidity, and wind velocity of 5 miles per hour or more reduce the efficiency of sprinkler applications. The pounding of soil by falling waterdrops can hasten the dispersal of soil particles.

Sprinkler systems are used by some lettuce farmers to help germinate and establish the crop by applying a small amount of water frequently.

*Trickle irrigation systems.*—These systems are designed to apply water directly onto or into the soil at the point of use. Water is applied to the soil surface with perforated tape, tubing or pipe, emitters, bubblers, or small spray jets. Below the surface, buried perforated tape tubing or pipe can be used. These systems can be used on all slopes. Where salts are a problem, the amount and distribution of water required for leaching necessitate the use of a supplemental system. Trickle irrigation pipelines, tubes, and orifices are small and are subject to plugging by sand, sediment, and chemical precipitates and by organic particles, algae, and other micro-organisms in the water. Filters, screens, sediment basins, and water additives are required. Careful management is essential.

Trickle irrigation systems, unlike others, are designed to apply water to the soil at rates and quantities close to the requirements of the plant. This requires application of water in small amounts at frequent intervals. This minimizes the requirement for the soil to have high available water capacity. These systems are well suited to use on shallow soils or on soils that have low available water capacity. Trickle systems have high initial installation cost, have high maintenance cost, and require intensive management. They probably are best suited for use where the water supply is limited, water cost is high, soil problems exist, or high value cash crops can be produced.

The delivery of water is a very important part of any irrigation program. Pipelines and concrete-lined ditches

are the most commonly used delivery methods. Pipelines are most efficient because no water is lost by evaporation or seepage before it reaches the field. In most instances pipelines are used to carry water from wells to irrigation ditches. When concrete-lined open ditches are used alone, the loss of water by evaporation can be as much as 5 percent. An unlined earthen ditch is least efficient because of the loss of water by both seepage and evaporation and the increased maintenance cost. Measurement of the amount of irrigation water applied and soil moisture content is an essential part of irrigation water management.

Salinity and sodicity are problems in some of the soils in the area. The limitation of salinity can be corrected or reduced by lowering the soil moisture deficit before irrigation. With more frequent and lighter applications of water, soil moisture tensions are kept lower, making it easier for plants to obtain moisture. If relatively salt-free water is available, many salts can be flushed or leached beyond the root zone of plants. Great care is necessary to maintain sodium absorption ratio and electrical conductivity values in proper balance. These leaching irrigations can create a greater demand for irrigation water and for drainage facilities. Sodicity commonly can be corrected by using amendments such as gypsum, sulphur, or sulfuric acid. These amendments turn the sodium into a form that can be easily flushed or leached beyond the root zone. The quantity of each amendment required should be calculated for each site based on testing of soil and water samples. If the soil and water chemistry is managed properly, soil particles will be dispersed and infiltration rates reduced to near zero.

In the following paragraphs some of the management practices used in the area are described.

**Conservation cropping systems.**—Conservation cropping systems consist of cultural and management measures needed for optimum long-term crop production. The system selected is influenced by the needs and desires of the farmer, the farmer's ability to finance the production of a particular crop, government crop controls, and the effectiveness of the cropping system in controlling diseases, insects, and weeds while maintaining soil tilth. In a part of the survey area, erosion control must be considered when planning a conservation cropping system. Some common cropping systems in the area are cotton for 1 year and small grain for 1 year, cotton for 2 years and small grain for 1 year, and continuous cotton with an application of manure between successive plantings.

**Fertilizer.**—Crops on most of the soils in the area respond favorably to fertilizer. The supply of potassium, calcium, magnesium, and iron is adequate in most of the soils. The Coolidge and Laveen soils have an

excessive supply of calcium carbonate and toxic salts. Excess calcium carbonate interferes with the uptake of iron by some crops, which causes iron chlorosis. The uptake of potassium is affected in some areas also. Restricted root development can severely limit soil moisture available to the plant. The kind and amount of fertilizer and other soil amendments needed depend on the kind of soil, the cropping history and management, and the crops grown. Soil tests provide part of the information needed to choose the proper composition and application rates.

**Crop residue use.**—Most of the soils in the area are low in organic matter content. The incorporation of crop residue into the soil improves the water intake rate and available water capacity, increases soil aeration and biological activity in the soil, improves soil structure, and increases the number of nutrients available to plants. Crop residue cushions the soil against the negative impacts of tillage and helps to control water erosion and soil blowing.

**Minimum tillage.**—Many of the soils in the survey area are unstable and are easily pulverized. These soils are susceptible to compaction from traffic or tillage. If fine textured soils are worked when wet, a plowpan is likely to form. Care should be taken to avoid pulverizing the soils when dry. Minimum or limited tillage reduces costs and improves soil tilth and the water intake characteristics of the soils.

### **Yields Per Acre**

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 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; 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 good-quality 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 Soil 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 grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider 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 and for engineering purposes.

In the capability system, soils generally are grouped at three levels: capability class, subclass, and unit (26). 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.

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, IIe. 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*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or 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, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units."

### Rangeland

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil and the kind and amount of annual precipitation. Effective management is based on the relationship between the soils and vegetation and water.

Table 6 shows, for each soil, the range site and the total annual production of vegetation in favorable, average, 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 established 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 a seasonal water table are also important.

*Potential annual 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 fruit 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, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimal production of vegetation, reduction of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

## 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 recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 7, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties generally are favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 7 can be supplemented by other information in this survey; for example, interpretations for dwellings without basements and for local roads and streets in table 8 and interpretations for septic tank absorption fields in table 9.

*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 are gently sloping 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.

*Golf fairways* are subject to heavy foot traffic and

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

## Wildlife Habitat

John C. York, biologist, Soil Conservation Service, helped to prepare this section.

The capacity of an area to produce vegetation determines the kinds of wildlife that live in the area. Some of the factors that limit the production of vegetation are discussed in this soil survey. Because the existence of all wildlife depends in some way on vegetation, it is necessary for land managers to know how they can best manage that vegetation.

The kinds and populations of animals on the desert are determined by evolution and climate, provided there is a suitable soil on which usable vegetation can grow. Animal populations fluctuate with the amount of moisture received in the survey area because the amount of vegetation fluctuates with moisture. The kinds of animals are relatively fixed, barring interference from man, and the mixes are determined by the kinds and amounts of vegetation.

Each map unit in the section "Detailed Soil Map Units" is rated for its capacity to produce vegetation. This rating is based on the existence of limitations, such as availability of moisture, stoniness, shallow soil depth, salinity, alkalinity, and presence of a hardpan.

Elements of wildlife habitat vary across the survey area. Each map unit was rated for its ability to produce some or all of the following elements: desertic riparian shrubs, trees, and vines; desertic herbaceous plants; desertic riparian herbaceous plants; and desertic shrubs, trees, and vines. The ratings are expressed as well suited, moderately well suited, poorly suited, and very poorly suited.

A rating of *well suited* means that soil properties are such that vegetation can easily be managed or established, soil limitations are moderate, and management will be necessary to maintain the soil and vegetation. *Moderately well suited* means that soil properties are such that vegetation can be improved or established, soil limitations are moderate, and management will be necessary to maintain the soil and vegetation. *Poorly suited* means that soil properties are such that limitations are severe. Managing the resource is possible, but establishing vegetation through planting may be very difficult and success is questionable. *Very poorly suited* means that soil properties are such that

limitations make it impractical to attempt to establish or improve vegetation. Failure is highly probable. In some instances, these soils might be managed successfully.

The system described above rates only those units in this survey area. Ratings for map units in this area cannot be compared to those in any other survey area unless the resource areas are the same.

In general, all bottom land range sites (Clay Bottom, Sandy Bottom, and Loamy Bottom) have been rated as moderately well suited or well suited to wildlife habitat. Saline Bottom sites are rated as poorly suited or very poorly suited. All bottom sites are rated higher because of their potential for flooding and receipt of extra moisture. Availability of extra moisture provides more opportunities for managing those sites. The range sites on rough, broken, rocky, basaltic, and volcanic mountain slopes and hillslopes are rated as suited, moderately well suited, or poorly suited. Proper management can improve this habitat because of the protection of the surface soil by rock fragments, the presence of microhabitats created by the rock, and the protection from grazing offered by the rock. The sandy sites are rated as poorly suited, but they can have a better rating depending on the amount of rain received in winter and early in spring. Ample rain in winter produces very heavy growth of plants. The map units that are very poorly suited are usually very dry, rocky, saline, and shallow or have a hardpan. These areas are severely limited for production of plants.

Vertebrate animals live throughout the survey area. Highly mobile species use all available spaces, while specialized species are restricted to one or two habitat types. Examples of the mobile species are bats, birds, deer, desert bighorn sheep, javelina, rabbits, coyotes, fox, coatis, raccoon, and Sonoran antelope. Some snakes, such as rattlers, bullsnakes, coachwhips, and kingsnakes, also have a fairly wide range. Deer, javelina, sheep, and antelope are restricted to areas of free water. Even though they have the ability to move, that action is controlled by the need for water. Animals that do not have mobility are rats and mice, gophers, lizards, skinks, toads, quail, most snakes, geckoes, and ground squirrels. These animals are usually nonspecific in the vegetation they eat, require no free water to survive, are mainly nocturnal, and are small. All of these are characteristics of animals that live in harsh, hot, dry climates.

## Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are

given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

*Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.*

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

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

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the field work 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 a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreation 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, embankments, 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 and 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 generally are 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 depth to a seasonal high water table and 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 the depth to the water table.

*Dwellings and small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings 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, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, 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 generally are 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, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

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

### Sanitary Facilities

Table 9 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features generally are 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 landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

*Septic tank absorption fields* are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that

part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock 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, large stones, and content of organic matter.

Excessive seepage because of rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, 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 needs to 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, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

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

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

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 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 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 depth to the water table is less than 1 foot. These soils may have layers of suitable material, but the material is less than 3 feet thick.

*Sand and gravel* are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 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 taxonomic unit 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 as much as 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 water table at or near the surface.

The surface layer of most soils generally is 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 generally are 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 much more than the height of the embankment can affect performance and safety of the embankment. Onsite investigation is needed to determine these properties.

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

*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, and soil reaction.

# Soil Properties

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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 to 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 "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 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 system adopted by the American Association of State Highway and Transportation Officials (1) and the Unified soil classification system (2).

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

The 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.

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

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

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

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

## Physical and Chemical Properties

Table 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.

*Depth* to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

*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, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving 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, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

*Available water capacity* refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the

design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

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

*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 the soil if used as construction material, and the potential of the soil to corrode metal and concrete.

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

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

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

*Erosion factor K* indicates the susceptibility of a soil to sheet and rill erosion. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, very fine sand, sand, and organic matter (as much as 4 percent) and

on soil structure and permeability. The estimates are modified by the presence of rock fragments. Values of  $K$  range from 0.02 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion.

*Erosion factor  $T$*  is an estimate of the maximum average 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 generally are not suitable for crops. They are extremely 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 very 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 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 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 very 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 very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.
8. Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

*Organic matter* is the plant and animal residue in the soil at various stages of decomposition. In table 13, the

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

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

## Soil and Water Features

Table 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 sand or gravelly sand. 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 clay that has 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 covering of the soil surface by flowing water, is caused by overflow from streams, by runoff from adjacent slopes, or by inflow from high tides. Shallow water standing or flowing for short periods after rainfall or snowmelt is not considered to be flooding. Standing water in swamps and marshes or in closed depressional areas is considered to be ponding.

Table 14 gives the frequency and duration of flooding and the time of year when flooding is most likely to occur.

Frequency, duration, and probable period of flooding are estimated. Frequency is expressed as *none*, *rare*, *occasional*, and *frequent*. *None* means that flooding is not probable, *rare* that it is unlikely but is possible under unusual weather conditions (chance of flooding in any year is 0 to 5 percent), *occasional* that it occurs infrequently under normal weather conditions (chance of flooding in any year is 5 to 50 percent), and *frequent* that it occurs often under normal weather conditions (chance of flooding in any year is more than 50 percent).

Duration is expressed as *very brief* (less than 2 days), *brief* (2 to 7 days), *long* (7 days to 1 month), and *very long* (more than 1 month). The time of year that flooding is most likely to occur is expressed in months. November-May, for example, means that flooding can occur during the period November through May. About two-thirds to three-fourths of all flooding occurs during the stated period.

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

Also considered are local information about the extent and level 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.

*Depth to bedrock* is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or

fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

A *cemented pan* is a cemented or indurated subsurface layer at a depth of 5 feet or less. Such a pan causes difficulty in excavation. Pans are classified as thin or thick. A *thin* pan is one that 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 one that is more than 3 inches thick if continuously indurated or more than 18 inches thick if it is 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, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

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

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

# Classification of the Soils

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The system of soil classification used by the National Cooperative Soil Survey has six categories (28). 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 sediment, 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 Torrifuvents (*Torri*, meaning hot and dry, plus *fluvent*, the suborder of the Entisols that formed in flood plain sediment).

**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 Torrifuvents.

**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, thickness 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 fine-silty, mixed (calcareous), hyperthermic Typic Torrifuvents.

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

## Soil Series and Their Morphology

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

Characteristics of the soil and the material in which it formed are identified for each unit. A pedon, a small three-dimensional area of soil, that is typical of the unit in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (25). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (28). 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 unit.

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

### Akela Series

The Akela series consists of very shallow and shallow, well drained soils on hillslopes and mountain slopes. These soils formed in medium textured to moderately coarse textured, very gravelly, calcareous eolian material and slope alluvium over basalt. Slope is

10 to 60 percent. Elevation is 2,000 to 3,000 feet. The average annual precipitation is about 10 to 12 inches, the average annual air temperature is 64 to 68 degrees F, and the average frost-free season is 180 to 240 days.

These soils are loamy-skeletal, mixed (calcareous), thermic Lithic Torriorthents.

Typical pedon of Akela very cobbly very fine sandy loam, in an area of Akela-Rock outcrop complex, 10 to 60 percent slopes; about 2,475 feet west and 1,567 feet south of the northeast corner of sec. 35, T. 10 S., R. 9 E.

A—0 to 2 inches; light yellowish brown (10YR 6/4) very cobbly very fine sandy loam, dark yellowish brown (10YR 4/4) moist; weak thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; few fine interstitial pores; 60 percent rock fragments; slightly effervescent; moderately alkaline; abrupt wavy boundary.

Bk—2 to 16 inches; light yellowish brown (10YR 6/4) very cobbly very fine sandy loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; few fine interstitial pores; 55 percent rock fragments; strongly effervescent; moderately alkaline; abrupt wavy boundary.

R—16 inches; lime-coated basalt.

From 35 to 60 percent of the surface is covered with cobbles. The content of rock fragments in the control section ranges from 45 to 75 percent. Depth to rock ranges from 4 to 20 inches.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 2 to 6 when dry or moist. Reaction is mildly alkaline or moderately alkaline.

The B horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 2 to 4 when dry or moist. Texture is very cobbly very fine sandy loam or very cobbly loam. Reaction is mildly alkaline or moderately alkaline.

### Antho Series

The Antho series consists of deep, somewhat excessively drained soils on flood plains. These soils formed in stream alluvium derived from granite, schist, rhyolite, andesite, and gneiss. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are coarse-loamy, mixed (calcareous), hyperthermic Typic Torrifluvents.

Typical pedon of Antho loamy fine sand; about 750 feet east and 600 feet north of the southwest corner of sec. 1, T. 5 S., R. 8 E.

A1—0 to 4 inches; light brownish gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; moderate medium platy structure; soft, very friable, nonsticky and nonplastic; few fine roots; common fine interstitial pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C1—4 to 8 inches; light brownish gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) moist; moderate thin platy structure; soft, very friable, nonsticky and nonplastic; few fine roots; common fine interstitial pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C2—8 to 14 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; moderate thin platy structure; soft, friable, nonsticky and nonplastic; few fine roots; few fine tubular pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C3—14 to 20 inches; light brownish gray (10YR 6/2) stratified loamy sand, dark grayish brown (10YR 5/2) moist; single grain; loose, nonsticky and nonplastic; few fine roots; common very fine roots; common very fine interstitial pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C4—20 to 25 inches; pale brown (10YR 6/3) stratified fine sandy loam, brown (10YR 4/3) moist; massive; soft, friable, nonsticky and nonplastic; few very fine roots; common very fine interstitial pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C5—25 to 28 inches; brown (10YR 5/3) stratified fine sandy loam, dark brown (10YR 4/3) moist; massive; soft, friable, nonsticky and nonplastic; few very fine roots; common very fine interstitial pores; strongly effervescent; moderately alkaline; clear smooth boundary.

C6—28 to 36 inches; brown (10YR 5/3) stratified sandy loam, dark brown (10YR 4/3) moist; massive; soft, friable, nonsticky and nonplastic; few fine roots; common very fine interstitial pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C7—36 to 60 inches; light brownish gray (10YR 6/2) stratified loamy fine sand, grayish brown (10YR 5/2) moist; single grain; loose, nonsticky and nonplastic; few fine roots; common very fine interstitial pores; slightly effervescent; moderately alkaline.

The 10- to 40-inch control section has thin strata (0.5

inch to 3 inches thick) of finer or coarser textured soil material.

The A and C horizons have hue of 7.5YR or 10YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 2 to 4 when dry or moist. Texture of the C horizon is fine sandy loam, sandy loam, loamy fine sand, or loamy sand with thin strata of finer or coarser textured soil material.

### Carrizo Series

The Carrizo series consists of deep, excessively drained soils on flood plains. These soils formed in very gravelly, coarse textured fan and stream alluvium derived from granite, schist, rhyolite, and andesite.

Slope is 1 to 5 percent. Elevation is 1,200 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are sandy-skeletal, mixed, hyperthermic Typic Torriorthents.

Typical pedon of Carrizo very gravelly fine sandy loam, in an area of Momoli-Carrizo complex, 1 to 8 percent slopes; about 2,380 feet west and 100 feet south of the northeast corner of sec. 3, T. 3 S., R. 3 E.

A1—0 to 5 inches; light yellowish brown (10YR 6/4) very gravelly fine sandy loam, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, slightly sticky and nonplastic; few very fine roots; common very fine vesicular pores; 15 percent of surface covered with fine pebbles; 55 percent fine angular pebbles in the soil; slightly effervescent; moderately alkaline; abrupt wavy boundary.

C1—5 to 20 inches; light yellowish brown (10YR 6/4) very gravelly coarse sand, dark brown (10YR 4/3) moist; single grain; loose, nonsticky and nonplastic; many fine roots; many coarse interstitial pores; 60 percent pebbles; slightly effervescent; moderately alkaline; clear wavy boundary.

C2—20 to 60 inches; brown (10YR 5/3) extremely gravelly coarse sand, dark brown (10YR 4/3) moist; single grain; loose, nonsticky and nonplastic; few fine roots; many coarse interstitial pores; 70 percent pebbles; strongly effervescent; moderately alkaline.

In some areas 10 to 15 percent of the surface is covered with rock fragments. The content of rock fragments in the control section ranges from 35 to 70 percent.

The A and C horizons have hue of 7.5YR or 10YR, value of 5 to 7 when dry and 4 or 5 when moist, and chroma of 3 or 4 when dry or moist. The C horizon is

very gravelly coarse sand, very gravelly sand, or extremely gravelly coarse sand.

### Casa Grande Series

The Casa Grande series consists of deep, well drained, saline-sodic soils on relict basin floors. These soils formed in stream alluvium derived from granite, rhyolite, andesite, quartzite, and some limestone and basalt. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are fine-loamy, mixed, hyperthermic Typic Natrargids.

Typical pedon of Casa Grande fine sandy loam; about 1,800 feet south and 490 feet east of the center of sec. 11, T. 6 S., R. 6 E.

Ap—0 to 13 inches; light brown (7.5YR 6/4) fine sandy loam, reddish brown (5YR 4/4) moist; massive; hard, friable, slightly sticky and slightly plastic; common fine roots; many fine tubular pores; strongly effervescent; moderately alkaline; abrupt wavy boundary.

Btkn1—13 to 23 inches; reddish brown (5YR 5/4) sandy clay loam, yellowish red (5YR 4/6) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, slightly sticky and slightly plastic; common fine roots; common thin clay films on faces of peds; many fine tubular pores; common fine soft lime masses; few fine white salt crystals; strongly effervescent; strongly alkaline; clear wavy boundary.

Btkn2—23 to 28 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky; hard, firm, slightly sticky and slightly plastic; common fine roots; common thin clay films on faces of peds; many fine tubular pores; common fine soft lime masses; few fine white salt crystals; strongly effervescent; strongly alkaline; clear wavy boundary.

Btkn3—28 to 49 inches; pinkish gray (7.5YR 7/2) sandy clay loam, light brown (7.5YR 6/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine tubular pores; few thin patchy clay films; violently effervescent; common medium soft lime masses; strongly alkaline; clear wavy boundary.

2Bkn—49 to 60 inches; pinkish gray (7.5YR 7/2) sandy clay loam, pinkish gray (7.5YR 7/2) moist; massive; hard, friable, sticky and plastic; few fine tubular pores; violently effervescent; common medium soft lime masses; strongly alkaline.

The depth to the natric horizon and secondary lime ranges from 4 to 18 inches. The profile commonly is moderately saline, but some pedons are only slightly saline and have an electrical conductivity that ranges from 4 to 26 millimhos per centimeter but is dominantly 8 to 16. The sodium adsorption ratio is 15 to 200 or more.

The A horizon has hue of 7.5YR or 10YR, value of 6 or 7 when dry and 3 or 4 when moist, and chroma of 3 or 4 when dry or moist. It is 8 to 17 inches thick in cultivated areas and 2 to 6 inches thick in desert areas. Texture is fine sandy loam or clay loam. Reaction is strongly alkaline or very strongly alkaline.

An E horizon is present in some pedons and ranges from 1 inch to 3 inches in thickness. It has hue of 10YR or 7.5YR, value of 6 or 7 when dry and 5 or 6 when moist, and chroma of 3 or 4 when dry or moist.

The Bt horizon has hue of 5YR or 7.5YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 4 to 8 when dry or moist. It is loam, sandy clay loam, or clay loam and has 18 to 35 percent clay. Reaction is strongly alkaline or very strongly alkaline.

The Bkn horizon has hue of 5YR to 10YR, value of 5 to 8 when dry and 4 to 6 when moist, and chroma of 2 to 8 when dry or moist. Texture is sandy loam, sandy clay loam, loam, or clay loam. Salt crystals are apparent in most places but are absent in some pedons. The calcium carbonate equivalent ranges from 15 to 25 percent, but it is slightly less in some pedons. Depth to the calcic horizon ranges from 20 to 40 inches or more. Reaction is strongly alkaline or very strongly alkaline.

## Cashion Series

The Cashion series consists of deep, well drained soils on flood plains. These soils formed in mixed, fine textured stream alluvium underlain by medium textured and moderately coarse textured stream alluvium derived from rhyolite, andesite, quartzite, and some limestone and basalt. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are clayey over loamy, mixed (calcareous), hyperthermic Typic Torrifluvents.

Typical pedon of Cashion clay; about 1,200 feet east and 1,340 feet south of the northwest corner of sec. 14, T. 10 S., R. 9 E.

Ap—0 to 12 inches; grayish brown (10YR 5/2) clay, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure; very hard, firm, sticky

and very plastic; common fine roots; common fine tubular pores; strongly effervescent; moderately alkaline; abrupt wavy boundary.

A—12 to 22 inches; grayish brown (10YR 5/2) clay, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure; very hard, firm, sticky and very plastic; common fine roots; common fine tubular pores; strongly effervescent; moderately alkaline; clear wavy boundary.

C1—22 to 34 inches; grayish brown (10YR 5/2) stratified clay, dark brown (10YR 3/3) moist; massive; very hard, firm, sticky and very plastic; thin strata of coarser textured material; common fine roots; common fine tubular pores; strongly effervescent; moderately alkaline; clear wavy boundary.

2C2—34 to 60 inches; light brownish gray (10YR 6/2) stratified silt loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; thin strata of finer and coarser textured material; few fine roots; very few fine tubular pores; strongly effervescent; moderately alkaline.

The profile has more than 1 percent organic matter to a depth of 22 to 30 inches or more. Depth to the 2C horizon ranges from 24 to 38 inches. A buried B horizon is present between depths of 40 and 60 inches in some pedons.

The A and C horizons have hue of 7.5YR or 10YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3 when dry or moist. Texture is clay or silty clay. Clay content is 40 to 60 percent.

The 2C horizon has hue of 10YR or 7.5YR, value of 6 when dry and 4 or 5 when moist, and chroma of 2 to 4 when dry or moist. Texture is loam, silt loam, very fine sandy loam, or fine sandy loam with thin strata of finer and coarser textured soil material. Lime accumulations and mica flakes are present in this horizon in some pedons.

## Cellar Series

The Cellar series consists of very shallow and shallow, somewhat excessively drained soils on hillslopes and mountain slopes. These soils formed in slope alluvium derived from granite, gneiss, and similar rock. Slope is 5 to 60 percent. Elevation is 2,000 to 4,500 feet. The average annual precipitation is about 8 to 12 inches, the average annual air temperature is 62 to 70 degrees F, and the average frost-free season is 180 to 240 days.

These soils are loamy-skeletal, mixed, nonacid, thermic Lithic Torriorthents.

Typical pedon of Cellar very gravelly sandy loam, in an area of Cellar-Rock outcrop complex, 5 to 60 percent slopes; about 1,584 feet south and 792 feet east of the northwest corner of sec. 35, T. 8 S., R. 9 E.

A—0 to 1 inch; yellowish brown (10YR 5/4) very gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; many fine roots; common fine tubular pores; noneffervescent; neutral; abrupt irregular boundary.

Bw—1 to 5 inches; yellowish brown (10YR 5/6) very gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; many fine roots; common fine tubular pores; noneffervescent; neutral; abrupt wavy boundary.

Cr—5 to 8 inches; weathered granite; common yellowish red (5YR 4/6) clay stains on angular pebbles; few fine and medium roots; clear wavy boundary.

2R—8 inches; granite stained with few thin yellowish red (5YR 4/6) clay films along fractures.

Depth to rock ranges from 4 to 20 inches. The profile is 35 to 60 percent fine angular pebbles and averages more than 50 percent rock fragments.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 3 or 4 when dry or moist. Reaction is neutral to moderately alkaline.

The Bw horizon has hue of 7.5YR or 10YR, value of 4 to 6 when dry and 3 or 4 when moist, and chroma of 4 to 6 when dry or moist. Texture is very gravelly sandy loam or very gravelly loam. Reaction is neutral to moderately alkaline.

### **Cherioni Series**

The Cherioni series consists of very shallow and shallow, somewhat excessively drained soils on hillslopes and mountain slopes. These soils formed in slope alluvium derived dominantly from basalt. Slope is 5 to 60 percent. Elevation is 1,200 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are loamy-skeletal, mixed, hyperthermic, shallow Typic Durorthids.

Typical pedon of Cherioni very cobbly very fine sandy loam, in an area of Cherioni-Rock outcrop complex, 5 to 60 percent slopes; about 1,000 feet east and 1,200 feet north of the southwest corner of sec. 5, T. 7 S., R. 2 E.

A—0 to 1 inch; light brown (7.5YR 6/4) very cobbly very fine sandy loam, brown (7.5YR 4/4) moist; weak thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many fine interstitial pores; about 45 percent partially lime-coated basalt cobbles and pan fragments; slightly effervescent; moderately alkaline; abrupt wavy boundary.

Bk1—1 to 6 inches; brown (7.5YR 5/4) very gravelly very fine sandy loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; many fine interstitial pores; about 55 percent basalt pebbles, cobbles, and pan fragments; few fine lime accumulations in root channels; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk2—6 to 8 inches; light brown (7.5YR 6/4) very gravelly very fine sandy loam, brown (7.5YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many fine interstitial pores; about 60 percent lime-coated basalt pebbles, cobbles, and pan fragments; few fine lime accumulations in root channels; strongly effervescent; moderately alkaline; abrupt wavy boundary.

2Bkqm—8 to 10 inches; lime- and silica-cemented duripan with a thin laminar surface; abrupt wavy boundary.

3R—10 to 12 inches; basalt; thin coating of lime on surface and in fractures.

About 40 to 50 percent of the surface is covered with cobbles, and 20 to 30 percent is covered with pan fragments and pebbles. Depth to the duripan is 5 to 20 inches. Depth to rock is 6 to 20 inches. The content of rock fragments in the control section ranges from 45 to 75 percent, but commonly it is about 60 percent.

The A horizon has hue of 7.5YR or 10YR, value of 6 to 8 when dry and 3 to 5 when moist, and chroma of 4 to 6 when dry or moist.

The B horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 4 or 5 when moist, and chroma of 4 to 6 when dry or moist.

### **Cipriano Series**

The Cipriano series consists of very shallow and shallow, somewhat excessively drained soils on fan terraces. These soils formed in gravelly or cobbly fan alluvium derived from basalt, andesite, and some limestone and schist. Slope is 1 to 8 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air

temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are loamy-skeletal, mixed, hyperthermic, shallow Typic Durorthids.

Typical pedon of Cipriano cobbly loam, 1 to 8 percent slopes; about 1,500 feet south and 1,700 feet west of the northeast corner of sec. 8, T. 7 S., R. 3 E.

A1—0 to 2 inches; brown (7.5YR 5/4) cobbly loam, brown (7.5YR 4/4) moist; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; few very fine roots; few fine vesicular pores; 20 percent of surface covered with cobbles; 15 percent pebbles in profile; slightly effervescent; moderately alkaline; abrupt wavy boundary.

Bw—2 to 9 inches; light brown (7.5YR 6/4) very gravelly loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; 40 percent pebbles and pan fragments; violently effervescent; moderately alkaline; abrupt wavy boundary.

2Bkqm—9 to 23 inches; indurated duripan.

Depth to the duripan commonly ranges from 8 to 20 inches. Thickness of the duripan ranges from 1 foot to 5 feet or more. In some pedons it is composed of a series of individual layers.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 3 or 4 when dry or moist.

The Bw horizon has hue of 7.5YR or 10YR, value of 6 or 7 when dry and 4 or 5 when moist, and chroma of 2 to 4 when dry or moist. Texture is very cobbly loam, very gravelly loam, very gravelly very fine sandy loam, or very gravelly sandy loam.

## Contine Series

The Contine series consists of deep, well drained soils on fan terraces and relict basin floors. These soils formed in fine textured fan alluvium derived from acid and basic igneous rock. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are fine, mixed, hyperthermic Typic Haplargids.

Typical pedon of Contine clay; about 1,140 feet north and 525 feet west of the southeast corner of sec. 8, T. 10 S., R. 7 E.

Ap1—0 to 8 inches; strong brown (7.5YR 5/6) clay, yellowish red (5YR 4/6) moist; massive; hard, firm,

sticky and plastic; many very fine roots; few fine tubular pores; slightly effervescent; moderately alkaline; clear smooth boundary.

Ap2—8 to 12 inches; strong brown (7.5YR 5/6) clay, yellowish red (5YR 5/6) moist; massive; hard, firm, sticky and plastic; common fine roots; few fine tubular pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

Bt1—12 to 16 inches; yellowish red (5YR 4/6) clay, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; common fine roots; few fine tubular pores; few thin clay films on faces of peds; slightly effervescent; moderately alkaline; abrupt wavy boundary.

