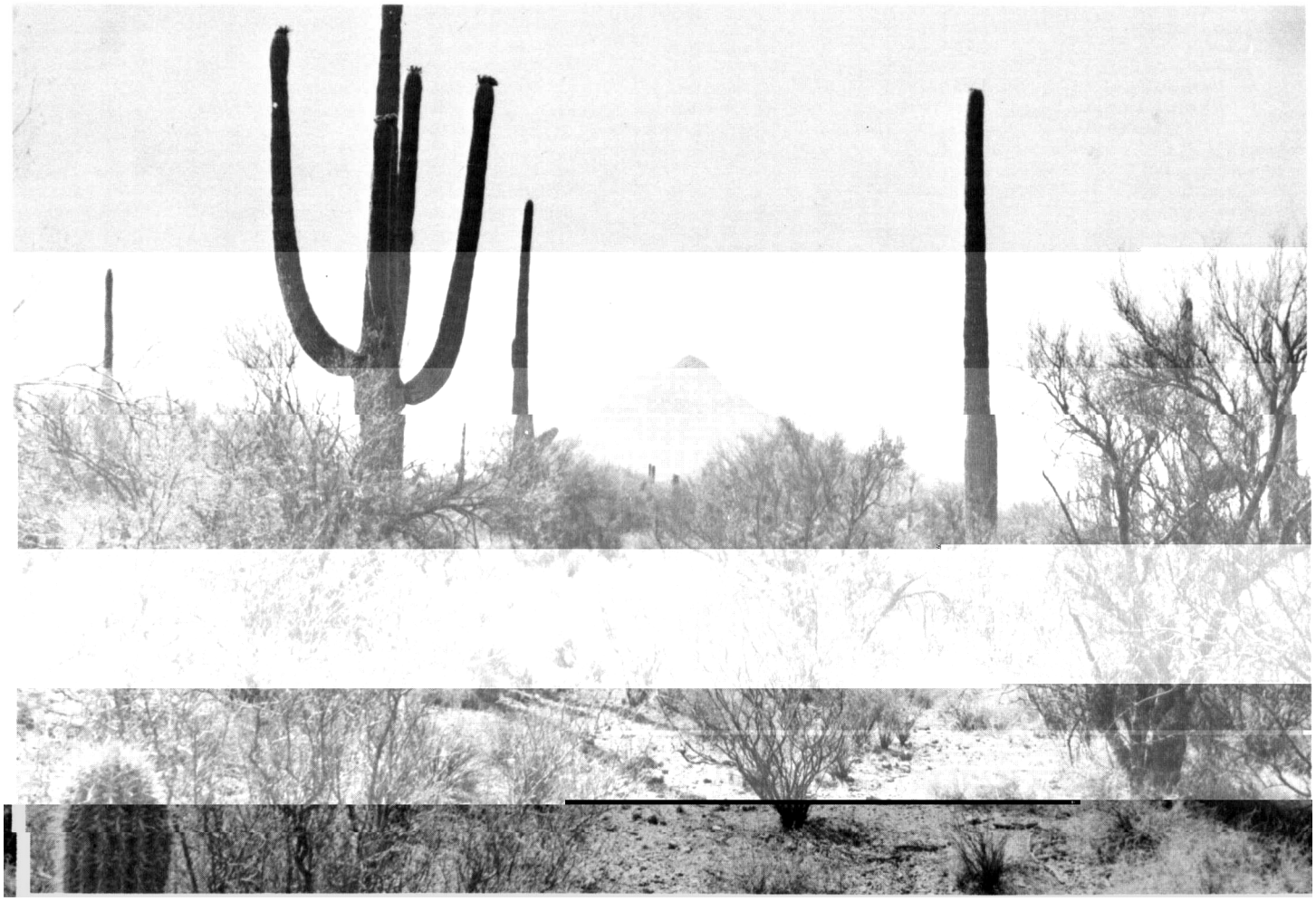
SOIL SURVEY OF

# Maricopa County, Arizona

## Central Part



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

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

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# SOIL SURVEY OF MARICOPA COUNTY, ARIZONA, CENTRAL PART

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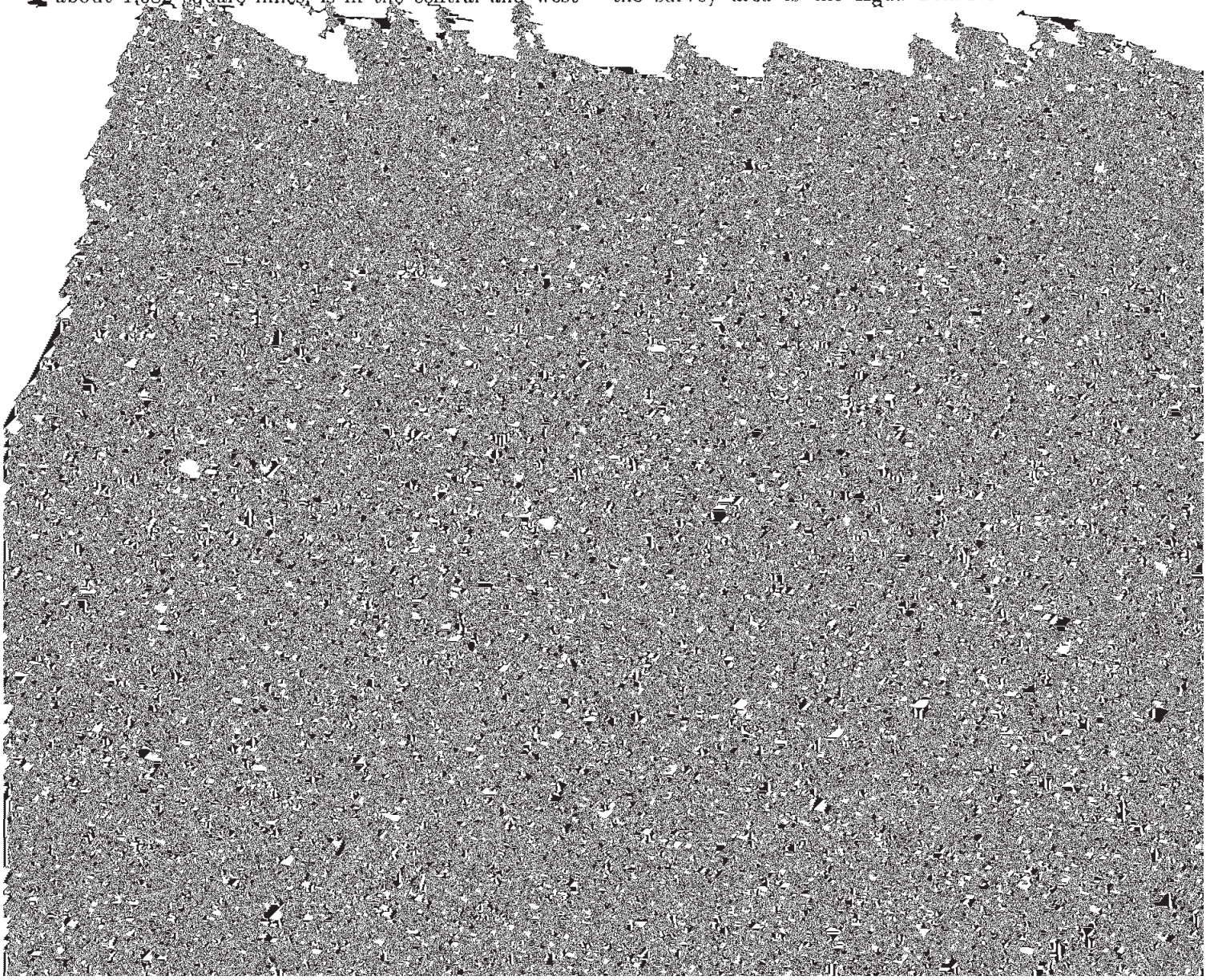
UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE UNIVERSITY OF ARIZONA AGRICULTURAL EXPERIMENT STATION

THE AREA SURVEYED (fig. 1), 1,076,330 acres or about 1,682 square miles, is in the central and west- Sun City, Surprise, Tolleson, and Youngtown. Within the survey area is the Agua Fria-New River and the



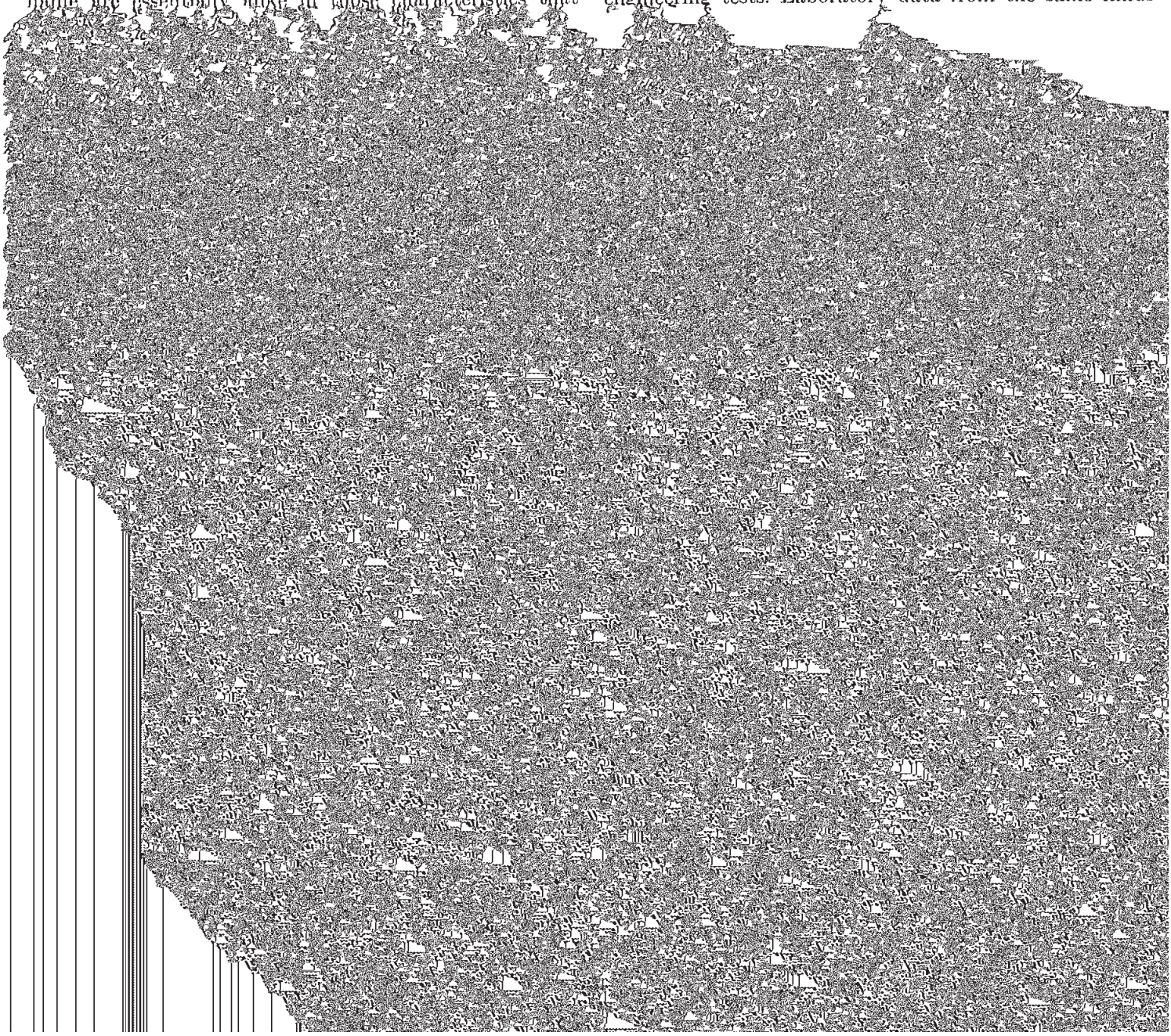
The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of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

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

as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. If there are two or more dominant series represented in the group, the name of the group ordinarily consists of the names of the dominant soils, joined by "and." Carrizo and Brios soils is an example.

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

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kinds



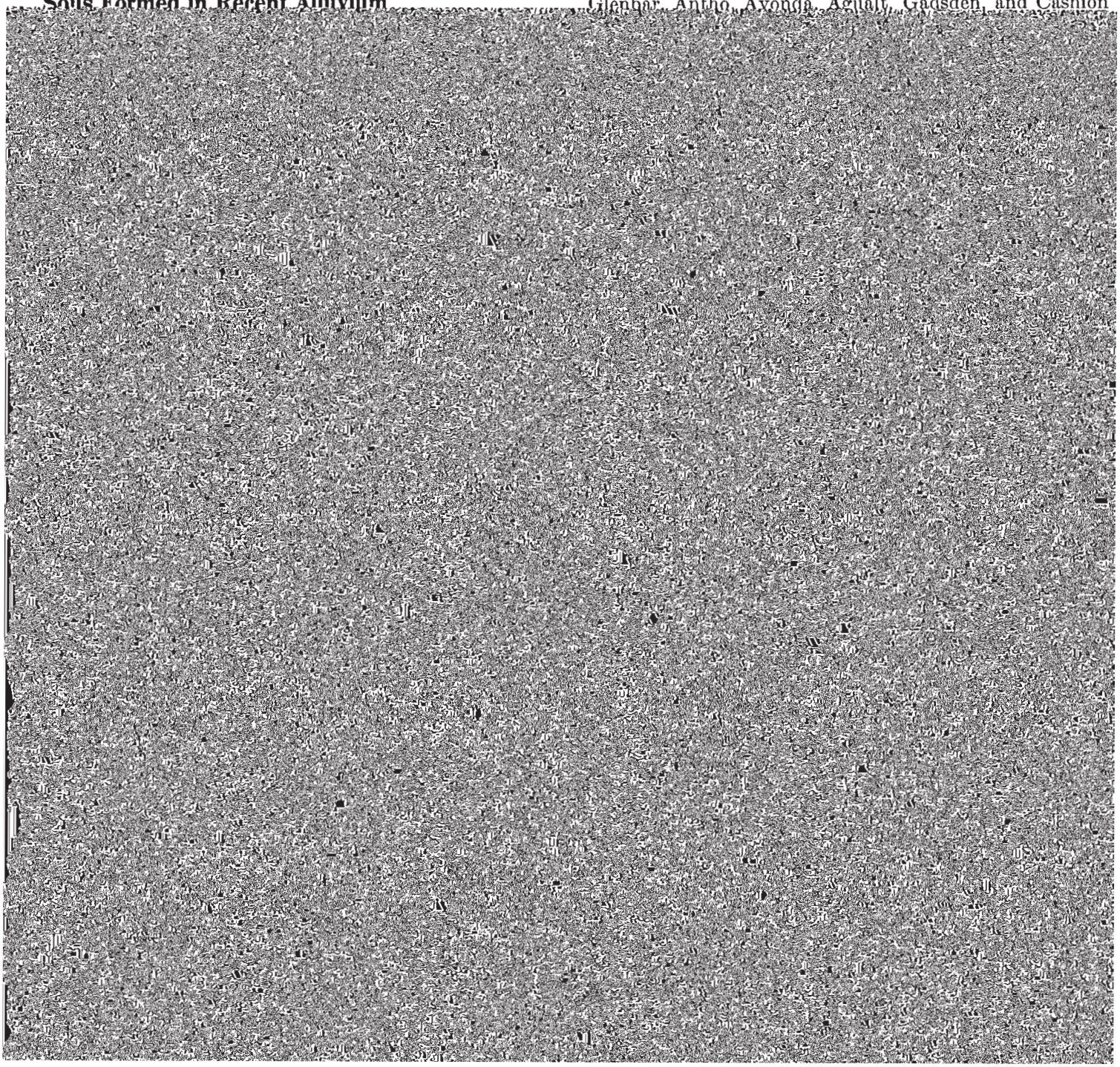
the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in this survey area have been grouped into three general kinds of landscapes for broad interpretative purposes. Each of the broad groups and the 10 soil associations are described on the pages that follow. The texture mentioned in the legend for each association refers to the dominant texture of the surface layer of the major soils.

## Soils Formed in Recent Alluvium

area. The soils formed in recent alluvium that was derived from a wide variety of rock, including granite-gneiss, schist, andesite, rhyolite, basalt, and quartzite. The natural vegetation is creosotebush, cactus, annual weeds and grasses, and scattered mesquite and paloverde trees. The elevation ranges from 750 to 1,400 feet. The mean annual precipitation is 6 to 8 inches, the mean annual air temperature is 69° to 74° F, and the frost-free season is 250 to 300 days.

This association makes up about 25 percent of the survey area. It is about 55 percent Gilman soils, 10 percent Estrella soils, 10 percent Avondale soils, and 25 percent Glenbar, Antho, Avonda, Agualt, Gadsden, and Cashion



loams or very fine sandy loams 20 to 39 inches deep over an old buried clay loam soil. Avondale soils have a dark-colored clay loam surface layer over loam or very fine sandy loam that is thinly stratified with finer or coarser textured material.

Parts of the cities of Phoenix, Glendale, and Buckeye are on this association. Cotton, alfalfa, small grain, safflower, sugar beets, grapes, citrus, and vegetables are the chief crops. A few areas are used as range following seasonal rains.

### 2. Antho-Valencia association

*Nearly level sandy loams on recent alluvial fans and valley plains*

This association (fig. 3) is on young alluvial fans and valley plains that are 1 mile to 5 miles from the mountains. In places it is underlain by an older land surface (see also fig. 4, p. 5). It occurs throughout the survey area. The soils formed in young alluvium that was derived from a wide variety of rock but was dominantly granitic. The native vegetation is creosotebush, cactus, annual weeds and grasses, and scattered mesquite and paloverde trees. The elevation ranges from 800 to 1,400 feet. The mean annual precipitation is 6 to 8 inches, the mean annual air temperature is about 69° to 74° F, and the frost-free season is 250 to 300 days.

This association makes up about 14 percent of the survey area. It is about 60 percent Antho soils, 15 percent Valencia soils, and 25 percent Gilman, Coolidge, Agualt, Maripo, Vint, Estrella, Carrizo, and Tremant soils.

Antho soils are sandy loam 40 inches deep or more. They are in the center of most mapped areas, and Valencia soils are along the margins. Valencia soils are sandy loam or fine sandy loam 20 to 39 inches deep over an old buried clay loam soil.

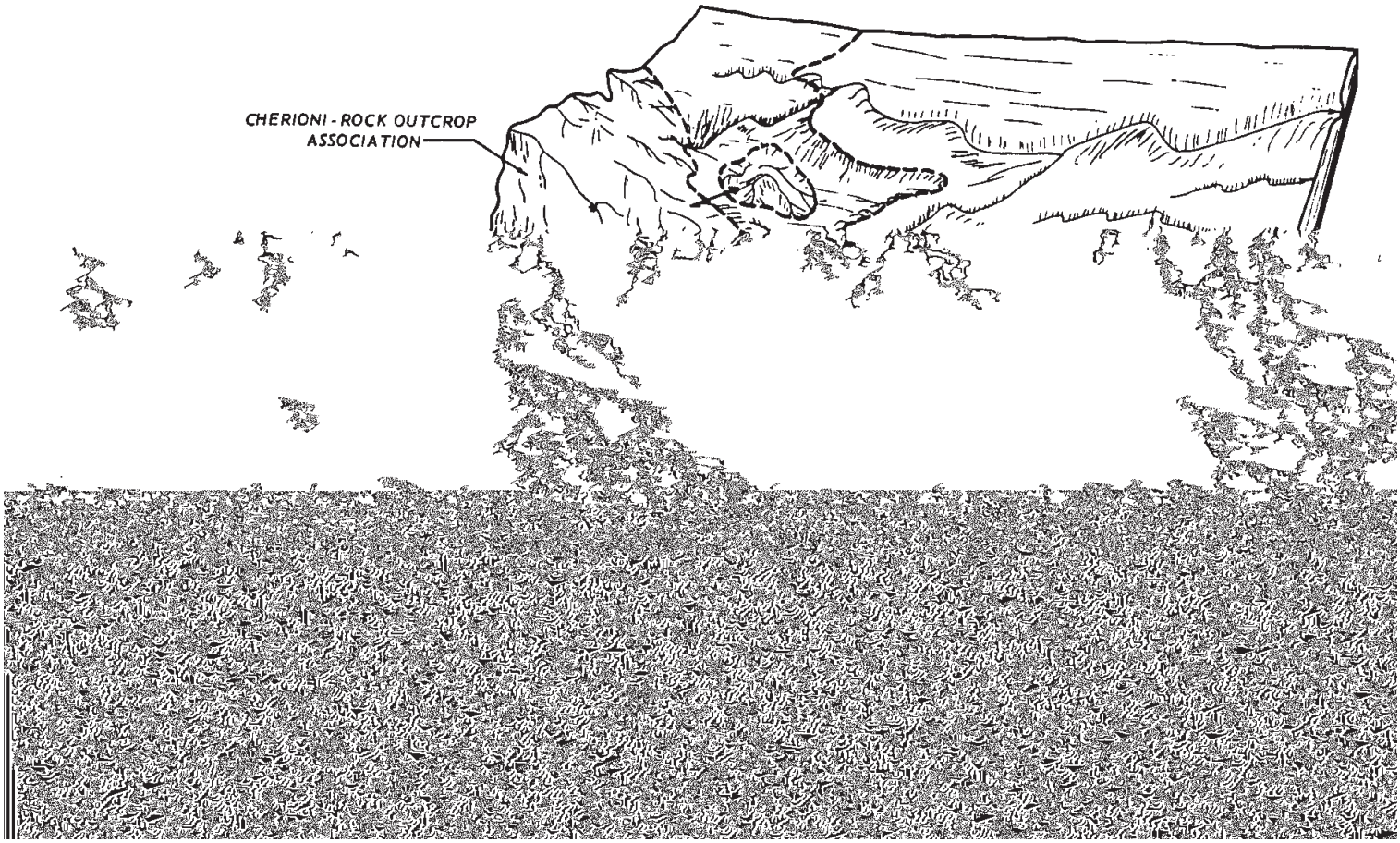
This association is cultivated in areas where irrigation water is available. Cotton, alfalfa, small grain, safflower, sugar beets, grapes, and citrus are the chief crops. A few areas are used as range. Part of the city of Phoenix is on this association.

### 3. Carrizo-Brios association

*Nearly level to gently sloping gravelly sandy loams and sandy loams in stream channels and on low stream terraces*

This association (see fig. 2, p. 3) is in or adjacent to the channels of the New River and the Gila, Salt, Agua Fria, and Hassayampa Rivers and on a few of the adjacent low-lying stream terraces. The soils formed in recent alluvium that was derived from a wide mixture of acid and basic igneous and metamorphic rock. They are subject to occasional flooding. The native vegetation is saltcedar, arrowweed, creosotebush, and saltbush. The elevation ranges from 750 to 1,300 feet. The mean annual air temperature is 69° to 74° F, and the frost-free season is 250 to 300 days.

This association makes up about 5 percent of the survey area. It is about 30 percent Carrizo soils, 30 percent Brios soils, 15 percent Vint soils, and 25 percent Torripsamments and Torrifluvents, frequently flooded, and Cashion, Gadsden, Maripo, and Antho soils.



Carrizo soils are typically in the lowest positions, nearest the present stream channels. Vint soils are in higher positions, along the outer margins of the mapped areas. Brios soils are in positions intermediate between Carrizo and Vint soils.

Carrizo soils have a surface layer of yellowish-brown gravelly sandy loam about 5 inches thick over pale-brown very gravelly coarse sand that extends to a depth of 60 inches or more. Brios soils have a surface layer of brown sandy loam about 14 inches thick over brown sand that extends to a depth of 60 inches or more. Vint soils are pale-brown loamy fine sand about 60 inches deep.

This association is cultivated in only a few areas, which are not subject to flooding. A few areas are used as range. The part of the assocation near Buckeye and Arlington has been designated the Fred J. Weiler Green Belt and serves as an important nesting area for dove and quail.

### *4. Torrifluvents association*

*Nearly level to gently sloping soils that are gravelly, cobbly, and stony throughout; on recent alluvial fans at the base of mountains*

This association is on alluvial fans at the base of the Estrella Mountains in Rainbow Valley. It is dissected by shallow stream channels that have cut 1 foot to 15 feet below the surface. The soils formed in cobbly, gravelly, and stony alluvium that was derived from the granite-gneiss mountains above. The native vegetation is creosote-bush, cactus, bursage, and scattered mesquite, paloverde, and ironwood trees. The elevation ranges from 1,250 to 1,500 feet. The mean annual precipitation is 6 to 8 inches, the mean annual air temperature is 69° to 74° F, and the frost-free season is 260 to 300 days.

This association makes up about 1 percent of the survey area. It is about 85 percent Torrifluvents and 15 percent Gunsight, Pinamt, and Pinal soils.

Torrifluvents are stratified and are 35 to 80 percent cobbles, gravel, and stones. The stony soils are more prevalent in the steeper areas nearest the base of mountains. The gravelly soils are more prevalent in areas more distant from the mountains.

This association is not cultivated. A few areas are used as range following seasonal rain.

## Soils Formed in Old Alluvium

This group of associations consists of nearly level to moderately steep soils in old alluvium on alluvial fans and valley plains.

### *5. Rillito-Gunsight-Perryville association*

*Nearly level to moderately steep gravelly loams and loams on old alluvial fans and valley plains*

This association (fig. 4) is on old alluvial fans and valley plains, mainly in the western part of the survey area. Some areas are near the base of mountains, but others are as much as 10 miles away. The undulating landscape is dissected by many stream channels that have cut 1 foot to 20 feet below the surface. The soils formed in old gravelly alluvium that was derived mainly from granite-gneiss, schist, andesite, and limestone. The natural vegetation is mainly creosotebush and scattered mesquite and paloverde trees. The elevation ranges from 800 to 1,400

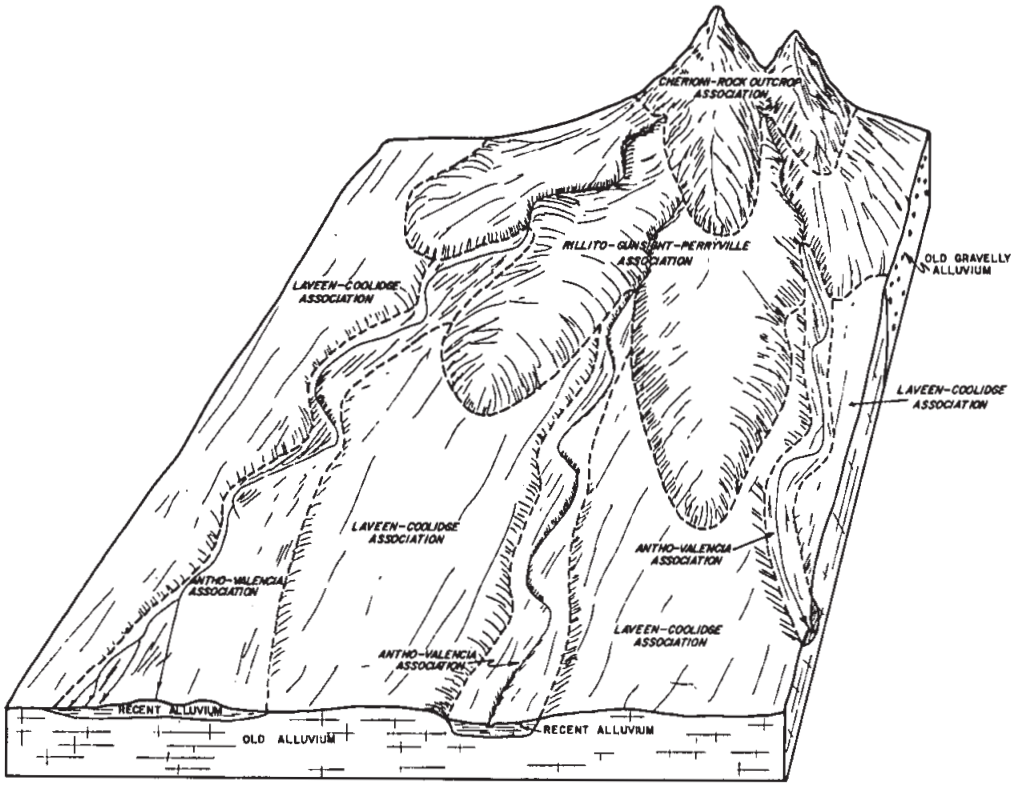



***Figure 4.*—Representative pattern of soils in the Rillito-Gunsight-Perryville, the Laveen-Coolidge, the Antho-Valencia, and the Cherioni-Rock outcrop associations.**

feet. The mean annual precipitation is 6 to 8 inches, the mean annual air temperature is 67° to 74° F, and the frost-free season is 250 to 300 days.

This association makes up about 16 percent of the survey area. It is about 25 percent Rillito soils, about 20 percent Gunsight soils, about 10 percent Perryville soils, and 45 percent Pinal, Laveen, Harqua, and Cherioni soils. One area south of Saddle Mountain is almost entirely Pinal soils.

Rillito soils are on the more gently sloping edges of alluvial fans and valley plains. Gunsight soils are in the slightly higher positions in the center of alluvial fans. Perryville soils are in slightly lower positions along the outer margins of the alluvial fans and valley plains.

Rillito soils have a surface layer of light yellowish-brown loam about 10 inches thick. The underlying material to a depth of 19 inches is light-brown gravelly loam and pinkish-white to very pale brown gravelly loam or gravelly sandy loam to a depth of 60 inches. The underlying material contains soft masses, filaments, and concretions of lime.

Gunsight soils have a surface layer of light-brown and pale-brown gravelly loam about 3 inches thick. The underlying material to a depth of 60 inches is light-brown very gravelly loam. The underlying material contains soft masses and concretions of lime and in some profiles is cemented with lime.

Perryville soils have a surface layer of very pale brown gravelly loam about 9 inches thick. The underlying material soils are loams that have soft masses and concretions of lime at a depth of about 24 inches.

Parts of the cities of Phoenix, Peoria, Surprise, Cashion, and Litchfield Park are on this association. The association is irrigated. Cotton, alfalfa, small grain, sugar beets, safflower, and citrus are the main crops. A few areas are used as range.

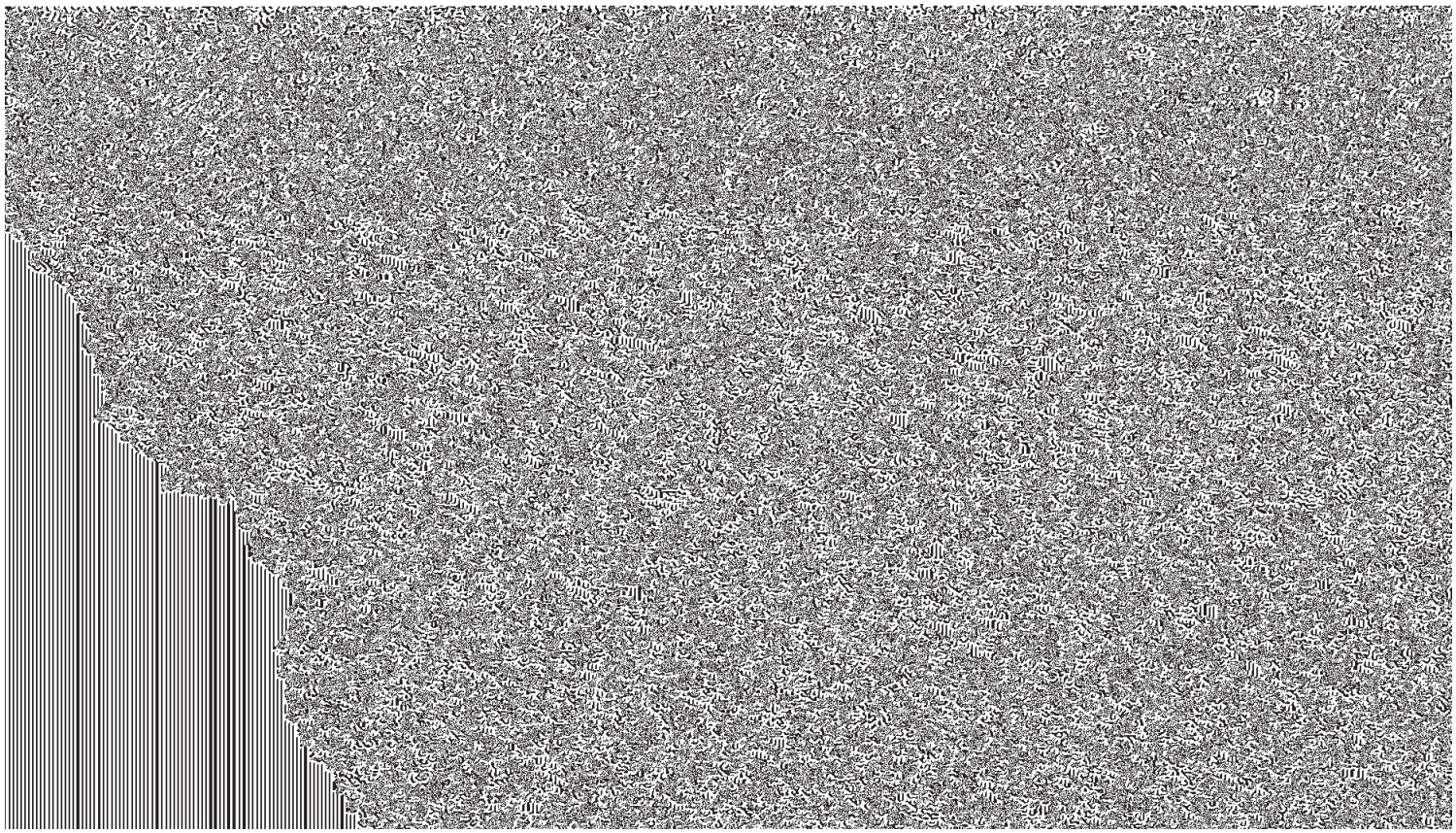
### 7. *Laveen-Coolidge association*

*Nearly level sandy loams, loams, and clay loams on old alluvial fans and valley plains*

This association (see fig. 4, p. 5) is on alluvial fans and valley plains that are 2 to 5 miles from the mountains. The largest area is a 3- to 5-mile wide area extending from Avondale to the Hassayampa River. A few smaller areas are in the Rainbow and Harquahala Valleys. The soils formed in alluvium that was derived from granite-gneiss, schist, limestone, andesite, rhyolite, and basalt. The native vegetation is creosotebush and scattered mesquite and paloverde trees. The elevation ranges from 800 to 1,400 feet. The mean annual precipitation is 6 to 8 inches, the mean annual air temperature is 69° to 73° F, and the frost-free season is 250 to 300 days.

This association makes up about 9 percent of the survey area. It is about 60 percent Laveen soils, 20 percent Coolidge soils, and 20 percent Mohall, Perryville, Tremant, Antho, Maripo, Rillito, and Gilman soils.

Laveen soils are at the lower ends of alluvial fans and



Ebon soils have a cobbly clay subsoil. Pinamt soils have a subsoil of very gravelly sandy clay loam. The underlying material is very gravelly sandy loam. The underlying material and lower part of the subsoil contain accumulations of lime. Tremant soils have a gravelly clay loam and clay loam subsoil. The underlying material is gravelly loam.

Parts of South Mountain Park, White Tank Regional Park, and Estrella Mountain Regional Park are on this association. The association is not cultivated. A few areas are used as range.

### 9. *Casa Grande-Harqua association*

*Nearly level to sloping, saline-alkali loams, sandy loams, and gravelly clay loams on valley plains*

This association is on old valley plains, mainly in the [illegible] 8 inches, the mean annual air temperature is 67° to 74° F, and the frost-free season is 250 to 300 days.

This association makes up about 11 percent of the survey area. It is 40 percent Cherioni soils, 35 percent Rock outcrop, and 25 percent Gunsight, Pinal, Gachado, and several shallow soils.

Cherioni soils are on the lower slopes of mountains and on a few pediments and low hills. Rock outcrop is scattered throughout most mapped areas of this association but is more prevalent in the highest parts of mountains and on low hills. Cherioni soils are very gravelly loams about 11 inches thick. They have an indurated hardpan about 7 inches thick over bedrock.

Part of the city of Phoenix is on this association, as well as parts of South Mountain Park, White Tank Regional Park, Estrella Mountain Regional Park, and [illegible]

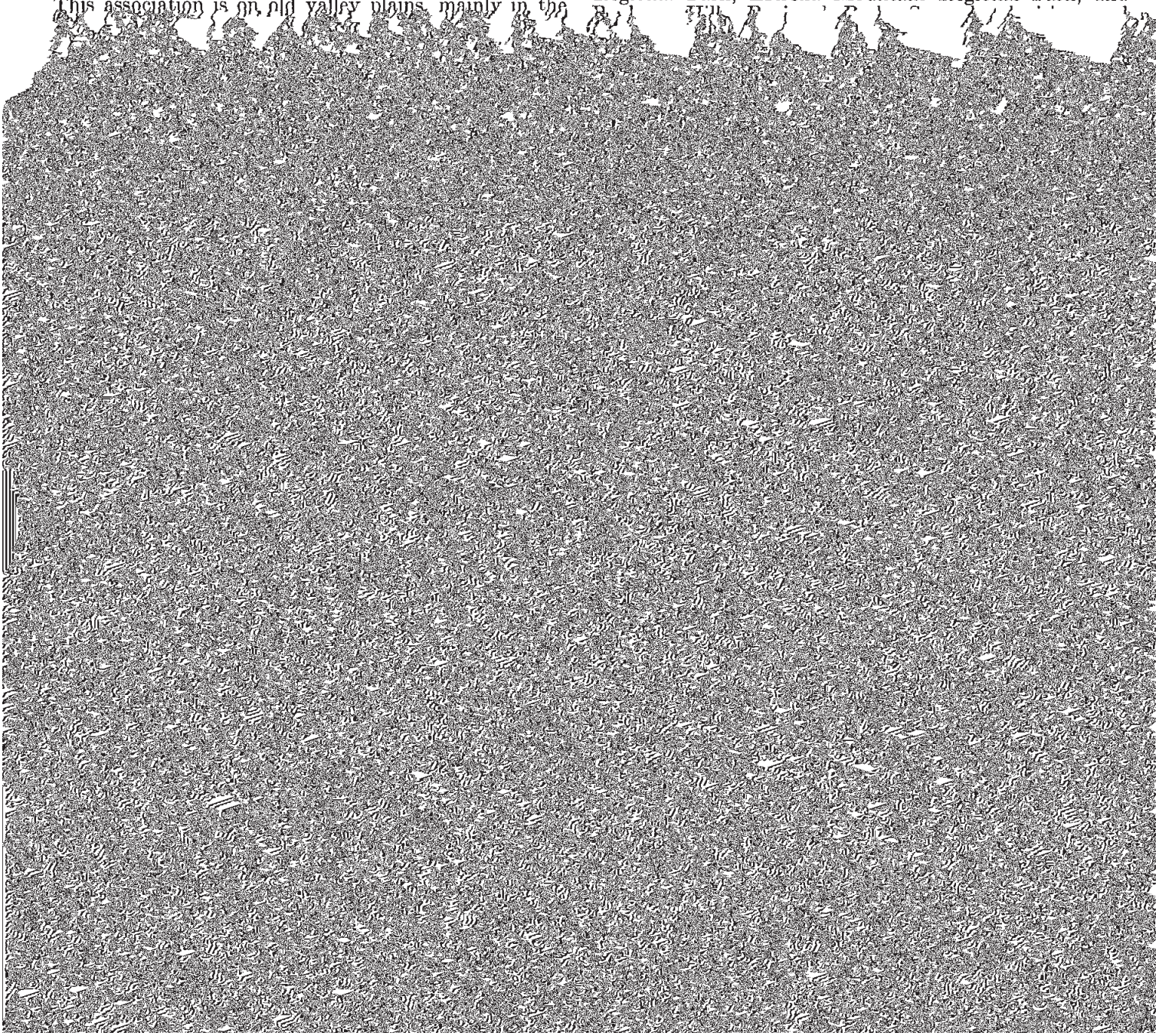


TABLE 1.—*Approximate acreage and proportionate extent of the soils*

| Soil | Acres | Percent [1] |
|---|---|---|
| Agualt loam | 8, 059 | 0. 75 |
| Antho sandy loam, 0 to 1 percent slopes | 32, 548 | 3. 02 |
| Antho sandy loam, 1 to 3 percent slopes | 649 | . 06 |
| Antho sandy loam, saline-alkali | 3, 654 | . 34 |
| Antho gravelly sandy loam, 0 to 1 percent slopes | 6, 014 | . 56 |
| Antho gravelly sandy loam, 1 to 3 percent slopes | 3, 619 | . 34 |
| Antho-Brios sandy loams | 9, 434 | . 88 |
| Antho-Carrizo complex, 0 to 1 percent slopes | 3, 861 | . 36 |
| Antho-Carrizo complex, 1 to 3 percent slopes | 1, 106 | . 10 |
| Antho-Carrizo complex, 0 to 3 percent slopes | 29, 356 | 2. 73 |
| Antho-Tremant complex, 1 to 5 percent slopes | 3, 403 | . 32 |
| Antho-Tremant-Mohall complex, 1 to 5 percent slopes | 3, 092 | . 29 |
| Antho association | 30, 848 | 2. 87 |
| Antho-Valencia association | 15, 724 | 1. 46 |
| Avonda clay loam | 1, 842 | . 17 |
| Avondale clay loam | 22, 045 | 2. 05 |
| Avondale clay loam, saline-alkali | 1, 319 | . 12 |
| Beardsley loam | 955 | . 09 |
| Brios loamy sand | 3, 969 | . 37 |
| Brios sandy loam | 4, 927 | . 46 |
| Brios loam | 1, 052 | . 10 |
| Calciorthids and Torriorthents, eroded | 1, 394 | . 13 |
| Carrizo gravelly sandy loam | 4, 703 | . 44 |
| Carrizo-Ebon complex, 3 to 12 percent slopes | 1, 928 | . 18 |
| Carrizo and Brios soils | 17, 457 | 1. 62 |
| Casa Grande sandy loam | 3, 672 | . 34 |
| Casa Grande loam | 6, 727 | . 62 |
| Gunsight-Rillito complex, 0 to 1 percent slopes | 6, 516 | 0. 61 |
| Gunsight-Rillito complex, 1 to 3 percent slopes | 4, 455 | . 41 |
| Gunsight-Rillito complex, 0 to 10 percent slopes | 25, 630 | 2. 38 |
| Harqua complex, 0 to 3 percent slopes | 9, 011 | . 84 |
| Harqua complex, 3 to 8 percent slopes | 1, 230 | . 11 |
| Harqua-Gunsight complex, 0 to 5 percent slopes | 22, 986 | 2. 14 |
| Harqua-Laveen complex | 3, 706 | . 34 |
| Harqua-Rillito complex, 1 to 3 percent slopes | 4, 729 | . 44 |
| La Palma very fine sandy loam | 1, 007 | . 09 |
| Laveen sandy loam | 18, 355 | 1. 70 |
| Laveen loam, 0 to 1 percent slopes | 75, 909 | 7. 06 |
| Laveen loam, 1 to 3 percent slopes | 1, 213 | . 11 |
| Laveen loam, saline-alkali | 6, 256 | . 58 |
| Laveen clay loam | 8, 049 | . 75 |
| Laveen-Antho complex, saline-alkali | 982 | . 09 |
| Maripo sandy loam | 11, 165 | 1. 04 |
| Mohall sandy loam | 2, 875 | . 27 |
| Mohall loam | 18, 973 | 1. 76 |
| Mohall clay loam | 31, 990 | 2. 97 |
| Mohall clay | 1, 459 | . 14 |
| Mohall-Tremant complex, 0 to 3 percent slopes | 8, 885 | . 83 |
| Mohall-Laveen association | 1, 212 | . 11 |
| Perryville sandy loam | 2, 084 | . 19 |
| Perryville loam, saline-alkali | 1, 712 | . 16 |
| Perryville gravelly loam, 0 to 1 percent slopes | 7, 267 | . 68 |
| Perryville gravelly loam, 1 to 3 percent slopes | 1, 666 | . 15 |
| Perryville-Rillito complex, 0 to 3 percent | | |

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

| Soil | Acres | Percent [1] | Soil | Acres | Percent [1] |
|---|---|---|---|---|---|
| Valencia sandy loam, saline-alkali | 1, 499 | 0. 14 | Wintersburg complex | 1, 378 | 0. 13 |
| Valencia gravelly sandy loam | 355 | . 03 | Borrow pits | 655 | . 06 |
| Vecont loam | 901 | . 08 | Dumps | 149 | . 01 |
| Vecont clay | 4, 691 | . 44 | Gravel pits | 1, 261 | . 11 |
| Vint loamy fine sand | 4, 107 | . 38 | Surveyed at High Intensity | 651, 106 | -------- |
| Vint fine sandy loam | 5, 141 | . 48 | Surveyed at Low Intensity | 424, 523 | -------- |
| Vint loam | 996 | . 09 | Lakes and all other water | 701 | . 06 |
| Vint clay loam | 396 | . 04 | | | |
| Vint-Carrizo complex | 686 | . 06 | Total | [2] 1, 076, 330 | 100. 00 |

[1] Figures were rounded to nearest hundredth.

[2] Acreage includes water.

describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*5*).[2]

## Agualt Series

The Agualt series consists of deep, well-drained soils. These soils formed in recent alluvium that was deposited on flood plains, low terraces, and alluvial fans. The alluvium was derived from a wide mixture of rock, including granite, granite-gneiss, andesite, and basalt. Slopes are 0 to 3 percent. Elevations are 800 to 1,500 feet. In areas not irrigated, the vegetation is creosotebush, cactus, annual weeds and grasses, and scattered mesquite and paloverde trees. The average annual rainfall is about 6 to 8 inches, the mean annual air temperature is 69° to 74° F, and the frost-free season is 250 to 300 days.

In a representative profile the soil is brown loam to a depth of about 27 inches and pale-brown sand to a depth of 60 inches. The soil is moderately alkaline throughout and in most places is calcareous throughout.

Premeability is moderate in the loamy upper part of the soil and very rapid in the sandy lower part. Runoff is slow, and the hazard of erosion is slight. The available water capacity is 5 to 7 inches. Roots penetrate to a depth of about 60 inches.

Agualt soils are used for irrigated crops, range, recreation, and wildlife. Irrigated crops are cotton, alfalfa, barley, safflower, sugar beets, sorghum, citrus, and vegetables.

Representative profile of Agualt loam, 200 feet east and 75 feet north of southwest corner of cultivated field SW¼SE¼SW¼ sec. 18, T. 2 N., R. 1 E.

Ap—0 to 11 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common fine and very fine roots; common very fine interstitial and tubular pores; common very fine mica flakes; strongly effervescent; moderately alkaline; abrupt, smooth boundary.

C1—11 to 27 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common fine and very fine roots; many very fine interstitial and tubular pores; common very fine mica flakes; strongly effervescent; few, fine

IIC2—27 to 60 inches, pale-brown (10YR 6/3) sand, brown (10YR 5/3) when moist; single grained; loose when dry, nonsticky and nonplastic when wet; few fine roots in upper part; many fine interstitial pores; many fine and very fine mica flakes; 5 percent fine waterworn gravel; slightly effervescent; moderately alkaline.

The soil is typically dry, but is sometimes moist in the upper part during July, August, and September. The Ap and C1 horizons have hue of 7.5YR and 10YR, value of 5 to 6 dry and 3 to 5 moist, and chroma of 2 through 4 dry and moist. They are very fine sandy loam or loam and have a few thin strata of finer and coarser material. The content of gravel ranges from 0 to about 10 percent. Lime filaments are few to common in the lower part of the C1 horizon. The IIC2 horizon is at a depth ranging from 20 to 39 inches, but is most commonly at 26 to 30 inches. It ranges from loamy sand to sand. In places this horizon is as much as 35 percent gravel. Thin strata of finer material are also common.

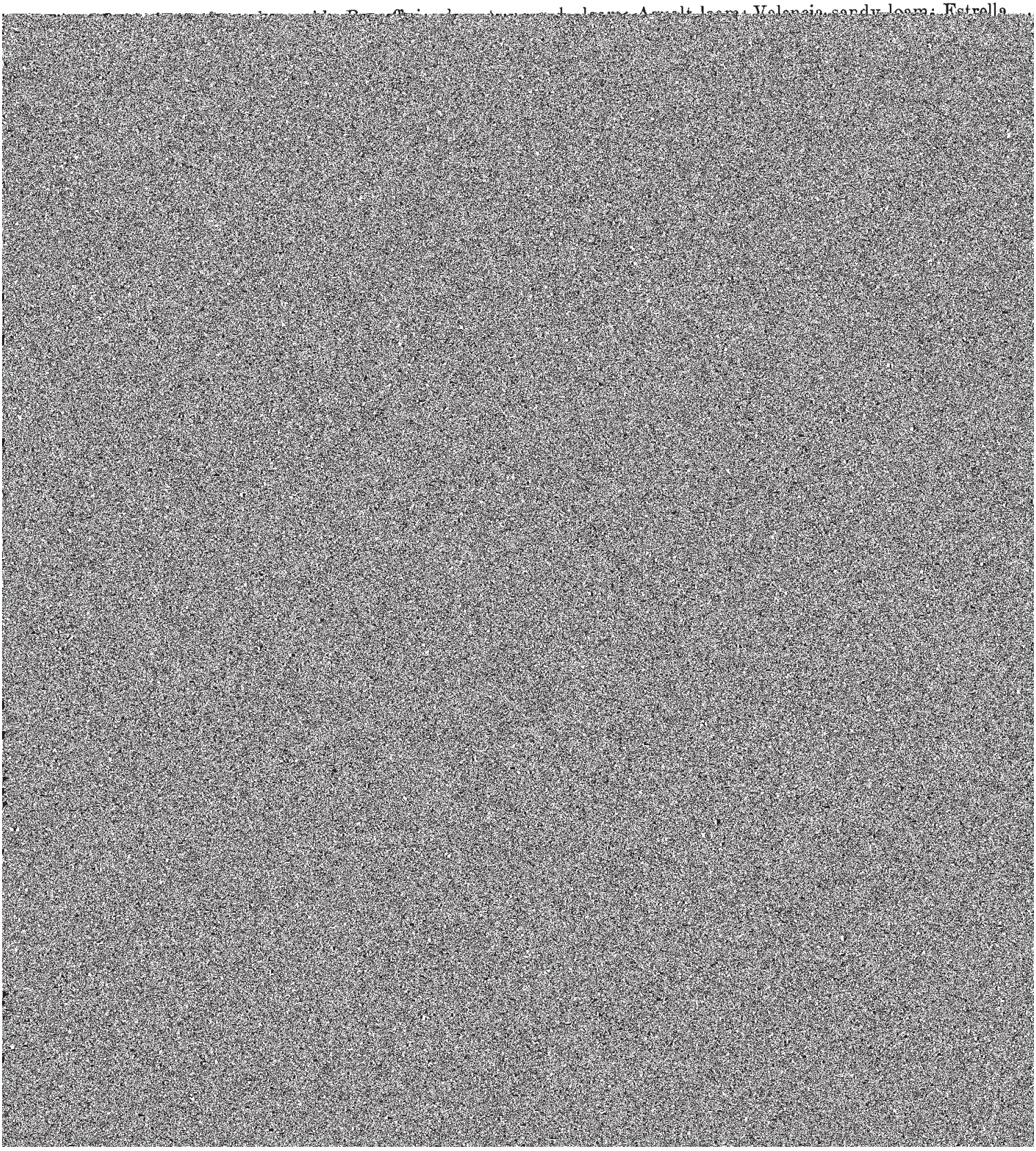
**Agualt loam** (Aa).—Areas of this soil are long and narrow and about 10 acres in size. Slopes are generally less than 1 percent, but range to 3 percent. Included in mapping are small areas of Gilman loam, 0 to 1 percent slopes; Maripo sandy loam; Antho sandy loam, 0 to 1 percent slopes; Carrizo gravelly sandy loam; and Laveen loam, 0 to 1 percent slopes. The total extent of all included soils does not exceed 15 percent.

