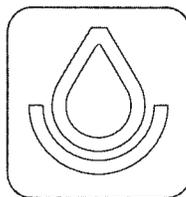


SOIL SURVEY OF

Yavapai County, Arizona, Western Part



**United States Department of Agriculture
Soil Conservation Service and Forest Service**
In cooperation with
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 leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in the period 1962-67. Soil names and descriptions were approved in 1968. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1968. This survey was made cooperatively by the Soil Conservation Service, the Forest Service, and the Arizona Agricultural Experiment Station. It is part of the technical assistance furnished to the Chino Winds, Triangle, and Wickenburg Natural Resource Conservation Districts.

Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for agriculture, industry, and recreation.

Locating Soils

All the soils of Yavapai County, Western Part, are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the range site, range herbage group, timber group, and wildlife group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of

soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitations or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the range sites, range herbage groups, and timber groups.

Foresters and others can refer to the section "Woodland," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Ranchers and others can find, under "Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

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SOIL SURVEY OF YAVAPAI COUNTY, ARIZONA, WESTERN PART

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

YAVAPAI COUNTY, WESTERN PART, is located in the north-central part of Arizona (fig. 1) and makes up approximately the western three-fourths of the county. The Survey Area covers 3,774,500 acres or 5,898 square miles, of which 788,413 acres lies within the boundary of the Western Division of the Prescott National Forest.

The main use in farming is livestock grazing. A limited acreage is used for timber and irrigated crops. Other important uses are recreation, wildlife habitat, mining, and watershed.

The area is in the Mexican Highlands and Sonoran Desert Sections of the Basin and Range Physiographic Province. In general the topography consists of a series of moderately steep and steep soils on hills and mountains and nearly level to strongly sloping soils on alluvial plains. The geology is quite variable. The many kinds of rock formations have exerted strong influence on the shaping of the topographic features and the development of the soils.

Elevations range from about 2,000 feet above sea level in the desert area to nearly 8,000 feet on top of Mt. Union. Annual precipitation ranges from 8 inches in the drier desert areas to 30 inches in the mountains near Crown King. Average annual temperature ranges from 45° to about 75° F.

Vegetation varies from a sparse cover of desert shrubs at lower elevations to a chaparral, grass, or pinyon pine-juniper cover in the intermediate areas. A mixed stand of conifer and oak covers the higher mountains. Marked differences in vegetation occur within short distances because of the wide variance in soils, elevation, precipitation, and temperature.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Yavapai County, Western Part, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

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

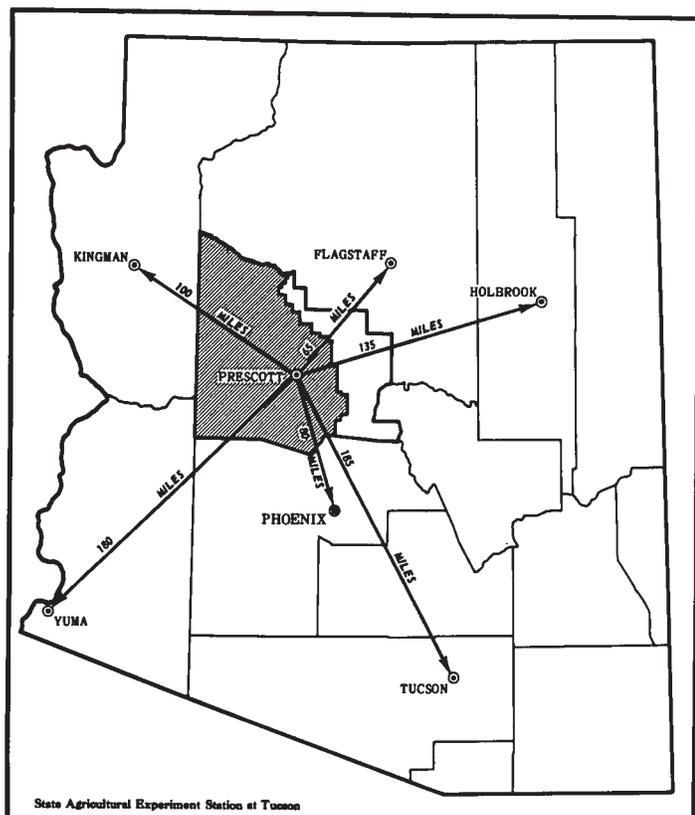


Figure 1.—Location of Yavapai County, Western Part, in Arizona.

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. Cordes and Springerville, 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 affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Lonti gravelly loam, 0 to 8 percent slopes, is one of several phases within the Lonti series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Three such kinds of mapping units are shown on the soil map of Yavapai County, Western Part: soil complexes, soil associations, and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Cellar-Chiricahua complex, 8 to 30 percent slopes, is an example.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one unit because the time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils, but the soils may differ greatly from one another. The name of an association consists of the names of the dominant soils, joined by a hyphen. Arp-Lynx association, rolling, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown 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. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Cross, Cabezon, and Apache soils, 2 to 15 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Badland is a land type in Yavapai County.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from fields or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland and rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Yavapai County, Western Part. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in an area, who want to compare different parts of an area, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the man-

agement of a farm or field, or for selecting 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.

Soils of Mountains and Hills

These soils are well drained, stony, cobbly, and gravelly loams. They are dominantly strongly sloping to very steep on hills and mountains. They formed in residual material and colluvium. Elevation ranges from 1,800 feet to 8,000 feet. The average annual precipitation ranges from 8 to 25 inches, and the average annual temperature ranges from 43° to 69° F. The length of the frost-free period ranges from 120 to 270 days.

1. *Rock land-Lehmans-House Mountain association*

Rock outcrop and shallow and very shallow; well-drained; gravelly, cobbly, and stony soils that are dominantly clay loam and loam

This association is made up of strongly sloping to very steep soils on hills and mountains. These soils formed in material weathered from basalt or andesite. The vegetation is desert shrubs, cactuses, and grasses. Annual precipitation is 8 to 12 inches. The average annual temperature ranges from 61° to 65° F, and the frost-free period ranges from 200 to 250 days. Elevation ranges from 1,800 to 4,500 feet.

This association makes up about 4 percent of the survey area. It is about 45 percent Rock land, about 20 percent Lehmans soils, about 15 percent House Mountain soils, and about 20 percent minor areas of Graham and Rimrock soils.

Rock land consists of 50 to 90 percent andesite or basalt rock outcrops and associated very shallow, stony soils. Lehmans and House Mountain soils are intermingled with Rock land. Lehmans soils are shallow and have a gravelly and stony clay loam surface layer and a gravelly clay and clay subsoil. They formed in material weathered from andesite or closely related material. House Mountain soils are shallow and very shallow and are gravelly loam throughout. They formed in place in material weathered from basalt.

This association is used mainly for seasonal grazing, wildlife, watershed, and mining. The principal kinds of wildlife are quail, javelina, deer, dove, and cottontail rabbits.

2. *Cellar association*

Shallow and very shallow; well-drained; gravelly, cobbly, and stony soils that are dominantly sandy loam

This association is made up of sloping to very steep soils on granite and schist hills and mountains. The vegetation is desert shrubs, cactuses, and grasses. Annual precipitation is 8 to 12 inches. The average annual temperature ranges from 57° to 69° F, and the frost-free period ranges from 180 to 270 days. Elevation ranges from 2,000 to 4,500 feet.

This association makes up about 6 percent of the survey area. It is about 95 percent Cellar soils and about 5 percent minor areas of Chiricahua, Continental, and Whitlock soils and Rock land.

Cellar soils are shallow and very shallow over bedrock. They have a gravelly, very gravelly, cobbly, or very stony sandy loam surface layer that is underlain by very gravelly loam.

This association is used mainly for seasonal grazing, mining, wildlife, and watershed. The principal kinds of wildlife are quail, javelina, dove, deer, and cottontail rabbits.

3. *Luzena-Faraway-Rock land association*

Rock outcrop and shallow and very shallow; well-drained; gravelly, cobbly, stony, and very stony soils that are dominantly loam

This association is made up of nearly level, moderately steep, and very steep soils on hills and mountains. These soils formed in material weathered from andesite or tuffaceous agglomerate. The vegetation is pinyon pine, juniper, oakbrush, and deerbrush, and an understory of grasses and annuals. Annual precipitation is 12 to 18 inches. The average annual temperature ranges from 50° to 57° F, and the frost-free period ranges from 160 to 240 days. Elevation ranges from 4,000 to 6,500 feet.

This association makes up about 3 percent of the survey area. It is about 45 percent Luzena soils, 30 percent Faraway soils, 23 percent Rock land, and about 2 percent minor areas of alluvial and colluvial soils.

Luzena soils have a very stony loam surface layer and a gravelly clay subsoil. They are shallow over bedrock. Faraway soils are gravelly and very stony loam throughout and also are shallow over bedrock. Rock land consists of 50 to 90 percent rock outcrops that have shallow, medium-textured soils scattered between them.

This association is used mainly for range, wildlife, watershed, and building-stone quarries. The principal kinds of wildlife are deer, quail, dove, and cottontail rabbits.

4. *Barkerville-Moano association*

Shallow and moderately deep; well-drained; gravelly, very gravelly, cobbly, stony, and very stony soils that are dominantly sandy loam and loam

This association is made up of soils underlain by weathered or fractured bedrock and nearly level to very steep soils on granite or schist hills and mountains (fig. 2). The vegetation is brush and an understory of grasses and annuals. Annual precipitation is 12 to 20 inches. The average annual temperature ranges from 50° to 57° F, and the frost-free period ranges from 140 to 220 days. Elevation ranges from 4,000 to 6,500 feet.

This association makes up about 25 percent of the survey area. It is about 70 percent Barkerville soils, about 20 percent Moano soils, and about 10 percent minor areas of Gaddes, Arp, Lynx, and Cordes soils.

Barkerville soils are gravelly, cobbly, or stony sandy loam throughout and are shallow over weathered granite. Moano soils are gravelly and stony loam throughout and are shallow over fractured schist.

This association is used mainly for range, wildlife, watershed, and mining. The deep Lynx soils along drainageways are the best sites for stock water tanks.



Figure 2.—A typical area in the Barkerville-Moano association. These moderately steep and steep Barkerville soils support a cover of chaparral.

The principal kinds of wildlife are deer, quail, cottontail rabbits, and dove.

5. Tortugas-Purner-Jacks association

Very shallow, shallow, and moderately deep; gravelly, cobbly, or stony soils that are dominantly loam

This association is made up of gently sloping to very steep soils on limestone or sandstone hills, ridges, and mountains. The vegetation is pinyon pine and juniper and an understory of grasses. Annual precipitation is 12 to 19 inches. The average annual temperature ranges from 48° to 57° F., and the frost-free period ranges from 120 to 200 days. Elevation ranges from 4,200 to 6,000 feet.

This association makes up about 6 percent of the survey area. It is about 40 percent Tortugas soils,

about 25 percent Purner soils, about 15 percent Jacks soils, and about 20 percent Boysag, minor areas of Moenkopie, Rune, Tours, and Dye soils and Rock land.

Tortugas and Purner soils are gravelly and stony loam throughout and are shallow over limestone bedrock. Jacks soils are gravelly and cobbly loam that have a gravelly clay loam and gravelly clay subsoil and are moderately deep over sandstone.

This association is used mainly for range, wildlife, watershed, and building-rock quarries. Controlling juniper is practical on the more level and less rocky areas. The deeper Rune and Tours soils along drainageways are the best sites for stock water tanks. The principal kinds of wildlife are deer, dove, cottontail rabbits, and turkey at higher elevations.

6. *Mirabal-Dandrea-Brolliar association*

Shallow and moderately deep; gravelly, cobbly, and stony soils that are dominantly sandy loam, loam, and silt loam

This association is made up of gently sloping soils on basalt mesas and moderately steep and steep soils on granite and schist hills and mountains. The vegetation is ponderosa pine, Gambel oak, and Douglas fir at the higher elevations, along with scattered aspen in the more favorable sites, and an understory of grasses. Annual precipitation is 18 to 25 inches. The average annual temperature ranges from 43° to 52° F, and the frost-free period ranges from 120 to 175 days. Elevation ranges from 6,000 to 8,000 feet.

This association makes up about 4 percent of the survey area. It is about 55 percent Mirabal soils, about 20 percent Dandrea soils, about 10 percent Brolliar soils, and about 15 percent minor areas of Hogg and Wilcoxson soils.

Mirabal soils are gravelly sandy loam throughout and are shallow over weathered granite. Dandrea soils have a gravelly loam surface layer and a gravelly clay loam and gravelly clay subsoil. They are moderately deep over weathered schist. Brolliar soils have a stony silt loam surface layer and a gravelly clay loam and gravelly clay subsoil. They are moderately deep over basalt.

This association is used mainly for timber, range, wildlife, recreation, watershed, and mining. The principal kinds of wildlife are deer, turkey, band-tailed pigeons, and black bear. A few dove and cottontail rabbits are in the aspen areas.

Soils of Valley Fans, Terraces, and Plains

These soils are well drained, coarse textured to fine textured, and nearly level to very steep. They are on valley fans, terraces, and plains. They formed in alluvium and residual material. Elevation ranges from 2,000 to 7,600 feet. The average annual precipitation ranges from 8 to 20 inches, and the average annual temperature ranges from 45° to 68° F. The length of the frost-free period ranges from 115 to 240 days.

7. *Continental-Whitlock-Cave association*

Deep and shallow; gravelly, cobbly, or stony soils that are dominantly sandy loam on nearly level to steep fans, plains, and valley side slopes

This association is made up of nearly level to steep soils on alluvial fans, plains, and valley sides. These soils formed in material weathered dominantly from granite. The vegetation is creosotebush, big galleta, snakeweed, desert shrubs, cactuses, and annuals. Annual precipitation is 8 to 12 inches. The average annual temperature ranges from 60° to 68° F, and the frost-free period ranges from 180 to 240 days. Elevation ranges from 2,000 to 4,500 feet.

This association makes up about 12 percent of the survey area. It is about 30 percent Continental soils, about 25 percent Whitlock soils, about 15 percent Cave soils, and about 30 percent minor areas of Mohave, Anthony, Palos Verdes, Latene, Tres Hermanos, and Gila soils.

Continental soils are deep and have a gravelly sandy loam surface layer. The subsoil is clay loam and clay, and a weakly cemented lime layer is at moderate depths. Whitlock soils are deep, gravelly sandy loam and sandy loam throughout. They have an accumulation of lime at a shallow depth. Cave soils are gravelly sandy loam throughout and are shallow to an indurated-lime hardpan.

This association is used mainly for seasonal grazing, wildlife, watershed, and mining. The principal kinds of wildlife are quail, javelina, deer, dove, and cottontail rabbits.

8. *Springerville-Cabazon association*

Shallow, moderately deep, and deep; gravelly, cobbly, or stony soils that are dominantly silty clay and loam on nearly level plains and mesas and on very steep side slopes

This association is made up of nearly level and sloping soils on plains and mesas and very steep soils on side slopes. These soils formed from basaltic materials. The vegetation at lower elevations is dominantly grass. At higher elevations open stands of juniper, oakbrush, and an understory of grasses are dominant. Annual precipitation is 12 to 18 inches. The average annual temperature ranges from 45° to 58° F, and the frost-free period ranges from 115 to 225 days. Elevation ranges from 4,200 to 7,600 feet.

This association makes up about 18 percent of the survey area. It is about 45 percent Springerville soils, about 30 percent Cabazon soils, and about 25 percent minor areas of Thunderbird, Waldroup, Venezia, Apache, and Lynx soils and Rock land.

Springerville soils are moderately deep to deep, cobbly or stony silty clay throughout. Cabazon soils are shallow and have a gravelly, cobbly, and stony loam surface layer and a cobbly clay loam and clay subsoil.

This association is used mainly for range, wildlife, and watershed. The principal kinds of wildlife are antelope and deer, but dove, quail, and small numbers of migrating waterfowl are present where water is available.

9. *Cabazon-Thunderbird-Venezia association*

Shallow and moderately deep; gravelly, cobbly, or stony soils that are dominantly loam and clay loam on gently sloping and undulating plains and mesas and on very steep side slopes

This association is made up of sloping and undulating soils on plains and mesas and very steep soils on side slopes. The vegetation is juniper or oakbrush in places, deerbrush, and an understory of grasses. The average annual temperature ranges from 45° to 58° F., and the frost-free period ranges from 118 to 235 days. Elevation ranges from 4,000 to 7,600 feet.

This association makes up about 3 percent of the survey area. It is about 40 percent Cabazon soils, about 25 percent Thunderbird soils, about 15 percent Venezia soils, and about 20 percent minor areas of Springerville, Waldroup, Cross, and Apache soils and Rock land.

Cabazon soils have a gravelly, cobbly, or stony loam surface layer and a cobbly clay loam and clay subsoil. They are shallow over basalt. Thunderbird soils have a

cobbly clay loam surface layer and a clay loam and clay subsoil. They are moderately deep over basalt. Texture is modified by gravel or cobblestones in places. Venezia soils are shallow over basalt and are gravelly and stony loam throughout.

This association is used mainly for range, wildlife, and watershed. It is suitable as habitat for deer, quail, dove, cottontail rabbits, and migrating waterfowl where water is available.

10. Pastura-Poley-Partri association

Deep to shallow soils are dominantly loam and gravelly sandy loam on nearly level to moderately steep fans, plains, and side slopes

This association is made up of nearly level to moderately steep soils on old alluvial fans. The vegetation is grasses or scattered juniper and an understory of grasses and annuals. Annual precipitation is 12 to 14 inches. The average annual temperature is 50° to 54° F, and the frost-free period ranges from 140 to 170 days. Elevation ranges from 4,600 to 5,600 feet.

This association makes up about 3 percent of the survey area. It is about 38 percent Pastura soils, about 35 percent Poley soils, about 25 percent Partri soils, and about 2 percent minor areas of Rune and Lynx soils along drainageways.

Pastura soils are gravelly loam throughout and shallow over an indurated-lime hardpan. Poley soils have a gravelly sandy loam surface layer and a clay and sandy clay loam subsoil. Weakly cemented soil material is at a moderate depth. Partri soils have a loam surface layer and a clay loam and clay subsoil. They have a weakly cemented lime layer at a moderate depth.

This association is used mainly for range, wildlife, and watershed. Control of juniper is a recommended practice. The deeper Partri, Poley, Lynx, and Rune soils along drainageways are the best sites for stock water tanks. The principal kinds of wildlife are antelope, deer, dove, cottontail rabbits, and migratory waterfowl.

11. Pastura-Abra-Lynx association

Shallow and deep soils that are dominantly loam, gravelly loam, and clay loam on nearly level to moderately steep fans, plains, flood plains, and side slopes

This association is made up of nearly level to sloping and moderately steep Pastura and Abra soils on old alluvial fans and plains and more level Lynx soils in drainageways. The vegetation is grasses or juniper and pinyon pine and an understory of grasses and annuals. Annual precipitation is 11 to 20 inches. The average annual temperature ranges from 50° to 57° F, and the frost-free period ranges from 140 to 220 days.

This association makes up about 9 percent of the survey area. It is about 35 percent Pastura soils, about 35 percent Abra soils, about 20 percent Lynx soils, and about 10 percent minor areas of Lonti, Poley, and Wineg soils.

Pastura soils are gravelly loam throughout and shallow to an indurated-lime hardpan. Abra soils are deep, calcareous, and dominantly loam throughout. Lynx soils are deep and are loam and clay loam throughout.

This association is used mainly for range, irrigated farming, urban development, wildlife, and watershed. Where the soils are cultivated, such irrigated crops as small grain, corn, and alfalfa are grown. Brush control and seeding are good improvement practices, but establishment is difficult on the Lynx soils. Juniper eradication on the Pastura and Abra soils has proven practical. The Lynx soils in drainageways are suitable for stock water storage tanks. The principal kinds of wildlife are deer, antelope, quail, dove, cottontail rabbits, and migratory waterfowl.

12. Lonti-Balon-Lynx association

Deep soils that are dominantly loam, clay loam, gravelly or cobbly sandy loam, and gravelly sandy clay loam on nearly level and very steep fans, plains, and flood plains

This association is made up of nearly level to moderately steep Lonti and Balon soils on fans and plains and nearly level Lynx soils on flood plains and in swales. Lonti and Balon soils formed in older alluvium, and Lynx soils formed in recent alluvial material. The vegetation is oakbrush, deerbrush, squawbrush, and an understory of grasses, snakeweed, cactuses, and annuals. On some areas of the Lynx soils, however, brush species are absent. Annual precipitation is 12 to 20 inches. The average annual temperature ranges from 51° to 58° F, and the frost-free period ranges from 140 to 225 days. Elevation ranges from 4,000 to 6,000 feet.

This association makes up about 7 percent of the survey area. It is about 70 percent Lonti soils, about 15 percent Balon soils, and about 15 percent Lynx soils and minor areas of Abra, Wineg, Cordes, Springerville, and coarse-textured alluvial soils.

Lonti soils are deep and have a thin, gravelly or cobbly sandy loam surface layer. The subsoil is gravelly sandy clay loam, gravelly clay, and gravelly clay loam. Balon soils are deep and have a gravelly sandy clay loam surface layer. The subsoil is gravelly sandy clay loam, gravelly clay loam, and gravelly sandy loam. Lynx soil are deep and are loam and clay loam throughout.

This association is used mainly for range, wildlife, urban development, recreation, and watershed. Some gold has been placer mined along the larger drainageways. Brush control and seeding are practical on these soils. Lynx soils along drainageways are good sites for stock water tanks. The principal kinds of wildlife are deer, quail, dove, cottontail rabbits, and migratory waterfowl.

Descriptions of the Soils

This section describes the soil series and mapping units in Yavapai County, Western Part. Each soil series is described in considerable detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second, detailed and in technical terms, is for scientists, engineers, and others who need to make thorough and precise studies of soils. Unless it is otherwise stated, the colors given in the descriptions are for dry soil.

As mentioned in the section "How This Survey Was Made," not all mapping units are part of a soil series. Rock land, for example, does not belong to a soil series, but nevertheless, is listed in alphabetical order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the capability unit, range site, timber group, and wildlife group in which the mapping unit has been placed. The page for the description of each capability unit and range site can be found by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in 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 (8)¹

Abra Series

The Abra series consists of deep, well-drained, calcareous soils that have a zone of accumulated lime in the lower part. These soils formed in mixed alluvium weathered from granite, basalt, limestone, sandstone, and schist. They are on nearly level plains and moderately steep alluvial fans. Slopes range from 0 to 30 percent. Elevation ranges from 4,000 to 5,500 feet. The vegetation is dominantly grass on the plains and pinyon pine and juniper on the alluvial fans. Annual precipitation is 11 to 16 inches. The average annual temperature is 50° to 57° F, and the frost-free period is 145 to 180 days.

In a representative profile the surface layer is light brownish-gray gravelly sandy loam about 3 inches thick. The underlying material is light brownish-gray, light yellowish-brown, and reddish-yellow loam about 47 inches thick. A weakly cemented zone of accumulated lime is in the lower part of the underlying material. Below the layer of lime is very pale brown loam that extends to a depth of 60 inches or more. The lower part of the underlying material is moderately alkaline and ranges from noneffervescent to violently effervescent.

Permeability is moderately slow. Available water capacity is high, and the effective rooting depth is more than 60 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas. Small areas in the

Chino Valley are used for irrigated crops and home-sites.

Representative profile of Abra gravelly sandy loam, 0 to 8 percent slopes, 2.25 miles N. and 0.87 mile W. of the SE. corner, sec. 10, T. 14 N., R. 1 W.:

A1—0 to 3 inches, light brownish-gray (10YR 6/2 gravelly sandy loam, dark grayish brown (10YR 4/2) when moist; moderate, very fine, granular structure; slightly hard, friable, slightly sticky and plastic; common fine and medium roots; few fine interstitial pores; violently effervescent; moderately alkaline; clear, wavy boundary.

C1—3 to 18 inches, light brownish-gray (10YR 6/2) loam, brown (10YR 4/3) when moist; massive; slightly hard, friable, slightly sticky and plastic; many fine roots; common fine and very fine tubular pores; violently effervescent; few, fine, white (N 8/0) segregations of lime; moderately alkaline; clear, wavy boundary.

C2ca—18 to 25 inches, light yellowish-brown (10YR 6/4) loam, yellowish brown (10YR 5/4) when moist; massive; slightly hard, friable, slightly sticky and plastic; common fine and very fine tubular pores; more than 15 percent lime; violently effervescent; many, medium and large, white (N 8/0) segregations and many, soft, very pale brown (10YR 7/4) masses of lime; moderately alkaline; clear, wavy boundary.

C3ca—25 to 50 inches, light yellowish-brown (10YR 6/4) and reddish-yellow (7.5YR 6/6) loam, yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) when moist; massive; very hard, friable, slightly sticky and plastic; few very fine and fine roots; common fine and very fine tubular pores; violently effervescent; many, medium, white (N 8/0) seams and soft masses of lime; moderately alkaline; gradual, wavy boundary.

C4—50 to 62 inches, very pale brown (10YR 7/3) loam, yellowish brown (10YR 5/4) when moist; massive; very hard, friable, slightly sticky and plastic; few very fine and fine roots; common very fine and fine tubular pores; violently effervescent; moderately alkaline.

Depth to the Cca horizon ranges from 8 to 28 inches. In the A horizon hue is 10YR or 7.5YR, value is 5 or 6 dry and 3 or 4 moist, and chroma is 2 to 3. The A horizon is loam, gravelly loam, sandy loam, and gravelly sandy loam.

In the C horizon hue is dominantly 10YR or 7.5YR but ranges from 5YR to 10YR, value is 5 to 7 dry and 3 to 5 moist, and chroma is 2 to 6. The Cca horizon contains veins and soft masses of lime. The lower part of the C horizon ranges from loamy lacustrine deposits to gravelly sandy deposits. It is moderately alkaline and ranges from effervescent to violently effervescent.

Abra gravelly sandy loam, 0 to 8 percent slopes (A₀B).—This soil is on plains that are dissected by long drainageways. It has the profile described as representative of the series.

Included with this soil in mapping are areas of a soil that has a gravelly loam surface layer. Also included, and making up about 15 percent of the mapped acreage, are areas of Wineg and Lonti gravelly loams on plains and Lynx loam in the drainageways. In addition, a few areas are included where slopes are 8 to 15 percent.

Runoff is slow on this soil. The hazard of erosion is slight.

This soil is used for range, wildlife habitat, home-sites, and watershed catchment areas. A few areas are irrigated. Capability unit VI_s-1; Limy Upland range site, 12- to 16-inch precipitation zone; wildlife group 7.

¹ Italic numbers in parenthesis refer to Literature Cited, p. 120.

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

Soil	Acres	Percent	Soil	Acres	Percent
Abra gravelly sandy loam, 0 to 8 percent slopes	19,646	0.5	Hogg gravelly loam, 0 to 8 percent slopes	3,478	0.1
Abra-Lonti loams, 0 to 5 percent slopes	5,581	.1	Hogg gravelly loam, 8 to 30 percent slopes	3,263	.1
Abra-Poley loams, 0 to 5 percent slopes	18,240	.5	House Mountain soils, 15 to 40 percent slopes	18,861	.5
Abra-Balon association, rolling	12,152	.3	Jacks very rocky loam, 3 to 15 percent slopes	17,195	.5
Abra-Balon association, hilly	1,189	(¹)	Jacks very rocky loam, 15 to 30 percent slopes	20,361	.5
Abra-Lynx association, rolling	3,391	.1	Latene gravelly sandy loam	629	(¹)
Abra-Wineg association, rolling	20,565	.5	Latene-Mohave complex	26,269	.7
Anthony gravelly loamy sand, 8 to 15 percent slopes	4,208	.1	Lehmans gravelly clay loam, 8 to 45 percent slopes	20,644	.5
Anthony gravelly sandy loam, 0 to 8 percent slopes	10,820	.3	Lehmans extremely rocky clay loam, 8 to 60 percent slopes	15,846	.4
Anthony-Mohave sandy loams, 1 to 3 percent slopes	35,378	.9	Lonti gravelly sandy loam, 15 to 30 percent slopes	47,192	1.3
Apache gravelly loam	13,941	.4	Lonti gravelly sandy loam, high rainfall, 0 to 15 percent slopes	6,074	.2
Apache very stony loam	8,452	.2	Lonti gravelly sandy loam, high rainfall, 15 to 30 percent slopes	3,164	.1
Arp gravelly clay loam, 0 to 20 percent slopes	4,643	.1	Lonti gravelly loam, 0 to 8 percent slopes	58,534	1.6
Arp cobbly clay loam, 10 to 25 percent slopes	5,665	.2	Lonti cobbly loam, 0 to 15 percent slopes	49,866	1.3
Arp very rocky clay loam, 20 to 40 percent slopes	4,647	.1	Lonti cobbly loam, 30 to 60 percent slopes	14,530	.4
Arp-Moano complex, 0 to 30 percent slopes	3,333	.1	Lonti complex, 2 to 30 percent slopes	9,354	.3
Arp-Lynx association, rolling	3,758	.1	Lonti-Abra gravelly sandy loams, 0 to 8 percent slopes	5,803	.2
Badland	21,560	.6	Lonti-Abra complex, 8 to 30 percent slopes	10,093	.3
Balon sandy loam, 0 to 15 percent slopes	8,347	.2	Lonti-Pastura complex, 0 to 20 percent slopes	4,871	.1
Balon gravelly sandy clay loam, 5 to 30 percent slopes	23,197	.6	Lonti-Cordes association, undulating	5,242	.1
Balon-Lynx association, rolling	3,309	.1	Lonti-Wineg complex, 3 to 15 percent slopes	24,616	.6
Barkerville cobbly sandy loam, 20 to 60 percent slopes	241,458	6.5	Lonti-Rock land association, hilly	3,736	.1
Barkerville very stony sandy loam, 5 to 25 percent slopes	33,028	.9	Luzena cobbly loam, 0 to 30 percent slopes	20,800	.6
Barkerville extremely rocky sandy loam, 20 to 60 percent slopes	237,948	6.4	Luzena very rocky loam, 10 to 30 percent slopes	7,549	.2
Bridge gravelly loam, 0 to 25 percent slopes	4,143	.1	Lynx soils	105,675	2.8
Brolliar very stony silt loam, 0 to 15 percent slopes	5,357	.1	Lynx soils, eroded	875	(¹)
Brolliar very stony silt loam, 15 to 30 percent slopes	1,590	(¹)	Lynx soils, wet variant	1,967	.1
Cabezon-Springerville complex, 5 to 25 percent slopes	96,974	2.6	Mirabal gravelly sandy loam, 8 to 20 percent slopes	13,926	.4
Cabezon-Springerville cobbly complex, 5 to 15 percent slopes	4,827	.1	Mirabal gravelly sandy loam, 20 to 60 percent slopes	43,318	1.1
Cabezon-Thunderbird complex, 5 to 15 percent slopes	11,111	.3	Mirabal-Dandrea complex, 20 to 60 percent slopes	7,075	.2
Cabezon soils, 8 to 45 percent slopes	74,840	2.0	Moano gravelly loam, 0 to 30 percent slopes	26,358	.7
Cave gravelly sandy loam, 2 to 15 percent slopes	8,840	.2	Moano very rocky loam, 15 to 60 percent slopes	163,251	4.4
Cave-Continental gravelly sandy loams, 2 to 30 percent slopes	49,470	1.3	Moano extremely rocky loam, 15 to 30 percent slopes	4,790	.1
Cellar very gravelly sandy loam, 8 to 30 percent slopes	24,970	.7	Moano-Lynx association, rolling	2,934	.1
Cellar very rocky sandy loam, 2 to 15 percent slopes	16,812	.4	Moenkopie association, undulating	2,268	.1
Cellar very rocky sandy loam, 15 to 60 percent slopes	42,420	1.1	Mohave sandy loam	16,613	.1
Cellar-Chiricahua complex, 8 to 30 percent slopes	9,602	.2	Palma sandy loam, 1 to 8 percent slopes	1,175	(¹)
Cellar soils, 20 to 60 percent slopes	95,919	2.5	Palos Verdes gravelly sandy loam, 8 to 40 percent slopes	18,982	.5
Continental gravelly sandy loam, 2 to 15 percent slopes	28,277	.7	Partri loam	5,624	.1
Continental-Cave gravelly sandy loams, 8 to 30 percent slopes	8,686	.2	Partri gravelly clay loam	6,924	.2
Continental-Whitlock gravelly sandy loams, 2 to 15 percent slopes	25,542	.7	Partri-Abra loams	6,116	.2
Continental-Loamy alluvial land association, sloping	4,662	.1	Pastura gravelly loam, 0 to 8 percent slopes	34,645	.9
Continental soils, 3 to 30 percent slopes	11,885	.3	Pastura complex, 1 to 30 percent slopes	34,836	.9
Cordes sandy loam	8,049	.2	Pastura-Poley complex, 2 to 8 percent slopes	2,311	.1
Cordes fine sandy loam, red variant	1,318	(¹)	Pastura-Lynx association, undulating	90,409	2.4
Cross, Cabezon, and Apache soils, 2 to 15 percent slopes	8,293	.2	Pastura-Rune association, undulating	3,501	.1
Dandrea gravelly loam, 20 to 60 percent slopes	13,745	.4	Poley gravelly sandy loam	18,496	.5
Dye gravelly loam, 2 to 15 percent slopes	9,534	.3	Poley-Partri loams	26,340	.7
Dye very rocky loam, 2 to 15 percent slopes	2,876	.1	Purner gravelly loam, 2 to 15 percent slopes	43,753	1.2
Faraway very rocky loam, 0 to 15 percent slopes	8,271	.2	Purner very stony loam, 2 to 15 percent slopes	11,724	.3
Faraway-Luzena complex, 20 to 40 percent slopes	36,235	1.0	Purner very stony loam, 15 to 30 percent slopes	1,136	(¹)
Faraway-Luzena complex, 40 to 60 percent slopes	33,111	.9	Purner-Boysag complex, 2 to 15 percent slopes	13,566	.4
Gaddes gravelly sandy loam, 3 to 25 percent slopes	27,053	.7	Purner and Dye soils, 2 to 30 percent slopes	8,200	.2
Gila soils	9,150	.2	Purner and Moenkopie soils, 8 to 30 percent slopes	12,969	.3
Graham-Rimrock complex, 0 to 8 percent slopes	2,301	.1	Retriever gravelly loam, 2 to 30 percent slopes	2,885	.1
Graham soils, 8 to 45 percent slopes	13,407	.4	Rimrock cobbly clay	5,549	.1
			Rimrock-Cave complex	3,686	.1
			Rimrock-Graham complex, 3 to 15 percent slopes	17,854	.5
			Rock land	236,233	6.0
			Rock land, low rainfall	79,935	2.1
			Rough broken land	30,217	.8
			Rune loam	5,655	.2
			Sandy and gravelly alluvial land	30,261	.8
			Showlow gravelly sandy loam, 0 to 8 percent slopes	8,125	.2

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

Soil	Acres	Percent	Soil	Acres	Percent
Springerville cobbly clay, 0 to 8 percent slopes----	52,055	1.4	Vekol-Mohave complex-----	34,570	0.9
Springerville very stony clay, 0 to 8 percent slopes.	7,956	.2	Venezia cobbly loam, 0 to 30 percent slopes-----	8,510	.2
Springerville-Cabezon complex, 3 to 30 percent slopes.	199,852	5.4	Venezia very stony loam, 30 to 60 percent slopes--	13,238	.4
Springerville-Pastura complex, 1 to 5 percent slopes.	2,695	.7	Venezia-Springerville complex, 0 to 20 percent slopes.	3,530	.1
Springerville-Thunderbird complex, 0 to 8 percent slopes.	16,811	.4	Venezia-Thunderbird complex, 5 to 15 percent slopes.	525	(¹)
Springerville-Lonti association, undulating-----	14,300	.4	Venezia-Thunderbird complex, 15 to 40 percent slopes.	39,180	1.0
Tajo gravelly loam, 0 to 8 percent slopes-----	11,091	.3	Waldroup-Cabezon association, hilly-----	9,205	.2
Tajo-Springerville complex, 0 to 15 percent slopes.	15,966	.4	Whitlock gravelly sandy loam, 0 to 15 percent slopes.	41,505	1.1
Thunderbird cobbly clay loam, 0 to 15 percent slopes.	46,591	1.2	Whitlock-Anthony gravelly sandy loams, 0 to 15 percent slopes.	17,144	.5
Thunderbird cobbly clay loam, 15 to 40 percent slopes.	24,281	.6	Wilcoxson gravelly loam, 30 to 60 percent slopes--	4,922	.1
Thunderbird-Cabezon complex, 0 to 15 percent slopes.	38,812	1.0	Wineg sandy loam-----	4,864	.1
Tortugas gravelly loam, 2 to 8 percent slopes-----	9,631	.3	Wineg-Abra complex-----	19,707	.5
Tortugas very rocky loam, 8 to 30 percent slopes--	57,390	1.5	Wineg-Lynx association-----	680	(¹)
Tortugas extremely rocky loam, 15 to 60 percent slopes.	69,234	1.8	Wineg and Poley soils-----	2,714	.1
Tours loam-----	4,258	.1	Placer diggings-----	531	(¹)
Tres Hermanos-Whitlock gravelly sandy loams, 0 to 15 percent slopes.	9,432	.3	Water-----	1,377	(¹)
			Total-----	3,774,500	100

¹ Less than 0.05 percent.