Bt2—16 to 26 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; common very fine roots; few very fine tubular pores; many moderately thick clay films on faces of peds; slightly effervescent; moderately alkaline; clear wavy boundary.

Btk1—26 to 35 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; few very fine roots; few very fine tubular pores; many moderately thick clay films on faces of peds; common soft lime masses; violently effervescent; moderately alkaline; clear wavy boundary.

Btk2—35 to 51 inches; light brown (7.5YR 6/4) clay, strong brown (7.5YR 5/6) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; few very fine roots; few very fine tubular pores; common moderately thick clay films on faces of peds; common soft lime masses; violently effervescent; moderately alkaline; clear wavy boundary.

Btk3—51 to 60 inches; light brown (7.5YR 6/4) clay loam, strong brown (7.5YR 5/6) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; few very fine tubular pores; common thin clay films on faces of peds; few fine soft lime masses; violently effervescent; strongly alkaline.

The control section is 0 to 10 percent rock fragments. The content of calcium carbonate is 15 to 25 percent in the lower part. The A horizon has hue of 7.5YR or 5YR, value of 4 to 6 when dry and 3 or 4 when moist, and chroma of 4 to 6 when dry or moist. The A horizon is clay or clay loam. The B horizon has hue of 5YR or

7.5YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 4 to 6 when dry or moist. The B horizon is clay, clay loam, or sandy clay. The sodium adsorption ratio is 4 to 10 in the lower part. A C horizon is present in some pedons at a depth of 40 to 60 inches. It is clay loam or loam.

### Coolidge Series

The Coolidge series consists of deep, somewhat excessively drained soils on fan terraces and stream terraces. These soils formed in fan and stream alluvium derived from granite, schist, andesite, rhyolite, and some basalt. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are coarse-loamy, mixed, hyperthermic Typic Calciorthids.

Typical pedon of Coolidge sandy loam; about 1,540 feet east and 100 feet north of the center of sec. 22, T. 5 S., R. 5 E.

A—0 to 7 inches; light brown (7.5YR 6/4) sandy loam, strong brown (7.5YR 5/6) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common fine roots; common fine tubular pores; 5 percent pebbles; strongly effervescent; moderately alkaline; abrupt wavy boundary.

Bw—7 to 19 inches; brown (7.5YR 6/4) sandy loam, strong brown (7.5YR 5/6) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; common fine roots; common fine tubular pores; 5 percent pebbles; strongly effervescent; moderately alkaline; abrupt wavy boundary.

Bk1—19 to 25 inches; light brown (7.5YR 6/4) sandy loam, reddish yellow (7.5YR 6/6) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; common fine tubular pores; 5 percent partially lime-coated pebbles; few fine lime accumulations and few soft lime masses; violently effervescent; moderately alkaline; clear wavy boundary.

Bk2—25 to 34 inches; pink (7.5YR 7/4) sandy loam, light brown (7.5YR 6/4) moist; massive; weakly cemented; very hard, very friable, slightly sticky and slightly plastic; few fine roots; few fine tubular pores; 10 percent lime-coated pebbles; many large soft lime masses; violently effervescent; moderately alkaline; abrupt wavy boundary.

Bk3—34 to 44 inches; pinkish white (7.5YR 8/2) sandy loam, light brown (7.5YR 6/4) moist; massive; weakly cemented; very hard, very friable, slightly

sticky and slightly plastic; few fine roots; few fine tubular pores; 10 percent lime-coated pebbles; many large soft lime masses; violently effervescent; moderately alkaline; abrupt wavy boundary.

Bk4—44 to 60 inches; light brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) moist; massive; hard, very friable, slightly sticky and slightly plastic; few fine roots; few fine tubular pores; 10 percent lime-coated pebbles; common medium soft lime masses; violently effervescent; moderately alkaline.

Depth to the layer of calcium carbonate accumulation ranges from 14 to 30 inches. The content of rock fragments in the control section is as much as 15 percent. The calcium carbonate equivalent is 10 to 20 percent. The sodium adsorption ratio is as much as 40 or more. The electrical conductivity is as much as 8 millimhos per centimeter, especially in the lower horizons.

The A horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 3 to 6 when moist, and chroma of 2 to 6 when dry or moist.

The B horizon has hue of 7.5YR or 10YR, value of 5 to 8 when dry and 3 to 6 when moist, and chroma of 2 to 6 when dry or moist. Texture of the B horizon dominantly is sandy loam or fine sandy loam. Coarser or finer textured soil material is below a depth of 40 inches in some pedons.

### Cuerda Series

The Cuerda series consists of deep, well drained soils on alluvial fans. These soils formed in mixed fan alluvium derived from acid and basic igneous rock. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are coarse-loamy, mixed, hyperthermic Fluventic Camborthids.

Typical pedon of Cuerda fine sandy loam; about 1,950 feet east and 200 feet south of the northwest corner of sec. 11, T. 5 S., R. 2 E.

Ap—0 to 9 inches; pale brown (10YR 6/3) fine sandy loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; common medium interstitial pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

Bw1—9 to 16 inches; pale brown (10YR 6/3) very fine sandy loam, brown (7.5YR 5/4) moist; weak fine

subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; common fine interstitial pores; slightly effervescent; moderately alkaline; clear wavy boundary.

Bw2—16 to 30 inches; light brown (7.5YR 6/4) very fine sandy loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; few fine interstitial pores; slightly effervescent; moderately alkaline; clear wavy boundary.

Bk—30 to 60 inches; light brown (7.5YR 6/4) thinly stratified loam, brown (7.5YR 4/4) moist; massive; slightly hard, firm, slightly sticky and slightly plastic; few very fine roots; common lime accumulations in pores and root channels; common fine interstitial pores; strongly effervescent; moderately alkaline.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 to 6 when dry or moist.

The Bw horizon has hue of 7.5YR or 10YR, value of 6 or 7 when dry and 4 to 6 when moist, and chroma of 4 when dry or moist. Texture is very fine sandy loam or loam. Some pedons have thin strata of finer or coarser textured soil material.

The Bk horizon has hue of 7.5YR or 10YR, value of 6 or 7 when dry and 4 to 6 when moist, and chroma of 4 when dry or moist. Texture is very fine sandy loam or loam.

## Dateland Series

The Dateland series consists of deep, well drained soils on fan terraces, stream terraces, and relict basin floors. These soils formed in fan and stream alluvium derived from acid and basic igneous rock. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are coarse-loamy, mixed, hyperthermic Typic Camborthids.

Typical pedon of Dateland fine sandy loam; about 300 feet west and 25 feet north of the southeast corner of sec. 33, T. 5 S., R. 2 E.

A—0 to 2 inches; light yellowish brown (10YR 6/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; moderate medium platy structure; soft, very friable, slightly sticky; few fine roots; few fine tubular pores;

mildly alkaline; abrupt smooth boundary.

Bw1—2 to 11 inches; light yellowish brown (10YR 6/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; weak coarse subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common fine roots; few fine tubular pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

Bw2—11 to 15 inches; strong brown (7.5YR 5/6) fine sandy loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common fine roots; few fine tubular pores; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bk1—15 to 27 inches; strong brown (7.5YR 5/6) very fine sandy loam, brown (7.5YR 4/4) moist; weak coarse subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; few fine roots; few fine tubular pores; few pebbles; lime accumulations in root channels and on the underside of pebbles; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk2—27 to 40 inches; strong brown (7.5YR 5/6) very fine sandy loam, brown (7.5YR 5/4) moist; weak fine prismatic structure parting to weak fine subangular blocky; soft, very friable, slightly sticky and slightly plastic; few fine roots; few fine tubular pores; few fine pebbles; lime accumulations in root channels and on the underside of pebbles; strongly effervescent; moderately alkaline; clear smooth boundary.

C—40 to 60 inches; strong brown (7.5YR 5/6) sandy loam, brown (7.5YR 4/4) moist; massive; soft, very friable, slightly sticky; few fine roots; few fine tubular pores; strongly effervescent; moderately alkaline.

The control section is as much as 30 percent rock fragments. The profile ranges from mildly alkaline to strongly alkaline throughout. The sodium adsorption ratio and the electrical conductivity in the saline phase are 4 to 16 or more.

The A horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 3 to 5 when moist, and chroma of 4 to 6 when dry or moist.

The Bw horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 4 to 6 when dry or moist.

The Bk horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 3 to 6 when dry or moist. It is very fine sandy loam, fine sandy loam, or loam.

## Denure Series

The Denure series consists of deep, somewhat excessively drained soils on fan terraces and stream terraces. These soils formed in fan and stream alluvium derived from granite, rhyolite, quartzite, and andesite. Slope is 0 to 8 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are coarse-loamy, mixed, hyperthermic Typic Camborthids.

Typical pedon of Denure sandy loam, 1 to 3 percent slopes; about 200 feet south and 300 feet west of the northeast corner of sec. 36, T. 5 S., R. 6 E.

- A—0 to 2 inches; light brown (10YR 6/4) sandy loam, dark brown (7.5YR 4/4) moist; weak medium platy structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; few fine tubular pores; slightly effervescent; moderately alkaline; abrupt wavy boundary.
- Bw—2 to 19 inches; light brown (7.5YR 6/4) sandy loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; few fine tubular pores; slightly effervescent; moderately alkaline; gradual wavy boundary.
- Bk—19 to 39 inches; light brown (7.5YR 6/4) sandy loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; few fine tubular pores; few fine secondary lime accumulations; strongly effervescent; moderately alkaline; clear wavy boundary.
- Bk2—39 to 54 inches; light brown (7.5YR 6/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few fine tubular pores; common fine secondary lime accumulations; strongly effervescent; moderately alkaline; clear wavy boundary.
- 2Bt1c—54 to 60 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine tubular pores; few fine soft lime masses; violently effervescent; moderately alkaline.

The profile is as much as 35 percent rock fragments. The buried Bt horizon is not within a depth of 60 inches in all pedons.

The A horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 4 or 5 when moist, and chroma of 4 to 6 when dry or moist. Texture is sandy loam, very gravelly sandy loam, fine sandy loam, or clay loam.

The B horizon has hue of 7.5YR or 10YR, value of 4 to 6 when dry and 4 or 5 when moist, and chroma of 3 to 6 when dry or moist. Texture is sandy loam, fine sandy loam, or gravelly sandy loam.

## Gadsden Series

The Gadsden series consists of deep, well drained soils on flood plains. These soils formed in fine textured stream alluvium derived from granite, schist, rhyolite, quartzite, andesite, and some limestone and basalt. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are fine, montmorillonitic (calcareous), hyperthermic Vertic Torrifuvents.

Typical pedon of Gadsden clay; about 800 feet west and 50 feet south of the northwest corner of sec. 6, T. 10 S., R. 7 E.

- Ap—0 to 13 inches; brown (10YR 5/3) clay, dark brown (10YR 3/3) moist; massive; hard, firm, sticky and plastic; common fine roots; common fine tubular pores; strongly effervescent; moderately alkaline; clear smooth boundary.
- C—13 to 25 inches; brown (10YR 5/3) clay, dark brown (10YR 3/3) moist; massive; very hard, firm, very sticky and very plastic; common very fine roots; few fine tubular pores; few pressure faces in cracks at a depth of 20 to 24 inches; cracks 0.5 inch wide or more observed to a depth of 24 inches; strongly effervescent; moderately alkaline; clear wavy boundary.
- C2—25 to 42 inches; brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; massive; very hard, firm, very sticky and very plastic; common very fine roots; many fine tubular pores; few very fine soft lime masses; strongly effervescent; moderately alkaline; clear wavy boundary.
- C3—42 to 60 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; massive; hard, friable, sticky and plastic; few very fine roots; few very fine tubular pores; strongly effervescent; moderately alkaline.

When dry the profile has cracks 1 centimeter wide or more that extend to a depth of 50 centimeters or more.

The profile has thin strata of coarser textured material.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3 when dry or moist.

The C horizon has hue of 10YR or 7.5YR, value of 4 to 6 when dry and 3 or 4 when moist, and chroma of 2 to 4 when dry or moist. It has many very thin and dense layers of clay, silty clay, silty clay loam, or clay loam and is more than 35 percent clay.

### Gilman Series

The Gilman series consists of deep, well drained soils on flood plains and alluvial fans. These soils formed in stream alluvium derived from granite, schist, rhyolite, quartzite, andesite, and some limestone and basalt. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are coarse-loamy, mixed (calcareous), hyperthermic Typic Torrifluvents.

Typical pedon of Gilman fine sandy loam; about 2,200 feet west and 375 feet south of the northeast corner of sec. 22, T. 8 S., R. 6 E.

Ap—0 to 14 inches; light yellowish brown (10YR 6/4) fine sandy loam, brown (7.5YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; common very fine roots; common fine tubular pores; strongly effervescent; moderately alkaline; abrupt smooth boundary.

C1—14 to 41 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and nonplastic; thin strata of sandy loam, loam, and silt loam; common very fine roots; common very fine tubular pores; strongly effervescent; strongly alkaline; gradual wavy boundary.

C2—41 to 60 inches; pale brown (10YR 6/3) sandy loam, dark yellowish brown (10YR 4/4) moist; massive; loose, nonsticky and nonplastic; thin strata of loam, silt loam, and very fine sandy loam; few very fine roots; few interstitial pores; strongly effervescent; strongly alkaline.

The profile has thin strata of finer or coarser textured material. Reaction is moderately alkaline or strongly alkaline.

The A horizon has hue of 10YR or 7.5YR, value of 4 to 7 when dry and 3 to 5 when moist, and chroma of 2 to 4 when dry or moist. Texture is clay loam or fine sandy loam.

The C horizon has hue of 10YR or 7.5YR, value of 4 to 7 when dry and 3 to 6 when moist, and chroma of 2 to 4 when dry or moist. Texture of the C horizon is sandy loam or very fine sandy loam and averages less than 18 percent clay. Some pedons are clay loam below a depth of 40 inches. These textures occur as many thin layers.

### Ginland Series

The Ginland series consists of deep, well drained soils on flood plains. These soils formed in stream alluvium derived from granite, schist, rhyolite, and some basic igneous rock. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are clayey over loamy, montmorillonitic (calcareous), hyperthermic Vertic Torrifluvents.

Typical pedon of Ginland clay; about 1,500 feet south and 500 feet east of the northwest corner of sec. 36, T. 6 S., R. 6 E.

Ap—0 to 13 inches; brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; hard, very firm, sticky and very plastic; many fine roots; common fine tubular pores; few fine lime filaments; strongly effervescent; moderately alkaline; abrupt smooth boundary.

A—13 to 24 inches; brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; hard, very firm, sticky and very plastic; many fine roots; common fine tubular pores; few calcium carbonate filaments; strongly effervescent; moderately alkaline; abrupt smooth boundary.

2Btkb1—24 to 35 inches; strong brown (7.5YR 5/6) sandy clay loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; many fine tubular pores; few thin clay films on faces of peds; common fine soft lime accumulations in root channels; strongly effervescent; moderately alkaline; gradual wavy boundary.

2Btk2—35 to 56 inches; reddish yellow (7.5YR 6/8) sandy clay loam, strong brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; common fine tubular pores; few thin clay bridges; common fine soft lime accumulations in root channels; strongly effervescent; moderately alkaline; gradual wavy boundary.

2Btk3—56 to 60 inches; reddish yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, sticky and plastic; few fine roots; common fine tubular pores; few thin clay bridges; common fine soft lime accumulations in root channels; violently effervescent; moderately alkaline.

Depth to the buried Bt horizon commonly is 20 to 30 inches but ranges from 20 to 39 inches. The profile is moderately alkaline or strongly alkaline. The sodium adsorption ratio is 2 to 30. The electrical conductivity is 0 to 8 millimhos per centimeter.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4 when dry or moist.

The buried Bt horizon has hue of 7.5YR or 5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 4 to 8 when dry or moist.

### Glenbar Series

The Glenbar series consists of deep, well drained soils on flood plains. These soils formed in stream alluvium derived from granite, schist, rhyolite, quartzite, and some limestone. Slope 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are fine-silty, mixed (calcareous), hyperthermic Typic Torrifluvents.

Typical pedon of Glenbar clay loam; about 1,195 feet north and 1,225 feet west of the southeast corner of sec. 28, T. 9 S., R. 7 E.

Ap—0 to 13 inches; light yellowish brown (10YR 6/4) clay loam, brown (7.5YR 4/4) moist; massive; hard, friable, sticky and plastic; common fine roots; common fine tubular pores; common thin (0.25 inch thick) strata of silt and silt loam; common fine lime threads; strongly effervescent; moderately alkaline; clear wavy boundary.

C—13 to 60 inches; light yellowish brown (10YR 6/4) stratified silt loam and silty clay loam, brown (7.5YR 4/4) moist; slightly hard, friable, sticky and slightly plastic; common fine roots; common fine tubular pores; common fine lime threads; strongly effervescent; moderately alkaline.

The control section commonly is silt loam or silty clay loam, but in some places it is loam or clay loam. In some areas a buried B horizon is below a depth of 40 inches.

The A and C horizons have hue of 10YR or 7.5YR, value of 5 to 7 when dry and 4 or 5 when moist, and chroma of 2 to 4 when dry or moist. The C horizon has strata of loam, silty clay loam, silt loam, or clay loam and averages 18 to 34 percent clay.

### Gunsight Series

The Gunsight series consists of deep, somewhat excessively drained soils on fan terraces. These soils formed in very gravelly fan alluvium derived mainly from basalt, andesite, schist, and rhyolite. Slope is 1 to 8 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are loamy-skeletal, mixed, hyperthermic Typic Calciorthids.

Typical pedon of Gunsight very gravelly fine sandy loam, in an area of Gunsight-Pinamt complex, 1 to 8 percent slopes; about 1,800 feet east and 200 feet north of the southwest corner of sec. 7, T. 9 S., R. 6 E.

A—0 to 3 inches; light brown (7.5YR 6/4) very gravelly fine sandy loam, brown (7.5YR 5/4) moist; weak very thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; few very fine tubular pores; 45 percent of the surface is covered with pebbles; 20 percent pebbles in horizon; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bw—3 to 12 inches; pink (7.5YR 7/4) gravelly loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable, slightly plastic; many fine roots; few very fine tubular pores; 20 percent pebbles; few pebbles partially coated with lime on underside; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk1—12 to 22 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; common very fine interstitial pores; 45 percent pebbles; many pebbles coated with lime on underside; common medium soft lime masses; violently effervescent; strongly alkaline; gradual wavy boundary.

Bk2—22 to 34 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable, sticky and slightly plastic; many very fine roots; common very fine interstitial pores; 50 percent pebbles; most pebbles coated with lime on underside; many medium soft lime masses; violently effervescent; moderately alkaline; gradual wavy boundary.

Bk3—34 to 60 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable, sticky and slightly plastic; few very fine roots; common very fine interstitial pores; 50 percent lime-coated pebbles; common medium soft lime masses; violently effervescent; strongly alkaline.

The control section is 35 to 80 percent rock fragments. The cambic horizon has weak subangular blocky structure or is massive. Depth to the calcic horizon is 10 to 20 inches. The calcium carbonate equivalent of the calcic horizon is 8 to 30 percent. The sodium adsorption ratio ranges from 4 to 40. The electrical conductivity ranges from 0 to 8 millimhos per centimeter. In some areas the calcic horizon is weakly cemented.

The A and B horizons have hue of 7.5YR or 10YR, value of 6 or 7 when dry and 4 or 5 when moist, and chroma of 3 or 4 when dry or moist. Texture of the B horizon is very gravelly sandy loam or very gravelly loam. Some pedons have very gravelly loamy sand in the lower part, and others have thin horizons that are less than 35 percent rock fragments. Reaction of the B horizon is moderately alkaline or strongly alkaline.

### La Palma Series

The La Palma series consists of moderately deep, well drained, saline-sodic soils on relict basin floors. These soils formed in loamy eolian material and stream alluvium derived from granite, schist, rhyolite, quartzite, andesite, and some basalt. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are fine-loamy, mixed, hyperthermic Petrocalcic Paleargids.

Typical pedon of La Palma fine sandy loam; about 700 feet east and 200 feet south of the northwest corner of sec. 24, T. 7 S., R. 8 E.

A1—0 to 3 inches; pale brown (10YR 6/3) fine sandy loam, dark yellowish brown (10YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; common very fine roots; common very fine tubular pores; strongly effervescent; moderately alkaline; abrupt wavy boundary.

Btn1—3 to 5 inches; pink (7.5YR 7/4) loam, brown (7.5YR 5/4) moist; strong coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; few thick clay films on faces of peds;

violently effervescent; very strongly alkaline; abrupt wavy boundary.

2Btn2—5 to 13 inches; pink (7.5YR 7/4) clay loam, brown (7.5YR 5/4) moist; moderate coarse prismatic structure parting to moderate coarse subangular blocky; hard, friable, sticky and plastic; common very fine roots; common very fine tubular pores; common thick clay films on faces of peds and in pores; violently effervescent; very strongly alkaline; abrupt wavy boundary.

2Btkn—13 to 18 inches; pinkish gray (7.5YR 7/2) clay loam, light brown (7.5YR 6/4) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and plastic; few very fine roots; few very fine tubular pores; few medium clay films on faces of peds; few fine lime masses; violently effervescent; very strongly alkaline; clear wavy boundary.

2Bkn—18 to 28 inches; pinkish white (7.5YR 8/2) loam, pinkish gray (7.5YR 7/2) moist; massive; very hard, friable, sticky and plastic; common fine lime masses; violently effervescent; very strongly alkaline; clear wavy boundary.

3Bkm—28 inches; lime-cemented hardpan with thin laminar cap about 2 inches thick; indurated.

Depth to the hardpan ranges from 20 to 40 inches but is dominantly 24 to 34 inches. It is moderately alkaline or strongly alkaline. The sodium adsorption ratio is 4 to 60 or more. The electrical conductivity is 4 to 16 millimhos per centimeter or more.

The A horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 3 to 5 when moist, and chroma of 3 or 4 when dry or moist. Texture commonly is fine sandy loam; however, areas that are deep plowed are loam.

The Bt horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 3 or 4 when dry or moist. The upper part is loam and clay loam, and the lower part is loam, sandy clay loam, or clay loam.

The Bk horizon has hue of 7.5YR or 10YR, value of 7 or 8 when dry and 6 or 7 when moist, and chroma of 3 or 4 when dry or moist. Texture is loam or clay loam. Reaction is strongly alkaline or very strongly alkaline.

The Bkm horizon is a lime-cemented hardpan that consists of several thin pans (1 inch to 2 inches thick) with soil material between them. Reaction is strongly alkaline or very strongly alkaline.

### Laveen Series

The Laveen series consists of deep, well drained soils on fan terraces and stream terraces. These soils formed in fan and stream alluvium derived from granite, schist, rhyolite, andesite, and basalt. Slope is 0 to 1

percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are coarse-loamy, mixed, hyperthermic Typic Calciorthids.

Typical pedon of Laveen loam; about 800 feet south and 250 feet east of the northwest corner of sec. 36, T. 4 S., R. 3 E.

Ap—0 to 15 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 4/4) moist; massive; slightly hard, very friable, nonsticky and slightly plastic; common very fine roots; common fine tubular pores; strongly effervescent; moderately alkaline; abrupt wavy boundary.

Bk1—15 to 30 inches; pink (7.5YR 7/4) loam, light brown (7.5YR 6/4) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; violently effervescent; 10 percent lime nodules and many medium soft lime masses; moderately alkaline; gradual wavy boundary.

Bk2—30 to 42 inches; pinkish gray (7.5YR 7/2) very fine sandy loam, light brown (7.5YR 6/4) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; few very fine roots; common very fine tubular pores; violently effervescent; 15 percent lime nodules and many medium soft lime masses; moderately alkaline; abrupt smooth boundary.

Bk3—42 to 60 inches; pink (7.5YR 7/4) gravelly fine sandy loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few fine roots; few very fine interstitial pores; 20 percent pebbles; slightly effervescent; moderately alkaline.

Depth to the calcic horizon ranges from 14 to 30 inches. The 10- to 40-inch control section is very fine sandy loam, loam, or silt loam and is less than 18 percent clay. The content of calcium carbonate in the calcic horizon ranges from 15 to 40 percent, and the content of lime nodules or concretions ranges from 5 to 25 percent. The sodium adsorption ratio ranges from 1 to 40. The electrical conductivity is as much as 8 millimhos per centimeter.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 or 3 when dry or moist. This horizon contains few, if any, lime nodules.

The Bw horizon, which is in areas where the soil has not been disturbed or has not been plowed to a depth of more than 10 inches, has hue of 7.5YR, 10YR, or

5YR, value of 5 to 8 when dry and 4 to 7 when moist, and chroma of 2 to 4.

The Bk horizon has hue of 7.5YR or 10YR, value of 5 to 8 when dry and 4 to 7 when moist, and chroma of 2 to 4 when dry or moist. Above a depth of 40 inches it is very fine sandy loam, loam, or silt loam that has less than 18 percent clay. Below a depth of 40 inches the texture ranges from gravelly sandy loam to loam. In some areas a Bw horizon is present just below the A horizon.

## Marana Series

The Marana series consists of deep, well drained, moderately slowly permeable soils on stream terraces. These soils formed in silty stream alluvium derived from granite, schist, andesite, and basalt. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are fine-silty, mixed, hyperthermic Typic Camborthids.

Typical pedon of Marana silty clay loam; about 27 feet north and 107 feet west of the southeast corner of sec. 1, T. 10 S., R. 8 E.

A—0 to 2 inches; yellowish brown (10YR 5/4) silty clay loam, dark yellowish brown (10YR 3/4) moist; weak very thin platy structure; soft, very friable, sticky and plastic; few fine roots; common very fine tubular pores; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bw1—2 to 8 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common fine vesicular pores; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk2—8 to 23 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common fine tubular pores; secondary lime accumulations in root channels and on root hairs in lower part; thin discontinuous very dark brown (10YR 2/2) organic stains on some faces of peds; strongly effervescent; moderately alkaline; gradual wavy boundary.

C—23 to 60 inches; brown (10YR 5/3) silty clay loam, brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and plastic; few fine tubular pores; few fine roots; strongly effervescent; moderately alkaline.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 3 to 6 when dry or moist. Reaction is mildly alkaline or moderately alkaline.

The B horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 3 to 6 when dry or moist.

The C horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 3 to 6 when dry or moist.

## Mohall Series

The Mohall series consists of deep, well drained soils on fan terraces, stream terraces, and relict basin floors. These soils formed in fan alluvium derived from granite, schist, rhyolite, and some neutral and basic igneous rock and limestone. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are fine-loamy, mixed, hyperthermic Typic Haplargids.

Typical pedon of Mohall loam; about 100 feet west and 100 feet north of the southeast corner of sec. 29, T. 7 S., R. 6 E.

Ap—0 to 16 inches; light brown (7.5YR 6/4) loam, dark brown (7.5YR 4/4) moist; massive; soft, very friable, slightly sticky and nonplastic; few fine roots; common fine tubular pores; strongly effervescent; moderately alkaline; abrupt wavy boundary.

Bt—16 to 24 inches; light reddish brown (5YR 6/4) clay loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; few medium roots; common very fine tubular pores; strongly effervescent; moderately alkaline; abrupt wavy boundary.

Btk1—24 to 37 inches; light reddish brown (5YR 6/4) clay loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and plastic; few fine roots; common fine tubular pores; few thin clay films on faces of peds; common fine soft lime masses; violently effervescent; moderately alkaline; clear wavy boundary.

Btk2—37 to 43 inches; light reddish brown (5YR 6/4) clay loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; few fine soft lime masses; violently effervescent; moderately

alkaline; clear wavy boundary.

Bk—43 to 60 inches; pink (7.5YR 7/4) sandy loam, brown (7.5YR 5/4) moist; massive; loose, very friable, nonsticky and nonplastic; common fine interstitial pores; few fine soft lime masses; strongly effervescent; moderately alkaline.

The solum is 20 to 50 inches thick or more. Depth to a zone of calcium carbonate accumulation ranges from 12 to 36 inches, and depth to the calcic horizon ranges from 20 to 40 inches. The calcium carbonate equivalent is 15 to 35 percent in the calcic horizon. The sodium adsorption ratio is 4 to 10 at a depth of 40 to 60 inches.

The A horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 3 to 5 when moist, and chroma of 2 to 6 when dry or moist. Texture is sandy loam, loam, or clay loam.

The Bt horizon has hue of 5YR or 7.5YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 3 to 6 when dry or moist. It is loam, sandy clay loam, or clay loam and is 18 to 35 percent clay.

The Bk horizon has hue of 7.5YR or 5YR, value of 5 to 7 when dry and 3 to 5 when moist, and chroma of 2 to 4 when dry or moist. It is sandy clay loam, loam, clay loam, or sandy loam.

## Momoli Series

The Momoli series consists of deep, somewhat excessively drained soils on fan terraces. These soils formed in fan alluvium derived from granite, schist, rhyolite, andesite, and basalt. Slope is 1 to 8 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are loamy-skeletal, mixed, hyperthermic Typic Camborthids.

Typical pedon of Momoli very gravelly fine sandy loam, in an area of Pinamt-Momoli complex, 1 to 8 percent slopes; about 800 feet north and 600 feet west of the southeast corner of sec. 33, T. 6 S., R. 3 E.

A—0 to 2 inches; light brown (7.5YR 6/4) very gravelly fine sandy loam, brown (7.5YR 4/4) moist; weak medium platy structure; slightly hard, very friable; few very fine roots; common very fine vesicular pores; 50 percent pebbles; slightly effervescent; moderately alkaline; abrupt wavy boundary.

Bw—2 to 26 inches; light brown (7.5YR 6/4) very gravelly sandy loam, brown (7.5YR 4/4) moist; massive; soft, very friable; many very fine roots; many very fine interstitial pores; few fine soft lime masses and 50 percent partially lime-coated

pebbles in lower part; strongly effervescent; moderately alkaline; abrupt wavy boundary.

Bk1—26 to 34 inches; light brown (7.5YR 5/4) very gravelly sandy loam, brown (7.5YR 4/4) moist; single grain; loose; few very fine roots; many very fine interstitial pores; few fine soft lime masses and threads and 60 percent partially lime-coated pebbles; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk2—34 to 60 inches; light brown (7.5YR 6/4) very gravelly loamy sand, brown (7.5YR 5/4) moist; single grain; loose; many fine interstitial pores; few fine soft lime masses; 45 percent partially lime-coated pebbles; slightly effervescent; moderately alkaline.

From 35 to 80 percent of the surface is covered with a varnished-desert pavement of gravel-sized rock fragments. The content of rock fragments in the profile ranges from 35 to 70 percent. The sodium adsorption ratio and electrical conductivity range from 0 to 8.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 4 to 6 when dry or moist. It is fine sandy loam or sandy loam and is 35 to 70 percent rock fragments.

The B horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 4 to 6 when dry or moist. It is fine sandy loam, sandy loam, or loam and is 35 to 70 percent pebbles. In some areas the lower part of the B horizon is loamy sand or coarse sandy loam and is more than 35 percent pebbles.