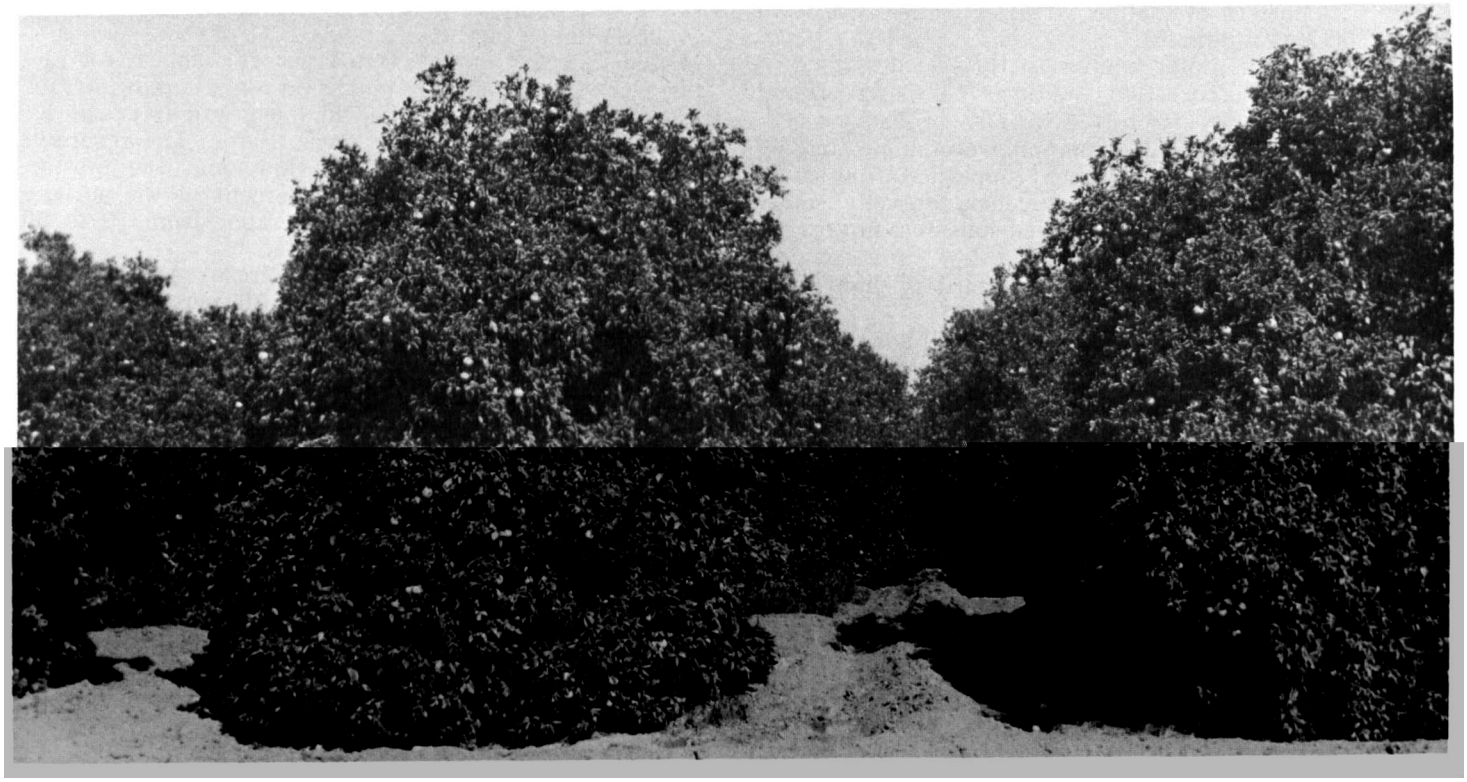
This Agualt soil is used for grazing. Capability unit IIs–7 irrigated, subclass VIIs dryland; Loam Upland range site; horticultural group 4; wildlife habitat group 2 irrigated, 10 dryland.

## Antho Series

The Antho series consists of deep, well-drained soils. These soils formed in recent alluvium deposited on alluvial fans and stream terraces. The alluvium was derived from a wide variety of rock, but was dominantly from granite. Slopes are generally less than 1 percent, but range to 3 percent. Elevations are 850 to 1,400 feet. In areas not cultivated, the vegetation is creosotebush, bursage, cactus, and scattered mesquite and paloverde trees. The precipitation is 6 to 8 inches, the mean annual air temperature is 69° to 74° F, and the frost-free season is 250 to 300 days.

In a representative profile the soil is light yellowish-brown and light-brown sandy loam to a depth of 47





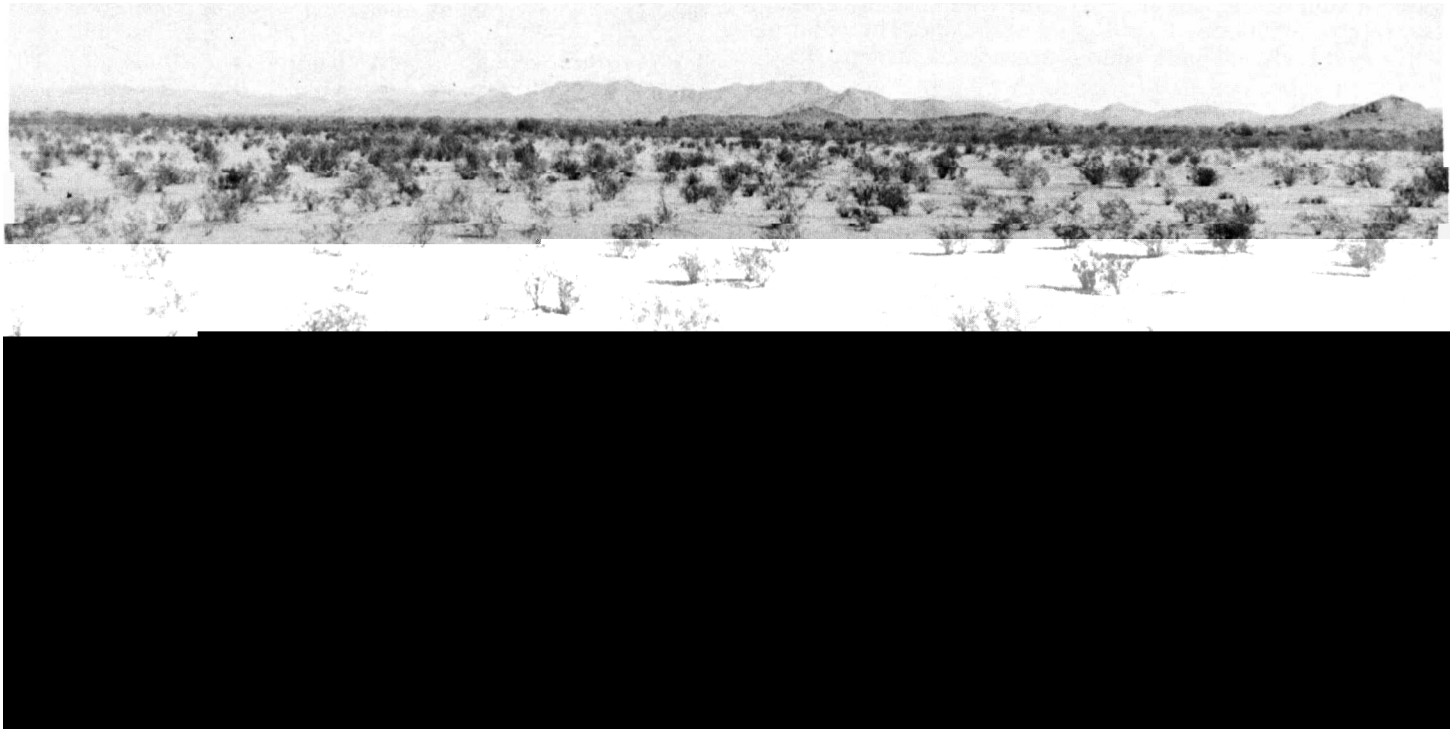


*Figure 5.—Top:* Citrus on Antho sandy loam. *Bottom:* Creosotebush on same soil.

a dendritic pattern of shallow stream channels spaced at 50- to 200-foot intervals.

[illegible]

Brios soil in Sandy Bottom range site; horticultural group 1; wildlife habitat group 4 irrigated, 11 dryland.

**Aztho-Carrizo complex, 0 to 1 percent slopes** (AfA) — [illegible]

mostly less than 1 percent, but a few convex ridges are more than 2 percent. In the more sloping parts, runoff is medium and the erosion hazard is moderate. Surface drainage is provided by a dendritic pattern of shallow stream channels spaced at 50- to 200-foot intervals. About 20 to 40 percent of the surface area is covered with gravel.

This mapping unit is about 35 percent an Antho sandy loam and an Antho gravelly sandy loam, 30 percent a Carrizo gravelly sandy loam, and 20 percent a Maripo sandy loam. The Carrizo soil is in or adjacent to old stream channels that form a braided pattern across larger bodies of Antho soils. The Maripo soil is in transitional areas between Carrizo and Antho soils.

Included with this unit in mapping are small areas of Brios sandy loam, Harqua gravelly loam, and Valencia sandy loam. The total extent of all inclusions seldom exceeds 15 percent.

This mapping unit provides grazing. Capability subclass VIIe dryland. Antho soils in Loam Upland range site; horticultural group 1; wildlife habitat group 11 dryland. Carrizo soil in Sandy Bottom range site; horticultural group 4; wildlife habitat group 12 dryland.

**Antho-Tremant complex, 1 to 5 percent slopes** (AHC).—This undulating mapping unit is on the upper part of alluvial fans that are ½ mile to 2 miles from the mountains. The largest area is on the east side of the White Tank Mountains. Slopes range from 1 to 5 percent. Runoff is medium, and the erosion hazard is moderate. Surface drainage is provided by a dentritic pattern of V-shaped stream channels spaced at 50- to 300-foot intervals. Areas range from 200 to 500 acres in size.

This mapping unit is about 40 percent an Antho gravelly sandy loam that has 1 to 5 percent slopes, and 30 percent a Tremant gravelly loam that has 1 to 3 percent slopes. The Antho soil has a profile similar to the one described as representative of the series, but it is 15 to 35 percent gravel. The Tremant soil has a profile similar to the one described as representative of the series, but the surface layer is gravelly loam 6 to 10 inches thick. The Antho soil is in slightly concave positions between stream channels and fan crests. The Tremant soil is on fan crests that are covered with a varnished desert pavement.

Included with this unit in mapping are small areas of Gunsight, Maripo, Rillito, Laveen, Carrizo, Mohall, Gilman, Valencia, and Estrella soils. The total extent of included soils does not exceed 30 percent of the unit.

This unit is not cultivated because slopes are complex. It provides grazing. Capability subclass VIIe dryland. Antho soil in Loam Upland range site; horticultural group 1; wildlife habitat group 11 dryland. Tremant soil in Loam Upland range site; horticultural group 2; wildlife habitat group 11 dryland.

**Antho-Tremant-Mohall complex, 1 to 5 percent slopes** (AkB).—This gently sloping to sloping mapping unit is on the upper parts of alluvial fans that are 1 mile to 3 miles from the base of the White Tank Mountains and other mountains. Elevation is generally more than 1,300 feet. Local relief is undulating, and slopes range from 1 to 5 percent. Runoff is medium, and the erosion hazard is moderate. A few slopes near stream channels are nearly 15 percent. On these, runoff is rapid. Surface drainage is provided by a dendritic pattern of V-shaped stream channels that are entrenched 5 to 25 feet. Areas are 200 to 400 acres in size.

This mapping unit is about 35 percent an Antho gravelly sandy loam that has 1 to 5 percent slopes; 15 percent Antho sandy loam, 1 to 3 percent slopes; 20 percent Tremant gravelly clay loam, 1 to 5 percent slopes, and 15 percent a Mohall gravelly sandy loam that has 0 to 1 percent slopes. These soils have profiles similar to the ones described as representative of their respective series, but the Antho gravelly sandy loam is 15 to 35 percent gravel and contains numerous thin strata of gravelly loamy sand and gravelly sand and the Mohall soil has a surface layer of gravelly sandy loam 5 to 10 inches thick. The Antho sandy loam and the Mohall and Tremant soils are on long, narrow convex ridges. From 40 to 90 percent of this surface area is covered with gravel and cobbles. The Antho sandy loam is in slightly concave depressional areas near stream channels.

Included with this unit in mapping are areas of Calciorthids and Torriorthents, eroded, along the margins of stream channels, where slopes range from 10 to 40 percent. Also included are a few small areas of Carrizo gravelly sandy loam and Gilman fine sandy loam. Included soils make up about 15 percent of this mapping unit.

This mapping unit provides grazing. None of the acreage is cultivated. Capability subclass VIIe dryland. Antho soils in Loam Upland range site; horticultural group 1; wildlife habitat group 11 dryland. Tremant soil in Loam Upland range site; horticultural group 2; wildlife habitat group 11 dryland. Mohall soil in Loam Upland range site; horticultural group 2; wildlife habitat group 11 dryland.

**Antho association** (AL).—This nearly level to gently sloping mapping unit is on alluvial fans that radiate out from nearby mountains. It occurs throughout the uncultivated part of the survey area, but is most extensive at the base of the Estrella Mountains in the Rainbow Valley. Slopes are generally less than 1 percent. Runoff is slow, and the erosion hazard is slight. A few slopes near stream channels are nearly 3 percent. On these, runoff is medium and the erosion hazard is moderate. Surface drainage is provided by a dendritic pattern of shallow stream channels, 1 foot to 3 feet deep, spaced at 50- to 300-foot intervals. Areas are somewhat pear shaped and range from 100 to 900 acres in size.

This mapping unit is about 55 percent an Antho sandy loam and 30 percent an Antho gravelly sandy loam. Antho gravelly sandy loam has a profile similar to the one described as representative of the series, but it is 15 to 35 percent gravel. Antho sandy loam is at the lower ends of alluvial fans farthest from the mountains. Antho gravelly sandy loam is on the higher parts of the alluvial fans nearest the mountains. Many of the more sloping areas have a few cobbles on the surface and in the profile.

Included with this unit in mapping are small areas of Coolidge sandy loam, Laveen sandy loam, Valencia sandy loam, Carrizo gravelly sandy loam, Maripo sandy loam, and Rock outcrop. The total extent of included soils seldom exceeds 15 percent of the unit.

This unit is grazed. None of the acreage is cultivated. Capability subclass VIIs dryland; Loam Upland range site; horticultural group 1; wildlife habitat group 11 dryland.

**Antho-Valencia association** (AM).—This mapping unit is on long, smooth valley plains that are 1 mile to 3 miles

from the base of the mountains. Slopes are 0 to 1 percent. Runoff is slow, and the erosion hazard is slight. Surface drainage is provided by a dendritic pattern of shallow

few fine gravel; strongly effervescent; moderately alkaline.

Hue is 7.5YR and 10YR. The Ap horizon has value of 4 to 5 dry and 3 moist and chroma of 2 to 3 dry and moist. The A

C2—37 to 60 inches, pale-brown (10YR 6/3) loam or very fine sandy loam, brown (10YR 4/3) when moist; massive; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; few very fine roots; many very fine tubular pores; strongly effervescent; few fine filaments of lime; moderately alkaline.

Generally the soil is no more than 3 percent coarse fragments. The A and C horizons have hue of 7.5YR to 10YR. The A horizon has value of 4 to 5 dry and 3 moist and chroma of 2 to 3 dry and moist. It is clay loam or silty clay loam and is more than 1 percent organic matter. The C horizon has value of 5 to 6 dry and 3 to 4 moist and chroma of 3 or 4 dry and moist. It is dominantly loam, but has a few ½- to 2-inch layers of sandy loam, very fine sandy loam, and clay loam. Lime filaments or threads are none to common in the C2 horizon. The soil contains few to many mica flakes.

**Avondale clay loam** (Ao).—This level and nearly level soil is on alluvial plains and low stream terraces. Slopes are less than 1 percent. Areas are long and narrow and about 60 acres in size.

This soil has the profile described as representative of the series. Included in mapping are small areas of Glenbar clay loam; Gilman loam, 0 to 1 percent slopes; and Trix clay loam. The total extent of included soils seldom exceeds 15 percent.

This Avondale soil holds 9 to 11 inches of water available to plants. It is used for irrigated crops and for range, recreation, and wildlife. Irrigated crops are cotton, alfalfa, barley, sorghum, sugar beets, safflower, grapes, citrus, and truck crops. Extensive areas occur in the cities of Phoenix, Glendale, and Buckeye. Capability unit I–1 irrigated, subclass VIIc dryland; Sandy Bottom range site; horticultural group 1; wildlife habitat group 1 irrigated, 11 dryland.

**Avondale clay loam, saline-alkali** (Ap).—This nearly level soil is on stream terraces along the margins of the Gila and Salt Rivers. Slopes are less than 1 percent. Areas are long narrow and range from 10 to 50 acres in size.

This soil has a profile similar to the one described as representative of the series, but it is moderately saline to strongly saline and moderately alkaline to strongly alkaline. Included in mapping are small areas of Glenbar clay loam, saline-alkali; Cashion clay, saline-alkali; and Gilman loam, saline-alkali.

This Avondale soil holds 6 to 8 inches of water available to plants. It is used for irrigated crops, range, recreation, and wildlife. Irrigated crops are cotton, alfalfa, barley, sorghum, sugar beets, and safflower. A few areas are used as homesites. Capability unit IIs–9 irrigated, subclass VIIs dryland; Sandy Bottom range site; horticultural group 5; wildlife habitat group 1 irrigated, 11 dryland.

## Beardsley Series

The Beardsley series consists of moderately deep, well-drained soils that are 20 to 40 inches deep over an indurated hardpan. These soils formed on old alluvial fans and stream terraces. The alluvium was derived from a wide mixture of rock, including andesite, granite, granite-gneiss, quartzite, and schist. Slopes are less than 1 percent. Elevations are 1,200 to 1,400 feet. The native vegetation is galleta and mesquite and paloverde trees. The average annual rainfall is 6 to 8 inches, the mean annual air temperature is 69° to 74° F, and the frost-free season is 250 to 300 days.

In a representative profile the surface layer is light-brown loam about 3 inches thick. The subsoil is reddish-brown clay loam and clay that extends to a depth of about 36 inches. It rests on an indurated hardpan that is impervious to roots and water. The soil is moderately alkaline throughout and strongly effervescent in the lower part of the subsoil.

Permeability of the subsoil is slow. Runoff is slow, and there is no erosion hazard. The available water capacity is 5 to 6 inches. Roots penetrate to a depth of 24 to 40 inches.

Beardsley soils are grazed.

Representative profile of Beardsley loam, 1,000 feet west and 660 feet south of northeast corner of sec. 8, T. 4 N., R. 1 E. in an uncultivated area north of Sun City:

A1—0 to 3 inches, light-brown (7.5YR 6/4) loam, dark brown (7.5YR 4/4) when moist; weak, thin, platy structure; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; common fine roots; common fine vesicular and few fine tubular pores; noneffervescent; moderately alkaline; abrupt, smooth boundary.

B1—3 to 10 inches, reddish-brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; common very fine and fine roots; few fine tubular and few very fine interstitial pores; noneffervescent; moderately alkaline; clear, wavy boundary.

B2t—10 to 36 inches, reddish-brown (5YR 5/4) clay, reddish brown (5YR 4/4) when moist; moderate, coarse, subangular blocky structure; very hard when dry, firm when moist, sticky and very plastic when wet; common fine roots in upper part and common very fine roots in lower part; few thin clay films on faces of peds; many pressure faces or small slickensides on faces of peds; strongly effervescent; few, very fine, soft, pinkish-white (7.5YR 8/2) lime masses; moderately alkaline; abrupt, wavy boundary.

Csicam—36 to 60 inches, light brownish-gray (10YR 6/2), white (10YR 8/2), and light-gray (10YR 7/2) indurated silica-lime cemented duripan and thin laminar layer on upper surface; massive; extremely hard; violently effervescent.

Thickness of the solum and depth to the duripan range from 20 to 40 inches, but are dominantly 30 to 40 inches. The duripan ranges from 6 to 24 inches or more in thickness. It is fractured in places. The A horizon has hue of 7.5YR and 10YR, value of 5 or 6 dry and 3 or 4 moist, and chroma of 3 or 4. A thin, light-colored A2 horizon occurs in places. The B horizon has hue of 5YR or 7.5YR, value of 4 to 6 dry and 4 or 5 moist, and chroma of 3 to 6. It ranges from heavy clay loam to clay. A few thin strata that range from 15 to 40 percent gravel occur in places, but the average is less than 15 percent coarse fragments by volume. The Bt horizon ranges from weak to moderate, medium to fine, prismatic or weak to moderate, medium to coarse, subangular or angular blocky.

**Beardsley loam** (BE).—This soil occurs as long, narrow areas about 400 acres in size. In a few areas the surface is gravelly. Slopes are less than 1 percent and slightly concave. Included in mapping are small areas of Vecont clay, Suncity very gravelly loam, Pinal gravelly loam, and Beardsley gravelly loam.

This Beardsley soil provides grazing. Capability subclass VIIs dryland; Clay Bottom range site; horticultural group 7; wildlife habitat group 9 dryland.

## Brios Series

The Brios series consists of deep, somewhat excessively drained soils. These soils formed in recent alluvium deposited on flood plains, low terraces, and alluvial fans.

The alluvium was derived from rhyolite, andesite, quartzite, and limestone. The surface is hummocky in some places. Slopes are 0 to 3 percent. The native vegetation is a sparse stand of creosotebush, cactus, annual weeds and grasses, and scattered mesquite, paloverde, and tamarix trees. Elevations are 700 to 1,300 feet. The climate is arid continental. The annual rainfall is 6 to 8 inches, the mean annual air temperature is about 69° to 74° F, and the frost-free season ranges from 250 to 300 days.

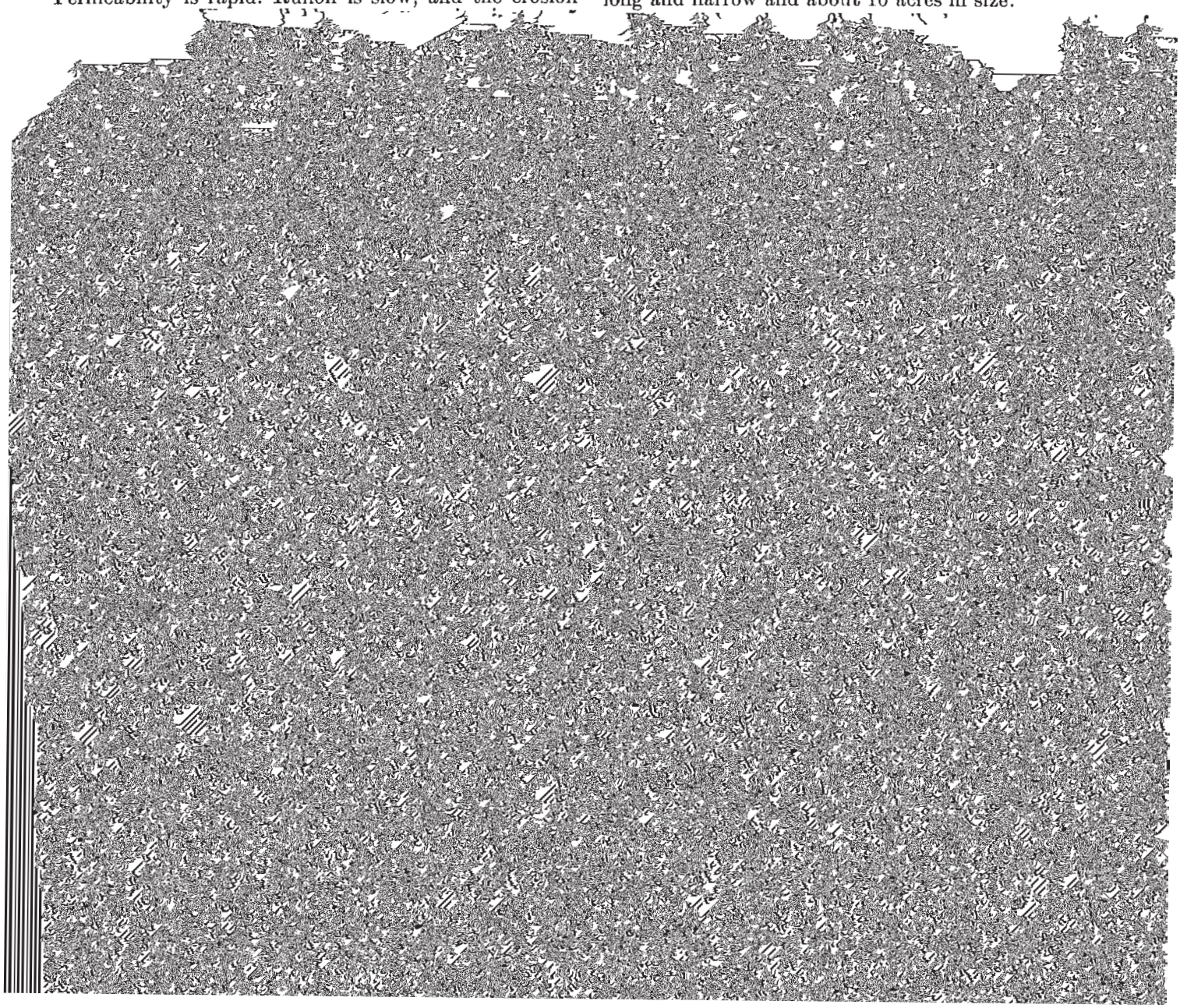
In a representative profile the surface layer is brown sandy loam about 14 inches thick. The underlying material to a depth of 60 inches is brown coarse sand that is stratified below a depth of 22 inches. The soil is moderately alkaline throughout. The surface layer is strongly effervescent, and the underlying material is slightly effervescent.

Permeability is rapid. Runoff is slow, and the erosion dominantly loamy sand 5 to 12 inches thick and in places it is sand.

Included in mapping are small areas of Carrizo gravelly sandy loam and Vint loamy fine sand. Also included are a few small areas adjacent to the Gila River where the soil is slightly saline.

This Brios soil is used for grazing. Soil blowing is a slight hazard. The only cultivated acreage is within fields of better soils. Irrigated crops are cotton, alfalfa, pasture grass, and citrus. A few areas provide a source of sand. Capability unit IVs-7 irrigated, subclass VIIs dryland; Sandy Bottom range site; horticultural group 4; wildlife habitat group 6 irrigated, 11 dryland.

**Brios sandy loam** (Bs).—This soil is on low terraces near the major drainageways and on alluvial fans. It occurs throughout the survey area. The surface is somewhat hummocky. Slopes are less than 1 percent. Areas are long and narrow and about 10 acres in size.



run parallel to and are one-eighth to one-fourth mile from the main stream channels.

Calciorthids and Torriorthents, eroded, is highly variable remnants of old soils that were derived from mixed acid and basic igneous and some sedimentary rocks. It ranges from loamy sand to clay loam, is 35 to 85 percent gravel and cobbles, and is mainly very calcareous. Stones are on the surface in some areas. Included in mapping in some more gently sloping areas are small areas of Gunsight

C3—25 to 60 inches, pale-brown (10YR 6/3) very gravelly coarse sand, dark yellowish brown (10YR 4/4) when moist; single grained; loose when dry; many fine interstitial pores; 35 percent gravel and 10 to 15 percent cobbles; slightly effervescent; moderately alkaline.

The soil is slightly to strongly effervescent. Hue of the Ap and C horizons is 10YR to 7.5YR, value is 5 to 7 dry and 4 or 5 moist, and chroma is 3 or 4 dry and moist. The A horizon is gravelly fine sandy loam, gravelly sandy loam, gravelly loamy sand, or gravelly sand. The content of coarse fragments

soil in Sandy Bottom range site; horticultural group 4; wildlife habitat group 12 dryland. Ebon soil in Clay Upland range site; horticultural group 3; wildlife habitat group 11 dryland.

**Carrizo and Brios soils** (CF).—This mapping unit is in or adjacent to channels of the Gila, Salt, and Hassayampa Rivers. It is hummocky and is dissected by many small stream channels and old meander cutoffs. Once every 5 to 20 years the lower lying areas are flooded. Flooding changes the soil material and occasionally the course of the main channel.

This mapping unit is typically about 45 percent Carrizo soil, 35 percent Brios soil, and 20 percent Vint soil. The Vint soil does not occur in some mapped areas, but is as much as 45 percent in others. These soils have profiles similar to the ones described as representative of their respective series, but their surface layer ranges from very gravelly sand to clay. The Carrizo soil is generally in slightly lower positions nearest to stream channels. The Vint soil, which is somewhat dunelike in appearance, is in slightly higher positions along the outer rim of most mapped areas. The Brios soil is in intermediate positions between the Carrizo and Vint soils. Included in mapping near Arlington are a few small areas of Gilman, Gadsden, Avondale, and Cashion soils.

This mapping unit is used for range, recreation, and wildlife. A few areas provide a source of sand and gravel. Capability subclass VIIs dryland. Carrizo soil in Sandy Bottom range site; horticultural group 4; wildlife habitat group 12 dryland. Brios soil in Sandy Bottom range site; horticultural group 4; wildlife habitat group 11 dryland.

## Casa Grande Series

The Casa Grande series consists of deep, well-drained, strongly alkaline soils on alluvial plains bordering drainageways and on the lower part of broad alluvial fans. These soils formed in valley-fill alluvium derived from mixed material. Slopes are mainly less than 1 percent, but range from 0 to 2 percent. In areas not cultivated the vegetation is desert saltbush, mesquite, and cactus. Elevations are 850 to 1,300 feet. The climate is arid continental. The mean annual temperature ranges from 67 to 72° F, and the frost-free season is 250 to 300 days. The annual precipitation ranges from 6 to 8 inches and occurs as thundershowers from July to September and as gentle fall and winter rains.

In a representative profile the surface layer is reddish-yellow sandy loam about 1 inch thick. The subsoil is about 22 inches thick. It is dark reddish-brown, yellowish-red, reddish-yellow, and strong-brown clay loam and loam. The underlying material is yellowish-red and brown loam and sandy loam to a depth of 60 inches. The subsoil and underlying material contain filaments and soft masses of lime and are very strongly alkaline. In places the surface layer is loam.

Permeability is slow. Runoff is slow to very slow, and the hazard of erosion is slight. The available water capacity is 7 to 8 inches. Roots penetrate to a depth of 60 inches.

18, T. 1 N., R. 8 W. in an uncultivated area in the Harquahala Valley:

A2—0 to 1 inch, reddish-yellow (7.5YR 6/6) sandy loam, strong brown (7.5YR 5/6) when moist; weak, thick, platy structure; slightly hard when dry, very friable when moist, nonsticky and slightly plastic when wet; few fine roots; many medium and coarse vesicular pores; strongly effervescent; moderately alkaline; abrupt, wavy boundary.

B21t—1 to 3 inches, dark reddish-brown (5YR 3/3) heavy loam, dark reddish brown (5YR 3/4) when moist; weak, coarse, prismatic structure; hard when dry, friable when moist, slightly sticky and plastic when wet; common fine and very fine roots; common fine vesicular pores; few thin clay films on faces of peds; slightly effervescent; very strongly alkaline; clear, wavy boundary.

B22tcasa—3 to 7 inches, yellowish-red (5YR 5/8) light clay loam, yellowish red (5YR 4/8) when moist; weak, medium, prismatic structure; hard when dry, friable when moist, slightly sticky and plastic when wet; common fine roots; common fine tubular pores; few thin clay films on faces of peds; common, fine, white (10YR 8/2) salt crystals; violently effervescent; few, fine, pinkish-white (7.5YR 8/2) filaments of lime and soft lime masses, pinkish gray (7.5YR 7/2) when moist; moderately alkaline; clear, wavy boundary.

B23tcasa—7 to 15 inches, reddish-yellow (5YR 6/8) clay loam, yellowish red (5YR 4/8) when moist; moderate, medium, subangular blocky structure; hard when dry, friable when moist, slightly sticky, plastic when wet; few fine roots; common fine tubular pores; common thin clay films on faces of peds; common, fine and medium, white (10YR 8/2) salt crystals; few, fine, black (5YR 2/1) coatings on faces of peds; violently effervescent; many, fine and medium, pinkish-white (7.5YR 8/2) filaments of lime and soft irregularly shaped lime masses, pink (7.5YR 8/4) when moist; very strongly alkaline; clear, wavy boundary.

B3casa—15 to 23 inches, strong-brown (7.5YR 5/8) light clay loam, strong brown (7.5YR 5/6) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist, slightly sticky, plastic when wet; few fine roots; common fine tubular pores; few, fine, white (10YR 8/2) gypsum cystals; violently effervescent; common, fine and medium, pinkish-white (7.5YR 8/2) filaments of lime and soft irregularly shaped lime masses, pink (7.5YR 8/4) when moist; very strongly alkaline; clear, smooth boundary.

C1casa—23 to 48 inches, yellowish-red (5YR 5/8) loam, yellowish red (5YR 4/8) when moist; massive; very hard when dry, friable when moist, slightly sticky, slightly plastic when wet; very few fine and medium roots; common fine tubular pores; violently effervescent; many, fine, pinkish-gray (5YR 7/2) filaments of lime and irregularly shaped soft lime masses, pinkish-gray (5YR 6/2) when moist; very strongly alkaline; clear, smooth boundary.

C2casa—48 to 60 inches, brown (7.5YR 5/4) sandy loam, dark brown (7.5YR 4/4) when moist; massive; slightly hard when dry, very friable when moist, slightly sticky, slightly plastic when wet; common fine tubular pores; violently effervescent; many, fine, pinkish-gray (7.5YR 7/2) filaments of lime and soft lime masses; very strongly alkaline.

The solum ranges from about 12 to 40 inches in thickness. The soil is generally dry unless irrigated. The B and C horizons are generally very strongly alkaline and in places are strongly saline. The content of calcium carbonate in the B and C horizons in most places is more than 15 percent; it ranges from 7 to 25 percent. Typically, the largest concentration of calcium carbonate is in the B2 horizon and it gradually decreases with increasing depth. In some places the largest concentration is

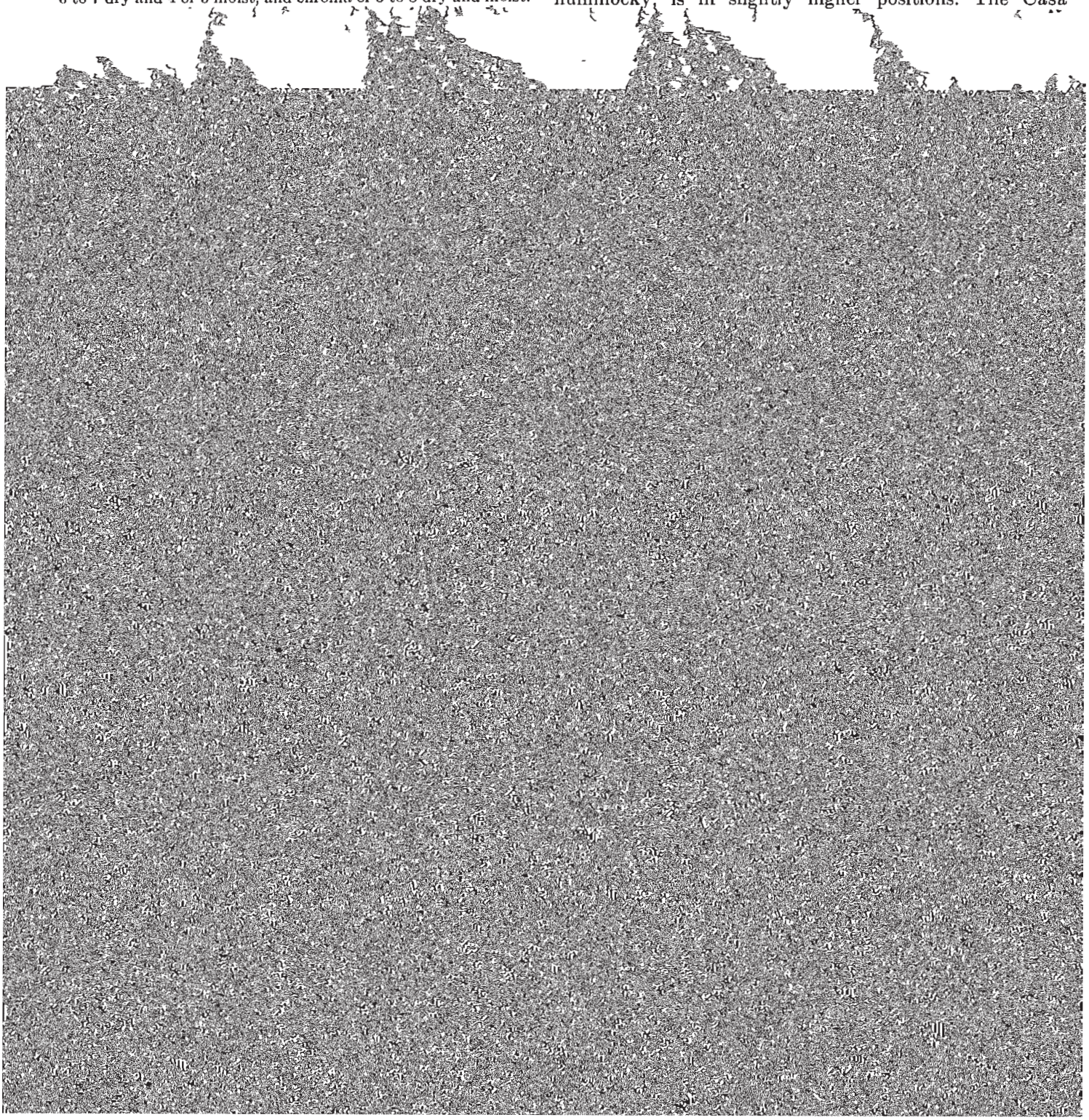
places the A2 horizon is a thin ashy coating on the top of the B21t horizon, and it is covered with a thin A1 horizon that ranges from 1 to 8 inches in thickness.

The B horizon has hue of 7.5YR and 5YR, value of 3 to 6 dry and 3 through 5 moist, and chroma of 4 to 8 dry and moist. It is sandy clay loam or clay loam. The B21t and B22tcasa horizons are generally prismatic, but are subangular blocky in places. The B23tcasa and B3casa horizons are generally subangular blocky, but are massive in some places.

The C horizon has hue of 7.5YR, 5YR, or 10YR, value of 6 to 7 dry and 4 or 5 moist, and chroma of 3 to 8 dry and moist.

intervals. Areas are long, narrow, and irregularly shaped and range from 20 to 300 acres in size.

This mapping unit is about 40 percent a Casa Grande sandy loam that has 0 to 1 percent slopes, and 35 percent a Casa Grande loam that has 0 to 1 percent slopes. These soils have profiles similar to the ones described as representative of their series, but their surface layer is sandy loam or loam. The Casa Grande sandy loam, which is hummocky, is in slightly higher positions. The Casa



The alluvium was derived from a wide mixture of rock, including granite, granite-gneiss, andesite, basalt, and limestone. Slopes are 0 to 1 percent. Elevations are 700 to 1,100 feet. In areas not irrigated the vegetation is creosotebush, tamarix, saltbush, mesquite, annual weeds, and grasses. The average annual rainfall is about 6 to 8 inches, the mean annual air temperature is 69° to 74° F, and the frost-free season is 250 to 300 days.

In a representative profile the surface layer is dark grayish-brown clay about 27 inches thick. The underlying material is pale-brown very fine sandy loam and light yellowish-brown silt loam to a depth of 60 inches. The soil is moderately alkaline to strongly alkaline, is slightly saline to strongly saline, and is generally calcareous throughout.

Permeability is slow. Runoff is slow, and the erosion hazard is slight. The available water capacity is 9 to 10 inches. Roots penetrate to a depth of more than 5 feet. Once every 5 years for about 5 hours, the soils are subject to flooding in a few areas near the Gila River.

Cashion soils are used for irrigated crops, range, recreation, and wildlife. Irrigated crops are cotton, alfalfa, sorghums, wheat, barley, sugar beets, and safflower.

Representative profile of Cashion clay, saline-alkali, 1,620 feet east and 100 feet north of the west quarter corner of sec. 3, T. 1 S., R. 3 W. in a cultivated field southwest of Liberty:

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) clay, dark brown (10YR 3/2) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; common fine and very fine roots; common very fine and fine tubular and interstitial pores; strongly effervescent; moderately alkaline; clear, smooth boundary.

A1—10 to 27 inches, dark grayish-brown (10YR 4/2) clay, dark brown (10YR 3/2) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; common very fine and fine roots; common very fine and fine tubular and interstitial pores; strongly effervescent; moderately alkaline; clear, smooth boundary.

IIC1—27 to 29 inches, pale-brown (10YR 6/3) very fine sandy loam, dark brown (10YR 4/3) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common fine and very fine roots; many very fine tubular and interstitial pores; many mica flakes; strongly effervescent; moderately alkaline; clear, smooth boundary.

IIC2—29 to 60 inches, light yellowish-brown (10YR 6/4) light silt loam, dark yellowish brown (10YR 4/4)

areas are long and narrow strips that have a concave surface.

Included with this soil in mapping are small areas of Gadsden clay, Avondale clay loam, Wintersburg clay loam, and Glenbar clay loam. Also included are a few areas of soils near the mouth of the Hassayampa River where loamy sand or sandy loam is below a depth of 30 inches, a few small areas of soils in the southwestern part of Phoenix where the surface layer is clay loam 8 to 10 inches thick, and some areas of soils near Arlington Canal that are moderately well drained. The total extent of all included soils seldom exceeds 20 percent.

This Cashion soil provides grazing. Capability unit IVs–9 irrigated, subclass VIIs dryland; Sandy Bottom range site; horticultural group 3; wildlife habitat group 8 irrigated, 11 dryland.

## Cherioni Series

The Cherioni series consists of well-drained soils that have a hardpan and are only 6 to 20 inches deep over basalt, andesite, granite or granite-gneiss bedrock. These soils formed on low hills and the lower slopes of mountains. Slopes range from 3 to 25 percent. Elevations are 800 to 1,800 feet. The native vegetation is creosotebush, cactus, mesquite, and paloverde trees. The average annual rainfall is 6 to 8 inches, the mean annual air temperature is 69° to 72° F, and the frost-free season is 270 to 325 days.

In a representative profile the surface layer is light yellowish-brown very gravelly loam about 1 inch thick. The underlying material is light yellowish-brown and very pale brown very gravelly loam about 5 inches thick. It rests on a white, silica-lime cemented hardpan about 6 inches thick. The pan cannot be broken by hand. Fractured andesite bedrock is just below the pan. The soil is moderately alkaline.

Permeability is moderate above the hardpan. Runoff is medium, and the erosion hazard is slight to moderate. The available water capacity is less than 2 inches. Roots penetrate to a depth of less than 20 inches.

Cherioni soils are used mainly for range. Several county parks are on these soils, and a few areas in the city of Phoenix are used as homesites.

Representative profile of Cherioni very gravelly loam in an area of Cherioni-Rock outcrop complex, 990 feet

C2sicam—6 to 12 inches, pinkish-white (7.5YR 8/2) and light-brown (7.5YR 6/4) extremely hard duripan, light brown (7.5YR 6/4) and pink (7.5YR 7/4) when moist; massive; ⅛-inch laminar layer on surface of pan; pan is 60 percent gravel; violently effervescent; moderately alkaline; abrupt, wavy boundary.

available water capacity is 6 to 7 inches. Roots penetrate to a depth of 60 inches or more.

Coolidge soils are used for irrigated crops, range, recreation, and wildlife. Irrigated crops are cotton, alfalfa, barley, safflower, sorghum, sugar beets, citrus, and grapes.

beets, sorghum, citrus, and grapes. Capability unit IIs-7 irrigated, subclass VIIs dryland; Loam Upland range site; horticultural group 2; wildlife habitat group 2 irrigated, 11 dryland.

Included with this unit in mapping are small areas of Antho sandy loam, 0 to 1 percent slopes; Perryville gravelly loam, 0 to 1 percent slopes; and Rillito loam, 0 to 1 percent slopes. Included soils make up about 20 percent of the unit.

common fine roots; few fine tubular, few very fine and common fine interstitial pores; 20 percent gravel; noneffervescent; moderately alkaline; abrupt, smooth boundary.

B1—2 to 13 inches, reddish-brown (5YR 4/4) very cobbly clay loam, yellowish red (5YR 4/6) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; common very fine, fine, and medium roots; few fine tubular and common fine interstitial pores; 60 percent gravel and cobbles; many pressure faces on peds; noneffervescent; moderately alkaline; clear, irregular boundary.

B21t—13 to 23 inches, yellowish-red (5YR 4/6) very cobbly clay, yellowish red (5YR 4/8) when moist; moderate, fine and medium, subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; common very fine and fine roots; few fine tubular and common fine interstitial pores; few thin clay films on peds; 60 percent rounded gravel and cobbles; many pressure faces on peds; noneffervescent; moderately alkaline; clear, wavy boundary.

B22tca—23 to 38 inches, reddish-brown (5YR 5/4) very cobbly clay, yellowish red (5YR 4/8) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; few very fine and fine roots; few fine tubular and common fine interstitial pores; few thin clay films on peds; 60 percent coarse gravel and cobbles; common black (10YR 2/1) stains on faces of peds; slightly effervescent; few, fine, pinkish-white (7.5YR 8/2), soft lime masses and gravel has thin lime coatings; moderately alkaline; clear, wavy boundary.

B3ca—38 to 60 inches, light reddish-brown (5YR 6/4) very cobbly sandy clay loam, yellowish red (5YR 4/6) when moist; massive; hard when dry, friable when moist, sticky and plastic when wet; common fine tubular and many fine interstitial pores; 70 percent coarse gravel and cobbles; strongly effervescent; few, fine, pinkish-white (7.5YR 8/2) lime filaments and soft lime masses; moderately alkaline.

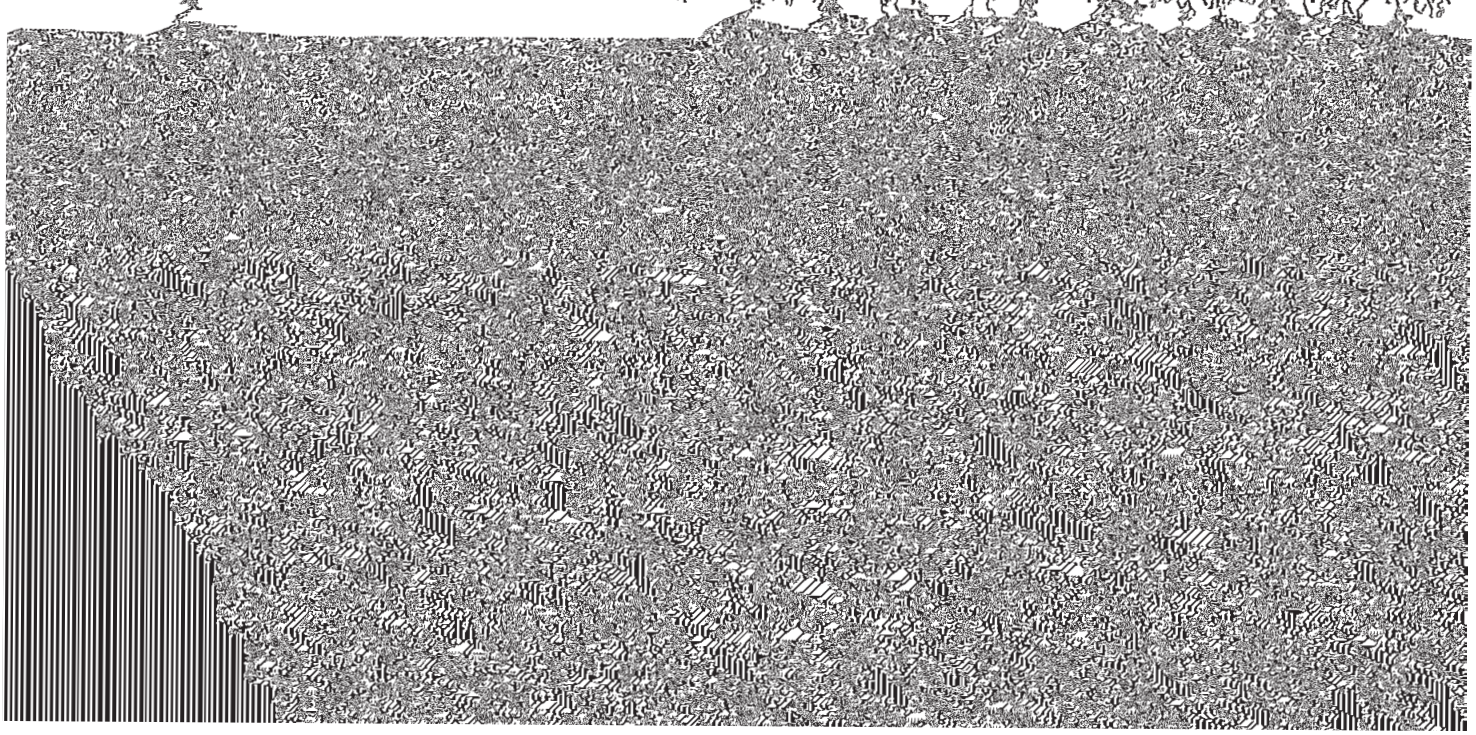
The solum ranges from 20 to 60 inches or more in thickness. The B horizon ranges from 35 to 80 percent coarse fragments by volume. In most places the solum is noncalcareous, but in some the upper part of the B horizon is weakly to strongly calcareous. The upper 15 inches of the solum is less than 0.9 percent organic matter. The mean annual soil temperature lying material is less than 35 percent gravel and the underlying material is weakly to strongly cemented below a depth of 30 inches. The total extent of all included soils seldom exceeds 25 percent.

This Ebon soil is used mainly for range (fig. 6), recreation, and wildlife. A few areas are used as homesites. Capability subclass VIIe dryland; Clay Upland range site; horticultural group 3; wildlife habitat group 11 dryland.