Abra-Lonti loams, 0 to 5 percent slopes (AbB).—This complex is about 60 percent Abra loam and 30 percent Lonti loam. The Abra soil is on the higher ridges, and the Lonti soil is on scattered side slopes and level areas.

Included with these soils in mapping, and making up about 10 percent of the acreage, are areas of Wineg sandy loam and Springerville gravelly clay. These included soils are on plains and in drainageways.

Runoff is slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, homesites, and watershed catchment areas. Both parts in capability unit VI_s-1; Limy Upland range site, 12- to 16-inch precipitation zone. Abra part in wildlife group 7; Lonti part in wildlife group 8.

Abra-Poley loams, 0 to 5 percent slopes (AeB).—This complex is about 50 percent Abra loam and 20 percent Poley loam. These soils are in medium-sized areas and are in so intricate a pattern that they cannot be mapped separately. The Abra soil is on scattered, slightly higher lying areas and the Poley soil is on nearly level areas and in depressions.

Included with these soils in mapping, and making up about 30 percent of the mapped acreage, are areas of Lynx loam, Wineg loam, and Pastura gravelly loam. Lynx soils are nearly level and in depressions, Wineg soils are on the more level areas, and Pastura soils are on the higher areas.

Runoff is slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, homesites, and watershed catchment areas. Capability unit VI_s-1; Limy Upland range site, 12- to 16-inch precipitation zone; wildlife group 7.

Abra-Balon association, rolling (AIC).—This association is about 50 percent Abra gravelly loam that has

slopes of 8 to 15 percent and 40 percent Balon gravelly sandy clay loam that has slopes of 8 to 15 percent. The Abra soil is on ridgetops and steep side slopes. The Balon soil is on lower areas adjacent to drainageways.

Included with these soils in mapping, and making up about 10 percent of the acreage, are areas of Lonti gravelly loam, Abra gravelly loam that has slopes of 0 to 8 percent, and Lynx loam in narrow drainageways.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used for range, wildlife habitat, homesites, and watershed catchment areas. Both parts in capability unit VI_e-1. Abra part in Limy Upland range site, 12- to 16-inch precipitation zone; Balon part in Loam Upland range site, 12- to 16-inch precipitation zone. Abra part in wildlife group 7; Balon part in wildlife group 8.

Abra-Balon association, hilly (AID).—This association is about 55 percent Abra gravelly loam that has slopes of 15 to 30 percent and 35 percent Balon gravelly sandy clay loam that has slopes of 15 to 30 percent. The Abra soil is on the tops and sides of ridges. The Balon soil is on the lower parts of side slopes adjacent to drainageways. Areas are dissected by a few long drainageways and many short side drainageways.

Included with these soils in mapping, and making up about 10 percent of the acreage, are areas of Lonti gravelly loam on the ridgetops and narrow bodies of Lynx loam in the drainageways.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used for range, wildlife habitat, homesites, and watershed catchment areas. Both parts in capability unit VI_e-1. Abra part in Limy Upland range site, 12- to 16-inch precipitation zone; Balon part in Loam Upland range site, 12- to 16-inch precipi-

tation zone. Abra part in wildlife group 7; Balon part in wildlife group 8.

Abra-Lynx association, rolling (AmC).—This association is about 60 percent Abra gravelly loam that has slopes of 8 to 20 percent and 30 percent Lynx loam that has slopes of 3 to 8 percent. The Abra soil is on strongly sloping and moderately steep alluvial fans, and the Lynx soil is in gently sloping drainageways.

Included with these soils in mapping, and making up about 10 percent of the acreage, are small areas of Lonti and Wineg gravelly loams.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used for range, wildlife habitat, homesites, and watershed catchment areas. Both parts in capability unit VIe-1. Abra part in Limy Upland range site, 12- to 16-inch precipitation zone; Lynx part in Loam Bottoms range site, 12- to 16-inch precipitation zone. Abra part in wildlife group 7; Lynx part in wildlife group 6.

Abra-Wineg association, rolling (AnC).—This association is about 55 percent Abra gravelly loam that has slopes of 3 to 15 percent and 35 percent Wineg sandy loam that has slopes of 3 to 8 percent. The Abra soil is on the tops and sides of ridges. The Wineg soil is on the lower parts of side slopes adjacent to drainageways.

Included with these soils in mapping, and making up about 10 percent of the acreage, are scattered small areas of Lonti gravelly loam and exposures of calcareous soil materials. Also included are narrow areas of Lynx loam along the drainageways.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used for range, wildlife habitat, homesites, and watershed catchment areas. Capability unit VIe-1; Limy Upland range site, 12- to 16-inch precipitation zone; wildlife group 7.

Anthony Series

The Anthony series consists of deep, well-drained soils. These soils formed in moderately coarse textured recent alluvium that weathered from a variety of rocks, dominantly granite. They are on nearly level to strongly sloping flood plains, low terraces, and fans. Slopes range from 0 to 15 percent but are dominantly less than 8 percent. Elevation ranges from 2,000 to 4,000 feet. The vegetation is desert shrubs and grass. Annual precipitation is 8 to 12 inches. The average annual air temperature is 61° to 67° F, and the frost-free period is 180 to 230 days.

In a representative profile the surface layer is brown gravelly sandy loam about 1 inch thick. The underlying layer is yellowish-brown gravelly sandy loam about 53 inches thick. These soils have thin strata of contrasting textures.

Permeability is moderately rapid. Available water capacity is moderate, and the effective rooting depth is more than 60 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas. Some isolated small areas along the Massayampa River are used for irrigated crops. Small grain and alfalfa are the main crops.

Representative profile of Anthony gravelly sandy loam, 0 to 8 percent slopes, 0.3 mile N. of the SE. corner, sec. 33, T. 10 N., R. 5 W.:

A1—0 to 1 inch, brown (10YR 5/3) gravelly sandy loam, dark grayish brown (10YR 4/2) when moist; weak, very thin, platy structure; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; many very fine and fine roots; common very fine and fine interstitial pores; strongly effervescent; moderately alkaline; clear, smooth boundary.

C1—1 to 15 inches, yellowish-brown (10YR 5/4) gravelly sandy loam, dark brown (10YR 4/3) when moist; massive, slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; many fine and very fine roots; common very fine and fine interstitial pores; strongly effervescent; moderately alkaline; diffuse, wavy boundary.

C2—15 to 54 inches, yellowish-brown (10YR 5/4) gravelly sandy loam, dark brown (10YR 4/3) when moist; massive; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; many fine and very fine roots; common very fine and fine interstitial pores; strongly effervescent; moderately alkaline.

Thin strata ranging from silt loam to loamy sand or gravelly loamy sand are present in many places. Gravel content ranges from a few pebbles to 35 percent by volume. These soils are neutral to moderately alkaline in the surface layer. They are underlain, in places, by a buried layer of clay accumulation at a depth of 40 inches or more.

In the A horizon hue is 10YR or 7.5YR, value is 5 to 7 dry and 4 or 5 moist, and chroma is 2 to 4. The A horizon is gravelly sandy loam, sandy loam, and gravelly loamy sand.

In the C horizon hue ranges from 10YR through 5YR but is dominantly 10YR or 7.5YR, value is 5 to 7 dry and 4 or 5 moist. The C horizon is variable but is generally gravelly sandy loam, sandy loam, or fine sandy loam.

Anthony gravelly loamy sand, 8 to 15 percent slopes (AoC).—This soil is on flood plains and low alluvial fans. It has a profile similar to the one described as representative of the series, but the surface layer is gravelly loamy sand. Included in mapping are narrow bodies of gravelly and sandy alluvium in drainageways and a few small areas that have slopes of 15 to 20 percent.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, and watershed catchment areas. A few isolated areas are irrigated. Capability unit VIIe-1; Loam Upland range site, 8- to 12-inch precipitation zone; wildlife group 2.

Anthony gravelly sandy loam, 0 to 8 percent slopes (ApB).—This soil is on fans that are dissected by numerous shallow drainageways. It has the profile described as representative of the series. Included in mapping are narrow bodies of gravelly and sandy alluvium in the drainageways.

Runoff is medium on this soil. The hazard of erosion is slight.

This soil is used for range, wildlife habitat, and watershed catchment areas. Some isolated areas are irrigated. Capability unit VIIs-1; Loam Upland range site, 8- to 12-inch precipitation zone; wildlife group 2.

Anthony-Mohave sandy loams, 1 to 3 percent slopes (ArA).—This complex is about 60 percent Anthony gravelly sandy loam and 35 percent Mohave sandy loam. These soils are in an intricate pattern on nearly level to gently sloping, low alluvial fans and flood plains. Areas are dissected by numerous shallow drain-

ageways. The Anthony soil is on the fan tops or slightly higher areas, and the Mohave soil is on the lower edges of the fans along drainageways. Included in mapping are small areas of Continental soils on ridges and narrow bodies of gravelly and sandy alluvium in the drainageways.

Runoff is slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. Capability unit VIIs-1; Loam Upland range site, 8- to 12-inch precipitation zone; wildlife group 2.

Apache Series

The Apache series consists of well-drained soils that are shallow to basalt and have a thin zone of lime accumulation. These soils formed in a thin layer of aeolian and volcanic debris over basalt on nearly level and undulating plains. Slopes range from 0 to 8 percent but are dominantly 0 to 5 percent. Elevation ranges from 4,500 to 5,500 feet. The vegetation is dominantly grass along with some winterfat, cactuses, and annuals. Annual precipitation is 10 to 14 inches. The average annual air temperature is about 55° F, and the frost-free period is 140 to 160 days.

In a representative profile the surface layer is dark grayish-brown gravelly heavy loam about 4 inches thick. The underlying layer is grayish-brown gravelly loam about 8 inches thick and is underlain by basalt.

Permeability is moderate. Available water capacity is low, and the effective rooting depth is 6 to 20 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Representative profile of Apache gravelly loam, 0.1 mile S. of the SW¹/₄ corner, sec. 18, T. 22 N., R. 2 W.:

A1—0 to 4 inches, dark grayish-brown (10YR 4/2) gravelly heavy loam, dark brown (10YR 3/3) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; many fine and very fine roots; many fine interstitial pores; slightly effervescent; moderately alkaline; clear, smooth boundary.

Cca—4 to 12 inches, grayish-brown (10YR 5/2) gravelly loam, dark brown (10YR 3/3) when moist; massive; hard when dry, friable when moist, slightly sticky and plastic when wet; very few very fine roots; common fine tubular pores; very hard white lime fragments that have trowelled upper surfaces (gravel); strongly effervescent; moderately alkaline; abrupt, irregular boundary.

R—12 to 18 inches, very dark gray (2.5Y N 3/0) basalt; extremely hard; violently effervescent.

Depth to bedrock ranges from 6 to 20 inches. The top 1 or 2 inches of the surface layer is leached of lime in some places.

In the A horizon hue is 10YR or 7.5YR, value is 4 or 5 dry and 2 or 3 moist, and chroma is 2 or 3. The A horizon and C horizon are gravelly loam, loam, light clay loam, or gravelly light clay loam. Gravel content of the A horizon ranges from 15 to 20 percent. In the C horizon hue is 10YR or 7.5YR. The zone of lime accumulation ranges from a thin covering on the basalt rock to a layer several inches thick.

Apache gravelly loam (As).—This nearly level soil is on basalt plains that are dissected by a few long shallow drainageways. It has the profile described as representative of the series.

Included with this soil in mapping are scattered small stony areas and a few silty areas in low-lying

positions. Also included are small bodies of Cross gravelly clay loam.

Runoff is very slow to slow on this soil. The hazard of erosion is none to slight.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VI s-1; Limy Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Apache very stony loam (At).—This undulating soil is on basalt plains that are dissected by a few long shallow drainageways. It is on the slightly higher lying areas and on side slopes adjacent to drainageways. This soil has a profile similar to the one described as representative of the series, but the surface layer is very stony loam.

Included with this soil in mapping are areas of Cross gravelly clay loam and Cabezon very stony clay loam. Also included are small areas of Apache gravelly loam.

Runoff is slow on this soil. The hazard of erosion is slight.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VII s-1; Limy Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Arp Series

The Arp series consists of moderately deep, well-drained soils that are underlain by extremely hard bedrock at a depth of 20 to 40 inches. These soils formed in place in material weathered from schist bedrock. Arp soils are in areas where there are moderately sloping to steep hills. Slopes range from 0 to 60 percent but are dominantly 0 to 35 percent. Elevation ranges from 4,000 to 5,500 feet. The vegetation is brush and grass. Annual precipitation is 12 to 16 inches. The average annual air temperature is 52° to 57° F, and the frost-free period is 140 to 200 days.

In a representative profile the surface layer is dark-brown gravelly clay loam about 2 inches thick (fig. 3). The subsoil is reddish-brown and strong-brown clay about 16 inches thick. It is underlain by light yellowish-brown gravelly heavy loam. Hard bedrock is at a depth of about 34 inches.

Permeability is slow. Available water capacity is low, and the effective rooting depth is 20 to 40 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas. Mining in these soils is mainly for copper, lead, zinc, silver, and gold.

Representative profile of Arp gravelly clay loam, 0 to 20 percent slopes, 0.6 mile S. and 0.5 mile W. of the NE corner, sec. 8, T. 12 N., R. 1 E.:

A1—0 to 2 inches, dark-brown (7.5YR 4/4) gravelly clay loam, dark reddish brown (5YR 3/4) when moist; moderate, fine, granular structure; slightly hard, friable, sticky and plastic; few fine roots; many fine interstitial pores; slightly acid; abrupt, smooth boundary.

B1t—2 to 5 inches, reddish-brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) when moist; moderate, fine and medium, subangular blocky structure; hard, friable, sticky and plastic; common fine, medium, and coarse roots; common fine tubular pores and many fine interstitial pores; neutral; clear, smooth boundary.



Figure 3.—Profile of Arp clay loam.

- B21t—5 to 11 inches, reddish-brown (5YR 5/4) clay, dark reddish brown (5YR 3/4) when moist; moderate, fine and medium, subangular blocky structure; hard, friable, sticky and plastic; common fine, medium, and coarse roots; few fine tubular pores and common fine interstitial pores; common thin clay films on ped faces; neutral; clear, smooth boundary.
- B22t—11 to 18 inches, strong-brown (7.5YR 5/6) clay, dark brown (7.5YR 4/4) when moist; massive, parting to moderate, medium, subangular blocky structure; hard, friable, sticky and plastic; few fine roots; few fine tubular pores and common fine interstitial pores; common thin clay films on ped faces; neutral; clear, irregular boundary.
- C—18 to 34 inches, light yellowish-brown (2.5Y 6/4) gravelly heavy loam; olive (5Y 5/3) when moist; massive; hard, firm, slightly sticky and plastic; few fine roots; few fine interstitial pores; common thin clay coatings on rock faces; medium acid; clear, smooth boundary.
- R—34 to 49 inches, pale-yellow (2.5Y 7/4) extremely hard schist.

The solum ranges from 12 to 22 inches in thickness, but is generally 15 to 18 inches. The solum ranges from slightly acid to neutral. Depth to consolidated schist ranges from 20 to 40 inches.

In the A horizon hue ranges from 5YR to 10YR, value is 4 or 5 dry and 2 or 3 moist, and chroma is 2 to 4. The A horizon is gravelly clay loam or cobbly clay loam. In the B2t horizon hue is dominantly 5YR but ranges from 2.5YR to 7.5YR, value is 4 or 5 dry, and chroma is 4 to 6. The B2t horizon is heavy clay loam or clay. The R horizon generally is schist but is phyllite in places.

Arp gravelly clay loam, 0 to 20 percent slopes (AuC). This soil is on schist hills that are dissected by a few long and numerous short drainageways. It has the profile described as representative of the series. Included in mapping are areas of Moano very rocky loam on the hills and narrow bodies of Lynx loam in the drainageways.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, watershed catchment areas, and mining. Capability unit VIe-1; Loam Upland range site, 12- to 16-inch precipitation zone; wildlife group 8.

Arp cobbly clay loam, 10 to 25 percent slopes (AvD).—This soil is on schist hills that are dissected by a few long and numerous short drainageways. It has a profile similar to the one described as representative of the series, but the surface layer is cobbly clay loam.

Included with this soil in mapping, and making up about 15 percent of the acreage, are areas of Moano very rocky loam, Arp very rocky clay loam, Arp gravelly clay loam, and narrow bodies of Lynx loam along the drainageways.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, watershed catchment areas, and mining. Capability unit VIe-1; Loam Upland range site, 12- to 16-inch precipitation zone; wildlife group 8.

Arp very rocky clay loam, 20 to 40 percent slopes (AwE).—This soil is on schist hills that are dissected by a few long and numerous short drainageways. It has a profile similar to the one described as representative of the series, but rock crops out of this soil in about 20 percent of the mapped areas. The surface layer is gravelly or cobbly clay loam. Included in mapping are small scattered areas of Moano very rocky loam.

Runoff is medium to rapid on this soil. The hazard of erosion is moderate to high.

This soil is used for range, wildlife habitat, watershed catchment areas, and mining. Capability unit VIIs-1; Loam Upland range site, 12- to 16-inch precipitation zone; wildlife group 8.

Arp-Moano complex, 0 to 30 percent slopes (AxD).—This complex is about 55 percent Arp gravelly clay loam that has slopes of 0 to 15 percent and about 35 percent Moano gravelly loam that has slopes of 8 to 30 percent. These soils are in an intricate pattern on nearly level to moderately steep schist hills that are dissected by numerous drainageways. The Arp soil is in benchlike areas, and the Moano soil is on ridgetops and steeper side slopes. Rock outcrops are common.

Included with these soils in mapping, and making up about 10 percent of the acreage, are areas of Moano gravelly loam, 0 to 30 percent slopes, and areas of Lynx loam in drainageways.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used for range, wildlife habitat, watershed catchment areas, and mining. Both parts in capability unit VIe-1. Arp part in Loam Upland range site, 12- to 16-inch precipitation zone; Moano part in Granitic Loam Hills range site, 12- to 16-inch precipita-

tion zone. Arp part in wildlife group 8; Moano part in wildlife group 5.

Arp-Lynx association, rolling (AyC).—This association is about 60 percent Arp gravelly clay loam that has slopes of 2 to 15 percent and 30 percent eroded Lynx loam that has slopes of 2 to 5 percent. The Arp soil is on gently sloping to strong sloping ridges, and the Lynx soil is in gently sloping drainageways. Moderately deep gullies are common in the Lynx soil.

Included with these soils in mapping, and making up about 10 percent of the acreage, are scattered areas of Moano very rocky loam, Arp soil that has a surface layer of gravelly sandy loam, and Arp very rocky clay loam. These included soils are mainly on ridges.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used for range, wildlife habitat, watershed catchment areas, and mining. Both parts in capability unit VIe-1. Arp part in Loam Upland range site, 12- to 16-inch precipitation zone; Lynx part in Loam Bottoms range site, 12- to 16-inch precipitation zone. Arp part in wildlife group 8; Lynx part in wildlife group 6.

Badland

Badland (Ba) consists of fine to coarse-textured lacustrine sediment and old alluvial deposits dissected by numerous drainageways. Most areas are barren or nearly barren and are actively eroding. Slopes are complex and are dominantly steep or very steep. Scattered creosotebush, catclaw, mesquite, and annuals grow in and along the washes.

Runoff is rapid or very rapid on this land type. The hazard of erosion is very high.

This land type is used dominantly as watershed catchment areas. It has little value for range, wildlife habitat, or recreation sites. Capability unit VIIIe-1.

Balon Series

The Balon series consists of deep, well-drained soils. These soils formed in mixed alluvium weathered from schist, granite, and basalt. They are on gently sloping to moderately steep alluvial fans. Slopes range from 0 to 30 percent but are dominantly 2 to 25 percent. Elevation ranges from 4,000 to 5,000 feet. The vegetation is brush and an understory of grass. On the nearly level areas grass is dominant. Annual precipitation is 12 to 16 inches. The average annual air temperature is 50° to 58° F, and the frost-free period is 145 to 225 days.

In a representative profile the surface layer is dark grayish-brown gravelly sandy clay loam about 3 inches thick. The subsoil is dark grayish-brown, brown, or brownish-yellow clay loam, gravelly clay loam, gravelly sandy clay loam, and gravelly sandy loam about 33 inches thick. The substratum is yellowish-brown and very pale brown gravelly sandy loam that has some lime in pockets and extends to a depth of 73 inches or more.

Permeability is moderately slow. Available water capacity is moderate, and the effective rooting depth is

more than 60 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas. Small areas have been subdivided for homesites.

Representative profile of Balon gravelly sandy clay loam, 5 to 10 percent slopes, 0.7 mile W. and 0.3 mile S. of the NE. corner, sec. 5, T. 12 N., R. 1 E.:

- A1—0 to 3 inches, dark grayish-brown (10YR 4/2) gravelly sandy clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist, nonsticky and slightly plastic when wet; few fine roots; many fine interstitial pores; medium acid; abrupt, smooth boundary.
- B1t—3 to 7 inches, dark grayish-brown (10YR 4/2) heavy clay loam, dark brown (7.5YR 3/2) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, friable when moist, slightly sticky and plastic when wet; common fine and medium roots; common fine tubular pores and many fine interstitial pores; few thin clay films on ped faces and in pores; neutral; clear, smooth boundary.
- B21t—7 to 15 inches, brown (7.5YR 5/4) gravelly clay loam, dark brown (7.5YR 4/4) when moist; moderate, medium, subangular blocky structure; very hard when dry, friable when moist, sticky and plastic when wet; many fine, medium, and coarse roots; common fine tubular pores and many fine interstitial pores; common thin clay films on ped faces and in pores; neutral; clear, wavy boundary.
- B22t—15 to 23 inches, mottled brownish-yellow (10YR 6/6), yellowish-brown (10YR 5/4), and pale-brown (10YR 6/3) gravelly sandy clay loam, mottled dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/6), and brown (10YR 5/3) when moist; weak, medium, subangular blocky structure; very hard when dry, friable when moist, sticky and plastic when wet; common fine, medium, and coarse roots; common fine tubular pores and many fine interstitial pores; few thin clay films on ped faces and in pores; mildly alkaline; clear, wavy boundary.
- B3t—23 to 36 inches, mottled light yellowish-brown (10YR 6/4), yellowish-brown (10YR 5/4), and pale-brown (10YR 6/3) gravelly heavy sandy loam, yellowish brown (10YR 5/4), brownish yellow (10YR 6/6), and dark yellowish brown (10YR 4/4) when moist; many, fine and medium, faint and distinct mottles; massive, parting to weak, medium, subangular blocky structure; very hard when dry, friable when moist, sticky and plastic when wet; common fine, medium, and coarse roots; few fine and medium tubular pores and many fine interstitial pores; few thin clay films on ped faces and as bridges holding mineral grains together; neutral; clear, wavy boundary.
- C1—36 to 54 inches, mottled light yellowish-brown (10YR 6/4), brownish-yellow (10YR 6/6), and dark yellowish-brown (10YR 4/4) gravelly heavy sandy loam, dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/6), brownish yellow (10YR 6/6), and dark brown (10YR 3/3) when moist; massive; hard when dry, friable when moist, slightly sticky and plastic when wet; common fine and medium roots; few fine tubular pores and many fine interstitial pores; neutral; gradual, wavy boundary.
- C2—54 to 73 inches, very pale brown (10YR 8/4) gravelly heavy sandy loam, yellowish brown (10YR 5/4) when moist; massive; hard when dry, friable when moist, nonsticky and slightly plastic when wet; few fine and medium roots; many fine interstitial pores; neutral.

The solum ranges from 24 to 45 inches in thickness. In the A horizon hue is 10YR or 7.5YR, value is 4 or 5 dry and 2 or 3 moist, and chroma is 2 to 4. The A horizon is sandy loam, gravelly sandy loam, gravelly sandy clay loam, or

gravely clay loam. Reaction ranges from medium acid to neutral.

In the B2t horizon hue is 10YR to 5YR but is dominantly 7.5YR or 10YR. Value is 4 to 6 dry and 3 to 6 moist, and chroma is 3 to 6. The B2t horizon is clay loam to sandy clay loam and generally is gravelly. Structure mostly ranges from subangular and angular blocky to prismatic.

The C horizon ranges from gravelly loamy sand to gravelly clay loam. Reaction of the C horizon ranges from neutral to moderately alkaline. Lime content of the C horizon ranges from none to small pockets of lime accumulation.

Balon sandy loam, 0 to 15 percent slopes (BdC).—This soil is on fans and ridges that are dissected by numerous side drainageways. It has a profile similar to the one described as representative of the series, but the surface layer is sandy loam 3 to 8 inches thick. Included in mapping are areas of Lynx loam and Cordes sandy loam in the gently sloping drainageways.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIe-1, Loam Upland range site, 12- to 16-inch precipitation zone; wildlife group 8.

Balon gravelly sandy clay loam, 5 to 30 percent slopes (BgD).—This soil is on alluvial fans that are dissected by numerous long drainageways. It has the profile described as representative of the series. Included in mapping are small scattered areas of Abra gravelly loam on the fans and narrow bodies of Lynx loam, eroded, in the drainageways.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, and watershed catchment areas. Small areas have been subdivided for homesites. Capability unit VIe-1; Loam Upland range site, 12- to 16-inch precipitation zone; wildlife group 8.

Balon-Lynx association, rolling (B1C).—This association is about 65 percent Balon gravelly sandy clay loam that has slopes of 8 to 20 percent, and 30 percent Lynx loam, eroded, that has slopes of 1 to 5 percent. The Balon soil is on gently rolling and rolling ridges that are dissected by numerous long drainageways and short side drainageways. The Lynx soil is in the gently sloping drainageways. Included in mapping, and making up about 5 percent of the acreage, are areas of Arp gravelly clay loam and Balon gravelly sandy clay loam that has slopes of 1 to 8 percent.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used for range, wildlife habitat, and watershed catchment areas. Small areas have been subdivided for homesites. Both parts in capability unit VIe-1. Balon part in Loam Upland range site, 12- to 16-inch precipitation zone; Lynx part in Loam Bottoms range site, 12- to 16-inch precipitation zone. Balon part in wildlife group 8; Lynx part in wildlife group 6.

Barkerville Series

The Barkerville series consists of well-drained soils that are very shallow and shallow over weathered bedrock. These soils are in areas where there are gently rolling to steep hills and mountains that are dissected

by numerous drainageways. Elevation ranges from 4,000 to 6,500 feet. The vegetation is brush and an understory of grass. At the lower elevations grass is dominant. Annual precipitation is 12 to 20 inches. The average annual air temperature is 50° to 57° F, and the frost-free period is 140 to 220 days.

In a representative profile the surface layer is dark grayish-brown cobbly sandy loam 5 inches thick. The underlying layer is yellowish-brown gravelly sandy loam that grades to highly weathered granite and is about 20 inches thick. Below this the material grades to slightly weathered coarse-grained granite.

Permeability is moderately rapid. Available water capacity is low, and the effective rooting depth is 20 to 40 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas. Some areas are used for homesites and mining. Mining is mainly for gold, silver, copper, lead, and zinc. Homesites are in the vicinity of Prescott.

Representative profile of Barkerville cobbly sandy loam, 20 to 60 percent slopes, 0.4 mile E. and 0.4 mile S. of the NW. corner, sec. 5., T. 9 N., R. 2 W.:

- O1 and O2—½ inch to 0, undecomposed and partly decomposed leaves and twigs from brush; about 25 percent of the surface is covered with cobblestones.
- A1—0 to 5 inches, dark grayish-brown (10YR 4/2) cobbly sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, thin platy structure; slightly hard when dry, friable when moist, nonsticky and slightly plastic when wet; few very fine and common fine and medium roots; many micro pores and very fine interstitial pores; mildly alkaline; clear, smooth boundary.
- C1—5 to 10 inches, yellowish-brown (10YR 5/4) and light-gray (10YR 7/2) gravelly sandy loam, dark yellowish brown (10YR 4/4) and light yellowish brown (10YR 6/4) when moist; massive; hard when dry, friable when moist, nonsticky and nonplastic when wet; few very fine, fine and medium roots; many micro pores and very fine interstitial pores; neutral; clear, wavy boundary.
- C2—10 to 25 inches, yellowish-brown (10YR 5/4) and light-gray (10YR 7/2) highly weathered granite (grus) that breaks to gravelly sandy loam, dark yellowish brown (10YR 4/4) and light yellowish brown (10YR 6/4) when moist; massive; very hard when dry, firm when moist, nonsticky and nonplastic when wet; very few very fine, fine, and medium roots along faces of fractures; many micro pores and fine interstitial pores; neutral; abrupt, wavy boundary.
- C3—25 to 30 inches, dark-brown (7.5YR 4/4), very pale brown (10YR 8/4), and reddish-yellow (7.5YR 7/6), slightly weathered granite.

The solum ranges from 4 to 10 inches in thickness. Depth to the C2 horizon ranges from 10 to 18 inches. The parent rock is slightly weathered material at a depth of 20 to 40 inches. Content of stones and cobblestones varies from 0 to 30 percent by volume. Content of fine angular gravel ranges from 10 to 50 percent.

In the A horizon hue is 10YR or 7.5YR, value is 4 or 5 dry and 2 to 3 moist, and chroma is 2 or 3. The A horizon is gravelly sandy loam, cobbly sandy loam, or very stony sandy loam. In the C horizon hue is 10YR or 7.5YR, value is 5 to 8 dry and 4 to 6 moist, and chroma is 2 to 6. The C horizon is mostly sandy loam or gravelly sandy loam.

Barkerville cobbly sandy loam, 20 to 60 percent slopes (BmF).—This soil is on granite hills and mountains that are dissected by numerous drainageways. It has the profile described as representative of the series.

Included with this soil in mapping, and making up about 10 percent of the acreage, are areas of soils that have a surface layer of gravelly sandy loam, small areas of Gaddes gravelly sandy loam, very rocky areas, and areas of Barkerville cobbly sandy loam that has slopes of 8 to 15 percent. The Gaddes soil is moderately sloping and moderately steep. Also included are areas of rock outcrops that make up about 5 percent of the acreage.

Runoff is rapid on this soil. The hazard of erosion is high.

This soil is used mainly for range, wildlife habitat, mining, and watershed catchment areas. Some areas in the vicinity of Prescott are used for homesites. Capability unit VIIe-1; Granitic Loam Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Barkerville very stony sandy loam, 5 to 25 percent slopes (BnD).—This soil is on hills that are dissected by a few long drainageways and many short side drainageways. It has a profile similar to the one described as representative of the series, but the surface layer is very stony sandy loam.

Included with this soil in mapping are some areas where the surface layer is gravelly sandy loam. Also included are small areas of Gaddes gravelly sandy loam on the hills and Cordes sandy loam in the drainageways, and some very rocky areas of Barkerville soils. These included areas make up about 10 percent of the acreage.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, mining, and watershed catchment areas. A few areas in the vicinity of Prescott are used for homesites. Capability unit VIIs-1; Granitic Loam Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Barkerville extremely rocky sandy loam, 20 to 60 percent slopes (BoF).—This soil is on granite hills and mountains that are dissected by numerous drainageways. It is about 65 percent Barkerville cobbly sandy loam and 20 percent rock outcrops. This soil has a profile similar to the one described as representative of the series, but it is extremely rocky. Between the rock outcrops the surface layer is gravelly sandy loam. Included in mapping, and making up about 15 percent of the acreage, are areas of Gaddes and Barkerville gravelly sandy loams that have 8 to 15 percent slopes and Cordes sandy loam in the drainageways.

Runoff is rapid on this soil. The hazard of erosion is moderate to high.

These soils are used for range, wildlife habitat, mining, and watershed catchment areas. Some areas in the vicinity of Prescott are used for homesites. Capability unit VIIs-1; Granitic Loam Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Boysag Series

The Boysag series consists of shallow, well-drained soils. These soils formed in place in material that weathered from calcareous sandstone or limestone. They are on nearly level to undulating plains. Elevation ranges from 5,000 to 6,500 feet. The vegetation is

pinyon and juniper and an understory of grass. Annual precipitation is 12 to 16 inches. The average annual air temperature is about 52° F, and the frost-free period is 125 to 145 days.

In a representative profile the surface layer is reddish-brown loam about 2 inches thick. The subsoil is reddish-brown, yellowish-red, or reddish-yellow clay loam, clay, or gravelly clay loam about 17 inches thick. It is underlain by yellowish-brown fractured, calcareous sandstone or limestone.

Permeability is slow. Available water capacity is low, and the effective rooting depth is 10 to 20 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Boysag soils in Yavapai County are mapped only in a complex with Purner soils.

Representative profile of Boysag loam that has 0 to 8 percent slopes, in an area of Purner-Boysag complex, 2 to 15 percent slopes, SW $\frac{1}{4}$ sec. 28, T. 24 N., R. 9 W.:

- A1—0 to 2 inches, reddish-brown (5YR 5/4) loam, dark reddish brown (5YR 3/4) when moist; thin crust over moderate, fine and very fine, granular structure; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; few to many very fine roots; many interstitial pores and vesicular pores, moderately alkaline; abrupt, smooth boundary.
- B1—2 to 5 inches, reddish-brown (5YR 4/4) clay loam, dark reddish-brown (5YR 3/4) when moist; moderate, fine and very fine, granular structure and weak, fine, subangular blocky; slightly hard when dry, friable when moist, sticky and plastic when wet; many fine and very fine roots; many interstitial pores and common fine and very fine tubular pores; moderately alkaline; abrupt, smooth boundary.
- B2t—5 to 12 inches, yellowish-red (5YR 4/6) clay, 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; many fine and very fine roots; common fine tubular pores; common moderately thick clay films on ped faces; noneffervescent to strongly effervescent; moderately alkaline; gradual, wavy boundary.
- B3tca—12 to 19 inches, reddish-yellow (5YR 6/6) gravelly clay loam, yellowish red (5YR 4/) when moist; massive parting to weak, medium, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; few fine roots; common fine and very fine pores; few thin clay films on ped faces and in pores; violently effervescent; common fine, pink (5YR 7/3) lime segregations and filaments, light reddish brown (5YR 6/4) when moist; moderately alkaline; abrupt, irregular boundary.
- R—19 to 23 inches, yellowish-brown (10YR 5/4) extremely hard, strongly effervescent fractured sandstone, dark yellowish brown (10YR 4/4) when moist.

The thickness of the solum and the depth to bedrock range from 10 to 20 inches but generally are about 14 to 20 inches. In the A horizon hue is 7.5YR or 5YR, value is 4 or 5 dry and 3 or 4 moist, and chroma is 4 or more. The A horizon is sandy loam, loam, gravelly sandy loam, or gravelly loam. Reaction in the A horizon ranges from slightly acid to moderately alkaline.

In the B2t horizon hue is 5YR or 2.5YR, value is 3 to 6 dry and 3 or 4 moist, and chroma is 3 to 6. The B2t horizon is heavy clay loam, clay, gravelly clay loam, or gravelly clay that is less than 35 percent coarse fragments. Lime segregations and filaments are present in the Bca horizon, and a thin lime coating is generally present on the upper surface of the bedrock.

Bridge Series

The Bridge series consists of well-drained, calcareous soils that are moderately deep over unconsolidated ash or tuff. These soils are on gently sloping to moderately steep old fans, terraces, and benches that are dissected by numerous long drainageways. Slopes range from 0 to 30 percent but are dominantly 0 to 25 percent. Elevation ranges from 3,500 to 4,000 feet. The vegetation is grass and some semidesert shrubs. Annual precipitation is about 12 inches. The average annual air temperature is about 60° F, and the frost-free period is 185 to 220 days.

In a representative profile the surface layer is pale-brown gravelly loam about 3 inches thick. The underlying layer is very pale brown sandy clay loam and brown gravelly loam about 27 inches thick. It is underlain by pinkish-gray weathered tuff or ash.

Permeability is moderate. Available water capacity is moderate, and the effective rooting depth is 20 to 40 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Representative profile of Bridge gravelly loam that has 8 to 15 percent slopes, in an area of Bridge gravelly loam, 0 to 25 percent slopes, 0.4 mile N. and 0.5 mile E. of the SW. corner, sec. 31, T. 13 N., R. 4 W.:

- A1—0 to 3 inches, pale-brown (10YR 6/3) gravelly loam, yellowish brown (10YR 5/4) when moist; weak, fine, granular structure; soft when dry, friable when moist, slightly sticky and plastic when wet; common fine and very fine roots; many interstitial pores; violently effervescent; moderately alkaline; clear, smooth boundary.
- C1—3 to 14 inches, very pale brown (10YR 7/3) sandy clay loam, yellowish brown (10YR 5/4) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; many fine and very fine roots; many very fine tubular pores; violently effervescent; moderately alkaline; gradual, smooth boundary.
- C2ca—14 to 30 inches, brown (7.5YR 5/4) gravelly loam, strong brown (7.5YR 5/6) when moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common fine roots; few very fine tubular pores; violently effervescent; common fine and medium, white (10YR 8/1) lime mottles; moderately alkaline; clear, wavy boundary.
- C3—30 to 50 inches, pinkish-gray (7.5YR 7/2) unconsolidated tuff, light brown (7.5YR 6/4) and brown (7.5YR 5/4) when moist; violently effervescent; moderately alkaline.

Depth to underlying unconsolidated ash or tuffaceous material ranges from 20 to 38 inches. Some places are slightly effervescent to violently effervescent in the A horizon and are strongly effervescent to violently effervescent in the C horizon.