## Pajarito Series

The Pajarito series consists of deep, somewhat excessively drained soils on fan terraces. These soils formed in fan alluvium derived from granite and rhyolite. Slope is 1 to 3 percent. Elevation is 2,000 to 3,600 feet. The average annual precipitation is about 10 to 12 inches, the average annual air temperature is 64 to 68 degrees F, and the average frost-free season is 180 to 240 days.

These soils are coarse-loamy, mixed, thermic Typic Camborthids.

Typical pedon of Pajarito gravelly sandy loam, in an area of Pajarito-Sonoita complex; about 50 feet east and 1,056 feet north of the southwest corner of sec. 13, T. 9 S., R. 10 E.

A—0 to 2 inches; light yellowish brown (10YR 6/4) gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; weak thin platy structure; slightly hard,

very friable, nonsticky and nonplastic; many very fine roots; many very fine vesicular pores; 20 percent pebbles; noneffervescent; neutral; clear wavy boundary.

Bw—2 to 20 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; many very fine roots; many very fine vesicular pores; 5 percent pebbles; noneffervescent; neutral; clear wavy boundary.

Bk1—20 to 23 inches; light brown (7.5YR 6/4) gravelly fine sandy loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; many very fine roots; many very fine vesicular pores; 20 percent pebbles; common fine secondary lime accumulations; slightly effervescent; moderately alkaline; abrupt wavy boundary.

Bk2—23 to 31 inches; light yellowish brown (10YR 6/4) gravelly loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; few very fine roots; many very fine vesicular pores; 20 percent pebbles; common fine secondary lime accumulations; strongly effervescent; moderately alkaline; clear wavy boundary.

C—31 to 60 inches; light yellowish brown (10YR 6/4) loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; few very fine roots; many very fine vesicular pores; 10 percent pebbles; strongly effervescent; moderately alkaline.

The content of rock fragments in the profile is 5 to 25 percent. At a depth of about 20 to 25 inches, fine secondary lime accumulations are present in pores and root channels.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 when moist, and chroma of 2 to 4 when dry or moist. Reaction is neutral or mildly alkaline.

The B horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 3 to 6 when moist, and chroma of 3 to 6 when dry or moist. Texture is gravelly fine sandy loam, gravelly sandy loam, gravelly loam, sandy loam, loam, or fine sandy loam. Reaction of the Bw horizon is neutral or mildly alkaline. Reaction of the Bk horizon is mildly alkaline or moderately alkaline.

The C horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 3 or 4 when dry or moist. Texture is gravelly fine sandy loam, gravelly sandy loam, gravelly loam, sandy loam, or loam.

## Pimer Series

The Pimer series consists of deep, well drained soils on flood plains. These soils formed in stream alluvium derived from granite, schist, rhyolite, quartzite, shale, limestone, andesite, and basalt. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are fine-silty, mixed (calcareous), hyperthermic Typic Torrifluvents.

Typical pedon of Pimer silty clay; about 1,400 feet south and 40 feet east of the northwest corner of sec. 14, T. 10 S., R. 9 E.

Ap—0 to 15 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and plastic; many fine roots; common fine tubular pores; strongly effervescent; moderately alkaline; abrupt smooth boundary.

C1—15 to 27 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and plastic; common fine roots; common very fine tubular pores; strongly effervescent; moderately alkaline; clear wavy boundary.

C2—27 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; strongly effervescent; moderately alkaline.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3 when dry or moist. The C horizon has hue of 10YR or 7.5YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 2 to 4 when dry or moist. The control section is silty clay, clay loam, silt loam, or loam and is 18 to 35 percent clay. Thin strata of finer or coarser textured soil material are below a depth of 15 inches. The content of organic matter is 1 percent or more at a depth of 22 to 38 inches.

## Pinamt Series

The Pinamt series consists of deep, well drained soils on fan terraces. These soils formed in very gravelly fan alluvium derived from granite, schist, rhyolite, andesite, and basalt. Slope is 1 to 8 percent. Elevation is 1,200 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average

frost-free season is 240 to 325 days.

These soils are loamy-skeletal, mixed, hyperthermic Typic Haplargids.

Typical pedon of Pinamt very gravelly loam, in an area of Pinamt-Momoli complex, 1 to 8 percent slopes (fig. 4); about 1,380 feet north and 125 feet east of the southwest corner of sec. 11, T. 7 S., R. 3 E.

A—0 to 2 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; many fine tubular pores; 30 percent pebbles in horizon; about 45 percent of the surface covered with a thin varnished-desert pavement; slightly effervescent; moderately alkaline; abrupt smooth boundary.

Bt—2 to 7 inches; yellowish red (5YR 5/6) very gravelly clay loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine roots; few very fine tubular pores; few thin clay films on faces of peds; 55 percent pebbles; strongly effervescent; moderately alkaline; abrupt wavy boundary.

Btk1—7 to 20 inches; yellowish red (5YR 5/6) very gravelly clay loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; slightly hard, friable, sticky and plastic; few very fine roots; common very fine tubular pores; few thin clay films on faces of peds; 65 percent pebbles; common medium soft lime masses; strongly effervescent; moderately alkaline; clear wavy boundary.

2Btk2—20 to 23 inches; light reddish brown (5YR 6/4) very gravelly sandy clay loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; few thin clay films on faces of peds; 60 percent pebbles; common soft lime masses; violently effervescent; moderately alkaline; clear wavy boundary.

2Bk1—23 to 54 inches; light brown (7.5YR 6/4) extremely gravelly sandy loam, brown (7.5YR 5/4) moist; massive; slightly hard, friable, nonsticky and nonplastic; few fine interstitial pores; 75 percent pebbles; common soft lime masses; violently effervescent; moderately alkaline; abrupt wavy boundary.

2Bk2—54 to 60 inches; light brown (7.5YR 6/2) very gravelly sandy loam, dark brown (7.5YR 7/2) moist; massive; hard, friable, nonsticky and nonplastic; common fine interstitial pores; 60 percent pebbles; many large hard lime masses; violently effervescent; moderately alkaline.



Figure 4.—Profile of Pinamt very gravelly loam in an area of Pinamt-Momoll complex, 1 to 8 percent slopes.

Thickness of the solum ranges from 20 to 40 inches or more. The Bk horizon in some pedons is weakly

cemented with lime. Depth to the calcic horizon is 5 to 20 inches.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 or 4 when dry or moist. Texture of the A horizon is very gravelly loam or very gravelly fine sandy loam.

The Bt horizon has hue of 5YR or 7.5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 4 to 6 when dry or moist. It is clay loam, sandy clay loam, or loam and is 35 to 75 percent rock fragments.

The Bk horizon has hue of 7.5YR or 10YR, value of 6 to 8 when dry and 4 to 6 when moist, and chroma of 2 to 6 when dry or moist. It is sandy loam, sandy clay loam, or loam and is 35 to 75 percent rock fragments.

### Quilotosa Series

The Quilotosa series consists of very shallow and shallow, somewhat excessively drained soils that formed in slope alluvium derived dominantly from granite and gneiss. Slope is 5 to 60 percent. Elevation is 1,200 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are loamy-skeletal, mixed (calcareous), hyperthermic Lithic Torriorthents.

Typical pedon of Quilotosa extremely stony loam, in an area of Quilotosa-Rock outcrop complex, 5 to 60 percent slopes; about 1,716 feet north and 660 feet west of the southeast corner of sec. 14, T. 5 S., R. 5 E.

A—0 to 2 inches; pale brown (10YR 6/3) extremely stony loam, brown (10YR 5/4) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many fine roots; many very fine interstitial pores; slightly effervescent; moderately alkaline; abrupt wavy boundary.

C—2 to 10 inches; brown (10YR 5/3) extremely gravelly sandy loam, brown (10YR 4/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few fine roots; many very fine interstitial pores; slightly effervescent; moderately alkaline; gradual wavy boundary.

2Cr—10 to 18 inches; weathered granite; few fine roots; slightly effervescent; calcium carbonate coatings on fracture planes; clear wavy boundary.

2R—18 inches; unweathered granite.

The content of rock fragments in the profile is as much as 60 to 80 percent. About 80 percent of the surface is covered with pebbles, cobbles, stones, and boulders. Depth to bedrock ranges from 4 to 20 inches.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3

or 4 when dry or moist. Some pedons have a Bw horizon between the A and C horizons.

The C horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 or 4 when dry or moist. It is extremely gravelly sandy loam or extremely gravelly loam. This horizon is absent where a Bw horizon is present in sufficient thickness.

### Rositas Series

The Rositas series consists of deep, somewhat excessively drained soils on dunes. These soils formed in eolian sand. Slope is 1 to 3 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are mixed, hyperthermic Typic Torripsamments.

Typical pedon of Rositas loamy fine sand; about 2,250 feet east and 200 feet north of the southwest corner of sec. 11, T. 6 S., R. 6 E.

A1—0 to 2 inches; light brown (7.5YR 6/4) loamy fine sand, dark brown (7.5YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; common fine interstitial pores; slightly effervescent; moderately alkaline; abrupt wavy boundary.

C1—2 to 12 inches; light brown (7.5YR 6/4) loamy sand, dark brown (7.5YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; many fine roots; common fine interstitial pores; strongly effervescent; moderately alkaline; gradual wavy boundary.

C2—12 to 40 inches; light brown (7.5YR 6/4) loamy sand, dark brown (7.5YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; few fine roots; common fine interstitial pores; strongly effervescent; moderately alkaline; gradual wavy boundary.

C3—40 to 60 inches; light brown (7.5YR 6/4) loamy sand, dark brown (7.5YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; common fine interstitial pores; strongly effervescent; strongly alkaline.

The A and C horizons have hue of 7.5YR or 10YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 3 or 4 when dry or moist. The 10- to 40-inch control section is loamy sand, loamy fine sand, or fine sand. Reaction of the C3 horizon is moderately alkaline or strongly alkaline.

### Saminiego Series

The Saminiego series consists of deep, well drained soils on stream terraces. These soils formed in stream alluvium derived from granite, schist, rhyolite, andesite, quartzite, limestone, and basalt. Slopes are 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are clayey over fine-silty, mixed, hyperthermic Typic Camborthids.

Typical pedon of Saminiego silty clay loam (fig. 5); about 2,376 feet north and 132 feet west of the southeast corner of sec. 7, T. 10 S., R. 9 E.

A—0 to 2 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; slightly hard, firm, sticky and plastic; common fine roots; common fine tubular and vesicular pores; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bw1—2 to 8 inches; dark brown (10YR 4/3) clay, very dark grayish brown (10YR 3/2) moist; strong medium prismatic structure parting to strong medium subangular blocky; hard, very firm, sticky and very plastic; common fine roots; common fine tubular pores; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bw2—8 to 21 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; strong medium prismatic structure parting to strong medium subangular blocky; very hard, extremely firm, sticky and very plastic; common fine roots; common fine tubular pores; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk—21 to 30 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; strong fine subangular blocky structure; very hard, extremely firm, sticky and very plastic; common fine roots; common fine tubular pores; common fine segregations of lime in root channels; strongly effervescent; moderately alkaline; abrupt smooth boundary.

2C—30 to 60 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; massive; slightly hard, firm, sticky and plastic; continuous thin organic stains in desiccation cracks; common very fine roots; common very fine tubular pores; strongly effervescent; moderately alkaline.

Depth to the 2C horizon ranges from 20 to 39 inches but is dominantly 24 to 30 inches.

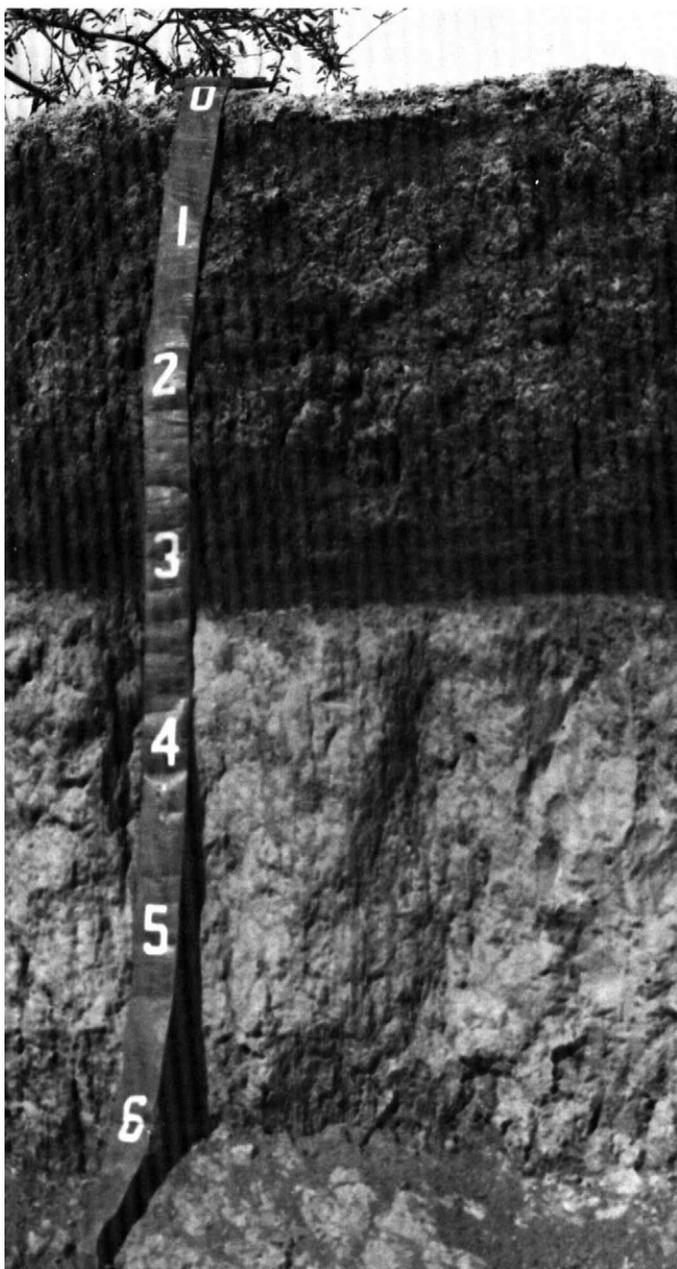


Figure 5.—Profile of Saminiego silty clay loam.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 to 4 when dry or moist. Reaction is mildly alkaline or moderately alkaline.

The B horizon has hue of 7.5YR or 10YR, value of 3 or 4 when dry and 2 or 3 when moist, and chroma of 1 to 4 when dry or moist. It is clay or silty clay and is 45 to 65 percent clay. Reaction is mildly alkaline or moderately alkaline.

The C horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 3 to 5 when moist, and chroma of 3 or 4 when dry or moist. It is silty clay loam or silt loam and is 10 to 30 percent clay.

### Sasco Series

The Sasco series consists of deep, well drained soils on stream terraces. These soils formed in silty stream alluvium derived from granite, schist, rhyolite, andesite, and quartzite. Slope is 0 to 1 percent. Elevation is 1,100 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are coarse-silty, mixed, hyperthermic Typic Camborthids.

Typical pedon of Sasco silt loam; about 400 feet east and 2,300 feet south of the northwest corner of sec. 2, T. 8 E., R. 10 S.

A—0 to 2 inches; dark yellowish brown (10YR 4/4) silt loam, dark brown (10YR 3/3) moist; moderate very fine granular structure; soft, friable, slightly sticky and slightly plastic; few very fine roots; many fine vesicular pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

Bw1—2 to 6 inches; pale brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; soft, friable, slightly sticky and plastic; common very fine roots; common fine vesicular pores; very few thin patchy organic stains lining pores; strongly effervescent; moderately alkaline; clear smooth boundary.

Bw2—6 to 26 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; soft, friable, slightly sticky and slightly plastic; few very fine roots; many fine vesicular pores; very few thin patchy organic stains lining pores; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk3—26 to 33 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; weak coarse subangular blocky structure; soft, friable, slightly sticky and slightly plastic; few very fine roots; many fine vesicular pores; very few thin organic stains lining pores; secondary lime in some root channels; strongly effervescent; abrupt smooth boundary.

C—33 to 47 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; weak fine subangular blocky structure; hard, firm, sticky and plastic; few fine roots; few very fine tubular pores; strongly

effervescent; moderately alkaline; clear smooth boundary.

2Btb—47 to 60 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; few fine roots; few very fine tubular pores; very few moderately thick patchy clay films on faces of peds and lining pores; strongly effervescent; moderately alkaline.

Depth to the buried soil, where present, ranges from 40 to 60 inches.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 to 6 when dry or moist.

The B horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 to 6 when moist, and chroma of 3 to 6 when dry or moist. Texture is silt loam or silt.

The C horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 3 to 6 when dry or moist. Texture is silt loam or silt.

### Sonoita Series

The Sonoita series consists of deep, somewhat excessively drained soils on fan terraces. These soils formed in alluvium derived dominantly from granite and rhyolite. Slope is 1 to 3 percent. Elevation is 2,000 to 3,600 feet. The average annual precipitation is about 10 to 12 inches, the average annual air temperature is 64 to 68 degrees F, and the frost-free season is 180 to 240 days.

These soils are coarse-loamy, mixed, thermic Typic Haplargids.

Typical pedon of Sonoita sandy loam, in an area of Pajarito-Sonoita complex; about 340 feet west and 3,000 feet south of the northeast corner of sec. 35, T. 9 S., R. 10 E.

A—0 to 2 inches; light yellowish brown (10YR 6/4) sandy loam, brown (10YR 4/3) moist; weak very thin platy structure; soft, very friable, nonsticky and nonplastic; common very fine roots; common very fine tubular pores; noneffervescent; neutral; abrupt smooth boundary.

BA—2 to 12 inches; strong brown (7.5YR 5/6) sandy loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; common very fine roots; common very fine tubular pores; noneffervescent; neutral; clear smooth boundary.

Bt—12 to 20 inches; strong brown (7.5YR 5/6) loam, dark brown (7.5YR 4/4) moist; weak fine subangular

blocky structure; slightly hard, friable, slightly sticky and nonplastic; few very fine roots; common fine tubular pores; common thin clay films on faces of peds and lining pores; about 6 percent pebbles; slightly effervescent; moderately alkaline; clear wavy boundary.

Btk—20 to 35 inches; strong brown (7.5YR 5/6) loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common fine tubular pores; common thin clay films on faces of peds and lining pores; few very fine lime masses; about 10 percent pebbles; slightly effervescent; moderately alkaline; abrupt smooth boundary.

Bk—35 to 44 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; very few fine roots; few fine tubular pores; lime accumulations in most pores; about 10 percent pebbles; strongly effervescent; moderately alkaline; clear wavy boundary.

2Btkb—44 to 60 inches; light brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; very few fine roots; few fine tubular pores; thin patchy clay films on faces of peds; few lime accumulations in pores; strongly effervescent; moderately alkaline.

The content of coarse fragments in the profile is 5 to 35 percent. The content of clay in the control section is less than 18 percent. A layer of secondary lime accumulation is at a depth of about 20 inches.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 6 when dry and 3 or 4 when moist, and chroma of 3 or 4 when dry or moist. Reaction is neutral or mildly alkaline.

The BA horizon is neutral or mildly alkaline. Texture is loam, sandy loam, fine sandy loam, or sandy clay loam.

The Bt horizon has hue of 5YR or 7.5YR, value of 4 to 6 when dry and 3 or 4 when moist, and chroma of 3 to 6 when dry or moist. Texture is loam, fine sandy loam, sandy clay loam, sandy loam, or gravelly sandy loam.

The Bk horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 to 6 when dry or moist. Texture is loam, sandy clay loam, gravelly sandy loam, sandy loam, or fine sandy loam.

## Toltec Series

The Toltec series consists of deep, well drained soils on relict basin floors. These soils formed in eolian material derived from stream alluvium over older silica-lime cemented alluvium derived from granite, schist, rhyolite, quartzite, andesite, and basalt. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are coarse-loamy, mixed, hyperthermic Typic Calciorthids.

Typical pedon of Toltec fine sandy loam; about 2,440 feet west and 100 feet north of the southeast corner of sec. 24, T. 7 S., R. 7 E.

- Ap—0 to 12 inches; pale brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and nonplastic; common fine roots; common fine tubular pores; 5 percent lime-silica cemented fragments; slightly effervescent; moderately alkaline; abrupt smooth boundary.
- Bw—12 to 24 inches; light brown (7.5YR 6/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common very fine roots; common very fine tubular pores; 10 percent pan fragments; strongly effervescent; moderately alkaline; clear smooth boundary.
- 2Bk—24 to 36 inches; light brown (7.5YR 6/4) very fine sandy loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; 15 percent pan fragments; common fine lime masses; violently effervescent; strongly alkaline; clear wavy boundary.
- 2Bkq1—36 to 50 inches; pinkish gray (7.5YR 7/2) extremely gravelly fine sandy loam, light brown (7.5YR 6/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; about 85 percent pebbles composed of silica-lime cemented pan fragments; violently effervescent; strongly alkaline; abrupt wavy boundary.
- 2Bkq2—50 to 60 inches; pinkish gray (7.5YR 7/2) very gravelly fine sandy loam; massive; slightly hard, friable, slightly sticky and slightly plastic; 55 percent pebbles composed of silica-lime cemented pan fragments; violently effervescent; strongly alkaline.

Depth to the Bkq horizon ranges from 20 to 40 inches but averages about 24 inches. It commonly occurs as a number of thin (1 to 5 centimeters thick)

plates separated by soil material. Pan fragments are scattered throughout the profile in most pedons. The profile ranges from mildly alkaline to strongly alkaline. The control section averages less than 35 percent rock fragments, which are mostly pan fragments. The sodium adsorption ratio ranges from 1 to 20. The electrical conductivity ranges from 1 to 16 millimhos per centimeter.

The A horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 3 or 4 when moist, and chroma of 2 to 6 when dry or moist.

The Bw horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 3 to 5 when moist, and chroma of 2 to 6 when dry or moist. Texture is fine sandy loam, very fine sandy loam, or sandy loam.

The Bkq horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 3 to 6 when moist, and chroma of 2 to 6 when dry or moist. Texture is extremely gravelly very fine sandy loam, very gravelly fine sandy loam, or very gravelly sandy loam. Rock fragments are mostly pan fragments.

## Tremant Series

The Tremant series consists of deep, well drained soils on fan terraces. These soils formed in gravelly fan alluvium derived dominantly from granite, schist, and rhyolite. Slope is 1 to 3 percent. Elevation is 1,200 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are fine-loamy, mixed, hyperthermic Typic Haplargids.

Typical pedon of Tremant gravelly loam, in an area of Tremant-Denure complex; about 2,225 feet north and 50 feet east of the southwest corner of sec. 17, T. 5 S., R. 2 E.

- A—0 to 2 inches; light brown (7.5YR 6/4) gravelly loam, dark brown (7.5YR 4/4) moist; weak medium platy structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; few very fine tubular pores; 15 percent pebbles; strongly effervescent; moderately alkaline; abrupt wavy boundary.
- Bt—2 to 5 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few thin clay films on faces of peds; common fine roots; common very fine tubular pores; 15 percent pebbles; strongly effervescent; moderately alkaline; clear wavy boundary.
- Btk1—5 to 16 inches; brown (7.5YR 5/4) gravelly clay

loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, firm, slightly sticky and plastic; few fine roots; few fine tubular pores; few thin clay films on faces of peds; violently effervescent; 15 percent pebbles; few very fine soft lime masses; moderately alkaline; clear wavy boundary.

Btk2—16 to 23 inches; brown (7.5YR 5/4) gravelly clay loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; hard, firm, slightly sticky and plastic; common fine tubular pores; 20 percent pebbles; few thin clay films on faces of peds; violently effervescent; many medium soft lime masses; moderately alkaline; gradual wavy boundary.

Bk1—23 to 36 inches; light brown (7.5YR 6/4) gravelly clay loam, brown (7.5YR 5/4) moist; massive; hard, firm, slightly sticky and plastic; common fine tubular pores; 25 percent pebbles; violently effervescent; many medium soft lime masses; moderately alkaline; clear wavy boundary.

Bk2—36 to 60 inches; light brown (7.5YR 6/4) gravelly sandy clay loam, brown (7.5YR 5/4) moist; massive; hard, firm, slightly sticky and plastic; few fine tubular pores; 35 percent pebbles; violently effervescent; common medium soft lime masses; moderately alkaline.

Varnished-desert pavement covers from 15 to 35 percent of the surface. A discontinuous E horizon 0.5 inch to 2 inches thick is present below the A horizon in some pedons. The content of coarse fragments in the control section ranges from 15 to 35 percent.

The A horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 4 or 5 when moist, and chroma of 3 or 4 when dry or moist.

The Bk horizon has hue of 7.5YR or 5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 4 or 5 when dry or moist. Texture is gravelly sandy clay loam, gravelly clay loam, gravelly loam, or gravelly sandy loam.

### **Trix Series**

The Trix series consists of deep, well drained soils on flood plains. These soils formed in moderately fine textured stream alluvium over older alluvium derived from granite, schist, and rhyolite. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are fine-loamy, mixed (calcareous), hyperthermic Typic Torrifuvents.

Typical pedon of Trix clay loam; about 1,500 feet east and 2,600 feet north of the southwest corner of sec. 25, T. 4 S., R. 3 E.

Ap—0 to 15 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/2) moist; massive; slightly hard, friable, sticky and plastic; common fine roots; common fine tubular pores; slightly effervescent; moderately alkaline; abrupt wavy boundary.

C—15 to 24 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/2) moist; massive; hard, friable, sticky and plastic; common fine roots; common fine pores; strongly effervescent; moderately alkaline; abrupt wavy boundary.

2Btkb1—24 to 34 inches; light reddish brown (5YR 6/4) sandy clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine roots; common fine tubular pores; common thin clay films on faces of peds; strongly effervescent; few fine soft lime masses; moderately alkaline; clear wavy boundary.

2Btkb2—34 to 44 inches; light reddish brown (5YR 6/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; few fine roots; common fine tubular pores; few thin clay films on faces of peds; violently effervescent; common fine soft lime masses; moderately alkaline; clear wavy boundary.

2Bkb1—44 to 48 inches; light reddish brown (5YR 6/4) clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and plastic; few very fine roots; common fine tubular pores; violently effervescent; few medium soft lime masses; moderately alkaline; clear wavy boundary.

2Bbk2—48 to 60 inches; pink (7.5YR 7/4) clay loam, light reddish brown (5YR 6/4) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and plastic; few fine tubular pores; violently effervescent; few medium soft lime masses; moderately alkaline.

Depth to the buried soil generally ranges from 24 to 30 inches. In places it ranges from 20 to 38 inches. The profile ranges from slightly effervescent to violently effervescent below a depth of about 15 inches.

The A and C horizons have hue of 10YR or 7.5YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 2 to 4 when dry or moist. The C horizon is clay loam, silt loam, or silty clay loam and is 18 to 35 percent clay. Some pedons have very thin strata of coarser textured soil material in the C horizon.

The 2B horizon has hue of 5YR or 7.5YR, value of 5

or 6 when dry and 3 to 5 when moist, and chroma of 3 to 6 when dry or moist. It is clay loam, sandy clay loam, or loam and is 18 to 35 percent clay. Few to many, very fine to medium lime segregations are present. The sodium adsorption ratio ranges from 0 to 20. The electrical conductivity ranges from 0 to 8 millimhos per centimeter.

### Vaiva Series

The Vaiva series consists of very shallow and shallow, well drained soils on hillslopes and mountain slopes. These soils formed in eolian material, slope alluvium, and residuum derived dominantly from granite and gneiss. Slope is 2 to 50 percent. Elevation is 1,200 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are loamy-skeletal, mixed, hyperthermic Lithic Haplargids.

Typical pedon of Vaiva extremely stony sandy loam, in an area of Vaiva-Rock outcrop complex, 15 to 50 percent slopes; about 1,000 feet west and 100 feet south of the northeast corner of sec. 4, T. 7 S., R. 2 E.

A—0 to 4 inches; brown (7.5YR 5/4) extremely stony sandy loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; common fine interstitial pores; 25 percent stones and 50 percent pebbles; slightly effervescent; moderately alkaline; abrupt wavy boundary.

Bt—4 to 11 inches; brown (7.5YR 5/4) very gravelly sandy clay loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; common very fine interstitial pores; common moderately thick clay films on pebbles and bridging sand grains; 50 percent pebbles; slightly effervescent; moderately alkaline; abrupt wavy boundary.

Btk—11 to 16 inches; light brown (7.5YR 6/4) extremely gravelly sandy clay loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; common fine interstitial pores; 75 percent pebbles; common moderately thick clay films on pebbles; thin lime coatings on some pebbles; few fine rounded lime masses; violently effervescent; moderately alkaline; abrupt wavy boundary.

2R—16 to 20 inches; fractured granite; common

yellowish red (5YR 5/6) clay coatings and few thin lime coatings in fractures; few very fine roots in fractures.

About 30 to 50 percent of the surface is covered with angular pebbles, cobbles, and stones. Depth to rock ranges from 4 to 20 inches. The content of rock fragments in the control section ranges from 35 to 75 percent but commonly is 50 to 70 percent. Reaction is mildly alkaline or moderately alkaline throughout.

The A horizon has hue of 7.5YR or 5YR, value of 4 to 6 when dry and 4 or 5 when moist, and chroma of 3 or 4 when dry or moist. It is extremely stony sandy loam or very gravelly loam.

The B horizon has hue of 7.5YR or 5YR, value of 4 to 6 when dry and 4 or 5 when moist, and chroma of 3 to 6 when dry or moist. It is very gravelly sandy clay loam, very gravelly clay loam, very gravelly loam, or extremely gravelly sandy clay loam and is more than 18 percent clay.

### Valencia Series

The Valencia series consists of deep, well drained soils on flood plains and alluvial fans. These soils formed in moderately coarse textured stream and fan alluvium deposited over older alluvium derived dominantly from acid and basic igneous rock and some metamorphic rock. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are coarse-loamy, mixed, hyperthermic Fluventic Camborthids.

Typical pedon of Valencia sandy loam; about 350 feet west and 2,440 feet south of the northeast corner of sec. 28, T. 5 S., R. 6 E.

Ap—0 to 8 inches; light yellowish brown (10YR 6/4) sandy loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common fine roots; common very fine vesicular pores; noneffervescent; moderately alkaline; abrupt wavy boundary.

Bw—8 to 17 inches; light brown (7.5YR 6/4) sandy loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; many very fine interstitial pores; about 1 percent pebbles; noneffervescent; moderately alkaline; clear wavy boundary.

Bk—17 to 28 inches; light brown (7.5YR 6/4) sandy

loam, brown (7.5YR 5/4) moist; soft, very friable, nonsticky and nonplastic; common fine roots; few fine tubular pores; lime accumulations lining pores, in root channels, and as a few fine masses; about 3 percent pebbles; strongly effervescent; moderately alkaline; clear wavy boundary.

2Btkb1—28 to 31 inches; light reddish brown (5YR 6/4) loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common fine tubular pores; few thin clay films on faces of peds; few lime accumulations in root channels and lining pores; about 5 percent pebbles; strongly effervescent; moderately alkaline; abrupt wavy boundary.

2Btkb2—31 to 39 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; few medium roots; few fine tubular pores; thin discontinuous clay films on faces of peds; few fine irregular lime masses; about 3 percent pebbles; strongly effervescent; moderately alkaline; clear wavy boundary.