**Ebon-Pinamt complex, 0 to 10 percent slopes** (EPD).—This nearly level to moderately steep mapping unit is on old alluvial fans that form a piedmont slope along the base of the White Tank Mountains. Most fans are 1 mile to 2 miles long. The mapping unit is dissected by intermittent stream channels spaced at 50- to 500-foot intervals that have cut 2 to 30 feet below the surface. Slopes range from 1 to 3 percent, but many short slopes near washes are nearly 10 percent. Areas range from 100 to 500 acres in size.

This mapping unit is about 40 percent an Ebon gravelly loam, 25 percent a Pinamt gravelly sandy loam, and 20 percent a Tremant gravelly loam. These soils have profiles similar to the ones described as representative of their respective series, but the Pinamt soil has a surface layer of gravelly sandy loam and the Tremant soil has a surface layer of gravelly loam. The Ebon soil is in the highest positions nearest the mountains and along the edge of intermittent stream channels. About 60 to 90 percent of the surface area is covered with granite-gneiss gravel and cobbles. The Pinamt soil is at the lower ends of alluvial fans. About 30 to 80 percent of the surface area is covered with granite-gneiss gravel and cobbles. The Tremant soil is in the center of alluvial fans. About 25 to 45 percent of the surface area is covered with granite-gneiss gravel and cobbles.

Included with this unit in mapping are small areas of Gunsight gravelly loam, 1 to 3 percent slopes; Carrizo gravelly sandy loam, 1 to 3 percent slopes; Rillito loam,



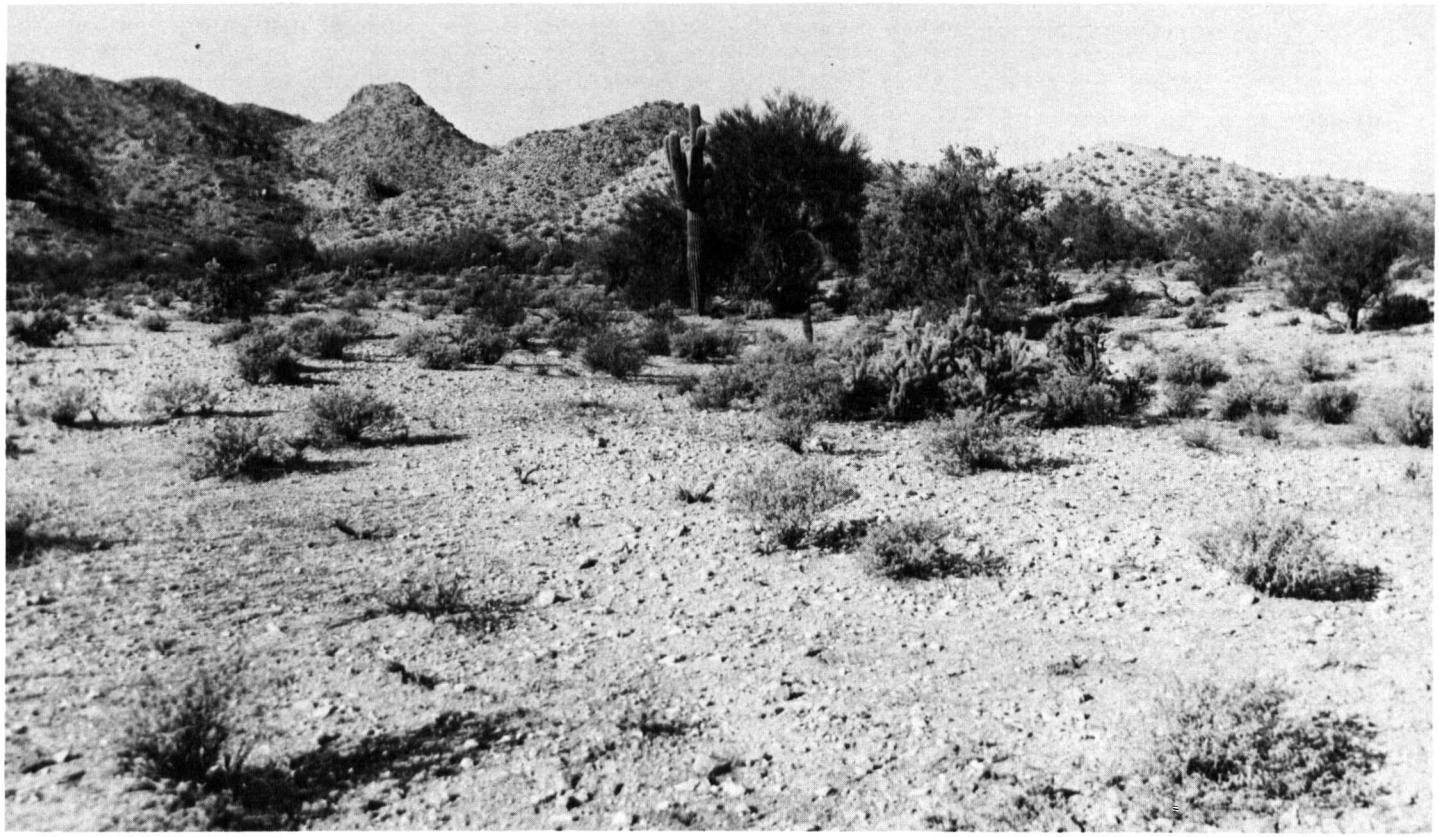


*Figure 6.*—**Clay Upland range site in poor condition on Ebon gravelly loam.**

In a representative profile the soil is brown and light-brown loam to a depth of about 24 inches. Below this, to a depth of 48 inches, is an older, buried soil that is brown and reddish-yellow clay loam. The underlying material is mottled light-brown gravelly clay loam to a depth of 60 inches. The lower part of the older soil and the underlying material contain a large concentration of lime and a few pebbles. The soil is generally moderately alkaline throughout, but in some areas the lower part is strongly alkaline to very strongly alkaline.

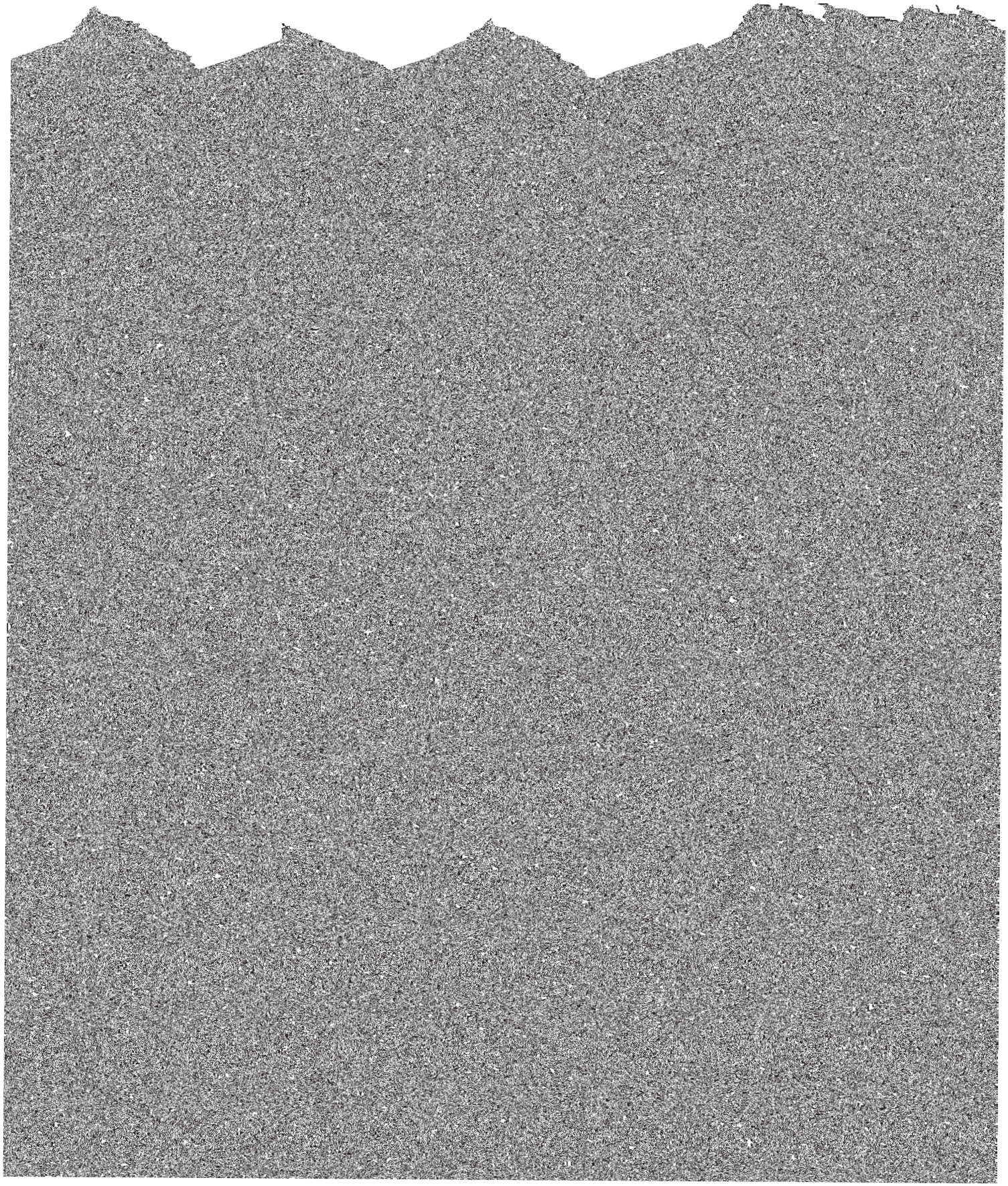
Permeability is moderately slow. Runoff is slow, and the erosion hazard is slight. The available water capacity is 10 to 12 inches. Roots penetrate to a depth of 60 inches.

Estrella soils are used for cotton, alfalfa, barley, sorghum, sugar beets, safflower, wheat, grapes, citrus, and truck crops and for range, wildlife, and recreation. Extensive parts of the cities of Phoenix and Glendale are on these soils.

tubular pores; strongly effervescent; few fine filaments of lime in lower part; moderately alkaline; abrupt, smooth boundary.

IIB21tcab—24 to 35 inches, brown (7.5YR 5/4) clay loam, reddish brown (5YR 4/4) when moist; moderate, fine and medium, subangular blocky structure; very hard when dry, friable when moist, sticky and plastic when wet; many fine tubular pores; many thin clay films on faces of peds and lining pores; strongly effervescent; many, fine and medium, distinct, pink (7.5YR 8/4) filaments of lime; moderately alkaline; gradual, smooth boundary.

IIB22tcab—35 to 48 inches, yellowish-red (5YR 4/6) clay loam, reddish brown (5YR 4/4) when moist; moderate, fine and medium, subangular blocky structure; very hard when dry, friable when moist, sticky and plastic when wet; many fine and very fine tubular pores; many thin clay films on faces of peds and lining pores; strongly effervescent; few soft lime nodules; common, fine and medium, distinct, pinkish-gray (5YR 7/2), irregularly shaped filaments of lime; moderately alkaline; abrupt, wavy boundary.



This mapping unit is about 40 percent Gachado very gravelly clay loam and about 40 percent Rock outcrop. Rock outcrop is in random, circular areas about 20 to 100 feet in diameter. It is surrounded by the Gachado soil.

Included with this unit in mapping are areas of Cherioni very gravelly loam and a few small areas of Rillito, Pinal, and Gunsight soils. These soils make up about 20 percent of this mapping unit.

This mapping unit is used for range and wildlife. Capability subclass VIIe dryland. Gachado soil in Loam Hills range site; horticultural group 7; wildlife habitat group 12 dryland.

## Gadsden Series

The Gadsden series consists of deep, well-drained soils. These soils formed in recent alluvium derived from a wide mixture of rocks that were deposited on flood plains and low terraces along the Gila and Salt Rivers. Slopes are less than 1 percent. Elevations are 750 to 1,150 feet. In areas not irrigated the vegetation is creosotebush, catclaw, fourwing saltbush, arrowweed, Mormon-tea, annual weeds and grasses, and scattered mesquite and tamarix trees. The average annual rainfall is about 6 to 8 inches, the mean annual air temperature is 69° to 73° F, and the frost-free season is 250 to 300 days.

In a representative profile the soil is brown clay to a depth of about 43 inches and brown clay loam to a depth of 60 inches. The soil is moderately alkaline throughout. It is strongly effervescent to a depth of 43 inches. In a few areas the surface layer is clay loam. In some areas the soil contains excessive amounts of saline and alkali salts.

Permeability is slow. Runoff is slow, and the erosion hazard is none to slight. The available water capacity is 9 to 10 inches. Roots penetrate to a depth of 60 inches or more.

Gadsden soils are used mainly for irrigated crops, range, recreation, and wildlife. Irrigated crops are cotton, alfalfa, sorghum, barley, and sugar beets. A few areas are used as building sites.

Representative profile of Gadsden clay, 78 feet west and 294 feet north of southeast corner of sec. 16, T. 1 N., R. 2 E. in cultivated field south of Phoenix:

Ap—0 to 10 inches, brown (7.5YR 5/2) clay, dark brown (7.5YR 3/2) when moist; weak, fine, subangular blocky structure; very hard when dry, friable when moist, sticky and plastic when wet; common medium and fine roots; common fine tubular and few fine interstitial pores; strongly effervescent; moderately alkaline; abrupt, smooth boundary.

A1—10 to 29 inches, brown (10YR 4/3) clay, dark brown (7.5YR 3/2) when moist; massive; very hard when dry, friable when moist, sticky and plastic when wet; common fine and very fine roots; few very fine and medium tubular pores; few pressure faces; strongly effervescent; few, fine, pinkish-white (7.5YR 8/2) filaments of lime in the lower part; moderately alkaline; clear, smooth boundary.

C1—29 to 43 inches, brown (7.5YR 5/4) clay, dark brown

C2—43 to 60 inches, brown (7.5YR 5/4) clay loam, brown (7.5YR 4/4) when moist; massive; hard when dry, friable when moist, slightly sticky and plastic when wet; common very fine roots; few fine tubular pores; common black (10YR 2/1) stains; weak planes of stratification; slightly effervescent; moderately alkaline.

These soils are effervescent throughout, but do not have a Cca horizon. They are generally dry, but sometimes in summer they are moist between depths of 10 and 40 inches. When the soil is dry, cracks are one-half inch wide or more at a depth of 20 inches. The soil temperature ranges from 72° to 80° F.

The A and C horizons have hue ranging from 10YR to 7.5YR, value ranging from 6 to 4 dry and 4 or 3 moist, and chroma ranging from 2 to 4 dry and moist. These horizons range from clay loam to clay. The Ap horizon ranges from weak, fine, subangular blocky to weak, medium, granular. A few pressure faces and a few slickensides occur throughout the C horizon. Thin layers of very fine sandy loam, loam, or clay loam are common between depths of 10 and 40 inches. Electrical conductivity ranges from 2 to 15 millimhos per centimeter.

**Gadsden clay loam** (Gb).—This nearly level soil is on flood plains of the Gila and Salt Rivers. The surface is smooth. Slopes are generally less than 0.5 percent. Areas range from 5 to 75 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is clay loam 10 to 14 inches thick. Included in mapping are small areas of Glenbar clay loam; Cashion clay, saline-alkali; and Avondale clay loam and areas of other Gadsden soils that have a surface layer of loam.

This Gadsden soil is used mainly for irrigated crops, range, recreation, and wildlife. Irrigated crops are cotton, alfalfa, barley, sorghums, and sugar beets. A few areas are used as building sites. Capability unit IIIs–8 irrigated, subclass VIIs dryland; Sandy Bottom range site; horticultural group 3; wildlife habitat group 3 irrigated, 9 dryland.

**Gadsden clay** (Gc).—This nearly level soil is on flood plains and low terraces along the Gila and Salt Rivers. The surface is generally smooth and slightly concave. When it is dry, cracks ranging from ½ inch to 2 inches wide often extend to a depth of 20 inches or more. Slopes are less than 0.5 percent. Areas range from 2 to 300 acres in size, but are generally less than 100 acres.

This soil has the profile described as representative of the series. Included in mapping are small areas of Glenbar clay; Glenbar clay loam; Cashion clay, saline-alkali; Avondale clay loam; and a few areas of Gadsden clay loam. Also included is a large area of soils south of the town of Cashion where the surface layer is lighter colored and a few thin lenses weakly cemented with lime and silica are below a depth of 30 inches. The total extent of all included soils is less than 20 percent.

This Gadsden soil is used mainly for irrigated crops, range, recreation, and wildlife. Irrigated crops are cotton, alfalfa, barley, sorghum, and sugar beets. A few areas are used as building sites. Capability unit IIIs–3 irrigated, subclass VIIs dryland; Sandy Bottom range site; horticultural group 3; wildlife habitat group 3 irrigated, 9

Areas are generally long and narrow and about 30 acres in size.

This soil has a profile similar to the one described as representative of the series, but it contains large amounts of salts and alkali. In areas not cultivated the surface area is often covered with a white crust of salt. When it is dry, cracks ranging from ½ inch to 1 inch wide extend to a depth of 6 to 12 inches.

Included with this soil in mapping are small areas of Glenbar clay loam; Cashion clay, saline-alkali; Avondale

C2—18 to 27 inches, light yellowish-brown (10YR 6/4) loam, dark yellowish-brown (10YR 4/4) when moist; massive; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; many fine roots; many fine and very fine and few medium tubular pores; strongly effervescent; few, fine, faint, pinkish-white (7.5YR 8/2) filaments of lime; moderately alkaline; gradual, smooth boundary.

C3—27 to 37 inches, light yellowish-brown (10YR 6/4) loam, dark brown (10YR 4/3) when moist; massive; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; common fine roots; few fine and very fine tubular pores; slightly [illegible] moderately alkaline; gradual, smooth

with saline and alkali salts. Also, in a few areas along the Arlington Canal, the water table is at a depth of 2 to 5 feet. In some areas several thin strata of sand are in the lower part.

Included with this soil in mapping are small areas of Vint fine sandy loam; Antho sandy loam, 0 to 1 percent slopes; Avondale clay loam, saline-alkali; and Marino

This Gilman soil is used mainly for range. Irrigated areas are used for cotton, alfalfa, barley, sugar beets, sorghum, and safflower. Capability unit IIs–9 irrigated, subclass VIIs dryland; Saline Upland range site; horticultural group 5; wildlife habitat group 1 irrigated, 11 dryland.

**Gilman complex, saline-alkali** (Gl).—This mapping

spaced at about 300- to 500-foot intervals. Slopes are generally less than 1 percent. Areas are pear shaped and about 400 acres in size.

This mapping unit is about 45 percent Gilman loam, 0 to 1 percent slopes, and 30 percent Laveen loam, 0 to 1 percent slopes. The Gilman soil is in concave positions that are slightly lower than the Laveen soil.

Included with this unit in mapping are areas of Estrella loam that are in intermediate positions between the Gilman and Laveen soils. This included soil makes up as much as 20 percent of the unit. Also included are small areas of Mohall loam, Tremant loam, Coolidge sandy loam, and Agualt loam. The total extent of all included soils is 25 percent.

This mapping unit is used for range. It is not cultivated. Capability subclass VIIc dryland. Gilman soil in Loam Upland range site; horticultural group 1; wildlife habitat group 11 dryland. Laveen soil in Loam Upland range site; horticultural group 2; wildlife habitat group 11 dryland.

**Gilman, Antho and Glenbar soils, severely eroded** (Go3).—This mapping unit is parallel to or near the main

These Gilman soils are used for irrigated crops, range, recreation, and wildlife. Irrigated crops are cotton, alfalfa, and barley.

Representative profile of Gilman loam, clayey subsoil variant, moderately saline, 100 feet north and 550 feet east of southwest corner of sec. 19, T. 1 S., R. 4 W. in an uncultivated area southwest of Palo Verde:

A1—0 to 3 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) when moist; massive; hard when dry, friable when moist, slightly sticky and plastic when wet; few very fine roots; common very fine interstitial and few very fine tubular pores; slightly saline; strongly effervescent; moderately alkaline; abrupt, smooth boundary.

C1—3 to 8 inches, light brownish-gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) when moist; massive; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; common very fine and few medium roots; common very fine interstitial and very fine tubular pores; slightly saline; strongly effervescent; moderately alkaline; clear, smooth boundary.

C2—8 to 28 inches, light brownish-gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) when

terraces. Slopes are generally less than 1 percent. Elevations are 700 to 1,250 feet. The climate is arid continental. In areas not cultivated, the vegetation is creosotebush, annual weeds and grasses, and scattered mesquite, tamarix, paloverde, and ironwood trees. The average annual rainfall is about 6 to 8 inches, the mean annual air temperature is about 68° to 71° F, and the frost-free season ranges from 250 to 300 days.

In a representative profile the surface layer is brown clay loam about 15 inches thick. The underlying material is light-brown and pale-brown clay loam and silty clay loam to a depth of 60 inches. The soil is moderately alkaline and is strongly effervescent throughout.

Permeability is moderately slow. Runoff is slow, and the erosion hazard is slight. Roots penetrate to a depth of 60 inches or more.

Glenbar soils are used for irrigated crops, range, recreation, and wildlife. Irrigated crops are cotton, alfalfa, wheat, barley, sorghum, safflower, sugar beets, grapes, citrus, vegetables, and pastures. The soils are also used as material for brick. The town of Tolleson and parts of the cities of Phoenix and Glendale are on these soils.

Representative profile of Glenbar clay loam, 23 feet east of the SW¼SW¼NE¼ sec. 3, T. 1 N., R. 1 E. in a cultivated field about one-half mile northeast of Tolleson:

Ap—0 to 15 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; weak, fine and medium, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; common very fine and fine roots; few fine tubular pores; strongly effervescent; moderately alkaline; abrupt, smooth boundary.

C1—15 to 27 inches, pale-brown (10YR 6/3) clay loam, dark brown (10YR 4/3) when moist; massive; hard when dry, friable when moist, sticky and plastic when wet; common very fine and fine roots; common very fine and fine tubular pores; common worm casts; strongly effervescent; moderately alkaline; clear, smooth boundary.

C2—27 to 48 inches, light-brown (7.5YR 6/4) silty clay loam, dark brown (7.5YR 4/4) when moist; massive; hard when dry, friable when moist, sticky and plastic when wet; common fine roots; common very fine and fine tubular pores; strongly effervescent; common fine filaments of lime; moderately alkaline; clear, smooth boundary.

C3—48 to 56 inches, pale-brown (10YR 6/3) silty clay loam, dark brown (10YR 4/3) when moist; massive; slightly hard when dry, friable when moist, sticky and plastic when wet; few fine roots; common fine and very fine tubular pores; strongly effervescent; few, fine, faint filaments of lime; moderately alkaline; abrupt, smooth boundary.

C4—56 to 60 inches, light-brown (7.5YR 6/4) clay loam to silty clay loam, dark brown (7.5YR 4/4) when moist; massive; hard when dry, friable when moist, sticky and plastic when wet; few fine roots; common fine tubular pores; strongly effervescent; common, fine, faint filaments of lime; moderately alkaline.

Hue is 10YR and 7.5YR, value is 5 to 7 dry and moist, and chroma is 2 to 4 dry and moist. The A horizon is generally clay loam, but ranges to silty clay loam, loam, or clay. The C horizon is generally clay loam, but ranges to heavy loam or silty clay loam. In places the soil is 50 inches of homogeneous clay loam, and in others it is 26 inches or more of clay loam over loam. In all cases, the soil between depths of 10 and 40 inches averages more than 18 percent but less than 35 percent clay. In most areas the soil is stratified with ½- to 5-millimeter layers of loam, very fine sandy loam, fine sandy loam, and clay. The soil is generally miscegenous throughout and the

**Glenbar loam** (Gr).—This level to nearly level soil is on valley plains and low terraces throughout the survey area. It is smooth. Slopes are generally less than 1 percent. Areas range from 3 to 250 acres in size, but average less than 50 acres.

This soil has a profile similar to the one described as representative of the series, but the surface layer is loam generally 8 to 13 inches thick and as much as 20 inches thick in places. The soil is commonly clay between depths of 10 and 40 inches, but is heavy loam or light clay in some small areas.

Included with this soil in mapping are a few areas of soils where the surface layer is darker colored than the one described as representative, some areas where the surface layer is fine sandy loam, and some areas in the Salt River Valley where the lower part of the soil has a few silica-cemented nodules. Also included are small areas of Gilman loam, 0 to 1 percent slopes; Avondale clay loam; and Gilman loam, clayey subsoil variant. The total extent of all included soils is generally less than 15 percent.

This Glenbar soil holds 11 to 13 inches of water available to plants. It is used for cotton, alfalfa, sugar beets, barley, citrus, and safflower and for range. Capability unit I–1 irrigated, subclass VIIc dryland; Loam Upland range site; horticultural group 1; wildlife habitat group 1 irrigated, 11 dryland.

**Glenbar loam, saline-alkali** (Gs).—This level to nearly level soil is on flood plains and low terraces in the Harquahala Valley and in the Buckeye area. Slopes are generally less than 1 percent. Areas are smooth and range from 2 to 200 acres in size.

The profile of this soil is similar to the one described as representative of the series, but the surface layer is only 8 to 12 inches thick and the texture ranges from very fine sandy loam to silt loam. It is affected by salts and alkali. In areas not cultivated, the surface is commonly covered with a thin white crust of salt. The soil ranges from slightly saline to strongly saline, but is typically moderately saline.

The available water capacity ranges from 7 to 8 inches. In a few areas near Palo Verde, the water table is within 3 feet of the surface.

Included with this soil in mapping are small areas of Gilman loam, saline-alkali; Estrella loam, saline-alkali; and Gadsden clay loam.

This Glenbar soil is used for irrigated crops, including cotton, alfalfa, barley, and bermudagrass pasture. It is also used for range. Capability unit IIs–9 irrigated, subclass VIIs dryland; Saline Upland range site; horticultural group 5; wildlife habitat group 1 irrigated, 13 dryland.

**Glenbar clay loam** (Gt).—This nearly level soil is on valley plains and alluvial terraces parallel to but ¼ to 1 mile from the Gila, Salt, and Agua Fria Rivers. Slopes are less than 1 percent. Areas are smooth and oblong in shape. They range from 5 to 2,000 acres in size, but are mostly about 70 acres in size.

This soil has the profile described as representative of the series. Included in mapping are small areas of Avondale clay loam; Gilman loam, 0 to 1 percent slopes; Trix clay loam; and Gadsden clay loam; and a few areas of soils that are affected by salts. Also included are a few

colored than the one described in the representative profile.

This Glenbar soil holds 11 to 13 inches of water available to plants. It is used for irrigated crops, range, recreation, and wildlife. Irrigated crops are cotton, alfalfa, wheat, barley, sorghum, safflower, sugar beets, citrus, grapes, and vegetables. Also, the soil is used as material for bricks. The town of Tolleson and parts of the cities of Phoenix and Glendale are on this soil. Capability unit I–1 irrigated, subclass VIIc dryland; Loam Upland range site; horticultural group 1; wildlife habitat group 1 irrigated, 11 dryland.

**Glenbar clay loam, saline-alkali** (Gu).—This level to nearly level soil is on flood plains and low alluvial terraces along the Gila and Salt Rivers. Slopes are less than 1 percent. Areas are smooth, are oblong in shape, and range from 3 to 100 acres in size.

This soil has a profile similar to the one described as representative of the series, but it is slightly saline to strongly saline. In areas not cultivated, the surface is generally covered with a thin white crust of salt. In irrigated areas, the soil is commonly nonsaline in the upper 20 inches.

This soil is mainly well drained, but is moderately well drained to somewhat poorly drained in a few areas below canals. The available water capacity is 7 to 8 inches.

Included with this soil in mapping are small areas of Avondale clay loam, saline-alkali; Cashion clay, saline-alkali; Gadsden clay, saline-alkali; and Gilman loam, saline-alkali.

This Glenbar soil is cultivated and used as range. Irrigated crops are cotton, alfalfa, barley, sorghums, safflower, and bermudagrass pasture. Capability unit IIs–9 irrigated, subclass VIIs dryland; Saline Upland range site; horticultural group 5; wildlife habitat group 1 irrigated, 13 dryland.

**Glenbar clay** (Gv).—This nearly level soil is on low stream terraces and valley plains, mainly in the southern half of the Salt River and Buckeye Valleys. Areas range from 5 to 100 acres in size, but are generally 20 to 30 acres.

This soil has a profile similar to the one described as representative of the series, but the surface layer is clay and ranges from 8 to 20 inches in thickness. In dry areas it generally has cracks that are one-half inch wide and 8 to 15 inches deep.

Included with this soil in mapping are small areas of Cashion clay, saline-alkali; Gadsden clay; and Avondale

climate is arid continental. The average annual rainfall ranges from about 6 to 8 inches, the mean annual air temperature is about 68° to 72° F, and the frost-free season is 250 to 300 days.

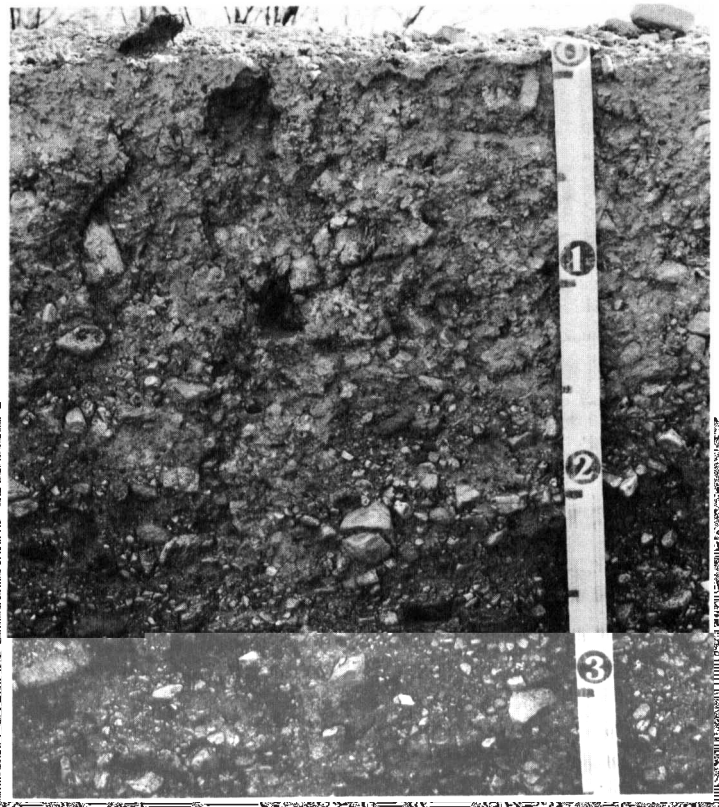
In a representative profile the surface layer is very pale brown and yellowish-brown gravelly loam about 1 inch thick. Below this is about 2 inches of light-brown loam, 4 inches of light-brown gravelly fine sandy loam, 39 inches of light-brown very gravelly loam, and 14 inches of yellowish-red and reddish-brown very gravelly sandy clay loam. The underlying material contains many soft lime masses and semirounded lime concretions (fig. 7) and in places is weakly cemented. The soil is moderately alkaline.

Permeability is moderate. Runoff is slow to medium, and the erosion hazard is slight to moderate. The available water capacity is 3 to 4 inches. Roots penetrate to a depth of 60 inches or more.

Gunsight soils are used for irrigated crops, range, recreation, and wildlife. Irrigated crops are cotton, alfalfa, citrus, and small grain. Some areas provide a source of gravel. A few areas are used as homesites.

Representative profile of Gunsight gravelly loam in an area of Gunsight-Rillito complex, 0 to 1 percent slopes, 500 feet north and 1,870 feet east of southwest corner of sec. 9, T. 1 S., R. 6 W. in an uncultivated area south of Wintersburg:

A1—0 to 1 inch, very pale brown (10YR 7/3) and yellowish-brown (10YR 5/4) gravelly loam, light yellowish brown (10YR 6/4) and dark yellowish brown (10YR 4/4) when moist; weak, thin, platy structure; slightly hard when dry, friable when moist, slightly sticky and



slightly plastic when wet; few fine roots; many fine and medium vesicular pores; 35 percent fine, medium, and coarse subangular gravel; strongly effervescent; very strongly alkaline; abrupt, smooth boundary.

C1—1 to 3 inches, light-brown (7.5YR 6/4) loam, brown (7.5YR 5/4) when moist; massive; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; few fine roots; few fine tubular and common fine interstitial pores; 10 percent fine, medium, and coarse subangular gravel; strongly effervescent; many, fine, distinct, pinkish-white (7.5YR 8/2) filaments of lime and few, fine, faint, soft lime masses; moderately alkaline; abrupt, smooth boundary.

C2ca—3 to 7 inches, light-brown (7.5YR 6/4) gravelly fine sandy loam, brown (7.5YR 5/4) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and slightly plastic; common fine roots; common fine tubular pores; 25 percent fine, medium, and coarse subangular gravel; violently effervescent; common, fine, distinct, pinkish-white (7.5YR 8/2), soft lime masses and many, fine, distinct filaments of lime; moderately alkaline; clear, wavy boundary.

C3ca—7 to 33 inches, light-brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 5/4) when moist; massive; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; few fine roots; common fine tubular and many fine interstitial pores; 50 percent fine, medium, and coarse subangular gravel; violently effervescent; common, fine and medium, distinct, pinkish-white (7.5YR 8/2), soft lime masses and common, fine, extremely hard, semi-rounded lime concretions; moderately alkaline; clear, wavy boundary.

C4ca—33 to 46 inches, light-brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 5/4) when moist; massive; slightly hard when dry, very friable when moist; slightly sticky and slightly plastic when wet; common fine tubular pores; 50 percent fine, medium, and coarse subangular gravel; violently effervescent; common,

percent, but some of the larger alluvial fan tops are nearly 1 percent and some short slopes along drainageways are nearly 10 percent.

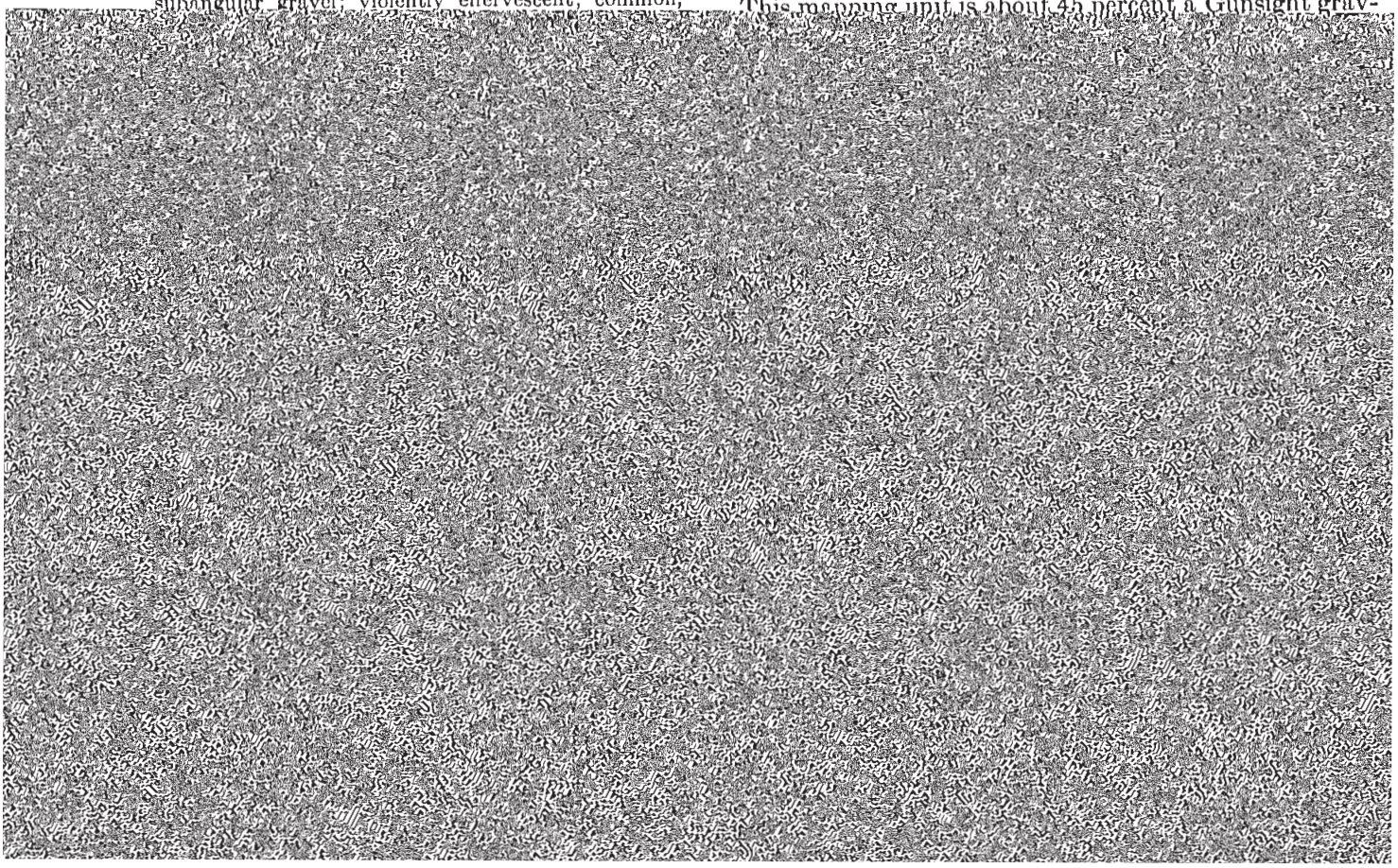
This mapping unit is about 40 percent a Gunsight cobbly loam, 30 percent a Pinal gravelly loam, and 12 percent a Pinamt cobbly loam. The Gunsight soil is on the sides and on some tops of alluvial fans. It has a profile similar to the one described as representative of the series, but the surface layer is cobbly and slopes range from 1 to 10 percent. The Pinal soil is on the tops of alluvial fans and in a few drainageways. The profile of this soil is similar to the one described as representative of the series, but slopes range from 1 to 3 percent. The Pinamt soil is on the tops and shoulders of some fans.

Included with this unit in mapping are a few areas of Rillito gravelly loam, 1 to 3 percent slopes; Antho gravelly sandy loam, 1 to 3 percent slopes; and Carrizo very gravelly sand. These included soils make up about 18 percent of the mapping unit.

This mapping unit provides grazing. Capability subclass VIIe dryland; Gunsight soil in Loam Upland range site; horticultural group 6; wildlife habitat group 11 dryland. Pinal soil in Loam Upland range site; horticultural group 7; wildlife habitat group 11 dryland.

**Gunsight-Rillito complex, 0 to 1 percent slopes** (GxA).—This deep, well-drained mapping unit is on old alluvial fans throughout the survey area. It is dissected by shallow stream channels spaced at 200- to 500-foot intervals. About 40 to 90 percent of the surface area is covered with gravel. Slopes range from 0 to 1 percent. Areas range from 5 to 250 acres in size, but most are less than 20 acres.

This mapping unit is about 45 percent a Gunsight grav-



Included with this unit in mapping are a few small areas of Laveen loam, 0 to 1 percent slopes; Pinal loam, 1 to 3 percent slopes; Coolidge gravelly sandy loam, 1 to 3 percent slopes; and Harqua gravelly clay loam, 0 to 1 percent slopes. Also included are a few areas of Rillito and Gunsight soils that are moderately saline to strongly saline in the lower part. The total extent of all included soils is about 10 percent.

This mapping unit is used for range. It is not cultivated. Capability subclass VIIe dryland; Loam Upland range site; horticultural group 6; wildlife habitat group 11 dryland.

**Gunsight-Rillito complex, 0 to 10 percent slopes** (GYD).—This nearly level to moderately steep mapping unit is on old alluvial fans. It is dissected by a series of stream channels at about 100- to 500-foot intervals. The stream channels range from a few feet to as much as 30 feet deep. Slopes on the tops of fans are seldom more than 1 percent, but short slopes along stream channels range to 10 percent. Areas are long and narrow and range from 50 to 1,000 acres in size.

This mapping unit is about 40 percent Gunsight soils and 40 percent Rillito soils. The Gunsight soils have a profile similar to the one described as representative of the series, but the surface layer is gravelly loam, cobbly loam, and gravelly sandy loam and the soils are slightly saline below a depth of 30 inches. Gunsight soils are mainly on the top of fans. Rillito soils have a profile similar to the one described as representative of the series, but the surface layer is loam, gravelly loam, gravelly sandy loam, and sandy loam and in places the soils are slightly saline below a depth of 30 inches. The Rillito soils are in circular spots near drainageways and near the tops of fans.

Included with this unit in mapping are small areas of Perryville gravelly loam, 0 to 3 percent slopes; Laveen loam, 0 to 3 percent slopes; Pinal loam, 0 to 3 percent slopes; Gilman loam, 0 to 1 percent slopes; Antho gravelly sandy loam; 0 to 3 percent slopes; and Carrizo gravelly sandy loam, 0 to 1 percent slopes. These included soils make up about 20 percent of the mapping unit.

The mapping unit is used for range. Capability subclass VIIe dryland; Loam Upland range site; horticultural group 6; wildlife habitat group 11 dryland.

## Harqua Series

The Harqua series consists of deep, well-drained soils on old alluvial fans. These soils are strongly saline and have distinct accumulations of calcium carbonate at a depth of about 12 inches. They formed in alluvium derived from granite, schist, gneiss, and rhyolite. Slopes contain segregations, filaments, and soft masses of lime. The soil is strongly saline and moderately alkaline.

Permeability is moderately slow. Runoff is slow to medium, and the erosion hazard is slight. The available water capacity is about 6 to 8 inches. Roots penetrate to a depth of 60 inches or more.

Harqua soils provide grazing. They are not cultivated.

Representative profile of Harqua gravelly clay loam in an area of Harqua complex, 0 to 3 percent slopes, 150 feet north and 1,550 feet south of northeast corner of sec. 13, T. 1 S., R. 9 W. in an uncultivated area at the south end of the Harquahala Valley:

A2—0 to 1 inch, pinkish-gray (7.5YR 7/2) gravelly clay loam, strong brown (7.5YR 5/6) when moist; weak, thick, platy structure; slightly hard when dry, firm when moist, sticky and plastic when wet; common vesicular pores; strongly effervescent; strongly alkaline; abrupt, smooth boundary.

A&Bsa—1 to 3 inches, pinkish-gray (7.5YR 7/2) and light reddish-brown loam, strong brown (7.5YR 5/6) and brown (7.5YR 5/4) when moist; weak, fine and medium, subangular blocky structure; slightly hard when dry, firm when moist, slightly sticky and plastic when wet; few tubular pores; strongly effervescent; moderately alkaline; abrupt, smooth boundary.

B21tsa—3 to 9 inches, reddish-brown (5YR 5/4) gravelly clay loam, yellowish red (5YR 4/6) when moist; weak, very fine, subangular blocky structure; slightly hard when dry, friable when moist, sticky and plastic when wet; many very fine interstitial pores; few thin clay films in pores; slightly effervescent; moderately alkaline; clear, smooth boundary.

B22tsa—9 to 12 inches, light reddish-brown (5YR 6/4) gravelly clay loam, reddish brown (5YR 4/4) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; common fine tubular and many fine interstitial pores; common thin clay films on peds and in pores and as bridges between sand grains; slightly effervescent; common, fine, pink (5YR 8/3), soft lime masses and salt crystals; moderately alkaline; clear, smooth boundary.

B31tcasa—12 to 20 inches, light reddish-brown (5YR 6/4) gravelly clay loam, reddish brown (5YR 4/4 and 5/4) when moist; massive; hard when dry, friable when moist, sticky and plastic when wet; common fine and very fine tubular pores; few thin clay films in pores and as bridges between sand grains; violently effervescent; many, coarse, pink (5YR 7/3) lime segregations and soft lime masses; moderately alkaline; abrupt, smooth boundary.

B32casa—20 to 28 inches, pink (7.5YR 7/4) gravelly clay loam, brown (7.5YR 5/4) when moist; massive; hard when dry, friable when moist, sticky and plastic when wet; many fine and very fine discontinuous tubular and common fine interstitial pores; few thin clay films in pores; strongly to violently effervescent; many, coarse, pinkish-white (7.5YR 8/2) filaments of lime and common, fine, pinkish-white (7.5YR 8/2), [illegible] moderately alkaline; abrupt, smooth

lime masses; moderately alkaline; abrupt, smooth boundary.

C3casa—37 to 60 inches, light-brown (7.5YR 6/4) gravelly clay loam, brown (7.5YR 5/4) and light brown (7.5YR 6/4) when moist; massive; hard when dry, friable when moist, sticky and plastic when wet; many fine and medium tubular pores; very few thin clay films in pores; slightly to strongly effervescent; common, medium, pink (7.5YR 8/4), soft lime masses; moderately alkaline.

The solum ranges from 10 to 40 inches or more in thickness. Depth to horizons that have distinct carbonate accumulation is less than 24 inches. The B horizon is very strongly saline and is moderately alkaline to very strongly alkaline. In some places exchangeable sodium is more than 15 percent. The A

**Harqua complex, 3 to 8 percent slopes** (HAC).—This gently sloping to moderately sloping mapping unit is on severely dissected old alluvial fans that parallel Centennial Wash and Luke Wash near Wintersburg. Most of the tops of fans have slopes of 0 to 3 percent. They break abruptly into sides that have slopes of 3 to 8 percent. The areas at the base of these side slopes are less sloping. The difference in elevation from the base to the crest of each hill is 20 to 50 feet. Except for intermittent drainageways, about 60 to 90 percent of the surface is covered with a varnished desert pavement. Most of the pavement is rounded gravel and a few cobbles. Runoff is medium. Areas are long and narrow and about 30 acres in size.

common fine tubular pores; strongly effervescent; common, fine, medium and coarse, pinkish-white (7.5YR 8/2), irregularly shaped, soft lime masses; 1 percent fine gravel; very strongly alkaline; gradual, smooth boundary.

C1ca—18 to 27 inches, light-brown (7.5YR 6/4) heavy loam,

that contains visible accumulations of lime below a depth of about 24 inches. The soil is moderately alkaline throughout.

Permeability is moderate. Runoff is slow to medium, and the erosion hazard is slight to moderate. Roots penetrate

**Laveen sandy loam** (Lb).—This nearly level soil is on old alluvial fans and valley plains. It occurs throughout the survey area. Slopes are slightly convex and less than 1 percent. Areas are long and narrow and about 50 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is sandy loam or fine sandy loam 6 to 14 inches thick. Included in mapping are small areas of Perryville sandy loam, Coolidge sandy loam, Valencia sandy loam, and Antho sandy loam, 0 to 1 percent slopes. The total extent of all included soils seldom exceeds 15 percent.

This Laveen soil holds 8 to 11 inches of water available to plants. It is used for cotton, alfalfa, barley, sorghum, sugar beets, safflower, citrus, and vegetables. A few areas are used for range, and a few areas are used as homesites. Capability unit I–2 irrigated, subclass VIIc dryland; Loam Upland range site; horticultural group 2; wildlife habitat group 1 irrigated, 11 dryland.

**Laveen loam, 0 to 1 percent slopes** (LcA).—This nearly level soil is on old alluvial fans and valley plains. It occurs throughout the survey area. Slopes are slightly convex and are generally less than 1 percent. Areas are long and narrow and about 60 acres in size.

This soil has the profile described as representative of the series. Included in mapping are small areas of Gilman loam, 0 to 1 percent slopes; Mohall loam; Estrella loam; Perryville gravelly loam, 0 to 1 percent slopes; and Rillito loam, 0 to 1 percent slopes. These included soils make up about 15 percent of the mapping unit. Also included are a few spots of soils that are affected by saline and alkali salts.

This Laveen soil holds 8 to 11 inches of water available to plants. It is used for cotton, alfalfa, barley, sorghum, safflower, wheat, citrus, sugar beets, and vegetables. Parts of the cities of Phoenix and Sun City are on this medium. Areas are long and narrow and about 30 acres in size.

This soil has a profile similar to the one described as representative of the series, but the underlying material is strongly alkaline to very strongly alkaline. Depth to this layer ranges from 8 to 30 inches. Salt content ranges from none to strongly saline.

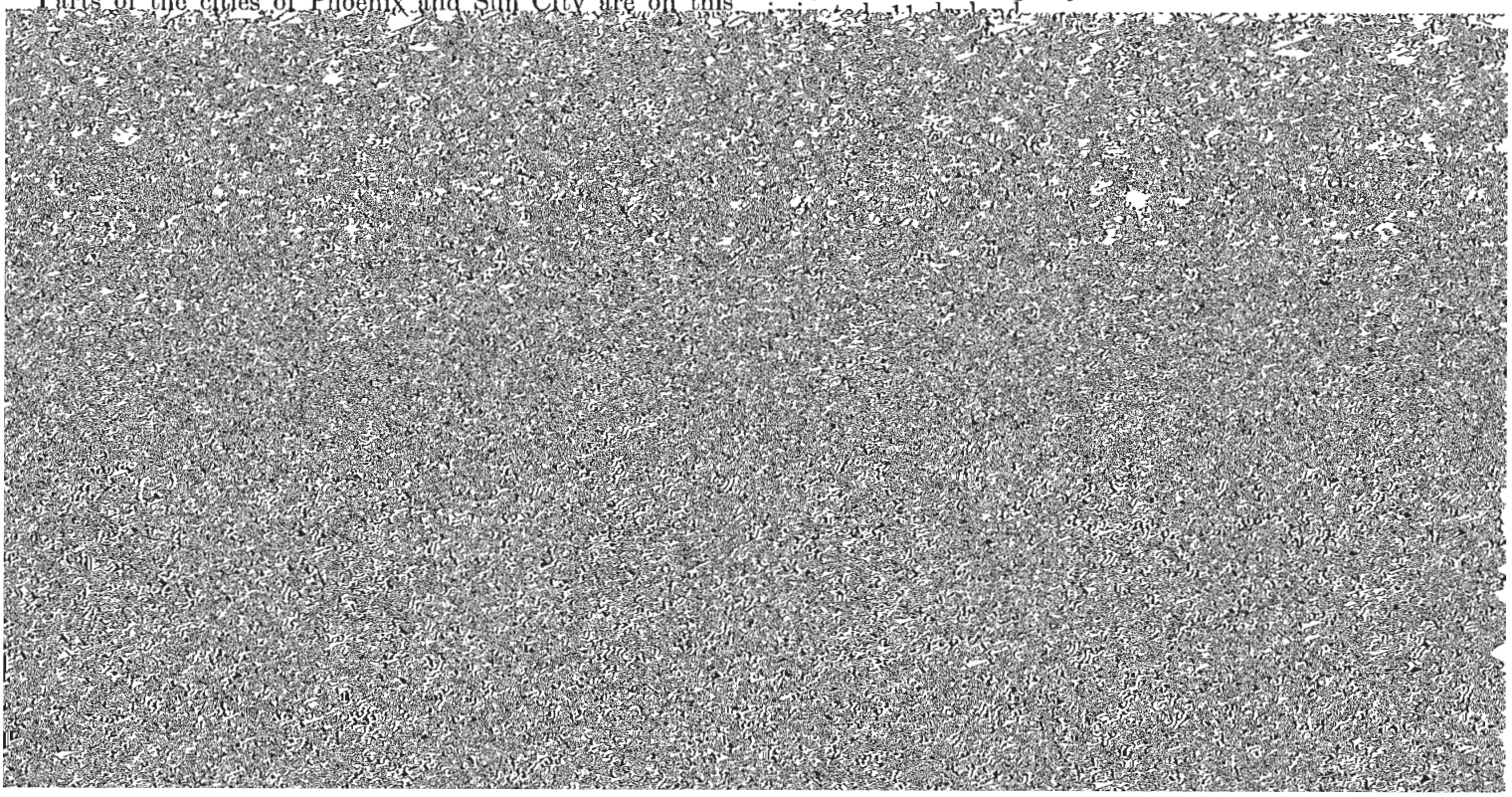
Included with this soil in mapping are a few areas of Casa Grande loam; Gilman loam, saline-alkali; Estrella loam, saline-alkali; Perryville loam, saline-alkali; and Laveen loam, 0 to 1 percent slopes. The total extent of all included soils seldom exceeds 20 percent.