In the A horizon hue is 10YR or 7.5YR, value is 5 to 7 dry and 3 to 5 moist, and chroma is 2 to 4. The A horizon is gravelly loam or gravelly sandy loam.

In the C horizon hue is 10YR or 7.5YR, value is 5 to 8 dry and 4 to 6 moist, and chroma is 2 to 6. The C horizon ranges from heavy sandy loam to loam, light clay loam, and light sandy clay loam, and is modified by gravel or cobbles.

Bridge gravelly loam, 0 to 25 percent slopes (BrD).—This soil is on fans, old terraces, or benches that are dissected by numerous long drainageways and short side drainageways.

Included with this soil in mapping are small areas of Continental gravelly loam on the fan tops and lower side slopes. Also included are coarse-textured alluvial soils in the drainageways.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIe-1; Loam Hills range site, 8 to 12-inch precipitation zone; wildlife group 4.

Brolliar Series

The Brolliar series consists of well-drained, moderately deep soils that are underlain by basalt. These soils formed in material that weathered from basalt, ash, and cinders. They are on nearly level to hilly uplands and mesas. Slopes range from 0 to 30 percent. Elevation ranges from 6,500 to 7,600 feet. The vegetation is mixed conifers and an understory of grasses. Annual precipitation is 18 to 22 inches. The average annual air temperature is about 44° F., and the frost-free period is 120 to 175 days.

In a representative profile the surface layer is dark grayish-brown very stony silt loam over dark-gray silt loam about 8 inches thick. The subsoil is dark grayish-brown, brown, and pale-brown gravelly clay and gravelly clay loam about 27 inches thick. It is underlain by dark-gray, dense basalt.

Permeability is slow. Available water capacity is low to moderate, and the effective rooting depth is 24 to 40 inches.

These soils are used mainly for trees, range, wildlife habitat, and watershed catchment areas.

Representative profile of Brolliar very stony silt loam, 0 to 15 percent slopes, NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 26, T. 17 N., R. 7 W.:

- O1—2 inches to 0, partly decomposed pine needles; medium acid.
- A11—0 to 3 inches, dark grayish-brown (10YR 4/2) very stony silt loam, very dark brown (10YR 2/2) when moist; weak, thin, platy structure parting to moderate, fine, granular; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common very fine and fine roots; many micro pores and very fine interstitial pores; neutral; clear, smooth boundary.
- A12—3 to 8 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) when moist; weak, fine, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; common very fine, fine and medium roots; common micro pores and very fine interstitial pores, and few very fine tubular pores; common medium gravel; neutral; clear, wavy boundary.
- B1—8 to 15 inches, dark grayish-brown (10YR 4/2) gravelly clay loam, very dark brown (10YR 2/2) when moist; weak, fine and medium, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; many fine, medium, and coarse roots; common micro pores and very fine interstitial pores; neutral; abrupt, wavy boundary.
- B2t—15 to 23 inches, brown (10YR 5/3) gravelly clay, dark brown (10YR 3/3) when moist; moderate, coarse, subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; few medium and coarse roots; common micro pores and very fine interstitial pores; many moderately thick clay films on ped faces and in pores; common

medium slickensides; neutral; abrupt, wavy boundary.

B3t—25 to 35 inches, pale-brown (10YR 6/3) gravelly clay loam, brown (7.5YR 5/4) when moist; massive parting to moderate, fine, subangular blocky structure; very hard when dry, friable when moist, slightly sticky and plastic when wet; very few fine roots; few micro pores and very fine interstitial pores; common thin clay films on ped faces; neutral; abrupt, irregular boundary.

R—35 to 37 inches, dark-gray (7.5YR 4/0), extremely hard, dense basalt.

Depth to basalt bedrock ranges from 24 to 40 inches. In the A horizon hue ranges from 10YR to 7.5YR, value from 3 to 5 dry and 2 to 3 moist, and chroma from 1 to 3. The A horizon ranges from loam to silt loam, clay loam, and silty clay loam, and is cobbly and stony in places.

In the B2t horizon hue ranges from 5YR to 10YR, value from 3 to 5 dry and 2 to 3 moist, and chroma from 2 to 4. The B2t horizon ranges from heavy clay loam to clay and silty clay and is gravelly in places.

Brolliar very stony silt loam, 0 to 15 percent slopes (BsC).—This soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping, and making up about 10 percent of the acreage, are areas of similar soils that are 40 to 72 inches deep over basalt. Also included, and making up about 5 percent of the acreage, are areas of rock outcrops and Cabezon very stony clay loam.

Runoff is slow on this soil. The hazard of erosion is slight.

This soil is used for trees, range, wildlife habitat, and watershed catchment areas. Capability unit VI_s-2; timber group 2; wildlife group 10.

Brolliar very stony silt loam, 15 to 30 percent slopes (BsD).—This soil is on hilly parts of uplands and mesa tops adjacent to drainageways. Included in mapping, and making up about 5 percent of the acreage, are areas of Cabezon very stony clay loam and rock outcrop.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for trees, range, wildlife habitat, and watershed catchment areas. Capability unit VI_s-2; timber group 2; wildlife group 10.

Cabezon Series

The Cabezon series consists of well-drained, shallow soils that are underlain by basalt. These soils formed in material weathered from basalt, ash, and cinders. They are in areas where there are nearly level plains to very steep hills. Slopes range from 0 to 60 percent. Elevation ranges from 4,800 to 7,600 feet. The vegetation is juniper and grass. In some areas oak brush is present at higher elevations. Annual precipitation is 12 to 18 inches. The average annual air temperature is 45° to 58° F, and the frost-free period is 118 to 210 days.

In a representative profile the surface layer is grayish-brown very stony loam about 1 inch thick. The subsoil is dark-brown cobbly clay loam and clay about 11 inches thick. It is underlain by dark-gray fractured basalt that has lime coatings. Content of coarse fragments ranges from a few to 35 percent cobbles and stones.

Permeability is slow. Available water capacity is low, and the effective rooting depth is less than 20 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Representative profile of Cabezon very stony clay loam, 5 to 25 percent slopes, from an area of Cabezon-Springerville complex, 5 to 25 percent slopes, 0.12 mile W. and 0.12 mile N. of the SE. corner, Sec. 7, T. 21 N., R. 9 W.:

A1—0 to 1 inch, grayish-brown (10YR 5/2) very stony loam, very dark grayish brown (10YR 3/2) when moist; moderate, very fine, granular structure; soft when dry, friable when moist, sticky and slightly plastic when wet; common very fine and fine roots; many interstitial pores and fine tubular pores; mildly alkaline; abrupt, smooth boundary.

B1t—1 to 5 inches, dark-brown (7.5YR 3/2) when dry and moist, cobbly clay loam; moderate, medium, subangular blocky structure; slightly hard when dry, friable when moist, sticky and plastic when wet; many very fine and fine roots; many interstitial pores and common fine tubular pores; mildly alkaline; abrupt, wavy boundary.

B2t—5 to 12 inches, dark-brown (7.5YR 3/2) and (7.5YR 4/4) when dry and moist, cobbly clay; weak, fine, prismatic structure parting to moderate, medium, subangular blocky; very hard when dry, firm when moist, sticky and plastic when wet; common fine and medium roots; common fine tubular pores; many moderately thick clay films on ped faces; mildly alkaline; abrupt, wavy boundary.

R—12 to 24 inches, dark-gray (5YR 4/1) fractured basalt; flecked with yellowish red (5YR 5/6); few lime coatings.

Depth to the extremely hard basalt ranges from 7 to 20 inches. In the A1 horizon hue is 10YR to 5YR, value is 4 and 5 dry, and chroma is less than 4. The A horizon is very stony loam, gravelly loam, cobbly loam, gravelly or cobbly silt loam, and gravelly or cobbly clay loam. In the B2t horizon hue is 5YR or 7.5YR. The B2t horizon is clay or heavy clay loam modified by gravel, cobbles, or stones.

Cabezon-Springerville complex, 5 to 25 percent slopes (CcD).—This complex is about 60 percent Cabezon very stony clay loam and about 30 percent Springerville cobbly clay. The Cabezon soil is also very rocky. These soils are in an intricate pattern on moderately sloping to moderately steep ridges, hills, and breaks. The Cabezon soil has the profile described as representative of the series. It is strongly sloping and moderately steep. The Springerville soil has gentler slopes and is less rocky.

Included with this soil in mapping, and making up about 10 percent of the acreage, are areas of Thunderbird cobbly clay loam, Cross gravelly clay loam, and Venezia gravelly loam. The included Venezia soil is on the ridgetops and steeper breaks, and the Thunderbird and Cross soils are scattered throughout.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VI_s-1. Cabezon part in Clay Loam Hills range site, 12- to 16-inch precipitation zone; Springerville part in Clay Upland range site, 12- to 16-inch precipitation zone. Cabezon part in wildlife group 5; Springerville part in wildlife group 9.

Cabezon-Springerville cobbly complex, 5 to 15 percent slopes (CbC).—This complex is about 60 percent Cabezon cobbly clay loam that has slopes of 8 to 15 percent and about 30 percent Springerville cobbly clay that has slopes of 5 to 8 percent. These soils are in an intricate pattern. The Cabezon soil is on higher and steeper side slopes, and the Springerville soil is moderately sloping. Included in mapping, and making up about 10 percent of the acreage, are scattered small areas of Cross and Thunderbird gravelly clay loams and Venezia gravelly loam.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VIe-1. Cabezon part in Clay Loam Hills range site, 12- to 16-inch precipitation zone; Springerville part in Clay Upland range site, 12- to 16-inch precipitation zone. Cabezon part in wildlife group 5; Springerville part in wildlife group 9.

Cabezon-Thunderbird complex, 5 to 15 percent slopes (CdC).—This complex is about 60 percent Cabezon very stony clay loam that has slopes of 5 to 15 percent and about 30 percent Thunderbird gravelly clay loam that has slopes of 5 to 8 percent. These soils are in an intricate pattern on moderately sloping to strongly sloping basalt plains. The Cabezon soil is on slightly higher lying areas and includes some rock outcrops. Included in mapping, and making up about 10 percent of the acreage, are small areas of Springerville cobbly clay that are gently sloping and areas of Lynx clay loam in drainageways.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VIi-1. Cabezon part in Clay Loam Hills range site, 12- to 16-inch precipitation zone; Thunderbird part in Clay Loam Upland range site, 12- to 16-inch precipitation zone. Cabezon part in wildlife group 5; Thunderbird part in wildlife group 10.

Cabezon soils, 8 to 45 percent slopes (CeE).—These soils are on basalt hills and mountains. Surface layers are gravelly, cobbly, or very stony clay loam and include some areas of rock outcrops. Included in mapping, and making up about 10 percent of the acreage, are areas of Venezia gravelly loam and Cross, Thunderbird, and Springerville gravelly clay loams. The Venezia soils are on ridgetops and steeper breaks, and the other soils have slopes of 8 to 15 percent.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used for range, wildlife habitat, and watershed catchment areas. Capability unit VIIi-1; Clay Loam Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Cave Series

The Cave series consists of well-drained soils that are shallow and very shallow to an indurated lime-cemented pan. These soils formed in mixed alluvium that weathered from a wide variety of rocks such as

granite, basalt, limestone, sandstone, and schist. They are nearly level to moderately steep on alluvial fans and plains. Slopes range from 2 to 15 percent. Elevation ranges from 2,000 to 4,000 feet. The vegetation is desert shrubs, cactuses, grass, and annuals. Annual precipitation is 8 to 12 inches. The average annual air temperature is 59° to 68° F, and the frost-free period is 180 to 230 days.

In a representative profile the surface layer and underlying layer are brown gravelly sandy loam about 11 inches thick. This is underlain by an indurated lime-cemented pan. The pan has a thin troweled surface.

Permeability is moderate. Available water capacity is low, and the effective rooting depth is 4 to 20 inches.

These soils are used mainly for seasonal grazing, wildlife habitat, mining, and watershed catchment areas.

Representative profile of Cave gravelly sandy loam, 2 to 15 percent slopes, 0.65 mile S. and 0.35 mile W. of the NE. corner, sec. 18, T. 9 N., R. 4 W.:

A1—0 to 4 inches, brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 4/3) when moist; weak, medium, platy structure; slightly hard when dry, very friable when moist, slightly sticky and plastic when wet; common fine and very fine roots; many fine interstitial pores; thin layer of gravel and lime fragments on surface; strongly effervescent; mildly alkaline; abrupt, smooth boundary.

C1—4 to 11 inches, brown (10YR 5/3) gravelly 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 fine interstitial pores; common fine to coarse; white (10YR 8/2) lime mottles and hard lime masses; strongly effervescent; moderately alkaline; abrupt, smooth boundary.

C2cam—11 to 23 inches, pinkish-gray (7.5YR 7/2) indurated lime cemented pan that has a thin (1/8-inch), troweled surface layer, pinkish gray (7.5YR 7/2) when moist; massive; violently effervescent; moderately alkaline.

Depth to the indurated lime-cemented pan ranges from 4 to 20 inches. In the A horizon hue is 10YR or 7.5YR, value is 5 to 7 dry and 3 or 4 moist, and chroma is 3 or 4. The A horizon is gravelly sandy loam or gravelly loam. Several horizontal indurated lime-cemented pans that have strata of soil material between them are common.

Cave gravelly sandy loam, 2 to 15 percent slopes (CgC).—This soil is on alluvial fans that are dissected by numerous shallow drainageways. It has the profile described as representative of the series.

Included with this soil in mapping, and making up about 5 percent of the acreage, are areas of Anthony gravelly sandy loam in the drainageways. Also included are areas of Cave soils that have slopes of 5 to 30 percent.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, mining, and watershed catchment areas. Capability unit VIIe-1; Caliche Upland range site, 8- to 12-inch precipitation zone; wildlife group 3.

Cave-Continental gravelly sandy loams, 2 to 30 percent slopes (CID).—This complex is about 55 percent Cave gravelly sandy loam and 35 percent Continental gravelly sandy loam. These soils are in an intricate pattern on gently sloping to moderately steep alluvial

fans. The Continental soil is on ridgetops and has more gentle slopes.

Included with these soils in mapping are areas of cobbly Cave soils and exposures of tuff or agglomerate along steep drainageways. Also included are areas of Anthony gravelly sandy loam in the drainageways. These included soils make up about 10 percent of the acreage.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used for range, wildlife habitat, mining, and watershed catchment areas. Both parts in capability unit VIIe-1. Cave part in Caliche Upland range site, 8- to 12-inch precipitation zone; Continental part in Loam Upland range site, 8- to 12-inch precipitation zone. Cave part in wildlife group 3; Continental part in wildlife group 2.

Cellar Series

The Cellar series consists of well-drained soils that are shallow and very shallow over granite. These soils are on gently sloping to steep granite hills and mountains. Slopes range from 2 to 60 percent. Elevation ranges from 2,000 to 4,500 feet. The vegetation is desert shrubs and cactuses and an understory of grass. Annual precipitation is 8 to 12 inches. The average annual air temperature is 57° to 69° F, and the frost-free period is 180 to 270 days.

In a representative profile the surface layer is pale-brown very stony sandy loam about 1 inch thick. The underlying layer is brown very gravelly loam about 7 inches thick. It is underlain by granite that is weathered or fractured in places.

Permeability is moderately rapid. Available water capacity is low, and the effective rooting depth is less than 20 inches.

These soils are used mainly for seasonal range, wildlife habitat, mining, and watershed catchment areas.

Representative profile of Cellar very stony sandy loam in an area of Cellar very gravelly sandy loam, 8 to 30 percent slopes, near Merritt Pass, approximately 0.4 mile NW. of the SE. corner, sec. 8, T. 7 N., R. 2 W.:

A1—0 to 1 inch, pale-brown (10YR 6/3) very stony sandy loam, brown (10YR 4/3) when moist; weak, thin and medium, platy structure; slightly hard when dry, friable when moist, nonsticky and slightly plastic when wet; common very fine roots; few fine tubular pores and common fine interstitial pores; moderately alkaline; abrupt, smooth boundary.

C—1 to 8 inches, brown (7.5YR 5/4) very gravelly heavy loam, dark brown (7.5YR 4/4) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine and fine roots; common fine tubular pores and many fine interstitial pores; moderately alkaline; abrupt, irregular boundary.

R—8 to 9 inches, white (N 8/0) granite, stained with few thin yellowish-red (5YR 4/6) coatings; noneffervescent to slightly effervescent in spots.

Depth to granite ranges from 4 to 15 inches but is generally about 8 inches. The soils range from noneffervescent to strongly effervescent and in reaction from neutral to moderately alkaline. Content of coarse fragments averages more than 50 percent.

In the A horizon hue is 10YR or 7.5YR, value is 5 or 6 dry and 3 or 4 moist, and chroma is 3 or 4. The A horizon

is gravelly or very gravelly sandy loam, cobbly or very cobbly sandy loam, very stony sandy loam, or gravelly loamy sand.

In the C horizon hue is 7.5YR or 10YR, value is 4 to 6 dry and 3 or 4 moist, and chroma is 4 to 6. The C horizon ranges from very gravelly sandy loam or very gravelly heavy loam to cobbly or very cobbly and very stony sandy loam.

Cellar very gravelly sandy loam, 8 to 30 percent slopes (CmD).—This soil is on granite or schist hills that are dissected by a few long extended drainageways and numerous short drainageways. The profile described as representative of the series is in an area of this soil.

Included with this soil in mapping, and making up about 10 percent of the acreage, are small areas of a clayey soil that is shallow over schist, and some very rocky and cobbly Cellar soils. Also included, and making up about 20 percent of the acreage, are areas of Cellar very gravelly sandy loam that has 30 to 60 percent slopes.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for seasonal range, wildlife habitat, mining, and watershed catchment areas. Capability unit VIIs-1; Loam Hills range site, 8- to 12-inch precipitation zone; wildlife group 4.

Cellar very rocky sandy loam, 2 to 15 percent slopes (CnC).—This soil is on low granite hills that are dissected by numerous short drainageways. It has a profile similar to the one described as representative of the series, but it is gently sloping to strongly sloping, and rock outcrops make up about 20 percent of the acreage. Included in mapping, and making up about 10 percent of the acreage, are areas of Chiricahua gravelly sandy loam that has 2 to 8 percent slopes.

Runoff is slow on this soil. The hazard of erosion is slight.

This soil is used for seasonal grazing, wildlife habitat, mining, and watershed catchment areas. Capability unit VIIs-1; Loam Hills range site, 8- to 12-inch precipitation zone; wildlife group 4.

Cellar very rocky sandy loam, 15 to 60 percent slopes (CnF).—This soil is on hills and mountains that are dissected by numerous short drainageways. It has a profile similar to the one described as representative of the series, but the surface has numerous rock outcrops. These outcrops make up about 20 percent of the acreage. Included in mapping, and making up about 10 percent of the acreage, are areas of Chiricahua gravelly sandy loam that has 15 to 30 percent slopes.

Runoff is medium to rapid on this soil. The hazard of erosion is moderate to high.

This soil is used for seasonal grazing, wildlife habitat, mining, and watershed catchment areas. Capability unit VIIs-1; Loam Hills range site, 8- to 12-inch precipitation zone; wildlife group 4.

Cellar-Chiricahua complex, 8 to 30 percent slopes (CoD).—This complex is about 60 percent Cellar gravelly and very stony sandy loams that have slopes of 8 to 30 percent and about 25 percent Chiricahua gravelly and very stony sandy loams that have slopes of 8 to 15 percent. One of the Chiricahua soils has the profile described as representative of the Chiricahua series.

Included with these soils in mapping, and making up

about 15 percent of the acreage, are scattered areas of very rocky and extremely rocky Cellar soils and Continental and Whitlock gravelly sandy loams.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used for range, wildlife habitat, mining, and watershed catchment areas. Capability unit VIIIs-1; Loam Hills range site, 8- to 12-inch precipitation zone; wildlife group 4.

Cellar soils, 20 to 60 percent slopes (CrF).—These soils are on granite hills and mountains. They have a profile similar to the one described as representative of the series, but they have an extremely rocky or gravelly sandy loam surface layer and steep slopes. Approximately 75 percent of these soils have slopes of 30 percent or more. A few long drainageways and numerous short drainageways dissect the areas. Included in mapping, and making up about 5 percent of the acreage, are areas of Chiricahua gravelly sandy loam that has 8 to 15 percent slopes.

Runoff is medium on these soils. The hazard of erosion is moderate to high.

These soils are used mainly for seasonal grazing, wildlife habitat, and watershed catchment areas. Capability unit VIIIs-1; Loam Hills range site, 8- to 12-inch precipitation zone; wildlife group 4.

Chiricahua Series

The Chiricahua series consists of shallow, well-drained, gravelly soils that formed in place in material weathered from granite. These soils are in areas where there are strongly sloping to moderately steep granite hills. Slopes range from 8 to 30 percent. Elevation ranges from 2,500 to 4,000 feet. The vegetation is dominantly grass and some desert shrubs, cactuses, and annuals. Annual precipitation is 8 to 12 inches. The average annual air temperature is 57° to 67° F, and the frost-free period is 170 to 230 days.

In a representative profile the surface layer is light-brown gravelly sandy loam about 5 inches thick. The subsoil is yellowish-red gravelly clay about 13 inches thick. It is underlain by yellowish-brown, yellow, and reddish-yellow weathered granite. Unweathered granite is at a depth of about 21 inches.

Permeability is slow. Available water capacity is low, and the effective rooting depth is less than 20 inches.

These soils are used mainly for seasonal grazing, wildlife habitat, mining, and watershed catchment areas.

Chiricahua soils in Yavapai County are mapped only in a complex with Cellar soils.

Representative profile of Chiricahua gravelly sandy loam that has 8 to 15 percent slopes, from an area of Cellar-Chiricahua complex, 8 to 30 percent slopes, 2.1 miles W. and 0.6 mile N. of the NE. corner, sec. 27, T. 10 N., R. 6 W.:

A1—0 to 5 inches, light-brown (7.5YR 6/4) gravelly sandy loam, dark brown (7.5YR 4/4) when moist; moderate, fine and medium, granular structure; slightly hard when dry, very friable when moist, nonsticky and slightly plastic when wet; common fine and few very fine roots; few fine tubular pores and

many fine and very fine interstitial pores; slightly acid; clear, smooth boundary.

B2t—5 to 18 inches, yellowish-red (5YR 5/6) and dark-red (2.5YR 3/6) gravelly clay, yellowish red (5YR 4/6) and dark red (2.5YR 3/6) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; few fine roots; many fine interstitial pores and few fine tubular pores; common moderately thick clay films on ped faces and in pores; mildly alkaline; clear, irregular boundary.

C—18 to 21 inches, yellowish-brown (10YR 5/4), yellow (10YR 7/6), and reddish-yellow (7.5YR 6/6) weathered granite (grus), reddish yellow (7.5YR 6/6) and strong brown (7.5YR 5/8) when moist; massive; very hard when dry; few moderately thick clay films on rock faces; neutral.

R—21 to 24 inches, unweathered granite.

Thickness of the solum and depth to weathered granite range from 10 to 20 inches, but average about 16 inches. Depth to unweathered bedrock ranges from 20 to 30 inches.

In the A horizon hue is 7.5YR to 2.5YR, value is 4 to 6 dry and 3 or 4 moist, and chroma is 2 to 4. The A horizon is gravelly sandy loam or very stony sandy loam. Reaction of the A horizon ranges from medium acid to slightly acid.

In the B2t horizon hue is 7.5YR to 2.5YR but is dominantly 5YR, value is 3 to 5 dry and 3 or 4 moist, and chroma is 3 to 6. The B2t horizon ranges from heavy clay loam to gravelly clay loam, gravelly clay, or clay. Reaction of the B horizon ranges from slightly acid to mildly alkaline.

Continental Series

The Continental series consists of deep, well-drained soils that have a zone of lime accumulation at a moderate depth. These soils formed in mixed alluvium weathered from granite and basic igneous rock. They are on gently sloping to moderately steep fans and valley slopes. Slopes range from 2 to 30 percent but are dominantly 2 to 15 percent. Elevation ranges from 2,000 to 4,500 feet. The vegetation is dominantly grass along with some desert shrubs and cactuses. Annual precipitation is 8 to 12 inches. The average annual air temperature is 57° to 67° F, and the frost-free period is 170 to 230 days.

In a representative profile the surface layer is brown gravelly sandy loam about 3 inches thick. The subsoil is dark-brown clay loam, yellowish-red and brown clay, and light-brown clay loam about 24 inches thick. The substratum is white gravelly sandy loam that is weakly cemented (fig. 4).

Permeability is slow. Available water capacity is moderate to high, and the effective rooting depth is 60 inches or more.

These soils are used mainly for seasonal grazing, wildlife habitat, and watershed catchment areas. A very limited acreage, north of Date Creek, is irrigated for orchards. The area in and north of Congress Junction has been subdivided for use as homesites.

Representative profile of Continental gravelly sandy loam, 2 to 15 percent slopes, 1 mile W. and 0.2 mile N. of the NE. corner, sec. 27, T. 10 N., R. 6 W.:

A1—0 to 3 inches, brown (7.5YR 5/4) gravelly sandy loam, dark brown (7.5YR 4/4) when moist; weak, thin, platy structure parting to moderate, fine and medium, granular; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; many very fine and few fine roots; common fine and very fine interstitial pores; neutral; clear, smooth boundary.



Figure 4.—Typical profile of Continental gravelly sandy loam that has a thin surface layer, a subsoil having prismatic and blocky structure, and an accumulation of lime in the lower part of the subsoil and upper part of the underlying material.

- B1t—3 to 8 inches, dark-brown (7.5YR 4/4) 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; many very fine and few fine roots; few fine tubular pores and common fine interstitial pores; common thin clay films on ped faces and in pores; mildly alkaline; clear, smooth boundary.
- B21t—8 to 15 inches, yellowish-red (5YR 4/6) light clay, yellowish red (5YR 4/6) when moist; moderate, fine and medium, prismatic structure parting to moderate, medium, subangular blocky; very hard when dry, firm when moist, sticky and plastic when wet; common very fine and few fine roots; few fine tubular pores and common fine interstitial pores; many thin clay films on ped faces and in pores; mildly alkaline; clear, wavy boundary.
- B22t—15 to 21 inches, brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) when moist; weak, fine, prismatic structure parting to moderate, medium, subangular blocky; very hard when dry, firm when moist, sticky and plastic when wet; common very fine roots; few fine tubular pores and common fine interstitial pores; common thin clay films on ped faces and in pores; noneffervescent to slightly effervescent; moderately alkaline; gradual, wavy boundary.
- B3ca—21 to 27 inches, light-brown (7.5YR 6/4) clay loam, dark brown (7.5YR 4/4) when moist; massive; very hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common very fine roots; few fine tubular pores and few fine interstitial pores; violently effervescent; many fine and medium, pinkish-white (7.5YR 8/2) lime mottles, filaments, and coatings, pinkish gray (7.5YR 7/2) when moist; moderately alkaline; abrupt, wavy boundary.

IICca—27 to 56 inches, white (10YR 8/1) weakly lime-cemented gravelly sandy loam; many, medium and large, distinct pink (7.5YR 7/4) mottles; light gray (10YR 7/1) when moist; massive; very hard when dry, friable when moist, nonsticky and nonplastic when wet; very few very fine roots; common fine tubular pores and common very fine interstitial pores; violently effervescent; moderately alkaline.

The solum ranges from 26 to 50 inches or more in thickness. The content of coarse fragments ranges from a few pebbles or cobblestones to about 30 percent gravel, cobblestones, or stones by volume.

In the A horizon hue is 7.5YR to 5YR, value is 4 or 5 dry and 3 or 4 moist, and chroma is 3 or 4. The A horizon is gravelly sandy loam, gravelly sandy clay loam, or very stony sandy loam. In the B2t horizon hue is 2.5YR to 7.5YR, value is 3 to 5 dry and 3 or 4 moist, and chroma is 4 to 6. The B2t horizon is heavy clay loam, gravelly clay loam, clay, or gravelly clay. Cementation in the B3 or Cca horizons is weak and discontinuous.

Continental gravelly sandy loam, 2 to 15 percent slopes (CsC).—This soil is on alluvial fans that are dissected by numerous shallow drainageways. It has the profile described as representative of the series.

Included with this soil in mapping, and making up about 15 percent of the acreage, are small scattered areas of Whitlock, Latene, and Anthony gravelly sandy loams. The Whitlock and Latene soils are on the fans and the Anthony soils is in the drainageways.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used mainly for seasonal grazing, wildlife habitat, and watershed catchment areas. A limited acreage is used for orchards and small areas have been subdivided for use as homesites. Capability unit VIIe-1; Loam Upland range site, 8- to 12-inch precipitation zone; wildlife group 2.

Continental-Cave gravelly sandy loams, 8 to 30 percent slopes (CtD).—This complex is about 55 percent Continental gravelly sandy loam and 35 percent Cave gravelly sandy loam. These soils are in an intricate pattern on strongly sloping to moderately steep alluvial fans that are dissected by numerous long drainageways. The Cave soil generally is on ridgetops and side slopes, and Continental soil is throughout the areas.

Included with these soils in mapping, and making up about 10 percent of the acreage, are areas of cobbly and very stony Continental soils and outcrops of tuff or agglomerate along the steep drainageways.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used mainly for seasonal grazing, wildlife habitat, and watershed catchment areas. Both parts in capability unit VIIe-1. Continental part in Loam Upland range site, 8- to 12-inch precipitation zone; Cave part in Caliche Upland range site, 8- to 12-inch precipitation zone. Continental part in wildlife group 2; Cave part in wildlife group 3.

Continental-Whitlock gravelly sandy loams, 2 to 15 percent slopes (CuC).—This complex is about 50 percent Continental gravelly sandy loam that has slopes of 2 to 8 percent and 35 percent Whitlock gravelly sandy loam that has slopes of 2 to 15 percent. These soils are in an intricate pattern on gently sloping to strongly sloping alluvial fans that are dissected by many small, shallow drainageways.

Included with these soils in mapping, and making up about 15 percent of the acreage, are small areas of Mohave sandy loam on nearly level or depressional areas and narrow areas of Anthony gravelly sandy loam in the drainageways.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used mainly for seasonal grazing, wildlife habitat, and watershed catchment areas. Capability unit VIIe-1; Loam Upland range site, 8- to 12-inch precipitation zone; wildlife group 2.

Continental-Loamy alluvial land association, sloping (Cv8).—This association is about 60 percent Continental gravelly sandy loam that has slopes of 0 to 8 percent and 30 percent Loamy alluvial land. These nearly level to moderately sloping or sloping soils are on fans that are dissected by numerous shallow drainageways. The Loamy alluvial land is adjacent to the shallow drainageways.

Included with these soils in mapping, and making up about 10 percent of the acreage, are small areas of Cave, Whitlock, and Tres Hermanos gravelly sandy loams, and clayey alluvial soils.

Runoff is slow on these soils. The hazard of erosion is slight.

These soils are used mainly for wildlife habitat and watershed catchment areas and for limited grazing. Continental part in capability unit VIIs-1; Loamy alluvial land part in capability unit VIIw-1. Continental part in Loam Upland range site, 8- to 12-inch precipitation zone; Loamy alluvial land part in Loam Bottoms range site, 8- to 12-inch precipitation zone. Continental part in wildlife group 2; Loamy alluvial land part in wildlife group 1.

Continental soils, 3 to 30 percent slopes (CwD).—These soils are on alluvial fans adjacent to granite hills that are dissected by numerous steep-sided drainageways. The surface layer is gravelly sandy clay loam and very stony sandy loam.

Included with these soils in mapping are small areas of stony outwash on the upper part of the fans and exposures of unconsolidated tuffaceous material along the drainageways. Also included are small areas of coarse-textured soils in the drainageways.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used mainly for seasonal grazing, wildlife habitat, and watershed catchment areas. Capability unit VIIs-1; Loam Upland range site, 8- to 12-inch precipitation zone; wildlife group 2.

Cordes Series

The Cordes series consists of deep, well-drained soils that formed in recent alluvium weathered from various sources. These soils are nearly level or gently sloping on low alluvial fans, flood plains, or swales. Slopes range from 2 to 5 percent. Elevation ranges from 4,000 to 5,500 feet. The vegetation is grass. Annual precipitation is 12 to 16 inches. The average annual air temperature is 50° to 57° F, and the frost-free period is 150 to 210 days.

In a representative profile the surface layer is grayish-brown sandy loam about 3 inches thick. The next layer is brown sandy loam about 31 inches thick. The underlying material, extending to a depth of 60 inches or more, is light-brown loamy sand.

Permeability is moderately rapid. Available water capacity is moderate, and the effective rooting depth is more than 60 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas. Limited areas are irrigated and cultivated where adequate water is available.

Representative profile of Cordes sandy loam, 0.5 mile E. of the SW. corner, sec. 3, T. 15 N., R. 2 W.:

A11—0 to 3 inches, grayish-brown (10YR 5/2) sandy loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; many very fine and fine roots; many very fine tubular pores; mildly alkaline; abrupt, smooth boundary.

A12—3 to 34 inches, brown (7.5YR 5/2) sandy loam, dark brown (7.5YR 3/2) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common very fine roots; common very fine tubular pores; moderately alkaline; gradual, smooth boundary.

C—34 to 60 inches, light-brown (7.5YR 6/4) loamy sand, dark brown (7.5YR 4/4) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; few very fine roots; many fine interstitial pores; moderately alkaline.

Depth to the C horizon ranges from 34 to 60 inches. Gravel content ranges from a few pebbles to approximately 30 percent by volume. Thin strata of finer or coarser textured materials are present in places.

In the A and C horizons hue is dominantly 7.5YR and 10YR. In the A horizon value is 4 or 5 dry. In the C horizon value is 5 or 6 dry and 3 or 4 moist, and chroma is 2 to 4. Few fine filaments of lime are present in some horizons.

Cordes sandy loam (Cx).—This nearly level to gently sloping soil is on alluvial fans and in swales and drainageways.

Included with this soil in mapping, and making up about 5 percent of the acreage, are small areas of Wineg sandy loam and a Cordes-like soil that is moderately deep over very gravelly sand. Also included are areas of gravelly coarse-textured soils in the drainageways.

Runoff is slow on this soil. The hazard of erosion is slight.

This soil is used for range, wildlife habitat, and watershed catchment areas. Limited acreages are irrigated and used for cultivated crops. Capability unit VIIs-1; Loam Bottoms range site, 12- to 16-inch precipitation zone; wildlife group 6.

Cordes Series, Red Variant

The Cordes series, red variant, consists of deep, well-drained, moderately coarse textured, reddish soils that formed in recent alluvial material weathered from mixed sources. These soils are nearly level to gently sloping on flood plains and alluvial fans. They are dissected by a few long, deep gullies. Elevation ranges from 4,000 to 5,500 feet. The vegetation is grass. Annual precipitation is 12 to 16 inches. The average

annual air temperature is 50° to 57° F, and the frost-free period is 150 to 210 days.

In a representative profile the surface layer is reddish-brown light fine sandy loam about 2 inches thick. The underlying material is reddish-brown and brown stratified fine sandy loam and sandy loam that extends to a depth of 62 inches or more.

Permeability is moderately rapid. Available water capacity is moderate, and the effective rooting depth is more than 60 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas. Limited acreages are irrigated and cultivated where adequate water is available.

Representative profile of Cordes fine sandy loam, red variant, approximately 300 feet W. of railroad to Seligman, approximately 3 miles S. of Audley, NE $\frac{1}{4}$ -SW $\frac{1}{4}$ sec. 14, T. 23 N., R. 7 W.:

- A1—0 to 2 inches, reddish-brown (5YR 5/3) light fine sandy loam, dark reddish brown (5YR 3/4) when moist; moderate, very fine, granular structure; loose when dry, very friable when moist, nonsticky and nonplastic when wet; few very fine roots; many interstitial pores; slightly effervescent; moderately alkaline; clear, smooth boundary.
- C1—2 to 10 inches, reddish-brown (5YR 4/4) sandy loam, dark reddish brown (5YR 3/4) when moist; massive; hard when dry, very friable when moist, slightly sticky and nonplastic when wet; many very fine and fine roots; many interstitial pores and few fine tubular pores; strongly effervescent; moderately alkaline; clear, smooth boundary.
- C2—10 to 34 inches, brown (7.5YR 5/4) fine sandy loam, dark reddish brown (5YR 3/4) when moist; massive; hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; common very fine roots; many interstitial pores and common very fine tubular pores; strongly effervescent; few, fine, distinct lime mottles; moderately alkaline; gradual, smooth boundary.
- C3—34 to 62 inches, reddish-brown (5YR 4/4) sandy loam, dark reddish brown (5YR 3/4) when moist; massive; hard when dry, very friable when moist; slightly sticky and slightly plastic when wet; strongly effervescent; few fine and medium lime mottles and few yellowish-red (5YR 4/6) weathered sandstone fragments; moderately alkaline.

Gravel content ranges from a few pebbles to approximately 20 percent by volume. Thin strata of finer or coarser textured material are present in places. In the A and C horizons hue is dominantly 5YR but ranges to 7.5YR dry. In the A horizon value is 5 or 6 dry and 3 moist, and chroma is 3 to 6. In the C horizon value is 4 or 5 dry and 3 or 4 moist, and chroma is 4 to 6.