2Bkb1—39 to 46 inches; light reddish brown (5YR 6/4) sandy clay loam, reddish brown (5YR 5/4) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; common fine tubular pores; few medium lime masses; about 3 percent pebbles; violently effervescent; moderately alkaline; clear wavy boundary.

2Bkb2—46 to 60 inches; pink (7.5YR 7/4) sandy loam, light brown (7.5YR 6/4) moist; massive; hard, firm, slightly sticky and slightly plastic; few very fine tubular pores; common fine irregular lime masses; about 3 percent pebbles; violently effervescent; moderately alkaline.

Depth to the buried Bt horizon generally ranges from 24 to 30 inches. In places it ranges from 20 to 39 inches. The profile ranges from mildly alkaline to strongly alkaline and nonsaline to moderately saline.

The A and C horizons have hue of 10YR or 7.5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 to 4 when dry or moist. Texture of the C horizon dominantly is sandy loam, fine sandy loam, or loamy very fine sand, but some pedons contain thin strata of coarser or finer textured material.

The Bt horizon has hue of 5YR or 7.5YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 3 to 6 when dry or moist. Texture is clay loam, sandy clay loam, or loam. Few to many, very fine and medium lime segregations are present, and they have value as high as 8 and chroma as low as 2. The sodium adsorption

ratio ranges from 0 to 20. The electrical conductivity ranges from 0 to 8 millimhos per centimeter.

## Why Series

The Why series consists of deep, somewhat excessively drained soils on alluvial fans and flood plains. These soils formed in stream and fan alluvium derived from acid and basic igneous rock. Slope is 0 to 1 percent. Elevation is 1,140 to 2,000 feet. The average annual precipitation is about 6 to 8 inches, the average annual air temperature is 68 to 72 degrees F, and the average frost-free season is 240 to 325 days.

These soils are coarse-loamy, mixed, hyperthermic Fluventic Camborthids.

Typical pedon of Why sandy loam; about 175 feet east and 100 feet north of the southeast corner of sec. 15, T. 5 S., R. 2 E.

A—0 to 2 inches; light yellowish brown (10YR 6/4) sandy loam, dark yellowish brown (10YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; common fine interstitial pores; common fine roots; about 2 percent fine pebbles; noneffervescent; moderately alkaline; abrupt smooth boundary.

Bw1—2 to 9 inches; light yellowish brown (10YR 6/4) sandy loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine interstitial pores; common very fine roots; about 5 percent pebbles; noneffervescent; moderately alkaline; clear wavy boundary.

Bw2—9 to 15 inches; light brown (7.5YR 6/4) sandy loam, brown (7.5YR 4/4) moist; weak medium subangular blocky structure; soft, friable, slightly sticky and nonplastic; common fine interstitial pores; few fine roots; about 10 percent pebbles; slightly effervescent; moderately alkaline; clear wavy boundary.

Bk1—15 to 25 inches; light brown (7.5YR 6/4) sandy loam, strong brown (7.5YR 4/6) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common fine interstitial pores; few very fine roots; about 10 percent fine pebbles; common lime accumulations in pores and root channels and on the underside of pebbles; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk2—25 to 37 inches; light brown (7.5YR 6/4) sandy loam, strong brown (7.5YR 4/6) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common medium

interstitial pores; few very fine roots; common lime accumulations in root channels and pores and on the underside of pebbles; about 2 percent fine pebbles; strongly effervescent; moderately alkaline; abrupt wavy boundary.

Bk3—37 to 60 inches; strong brown (7.5YR 5/6) sandy loam, strong brown (7.5YR 4/6) moist; massive; soft, friable, slightly sticky and slightly plastic; common fine interstitial pores; few very fine roots; few thin lime accumulations in pores and root channels and on the underside of pebbles; about 3 percent pebbles; strongly effervescent; moderately alkaline.

The A horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 3 to 5 when moist, and chroma of 2 to 6 when dry or moist.

The Bw horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 3 to 5 when moist, and chroma of 2 to 6 when dry or moist. Texture is sandy loam or fine sandy loam.

The Bk horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 3 to 5 when moist, and chroma of 2 to 6 when dry or moist. Texture is sandy loam or fine sandy loam.



# Formation of the Soils

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Carl L. Glocker, soil scientist, Soil Conservation Service, helped to prepare this section.

Soil is a natural, three-dimensional body on the surface of the Earth that supports plants. The soil mantle on the Earth's surface is not uniform from place to place, but all soils have some things in common. They all consist of mineral material, organic matter, living organisms, water, and air, all of which occur in varying amounts in different soils.

Soils result from the action of soil-forming processes on materials deposited or accumulated by geologic processes. 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; the topography, or lay of the land; and the length of time that the forces of soil formation have acted on the parent material (14). These factors of soil formation are interdependent, and few generalizations can be made regarding any one factor unless the effects of the others are known (8).

The many combinations of these soil-forming processes control the basic changes that determine the characteristics of the soil. These changes, including removals, transfers, additions, and transformations, depend on physical and chemical processes that are continuously taking place.

These changes within the soil determine the horizon differentiation in the profile. The degree of horizon development determines the age, or maturity, of the soil. Thus, a soil lacking horizon development is a young soil. On the other hand, a soil that has well expressed horizons is an older soil.

The five major soil-forming factors and their influence on the development of soils in the survey area are described briefly in this section. In the section "Landforms, Geomorphic Surfaces, and Soils," the cumulative effects of these five soil-forming factors on the various kinds of soil are discussed (fig. 6).

Throughout the Quaternary period tectonism and cyclic change in climate have been major factors influencing erosion and deposition on a regional scale

(13). The survey area is located in the Basin and Range province (24), which is characterized by numerous mountain ranges that rise abruptly from broad, plainlike valleys or basins. These features have resulted mainly from mid-Tertiary block faulting. Uplifted blocks eroded to form mountains and pediments, and the downfaulted blocks filled with sediment (15).

This area is situated in the Phoenix basin part of the Sonoran Desert (22). The Sonoran Desert covers most of southwestern Arizona and much of northwestern Mexico, and it extends into the extreme southeastern part of California. In general the Sonoran Desert receives precipitation in winter as well as during thunderstorms in summer.

## Parent Material

Formation of the major drainageways is believed to have occurred prior to a major mountain building epoch 25 to 40 million years ago. These ancestral rivers were tributary systems that are now the Colorado River (15). The river flowed in a northwesterly direction through the survey area. The great canyons formed during the late Tertiary and early Quaternary periods gradually collected alluvial deposits from higher adjacent mountain slopes. Most of the parent material in this survey area accumulated in this way, but some resulted from eolian transport. The parent material of a few areas on hillslopes or mountain slopes is residual.

The deposits of the Santa Cruz River contributed most of the stream alluvium. Stream alluvium can also be traced to alluvial deposits of the Gila River and the McClellan and Santa Rosa Washes. Soils such as those of the Gilman, Ginland, and Glenbar series formed in stream alluvium.

Picacho Peak, a narrow volcanic ridge 5 kilometers long, is a prominent landmark along the west side of Interstate 10 in the southeastern part of the survey area. The Saminiego Hills, which are about 5 kilometers south and west of Picacho Peak, are connected to Picacho Peak by a northeasterly oriented "range" that extends northward under the alluvium. The block-faulting event of Tertiary-Quaternary age that created

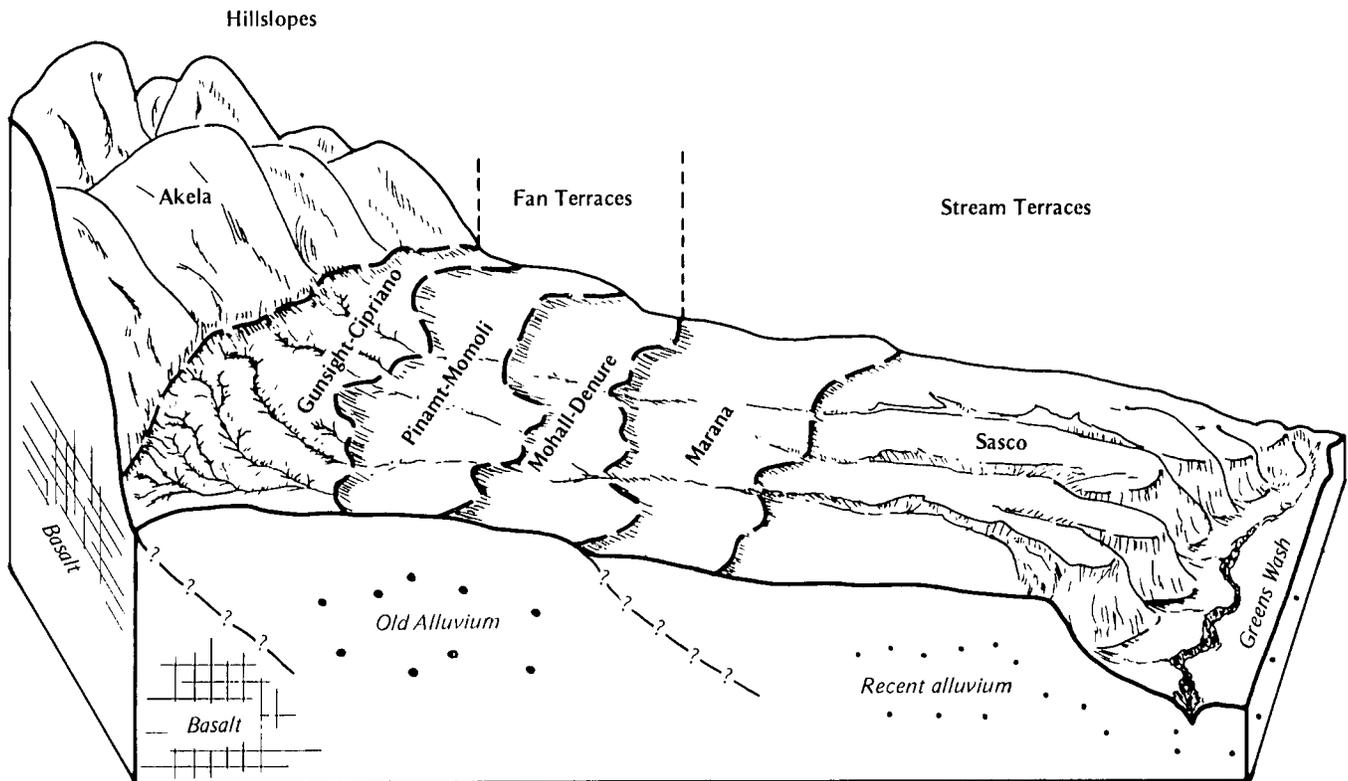


Figure 6.—Generalized relationship of some soils in the survey area.

this range separated the Picacho basin on the west from the Avra basin to the east (21). The boundary faults that separate this structural block from basins on either side are not exposed at the surface. The main channel of the Santa Cruz River, flowing perpendicularly to the buried ridge, bisects the alluvial saddle between the Saminiego Hills and Picacho Peak. Emerging from the saddle, the main channel separates abruptly into several shallow, narrow channels for a short distance where the stream gradient is reduced. Debouching onto an enormous alluvial plain and merging with stream alluvium from McClellan Wash, the Santa Cruz River formed the area called the Santa Cruz Flats. The deltaic Holocene alluvium of the Santa Cruz Flats onlaps the relict basin floor and is several miles wide. Near Arizona City and Eloy the deltaic mantle of alluvium becomes thinner.

The Santa Cruz River flood plain is modified and reshaped by overflow from the Santa Cruz Flats as it moves along the low gradient of the relict basin floor. Very low gradients allow floodwater to detour widely, forming flood plain playas that are elongated or braided alternately with cut-and-fill channel segments (19). Meandering west by northwest across the relict basin

floor, the Santa Cruz River intercepts the Santa Rosa Wash about 1 mile north of the town of Stanfield. Although this river channel is not so large as the Santa Cruz River, it drains the relatively large watershed of the Santa Rosa Valley. Eventually, the channels from the Santa Cruz River flow into the Gila River north of the town of Maricopa.

Fan alluvium in the area is derived from a variety of sources. Granite, gneiss, schist, and basalt are the dominant rock sources. Andesite, shale, quartzite, and limestone are present, but they are not extensive. Fan alluvium in the survey area appears to have occurred in two environments that are transitional to one another. Narrow belts of active erosion and sedimentation (channels) alternate with wide areas in which there was rather uniform sedimentation and little erosion (interfluves). Cross-bedding and cut-and-fill structures are common on the proximal end of fans. Soils in the Pinamt and Tremant series formed in fan alluvium.

The alluvium of the distal end of fans commonly grades upward into low gravel sediment. The more gently sloping areas of alluvium are characterized by thinner, sheetlike bodies of generally low gravel, low carbonate sediment that commonly extend laterally into

the upper, low-gravel facies of the channel zone sequence below exposed by gullies (washes) (4).

Deep eolian parent material is not extensive within the survey area. The areas of deep eolian material occur along the leeward edge of the alluvial flats. These eolian deposits are 1 meter or more in thickness. Thin eolian sediment mantles the alluvial sediment of the relict basin floor to form coppice dunes around the native vegetation. The soils of the Rositas series display the stratification of fine and very fine sand that could be interpreted as wind-deposited.

The upper part of the epipedon of many soils in the area is slightly calcareous because of the continual addition of calcareous dust. Barren, unprotected stream alluvium is probably a major source of calcareous eolian material.

Lime accumulations in soils that have a cambic horizon, such as those of the Dateland series, show little eolian carbonate influence. Large accumulations of carbonates in soils, such as those of the Gunsight series, are associated with large accumulations of precipitation-deposited and eolian-supplied sediment. The ubiquity of calcareous dust strongly suggests that carbonate accumulations in soils are due partially to carbonates in precipitation and partially to eolian transport of calcareous dust (8). Analysis of unpublished National Soil Survey Laboratory data shows carbonate and sodium accumulations to be proportional to gravel content. It can be surmised that soils with more gravel have trapped higher percentages of wind- and precipitation-supplied calcium carbonate and sodium.

## Climate

Climate, past and present, has a profound and continuing effect on desert soil formation. Heat and moisture controls the kinds and amounts of organisms inhabiting the area (5). Temperature and moisture, especially, affect the accumulation of organic matter, the type and rate of weathering of the soil mineral constituents, and the development of diagnostic features in soil horizons. Paleosols that developed largely during wetter periods are prominent as both relict and buried features (13). The present desert environment is characterized by climatic extremes, such as low rainfall, high temperatures, very high evaporation rates, and strong winds. As a result the soils in the area have an aridic moisture regime.

Rainfall and temperatures are similar to those of low latitude or tropical deserts. The survey area nearly parallels 33 degrees north latitude along the northern boundary (23). Rainfall is meager, erratic, and influenced by subtropical high pressure air masses and trade winds flowing from the Gulf of California and Gulf

of Mexico. Descending air masses have lost most of their moisture by the time they reach the survey area. In addition to being dry, descending air currents tend to dissipate cloud cover and allow more sunlight to heat the land. The average annual rainfall of 8.5 inches (20) wets the soils to a depth of 15 to 23 inches at Casa Grande; however, the soil is dry more than three-fourths of the time and thus has a Typic aridic soil moisture regime. Rainfall is characterized by a monsoon pattern with two distinct periods. Rains during the period from November to February are gentle and longer lasting than those during July, August, and September, which consist of brief and violent thunderstorms. Evaporation rates are 15 to 20 times the annual precipitation. Cloud cover is minimal. Normally, clear skies prevail 70 percent of the possible time, and in summer they exceed 90 percent. Relative humidity is low, commonly 15 to 30 percent, and 5 percent humidity is not unusual. Strong, desiccating winds in spring and during thunderstorms in summer contribute to additions of eolian sodium, calcium carbonate, and other sediment. Typical wind velocities range from 10 to 40 miles per hour. The total number of days with strong winds is rather low in the Phoenix basin, as is evidenced by coppice dunes being the most common eolian landscape feature. Air temperatures are mild in winter. Average temperature in December is 55 degrees F. Average temperature in July is 105 degrees. Mean annual air temperature is 72 degrees. Soil temperatures typically are 2 to 6 degrees warmer. Freezing temperatures are rare, and the annual frost-free period is 250 to 290 days. The average number of days when the temperature exceeds 100 degrees is 54. Diurnal temperature fluctuations typically are 20 to 30 degrees. In this arid environment, mean annual soil temperatures exceed 72 degrees, but they are 68 to 70 degrees above 2,200 feet. This approximates the boundary between the hyperthermic and thermic soil temperature regimes.

## Living Organisms

Living organisms, including higher plants and animals as well as bacteria, fungi, lichens, and mosses, contribute to soil formation. Their life cycle is governed by the desert climate.

Desert plants have adapted to the limited available moisture resulting from low rainfall and high runoff, high salt content, desiccating winds, and high evaporation rates. Desert vegetation is widely spaced, and scrubby plants are common (6).

Along washes, streams, and areas where the water table is at a shallow depth, plants called phreatophytes grow. These plants, such as tamarisk (saltcedar) and

mesquite, have developed long taproots. The halophytes, or salt-loving plants, such as saltgrass, iodine weed, and canyon ragweed, occupy areas where the soils are high in content of salts and sodium. The most abundant plants are the xerophytes. They are in upland areas and survive by using a variety of mechanisms. Leaflessness during the dry season reduces transpiration losses. Shallow and widely branching root systems accumulate as much moisture as possible during storms. Storage of water during the wet season aids survival during the long dry periods. Succulents, like cacti, accumulate moisture in pulpy stems. Ephemeral or annual plants adapt by completing an entire life cycle in a brief period during or immediately after a rainy period. Waxy leaves and stems and very small stomata reduce loss of moisture because of transpiration. Thorns reduce grazing by animals.

Vegetation, including fungi, influences soil formation by returning residue to the soil and aiding in decomposition. Vegetation is a factor in the transfer of minerals in the soil mass and in soil reaction. In conjunction with climate and relief, it affects the movement of material by leaching (8).

Generally, there is little evidence that the sparse vegetation associated with the soils in this survey area has had any measurable effect on soil development. The soils in the survey area typically have less than 0.4 percent organic carbon in the surface layer.

Animals and insects adapt to the arid environment by unique mechanisms. Most organisms are nocturnal and have short life cycles. During extreme drought reproduction is severely limited. Small rodents and reptiles live underground. Termites and other insects may live several feet below the ground.

Bacteria, nematodes, and other forms of animal life aid in the weathering of material and the decomposition of organic matter. The larger animals, such as rock squirrels, gophers, javelina, and skunks, mainly turn and mix the soil during their burrowing activities (29).

Humans have had a marked effect on soil development also. Their cultural activities have disturbed the natural balance of certain factors and altered related conditions. They have accelerated erosion by overgrazing with livestock and by tilling sloping areas. Changes in drainage conditions or relief, induced by land shaping, also influence soil development. Modification of natural fertility differences by adding fertilizers, using organic residue, or cropping without replacing nutrients also alters the soil-forming processes and resulting soil characteristics.

Two pedons of the Casa Grande series (fine-loamy, mixed, hyperthermic Typic Natrargids), one in an irrigated area and one in an undisturbed desert area,

were selected for sampling (31). The morphology of the pedons matched well because they were only 123 meters apart. The laboratory analysis of the irrigated soil showed significant modification of all analyzed properties when compared with the undisturbed site; for example, the sodium absorption ratio values had been reduced 93 percent. This can be attributed to the leaching and soil amendment program initiated by the farmer some 30 or more years ago. All of the Casa Grande soils under cultivation have undergone significant modification from their natural condition. Some of their properties have been changed permanently.

As a rule, plants, animals, insects, bacteria, and fungi affect the formation of soils by increasing the organic matter content of the soils, producing gains or losses in plant nutrients, mixing layers, and changing structure and porosity.

## Topography

Topography influences soil formation primarily through its effect upon runoff and erosion (25). Aspect can be important where slopes are steep. In general, on active slopes (more than 45 percent) runoff is greater and little moisture is retained in the soil. Because moisture is essential in the weathering process, these areas have few well developed soil horizons. In these areas, erosion caused by excessive runoff results in soils being eroded at about the same rate or at a greater rate than they are being created by weathering from the parent rock or are being deposited as alluvium. This results in bedrock being at or near the surface or in shallow soils that have only thin, weakly developed horizons. Quilotosa soils are an example.

On the low gradient, stable slopes (less than 15 percent) the rate of soil erosion is slower than the weathering of parent material. Runoff is slow to medium, but in some places runoff from higher lying slopes supplements the direct precipitation received. Slower runoff, with or without additional runoff moisture, allows water more time to enter the soil and to percolate deeper. Parent material then weathers more rapidly. Under these conditions, erosion is slow, nutrients are released, plants become established, and micro-organisms multiply. The Casa Grande, Contine, and Mohall soils are examples of soils on stable slopes. These soils have well expressed diagnostic horizons. They represent the major part of the cropland developed in the area. Stable slopes that are nearly level and have uniform soil horizons below the surface are easily modified to fit present irrigation water delivery systems.

Soils that formed on metastable slopes (15 to 45

percent) have medium or rapid runoff. Erosion on these slopes occurs at a moderate rate. Soil development occurs, but horizonation is not well expressed. Many areas have incipient cambic or calcic horizons. No diagnostic horizons other than an ochric epipedon develop, mostly because they are too thin. Soils of the Cellar and Akela series are examples.

Some soils on plane or concave surfaces receive large quantities of runoff moisture and the accompanying sediment. These are active surfaces. Under these circumstances accumulations exceed the rate of soil development. Soils of the Gadsden, Gilman, and Glenbar series are examples.

## Time

The soils in this survey area have a wide range in profile characteristics. Researchers, such as Parsons (18), have determined that certain of these characteristics require a long period of time to become well expressed. Other profile characteristics might develop in shorter periods of time, but they require climatic conditions similar to those known to have occurred only in the distant past. Four divisions of time will be used to help explain these variations. They are early to middle Pleistocene (more than 250,000 years before the present), late Pleistocene (12,000 to 250,000 years before the present), early Holocene (5,000 to 12,000 years before the present), and late Holocene or Recent (less than 5,000 years before the present). Soil investigations seem to indicate this kind of timespan, but lack of more precise data prevents greater precision.

The early to middle Pleistocene time range was selected to help describe and separate soils thought to be very old (Paleargids and Durorthids) from soils that appear to be somewhat younger. Also, it is a time determined to be significant for the development of petrocalcic horizons and duripans (9). Late Pleistocene encompasses soils thought to be paleosols, but not ancient Haplargids, such as Mohall and Contine soils. The date of 12,000 years before the present was chosen as the end of the period of development of soils having well developed diagnostic horizons. Researchers agree that about this time a long period of climatic and geologic stability ended. Climatic changes after this approximate date fluctuated widely. By about 5,000 years before the present, the climate had become very similar to the one we experience today. Again, researchers, such as paleontologists and paleobotanists, agree that the change occurred about 4,000 to 5,000 years before the present. A date of 8,000 years before the present could have been used, but since radiocarbon dating puts most Camborthids at

about 3,500 years of age, the date of 5,000 years before the present accomplishes a separation.

## Landforms, Geomorphic Surfaces, and Soils

Landforms are three-dimensional parts of a landscape that have similar characteristics. They generally are recognizable because they are significant in some way (19). Geomorphic surfaces (18) typically relate to the parts of the landscape that formed at about the same time. From the lowest geomorphic surface on the landscape to the highest, they follow a chronological sequence from youngest to oldest. It is not uncommon for a landform to have two or more geomorphic surfaces within its boundaries. The following landforms are recognized in this survey area: flood plains, alluvial fans, low stream terraces, high fan terraces, hillslopes, and mountain slopes. In this section an attempt is made to correlate the geomorphic surfaces on each of these landforms with those identified by Parsons (16, 17, 18) and Gile and others (10). Parsons' studies were carried out along the Colorado River near Lake Havasu City, Arizona. Gile and others studied an area near Las Cruces, New Mexico; this study is known as the "Desert Project." Specifically, the effects of soil age, soil climate, and parent material are described in this section.

The soils examined and described in this survey area appear to have evolved as a result of a wide variety of past climatic conditions. Soils that show extensive weathering obviously could not have developed under the present conditions. The climate required for the development of argillic horizons, duripans, petrocalcic horizons, and probably most calcic horizons must have been cooler and wetter than the present climate. Research at the Desert Project suggests that for some time prior to the last interglacial period (10,000 to 12,500 years before the present) the average annual precipitation was probably more than 30 inches and temperatures were cool. These conditions allowed the weathering of minerals, leaching of cations, oxidation of iron and other minerals, accumulation of organic matter, and deepening of profiles. At the same time landscapes were stabilized by organic matter that accumulated in the surface layer. Major changes in climate appear to have triggered the erosion of soils at higher elevations, with subsequent deposition of sediment at lower elevations. Soil scientists have been able to recognize these changes and identify the different soils that developed. Seven landforms were identified. The geomorphic surfaces within these landforms have at least three major differences in climate and four different ages. Hillslopes were not considered among the six geomorphic surfaces. Climate does not appear

to be as important as surface stability on hillslopes; therefore, hillslopes are discussed as a landform.

*Flood plains landform.*—Flood plains are the lowest landform on the landscape. The lowest, near Lake Havasu City, was called the Earp surface by Parsons (18). He identified the slightly higher lying flood plain as Cimarron Lake. Both the Earp and Cimarron Lake surfaces are called arroyo (channel and fan) alluvium in the Desert Project by Gile (9). Both researchers consider these surfaces to be late Holocene. The lower of the two flood plains has the low relief of bar and channel topography typically associated with lateral accretion deposits (12). Included features are stream channels and associated filled channels. Shallow anastomosing, or braided, channels parallel the stream. Calcareous stream alluvium generally consists of roughly stratified, coarse grained material. Vegetation is sparse or absent. Regular flooding inundates this active surface. Rapid changes result from the shifting of alluvium. This lower flood plain is represented by flat-bottomed flood plains (washes) that are associated with steep-sided fan terraces as well as with the stream channels of the Santa Rosa Wash and the Santa Cruz and Gila Rivers. In some third-order valleys, the two flood plains are not separable (11). This barren, unprotected stream alluvium is a major source of calcareous eolian sediment. Flood plains began to form only a short time ago. In fact, in a few places metallic artifacts have been found in similar stream alluvium; hence, a postsettlement date is appropriate (30).

Soils of the flood plains landform are typified by Torrifluvents and Torriorthents, such as the Antho and Carrizo soils. Having formed on a dynamic flood plain, these soils display little evidence of soil formation in the unconsolidated, finely stratified, sandy or gravelly stream alluvium. Organic matter content is less than 1 percent and along with content of soluble salts, such as calcium carbonate, decreases irregularly as depth increases (27).

The higher of the two flood plains has undulating bars and channels oriented approximately parallel to the stream. The height of the bars and the width of the channels are related to stream competence (30). Broad, slightly concave flats and cut-and-fill channels (11) are presently associated with overflow channels of rivers and washes. Longitudinal stream profiles with segmented gradients reflect the complex and dynamic nature of this depositional environment. On the Santa Cruz Flats, floodwaters spread across a wide area. The texture of the unconsolidated stream alluvium generally is loam to clay, although sandy loam is present in some areas. Small amounts of gypsum are present in some places.

The age of this higher flood plain is estimated to be

less than 3,290 years before the present on the basis of carbon-14 dating of similar landforms. The partial abandonment of this geomorphic surface probably occurred less than 550 years before the present (30).

The soils that formed on this higher flood plain are Torrifluvents. Representative soils are those of the Gadsden, Gilman, Ginland, and Glenbar series. These soils are stratified and exhibit little development except for a dark colored epipedon and dark colored buried horizons in which the organic matter content approaches 1 percent. Such a large amount of organic matter is rare in the surrounding soils; therefore, it is probable that these soils formed in place under vegetation growing during wetter seasons and before these horizons could be buried by sediment lower in content of organic matter.

The Gadsden soils have a clay content of more than 40 percent. The clearly stratified alluvium normally displayed in stream alluvium has been nearly obliterated because of the vertic properties of these soils. The Pimer soils have a clay content of 25 to 34 percent and a silt content of more than 45 percent. The high silt content of these soils is a result of the deposition environment induced by the low gradient of the higher flood plain in relation to the stream channel. The organic matter content of Gadsden and Pimer soils is about 2 percent.

The Ginland and Trix soils formed in stream alluvium deposited in sags and flood plain playas on the relict basin floor. As the floodwaters of the stream channels moved along the low gradient of the relict basin floor, minor changes in topography caused the floodwaters to either concentrate or spread widely. Cutting and backfilling ensued. Recent alluvial flats and flood plain playas were formed (19). These elongated components of the flood plain are braided alternately with shallow cut-and-fill channel segments.

*Alluvial fans landform.*—In this survey area shallow anastomosing channels radiate across broad, low angle coalescent alluvial plains. All alluvial fans are closely related in age and are considered to be a single geomorphic surface. These active surfaces formed when runoff debouched from the higher adjacent flood plains and hillslopes and spread thin sheets of calcareous fan alluvium across the surface. It is in this environment that the Cuerda, Valencia, and Why soils developed. Valencia soils have a cambic horizon that formed in early Holocene alluvium 20 to 40 inches thick. A fine-loamy paleosol that has a well developed argillic horizon is below the cambic horizon. Cuerda and Why soils have more than 40 inches of this same alluvium. Buried soils are 40 to 60 inches or more from the soil surface. The development of cambic horizons in the overlying sediment suggests that it is late Holocene.

The fact that the soils buried by this Holocene sediment are paleosols suggests that the buried sediment is Pleistocene in age. In the Desert Project (9), soils that have a cambic horizon were determined to be less than 8,000 years old. Where the sediment onlaps the relict basin floor, the alluvial fan is continuous, broad, and gently sloping.

*Stream terraces landform.*—The series of terraces along the Santa Cruz River and Santa Rosa Wash are closely related in age and are considered as a single geomorphic surface. This surface represents the oldest geomorphic surface associated with the present drainage systems in southern Arizona. It has the bar and channel morphology typical of abandoned flood plains associated with aggrading streams (12). Bars and channels are not prominent because they have been modified by eolian sediment and by overflow deposits that partially filled the channels. The drainage system is integrated. Deposits consist of weakly consolidated stream alluvium that is dominantly silt and clay and in some places contains small amounts of gypsum. A faint desert varnish, or patina, exists on some rock fragments (18).

Near Lake Havasu City the age of the deposits below a geomorphic surface called Arch Creek by Parsons (18) was determined by carbon-14 dating methods. The ages obtained range from a minimum of 3,270 years before the present to a maximum of about 10,000 years before the present. This early Holocene timespan corresponds with similar carbon-14 dates for low stream terraces in southern Arizona and in other western states (16). A similar conclusion was obtained for a small area of the Rio Grande stream terrace in the Desert Project (9).

Typical soils of the stream terraces landform, which is also a geomorphic surface, are the Camborthids, such as those of the Marana, Saminiego, and Sasco series. These soils formed on this geomorphic surface because it has been stable for the relatively short period of time required for cambic horizons to develop. Calcium carbonate coats vertical ped faces in the cambic horizons and has accumulated in pores and root channels below. This is the youngest geomorphic surface on which soils with stage I carbonate accumulations occur (10). Organic matter content is comparatively high throughout the profile. Variations in content with depth suggest that it either accumulated in place when this surface was still a flood plain or that it was inherited from alluvial parent material. The water table beneath this surface is very deep, which precludes the possibility of the capillary induced rise of salts that is common to soils on flood plains and low stream terraces. Headward erosion and piping adjacent to terrace escarpments are serious problems.