This Laveen soil holds 7 to 8 inches of water available to plants. It is used for irrigated crops, recreation, and wildlife. A few areas are used as range following seasonal rains. Irrigated crops are cotton, alfalfa, sorghum, barley, and safflower. Capability unit IIs–9 irrigated, subclass VIIs dryland; Saline Upland range site; horticultural group 5; wildlife habitat group 1 irrigated, 13 dryland.

**Laveen clay loam** (Le).—This nearly level soil is on valley plains, mainly at the northern end of the Salt River Valley. Slopes are less than 1 percent. Areas are long and narrow and about 30 acres in size.

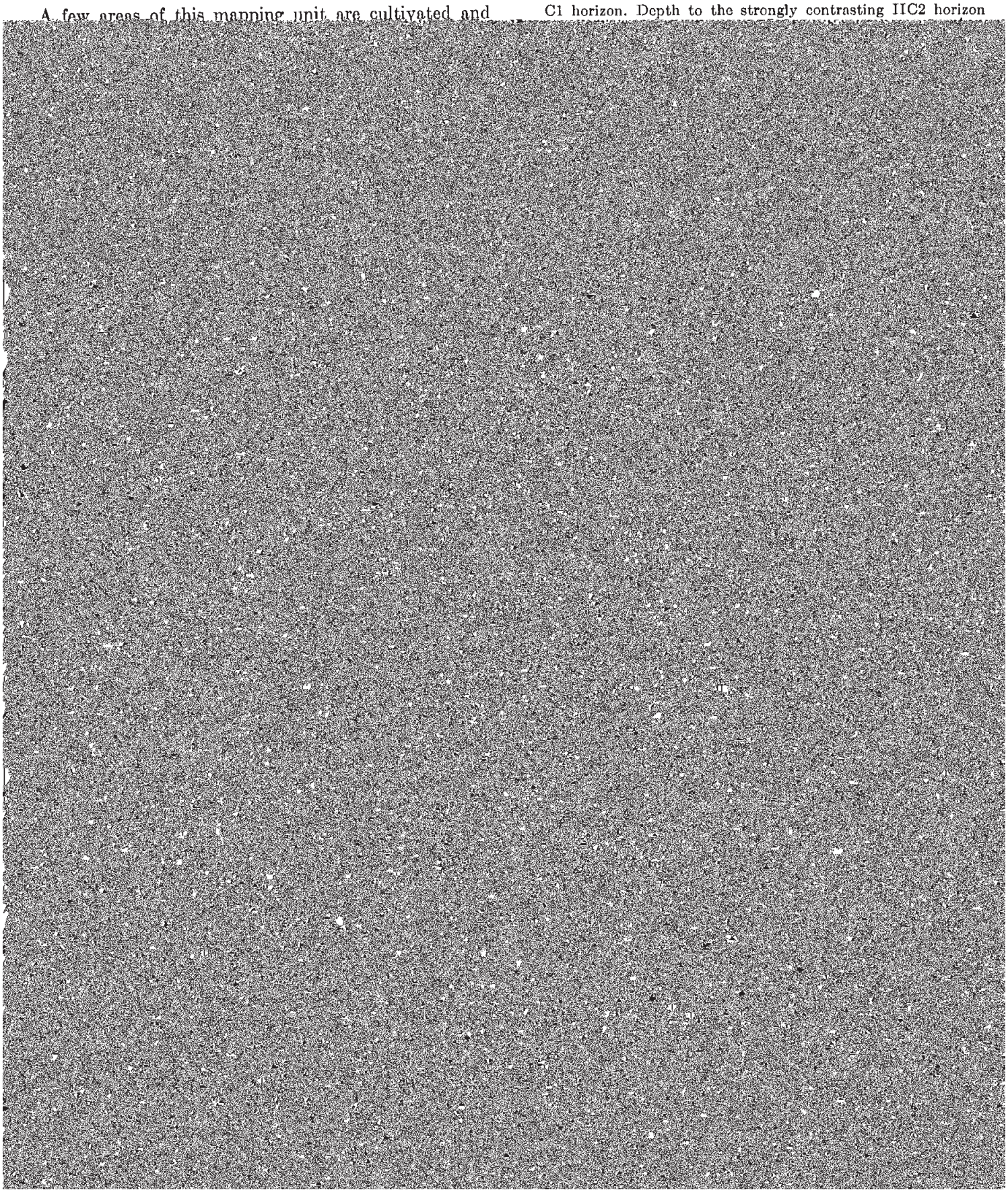
This soil has a profile similar to the one described as representative of the series, but the surface layer differs in texture and is 8 to 14 inches thick. Included in mapping are small areas of Mohall clay loam, Trement clay loam, Vecont clay, and Tucson clay loam. Included soils make up about 15 percent of the mapping unit.

This Laveen soil holds 8 to 11 inches of water available to plants. It is used for cotton, alfalfa, sorghum, barley, sugar beets, grapes, citrus, and vegetables. Parts of the cities of Phoenix, Glendale, Sun City, and Peoria are on this soil. Some areas are used for range. Capability unit I–1 irrigated, subclass VIIc dryland; Loam Upland range site; horticultural group 2; wildlife habitat group 1 irrigated, 11 dryland.



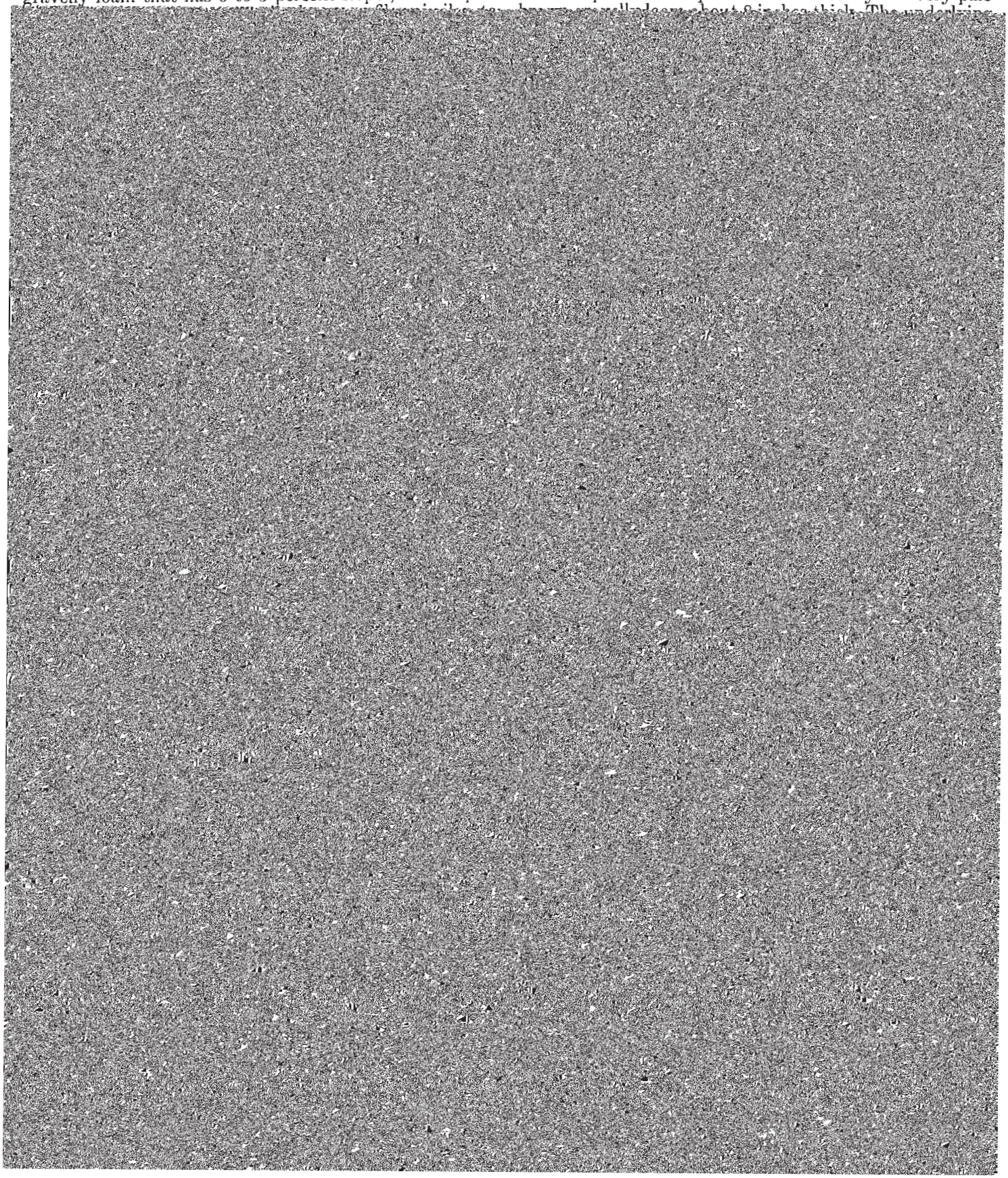
A few areas of this mapping unit are cultivated and

C1 horizon. Depth to the strongly contrasting IIC2 horizon



gravelly loam that has 0 to 3 percent slopes, and 15 per-

In a representative profile the surface layer is very pale



The soil has hue of 10YR or 7.5YR, value of 6 or 7 dry and 4 to 7 moist, and chroma of 2 to 4 dry and moist. The A horizon is loam, gravelly loam, sandy loam, gravelly sandy loam, or sandy loam. The Cca horizon is loam, gravelly loam, sandy loam, gravelly sandy loam, or very gravelly loamy sand. The soil between depths of 10 and 40 inches is more than 40 percent calcium carbonate by weight and is 15 to 35 percent coarse fragments that are mostly lime nodules or concretions. In places there is a 2- to 10-inch C1 horizon. Depth to the IIC6 horizon is 40 inches or more.

**Perryville sandy loam** (Pa).—This nearly level soil is on old alluvial fans, valley plains, and stream terraces. It occurs throughout the survey area, but is prevalent in the northern part of the Buckeye Valley. Slopes are slightly convex and generally less than 1 percent. Areas range from 3 to 50 acres in size, but are generally about 15 acres.

The profile of this soil is similar to the one described as representative of the series, but the surface layer is sandy loam 6 to 12 inches thick. Included in mapping are small areas of Laveen sandy loam, Coolidge sandy loam, and Rillito sandy loam, 0 to 1 percent slopes. Included soils make up about 15 percent of the mapping unit.

This Perryville soil is used for cotton, alfalfa, small grain, sugar beets, and safflower. A few areas are used as homesites. Some areas are used for range. Capability unit IIs–7 irrigated, subclass VIIs dryland; Loam Upland range site; horticultural group 6; wildlife habitat group 1 irrigated, 11 dryland.

**Perryville loam, saline-alkali** (Pb).—This mapping unit is on old alluvial fans and valley plains near Tonopah and Wintersburg. The surface is convex. Slopes are generally less than 1 percent, but in a few areas they are about 1.5 percent. Areas are oblong in shape and about 40 acres in size.

This soil has a profile similar to the one described as representative of the series, but it is strongly to very strongly alkaline and slightly saline to moderately saline between depths of 10 and 30 inches.

Included with this soil in mapping are small areas of Rillito loam, 0 to 1 percent slopes; Laveen loam, saline-alkali; and Coolidge sandy loam. Also included are small areas of other soils similar to Perryville soils. These soils have strata of gravelly sand and gravelly loamy sand or, in places, an older, buried soil below a depth of 30 inches. Included soils make up about 20 percent of the unit.

This Perryville soil is used for range. It is seldom cultivated. Capability unit IIIs–9 irrigated, subclass VIIs dryland; Saline Upland range site; horticultural group 5; wildlife habitat group 5 irrigated, 14 dryland.

**Perryville gravelly loam, 0 to 1 percent slopes** (PeA).—This nearly level soil is on old alluvial fans, valley plains, and stream terraces. It occurs throughout the survey area. Slopes are slightly convex and generally less than 1 percent. Areas range from 2 to 250 acres in size, but are generally about 15 acres.

Included with this soil in mapping are small areas of Rillito loam, 1 to 3 percent slopes; Laveen loam, 1 to 3 percent slopes; and Coolidge sandy loam. Also included are a few areas of soils near Tonopah and Wintersburg that are affected by saline and alkali salts and a few areas where the surface layer is gravelly sandy loam. Included soils make up about 20 percent of the mapping unit.

This Perryville soil is used for cotton, alfalfa, small grains, and safflower. A few areas are used as homesites, and a few areas are used for range. Capability unit IIe–7 irrigated, subclass VIIe dryland; Loam Upland range site; horticultural group 6; wildlife habitat group 1 irrigated, 11 dryland.

**Perryville gravelly loam, 1 to 3 percent slopes** (PeB).—This gently sloping soil is on old alluvial fans and stream terraces. It occurs throughout the survey area, but is most extensive near Perryville and McMicken Dam. Slopes are generally convex. They range from 1 to 3 percent, but a few short side slopes are nearly 5 percent. Runoff is medium, and the erosion hazard is moderate. Areas range from 2 to 108 acres in size, but are generally about 15 acres.

Included with this soil in mapping are small areas of Rillito loam, 1 to 3 percent slopes; Laveen loam, 1 to 3 percent slopes; and Coolidge sandy loam. Also included are a few areas of soils near Tonopah and Wintersburg that are affected by saline and alkali salts and a few areas where the surface layer is gravelly sandy loam. Included soils make up about 20 percent of the mapping unit.

This Perryville soil is used for cotton, alfalfa, small grains, and safflower. A few areas are used as homesites, and a few areas are used for range. Capability unit IIe–7 irrigated, subclass VIIe dryland; Loam Upland range site; horticultural group 6; wildlife habitat group 1 irrigated, 11 dryland.

**Perryville-Rillito complex, 0 to 3 percent slopes** (PRB).—This nearly level to gently sloping mapping unit is on old alluvial fans and valley plains. It is dissected by shallow stream channels, 1 foot to 3 feet deep, at about 50- to 200-foot intervals. Slopes are generally slightly convex and less than 1 percent, but a few short side slopes are nearly 3 percent.

This mapping unit is about 35 percent a Perryville loam that has 0 to 1 percent slopes, 30 percent a Rillito gravelly loam that has 0 to 1 percent slopes, 10 percent a Perryville sandy loam that has 1 to 3 percent slopes, and 10 percent Rillito gravelly sandy loam that has 1 to 3 percent slopes. Perryville soils surround Rillito soils and are nearly gravel free. Rillito soils are on slightly higher, ridgelike positions, and 20 to 50 percent of the surface is covered with gravel.

Included with this unit in mapping are small areas of Antho sandy loam, 0 to 1 percent slopes; Coolidge sandy loam; Laveen sandy loam; and Gunsight gravelly loam, 0 to 1 percent slopes. Included soils make up about 15 percent of the mapping unit.

This mapping unit is used for range. It is not cultivated. Capability subclass VIIs dryland; Loam Upland range site; horticultural group 6; wildlife habitat group 11 dryland.

## Pinal Series

In a representative profile the surface layer is light yellowish-brown loam about 8 inches thick. The underlying material is light yellowish-brown cobbly loam to a depth of 12 inches. It is underlain by a white, indurated, silica-lime cemented hardpan. The soil is strongly alkaline and calcareous throughout.

Permeability is moderate in the upper part, but the pan is nearly impermeable. Runoff is medium, and the erosion [illegible] The available water capacity

Included with this soil in mapping are a few areas of a Gunsight gravelly loam that has 1 to 3 percent slopes; Coolidge gravelly sandy loam, 1 to 3 percent slopes; La Palma very fine sandy loam; Rillito loam, 1 to 3 percent slopes; and a Cherioni very gravelly fine sandy loam that has 3 to 5 percent slopes. Also included are some areas of soils near the base of mountains that have more than 15 percent of the surface covered with gravel and have weakly to strongly cemented pans. The total extent of all included

**Pinal-Suncity complex, 0 to 3 percent slopes** (PWB).—This nearly level to gently sloping mapping unit is on very old alluvial fans and stream terraces. It is most extensive about 4 miles north of Sun City, on both sides of the Agua Fria River. Slopes are generally less than 1 percent, but in a few areas near the base of the mountains they are nearly 3 percent. In some areas the surface is almost gravel free, but in other areas the gravel content ranges to as much as 90 percent.

This mapping unit is about 55 percent a Pinal gravelly loam that has 0 to 3 percent slopes and 35 percent a Suncity gravelly loam. The Pinal soil has a profile similar to the one described as representative of the series, but the surface is covered with gravel. The Suncity soil has the profile described as representative of the series. The Suncity soil is in oval areas about 50 feet in diameter. It is surrounded by the Pinal soil.

Included with this unit in mapping are small areas of Beardsley and Gunsight soils. Included soils make about 10 percent of the unit.

This mapping unit is used for range. It is not cultivated. A few areas are used as homesites. Capability subclass VIIs dryland; Loam Upland range site; horticultural group 7; wildlife habitat group 11 dryland.

## Pinamt Series

The Pinamt series consists of deep, well-drained soils. These soils formed on old alluvial fans at the base of mountains. The alluvium was derived from stratified very

B1—2 to 6 inches, light-brown (7.5YR 6/4) very gravelly sandy loam, brown (7.5YR 5/4) when moist; massive; soft when dry, loose when moist, slightly sticky and nonplastic when wet; common fine and very fine roots; many fine interstitial and few fine tubular pores; 80 percent gravel and cobbles; slightly effervescent; moderately alkaline; clear, wavy boundary.

B2tca—6 to 22 inches, yellowish-red (5YR 5/6) very gravelly sandy clay loam, yellowish red (5YR 4/6) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; common very fine and fine roots; common fine tubular and interstitial pores; few thin clay films on peds; 60 percent gravel and cobbles; strongly effervescent; common, medium, white (10YR 8/2) filaments of lime and lime spots, very pale brown (10YR 7/3) when moist; moderately alkaline; clear, smooth boundary.

B3ca—22 to 35 inches, yellowish-red (5YR 5/6) very cobbly sandy loam, yellowish red (5YR 4/6) when moist; massive; slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; very few fine roots; few fine tubular and many fine interstitial pores; 80 percent gravel and cobbles; violently effervescent; common, medium, white (10YR 8/2) filaments of lime, very pale brown (10YR 7/3) when moist; moderately alkaline; gradual, wavy boundary.

Cca—35 to 60 inches, very pale brown (10YR 7/4) very gravelly sandy loam, strong brown (7.5YR 5/6) and reddish yellow (7.5YR 6/6) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; very few fine roots; few fine tubular and common fine interstitial pores; 50 percent gravel and cobbles; violently effervescent; common, medium, white (10YR 8/2) lime spots and soft masses; moderately alkaline.

The solum ranges from 15 to 48 inches in thickness. The soil

About 30 to 80 percent of the surface is covered with cobbles, gravel, and a few stones. Slopes range from 2 to 10 percent. The Tremant soils are in the center of alluvial fans. They have profiles similar to the one described as representative of the series, but their surface layer ranges from gravelly sandy loam to gravelly clay loam. About 20 to 50 percent of the surface is covered with gravel and a few stones and cobbles. Slopes range from 1 to 3 percent.

Included with this unit in mapping are areas of a Gunsight gravelly loam that has 3 to 10 percent slopes; Altho gravelly sandy loam, 1 to 3 percent slopes; a Rillito gravelly loam that has 1 to 3 percent slopes; Ebon [illegible]

C1—2 to 10 inches, light yellowish-brown (10YR 6/4) fine sandy loam, brown (7.5YR 5/4) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and slightly plastic when wet; common fine roots; few fine tubular pores; strongly effervescent; common, fine, pinkish-white (7.5YR 8/2) filaments of lime, light brown (7.5YR 6/4) when moist; moderatly alkaline; clear, wavy boundary.

C2ca—10 to 19 inches, light-brown (7.5YR 6/4) gravelly loam, brown (7.5YR 5/4) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and slightly plastic when wet; few medium and common fine roots; few fine tubular pores; 25 percent fine, medium, and coarse, subangular, lime-coated gravel; violently effervescent; many, fine and medium, pinkish-white (7.5YR 8/2) filaments

percent. Areas are dissected by shallow stream channels at 100- to 500-foot intervals. They are generally oval in shape and about 10 acres in size.

The soil has a profile similar to the one described as representative of the series, but the surface layer is sandy loam 6 to 12 inches thick.

Included with this soil in mapping are small areas of Coolidge sandy loam, Laveen sandy loam, Tremant loam, Perryville sandy loam, and Pinal loam, 0 to 1 percent slopes. The total extent of all included soils is about 20 percent.

This Rillito soil is used for irrigated crops, range, recreation, wildlife, and a few homesites. Irrigated crops are cotton, alfalfa, small grain, safflower, and citrus. Capability unit IIs-6 irrigated, subclass VIIs dryland; Loam Upland range site; horticultural group 6; wildlife habitat group 2 irrigated, 11 dryland.

**Rillito sandy loam, 1 to 3 percent slopes** (RaB).—This gently sloping soil is on old alluvial fans. In most places slopes are convex. The erosion hazard is moderate. Areas are long and narrow and about 50 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is sandy loam 8 to 10 inches thick.

Included with this soil in mapping are small areas of Laveen sandy loam; Coolidge gravelly sandy loam, 1 to 3 percent slopes; Perryville gravelly sandy loam, 1 to 3 percent slopes; and Pinal loam, 0 to 1 percent slopes. Also included are a few areas where slopes are short and are more than 3 percent and a few areas where the surface is gravelly. The total extent of all included soils is about 20 percent.

This Rillito soil is used for irrigated crops and range. A few areas are used as homesites. Only a small acreage is cultivated. Irrigated crops are cotton, alfalfa, barley, safflower, and citrus. Capability unit IIe-6 irrigated, subclass VIIe dryland; Loam Upland range site; horticultural group

foot intervals. Areas are long and narrow and about 20 acres in size.

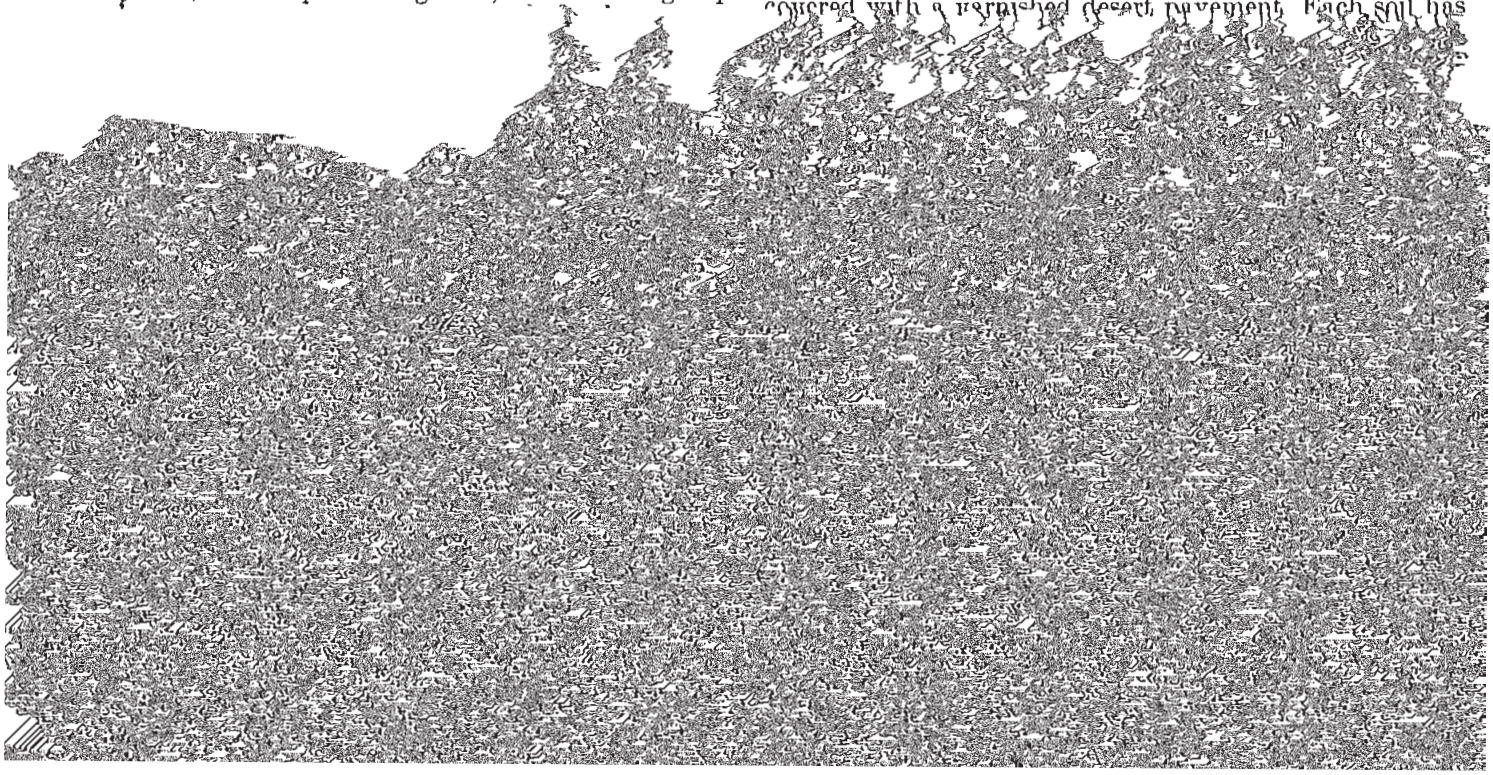
The soil has a profile similar to the one described as representative of the series, but the surface layer is loam about 10 inches thick and depth to the gravelly underlying material is 2 to 10 inches less than in the representative profile.

Included with this soil in mapping are small areas of Laveen loam, 1 to 3 percent slopes; Perryville gravelly loam, 1 to 3 percent slopes; and Pinal loam, 1 to 3 percent slopes. The total extent of all included soils seldom exceeds 20 percent.

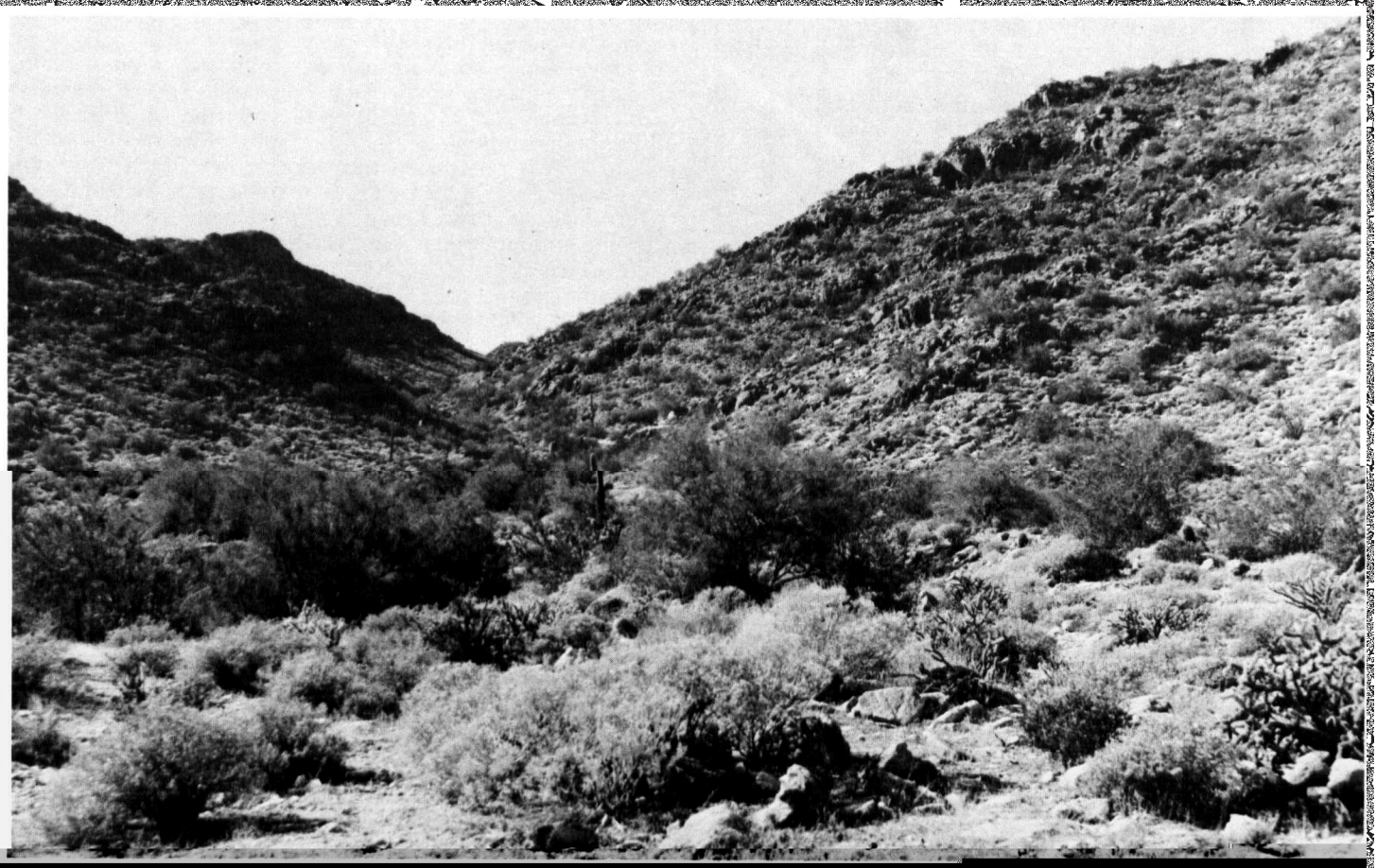
This Rillito soil is used for irrigated crops, range, recreation, wildlife, and a few homesites. The only acreages cultivated are those in fields of better soils. The crops are cotton, alfalfa, safflower, and citrus. Capability unit IIe-6 irrigated, subclass VIIe dryland; Loam Upland range site; horticultural group 6; wildlife habitat group 2 irrigated, 11 dryland.

**Rillito-Harqua complex, 1 to 3 percent slopes** (RhB).—This mapping unit is on old alluvial fans in the Harquahala Valley and in the Tonopah area. It is dissected by numerous shallow intermittent stream channels at 200- to 500-foot intervals. Slopes are mainly 1 to 3 percent, but in a few areas they are less than 1 percent and in some they are short and as much as 5 percent. The erosion hazard is moderate. Areas are long and narrow and about 250 acres in size.

This mapping unit is about 30 percent Rillito gravelly loam, Rillito gravelly sandy loam, and Rillito sandy loam; about 30 percent Harqua gravelly clay loam, Harqua gravelly loam, and Harqua loam; and about 30 percent Gunsight gravelly loam and Gunsight gravelly sandy loam. Rillito and Gunsight soils are near the center of alluvial fans and on steeper side slopes. Harqua soils occur as small oval areas also near the center of the alluvial fans. They are slightly saline to strongly saline and are covered with a varnished desert pavement. Each soil has



This mapping unit is 30 percent Rillito gravelly loam and Rillito sandy loam; 30 percent Perryville gravelly loam; 15 percent Gunsight gravelly loam and Gunsight gravelly sandy loam; and 15 percent Pinal gravelly loam.



outcrop is suitable only for recreation, wildlife habitat, water supply, and esthetic purposes.

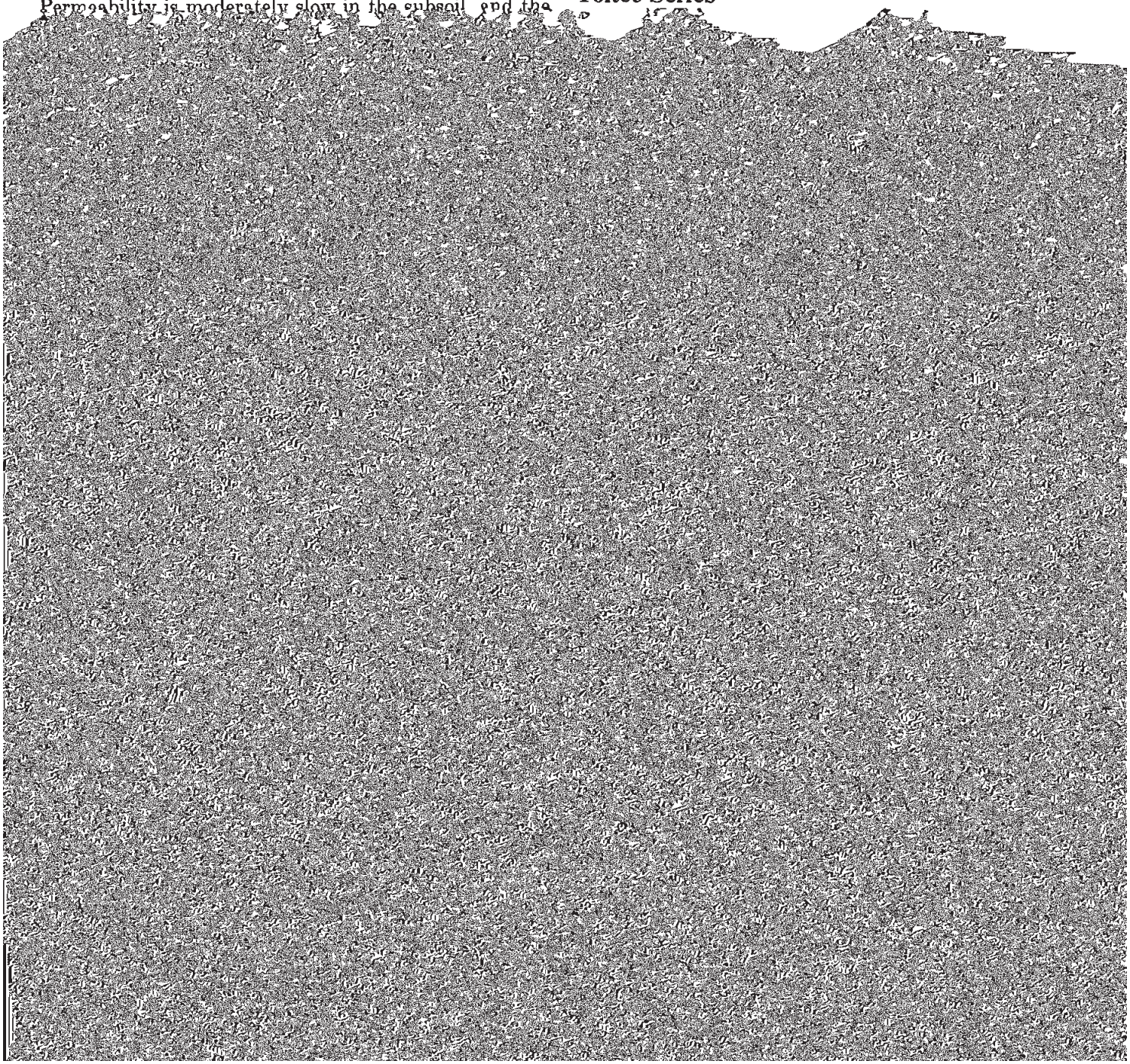
**Rock outcrop-Cherioni complex** (RS).—This mapping unit is on mountainsides and some low hills of the area

are 1,050 to 1,400 feet. The native vegetation is creosote-bush, bursage, cactus, annual weeds and grasses, and scattered mesquite, paloverde, and ironwood trees. The average annual railfall is about 6 to 8 inches, the mean annual air temperature is 69° to 74° F, and the frost-free season is 270 to 320 days.

In a representative profile the surface is light yellowish-brown and light brown very gravelly loam and loam about 3 inches thick. The subsoil is brown and reddish-brown loam and clay loam about 10 inches thick. It is underlain by a pinkish-white indurated pan. The soil is moderately alkaline and weakly saline to strongly saline. It is generally calcareous throughout.

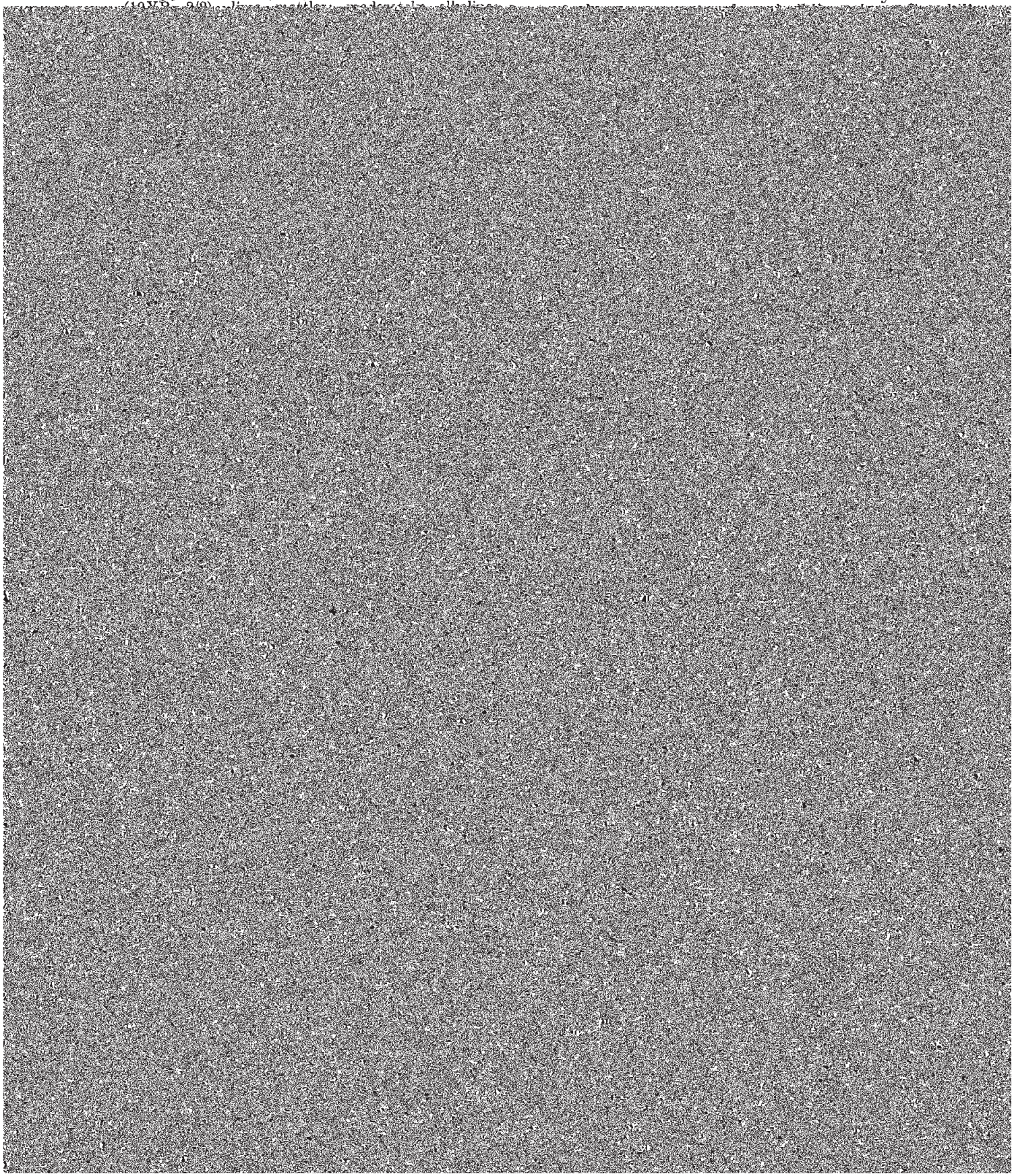
Permeability is moderately slow in the subsoil and the moist, and chroma of 4 to 6 dry and moist. It is sandy loam, very fine sandy loam, loam, gravelly very fine sandy loam, gravelly loam, very gravelly very fine sandy loam, or very gravelly loam. The B horizon has hue of 7.5YR and 5YR, value of 4 or 5 dry and 3 or 4 moist, and chroma of 4 to 6 dry and moist. It is clay loam or gravelly clay loam. The coarse fragment content averages less than 35 percent. The B horizon ranges from slightly to strongly saline. Lime filaments and soft masses or both occur throughout the B horizon in some places, but only in the lower part in others. In places the B3tca horizon contains pan fragments. The Csicam horizon is an indurated layer that ranges from 6 inches to 3 feet in thickness or it is several ½- to 3-inch indurated layers separated by softer material.

## Toltec Series



strongly effervescent; few, medium and coarse, white

Several areas of Torriorthents in the city of Phoenix



pores; 50 percent subangular gravel; noneffervescent; moderately alkaline; abrupt, smooth boundary.

B21t—1 to 8 inches, reddish-brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) when moist; weak, very fine, subangular blocky structure; slightly hard when dry, very friable when moist, sticky and plastic when wet; many fine roots; few fine and medium tubular pores; few thin clay films on peds; 5 percent gravel; slightly effervescent; moderately alkaline; abrupt, smooth boundary.

B22tca—8 to 14 inches, reddish-brown (5YR 5/4) gravelly clay loam, reddish brown (5YR 4/4) when moist; weak, fine, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many fine interstitial pores; common thin clay films on peds and in pores; 15 to 20 percent gravel; violently effervescent; many, fine, pinkish-white (5YR 8/2) lime filaments; moderately alkaline; clear, smooth boundary.

B23tca—14 to 23 inches, yellowish-red (5YR 5/8) and pink (7.5YR 7/4) gravelly clay loam, reddish brown (5YR 4/4) and reddish yellow (7.5YR 6/6) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few fine roots; few medium interstitial and very few fine tubular pores; few thin clay films on peds and in pores; 35 percent gravel; violently effervescent; many, coarse, pinkish-white (5YR 8/2) lime [illegible]

less than 1 percent. Areas are long and narrow and about 15 acres in size.

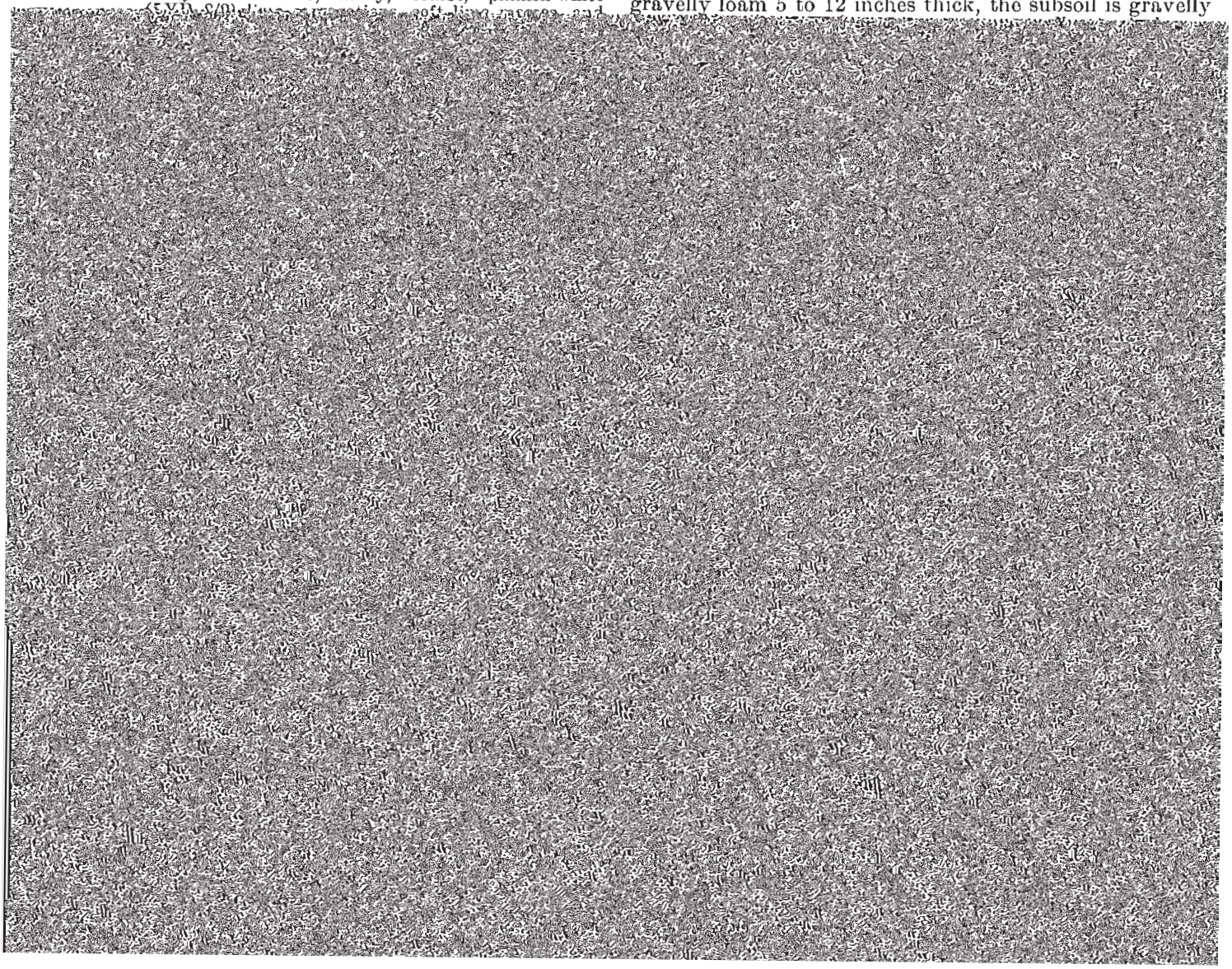
This soil has a profile similar to the one described as representative of the series, but the surface layer is 8 to 12 inches thick and is relatively free of gravel.

Included with this soil in mapping are small areas of Rillito loam, 0 to 1 percent slopes; Laveen loam, 0 to 1 percent slopes; and Mohall loam. The total extent of all included soils seldom exceeds 15 percent.

This Tremant soil is used for cotton, alfalfa, sorghum, barley, grapes, safflower, and citrus. It is also used for range. A few areas are used as homesites. Capability unit IIs-7 irrigated, subclass VIIs dryland; Loam Upland range site; horticultural group 2; wildlife habitat group 1 irrigated, 11 dryland.

**Tremant gravelly loam, 0 to 1 percent slopes** (TfA).—This nearly level soil is on old alluvial fans and stream terraces, mainly in the northern part of the Salt River Valley. Slopes are less than 1 percent. Areas are long and narrow and about 15 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is gravelly loam 5 to 12 inches thick, the subsoil is gravelly



gravel. Included in mapping are small areas of Mohall clay loam; Vecont clay; Laveen loam, 0 to 1 percent slopes; Harqua gravelly clay loam, 0 to 1 percent slopes; and Rillito loam, 0 to 1 percent slopes. The total extent of all included soils seldom exceeds 15 percent.

This soil is used for irrigated crops and range. Irrigated crops are cotton, alfalfa, barley, sorghum, sugar beets, citrus, grapes, and safflower. A few areas are used as homesites. Capability unit IIs-7 irrigated, subclass VIIs dryland; Loam Upland range site; horticultural group 2; wildlife habitat group 1 irrigated, 11 dryland.

**Tremant gravelly clay loam (Tr).**—This nearly level River Valley. It is dissected by shallow stream channels at 50- to 300-foot intervals. Slopes are generally less than 1 percent, but a few short side slopes are as much as 2 percent. Areas are long and narrow and range from 12 to 200 acres in size.

This mapping unit is about 40 percent Tremant gravelly clay loam, 25 percent a Rillito gravelly loam that has 0 to 1 percent slopes, and 20 percent a Gunsight gravelly loam that has 0 to 1 percent slopes. These soils have profiles similar to the ones described as representative of their respective series, but the Rillito soil has a surface layer of gravelly loam. The Tremant soil is in small

group 1 irrigated, 11 dryland. Rillito soil in Loam Upland range site; horticultural group 6; wildlife habitat group 2 irrigated, 11 dryland.

**Tremant-Rillito complex, 0 to 5 percent slopes** (TSC).—This nearly level to sloping mapping unit is on old alluvial fans. It is dissected by intermittent stream channels at 100- to 300-foot intervals. The channels have cut 1 foot to 15 feet below the surface. Slopes are generally less than 1 percent, but many short side slopes are as much as 5 percent. The erosion hazard is moderate. Areas are long and narrow and about 100 acres in size.

This mapping unit is about 35 percent Tremant gravelly clay loam, 30 percent a Rillito gravelly loam that has 0 to 3 percent slopes, and 20 percent a Gunsight gravelly loam that has 0 to 5 percent slopes. These soils have profiles similar to the ones described as representative of their respective series, but the Rillito soil has a surface layer of gravelly loam and slopes of more than 1 percent. The Tremant soil is in oval-shaped areas that are about 200 feet in diameter and are near the center of alluvial fans. It is 80 to 90 percent covered with a varnished desert pavement of gravel and a few cobbles. The Rillito soil is on concave side slopes near the center of a few alluvial fans. The Gunsight soil is on the steeper, concave sides of alluvial fans. The Gunsight and Rillito soils are 40 to 60 percent covered with unvarnished gravel.

Included with this unit in mapping are a few areas of Carrizo gravelly sandy loam; Laveen sandy loam; Coolidge gravelly sandy loam, 1 to 3 percent slopes; and Perryville gravelly loam, 0 to 1 percent slopes. Included soils make up no more than 15 percent of the unit.

This mapping unit is used for range. It is not cultivated. A few areas are used as homesites. Capability subclass VIIs dryland. Tremant soil in Loam Upland range site; horticultural group 2; wildlife habitat group 11 dryland. Rillito soil and Gunsight soil in Loam Upland range site; horticultural group 6; wildlife habitat group 11 dryland.

## Trix Series

The Trix series consists of deep, well-drained soils. These soils formed in 20 to 40 inches of recent alluvium that was deposited over an older surface on valley plains and low terraces. The alluvium was derived from granite, schist, rhyolite, and some material from basic igneous rocks. Slopes are less than 1 percent. Elevations range from 900 to 1,300 feet. In areas not cultivated the vegetation is creosotebush, cactus, annual weeds and grasses, and scattered mesquite and paloverde trees. Precipitation is 6 to 8 inches, the mean annual air temperature is 69° to 74° F, and the frost-free season is 250 to 300 days.