Cordes fine sandy loam, red variant (Cy).—This nearly level to gently sloping soil is on flood plains and alluvial fans.

Included with this soil in mapping are small areas of a soil similar to the Cordes, red variant soil, but that is moderately deep over very gravelly sand. Also included are coarse-textured gravelly soils in drainageways. These included soils make up about 2 percent of the acreage.

Runoff is slow on this soil. The hazard of erosion is slight.

This soil is used for range, wildlife habitat, and watershed catchment areas. Limited acreages are irrigated and are used for cultivated crops. Capability

unit VI \bar{s} -1; Loam Bottoms range site, 12- to 16-inch precipitation zone; wildlife group 6.

Cross Series

The Cross series consists of well-drained soils that are shallow or very shallow over bedrock. These soils formed in place in material weathered from basalt. They are in areas where there are nearly level to rolling hills and plains. Slopes range from 2 to 15 percent. Elevation ranges from 4,500 to 6,000 feet. The vegetation is dominantly grass. Annual precipitation is about 11 inches. The average annual air temperature is 50° to 53° F, and the frost-free period is 140 to 160 days.

In a representative profile the surface layer is dark grayish-brown gravelly clay loam about 3 inches thick. The subsoil is dark grayish-brown clay about 11 inches thick. It is underlain by a thin, weakly lime-cemented layer about 5 inches thick. Basalt is at a depth of about 19 inches.

Permeability is slow. Available water capacity is low, and the effective rooting depth is 10 to 20 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Representative profile of Cross gravelly clay loam, 2 to 15 percent slopes, from an area of Cross, Cabezon, and Apache soils, 2 to 15 percent slopes, 0.2 mile N. and 0.3 mile E. of the SW. corner, sec. 34, T. 23 N., R. 5 W.:

- A1—0 to 3 inches, dark grayish-brown (10YR 4/2) gravelly clay loam, dark brown (7.5YR 3/2) when moist; strong, fine, granular structure; hard when dry, friable when moist, sticky and plastic when wet; many very fine and fine roots; many fine interstitial pores; moderately alkaline; abrupt, smooth boundary.
- B2t—3 to 14 inches, dark grayish-brown (10YR 4/2) clay, dark brown (7.5YR 3/2) when moist; moderate, medium, subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; many very fine and fine roots; many very fine tubular pores; many moderately thick clay films on ped faces; common medium gravel; moderately alkaline; clear, wavy boundary.
- Cca—14 to 19 inches, white (N 8/0) weakly lime-cemented basalt gravel and cobblestones that have a thin ($\frac{1}{4}$ -inch) laminar layer in places on the upper part, pinkish white (7.5YR 8/2) when moist; massive; common very fine roots; violently effervescent; moderately alkaline; abrupt, wavy boundary.
- R—19 to 22 inches, black (7.5YR N 2/0) and very dark gray (N 3/0) basalt.

Depth to basalt ranges from 8 to 20 inches. Gravel content of the A horizon ranges from 10 to 30 percent by volume and 5 to 10 percent of the surface is covered by cobblestones and stones in places.

The A horizon has value of 4 or 5 dry and chroma of 2 or 3 dry or moist. The A horizon is clay loam or gravelly clay loam. In the Bt horizon hue is 10YR to 5YR, value is 3 to 5 dry and 2 or 3 moist, and chroma is 2 or 3. The Bt horizon is heavy clay loam or clay. The Cca horizon ranges from weakly cemented to strongly cemented and is discontinuous. In some places the Cca horizon tongues into fractures in the basalt.

Cross, Cabezon, and Apache soils, 2 to 15 percent slopes (CzC).—These soils are on basalt plains or hills. They consist of about 45 percent Cross gravelly clay loam and about 45 percent Cabezon gravelly clay loam and Apache gravelly loam, although each soil may not

be present in all delineations. The Apache soil has slopes of 2 to 8 percent and the Cross and Cabezon soils have slopes of 2 to 15 percent. Dominant slopes are 2 to 8 percent. The Cabezon soil has a profile similar to the one described as representative of the series, but the surface layer is gravelly clay loam.

Included with these soils in mapping are stony and rocky areas, small areas of Springerville and Thunderbird cobbly clay loams, and a few areas of soils that have slopes of 15 to 30 percent. These included areas make up about 10 percent of the acreage.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used for range, wildlife habitat, and watershed catchment areas. All parts in capability unit VIe-1. Cross and Cabezon parts in Clay Loam Hills range site, 12- to 16-inch precipitation zone; Apache part in Limy Hills range site, 12- to 16-inch precipitation zone. All parts in wildlife group 5.

Dandrea Series

The Dandrea series consists of moderately deep, well-drained soils. These soils formed in place in material weathered from schist or rhyolite bedrock. They are in areas where there are rolling to very steep hills and mountains. Slopes range from 15 to 60 percent. Elevation ranges from 6,000 to 8,000 feet. The vegetation is a mixed stand of ponderosa pine, Gambel oak, and Douglas-fir and an understory of grass. Annual precipitation is 18 to 25 inches. The average annual air temperature is about 43° F, and the frost-free period is 120 to 150 days.

In a representative profile the surface layer is dark grayish-brown gravelly loam about 7 inches thick. The subsoil is reddish-yellow gravelly clay loam and brown gravelly clay about 22 inches thick. It is underlain by brown weathered schist that has tongues of gravelly clay extending to a depth of 50 inches or more.

Permeability is slow. Available water capacity is moderate, and the effective rooting depth is 20 to 40 inches.

These soils are used mainly for trees, range, wildlife habitat, mining, and watershed catchment areas. Mining is mainly for gold, silver, and copper. Limited areas have been subdivided for use as summer homesites.

Representative profile of Dandrea gravelly loam, 20 to 60 percent slopes, 500 feet S. and 800 feet W. of the NE. corner, sec. 33, T. 13 N., R. 2 W.:

O1—1 inch to 0, raw and decomposing pine and oak litter.

A11—0 to 3 inches, dark grayish-brown (10YR 4/2) gravelly heavy loam, very dark grayish brown (10YR 3/2) when moist; strong, fine and medium, granular structure; soft when dry, friable when moist, slightly sticky and plastic when wet; many very fine roots; many micro pores and very fine interstitial pores; neutral; clear, smooth boundary.

A12—3 to 7 inches, dark grayish-brown (10YR 4/2) gravelly heavy loam, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist, sticky and plastic when wet; many very fine and fine and common medium roots; many micro pores and very fine interstitial pores; neutral; clear, smooth boundary.

B1t—7 to 12 inches, reddish-yellow (7.5YR 6/6) gravelly clay loam, dark brown (7.5YR 4/4) when moist;

moderate, fine, subangular blocky structure; slightly hard when dry, friable when moist, sticky and plastic when wet; common very fine and many fine, medium, and coarse roots; common micro pores and very fine interstitial pores; common thin clay films on ped faces; neutral; gradual, irregular boundary.

B2t—12 to 29 inches, brown (7.5YR 5/4) gravelly clay, dark brown (7.5YR 4/4) when moist; common, medium, faint reddish-yellow (7.5YR 7/6) mottles, strong brown (7.5YR 5/6) when moist; moderate, medium, subangular and angular blocky structure; very hard when dry, firm when moist, sticky and very plastic when wet; few very fine and common fine, medium, and coarse roots; common micro interstitial pores; common moderately thick clay films on ped faces; neutral; gradual, irregular boundary.

C—29 to 50 inches, brown (7.5YR 5/4) highly weathered schist, strong brown (7.5YR 5/6) when moist; reddish-yellow (7.5YR 6/6) mottles, strong brown (7.5YR 5/6) when moist; rock controlled structure.

Depth to the C horizon ranges from 15 to 40 inches but is dominantly 20 to 40 inches. Content of gravel and cobbles ranges from 20 to 35 percent by volume.

In the A horizon hue is 10YR, value is 4 or 5 dry and 2 or 3 moist, and chroma is 2 to 4. In the B horizon hue is 7.5YR or 10YR but centers on 7.5YR. In the B horizon value is 5 to 7 dry and 3 to 5 moist, and chroma is 4 to 6. The Bt horizon ranges from gravelly heavy clay loam to gravelly clay. Thin tongues of the Bt horizon extended into the C material to a depth of 50 inches or more.

Dandrea gravelly loam, 20 to 60 percent slopes (DaF).
—This soil is on schist hills and mountains that are dissected by numerous drainageways.

Included with this soil in mapping, and making up about 10 percent of the acreage, are very rocky areas, some Mirabal gravelly sandy loam, and small areas of Lynx loam and Cordes sandy loam along the drainageways.

Runoff is rapid on this soil. The hazard of erosion is high.

This soil is used for trees, wildlife habitat, mining, and watershed catchment areas. Limited acreages are used for summer homesites. Capability unit VIIe-2; timber group 1; wildlife group 11.

Dye Series

The Dye series consists of shallow, well-drained soils. These soils formed in place in material weathered from limestone or calcareous sandstone. They are in areas where there are nearly level to strongly sloping hills. Slopes range from 2 to 15 percent. Elevation ranges from 5,000 to 6,500 feet. The vegetation is pinyon pine and juniper and an understory of grass. Annual precipitation is 12 to 16 inches. The average annual air temperature is about 53° F, and the frost-free period is 140 to 160 days.

In a representative profile the surface layer is reddish-brown gravelly loam about 2 inches thick. The subsoil is reddish-brown clay loam and yellowish-red clay about 18 inches thick. It is underlain by massive limestone.

Permeability is slow. Available water capacity is low, and the effective rooting depth is 10 to 20 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Representative profile of Dye gravelly loam, 2 to 15 percent slopes, 0.5 mile S. and 0.75 mile W. of the E $\frac{1}{4}$ corner, sec. 29, T. 23 N., R. 7 W.:

- A1—0 to 2 inches, reddish-brown (5YR 5/3) gravelly loam, dark reddish brown (5YR 3/3) when moist; moderate, fine, granular structure; soft when dry, friable when moist, nonsticky and plastic when wet; common fine and very fine roots; many fine interstitial pores; mildly alkaline; abrupt, smooth boundary.
- B1t—2 to 5 inches, reddish-brown (5YR 5/4) clay loam, dark reddish brown (5YR 3/4) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist, slightly sticky and plastic when wet; common very fine and fine roots; common very fine tubular pores; common thin clay films on ped faces; common gravel and a few cobblestones; moderately alkaline; clear, smooth boundary.
- B2t—5 to 20 inches, yellowish-red (5YR 5/6) clay, yellowish red (5YR 4/6) when moist; moderate, medium, subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; common very fine and few fine and coarse roots; common very fine tubular pores; many thin clay films on ped faces and in pores; common gravel and a few cobblestones; moderately alkaline; abrupt, irregular boundary.
- R—20 to 22 inches, gray (2.5Y N 5/0) massive, dense, fractured, calcareous, extremely hard limestone.

Depth to bedrock ranges from 12 to 20 inches. Tongues of the B2t horizon extend into the fractures of the R horizon in some places. Content of gravel ranges from 5 to 35 percent. Reaction ranges from neutral to moderately alkaline throughout. The soil is slightly effervescent in the lower part of the B2t horizon in some places and has lime filaments immediately above the bedrock in places.

In the A horizon hue is 10YR to 5YR but is dominantly 7.5YR and 5YR. Value is 4 to 6 dry and 3 or 4 moist, and chroma is 3 or 4. The A horizon is gravelly loam, gravelly fine sandy loam, or gravelly light clay loam.

In the B2t horizon hue is 5YR or 2.5YR, value is 4 to 6 dry and 3 or 4 moist, and chroma is 3 to 6. The B2t horizon is heavy clay loam or clay.

Dye gravelly loam, 2 to 15 percent slopes (DgC).—This soil is on limestone or calcareous sandstone hills that are dissected by a few short shallow drainageways. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Purner gravelly loam and Dye stony and very rocky loams on the hills. Also included are areas of Tours and Rune loams in the drainageways. These included soils make up about 15 percent of the acreage.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIe-1; Limy Upland range site, 12- to 16-inch precipitation zone; wildlife group 7.

Dye very rocky loam, 2 to 15 percent slopes (DrC).—This soil is on limestone or calcareous sandstone hills that are dissected by a few shallow drainageways. It has a profile similar to that described as representative of the series, but is about 20 percent rock outcrops.

Included with this soil in mapping are small areas of Tortugas and Purner gravelly and very stony loams on the hills. Also included are areas of Tours and Rune loams in the drainageways. These included soils make up about 10 percent of the acreage.

Runoff is slow on this soil. The hazard of erosion is slight.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIIs-1; Limy Upland range site, 12- to 16-inch precipitation zone; wildlife group 7.

Faraway Series

The Faraway series consists of very shallow and shallow, well-drained soils. These soils formed in place in material weathered from bedrock. They are in areas where there are nearly level to very steep andesite or tuffaceous agglomerate hills and mountains. Slopes range from 0 to 60 percent. Elevation ranges from 4,000 to 6,500 feet. The vegetation is grass and brush and juniper in some places. Annual precipitation is 12 to 18 inches. The average annual air temperature is 50° to 56° F, and the frost-free period is 170 to 240 days.

In a representative profile the surface layer is brown gravelly and very stony loam about 7 inches thick. It is underlain by light reddish-brown andesite.

Permeability is moderate. Available water capacity is low, and the effective rooting depth is less than 20 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Representative profile of Faraway very rocky loam that has 0 to 8 percent slopes, in an area of Faraway very rocky loam, 0 to 15 percent slopes, 0.4 mile S. and 0.1 mile E. of the NW. corner, sec. 15, T. 20 N., R. 8 W.:

- A11—0 to 2 inches, brown (7.5YR 5/2) gravelly loam, dark brown (7.5YR 3/2) when moist; massive; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; common very fine roots; many fine vesicular pores; neutral; abrupt, smooth boundary.
- A12—2 to 7 inches, brown (7.5YR 4/2) very stony loam, dark brown (7.5YR 3/2) when moist; massive; slightly hard when dry, friable when moist, sticky and plastic when wet; many fine roots; common very fine tubular pores and many fine interstitial pores; neutral; abrupt, wavy boundary.
- R—7 to 9 inches, light reddish-brown (5YR 6/4) hard andesite, reddish brown (5YR 5/4) when moist.

Depth to bedrock ranges from 5 to 15 inches. Reaction ranges from slightly acid to mildly alkaline, effervescence is weak in some rock crevices. In places a C horizon is present. Hue is 10YR or 7.5YR, value is 2 or 3 moist, and chroma is 2 or 3.

The A horizon is silt loam, loam, or sandy loam modified by gravel, cobblestones, or stones. Content of coarse fragments ranges from 35 to 70 percent by volume and consists of gravel, cobblestones, and stones.

Faraway very rocky loam, 0 to 15 percent slopes (FaC).—This soil is on andesite or agglomerate hills and ridges that are dissected by numerous short drainageways. It is about 25 percent rock outcrops. The profile described as representative of the series is in an area of this soil.

Included with this soil in mapping, and making up about 15 percent of the acreage, are areas of Faraway extremely rocky or very stony loam and Lynx loam in the drainageways.

Runoff is slow to medium on these soils. The hazard of erosion is slight to moderate.

These soils are used for range, wildlife habitat, and watershed catchment areas. Capability unit VIs-1; Clay Loam Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Faraway-Luzena complex, 20 to 40 percent slopes (FIE).—This complex is about 60 percent Faraway very rocky loam and 30 percent Luzena gravelly loam. These soils are in a very intricate pattern on moderately steep and steep rhyolite and andesite hills and mountains that are dissected by numerous short, steep drainageways.

Included with these soils in mapping, and making up about 10 percent of the acreage, are small areas of Luzena gravelly loam that has 0 to 15 percent slopes, and areas of steep escarpments.

Runoff is rapid on these soils. The hazard of erosion is high.

These soils are used for range, wildlife habitat, and watershed catchment areas. Capability unit VIIIs-1; Clay Loam Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Faraway-Luzena complex, 40 to 60 percent slopes (FIF).—This complex is about 60 percent Faraway extremely rocky loam and 30 percent Luzena cobbly loam. These soils are in a complex pattern on steep to very steep rhyolite and andesite hills and mountains that are dissected by numerous short, steep drainageways.

Included with these soils in mapping, and making up about 10 percent of the acreage, are areas of gravelly Faraway and Luzena soils, Rock land, and steep escarpments.

Runoff is rapid on these soils. The hazard of erosion is high.

These soils are used for range, wildlife habitat, and watershed catchment areas. Capability unit VIIIs-1; Clay Loam Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Gaddes Series

The Gaddes series consists of moderately deep, well-drained soils. These soils formed in place in material weathered from granitic material. They are on pediment surfaces or in undulating to moderately steep areas on granite hills and mountains. Slopes range from 3 to 35 percent but are dominantly 3 to 25 percent. Elevation ranges from 4,000 to 6,000 feet. The vegetation is dominantly brush and an understory of grass. Annual precipitation is 14 to 16 inches. The average annual air temperature is 52° to 57° F, and the frost-free period is 140 to 170 days.

In a representative profile the surface layer is brown gravelly sandy loam about 2 inches thick. The subsoil is reddish-brown gravelly sandy clay loam and gravelly clay loam about 22 inches thick. It is underlain by reddish-brown highly weathered granite.

Permeability is slow. Available water capacity is moderate, and the effective rooting depth is 20 to 40 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Representative profile of Gaddes gravelly sandy loam, 3 to 25 percent slopes, 0.5 mile S. and 0.12 mile E. of the NW. corner, sec. 5, T. 9 N., R. 2 W.:

A1—0 to 2 inches, brown (7.5YR 4/4) gravelly sandy loam, dark reddish brown (5YR 3/4) when moist; moderate, medium, platy structure parting to strong, very fine, granular; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; common very fine roots; many fine interstitial pores; slightly acid; abrupt, smooth boundary.

B21t—2 to 5 inches, reddish-brown (5YR 4/4) gravelly sandy clay loam, dark reddish brown (5YR 3/4) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, firm when moist, slightly sticky and very plastic when wet; many fine and very fine interstitial pores; few thin clay films on ped faces; neutral; clear, smooth boundary.

B22t—5 to 11 inches, reddish-brown (5YR 4/4) gravelly clay loam, yellowish red (5YR 4/6) when moist; weak to moderate, fine and medium, subangular blocky structure; very hard when dry, firm when moist, slightly sticky and plastic when wet; common fine and very fine roots; common fine tubular pores; common thin clay films on ped faces; neutral; clear, wavy boundary.

B23t—11 to 24 inches, reddish-brown (5YR 4/4) gravelly clay loam, yellowish red (5YR 4/6) when moist; common, medium, distinct, yellowish-red (5YR 4/8) and reddish-yellow (5YR 6/8) mottles, reddish yellow (7.5YR 6/8) and yellowish red (5YR 4/8) when moist; massive; hard when dry, firm when moist, slightly sticky and plastic when wet; few fine and very fine roots; common fine interstitial pores; common moderately thick clay films in pores and as bridges holding mineral grains together; slightly acid; clear, wavy boundary.

C1—24 to 36 inches, reddish-brown (5YR 4/4) highly weathered granite that grades to very gravelly heavy sandy loam, yellowish red (5YR 4/6) when moist; common, fine, distinct, dark-brown (7.5YR 3/2) and strong-brown (7.5YR 5/6) mottles moist; massive; hard when dry, firm when moist, slightly sticky and plastic when wet; common fine interstitial pores; many thin clay films on surfaces; slightly acid; gradual, wavy boundary.

C2—36 to 54 inches, reddish-brown (5YR 4/4) weathered granite that grades to very gravelly loamy sand, yellowish red (5YR 4/6) when moist; common, fine, distinct, dark-brown (7.5YR 3/2) and strong-brown (7.5YR 5/6) mottles moist; massive; hard when dry, firm when moist, nonsticky and nonplastic when wet; common interstitial pores; slightly acid.

Depth to weathered granite ranges from 20 to 40 inches. In the A horizon hue is 5YR to 10YR but is dominantly 7.5YR. Value is 4 or 5 dry and 2 or 3 moist, and chroma is 2 to 4. Reaction ranges from slightly acid to mildly alkaline. The A horizon is gravelly sandy loam or gravelly sandy clay loam.

In the B horizon hue is 7.5YR to 2.5YR but is dominantly 5YR. Value is 3 to 6 dry and 3 to 5 moist, and chroma is 3 to 6. The B horizon is heavy clay loam, sandy clay loam, gravelly clay, gravelly sandy clay loam, and gravelly clay loam.

The weathered granite in the C horizon becomes harder as depth increases.

Gaddes gravelly sandy loam, 3 to 25 percent slopes (GdD).—This soil is on granite hills and in basinlike areas dissected by numerous short, shallow drainageways.

Included with this soil in mapping, and making up about 15 percent of the acreage, are narrow areas of Cordes sandy loam and Lynx loam in the drainageways, areas of Rock land and Barkerville gravelly sandy loam, and scattered areas of Barkerville cobbly and very stony soils.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIe-1; Granitic Loam Hills range site, 12- to 16-inch precipitation zone; wildlife group 8.

Gila Series

The Gila series consists of deep, well-drained soils. These soils formed in mixed recent alluvium weathered from a wide variety of rocks. They are on nearly level to gently sloping flood plains and low terraces. Slopes range from 0 to 5 percent. Elevation ranges from 2,000 to 4,200 feet. The vegetation is desert shrubs and an understory of grass and annuals. Annual precipitation is 8 to 12 inches. The average annual air temperature is about 68° F, and the frost-free period is 200 to 250 days.

In a representative profile the surface layer is brown fine sandy loam about 15 inches thick. The underlying layer is brown and pale-brown silt loam and very fine sandy loam to a depth of 60 inches or more.

Permeability is moderate. Available water capacity is high, and the effective rooting depth is more than 60 inches.

These soils are used mainly for seasonal grazing, wildlife habitat, and watershed catchment areas. Irrigated crops are grown along the Hassayampa River and Date Creek areas of this soil.

Representative profile of Gila fine sandy loam, from an area of Gila soils, 220 feet S. of the N $\frac{1}{4}$ corner, sec. 21, T. 8 N., R. 5 W.:

- A1—0 to 15 inches, brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) when moist; single grained; loose when dry and moist, nonsticky and nonplastic when wet; many very fine and common fine roots; many interstitial pores; slightly effervescent; mildly alkaline; clear, wavy boundary.
- C1—15 to 26 inches, brown (10YR 5/3) silt loam, dark brown (10YR 3/3) when moist; massive; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; common fine roots; few very fine tubular pores; strongly effervescent; mildly alkaline; clear, wavy boundary.
- C2—26 to 60 inches, pale-brown (10YR 6/3) very fine sandy loam, dark grayish brown (10YR 4/2) when moist; massive; loose when dry and moist, slightly sticky and slightly plastic when wet; strongly effervescent; moderately alkaline.

These soils are stratified. The thickness and texture of the strata are quite variable. Reaction ranges from neutral to strongly alkaline throughout the profile. In some places the A horizon is noncalcareous.

In the A horizon hue is 10YR or 7.5YR, value is 4 to 7 dry and 3 to 5 moist, and chroma is 2 to 4. The A1 horizon is dominantly loam, silt loam, and fine sandy loam; but sandy loam is also present.

In the C horizon hue is 10YR or 7.5YR, value is 4 to 7 dry and 3 to 6 moist, and chroma is 2 to 4. The C horizon is light loam, light silt loam, and very fine sandy loam. Mycelium-like lime veins are present in the C horizon in places.

Gila soils (Go).—These nearly level and gently sloping soils are on flood plains and low terraces along drainageways. The surface layer is loam, fine sandy loam, or silt loam. This mapping unit is about 70 percent Gila soils and 30 percent Anthony gravelly sandy loam and coarse-textured alluvial soils in drainageways.

Runoff is slow on these soils. The hazard of erosion is slight. In some areas Gila soils are subject to flooding.

These soils are used mainly for seasonal grazing, wildlife habitat, and watershed catchment areas. A few small areas are cultivated. Capability unit VIIc-1; Loam Bottoms range site, 8- to 12-inch precipitation zone; wildlife group 1.

Graham Series

The Graham series consists of well-drained soils that are shallow over basalt. These soils formed in place on gently sloping plains to steep hills or mountain slopes. Slopes range from 0 to 45 percent. Elevation ranges from 2,200 to 4,000 feet. The vegetation is dominantly tobosa grass and desert shrubs. Annual precipitation is 8 to 12 inches. The average annual air temperature is 58° to 65° F, and the frost-free period is 200 to 240 days.

In a representative profile the surface layer is brown very stony clay loam about 2 inches thick. The subsoil is reddish-brown clay about 10 inches thick. It is underlain by gray massive bedrock.

Permeability is slow. Available water capacity is low, and the effective rooting depth is about 8 to 20 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Representative profile of Graham very stony clay loam, 8 to 45 percent slopes, from an area of Graham soils, 8 to 45 percent slopes, 0.6 mile N. and 0.1 mile E. of the SW. corner, sec. 26, T. 9 $\frac{1}{2}$ N., R. 2 E.:

- A1—0 to 2 inches, brown (7.5YR 4/2) very stony clay loam, dark brown (7.5YR 3/2) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist, sticky and plastic when wet; few very fine and fine roots; many interstitial pores; mildly alkaline; clear, smooth boundary.
- B1t—2 to 5 inches, reddish-brown (5YR 4/3) light clay, dark reddish brown (5YR 3/3) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; common fine and very fine and medium roots; common very fine and fine tubular pores; few thin clay films on ped faces; mildly alkaline; clear, smooth boundary.
- B2t—5 to 12 inches, reddish-brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) when moist; moderate, medium and coarse, subangular blocky structure; hard when dry, firm when moist, sticky and very plastic when wet; common very fine and fine and few medium roots; common very fine and fine tubular pores; many thin clay films on ped faces; mildly alkaline; clear, wavy boundary.
- R—12 to 14 inches, gray (7.5YR 5/0) basalt, dark gray (10YR 4/1) when moist.

Depth to basalt ranges from 8 to 20 inches but averages about 12 to 16 inches.

In the A horizon hue is 7.5YR or 5YR but ranges to 10YR in places. Value is 3 to 5 dry and 2 to 3 moist, and chroma is 2 or 3. The A horizon is very stony clay loam, gravelly and cobbly clay loam and loam, and very cobbly clay loam or loam.

In the B2t horizon hue is 7.5YR to 2.5YR but is dominantly 5YR. Value is 3 to 5 dry and 2 or 3 moist, and chroma is 2 or 3. The B2t horizon is gravelly clay, clay, or gravelly heavy clay loam. A thin Bca horizon is immediately above the R horizon in places. Where the bedrock is fractured, the B horizon tongues into the fractures.

Graham-Rimrock complex, 0 to 8 percent slopes (GrB).—This complex is about 55 percent Graham gravelly loam and 35 percent Rimrock gravelly clay loam. These

soils are in a complex pattern in areas that are dissected by a few large, deep drainageways.

Included with these soils in mapping, and making up about 10 percent of the acreage, are small areas of a cobbly Rimrock soil and Graham gravelly loam that has 8 to 15 percent slopes.

Runoff is slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. Capability unit VII_s-1; Loam Hills range site, 8- to 12-inch precipitation zone; wildlife group 4.

Graham soils, 8 to 45 percent slopes (G_sE).—These soils are on basalt hills. The surface layer is very stony clay loam, cobbly clay loam, cobbly loam, and gravelly or very cobbly clay loam. The profile described as representative of the series is in an area of these soils.

Included with these soils in mapping, and making up about 10 percent of the acreage, are areas of rock outcrops. Also included, and making up about 10 percent of the acreage, are areas of Rimrock soils that have slopes of 0 to 15 percent.

Runoff is medium to rapid on these soils. The hazard of erosion is moderate to high.

These soils are used for range, wildlife habitat, and watershed catchment areas. Capability unit VII_s-1; Loam Hills range site, 8- to 12-inch precipitation zone; wildlife group 4.

Hogg Series

The Hogg series consists of moderately deep, well-drained soils that are underlain by limestone. These soils formed in place on gently sloping plains to moderately steep hills and ridges. Slopes range from 0 to 30 percent. Elevation ranges from 6,200 to 7,200 feet. The vegetation is an open stand of ponderosa pine, Gambel oak, alligator juniper, pinyon pine, and an understory of grass. Annual precipitation is 18 to 22 inches. The average annual air temperature is 44° F, and the frost-free period is 120 to 150 days.

In a representative profile the surface layer is brown gravelly loam about 2 inches thick. The subsoil is brown clay loam and reddish-brown clay about 28 inches thick. It is underlain by massive limestone.

Permeability is slow. Available water capacity is moderate, and the effective rooting depth is about 30 inches.

These soils are used for trees, grazing, wildlife habitat, and watershed catchment areas.

Representative profile of Hogg gravelly loam, 0 to 8 percent slopes, NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 8, T. 18 N., R. 6 W.:

O1—Thin covering of partly decayed pine needles.

A1—0 to 2 inches, brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) when moist; weak, thin, platy structure parting to weak, fine, granular; slightly hard when dry, friable when moist, slightly sticky and nonplastic when wet; common very fine roots; many micro pores and very fine interstitial pores; mildly alkaline; abrupt, smooth boundary.

B1—2 to 6 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) when moist; weak, fine, subangular blocky structure; hard when dry, firm when moist, sticky and plastic when wet; few very fine, fine, and medium roots; common micro pores and very fine

interstitial pores; few fine pebbles; mildly alkaline; clear, smooth boundary.

B2t—6 to 16 inches, reddish-brown (5YR 4/3) clay, dark, reddish brown (5YR 3/4) when moist; moderate, medium, subangular blocky structure; extremely hard when dry, very firm when moist, sticky and very plastic when wet; common fine, medium and coarse roots; common micro pores and very fine interstitial pores; few thin clay films on ped faces; few cobblestones and stones; mildly alkaline; gradual, wavy boundary.

B22t—16 to 30 inches, reddish-brown (5YR 4/4) clay, reddish brown (5YR 4/4) when moist; moderate, medium, subangular blocky structure; extremely hard when dry, very firm when moist, sticky and very plastic when wet; common medium, fine, and coarse roots; common micro pores and very fine interstitial pores; common thick clay films on ped faces; common fine white gravel and lime nodules; mildly alkaline; abrupt, irregular boundary.

R—30 to 32 inches, limestone.

Depth to bedrock ranges from 20 to 60 inches but averages about 25 to 30 inches. An O1 horizon 1 to 3 inches thick is present in places.

In the A horizon hue is 10YR or 7.5YR, value is 4 or 5 dry and 3 moist, and chroma is 2 or 3. The A horizon ranges from gravelly loam and gravelly or stony fine sandy loam, to fine sandy loam and loam.

In the B2t horizon hue ranges from 7.5YR to 2.5YR but is dominantly 5YR. Value is 3 to 5 dry and 3 or 4 moist, and chroma is 3 to 6. The B2t horizon is heavy clay loam, clay, gravelly clay, or gravelly clay loam.

Hogg gravelly loam, 0 to 8 percent slopes (HgB).—This soil is on mesas or ridgetops. It has the profile described as representative of the series.

Included with this soil in mapping, and making up about 10 percent of the acreage, are areas of Hogg very rocky loam and shallow soils similar to those of the Hogg series.

Runoff is slow on this soil. The hazard of erosion is slight.

This soil is used for trees, wildlife habitat, and watershed catchment areas. Capability unit VI_s-2; timber group 2; wildlife group 11.

Hogg gravelly loam, 8 to 30 percent slopes (HgD).—This soil is on ridges and side slopes that are dissected by numerous drainageways that have steep sides.

Included with this soil in mapping, and making up about 5 percent of the acreage, are small areas of Hogg very rocky loam and a shallow soil similar to Hogg soils.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for trees, wildlife habitat, and watershed catchment areas. Capability unit VI_e-2; timber group 2; wildlife group 11.

House Mountain Series

The House Mountain series consists of well-drained soils that are very shallow and shallow over basalt. These soils formed in place on rolling to steep basalt hills and mountains. Slopes range from 15 to 40 percent. Elevation ranges from 1,800 to 4,500 feet. The vegetation is desert shrubs, cactuses, and grass. Annual precipitation is 8 to 12 inches. The average annual air temperature is 61° to 65° F, and the frost-free period is about 225 days.

In a representative profile the surface layer is brown very gravelly loam about 1 inch thick. The underlying layer is reddish-brown gravelly loam about 6 inches thick. It is underlain by fractured bedrock.

Permeability is moderate. Available water capacity is low, and the effective rooting depth is less than 20 inches.

These soils are used mainly for seasonal grazing, wildlife habitat, and watershed catchment areas.

Representative profile of House Mountain very gravelly loam that has 15 to 30 percent slopes, in an area of House Mountain soils, 15 to 40 percent slopes, 0.6 mile W. of the SE. corner, sec. 16, T. 13 N., R. 8 W.:

A1—0 to 1 inch, brown (7.5YR 5/2) very gravelly loam, dark brown (7.5YR 3/2) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common fine roots; common fine and very fine interstitial pores; moderately alkaline; abrupt, smooth boundary.

C—1 to 7 inches, reddish-brown (5YR 5/3) gravelly loam, dark reddish brown (5YR 3/3) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common fine and few very fine roots; common fine and very fine interstitial pores; moderately alkaline; abrupt, irregular boundary.

R—7 to 11 inches, weak-red (2.5YR 4/2), fractured vesicular basalt.

Depth to bedrock ranges from 4 to 20 inches but averages about 8 to 15 inches. The soil ranges from noneffervescent to strongly effervescent in the C horizon near the bedrock. Average coarse fragment content of the soil profile ranges from 20 to 35 percent by volume.

In the A horizon hue is 7.5YR or 10YR, value is 4 or 5 dry, and chroma is 2 to 4. The surface layer is cobbly or stony in places. The A horizon is loam, sandy loam, cobbly loam, stony loam, gravelly loam, or very gravelly loam.

In the C horizon hue is 10YR to 5YR, value is 4 or 5 dry and 3 moist, and chroma is 2 to 4. The C horizon is gravelly loam, gravelly light clay loam, or cobbly light clay loam.

House Mountain soils, 15 to 40 percent slopes (HmE).—These soils are on basalt hills and mountains that are dissected by numerous short drainageways. They have a surface layer of very gravelly, gravelly, cobbly, and stony loam, loam, and sandy loam.

Included with these soils in mapping are areas of rock outcrops that make up about 20 percent of the acreage and small areas of Graham and Rimrock gravelly clay loam. Also included are small areas of House Mountain soils that have slopes of 0 to 15 percent.

Runoff is medium to rapid on these soils. The hazard of erosion is moderate to high.

These soils are used for seasonal grazing, wildlife habitat, and watershed catchment areas. Capability unit VII_s-1; Loam Hills range site, 8- to 12-inch precipitation zone; wildlife group 4.

Jacks Series

The Jacks series consists of moderately deep, well-drained soils that formed in place in material weathered from sandstone. These soils are gently sloping to moderately steep on sandstone ridges and hills. Slopes range from 3 to 30 percent. Elevation ranges from 4,500 to 6,000 feet. The vegetation is pinyon pine and juniper and an understory of grass, but in some areas only grass is present. Annual precipitation is 14 to 19

inches. The average annual air temperature is 48° to 57° F, and the frost-free period is 140 to 160 days.

In a representative profile the surface layer is brown cobbly loam about 2 inches thick. The subsoil is dark-brown gravelly clay loam and dark reddish-brown and yellowish-red gravelly clay about 28 inches thick. It is underlain by light-gray extremely hard sandstone.

Permeability is slow. Available water capacity is moderate, and the effective rooting depth is 20 to 50 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas. In areas underlain by Coconino sandstone, rock quarries produce building stone.

Representative profile of Jacks very rocky loam, 15 to 30 percent slopes, SW $\frac{1}{4}$ sec. 10, T. 16 N., R. 6 W.:

A1—0 to 2 inches, brown (10YR 4/3) cobbly loam, dark brown (10YR 3/3) when moist; moderate, very fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine roots; common fine interstitial pores; mildly alkaline; clear, smooth boundary.

B1t—2 to 5 inches, dark-brown (7.5YR 3/2) gravelly clay loam, dark brown (7.5YR 3/2) when moist; moderate, fine, subangular blocky structure; slightly hard when dry, friable when moist, sticky and plastic when wet; many very fine roots; few very fine tubular pores and common fine interstitial pores; few clay bridges holding mineral grains together; neutral; clear, smooth boundary.

B21t—5 to 10 inches, dark reddish-brown (5YR 3/4) gravelly clay, dark reddish brown (5YR 3/4) when moist; moderate, fine, subangular blocky structure; very hard when dry, friable when moist, sticky and plastic when wet; many very fine and fine and few coarse roots; very few very fine and fine tubular pores; common moderately thick clay films on ped faces; neutral; gradual, wavy boundary.

B22t—10 to 30 inches, yellowish-red (5YR 4/6) gravelly clay, yellowish red (5YR 4/6) when moist; strong, medium and coarse, angular blocky structure; extremely hard when dry, very firm when moist, sticky and plastic when wet; common very fine roots; very few fine and very fine tubular pores; many moderately thick clay films on ped faces; neutral; abrupt, irregular boundary.

R—30 to 42 inches, light-gray (10YR 7/2) extremely hard (Coconino) sandstone.

Depth to sandstone bedrock ranges from 20 to 50 inches but averages 24 to 30 inches. Reaction is slightly acid to mildly alkaline in the A horizon but ranges from neutral to moderately alkaline in the B horizon.