The Santa Cruz Reservoir Project of 1911, conceived by Colonel Epes Randolph, General L.H. Manning, and a Mr. Griffith and associates, planned for the construction of a dam that was to form the Santa Cruz Reservoir and construction of diversion canals to this reservoir from the Santa Cruz and Santa Rosa Rivers (7). The site of this reservoir is a natural depression at their confluence.

The diversion of the Santa Cruz River across the low stream terraces has caused extensive soil erosion. The headward erosion associated with the downcutting of the diverted Santa Cruz River has occurred at an incredible rate. The flood of October 1983 and subsequent erosion of Greene's Canal (Santa Cruz River Diversion) resulted in a 20 percent increase in the carrying capacity of the canal. Greene's Canal has been incised and widened dramatically, establishing the fact it is a terrace or cut surface.

Overbank flooding during major events deposits thin strata of silt but does not inhibit soil development. The Sasco, Saminiego, and Marana soils that developed in this material are not extensive in southern Arizona.

*Relict basin floors landform.*—This complex of geomorphic surfaces is the main valley floor in the Phoenix basin that has been accumulating fine grained alluvial sediment for several million years (21). It does not have an integrated drainage system, although a few narrow flood plains cross the surface. Paleosols are common, and some are associated with one of a sequence of four major zones of lime accumulation, two of which are cemented. Also, slopes are less than 1 percent and content of rock fragments is less than 2 percent. Almost all soils have either fine lime nodules or mottles indicative of a relict water table at a depth of 3 to 6 feet.

Young alluvium, probably of early Holocene age, overlies these old deposits in some places. These deposits appear to be the alluvium washed from adjacent fan terraces during the period of landscape instability in late Pleistocene-early Holocene time. Research at the Desert Project demonstrates the multiepisodic nature of some landscapes. Soil development and research from the Desert Project would indicate three, and possibly four, episodes of deposition and development.

The oldest soils on this landform are those of the La Palma series. These soils developed in calcareous, nongravelly alluvium. They have an argillic horizon above a petrocalcic horizon at a depth of 20 to 40 inches. It appears that a water table was perched above the petrocalcic horizon until pumping for irrigation removed it in the 1800's.

La Palma soils are thought to occupy geomorphic surfaces similar to those called Fort Mohave, near Lake

Havasu City, by Parsons (18) and La Mesa, near Las Cruces, New Mexico, by Gile (9). Thus, La Palma soils are probably at least Pleistocene in age. Use of Parsons' data would lead to the conclusion that this part of the relict basin floor, and therefore the La Palma soils, is of late Pleistocene age. Studies by Gile (9) at the Desert Project placed soils with petrocalcic horizons on the La Mesa surface. The Paleargids there are similar to the La Palma soils in this survey area. Dating methods on selected ash deposits suggest an age of 400,000 years before the present. Carbon-14 dating of organic and inorganic carbonates indicates that a water table was present 22,000 to 29,000 years before the present. As with the La Palma soils, research shows that the stage IV cementation (10) was accomplished well before the water table developed (9). These soils then can be considered to be early to middle Pleistocene in age.

Casa Grande soils are representative of Typic Natrargids. These soils are also on the relict basin floors landform. Parsons identified a similar surface as Fort Mohave, near Lake Havasu City, and considered it to be late Pleistocene in age. At the Desert Project it would be correlated with a surface of the same age—Jornada I-Middle Pleistocene. National Soil Survey Laboratory data (27) for this survey area and adjacent survey areas indicate that these soils are on the coarse side of the fine-loamy particle-size class. Clay content is about 12 percent in the upper 10 inches, is about 18 percent in the next 10 inches, and reaches a maximum of about 22 percent at a depth of 30 inches. Below a depth of 30 inches clay content is 15 to 20 percent lower than that in the horizon above. Before irrigation the sodium adsorption ratio follows a similar but more complicated pattern. It increases from 45 to 100 at a depth of about 10 inches, decreases to about 80 or less at a depth of 20 inches, and then increases again to about 90 at a depth of 30 inches. After a decrease to about 50 at a depth of 40 inches, the sodium adsorption ratio increases steadily with increasing depth to 100 and to as much as 212. Electrical conductivity ranges from 4 to 8 millimhos per centimeter in the upper 10 inches and from 14 to 17 millimhos per centimeter at a depth of 10 to 40 inches. Below a depth of 40 inches it decreases slightly to about 10. The data also show that the calcic horizon commonly is about 8 inches thick and has a calcium carbonate equivalent of 15 to 18 percent at a depth of 30 inches (fig. 7). One pedon sampled in the survey area did not have 15 percent calcium carbonate equivalent in any horizon. If the clay content, content of fine sand on a clay-free basis, sodium adsorption ratio, and calcium carbonate equivalent are examined together, it becomes evident that the weathering profile is strongly expressed. The sand

content on a clay-free basis shows that all four pedons sampled have very uniform parent material to a depth of at least 40 inches and, for most pedons, to a depth of 60 inches; therefore, changes in content of clay, sodium, and calcium carbonate can be attributed to pedogenesis.

The sodium adsorption ratio and calcium carbonate content show maxima at a depth of about 12 inches and again at a depth of about 30 inches. Clay content is also highest at a depth of about 30 inches. It would appear that the major part of the sodium and calcium carbonate is moving downward along with the alluvial clay. These characteristics probably can be attributed to the paleoclimate. The upper maxima for sodium and calcium carbonate could be the depth of leaching of eolian sediment deposited in Holocene time. These upper maxima coincide with the depth of wetting in the present climate.

Soils of the Mohall series are a good example of the soils on relict basin floors that are classified as Haplargids. Research by Parsons (18) establishes soil age as late Pleistocene. The Desert Project suggests that Haplargids on this geomorphic surface could be either Middle or Late Pleistocene in age; their textures indicate some similarity with La Palma soils. These soils have a light brown argillic horizon that begins at a depth of about 5 inches and continues to a depth of about 46 inches. Texture is mostly clay loam, but a few pedons have thin horizons of clay. The clay content is about 25 percent at a depth of 6 inches, 32 percent at a depth of about 25 inches, and 20 to 30 percent at a depth of about 40 inches. Most pedons show a rapid but erratic increase to near maximum clay content at a depth of about 10 inches. Clay content remains high to a depth of about 30 inches and then decreases gradually and uniformly to about 20 percent at a depth of about 48 inches. The clay maximum for all pedons sampled is more than 27 percent (fig. 8).

The weathering of clay seems to be substantial. Maxima appear to be nearly double the amount supplied in the parent material. It is possible that both the erratic increase in the upper horizon and the high clay maxima are the result of additions of eolian clay in Holocene time (9). Clay films are moderately thick and discontinuous.

Organic matter accumulations have been very small. Oxidation by high temperatures or erosion by water and wind has kept maxima at about an average of 0.5 percent for the upper 15 inches. Cultivated areas, though not sampled extensively, seem to have only slightly higher values. Availability of plant nutrients is affected. Compaction by tillage implements is a severe problem because of the lack of organic matter residue to balance the weakly cemented soil aggregates. At the

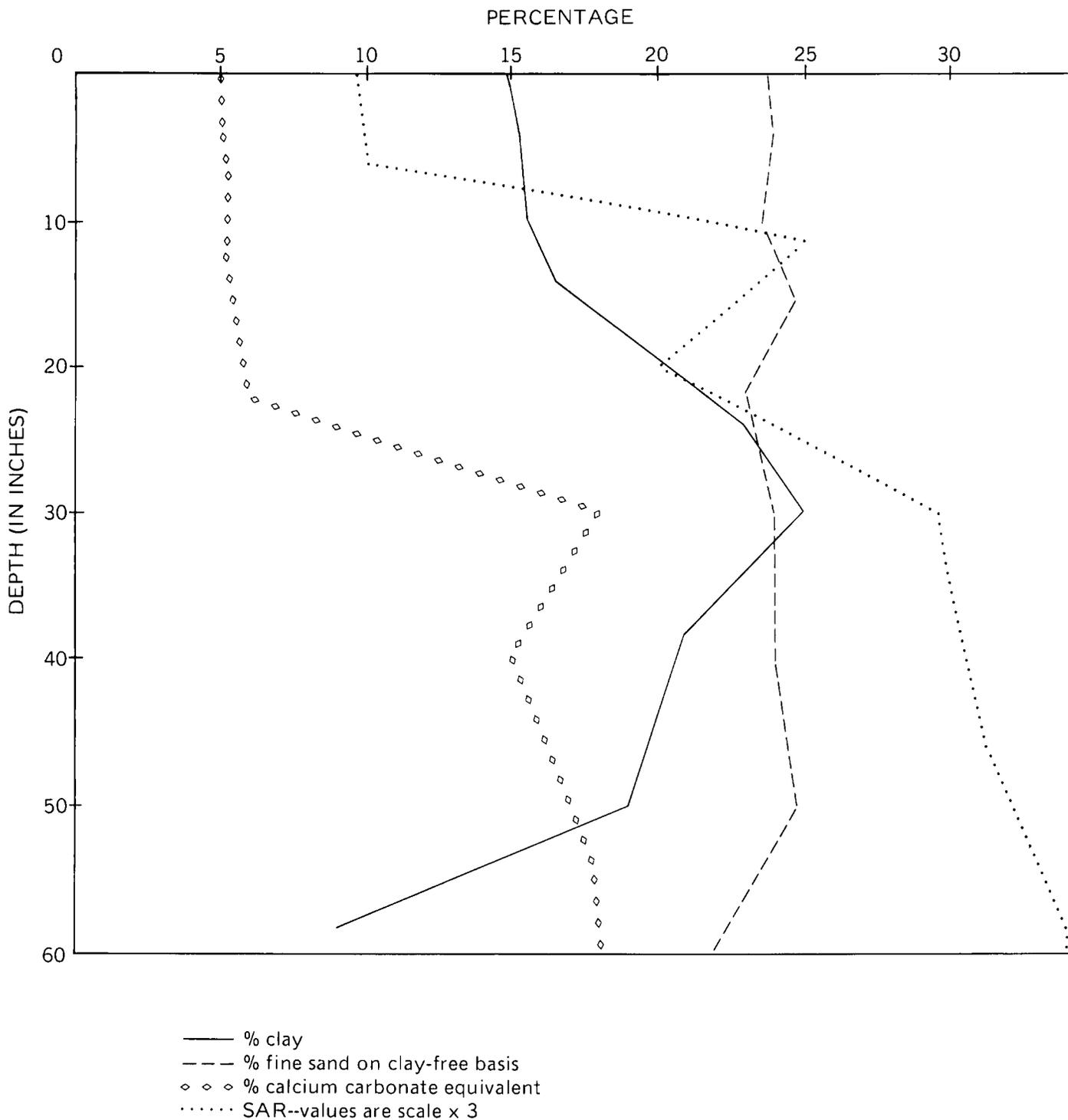


Figure 7.—Depth/property curves showing some of the characteristics of the Casa Grande soils.

Desert Project it was determined that organic matter is being lost to erosion on these kinds of soil.

Content of sodium is very low in the upper horizons

and increases steadily as depth increases. Sodium adsorption ratios follow a very definite pattern. They are less than 2 to a depth of 30 inches, and then they

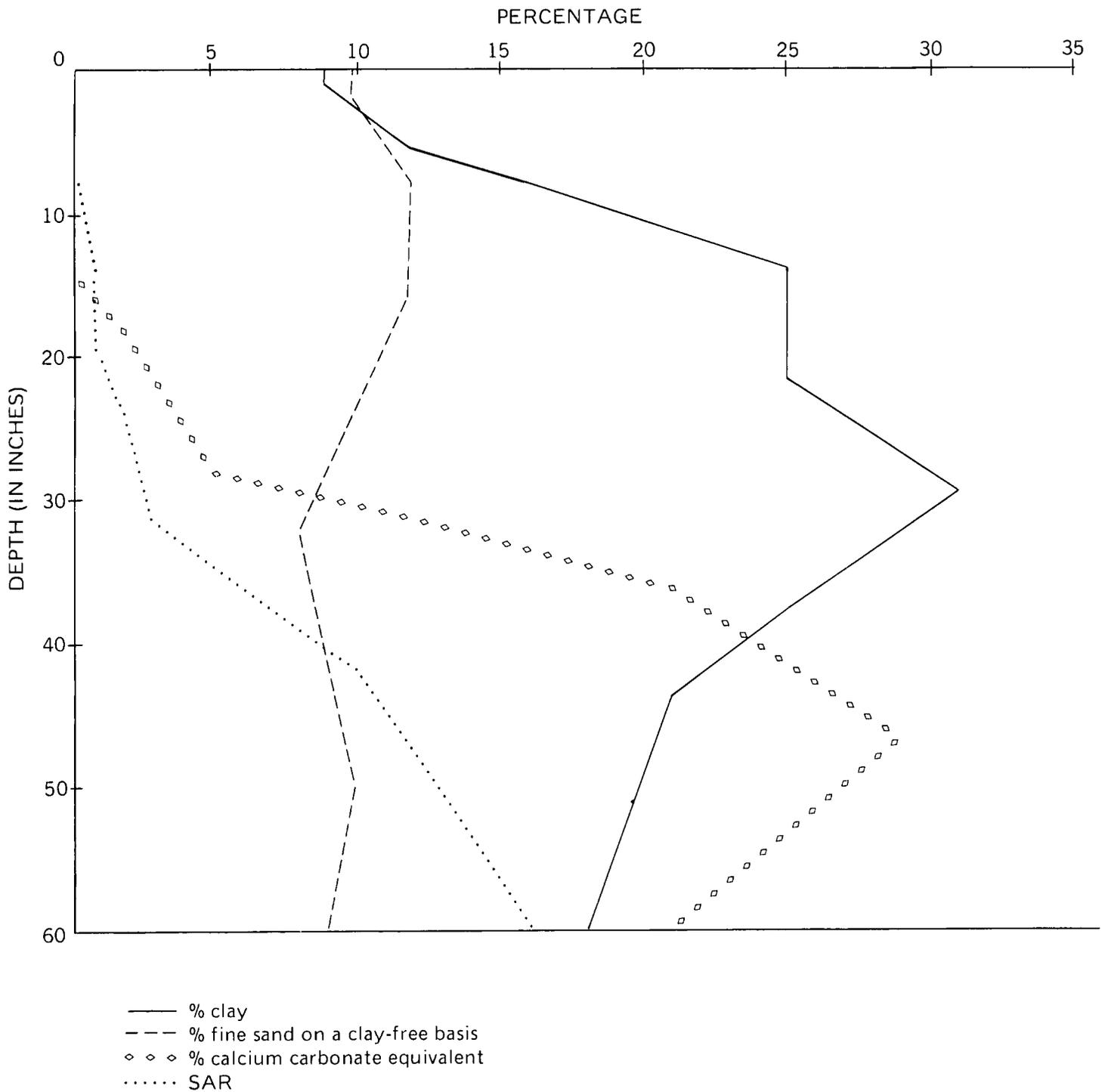


Figure 8.—Depth/property curves showing some of the important characteristics of the Mohall soils.

increase to about 10 at a depth of 40 inches. Below a depth of 40 inches, increases are slow and regular as depth increases. These data suggest that the sodium adsorption ratio in the parent material was as much as

10 throughout the profile. Leaching of soluble minerals drastically reduced the amount in the upper horizon. In most places, however, the sodium has not been

leached to a depth beyond the reach of capillary rise if the soils are irrigated.

Calcium carbonate is leached deeply. Maxima of 20 to 30 percent occur at a depth of 40 to 50 inches. The highest content occurs just below the area of maximum clay accumulation. This seems to indicate that carbonates are being leached faster than clay is accumulating. A small amount of carbonates might have been deposited as eolian sediment after the clay had migrated; however, the weathering of the soil profile is well expressed by these clay and lime accumulations. This reinforces the conclusion that calcium carbonate must be removed before clay can migrate. It is apparent that there has not been any significant addition during Holocene time; small accumulations and subsequent leaching could have occurred in late Holocene time.

The Mohall soils are thought to have formed in fan alluvium, whereas the Casa Grande soils are thought to have formed in stream alluvium. Calculations of content of fine sand on a clay-free basis show the percentage for both soils to be similar. Mohall soils are clay loam or clay in their horizons of maximum clay accumulation. The Casa Grande soils are sandy clay loam in the similar horizons. Clay content of the argillic horizon in the Casa Grande soils is about 10 percent less than that of the Mohall soils.

The Mohall soils on the relict basin floor commonly occupy the outer edges adjacent to fan terraces. If the surrounding fan terraces supplied the parent material, the Mohall soils are in their expected location. The Casa Grande soils are on a cone-shaped alluvial deposit that has its apex pointed upstream to the Santa Cruz River. It is downstream of the block-faulted ridge between Picacho Peak and the Samaniego Hills. It would appear that changes in gradient below this saddle caused the Santa Cruz River to abandon this huge alluvial fan in Pleistocene time. The Casa Grande soils occupy slightly higher positions on the relict basin floor than do the Mohall soils.

Differences in clay content could be explained in either of two ways. If clay content for both series were similar initially, more complete leaching would have taken place if the clay had been sodium dispersed. Interstitial pore space allows free flow of individual clay particles; thus, the Casa Grande soils have about 10 percent less clay. It is also likely that the clay content of the parent material is now reflected in the texture of the argillic horizon. If the fan alluvium had been carried in floodwater at or near maximum bedload and then deposited on nearly level slopes as a viscous material, little or no clay would have been sorted out and carried to lower slopes. The stream alluvium parent material of the Casa Grande soils has traveled a long distance and

thus has had the opportunity to be sorted before deposition.

Denure and Dateland soils occupy a geomorphic surface of the relict basin floors landform that seems to correlate with the surface called Fort Mohave, at Lake Havasu City, by Parsons and Organ, and near Las Cruces, New Mexico, by Gile. The Fort Mohave surface is considered to be late Pleistocene by Parsons. Gile has shown by means of a series of radiocarbon dates that the Camborthids of the Organ surface are no older than late Holocene (about 2,600 to 4,000 years before the present). All of the Camborthids in this survey area exhibit youthful profiles. The cambic horizon has subangular blocky structure. Carbonates are only partially leached. Carbonate accumulation occurs as fillings in roots and pores, as masses, and as coatings on the undersides of pebbles. The clay content is about 7 percent, and there is no accumulation. Also, there is no increase in horizon chroma, which indicates that there has been little or no oxidation of weatherable minerals. Soil Survey Investigations Staff data show that the calcium carbonate equivalent increases from 1 to 2 percent at a depth of 30 inches. At a depth of about 16 inches water extractable cations, such as calcium and sodium, increase by a factor of 2 or more. This coincides with the depth of wetting, which has been determined to be 15 to 23 inches depending on the texture of the soil. It is probable that these soils are late Holocene, as suggested by Gile.

*Low fan terraces landform.*—This complex of geomorphic surfaces seems to be composed of at least two geomorphic surfaces on the largest and lowest of a series of three fan terraces. This complex onlaps the relict basin floor complex. It exhibits multiepisodic deposition from degrading landforms above, just as does the relict basin floors landform. A similar landform was called Fort Mohave geomorphic surface, near Lake Havasu City, by Parsons (18). He assigned it a late Pleistocene age. A similar landform in the Desert Project, near Las Cruces, New Mexico, is the Organ-Isaack's Ranch-Jornada II complex of geomorphic surfaces (9). The Organ surface was thought to be of Holocene age; Jornada II, late Pleistocene; and Isaack's Ranch, intermediate in age.

Soils on these fan terraces are those of the Dateland, Denure, Gunsight, Laveen, Mohall, Momoli, Pajarito, and Tremant series. Dateland, Denure, Momoli, and Pajarito soils are Camborthids. The Desert Project placed similar Camborthids on the Organ surface and assigned them mostly a late Holocene age. Gunsight and Laveen soils are Calciorthids that developed in parent material that was high in content of calcium carbonate and was high and low in content of

gravel, respectively. These soils correlate well with the Calciorthids of the late Pleistocene-early Holocene Isaack's Ranch geomorphic surface. Mohall soils in areas of this landform are on a geomorphic surface similar to that of Issack's Ranch. These Mohall soils appear to be similar to those previously described on relict basin floors. It is suspected that laboratory data would confirm a separation of the apparently older Mohall soils of the relict basin floor complex from the Mohall soils on fan terraces. No observable differences could be ascertained, and therefore they are mapped as the same soils. Because slope and location on the landscape are different, they can easily be separated at a later date if data warrant.

The Gunsight soils represent the Calciorthids (fig. 9) of the low fan terraces landform. Gunsight landscapes are dissected and are stable or metastable. The slow erosion plus steady additions of calcium carbonate by wind and precipitation seem to have prevented the leaching of carbonates. It appears that the gravel is a reliable dust trap. Data show that maximum accumulations of about 33 percent calcium carbonate equivalent occur at a depth of about 15 inches. This is the approximate depth of wetting in the present climate. Carbonate levels decrease to about 20 percent at a depth of 40 inches and then remain constant or increase slightly as depth increases. These percentages will at least double when carbonates are calculated on a gravel-free basis. The amount of pebbles increases rapidly to 65 to 85 percent, by volume, at a depth of about 30 inches. Below this depth the content of pebbles either remains constant or increases slowly as depth increases. The sodium adsorption ratio follows a similar pattern, increasing to about 25 at a depth of about 25 inches. It then remains constant or increases slowly as depth increases. These data can be interpreted to mean that calcium carbonate and sodium entered the soil as part of the same Holocene deposits. Sodium, which is more soluble, is leached slightly deeper. An argillic horizon apparently could not develop because the carbonate level was high initially and stayed that way for long periods of time. It does not appear to have ever been low enough for illuviation of clay. Losses because of leaching and erosion were probably offset by eolian accumulations.

*High fan terraces landform.*—The two, and in some places three, fan terraces in areas of this landform were developed by the lowering base level, which simultaneously incised and destroyed higher landforms. This landform is called the Bullhead geomorphic surface, near Lake Havasu City, by Parsons (18). It is among the oldest geomorphic surfaces remaining in the survey area. It is composed of erosional remnants well above the general valley floor. Tectonic uplift and,

especially, climatic change probably contributed to the base level changes in late Pleistocene-early Holocene time. Topography varies from that of stable fan terraces and pediments to that of a complex of metastable hillslopes (17, 30). The fan terraces on this landform seem to correlate well with the middle Pleistocene Jornada I surface of the Desert Project.

Areas of this landform are underlain by basalt and pyroclastic rock and by poorly sorted slope alluvium or fan alluvium (3). Calcareous dust has likely contributed to the parent material (9). This landform, also a geomorphic surface, is considered to be middle Pleistocene in age because of its position on the landscape and the presence of a strong duripan. The duripan is considered to be a relict paleosol on the basis of stratigraphic and mineralogic evidence for lithologic discontinuities. Remnants of similar areas near the Table Top and Sawtooth Mountains were protected from late Pleistocene erosion by the resistant duripan and bedrock. The desert pavement is well expressed and has a distinct desert varnish (18).

Typical soils on these surfaces are those of the Cherioni and Cipriano series. They are Durorthids and represent the most advanced stage of soil formation in the survey area. The Cherioni soils are shallow over basalt, and the Cipriano soils formed over gravelly and cobbly fan alluvium. The duripan has pendants and a thick laminar cap, which indicates stage IV lime cementation (9). Gunsight soils occur on these surfaces also.

These are the oldest surfaces recorded by the researchers. Relatively long periods of time are required for the dissolution, illuviation, and precipitation of silica from pyroclastic parent material. Data from the Desert Project have shown that the last significant ashfall occurred about 600,000 years before the present. Volcanic rock and feldspar also could be a source. The gravelly, calcareous overburden probably prevented the development of an argillic horizon in much the same way as it did in the Gunsight soils.

*Hillslopes landform.*—This landform has no specific age connection; therefore, it is not considered to be a single geomorphic surface (30). The topography is well dissected and is predominantly steeply sloping.

Erosion is active in much of the area, and some mass movement is evident. In certain areas, however, occasional remnants of older geomorphic surfaces are present.

The hillslopes landform can be divided into several geomorphic units. Three significant gradient breaks are apparent, and they correspond to stable, metastable, and active slopes (17). The soils on hillslopes formed in slope alluvium derived from granite, basalt, and pyroclastics (3). Landscape age is variable.

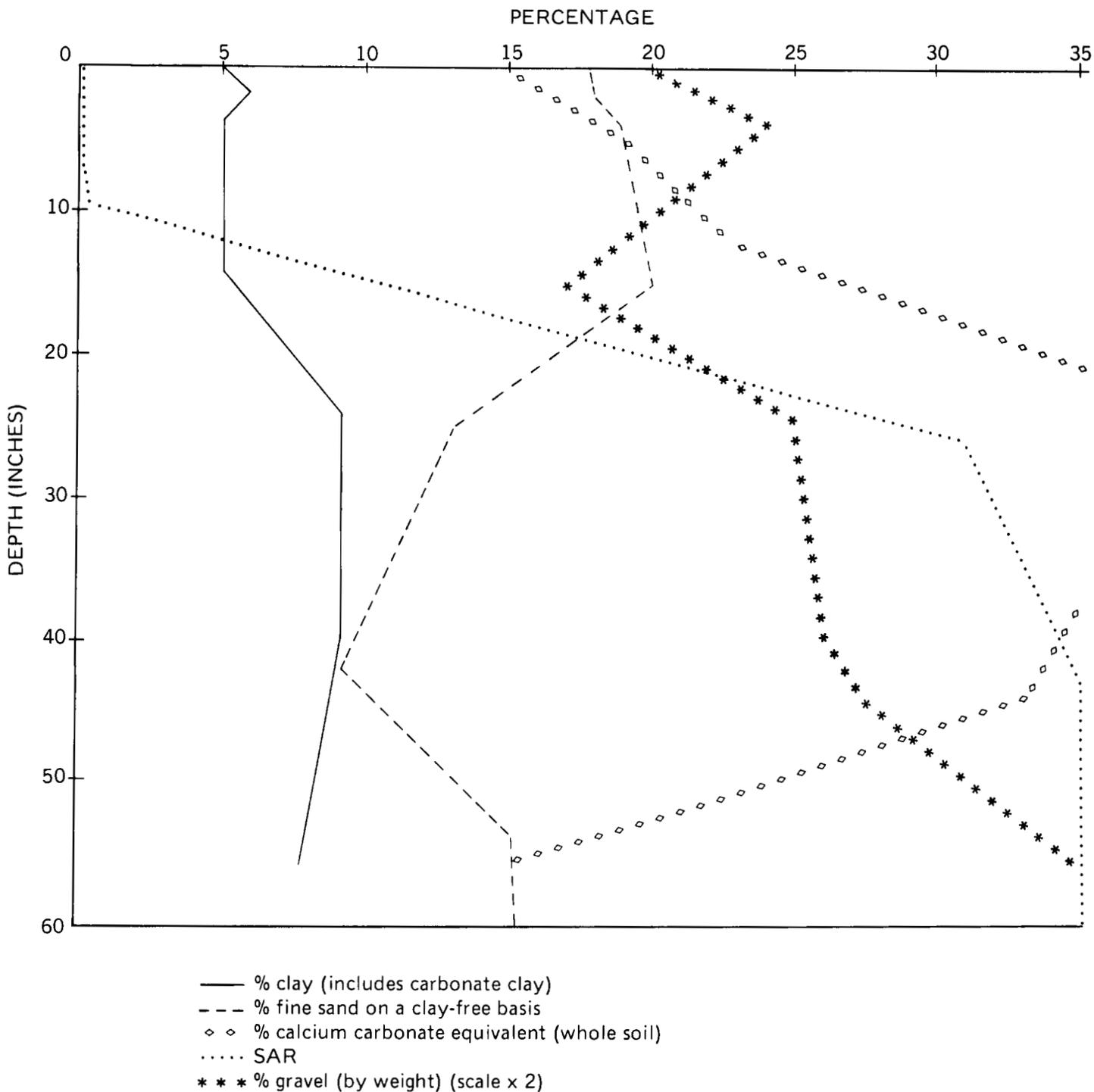


Figure 9.—Depth/property curves showing some of the important characteristics of the Gunsight soils.

The soils on the hillslopes are those of the Akela, Cellar, Quilotosa, and Vaiva series. Akela, Cellar, and Quilotosa soils are shallow to bedrock and only have an ochric epipedon. Vaiva soils, which are Haplargids, are

representative of soils on stable and metastable summits, shoulders, and rock-floored pediments. An abrupt boundary between the solum and bedrock suggests that these soils are not residual but that they

formed in slope alluvium. Landscapes are probably as old as early Pleistocene and possibly older.

Akela and Quilotosa soils are on positions that are both metastable (15 to 40 percent slopes) and active (more than 40 percent slopes). Where these soils are on metastable slopes, incipient cambic horizons and, in places, calcic horizons are present. These horizons are

not diagnostic because they do not meet the thickness required by Soil Taxonomy (28).

Where these and other soils classified as Torriorthents occupy active slopes, horizon differentiation is difficult to observe. Erosion seems to be keeping pace with soil development.

## References

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- (1) American Association of State Highway and Transportation Officials. 1982. Standard specifications for highway materials and methods of sampling and testing. Ed. 13, 2 vols., illus.
- (2) American Society for Testing and Materials. 1985. Standard test method for classification of soils for engineering purposes. ASTM Stand. D 2487.
- (3) Arizona Department of Transportation. 1964. Arizona materials inventory, Pinal County. 33 pp., illus., maps.
- (4) Arizona Geological Institute. 1966. Glossary of geology and related sciences. Second Ed. Repr., 497 pp.
- (5) Cooke, R.V., and Andrew Warren. 1973. The desert context, part 1. *In* Geomorphology in Deserts. pp. 1-45, illus.
- (6) Fairbridge, R.W. 1972. Climatology of a glacial cycle. *In* Quaternary Research, A Review Volume for the VIIth Congress of the International Association for Quaternary Research. pp. 283-302, illus.
- (7) Fuller, P.F. (n.d.) Report upon the Santa Cruz Reservoir Project. Unpublished tech. rep., 64 pp., illus.
- (8) Gile, L.H., F.F. Peterson, and Robert B. Grossman. 1965. Morphological and genetic sequences of carbonate accumulation in desert soils. *Soil Sci.* 101: 347-360, illus.
- (9) Gile, L.H., and Robert B. Grossman. 1979. The Desert Project soil monograph. 984 pp., illus.
- (10) Gile, L.H. 1981. Supplement to the Desert Project monograph. Rio Grande Historical Collections. 84 pp., illus.
- (11) Hadley, R.F. 1968. Ephemeral streams. *In* Encyclopedia of Geomorphology. pp. 312-314, illus.
- (12) Happ, S.C., G. Rittenhouse, and G.C. Dobson. 1940. Types of deposits. *In* Some Principles of Accelerated Stream and Valley Sedimentation. U.S. Dep. Agric., pp. 22-26, illus.
- (13) Hawley, J.W. 1975. Quaternary history of Dona Ana County region, south-central New Mexico. *In* New Mexico Geological Society Guidebook, 26th Field Conf., Las Cruces Area. pp. 139-150, illus.
- (14) Jenny, H. 1980. Ecosystems and soil. *In* The Soil Resources: Origin and Behavior. pp. 10-11, illus.
- (15) Kottlowski, F.E., M.E. Cooley, and Robert V. Ruhe. 1965. Quaternary geology of the Southwest. *In* Quaternary Research, A Review Volume for the VIIth Congress of the International Association for Quaternary Research. pp. 287-298, illus.
- (16) Parsons, R.B., C.A. Balster, and A.O. Ness. 1970. Soil development and geomorphic surfaces, Willamette Valley, Oregon. *Soil Sci. Soc. Am. Proc.* 34: 485-491, illus.
- (17) Parsons, R.B., and R.C. Herriman. 1975. A lithosequence in the mountains of southwestern Oregon. *Soil Sci. Soc. Am. J.* 39: 943-948, illus.
- (18) Parsons, R.B., R.C. Herriman, and T.D. Cook. 1984. Geomorphic surfaces and soils, Colorado River Area, Arizona and California. U.S. Dep. Agric., Soil Conserv. Serv., 48 pp., illus.
- (19) Peterson, F.F. 1981. Landforms of the basin and range province defined for soil survey. *Nev. Agric. Exp. Stn. Tech. Bull.* 28, 52 pp., illus.