In a representative profile the surface layer is brown clay loam about 10 inches thick. The underlying material is light-brown clay loam to a depth of 30 inches. Below this to a depth of 65 inches is an old buried soil of brown sandy clay loam and clay loam. The lower part of the soil contains visible amounts of lime. The soil is moderately alkaline and strongly to violently effervescent.

Permeability is moderately slow. Runoff is slow, and the erosion hazard is slight. The available water capacity is 11 to 13 inches. Roots penetrate to a depth of 5 feet or more.

Trix soils are used for cotton, alfalfa, sorghum, barley, sugar beets, safflower, citrus, wheat, and truck crops. Parts of the cities of Phoenix and Glendale are on these soils.

Representative profile of Trix clay loam, 17 feet east and 34 feet south of northwest corner of NE¼ of sec. 22; T. 2 N., R. 1 E. in a cultivated field west of Glendale:

Ap—0 to 10 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5 YR 4/4) when moist; massive; hard when dry, firm when moist, sticky and plastic when wet; common fine and very fine roots; few fine tubular pores; strongly effervescent; moderately alkaline; abrupt, smooth boundary.

C1—10 to 30 inches, light-brown (7.5YR 6/4) clay loam, dark brown (7.5YR 4/4) when moist; massive; very hard when dry, firm when moist, sticky and plastic when wet; common fine and very fine roots; many very fine and few fine tubular pores; violently effervescent; few, fine, faint filaments of lime; moderately alkaline; abrupt, smooth boundary.

B1tb—30 to 34 inches, brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) when moist; massive; hard when dry, friable when moist, sticky and plastic when wet; common fine and very fine roots; common very fine and few fine tubular pores; few thin clay films in pores; common fine gravel; strongly effervescent; few fine filaments of lime; moderately alkaline; gradual, smooth boundary.

B2tb—34 to 49 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) when moist; moderate, fine and medium, subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; common fine and very fine roots; few fine tubular pores; common thin clay films on peds and in pores; strongly effervescent; common faint filaments of lime; moderately alkaline; clear, wavy boundary.

B3cab—49 to 65 inches, brown (7.5YR 5/4) and light brown (7.5YR 6/4) clay loam, dark brown (7.5YR 4/4) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; common fine and very fine roots; many fine tubular pores; violently effervescent; few, fine and medium, distinct, pinkish-white (7.5YR 8/2) filaments and segregations of lime, pinkish gray (7.5YR 7/2) when moist; moderately alkaline.

The soil ranges from slightly to strongly effervescent. Depth to the buried B horizon ranges from 20 to 39 inches, but is commonly 30 inches.

The A horizon has hue of 10YR and 7.5YR and value of 5 or 6 dry and 3 or 4 moist. It is dominantly clay loam, but is silty clay loam in places. This horizon is weak, fine, granular, or it is massive.

The C1 horizon has hue of 10YR and 7.5YR, value of 4 to 6 dry and 3 to 5 moist, and chroma of 2 to 4 dry and moist. It is heavy loam, clay loam, and silty clay loam. The buried Bt horizon has hue of 7.5YR and 5YR, value of 5 or 6 dry and 4 or 5 moist, and chroma of 3 to 6 dry and moist. It is heavy loam, clay loam, and sandy clay loam and ranges from weak to moderate subangular blocky. A loam Cca horizon that contains many lime segregations and masses is within a depth of 60 inches in many places.

**Trix clay loam** (Tt).—This soil is mainly in the Salt River Valley and is most extensive near Glendale. Slopes are generally slightly concave and less than 1 percent. Areas are generally more than 40 acres in size.

Included with this soil in mapping are a few small areas of Avondale clay loam, Glenbar clay loam, Mohall clay loam, and Laveen clay loam. Included soils make up about 12 percent of the mapping unit.

All the acreage of this Trix soil is cultivated, except those areas covered with buildings. Capability unit I–1 irrigated, subclass VIIc dryland; Loam Upland range site; horticultural group 1; wildlife habitat group 1 irrigated, 11 dryland.

## Tucson Series

The Tucson series consists of deep, well-drained soils that have large amounts of lime near the surface. These soils formed on old alluvial fans and valley plains parallel-

irregularly shaped and rounded, soft lime masses, pinkish white (7.5YR 8/2) when moist; moderately alkaline; clear, smooth boundary.

Cca—36 to 65 inches, light-brown (7.5YR 6/4) heavy loam, dark brown (7.5YR 4/4) when moist; weak, medium and coarse, subangular blocky structure; hard when

bility unit I–1 irrigated, subclass VIIc dryland; Loam Upland range site; horticultural group 2; wildlife habitat group 1 irrigated, 11 dryland.

## Valencia Series

The Valencia series consists of deep, well-drained soils. These soils formed in 20 to 40 inches of recent alluvium that was deposited over an older surface on valley plains and alluvial fans. The recent alluvium and the older, underlying alluvium both were derived from acid and basic igneous rocks and some shale and limestone. Slopes are 0 to 1 percent. Elevations are 800 to 1,400 feet. The natural vegetation is creosotebush, annual weeds, and grasses, cactus, and scattered mesquite and paloverde trees. The average annual rainfall is 6 to 8 inches, the mean annual air temperature is 69° to 74° F, and the frost-free season is 250 to 300 days.

In a representative profile the surface layer is brown sandy loam about 10 inches thick. The underlying material is light-brown sandy loam to a depth of 26 inches. Below this is older, buried light-brown and brown clay loam and sandy clay loam to a depth of 60 inches or more. The upper part of the soil is weakly effervescent to strongly effervescent, and the lower part is strongly effervescent to violently effervescent. The soil is generally moderately alkaline, but in some areas the lower part is strongly alkaline to very strongly alkaline.

Permeability is moderately rapid in the upper part of the soil and moderately slow in the lower part. Runoff is slow, and the erosion hazard is slight. Roots penetrate to a depth of 60 inches or more.

Valencia soils are used for irrigated crops, recreation, range, and wildlife. Irrigated crops are cotton, alfalfa, small grains, grapes, sorghum, citrus, sugar beets, safflower, and truck crops. Part of the city of Phoenix is on these soils. Some areas are used as homesites.

Representative profile of Valencia sandy loam, 580 feet north and 340 feet west of southeast corner of sec. 20, T. 2 S., R. 1 W. in a cultivated field in the Rainbow Valley:

Ap—0 to 10 inches, brown (7.5YR 5/4) sandy loam, dark brown (7.5YR 4/4) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few fine roots; many fine interstitial pores; slightly effervescent; moderately alkaline; abrupt, smooth boundary.

C1—10 to 22 inches, light-brown (7.5YR 6/4) sandy loam, dark brown (7.5YR 4/4) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few fine roots; few very fine tubular pores; strongly effervescent; few, fine, faint, pinkish-white (7.5YR 8/2) filaments of lime; moderately alkaline; abrupt, smooth boundary.

C2—22 to 26 inches, light-brown (7.5YR 6/4) sandy loam, dark brown (7.5YR 4/4) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few fine roots; common very fine tubular pores; strongly effervescent; moderately alkaline; clear, smooth boundary.

IIB21tcab—26 to 31 inches, light-brown (7.5YR 6/4) light sandy clay loam, reddish brown (5YR 4/4) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few fine roots; common very fine and fine tubular pores; few thin clay films on peds and in pores; strongly effervescent to violently effervescent; common, fine, distinct, pink (7.5YR 8/4) filaments of lime, light brown (7.5YR 6/4) when moist; moderately alkaline; clear, wavy boundary.

IIB22tcab—31 to 48 inches, brown (7.5YR 5/4) clay loam, reddish-brown (5YR 4/4) when moist; moderate, medium, subangular blocky structure; hard when dry, friable when moist, slightly sticky and plastic when wet; few fine roots; few very fine tubular pores; common thin clay films on peds and in pores; violently effervescent; common, fine and medium, distinct, pink (7.5YR 8/4) filaments and mottles of lime, pink (7.5YR 7/4) when moist; moderately alkaline; gradual, wavy boundary.

IIB3tcab—48 to 60 inches, light-brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist, slightly sticky and plastic when wet; common very fine and few fine tubular pores; few thin clay films on peds and in pores; violently effervescent; many, medium, distinct, pinkish-white (7.5YR 8/2) lime mottles, pink (7.5YR 8/4) when moist; moderately alkaline.

Depth to the buried IIB2t horizon is dominantly 20 to 30 inches, but ranges from 20 to 39 inches. The soil ranges from effervescent to violently effervescent and is mildly alkaline to moderately alkaline and in a few places is strongly alkaline to very strongly alkaline.

The A and C horizons have hue of 7.5YR and 10YR, value of 5 or 6 dry and 4 or 5 moist, and chroma of 2 to 4 dry and moist. These horizons commonly are fine sandy loam and sandy loam, but contain strata of finer textured or coarser textured material in places. The B2t horizon has hue of 5YR and 7.5YR, value of 5 or 6 dry and 3 to 5 moist, and chroma of 3 to 6 dry and moist. It is clay loam, sandy clay loam, or heavy loam. It is mainly weak or moderate, fine to medium, subangular blocky. In places it is massive. The buried part of the soil contains few to many, very fine to medium filaments and masses of powdery lime. A IIB1b horizon of gravelly sandy loam, sandy clay loam, or gravelly sandy clay loam occurs in places.

**Valencia sandy loam** (Va).—This nearly level soil is at the lower ends of alluvial fans and valley plains. It occurs throughout the survey area. Slopes are generally less than 1 percent. Unless cultivated, areas are dissected by shallow stream channels at 200- to 500-foot intervals. Areas are generally about 40 acres in size, but range from 2 to 400 acres.

This soil has the profile described as representative of the series. Included in mapping are a few small areas of Collidge sandy loam, Estrella loam, and Mohall sandy loam. Included soils make up about 15 percent of the mapping unit.

This Valencia soil holds 8 to 10 inches of water available to plants. It is used for cotton, alfalfa, sorghum, small grain, safflower, sugar beets, citrus, and truck crops. Part of the city of Phoenix is on the soil. A few areas are used for range. Capability unit I–2 irrigated, subclass VIIc dryland; Loam Upland range site; horticultural group 1; wildlife habitat group 1 irrigated, 11 dryland.

**Valencia sandy loam, saline-alkali** (Vb).—This nearly level soil is on alluvial fans and valley plains in the Harquahala Valley and near Wintersburg. Unless cultivated, it is hummocky. Slopes are less than 1 percent. Areas are oval in shape and range from 2 to 50 acres in size.

This soil has a profile similar to the one described as representative of the series, but is strongly saline to very strongly saline and alkaline in the lower part. Included in mapping are small areas of Casa Grande sandy loam; Antho sandy loam, saline-alkali, 0 to 1 percent slopes; Estrella loam, saline-alkali; and Coolidge sandy loam, 0 to 1 percent slopes. Included soils make up about 30 percent of the mapping unit.

Permeability is slow in the lower part of the soil. The available water capacity is 6 to 8 inches.

This Valencia soil is used for cotton, alfalfa, barley, sorghum, sugar beets, and safflower. About half the acreage is used for range and is not cultivated. Capability unit IIs-9 irrigated, subclass VIIs dryland; Saline Upland range site; horticultural group 5; wildlife habitat group 1 irrigated, 11 dryland.

**Valencia gravelly sandy loam** (Vc).—This nearly level soil is on alluvial fans and valley plains. It occurs throughout the survey area. Slopes are slightly convex and less than 1 percent. Areas are long and narrow and about 10 acres in size.

This soil has a profile similar to the one described as representative of the series, but the upper 10 to 30 inches is 15 to 35 percent gravel and the available water capacity is 7.5 to 8.5 inches. Included in mapping are a few small areas of Antho gravelly sandy loam, 0 to 1 percent slopes; Carrizo gravelly sandy loam; and Estrella loam. Included soils make up about 20 percent of the unit.

This Valencia soil holds 8 to 10 inches of water available to plants. About half the acreage is cultivated. Cotton, alfalfa, barley, safflower, citrus, and grapes are the main crops. A few areas are used for range. Capability unit I-2 irrigated, subclass VIIc dryland; Loam Upland range site; horticultural group 1; wildlife habitat group 1 irrigated, 11 dryland.

## Vecont Series

The Vecont series consists of deep, well-drained soils. These soils formed in alluvium that was deposited in slightly concave, depressed areas in old alluvial fans and valley plains. The alluvium was derived from a wide mixture of rock, including granite, andesite, rhyolite, schist, limestone, and basalt. Slopes are generally less than 1 percent. Elevations are 1,000 to 1,400 feet. In areas not cultivated, the vegetation is creosotebush, galleta, annual weeds and grasses, and scattered mesquite and paloverde trees. The precipitation is 6 to 8 inches, the mean annual air temperature is 69° to 74° F, and the frost-free season is 260 to 300 days.

In a representative profile the surface layer is brown clay about 15 inches thick. The subsoil is reddish-brown, brown, and light-brown clay to a depth of 65 inches. The lower part of the subsoil contains segregations of lime and common lime concretions. The soil is slightly effervescent to strongly effervescent and moderately alkaline throughout.

Permeability is slow. Runoff is slow, and the erosion hazard is slight. The available water capacity is 8 to 10 inches. Roots penetrate to a depth of 60 inches or more. These soils commonly crack when dry.

Vecont soils are used for irrigated crops and range. Irrigated crops are cotton, alfalfa, barley, sugar beets, sorghum, grapes, and citrus. A few areas are used as building sites.

slightly effervescent; moderately alkaline; abrupt, smooth boundary.

B21t—15 to 33 inches, reddish-brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) when moist; weak, coarse, prismatic and weak, coarse, subangular blocky structure; very hard when dry, firm when moist, sticky and very plastic when wet; very few, very fine tubular pores; common thin clay films on peds and in pores; compacted at a depth of 15 to 20 inches; noneffervescent and slightly effervescent in root channels; moderately alkaline; abrupt, smooth boundary.

B22tca—33 to 47 inches, brown (7.5YR 5/4) clay, reddish brown (5YR 4/4) when moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; very hard when dry, very firm when moist, sticky and very plastic when wet; few fine tubular pores; common thin clay films on peds and in pores; strongly effervescent to violently effervescent; common fine and very fine filaments and irregularly shaped concretions of lime and distinct, pinkish-white (7.5YR 8/2) masses of lime; moderately alkaline; abrupt, smooth boundary.

B23tca—47 to 51 inches, brown (7.5YR 5/4) heavy clay loam or clay, dark brown (7.5YR 4/4) when moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; very hard when dry, firm when moist, sticky and plastic when wet; few fine tubular pores; common thin clay films on peds and in pores; few worm casts; strongly effervescent; many, fine and medium, white (7.5YR 8/2) masses and common irregularly shaped concretions and filaments of lime; moderately alkaline; abrupt, smooth boundary.

B24t—51 to 65 inches, light-brown (7.5YR 6/4) clay or clay loam, brown (7.5YR 5/4) when moist; moderate, fine, subangular blocky structure; hard when dry, firm when moist, sticky and very plastic when wet; few fine tubular pores; few thin clay films on peds and in pores; 10 percent gravel; violently effervescent; many prominent, medium, pinkish-white (7.5YR 8/2) masses of lime and few, extremely hard, irregularly shaped lime concretions; moderately alkaline.

The soil is generally slightly effervescent, but in some uncultivated areas it is noneffervescent to a depth of 20 inches or more. Depth to lime accumulation ranges from 30 to 36 inches.

The A horizon has hue of 10YR and 7.5YR, value of 5 or 6 dry and 3 or 4 moist, and chroma of 2 to 4 dry and moist. It is loam, heavy clay loam, heavy silty clay loam, clay, and heavy sandy clay loam. The B2t horizon has hue of 7.5YR and 5YR, value of 4 or 5 dry and 3 to 5 moist, and chroma of 3 or 4 dry and moist. It is heavy clay loam, clay, silty clay, and sandy clay. It is mainly weak prismatic or weak to moderate subangular blocky, but in places is massive. In places, a clay loam Cca horizon is below a depth of 30 inches.

**Vecont loam** (Ve).—This soil is in slightly concave stream channels and slight depressions on old alluvial fans and valley plains. It is mainly near McMicken Dam. Runoff from the surrounding, gently sloping soils on hills has formed a few shallow gullies. Slopes are less than 1 percent. Areas are long and narrow and range from 30 to 160 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is loam 5 to 10 inches thick. Included in mapping are small areas of Mohall loam; Gilman loam, 0 to 1 percent slopes; Laveen loam, 0 to 1 percent slopes, and a few areas of soils containing excessive saline or alkali salts, or both. The

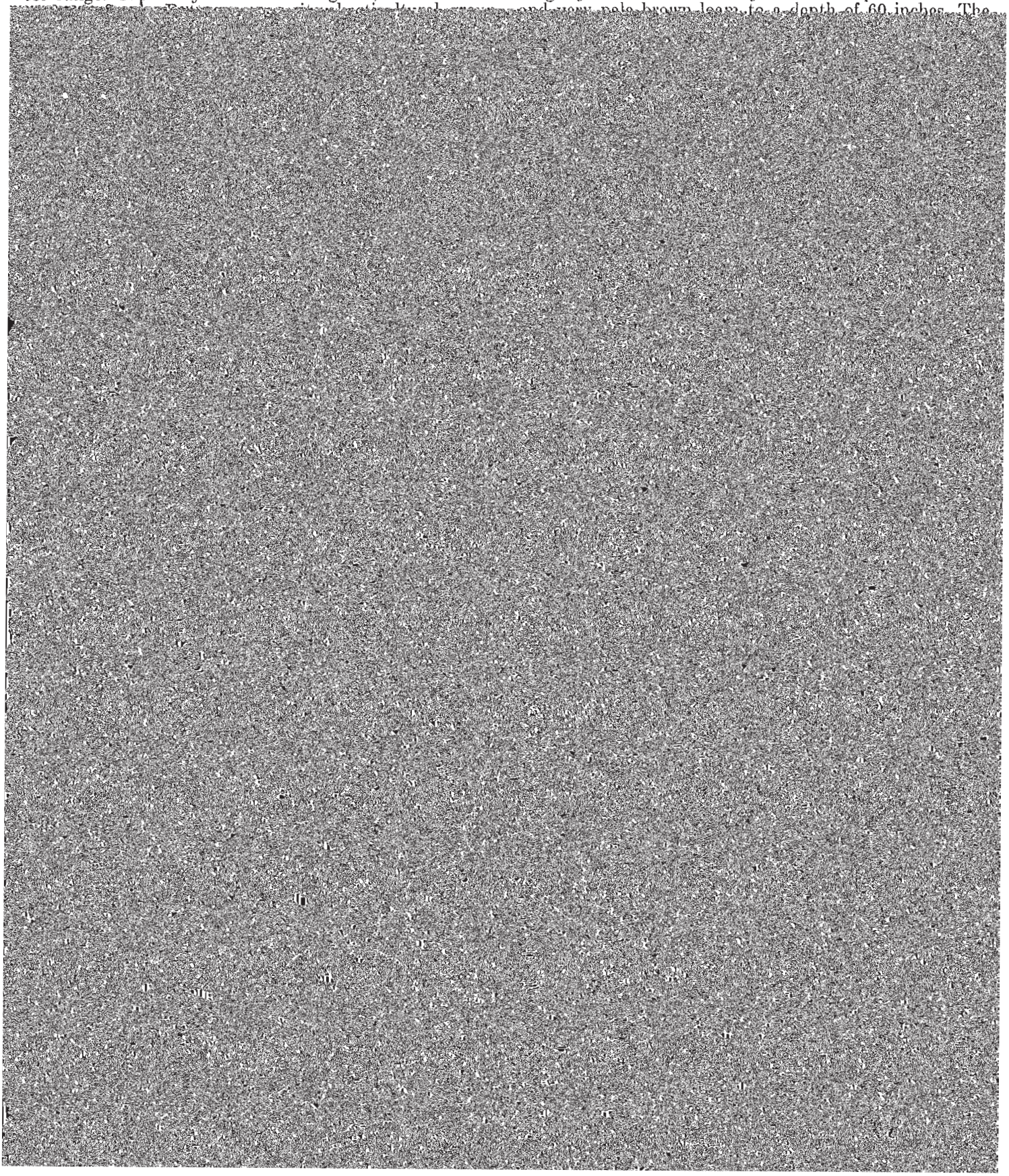
**Vecont clay** (Vf).—This nearly level soil is in slightly concave, depressed areas and stream channels in old alluvial fans and valley plains, mainly in the northern part of the Salt River Valley. Areas are long and narrow and about 40 acres in size.

This soil has the profile described as representative of the series. Included in mapping are small areas of Mohall clay loam; Estrella loam; and Laveen loam, 0 to 1 percent slopes. Included soils make up less than 15 percent of the

The soil has hue of 10YR and 7.5YR, value of 5 or 6 dry and 3 to 5 moist, and chroma of 2 to 4 dry and moist. It contains few to many mica flakes and in places filaments or threads of lime.

The A horizon ranges from fine sand to clay loam and is slightly to strongly calcareous. The soil between depths of 10 and 40 inches ranges from loamy sand to loamy fine sand and has common, thin strata of fine sandy loam, sandy loam, very fine sandy loam, and sand. A few to many, fine, water-worn pebbles occur throughout the profile, but never exceed 15 percent of the soil mass.

for range. Capability unit IIs-7 irrigated, subclass VIIs is light yellowish-brown sandy loam to a depth of 18 inches



All the acreage of this mapping unit except that in the town of Buckeye is irrigated. Crops are cotton, alfalfa, barley, sugar beets, sorghum, safflower, and lettuce. Capability unit IIIs–3 irrigated, subclass VIIs dryland; horticultural group 2; wildlife habitat group 3 irrigated, 11 dryland.

## *Use and Management of the Soils*

General practices of good management for all soils of Maricopa County, Central Part, are suggested on the pages that follow. The capability grouping used by the Soil Conservation Service, in which the soils are grouped according to their suitability for crops, and the system adopted locally by the State of Arizona are explained. Management is suggested, by capability unit, for irrigated crops and range. Estimated yields of the principal crops are listed in table 2.

This part of the survey also contains information [illegible] most row crops and some small grain. Citrus and other trees require a modification of the furrow system. Small basins around each tree are connected with furrows. Sprinklers are sometimes used for shallow-rooted crops, such as vegetables, for germination of seeds. They are also used on very sandy soils.

If water is applied too rapidly to fine-textured soils, such as Gadsden and Cashion soils, it runs off. If water is applied too rapidly on coarse-textured soils, such as Brios and Carrizo soils, it penetrates below the root zone and is lost. A properly designed irrigation system matches the soil characteristics with the right grade and length of run. Water can be conserved by using pipelines and cement-lined ditches and reusing irrigation tail water. General suggestions are given in the description of each capability unit. More specific suggestions are available in the local Soil Conservation Service field office.

*Fertilization.*—Fertilizer is generally required to obtain profitable yields in the survey area. The amount and kind [illegible]

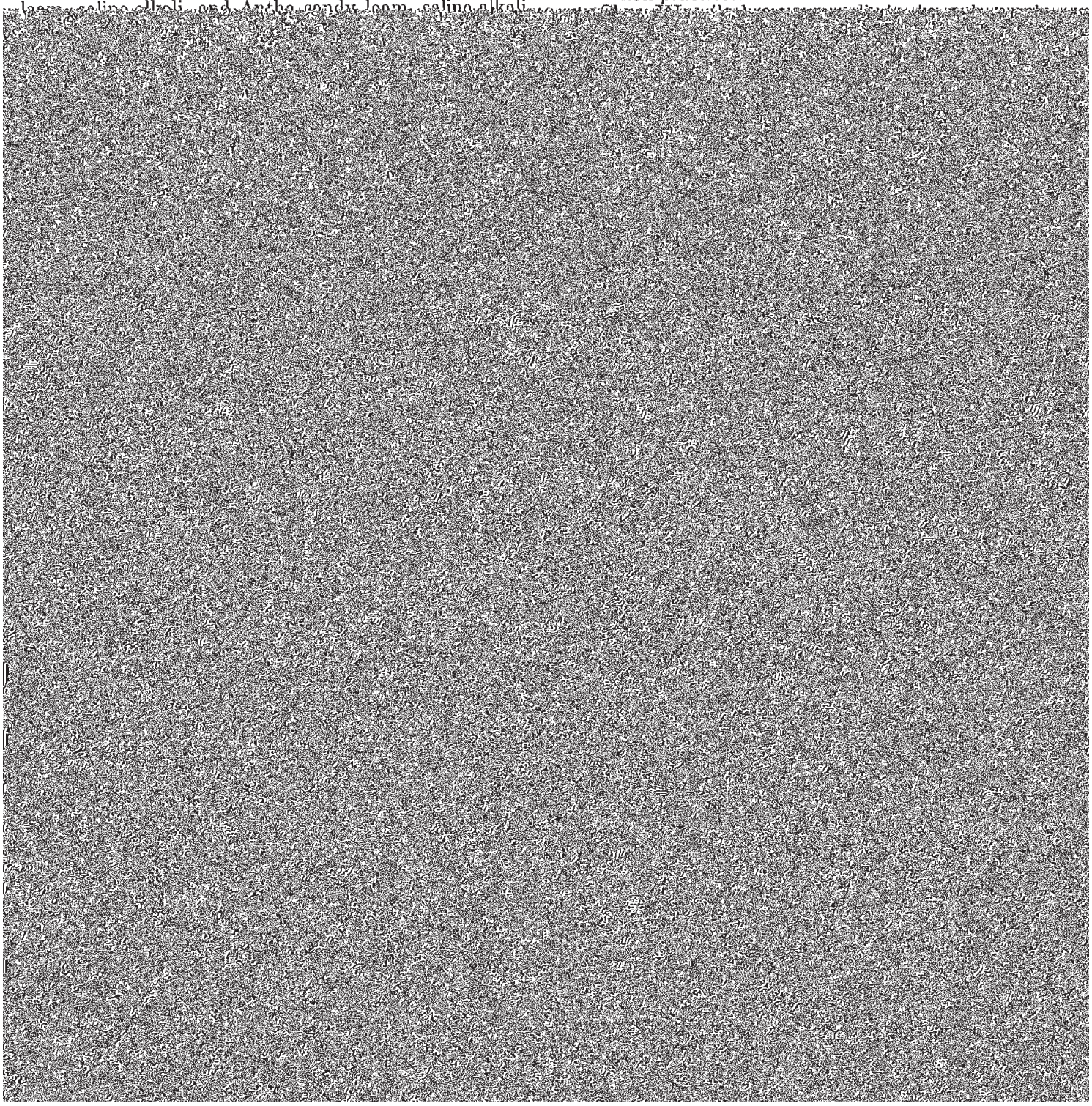
25° C. The exchangeable sodium percentage is less than 15, and the pH value is below 8.5. The Gilman loam, clayey subsoil variant, moderately saline, is the only soil in this class.

Saline-alkaline soils have a conductivity of the saturation extract of greater than 4 millimhos per centimeter at 25° C and an exchangeable sodium percentage greater than 15. The pH value ranges from 7.9 to 10. Most soils that are too saline or too alkaline are in this class. Gilman loam, saline alkali, and Antho sandy loam, saline alkali

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, 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 require moderate conservation practices.



### *Managing irrigated soils, by capability units*[3]

On the pages that follow, each capability unit in the survey area is described and the use and management are briefly discussed. The names of the soil series represented are mentioned, but this does not mean that all of the soils in a given series are in that unit. To find the capability unit for a specific soil, refer to the Guide to Mapping Units at the back of the survey.

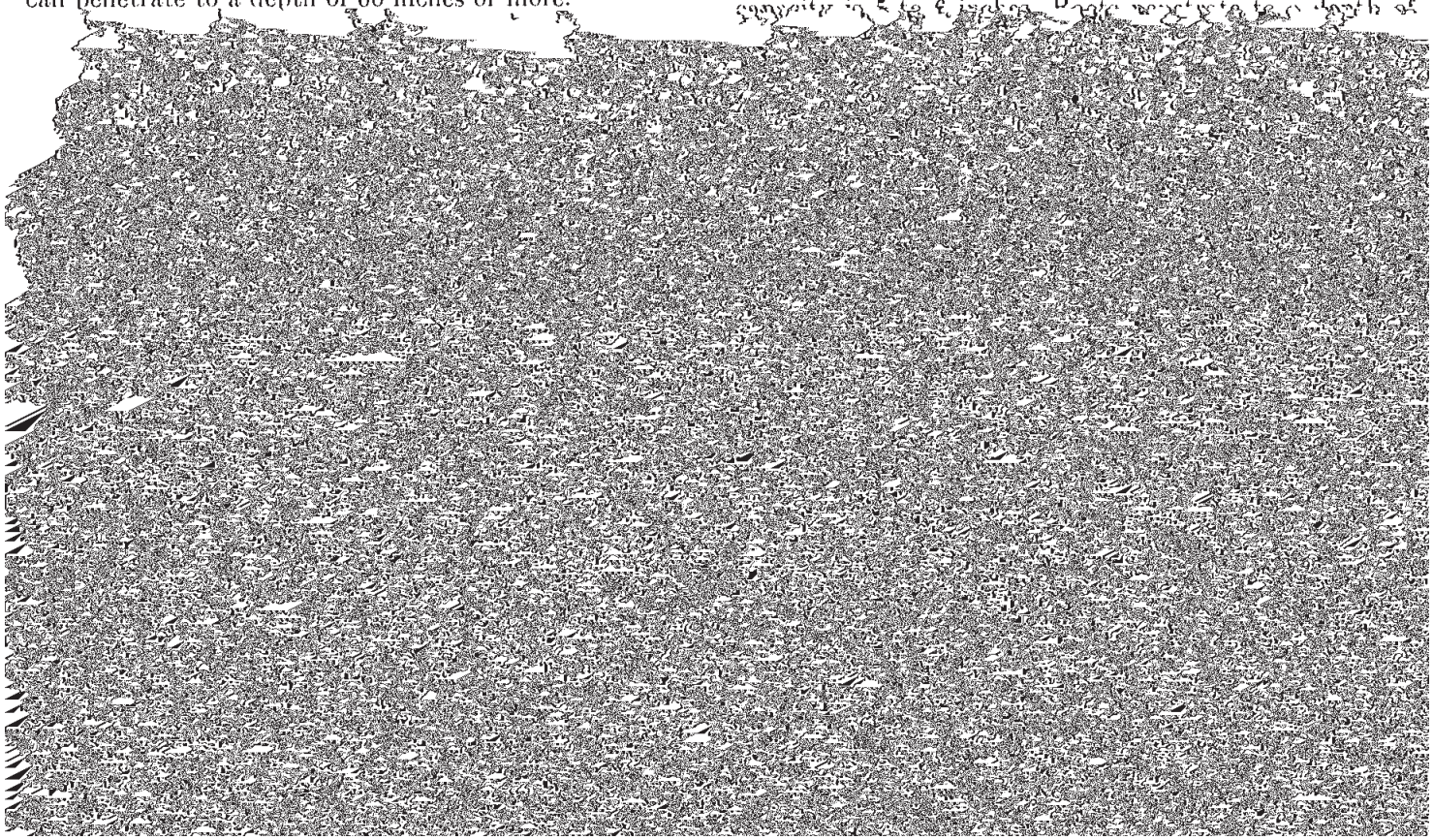
Irrigation is needed to grow crops in this area, and about 30 percent of the acreage is irrigated. The water is supplied from several sources and varies considerably in quality and quantity. Surface water comes from several reservoirs on the Agua Fria, Salt, and Verde Rivers. Underground water supplements surface water in some areas but in others is the sole source of supply.

Most crops commonly grown in the area are listed in table 2. In addition to the crops listed, the soils of this area are used for wheat, grapes, lettuce, cabbage, broccoli, carrots, radishes, onions, potatoes, tomatoes, cantaloupe, watermelon, strawberries, roses, pecans, plums, apricots, and dates. Also, some areas are used as pasture.

#### CAPABILITY UNIT I-1 IRRIGATED

Soils of the Avondale, Estrella, Gilman, Glenbar, Laveen, Mohall, and Tucson series are in this unit. They are loams or clay loams that are relatively free of salts and alkali. Laveen, Mohall, and Tucson soils have concentrations of lime at a depth of 14 to 26 inches. Slopes are 0 to 1 percent.

Permeability is moderate to moderately slow. Runoff is medium to very slow, and the erosion hazard is slight. The available water capacity is 6 to 13.5 inches. Roots can penetrate to a depth of 60 inches or more.



important. Light, frequent applications of water are needed when plants are young. Cuts made in land leveling or shaping that are deeper than 1½ feet can expose the underlying concentrations of lime in Mohall and Laveen soils. Irrigation runs should be no longer than 1,320 feet. Sprinklers can be used for shallow-rooted crops, such as vegetables.

#### CAPABILITY UNIT IIe-1 IRRIGATED

Soils of the Gilman and Laveen series are in this unit. They are loams that are relatively free of toxic concentration of salts or alkali. Laveen soils have concentrations of lime within 24 inches of the surface. Slopes are 1 to 3 percent.

Permeability is moderate. Runoff is slow to medium, and the erosion hazard is moderate. The available water capacity is 8 to 11 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are suited to all climatically adapted crops of the area. Lime-induced chlorosis can affect citrus trees in some areas of Laveen soils.

The major limitations are the slope and the erosion hazard. The erosion hazard can be reduced by irrigating on the contour or across the slope. Deep cuts in land leveling expose the underlying concentration of lime in the Laveen soils. Generally irrigation runs should be no longer than 880 feet.

#### CAPABILITY UNIT IIe-4 IRRIGATED

Two soils of the Antho series are in this unit. These soils are relatively free of toxic concentration of salts and alkali.

Permeability is moderately rapid. Runoff is medium, and the erosion hazard is moderate. The available water capacity is [illegible] inches. Roots can penetrate to a depth of

The main limitations are the slope, the erosion hazard, and a slightly reduced water capacity. The erosion hazard can be reduced by irrigating on the contour or across the slope. Special attention must be given to the frequency of irrigation because the soils appear droughty if they are adjacent to soils that hold more available water. Cuts made in land leveling or shaping that are deeper than 1 foot can expose the underlying concentrations of lime. Applications of manure are beneficial in leveled areas where cuts have exposed lime concentrations. Phosphorus should be applied in split applications during the growing season in such areas because it is readily tied up in the soil. Generally irrigation runs should be no more than 1,320 feet long.

#### CAPABILITY UNIT IIe-7 IRRIGATED

Soils of the Coolidge and Perryville series are in this unit. They have a surface layer of gravelly sandy loam or gravelly loam and a subsoil of sandy loam or gravelly loam. All are relatively free of toxic concentrations of salts and alkali, but have concentrations of lime at or near the surface. Slopes are 1 to 3 percent.

Permeability is moderate to moderately rapid. Runoff is slow to medium, and the erosion hazard is slight to moderate. The available water capacity is 6 to 7 inches. Roots penetrate to a depth of 60 inches or more.

These soils are used for cotton, alfalfa, barley, safflower, and citrus. Lime-induced chlorosis is sometimes evident in citrus grown on these soils. The soils are not suited to sorghum and related crops.

The main limitations are the slope, the erosion hazard, the limited water capacity, and the concentrations of lime tion system should be designed so that they can be irrigated separately and more frequently. Deep cuts in land leveling do not expose unfavorable material. Irrigation runs should be no longer than 880 feet. Sprinklers can be used in some areas for shallow-rooted crops.

#### CAPABILITY UNIT IIs-6 IRRIGATED

Soils of the Rillito and Tremant series are in this unit. They have a surface layer of sandy loam, loam, gravelly loam, or gravelly clay loam. The subsoil is gravelly loam, gravelly clay loam, or clay loam, and the underlying material is gravelly loam. The soils are relatively free of toxic concentrations of salts and alkali. They have concentrations of lime at a depth of 10 to 14 inches. Slopes are 0 to 1 percent.

Permeability is moderate to slow. Runoff is slow to medium, and the erosion hazard is slight. The available water capacity is 5 to 8 inches. Roots penetrate to a depth of 60 inches or more.

These soils are used for cotton, alfalfa, barley, safflower, citrus, and sorghums. Lime-induced chlorosis is sometimes evident in citrus grown on these soils. Sorghum becomes chlorotic if grown in areas of Rillito soils.

The main limitation is the content of coarse fragments and the reduced water capacity. Special attention must be given to the frequency of irrigation. These soils appear droughty in fields with soils that hold more available water. If feasible, the irrigation system should be designed so that they can be irrigated separately and more frequently. Generally irrigation runs should be no longer than 880 feet. Deep cuts in land leveling generally expose concentrations of lime and more gravelly material.

no longer than 880 feet. Deep cuts in land leveling expose the underlying concentration of lime.

#### CAPABILITY UNIT IIs-9 IRRIGATED

This unit consists of saline-alkali soils of the Antho, Avondale, Estralla, Gilman, Glenbar, Laveen, and Valencia series. The texture ranges from sandy loam to clay loam. Laveen soils have concentrations of lime at a depth of less than 30 inches. Slopes are 0 to 1 percent.

Permeability is moderately rapid to slow. Runoff is slow to medium, and the erosion hazard is slight. The available water capacity is 5 to 12 inches. Roots penetrate to a depth of 60 inches or more.

These soils are used for cotton, alfalfa, barley, safflower, sugar beets, and sorghum.

The main limitation is the toxic concentration of salts and alkali, which reduces the amount of water available to plants. Careful attention must be paid to the frequency of irrigation. Several leaching irrigations are needed each year. Generally deep cuts do not expose unfavorable material. Concentrations of lime, however, are within 30 inches of the surface in Laveen soils. Irrigation runs should be no longer than 1,320 feet.

#### CAPABILITY UNIT IIIs-3 IRRIGATED

Soils of the Gadsden, Glenbar, Mohall, Vecont, and Wintersburg series are in this unit. They have a surface layer of clay, and the underlying material ranges from loam to clay. All are relatively free of toxic concentrations of salts and alkali. Mohall soils have concentrations of lime at a depth of less than 30 inches. Slopes are less than 1 percent.

Permeability is moderately slow or slow. Runoff is slow to medium, and the erosion hazard is slight. The available water capacity is 8 to 13 inches. Roots penetrate to a depth of 60 inches or more.

These soils are used for most locally grown crops. Citrus trees readily become chlorotic if the soils are waterlogged.

The main limitation is the clay surface layer and the resulting slow intake rate. Care must be taken to ensure adequate penetration of water. These soils are easily compacted if tilled when wet. Plowpans are prevalent. Crop residue should be returned to the soil. Also, applications of manure or gin trash or plowing under green-manure crops improves tilth and increases the water intake rate. In order to avoid scalding the plants in hot weather, irrigation sets for alfalfa should not exceed 24 hours. The surface should not become too dry during the growing season because deep cracks form. Several deep leachings each year are needed to remove salts and alkali from the soil. Flat leveling aids in the leaching and removal of salts. Irrigation runs should be no longer than 1,320 feet. Deep cuts do not expose unfavorable material in most of these soils, but cuts of more than 2 feet expose concentrations of lime in the Mohall soils.

#### CAPABILITY UNIT IIIs-7 IRRIGATED

Soils of the Antho, Brios, Maripo, and Vint series are in this unit. They have a surface layer ranging from loamy sand to loam and underlying material of sand, loamy fine sand, or gravelly loamy sand. They are relatively free of toxic concentrations of salts and alkali. Slopes are less than 1 percent.

Permeability is rapid to moderately rapid. Runoff is very slow to medium. The erosion hazard is slight, but young plants are subject to some wind damage from sand blasting. The available water capacity is 4 to 7 inches. Roots penetrate to a depth of 60 inches or more.

These soils are used for most crops climatically suited to the area.

The main limitation is the limited available water capacity. Special attention must be given to the frequency of irrigation. Many of these soils appear droughty if they are adjacent to soils that hold more available water. If feasible, the irrigation systems should be designed so that they can be irrigated separately and more frequently. Fertilizer containing nitrogen should be applied in two applications, and in small amounts because the nitrogen readily leaches out of the root zone. Manure, gin trash, or green-manure crops improve tilth and increase the available water capacity. Overuse of irrigation water and excessive leaching of fertilizer can occur if the soils are leveled. Irrigation runs should be no longer than 660 feet. Cuts in land leveling should be no deeper than 6 to 12 inches in Maripo and Brios soils. Deep cuts are not damaging in Vint soils.

#### CAPABILITY UNIT IIIs-8 IRRIGATED

Soils of the Gadsden and Vecont series are in this unit. They have a surface layer of clay loam or loam and the underlying material is clay. They are relatively free of salts and alkali. Slopes are less than 1 percent.

Permeability is slow. Runoff is slow, and the erosion hazard is slight. The available water capacity is 8 to 10 inches. Roots penetrate to a depth of 60 inches or more.

These soils are used for cotton, alfalfa, barley, sugar beets, and sorghum.

The main limitation is slow permeability. Care must be taken to ensure adequate penetration of water. If these soils are in the same field as coarser textured soils, they appear droughty. If feasible, the irrigation system should be designed so that they are irrigated separately and with a smaller head of water. Care must be taken to ensure that these soils are not tilled when wet. They are easily compacted, and a plowpan forms readily. Growing alfalfa and plowing under crop residue increase permeability. In order to avoid scalding the plants in hot weather, irrigation sets for alfalfa should not exceed 24 hours. The soils should be deep leached at least twice a year to prevent the accumulation of salts. Flat leveling helps to deep leach the salts. Irrigation runs should be no longer than 1,320 feet. Sprinklers are not satisfactory because the intake rate is low. No unfavorable material is exposed in land leveling or shaping.

#### CAPABILITY UNIT IIIs-9 IRRIGATED

Soils of the Casa Grande, La Palma, and Perryville series and the Gilman variant are in this unit. They have a surface layer ranging from sandy loam to loam and underlying material of clay or clay loam. All are severely affected by saline and alkali salts or both. Casa Grande, La Palma, and Perryville soils have concentrations of lime at or near the surface. La Palma soils have an indurated hardpan at a depth of less than 40 inches. Slopes are less than 1 percent.

Permeability is slow to moderate. Runoff is very slow to medium, and the erosion hazard is slight. The available water capacity is 3 to 10 inches. Roots can penetrate to a

depth of 60 inches or more in all but the La Palma soil, which is only 20 to 40 inches deep over a hardpan.

These soils are used for cotton, alfalfa, barley, safflower, sugar beets, and sorghum. The La Palma soil is not suited to citrus or alfalfa unless the indurated hardpan is removed.

The main limitation is the moderate to high toxic concentration of saline or alkali salts or both. Salts is a continuous limitation. Careful attention must be given to the frequency of irrigation because the water available to plants is somewhat restricted by the content of salts. Care must be taken to ensure adequate penetration of irrigation water. Flat leveling and deep leaching are beneficial in reclaiming these soils. Soil amendments improve the infiltration rate of leaching water in some areas. Runs should be no longer than 1,320 feet. Crop residue should be returned to the soil. Adding manure or gin trash or plowing under green-manure crops improves tilth and increases the infiltration of water. Sprinklers are not adequate because the intake rate is slow.

#### CAPABILITY UNIT IVs-5 IRRIGATED

The one soil in this unit, Pinal loam, 0 to 1 percent slopes, is relatively free of salts and alkali. It is loam or cobbly loam that is 4 to 20 inches over an indurated hardpan.

Permeability is moderate in the upper part of the soil, but the pan is impermeable. Runoff is medium, and the erosion hazard is slight. The available water capacity is [illegible] inches. Roots penetrate to a depth of less than 20 [illegible] green-manure crops, crop residue, gin trash, or manure increases the water capacity and improves tilth. Fertilizer should be applied in small amounts and in two applications or it will be leached rapidly from the root zone by irrigation water. Sprinklers are suitable on these soils.

#### CAPABILITY UNIT IVs-9 IRRIGATED

The two soils in this unit, Cashion clay, saline-alkali, and Gadsden clay, saline-alkali, have toxic concentrations of saline and alkali salts. The Gadsden soil is clay throughout, and the Cashion soil is underlain by silt loam at a depth of about 27 inches. Slopes are less than 1 percent.

Permeability is slow. Runoff is slow, and the erosion hazard is slight. The available water capacity is 9 to 10 inches. Roots penetrate to a depth of 60 inches or more.

These soils are used for cotton, alfalfa, barley, safflower, sugar beets, and sorghum. Sorghum shows the effect of salts in some areas.

The main limitations are the toxic content of saline and alkali salts and the slow rates of infiltration and permeability. Applications of soil amendments are needed on some fields to improve infiltration and to help leach saline and alkali salts. Special attention must be given to the frequency of irrigation. These soils are easily waterlogged. If they are not watered enough, however, they appear droughty. They are easily compacted by tillage equipment, especially if cultivated when wet. All crop residue should be returned to the soil. Green-manure crops, gin trash, and manure improve tilth and the infiltration rate. Fields should be leveled flat to ensure adequate penetra-

inches. Some are gravelly or very gravelly. Others have concentrations of lime. Slopes are less than 1 percent.

Permeability is rapid to slow. Runoff is slow to medium, and the erosion hazard is slight. The available water capacity ranges from 1 to 12 inches. Roots penetrate to a depth of 60 inches or more in most of the soils, but are restricted to 40 inches or less in the soils that have a hardpan.

These soils are used as range and wildlife habitat. For additional information, see the sections on range and wildlife.

The main limitation is limited water capacity, high content of saline or alkali salts or both, slow water infiltration rate, slow permeability, restricted root zone, or a high content of gravel or cobbles.

#### CAPABILITY SUBCLASS VIIc DRYLAND

Soils in this subclass have a surface layer ranging from sandy loam to clay loam and underlying material of loam or clay loam. All are relatively free of toxic concentrations of saline or alkali salts or both. Some have concentrations of lime. Slopes are less than 1 percent.

Permeability is moderately rapid to moderately slow. Runoff is slow to medium, and the erosion hazard is none to slight. The available water capacity is 8 to 13 inches. Roots penetrate to a depth of 60 inches or more.

These soils are used as range and wildlife habitat. For additional information, see the sections on range and wildlife.

The main limitation is the arid climate.

#### CAPABILITY SUBCLASS VIII DRYLAND

The soils and land types in this subclass are on low hills and mountains and in stream channels. The low hill and mountain areas are mainly Rock outcrop. The areas in stream channels are subject to frequent flooding. As a result, recreation, wildlife habitat, water supply, and esthetic purposes are the main uses.

## Estimated Yields

Table 2 shows estimated average acre yields of the principal crops grown on arable soils under a high level of management. The estimates are based on observations of members of the Soil Conservation Service and the University of Arizona Agricultural Extension Service and on comparison with similar soils in other areas. Averages are those that can be expected over a period of years. In any given year, yields can be considerably higher or considerably lower than those listed in the table.

To achieve the yields shown, it is assumed that a good quality of irrigation water is available, that an adequate amount of fertilizer is applied, and that a soil-conserving cropping system is used. It is further assumed that cotton is a short staple, solid-planted crop that follows a small grain crop, and that all residue is returned to the soil. Alfalfa, grown only for hay, is planted in fall and is not allowed to lie dormant in summer. It has a normal growing season of 3 years. Barley is planted between the middle of November and December. Safflower is planted from December 15 to January 15 and harvested from July to August. Sugar beets are planted from about August 15 to October 15 and harvested from the middle of May to the middle of July. Yields for sorghum are long-term yields; short-term yields are about 30 percent less.

## Range Resources

About 682,500 acres in the survey area is classified as range. The area is low in elevation, and the climate is hot and dry. The elevation ranges from 700 feet in the valleys to 3,650 feet in the Estrella Mountains. Temperatures are high in summer, normally above 100° F from June until mid-September. In winter the nighttime temperature often falls to a low of 32° for about 2 months. Rainfall is 6 to 8 inches annually. Winter storms, mainly from November to March, are occasional gentle rains.

TABLE 2.—*Estimated average yields per acre under optimum management*

[Absence of yield figure indicates that the crop is not commonly grown or is not suited to the soil. Only arable soils are listed]

| Soils | Cotton lint | Alfalfa | Barley | Safflower | Sugar beets | Sorghum | Citrus | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Grapefruit | Valencia oranges | Navel oranges | Lemons | Tangerines |
| | *Pounds* | *Tons* | *Bushel* | *Tons* | *Tons* | *Bushel* | *Boxes* | *Boxes* | *Boxes* | *Boxes* | *Boxes* |
| Agualt loam | 850 | 5.5 | 62 | 1.3 | 17 | 60 | 369 | 133 | 98 | 330 | 117 |
| Antho gravelly sandy loam, 0 to 1 percent slopes | 950 | 6.0 | 58 | ------ | ------ | 64 | 461 | 165 | 117 | 407 | 146 |
| Antho sandy loam, 0 to 1 percent slopes | 1,150 | 7.0 | 70 | 1.6 | 17 | 71 | 492 | 178 | 125 | 437 | 155 |
| Antho sandy loam, 1 to 3 percent slopes | 850 | 5.5 | 54 | 1.3 | ------ | ------ | 461 | 165 | 117 | 407 | 146 |
| Antho sandy loam, saline-alkali | 850 | 6.0 | 54 | ------ | ------ | 67 | ------ | ------ | ------ | ------ | ------ |
| Antho-Brios sandy loams | 800 | 4.0 | ------ | ------ | ------ | 53 | ------ | ------ | ------ | ------ | ------ |
| Antho-Carrizo complex, 0 to 1 percent slopes | 750 | 3.9 | ------ | ------ | ------ | ------ | 415 | 146 | 104 | 350 | 131 |
| Avonda clay loam | 900 | 6.0 | 62 | 1.3 | 16 | 78 | ------ | ------ | ------ | ------ | ------ |
| Avondale clay loam | 1,200 | 8.0 | 83 | 1.4 | 25 | 125 | 492 | 178 | 125 | 437 | 155 |
| Avondale clay loam, saline-alkali | 1,000 | 7.0 | 62 | 1.3 | 18 | 82 | ------ | ------ | ------ | ------ | ------ |
| Brios loam | 700 | 4.5 | 50 | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ |
| Brios loamy sand | 600 | 4.0 | ------ | ------ | ------ | ------ | 338 | 117 | 82 | 300 | 106 |
| Brios sandy loam | 650 | 4.0 | 41 | ------ | ------ | ------ | 338 | 117 | 82 | 300 | 106 |
| Casa Grande loam | 800 | 5.0 | 54 | 1.1 | 17 | 67 | ------ | ------ | ------ | ------ | ------ |
| Casa Grande sandy loam | 900 | 5.5 | 58 | 1.1 | 17 | 67 | ------ | ------ | ------ | ------ | ------ |
| Casa Grande-Laveen complex, alkali | 800 | 5.5 | 62 | ------ | ------ | 67 | ------ | ------ | ------ | ------ | ------ |
| Cashion clay, saline-alkali | 850 | 6.2 | 58 | 1.0 | 18 | 100 | ------ | ------ | ------ | ------ | ------ |

TABLE 2.—*Estimated average yields per acre under optimum management*—Continued

| Soils | Cotton lint | Alfalfa | Barley | Safflower | Sugar beets | Sorghum | Citrus | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Grapefruit | Valencia oranges | Navel oranges | Lemons | Tangerines |
| | *Pounds* | *Tons* | *Bushel* | *Tons* | *Tons* | *Bushel* | *Boxes* | *Boxes* | *Boxes* | *Boxes* | *Boxes* |
| Coolidge gravelly sandy loam, 1 to 3 percent slopes | 850 | 5.0 | ---- | ---- | ---- | ---- | 461 | 165 | 117 | 407 | 146 |
| Coolidge sandy loam | 1,100 | 7.0 | 70 | 1.5 | 17 | 64 | 430 | 157 | 112 | 387 | 137 |
| Estrella loam | 1,300 | 9.0 | 75 | 1.7 | 20 | 107 | 523 | 186 | 133 | 462 | 164 |
| Estrella loam, saline-alkali | 1,000 | 8.0 | 62 | 1.4 | 15 | 78 | ---- | ---- | ---- | ---- | ---- |
| Gadsden clay | 900 | 6.5 | 62 | ---- | 20 | 107 | ---- | ---- | ---- | ---- | ---- |
| Gadsden clay, saline-alkali | 800 | 6.2 | 54 | ---- | 16 | 89 | ---- | ---- | ---- | ---- | ---- |
| Gadsden clay loam | 950 | 6.7 | 66 | ---- | 20 | 107 | ---- | ---- | ---- | ---- | ---- |
| Gilman fine sandy loam | 1,250 | 8.5 | 70 | 1.65 | 18 | 89 | 507 | 181 | 128 | 450 | 160 |
| Gilman fine sandy loam, saline-alkali | 1,000 | 7.0 | 62 | 1.4 | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Gilman loam, 0 to 1 percent slopes | 1,350 | 9.0 | 75 | 1.7 | 20 | 107 | 523 | 186 | 133 | 462 | 164 |
| Gilman loam, 1 to 3 percent slopes | 1,000 | 7.5 | 62 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Gilman loam, clayey subsoil variant, moderately saline | 850 | 5.5 | 50 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Gilman loam, saline-alkali | 900 | 7.5 | 62 | 1.5 | 15 | 85 | ---- | ---- | ---- | ---- | ---- |
| Glenbar clay | 900 | 6.5 | 62 | 1.1 | 20 | 107 | ---- | ---- | ---- | ---- | ---- |
| Glenbar clay loam | 1,200 | 8.0 | 83 | 1.4 | 25 | 125 | 492 | 178 | 125 | 437 | 155 |
| Glenbar clay loam, saline-alkali | 900 | 7.5 | 66 | 1.2 | ---- | 85 | ---- | ---- | ---- | ---- | ---- |
| Glenbar loam | 1,300 | 8.5 | 75 | 1.5 | 22 | 107 | 507 | 181 | 128 | 450 | 160 |
| Glenbar loam, saline-alkali | 850 | 7.0 | 66 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Gunsight-Rillito complex, 0 to 1 percent slopes | 650 | 5.5 | 54 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |

The summer season is characterized by scattered thunderstorms and heavy rainfall. Much of the precipitation received is lost to runoff and evaporation.