In the A horizon hue is 7.5YR or 10YR but is dominantly 7.5YR. Value is 4 to 6 dry and 3 to 5 moist. Chroma is 3 to 6. The A horizon is cobbly loam, gravelly loam, cobbly or stony and very stony fine sandy loam, fine sandy loam, loam, or rocky and very rocky loam. Content of coarse fragments in the A horizon ranges from none to 50 percent stones, cobblestones, and gravel.

In the B2t horizon hue is 5YR or 2.5YR, but is dominantly 5YR. Value is 3 to 5 dry, and chroma is 4 to 6 dry and moist. The B2t horizon is gravelly clay, clay, gravelly heavy clay loam, and heavy clay loam. Content of coarse fragments in the B2t horizon ranges from few to 20 percent cobblestones and 5 to 10 percent gravel. Structure of the B2t horizon is angular or subangular blocky or prismatic. A few calcareous spots are in the lower part of the B2t horizon in places.

Jacks very rocky loam, 3 to 15 percent slopes (J_{vc}).—This soil is on sandstone hills dissected by a few short drainageways that have steep sides. About 20 percent of the acreage is rock outcrops. This soil has a profile similar to the one described as representative of the series, but the surface layer is dominantly gravelly and

very rocky. Stone-size fragments also are common throughout.

Included with this soil in mapping are areas of Jacks very stony loam that has 3 to 15 percent slopes, Jacks cobbly loam that has 15 to 30 percent slopes, Tortugas gravelly loam, and narrow bodies of Lynx loam in the drainageways. These included soils make up about 20 percent of the acreage.

Runoff is slow to medium on this soil. The hazard of erosion is slight.

This soil is used mainly for range, wildlife habitat, and watershed catchment areas. Capability unit VIs-1; Limy Upland range site, 12- to 16-inch precipitation zone; wildlife group 7.

Jacks very rocky loam, 15 to 30 percent slopes (JaD).—This soil is on sandstone hills that are dissected by many short drainageways and a few long drainageways. About 20 percent of the acreage is rock outcrops. This soil has the profile described as representative of the series.

Included with this soil in mapping, and making up about 10 percent of the acreage, are areas of Jacks very stony loam. Also included, and making up about 10 percent, are areas of Moenkopie gravelly loam, Tours loam, and Rune loam. The Tours and Rune soils are in the drainageways.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIs-1; Limy Upland range site, 12- to 16-inch precipitation zone; wildlife group 7.

Latene Series

The Latene series consists of deep, well-drained, calcareous soils that have a distinct zone of lime accumulation. These soils formed in mixed alluvium weathered from granite, basalt, limestone, and related rocks. They are nearly level to moderately sloping on alluvial fans and stream terraces. Slopes range from 0 to 8 percent. Elevation ranges from 2,000 to 4,000 feet. The vegetation is dominantly desert shrubs and an understory of grass. Annual precipitation is 8 to 12 inches. The average annual air temperature is 58° to 68° F, and the frost-free period is 220 to 260 days.

In a representative profile the surface layer is pinkish-gray gravelly sandy loam about 4 inches thick. The upper part of the underlying layer is light-brown or mottled pinkish-gray and white loam that has a zone of lime accumulation and is about 39 inches thick (fig. 5). The lower part of the underlying layer is stratified white and pinkish-gray gravelly sandy loam to a depth of 50 inches or more.

Permeability is moderate. Available water capacity is high, and the effective rooting depth is more than 50 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Representative profile of Latene gravelly sandy loam, 0.9 mile S. and 0.9 mile E. of the NW. corner, sec. 21, T. 9 N., R. 6 W.:



Figure 5.—Profile of Latene loam that has accumulated lime in the gravelly subsoil.

A1—0 to 4 inches, pinkish-gray (7.5YR 7/2) gravelly sandy loam, brown (7.5YR 5/4) when moist; weak, thick, platy structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine and few fine roots; common very fine interstitial pores and few fine tubular pores; violently effervescent; moderately alkaline; gradual, wavy boundary.

C1—4 to 21 inches, light-brown (7.5YR 6/4) loam, brown (7.5YR 5/4) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common fine, many very fine, and few coarse roots; common very fine and fine tubular pores and common fine interstitial pores; violently effervescent; few, fine, white (N 8/0), soft lime segregations; moderately alkaline; clear, wavy boundary.

C2ca—21 to 43 inches, mottled, pinkish-gray (7.5YR 7/2) and white (N 8/0) light loam, light brown (7.5YR 6/4) 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 and fine tubular pores; violently effervescent; many large and medium white (N 8/0) soft lime segregations; common slightly hard to

hard lime concretions; moderately alkaline; clear, broken boundary.

C3ca—43 to 50 inches, stratified white (N 8/0) and pinkish-gray (7.5YR 7/2) gravelly sandy loam, pink (7.5YR 7/4) and dark brown (7.5YR 4/4) when moist; massive; very hard when dry, firm when moist, non-sticky and nonplastic when wet; few fine tubular pores; violently effervescent.

Depth to the Cca horizon ranges from 14 to 30 inches. In the A1 horizon hue is 7.5YR or 10YR, value is 5 to 7 dry and 4 or 5 moist, and chroma is 2 to 4. The A1 horizon is dominantly gravelly sandy loam and sandy loam. Content of lime nodules in the surface layer ranges from few to none.

In the C1 and C2ca horizons hue is dominantly 7.5YR or 10YR, value is 5 to 8 dry and 4 to 7 moist, and chroma is 2 to 4. The C1 and C2 horizons are fine sandy loam, loam, or silt loam. In some places the Cca horizon extends to a depth of 6 feet or more and has limy, but less nodular, material below a depth of 3 feet. The Cca horizon is weakly cemented in places. Size and content of lime nodules in the Cca horizon varies from few, fine to many, medium and coarse.

Latene gravelly sandy loam (Lc).—This nearly level to gently sloping soil is on alluvial fans or plains that are dissected by numerous long shallow drainageways. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Anthony and Mohave sandy loams on the fan tops and Vekol loam in swales. These included soils make up about 10 percent of the acreage.

Runoff is slow on this soil. The hazard of erosion is slight.

This soil is used mainly for range, wildlife habitat, and watershed catchment areas. Capability unit VIIc-1; Loam Upland range site, 8- to 12-inch precipitation zone; wildlife group 2.

Latene-Mohave complex (Lc).—This complex is about 55 percent Latene gravelly sandy loam and 35 percent Mohave sandy loam. These soils are in an intricate pattern on nearly level to undulating fans. The Latene soil is on low ridgetops or higher lying areas, and the Mohave soil is on side slopes and in swales where slopes generally are less than 3 percent.

Included with these soils in mapping, and making up about 10 percent of the acreage, are small areas of Anthony sandy loam and narrow areas of Vekol loam. The Anthony soil is on the fan tops and the Vekol soil is in swales.

Runoff is slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. Capability unit VIIc-1; Loam Upland range site, 8- to 12-inch precipitation zone; wildlife group 2.

Lehmans Series

The Lehmans series consists of shallow, well-drained soils that are underlain by bedrock at a depth of 10 to 20 inches. These soils formed in material weathered from andesite or related tuff and agglomerate. They are in areas where there are moderately sloping to very steep hills or mountains. Slopes range from 8 to 60 percent. Elevation ranges from 1,800 to 4,000 feet. The vegetation is desert shrubs and cactuses and an understory of scattered grasses. Annual precipitation is 8

to 11 inches. The average annual air temperature is about 65° F, and the frost-free period is 200 to 250 days.

In a representative profile the surface layer is brown gravelly clay loam about 1 inch thick. The subsoil is reddish-brown and brown gravelly clay and clay about 13 inches thick. It is underlain by pale-red extremely hard andesite or tuffaceous agglomerate.

Permeability is slow. Available water capacity is low, and the effective rooting depth is less than 20 inches.

These soils are used mainly for seasonal grazing, mining, wildlife habitat, and watershed catchment areas.

Representative profile of Lehmans gravelly clay loam, 8 to 45 percent slopes, 0.24 mile S. and 0.12 mile E. of the NW. corner, sec. 22, T. 8 N., R. 1 W.:

A1—0 to 1 inch, brown (7.5YR 5/2) gravelly clay loam, dark brown (7.5YR 3/2) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist, sticky and plastic when wet; common fine roots; many fine interstitial pores; moderately alkaline; abrupt, wavy boundary.

B21t—1 to 8 inches, reddish-brown (5YR 5/3) gravelly clay, reddish brown (5YR 4/4) when moist; moderate, medium and fine, subangular blocky structure; very hard when dry, friable when moist, sticky and plastic when wet; common very fine and few coarse roots; few fine tubular pores and common fine interstitial pores; many thin clay films on ped faces and in pores; neutral; clear, wavy boundary.

B22t—8 to 14 inches, brown (7.5YR 5/4) light clay, dark brown (7.5YR 4/4) when moist; weak, medium, subangular blocky structure; hard when dry, firm when moist, sticky and plastic when wet; common very fine roots; very few fine tubular pores and common fine interstitial pores; common thin clay films on ped faces and in pores; neutral; abrupt, wavy boundary.

R—14 to 16 inches, pale-red (10R 6/4), reddish-gray (10R 5/1), and red (10R 5/6) massive, extremely hard andesite.

Depth to bedrock ranges from 10 to 20 inches but is dominantly 14 to 18 inches. Coarse fragments range from gravel to stone size and from 10 to 30 percent by volume.

In the A horizon hue is 10YR to 5YR but is dominantly 7.5YR. Value is 4 to 6 dry and 3 or 4 moist. Chroma is 2 to 6. In the B2t horizon hue is 7.5YR to 2.5YR but is dominantly 5YR and 7.5YR. Value is 4 or 5 dry and 3 to 5 moist. Chroma is 3 to 6. The B2t horizon is gravelly heavy clay loam, clay, and gravelly clay.

Lehmans gravelly clay loam, 8 to 45 percent slopes (Le).—This soil is on andesite, tuff, or agglomerate hills and mountains that are dissected by numerous steep-sided drainageways. It has the profile described as representative of the series.

Included with this soil in mapping are areas where rock outcrops and stones are common. Also included are deep, colluvial soils on the lower parts of side slopes and coarse-textured alluvial soils in the drainageways. These included soils make up about 10 percent of the acreage.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, mining, and watershed catchment areas. Capability unit VIIe-1; Loam Hills range site, 8- to 12-inch precipitation zone; wildlife group 4.

Lehmans extremely rocky clay loam, 8 to 60 percent slopes (Lh).—This soil is on andesite, tuff, or agglomerate hills and mountains that are dissected by numerous short drainageways and a few long drainageways that have steep sides. About 40 percent of the acreage is rock outcrops and exposures of tuff and agglomerate.

Included with these soils in mapping, and making up about 10 percent of the acreage, are deep colluvial soils on the lower parts of side slopes and coarse-textured alluvial soils in the drainageways.

Runoff is medium to rapid on these soils. The hazard of erosion is moderate to high.

These soils are used for range, wildlife habitat, mining, and watershed catchment areas. Capability unit VII_s-1; Loam Hills range site, 8- to 12-inch precipitation zone, wildlife group 4.

Loamy Alluvial Land

Loamy alluvial land consists of stratified, gravelly, medium-textured soils that are underlain by moderate to shallow, stratified gravelly loamy sand and sand. This material is in and adjacent to shallow drainageways. The alluvium weathered from a wide variety of rocks but is dominantly acid igneous material. Areas are rarely flooded, and then only for short periods.

Permeability is moderate. Available water capacity is low to moderate. Effective rooting depth is 60 inches or more.

This land type is used for limited grazing, wildlife habitat, and watershed.

This land type is mapped only in association with Continental soils. Capability unit VII_w-1; Loam Bottoms range site, 8- to 12-inch precipitation zone; wildlife group 1.

Lonti Series

The Lonti series consists of deep, well-drained soils. These soils formed in mixed alluvium weathered from granite, schist, basalt, and sandstone. Lonti soils are on nearly level plains to very steep alluvial fans. Slopes range from 0 to 60 percent. Elevation ranges from 4,000 to 5,500 feet. The vegetation is grass, brush, and some pinyon pine and juniper at higher elevations. Annual precipitation is 12 to 20 inches. The average annual air temperature is 52° to 57° F, and the frost-free period is 140 to 200 days.

In a representative profile the surface layer is grayish-brown gravelly sandy loam about 2 inches thick. The subsoil is dark-brown gravelly sandy clay loam and reddish-brown gravelly clay and gravelly clay loam about 43 inches thick. The substratum is pink and light reddish-brown gravelly sandy clay loam to a depth of 68 inches or more.

Permeability is slow. Available water capacity is high, and the effective rooting depth is more than 60 inches.

These soils are used mainly for range, wildlife habitat, recreation, and watershed catchment areas. Limited acreages of Lonti soils are used for irrigated crops in the Chino Valley area. Small areas have been subdivided for use as homesites and for small commercial buildings.

Representative profile of Lonti gravelly sandy loam, 0 to 8 percent slopes, from an area of Lonti-Abra gravelly sandy loams, 0 to 8 percent slopes, 0.5 mile W. and 0.3 mile N. of the SE. corner, sec. 3, T. 15 N., R. 4 W.:

- A1—0 to 2 inches, grayish-brown (10YR 5/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium and thick, platy structure; slightly hard when dry, very friable when moist; slightly sticky and slightly plastic when wet; common very fine and fine roots; many very fine and fine vesicular pores; neutral; clear, wavy boundary.
- B1t—2 to 5 inches, dark-brown (10YR 3/3) dry and moist, gravelly sandy clay loam; moderate, very fine and fine, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; many very fine and fine roots; many fine and very fine interstitial pores and common very fine and fine tubular pores; few thin clay films on ped faces; neutral; clear, wavy boundary.
- B21t—5 to 10 inches, reddish-brown (5YR 4/3) gravelly light clay, reddish brown (5YR 4/4) when moist; weak, fine and medium, subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; many very fine and fine roots; common fine interstitial pores; common thin clay films on ped faces; slightly acid; clear, smooth boundary.
- B22t—10 to 26 inches, reddish-brown (5YR 4/4) gravelly light clay, dark reddish brown (5YR 3/4) when moist; moderate, medium, subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; common fine and medium roots; common very fine and fine tubular pores and many fine interstitial pores; common moderately thick clay films on ped faces; many pressure faces; slightly acid; clear, wavy boundary.
- B3t—26 to 45 inches, reddish-brown (5YR 5/4) gravelly clay loam, reddish brown (5YR 4/4) when moist; weak, medium, subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; few fine and very fine roots; few very fine and fine tubular pores and common fine interstitial pores; common moderately thick clay films on ped faces; common pressure faces; moderately alkaline; gradual, wavy boundary.
- C1ca—45 to 55 inches, pink (5YR 7/3) gravelly sandy clay loam, yellowish red (5YR 5/6) when moist; massive; very hard when dry, firm when moist, slightly sticky and plastic when wet; few fine and very fine roots; very few fine tubular pores and common fine interstitial pores; few pressure faces; slightly effervescent in matrix but violently effervescent in common, medium, prominent, white (10YR 8/1), soft lime segregations; moderately alkaline; gradual, irregular boundary.
- C2ca—55 to 68 inches, light reddish-brown (5YR 6/4) very gravelly sandy clay loam, reddish brown (5YR 5/4) when moist; massive; hard when dry, friable when moist, sticky and plastic when wet; few fine roots; common fine tubular pores and many interstitial pores; noneffervescent in matrix but strongly effervescent in common, medium, prominent, white (10YR 8/1), soft lime segregations; moderately alkaline.

Depth to the Cca horizon ranges from 18 to 45 inches. Content of coarse fragments averages from 15 to 35 percent by volume. Reaction ranges from slightly acid to neutral in the A1 and B1t horizons, from slightly acid to moderately alkaline in the B2t horizon, and from mildly alkaline to moderately alkaline in the B3t and Cca horizons.

In the A and B1t horizons, hue ranges from 5YR to 10YR but is dominantly 7.5YR or 10YR. Value is 3 to 5 dry and 3 or 4 moist. The A horizon is gravelly sandy loam, sandy loam, gravelly loam, and cobbly loam.

In the B2t horizon hue is 5YR or 7.5YR, value is 4 and 5 dry, and chroma is 3 to 6. The B2t horizon is heavy clay loam, gravelly clay loam, clay, and gravelly clay. Structure of the

B2t horizon is medium and fine, subangular blocky to medium prismatic.

The Cca horizon ranges from gravelly clay loam or gravelly sandy clay loam to very gravelly sandy clay loam. In some places below a depth of 40 inches, the profile is gravelly or very gravelly loamy sand. Lime occurs as medium to large soft segregations.

Lonti gravelly sandy loam, 15 to 30 percent slopes (LkD).—This soil is on old fans that are dissected by numerous drainageways.

Included with this soil in mapping are narrow areas of Lynx loam and Cordes sandy loam along the drainageways. Also included are areas of Lonti gravelly sandy loam that has 8 to 15 percent slopes and moderately eroded soils that have 20 to 30 percent slopes. These included soils make up about 10 percent of the acreage.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, recreation, and watershed catchment areas. Capability unit VIe-1; Loam Upland range site, 12- to 16-inch precipitation zone; wildlife group 8.

Lonti gravelly sandy loam, high rainfall, 0 to 15 percent slopes (LlC).—This soil is on alluvial fans that are dissected by numerous long drainageways. It has a profile similar to the one described as representative of the series, but it receives about 18 to 20 inches annual precipitation. The vegetation is ponderosa pine.

Included with this soil in mapping are small areas of Lynx loam and Cordes sandy loam in the drainageways. Also included are areas of a moderately deep, fine-textured soil that is underlain by sandstone. These included soils make up about 10 percent of the acreage.

Runoff is slow to medium on this soil. The hazard of erosion is moderate.

This soil is used for trees, wildlife habitat, and watershed catchment areas. Capability unit VIe-2; timber group 1; wildlife group 11.

Lonti gravelly sandy loam, high rainfall, 15 to 30 percent slopes (LlD).—This soil is on alluvial fans that are dissected by long drainageways and have moderately steep sides. It has a profile similar to the one described as representative of the series, but it receives about 18 to 20 inches annual precipitation. The vegetation is ponderosa pine and an understory of grass.

Included with this soil in mapping are areas of a moderately deep clayey soil that has a surface layer of gravelly sandy loam and is underlain by sandstone bedrock. Also included are narrow areas of Lynx loam in the drainageways. These included soils make up about 20 percent of the acreage.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for trees, wildlife habitat, and watershed catchment areas. Capability unit VIe-2; timber group 1; wildlife group 11.

Lonti gravelly loam, 0 to 8 percent slopes (LmB).—This soil is on old fans that are dissected by a few shallow drainageways and moderately deep drainageways. It has a profile similar to the one described as representative of the series, but the surface layer is gravelly loam.

Included with this soil in mapping are small areas of Lonti cobbly loam that has 8 to 15 percent slopes, Abra gravelly loam that has 0 to 8 percent slopes, and Lynx loam that has 0 to 8 percent slopes. The Lynx loam is in narrow areas along the drainageways.

Runoff is slow on this soil. The hazard of erosion is slight.

This soil is used for range, wildlife habitat, and watershed catchment areas. A few small areas have been subdivided for use as homesites. Capability unit VIe-1; Loam Upland range site, 12- to 16-inch precipitation zone; wildlife group 8.

Lonti cobbly loam, 0 to 15 percent slopes (LnC).—This soil is on old fans that are dissected by numerous long drainageways. It has a profile similar to the one described as representative of the series, but the surface layer is cobbly loam.

Included with this soil in mapping are small areas of Abra soil, Wineg soil, and Lonti gravelly sandy loam that has 0 to 15 percent slopes. Also included are narrow bodies of Lynx loam and Cordes sandy loam along the drainageways. These included soils make up about 15 percent of the acreage.

Runoff is slow to medium on this soil. The hazard of erosion is slight to moderate.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIe-1; Loam Upland range site, 12- to 16-inch precipitation zone; wildlife group 8.

Lonti cobbly loam, 30 to 60 percent slopes (LnF).—This soil is on fans that are deeply dissected by drainageways that have steep sides. It has a profile similar to the one described as representative of the series, but it has a surface layer of cobbly loam, is steep and very steep, and depth to the limy substratum is 18 to 26 inches.

Included with this soil in mapping are areas of Lonti cobbly loam that has 15 to 30 percent slopes and small areas of eroded, calcareous soil material. These included areas make up about 10 percent of the acreage.

Runoff is rapid on this soil. The hazard of erosion is high.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIIe-1; Loam Upland range site, 12- to 16-inch precipitation zone; wildlife group 8.

Lonti complex, 2 to 30 percent slopes (LoD).—This complex is about 60 percent Lonti sandy loam that has slopes of 2 to 15 percent and about 30 percent Lonti cobbly loam that has slopes of 15 to 30 percent. These soils are in an intricate pattern on gently sloping to moderately steep old alluvial fans or terraces that are dissected by numerous drainageways.

Included with these soils in mapping are small areas of Abra gravelly sandy loam and Lonti cobbly loam that have 30 to 45 percent slopes. These included soils make up about 10 percent of the acreage.

Runoff is slow to medium on these soils. The hazard of erosion is moderate.

These soils are used for range, wildlife habitat, and watershed catchment areas. Capability unit VIe-1; Loam Upland range site, 12- to 16-inch precipitation zone; wildlife group 8.

Lonti-Abra gravelly sandy loams, 0 to 8 percent slopes (LpB).—This complex is about 50 percent Lonti gravelly sandy loam and 35 percent Abra gravelly sandy loam. These soils are in an intricate pattern on nearly level to gently rolling plains that are dissected by a few long, shallow drainageways and moderately deep drainageways and swales. The profile described as representative of the series is in an area of these soils.

Included with these soils in mapping are small scattered areas of Wineg and Balon gravelly sandy loams in depressions and Lynx loam in the drainageways. These included soils make up about 15 percent of the acreage.

Runoff is slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VI_s-1. Lonti part is Loam Upland range site, 12- to 16-inch precipitation zone; Abra part in Limy Upland range site, 12- to 16-inch precipitation zone. Lonti part in wildlife group 8; Abra part in wildlife group 7.

Lonti-Abra complex, 8 to 30 percent slopes (LrD).—This complex is about 50 percent Lonti gravelly loam that has slopes of 8 to 30 percent and about 35 percent Abra gravelly sandy loam that has slopes of 8 to 15 percent. These soils are in an intricate pattern on strongly sloping to moderately steep alluvial fans that are dissected by numerous long drainageways that have moderately steep sides. The Abra soil is on the ridgetops and scattered higher lying areas.

Included with these soils in mapping are areas of Springerville and Lonti gravelly clay loams that have slopes of 2 to 8 percent, and Lynx clay loam in the drainageways. These included soils make up about 15 percent of the acreage.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VI_e-1. Lonti part in Loam Upland range site, 12- to 16-inch precipitation zone; Abra part in Limy Upland range site, 12- to 16-inch precipitation zone. Lonti part in wildlife group 8; Abra part in wildlife group 7.

Lonti-Pastura complex, 0 to 20 percent slopes (LsC).—This complex is about 55 percent Lonti gravelly loam and 35 percent Pastura gravelly loam. These soils are in an intricate pattern on undulating to hilly alluvial fans that are dissected by a few long drainageways and numerous short drainageways that have moderately steep sides.

Included with these soils in mapping, and making up about 10 percent of the acreage, are areas of Lonti gravelly sandy loam that has slopes of 0 to 8 percent, Lonti cobbly loam that has slopes of 8 to 20 percent, and Lynx loam in the drainageways.

Runoff is slow to medium on these soils. The hazard of erosion is slight to moderate.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VI_e-1. Lonti part in Loam Upland range site, 12- to 16-inch precipitation zone; Pastura part in Limy Hills range site, 12- to 16-inch precipitation zone. Lonti

part in wildlife group 8; Pastura part in wildlife group 5.

Lonti-Cordes association, undulating (LrB).—This association is about 55 percent Lonti gravelly sandy loam and 35 percent Cordes sandy loam. The Lonti gravelly sandy loam is on gently rolling ridges and the Cordes sandy loam is in nearly level drainageways. Dominant slopes are less than 8 percent.

Included with these soils in mapping, and making up about 10 percent of the acreage, are areas of Abra and Wineg gravelly sandy loam and Lynx loam. The Abra and Wineg soils are in scattered areas on the ridges, and Lynx soil is in the drainageways.

Runoff is slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VI_s-1. Lonti part in Loam Upland range site, 12- to 16-inch precipitation zone; Cordes part in Loam Bottoms range site, 12- to 16-inch precipitation zone. Lonti part in wildlife group 8; Cordes part in wildlife group 6.

Lonti-Wineg complex, 3 to 15 percent slopes (LuC).—This complex is about 50 percent Lonti gravelly sandy loam and 35 percent Wineg sandy loam. These soils are in an intricate pattern on undulating to rolling plains that are dissected by a few long drainageways and many short drainageways that have moderately sloping sides.

Included with these soils in mapping are small areas of Abra gravelly loam, areas of Lonti cobbly loam, and exposures of limy materials on moderately steep breaks. Also included are small narrow areas of Lynx loam in the drainageways. These included soils make up about 15 percent of the acreage.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VI_e-1. Lonti part in Loam Upland range site, 12- to 16-inch precipitation zone; Wineg part in Limy Upland range site, 12- to 16-inch precipitation zone. Lonti part in wildlife group 8; Wineg part in wildlife group 7.

Lonti-Rock land association, hilly (LvE).—This association is about 55 percent Lonti gravelly loam that has 2 to 15 percent slopes and 35 percent Rock land. The soils in this complex are gently to strongly sloping on fans that are dissected by numerous drainageways that have 15 to 40 percent side slopes. The Rock land areas are on the exposed steep side slopes and are 50 to 90 percent rock outcrops and very shallow limy soil material.

Included with these soils in mapping, and making up about 10 percent of the acreage, are small areas of Wineg sandy loam that has slopes of 2 to 8 percent and Lonti cobbly and very stony loams that have slopes of 8 to 30 percent.

Runoff is medium to rapid on these soils. The hazard of erosion is slight to moderate.

These soils are used for range, wildlife habitat, and watershed catchment areas. Lonti part in capability unit VI_e-1, Rock land part in capability unit VII_s-1.

Lonti part in Loam Upland range site, 12- to 16-inch precipitation zone; Lonti part in wildlife group 8.

Luzena Series

The Luzena series consists of shallow, well-drained soils that formed in place on bedrock. These soils are on gently sloping to very steep andesite, rhyolite, and related tuff and agglomerate hills and mountains. Slopes range from 0 to 60 percent but are dominantly 0 to 30 percent. Elevation ranges from 4,000 to 6,200 feet. The vegetation is dominantly grass and some brush. Juniper is dominant at the higher elevation in the northern part of the survey area. Annual precipitation is 12 to 18 inches. The average annual air temperature is 50° to 57° F, and the frost-free period is 160 to 220 days.

In a representative profile the surface layer is grayish-brown very stony loam about 3 inches thick. The subsoil is dark grayish-brown and brown gravelly clay about 11 inches thick. It is underlain by light-gray massive agglomerate, andesite, or rhyolite.

Permeability is slow, Available water capacity is low, and the effective rooting depth is less than 20 inches.

These soils are used for range, wildlife habitat, and watershed catchment areas.

Representative profile of Luzena very stony loam in an area of Luzena very rocky loam, 10 to 30 percent slopes, 100 feet N. of the N $\frac{1}{4}$ corner, sec. 36, T. 12 N., R. 4 W.:

A1—0 to 3 inches, grayish-brown (10YR 5/2) very stony loam, very dark brown (10YR 2/2) when moist; moderate, very fine and fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common very fine and fine roots; many fine interstitial pores and few very fine tubular pores; mildly alkaline; clear, wavy boundary.

B21t—3 to 7 inches, dark grayish-brown (10YR 4/2) gravelly clay, dark brown (10YR 3/3) when moist; weak, fine and medium, subangular blocky structure; hard when dry, friable when moist, slightly sticky and plastic when wet; many very fine and fine roots; common very fine interstitial pores and tubular pores; few very fine and fine pores; coarse fragments include gravel and cobbles; mildly alkaline; clear, wavy boundary.

B22t—7 to 14 inches, brown (7.5YR 4/2) gravelly clay, dark brown (7.5YR 3/2) when moist; moderate, medium and coarse, subangular blocky structure; very hard when dry, firm when moist, slightly sticky and plastic when wet; common fine and very fine roots; few very fine interstitial pores and tubular pores; common moderately thick clay films on ped faces; moderately alkaline; abrupt, irregular boundary.

R—14 to 17 inches, light-gray (10YR 6/1) massive andesite that has coatings of yellowish brown (10YR 5/6).

Thickness of the solum and depth to bedrock range from 7 to 20 inches. Content of coarse fragments in the Bt horizon is less than 35 percent by volume.

In the A horizon hue is 7.5YR or 10YR, value is 4 and 5 dry and 2 and 3 moist, and chroma is 2 and 3. The A horizon is gravelly, cobbly, or very stony loam or fine sandy loam in places. In the B2t horizon hue is 7.5YR or 5YR but ranges to 10YR. The B2t horizon is gravelly or cobbly heavy clay loam, clay, gravelly clay, or cobbly clay.

Luzena cobbly loam, 0 to 30 percent slopes (LwD).—This soil is mostly strongly sloping and moderately

steep on andesite hills, but it ranges to nearly level in places. It has a profile similar to the one described as representative of the series, but the surface layer is cobbly loam.

Included with this soil in mapping are small areas of rock outcrops, tuffaceous agglomerate exposures, and Faraway very rocky soils. Also included are narrow areas of Cordes sandy loam and areas of Lynx loam along drainageways. These included soils make up about 10 percent of the acreage.

Runoff is medium to rapid on this soil. The hazard of erosion is moderate.

These soils are used for range, wildlife habitat, and watershed catchment areas. Capability unit VIe-1; Clay Loam Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Luzena very rocky loam, 10 to 30 percent slopes (LxD).—This complex is on andesite or agglomerate hills that are dissected by a few long drainageways and many short drainageways that have steep sides. About 60 percent of this complex is Luzena very stony loam, and 25 percent is rock outcrops. The profile described as representative of the series is in an area of this soil. Included in mapping, and making up about 15 percent of the acreage, are areas of deep clay soils and Faraway soils.

Runoff is medium to rapid. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIi-1; Clay Loam Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Lynx Series

The Lynx series consists of deep, well-drained soils. These soils formed in mixed recent alluvium weathered from granite, schist, basalt, sandstone, limestone, and related rocks. They are nearly level to gently sloping on flood plains, fans, and in swales. Slopes range from 0 to 5 percent. Elevation ranges from 4,000 to 6,000 feet. The vegetation is grass. Annual precipitation is 12 to 20 inches. The average annual air temperature is 51° to 57° F, and the frost-free period is 140 to 220 days.

In a representative profile the surface layer is grayish-brown loam about 2 inches thick. Below this, and extending to a depth of 68 inches or more, is brown or dark grayish-brown clay loam (fig. 6). The soil is stratified with thin layers of fine gravel in places.

Permeability is moderately slow. Available water capacity is high, and the effective rooting depth is more than 60 inches.

These soils are used mainly for range, wildlife habitat, recreation, and watershed catchment areas. If adequate water is available, irrigated crops are grown in the Big Chino area and along the larger streams.

Representative profile of Lynx loam, from an area of Lynx soils, approximately 0.5 mile NW. of Dewey on State Highway 69 in sec. 3, T. 13 N., R. 1 E.:

A11—0 to 2 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; mod-

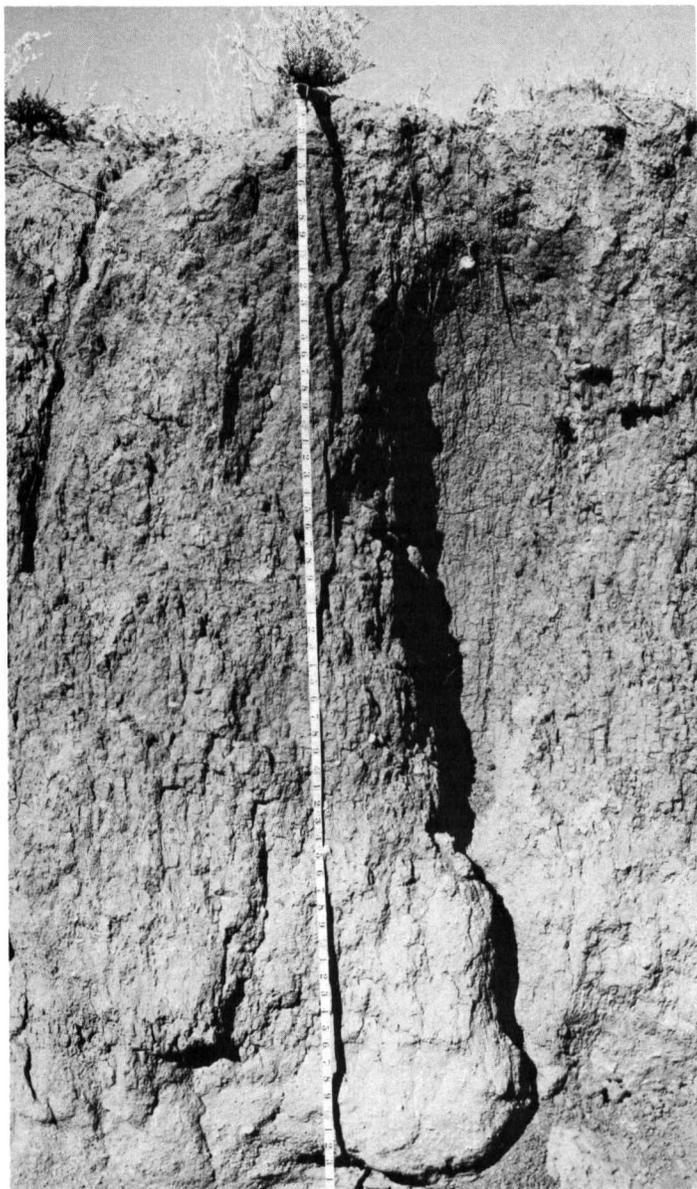


Figure 6.—Profile of Lynx loam. This soil is nearly 6 feet thick over the underlying gravelly material.

erate, medium to thick, platy structure parting to moderate, fine, granular; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; many fine roots; many fine vesicular pores; neutral; clear, wavy boundary.

A12—2 to 14 inches, brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) when moist; weak, medium to thick, platy structure; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; many fine and medium roots; many fine and medium tubular pores; neutral; clear, wavy boundary.

A13—14 to 68 inches, dark grayish-brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) when moist; weak, fine, subangular blocky structure; slightly hard when dry, friable when moist, sticky and plastic when wet; few fine and medium roots; many fine, medium, and large tubular pores; common small pressure faces; mildly alkaline.

Content of coarse fragments generally is less than 15 percent by volume. Reaction ranges from neutral to moderately alkaline.

Lime filaments or segregations are present in the lower part of the A horizon in places. The A horizon has chroma of 2 and 3. The A11 horizon is loam, fine sandy loam, or clay loam that is modified by gravel in some places. The A12 and A13 horizons range from heavy loam or heavy silt loam to light clay loam.

Lynx soils (Ly).—These soils consist of Lynx loam and Lynx clay loam. They are along the nearly level bottoms of larger drainageways and on gently sloping alluvial fans. Lynx loam has the profile described as representative of the series. Slopes are dominantly less than 5 percent.

Included with these soils in mapping, and making up about 15 percent of the acreage, are areas of Cordes sandy loam and very gravelly alluvial soils.

Runoff is slow to medium on these soils. The hazard of erosion is slight.

These soils are used for range, irrigated crops, building sites, recreational areas, wildlife habitat, and watershed catchment areas. A number of homesites are on these soils in the Miller Valley and Forbing Park areas. Parts of Prescott College, Yavapai Junior College, and parts of the Whipple and Willow Creek recreation parks are on these soils. Capability unit VIc-1; Loam Bottoms range site, 12- to 16-inch precipitation zone; wildlife group 6.

Lynx soils, eroded (Ly2).—These soils are on undulating or gently rolling plains that are dissected by numerous shallow gullies, moderately deep gullies, and deep gullies. They have a profile similar to the one described as representative of the series, but they are severely gullied and are more calcareous.

Included with these soils in mapping are scattered areas of calcareous, slope-washed material. This material is derived from the adjacent lakebed sediment and consists mostly of clay loam. Also included are low mounds of exposed, calcareous lakebed materials that are mostly loam or clay loam. These included areas make up about 20 percent of the acreage.

Runoff is medium to rapid on these soils. The hazard of erosion is high.

These soils are used for range, wildlife habitat, and watershed catchment areas. Capability unit VIe-1; Loam Bottoms range site, 12- to 16-inch precipitation zone; wildlife group 6.

Lynx Series, Wet Variant

The Lynx soils, wet variant, consist of deep, somewhat poorly drained soils. These soils formed in mixed recent alluvial material weathered from granite, schist, basalt, sandstone, limestone, and related rock. They are on nearly level flood plains and in swales. Slopes range from 0 to 1 percent. Elevation ranges from 4,000 to 6,000 feet. The vegetation is sedges and rushes and scattered shrubs. Annual precipitation is 12 to 16 inches. The average annual air temperature is 51° to 57° F, and the frost-free period is 140 to 220 days.