- (20) Sellers, W.D., and R.H. Hill. 1974. Arizona climate, 1931 to 1972. Rev. Second Ed., 593 pp., illus.
- (21) Shafequallah, M., D.J. Lynch, P.E. Damon, and H.W. Peitee. 1976. Geology, geochronology and geochemistry of the Picacho Peak area, Pinal County, Arizona. *Ariz. Geol. Soc. Dig.* 10: 305-322, illus.
- (22) Shreve, Forrest, and Ira L. Wiggins. 1964. Vegetation and flora of the Sonoran Desert, vol. 1. 370 pp., illus.
- (23) Stone, Richard. 1968. Deserts and desert landforms. *In* Encyclopedia of Geomorphology. pp. 271-279, illus.
- (24) Thornbury, W.D. 1954. Principles of geomorphology. pp. 276-286, illus.
- (25) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. (Supplements replacing pp. 173-188 issued May 1962.)
- (26) United States Department of Agriculture. 1961. Land capability classification. U.S. Dep. Agric. Handb. 210, 21 pp.
- (27) United States Department of Agriculture. 1974. Soil survey laboratory data and descriptions for some soils of Arizona. *Soil Surv. Invest. Rep.* 28, 383 pp.
- (28) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. U.S. Dep. Agric. Handb. 436, 754 pp., illus.
- (29) United States Department of Agriculture. 1981. Soil survey of Gila-Duncan area, Arizona, parts of Graham and Greenlee Counties. 174 pp., illus., maps.
- (30) United States Department of Agriculture. 1983. Soil survey of Multnomah County, Oregon. *Soil Conserv. Serv.*, pp. 131-137.
- (31) United States Department of Agriculture. 1985. Characterization data for Arizona. Project CP84-AZ-126. Natl. Soil Surv. Lab., Lincoln, Nebr.

# Glossary

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**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.

**Alkali (sodic) 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.

**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.** Unconsolidated clastic material deposited by running water, including gravel, sand, silt, clay, and various mixtures of these materials.

**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.

**Arroyo.** The flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in alluvium.

**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
Moderately high .....	7.5 to 10
High .....	more than 10

**Back slope.** The geomorphic component that forms the steepest inclined surface and principal element of many hillslopes. Back slopes in profile are

commonly steep, are linear, and may or may not include cliff segments.

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

**Bottom land.** The normal floodplain of a stream, subject to flooding.

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

**Brush management.** Use of mechanical, chemical, or biological methods to reduce or eliminate competition of woody vegetation to allow understory grasses and forbs to recover, or to make conditions favorable for reseeding. It increases production of forage, which reduces erosion. Brush management may improve the habitat for some species of wildlife.

**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 just 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.

**Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay,

less than 45 percent sand, and less than 40 percent silt.

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

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

**Coarse textured soil.** Sand or loamy sand.

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

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

**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.** Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

**Conservation cropping system.** Growing crops in combination with needed cultural and management practices. If soil improving crops and practices used in the system more than offset the soil depleting crops and deteriorating practices, then it is a good conservation cropping system. 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.

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

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

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

*Firm.*—When moist, crushes under moderate

pressure between thumb and forefinger, but resistance is distinctly noticeable.

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

*Sticky.*—Adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

*Hard.*—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

*Soft.*—When dry, breaks into powder or individual grains under very slight pressure.

*Cemented.*—Hard; little affected by moistening.

**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.

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

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

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

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

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

**Deferred grazing.** Postponing grazing or arresting grazing for a prescribed period.

**Delta.** A body of alluvium whose surface is nearly flat and fan shaped, deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

**Deltaic.** Pertaining to or like a delta.

**Dense layer** (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

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

**Desert pavement.** A layer of gravel or coarser fragments on a desert soil surface that was emplaced by upward movement of fragments from underlying sediment or remains after finer particles have been removed by running water or wind.

**Desert Project.** A study of the relationship between

soils and geomorphology in an arid and semiarid environment. The fundamental premise was that once the relationship was understood it could be extrapolated to other areas of similar climate and geology. In August 1957, the Desert Soil-Geomorphology Project, informally termed "the Desert Project," was started by the Soil Survey Investigations, Soil Conservation Service, in Dona Ana County, New Mexico. The study was terminated in June 1972.

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

**Drainage class (natural).** Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

*Excessively drained.*—These soils have very high and high hydraulic conductivity and low water holding capacity. They are not suited to crop production unless irrigated.

*Somewhat excessively drained.*—These soils have high hydraulic conductivity and low water holding capacity. Without irrigation, only a narrow range of crops can be grown and yields are low.

*Well drained.*—These soils have intermediate water holding capacity. They retain optimum amounts of moisture, but they are not wet close enough to the surface or long enough during the growing season to adversely affect yields.

*Moderately well drained.*—These soils are wet close enough to the surface or long enough that planting or harvesting operations or yields of some field crops are adversely affected unless artificial drainage is provided. Moderately well drained soils commonly have a layer with low hydraulic conductivity, a wet layer relatively high in the profile, additions of water by seepage, or some combination of these.

*Somewhat poorly drained.*—These soils are wet close enough to the surface or long enough that planting or harvesting operations or crop growth is markedly restricted unless artificial drainage is provided. Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, a wet layer high in the profile, additions of water through seepage, or a combination of these.

*Poorly drained.*—These soils commonly are so wet at or near the surface during a considerable part

of the year that field crops cannot be grown under natural conditions. Poorly drained conditions are caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these.

*Very poorly drained.*—These soils are wet to the surface most of the time. They are wet enough to prevent the growth of important crops (except rice) unless artificially drained.

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

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

**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.

**Ephemeral stream.** A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

**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 floodplains and coastal plains. Synonym: natural erosion.

*Erosion (accelerated).* Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature; for example, fire that exposes the surface.

**Escarpment.** A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and produced by erosion or faulting. Synonym: scarp.

**Excess alkali** (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

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

**Fan alluvium.** More-or-less stratified sediment that

occupies a pediment immediately downslope from its source. Generally, the most gravelly deposits are on the upslope side.

**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.

**Fine textured soil.** Sandy clay, silty clay, or clay.

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

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

**Forb.** Any herbaceous plant not a grass or a sedge.

**Fragile** (in tables). A soil that is easily damaged by use or disturbance.

**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.

**Gilgal.** Commonly a succession of microbasins and microknolls.

**Geomorphic surface.** A geomorphic surface represents an episode of landscape development. A mappable part of the land surface that is defined in terms of morphology (such as relief, slope, and aspect), origin (such as erosional and constructional), age (absolute, relative), and stability of component landforms (buried, exhumed, relict).

**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 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

**Ground water** (geology). Water filling all the unblocked pores of underlying material below the water table. Water under the surface of the earth regardless of the geologic structure in which it is standing or moving. Ground water does not include water flowing in underground streams with ascertainable banks or beds.

**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.

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

**Hardpan.** A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

**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.

**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—*A horizon.*—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

*B horizon.*—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

*E horizon.*—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

*C horizon.*—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the number 2 precedes the letter C.

*R layer.*—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

**Hydrologic soil groups.** Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

**Igneous rock.** Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

**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.

**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

**Intermittent stream.** A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

**Irrigation.** Application of water to soils to assist in production of crops. Methods of irrigation are—  
**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.

**Basin.**—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

**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.

**Landform.** Any physical, recognizable form or feature of the earth's surface, having a characteristic shape and produced by natural causes. It includes major forms such as a plain, plateau, or mountain and minor forms such as a hill, valley, slope, esker, or dune. Taken together, the landforms make up the surface configuration of the earth. The "landform" concept involves both empirical description of a terrain (land surface form) class and interpretation of genetic factors (natural cause).

**Large stones** (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

**Leaching.** The removal of soluble material from soil or other material by percolating water.

**Light textured soil.** Sand or loamy sand.

**Liquid limit.** The moisture content at which the soil passes from a plastic to a liquid state.

**Loam.** Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

**Low strength.** The soil is not strong enough to support loads.

**Medium textured soil.** Very fine sandy loam, loam, silt loam, or silt.

**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.

**Mottling, soil.** Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

**Mountain.** A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides and considerable bare-rock surface. A mountain can occur as a single, isolated mass or in a group forming a chain or range.

**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 between 6.6 and 7.3. (See Reaction, soil.)

**Nutrient, plant.** Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

**Organic matter.** Plant and animal residue in the soil in various stages of decomposition.

**Pan.** A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan*, *fragipan*, *claypan*, *plowpan*, and *traffic pan*.

**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.

**Pedon.** The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

**Percs slowly** (in tables). The slow movement of water

through the soil, adversely affecting the specified use.

**Permeability.** The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are—

Very slow .....	less than 0.06 inch
Slow .....	0.06 to 0.2 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. For example, slope, stoniness, and thickness.

**pH value.** A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

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

**Plasticity index.** The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

**Plastic limit.** The moisture content at which a soil changes from semisolid to plastic.

**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.

**Plowpan.** A compacted layer formed in the soil directly below the plowed layer.

**Ponding.** Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

**Poor filter** (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

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

**Potential native plant community.** The plant community on a given site that will be established if present environmental conditions continue to prevail and the site is properly managed. (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 increases the vigor and reproduction of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

**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	.....	below 4.5
Very strongly acid	.....	4.5 to 5.0
Strongly acid	.....	5.1 to 5.5
Medium acid	.....	5.6 to 6.0
Slightly acid	.....	6.1 to 6.5
Neutral	.....	6.6 to 7.3
Mildly alkaline	.....	7.4 to 7.8
Moderately alkaline	.....	7.9 to 8.4
Strongly alkaline	.....	8.5 to 9.0
Very strongly alkaline	.....	9.1 and higher

**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.

**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.

**Rooting depth** (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

**Runoff.** The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

**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 degree to which soils are affected by soluble salts. It is expressed as—

Nonsaline	.....	0 to 2 millimhos per centimeter
Slightly saline	.....	2 to 8 millimhos per centimeter
Moderately saline	.....	8 to 16 millimhos per centimeter
Strongly saline	.....	more than 16 millimhos per centimeter

**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.

**Saprolite** (soil science). 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.

**Seepage** (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

**Series, soil.** A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

**Shale.** Sedimentary rock formed by the hardening of a clay deposit.

**Sheet erosion.** The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

**Shrink-swell** (in tables). The shrinking of soil when dry

and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

**Silt.** As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

**Slippage** (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

**Slope.** The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

**Slope** (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

**Slope alluvium.** Sediment and gravel transported on mountain slopes and hillslopes, primarily by alluvial processes, and characterized by some particle sorting. Sorting can be expressed by changes in size or specific gravity of coarse fragments or by the presence of stone lines.

**Slow intake** (in tables). The slow movement of water into the soil.

**Small stones** (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

**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 underlying material. 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 6 to 15 inches (15 to 38 centimeters) in length if flat.

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

**Stream alluvium.** Sediment transported and deposited by a historical or present-day stream. This sediment is characterized by well sorted, stratified material that can reflect any of the lithologies of the surrounding watershed.

**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 grain* (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 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.** Water in a river or channel, immediately downstream from a structure. Water that reaches the lower end of a field.

**Tailwater recovery.** The process of collecting irrigation water runoff for reuse in the system.

**Talus.** Rock fragments of any size or shape, commonly coarse and angular, derived from and lying at the base of a cliff or very steep, rock slope. The accumulated mass of such loose, broken rock formed chiefly by falling, rolling, or sliding.

**Terrace** (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

**Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

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

**Tilth, soil.** The physical condition of the soil as related to tillage, seedbed preparation, seedling

emergence, and root penetration.

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

**Topsoil.** The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

**Toxicity** (in tables). An excessive amount of toxic substances, such as sodium or sulfur, that severely hinder establishment of vegetation or severely restrict plant growth.

**Trace elements.** Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

**Unstable fill** (in tables). Risk of caving or sloughing on banks of fill material.

**Valley fill.** Alluvium deposited by heavily loaded streams.

**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.

**Wilting point (or permanent wilting point).** The moisture content of soil, on an oven-dry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.



# Tables

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TABLE 1.--TEMPERATURE AND PRECIPITATION  
 [Recorded in the period 1951-80 at Casa Grande, Arizona]

Month	Temperature						Precipitation			
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have--		Average number of growing degree days*	Average	2 years in 10 will have--		Average number of days with 0.10 inch or more
				Maximum temperature higher than--	Minimum temperature lower than--			Less than--	More than--	
° F	° F	° F	° F	° F	Units	In	In	In		
January----	66.3	35.8	51.1	81	21	98	0.81	---	1.39	2
February---	71.4	38.8	55.1	88	26	180	.66	.06	1.12	2
March-----	76.4	43.3	59.9	93	29	320	.85	.18	1.39	2
April-----	85.3	48.8	67.1	100	35	513	.29	---	.50	1
May-----	94.4	57.4	75.9	109	41	803	.11	---	.20	0
June-----	104.2	66.6	85.4	115	52	1,062	.20	---	.34	1
July-----	106.4	76.2	91.3	115	63	1,280	.90	.29	1.39	3
August-----	103.5	73.9	88.7	113	62	1,200	1.80	.46	2.87	3
September--	99.7	66.6	83.2	110	51	996	.61	---	1.06	1
October----	89.5	54.3	71.9	101	36	679	.78	.02	1.34	2
November---	75.9	42.6	59.3	91	28	285	.66	---	1.15	1
December---	67.3	35.7	51.5	82	23	105	.91	.05	1.55	2
Yearly:										
Average--	86.7	53.3	70.0	---	---	---	---	---	---	---
Extreme--	---	---	---	116	19	---	---	---	---	---
Total----	---	---	---	---	---	7,521	8.58	6.24	10.76	20

\* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL  
(Recorded in the period 1951-80 at Casa Grande, Arizona)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Feb. 9	Mar. 11	Mar. 26
2 years in 10 later than--	Jan. 27	Feb. 28	Mar. 18
5 years in 10 later than--	Dec. 29	Feb. 7	Mar. 2
First freezing temperature in fall:			
1 year in 10 earlier than--	Dec. 9	Nov. 19	Nov. 8
2 years in 10 earlier than--	Dec. 18	Nov. 28	Nov. 14
5 years in 10 earlier than--	Jan. 7	Dec. 14	Nov. 25

TABLE 3.--GROWING SEASON  
(Recorded in the period 1956-82 at Casa Grande, Arizona)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	322	273	234
8 years in 10	338	285	245
5 years in 10	365	308	268
2 years in 10	365	336	290
1 year in 10	365	365	301

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1	Akela-Rock outcrop complex, 10 to 60 percent slopes-----	1,365	0.1
2	Antho loamy fine sand-----	3,486	0.4
3	Casa Grande fine sandy loam-----	95,665	10.2
4	Casa Grande clay loam-----	25,882	2.8
5	Cashion clay-----	3,202	0.3
6	Cellar-Rock outcrop complex, 5 to 60 percent slopes-----	2,688	0.3
7	Cherioni-Rock outcrop complex, 5 to 60 percent slopes-----	17,094	1.8
8	Cipriano cobbly loam, 1 to 8 percent slopes-----	21,394	2.3
9	Contine clay loam-----	28,854	3.1
10	Contine clay-----	6,751	0.7
11	Coolidge sandy loam-----	10,038	1.1
12	Cuerda fine sandy loam-----	3,640	0.4
13	Dateland fine sandy loam-----	23,515	2.5
14	Dateland fine sandy loam, saline-----	6,793	0.7
15	Denure very gravelly sandy loam, 1 to 8 percent slopes-----	16,233	1.7
16	Denure sandy loam, 1 to 3 percent slopes-----	111,792	11.9
17	Denure fine sandy loam, 0 to 1 percent slopes-----	13,339	1.4
18	Denure clay loam, 0 to 1 percent slopes-----	4,452	0.5
19	Dumps-Pits association-----	1,827	0.2
20	Gadsden clay-----	6,205	0.7
21	Gilman fine sandy loam-----	15,590	1.7
22	Gilman clay loam-----	2,237	0.2
23	Ginland clay-----	7,056	0.8
24	Glenbar clay loam-----	24,554	2.6
25	Gunsight-Cipriano complex, 1 to 8 percent slopes-----	19,919	2.1
26	Gunsight-Pinamt complex, 1 to 8 percent slopes-----	8,074	0.9
27	La Palma fine sandy loam-----	6,227	0.7
28	Laveen loam-----	28,539	3.0
29	Marana silty clay loam-----	52,038	5.6
30	Mohall sandy loam-----	31,485	3.3
31	Mohall loam-----	59,497	6.4
32	Mohall clay loam-----	35,532	3.8
33	Mohall-Denure association-----	12,810	1.4
34	Momoli-Carrizo complex, 1 to 8 percent slopes-----	18,995	2.0
35	Pajarito-Sonoita complex-----	5,880	0.6
36	Pimer silty clay-----	924	0.1
37	Pinamt-Momoli complex, 1 to 8 percent slopes-----	49,067	5.2
38	Pits-----	2,058	0.2
39	Quilotosa-Rock outcrop complex, 5 to 60 percent slopes-----	1,192	0.1
40	Rositas loamy fine sand-----	4,736	0.5
41	Saminiego silty clay loam-----	10,899	1.2
42	Sasco silt loam-----	32,225	3.4
43	Toltec fine sandy loam-----	29,557	3.2
44	Tremant-Denure complex-----	4,414	0.5
45	Trix clay loam-----	13,566	1.4
46	Vaiva-Rock outcrop complex, 2 to 15 percent slopes-----	8,211	0.9
47	Vaiva-Rock outcrop complex, 15 to 50 percent slopes-----	42,735	4.6
48	Valencia sandy loam-----	3,058	0.3
49	Why sandy loam-----	1,730	0.2
	Total-----	937,020	100.0

TABLE 5.--YIELDS PER ACRE OF IRRIGATED CROPS

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil. Only the soils suited to irrigated crops are listed]

Soil name and map symbol	Cotton lint	Alfalfa hay	Grain sorghum	Wheat
	<u>Lbs</u>	<u>Tons</u>	<u>Bu</u>	<u>Bu</u>
2----- Antho	950	7.5	72	---
3, 4----- Casa Grande	900	6.0	75	60
5----- Cashion	1,100	7.0	93	70
9, 10----- Contine	1,300	8.2	95	83
11----- Coolidge	950	6.5	70	80
13----- Dateland	1,200	8.2	95	85
16----- Denure	950	7.0	90	70
17, 18----- Denure	1,100	7.9	90	80
20----- Gadsden	1,200	9.5	90	85
21, 22----- Gilman	1,320	10.5	95	95
23----- Ginland	1,200	9.5	90	85
24----- Glenbar	1,400	10.0	95	95
27----- La Palma	780	6.0	55	65
28----- Laveen	1,250	9.5	85	80
29----- Marana	1,500	10.0	105	95
30, 31, 32----- Mohall	1,600	11.0	105	100
36----- Pimer	1,300	9.0	95	90
40----- Rositas	900	6.5	65	---
41----- Saminiego	1,400	10.0	90	80

TABLE 5.--YIELDS PER ACRE OF IRRIGATED CROPS--Continued

Soil name and map symbol	Cotton lint	Alfalfa hay	Grain sorghum	Wheat
	<u>Lbs</u>	<u>Tons</u>	<u>Bu</u>	<u>Bu</u>
42----- Sasco	1,450	10.5	100	95
43----- Toltec	1,080	7.0	50	65
45----- Trix	1,400	10.0	95	96
48----- Valencia	1,300	9.5	90	83

TABLE 6.--RANGELAND PRODUCTIVITY

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
1*: Akela----- Rock outcrop.	Basalt Hills, 10-12" p.z.-----	550	400	300
2----- Antho	Sandy Bottom, 7-10" p.z.-----	2,000	1,300	850
3, 4----- Casa Grande	Saline Upland (loamy), 7-10" p.z.-----	400	250	150
5----- Cashion	Clay Bottom, 7-10" p.z.-----	1,100	850	600
6*: Cellar----- Rock outcrop.	Granitic Hills, 10-12" p.z.-----	800	700	500
7*: Cherioni----- Rock outcrop.	Basalt Hills, 7-10" p.z.-----	700	450	300
8----- Cipriano	Limy Upland, 7-10" p.z.-----	250	175	100
9----- Contine	Clay Loam Upland, 7-10" p.z.-----	600	400	250
10----- Contine	Clay Upland, 7-10" p.z.-----	550	400	200
11----- Coolidge	Limy Fan, 7-10" p.z.-----	400	300	200
12----- Cuerda	Sandy Bottom, 7-10" p.z.-----	2,100	1,400	900
13----- Dateland	Limy Fan, 7-10" p.z.-----	450	300	150
14----- Dateland	Saline Upland (loamy), 7-10" p.z.-----	400	250	150
15----- Denure	Sandy Loam Upland, 7-10" p.z.-----	600	450	350
16, 17, 18----- Denure	Limy Fan, 7-10" p.z.-----	450	300	150
20----- Gadsden	Clay Bottom, 7-10" p.z.-----	1,100	850	600
21, 22----- Gilman	Loamy Bottom, 7-10" p.z.-----	1,300	900	600

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
24----- Glenbar	Loamy Bottom, 7-10" p.z.-----	1,300	900	600
25*: Gunsight-----	Limy Upland, 7-10" p.z.-----	250	150	100
Cipriano-----	Limy Upland, 7-10" p.z.-----	250	175	100
26*: Gunsight-----	Limy Upland, 7-10" p.z.-----	250	150	100
Pinamt-----	Limy Upland, 7-10" p.z.-----	350	200	100
27----- La Palma	Saline Upland (loamy), 7-10" p.z.-----	400	250	150
28----- Laveen	Limy Fan, 7-10" p.z.-----	700	350	250
29----- Marana	Loamy Upland, 7-10" p.z.-----	800	450	300
30----- Mohall	Sandy Loam Upland, 7-10" p.z.-----	650	450	300
31----- Mohall	Loamy Upland, 7-10" p.z.-----	600	400	250
32----- Mohall	Clay Loam Upland, 7-10" p.z.-----	600	400	250
33*: Mohall-----	Sandy Loam Upland, 7-10" p.z.-----	650	450	300
Denure-----	Sandy Loam Upland, 7-10" p.z.-----	600	400	300
34*: Momoli-----	Limy Fan, 7-10" p.z.-----	500	350	250
Carrizo-----	Sandy Bottom, 7-10" p.z.-----	2,200	1,300	850
35*: Pajarito-----	Deep Sandy Loam, 10-12" p.z.-----	800	400	200
Soncita-----	Sandy Loam Upland, 10-12" p.z.-----	800	600	400
36----- Pimer	Clay Bottom, 7-10" p.z.-----	950	700	500
37*: Pinamt-----	Limy Upland, 7-10" p.z.-----	350	200	100
Momoli-----	Limy Fan, 7-10" p.z.-----	500	350	250
39*: Quilotosa-----	Granitic Hills, 7-10" p.z.-----	550	400	250
Rock outcrop.				

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
40----- Rositas	Sandy Upland, 7-10" p.z.-----	1,000	650	400
41----- Saminiego	Clay Upland, 7-10" p.z.-----	800	400	300
42----- Sasco	Loamy Upland, 7-10" p.z.-----	800	450	300
43----- Toltec	Saline Upland (loamy), 7-10" p.z.-----	400	250	150
44*: Tremant-----	Limy Fan, 7-10" p.z.-----	600	350	250
Denure-----	Limy Fan, 7-10" p.z.-----	450	300	150
45----- Trix	Loamy Bottom, 7-10" p.z.-----	900	750	500
46*: Vaiva-----	Shallow Upland, 7-10" p.z.-----	350	300	150
Rock outcrop.				
47*: Vaiva-----	Granitic Hills, 7-10" p.z.-----	500	400	250
Rock outcrop.				
48----- Valencia	Sandy Bottom, 7-10" p.z.-----	2,100	1,400	900
49----- Why	Sandy Bottom, 7-10" p.z.-----	2,100	1,400	900

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

TABLE 7.--RECREATIONAL DEVELOPMENT

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

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1*: Akela-----  Rock outcrop.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones.	Severe: large stones, slope.	Severe: large stones, slope, thin layer.
2----- Antho	Severe: flooding.	Slight-----	Moderate: flooding.	Slight-----	Moderate: droughty, flooding.
3, 4----- Casa Grande	Severe: excess sodium, excess salt.	Severe: excess sodium, excess salt.	Severe: excess sodium, excess salt.	Slight-----	Severe: excess salt, excess sodium, droughty.
5----- Cashion	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey, flooding.	Moderate: too clayey.	Severe: too clayey.
6*: Cellar-----  Rock outcrop.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones.	Severe: small stones, slope, thin layer.
7*: Cherioni-----  Rock outcrop.	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: large stones, slope, depth to rock.	Severe: large stones, slope.	Severe: large stones, slope, thin layer.
8----- Cipriano	Severe: cemented pan.	Severe: cemented pan.	Severe: large stones, small stones.	Moderate: large stones, dusty.	Severe: large stones, droughty.
9----- Contine	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
10----- Contine	Moderate: too clayey.	Moderate: too clayey.	Severe: too clayey.	Moderate: too clayey.	Severe: too clayey.
11----- Coolidge	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
12----- Cuerda	Severe: flooding.	Slight-----	Moderate: flooding.	Slight-----	Moderate: flooding.
13----- Dateland	Slight-----	Slight-----	Moderate: small stones.	Slight-----	Slight.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
14----- Dateland	Severe: excess sodium, excess salt.	Severe: excess sodium, excess salt.	Severe: excess sodium, excess salt.	Slight-----	Severe: excess salt, excess sodium.
15----- Denure	Severe: small stones.	Severe: small stones.	Severe: small stones.	Slight-----	Severe: small stones.
16----- Denure	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
17, 18----- Denure	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
19*: Dumps.  Pits.					
20----- Gadsden	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey, flooding.	Moderate: too clayey.	Severe: too clayey.
21, 22----- Gilman	Severe: flooding.	Slight-----	Moderate: flooding.	Slight-----	Moderate: flooding.
23----- Ginland	Severe: flooding.	Moderate: too clayey.	Severe: too clayey.	Moderate: too clayey.	Severe: too clayey.
24----- Glenbar	Severe: flooding.	Moderate: dusty.	Moderate: flooding.	Slight-----	Moderate: flooding.
25*: Gunsight-----	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones, droughty.
Cipriano-----	Severe: cemented pan.	Severe: cemented pan.	Severe: large stones, small stones.	Moderate: large stones, dusty.	Severe: large stones, droughty.
26*: Gunsight-----	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones, droughty.
Pinamt-----	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones, droughty.
27----- La Palma	Severe: excess sodium, excess salt.	Severe: excess sodium, excess salt.	Severe: excess sodium, excess salt.	Slight-----	Severe: excess salt, excess sodium, droughty.
28----- Laveen	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Slight-----	Slight.
29----- Marana	Severe: flooding.	Moderate: percs slowly.	Moderate: percs slowly.	Slight-----	Slight.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
30----- Mohall	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
31----- Mohall	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Slight-----	Slight.
32----- Mohall	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
33*: Mohall-----	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
Denure-----	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
34*: Momoli-----	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones, droughty.
Carrizo-----	Severe: flooding, small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones, droughty.
35*: Pajarito-----	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight-----	Moderate: small stones.
Sonoita-----	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: droughty.
36----- Pimer	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey, flooding.	Moderate: too clayey.	Severe: too clayey.
37*: Pinamt-----	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones, droughty.
Momoli-----	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones, droughty.
38*. Pits					
39*: Quilotosa-----	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: large stones, slope, small stones.	Severe: slope.	Severe: large stones, droughty, slope.
Rock outcrop.					
40----- Rositas	Slight-----	Slight-----	Moderate: small stones.	Slight-----	Moderate: droughty.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
41----- Saminiego	Severe: flooding.	Moderate: percs slowly.	Moderate: percs slowly.	Severe: erodes easily.	Slight.
42----- Sasco	Severe: flooding.	Slight-----	Slight-----	Slight-----	Slight.
43----- Toltec	Slight-----	Slight-----	Slight-----	Slight-----	Severe: excess sodium.
44*: Tremant-----	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Slight.
Denure-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
45----- Trix	Severe: flooding.	Slight-----	Moderate: flooding.	Slight-----	Moderate: flooding.
46*: Vaiva-----	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Slight-----	Severe: small stones.
Rock outcrop.					
47*: Vaiva-----	Severe: slope, large stones, small stones.	Severe: slope, large stones, small stones.	Severe: large stones, slope, small stones.	Severe: large stones, slope.	Severe: small stones, large stones, droughty.
Rock outcrop.					
48----- Valencia	Severe: flooding.	Slight-----	Moderate: flooding.	Slight-----	Moderate: flooding.
49----- Why	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.