A wide variety of unique species occurs in the desert shrub plant community. Desert landscapes are favorites of artists and photographers. The giant saguaro, a favorite and the Arizona State flower, grows to a height of more than 50 feet and has as many as 50 arms. The largest are believed to be 150 to 200 years old.

Ironwood, a desert tree, is a climax species on the warmer Clay Upland range site. The Indians were known to use it for arrowheads because it is hard, brittle, and heavy.

One of the oldest and most conspicuous plants of the area is the ocotillo, sometimes called coachwhip. In dry weather it drops its leaves, but refoliates immediately after a good rain and develops an attractive red flower.

Jumping cholla cactus is another unique plant found on the warm slopes. Its dense, barbed spines are on easily detached joints. Painful and persistent barbs are the consequence of brushing too close to this plant.

Most of the desert plants played a very important role in the lives of the Indians who lived in the area. Plants were used for food, medicine, shelter, tools, weapons, and fuel. They were also used in ornaments, dyes and paints, gums and adhesives, soap, musical instruments, insect traps, perfumes, and baskets and in games and ceremonial rites.

The area provides habitat for several important desert wildlife species, including the rare and endangered desert bighorn sheep. Other wildlife species using the area are desert mule deer, javelina, Gambel quail, mourning and white-winged doves, rabbits, and numerous songbirds.

Soils of the area vary widely in depth and texture. Those in the valleys range from shallow to deep. The surface layer is medium textured to coarse textured. The subsoil is somewhat finer textured. Steep soils on the hills and mountains are shallow, rocky, and coarse textured. Soils of the Loamy Upland range site have a desert var-

wheat and filaree. Most of the permittees are absentee operators who use the range to graze steers.

Practices that can improve range in this survey area are those that benefit management rather than mechanical treatment and reseeding. Fencing and development of stockwater facilities that help proper grazing and planned grazing systems can be most beneficial. Water spreading to make wider use of runoff could be beneficial in some areas.

Mechanical treatment and reseeding of range is possible. Low rainfall, hazardous soil conditions, and high cost, however, make the feasibility of these practices questionable.

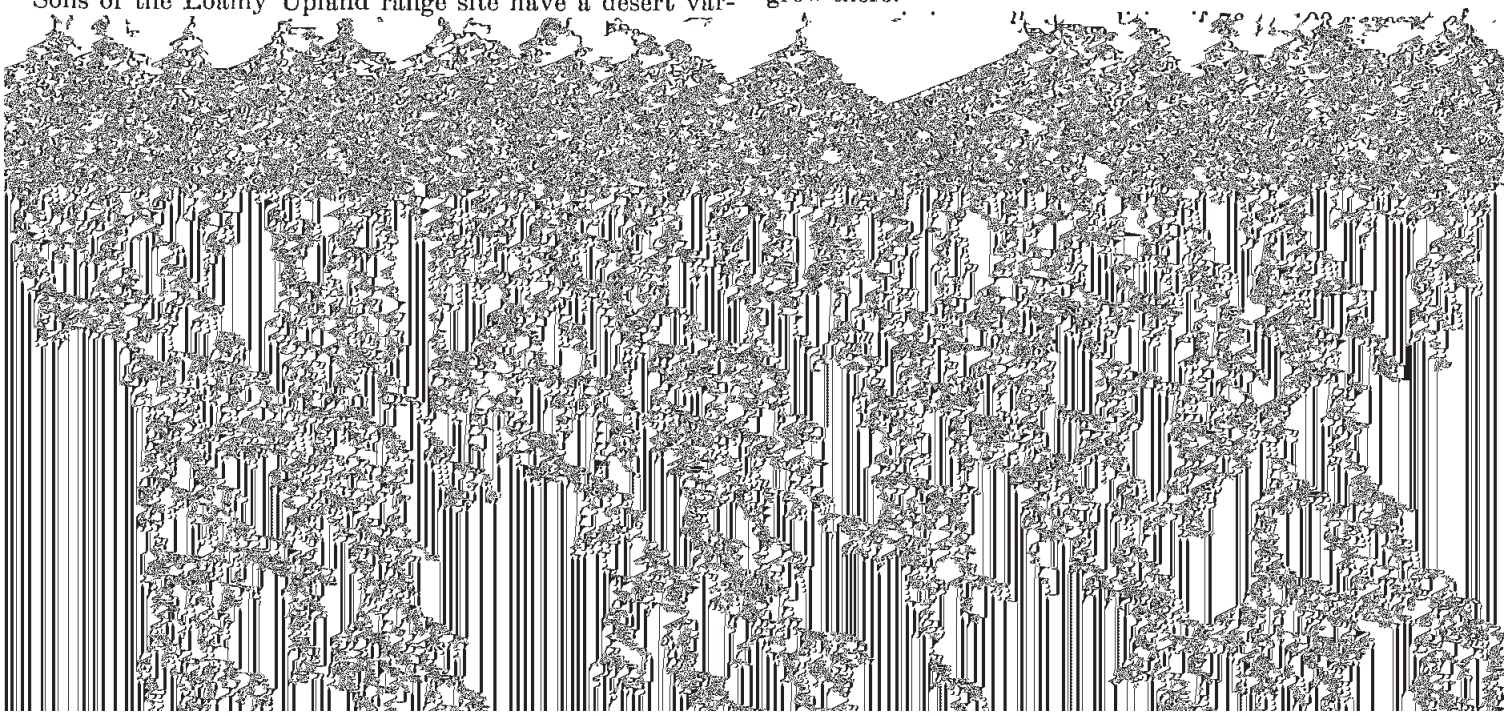
### *Range sites and condition classes*

Soils are grouped into range sites according to their capacity to produce the same kinds, amounts, and proportions of range plants. A range site is the product of all environmental factors responsible for its development.

A plant community existing within a range site that has not undergone abnormal disturbance is the potential, or climax, plant community for that site. Climax plant communities are not precise or fixed in their composition, but vary, within reasonable limits, from year to year and from place to place.

Abnormal disturbance, such as overuse by livestock, excessive burning, erosion, or plowing, results in changes in the climax plant community or even complete destruction if disturbance is drastic enough. If the range site has not deteriorated significantly under such disturbance, secondary plant succession progresses in the direction of the natural potential or climax plant community for the site.

Four range condition classes are used to indicate the degree of departure from the potential, or climax, vegetation brought about by grazing or other uses. The classes show the present condition of the native vegetation on a range site in relation to the native vegetation that could grow there.



### *Descriptions of range sites*

On the following pages, six range sites of the survey area are described, and the climax plants and principal invaders on the sites are listed. Only limited data are available concerning the kinds and amounts of climax vegetation that can be expected, but an estimate is given of the potential annual yield of air-dry vegetation for each site when it is in excellent condition. It is recognized that small areas at the higher elevations of the desert mountains receive annual precipitation in excess of 8 inches per year and are somewhat lower in temperature. These areas are minor in extent and are included with the adjacent range sites. The soils in each site can be determined by referring to the "Guide to Mapping Units" at the back of this soil survey.

#### CLAY UPLAND RANGE SITE

Following are the kinds and amounts of potential vegetation.

| Species: | *Percent* | Species: | *Percent* |
|---|---|---|---|
| Bush muhly | 10–15 | Cactus | 5–10 |
| Plains bristlegrass | 5–10 | Blue paloverde | 0–5 |
| Arizona cottontop | 5–10 | Catclaw | 0–5 |
| Three-awns | 5–10 | Desert broom | 0–5 |
| Desert saltbush | 30–50 | Wolfberry | 0–5 |
| Mesquite | 5–10 | Graythorn | 0–5 |
| Creosotebush | 5–15 | Fluffgrass | 0–2 |
| Four-wing saltbush | 5–15 | Native annuals | 0–10 |

#### SANDY BOTTOM RANGE SITE

This site is in stream channels and on flood plains and the adjacent low stream terraces along the major streams. A major part along the Gila River has been designated as the J. Fred Weiler Green Belt. The water table in this [illegible] between depths of 4 and 25 feet and gen-

the more palatable forage species to have almost disappeared. Creosotebush has increased and is dominant.

The following are the kinds and amounts of potential vegetation.

| Species: | Percent | Species: | Percent |
|---|---|---|---|
| Bush muhly | 5–10 | Littleleaf paloverde | 0–5 |
| Big galleta | 15–30 | Triangle bursage | 0–5 |
| Plains bristlegrass | 0–5 | White bursage | 0–5 |
| Arizona cottontop | 0–5 | Staghorn cholla | 0–5 |
| Range ratany | 5–10 | Graythorn | 0–5 |
| Creosotebush | 10–50 | Saguaro | 0–5 |
| Three-awn | 10–25 | | |

#### LOAM HILLS RANGE SITE

This site is on low hills and mountain ranges, including the Estrella, Salt River, Eagletail, and White Tank Mountains. Although bedrock exposures that have 15 to 80 percent slopes are not in this site, they influence runoff. The total extent of this site is about 120,000 acres.

The soils are very gravelly very fine sandy loams to very gravelly clay loams that are less than 20 inches deep over bedrock. Some areas are cobbly and others are stony.

Permeability is moderate to moderately slow. Runoff is medium in some areas, but is rapid in areas where bedrock is exposed.

Potential production on this range site is 800 pounds of air-dry herbage per acre in favorable years and 200 pounds in unfavorable years. This site has not deteriorated as much as other range sites because it is inaccessible to livestock grazing.

Following are the kinds and amounts of potential vegetation.

| Species: | Percent | Species: | Percent |
|---|---|---|---|
| Bush muhly | 10–15 | Four-wing saltbush | 5–15 |
| Desert needlegrass | 5–10 | Brittlebush | 5–10 |
| Slender tridens | 0–5 | Big galleta | 15–30 |
| Arizona cottontop | 0–5 | Three-awn | 5–10 |
| Black grama | 5–10 | Mormon-tea | 5–10 |
| Dropseed | 5–10 | Annuals | 0–25 |
| Range ratany | 10–15 | | |

#### CLAY BOTTOM RANGE SITE

This range site is in the area north of Sun City and at the northeast end of the White Tank Mountains. It

## Managing Soils for Wildlife [4]

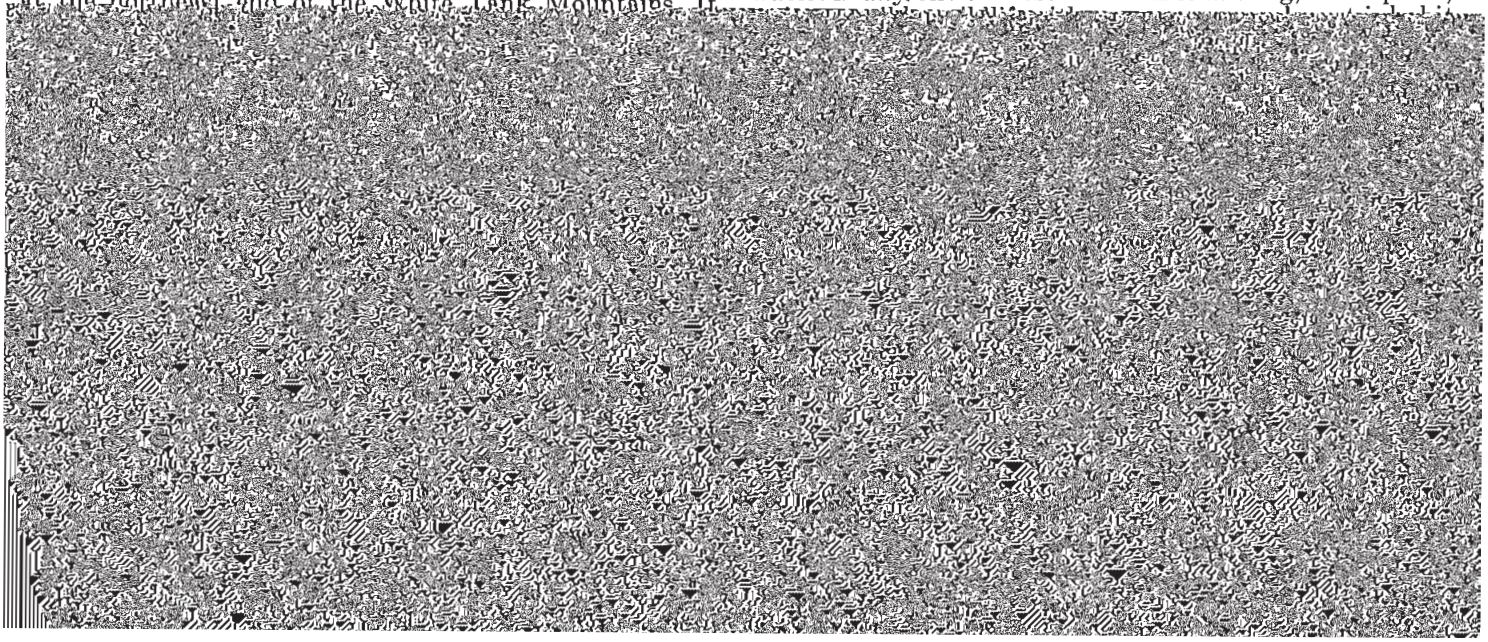
Table 3 lists wildlife species represented in the survey area and the kind of habitat required for each.

TABLE 3.—*Wildlife species and habitat*

[× means minor importance. ×× means major importance]

| Representative species of wildlife | Kind of habitat required | | | |
|---|---|---|---|---|
| | Openland | | Wetland | Rangeland |
| | Irrigated | Dryland | | |
| Javelina | | × | | ×× |
| Desert mule deer | | × | × | ×× |
| Bobcat | × | × | × | × |
| Coyote | × | × | × | ×× |
| Gray fox | × | × | × | × |
| Kit fox | × | × | × | ×× |
| Mexican racoon | ×× | × | ×× | |
| Ringtail | | × | × | ×× |
| Coati | | × | × | ×× |
| Badger | | × | | ×× |
| Desert cottontail | × | ×× | ×× | ×× |
| Kangaroo rat | | ×× | | ×× |
| White-winged dove | ×× | | ×× | |
| Mourning dove | ×× | ×× | ×× | ×× |
| Gambel quail | × | ×× | × | ×× |
| Roadrunner | × | × | × | ×× |
| Elf owl | | × | | ×× |
| Sidewinder rattlesnake | | × | | ×× |
| Banded gecko | | × | | ×× |
| Chuckwalla | | | | ×× |
| Desert tortoise | | × | × | ×× |
| Colorado River toad | ×× | × | ×× | × |

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, inadequate,



improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of wildlife are very severe, and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

The elements of wildlife habitat are briefly described in the following paragraphs.

*Grain and seed crops* are seed-producing annuals used by wildlife. Examples are corn, wheat, oats, barley, safflower, and sunflowers. The major soil properties that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations.

*Grasses and legumes* are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Examples are fescue, bush muhly, lovegrass, Arizona cottontop, catclaw, clover, alfalfa, and trefoil. Major soil properties that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture

wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control devices in marshes or streams. Examples are marshes, waterfowl feeding areas, and ponds. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed.

The kinds of wildlife habitat are briefly described in the following paragraphs.

*Openland habitat* consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The kinds of wildlife attracted to these areas include Gambel quail, roadrunner, mourning dove, white-winged dove, Mexican raccoon, and Colorado River toad.

*Wetland habitat* consists of open, marshy or swampy, shallow-water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are Mexican raccoon, desert cottontail, white-winged dove, mourning dove, and Colorado River toad.

*Rangeland habitat* consists of areas of wild herbaceous plants and shrubs. Wildlife attracted to rangeland include Mexican raccoon, desert cottontail, white-winged dove, mourning dove, and Colorado River toad.

### *Wildlife habitat groups*

Soils of the survey area have been assigned to 14 wildlife habitat groups according to their potential for producing three types of habitat for native wildlife.

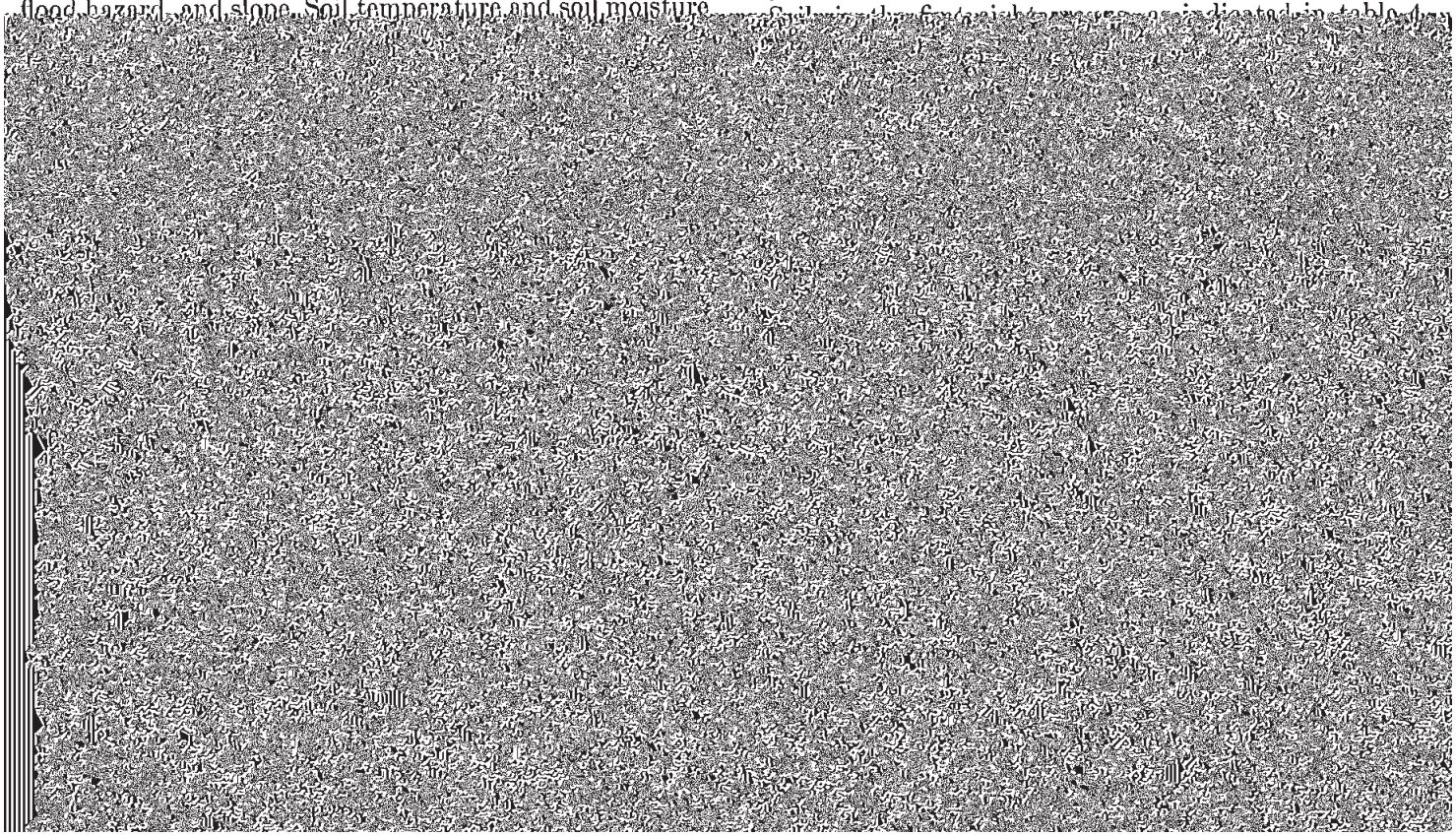


TABLE 4.—*Suitability of soils, by soil groups, for wildlife habitat*

| Wildlife habitat suitability groups | Potential for habitat elements | | | | | | Potential for kinds of habitat | | |
|---|---|---|---|---|---|---|---|---|---|
| | Grain and seed crops | Grass and legume crops | Wild herbaceous plants | Shrubs | Wetlands plants | Shallow water | Openland | Wetland | Rangeland |
| | IRRIGATED SOILS | | | | | | | | |
| Group 1 | Good | Good | Good | Good | Poor | Fair | Good | Poor. | |
| Group 2 | Good | Good | Good | Good | Poor | Very poor | Good | Very poor. | |
| Group 3 | Fair | Fair | Fair | Fair | Poor | Good | Fair | Fair. | |
| Group 4 | Fair | Fair | Fair | Fair | Poor | Very poor | Fair | Very poor. | |
| Group 5 | Fair | Fair | Fair | Fair | Very poor | Good | Fair | Poor. | |
| Group 6 | Poor | Poor | Poor | Poor | Poor | Very poor | Poor | Very poor. | |
| Group 7 | Poor | Poor | Poor | Poor | Poor | Poor | Poor | Poor. | |
| Group 8 | Poor | Poor | Poor | Poor | Poor | Good | Poor | Fair. | |
| | DRYLAND SOILS | | | | | | | | |
| Group 9 | | | Fair: good in places in Gila River. | Fair: good in places in Gila River. | Very poor: good in places in Gila River. | Very poor: in good places in Gila River. | | Very poor: good in places in Gila River. | Fair: good in places in Gila River. |
| Group 10 | | | Poor | Fair | Very poor | Very poor | | Very poor | Poor. |
| Group 11 | | | Poor | Poor | Poor | Very poor | | Very poor | Poor. |
| Group 12 | | | Poor | Poor | Very poor | Very poor | | Very poor | Poor. |
| Group 13 | | | Very poor | Very poor | Poor | Very poor | | Very poor | Poor. |
| Group 14 | | | Very poor | Very poor | Very poor | Very poor | | Very poor | Very poor. |

Important wildlife species are jackrabbits, cottontail rabbits, skunks, mourning dove, white-winged dove, Gambel quail, and songbirds.

#### WILDLIFE HABITAT GROUP 2

The soils in this group are on alluvial fans, valley plains, and stream terraces. They are good for openland wildlife and very poor for wetland wildlife. They are deep and well drained and are moderately rapidly permeable. All are irrigated. The surface layer is sandy loam, fine sandy loam, or loam. The underlying material ranges from loamy fine sand to loam. In some places the soils have gravelly lower layers, and in some they contain concentrations of lime. Slopes range from 0 to 3 percent.

The average annual rainfall is 6 to 8 inches. The available water capacity is 5.0 to 7.5 inches. The mean annual air temperature is 68° to 74° F, and the frost-free season is 250 to 300 days. The vegetation is mainly cotton, alfalfa, barley, sorghum, safflower, and sugar beets.

Important wildlife species are jackrabbits, cottontail rabbits, mourning dove, white-winged dove, Gambel quail, skunks, and songbirds.

#### WILDLIFE HABITAT GROUP 3

Most of the soils in this group are on flood plains, low stream terraces, and valley plains adjacent to stream channels. They are fair for openland wildlife and wetland wildlife. All are deep and well drained and are slowly to moderately slowly permeable. Most have a surface layer of clay loam or clay, but a few are loam. The lower layers range from loam to clay. Some soils contain lime concentrations. Slopes are less than 1 percent.

The average annual rainfall is 6 to 8 inches. The available water capacity is 8 to 13 inches. The mean annual air temperature is 68° to 74° F, and the frost-free season is 250 to 300 days. Some of these soils are subject to flooding. The vegetation is mainly cotton, alfalfa, barley, sorghum, safflower, and sugar beets.

Some of the important wildlife species are jackrabbits, cottontail rabbits, skunks, rodents, white-winged dove, mourning dove, Gambel quail, and songbirds.

#### WILDLIFE HABITAT GROUP 4

The soils in this group are on alluvial fans, flood plains, and low stream terraces along major streams. They are fair for openland wildlife and very poor for wetland wildlife. They are deep and well drained and are rapidly to moderately rapidly permeable. The surface layer ranges from loamy fine sand to sandy loam, and the lower layers range from sand to sandy loam. Slopes range from 0 to 1 percent.

The average annual rainfall is 6 to 8 inches. The available water capacity is 4 to 7 inches. The mean annual air temperature is 69° to 74° F, and the frost-free season is 250 to 300 days. Some areas are subject to flooding. The vegetation is mainly cotton, alfalfa, sorghum, barley, wheat, and safflower.

Some of the important wildlife species are jackrabbit, cottontail rabbit, rodents, skunk, mourning dove, white-winged dove, Gambel quail, and songbirds.

#### WILDLIFE HABITAT GROUP 5

The soils in this group are on valley plains and alluvial fans. They are fair for openland wildlife and poor for wetland wildlife. They are deep, well drained, and saline-

alkali. The surface layer ranges from sandy loam to loam. The lower layers range from loam to clay loam. All soils contain excessive amounts of saline or alkali salts or both and have visible concentrations of lime. Some are underlain by a hardpan, which is below a depth of 20 inches. Slopes are less than 1 percent.

The average annual rainfall is 6 to 8 inches. The available water capacity is 3 to 8 inches. The mean annual air temperature is 67° to 74° F, and the frost-free season is 250 to 300 days. The vegetation is mainly cotton, alfalfa, barley, sorghum, and safflower.

Some of the important wildlife species are jackrabbits, cottontail rabbits, rodents, skunks, mourning dove, white-winged dove, Gambel quail, and songbirds.

#### WILDLIFE HABITAT GROUP 6

The soils in this group are poor for openland wildlife and very poor for wetland wildlife. They are deep and well

#### WILDLIFE HABITAT GROUP 9

The soils in this group are on old alluvial fans, stream terraces, and flood plains and in stream channels. They are generally very poor for wetland wildlife and fair for rangeland wildlife, but in some areas along the Gila River they provide good wetland and rangeland habitat. They are deep, well-drained to excessively drained very gravelly sands to clays. Some have a hardpan at a depth of 20 to 40 inches. None are irrigated. Slopes are less than 1 percent.

The average annual rainfall is 6 to 8 inches, but most soils receive some additional runoff. The mean annual temperature is 69° to 74° F, and the frost-free season is 250 to 300 days. The water table is above a depth of 5 feet in a few places along the Gila River. The vegetation along the Gila River is saltcedar, arrowweed, saltbush, creosotebush, and mesquite. Vegetation on the old alluvial fans is galleta, mesquite, littleleaf paloverde, triangle bursage,

#### WILDLIFE HABITAT GROUP 12

Some of the soils in this group are on low hills and mountains, and others are in or near stream channels. All are very poor for wetland wildlife and poor for rangeland wildlife. Some are deep and well drained to excessively drained, and others are shallow over bedrock. The surface layer ranges from loamy sand to clay loam and contains variable amounts of gravel and cobbles. The lower layers range from sand to loam and also contain variable amounts of gravel and cobbles. None of the soils are irrigated. Slopes range from 0 to 90 percent.

The annual rainfall is 6 to 8 inches. The mean annual air temperature is 69° to 74° F, and the frost-free season is 250 to 325 days. Vegetation is mainly creosotebush, range ratany, triangle bursage, white bursage, joint fir, bladdersage, paloverde, wolfberry, and cactus.

upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, farmers, and individual land owners.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, drainage condition, shrink-swell potential, grain size, plasticity, and reaction. Also important are depth to the water table, depth to bedrock, and slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commer-

TABLE 5.—*Estimates of soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil that may that appear in the first column.

| Soil series and map symbols | Hydrologic group | Depth from surface | Dominant USDA texture | Classification | | Coarse fraction greater than 3 inches in diameter |
|---|---|---|---|---|---|---|
| | | | | Unified | AASHTO | |
| | | *Inches* | | | | |
| Agualt:[1] Aa | B | 0–27 | Loam | ML | A–4 | 0 |
| | | 27–60 | Sand | SP | A–3 | 0 |
| *Antho: [illegible] | B | [illegible] | Sandy loam or gravelly [illegible] | SM | A–2 | 0 |

*significant in engineering*

have different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series The symbol > means more than]

| Percentage of material less than 3 inches in diameter passing sieve— | | | | Liquid limit | Plasticity index | Permeability | Available water capacity | Reaction | Salinity | Shrink-swell potential | Risk of corrosion to— | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. 4 | No. 10 | No. 40 | No. 200 | | | | | | | | Uncoated steel | Concrete |
| | | | | | | *Inches per hour* | *Inches per inch of soil* | *pH* | *Millimhos per centimeter* | | | |
| ------- | 100 | 85–95 | 55–65 | 25–35 | 0–5 | 0. 6–2. 0 | 0. 15–0. 18 | 7. 9–8. 4 | 1–2 | Low------ | High------ | Low. |
| 95–100 | 85–95 | 55–65 | 0–3 | ------- | [2] NP | >20. 0 | 0. 05–0. 07 | 7. 9–8. 4 | 1–2 | Low------ | High------ | Low. |
| 80–100 | 50–75 | 50–60 | 15–30 | ------- | NP | 2. 0–6. 0 | 0. 08–0. 12 | 7. 9–8. 4 | 1–2 | Low------ | High------ | Low. |
| 80–100 | 50–75 | 50–60 | 15–30 | ------- | NP | 2. 0–6. 0 | 0. 08–0. 12 | 8. 5–9. 0 | 4–8 | Low------ | High------ | High. |
| ------- | 100 | 90–100 | 70–80 | 30–35 | 11–15 | 0. 2–0. 6 | 0. 19–0. 20 | 7. 9–8. 4 | 1–2 | Moderate-- | High [3]----- | Low. |
| ------- | 100 | 95–100 | 55–65 | 25–35 | NP–10 | 0. 6–2. 0 | 0. 15–0. 17 | 7. 9–8. 4 | 1–2 | Low------ | High------ | Low. |
| 85–95 | 75–90 | 55–65 | 0–10 | ------- | NP | 6. 0–20. 0 | 0. 05–0. 07 | 7. 9–8. 4 | 1–2 | Low------ | High------ | Low. |
| ------- | 100 | 90–100 | 70–80 | 30–35 | 11–15 | 0. 2–0. 6 | 0. 19–0. 21 | 7. 9–8. 4 | 1–2 | Moderate-- | High [3]----- | Low. |
| ------- | 100 | 85–95 | 55–65 | 25–35 | NP–5 | 0. 6–2. 0 | 0. 15–0. 17 | 7. 9–8. 4 | 1–2 | Low------ | High------ | Low. |
| ------- | 100 | 90–100 | 70–80 | 30–35 | 11–15 | 0. 2–0. 6 | 0. 19–0. 21 | 7. 9–8. 4 | 4–40 | Moderate-- | High------ | High. |
| ------- | 100 | 85–95 | 55–65 | 25–35 | NP–5 | 0. 6–2. 0 | 0. 15–0. 17 | 7. 9–8. 4 | 4–40 | Low------ | High------ | High. |

TABLE 5.—*Estimates of soil propertie*

| Soil series and map symbols | Hydrologic group | Depth from surface | Dominant USDA texture | Classification | | Coarse fraction greater than 3 inches in diameter |
|---|---|---|---|---|---|---|
| | | | | Unified | AASHTO | |
| | | *Inches* | | | | |
| Estrella: | | | | | | |
| Es | B | 0–24 | Loam | ML | A–4 | 0 |
| | | 24–60 | Clay loam | CL | A–6 | 0 |
| Et | B | 0–24 | Loam | ML | A–4 | 0 |
| | | 24–60 | Clay loam | CL | A–6 | 0 |
| *Gachado: GA | D | 0–14 | Very gravelly sandy clay loam. | GC | A–6 or A–2 | 5–15 |
| No valid estimate can be made for Rock outcrop part. | | 14 | Bedrock. | | | |
| Gadsden: [1] | | | | | | |
| Gb, Gc | D | 0–60 | Clay and clay loam | CH | A–7 | 0 |
| Gd | D | 0–60 | Clay and clay loam | CH | A–7 | 0 |
| *Gilman: [1] | | | | | | |
| Ge, GgA, GgB, GM, GN | B | 0–60 | Loam and very fine sandy loam. | ML | A–4 | 0 |
| For Antho part of GM and Laveen part of GN, see their respective series. | | | | | | |

*significant in engineering*—Continued

| Percentage of material less than 3 inches in diameter passing sieve— | | | | Liquid limit | Plasticity index | Permeability | Available water capacity | Reaction | Salinity | Shrink-swell potential | Risk of corrosion to— | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. 4 | No. 10 | No. 40 | No. 200 | | | | | | | | Uncoated steel | Concrete |
| | | | | | | *Inches per hour* | *Inches per inch of soil* | *pH* | *Millimhos per centimeter* | | | |
| 100 | 95–100 | 75–85 | 65–75 | ------- | NP | 0. 6–2. 0 | 0. 16–0. 18 | 7. 9–8. 4 | 1–2 | Low------ | High------ | Low. |
| ------- | 100 | 85–95 | 70–80 | 30–40 | 12–18 | 0. 2–0. 6 | 0. 18–0. 20 | 7. 9–8. 5 | 2–4 | Moderate-- | High------ | Low. |
| 100 | 95–100 | 75–85 | 65–75 | ------- | NP | 0. 6–2. 0 | 0. 16–0. 18 | 7. 9–8. 4 | 1–2 | Low------ | High------ | Low. |
| ------- | 100 | 85–95 | 70–80 | 30–40 | 12–18 | 0. 2–0. 6 | 0. 18–0. 20 | 8. 5–9. 6 | 4–8 | Moderate-- | High------ | Low. |
| 60–70 | 50–70 | 40–50 | 25–40 | 30–40 | 15–20 | 0. 06–0. 20 | 0. 08–0. 16 | 7. 9–8. 4 | 1–2 | Low------ | High------ | Low. |
| ------- | 100 | 90–100 | 80–90 | 50–60 | 25–35 | 0. 2–0. 06 | 0. 15–0. 17 | 7. 9–8. 4 | 2–4 | High------ | High------ | Moderate. |
| ------- | 100 | 90–100 | 80–90 | 50–60 | 25–35 | 0. 2–0. 06 | 0. 15–0. 17 | 8. 5–9. 0 | 4–15 | High------ | High------ | High. |
| 100 | 95–100 | 75–85 | 65–75 | ------- | NP | 0. 6–2. 0 | 0. 16–0. 18 | 7. 9–8. 4 | 1–2 | Low------ | High------ | Low. |
| 100 | 95–100 | 75–85 | 65–75 | ------- | NP | 0. 6–2. 0 | 0. 16–0. 18 | 8. 4–9. 6 | 4–40 | Low------ | High------ | Moderate to high. |
| 100 | 95–100 | 75–85 | 65–75 | ------- | NP | 0. 6–2. 0 | 0. 16–0. 18 | 7. 9–8. 4 | 9–15 | Low------ | High------ | High. |
| 100 | 100 | 90–100 | 80–90 | 50–60 | 25–35 | 0. 2–0. 6 | 0. 14–0. 16 | 7. 9–8. 4 | 9–15 | High------ | High------ | High. |
| 100 | 95–100 | 85–95 | 75–85 | 35–45 | 20–30 | 0. 2–0. 6 | 0. 19–0. 21 | 7. 9–8. 4 | 0–4 | Moderate to high. | High------ | Low to moderate. |
| 100 | 95–100 | 85–95 | 75–85 | 35–45 | 20–30 | 0. 2–0. 6 | 0. 19–0. 21 | 7. 9–9. 0 | 4–15 | Moderate to high. | High---- | High. |
| 35–60 | 25–50 | 20–30 | 15–20 | 20–30 | 10–15 | 0. 6–2. 0 | 0. 05–0. 07 | 7. 9–8. 4 | 1–4 | Low------ | High------ | Low. |
| 85–100 | 65–85 | 60–75 | 50–65 | 30–40 | 12–20 | 0. 2–0. 6 | 0. 17–0. 19 | 7. 9–9. 0 | 4–20 | Moderate-- | High------ | High. |
| 80–90 | 65–85 | 55–75 | 40–60 | 30–40 | 11–20 | 0. 2–0. 6 | 0. 09–0. 11 | 7. 9–9. 6 | 15–60 | Moderate-- | High------ | High. |
| 100 | 100 | 85–95 | 60–75 | 25–35 | NP | 0. 6–2. 0 | 0. 16–0. 18 | 7. 9–9. 0 | 4–15 | Low------ | High------ | High. |
| 100 | 100 | 90–100 | 70–80 | 30–40 | 15–25 | 0. 06–0. 2 | 0. 10–0. 18 | 8. 5–9. 6 | 8–20 | Moderate-- | High------ | High. |
| 95–100 | 85–100 | 70–85 | 50–70 | 25–40 | NP–15 | 0. 6–2. 0 | 0. 13–0. 18 | 7. 9–8. 4 | 1–4 | Low------ | High------ | Low to moderate. |
| 95–100 | 85–100 | 70–85 | 50–70 | 25–40 | NP–15 | 0. 6–2. 0 | 0. 13–0. 18 | 8. 5–9. 6 | 4–8 | Low------ | High------ | High. |
| 95–100 | 85–95 | 60–70 | 30–40 | ------- | NP | 2. 0–6. 0 | 0. 11–0. 13 | 7. 9–8. 4 | 1–2 | Low------ | High------ | Low. |
| 75–90 | 60–75 | 30–45 | 0–15 | ------- | NP | 6. 0–20. 0 | 0. 04–0. 06 | 7. 9–8. 4 | 1–2 | Low------ | High------ | Low. |
| 95–100 | 95–100 | 85–95 | 70–80 | 30–40 | 20–30 | 0. 2–0. 6 | 0. 19–0. 21 | 7. 9–8. 4 | 1–2 | Moderate-- | High------ | Low. |
| 95–100 | 95–100 | 85–95 | 50–65 | 25–35 | NP | 0. 6–2. 0 | 0. 15–0. 17 | 7. 9–8. 4 | 1–2 | Low------ | High------ | Low. |
| 80–90 | 55–75 | 40–55 | 30–40 | 25–40 | 5–10 | 0. 6–2. 0 | 0. 10–0. 13 | 7. 9–8. 4 | 1–2 | Low------ | High------ | Low. |
| 95–100 | 85–95 | 55–65 | 25–35 | 20–30 | NP–5 | 2. 0–6. 0 | 0. 09–0. 11 | 7. 9–8. 4 | 1–4 | Low------ | High------ | Low. |
| 80–90 | 55–75 | 40–55 | 30–40 | 25–40 | 5–10 | 0. 6–2. 0 | 0. 10–0. 13 | 8. 5–9. 6 | 4–8 | Low------ | High------ | High. |
| 95–100 | 85–95 | 55–65 | 25–35 | 20–30 | NP–5 | 2. 0–6. 0 | 0. 09–0. 11 | 8. 5–9. 6 | 4–8 | Low------ | High------ | High. |

TABLE 5.—*Estimates of soil properties*

| Soil series and map symbols | Hydrologic group | Depth from surface | Dominant USDA texture | Classification | | Coarse fraction greater than 3 inches in diameter |
|---|---|---|---|---|---|---|
| | | | | Unified | AASHTO | |
| | | *Inches* | | | | |
| *Pinal: PsA, PsB, PT, PvB, PWB. For La Palma part of PvB and Suncity part of PWB, see their respective series. | D | 0–12 | Loam | ML or SM | A–4 | 0–5 |
| | | 12 | Indurated silica-cemented hardpan. | | | |
| *Pinamt: PYD. For Tremant part, see Tremant series. | B | 0–22 | Very gravelly sandy clay loam. | GM | A–2 | 5–40 |
| | | 22–60 | Very gravelly sandy loam. | GM | A–1 | 5–30 |
| *Rillito: RaA, RaB, RbA, RbB, RhB, RpE. For Harqua part of RhB and Perryville part of RpE, see their respective series. | B | 0–60 | Gravelly loam and gravelly sandy loam. | SM or SC–SM | A–2 or A–4 | 0 |
| *Rock outcrop: RS. For Cherioni part, see Cherioni series. No valid estimate can be made for Rock outcrop. | | | | | | |
| Suncity. Mapped only in a complex with Pinal soils. | D | 0–13 | Clay loam | CL | A–6 | 0–5 |
| | | 13 | Indurated silica-lime cemented hardpan. | | | |
| Toltec: Ta | C | 0–28 | Loam | ML | A–4 | 0 |
| | | 28–60 | Weakly to strongly cemented hardpan. | ---------- | ---------- | ---------- |
| Torrifluvents: [1] TB. No valid estimate can be made. | | | | | | |
| Torriorthents: Tc. No valid estimate can be made. | | | | | | |
| *Torripsamments: TD. No valid estimate can be made. For Torrifluvents part, see Torrifluvents. | | | | | | |
| *Tremant: Te, TfA, TfB, Tg, Th, TPB, TrA, TrB, TSC. For Rillito part of TrA, TrB, and TSC, see Rillito series. | B | 0–23 | Gravelly clay loam | SC or GC | A–6 | 0–10 |
| | | 23–60 | Gravelly loam | SM | A–4 | 0–10 |
| Trix: Tt | B | 0–60 | Clay loam | CL | A–6 | 0 |
| Tucson: Tu, Tw | B | 0–14 | Loam | ML | A–4 | 0 |
| | | 14–60 | Clay loam and loam | CL | A–6 | 0 |
| Valencia: | | | | | | |
| Va, Vc | B | 0–26 | Sandy loam | SM | A–2 | 0 |
| | | 26–60 | Clay loam and sandy clay loam. | CL | A–6 | 0 |
| Vb | B | 0–26 | Sandy loam | SM | A–2 | 0 |
| | | 26–60 | Clay loam and sandy clay loam. | CL | A–6 | 0 |
| Vecont: Ve, Vf | D | 0–60 | Clay | CH | A–7 | 0 |
| *Vint: [1] Vg, Vh, Vk, Vn, Vr. For Carrizo part of Vr, see Carrizo series. | B | 0–60 | Loamy fine sand | SM | A–2 | 0 |
| Wintersburg: Wg | C | 0–60 | Clay loam and loam | CL | A–6 | 0 |

[1] Subject to rare flooding of very brief duration in local areas.
[2] NP is nonplastic.