In a representative profile the surface layer is grayish-brown loam about 5 inches thick. Below this is dark-gray, gray, and grayish-brown light clay loam that

extends to a depth of 60 inches. It is underlain by brown sandy clay loam that is 12 inches or more thick.

Permeability is moderately slow. Available water capacity is high, and the effective rooting depth is more than 60 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Representative profile of Lynx loam, wet variant, from an area of Lynx soils, wet variant, 0.25 mile S. and 0.12 mile W. of the NE. corner, sec. 13, T. 11 N., R. 5 W.:

A11—0 to 5 inches, grayish-brown (10YR 5/2) loam, very dark brown (10YR 2/2) when moist; strong, fine and medium, subangular blocky structure; hard when dry, firm when moist, slightly sticky and plastic when wet; many fine, medium, and coarse roots; many very fine interstitial pores; moderately alkaline; clear, smooth boundary.

A12—5 to 16 inches, dark-gray (10YR 4/1) light clay loam, black (10YR 2/1) when moist; weak, fine and medium, subangular blocky structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common very fine, fine, and medium roots; many very fine and fine tubular pores; slightly effervescent; moderately alkaline; abrupt, smooth boundary.

A13—16 to 21 inches, gray (10YR 5/1) light clay loam, very dark grayish brown (10YR 3/2) when moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common very fine, fine, and medium roots; many very fine and fine tubular pores; strongly effervescent; moderately alkaline; abrupt, smooth boundary.

A14—21 to 60 inches, grayish-brown (10YR 5/2) light clay loam, dark brown (10YR 3/3) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common very fine, fine, and medium roots; many very fine and fine tubular pores; strongly effervescent; mildly alkaline; gradual, smooth boundary.

A15—60 to 72 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common very fine, fine, and medium roots; common very fine and fine tubular pores; moderately alkaline; abrupt, smooth boundary.

Lime filaments or segregations are present in the lower part of the A horizon in places. In the A horizon hue is 10YR or 7.5YR but is dominantly 10YR. The A11 horizon is loam or silt loam. Underlying the A11 horizon is heavy loam, light clay loam, and sandy clay loam.

Lynx soils, wet variant (Lz).—The Lynx soils, wet variant, are on nearly level flood plains and in swales. These soils are subject to intermittent flooding and seepage from adjacent higher lying areas. They are wet for significant periods, and the water table is at a depth of 2 to 3 feet during these periods.

Included with these soils in mapping, and making up about 15 percent of the acreage, are areas of Cordes sandy loam, generally at slightly higher elevations.

Runoff is very slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. Capability unit Vw-1; Loam Bottoms range site, 12- to 16-inch precipitation zone; wildlife group 6.

Mirabal Series

The Mirabal series consists of well-drained soils that are shallow over bedrock. These soils formed in place in material weathered from granite or gneiss. They are in areas where there are strongly sloping to steep mountains. Slopes range from 5 to 60 percent. Elevation ranges from 6,000 to 8,000 feet. The vegetation is a mixed stand of ponderosa pine, Gambel oak, and Douglas-fir and an understory of grass. Annual precipitation is 18 to 25 inches. The average annual air temperature is about 43°F, and the frost-free period is 130 to 170 days.

In a representative profile the surface layer is grayish-brown gravelly sandy loam about 5 inches thick that is slightly acid. The next layer is light-gray gravelly sandy loam about 9 inches thick that is slightly acid. It is underlain by yellowish-brown weathered granite that grades into unweathered granite at a variable depth.

Permeability is moderately rapid. Available water capacity is low, and the effective rooting depth is 10 to 20 inches.

These soils are used mainly for trees, wildlife habitat, recreation, mining, and watershed catchment areas. Small areas have been subdivided for sites for homes and summer cabins. Mining is mainly for gold, silver, and copper.

Representative profile of Mirabal gravelly sandy loam, 20 to 60 percent slopes, NW¼ sec. 36, T. 9 N., R. 1 W.:

O1—1 inch to 0, partly decomposed pine needles, abrupt, smooth boundary.

A1—0 to 5 inches, grayish-brown (10YR 5/2) gravelly sandy loam, dark brown (10YR 3/3) when moist; weak, fine and medium, granular structure; slightly hard, very friable, nonsticky and slightly plastic; common fine, medium, and coarse roots; many fine and medium interstitial pores; slightly acid; clear, smooth boundary.

C1—5 to 14 inches, light-gray (10YR 7/2) gravelly sandy loam, dark brown (10YR 4/3) when moist; massive; slightly hard, very friable, nonsticky and slightly plastic; many fine, medium, and coarse roots; many fine and medium interstitial pores; common to many pebbles and cobbles; slightly acid; clear, wavy boundary.

C2—14 to 29 inches, yellowish-brown (10YR 5/8) moist and dry, weathered granite (grus); massive.

Depth to weathered granite ranges from 10 to 30 inches; depth to unweathered bedrock is variable but averages more than 20 inches.

The A horizon is gravelly, very gravelly, stony, and very stony sandy loam or loam. Reaction in the A1 horizon ranges from medium acid to neutral. In the A horizon value is 4 to 6 dry and 3 or 4 moist, and chroma is 2 or 3. In the C horizon value is 5 to 8 dry and 4 to 6 moist, and chroma is 2 to 8.

Mirabal gravelly sandy loam, 8 to 20 percent slopes (MbC).—This soil is on hills or mountains that are dissected by numerous short drainageways and a few long drainageways.

Included with this soil in mapping, and making up about 20 percent of the acreage, are areas of rock outcrops, areas of Dandrea gravelly loam, and narrow areas of coarse-textured recent soils in the drainageways.

Runoff is medium to rapid on this soil. The hazard of erosion is moderate to high.

This soil is used for trees, wildlife habitat, recreation, mining, and watershed catchment areas. Capability unit VIe-2; timber group 1; wildlife group 11.

Mirabal gravelly sandy loam, 20 to 60 percent slopes (MbF).—This soil is on mountainous areas that are dissected by numerous short drainageways and a few long drainageways. It has the profile described as representative of the series.

Included with this soil in mapping, and making up about 20 percent of the acreage, are areas of Dandrea gravelly loam, areas of rock outcrops, and narrow areas of coarse-textured, recent alluvial soils in the drainageways.

Runoff is rapid on this soil. The hazard of erosion is high.

This soil is used for trees, wildlife habitat, recreation, mining, and watershed catchment areas. Capability unit VIIe-2; timber group 1; wildlife group 11.

Mirabal-Dandrea complex, 20 to 60 percent slopes (MdF).—This complex is about 55 percent Mirabal gravelly sandy loam and 35 percent Dandrea gravelly loam. These soils are in an intricate pattern on moderately steep to very steep hills and mountains that are dissected by numerous short drainageways and a few long drainageways.

Included with these soils in mapping, and making up about 10 percent of the acreage, are areas of rock outcrops, very stony areas, areas of Mirabel gravelly sandy loam, and areas of Dandrea gravelly sandy loam that has slopes of 8 to 15 percent.

Runoff is medium on these soils. The hazard of erosion is high.

These soils are used for trees, wildlife habitat, recreation, mining, and watershed catchment areas. Both parts in capability unit VII-2. Mirabal part in timber group 1; Dandrea part in timber group 1. Both parts in wildlife group 11.

Moano Series

The Moano series consists of well-drained soils that are very shallow and shallow over schist. These soils formed in place on gently sloping to very steep hills. Slopes range from 0 to 60 percent. Elevation ranges from 4,000 to 5,500 feet. The vegetation at higher elevations is brush and an understory of grass. At the lower elevations grasses are dominant. Annual precipitation is 12 to 16 inches. The average annual air temperature is 50° to 57° F, and the frost-free period is 140 to 200 days.

In a representative profile the surface layer is brown gravelly loam about 3 inches thick. The next layer is brown gravelly heavy loam about 6 inches thick. It is underlain by olive-brown schist.

Permeability is moderate. Available water capacity is low, and the effective rooting depth is less than 20 inches.

These soils are used mainly for range, wildlife habitat, mining, and watershed catchment areas. The underlying rock is used for building stone in limited amounts.

Representative profile of Moano gravelly loam, 0 to 30 percent slopes, 0.2 mile E. and 0.1 mile S. of the NW. corner, sec. 23, T. 12 N., R. 1 E.:

A1—0 to 3 inches, brown (7.5YR 4/4) gravelly loam, dark brown (7.5YR 3/2) when moist; moderate, very fine and fine, granular structure; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; common very fine and fine roots; many fine interstitial pores; neutral; clear, irregular boundary.

C—3 to 9 inches, brown (7.5YR 4/4) gravelly heavy loam, brown (7.5YR 4/4) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; many fine and medium and few coarse roots; many fine interstitial pores; moderately alkaline; clear, irregular boundary.

R1—9 to 14 inches, olive (5Y 4/4) to olive-brown (2.5Y 4/4), hard, slightly weathered schist.

R2—14 to 16 inches, pale-yellow (2.5YR 7/4), extremely hard schist.

Depth to bedrock ranges from 6 to 20 inches but generally is 6 to 16 inches. Because of the variability of parent rock, reaction ranges from slightly acid to moderately alkaline throughout.

In the A horizon hue is 10YR or 7.5YR, value is 4 or 5 dry and 3 or 4 moist, and chroma is 2 to 4. The A horizon is gravelly loam or very gravelly loam. Structure of the A horizon ranges from platy to granular.

In the C horizon hue is 10YR to 5YR, value is 4 to 6 dry and 3 or 4 moist, and chroma is 4 to 6. The C horizon is gravelly loam or gravelly light clay loam. Content of gravel in the C horizon ranges from 15 to 35 percent by volume.

Moano gravelly loam, 0 to 30 percent slopes (MgD).—This soil is on hills that are dissected by numerous short drainageways and a few long drainageways. It has the profile described as representative of the series.

Included with this soil in mapping, and making up about 15 percent of the acreage, are small areas of Arp gravelly clay loam that has slopes of 0 to 15 percent and areas of Lynx loam in the drainageways.

Runoff is medium to rapid on this soil. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, mining, and watershed catchment areas. Capability unit VIIe-1; Granitic Loam Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Moano very rocky loam, 15 to 60 percent slopes (MkF).—This complex is about 70 percent Moano gravelly loam and 20 percent rock outcrops. This complex is on moderately steep and very steep hills and mountains that are dissected by numerous short drainageways.

Included with this soil in mapping, and making up about 10 percent of the acreage, are small areas of Arp gravelly clay loam that has slopes of 8 to 30 percent and narrow areas of Lynx soils in the drainageways.

Runoff is rapid. The hazard of erosion is moderate to high.

This soil is used for range, wildlife habitat, mining, and watershed catchment areas. Capability unit VIIs-1; Granitic Loam Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Moano extremely rocky loam, 15 to 30 percent slopes (MoD).—This complex is about 60 percent Moano gravelly loam and about 30 percent rock outcrops. It is on strongly sloping and moderately steep hills that are dissected by numerous short drainageways.

Included with this soil in mapping, and making up about 10 percent of the acreage, are small areas of Arp

gravelly clay loam and narrow areas of Lynx loam in the drainageways.

Runoff is medium to rapid. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, mining, and watershed catchment areas. Capability unit VII_s-1; Granitic Loam Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Moano-Lynx association, rolling (MrC).—This association is about 60 percent Moano soils and 30 percent Lynx soils. The Moano soil is moderately sloping and moderately steep on hills and has slopes ranging from 8 to 20 percent. The Lynx soil is nearly level to gently sloping in swales and drainageways. Rock outcrops are common. A few moderately deep and deep gullies are in the Lynx soil.

Included with these soils in mapping, and making up about 10 percent of the acreage, are areas of Arp gravelly clay loam that has 0 to 15 percent slopes.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used for range, wildlife habitat, mining, and watershed catchment areas. Both parts in capability unit VII_e-1. Moano part in Granitic Loam Hills range site, 12- to 16-inch precipitation zone. Lynx part in Loam Bottoms range site, 12- to 16-inch precipitation zone. Moano part in wildlife group 5; Lynx part in wildlife group 6.

Moenkopie Series

The Moenkopie series consists of well-drained soils that are very shallow and shallow over sandstone. These soils are nearly level to strongly sloping on hills. Slopes range from 0 to 10 percent but are dominantly 1 to 8 percent. Elevation ranges from 5,000 to 6,000 feet. The vegetation is juniper and pinyon pine, and an understory of brush and grass. Annual precipitation is 12 to 14 inches. The average annual air temperature is 48° to 57° F, and the frost-free period is 120 to 200 days.

In a representative profile the surface and underlying layers are yellowish-red fine sandy loam about 9 inches thick. Below this is dense, light reddish-brown or red sandstone bedrock that has a thin zone of lime accumulation on the upper part.

Permeability is moderate. Available water capacity is low, and the effective rooting depth is 10 to 20 inches.

These soils are used for range, wildlife habitat, and watershed catchment areas.

Representative profile of Moenkopie fine sandy loam that has 0 to 8 percent slopes from an area of Moenkopie association, undulating, 1.6 miles E. of the NW corner, sec. 36, T. 23 N., R. 7 W.:

A1—0 to 2 inches, yellowish-red (5YR 4/6) fine sandy loam, dark reddish brown (5YR 3/4) when moist; single grained; loose when dry and moist, nonsticky and nonplastic when wet; common very fine roots; many fine interstitial pores; moderately alkaline; abrupt, wavy boundary.

C—2 to 9 inches, yellowish-red (5YR 4/6) fine sandy loam, dark reddish brown (5YR 3/4) when moist; massive; soft when dry, very friable when moist, nonsticky and slightly sticky when wet; common very fine roots; many fine interstitial pores; strongly

effervescent; moderately alkaline; abrupt, irregular boundary.

R—9 to 14 inches, light reddish-brown (2.5YR 6/4) and red (2.5YR 4/8) calcareous sandstone that has a thin (1/8- to 1/2-inch), white (N 8/0) and pink (5YR 8/3) lime coating or layer on upper part.

Depth to sandstone ranges from 5 to 20 inches, but the average depth is about 10 inches. In the A and C horizons hue generally is 5YR but ranges to 2.5YR. Value is 4 to 6 dry and 3 or 4 moist. Chroma is 4 to 6. The A horizon is fine sandy loam, sandy loam, gravelly loam, and very stony loam. Lime coatings or accumulations above the bedrock are absent in places.

Moenkopie association, undulating (MsB).—This association is about 50 percent Moenkopie fine sandy loam on gently sloping sandstone ridges and 35 percent Cordes fine sandy loam, red variant, in nearly level swales.

Included with these soils in mapping, and making up about 15 percent of the acreage, are areas of Purner and Pastura gravelly loams, rock outcrops, and soils similar to the Cordes, red variant, soil, but that are shallow over bedrock.

Runoff is slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. Capability unit VII_s-1; Limy Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Mohave Series

The Mohave series consists of deep, well-drained soils that have a distinct zone of lime accumulation. These soils formed in mixed alluvium weathered from granite, schist, and rhyolite and some limestone. They are nearly level to undulating on alluvial fans and plains. Elevation ranges from 2,000 to 4,000 feet. The vegetation is desert shrubs and cactuses and an understory of annual and perennial grasses. Annual precipitation is 8 to 11 inches. The average annual air temperature is 58° to 68° F, and the frost-free period is 200 to 240 days.

In a representative profile the surface layer is light yellowish-brown sandy loam about 4 inches thick. The subsoil is brown sandy loam, light to heavy clay loam, and heavy loam about 51 inches thick. It is underlain by reddish-brown gravelly loamy coarse sand that extends to a depth of 60 inches or more.

Permeability is moderately slow. Available water capacity is high, and the effective rooting depth is 59 inches or more.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Representative profile of Mohave sandy loam, 0.4 mile W. and 0.3 mile N. of the SE. corner, sec. 32, T. 10 N., R. 6 W.:

A1—0 to 4 inches, light yellowish-brown (10YR 6/4) sandy loam, dark yellowish brown (10YR 4/4) when moist; weak, medium, platy structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine and few fine roots; common very fine and fine tubular pores and common very fine interstitial pores; neutral; clear, wavy boundary.

B1t—4 to 11 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; many very fine roots; common very fine and fine tubular pores and common very fine interstitial pores; few thin clay films in pores and as bridges between sand grains; mildly alkaline; clear, wavy boundary.

B2t—11 to 28 inches, brown (7.5YR 5/4) light clay loam, dark brown (7.5YR 4/4) when moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; slightly hard when dry, friable when moist, sticky and plastic when wet; many very fine roots; few very fine and fine tubular pores and few fine interstitial pores; few thin clay films on ped faces and in pores; moderately alkaline; clear, wavy boundary.

B3tca—28 to 39 inches, strong-brown (7.5YR 5/6) heavy loam, dark brown (7.5YR 4/4) when moist; massive; hard when dry, friable when moist, slightly sticky and plastic when wet; few very fine roots; common fine tubular pores and few fine interstitial pores; few thin clay films in pores; strongly effervescent; moderately alkaline; clear, wavy boundary.

IIB2tcab—39 to 55 inches, brown (7.5YR 5/4) heavy clay loam, dark brown (7.5YR 4/4) when moist; strong, medium, prismatic structure parting to moderate, medium, subangular blocky; very hard when dry, firm when moist, sticky and plastic when wet; very few very fine roots; common fine tubular pores; common moderately thick clay films on ped faces and in pores; strongly effervescent; many fine and medium, pink (7.5YR 7/4) lime segregations and filaments; moderately alkaline; clear, wavy boundary.

IIIC—55 to 60 inches, reddish-brown (5YR 5/4) gravelly loamy coarse sand, reddish brown (5YR 4/4) when moist; massive; slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; common fine interstitial pores; moderately alkaline.

The solum ranges from 25 to 50 inches or more in thickness. In the A horizon hue is 7.5YR or 10YR, value is 5 or 6 and 3 to 5 moist, and chroma is 3 to 6. The B2t horizon is sandy loam, fine sandy loam, loam, or light sandy clay loam. In the Bt horizon hue is 7.5YR or 5YR, value is 5 or 6 dry and 3 to 5 moist, and chroma is 3 to 6. The B2t horizon is sandy clay loam, heavy loam, or clay loam.

Mohave sandy loam (Mt).—This nearly level to gently sloping or undulating soil is on alluvial fans that are dissected by numerous shallow drainageways.

Included with this soil in mapping, and making up about 10 percent of the acreage, are small areas of Anthony and Latene gravelly sandy loams on ridges, and Vekol loam in swales.

Runoff is slow on this soil. The hazard of erosion is slight.

This soil is used for range, wildlife habitat, building sites, and watershed catchment areas. A limited acreage north of Wickenburg is irrigated. Capability unit VIIc-1; Loam Upland range site, 8- to 12-inch precipitation zone; wildlife group 2.

Palma Series

The Palma series consists of deep, well-drained soils. These soils formed in windblown material weathered from mixed sources. They are on nearly level to gently rolling plains. Slopes range from 0 to 8 percent. Elevation ranges from 4,700 to 5,500 feet. The vegetation is grasses. Annual precipitation is 12 to 16 inches. The average annual air temperature is about 53° F, and the frost-free period is about 142 days.

In a representative profile the surface layer is reddish-brown sandy loam about 5 inches thick. The subsoil is reddish-brown and yellowish-red sandy loam about 37 inches thick. It is underlain by yellowish-red fine sandy loam.

Permeability is moderately rapid. Available water capacity is moderate, and the effective rooting depth is 60 inches or more.

These soils are used for range, wildlife habitat, and watershed catchment areas.

Representative profile of Palma sandy loam that has 1 to 8 percent slopes, 0.9 mile N. and 0.3 mile W. of the SE. corner, sec. 25, T. 24 N., R. 8 W.:

A1—0 to 5 inches, reddish-brown (5YR 5/4) sandy loam, reddish brown (5YR 4/4) when moist; weak, medium and thick, platy structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; many very fine and fine roots; many fine interstitial pores and very few fine tubular pores; neutral; clear, smooth boundary.

B2t—5 to 25 inches, reddish-brown (5YR 4/4) sandy loam, dark reddish brown (5YR 3/4) when moist; weak, very coarse, prismatic structure; slightly hard when dry, very friable when moist, slightly sticky and nonplastic when wet; few very fine and common fine roots; common fine interstitial pores and few fine tubular pores; clay as few thin bridges between mineral grains and as thin coatings in pores; moderately alkaline; gradual, wavy boundary.

B3—25 to 42 inches, yellowish-red (5YR 5/6) light sandy loam, yellowish red (5YR 4/6) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; few fine roots; few fine tubular pores; moderately alkaline; gradual, wavy boundary.

Cca—42 to 60 inches, yellowish-red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and slightly plastic when wet; very few fine roots; common very fine and fine tubular pores and very fine interstitial pores; slightly effervescent; moderately alkaline; gradual, wavy boundary.

Lime segregations are present in the lower part of the Cca horizon in places. The profile is sandy loam and fine sandy loam to a depth of 60 inches or more. In the A horizon hue is 5YR or 7.5YR, value is 5 or 6 dry, and chroma is 4 to 6. Color values of the B2t horizon are 4 or 5 dry and 3 or 4 moist, and chroma is 4 to 6.

Palma sandy loam, 1 to 8 percent slopes (PaB).—This soil is on plains that are dissected by a few drainageways. Included in mapping are narrow areas of Partri loam, Cordes sandy loam, and Rune loam in swales.

Runoff is very slow on this soil. The hazard of soil blowing is moderate.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIe-1; Limy Upland range site, 12- to 16-inch precipitation zone; wildlife group 7.

Palos Verdes Series

The Palos Verdes series consists of well-drained, gravelly light clay loams that are underlain by weakly cemented, gravelly alluvium. These soils formed in mixed alluvium weathered from granite, basalt, schist, limestone, and sandstone. They are on moderately sloping to steep alluvial fans and ridges that are dissected by numerous drainageways. Slopes range from 8 to 40

percent. Elevation ranges from 2,000 to 4,500 feet. The vegetation is dominantly desert shrubs and cactuses and an understory of grass. Annual precipitation is 8 to 10 inches. The average annual air temperature is about 65° F, and the frost-free period is 180 to 240 days.

In a representative profile the surface layer is brown gravelly sandy loam about 1 inch thick. The subsoil is brown gravelly clay loam about 7 inches thick. It is underlain by gray and strong-brown stratified gravelly sandy loam that is weakly cemented and is slightly calcareous to strongly calcareous.

Permeability is moderate. Available water capacity is moderate, and the effective rooting depth is 60 inches and more.

These soils are used for seasonal grazing, wildlife habitat, and watershed catchment areas.

Representative profile of Palos Verdes gravelly sandy loam, 8 to 40 percent slopes, 0.5 mile S. of the SW. corner, sec. 32, T. 8 N., R. 1 E.:

A1—0 to 1 inch, brown (7.5YR 5/4) gravelly sandy loam, dark brown (7.5YR 3/2) when moist; weak, thin, platy structure parting to weak, fine, granular; soft when dry, very friable when moist, nonsticky and nonplastic when wet; few very fine roots; common very fine interstitial pores; mildly alkaline; abrupt, smooth boundary.

B2t—1 to 8 inches, brown (7.5YR 5/4) gravelly light clay loam, dark brown (7.5YR 4/4) when moist; weak, fine, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few very fine and common fine roots; common very fine interstitial pores and few very fine tubular pores; very few thin clay films on ped faces and in pores; mildly alkaline; abrupt, wavy boundary.

Cca—8 to 40 inches, gray (N 6/0) and strong-brown (7.5YR 5/6) stratified gravelly sandy loam that is alternately weakly cemented and noncemented, grayish brown (10YR 5/2) and dark yellowish brown (10YR 4/4) when moist; massive; very hard and slightly hard when dry, very firm and very friable when moist; nonsticky and nonplastic when wet; few fine and very fine roots; slightly effervescent; moderately alkaline.

The solum ranges from 8 to 18 inches in thickness, but it averages 8 to 12 inches. The solum contains 25 to 35 percent fine and medium gravel and a few cobblestones. Reaction of the solum ranges from mildly alkaline to moderately alkaline.

In the A horizon hue is 7.5YR or 10YR, value is 4 to 6 dry and 3 or 4 moist, and chroma is 2 to 4. The A horizon is gravelly sandy loam, very gravelly sandy loam, or gravelly loam.

In the B2t horizon hue is 7.5YR or 10YR, value is 4 to 6 dry and 3 to 5 moist, and chroma is 3 or 4. The B2t horizon is gravelly sandy clay loam or gravelly light clay loam.

The Cca horizon is normally stratified, consisting of weakly cemented gravelly alluvium and noncemented gravelly alluvium that ranges from slightly effervescent to strongly effervescent. Discontinuous strongly cemented strata are present in places.

Palos Verdes gravelly sandy loam, 8 to 40 percent slopes (PcE).—This soil is on alluvial fans or ridges that are dissected by numerous drainageways.

Included with this soil in mapping are small areas of Cave and Continental gravelly sandy loams that have slopes of 8 to 30 percent. Also included are agglomerate outcrops along the sides of the drainageways and coarse-textured alluvial soils in the drainageways.

These included soils make up about 10 percent of the acreage.

Runoff is medium to rapid on this soil. The hazard of erosion is high.

This soil is used for seasonal grazing, wildlife habitat, and watershed catchment areas. Capability unit VIIe-1; Loam Hills range site, 8- to 12-inch precipitation zone; wildlife group 4.

Partri Series

The Partri series consists of deep, well-drained soils that have a zone of lime accumulation at a moderate depth. These soils formed in mixed alluvium weathered from limestone, sandstone, and basalt. They are on nearly level and moderately sloping alluvial fans or plains. Slopes range from 0 to 8 percent but are dominantly less than 5 percent. Elevation ranges from 4,800 to 5,400 feet. The vegetation is dominantly grass along with scattered juniper in places. Annual precipitation is about 12 inches. The average annual air temperature is about 53° F, and the frost-free period is 140 to 160 days.

In a representative profile the surface layer is brown loam about 2 inches thick. The subsoil is reddish-brown clay loam and clay about 26 inches thick. The substratum, extending to a depth of 64 inches, is white, weakly lime-cemented gravelly clay loam.

Permeability is slow. Available water capacity is high, and the effective rooting depth is more than 60 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Representative profile of Partri loam from an area of Poley-Partri loams, 0.4 mile E. and 0.4 mile N. of the S¹/₄ corner, sec. 32, T. 23 N., R. 7 W.:

A1—0 to 2 inches, brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) when moist; moderate, very fine, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; many fine and very fine roots; many fine interstitial pores; moderately alkaline; abrupt, smooth boundary.

B1t—2 to 15 inches, reddish-brown (5YR 4/3) heavy clay loam, dark reddish brown (5YR 3/3) when moist; weak, fine and medium, subangular blocky structure; slightly hard when dry, friable when moist, sticky and plastic when wet; many fine and very fine roots; common very fine tubular and interstitial pores; common thin clay films on ped faces and in pores; slightly effervescent in pockets; moderately alkaline; gradual, wavy boundary.

B2t—15 to 28 inches, reddish-brown (5YR 4/4) clay, yellowish red (5YR 4/6) when moist; strong, fine and medium, prismatic structure; very hard when dry, firm when moist, sticky and plastic when wet; common very fine and fine roots; very few very fine tubular pores; many moderately thick clay films on ped faces and in pores; strongly effervescent; few fine, white (N 8/0) lime mottles; moderately alkaline; gradual, wavy boundary.

Cca—28 to 64 inches, white (N 8/0) weakly lime-cemented gravelly clay loam; massive; hard when dry, friable when moist, sticky and plastic when wet; very few fine roots; common very fine and few fine tubular pores; violently effervescent; moderately alkaline; Cca horizon is more than 15 percent calcium carbonate.

Thickness of the solum and depth to the lime horizon range from 20 to 36 inches but average 20 to 30 inches. Reaction in the upper 10 inches of the soil ranges from neutral to moderately alkaline.

In the A horizon hue is 7.5YR or 10YR, value is 4 or 5, and chroma is 2 or 3. The A horizon is loam, gravelly loam, or gravelly clay loam.

In the B2t horizon hue is 7.5YR or 5YR, value is 4 or 5 dry and 3 or 4 moist, and chroma is 4 to 6. The B2t horizon is heavy clay loam or clay. Structure ranges from moderate to strong, prismatic, or blocky.

The Cca horizon is lime segregations or weakly cemented marly materials that are gravelly and cobbly in places.

Partri loam (Pd).—This nearly level and undulating soil is on alluvial plains. A few areas are gently rolling and are dissected by a few shallow drainageways.

Included with this soil in mapping, and making up about 10 percent of the acreage, are small areas of Pastura gravelly loam and Poley and Rune loams. The Rune soil is in the drainageways.

Runoff is very slow on this soil. The hazard of erosion is slight.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VI_s-1; Limy Upland range site, 12- to 16-inch precipitation zone; wildlife group 7.

Partri gravelly clay loam (Pe).—This nearly level and undulating gently sloping soil is on alluvial fans that are dissected by numerous shallow drainageways. It has a profile similar to the one described as representative of the series, but the surface layer is gravelly clay loam.

Included with this soil in mapping are small areas of Pastura, Purner, and Dye gravelly loams and limestone rock outcrops. Also included are narrow areas of Rune loam in the drainageways. These included soils make up about 15 percent of the acreage.

Runoff is very slow on this soil. The hazard of erosion is slight.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VI_s-1; Limy Upland range site, 12- to 16-inch precipitation zone; wildlife group 7.

Partri-Abra loams (Pf).—This complex is about 50 percent Partri loam and 35 percent Abra loam. These soils are in an intricate pattern on nearly level and undulating plains. The Abra soil is in some of the larger drainageways.

Included with these soils in mapping, and making up about 15 percent of the acreage, are small areas of Pastura, Purner, and Dye soils.

Runoff is very slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VI_s-1; Limy Upland range site, 12- to 16-inch precipitation zone; wildlife group 7.

Pastura Series

The Pastura series consists of well-drained soils that are shallow over an indurated lime hardpan. These soils formed in mixed alluvium weathered from limestone and sandstone materials. They are on nearly level to moderately steep fans. Slopes range from 0 to 30 percent. Elevation ranges from 4,600 to 5,400 feet. The vegetation is grass or juniper and an understory of

grass. Annual precipitation is 12 to 14 inches. The average annual air temperature is about 54° F, and the frost-free period is 140 to 170 days.

In a representative profile the upper 11 inches is pale-brown and brown gravelly loam. It is underlain by a pinkish-white indurated gravelly layer that has a thin laminar layer on the upper part (fig. 7).

Permeability is moderate. Available water capacity is low, and the effective rooting depth is less than 20 inches.

These soils are used mainly for range, wildlife habitat, homesites, and watershed catchment areas.

Representative profile of Pastura gravelly loam, from an area of Pastura-Poley complex, 2 to 8 percent slopes, 0.5 mile W. and 0.5 mile S. of the NE. corner, sec. 13, T. 19 N., R. 4 W.:

A1—0 to 2 inches, pale-brown (10YR 6/3) gravelly loam, brown (10YR 4/3) when moist; weak, medium, platy structure parting to weak, fine, granular; slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; few very fine roots; many very fine interstitial pores; violently effervescent; moderately alkaline; clear, smooth boundary.



Figure 7.—Profile of Pastura gravelly loam that has several layers of cemented material in the substratum.

C1—2 to 11 inches, brown (10YR 5/3) gravelly loam, dark brown (10YR 4/3) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common very fine and fine roots; very few very fine tubular pores and common very fine interstitial pores; violently effervescent; moderately alkaline, abrupt, wavy boundary.

C2cam—11 to 19 inches, pinkish-white (7.5YR 8/2), lime-indurated gravelly hardpan that has a thin laminar layer on the upper part of the surface, pink (7.5YR 7/4) when moist; massive; extremely hard when dry, extremely firm when moist; horizon is fractured in places; violently effervescent; moderately alkaline.

Depth to the lime hardpan ranges from 8 to 20 inches. Gravel-size fragments of lime, limestone, sandstone, and chert are on the surface and throughout the profile.

In the A1 horizon hue ranges from 10YR through 5YR, but is dominantly 10YR or 7.5YR. Value is 4 to 6 dry and 3 to 5 moist, and chroma is 3 or 4. In the C1 horizon hue is 5YR to 10YR, value is 5 to 7 dry and 4 to 6 moist, and chroma is 2 to 6. The A and C horizons are loam, gravelly loam, gravelly silt loam, or gravelly very fine sandy loam. A series of strongly cemented to indurated strata are present in places. These strata range in thickness from 6 to 36 inches, are gravelly, and are separated by layers of weakly cemented gravelly and cobbly materials.

Pastura gravelly loam, 0 to 8 percent slopes (PgB).—This soil is on alluvial plains or fans.

Included with this soil in mapping are small areas of Pastura cobbly loam and Pastura stony loam. Also included is a shallow soil that has a thin clayey horizon over a lime hardpan. These included soils make up about 5 percent of the acreage.

Runoff is slow on this soil. The hazard of erosion is slight.

This soil is used for range, wildlife habitat, and watershed catchment areas. Limited areas in the vicinity of Paulden have been subdivided for use as homesites. Capability unit VI_s-1; Limy Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Pastura complex, 1 to 30 percent slopes (PhD).—This complex is about 50 percent Pastura gravelly loam and 40 percent Pastura cobbly loam. These soils are in an intricate pattern on old alluvial fans or stream terraces that are dissected by numerous drainageways. The Pastura gravelly loam is on nearly level to gently sloping ridgetops. The Pastura cobbly loam is on the sides of the drainageways.

Included with these soils in mapping, and making up about 10 percent of the acreage, are small areas of Poley gravelly sandy loam on the ridgetops and steeper side slopes along the drainageways, and coarse-textured alluvial soils in the drainageways.

Runoff is slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. Limited areas in the vicinity of Paulden have been subdivided for use as homesites. Capability unit VI_e-1; Limy Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Pastura-Poley complex, 2 to 8 percent slopes (PIB).—This complex is about 55 percent Pastura gravelly loam and 35 percent Poley sandy loam. These soils are in an intricate pattern on undulating and gently rolling old terraces or fans that are dissected by a few long shallow drainageways. Pastura gravelly loam is on the slightly

higher areas and has the profile described as representative of the series. Poley sandy loam is in the lower-lying or depressional areas. It has a profile similar to that described as representative of the Poley series, but is not gravelly.

Included with these soils in mapping, and making up about 10 percent of the acreage, are areas of Pastura cobbly loam that has slopes of 8 to 30 percent and coarse-textured soils in the drainageways.

Runoff is slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VI_s-1. Pastura part in Limy Hills range site, 12- to 16-inch precipitation zone; Poley part in Limy Upland range site, 12- to 16-inch precipitation zone. Pastura part in wildlife group 5; Poley part in wildlife group 7.

Pastura-Lynx association, undulating (PmB).—This association is about 60 percent Pastura soils and about 30 percent Lynx soils. The Pastura gravelly loam is on gently sloping alluvial fans. The Lynx soils are in nearly level swales and drainageways.

Included with these soils in mapping are areas of Poley and Wineg sandy loams and Pastura cobbly loams on the fans. Also included are small areas of a moderately deep phase of Lynx loam in the swales. These included soils make up about 10 percent of the acreage.

Runoff is slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VI_s-1. Pastura part in Limy Hills range site, 12- to 16-inch precipitation zone; Lynx part in Loam Bottoms range site, 12- to 16-inch precipitation zone. Pastura part in wildlife group 5; Lynx part in wildlife group 6.

Pastura-Rune association, undulating (PnB).—This association is 60 percent Pastura gravelly fine sandy loam and 30 percent Rune soils. The Pastura soil is on gently sloping to moderately sloping alluvial fans. The Rune soils are in swales.

Included with these soils in mapping are small areas of Tours loam or Cordes fine sandy loam, red variant, and moderately deep phases of alluvial soils in drainageways. Also included are small areas of Poley sandy loam on the fans. These included soils make up about 10 percent of the acreage.

Runoff is slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VI_s-1. Pastura part in Limy Hills range site, 12- to 16-inch precipitation zone; Rune part in Loam Bottoms range site, 12- to 16-inch precipitation zone. Pastura part in wildlife group 5; Rune part in wildlife group 6.

Poley Series

The Poley series consists of deep, well-drained soils that have a zone of lime accumulation at a moderate

depth. These soils formed in mixed alluvium weathered from sandstone and limestone along with some influence from other materials. They are on nearly level to moderately sloping alluvial fans and plains. Slopes range from 0 to 9 percent but are dominantly 0 to 8 percent. Elevation ranges from 4,800 to 5,600 feet. The vegetation is grass. Annual precipitation is 12 to 14 inches. The average annual air temperature is about 53° F, and the frost-free period is 140 to 160 days.

In a representative profile the surface layer is reddish-brown gravelly sandy loam about 2 inches thick. The subsoil is yellowish-red clay and sandy clay loam about 22 inches thick. The substratum is white, weakly lime-cemented, very cobbly coarse sandy loam.

Permeability is slow. Available water capacity is moderate, and the effective rooting depth is 40 to 60 inches.

These soils are used mainly for range, wildlife habitat, irrigated crops, and watershed catchment areas.

Representative profile of Poley gravelly sandy loam, 0.7 mile E. and 0.5 mile N. of the NW. corner, sec. 32, T. 23 N., R. 6 W.:

A1—0 to 2 inches, reddish-brown (5YR 5/4) gravelly sandy loam, reddish brown (5YR 4/4) when moist; weak, very fine, granular structure; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; many very fine and fine roots; many fine interstitial pores; moderately alkaline; abrupt, smooth boundary.