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

TABLE 8.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1*: Akela-----	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: large stones, slope, thin layer.
Rock outcrop.						
2----- Antho	Severe: cutbanks cave, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
3, 4----- Casa Grande	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength.	Severe: excess salt, excess sodium droughty.
5----- Cashion	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, shrink-swell.	Severe: too clayey.
6*: Cellar-----	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: small stones slope, thin layer.
Rock outcrop.						
7*: Cherioni-----	Severe: depth to rock, cemented pan, slope.	Severe: slope, depth to rock, cemented pan.	Severe: depth to rock, cemented pan, slope.	Severe: slope, depth to rock, cemented pan.	Severe: depth to rock, cemented pan, slope.	Severe: large stones slope, thin layer.
Rock outcrop.						
8----- Cipriano	Severe: cemented pan.	Severe: thin layer, droughty.				
9----- Contine	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
10----- Contine	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
11----- Coolidge	Slight-----	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
12----- Cuerda	Slight-----	Slight-----	Slight-----	Slight-----	Slight-----	Slight.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
13----- Dateland	Slight-----	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
14----- Dateland	Slight-----	Slight-----	Slight-----	Slight-----	Slight-----	Severe: excess salt, excess sodium.
15----- Denure	Slight-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
16, 17, 18----- Denure	Slight-----	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
19*: Dumps.  Pits.						
20----- Gadsden	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, shrink-swell.	Severe: too clayey.
21, 22----- Gilman	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
23----- Ginland	Moderate: too clayey, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: too clayey.
24----- Glenbar	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
25*: Gunsight	Slight-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Severe: small stones, droughty.
Cipriano-----	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Severe: thin layer, droughty.
26*: Gunsight	Slight-----	Slight-----	Slight-----	Slight-----	Slight-----	Severe: small stones, droughty.
Pinamt-----	Moderate: large stones.	Moderate: large stones.	Moderate: large stones.	Moderate: slope, large stones.	Moderate: large stones.	Severe: small stones, droughty.
27----- La Palma	Severe: cemented pan.	Moderate: shrink-swell, cemented pan.	Severe: cemented pan.	Moderate: shrink-swell, cemented pan.	Moderate: cemented pan, low strength, shrink-swell.	Severe: excess salt, excess sodium, droughty.
28----- Laveen	Slight-----	Slight-----	Slight-----	Slight-----	Slight-----	Slight.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
29----- Marana	Slight-----	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.	Slight.
30, 31, 32----- Mohall	Slight-----	Moderate: shrink-swell.	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Slight.
33*: Mohall-----	Slight-----	Moderate: shrink-swell.	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Slight.
Denure-----	Slight-----	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
34*: Momoli-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Severe: small stones, droughty.
Carrizo-----	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: small stones, droughty.
35*: Pajarito-----	Slight-----	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: small stones.
Sonoita-----	Slight-----	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
36----- Pimer	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: too clayey.
37*: Pinamt-----	Moderate: large stones.	Moderate: large stones.	Moderate: large stones.	Moderate: slope, large stones.	Moderate: large stones.	Severe: small stones, droughty.
Momoli-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Severe: small stones, droughty.
38*. Pits						
39*: Quilotosa-----	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: large stones, droughty, slope.
Rock outcrop.						
40----- Rositas	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
41----- Saminiego	Moderate: cutbanks cave, too clayey.	Severe: flooding, shrink-swell.	Severe: flooding.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.	Slight.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
42----- Sasco	Moderate: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
43----- Toltec	Slight-----	Slight-----	Slight-----	Slight-----	Slight-----	Severe: excess sodium.
44*: Tremant-----	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: small stones.
Denure-----	Slight-----	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
45----- Trix	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
46*: Vaiva-----	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: small stones, droughty.
Rock outcrop.						
47*: Vaiva-----	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: small stones, large stones, droughty.
Rock outcrop.						
48----- Valencia	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
49----- Why	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty.

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

TABLE 9.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1*: Akela-----	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, seepage, small stones.
Rock outcrop.					
2----- Antho	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding.	Severe: flooding.	Good.
3, 4----- Casa Grande	Severe: percs slowly.	Slight-----	Slight-----	Slight-----	Good.
5----- Cashion	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
6*: Cellar-----	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
Rock outcrop.					
7*: Cherioni-----	Severe: depth to rock, cemented pan, slope.	Poor: area reclaim, slope.			
Rock outcrop.					
8----- Cipriano	Severe: cemented pan.	Severe: cemented pan, large stones.	Severe: cemented pan.	Severe: cemented pan.	Poor: area reclaim, small stones.
9, 10----- Contine	Severe: percs slowly.	Slight-----	Slight-----	Slight-----	Good.
11----- Coolidge	Slight-----	Severe: seepage.	Slight-----	Slight-----	Good.
12----- Cuerda	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
13----- Dateland	Slight-----	Severe: flooding.	Moderate: flooding.	Moderate: flooding.	Good.
14----- Dateland	Slight-----	Severe: seepage.	Slight-----	Slight-----	Good.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
15, 16, 17, 18----- Denure	Slight-----	Severe: seepage.	Slight-----	Slight-----	Good.
19*: Dumps. Pits.					
20----- Gadsden	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Poor: hard to pack.
21, 22----- Gilman	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
23----- Ginland	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
24----- Glenbar	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
25*: Gunsight-----	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----	Slight-----	Poor: small stones.
Cipriano-----	Severe: cemented pan.	Severe: cemented pan, large stones.	Severe: cemented pan.	Severe: cemented pan.	Poor: area reclaim, small stones.
26*: Gunsight-----	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----	Slight-----	Poor: small stones.
Pinamt-----	Moderate: large stones.	Severe: seepage.	Moderate: large stones.	Slight-----	Poor: small stones.
27----- La Palma	Severe: cemented pan, percs slowly.	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Poor: area reclaim.
28----- Laveen	Moderate: percs slowly.	Moderate: seepage.	Slight-----	Slight-----	Good.
29----- Marana	Severe: percs slowly.	Severe: flooding.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
30, 31, 32----- Mohall	Severe: percs slowly.	Moderate: seepage.	Slight-----	Slight-----	Good.
33*: Mohall-----	Severe: percs slowly.	Moderate: seepage.	Slight-----	Slight-----	Good.
Denure-----	Slight-----	Severe: seepage.	Slight-----	Slight-----	Good.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
34*: Momoli-----	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight-----	Poor: seepage, too sandy, small stones.
Carrizo-----	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, too sandy.	Severe: flooding.	Poor: seepage, too sandy, small stones.
35*: Pajarito-----	Slight-----	Severe: seepage.	Slight-----	Slight-----	Good.
Sonoita-----	Slight-----	Severe: seepage.	Slight-----	Slight-----	Good.
36----- Pimer	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
37*: Pinamt-----	Moderate: large stones.	Severe: seepage.	Moderate: large stones.	Slight-----	Poor: small stones.
Momoli-----	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight-----	Poor: seepage, too sandy, small stones.
38*. Pits					
39*: Quilotosa-----	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, small stones, slope.
Rock outcrop.					
40----- Rositas	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight-----	Poor: seepage, too sandy.
41----- Saminiego	Severe: percs slowly.	Severe: flooding.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
42----- Sasco	Severe: percs slowly.	Severe: flooding.	Moderate: flooding.	Moderate: flooding.	Good.
43----- Toltec	Moderate: percs slowly.	Moderate: seepage.	Slight-----	Slight-----	Poor: excess sodium.
44*: Tremant-----	Severe: percs slowly.	Moderate: slope.	Slight-----	Slight-----	Good.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
44*: Denure-----	Slight-----	Severe: seepage.	Slight-----	Slight-----	Fair: small stones.
45----- Trix	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
46*: Vaiva-----  Rock outcrop.	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.
47*: Vaiva-----  Rock outcrop.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, small stones, slope.
48----- Valencia	Severe: flooding, percs slowly.	Severe: seepage, flooding.	Severe: flooding.	Severe: flooding.	Good.
49----- Why	Severe: flooding.	Severe: flooding, seepage.	Severe: flooding.	Severe: flooding.	Good.

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

TABLE 10.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1*: Akela-----	Poor: area reclaim, slope.	Improbable: thin layer.	Improbable: thin layer.	Poor: area reclaim, small stones, slope.
Rock outcrop.				
2----- Antho	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
3, 4----- Casa Grande	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, excess sodium.
5----- Cashion	Poor: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
6*: Cellar-----	Poor: area reclaim, slope.	Improbable: thin layer.	Improbable: thin layer.	Poor: area reclaim, small stones, slope.
Rock outcrop.				
7*: Cherioni-----	Poor: area reclaim, slope.	Improbable: thin layer.	Improbable: thin layer.	Poor: area reclaim, small stones, slope.
Rock outcrop.				
8----- Cipriano	Poor: area reclaim.	Improbable: thin layer.	Improbable: thin layer.	Poor: area reclaim, small stones.
9, 10----- Contine	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
11----- Coolidge	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
12----- Cuerda	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.
13----- Dateland	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
14----- Dateland	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, excess sodium.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
15, 16, 17, 18----- Denure	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.
19*: Dumps. Pits.				
20----- Gadsden	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
21----- Gilman	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.
22----- Gilman	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
23----- Ginland	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
24----- Glenbar	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
25*: Gunsight-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
Cipriano-----	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
26*: Gunsight-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
Pinamt-----	Fair: large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
27----- La Palma	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt.
28----- Laveen	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.
29----- Marana	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
30, 31, 32----- Mohall	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
33*: Mohall-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Denure-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
34*: Momoli-----	Good-----	Probable-----	Probable-----	Poor: small stones, area reclaim.
Carrizo-----	Good-----	Probable-----	Probable-----	Poor: small stones, area reclaim.
35*: Pajarito-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Sonoita-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.
36----- Pimer	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
37*: Pinamt-----	Fair: large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
Momoli-----	Good-----	Probable-----	Probable-----	Poor: small stones, area reclaim.
38*. Pits				
39*: Quilotosa-----	Poor: area reclaim, slope.	Improbable: thin layer.	Improbable: thin layer.	Poor: area reclaim, small stones, slope.
Rock outcrop.				
40----- Rositas	Good-----	Probable-----	Improbable: too sandy.	Too sandy.
41----- Saminiego	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
42----- Sasco	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
43----- Toltec	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
44*: Tremant-----	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Denure-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.
45----- Trix	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
46*: Vaiva-----  Rock outcrop.	Poor: area reclaim.	Improbable: thin layer.	Improbable: thin layer.	Poor: area reclaim, small stones.
47*: Vaiva-----  Rock outcrop.	Poor: area reclaim, slope.	Improbable: thin layer.	Improbable: thin layer.	Poor: area reclaim, small stones, slope.
48----- Valencia	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
49----- Why	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.

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

TABLE 11.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Limitations for--		Features affecting irrigation
	Pond reservoir areas	Embankments, dikes, and levees	
1*: Akela-----  Rock outcrop.	Severe: depth to rock, slope.	Severe: thin layer.	Droughty, depth to rock, slope.
2----- Antho	Severe: seepage.	Severe: piping.	Droughty, fast intake, soil blowing.
3----- Casa Grande	Slight-----	Severe: piping, excess sodium.	Droughty, soil blowing, percs slowly.
4----- Casa Grande	Slight-----	Severe: piping, excess sodium.	Droughty, percs slowly, excess sodium.
5----- Cashion	Moderate: seepage.	Severe: piping.	Slow intake, percs slowly, flooding.
6*: Cellar-----  Rock outcrop.	Severe: depth to rock, slope.	Severe: thin layer.	Droughty, depth to rock, slope.
7*: Cherioni-----  Rock outcrop.	Severe: depth to rock, cemented pan, slope.	Severe: thin layer.	Droughty, depth to rock, cemented pan.
8----- Cipriano	Severe: cemented pan.	Severe: thin layer.	Droughty, cemented pan, slope.
9----- Contine	Slight-----	Moderate: hard to pack.	Percs slowly.
10----- Contine	Slight-----	Moderate: hard to pack.	Slow intake, percs slowly.
11----- Coolidge	Severe: seepage.	Severe: piping.	Soil blowing.
12----- Cuerda	Moderate: seepage.	Severe: piping.	Soil blowing.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting irrigation
	Pond reservoir areas	Embankments, dikes, and levees	
13----- Dateland	Moderate: seepage.	Severe: piping.	Soil blowing.
14----- Dateland	Severe: seepage.	Severe: piping, excess sodium.	Droughty, soil blowing.
15----- Denure	Severe: seepage.	Severe: piping.	Droughty, soil blowing, slope.
16, 17----- Denure	Severe: seepage.	Severe: piping.	Droughty, soil blowing.
18----- Denure	Severe: seepage.	Severe: piping.	Droughty.
19*: Dumps.  Pits.			
20----- Gadsden	Slight-----	Moderate: hard to pack.	Slow intake, percs slowly, flooding.
21----- Gilman	Moderate: seepage.	Severe: piping.	Soil blowing.
22----- Gilman	Moderate: seepage.	Severe: piping.	Favorable.
23----- Ginland	Slight-----	Moderate: piping.	Slow intake, percs slowly, flooding.
24----- Glenbar	Slight-----	Moderate: piping.	Flooding.
25*: Gunsight-----	Moderate: seepage, slope.	Severe: seepage.	Droughty, slope.
Cipriano-----	Severe: cemented pan.	Severe: thin layer.	Droughty, cemented pan, slope.
26*: Gunsight-----	Moderate: seepage, slope.	Severe: seepage.	Droughty, slope.
Pinamt-----	Severe: seepage.	Moderate: large stones.	Large stones, droughty, slope.
27----- La Palma	Moderate: cemented pan.	Severe: thin layer, excess sodium.	Droughty, soil blowing, percs slowly.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting irrigation
	Pond reservoir areas	Embankments, dikes, and levees	
28----- Laveen	Moderate: seepage.	Severe: piping.	Favorable.
29----- Marana	Slight-----	Moderate: piping.	Erodes easily.
30----- Mohall	Moderate: seepage.	Moderate: seepage.	Soil blowing.
31, 32----- Mohall	Moderate: seepage.	Moderate: seepage.	Favorable.
33*: Mohall-----	Moderate: seepage.	Moderate: seepage.	Soil blowing.
Denure-----	Severe: seepage.	Severe: piping.	Droughty, soil blowing.
34*: Momoli-----	Severe: seepage.	Severe: seepage.	Droughty, slope.
Carrizo-----	Severe: seepage.	Severe: seepage.	Droughty, slope.
35*: Pajarito-----	Severe: seepage.	Severe: piping.	Favorable.
Sonoita-----	Severe: seepage.	Severe: piping.	Droughty, soil blowing.
36----- Pimer	Slight-----	Moderate: piping.	Slow intake, percs slowly, flooding.
37*: Pinamt-----	Severe: seepage.	Moderate: large stones.	Large stones, droughty, slope.
Momoli-----	Severe: seepage.	Severe: seepage.	Droughty.
38* Pits			
39*: Quilotosa-----	Severe: depth to rock, slope.	Severe: thin layer.	Droughty, depth to rock, slope.
Rock outcrop.			
40----- Rositas	Severe: seepage.	Severe: seepage, piping.	Droughty, fast intake, soil blowing.
41----- Saminiego	Slight-----	Severe: piping.	Percs slowly.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting irrigation
	Pond reservoir areas	Embankments, dikes, and levees	
42----- Sasco	Moderate: seepage.	Severe: piping.	Favorable.
43----- Toltec	Moderate: seepage.	Severe: piping.	Soil blowing, excess sodium.
44*: Tremant-----	Slight-----	Severe: piping.	Soil blowing, slope.
Denure-----	Severe: seepage.	Severe: piping.	Droughty, soil blowing.
45----- Trix	Slight-----	Moderate: piping.	Flooding.
46*, 47*: Vaiva-----	Severe: depth to rock, slope.	Severe: thin layer.	Droughty, depth to rock, slope.
Rock outcrop.			
48----- Valencia	Severe: seepage..	Severe: piping.	Soil blowing, flooding.
49----- Why	Severe: seepage.	Severe: piping.	Soil blowing, flooding.

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

TABLE 12.--ENGINEERING INDEX PROPERTIES

[The symbol &lt; means less than; &gt; means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1*: Akela-----	0-2	Very cobbly very fine sandy loam.	SM	A-2	50-60	75-80	65-75	55-70	30-35	15-20	NP-5
	2-16	Very cobbly very fine sandy loam, extremely cobbly fine sandy loam.	SM	A-2	50-60	70-85	60-75	50-70	30-35	15-20	NP-5
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
2----- Antho	0-4	Loamy fine sand	SM	A-2	0	100	100	50-80	15-35	---	NP
	4-36	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-2, A-4	0	100	95-100	60-70	30-40	15-20	NP-5
	36-60	Loamy fine sand	SM	A-2	0	100	100	50-60	15-25	---	NP
3----- Casa Grande	0-13	Fine sandy loam	SM	A-4, A-2	0	100	100	60-70	30-40	15-20	NP-5
	13-60	Clay loam, loam, sandy clay loam.	CL, SC	A-6	0	100	95-100	80-95	45-70	30-40	10-15
4----- Casa Grande	0-13	Clay loam-----	CL, ML	A-6	0	100	100	90-100	70-80	35-40	10-15
	13-60	Clay loam, loam, sandy clay loam.	CL, SC	A-6	0	100	95-100	80-95	45-70	30-40	10-15
5----- Cashion	0-12	Clay-----	CL, CH	A-7	0	100	100	90-100	75-95	45-55	20-30
	12-34	Clay, silty clay, clay loam.	CL, CH	A-7	0	100	100	90-100	70-90	40-55	15-30
	34-60	Very fine sandy loam, silt loam, loam.	CL-ML	A-4	0	100	100	85-95	60-80	25-30	5-10
6*: Cellar-----	0-1	Very gravelly sandy loam.	SM, GM	A-1	0-20	35-60	20-50	15-35	10-20	15-20	NP-5
	1-5	Very gravelly loam, very gravelly sandy loam.	GM	A-1	0-20	50-60	35-50	25-45	10-25	15-20	NP-5
	5	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
7*: Cherioni-----	0-1	Very cobbly very fine sandy loam.	SM-SC, SM	A-4	50-60	85-95	80-90	70-85	35-45	15-25	NP-10
	1-8	Very gravelly very fine sandy loam, very gravelly loam, very gravelly sandy loam.	GM, GM-GC	A-1, A-2	0	30-60	25-50	20-40	10-25	15-25	NP-10
	8-10	Indurated-----	---	---	---	---	---	---	---	---	---
	10	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
8----- Cipriano	0-2	Cobbly loam-----	SM-SC	A-4	20-40	75-85	70-80	55-75	40-50	20-30	5-10
	2-9	Very gravelly loam.	GM-GC	A-4	0-5	50-60	40-50	35-45	25-35	20-30	5-10
	9	Indurated-----	---	---	---	---	---	---	---	---	---
9----- Contine	0-12	Clay loam-----	CL, ML	A-7	0	100	100	90-100	70-85	35-45	10-20
	12-51	Clay, clay loam, sandy clay.	CL, CH	A-7	0	100	100	85-95	50-70	40-55	20-30
	51-60	Loam, clay loam	CL	A-6	0	100	100	85-95	60-80	30-40	10-20
10----- Contine	0-12	Clay-----	CL, ML	A-7	0	100	100	90-100	70-85	45-50	15-25
	12-51	Clay, clay loam, sandy clay.	CL, CH	A-7	0	100	100	85-95	50-70	40-55	20-30
	51-60	Loam, clay loam	CL	A-6	0	100	100	85-95	60-80	30-40	10-20
11----- Coolidge	0-7	Sandy loam-----	SM	A-4, A-2	0	100	90-95	60-70	30-40	15-20	NP-5
	7-44	Sandy loam-----	SM	A-4, A-2	0	100	90-95	60-70	30-40	15-20	NP-5
	44-60	Sandy clay loam	SM-SC, SC	A-2, A-4	0	100	90-95	70-85	30-50	25-35	5-15
12----- Cuerda	0-9	Fine sandy loam	SM	A-4	0	100	100	70-85	40-50	15-25	NP-5
	9-30	Very fine sandy loam.	CL-ML, ML	A-4	0	100	100	85-95	50-65	15-25	NP-10
	30-60	Loam-----	CL-ML	A-4	0	100	100	85-95	60-75	25-30	5-10
13----- Dateland	0-2	Fine sandy loam, very fine sandy loam.	SM	A-2	0	90-100	85-95	60-70	25-35	15-20	NP-5
	2-40	Fine sandy loam	SM	A-2	0	95-100	90-95	55-65	25-35	15-25	NP-5
	40-60	Fine sandy loam, gravelly sandy loam, sandy loam.	SM, SM-SC	A-2, A-1	0	70-80	50-80	30-50	15-30	15-25	NP-10
14----- Dateland	0-2	Fine sandy loam	SM, SM-SC	A-2	0	90-100	85-95	60-70	25-35	15-25	NP-10
	2-40	Fine sandy loam, very fine sandy loam.	SM, SM-SC	A-2	0	95-100	90-95	55-65	25-35	15-25	NP-10
	40-60	Fine sandy loam, gravelly sandy loam, sandy loam.	SM, SM-SC	A-2, A-1	0	70-80	50-80	30-50	15-30	15-25	NP-10

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit Pct	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
15----- Denure	0-8	Very gravelly sandy loam.	SM	A-1, A-2	0	75-85	45-75	25-50	10-30	15-20	NP-5
	8-54	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	95-100	90-95	60-70	30-45	15-25	NP-5
	54-60	Sandy clay loam	SM-SC, SC, CL-ML, CL	A-4, A-6	0	100	100	85-95	45-55	25-35	5-15
16----- Denure	0-2	Sandy loam-----	SM	A-2, A-4	0	100	95-100	65-90	30-40	15-20	NP-5
	2-54	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	95-100	90-95	60-70	30-45	15-25	NP-5
	54-60	Sandy clay loam	SM-SC, SC, CL-ML, CL	A-4, A-6	0	100	100	85-95	45-55	25-35	5-15
17----- Denure	0-2	Fine sandy loam	SM	A-2, A-4	0	100	95-100	65-90	30-40	15-20	NP-5
	2-54	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	95-100	90-95	60-70	30-45	15-25	NP-5
	54-60	Sandy clay loam	SM-SC, SC, CL-ML, CL	A-4, A-6	0	100	100	85-95	45-55	25-35	5-15
18----- Denure	0-15	Clay loam-----	CL	A-6, A-7	0	100	100	90-100	70-80	35-45	15-20
	15-54	Sandy loam, fine sandy loam.	SM, SM-SC, SC	A-2, A-4, A-6	0	95-100	90-95	60-70	30-45	15-30	NP-5
	54-60	Sandy clay loam	SM-SC, SC, CL-ML, CL	A-4, A-6	0	100	100	85-95	45-55	25-35	5-15
19*: Dumps.  Pits.											
20----- Gadsden	0-13	Clay-----	CH	A-7	0	100	100	90-100	80-90	50-60	25-35
	13-42	Clay, silty clay	CH	A-7	0	100	100	90-100	80-90	50-60	25-35
	42-60	Silty clay loam	CL	A-6	0	100	100	90-100	80-90	30-35	15-20
21----- Gilman	0-14	Fine sandy loam	SM-SC, SM	A-4	0	100	95-100	65-85	40-50	20-30	NP-10
	14-60	Stratified sandy loam to silt loam.	ML	A-4	0	100	95-100	80-90	50-65	20-25	NP-5
22----- Gilman	0-12	Clay loam-----	ML, CL	A-6	0	100	95-100	90-100	70-80	35-40	10-15
	12-60	Stratified sandy loam to silt loam.	ML	A-4	0	100	95-100	80-90	50-65	20-25	NP-5
23----- Ginland	0-24	Clay-----	CL, CH	A-7	0	100	100	90-100	75-95	45-60	25-35
	24-60	Sandy clay loam, loam, clay loam.	CL	A-6	0	100	100	80-90	50-70	25-35	10-15
24----- Glenbar	0-13	Clay loam-----	ML, CL	A-6, A-7	0	100	100	95-100	70-80	35-45	10-20
	13-60	Silt loam, silty clay loam, loam.	CL, CL-ML	A-6, A-4	0	100	100	95-100	75-95	25-40	5-15
25*: Gunsight-----	0-3	Very gravelly fine sandy loam.	GM-GC, GM	A-2, A-1	0-10	35-55	30-50	25-50	10-35	20-30	NP-10
	3-12	Gravelly loam----	SM-SC	A-4	0-10	70-85	60-75	50-70	35-55	25-30	5-10
	12-60	Very gravelly loam, very gravelly sandy loam.	GM, GM-GC	A-1, A-2	0-10	35-55	30-50	25-50	10-30	15-25	NP-10

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
25*: Cipriano-----	0-2	Cobbly loam-----	SM-SC	A-4	20-40	75-85	70-80	55-75	40-50	20-30	5-10
	2-9	Very gravelly loam.	GM-GC	A-4	0-5	50-60	40-50	35-45	25-35	20-30	5-10
	9	Indurated-----	---	---	---	---	---	---	---	---	---
26*: Gunsight-----	0-3	Very gravelly fine sandy loam.	GM-GC, GM	A-2, A-1	0-10	35-55	30-50	25-50	10-35	20-30	NP-10
	3-12	Gravelly loam----	SM-SC	A-4	0-10	70-85	60-75	50-70	35-55	25-30	5-10
	12-60	Very gravelly loam, very gravelly sandy loam, extremely gravelly loam.	GM-GC	A-2, A-1	0-10	35-55	20-50	15-50	5-30	25-30	5-10
Pinamt-----	0-2	Very gravelly loam.	GM-GC	A-2	0-15	25-55	20-50	15-45	10-35	25-30	5-10
	2-23	Very gravelly sandy clay loam, very gravelly clay loam, extremely gravelly loam.	GC	A-2	15-30	20-55	15-50	10-40	10-35	25-40	10-15
	23-60	Extremely gravelly sandy loam, very gravelly loam, very gravelly sandy loam.	GP-GM, GM	A-2, A-1	15-30	20-55	15-50	10-40	5-20	15-25	NP-5
27----- La Palma	0-3	Fine sandy loam	SM	A-2, A-4	0	100	100	60-70	30-40	15-20	NP-5
	3-28	Clay loam, loam	CL	A-6	0	100	100	85-95	65-75	30-40	10-15
	28	Cemented-----	---	---	---	---	---	---	---	---	---
28----- Laveen	0-15	Loam-----	CL-ML	A-4	0	100	100	85-95	50-65	20-25	5-10
	15-42	Loam, very fine sandy loam, silt loam.	CL-ML, ML	A-4	0	100	100	85-95	55-75	15-25	NP-10
	42-60	Gravelly fine sandy loam.	SM	A-2, A-4	0	65-85	60-75	40-65	25-40	20-25	NP-5
29----- Marana	0-2	Silty clay loam	CL	A-6	0	100	100	95-100	85-95	30-40	10-15
	2-60	Silty clay loam	CL	A-6	0	100	100	95-100	85-95	30-40	10-15
30----- Mohall	0-16	Sandy loam-----	SM	A-2, A-4	0	100	85-95	50-65	25-40	15-20	NP-5
	16-43	Sandy clay loam, clay loam.	SC, CL	A-6	0	100	95-100	75-85	35-70	30-40	10-15
	43-60	Sandy loam-----	SM	A-2	0	100	90-95	60-70	30-35	20-25	NP-5
31----- Mohall	0-18	Loam-----	CL-ML	A-4	0	100	100	85-95	60-75	25-30	5-10
	18-43	Sandy clay loam, clay loam.	SC, CL	A-6	0	100	95-100	75-85	35-70	30-40	10-15
	43-60	Sandy loam-----	SM	A-2	0	100	90-95	60-70	30-35	20-25	NP-5
32----- Mohall	0-16	Clay loam-----	CL, ML	A-6	0	100	100	85-95	70-80	35-40	10-15
	16-43	Sandy clay loam, clay loam.	SC, CL	A-6	0	100	95-100	75-85	35-70	30-40	10-15
	43-60	Sandy loam-----	SM	A-2	0	100	90-95	60-70	30-35	20-25	NP-5

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
33*: Mohall-----	0-16	Sandy loam-----	SM	A-2, A-4	0	100	85-95	50-65	25-40	15-20	NP-5
	16-43	Sandy clay loam, clay loam.	SC, CL	A-6	0	100	95-100	75-85	35-70	30-40	10-15
	43-60	Sandy loam-----	SM	A-2	0	100	90-95	60-70	30-35	20-25	NP-5
Denure-----	0-2	Sandy loam-----	SM	A-2, A-4	0	100	95-100	65-90	30-40	15-20	NP-5
	2-54	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	95-100	90-95	50-70	30-40	15-25	NP-5
	54-60	Sandy clay loam	SM-SC, SC, CL-ML, CL	A-4, A-6	0	100	100	85-95	45-55	25-35	5-15
34*: Momoli-----	0-2	Very gravelly fine sandy loam.	SM, GM	A-1	0-5	35-65	20-50	15-35	10-20	20-25	NP-5
	2-34	Very gravelly loam, very gravelly fine sandy loam, very gravelly sandy loam.	GM, GM-GC	A-2, A-1	0-5	40-65	25-50	20-40	10-35	20-30	NP-10
	34-60	Very gravelly loamy sand, very gravelly fine sand.	GM, GP-GM, SM, SP-SM	A-1	0-5	40-70	25-50	15-40	5-15	---	NP
Carrizo-----	0-5	Very gravelly fine sandy loam.	GM	A-1	0	35-55	30-50	20-35	15-25	20-25	NP-5
	5-60	Extremely gravelly coarse sand, very gravelly coarse sand, very gravelly sand.	GP, GM, SP, SM	A-1	0-25	30-65	15-60	5-35	0-15	---	NP
35*: Pajarito-----	0-2	Gravelly sandy loam.	SM, GM	A-1, A-2	0-5	60-80	55-75	30-50	20-30	15-20	NP-5
	2-23	Fine sandy loam, gravelly fine sandy loam.	SM	A-2	0	80-100	70-90	50-75	30-45	15-25	NP-5
	23-60	Gravelly loam, loam.	SM-SC, SC, ML, CL-ML	A-4	0	80-95	70-85	60-80	40-55	15-20	NP-10
Sonoita-----	0-2	Sandy loam-----	SM	A-2	0-5	80-90	75-90	50-65	25-35	15-25	NP-5
	2-44	Sandy loam, loam, fine sandy loam.	SM	A-4	0-5	95-100	90-95	60-75	35-50	15-25	NP-5
	44-60	Sandy clay loam	SM-SC, SC	A-2, A-4, A-6	0-5	95-100	90-95	70-85	30-50	25-35	5-15
36----- Pimer	0-15	Silty clay-----	CH, CL	A-7	0	100	100	90-100	85-95	45-55	20-30
	15-27	Loam, clay loam, silty clay loam.	CL	A-6	0	100	100	85-100	75-90	30-40	10-15
	27-60	Silt loam-----	ML, CL-ML	A-4	0	100	100	95-100	85-95	15-25	NP-10

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
37*: Pinamt-----	0-2	Very gravelly loam.	GM-GC	A-2	0-15	25-55	20-50	15-45	10-35	25-30	5-10
	2-23	Very gravelly sandy clay loam, very gravelly clay loam, extremely gravelly loam.	GC	A-2	15-30	20-55	15-50	10-40	10-35	25-40	10-15
	23-60	Very gravelly sandy loam, extremely gravelly sandy loam.	GP-GM, GM	A-1, A-2	15-30	20-55	15-50	10-40	5-20	15-25	NP-5
Momoli-----	0-2	Very gravelly fine sandy loam.	SM, GM	A-2, A-1	0-5	40-65	25-50	20-40	10-30	20-30	NP-5
	2-34	Very gravelly loam, very gravelly fine sandy loam, very gravelly sandy loam.	GM, GM-GC	A-2, A-1	0-5	40-65	25-50	20-40	10-35	20-30	NP-10
	34-60	Very gravelly loamy sand, very gravelly fine sand.	GM, GP-GM, SM, SP-SM	A-1	0-5	40-70	25-50	15-40	5-15	---	NP
38*. Pits											
39*: Quilotosa-----	0-2	Extremely stony loam.	SM-SC	A-4	40-50	70-80	60-70	50-60	35-45	20-25	5-10
	2-10	Extremely gravelly sandy loam, extremely gravelly fine sandy loam.	GP-GM, GM-GC, GM	A-2, A-1	0-15	30-35	20-25	10-20	5-15	15-25	NP-10
	10-18	Weathered bedrock	---	---	---	---	---	---	---	---	---
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
40----- Rositas	0-2	Loamy fine sand	SM	A-1, A-2	0	100	80-100	40-85	15-35	---	NP
	2-60	Sand, fine sand, loamy sand.	SM, SP-SM	A-3, A-2, A-1	0	100	80-100	40-85	5-30	---	NP
41----- Saminiego	0-2	Silty clay loam	ML, CL	A-6, A-7	0	100	100	95-100	85-95	35-45	10-20
	2-30	Clay, silty clay	CL, CH	A-7	0	100	100	90-100	85-95	45-65	20-40
	30-60	Silty clay loam, silt.	CL-ML, CL	A-4, A-6	0	100	100	95-100	90-95	15-35	5-15
42----- Sasco	0-2	Silt loam-----	CL-ML	A-4	0	100	100	95-100	70-90	15-25	5-10
	2-47	Silt loam, silt	ML, CL-ML	A-4	0	100	100	95-100	85-100	15-25	NP-10
	47-60	Clay loam-----	ML, CL	A-6, A-7	0	100	100	95-100	70-80	35-45	10-20