*significant in engineering*—Continued

| Percentage of material less than 3 inches in diameter passing sieve— | | | | Liquid limit | Plasticity index | Permeability | Available water capacity | Reaction | Salinity | Shrink-swell potential | Risk of corrosion to— | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. 4 | No. 10 | No. 40 | No. 200 | | | | | | | | Uncoated steel | Concrete |
| | | | | | | *Inches per hour* | *Inches per inch of soil* | *pH* | *Millimhos per centimeter* | | | |
| 80–95 | 70–85 | 65–75 | 40–60 | 25–35 | NP–10 | 0.6–2.0 | 0.12–0.18 | 7.9–8.4 | 2–4 | Low | High | Low. |
| 45–75 | 30–55 | 20–40 | 15–30 | 30–40 | 5–10 | 0.2–0.6 | 0.08–0.10 | 7.9–8.4 | 1–4 | Low | High | Low. |
| 45–75 | 30–55 | 15–30 | 15–20 | ------- | NP | 2.0–6.0 | 0.05–0.07 | 7.9–8.4 | 1–4 | Low | High | Low. |
| 80–90 | 50–75 | 40–60 | 30–40 | 25–35 | NP–15 | 0.6–2.0 | 1.09–0.12 | 7.9–8.4 | 0–4 | Low | High | Moderate. |
| 90–100 | 85–95 | 70–85 | 60–70 | 30–40 | 10–20 | 0.2–0.6<br><0.06 | 0.15–0.18 | 7.9–8.4 | 4–20 | Moderate | High | Moderate to high. |
| 100 | 100 | 75–90 | 60–75 | 30–40 | NP–10 | 0.6–2.0 | 0.16–0.18 | 7.9–8.4 | 2–4 | Low | High | Moderate. |
| ------- | ------- | ------- | ------- | ------- | ------- | 0.06–0.2 | 0.06–0.08 | 7.9–9.0 | 2–15 | Low | High | Moderate. |
| 60–80 | 50–75 | 45–60 | 35–50 | 20–40 | 10–20 | 0.2–0.6 | 0.13–0.15 | 7.9–8.4 | 1–4 | Moderate | High | Low. |

TABLE 6.—*Interpretation of*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil that may have appear in the

| Soil series and map symbols | Degree and kind of limitation for— | | | |
|---|---|---|---|---|
| | Septic tank absorption fields | Sewage lagoons | Shallow excavations | Dwellings without basements |
| Agualt: Aa | Slight: possible hazard of pollution of ground water. | Severe: very rapidly permeable below a depth of 20 to 40 inches. | Severe: too sandy; unstable below a depth of 20 to 40 inches. | Slight: some areas subject to occasional flooding. |
| *Antho: AbA, AbB, Ac, AdA, AdB, Ae, AfA, AfB, AGB, AHC, AkB, AL, AM. For Brios part of Ae; Carrizo part of AfA, AfB, AGB; Tremant part of AHC; Mohall part of AkB; and Valencia part of AM, see their respective series. | Slight | Severe: moderately rapidly permeable. | Slight: gravelly phases are moderate. | Slight |
| Avonda: An | Slight: possible hazard of pollution of ground water. | Severe: rapidly permeable below a depth of 20 to 40 inches. | Severe: too sandy; unstable below a depth of 20 to 40 inches. | Slight |
| Avondale: Ao, Ap | Slight | Moderately permeable. | Slight | Slight |
| Beardsley: BE | Severe: slowly permeable over impermeable pan. | Severe: impermeable pan at a depth of 20 to 40 inches. | Severe: hardpan below a depth of 20 to 40 inches. | Severe: high shrink-swell potential; less than 20 to 40 inches to indurated hardpan. |
| Brios: Br, Bs, Bt | Severe: flooding; possible hazard of pollution to ground water. | Severe: rapidly permeable. | Severe: too sandy; unstable. | Severe: flooding |
| *Calciorthids: CA2. For Torriorthents part, see Torriorthents. Too variable to be estimated. | | | | |
| *Carrizo: Cb, CeD, CF. For Ebon part of CeD and Brios part of CF, see their respective series. | Severe: flooding; possible hazard of pollution to ground water. | Severe: rapidly permeable. | Severe: too sandy; unstable. | Severe: flooding |
| *Casa Grande: Cg, Ch, Ck, Cm. For Laveen part of Cm, see Laveen series. | Severe: slowly permeable. | Slight | Moderate: unstable; high salt content. | Moderate: moderate shrink-swell potential. |
| Cashion: Cn | Slight | Slight | Moderate: too clayey. | Severe: high shrink-swell potential; flooding in some areas. |

*engineering properties*

different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series that first column]

| Degree and kind of limitation for—Continued | | Suitability as a source of— | | | Soil features affecting— | |
|---|---|---|---|---|---|---|
| Sanitary landfill (trench type) | Local roads and streets | Road fill | Sand | Topsoil | Pond reservoir areas | Embankments, dikes, and levees |
| Severe: too sandy; very rapidly permeable below a depth of 20 to 40 inches. | Moderate: excess fines. | Good | Fair: 20 to 40 inches of overburden. | Poor: sand below a depth of 20 to 40 inches. | Rapidly permeable. | Medium shear strength; high compacted permeability. |
| Severe: too [illegible] | Slight | Good | Poor: high content of [illegible] | Good | Moderately rapidly [illegible] | Fair to good compaction charac- |

TABLE 6.—*Interpretation of*

| Soil series and map symbols | Degree and kind of limitation for— | | | |
|---|---|---|---|---|
| | Septic tank absorption fields | Sewage lagoons | Shallow excavations | Dwellings without basements |
| *Cherioni: CO. Rock outcrop part is too variable to be rated. | Severe: less than 20 inches to bedrock. | Severe: less than 20 inches to bedrock. | Severe: less than 20 inches to bedrock. | Severe: less than 20 inches to bedrock. |
| *Coolidge: Cp, CrB, Cs, CV. For Tremant part of Cs and Laveen part of CV, see their respective series. | Slight | Severe: moderately rapidly permeable. | Slight to moderate: gravelly. | Slight |
| Dune land: Dn. Too variable to be rated. | | | | |
| *Ebon: EbD, EPD. For Pinamt part of EPD, see Pinamt series. | Severe: slowly permeable. | Severe: 50 to 90 percent gravel and cobbles. | Severe: 50 to 90 percent gravel and cobbles. | Slight |
| Estrella: Es, Et | Severe: moderately slowly permeable. | Slight | Slight | Moderate: moderate shrink-swell potential. |
| *Gachado: GA. Rock outcrop part is too variable to be rated. | Severe: bedrock at a depth of less than 20 inches. | Severe: bedrock at a depth of less than 20 inches. | Severe: bedrock at a depth of less than 20 inches. | Severe: bedrock at a depth of less than 20 inches. |
| Gadsden: Gb, Gc, Gd | Severe: slowly permeable. | Slight | Severe: too clayey | Severe: high shrink-swell potential. |
| *Gilman: Ge, Gf, GgA, GgB, Gh, GL, GM, | Slight | Moderate: moderately permeable | Slight | Slight: flooding in some areas |

*engineering properties*—Continued

| Degree and kind of limitation for—Continued | | Suitability as a source of— | | | Soil features affecting— | |
|---|---|---|---|---|---|---|
| Sanitary landfill (trench type) | Local roads and streets | Road fill | Sand | Topsoil | Pond reservoir areas | Embankments, dikes, and levees |
| Severe: less than 20 inches to bedrock. | Severe: less than 20 inches to bedrock. | Poor: bedrock at a depth of less than 20 inches. | Poor: excess fines. | Poor: very gravelly and cobbly; less than 20 inches to bedrock; slope. | Less than 20 inches to bedrock; slopes are 3 to 25 percent. | Less than 20 inches to bedrock. |
| Slight | Slight | Good | Poor: excess fines. | Fair: 24 inches to lime accumulation. | Moderately rapidly permeable. | Medium compacted permeability; medium shear strength; susceptible to piping. |
| Slight | Slight | Good | Unsuited: excess fines. | Poor: more than 50 percent gravel and cobbles. | 50 to 90 percent gravel and cobbles. | Low compacted permeability; medium shear strength. |
| Slight | Moderate: excess fines. | Fair: excess fines. | Unsuited: excess fines. | Good | Moderately slowly permeable. | Medium compacted permeability; susceptible to piping; low shear strength. |
| Severe: bedrock at a depth of less than 20 inches. | Severe: bedrock at a depth of less than 20 inches. | Poor: limited material. | Unsuited: excess fines; limited material. | Poor: less than 20 inches to bedrock. | 15 to 50 percent gravel and cobbles; less than 20 inches to bedrock. | Less than 20 inches to bedrock. |
| Severe: too clayey. | Severe: high shrink-swell potential; excess fines. | Poor: high shrink-swell potential; excess fines. | Unsuited: excess fines. | Poor: clayey; Gd is high in salts. | Slowly permeable | Low shear strength; low compacted permeability. |
| Slight: flooding in some areas. | Moderate: excess fines; flooding in some areas. | Fair: excess fines. | Unsuited: excess fines. | Good. Fair to poor for Gf, Gh, and part of GL; contains toxic quantities of salts. | Moderately permeable. | Medium compacted permeability; susceptible to piping; low shear strength. |
| Severe: too clayey below a depth of 20 to 40 inches; flooding in some areas. | Severe: excess fines below a depth of 20 to 40 inches; high shrink-swell potential; flooding in some areas. | Poor: excess fines. | Unsuited: excess fines. | Poor: excess salts. | Slowly permeable | Low shear strength; low compacted permeability; susceptible to piping. |
| Moderate: too clayey. | Severe: moderate to high shrink-swell potential; excess fines. | Poor: excess fines; moderate to high shrink-swell potential. | Unsuited: excess fines. | Fair: clay loam. Poor for Gs: excess salts. | Moderately slowly permeable. | Susceptible to piping; medium compacted permeability; low shear strength. |
| Slight: underlain by coarse | Slight if slopes are 0 to 8 per- | Good | Unsuited: excess fines. | Poor: more than 50 per- | Moderately slowly permeable; | Low compacted permeability; |

TABLE 6.—*Interpretation of*

| Soil series and map symbols | Degree and kind of limitation for— | | | |
|---|---|---|---|---|
| | Septic tank absorption fields | Sewage lagoons | Shallow excavations | Dwellings without basements |
| *Harqua: HAB, HAC, HLC, HM, HrB. For Gunsight part of HLC, Laveen part of HM, and Rillito part of HrB, see their respective series. | Severe: moderately slowly permeable. | Moderate: 15 to 50 percent gravel. | Moderate: gravelly. | Moderate: moderate shrink-swell potential. |
| La Palma: La | Severe: indurated hardpan at a depth of 20 to 40 inches. | Severe: less than 40 inches to hardpan. | Severe: rippable indurated hardpan at a depth of 20 to 40 inches. | Moderate: moderate shrink-swell potential. |
| *Laveen: Lb, LcA, LcB, Ld, Le, Lf. For Antho part of Lf, see Antho series. | Slight | Moderate: moderately permeable. | Slight | Slight |
| Maripo: Ma | Slight: possible pollution to ground water. | Severe: moderately rapidly permeable below a depth of 20 to 40 inches. | Severe: unstable below a depth of 20 to 40 inches. | Slight |
| *Mohall: Mo, Mp, Mr, Ms, MTB, MV. For Tremant part of MTB, and Laveen part of MV, see their respective series. | Severe: moderately slowly permeable. | Moderate: moderately permeable below a depth of 20 to 40 inches. | Moderate: too clayey. | Moderate: moderate shrink-swell potential. |
| *Perryville: Pa, Pb, PeA, PeB, PRB. For Rillito part of PRB, see Rillito series. | Slight | Moderate: moderately permeable. | Moderate: gravelly. | Slight |
| *Pinal: PsA, PsB, PT, PvB, PWB. For La Palma part of PvB and Suncity part of PWB, see their respective series. | Severe: less than 20 inches to hardpan. | Severe: less than 20 inches to hardpan. | Severe: less than 20 inches to hardpan. | Severe: less than 20 inches to hardpan. |
| *Pinamt: PYD. For Tremant part of PYD, see Tre- | Slight | Severe: more than 50 percent coarse | Severe: very gravelly. | Slight |

*engineering properties*—Continued

| Degree and kind of limitation for—Continued | | Suitability as a source of— | | | Soil features affecting— | |
|---|---|---|---|---|---|---|
| Sanitary landfill (trench type) | Local roads and streets | Road fill | Sand | Topsoil | Pond reservoir areas | Embankments, dikes, and levees |
| Slight | Moderate: moderate shrink-swell potential; excess fines. | Fair: excess fines; moderate shrink-swell potential. | Unsuited: excess fines. | Poor: excess salts; more than 15 percent gravel. | Moderately slowly permeable; 15 to 50 percent gravel. | Medium shear strength; low compacted permeability. |
| Severe: rippable hardpan at a depth of 20 to 40 inches. | Severe: excess fines; moderate shrink-swell potential. | Poor: excess fines; moderate shrink-swell potential. | Unsuited: excess fines. | Poor: excess salts. | Hardpan at a depth of 20 to 40 inches. | Low shear strength; low compacted permeability; susceptible to piping. |
| Slight | Moderate: excess fines. | Fair: excess fines. | Unsuited: excess fines. | Fair below a depth of 14 to 24 inches; high lime content. Poor for Ld and Lf: excess salts. | Moderately permeable. | Low shear strength; susceptible to piping. |
| Severe: too sandy; moderately rapidly permeable below a depth of 20 to 40 inches. | Slight | Good | Fair: excess fines. | Poor: gravelly loamy sand at a depth of 20 to 40 inches. | Moderately rapidly permeable. | Medium shear strength; medium compacted permeability; susceptible to piping. |
| Moderate: too clayey. | Severe: excess fines; moderate shrink-swell potential. | Fair: excess fines; moderate shrink-swell potential. | Unsuited: excess fines. | Fair: clay loam | Moderately slowly permeable. | Low shear strength; medium compacted permeability; susceptible to piping. |
| Slight | Moderate: excess fines | Fair: excess fines | Unsuited: excess fines | Poor: more than 15 per- | Moderately per- meable; 15 to | Medium com- pacted per- |

TABLE 6.—*Interpretation of*

| Soil series and map symbols | Degree and kind of limitation for— | | | |
|---|---|---|---|---|
| | Septic tank absorption fields | Sewage lagoons | Shallow excavations | Dwellings without basements |
| Suncity. Mapped only in complex with Pinal soils. | Severe: less than 20 inches to hardpan. | Severe: less than 20 inches to hardpan. | Severe: less than 20 inches to hardpan. | Severe: less than 20 inches to hardpan. |
| Toltec: Ta | Severe: hardpan at a depth of 20 to 40 inches. | Severe: hardpan at a depth of 20 to 40 inches. | Severe: hardpan at a depth of 20 to 40 inches. | Slight |
| Torrifluvents: TB. Too variable to be rated. | | | | |
| Torriorthents: Tc. Too variable to be rated. | | | | |
| *Torripsamments: TD. Too variable to be rated. For Torrifluvents part, see Torrifluvents. | | | | |
| *Tremant: Te, TfA, TfB, Tg, Th, TPB, TrA, TrB, TSC. For Rillito part of TrA, TrB, and TSC, see Rillito series. | Slight if lines are below slowly permeable solum. | Moderate: 15 to 35 percent coarse fragments; moderately permeable below a depth of 20 inches. | Moderate: gravelly. | Slight |
| Trix: Tt | Severe: moderately slowly permeable. | Slight | Moderate: too clayey. | Moderate: moderate shrink-swell potential. |
| Tucson: Tu, Tw | Severe: moderately slowly permeable. | Slight | Moderate: too clayey. | Moderate: moderate shrink-swell potential. |
| Valencia: Va, Vb, Vc | Severe: moderately slowly permeable. | Slight | Moderate: too clayey. | Slight |
| Vecont: Ve, Vf | Severe: slowly permeable. | Slight | Severe: too clayey. | Severe: high shrink-swell potential. |
| *Vint: Vg, Vh, Vk, Vn, Vr. For Carrizo part of Vr, see Carrizo series. | Slight: possible hazard of pollution to ground water. | Severe: moderately rapidly permeable. | Severe: too sandy. | Slight |
| Wintersburg: Wg | Severe: moderately slowly permeable. | Slight | Slight | Moderate: moderate shrink-swell potential. |

*engineering properties*—Continued

| Degree and kind of limitation for—Continued | | Suitability as a source of— | | | Soil features affecting— | |
|---|---|---|---|---|---|---|
| Sanitary landfill (trench type) | Local roads and streets | Road fill | Sand | Topsoil | Pond reservoir areas | Embankments, dikes, and levees |
| Severe: less than 20 inches to hardpan. | Severe: less than 20 inches to hardpan. | Poor: excess fines; less than 20 inches to hardpan. | Unsuited: less than 20 inches to hardpan; excess fines. | Poor: less than 20 inches to hardpan; excess salts. | Less than 20 inches to hardpan. | Less than 20 inches to hardpan. |
| Slight | Moderate: excess fines. | Fair: excess fines. | Unsuited: excess fines. | Poor: hardpan at a depth of 20 to 40 inches. | Slowly permeable. | Medium compacted permeability; low shear strength; susceptible to piping. |
| Slight | Moderate: moderate shrink-swell potential. | Fair: excess fines. | Unsuited: excess fines. | Poor: more than 15 percent gravel. | Slowly permeable. | Medium compacted permeability; medium shear strength. |
| Slight | Moderate: excess fines; moderate shrink-swell potential. | Poor: excess fines. | Unsuited: excess fines. | Fair: clay loam. | Moderately slowly permeable. | Medium shear strength; fair to good compaction characteristics; medium compacted permeability. |
| Slight | Severe: excess fines; moderate shrink-swell potential. | Poor: excess fines. | Unsuited: excess fines. | Fair: clay loam. | Moderately slowly permeable. | Fair to good compaction characteristics; medium shear strength; medium compacted permeability. |
| Moderate: too clayey. | Slight | Fair: excess fines. | Poor: excess fines. | Good. Poor for Vb: excess fines. | Moderately slowly permeable. | Medium shear strength; good compaction characteristics; low compacted permeability. |
| Severe: too clayey. | Severe: high shrink-swell potential; excess fines. | Poor: excess fines. | Unsuited: excess fines. | Poor: clay | Slowly permeable. | Low shear strength; fair compaction characteristics; low compacted permeability. |
| Severe: too sandy; moderately rapidly permeable; flooding in some areas. | Slight: flooding in some areas. | Good | Fair: 15 to 25 percent fines. | Poor: loamy sand. | Moderately rapidly permeable. | Fair compaction characteristics; susceptible to piping; medium shear strength. |
| Slight | Severe: excess fines; moderate shrink-swell potential. | Poor: excess fines. | Unsuited: excess fines. | Fair: clay loam. | Moderately slowly permeable. | Low shear strength; fair compaction characteristics; low compacted permeability. |

In the Unified system (*7*) soils are classified according to particle size distribution, plasticity, liquid limit, and content of organic matter. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, CL–ML.

The AASHTO system (*1*) is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The estimated AASHTO classification, without group index numbers, is given in table 5 for all soils mapped in the survey area.

### *Soil properties significant in engineering*

Several estimated soil properties significant in engineering are listed in table 5. These estimates are for representative soil profiles, by layers sufficiently different to have different significance in soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 5.

Soil texture is described in table 5 in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary at the back of this soil survey.

Depth to water table is not given in table 5 because none of the soils in the survey area have a high water table. The water table remains at such a great depth that it is not significant in engineering projects.

Depth to bedrock is not given in table 5 because most soils in the survey area are deep enough over bedrock that bedrock does not affect their use. Bedrock is at a depth of 6 to 20 inches in the Cherioni soils and at a depth of 9 to 20 inches in the Gachado soils.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from the semisolid to plastic state; and the liquid limit, from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table 5.

Permeability is the quality that enables a soil to transmit water or air. It is estimated on basis of those soil characteristics observed in the field, particularly structure, porosity, and texture. The estimates in table 5 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary.

Salinity refers to the amount of soluble salts in the soil, It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25° C. Salinity affects the suitability of a soil for crops, its stability when used as construction material, and the risk of corrosion of the soil to metals and concrete.

Shrink-swell potential is the relative change in volume to be expected with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils causes much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material having this rating.

The risk of corrosion, as used in table 5, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. Rate of corrosion on uncoated steel is related to soil properties, such as drainage, texture, total acidity, and electrical conductivity of the soil material. The rate of corrosion on concrete is influenced mainly by the content of soduim or magnesium sulfate, but also by soil texture and acidity. Installations of uncoated steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. A corrosion rating of *low* indicates a low probability of soil-induced corrosion damage. A rating of *high* indicates a high probability of damage, so that protective measures for steel and more resistant concrete should be used to avoid or minimize damage.

### *Engineering interpretations*

The interpretations in table 6 are based on the engineering properties of soils shown in table 5, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of the survey area. Ratings in table 6 summarize the limitation or suitability of the soils for all listed purposes but pond reservoir areas, embankments, dikes, and levees.

Limitations are expressed as slight, moderate, severe. Sanitary landfill is a method of disposing of refuse in

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Stones or organic material in a soil are among factors that are unfavorable.

## Recreation

Knowledge of soils is necessary in planning, developing, and maintaining areas used for recreation. In table 7 the soils of the survey area are rated according to limitations that affect their suitability for camp areas, playgrounds, picnic areas, and paths and trails, and lawn and golf fairways.

In table 7 the soils are rated as having slight, moderate, or severe limitations for the specified uses. For all of

TABLE 7.—*Soil limitations for*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils for referring to other series that

| Soil series and map symbols | Camp areas | Picnic areas |
|---|---|---|
| Agualt: Aa | Severe: flooding | Moderate: flooded for short periods |
| *Antho: AbA, AbB, Ac, Ae, AfA, AfB, AGB, AHC, AkB, AL, AM. For Carrizo part of AfA, AfB, AGB; Tremant part of AkB, AHC; Brios part of Ae; Mohall part of AkB; and Valencia part of AM; see their respective series. | Slight | None to slight |
| AdA, AdB | Moderate: 20 to 50 percent gravel | Moderate: 20 to 50 percent gravel |
| Avonda: An | Moderate: clay loam surface layer | Moderate: clay loam surface layer |
| Avondale: Ao, Ap | Moderate: clay loam surface layer | Moderate: clay loam surface layer |
| Beardsley: BE | Moderate: slow permeability | None to slight |
| Brios: Br, Bs, Bt | Severe: flooding | None to slight |
| *Carrizo: Cb, CeD, CF. For Ebon part of CeD and Brios part of CF, see their respective series. | Severe: flooding; gravelly | Severe: flooding |
| *Casa Grande: Cg, Ch, Ck, Cm. For Laveen part of Cm, see Laveen series. | Moderate: slow permeability | Slight |
| Cashion: Cn | Severe: clay surface layer; flooding | Severe: clay surface layer |
| *Cherioni: CO. For Rock outcrop part, see Rock outcrop. | Severe: more than 50 percent coarse fragments; slope; bedrock at a depth of less than 20 inches. | Severe: more than 50 percent coarse fragments; bedrock at a depth of less than 20 inches. |
| *Coolidge: Cp, CrB, Cs, CV. For Tremant part of Cs and Laveen part of CV, see their respective series. | Slight for Cp, Cs, CV. Moderate for CrB: 20 to 50 percent gravel. | Slight for Cp, Cs, CV. Moderate for CrB: 20 to 50 percent gravel. |
| Dune land: Dn. No valid ratings can be made. | | |
| *Ebon: EbD, EPD. For Pinamt part of EPD, see Pinamt series. | Severe: 50 to 90 percent gravel and cobbles. | Severe: 50 to 90 percent gravel and cobbles. |
| Estrella: Es, Et | Slight | Slight |
| *Gachado: GA. Rock outcrop part is not rated. | Severe: more than 50 percent gravel and cobbles; bedrock at a depth of less than 20 inches. | Severe: more than 50 percent gravel and cobbles; bedrock at a depth of less than 20 inches. |
| Gadsden: Gb, Gc, Gd | Severe: slow permeability; flooding in some areas. | Moderate for Gb: clay loam surface layer. Severe for Gc, Gd: clay surface layer. |

these ratings, it is assumed that a good cover of vegetation can be established and maintained. A limitation of *slight* means that soil properties are generally favorable and limitations are so minor that they easily can be overcome. A *moderate* limitation can be overcome or modified by planning, by design, or by special maintenance. A *severe* limitation means that costly soil reclamation, special design, intense maintenance, or a combination of these, is required.

Camp areas are used intensively for tents and small camp trailers and the accompanying activities of outdoor living. Little preparation of the site is required, other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils have mild slopes, good drainage, a surface that is free of rocks and coarse fragments and is firm after rains but not dusty when dry; and are not flooded during periods of heavy use.

*recreational facilities*

in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions appear in the first column of this table]

| Playgrounds | Paths and trails | Lawns and golf fairways |
|---|---|---|
| Moderate: flooded for short periods | None to slight | None to slight if protected.<br>Moderate to severe if flooded. |
| None to slight | None to slight | None to slight. |
| Severe: 20 to 50 percent gravel | Moderate: 20 to 50 percent gravel | Moderate: 20 to 50 percent gravel. |
| Moderate: clay loam surface layer | Moderate: clay loam surface layer | Moderate: clay loam surface layer. |
| Moderate: clay loam surface layer | Moderate: clay loam surface layer | Moderate: clay loam surface layer.<br>Moderate to severe for saline-alkali phase of Ap. |
| Moderate: slow permeability | None to slight | Severe: slow permeability. |
| Moderate: flooding | None to slight | Severe: flooding.<br>Moderate if protected from flooding: rapid permeability. |
| Severe: flooding; 20 to 50 percent gravel | Severe: flooding | Severe: low available water capacity; flooding. |
| Moderate: slow permeability | Slight | Severe: saline-alkali; slow permeability. |
| Severe: clay surface layer; flooding | Severe: clay surface layer | Moderate: clay surface layer; occasionally flooded; saline-alkali. |
| Severe: more than 50 percent coarse fragments; bedrock at a depth of less than 20 inches. | Severe: shallow soil; more than 50 percent coarse fragments; bedrock at a depth of less than 20 inches. | Severe: steep slope; more than 50 percent gravel and cobbles; bedrock at a depth of less than 20 inches. |
| Slight for Cp, Cs, CV.<br>Moderate for CrB: 20 to 50 percent gravel. | Slight for Cp, Cs, CV.<br>Moderate for CrB: 20 to 50 percent gravel. | Slight for Cp, Cs, CV.<br>Moderate for CrB: 20 to 50 percent gravel. |
| Severe: more than 50 percent gravel and cobbles. | Severe: 50 to 90 percent gravel and cobbles | Severe: 50 to 90 percent gravel and cobbles; slow permeability. |
| Slight | Slight | Slight for Es.<br>Moderate for Et: saline-alkali. |
| Severe: more than 20 percent gravel and cobbles; bedrock at a depth of less than 20 inches. | Severe: more than 50 percent gravel and cobbles; bedrock at a depth of less than 20 inches. | Severe: more than 50 percent gravel and cobbles; bedrock at a depth of less than 20 inches. |
| Severe: clay surface layer; slow permeability. | Moderate for Gb: clay loam surface layer.<br>Severe for Gc and Gd: clay surface layer. | Severe: clay surface layer; slow permeability; saline-alkali for Gd; rare brief flooding in some areas. |

TABLE 7.—*Soil limitations for*

| Soil series and map symbols | Camp areas | Picnic areas |
|---|---|---|
| *Gilman: Ga, Gf, GgA, GgB, Gh, and parts of | Slight | Slight |

*recreational facilities*—Continued

| | | |
|---|---|---|
| | | |

TABLE 7.—*Soil limitations for*

| Soil series and map symbols | Camp areas | Picnic areas |
|---|---|---|
| *Tremant: Te, TfA, TfB, Tg, Th, TPB, TrA, TrB, TSC. For Rillito part of TrA, TrB, and TSC, see Rillito series. | Moderate: 20 to 50 percent coarse fragments; slow permeability. | Slight for Te. Moderate for rest: 20 to 50 percent coarse fragments; clay loam surface layer in Tg. |
| Trix: Tt | Moderate: clay loam; moderately slow permeability. | Moderate: clay loam |
| Tucson: Tu, Tw | Moderate: moderately slow permeability; Tw has a clay loam surface layer. | Slight for Tu. Moderate for Tw: clay loam |
| Valencia: | | |
| Va, Vb | Slight | Slight |
| Vc | Moderate: 20 to 50 percent gravel | Moderate: 20 to 50 percent gravel |
| Vecont: Ve, Vf | Moderate for Ve: slow permeability; loam. Severe for Vf: clayey. | Slight for Ve: loam. Severe for Vf: clayey. |
| *Vint: Vg, Vh, Vk, Vn, Vr. For Carrizo part, see Carrizo series. | Slight for Vh and Vk. Moderate for Vg and Vn: loamy fine sand and clay loam. | Slight for Vh and Vk. Moderate for Vg and Vn: loamy fine sand and clay loam. |
| Wintersburg: Wg | Moderate: clay loam surface layer; moderately slow permeability. Severe: clay member of complex. | Moderate: clay loam surface layer. Severe: clay member of complex. |

Picnic areas are attractive natural or landscaped tracts used primarily for preparing meals and eating outdoors. These areas are subject to heavy foot traffic. Most of the vehicular traffic is confined to access roads. The best soils are firm when wet but not dusty when dry; are not flooded during the season of use; and do not have slopes or stones that greatly increase cost of leveling sites or of building access roads.

Playgrounds are areas used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. The best soils have a nearly level surface free of coarse fragments and rock outcrops; have good drainage and a surface that is firm after rain, but not dusty when dry; and are not flooded during periods of heavy use. If grading and leveling are required, depth to rock is important.

Paths and trails are used for local and cross-country travel by foot or horseback. Design and layout should require little or no cutting and filling. The best soils are at least moderately well drained, are firm when wet but not dusty when dry, are flooded not more than once during the season of use, have slopes of less than 15 percent, and have few or no rocks or stones on the surface.

Lawns and golf fairways are affected by such soil properties as slope, drainage, frequency of flooding, stoniness, and texture of the surface layer. Traps and roughs are not considered part of the fairway.

## Trees and Shrubs [6]

This part of the survey provides a guide to homeowners for selecting tree and shrub plantings according to kinds of soil. General suggestions on planting are listed in table 8. The table also shows the suitability of plants on specific kinds of soil. It lists most of the trees and shrubs commonly grown in the area and the limitations by soil groups for growth of the specified plantings.

Each soil in the survey area is assigned to one of seven horticultural groups. The soils in each group are similar and have similar effect on the growth of specified plantings. Criteria for the soil groupings follow:

Group 1. Soils have few limitations to plant growth.

Group 2. Soils are moderately deep over concentrations of lime, which causes chlorosis in susceptible plants.

Group 3. Soils are clayey and are easily waterlogged, both of which can cause chlorosis in plants.

Group 4. Soils are sandy and droughty.

Group 5. Soils are slightly to strongly saline and alkaline.

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*recreational facilities*—Continued

| Playgrounds | Paths and trails | Lawns and golf fairways |
|---|---|---|
| Severe: more than 20 percent gravel; slow permeability. | Slight for Te.<br>Moderate for rest: 20 to 50 percent coarse fragments; clay loam surface layer in Tg. | Moderate: 20 to 50 percent gravel; slow permeability. |
| Moderate: clay loam; moderately slow permeability. | Moderate: clay loam | Moderate: clay loam; moderately slow permeability. |
| Moderate: moderately slow permeability; Tw has a clay loam surface layer. | Slight for Tu.<br>Moderate for Tw: clay loam. | Moderate: moderately slow permeability; Tw has a clay loam surface layer. |
| Slight<br>Severe: more than 20 percent gravel | Slight<br>Moderate: 20 to 50 percent gravel | None to slight.<br>Moderate: 20 to 50 percent gravel. |
| Moderate for Ve: loam; slow permeability.<br>Severe for Vf: clayey. | Slight for Ve: loam surface layer.<br>Severe for Vf: clayey. | Severe: slow permeability; Vf has clayey surface layer. |
| Slight for Vh and Vk.<br>Moderate for Vg and Vn: loamy fine sand and clay loam. | Slight for Vh and Vk.<br>Moderate for Vg and Vn: loamy fine sand and clay loam. | Slight for Vh and Vk.<br>Moderate for Vg and Vn: loamy fine sand and clay loam. |
| Moderate: clay loam surface layer; moderately slow permeability.<br>Severe: clay member of complex. | Moderate: clay loam surface layer<br>Severe: clay member of complex. | Moderate: clay loam and clay; moderately slow permeability. |

TABLE 8.—*Tree and shrub planting guide*

EVERGREEN SHRUBS (ROOT DEPTH 2 TO 2½ FEET)

| Common and botanical names | Characteristics of plantings | Limitation of soils for plant growth[1] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Group 7 |
| Abelia *Abelia grandiflora.* | Sunny sites; 4 to 8 feet high; 3 to 6 feet wide; evergreen foliage; low salt tolerance. | Slight | Moderate | Moderate | Moderate | Severe | Moderate | Severe. |
| Bottlebrush *Callistemon* sp. | Sunny sites; 6 to 8 feet high; 4 to 6 feet wide; light green foliage; red flower April to June; highly sus- | Slight | Moderate | Moderate | Slight | Severe | Moderate | Severe. |

TABLE 8.—*Tree and shrub planting guide*—Continued

EVERGREEN SHRUBS—Continued

| Common and botanical names | Characteristics of plantings | Limitation of soils for plant growth [1] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Group 7 |
| Holly, Chinese *Ilex cornuta* var. | Partially shady sites; 4 to 6 feet high; 3 to 5 feet wide; green or variegated foliage; red berries in fall; strongly chlorotic if overwatered; moderately susceptible to root rot. | Slight | Severe | Severe | Moderate | Severe | Severe | Severe. |
| Hopseed *Dodonaea viscosa.* | Partially shady sites; 6 to 8 feet high; 6 to 10 feet wide; foliage red, purple in winter; moderately susceptible to chlorosis; occasional root rot. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Severe. |
| Jasmine, primrose *Jasminum mesnyi.* | Sunny sites; 3 to 5 feet high; 4 to 6 feet wide; dark green foliage; yellow flower in March; occasional nematodes; semi-frost tender. | Slight | Moderate | Moderate | Moderate | Severe | Moderate | Moderate. |
| Myrtle *Myrtus communis* var. | Sunny sites; 4 to 8 feet high; 4 to 5 feet wide; green foliage; white flower in April; strongly chlorotic; frequent root rot. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Severe. |
| Bamboo, heavenly *Nandina domestica.* | Partially shady sites; 3 to 5 feet high; 1 to 2 feet wide; bronze foliage in fall and winter; strongly chlorotic; moderately susceptible to nematodes. | Slight | Moderate | Moderate | Moderate | Severe | Moderate | Moderate. |
| Natal plum *Carissa grandiflora.* | Sunny sites; 1 to 6 feet high; 2 to 4 feet wide; dark green foliage; white flower from March to May; chlorotic if overwatered; frost tender. | Slight | Moderate | Moderate | Slight | Moderate | Moderate | Moderate. |
| Oleander *Nerium oleander* var. | Sunny sites; 6 to 15 feet high; 8 to 15 feet wide; green or variegated foliage; multicolored flower May to September; root rot; highly competitive to | Slight | Slight | Slight | Moderate | Moderate | Slight | Moderate. |

TABLE 8.—*Tree and shrub planting guide*—Continued

EVERGREEN SHRUBS—Continued

| Common and botanical names | Characteristics of plantings | Limitation of soils for plant growth [1] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Group 7 |
| *Punica granatum* | dark green, yellow in fall; orange flower June to August; moderately susceptible to chlorosis. | | | | | | | |
| Privet, Japanese *Ligustrum japonicum* var. | Sunny sites; 5 to 10 feet high; 4 to 8 feet wide; medium green foliage; suceptible to salts; highly susceptible to nematodes. | Slight | Moderate | Moderate | Moderate | Moderate | Moderate | Moderate. |
| Pyracantha *Pyracantha* sp. | Sunny sites; 2 to 10 feet high; 5 to 15 feet wide; green foliage; white flower March to April, red berries in winter; strongly chlorotic; occasional root rot. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Severe. |
| Raphiolepis *Raphiolepis indica* var. | Shady sites; 2 to 4 feet high; 1 to 3 feet wide; light green foliage; pink to rose flower in spring; moderately susceptible to chlorosis. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Moderate. |
| Silverberry *Elaeagnus pungens* var. | Sunny sites; 5 to 7 feet high; 4 to 8 feet wide; silvery foliage; red berries in fall; should not be overwatered. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Moderate. |
| Citrus, ornamental *Citrus* sp. | Sunny sites; 8 to 12 feet high; 6 to 12 feet wide; green foliage; white flower in spring; moderately susceptible to chlorosis. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Severe. |
| Texas mountain laurel *Sophora secundiflora.* | Sunny sites; 6 to 8 feet high; 5 to 10 feet wide; light green foliage; flower violet, blue in spring; moderately susceptible to chlorosis. | Slight | Moderate | Moderate | Slight | Moderate | Moderate | Severe. |
| Texas ranger *Fruteseens* | Sunny sites; 4 to 5 feet high; 2 to 4 feet wide; gray to | Slight | Slight | Slight | Slight | Moderate | Slight | Severe. |

TABLE 8.—*Tree and shrub planting guide*—Continued

CONIFEROUS EVERGREENS (ROOT DEPTH 2½ TO 6 FEET)

| Common and botanical names | Characteristics of plantings | Limitation of soils for plant growth [1] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Group 7 |
| Arborvitae, Baker (compact) *Platycladus orientalis* var. 'Bakeri'. | Sunny sites; 4 to 12 feet high; 2 to 10 feet wide; green or yellow foliage; compact to tall cone form; nitrogen sensitive; moderately chlorotic; red spider mites often a problem. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Severe. |
| Cypress, Italian *Cupressus sempervirens* var. | Sunny sites; 30 feet high; 1 to 3 feet wide; green foliage; tall column form; nitrogen sensitive; red spider mites a constant problem. | Slight | Slight | Moderate | Slight | Moderate | Slight | Severe. |
| Juniper, Hollywood *Juniperus chinensis* var. 'Torulosa'. | Sunny sites; 8 to 10 feet high; 3 to 6 feet wide; rich green foliage; twisted columnar form; nitrogen and salts sensitive; mites often a problem. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Severe. |
| Juniper, Pfitzer *Juniperus chinensis* var. 'Pfitzeriana'. | Sunny sites; 4 to 6 feet high; 8 to 15 feet wide; gray-green feathery foliage; upright, spreading form; nitrogen and salts sensitive; mites often a problem. | Slight | Slight | Moderate | Slight | Severe | Slight | Severe. |
| Juniper, Seagreen *Juniperus* sp. | Sunny sites; 4 to 6 feet high; 3 to 5 feet wide; green foliage; vase form; nitrogen and salts sensitive; mites often a problem. | Slight | Slight | Moderate | Slight | Severe | Slight | Severe. |
| Juniper, Prostrate *Juniperus horizontalis.* | Partially shady sites; 1 to 2 feet high; 6 to 8 feet wide; green foliage; spreading form; nitrogen and salts sensitive; mites often a problem. | Slight | Slight | Moderate | Slight | Severe | Slight | Moderate |
| Juniper, Tamarix *Juniperus sabina* var. 'Tamariscifolia'. | Sunny sites; 2 to 3 feet high; 10 to 20 feet wide; blue-green foliage; spreading form; nitrogen and salts sensitive; mites often a problem. | Slight | Slight | Moderate | Slight | Severe | Slight | Moderate |
| Juniper, Rocky Mountain *Juniperus scopulorum.* | Sunny sites; 10 to 15 feet high; 2 to 4 feet wide; gray-blue to green foliage; upright form; nitrogen and salts sensitive; mites often a problem. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Severe. |
| Juniper, blue column *Juniperus chinensis* var. 'Columnaris'. | Sunny sites; 20 to 30 feet high; 3 to 5 feet wide; blue-green foliage; columnar form; nitrogen and salts sensitive; mites often a problem. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Severe. |
| Pine, Aleppo *Pinus halepensis.* | Sunny sites; 40 feet high; 10 to 15 feet wide; light green foliage; open form; salts and nitorgen sensitive; needle blight in fall. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Severe. |
| Pine, Canary Island *Pinus canariensis.* | Sunny sites; 40 feet high; 10 to 15 feet wide; blue-green to dark foliage; tall layered form; salts and nitrogen sensitive. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Severe. |

See footnote at end of table.

TABLE 8.—*Tree and shrub planting guide*—Continued

CONIFEROUS EVENGREENS—Continued

| Common and botanical names | Characteristics of plantings | Limitation of soils for plant growth [1] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Group 7 |
| Crapemyrtle *Lagerstroemia indica.* | Partially shady sites; 10 feet high; 10 feet wide; green foliage; multicolored flower varieties June to September; highly susceptible to chlorosis. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Severe. |
| NATIVE SHRUBS (ROOT DEPTH 1 TO 3 FEET) | | | | | | | | |
| Beargrass *Nolina Bigelovii.* | Sunny sites; 3 to 6 feet high; 4 to 7 feet wide; light green foliage; white flower June and July; sensitive to overwatering. | Slight | Slight | Slight | Slight | Severe | Slight | Moderate. |
| Beloperone *Beloperone californica.* | Sunny to partially shady; 3 to 6 feet high; 3 to 5 feet wide; light green foliage; red flower May and June; sensitive to overwatering. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Moderate. |
| Brickellbush *Brickellia* sp. | Sunny sites; 1 to 3 feet high; 2 to 4 feet wide; yellow, white and purple flower May to September; sensitive to overwatering. | Slight | Slight | Slight | Slight | Moderate | Slight | Moderate. |
| Brittlebush *Encelia* sp. | Sunny sites; 1½ to 2 feet high; 2 to 4 feet wide; gray foliage; yellow flower April and May; sensitive to overwatering. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Moderate. |
| Century plant *Agave americana.* | Sunny sites; blue-green foliage, many thorns; yellow flower May to August; sensitive to overwatering. | Slight | Slight | Moderate | Slight | Severe | Slight | Moderate. |
| Creosotebush *Larrea divaricata.* | Sunny sites; 5 to 11 feet high; 4 to 15 feet wide; gray-green foliage; yellow flower April and May; sensitive to overwatering. | Slight | Slight | Slight | Slight | Moderate | Slight | Moderate. |
| Indigobush *Dalea* sp. | Sunny sites; 3 to 12 feet high; 5 to 10 feet wide; gray-green foliage; purple flower April to October; sensitive to overwatering. | Slight | Slight | Slight | Slight | Moderate | Slight | Moderate. |
| Fairy duster *Calliandra eriophylla.* | Sunny sites; ½ to 3 feet high; 3 to 5 feet wide; gray foliage; pink to purple flower March to May; sensitive to overwatering. | Slight | Slight | Slight | Slight | Moderate | Slight | Slight. |
| Desert honeysuckle | Sunny sites; 2 to 8 feet high; 2 to 6 feet wide; | Slight | Moderate | Moderate | Slight | Severe | Moderate | Moderate. |

TABLE 8.—*Tree and shrub planting guide*—Continued

NATIVE SHRUBS—Continued

| Common and botanical names | Characteristics of plantings | Limitation of soils for plant growth [1] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Group 7 |
| Ocotillo *Fouquieria splendens.* | Sunny sites; 6 to 20 feet high; 5 to 15 feet wide; green foliage; red flower April to June; sensitive to overwatering. | Slight | Slight | Slight | Slight | Severe | Slight | Slight. |
| Sage *Salvia* sp. | Sunny sites; 2 to 9 feet high; 1 to 8 feet wide; gray foliage; blue to purple flower April to August; sensitive to overwatering. | Slight | Slight | Slight | Slight | Severe | Slight | Moderate. |
| Saltbush *Atriplex* sp. | Sunny sites; 1 to 6 feet high; 1 to 8 feet wide; gray-green to silvery foliage; gray flower in April to small in May; sensitive to overwatering. | Slight | Slight | Slight | Slight | Slight | Slight | Slight. |
| Senna *Cassia* sp. | Sunny sites; 2 to 9 feet high; 3 to 14 feet wide; gray foliage; yellow flower April to July; sensitive to overwatering. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Moderate. |
| Yucca *Yucca* sp. | Sunny to partially shady; 1 to 20 feet high; 2 to 10 feet wide; gray to green foliage; white flower March to June; sensitive to overwatering. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Moderate. |

TABLE 8.—*Tree and shrub planting guide*—Continued

DECIDUOUS SHADE TREES—Continued

| Common and botanical names | Characteristics of plantings | Limitation of soils for plant growth[1] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Group 7 |
| Silk Tree (Mimosa) *Albizia julibrissin.* | Sunny sites; 12 to 15 feet high; 15 to 25 feet wide; light green foliage; pink flower in summer; leaf hoppers and sooty canker. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Severe. |
| Mulberry *Morus* sp. | Sunny sites; 40 to 50 feet high; 30 to 45 feet wide; dark green foliage; yellow in fall; root rot, nematodes, sooty canker. | Slight | Slight | Slight | Moderate | Severe | Slight | Severe. |
| Pecan *Carya illinoinensis.* | Sunny sites; 50 to 60 feet high; 40 to 60 feet wide; dark green foliage; susceptible to root rot, aphids, and occasional gall. | Slight | Moderate | Moderate | Moderate | Severe | Moderate | Severe. |
| Chinese Pistache *Pistacia chinensis.* | Sunny sites; 40 to 50 feet high; 30 to 45 feet wide; green foliage, bronze in fall; occasional root rot. | Slight | Slight | Slight | Slight | Moderate | Slight | Severe. |
| Willow, weeping *Salix babylonica.* | Sunny sites; 40 to 50 feet high; 50 feet wide; light green foliage, yellow in fall; bark sun burns, susceptible to chlorosis; highly susceptible to nematodes. | Slight | Moderate | Moderate | Moderate | Severe | Moderate | Severe. |
| Desert Willow *Chilopsis linearis.* | Sunny sites; 15 to 20 feet high; 15 to 25 feet wide; light green foliage; purple flower spring to fall; susceptible to root rot. | Slight | Slight | Slight | Moderate | Moderate | Slight | Severe. |
| Sycamore *Platanus* sp. | Sunny sites; 40 to 50 feet high; 30 to 40 feet wide; bronze flower in fall; highly susceptible to chlorosis; leaf burn. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Severe. |

FLOWERING TREES (ROOT DEPTH 6 TO 8 FEET)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Acacia, Bailey *Acacia baileyana.* | Sunny sites; 20 to 25 feet high; 20 to 40 feet wide; feathery, blue-gray foliage; yellow flower January to February; occational chlorosis. | Slight | Moderate | Moderate | Slight | Moderate | Moderate | Severe. |
| Bottlebrush *Callistemon* sp. | Sunny sites; 18 feet high; 10 feet wide; gray-green to purplish foliage; red flower April to June; highly susceptible to chlorosis. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Severe. |
| Jacaranda *Jacaranda scutifolia.* | Sunny sites; 30 feet high; 15 to 30 feet wide; fern-like, light green foliage; lavender flower April to September; frost tender and occasional chlorosis. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Severe. |
| Orchid Tree *Bauhinia variegata.* | Sunny sites; 15 feet high; 10 to 20 feet wide; light green foliage; white flower January to April; frost tender; salts sensitive. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Severe. |

See footnote at end of table.

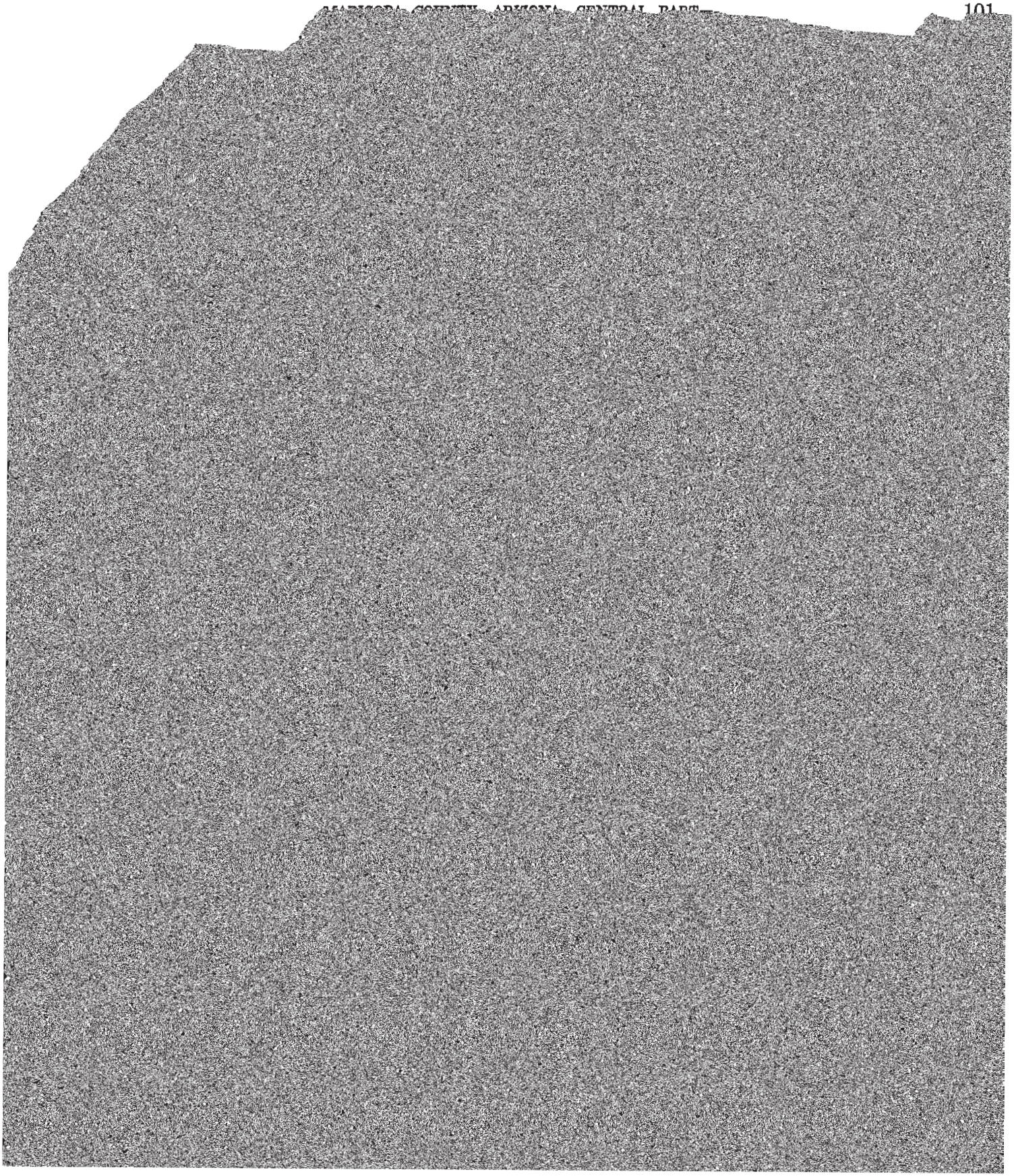


TABLE 8.—*Tree and shrub planting guide*—Continued

FAN-TYPE PALMS (ROOT DEPTH 1 TO 4 FEET)

| Common and botanical names | Characteristics of plantings | Limitation of soils for plant growth[1] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Group 7 |
| Palmetto *Sabal* sp. | Sunny sites; 6 to 80 feet high; 6 to 18 feet wide; greenfoliage; white flower. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Severe. |
| Palm, California fan *Washingtonia filifera.* | Sunny sites; 10 to 60 feet high; 15 to 25 feet wide; green foliage; white flower; susceptible to bed rot and occasionally to nematodes. | Slight | Slight | Moderate | Slight | Moderate | Slight | Moderate. |
| Palm, Mexican fan *Washingtonia robusta.* | Sunny sites; 80 to 100 feet high; 15 to 25 feet wide; green foliage; white flower; susceptible to bed rot and occasionally to nematodes. | Slight | Slight | Moderate | Slight | Moderate | Slight | Severe. |
| Quadalupe palm | Sunny sites; 40 feet high; 6 to 8 feet wide; light green foliage; white flower. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Severe. |
| Mexican blue palm. | Sunny sites; 40 feet high; 6 to 8 feet wide; silvery blue foliage; creamy white flower. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Severe. |
| Mediterranean fan palm. | Sunny sites; 15 to 20 feet high; 5 to 15 feet wide; green foliage; white flower. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Moderate. |

PINNATE OR FEATHER PALMS (ROOT DEPTH 1 TO 4 FEET)

TABLE 8.—*Tree and shrub planting guide*—Continued

GROUND COVER (ROOT DEPTH 1 TO 3 FEET)

| Common and botanical names | Characteristics of plantings | Limitation of soils for plant growth[1] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Group 7 |
| Fern Asparagus *Asparagus densiflorus* var. 'Springeri' | Partially to fully shady; ½ to 1 foot high; 1 to 3 feet wide; light green foliage; pink flower in spring; susceptible to chlorosis; semi-frost tender. | Slight | Moderate | Moderate | Slight | Severe | Moderate | Moderate. |
| Gazania *Gazania* sp. | Sunny sites; ½ to 1 foot high; 6 inches to 1 foot wide; green foliage; multicolored flower April to June. | Slight | Slight | Slight | Moderate | Severe | Slight | Moderate. |
| Ivy, Algerian *Hedera canariensis.* | Shady sites; ½ to 1 foot high; 6 to 12 feet wide; evergreen foliage; susceptible to root rot; sensitive to overwatering; scale. | Slight | Moderate | Moderate | Moderate | Severe | Moderate | Moderate. |
| Ivy, English *Hedera helix.* | Shady sites; ½ to 1 foot high; 6 to 12 feet wide; evergreen foliage; susceptible to occasional root rot. | Slight | Slight | Slight | Slight | Severe | Slight | Moderate. |
| Ice plant *Malephora* sp. | Partially shady to sunny; ⅙ to ½ inch high; 6 inches to 1 foot wide; gray to blue-green foliage; purple flower April to June; susceptible to nematodes and root rot. | Slight | Moderate | Moderate | Moderate | Severe | Moderate | Moderate. |
| Lippia | Sunny to semishady sites; | Slight | Slight | Slight | Moderate | Moderate | Slight | Moderate. |

TABLE 8.—*Tree and shrub planting guide*—Continued

GROUND COVER—Continued

| Common and botanical names | Characteristics of plantings | Limitation of soils for plant growth [1] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Group 7 |
| Periwinkle *Vinca major.* | Partially shady sites; ½ to 2 feet high; 3 to 6 feet wide; green foliage; lavender flower spring and summer; susceptible to chlorosis. | Slight | Moderate | Moderate | Slight | Moderate | Moderate | Moderate. |
| Star Jasmine *Trachelospermum jasminoides.* | Partially shady sites; ½ to 1 feet high; 3 to 6 feet wide; green foliage in spring; white flower in spring; nematodes, occasional root rot. | Slight | Slight | Moderate | Moderate | Moderate | Slight | Moderate. |
| Lavender-cotton *Santolina chamaecyparissus* | Sunny sites; 1 to 2 feet high; 1 to 3 feet wide; gray foliage; yellow flower in summer; root rot. | Slight | Moderate | Moderate | Moderate | Moderate | Moderate | Moderate. |

[1] Slight—little modification of the site needed for growth of climatically adapted species.
Moderate—some modification of the site is necessary for growth of other than recommended plants.

available water capacity. They are relatively free of salts and alkali and do not contain visible lime.

Nitrogen should be applied in the irrigation water five to six times a year. Phosphorus should be applied two or three times a year and mixed into the soil as deeply as possible. Mixing manure, straw, or peat moss with the soil improves water capacity.

One inch of water applied in the tree well four to eight times a year wets the soil to a depth of 5 feet. At field capacity, the water available is adequate to supply mature trees or shrubs for about 7 to 10 days in summer and 10 to 15 days in winter.

#### HORTICULTURAL GROUP 5

Soils in this group are deep sandy loams to clay loams. They contain excessive amounts of saline or alkali salts or both. Some contain visible lime at a depth of less than 12 inches.

Unless these soils are reclaimed, only salt-tolerant species grow. Soil amendments help in reclaiming the soil. They should be mixed as deeply as possible, and several deep leachings with water should follow. In some areas, several years are needed to reclaim the soil before any but salt-tolerant species succeed.

One inch of water applied in the tree well four to eight times a year wets the soil to a depth of 5 feet. At field capacity, the water available is adequate to supply mature trees or shrubs for about 7 to 10 days in summer and 10 to 15 days in winter.

soils in horticultural group 5. Water moves through the soils at a moderate or slow rate, but is stopped by the hardpan. Roots cannot penetrate the hardpan or bedrock.

The hardpan can be broken up or removed by blasting or heavy equipment. Adding topsoil, however, is a more practical method of increasing rooting depth.

One inch of water applied to the tree well one to two times wets some of these soils. At field capacity in these soils, the water available is adequate to supply mature plants about 4 to 7 days in summer and 7 to 10 days in winter. The other soils in this group require 1 inch of water applied in the tree well three to eight times to wet them thoroughly. At field capacity in these soils, water available is adequate to supply mature plants for about 8 to 12 days in summer and 12 to 15 days in winter. Over-irrigation waterlogs the soils and makes plants chlorotic.

The high content of lime causes iron chlorosis in mature, susceptible plants, and iron in the form of chelate is needed. Small amounts of phosphorus should be worked into the soils as deeply as possible two to three times a year. Nitrogen should be applied in the irrigation water four or five times during the year.

## Formation and Classification of Soils

deposited on the younger surface. In other areas, soils of the younger surface are being eroded and sediment is deposited on the older surface. Trix and Estrella soils formed in such areas. The parent material of the soils on both surfaces is essentially the same, mainly granite-gneiss, schist, andesite, rhyolite, granite, basalt, and limestone.