B1t—2 to 6 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; weak, medium and coarse, subangular blocky structure; hard when dry, friable when moist, slightly sticky and plastic when wet; many very fine and fine roots; common very fine tubular pores; few thin clay films in pores and as bridges holding mineral grains together; moderately alkaline; clear, smooth boundary.

B21t—6 to 18 inches, yellowish-red (5YR 4/6) or red (2.5YR 4/6) dry and moist, clay; moderate, medium and coarse, prismatic structure parting to moderate, medium and coarse, subangular blocky; very hard when dry, firm when moist, slightly sticky and plastic when wet; many very fine and common fine roots; common very fine tubular pores; many thin clay films on ped faces and in pores; moderately alkaline; clear, wavy boundary.

B22tca—18 to 24 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/8) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist, slightly sticky and plastic when wet; common very fine roots; common very fine tubular pores; common thin clay films on ped faces and in pores; violently effervescent; many medium, white (N 8/0), soft lime segregations and mycelia-like veins; moderately alkaline; gradual, wavy boundary.

Cca—24 to 60 inches, white (N 8/0), weakly lime-cemented very cobbly coarse sandy loam; massive; hard when dry, firm when moist, nonsticky and nonplastic when wet; few fine roots; many very fine interstitial pores; violently effervescent; cobblestones and gravel decrease with increasing depth; moderately alkaline.

Thickness of the solum and depth to the zone of lime accumulation ranges from 20 to 36 inches but averages 20 to 30 inches. Reaction in the solum ranges from neutral to moderately alkaline.

In the A horizon hue is 5YR or 7.5YR, value is 5 or 6 dry and 3 or 4 moist, and chroma is 4 to 6. The A horizon is gravelly sandy loam, sandy loam, gravelly loam, or loam.

In the B2t horizon hue is 5YR or 2.5YR, and chroma is 4 to 8. The B2t horizon ranges from sandy clay loam to clay. A B3tca horizon is present in some areas. The zone of lime accumulation ranges from a heavy concentration of lime to weakly lime-cemented very cobbly and very gravelly materials.

Poley gravelly sandy loam (Po).—This nearly level to moderately sloping soil is on alluvial fans and plains that are dissected by a few long shallow drainageways and moderately deep drainageways. It has the profile described as representative of the series.

Included with this soil in mapping, and making up about 10 percent of the acreage, are areas of Pastura gravelly loam and Poley cobbly sandy loam or Poley sandy loam along the drainageways.

Runoff is slow on this soil. The hazard of erosion is slight.

This soil is used for range, wildlife habitat, and watershed catchment areas. A limited acreage is irrigated and cultivated. Capability unit VI_s-1; Limy Upland range site, 12- to 16-inch precipitation zone; wildlife group 7.

Poley-Partri loams (Pp).—This complex is about 60 percent Poley loam and about 30 percent Partri loam. The Poley loam has a profile similar to the one described as representative of the Poley series, but it has a loam surface layer. The Partri loam has the profile described as representative of the Partri series. These soils are in an intricate pattern on nearly level and undulating plains. The Poley soil is in slightly higher lying areas.

Included with these soils in mapping, and making up about 10 percent of the acreage, are areas of Pastura gravelly loam on the plains and Rune loam in the larger drainageways.

Runoff is very slow to slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. Capability unit VI_s-1; Limy Upland range site, 12- to 16-inch precipitation zone; wildlife group 7.

Purner Series

The Purner series consists of well-drained soils that are shallow over limestone. These soils are on gently sloping to moderately steep limestone ridges or low hills. Slopes range from 2 to 30 percent but are dominantly 2 to 10 percent. Elevation ranges from 5,000 to 5,800 feet. The vegetation is juniper and an understory of grass and brush. Annual precipitation is 12 to 14 inches. The average annual air temperature is about 53° F, and the frost-free period is 140 to 160 days.

In a representative profile the surface layer is reddish-brown gravelly loam about 9 inches thick. The next layer is white lime-cemented gravelly loam about 6 inches thick. It is underlain by white, dark-gray, or pinkish-gray dense limestone.

Permeability is moderate. Available water capacity is low, and the effective rooting depth is less than 20 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Representative profile of Purner gravelly loam, 2 to 15 percent slopes, 600 feet N. of the E $\frac{1}{4}$ corner, sec. 31, T. 23 N., R. 7 W.:

A11—0 to 2 inches, reddish-brown (5YR 5/3) gravelly loam, dark reddish brown (5YR 3/3) when moist; weak, fine, granular structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; many very fine and fine roots; many fine interstitial pores; violently effervescent; moderately alkaline; abrupt, wavy boundary.

A12—2 to 9 inches, reddish-brown (5YR 5/3) gravelly loam, dark reddish brown (5YR 3/3) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; many very fine and fine roots; many fine interstitial pores; violently effervescent; moderately alkaline; clear, wavy boundary.

Cca—9 to 15 inches, white (N 8/0), weakly and strongly lime-cemented gravelly loam, pinkish gray (7.5YR 6.2) when moist; massive; hard and very hard when dry, firm and very firm moist, nonsticky and nonplastic when wet; common fine roots; common fine interstitial pores; abrupt, irregular boundary.

R—15 to 27 inches, white (N 8/0), dark-gray (5YR 4/1), and pinkish-gray (7.5YR 6/2) dense limestone.

Depth to bedrock ranges from 7 to 18 inches but averages 8 to 12 inches. The soil contains 20 to 30 percent gravel and some stones. In the A horizon hue is 5YR, value is 4 or 5 dry and 2 or 3 moist, and chroma is 2 or 3. The A horizon is gravelly loam, gravelly light clay loam, or very stony loam.

Purner gravelly loam, 2 to 15 percent slopes (PrC).—This soil is on limestone ridges and low hills dissected by a few short drainageways that have moderately steep sides. It has the profile described as representative of the series.

Included with this soil in mapping are areas of Partri loam and Dye gravelly loam that have slopes of less than 5 percent, and areas of Purner very stony loam that has slopes of 15 to 30 percent. Also included are narrow areas of recent alluvial soils in the drainageways. These included soils make up about 15 percent of the acreage.

Runoff is slow to medium on this soil. The hazard of erosion is slight to moderate.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIe-1; Limy Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Purner very stony loam, 2 to 15 percent slopes (PsC).—This soil is on limestone ridges and low hills that are dissected by a few short drainageways that have moderately steep sides. It has a profile similar to the one described as representative of the series, but the surface layer is very stony.

Included with this soil in mapping are small areas of Dye gravelly loam that has slopes of 2 to 8 percent and rock outcrops on the sides of the drainageways. Also included are narrow areas of recent alluvial soils in the drainageways. These included soils make up about 10 percent of the acreage.

Runoff is slow to medium on this soil. The hazard of erosion is slight.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIc-1; Limy Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Purner very stony loam, 15 to 30 percent slopes (PsD).—This soil is on limestone hills that are dissected by few short drainageways that have moderately steep sides. It has a profile similar to the one described as representative of the series, but it has a very stony surface layer.

Included with this soil in mapping are small areas of Dye gravelly loam that has slopes of 2 to 15 percent and areas of rock outcrops along the drainageways. Also included are narrow areas of recent alluvial soils in the drainageways. These included soils make up 10 percent of the acreage.

Runoff is medium on this soil. The hazard of erosion is slight to moderate.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIc-1; Limy Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Purner-Boysag complex, 2 to 15 percent slopes (PuC).—This complex is about 50 percent Purner and about 35 percent Boysag soils. These soils are in an intricate pattern on undulating to rolling limestone ridges and low hills. The Purner soil generally is on the slightly higher lying areas and has steeper slopes.

Included with these soils in mapping are small areas of Moenkopie very rocky and gravelly loams, rock outcrops on the ridges, and recent alluvial soils in drainageways. Also included are small areas of Partri loam adjacent to the drainageways. These included soils make up about 10 percent of the acreage.

Runoff is slow to medium on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VIe-1. Purner part in Limy Hills range site, 12- to 16-inch precipitation zone; Boysag part in Limy Upland range site, 12- to 16-inch precipitation zone. Purner part in wildlife group 5; Boysag part in wildlife group 7.

Purner and Dye soils, 2 to 30 percent slopes (PvD).—This mapping unit is about 60 percent Purner and about 30 percent Dye soils. These are undulating to moderately steep soils on limestone and sandstone ridges and hills that are dissected by a few long broad swales and many short drainageways that have strongly sloping sides. Very stony and very rocky areas are common in the Purner soil on the steep side slopes. The Purner soil has a profile similar to the one described as representative of the series, but it has a very stony surface layer.

Included with these soils in mapping, and making up about 10 percent of the acreage, are areas of Moenkopie very rocky and gravelly loam, Jacks very rocky and gravelly loam, Rune and Tours loam, rock outcrops, and Cordes fine sandy loam, red variant, in the drainageways.

Runoff is slow to medium on these soils. The hazard of erosion is slight to moderate.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VIc-1. Purner part in Limy Hills range site, 12- to 16-inch precipitation zone; Dye part in Limy Upland

range site, 12- to 16-inch precipitation zone. Purner part in wildlife group 5; Dye part in wildlife group 7.

Purner and Moenkopie soils, 8 to 30 percent slopes (PwD).—This mapping unit is about 60 percent Purner and about 30 percent Moenkopie soils. These soils are on strongly sloping and moderately steep, intermingled limestone and sandstone hills that are dissected by a few long, broad drainageways and many short drainageways that have steep sides. The Purner soil is on the limestone, and the Moenkopie soil is on the sandstone. The Purner soil is similar to the soil described as representative of the series, but is very stony.

Included with these soils in mapping, and making up about 10 percent of the acreage, are areas of Purner and Moenkopie very rocky loams, Dye gravelly loam, and narrow areas of recent alluvial soils in the drainageways.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used for range, wildlife habitat, and watershed catchment areas. Capability unit VI_s-1; Limy Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Retriever Series

The Retriever series consists of well-drained, calcareous soils that are shallow or very shallow over limestone. These soils formed on gently sloping to moderately steep limestone hills. Slopes range from 2 to 30 percent. Elevation ranges from 1,800 to 4,500 feet. The vegetation is a sparse cover of desert shrubs and an understory of grass. Annual precipitation is 8 to 13 inches. The average annual air temperature is 61° to 65° F, and the frost-free period is about 225 days.

In a representative profile the surface and underlying layers are pale-brown gravelly loam about 8 inches thick. Below this is light-gray massive limestone.

Permeability is moderate. Available water capacity is low, and the effective rooting depth is less than 20 inches.

These soils are used mainly for seasonal grazing, wildlife habitat, and watershed catchment areas.

Representative profile of Retriever gravelly loam, 2 to 30 percent slopes, 0.2 mile S. and 0.7 mile E. of the NW. corner, sec. 21, T. 7 N., R. 1 E.:

A1—0 to 3 inches, pale-brown (10YR 6/3) gravelly loam, dark yellowish brown (10YR 4/4) when moist; weak, medium, platy structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; many very fine and few fine roots; many interstitial pores; violently effervescent; moderately alkaline; clear, smooth boundary.

C—3 to 8 inches, pale-brown (10YR 6/3) gravelly loam, dark yellowish brown (10YR 4/4) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine and few fine roots; many interstitial pores; violently effervescent; moderately alkaline; clear, smooth boundary.

R—8 to 10 inches, light-gray (10YR 7/1), extremely hard limestone.

Depth to bedrock ranges from 5 to 18 inches but averages 6 to 12 inches. Content of coarse fragments is variable but this soil is either gravelly, cobbly, or stony throughout the

entire profile. Content of coarse fragments ranges from 15 to 35 percent by volume.

In the A horizon hue is 7.5YR or 10YR. Value in the A1 horizon is 6 and 7 dry and 4 and 5 moist. Chroma is 2 to 4. In the C horizon hue is 10YR to 5YR but is dominantly 7.5YR. Value is 6 and 7 dry and 4 and 5 moist. Chroma is 3 or 4. The C horizon is gravelly sandy loam, gravelly loam, loam, or gravelly light clay loam. A Cca horizon is present in places that is weakly cemented or rests directly on bedrock.

Retriever gravelly loam, 2 to 30 percent slopes (ReD).

—This soil is on limestone hills that are dissected by numerous deep entrenched drainageways. Slopes are dominantly 15 to 30 percent. Included in mapping are small areas of rock outcrops along the drainageways.

Runoff is medium to rapid on this soil. The hazard of erosion is moderate to high.

This soil is used for seasonal grazing, wildlife habitat, and watershed catchment areas. Capability unit VII_e-1; Caliche Upland range site, 8- to 12-inch precipitation zone; wildlife group 3.

Rimrock Series

The Rimrock series consists of moderately deep and deep, well-drained soils that formed in place on basalt flows, cinders, or volcanic bombs. Slopes are nearly level to rolling and the surface has a gilgai microrelief. Slopes range from 0 to 15 percent but are dominantly 0 to 5 percent. Elevation ranges from 2,500 to 5,000 feet. The vegetation is grass, desert shrubs, and cactuses. Annual precipitation is 8 to 12 inches. The average annual air temperature is about 60° to 68° F, and the frost-free period is 200 to 240 days.

In a representative profile the surface layer is brown cobbly clay about 2 inches thick. The next layer is dark-brown clay about 32 inches thick. It is underlain by massive basalt.

Permeability is slow. Available water capacity is moderate and high, and the effective rooting depth is 20 to 60 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Representative profile of Rimrock cobbly clay, 0.4 mile S. and 0.4 mile E. of the NW. corner, sec. 2, T. 9 N., R. 5 W.:

A1—0 to 2 inches, brown (7.5YR 5/3) cobbly heavy clay, dark brown (7.5YR 3/2) when moist; moderate, thin, platy structure parting to strong, fine, granular; slightly hard when dry, friable when moist, sticky and plastic when wet; common very fine roots; many very fine interstitial pores and few very fine tubular pores; moderately alkaline; clear, smooth boundary.

C—2 to 34 inches, dark-brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) when moist; massive; very hard when dry, firm when moist, very sticky and very plastic when wet; many very fine and common fine roots; common fine interstitial pores and common very fine and fine tubular pores; many pressure faces and medium slickensides forming medium and large parallelepipeds that have oblique cleavage; slightly effervescent to strongly effervescent; moderately alkaline; clear, wavy boundary.

R—34 to 44 inches, extremely hard, fractured basalt that has thin, white (10YR 8/2) lime coatings on upper part and in cracks and seams.

Depth to bedrock ranges from 28 inches to approximately 50 inches. Basalt cobblestones and stones on the surface

range from few to many. Secondary calcium carbonate and lime nodules are present in places immediately above the parent rock. Cracks that are 2 inches or more wide and 20 to 36 inches deep are common if the soil is dry.

In the A1 horizon hue is 2.5YR to 7.5YR, value is 4 or 5 dry and 2 to 4 moist, and chroma is 2 to 4. The A horizon is clay, silty clay, heavy silty clay loam, or clay loam, all of which are modified by coarse fragments. In the C horizon hue is 7.5YR to 2.5YR, value is 3 to 5 dry and 2 to 4 moist, and chroma is 2 to 4. The C horizon is clay or silty clay.

Rimrock cobbly clay (Rk).—This nearly level to undulating soil is on basalt plains. It has the profile described as representative of the series.

Included with this soil in mapping, and making up about 10 percent of the acreage, are areas of Rimrock gravelly clay loam, Rimrock very stony clay, Graham gravelly clay loam, and Cave gravelly sandy loam.

Runoff is very slow on this soil. The hazard of erosion is slight.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIIIs-1; Loam Hills range site, 8- to 12-inch precipitation zone; wildlife group 4.

Rimrock-Cave complex (Rm).—This complex is about 60 percent Rimrock cobbly clay and 30 percent Cave gravelly sandy loam. These soils are in an intricate pattern on nearly level to gently sloping basalt plains and mesa tops. The Cave soil has slopes of less than 5 percent.

Included with these soils in mapping are small areas of rock outcrops, areas of Rimrock very stony clay, and areas of Rimrock cobbly clay that has slopes of 8 to 15 percent. Also included are narrow areas of clay loam alluvial soils in drainageways. These included soils make up about 10 percent of the acreage.

Runoff is very slow and slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VIIIs-1. Rimrock part in Loam Hills range site, 8- to 12-inch precipitation zone; Cave part in Caliche Upland range site, 8- to 12-inch precipitation zone. Rimrock part in wildlife group 4; Cave part in wildlife group 3.

Rimrock-Graham complex, 3 to 15 percent slopes (Rn).—This complex is about 60 percent Rimrock cobbly clay that has slopes of 0 to 8 percent and 30 percent Graham very stony clay loam that has slopes of 8 to 15 percent. These soils are in an intricate pattern on gently to strongly sloping basalt plains that are dissected by a few deep drainageways that have steep sides. The Graham soil is on low ridges and slightly higher lying areas, or near the edges of steep drainageways.

Included with these soils in mapping are small areas of Rimrock gravelly clay loam and Graham very stony clay loam that has slopes of 0 to 8 percent. Also included are areas of House Mountain very rocky and gravelly loam and rock outcrops in the Graham soil. These included areas make up about 10 percent of the acreage.

Runoff is slow to medium on these soils. The hazard of erosion is slight to moderate.

These soils are used for range, wildlife habitat, and watershed catchment areas. Capability unit VIIe-1;

Loam Hills range site, 8- to 12-inch precipitation zone; wildlife group 4.

Rock Land

Rock land (Ro) consists of 50 to 90 percent rock outcrops, and the rest is shallow and very shallow soils. It is gently rolling and steep on hills, mountains, and divides that are dissected by numerous drainageways and vertical escarpments. The rock outcrops are granite, basalt, limestone, sandstone, or tuff.

Runoff is medium to high. The hazard of erosion is slight.

The vegetation is grass, chaparral, or juniper. Forage production is limited because of the rock outcrops and shallow and very shallow soil depth (fig. 8). Capability unit VIIs-1.

Rock Land, Low Rainfall

Rock land, low rainfall (Rr), consists of 50 to 90 percent rock outcrops, and the rest is shallow and very shallow soils. It is in desert areas and is gently sloping to steep on hills, mountains, and divides that are dissected by numerous drainageways and vertical escarpments. The rock outcrops are basalt, andesite, granite, or tuff. Annual precipitation is less than 12 inches.

Runoff is medium to high. The hazard of erosion is slight.

The vegetation is a sparse cover of desert shrubs and an understory that is dominantly annual grasses. Forage production is severely limited because of the rock outcrops, limited rainfall, and shallow and very shallow depth to bedrock. Capability unit VIIs-1.

Rough Broken Land

Rough broken land (Rs) consists of very shallow to deep soils and soil materials that range from sandy loam to clay loam and are generally calcareous. It is moderately steep and very steep on fans that are highly dissected by numerous steep-sided drainageways. Slopes are highly variable but are dominantly 15 to 60 percent. The soils and soil materials are variable because of the wide variety of materials that form the fans. The surface layer in some areas is gravelly. Soil slipping is common. Tuffaceous material is exposed along some of the drainageways. Geologic erosion is active.

Included with this land type in mapping are small areas of Lonti gravelly loam and similar soils that appear to be remnants of old surfaces.

Runoff is rapid. The hazard of erosion is high.

This land type is used for limited grazing, wildlife habitat, and watershed catchment areas. Capability unit VIIe-1.

Rune Series

The Rune series consists of deep, well-drained soils. These soils formed in mixed alluvium that weathered from shale, limestone, sandstone, and basalt. They are

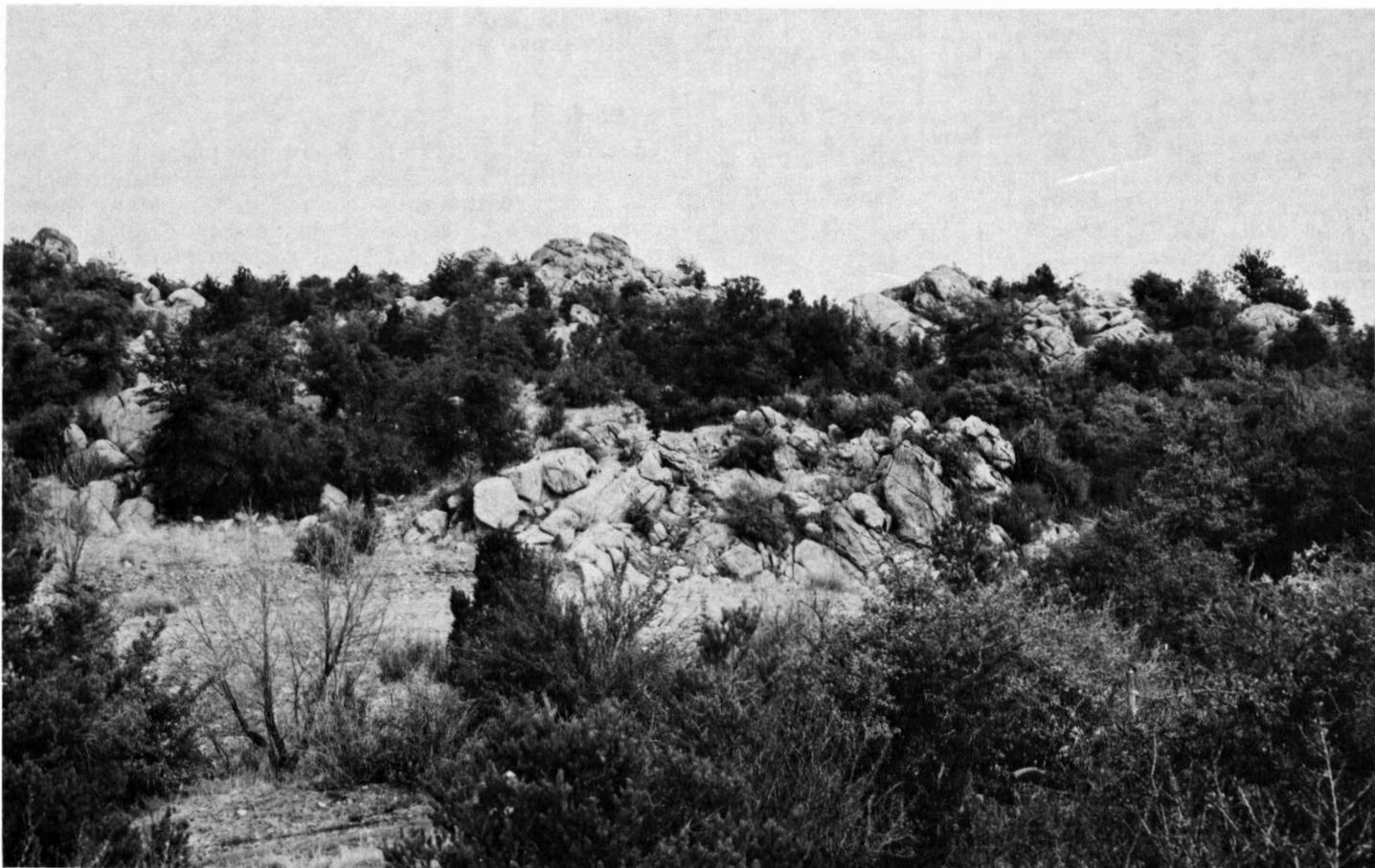


Figure 8.—Typical area of Rock land. The pockets of soil between the granite outcrops support some vegetation.

nearly level to gently sloping on flood plains or in swales. Slopes range from 0 to 5 percent. Elevation ranges from 4,700 to 6,500 feet. The vegetation is grass. Annual precipitation is 12 to 16 inches. The average annual air temperature is 49° to 57° F, and the frost-free period is 140 to 160 days.

In a representative profile the surface layer is reddish-brown loam about 2 inches thick. It is underlain by reddish-brown clay to light clay loam about 58 inches thick.

Permeability is slow. Available water capacity is high, and the effective rooting depth is more than 60 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Representative profile of Rune loam, 0.5 mile E. and 0.2 mile S. of the NW. corner, sec. 6, T. 22 N., R. 7 W.:

A1—0 to 2 inches, reddish-brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) when moist; weak, thin, platy structure parting to weak, very fine, granular; soft when dry, very friable when moist, slightly sticky and plastic when wet; many very fine and fine roots; many fine interstitial pores; strongly effervescent; moderately alkaline; clear, smooth boundary.

C1—2 to 14 inches, reddish-brown (5YR 4/3) light clay loam, dark reddish brown (5YR 3/3) when moist; weak, fine, granular structure; hard when dry, friable when moist, sticky and plastic when wet; many fine and very fine roots; common very fine and fine tubular pores; strongly effervescent; moderately alkaline; clear, smooth boundary.

C2—14 to 23 inches, reddish-brown (5YR 4/3) heavy clay loam, dark reddish brown (5YR 3/3) when moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; very hard when dry, firm when moist, sticky and plastic when wet; many fine and very fine roots; few very fine and fine tubular pores; common thin pressure faces; strongly effervescent; moderately alkaline; clear, wavy boundary.

C3—23 to 60 inches, reddish-brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) when moist; weak, medium, prismatic structure parting to moderate, medium, subangular and angular blocky; very hard when dry, firm when moist, very sticky and very plastic when wet; common very fine roots; common very fine and fine tubular pores; many thin pressure faces; violently effervescent; common, fine, pink (5YR 7/3) lime filaments; moderately alkaline.

This soil generally is deep or very deep, but contrasting layers ranging from gravel to shale are below a depth of 40 inches in places. Filaments and soft, irregularly shaped, small- to medium-sized lime segregations are immediately below the A horizon in places.

In the A horizon hue is dominantly 5YR but ranges to 2.5YR, and value is 4 or 5 dry and 2 or 3 moist. The A horizon

is loam, clay loam, or silty clay loam. In the C horizon hue is 5YR or 2.5YR, and value is 4 or 5. The C horizon is light clay loam to clay.

Rune loam (Rt).—This nearly level or gently sloping soil is on flood plains or in swales that are dissected by a few moderately deep gullies.

Included with this soil in mapping are areas of Rune soil that has a surface layer of clay loam and silty clay loam. Also included, and making up about 10 percent of the acreage, are areas of Partri and Poley loams and Dye and Purner gravelly loams. The Partri and Poley soils are on the flood plains, and the Dye and Purner soils extend into the swales.

Runoff is slow on this soil. The hazard of erosion is slight to moderate.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIe-1; Loam Bottoms range site, 12- to 16-inch precipitation zone; wildlife group 6.

Sandy and Gravelly Alluvial Land

Sandy and gravelly alluvial land (So) consists of sandy and gravelly alluvial soils that are nearly level in drainageway bottoms and along the larger streams and washes. The alluvium weathered from a wide variety of rocks and varies with the geologic material. Gravelly sands and riverwash areas are dominant. Areas are subject to frequent flooding. Included in mapping are small areas of sandy loams and loams and recent alluvial soils.

Runoff is slow. The hazard of erosion is high.

Sandy and gravelly alluvial land is used for wildlife habitat and watershed catchment areas. Capability unit VIIw-1; wildlife groups 1 and 6.

Showlow Series

The Showlow series consists of deep, well-drained soils. These soils formed in mixed alluvium weathered from sandstone, schist, granite, and quartzite. They are on nearly level to gently rolling alluvial fans, ridges, or plains. Slopes range from 0 to 8 percent. Elevation ranges from 4,800 to 6,400 feet. The vegetation is grass. Annual precipitation is 14 to 18 inches. The average annual air temperature is 47° to 57° F, and the frost-free period is 117 to 170 days.

In a representative profile the surface layer is dark-gray gravelly sandy loam about 4 inches thick. The upper part of the subsoil is dark grayish-brown loam about 12 inches thick. The lower part of the subsoil is reddish-brown gravelly clay or clay about 30 inches thick. The substratum is light reddish-brown, calcareous, very gravelly clay loam that extends to a depth of 54 inches or more.

Permeability is slow. Available water capacity is high, and the effective rooting depth is more than 60 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Representative profile of Showlow gravelly sandy loam, 0 to 8 percent slopes, SW $\frac{1}{4}$.NE $\frac{1}{4}$ sec. 20, T. 14 N., R. 4 W.:

A1—0 to 4 inches, dark-gray (10YR 4/1) gravelly sandy loam, very dark gray (10YR 3/1) when moist; weak, medium, platy structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common very fine and fine roots; common micro pores, very fine interstitial pores, and few fine tubular pores; neutral; abrupt, smooth boundary.

B1—4 to 16 inches, dark grayish-brown (10YR 4/2) heavy loam, very dark grayish brown (10YR 3/2) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; common very fine and few fine roots; common very fine and fine tubular pores; common gravel; neutral; clear, wavy boundary.

B21t—16 to 24 inches, reddish-brown (5YR 4/3) gravelly clay, dark reddish brown (5YR 3/4) when moist; moderate, medium, subangular and angular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; very few very fine roots; common micro pores and very fine tubular and interstitial pores; common thin clay films on ped faces and in pores; neutral; abrupt, smooth boundary.

B22t—24 to 35 inches, reddish-brown (5YR 4/4) clay, reddish brown (5YR 4/4) when moist; strong, medium and coarse, prismatic structure; very hard when dry, firm when moist, sticky and very plastic when wet; very few very fine roots; common micro pores and common very fine and few fine tubular and interstitial pores; many moderately thick clay films on ped faces and in pores; few small slickensides in lower part of horizon; common fine gravel; neutral; gradual, smooth boundary.

B3tca—35 to 46 inches, reddish-brown (5YR 5/4) gravelly clay, reddish brown (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 micro pores and fine interstitial pores; common moderately thick clay films on ped faces; slightly effervescent; neutral; diffuse, wavy boundary.

Cca—46 to 54 inches, light reddish-brown (5YR 6/4) very gravelly clay loam, reddish brown (5YR 5/4) when moist; massive; very hard when dry, firm when moist, sticky and plastic when wet; common micro pores and very fine interstitial pores; strongly effervescent; mildly alkaline.

The solum ranges from 24 to 46 inches in thickness. Depth to the zone of lime accumulation ranges from 18 to 40 inches but is dominantly about 24 to 36 inches. Content of coarse fragments in the solum ranges from 10 to 35 percent by volume. Reaction in the A horizon ranges from medium acid to neutral, and in the B2t horizon from natural to moderately alkaline.

In the A horizon and B1 horizon hue is 10YR to 5YR, value is 3 to 5 dry and 2 or 3 moist, and chroma is 1 to 3. The A horizon is gravelly sandy loam or sandy loam.

In the B2t horizon hue is 7.5YR to 2.5YR, value is 4 or 5 dry, and chroma is 3 to 6. The B2t horizon is clay, gravelly heavy clay loam, or gravelly clay.

The Cca horizon is gravelly sandy loam, gravelly sandy clay loam, gravelly loam, very gravelly clay loam, very gravelly loam, or very gravelly sandy clay loam.

Showlow gravelly sandy loam, 0 to 8 percent slopes (ShB).—This soil is on fans or plains dissected by a few drainageways that have moderately sloping sides.

Included with this soil in mapping, and making up about 10 percent of the acreage, are areas of Lonti gravelly sandy loam on the plains and Cordes sandy loam and Lynx loam in the drainageways.

Runoff is very slow and slow on this soil. The hazard of erosion is slight.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIa-1;

Limy Upland range site, 12- to 16-inch precipitation zone; wildlife group 7.

Springerville Series

The Springerville series consists of moderately deep and deep, well-drained soils. These soils formed in material weathered from basalt, cinders, and volcanic bombs. Wide deep cracks form as the soils dry out. These soils are on nearly level to rolling plains or mesas. Slopes range from 0 to 30 percent but are dominantly 0 to 5 percent. Elevation ranges from 4,200 to 7,500 feet. The vegetation is mainly grass, but juniper and pinyon pine are present at higher elevations in the northern part of the county. Annual precipitation is 12 to 18 inches. The average annual air temperature is 45° to 57° F, and the frost-free period is 115 to 225 days.

In a representative profile the surface layer is brown stony clay and silty clay about 4 inches thick. It is underlain by brown silty clay, about 35 inches thick, that becomes stony immediately above extremely hard, massive basalt.

Permeability is slow. Available water capacity is moderate or high, and the effective rooting depth is 20 to 60 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Representative profile of Springerville stony clay, 0 to 8 percent slopes, from an area of Springerville-Thunderbird complex, 0 to 8 percent slopes, 10.5 miles south of the junction of U.S. Highways 66 and 89, approximately 300 feet NW. of the SE. corner sec. 25, T. 20 N., R. 1 W.:

A11—0 to 1 inch, brown (7.5YR 4/2) stony clay, dark brown (7.5YR 3/2) when moist; soft crust $\frac{1}{4}$ inch thick at the surface; strong, very fine, granular structure; hard when dry, friable when moist, very sticky and very plastic when wet; few fine roots; many fine interstitial pores; hard angular basalt stones; mildly alkaline; abrupt, smooth boundary.

A12—1 to 4 inches, brown (7.5YR 4/2) stony silty clay, dark brown (7.5YR 3/2) when moist; strong, medium and fine, subangular blocky structure parting to moderate, fine, granular; very hard when dry, firm when moist, very sticky and very plastic when wet; many fine roots; common very fine and fine tubular pores and interstitial pores; mildly alkaline; clear, wavy boundary.

C1—4 to 9 inches, brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) when moist; parallelepiped-like peds parting to moderate, medium, fine, subangular blocky structure; extremely hard when dry, very firm when moist, very sticky and very plastic when wet; many fine roots; few to common fine and very fine tubular pores and common fine interstitial pores; common to many small slickensides; slightly effervescent; mildly alkaline; gradual, wavy boundary.

C2—9 to 15 inches, brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) when moist; parallelepiped-like peds parting to moderate, medium, fine, angular blocky structure; extremely hard when dry, very firm when moist, very sticky and very plastic when wet; many fine roots; common fine tubular pores and interstitial pores; many small slickensides; common, fine, light-gray, weathered basalt fragments; slightly effervescent; mildly alkaline; gradual, wavy boundary.

C3—15 to 25 inches, brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) when moist; massive; extremely hard when dry, very firm when moist, very sticky and very plastic when wet; weathered basalt fragments; common fine and very fine roots; many very fine and fine tubular pores; many slickensides that intersect; few fine black concretions; slightly effervescent with common, fine, distinct, light-gray (10YR 7/2) and white (10YR 8/2) lime segregations and few, fine, hard, white (10YR 8/2) lime concretions; mildly alkaline; gradual, wavy boundary.

C4—25 to 35 inches, brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) when moist; massive; extremely hard when dry, very firm when moist, very sticky and very plastic when wet; few fine roots; many intersecting slickensides; few weathered basalt stones; slightly effervescent; few, fine, hard, white (10YR 8/2) lime concretions; mildly alkaline; gradual, wavy boundary.

C5—35 to 39 inches, brown (7.5YR 4/2) stony silty clay, dark brown (7.5YR 3/2) when moist; massive; very hard when dry, very firm when moist, very sticky and very plastic when wet; common slickensides, slightly effervescent to strongly effervescent; common fine, hard, pink (7.5YR 8/4) and white (10YR 8/2) lime concretions; few, coarse, white (10YR 8/2), soft lime segregations as much as $\frac{5}{8}$ inch in diameter; mildly alkaline; abrupt, irregular boundary.

R—39 to 50 inches, extremely hard, slightly weathered olivine basalt.

Depth to bedrock ranges from 28 to 78 inches. Depth to basalt is variable within a short distance. These soils when dry have cracks that are 1 inch or more wide and 20 to 36 inches deep. Coarse fragments are gravel, cobblestones, or stones, and content ranges from few to as much as 35 percent by volume. The soil is effervescent to dilute hydrochloric acid in places, and secondary carbonate nodules are present in places above the parent rock.

In the C horizon hue is 5YR to 10YR but is dominantly 5YR to 10YR, value is 3 to 5 dry and 2 or 3 moist, and chroma is 2 or 3. The A horizon is stony silty clay, cobbly, gravelly, or stony clay, silty clay loam, or heavy clay loam. The silty clay loam or heavy clay loam horizons do not exceed 2 inches in thickness.

In the C horizon hue is 5YR to 10YR but is dominantly 7.5YR. Value is 3 to 5 dry and 2 to 4 moist, and chroma is 2 or 3. The C horizon is silty clay, clay, stony silty clay, or cobbly clay.

Springerville cobbly clay, 0 to 8 percent slopes (S1B).—This soil is on basalt plains. It has a profile similar to the one described as representative of the series, but the surface layer is cobbly clay. In some areas the surface layer is gravelly clay.

Included with this soil in mapping are small areas of rock outcrops and Springerville very stony clay on small ridges or breaks. Also included are small areas of Pastura and Apache gravelly loam. These included areas make up about 10 percent of the acreage.

Runoff is very slow to slow on this soil. The hazard of erosion is slight.

This soil is used mainly for range, wildlife habitat, and watershed catchment areas. Capability unit VI-s-1; Clay Upland range site, 12- to 16-inch precipitation zone; wildlife group 9.

Springerville very stony clay, 0 to 8 percent slopes (SmB).—This soil is on basalt plains. It has a profile similar to the one described as representative of the series, but the surface layer is very stony clay. Cobblestones and stones are common on the surface.

Included with this soil in mapping, and making up about 5 percent of the acreage, are areas of rock outcrops and small areas of Springerville soils that do not have a very stony surface layer.