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
43----- Toltec	0-12	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4, A-2	0	100	100	60-80	30-55	15-25	NP-10
	12-36	Loam, fine sandy loam, very fine sandy loam.	ML, CL-ML	A-4	0	100	100	75-85	50-65	15-25	NP-10
	36-60	Very gravelly fine sandy loam, extremely gravelly fine sandy loam.	GM	A-1	0	35-45	20-40	15-35	10-20	15-25	NP-5
44*: Tremant-----	0-2	Gravelly loam----	SM-SC, CL-ML	A-4	0	80-100	75-95	60-90	45-65	20-25	5-10
	2-36	Loam, gravelly clay loam, gravelly sandy clay loam.	CL, SC	A-6	0-10	80-90	65-85	55-70	35-55	30-40	10-15
	36-60	Gravelly loam, gravelly sandy clay loam, gravelly clay loam.	CL-ML, SM-SC, CL, SC	A-4, A-6	0-10	80-90	65-75	55-70	35-55	25-40	5-15
Denure-----	0-2	Sandy loam-----	SM	A-2, A-4	0	100	95-100	65-90	30-40	15-20	NP-5
	2-54	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	95-100	90-95	60-70	30-45	15-25	NP-5
	54-60	Sandy clay loam	SM-SC, SC, CL-ML, CL	A-4, A-6	0	100	100	85-95	45-55	25-35	5-15
45----- Trix	0-15	Clay loam-----	CL, ML	A-6, A-7	0	100	100	90-100	70-80	35-45	10-20
	15-60	Sandy clay loam, clay loam, loam.	CL	A-6	0	100	100	85-95	50-75	30-40	10-15
46*: Vaiva-----	0-4	Very gravelly loam.	GM-GC	A-2, A-4	0-5	45-55	40-50	35-45	25-40	25-30	5-10
	4-16	Very gravelly sandy clay loam, extremely gravelly sandy clay loam.	GC, GM-GC, GP-GC	A-2, A-1	0-5	25-40	15-35	10-30	5-25	25-35	5-15
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
47*: Vaiva-----	0-4	Extremely stony sandy loam.	GM, SM	A-2, A-1	50-70	50-75	45-70	25-50	15-30	20-25	NP-5
	4-16	Very gravelly sandy clay loam, extremely gravelly sandy clay loam.	GC, GM-GC, GP-GC	A-2	0-5	25-40	15-35	10-30	5-25	25-35	5-15
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
48----- Valencia	0-8	Sandy loam-----	SM	A-2, A-4	0	100	100	55-70	25-40	15-20	NP-5
	8-28	Sandy loam-----	SM	A-2	0	100	100	55-70	25-40	15-20	NP-5
	28-46	Sandy clay loam, loam, sandy loam.	SM, ML	A-4	0	100	100	65-85	40-55	15-35	NP-10
	46-60	Sandy loam-----	SM	A-2, A-4	0	100	100	55-75	25-40	15-20	NP-5
49----- Why	0-2	Sandy loam-----	SM	A-2, A-4	0	100	100	55-75	25-40	15-20	NP-5
	2-60	Sandy loam-----	SM	A-2, A-4	0	100	100	55-75	25-40	15-20	NP-5

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

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction pH	Salinity mmhos/cm	Shrink- swell potential	Erosion factors		Wind erodi- bility group	Organic matter Pct
								K	T		
1*: Akela-----	0-2 2-16 16	5-15 6-15 ---	0.6-2.0 0.6-2.0 ---	0.04-0.09 0.04-0.09 ---	7.4-8.4 7.4-8.4 ---	<2 <2 ---	Low----- Low----- -----	0.17 0.17 ---	1	8	.5-1
Rock outcrop.											
2----- Antho	0-4 4-36 36-60	3-5 5-15 3-5	2.0-6.0 2.0-6.0 2.0-6.0	0.09-0.11 0.10-0.12 0.09-0.11	7.9-8.4 7.9-8.4 7.9-8.4	<2 <2 <2	Low----- Low----- Low-----	0.17 0.20 0.17	5	2	<1
3----- Casa Grande	0-13 13-60	10-15 25-35	0.6-2.0 0.06-0.2	0.10-0.12 0.05-0.10	7.9-9.0 8.5-9.0	8-16 8-16	Low----- Moderate	0.20 0.37	5	3	<1
4----- Casa Grande	0-13 13-60	30-35 25-35	0.2-0.6 0.06-0.2	0.17-0.20 0.05-0.10	7.9-9.0 8.5-9.0	8-16 8-16	Moderate Moderate	0.37 0.37	5	5	<1
5----- Cashion	0-12 12-34 34-60	40-50 35-50 18-25	0.06-0.2 0.06-0.2 0.6-2.0	0.14-0.17 0.14-0.21 0.15-0.21	7.9-8.4 7.9-8.4 7.9-8.4	<2 <2 <2	High----- High----- Low-----	0.32 0.32 0.37	5	8	1-2
6*: Cellar-----	0-1 1-5 5	10-15 10-15 ---	2.0-6.0 2.0-6.0 ---	0.05-0.07 0.06-0.09 ---	6.6-8.4 6.6-8.4 ---	<2 <2 ---	Low----- Low----- -----	0.05 0.05 ---	1	8	<1
Rock outcrop.											
7*: Cherioni-----	0-1 1-8 8-10 10	10-20 10-20 --- ---	0.6-2.0 0.6-2.0 --- ---	0.05-0.08 0.08-0.12 --- ---	7.9-8.4 7.9-8.4 --- ---	<2 <2 --- ---	Low----- Low----- ----- -----	0.20 0.10 --- ---	1	8	<.5
Rock outcrop.											
8----- Cipriano	0-2 2-9 9	15-25 15-25 ---	0.6-2.0 0.6-2.0 ---	0.12-0.15 0.05-0.08 ---	7.9-8.4 7.9-8.4 ---	<2 <2 ---	Low----- Low----- -----	0.32 0.20 ---	1	8	<.5
9----- Contine	0-12 12-51 51-60	30-40 35-50 25-35	0.06-0.2 0.06-0.2 0.06-0.2	0.14-0.16 0.14-0.16 0.16-0.21	7.4-8.4 7.4-8.4 8.5-9.0	<2 <2 <2	Moderate High----- Moderate	0.28 0.24 0.28	5	8	.5-1
10----- Contine	0-12 12-51 51-60	40-45 35-50 25-35	0.06-0.2 0.06-0.2 0.06-0.2	0.14-0.20 0.14-0.20 0.16-0.21	7.4-8.4 7.4-8.4 8.5-9.0	<2 <2 <2	High----- High----- Moderate	0.28 0.24 0.28	5	8	.5-1
11----- Coolidge	0-7 7-44 44-60	5-10 5-10 20-30	2.0-6.0 2.0-6.0 0.2-0.6	0.11-0.13 0.11-0.13 0.14-0.16	7.9-8.4 7.9-8.4 7.9-8.4	<2 <8 <8	Low----- Low----- Low-----	0.20 0.20 0.28	5	3	.5-1

See footnote at end of table.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
	In	Pct	In/hr	In/in	pH	mmhos/cm		K	T		Pct
12----- Cuerda	0-9	15-20	0.6-2.0	0.13-0.15	7.9-8.4	<2	Low-----	0.24	5	3	<1
	9-30	15-20	0.6-2.0	0.15-0.17	7.9-8.4	<2	Low-----	0.24			
	30-60	20-25	0.6-2.0	0.16-0.18	7.9-8.4	<2	Low-----	0.43			
13----- Dateland	0-2	10-15	2.0-6.0	0.11-0.15	7.4-7.8	<2	Low-----	0.24	5	3	<.5
	2-40	10-20	0.6-2.0	0.11-0.15	7.9-8.4	<2	Low-----	0.24			
	40-60	10-20	0.6-2.0	0.12-0.14	7.9-8.4	<2	Low-----	0.24			
14----- Dateland	0-2	10-20	2.0-6.0	0.05-0.10	8.5-9.0	8-16	Low-----	0.24	5	3	<1
	2-40	10-20	0.6-2.0	0.05-0.10	8.5-9.0	8-16	Low-----	0.24			
	40-60	10-20	2.0-6.0	0.05-0.08	8.5-9.0	8-16	Low-----	0.24			
15----- Denure	0-8	10-15	2.0-6.0	0.09-0.11	7.9-8.4	<2	Low-----	0.17	5	8	.5-1
	8-54	10-20	2.0-6.0	0.11-0.13	7.9-8.4	<2	Low-----	0.24			
	54-60	20-30	0.2-0.6	0.14-0.16	7.9-8.4	<2	Low-----	0.28			
16, 17----- Denure	0-2	5-15	2.0-6.0	0.13-0.15	7.9-8.4	<2	Low-----	0.20	5	3	.5-1
	2-54	10-20	2.0-6.0	0.11-0.13	7.9-8.4	<2	Low-----	0.24			
	54-60	20-30	0.2-0.6	0.14-0.16	7.9-8.4	<2	Low-----	0.28			
18----- Denure	0-15	27-35	0.2-0.6	0.19-0.21	7.9-8.4	<2	Moderate	0.32	5	5	.5-1
	15-54	10-20	2.0-6.0	0.11-0.13	7.9-8.4	<2	Low-----	0.24			
	54-60	20-30	0.2-0.6	0.14-0.16	7.9-8.4	<2	Low-----	0.28			
19*: Dumps.  Pits.											
20----- Gadsden	0-13	50-55	0.06-0.2	0.15-0.17	7.9-8.4	<2	High-----	0.28	5	8	<1
	13-42	50-55	0.06-0.2	0.15-0.17	7.9-8.4	<2	High-----	0.28			
	42-60	27-30	0.2-0.6	0.19-0.21	7.9-8.4	<2	Low-----	0.37			
21----- Gilman	0-14	10-20	0.6-2.0	0.13-0.15	7.9-8.4	<2	Low-----	0.28	5	3	<.5
	14-60	10-15	0.6-2.0	0.16-0.18	7.9-8.4	<2	Low-----	0.43			
22----- Gilman	0-12	30-35	0.2-0.6	0.19-0.21	7.9-8.4	<2	Moderate	0.32	5	4L	<.5
	12-60	10-15	0.6-2.0	0.16-0.18	7.9-8.4	<2	Low-----	0.43			
23----- Ginland	0-24	40-55	0.06-0.2	0.14-0.17	7.9-8.4	<8	High-----	0.32	5	8	<2
	24-60	20-30	0.2-0.6	0.05-0.10	7.9-8.4	<8	Moderate	0.28			
24----- Glenbar	0-13	30-40	0.2-0.6	0.16-0.18	7.9-8.4	<2	Moderate	0.32	5	4L	<.5
	13-60	18-35	0.2-0.6	0.19-0.21	7.9-8.4	<2	Moderate	0.37			
25*: Gunsight-----	0-3	15-25	0.6-2.0	0.04-0.10	7.9-8.4	<8	Low-----	0.15	5	8	<.5
	3-12	20-27	0.6-2.0	0.10-0.15	7.9-8.4	<8	Low-----	0.28			
	12-60	10-20	0.6-2.0	0.04-0.10	7.9-8.4	<8	Low-----	0.10			
Cipriano-----	0-2	15-25	0.6-2.0	0.12-0.15	7.9-8.4	<2	Low-----	0.32	1	8	<.5
	2-9 9	15-25 ---	0.6-2.0 ---	0.05-0.08 ---	7.9-8.4 ---	<2 ---	Low----- -----	0.20 ---			
26*: Gunsight-----	0-3	15-25	0.6-2.0	0.04-0.10	7.9-8.4	<8	Low-----	0.15	5	8	<.5
	3-12	20-27	0.6-2.0	0.10-0.15	7.9-8.4	<8	Low-----	0.28			
	12-60	10-20	0.6-2.0	0.04-0.12	7.9-8.4	<8	Low-----	0.10			

See footnote at end of table.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	In/hr	In/in	pH	mmhos/cm					Pct
26*: Pinamt-----	0-2 2-23 23-60	20-27 20-35 10-20	0.2-0.6 0.2-0.6 2.0-6.0	0.04-0.12 0.03-0.11 0.03-0.10	7.9-8.4 7.9-8.4 7.9-8.4	<4 <4 <4	Low----- Low----- Low-----	0.15 0.15 0.15	5	8	<.5
27----- La Palma	0-3 3-28 28	10-15 25-35 ---	0.6-2.0 0.06-0.2 ---	0.03-0.11 0.05-0.14 ---	7.9-8.4 >8.5 ---	4-16 8-16 ---	Low----- Moderate ---	0.20 0.32 ---	2	3	.5-.8
28----- Laveen	0-15 15-42 42-60	15-20 10-18 15-20	0.6-2.0 0.6-2.0 2.0-6.0	0.15-0.18 0.15-0.18 0.10-0.13	7.9-8.4 7.9-8.4 7.9-8.4	<8 <8 <8	Low----- Low----- Low-----	0.43 0.55 0.24	5	4L	.5-.8
29----- Marana	0-2 2-60	27-34 27-34	0.2-0.6 0.2-0.6	0.19-0.21 0.19-0.21	7.9-8.4 7.9-8.4	<2 <2	Moderate Moderate	0.49 0.49	5	4L	<1
30----- Mohall	0-16 16-43 43-60	10-15 25-35 15-20	2.0-6.0 0.2-0.6 0.6-2.0	0.11-0.13 0.14-0.21 0.11-0.13	7.9-8.4 7.9-8.4 7.9-8.4	<2 <2 <2	Low----- Moderate Low-----	0.20 0.28 0.32	5	3	.5-1
31----- Mohall	0-18 18-43 43-60	20-25 25-35 15-20	0.2-0.6 0.2-0.6 0.6-2.0	0.16-0.21 0.14-0.21 0.11-0.13	7.9-8.4 7.9-8.4 7.9-8.4	<2 <2 <2	Low----- Moderate Low-----	0.32 0.28 0.32	5	4L	.5-1
32----- Mohall	0-16 16-43 43-60	30-35 25-35 15-20	0.2-0.6 0.2-0.6 0.6-2.0	0.16-0.21 0.14-0.21 0.11-0.13	7.9-8.4 7.9-8.4 7.9-8.4	<2 <2 <2	Moderate Moderate Low-----	0.32 0.28 0.32	5	8	.5-1
33*: Mohall-----	0-16 16-43 43-60	10-15 25-35 15-20	2.0-6.0 0.2-0.6 0.6-2.0	0.11-0.13 0.14-0.21 0.11-0.13	7.9-8.4 7.9-8.4 7.9-8.4	<2 <2 <2	Low----- Moderate Low-----	0.20 0.28 0.32	5	3	.5-1
Denure-----	0-2 2-54 54-60	5-15 10-20 20-30	2.0-6.0 2.0-6.0 0.2-0.6	0.13-0.15 0.09-0.13 0.14-0.16	7.9-8.4 7.9-8.4 7.9-8.4	<2 <2 <2	Low----- Low----- Low-----	0.55 0.24 0.28	5	3	.5-1
34*: Momoli-----	0-2 2-34 34-60	10-15 10-20 3-8	2.0-6.0 2.0-6.0 6.0-20	0.04-0.08 0.05-0.10 0.03-0.05	7.9-8.4 7.9-8.4 7.9-8.4	<4 <4 <4	Low----- Low----- Low-----	0.10 0.10 0.02	5	8	<1
Carrizo-----	0-5 5-60	10-15 0-5	2.0-6.0 >20	0.05-0.10 0.03-0.04	7.9-8.4 7.9-8.4	<2 <2	Low----- Low-----	0.17 0.10	5	8	<.5
35*: Pajarito-----	0-2 2-23 23-60	7-18 10-18 10-15	2.0-6.0 2.0-6.0 2.0-6.0	0.09-0.11 0.13-0.15 0.13-0.16	6.6-7.3 7.4-7.8 7.9-8.4	<2 <2 <2	Low----- Low----- Low-----	0.20 0.32 0.32	5	4	.4-.7
Sonoita-----	0-2 2-44 44-60	5-12 10-20 20-30	0.6-2.0 2.0-6.0 2.0-6.0	0.13-0.15 0.07-0.13 0.14-0.16	6.6-7.3 7.4-8.4 7.4-8.4	<2 <2 <2	Low----- Low----- Low-----	0.24 0.20 0.32	5	3	.5-1
36----- Pimer	0-15 15-27 27-60	40-50 25-35 10-20	0.06-0.2 0.2-0.6 0.2-0.6	0.15-0.17 0.19-0.21 0.19-0.21	7.9-8.4 7.9-8.4 7.9-8.4	<2 <2 <2	High----- Moderate Low-----	0.32 0.43 0.43	5	8	1-2

See footnote at end of table.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	In/hr	In/in	pH	mmhos/cm					Pct
37*:											
Pinamt-----	0-2	20-27	0.2-0.6	0.04-0.12	7.9-8.4	<4	Low-----	0.15	5	8	<.5
	2-23	20-35	0.2-0.6	0.03-0.11	7.9-8.4	<4	Low-----	0.15			
	23-60	10-20	2.0-6.0	0.03-0.10	7.9-8.4	<4	Low-----	0.15			
Momoli-----	0-2	10-20	2.0-6.0	0.05-0.10	7.9-8.4	<4	Low-----	0.10	5	8	<1
	2-34	10-20	2.0-6.0	0.05-0.10	7.9-8.4	<4	Low-----	0.10			
	34-60	3-8	6.0-20	0.03-0.05	7.9-8.4	<4	Low-----	0.02			
38*:											
Pits											
39*:											
Quilotosa-----	0-2	10-20	0.6-2.0	0.04-0.07	7.9-8.4	<2	Low-----	0.05	1	8	<1
	2-10	5-20	2.0-6.0	0.04-0.07	7.9-8.4	<2	Low-----	0.05			
	10-18	---	---	---	---	---	-----	---			
	18	---	---	---	---	---	-----	---			
Rock outcrop.											
40-----	0-2	0-5	6.0-20	0.06-0.08	7.9-8.4	2-4	Low-----	0.20	5	2	<.5
Rositas	2-60	0-6	6.0-20	0.05-0.08	7.9-8.4	2-4	Low-----	0.20			
41-----	0-2	27-40	0.2-0.6	0.19-0.21	7.9-8.4	<2	Moderate	0.49	5	8	1-2
Samiego	2-30	40-65	0.06-0.2	0.14-0.16	7.9-8.4	<2	High-----	0.32			
	30-60	10-30	0.2-0.6	0.19-0.21	7.9-8.4	<2	Moderate	0.49			
42-----	0-2	10-20	0.6-2.0	0.19-0.21	7.9-8.4	<2	Low-----	0.55	5	4L	<1
Sasco	2-47	4-18	0.2-0.6	0.16-0.20	7.9-8.4	<2	Low-----	0.55			
	47-60	30-40	0.2-0.6	0.19-0.21	7.9-8.4	<2	Moderate	0.32			
43-----	0-12	10-20	0.6-2.0	0.11-0.17	7.9-8.4	<8	Low-----	0.20	5	3	.5-1
Toltec	12-36	10-18	0.6-2.0	0.13-0.18	7.9-8.4	<8	Low-----	0.28			
	36-60	10-20	0.6-2.0	0.04-0.06	8.5-9.0	<8	Low-----	0.10			
44*:											
Tremant-----	0-2	15-20	0.6-2.0	0.07-0.13	7.9-8.4	<4	Low-----	0.37	5	4L	<.5
	2-36	25-35	0.2-0.6	0.12-0.21	7.9-8.4	<4	Moderate	0.28			
	36-60	20-35	0.2-0.6	0.10-0.15	7.9-8.4	<4	Moderate	0.32			
Denure-----	0-2	5-15	2.0-6.0	0.13-0.15	7.9-8.4	<2	Low-----	0.17	5	3	.5-1
	2-54	10-20	2.0-6.0	0.09-0.13	7.9-8.4	<2	Low-----	0.24			
	54-60	20-30	0.2-0.6	0.14-0.16	7.9-8.4	<2	Low-----	0.28			
45-----	0-15	30-40	0.2-0.6	0.19-0.21	7.9-8.4	<2	Moderate	0.32	5	4L	<1
Trix	15-60	25-35	0.2-0.6	0.16-0.21	7.9-8.4	<8	Moderate	0.32			
46*:											
Vaiva-----	0-4	15-25	0.6-2.0	0.08-0.10	7.4-8.4	<2	Low-----	0.20	1	8	<1
	4-16	20-35	0.6-2.0	0.04-0.10	7.4-8.4	<2	Low-----	0.17			
	16	---	---	---	---	---	-----	---			
Rock outcrop.											
47*:											
Vaiva-----	0-4	10-15	2.0-6.0	0.06-0.08	7.4-8.4	<2	Low-----	0.05	1	8	<1
	4-16	20-35	0.6-2.0	0.04-0.10	7.4-8.4	<2	Low-----	0.10			
	16	---	---	---	---	---	-----	---			

See footnote at end of table.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors		Wind erodi- bility group	Organic matter
	In	Pct	In/hr	In/in	pH	mmhos/cm		K	T		Pct
47*: Rock outcrop.											
48----- Valencia	0-8	5-15	2.0-6.0	0.11-0.13	7.9-8.4	<8	Low-----	0.20	5	3	<1
	8-28	5-15	2.0-6.6	0.11-0.13	7.9-8.4	<8	Low-----	0.20			
	28-46	18-30	0.2-0.6	0.14-0.16	7.9-8.4	<8	Moderate	0.32			
	46-60	10-20	0.6-2.0	0.11-0.13	7.9-8.4	<8	Low-----	0.20			
49----- Why	0-2	5-20	2.0-6.0	0.11-0.13	7.9-8.4	<2	Low-----	0.20	5	3	<1
	2-60	5-20	2.0-6.0	0.11-0.13	7.9-8.4	<2	Low-----	0.20			

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

TABLE 14.--SOIL AND WATER FEATURES

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

Soil name and map symbol	Hydro-logic group	Flooding			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Hardness	Depth	Thick-ness	Uncoated steel	Concrete
					In		In			
1*: Akela----- Rock outcrop.	D	None-----	---	---	4-20	Hard	---	---	High-----	Low.
2----- Antho	B	Occasional	Brief-----	Jul-Sep	>60	---	---	---	High-----	Low.
3, 4----- Casa Grande	C	None-----	---	---	>60	---	---	---	High-----	High.
5----- Cashion	D	Occasional	Brief-----	Jul-Sep	>60	---	---	---	High-----	Low.
6*: Cellar----- Rock outcrop.	D	None-----	---	---	4-20	Hard	---	---	High-----	Low.
7*: Cherioni----- Rock outcrop.	D	None-----	---	---	6-21	Hard	5-20	Thick	High-----	Low.
8----- Cipriano	D	None-----	---	---	>60	---	8-20	Thick	High-----	Low.
9, 10----- Contine	C	None-----	---	---	>60	---	---	---	High-----	Low.
11----- Coolidge	B	None-----	---	---	>60	---	---	---	High-----	Moderate.
12----- Cuerda	B	Occasional	Very brief	Jul-Sep	>60	---	---	---	High-----	Low.
13----- Dateland	B	Rare-----	---	Jul-Sep	>60	---	---	---	High-----	Low.
14----- Dateland	B	None-----	---	---	>60	---	---	---	High-----	High.
15, 16, 17, 18----- Denure	B	None-----	---	---	>60	---	---	---	High-----	Low.
19*: Dumps. Pits.										
20----- Gadsden	D	Occasional	Brief-----	Jul-Sep	>60	---	---	---	High-----	Low.

See footnote at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro- logic group	Flooding			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Hard- ness	Depth	Thick- ness	Uncoated steel	Concrete
					In		In			
21, 22----- Gilman	B	Occasional	Brief-----	Jul-Sep	>60	---	---	---	High-----	Low.
23----- Ginland	D	Occasional	Brief-----	Jul-Sep	>60	---	---	---	High-----	Moderate.
24----- Glenbar	B	Occasional	Brief-----	Jul-Sep	>60	---	---	---	High-----	Low.
25*: Gunsight-----	B	None-----	---	---	>60	---	---	---	High-----	Moderate.
Cipriano-----	D	None-----	---	---	>60	---	8-20	Thick	High-----	Low.
26*: Gunsight-----	B	None-----	---	---	>60	---	---	---	High-----	Moderate.
Pinamt-----	B	None-----	---	---	>60	---	---	---	High-----	Low.
27----- La Palma	C	None-----	---	---	>60	---	20-40	Thick	High-----	High.
28----- Laveen	B	None-----	---	---	>60	---	---	---	High-----	Moderate.
29----- Marana	B	Rare-----	Very brief	---	>60	---	---	---	High-----	Low.
30, 31, 32----- Mohall	B	None-----	---	---	>60	---	---	---	High-----	Low.
33*: Mohall-----	B	None-----	---	---	>60	---	---	---	High-----	Low.
Denure-----	B	None-----	---	---	>60	---	---	---	High-----	Low.
34*: Momoli-----	B	None-----	---	---	>60	---	---	---	High-----	Low.
Carrizo-----	A	Occasional	Brief-----	Jul-Sep	>60	---	---	---	High-----	Low.
35*: Pajarito-----	B	None-----	---	---	>60	---	---	---	High-----	Low.
Sonoita-----	B	None-----	---	---	>60	---	---	---	High-----	Low.
36----- Pimer	B	Occasional	Brief-----	Jul-Sep	>60	---	---	---	High-----	Low.
37*: Pinamt-----	B	None-----	---	---	>60	---	---	---	High-----	Low.
Momoli-----	B	None-----	---	---	>60	---	---	---	High-----	Low.
38*. Pits										

See footnote at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Hardness	Depth	Thick-ness	Uncoated steel	Concrete
					In		In			
39*: Quilotosa----- Rock outcrop.	D	None-----	---	---	4-20	Hard	---	---	High-----	Low.
40----- Rositas	A	None-----	---	---	>60	---	---	---	High-----	Low.
41----- Saminiego	C	Rare-----	---	---	>60	---	---	---	High-----	Low.
42----- Sasco	B	Rare-----	---	---	>60	---	---	---	High-----	Low.
43----- Toltec	C	None-----	---	---	>60	---	---	---	High-----	High.
44*: Tremant----- Denure-----	B B	None----- None-----	--- ---	--- ---	>60 >60	--- ---	--- ---	--- ---	High----- High-----	Low. Low.
45----- Trix	B	Occasional	Brief-----	Jul-Sep	>60	---	---	---	High-----	Moderate.
46*: Vaiva----- Rock outcrop.	D	None-----	---	---	4-20	Hard	---	---	High-----	Low.
47*: Vaiva----- Rock outcrop.	D	None-----	---	---	4-20	Hard	---	---	High-----	Low.
48----- Valencia	B	Occasional	Brief-----	Jul-Sep	>60	---	---	---	High-----	Moderate.
49----- Why	B	Occasional	Very brief	Jul-Sep	>60	---	---	---	High-----	Low.

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

TABLE 15.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Akela-----	Loamy-skeletal, mixed (calcareous), thermic Lithic Torriorthents
Antho-----	Coarse-loamy, mixed (calcareous), hyperthermic Typic Torrifluvents
Carrizo-----	Sandy-skeletal, mixed, hyperthermic Typic Torriorthents
Casa Grande-----	Fine-loamy, mixed, hyperthermic Typic Natrargids
Cashion-----	Clayey over loamy, mixed (calcareous), hyperthermic Typic Torrifluvents
Cellar-----	Loamy-skeletal, mixed, nonacid, thermic Lithic Torriorthents
Cherioni-----	Loamy-skeletal, mixed, hyperthermic, shallow Typic Durorthids
Cipriano-----	Loamy-skeletal, mixed, hyperthermic, shallow Typic Durorthids
Contine-----	Fine, mixed, hyperthermic Typic Haplargids
Coolidge-----	Coarse-loamy, mixed, hyperthermic Typic Calciorthids
Cuerda-----	Coarse-loamy, mixed, hyperthermic Fluventic Camborthids
Dateland-----	Coarse-loamy, mixed, hyperthermic Typic Camborthids
Denure-----	Coarse-loamy, mixed, hyperthermic Typic Camborthids
Gadsden-----	Fine, montmorillonitic (calcareous), hyperthermic Vertic Torrifluvents
Gilman-----	Coarse-loamy, mixed (calcareous), hyperthermic Typic Torrifluvents
GINLAND-----	Clayey over loamy, montmorillonitic (calcareous), hyperthermic Vertic Torrifluvents
Glenbar-----	Fine-silty, mixed (calcareous), hyperthermic Typic Torrifluvents
Gunsight-----	Loamy-skeletal, mixed, hyperthermic Typic Calciorthids
La Palma-----	Fine-loamy, mixed, hyperthermic Petrocalcic Paleargids
Laveen-----	Coarse-loamy, mixed, hyperthermic Typic Calciorthids
Marana-----	Fine-silty, mixed, hyperthermic Typic Camborthids
Mohall-----	Fine-loamy, mixed, hyperthermic Typic Haplargids
Momoli-----	Loamy-skeletal, mixed, hyperthermic Typic Camborthids
Pajarito-----	Coarse-loamy, mixed, thermic Typic Camborthids
Pimer-----	Fine-silty, mixed (calcareous), hyperthermic Typic Torrifluvents
Pinamt-----	Loamy-skeletal, mixed, hyperthermic Typic Haplargids
Quilotosa-----	Loamy-skeletal, mixed (calcareous), hyperthermic Lithic Torriorthents
Rositas-----	Mixed, hyperthermic Typic Torripsamments
Saminiego-----	Clayey over fine-silty, mixed, hyperthermic Typic Camborthids
Sasco-----	Coarse-silty, mixed, hyperthermic Typic Camborthids
Sonoita-----	Coarse-loamy, mixed, thermic Typic Haplargids
Toltec-----	Coarse-loamy, mixed, hyperthermic Typic Calciorthids
Tremant-----	Fine-loamy, mixed, hyperthermic Typic Haplargids
Trix-----	Fine-loamy, mixed (calcareous), hyperthermic Typic Torrifluvents
Vaiva-----	Loamy-skeletal, mixed, hyperthermic Lithic Haplargids
Valencia-----	Coarse-loamy, mixed, hyperthermic Fluventic Camborthids
Why-----	Coarse-loamy, mixed, hyperthermic Fluventic Camborthids

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