Material on the alluvial fans has been transported by ephemeral streams from the nearby mountains. Near the base of mountains are some very old surfaces on which Ebon, Pinamt, and Pinal soils formed. In some of these areas ephemeral streams are entrenched 10 to 20 feet, leaving stable surfaces and contributing minor amounts of sediment to the alluvial fans below. Mature soils, such as the Ebon and Pinamt soils, formed mainly at the base of the granite-gneiss mountains. Pinal soils, for example, are at the base of the granite-gneiss, basalt, welded tuff, schist, and andesite mountains. In many areas, these very old surfaces have been stripped away or buried and surfaces of a moderate age occur directly at the base of the mountain. Gunsight, Rillito, and Coolidge soils are on these surfaces, Immediately below are very young surfaces and the Antho and Carrizo soils. The parent material of all soils on alluvual fans reflects the mountains above and is dominantly granitic. In many areas, the very young alluvial fans are encroaching on older surfaces of the valley plain below. Valencia soils formed in this manner.

Soils on the mountains are forming in material weathered in place from hard bedrock, including granite-gneiss, basalt, granite, schist, welded tuff, andesite, and rhyolite.

Wind transported silt is a minor but important source of soil material for all soils in the area. This material is soon reworked by water and incorporated into alluvial deposit.

### Climate

Climate is a very important factor in the soil-forming process in the Maricopa County, Central Part. The present climate is warm, arid, and semi-arid continental. Rainfall is low, and temperatures are high. Soil temperature readings indicate that the soils are in a hyperthermic family. Enough moisture is available for the weathering of minerals and the formation of silicate clays, but is not sufficient to rapidly move carbonates and clay into the subsoil. Climate in the past 10,000 years is believed to have been much more humid than the present (*2*). Many soils that have a B horizon, such as Mohall, Tucson, Ebon, Tremant, and Pinamt soils, are believed to have formed then. As the climate became drier, carbonates were leached less deeply, and many of the B horizons that were probably once free of lime are now calcareous within a few inches of the surface. Several of the more stable areas, such as those under a desert pavement, have a miniature profile in the upper 3 to 4 inches of the soil. This profile is in an ABC horizon sequence and may be the type of profile that is forming under the present climate.

### Relief

Relief, or lay of the land, influences soil formation through its effect on moisture, temperature, and erosion. Most of the area is characterized by broad, featureless valleys that range from 750 to 1,350 feet in elevation and are bounded by north-oriented mountain ranges 900 to 3,700 feet high. The four general landforms in the area are the mountains and low hills, the alluvial fans at the base of mountains, the valley plains in the center of valleys, and the low stream terraces and flood plains that are in or adjacent to major stream channels of the area.

Erosion has been very active. The mountains and some alluvial fans are steep and are the most active. Antho and Carrizo soils do not have well-defined horizons because they are on gently sloping alluvial fans that receive deposition during every major storm. Shape of the slope is also important. Convex-shaped slopes are more subject to erosion, produce more runoff, and are less deeply leached of lime than flatter slopes. Rillito, Gunsight, and Perryville soils are on alluvial fans that have a convex surface. Vecont and Beardsley soils are in concave swales that receive additional moisture and sediment during major storms. As a result of air drainage, air temperatures in winter are about 5° warmer on the alluvial fans than on the lower valley plains.

Aspect has had little effect on soil formation in this area except for a few mountain ranges. Soils on some mountains are slightly deeper on the north-and east-facing slopes because rainfall is more effective, temperatures are cooler, plants are more numerous, and some silts are wind deposited there.

### Organisms

The effect of plants, animals, and men is important in soil formation.

The hot, dry climate of the area inhibits plant growth, and the organic-matter content of most soils is only 0.1 to 0.5 percent before irrigation. The high temperature and lack of moisture favor rapid oxidation and destroy organic matter as fast as it accumulates. The kind of plants that grow in a particular place depend on the microrelief and the moisture available. Scattered mesquite, paloverde, and ironwood trees are along narrow drainageways. Creosotebush and cactus grow on the drier sites. The root systems of these plants provide little organic matter. Grass grows in swales where runoff concentrates and the content of organic matter is somewhat higher, but seldom is more than 0.5 percent.

Rodents and reptiles are important soil-forming factors. In some areas they have physically mixed the soil and destroyed soil horizons. In others they bring lime to the surface, which inhibits formation of soil horizons.

Man has had a strong influence on soil formation. Vast populations of plants grew in irrigated areas where previously the plant cover had been sparse. The content of organic matter increased to about 1 percent, or in a few soils to nearly 1.5 percent. Bacterial activity increased greatly. Some soils received large applications of manure. Some that had previously had large concentrations of salt were reclaimed or partly reclaimed. Some that were relatively free of salts received additions of salts from low-quality irrigation water. Nearly all soils in the area have been leveled to some degree. The surface and occasionally the subsoil of some soils have been removed and deposited on other soils. Muddy irrigation water has deposited large amounts of silt, clay, and organic matter over large areas. The surface layer of these soils is now clay or clay loam and is more than 1 percent organic matter. Accelerated erosion in some desert areas has resulted from overgrazing, roadbuilding, and the diversion of stream channels.

### *Time*

Soils of the area range from very young to very old. The kind of horizon and the degree of profile formation depend in part on how long the surface has remained stable, or how long the soil-forming processes have been active.

Soils in stream channels, flood plains, and low stream channels are very young. They receive fresh sediment during periodic flooding, and well-defined horizons have not had time to form. Some organic matter has accumulated to form an A1 horizon, but no further differentiation of horizons has taken place. Before irrigation, the soil profile is noneffervescent to slightly effervescent. No filaments of lime and no lime coatings on coarse fragments occur. Brios, Vint, and Carrizo soils are examples. They are probably no more than a few hundred years old.

Soils on valley plains are of several ages. Gilman, Antho, and Glenbar, which are some of the younger soils, occasionally receive additions of sediment and have not had time for well-defined horizons to form. A few filaments

and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Because this system is under continual study, readers interested in developments of the current system should search the latest literature available (*4, 6*).

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the differentiae used as a basis for classification are soil properties that can be observed in the field, or that can be inferred from observable field soil properties or from combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or affect soil genesis. In table 9 the soil series of Maricopa County, Central Part, are classified according to the current system. Classes of the

TABLE 9.—*Soil series classified according to the current system of classification* [1]

| Series | Family | Subgroup | Order |
|---|---|---|---|
| Agualt | Coarse-loamy over sandy or sandy-skeletal, mixed, (calcareous), hyperthermic. | Typic Torrifluvents | Entisols. |
| Antho | Coarse-loamy, mixed, (calcareous), hyperthermic | Typic Torrifluvents | Entisols. |
| Avonda | Fine-loamy over sandy or sandy-skeletal, mixed, (calcareous), hyperthermic. | Typic Torrifluvents | Entisols. |
| Avondale | Fine-loamy, mixed, (calcareous), hyperthermic | Typic Torrifluvents | Entisols. |
| Beardsley | Fine, mixed, hyperthermic | Typic Durargids | Aridisols. |
| Brios | Sandy, mixed, hyperthermic | Typic Torrifluvents | Entisols. |
| Carrizo | Sandy-skeletal, mixed, hyperthermic | Typic Torriorthents | Entisols. |
| Casa Grande | Fine-loamy, mixed, hyperthermic | Typic Natargids | Aridisols. |
| Cashion | Clayey over loamy, mixed, hyperthermic | Typic Torrifluvents | Entisols. |
| Cherioni | Loamy-skeletal, mixed, hyperthermic | Typic Durorthids | Aridisols. |
| Coolidge | Coarse-loamy, mixed, hyperthermic | Typic Calciorthids | Aridisols. |
| Ebon | Clayey-skeletal, mixed, hyperthermic | Typic Haplargids | Aridisols. |
| Estrella | Fine-loamy, mixed, (calcareous), hyperthermic | Typic Torrifluvents | Entisols. |
| Gachado | Loamy-skeletal, mixed, hyperthermic | Lithic Haplargids | Aridisols. |
| Gadsden | Fine, montmorillonitic, (calcareous), hyperthermic | Vertic Torrifluvents | Entisols. |
| Gilman | Coarse-loamy, mixed, (calcareous), hyperthermic | Typic Torrifluvents | Entisols. |
| Glenbar | Fine-silty, mixed, (calcareous), hyperthermic | Typic Torrifluvents | Entisols. |
| Gunsight | Loamy-skeletal, mixed, hyperthermic | Typic Calciorthids | Aridisols. |
| Harqua | Fine-loamy, mixed, hyperthermic | Typic Haplargids | Aridisols. |
| La Palma | Fine-loamy, mixed, hyperthermic | Typic Durargids | Aridisols. |
| Laveen | Coarse-loamy, mixed, hyperthermic | Typic Calciorthids | Aridisols. |
| Maripo | Coarse-loamy over sandy or sandy-skeletal, mixed, (calcareous), hyperthermic. | Typic Torrifluvents | Entisols. |
| Mohall | Fine-loamy, mixed, hyperthermic | Typic Haplargids | Aridisols. |
| Perryville | Coarse-loamy, carbonatic, hyperthermic | Typic Calciorthids | Aridisols. |
| Pinal | Coarse-loamy, mixed, hyperthermic | Typic Durorthids | Aridisols. |
| Pinamt | Loamy-skeletal, mixed, hyperthermic | Typic Haplargids | Aridisols. |
| Rillito | Coarse-loamy, mixed, hyperthermic | Typic Calciorthids | Aridisols. |
| Suncity | Fine-loamy, mixed, hyperthermic | Typic Durargids | Aridisols. |
| Toltec | Coarse-loamy, mixed, hyperthermic | Entic Durorthids | Aridisols. |
| Tremant | Fine-loamy, mixed, hyperthermic | Typic Haplargids | Aridisols. |
| Trix | Fine-loamy, mixed, (calcareous), hyperthermic | Typic Torrifluvents | Entisols. |
| Tucson | Fine-loamy, mixed, hyperthermic | Typic Haplargids | Aridisols. |
| Valencia | Coarse-loamy, mixed, (calcareous), hyperthermic | Typic Torrifluvents | Entisols. |
| Vecont | Fine, mixed, hyperthermic | Typic Haplargids | Aridisols. |
| Vint | Sandy, mixed, hyperthermic | Typic Torrifluvents | Entisols. |
| Wintersburg | Fine-loamy, mixed, hyperthermic | Typic Calciorthids | Aridisols. |

[1] Placement of some soil series in the current system of classification, particularly in families, can change as more precise information becomes available. Soils classified as of March 1973.

family differentiae. An example is the fine-loamy, mixed, hyperthermic family of Typic Haplargids.

Two soil orders are represented in the survey area—Aridisols and Entisols.

*Aridisols* in this area probably formed in a moister and cooler climate than that of the present. No water is available in any part of the moisture-control section more than 50 percent of the year. Aridisols have a light-colored surface layer that is less than 1 percent organic matter. Two suborders, argids and orthids, are in the Aridisol order.

Argids have an argillic or a natric horizon, and in places have a calcic horizon or a duripan. The argids in the survey area are classified in three great groups—Durargids, Natrargids, and Haplargids.

Durargids have a duripan below the argillic horizon. Beardsley soils are examples. All soils in this great group are in a typic suborder.

Natrargids have a natric horizon that generally is more than 15 percent exchangeable sodium. Casa Grande soils are examples. All soils in this great group are in a typic suborder.

Haplargids have an argillic horizon and lack a duripan or a natric horizon. They generally have a calcic horizon. Mohall soils are examples. Except for Gachado soils, all soils of this great group are in a typic suborder. Gachado soils are underlain by bedrock at a depth of less than 50 centimeters and are classified as Lithic Haplargids.

Orthids in this area have no argillic or natric horizon, but have a calcic horizon or a duripan within a depth of 1 meter. Two great groups of orthids, Durorthids and Calciorthids, are in the survey area.

Durorthids have a platy or massive duripan within a depth of 1 meter and lack a cambic horizon. Pinal soils are Typic Durorthids that have an indurated duripan. Toltec soils are Entic Durorthids that have a weakly cemented to strongly cemented duripan. Calciorthids have a calcic horizon within a depth of 1 meter and are calcareous above the calcic horizon after the upper 18 centimeters are mixed. They have no duripan within a depth of 1 meter. All soils in this great group are in a typic subgroup.

*Entisols* in this area are too young to have diagnostic horizons. They have a light-colored surface layer that is

less than 1 percent organic matter. They are on valley plains, alluvial fans, stream terraces, and flood plains that receive periodic depositions of fresh alluvium. Two suborders of Entisols, Orthents and Fluvents, are in the survey area.

Orthents have an organic-carbon content that decreases with increasing depth and is less than 0.2 percent within a depth of 1.25 meters. Only one great group, Torriorthents, is classified in this suborder. These soils have no water available in any part of the moisture-control section more than 50 percent of the time when the soil temperature at a depth of 50 centimeters is more than 5° C. Carrizo soils are examples of a Typic Torriorthent.

Fluvents have an organic-carbon content that decreases irregularly with increasing depth. Only one great group, Torrifluvents, is classified in this suborder. These soils have no water available in the moisture-control section more than 50 percent of the time when the soil temperature at a depth of 50 centimeters is more than 5° C. All but Gadsden soils are in a typic suborder. Gilman and Estrella soils are examples. Gilman soils have no diagnostic horizon within a depth of 1 meter. Estrella soils have an argillic horizon within a depth of 1 meter, but it is a buried horizon. Gadsden soils are classified as Vertic Torrifluvents. They are clayey and unless irrigated, have deep cracks that remain open for more than 240 days during the year.

## Laboratory Analyses

Results of the physical and chemical analyses of soils are shown in table 10. Data for Perryville and La Palma soils were taken from the site location for the series described in the section "Descriptions of the Soils." Data for the remaining soils, although not based on the representative profile, represent the physical and chemical properties typical of the series. Each profile was sampled in two or more areas, but the results were similar and data are given for only one profile. The methods of analyses are described in the following paragraphs:

*Sample preparation.* All samples were air dried and the clods were broken up with a wooden rolling pin and screened through a 2-millimeter round-holed sieve. Coarse fragments larger than 2 millimeters were weighed to determine the gravel content and then discarded.

*Size class and diameter of particles.* Organic matter was destroyed by hydrogen peroxide and the sample was dispersed with sodium metaphosphate. The sand fraction was separated from the silt and clay by screening through a 300-mesh sieve. The sand fraction was further screened through a nest of sieves to determine individual sand fractions. Silt and clay were determined by the pipette method.

*Reaction.* Soil reaction, expressed in pH value, was measured with a glass electrode pH meter at a 1:10 water ratio and as a saturated paste.

*Cation exchange capacity.* The sample was saturated and leached with an ammonium acetate solution. Water, granular zinc, and 1N NaOH were added to the sample and distilled into a 4 percent boric acid solution. The solution was then titrated with hydrochloric acid.

*Extractable cations.* The sample was saturated and leached with ammonium acetate. The leachate was analyzed for calcium and magnesium by atomic adsorption. Potassium and sodium were analyzed by flame photometry.

*Exchangeable sodium.* The percentage of exchangeable sodium, or the degree of saturation of the exchange complex with sodium, is a value derived by dividing the exchangeable sodium by the cation exchange capacity ($NH_4O$ Ac) and multiplying the result by 100.

*Electrical conductivity.* An extract was drawn from a saturated paste. Conductivity of the saturation extract was determined by a conductivity bridge and conductivity cell. Readings were converted to mmhos/cm after correcting to 25° C using a standard table.

*Organic carbon.* The percent of organic carbon was determined by acid dichromate digestion and ferrous sulfate titration.

*Carbonate as $CaCO_3$.* Calcium carbonate was determined by measurement of $CO_2$ gas given off from the acidification of samples with HCl.

*Bulk density oven dry.* Values were obtained by collecting natural clods and dipping them in a solution of saran resin that had been dissolved in methyl ethyl ketone and measuring the displacement when a saran-coated clod was dipped in water. Corrections were made for coarse fragments greater than 2 millimeters.

*Water content, ⅓ bar.* The determination was made using a pressure plate on natural clods coated with saran.

*Water content, 15 bar.* The determination was made using a pressure membrane extraction on sieved samples.

# *Additional Facts About the Area*

In this section the physiography, relief, and drainage of the survey area are described and a brief history of the irrigation and water supply is given. The farming of the area is described, and harvested acreages of the principal crops are listed. The section also includes a report on the climate of the survey area.

## Physiography, Relief, and Drainage

Maricopa County, Central Part, is characterized by broad, featureless valleys between north-oriented mountain ranges. Elevations range from 750 to 1,350 feet in the valleys and from 900 to 3,700 feet in the mountains. All the valleys have a southward gradient except Rainbow Valley, which has a northward gradient.

Drainage of the Salt River Valley mainly is provided by the Gila River and its Agua Fria and Salt River tributaries. Drainage of the Rainbow Valley mainly is Waterman Wash, which also flows into the Gila River. Harquahala Valley is drained by Centennial Wash. Except for a few areas between Buckeye and Gillespie Dam, the entire survey area is well drained. The water table in most areas is below a depth of 200 feet and dropping.

The four general landforms in the area are valley plains; stream channels, flood plains, and low terraces; alluvial fans; and mountains and low hills. The valley plains appear to be level, but rise steadily with increasing steepness from the axial trough toward the marginal mountains. Slope is less than 1 percent near the axial trough and approaches 9 or 10 percent near the mountains.

Stream channels, flood plains, and low terraces are the lowest points on the landscape. They are in or adjacent to the major stream channels. Valley plains and the rem-

TABLE 10.—*Physical and chemical*

[A dashed line or no entry

| Soil | Horizon | Depth | Size class and diameter of particles [1] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Very coarse sand (2.0–1.0 mm) | Coarse sand (1.0–0.5 mm) | Medium sand (0.5–0.25 mm) | Fine sand (0.25–0.10 mm) | Very fine sand (0.10–0.5 mm) | Silt (0.5–0.002 mm) | Clay (less than 0.002 mm) | Gravel [3] (2–76 mm) |
| | | *cm* | *Pct* | *Pct* | *Pct* | *Pct* | *Pct* | *Pct* | *Pct* | *Pct* |
| Casa Grande fine sandy loam | A1 | 0–7 | 5.6 | 10.7 | 10.5 | 20.5 | 22.1 | 26.0 | 4.6 | 1 |
| | B21tca | 7–16 | 4.0 | 7.1 | 7.1 | 14.4 | 17.0 | 35.3 | 15.1 | 2 |
| | B22tca | 16–36 | 3.3 | 7.1 | 8.0 | 14.4 | 15.7 | 29.8 | 21.7 | 2 |
| | B31tca | 36–65 | 3.1 | 9.8 | 10.1 | 13.0 | 13.1 | 27.2 | 23.7 | 2 |
| | B32tca | 65–92 | 1.1 | 5.4 | 7.7 | 13.9 | 18.3 | 36.3 | 17.3 | ---- |
| | C1ca | 92–130 | 1.9 | 6.0 | 7.6 | 13.2 | 18.3 | 38.1 | 14.9 | 3 |
| | C2 | 130–165 | .7 | 4.8 | 12.4 | 33.0 | 16.9 | 24.1 | 8.1 | 1 |
| Gilman loam | Ap | 0–36 | 5.2 | 6.5 | 5.6 | 14.4 | 20.9 | 36.8 | 10.6 | 4 |
| | C1 | 36–51 | 5.8 | 5.3 | 4.8 | 14.6 | 21.4 | 37.9 | 10.3 | 3 |
| | C2 | 51–71 | 1.3 | 2.3 | 4.1 | 18.3 | 23.0 | 43.6 | 7.4 | 1 |
| | C3 | 71–91 | 1.4 | 1.9 | 2.5 | 10.8 | 23.3 | 52.8 | 7.3 | ---- |
| | C4 | 91–109 | 1.5 | 2.7 | 4.3 | 16.6 | 26.3 | 41.0 | 7.6 | 1 |
| | C5 | 109–127 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 2 |
| | C6 | 127–152 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 1 |
| Harqua gravelly loam | A2 | 0–2.5 | 3.4 | 4.2 | 2.8 | 7.7 | 18.0 | 50.5 | 13.4 | 9 |
| | A&B | 2.5–8 | 6.7 | 6.1 | 3.2 | 7.1 | 16.5 | 43.0 | 17.5 | 30 |
| | B2tsa | 8–23 | 7.9 | 7.9 | 3.3 | 5.4 | 12.4 | 26.1 | 37.0 | 32 |
| | B31tcasa | 23–38 | 18.7 | 10.2 | 3.8 | 6.7 | 16.1 | 19.2 | 25.3 | 35 |
| | B32tcasa | 38–48 | 15.6 | 11.2 | 5.0 | 9.8 | 21.1 | 20.5 | 16.8 | 43 |
| | B33tcasa | 48–76 | 6.0 | 6.5 | 3.0 | 5.1 | 20.4 | 37.5 | 21.5 | 7 |
| | C1casa | 76–99 | 7.6 | 7.6 | 4.0 | 6.5 | 22.1 | 31.5 | 20.5 | 12 |
| | C2casa | 99–122 | 12.3 | 12.1 | 5.7 | 7.3 | 24.8 | 23.8 | 14.1 | 18 |
| | IIC3casa | 122–152 | 34.0 | 28.6 | 7.3 | 4.1 | 3.9 | 9.2 | 13.0 | 59 |
| | IIIC4sa | 152–178 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 47 |
| La Palma very fine sandy loam | A11 | 0–4 | .3 | .9 | 1.1 | 9.6 | 27.9 | 53.6 | 6.6 | ---- |
| | A12 | 4–12 | .2 | .6 | 1.0 | 9.3 | 29.8 | 53.0 | 6.1 | ---- |
| | B1t | 12–19 | .1 | .6 | .8 | 8.9 | 26.5 | 56.6 | 6.5 | ---- |
| | B2tca | 19–29 | .5 | .9 | 1.0 | 7.8 | 21.1 | 48.4 | 20.3 | ---- |
| | B3tca | 29–46 | .7 | .9 | 1.4 | 6.0 | 16.0 | 43.6 | 31.4 | ---- |
| | C1ca | 46–68 | 18.2 | 7.8 | 3.4 | 6.5 | 9.6 | 33.1 | 21.4 | ---- |
| | C2sicam | 68–73 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Laveen loam | Ap1 | 0–15 | 5.1 | 9.5 | 7.3 | 13.4 | 17.0 | 35.3 | 12.4 | 8 |
| | Ap2 | 15–38 | 5.2 | 9.0 | 7.3 | 12.8 | 18.6 | 34.4 | 12.7 | 9 |
| | C1 | 38–61 | 8.3 | 8.0 | 5.4 | 9.5 | 14.0 | 37.2 | 17.6 | 18 |
| | C2ca | 61–96 | 6.5 | 6.7 | 4.6 | 8.7 | 13.9 | 39.5 | 20.2 | 12 |
| | C3ca | 96–127 | 7.8 | 5.7 | 3.6 | 6.6 | 9.6 | 46.9 | 19.8 | 30 |
| | C4ca | 127–213 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 15 |
| | C5 | 213–249 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 1 |
| Perryville gravelly loam | Ap | 0–23 | 5.4 | 7.3 | 4.4 | 9.7 | 15.8 | 39.9 | 17.5 | 20 |
| | C1ca | 23–41 | 7.2 | 5.8 | 3.4 | 7.2 | 12.7 | 43.8 | 19.9 | 35 |
| | C2ca | 41–69 | 7.6 | 6.6 | 4.0 | 7.5 | 11.3 | 45.0 | 18.1 | 43 |
| | C3ca | 69–96 | 5.8 | 8.3 | 4.8 | 8.5 | 11.9 | 45.1 | 15.6 | 24 |
| | C4ca | 96–142 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 5 |
| | C5ca | 142–165 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 4 |
| | IIC6ca | 165–183 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 55 |

[1] Based on percent of soil less than 2 millimeters in diameter.
[2] Approximate values.

nants of a few old stream terraces are at slightly higher elevations. They roughly parallel but are one-fourth to one-half mile from the major stream channels. Near the base of mountains are alluvial fans. They are generally at right angles to the valley plains. They are generally distinct where the ephemeral stream leaves the mountain, but lose their identity downslope where they coalesce, forming a single broad plain. Often the alluvial fan surface is a complex pattern of old and young alluvium. The areas of old alluvium appear stable because the ephemeral

*analysis of representative soils*

indicates no data is available]

| Reaction | | Cation exchange capacity ($NH_4OAc$) | Extractable cations (meq per 100 g of soil) | | | | Exchangeable sodium | Electrical conductivity [2] | Organic carbon | Carbonate as $CaCO_3$ | Bulk density oven dry | Water content | | Coefficient of linear extensibility |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Satu- | In 1:10 soil | | Calcium | Magnesium | Potassium | Sodium | | | | | | | 15 | |

hardpan. The area in the southern part of the Harquahala Valley is underlain by a highly mottled, highly stratified sediment, and the nearby hills show evidence of having been an old shoreline.

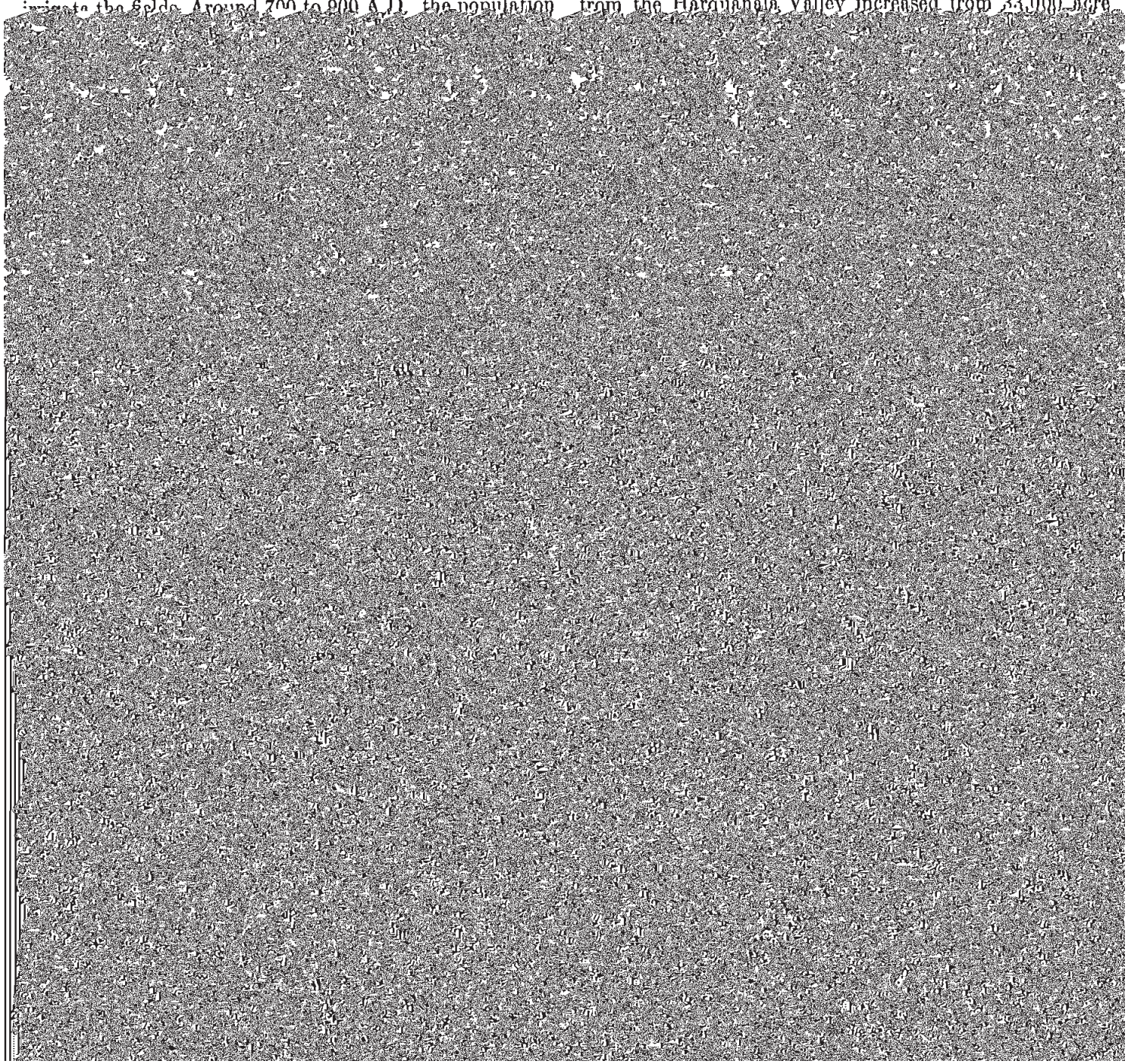
## History of Irrigation and Water Supply

The white man was not the first to dig canals and irrigate the fields in Maricopa County, Central Part. Centuries before the first white settlers came, Indians farmed the area. These Indians, given the name "Hohokam," settled on the banks of the Gila River about 300 years before the birth of Christ. They depended upon periodic flooding to irrigate the fields. Around 700 to 900 A.D. the population

is obtained from deep pumps and the Gila River and through a water right from the Salt River Project. These sources are supplemented by tail water from farms above and sewage effluent from the city of Phoenix.

Other irrigation districts in the survey area are New States, Arlington, and St. Johns. Some of them had water rights to surface water, but surrendered them to other irrigation districts for rights to tail water or water from deep wells.

The Harquahala and Rainbow Valleys and the area near Tonopah and Wintersburg have been cultivated for only a short time. These areas depend on deep wells for irrigation water. The annual pumpage of irrigation water from the Harquahala Valley increased from 33,000 acre



planted late in July. Sorghum is planted in furrows and grown for both ensilage and grain. Ensilage is cut before November 1 or the first killing frost. Sorghum for grain is

| | Acres |
|---|---|
| Potatoes | 11,580 |
| Irish | 11,080 |

TABLE 11.—*Temperature and precipitation*

[Data recorded at Buckeye for period 1941 to 1970. Elevation 870 feet]

| Month | Temperature | | | | Precipitation | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Average daily maximum | Average daily minimum | Two years in 10 will have at least 4 days with— | | Average monthly total | One year in 10 will have— | | Days with snow cover | Average depth of snow on days with snow cover |
| | | | Maximum temperature equal to or higher than— | Minimum temperature equal to or less than— | | Less than— | More than— | | |
| | °F | °F | °F | °F | Inches | Inches | Inches | Number | Inches |
| January | 67 | 34 | 77 | 25 | 0.7 | [1] T | 1.6 | [2] | T |
| February | 72 | 38 | 83 | 28 | .7 | T | 1.7 | [2] | T |
| March | 77 | 42 | 89 | 33 | .7 | T | 1.8 | 0 | 0 |
| April | 85 | 48 | 99 | 39 | .3 | 0 | .9 | 0 | 0 |
| May | 95 | 55 | 107 | 46 | .1 | 0 | .3 | 0 | 0 |
| June | 103 | 63 | 114 | 54 | .1 | 0 | .2 | 0 | 0 |
| July | 107 | 74 | 114 | 65 | .8 | T | 1.7 | 0 | 0 |
| August | 105 | 73 | 112 | 64 | 1.3 | .1 | 2.7 | 0 | 0 |
| September | 101 | 65 | 110 | 55 | .7 | 0 | 2.3 | 0 | 0 |
| October | 90 | 52 | 100 | 42 | .4 | 0 | 1.0 | 0 | 0 |
| November | 77 | 41 | 88 | 32 | .5 | T | 1.2 | 0 | 0 |
| December | 68 | 35 | 79 | 27 | .8 | T | 2.2 | [2] | T |
| Year | 87 | 52 | [3] 116 | [4] 23 | 7.1 | 3.8 | 10.8 | [2] | T |

[1] Trace.
[2] Less than 0.5 day.
[3] Average annual highest temperature.
[4] Average annual lowest temperature.

TABLE 12.—*Probabilities of last freezing temperatures in spring and first in fall*

[Data recorded at Buckeye for period 1935 to 1964. Elevation 870 feet]

| Probability | Dates for given probability and temperature | | | |
|---|---|---|---|---|
| | 20° F or lower | 24° F or lower | 28° F or lower | 32° F or lower |
| Spring: | | | | |
| 1 year in 10 later than | January 17 | February 17 | March 17 | March 31. |
| 2 years in 10 later than | | February 8 | March 7 | March 24. |
| 5 years in 10 later than | | January 18 | February 13 | March 10. |
| Fall: | | | | |
| 1 year in 10 earlier than | December 28 | November 26 | November 11 | October 31. |
| 2 years in 10 earlier than | | December 5 | November 18 | November 5. |
| 5 years in 10 earlier than | | December 26 | December 3 | November 17. |

Late in spring and early in summer, when the air is dry, the temperature normally varies by 40° or more between early afternoon and daybreak, and evenings are moderately cool. In July and August, however, higher relative humidity sometimes holds minimum temperatures above 80°. In winter, minimum temperatures fall to 32° or lower on an average of 29 days in Tempe, and on 44 days in Buckeye.

There are two separate precipitation seasons. The first occurs from November to March, when the area is subjected to occasional storms from the Pacific Ocean. Winter precipitation is most when the middle-latitude storm [illegible] north of its normal position, the area generally has little precipitation, a pattern that can last into spring. An example is the period from December 30, 1971 through June 6, 1972 (a period of 160 consecutive days) when no measurable precipitation was reported at Phoenix Airport. Snowfall is rare in the valleys in this section of Arizona. An occasional light fall occurs in the mountains above the 2,500-foot level.

The second rainfall season occurs in July, August, and most of September, when the area experiences widespread thunderstorm activity associated with moist air moving into Arizona from the southern quadrant. The time of

unusually heavy precipitation can occur near the end of

**Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material

control weeds, to aid decomposition of plant residues, and to encourage the storage of moisture for the succeeding grain crop.

**Fertility, soil.** The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors, such as light, moisture, temperature, and the physical condition of the soil, are favorable.

**Field moisture capacity.** The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has been allowed to drain away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

**Flood plain.** Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

**Hardpan.** A hardened or cemented soil horizon, or layer. The soil material may be sandy or clayey, and it may be cemented by iron oxide, silica, calcium carbonate, or other substance.

**Horizon, soil.** A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

*O horizon.*—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

*A horizon.*—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

*B horizon.*—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

*C horizon.*—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

*R layer.*—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

**Irrigation.** Application of water to soils to assist in production of crops. Methods of irrigation are—

Furrow. Water is applied at the upper end of a strip in which

**Mottling, soil.** Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominant.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

**Munsell notation.** A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

**Parent material.** Disintegrated and partly weathered rock from which soil has formed.

**Ped.** An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

**Permeability.** The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

**pH.** See Reaction, soil.

**Plowpan.** A compacted layer formed in the soil immediately below the plowed layer.

**Profile, soil.** A vertical section of the soil through all its horizons and extending into the parent material.

**Reaction, soil.** The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

| | *pH* | | *pH* |
|---|---|---|---|
| Extremely acid | Below 4.5 | Neutral | 6.6 to 7.3 |
| Very strongly acid | 4.5 to 5.0 | Mildly alkaline | 7.4 to 7.8 |
| Strongly acid | 5.1 to 5.5 | Moderately alkaline | 7.9 to 8.4 |
| Medium acid | 5.6 to 6.0 | Strongly alkaline | 8.5 to 9.0 |
| Slightly acid | 6.1 to 6.5 | Very strongly alkaline | 9.1 and higher. |

**Root zone.** The part of the soil that is penetrated, or can be penetrated, by plant roots.

**Runoff.** Surface drainage of rainfall or melted snow.

**Saline soil.** A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

**Sand.** Individual rock or mineral fragments in a soil that range in

*Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

**Subsoil.** Technically, the B horizon; roughly, the part of the solum below plow depth.

**Subsoiling.** Tillage of a soil below normal depth ordinarily to shatter a hardpan or claypan.

**Substratum.** Technically, the part of the soil below the solum.

**Surface soil.** The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

**Tail water.** That portion of the irrigation water that reaches the end of the field.

**Terrace** (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

**Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

**Tillage pan.** See Plowpan.

**Tilth, soil.** The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

**Topsoil.** A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

**Valley plain.** Broad, nearly level, featureless flood plain produced by the filling of a valley floor.

**Waterlogged.** Saturated with water. Soil condition where a high or perched water table is detrimental to plant growth, resulting from overirrigation, seepage, or inadequate drainage; the replacement of most of the soil air by water.

**Water table.** The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. Capability units for irrigated soils are described on pages 59 to 62. Capability subclasses for dryland soils are described on pages 62 and 63. Range sites are described on pages 66 and 67. Other information is given in tables as follows:

Acreage and extent, table 1.

Engineering, tables 5 and 6,

| Map symbol | Mapping unit | Page | Capability unit and subclass Irrigated Symbol | Capability unit and subclass Dryland Symbol | Range site Name | Horticultural group Number | Wildlife habitat group Irrigated | Page | Wildlife habitat group Dryland | Page |
|---|---|---|---|---|---|---|---|---|---|---|
| CeD | Carrizo-Ebon complex, 3 to 12 percent slopes | 17 | ------ | VIIe | ---------- | --- | --- | -- | -- | -- |
| | Carrizo soil | -- | ------ | ------ | Sandy Bottom | 4 | --- | -- | 12 | 71 |
| | Ebon soil | -- | ------ | ------ | Clay Upland | 3 | --- | -- | 11 | 70 |
| CF | Carrizo and Brios soils | 18 | ------ | VIIs | Sandy Bottom | 4 | --- | -- | -- | -- |
| | Carrizo soil | -- | ------ | ------ | ---------- | --- | --- | -- | 12 | 71 |
| | Brios soil | -- | ------ | ------ | ---------- | --- | --- | -- | 11 | 70 |
| Cg | Casa Grande sandy loam | 19 | IIIs-9 | VIIs | Saline Upland | 5 | 5 | 69 | 14 | 71 |
| Ch | Casa Grande loam | 19 | IIIs-9 | VIIs | Saline Upland | 5 | 5 | 69 | 14 | 71 |
| Ck | Casa Grande complex | 19 | ------ | VIIs | Saline Upland | 5 | --- | -- | 14 | 71 |
| Cm | Casa Grande-Laveen complex, alkali | 19 | IIIs-9 | VIIs | Saline Upland | 5 | 5 | 69 | 14 | 71 |
| Cn | Cashion clay, saline-alkali | 20 | IVs-9 | VIIs | Sandy Bottom | 3 | 8 | 70 | 11 | 70 |
| CO | Cherioni-Rock outcrop complex | 21 | ------ | VIIe | Loam Hills | 7 | --- | -- | 12 | 71 |
| Cp | Coolidge sandy loam | 21 | IIs-7 | VIIs | Loam Upland | 2 | 2 | 69 | 11 | 70 |
| CrB | Coolidge gravelly sandy loam, 1 to 3 percent slopes | 22 | IIe-7 | VIIe | Loam Upland | 2 | 2 | 69 | 11 | 70 |
| Cs | Coolidge-Tremant complex | 22 | IIs-6 | VIIs | Loam Upland | 2 | 2 | 69 | 11 | 70 |
| CV | Coolidge-Laveen association, 0 to 3 percent slopes | 22 | ------ | ------ | Loam Upland | 2 | --- | -- | 11 | 70 |
| | Coolidge soil | -- | ------ | VIIs | ---------- | --- | --- | -- | -- | -- |
| | Laveen soil | -- | ------ | VIIc | ---------- | --- | --- | -- | -- | -- |
| Dn | Dune land | 22 | ------ | VIIs | Loam Upland | 4 | --- | -- | 12 | 71 |
| EbD | Ebon gravelly loam, 0 to 8 percent slopes | 23 | ------ | VIIe | Clay Upland | 3 | --- | -- | 11 | 70 |
| EPD | Ebon-Pinamt complex, 0 to 10 percent slopes | 23 | ------ | VIIe | Clay Upland | --- | --- | -- | 11 | 70 |
| | Ebon soil | -- | ------ | ------ | ---------- | 3 | --- | -- | -- | -- |
| | Pinamt soil | -- | ------ | ------ | ---------- | 2 | --- | -- | -- | -- |
| Es | Estrella loam | 25 | I-1 | VIIc | Loam Upland | 1 | 1 | 68 | 11 | 70 |
| Et | Estrella loam, saline-alkali | 25 | IIs-9 | VIIs | Saline Upland | 5 | 1 | 68 | 11 | 70 |
| GA | Gachado-Rock outcrop complex | 25 | ------ | VIIe | Loam Hills | 7 | --- | -- | 12 | 71 |
| Gb | Gadsden clay loam | 26 | IIIs-8 | VIIs | Sandy Bottom | 3 | 3 | 69 | 9 | 70 |
| Gc | Gadsden clay | 26 | IIIs-3 | VIIs | Sandy Bottom | 3 | 3 | 69 | 9 | 70 |
| Gd | Gadsden clay, saline-alkali | 26 | IVs-9 | VIIs | Sandy Bottom | 3 | 8 | 70 | 11 | 70 |
| Ge | Gilman fine sandy loam | 27 | I-2 | VIIc | Loam Upland | 1 | 1 | 68 | 11 | 70 |
| Gf | Gilman fine sandy loam, saline-alkali | 27 | IIs-9 | VIIs | Saline Upland | 5 | 1 | 68 | 11 | 70 |
| GgA | Gilman loam, 0 to 1 percent slopes | 28 | I-1 | VIIc | Loam Upland | 1 | 1 | 68 | 11 | 70 |
| GgB | Gilman loam, 1 to 3 percent slopes | 28 | IIe-1 | VIIe | Loam Upland | 1 | 1 | 68 | 11 | 70 |
| Gh | Gilman loam, saline-alkali | 28 | IIs-9 | VIIs | Saline Upland | 5 | 1 | 68 | 11 | 70 |
| GL | Gilman complex, saline-alkali | 28 | ------ | VIIs | Saline Upland | 5 | --- | -- | 11 | 70 |
| GM | Gilman-Antho association | 28 | ------ | ------ | Loam Upland | 1 | --- | -- | 11 | 70 |
| | Gilman soil | -- | ------ | VIIc | ---------- | --- | --- | -- | -- | -- |
| | Antho soil | -- | ------ | VIIs | ---------- | --- | --- | -- | -- | -- |
| GN | Gilman-Laveen association | 28 | ------ | VIIc | Loam Upland | --- | --- | -- | 11 | 70 |
| | Gilman soil | -- | ------ | ------ | ---------- | 1 | --- | -- | -- | -- |
| | Laveen soil | -- | ------ | ------ | ---------- | 2 | --- | -- | -- | -- |
| Go3 | Gilman, Antho and Glenbar soils, severely eroded | 29 | ------ | VIIe | Saline Upland | 5 | --- | -- | 11 | 70 |
| Gp | Gilman loam, clayey subsoil variant, moderately saline | 29 | IIIs-9 | VIIs | Sandy Bottom | 5 | 3 | 69 | 13 | 71 |
| Gr | Glenbar loam | 30 | I-1 | VIIc | Loam Upland | 1 | 1 | 68 | 11 | 70 |
| Gs | Glenbar loam, saline-alkali | 30 | IIs-9 | VIIs | Saline Upland | 5 | 1 | 68 | 13 | 71 |
| Gt | Glenbar clay loam | 30 | I-1 | VIIc | Loam Upland | 1 | 1 | 68 | 11 | 70 |
| Gu | Glenbar clay loam, saline-alkali | 31 | IIs-9 | VIIs | Saline Upland | 5 | 1 | 68 | 13 | 71 |
| Gv | Glenbar clay | 31 | IIIs-3 | VIIs | Loam Upland | 1 | 3 | 69 | 11 | 70 |

GUIDE TO MAPPING UNITS--Continued

| Map symbol | Mapping unit | Page | Capability unit and subclass Irrigated Symbol | Capability unit and subclass Dryland Symbol | Range site Name | Horticultural group Number | Wildlife habitat group Irrigated | Page | Wildlife habitat group Dryland | Page |
|---|---|---|---|---|---|---|---|---|---|---|

GUIDE TO MAPPING UNITS--Continued

| Map symbol | Mapping unit | Page | Capability unit and subclass Irrigated Symbol | Capability unit and subclass Dryland Symbol | Range site Name | Horticultural group Number | Wildlife habitat group Irrigated | Wildlife habitat group Page | Wildlife habitat group Dryland | Wildlife habitat group Page |
|---|---|---|---|---|---|---|---|---|---|---|
| PvB | Pinal-La Palma loams, 1 to 3 percent slopes | 42 | ------ | VIIe | ---------- | --- | --- | -- | -- | -- |
| | Pinal soil | -- | ------ | ------ | Loam Upland | 7 | --- | -- | 11 | 70 |
| | La Palma soil | -- | ------ | ------ | Saline Upland | 5 | --- | -- | 14 | 71 |
| PWB | Pinal-Suncity complex, 0 to 3 percent slopes | 43 | ------ | VIIs | Loam Upland | 7 | --- | -- | 11 | 70 |
| PYD | Pinamt-Tremant complex, 1 to 10 percent slopes | 43 | ------ | VIIe | ---------- | 2 | --- | -- | 11 | 70 |
| | Pinamt soil | -- | ------ | ------ | Clay Upland | --- | --- | -- | -- | -- |
| | Tremant soil | -- | ------ | ------ | Loam Upland | --- | --- | -- | -- | -- |
| RaA | Rillito sandy loam, 0 to 1 percent slopes | 44 | IIs-6 | VIIs | Loam Upland | 6 | 2 | 69 | 11 | 70 |
| RaB | Rillito sandy loam, 1 to 3 percent slopes | 45 | IIe-6 | VIIe | Loam Upland | 6 | 2 | 69 | 11 | 70 |
| RbA | Rillito loam, 0 to 1 percent slopes | 45 | IIs-6 | VIIs | Loam Upland | 6 | 2 | 69 | 11 | 70 |
| RbB | Rillito loam, 1 to 3 percent slopes | 45 | IIe-6 | VIIe | Loam Upland | 6 | 2 | 69 | 11 | 70 |
| RhB | Rillito-Harqua complex, 1 to 3 percent slopes | 45 | ------ | VIIe | ---------- | --- | --- | -- | -- | -- |
| | Rillito soil | -- | ------ | ------ | Loam Upland | 6 | --- | -- | 11 | 70 |
| | Harqua soil | -- | ------ | ------ | Saline Upland | 5 | --- | -- | 14 | 71 |
| RpE | Rillito-Perryville complex, 5 to 20 percent slopes | 45 | ------ | VIIe | Loam Upland | 6 | --- | -- | 11 | 70 |
| RS | Rock outcrop-Cherioni complex | 46 | ------ | ------ | ---------- | --- | --- | -- | -- | -- |
| | Rock outcrop | -- | ------ | VIII | ---------- | --- | --- | -- | -- | -- |
| | Cherioni soil | -- | ------ | VIIe | Loam Hills | 7 | --- | -- | 12 | 71 |
| Ta | Toltec loam | 48 | IIs-7 | VIIs | Loam Upland | 7 | 1 | 68 | 11 | 70 |
| TB | Torrifluvents | 48 | ------ | VIIe | Loam Upland | 4 | 4 | 69 | 11 | 70 |
| Tc | Torriorthents | 48 | ------ | VIIs | ---------- | --- | --- | -- | -- | -- |
| TD | Torripsamments and Torrifluvents, frequently flooded | 48 | ------ | VIII | ---------- | 4 | --- | -- | -- | -- |
| Te | Tremant loam | 49 | IIs-7 | VIIs | Loam Upland | 2 | 1 | 68 | 11 | 70 |
| TfA | Tremant gravelly loam, 0 to 1 percent slopes | 49 | IIs-6 | VIIs | Loam Upland | 2 | 1 | 68 | 11 | 70 |
| TfB | Tremant gravelly loam, 1 to 3 percent slopes | 49 | IIe-6 | VIIe | Loam Upland | 2 | 1 | 68 | 11 | 70 |
| Tg | Tremant clay loam | 49 | IIs-7 | VIIs | Loam Upland | 2 | 1 | 68 | 11 | 70 |
| Th | Tremant gravelly clay loam | 50 | IIs-6 | VIIs | Loam Upland | 2 | 1 | 68 | 11 | 70 |
| TPB | Tremant complex, 0 to 3 percent slopes | 50 | ------ | VIIs | Loam Upland | 2 | --- | -- | 11 | 70 |
| TrA | Tremant-Rillito complex, 0 to 1 percent slopes | 50 | IIs-6 | VIIs | Loam Upland | --- | --- | -- | 11 | 70 |
| | Tremant soil | -- | ------ | ------ | ---------- | 2 | 1 | 68 | -- | -- |
| | Rillito soil | -- | ------ | ------ | ---------- | 6 | 2 | 69 | -- | -- |
| TrB | Tremant-Rillito complex, 1 to 3 percent slopes | 50 | ------ | VIIe | Loam Upland | --- | --- | -- | 11 | 70 |
| | Tremant soil | -- | ------ | ------ | ---------- | 2 | 1 | 68 | -- | -- |
| | Rillito soil | -- | ------ | ------ | ---------- | 6 | 2 | 69 | -- | -- |
| TSC | Tremant-Rillito complex, 0 to 5 percent slopes | 51 | ------ | VIIs | Loam Upland | --- | --- | -- | 11 | 70 |
| | Tremant soil | -- | ------ | ------ | ---------- | 2 | --- | -- | -- | -- |
| | Rillito soil | -- | ------ | ------ | ---------- | 6 | --- | -- | -- | -- |
| Tt | Trix clay loam | 51 | I-1 | VIIc | Loam Upland | 1 | 1 | 68 | 11 | 70 |
| Tu | Tucson loam | 52 | I-1 | VIIc | Loam Upland | 2 | 1 | 68 | 11 | 70 |
| Tw | Tucson clay loam | 52 | I-1 | VIIc | Loam Upland | 2 | 1 | 68 | 11 | 70 |
| Va | Valencia sandy loam | 53 | I-2 | VIIc | Loam Upland | 1 | 1 | 68 | 11 | 70 |
| Vb | Valencia sandy loam, saline-alkali | 53 | IIs-9 | VIIs | Saline Upland | 5 | 1 | 68 | 11 | 70 |
| Vc | Valencia gravelly sandy loam | 54 | I-2 | VIIc | Loam Upland | 1 | 1 | 68 | 11 | 70 |
| Ve | Vecont loam | 54 | IIIs-8 | VIIs | Clay Bottom | 3 | 3 | 69 | 9 | 70 |

GUIDE TO MAPPING UNITS--Continued

| Map symbol | Mapping unit | Page | Capability unit and subclass Irrigated Symbol | Capability unit and subclass Dryland Symbol | Range site Name | Horticultural group Number | Wildlife habitat group Irrigated | Wildlife habitat group Irrigated Page | Wildlife habitat group Dryland | Wildlife habitat group Dryland Page |
|---|---|---|---|---|---|---|---|---|---|---|
| Vf | Vecont clay | 55 | IIIs-3 | VIIs | Clay Bottom | 3 | 3 | 69 | 9 | 70 |
| Vg | Vint loamy fine sand | 55 | IIIs-7 | VIIs | Sandy Bottom | 4 | 4 | 69 | 11 | 70 |
| [illegible] | [illegible] | 55 | IIIs-7 | VIIs | Sandy Bottom | 4 | 2 | 69 | 11 | 70 |

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