Runoff is very slow and slow on this soil. The hazard of erosion is slight.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIs-1; Clay Upland range site, 12- to 16-inch precipitation zone; wildlife group 9.

Springerville-Cabezon complex, 3 to 30 percent slopes (SnD).—This complex is about 55 percent Springerville cobbly clay that has slopes of 3 to 8 percent, 15 percent Cabezon very stony clay loam that has slopes of 8 to 15 percent, and 15 percent Cabezon very rocky clay loam that has slopes of 15 to 30 percent. These soils are in an intricate pattern on rolling and moderately steep basalt plains and hills. The Cabezon very stony clay loam has a profile similar to the one described as representative of the series, but it has a very stony clay loam surface layer. The Cabezon very rocky clay loam has a profile similar to the one described as representative of the series, but it has a clay loam surface layer and contains rock outcrops.

Included with these soils in mapping are small areas of Venezia and Apache gravelly loams, Thunderbird and Cross gravelly clay loams, and Springerville cobbly clay that has slopes of 0 to 3 percent. The Venezia and Cross soils are associated with the Cabezon soils, and the Thunderbird and Apache soils are associated with the Springerville soils. These included soils make up about 15 percent of the acreage.

Runoff is low to medium on these soils. The hazard of erosion is slight to moderate.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VIs-1. Springerville part in Clay Upland range site, 12- to 16-inch precipitation zone; Cabezon part in Clay Loam Hills range site, 12- to 16-inch precipitation zone. Springerville part in wildlife group 9; Cabezon part in wildlife group 5.

Springerville-Pastura complex, 1 to 5 percent slopes (SpB).—This complex is about 55 percent Springerville cobbly clay and 25 percent Pastura gravelly loam. These soils are in an intricate pattern on nearly level and undulating basalt plains. Basalt is below the Pastura soil at a depth of 3 to 6 feet. Large stones are common throughout but cover less than 10 percent of the surface.

Included with these soils in mapping, and making up about 20 percent of the acreage, are small areas of Cross and Thunderbird gravelly clay loams, Apache gravelly loam, and Springerville very stony clay.

Runoff is slow to very slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VIs-1. Springerville part in Clay Upland range site, 12- to 16-inch precipitation zone; Pastura part in Limy Hills range site, 12- to 16-inch precipitation zone. Springerville part in wildlife group 9; Pastura part in wildlife group 5.

Springerville-Thunderbird complex, 0 to 8 percent slopes (StB).—This complex is about 55 percent Springerville stony clay and 35 percent Thunderbird cobbly clay loam. These soils are in an intermingled pattern on nearly level to gently rolling plains that are dissected by few long, moderately deep drainageways that have moderately sloping sides. The Springerville soil has the profile described as representative of the series. The Thunderbird soil generally is on the sides of the drainageways or on slightly higher lying areas. In some areas the surface layer is cobbly.

Included with these soils in mapping are areas where tuff and agglomerate or calcareous soil materials are exposed along the drainageways. Also included are areas of these soils along drainageways that have slopes of 8 to 15 percent. These included soils make up about 10 percent of the acreage.

Runoff is very slow and slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VIs-1. Springerville part in Clay Upland range site, 12- to 16-inch precipitation zone; Thunderbird part in Clay Loam Upland range site, 12- to 16-inch precipitation zone. Springerville part in wildlife group 9; Thunderbird part in wildlife group 10.

Springerville-Lonti association, undulating (SuB).—This association is about 50 percent Springerville cobbly clay and about 40 percent Lonti gravelly loam. These soils are on nearly level to undulating plains. The Springerville soil is in the swales or depressions, and the Lonti soils are on slightly higher areas or low ridges.

Included with these soils in mapping are small areas of Lynx loam in drainageways and some areas of soils that have slopes of 8 to 15 percent on the sides of some drainageways. Also included are small areas of calcareous clay loams. These included soils make up about 10 percent of the acreage.

Runoff is very slow to slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VIs-1. Springerville part in Clay Upland range site, 12- to 16- precipitation zone; Lonti part in Loam Upland range site, 12- to 16-inch precipitation zone. Springerville part in wildlife group 9; Lonti part in wildlife group 8.

Tajo Series

The Tajo series consists of moderately deep, well-drained, calcareous soils that have a lime-indurated hardpan at a moderate depth. These soils formed in material that weathered from basalt or cinders. They are on undulating or rolling basalt uplands and plains. Slopes range from 0 to 15 percent. Elevation ranges from 5,000 to 6,000 feet. The vegetation is grass or juniper and an understory of grass. Annual precipitation is 12 to 14 inches. The average annual air temperature is about 53° F, and the frost-free period is 140 to 160 days.

In a representative profile the surface layer is brown gravelly loam about 3 inches thick. The subsoil is brown and grayish-brown calcareous clay loam about 25 inches thick. The substratum is a weakly stratified and indurated white lime-cemented hardpan. It is underlain by basalt at a depth of 63 inches.

Permeability is moderately slow. Available water capacity is moderate, and the effective rooting depth is 20 to 34 inches.

These soils are used for range, wildlife habitat, and watershed catchment areas.

Representative profile of Tajo gravelly loam, 0 to 8 percent slopes, SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 3, T. 20 N., R. 6 W.:

A1—0 to 3 inches, brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) when moist; moderate, medium, platy structure parting to moderate, fine, granular; slightly hard when dry, friable when moist, slightly sticky and nonplastic when wet; common very fine roots; many micro pores and very fine interstitial pores; slightly effervescent; mildly alkaline; abrupt, smooth boundary.

B1—3 to 14 inches, brown (10YR 5/3) light clay loam, dark brown (10YR 3/3) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; few very fine roots; many micro pores and very fine interstitial pores, and common very fine tubular pores; common gravel; slightly effervescent; moderately alkaline; clear, smooth boundary.

B2t—14 to 28 inches, grayish-brown (10YR 5/2) clay loam, dark brown (10YR 4/3) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; very few very fine roots; common very fine interstitial pores and tubular pores; few thin clay films on ped faces and in pores; strongly effervescent; moderately alkaline; clear, wavy boundary.

C1ca—28 to 40 inches, white (10YR 8/1), weakly lime-cemented basalt, cinder gravel, and hardpan fragments, very pale brown (10YR 8/3) when moist; massive; hard and very hard when dry, firm and very firm moist; violently effervescent; moderately alkaline; abrupt, wavy boundary.

C2cam—40 to 46 inches, white (10YR 8/1) lime-indurated hardpan, white (10YR 8/2) when moist; massive; extremely hard when dry, extremely firm when moist; violently effervescent; strongly alkaline; clear, wavy boundary.

C3ca—46 to 63 inches, white (10YR 8/1), stratified, weakly and strongly cemented marly material and cinders, white (10YR 8/2) when moist; massive; hard to extremely hard when dry, firm to extremely firm when moist; violently effervescent; strongly alkaline; clear, wavy boundary.

R—63 to 73 inches, reddish-yellow (7.5YR 6/6) basalt.

The solum ranges from 20 to 34 inches in thickness. Depth to the R horizon ranges from 32 to 65 inches. Content of gravel in the A horizon ranges from 15 to 20 percent by volume.

In the A horizon and in the upper part of the B horizon hue is 10YR or 7.5YR, value is 3 to 5 dry and 2 or 3 moist, and chroma is 2 or 3. The A horizon is gravelly loam and gravelly light clay loam.

In the B2t horizon hue is 10YR or 7.5YR, value is 4 or 5 dry and 2 to 4 moist, and chroma is 2 or 3. The B2t horizon is clay loam and gravelly clay loam.

Tajo gravelly loam, 0 to 8 percent slopes (T_aB).—This soil is on basalt uplands or plains. It has the profile described as representative of the series. A few cobblestones and stones are present on the surface.

Included with this soil in mapping are small areas of Apache gravelly loam, Thunderbird gravelly clay

loam, and Springerville cobbly clay. Also included are small areas of soils that have slopes of 8 to 15 percent. These included soils make up about 10 percent of the acreage.

Runoff is slow on this soil. The hazard of erosion is slight.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIs-1; Clay Loam Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Tajo-Springerville complex, 0 to 15 percent slopes (T_cC).—This complex is about 55 percent Tajo gravelly loam that has slopes of 0 to 15 percent and 35 percent Springerville cobbly clay that has slopes of 0 to 8 percent. These soils are in an intricate pattern on nearly level to rolling basalt plains or mesa tops. The Springerville cobbly clay has a profile similar to the one described as representative of the series, but it has a cobbly clay surface layer.

Included with these soils in mapping, and making up about 10 percent of the acreage, are areas of Apache gravelly loam and Cabezon and Thunderbird gravelly clay. Also included are small areas of soils that have slopes of 15 to 30 percent.

Runoff is slow to medium on these soils. The hazard of erosion is slight to moderate.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VIe-1. Tajo part in Clay Loam Hills range site, 12- to 16-inch precipitation zone; Springerville part in Clay Upland range site, 12- to 16-inch precipitation zone. Tajo part in wildlife group 5; Springerville part in wildlife group 9.

Thunderbird Series

The Thunderbird series consists of moderately deep, well-drained soils that formed from basalt. These soils are on nearly level and undulating plains and steep hills. Slopes range from 0 to 40 percent. Elevation ranges from 4,000 to 7,500 feet. The vegetation is juniper and grass at the higher elevations and grass at the lower elevations. Annual precipitation is 12 to 18 inches. The average annual air temperature is 54° F, and the frost-free period is 120 to 210 days.

In a representative profile the surface layer is grayish-grown cobbly clay loam about 2 inches thick. The subsoil is dark-gray clay loam and clay about 26 inches thick. The substratum is brown gravelly clay loam about 3 inches thick. It is underlain by dark-gray basalt at a depth of 31 inches.

Permeability is slow. Available water capacity is moderate, and the effective rooting depth is 20 to 40 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Representative profile of Thunderbird cobbly clay loam, 0 to 15 percent slopes, NE $\frac{1}{4}$ sec. 11, T. 15 N., R. 4 W.:

A1—0 to 2 inches, grayish-brown (10YR 5/2) cobbly clay loam, very dark grayish brown (10YR 3/2) when moist; strong, thin, platy structure parting to moderate, very fine, granular; slightly hard when dry, friable when moist; nonsticky and slightly plastic

when wet; many very fine and fine roots; many interstitial pores and common fine and very fine tubular pores; coarse fragments include basalt cobbles and gravel; neutral; clear, smooth boundary.

B1t—2 to 7 inches, dark-gray (10YR 4/1) heavy clay loam, very dark brown (10YR 2/2) when moist; moderate, fine and very fine, subangular blocky structure; hard when dry, firm when moist, sticky and plastic when wet; many fine and very fine roots; common very fine tubular pores; few thin clay films on ped faces; common basalt cobbles and gravel; mildly alkaline; clear, wavy boundary.

B21t—7 to 13 inches, dark-gray (10YR 4/1) clay, very dark grayish brown (10YR 3/2) when moist; moderate, medium and coarse, prismatic structure parting to moderate, medium and coarse, subangular blocky; very hard when dry, firm when moist, sticky and plastic when wet; many very fine roots; common very fine and fine tubular pores; common thin clay films on ped faces; common basalt cobbles and gravel; moderately alkaline; gradual, wavy boundary.

B22t—13 to 28 inches, dark-gray (10YR 4/1) clay, very dark grayish brown (10YR 3/2) when moist; weak, medium and coarse, angular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; many very fine roots; common very fine and fine tubular pores; common thin clay films on ped faces; common basalt cobbles and gravel; moderately alkaline; clear, wavy boundary.

Cca—28 to 31 inches, brown (7.5YR 5/4) gravelly clay loam, strong brown (7.5YR 5/6) and reddish yellow (7.5YR 7/6) when moist; massive; very hard when dry, firm when moist, slightly sticky and plastic when wet; common very fine roots; few fine tubular pores; few thin clay films in pores; violently effervescent; moderately alkaline; abrupt, irregular boundary.

R—31 to 33 inches, dark-gray (N 4/0) basalt.

The solum ranges from 20 to 40 inches in thickness. Depth to bedrock ranges from 20 to 44 inches. The surface layer ranges from gravelly to cobbly.

The A1 horizon is loam, clay loam, and gravelly, cobbly, or stony clay loam. In the A horizon hue is 7.5YR to 10YR, value is 4 or 5 dry and 2 and 3 moist, and chroma is 2 and 3. In the B horizon hue is 10YR to 5YR, value is 3 to 5 dry and 2 to 4 moist, and chroma is 1 to 3. The B2t horizon is heavy clay loam and gravelly or cobbly clay. In the Cca horizon hue is 10YR or 7.5YR, value is 5 to 7, and chroma is 4 to 6.

Thunderbird cobbly clay loam, 0 to 15 percent slopes (TdC).—This soil is on basalt hills. It has the profile described as representative of the series. In some areas the surface layer is gravelly.

Included with this soil in mapping are some areas of Thunderbird very stony soils and rock outcrops. Also included are scattered small areas of Cabezon and Springerville gravelly clay loam and Apache gravelly loam. These included soils make up about 15 percent of the acreage.

Runoff is slow on this soil. The hazard of erosion is slight to moderate.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIe-1; Clay Loam Upland range site, 12- to 16-inch precipitation zone; wildlife group 10.

Thunderbird cobbly clay loam, 15 to 40 percent slopes (TdE).—This soil is on basalt hills and mesas. Some areas of this soil are gravelly.

Included with this soil in mapping are small areas of Thunderbird very stony soils and exposures of basalt and tuffaceous outcrops. Also included are small

scattered areas of Cabezon gravelly clay loam, Venezia gravelly loam, and areas of gently sloping Springerville cobbly clay. These included soils make up about 15 percent of the acreage.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIe-1; Clay Loam Upland range site, 12- to 16-inch precipitation zone; wildlife group 10.

Thunderbird-Cabezon complex, 0 to 15 percent slopes (ThC).—This complex is about 60 percent Thunderbird cobbly clay loam, 0 to 15 percent slopes, and 30 percent Cabezon very stony clay loam that has slopes of 8 to 15 percent. These soils are in an intricate pattern on nearly level to rolling basalt plains that are dissected by a few long drainageways. Rock outcrops are common on the Cabezon soil.

Included with these soils in mapping, and making up about 10 percent of the acreage, are areas of Cabezon very stony clay loam and Springerville cobbly clay that have slopes of 0 to 8 percent.

Runoff is slow on these soils. The hazard of erosion is slight to moderate.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VIe-1. Thunderbird part in Clay Loam Upland range site, 12- to 16-inch precipitation zone; Cabezon part in Clay Loam Hills range site, 12- to 16-inch precipitation zone. Thunderbird part in wildlife group 10; Cabezon part in wildlife group 5.

Tortugas Series

The Tortugas series consists of shallow and very shallow, well-drained soils. These soils formed in place in material weathered from limestone. They are on gently rolling ridges to steep and very steep hills. Slopes range from 0 to 60 percent. Elevation ranges from 4,200 to 6,000 feet. The vegetation is dominantly juniper and an understory of grass. Annual precipitation is 12 to 18 inches. The average annual air temperature is 48° to 56° F, and the frost-free period is 120 to 200 days.

In a representative profile the surface layer is brown very stony loam about 9 inches thick. It is underlain by pinkish-gray, dense limestone.

Permeability is moderate. Available water capacity is low, and the effective rooting depth is less than 20 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Representative profile of Tortugas extremely rocky loam that has 15 to 30 percent slopes, in an area of Tortugas extremely rocky loam, 15 to 60 percent slopes, 500 feet E. of U.S. Highway 89 along the N. sec. line of sec. 26, T. 18 N., R. 2 W.:

A1—0 to 9 inches, brown (7.5YR 4/2) very stony heavy loam, dark brown (7.5YR 3/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist, sticky and slightly plastic when wet; many fine and very fine roots; many interstitial pores; strongly effervescent; moderately alkaline; abrupt, irregular boundary.

R—9 to 10 inches, pinkish-gray (5YR 6/2), dark grayish-brown (10YR 4/2), and very pale brown (10YR 8/3), dense, extremely hard limestone.

Depth to extremely hard limestone or calcareous sandstone ranges from 6 to 20 inches but averages about 12 inches.

In the A horizon hue is 10YR or 7.5YR, value is 4 or 5 dry and 2 or 3 moist, and chroma is 2 or 3. The A horizon is gravelly loam, cobbly loam, very stony loam, very gravelly loam, and very cobbly loam.

In places a C horizon is present. Where present, the C horizon has hue of 7.5YR or 10YR, value of 5 to 8 dry and 4 to 7 moist, and chroma of 2 to 4. Coarse fragment size is variable and averages more than 35 percent by volume larger than 2 millimeters in size. Lime coatings are present in places immediately above the bedrock.

Tortugas gravelly loam, 2 to 8 percent slopes (TIB).—This soil is on low limestone ridges and hills that are dissected by a few long drainageways. Rock outcrops are common but make up less than 10 percent of the acreage.

Included with this soil in mapping, and making up about 10 percent of the acreage, are small areas of Dye gravelly loam, Tortugas very stony loam, and Lynx loam in the drainageways.

Runoff is slow on this soil. The hazard of erosion is slight.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIs-1; Limy Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Tortugas very rocky loam, 8 to 30 percent slopes (TmD).—This complex is about 70 percent Tortugas very stony loam and about 20 percent rock outcrops. It is on limestone hills that are dissected by numerous short drainageways.

Included with this soil in mapping, and making up about 10 percent of the acreage, are areas of Dye and Tortugas gravelly loams that have slopes of 0 to 8 percent, Lynx loam in the drainageways, and small areas that have slopes of 30 to 60 percent along the deep drainageways.

Runoff is medium. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIs-1; Limy Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Tortugas extremely rocky loam, 15 to 60 percent slopes (TnF).—This complex is about 60 percent Tortugas very stony loam and about 30 percent rock outcrops. It is on limestone hills. The profile described as representative of the series is in an area of this soil.

Included with this soil in mapping, and making up about 10 percent of the acreage, are areas of Tortugas very rocky loam and narrow areas of Lynx loam in drainageways.

Runoff is rapid on these soils. The hazard of erosion is high.

The soils in this mapping unit are used for range, wildlife habitat, and watershed catchment areas. Capability unit VIIs-1; Limy Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Tours Series

The Tours series consists of deep, well-drained soils. These soils formed in alluvial material weathered from sandstone, shale, basalt, quartzite, and limestone. They are on nearly level to gently sloping low fans and flood plains. Slopes range from 0 to 5 percent. Elevation ranges from 5,000 to 6,000 feet. The vegetation is grass. Annual precipitation is 10 to 14 inches. The average annual air temperature is 46° to 54° F, and the frost-free period is 140 to 170 days.

In a representative profile the surface layer is reddish-brown loam about 2 inches thick. It is underlain by stratified reddish-brown loam and clay loam to a depth of about 60 inches.

Permeability is moderately slow. Available water capacity is high, and the effective rooting depth is 60 inches or more.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Representative profile of Tours loam, SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 8, T. 20 N., R. 6 W.:

A1—0 to 2 inches, reddish-brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine roots; many micro pores and very fine interstitial pores, and common very fine tubular pores; slightly effervescent; moderately alkaline; abrupt, smooth boundary.

C1—2 to 11 inches, reddish-brown (5YR 5/3) heavy loam, dark reddish brown (5YR 3/4) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; common very fine roots; many micro pores and very fine interstitial pores, and common very fine and fine tubular pores; strongly effervescent; moderately alkaline; clear, smooth boundary.

C2—11 to 35 inches, reddish-brown (5YR 4/3) light clay loam, dark reddish brown (5YR 3/3) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; common very fine roots; many micro pores and very fine interstitial pores, and common very fine and fine tubular pores; strongly effervescent; moderately alkaline; gradual, smooth boundary.

C3—35 to 60 inches, reddish-brown (5YR 5/3) loam, dark reddish brown (5YR 3/3) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; few very fine roots; many micro pores and very fine interstitial pores, and common very fine and fine tubular pores; strongly effervescent; few very fine, white (10YR 8/2) lime filaments; moderately alkaline.

These soils are more than 60 inches deep. The soil ranges from slightly calcareous to strongly calcareous in places.

In the A horizon hue is 7.5YR to 2.5YR, value is 4 to 6 dry and 3 or 4 moist, and chroma is 3 or 4. The A horizon is loam, silt loam, silty clay loam, clay loam, or sandy clay loam.

In the C horizon hue is 2.5YR or 5YR, value is 3 or 4 moist, and chroma is 3 to 6. The C horizon ranges from loam, heavy loam, or heavy silt loam to light clay loam or light silty clay loam, and is stratified in places with thin layers of finer or coarser soil material.

Tours loam (To).—This nearly level to gently sloping soil is on low fans and flood plains that are dissected by a few long, moderately deep and deep gullies.

Included with this soil in mapping, and making up about 5 percent of the acreage, are areas of Rune loam and coarse-textured, gravelly alluvial soils.

Runoff is slow on this soil. The hazard of erosion is slight.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIC-1; Loam Bottoms range site, 12- to 16-inch precipitation zone; wildlife group 6.

Tres Hermanos Series

The Tres Hermanos series consists of deep, well-drained, calcareous soils. These soils formed in mixed alluvium weathered from granite, basalt, limestone, sandstone, and schist. They are on nearly level to strongly sloping old fans and plains. Slopes range from 0 to 15 percent. Elevation ranges from 2,000 to 4,000 feet. The vegetation is desert shrubs and cactuses and an understory of grass. Annual precipitation is 8 to 12 inches. The average annual air temperature is 57° to 65° F, and the frost-free period is 180 to 240 days.

In a representative profile the surface layer is light-brown gravelly sandy loam about 2 inches thick. The subsoil is brown gravelly sandy clay loam about 13 inches thick. The substratum is white or light-brown calcareous gravelly sandy loam and gravelly loamy sand extending to a depth of 60 inches or more.

Permeability is moderately slow. Available water capacity is moderate, and the effective rooting depth is more than 60 inches.

This soil is used mainly for seasonal grazing, wildlife habitat, and watershed catchment areas.

Representative profile of Tres Hermanos gravelly sandy loam that has slopes of 0 to 8 percent, from an area of Tres Hermanos-Whitlock gravelly sandy loams, 0 to 15 percent slopes, 0.12 mile S. of the N $\frac{1}{4}$ corner, sec. 35, T. 11 N., R. 10 W.:

A1—0 to 2 inches, light-brown (7.5YR 6/4) gravelly sandy loam, brown (7.5YR 5/4) when moist; weak, medium, platy structure; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; common fine and very fine roots; many fine interstitial pores; strongly effervescent; moderately alkaline; abrupt, smooth boundary.

B21t—2 to 7 inches, brown (7.5YR 5/4) to light reddish-brown (5YR 6/4) gravelly sandy clay loam, dark brown (7.5YR 4/4) when moist; weak, fine and medium, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few very fine and fine roots; common fine and very fine tubular pores; few thin clay films on ped faces and as bridges between sand grains; strongly effervescent; moderately alkaline; clear, wavy boundary.

B22t—7 to 15 inches; brown (7.5YR 5/4) sandy clay loam dark brown (7.5YR 4/4) when moist; weak, fine and medium, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; many very fine and fine roots; few fine tubular pores; few thin clay films on ped faces and as bridges between sand grains; common gravel; strongly effervescent; moderately alkaline; clear, wavy boundary.

C1ca—15 to 24 inches, white (10YR 8/2) gravelly loamy sand that is weakly lime-cemented in places, light gray (10YR 7/2) when moist; massive; hard to slightly hard when dry, friable when moist, non-sticky and nonplastic when wet; common very fine roots in cracks; common very fine tubular pores; violently effervescent; moderately alkaline; clear, irregular boundary.

C2ca—24 to 60 inches, light-brown (7.5YR 6/4) gravelly sandy loam, strong brown (7.5YR 5/6) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common very fine roots; common very fine tubular pores; violently effervescent; common fine, pinkish-white (7.5YR 8/2) lime filaments; moderately alkaline.

The solum ranges from 12 to 30 inches in thickness. Reaction in the solum ranges from moderately alkaline to strongly alkaline.

In the A horizon hue is 7.5YR or 5YR, value is 5 or 6 dry and 4 or 5 moist, and chroma is 2 to 4. The A horizon is gravelly sandy loam or gravelly loam. In the B2t horizon hue is 7.5YR or 5YR, value is 4 or 5 moist, and chroma is 4 or 5. The B2t horizon is gravelly sandy clay loam, sandy clay loam, or clay loam. Content of gravel in the B2t horizon ranges from 15 to 35 percent. In the Cca horizon hue is 10YR to 5YR.

Tres Hermanos-Whitlock gravelly sandy loams, 0 to 15 percent slopes (T_wC).—This complex is about 50 percent Tres Hermanos gravelly sandy loam that has slopes of 0 to 8 percent and 40 percent Whitlock gravelly sandy loam that has slopes of 0 to 15 percent. These soils are in an intricate pattern on gently sloping to strongly sloping alluvial fans that are dissected by numerous shallow and moderately deep drainageways.

Included with these soils in mapping, and making up about 10 percent of the acreage, are small areas of Continental gravelly sandy loam on ridges and Anthony gravelly sandy loam in the drainageways.

Runoff is slow on these soils. The hazard of erosion is slight to moderate.

These soils are used for seasonal grazing, wildlife habitat, and watershed catchment areas. Capability unit VIIe-1; Loam Upland range site, 8- to 12-inch precipitation zone; wildlife group 2.

Vekol Series

The Vekol series consists of deep, well-drained soils. These soils formed in mixed alluvium that weathered dominantly from granite and related rocks. They are nearly level or in depressions on old alluvial fans or plains. Slopes range from 0 to 2 percent. Elevation ranges from 2,000 to 3,000 feet. The vegetation is grass. Annual precipitation is 8 to 11 inches. The average annual air temperature is 62° to 66° F, and the frost-free period is 200 to 240 days.

In a representative profile the surface layer is brown loam about 3 inches thick. The subsoil is brown and reddish-brown clay or heavy clay loam about 30 inches thick. The substratum is yellowish-red gravelly sandy loam about 27 inches thick.

Permeability is slow. Available water capacity is high, and the effective rooting depth is 60 inches or more.

These soils are used mainly for seasonal grazing, wildlife habitat, and watershed catchment areas.

Representative profile of Vekol loam from an area of Vekol-Mohave complex, NW $\frac{1}{4}$ sec. 22, T. 9 N., R. 7 W.:

A1—0 to 3 inches, brown (10YR 5/3) heavy loam, dark brown (7.5YR 4/4) when moist; moderate, thin and medium, platy structure parting to weak, fine, granular; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet;

- many fine and very fine roots; common interstitial pores and very fine tubular pores; moderately alkaline; abrupt, smooth boundary.
- B21t—3 to 10 inches, brown (7.5YR 5/4) heavy 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; many fine and common very fine roots; common fine and very fine tubular pores; few thin clay films on ped faces; moderately alkaline; clear, smooth boundary.
- B22t—10 to 22 inches, reddish-brown (5YR 5/4) clay, reddish brown (5YR 4/4) when moist; weak, fine, prismatic structure parting to weak, fine and medium, subangular blocky; very hard when dry, firm when moist, sticky and plastic when wet; common fine roots; common fine tubular pores; common thin clay films on ped faces and in pores; moderately alkaline; clear, wavy boundary.
- B3tca—22 to 33 inches, brown (7.5YR 5/4) heavy clay loam, dark brown (7.5YR 4/4) when moist; weak, fine, subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; few fine roots; common fine tubular pores; few thin clay films on ped faces; slightly effervescent to strongly effervescent; common, fine, white (5YR 8/1) lime masses and filaments; moderately alkaline; gradual, wavy boundary.
- IIC—33 to 60 inches, yellowish-red (5YR 4/6) gravelly sandy loam, yellowish red (5YR 4/6) when moist; massive; hard when dry, friable when moist, nonsticky and nonplastic when wet; very few fine roots; moderately alkaline; gradual, wavy or irregular boundary.

The solum ranges from 28 to 60 inches in thickness. The soil generally is slightly effervescent in the surface layer but is noneffervescent to a depth of 20 to 30 inches in places. Reaction ranges from mildly alkaline to moderately alkaline throughout the profile.

In the A horizon hue is 10YR to 5YR, value is 5 or 6 dry and 3 or 4 moist, and chroma is 2 to 4. The A horizon is loam, silty clay loam, clay loam, or clay.

In the B2t horizon hue is 7.5YR or 5YR, value is 5 or 6 dry and 3 or 4 moist, and chroma is 3 or 4. The B2t horizon is clay, silty clay, or heavy clay loam. A buried B2t horizon is present in places below a depth of 4 feet.

Vekol-Mohave complex (Vm).—This complex is about 55 percent Vekol loam and about 35 percent Mohave soils. These soils are in an intricate pattern on nearly level plains and in swales. The Vekol loam is on the lower parts of fans and in swales. The Mohave sandy loam is on slightly higher areas.

Included with these soils in mapping, and making up about 10 percent of the acreage, are small areas of Anthony and Latene gravelly sandy loams and Gila loam.

Runoff is slow on these soils. The hazard of erosion is slight.

These soils are used mainly for seasonal grazing, wildlife habitat, and watershed catchment areas. Both parts in capability unit VII-1. Vekol part in Loam Bottoms range site, 8- to 12-inch precipitation zone; Mohave part in Loam Upland range site, 8- to 12-inch precipitation zone. Vekol part in wildlife group 2; Mohave part in wildlife group 1.

Venezia Series

The Venezia series consists of very shallow or shallow, well-drained soils. These soils formed in place in material weathered from basalt. They are on gently sloping to very steep hills, ridges, and mountainous

areas. Elevation ranges from 4,000 to 5,500 feet. The vegetation is brush and an understory of grass or, at the lower elevations, only grass. Annual precipitation is 12 to 18 inches. The average annual air temperature is 52° to 57° F, and the frost-free period is 140 to 235 days.

In a representative profile the surface layer is brown very stony loam and heavy loam about 10 inches thick. It is underlain by dark-gray, dense basalt.

Permeability is moderate. Available water capacity is low, and the effective rooting depth is less than 20 inches.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Representative profile of Venezia very stony loam, 30 to 60 percent slopes, 0.5 mile N. and 0.2 mile E. of the SW. corner, sec. 12, T. 10 N., R. 5 W.:

A11—0 to 2 inches, brown (10YR 5/3) very stony loam, dark brown (10YR 3/3) when moist; weak, medium, platy structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common fine and very fine roots; many fine vesicular pores and common fine interstitial pores and tubular pores; stones cover about 20 percent of the surfaces; mildly alkaline; clear, smooth boundary.

A12—2 to 10 inches, brown (10YR 4/3) heavy loam, dark brown (7.5YR 3/2) and (10YR 3/3) rubbed when moist; weak, fine and medium, subangular blocky structure; slightly hard when dry, friable when moist, sticky and plastic when wet; common fine and very fine roots; many very fine tubular pores and common fine interstitial pores; neutral; abrupt, irregular boundary.

R—10 to 12 inches, dark-gray (N 4/0), dense basalt.

Depth to bedrock ranges from 5 to 16 inches but is dominantly 8 to 12 inches. Reaction ranges from neutral to moderately alkaline throughout the profile. Stones and cobblestones cover from 10 to 40 percent of the surface. Content of gravel in the A horizon ranges from 20 to 40 percent.

In the A horizon hue is 10YR or 7.5YR, value is 3 to 5 dry and 2 or 3 moist, and chroma is 2 or 3. The A horizon is gravelly loam, cobbly loam, and very stony loam in the upper part and heavy loam or light clay loam in the lower part.

Venezia cobbly loam, 0 to 30 percent slopes (VnD).—This soil is on basalt hills that are dissected by numerous short drainageways. It has a profile similar to the one described as representative of the series, but the surface layer is cobbly loam.

Included with this soil in mapping, and making up about 10 percent of the acreage, are small areas of Cabezon gravelly clay loam and areas of rock outcrops.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIe-1; Granitic Loam Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Venezia very stony loam, 30 to 60 percent slopes (VrF).—This soil is on basalt hills and mountainous areas that are dissected by a few long and numerous short drainageways that have steep sides. In some areas the surface layer is cobbly or gravelly. Rock outcrops are common but cover less than 10 percent of the surface. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Venezia soils that have 15 to 30 percent slopes and Thunderbird cobbly clay loam that has 15 to 30 percent slopes. Also included are small areas of Cabezon very stony clay loam. These included soils make up about 15 percent of the acreage.

Runoff is rapid on this soil. The hazard of erosion is high.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIIIs-1; Granitic Loam Hills range site, 12- to 16-inch precipitation zone; wildlife group 5.

Venezia-Springerville complex, 0 to 20 percent slopes (VsC).—This complex is about 55 percent Venezia very stony loam and 30 percent Springerville cobbly clay. These soils are in an intricate pattern on nearly level to moderately steep basalt plains that are dissected by a few long drainageways that have steep sides. The Venezia very stony loam has a profile similar to the one described as representative of the series, but it has slopes of 8 to 15 percent. Springerville cobbly clay has a profile similar to that described as representative of the series, but it has a cobbly clay surface layer. Rock outcrops are common but cover only about 5 percent of the surface.

Included with these soils in mapping, and making up about 10 percent of the acreage, are small areas of Thunderbird, Cabezon, and Cross gravelly clay loams that have slopes of as much as 30 percent.

Runoff is medium and the hazard of erosion is moderate on the Venezia soil. Runoff is slow and the hazard of erosion is slight on the Springerville soil.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VIs-1. Venezia part in Granitic Loam Hills range site, 12- to 16-inch precipitation zone, Springerville part in Clay Upland range site, 12- to 16-inch precipitation zone. Venezia part in wildlife group 5; Springerville part in wildlife group 9.

Venezia-Thunderbird complex, 5 to 15 percent slopes (VtC).—This complex is about 60 percent Venezia gravelly loam that has slopes of 5 to 15 percent and 30 percent Thunderbird cobbly clay loam that has slopes of 5 to 8 percent. These soils are in an intricate pattern on moderately sloping to strongly sloping basalt hills dissected by a few drainageways that have moderately steep sides. The Venezia gravelly loam has a profile similar to the one described as representative of the series, but it has a gravelly loam surface layer. Rock outcrops are common throughout the acreage.

Included with these soils in mapping, and making up about 10 percent of the acreage, are small areas of Cabezon and Cross gravelly clay loams and Springerville cobbly clay.

Runoff is medium and the hazard of erosion is moderate on the Venezia soil. Runoff is low and the hazard of erosion is slight on the Thunderbird soil.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VIe-1. Venezia part in Granitic Loam Hills range site, 12- to 16-inch precipitation zone; Thunderbird part in Clay Loam Upland range site, 12- to 16-inch

precipitation zone. Venezia part in wildlife group 5; Thunderbird part in wildlife group 10.

Venezia-Thunderbird complex, 15 to 40 percent slopes (VtE).—This complex is about 60 percent Venezia gravelly loam that has slopes of 15 to 40 percent and 30 percent Thunderbird cobbly clay loam that has slopes of 15 to 30 percent. The Venezia gravelly loam has a profile similar to the one described as representative of the series, but it has a surface layer of cobbly loam. The Thunderbird cobbly clay loam has a profile similar to that described as representative of the series, but it has moderately steep and steep slopes.

Included with these soils in mapping, and making up about 10 percent of the acreage, are small scattered areas of Cabezon and Cross gravelly clay loams and Springerville cobbly clay. Also included are exposures of tuff and rock outcrops on the steeper areas.

Runoff is rapid on both soils. The hazard of erosion is high on Venezia soils and moderate on Thunderbird soils.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VIIe-1. Venezia part in Granitic Loam Hills range site, 12- to 16-inch precipitation zone; Thunderbird part in Clay Loam Upland range site, 12- to 16-inch precipitation zone. Venezia part in wildlife group 5; Thunderbird part in wildlife group 10.

Waldroup Series

The Waldroup series consists of deep, well-drained soils. These soils formed on cinders. They are on gently sloping to steep cinder cones and basalt flows. Slopes range from 2 to 30 percent or more. Elevation ranges from 5,000 to 6,800 feet. The vegetation is juniper along with an understory of brush and grass. Annual precipitation is 14 to 18 inches. The average annual air temperature is 52° to 55° F, and the frost-free period is 120 to 200 days.

In a representative profile the surface layer is brown very gravelly loam about 2 inches thick. The subsoil is reddish-brown heavy loam and gravelly clay about 19 inches thick. It is underlain by a substratum of mostly yellowish-red cinders that are weakly cemented.

Permeability is slow. Available water capacity is moderately high, and the effective rooting depth is 40 to 60 inches.

These soils are used for range, wildlife habitat, and watershed catchment areas.

Representative profile of Waldroup very gravelly loam that has slopes of 15 to 30 percent, from an area of Waldroup-Cabezon association, hilly, 500 feet S. and 500 feet E. of the NE. corner, sec. 20, T. 22 N., R. 4 W.:

A1—0 to 2 inches, brown (7.5YR 4/4) very gravelly loam, dark reddish brown (5YR 3/3) when moist; moderate, fine, granular structure; soft when dry, friable when moist, slightly sticky and plastic when wet; common fine roots; common fine interstitial pores; neutral; clear, wavy boundary.

B1t—2 to 6 inches, reddish-brown (5YR 4/4) heavy loam, dark reddish brown (5YR 3/3) when moist; moderate, fine and medium, granular structure; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; many fine and medium roots; common fine interstitial pores; few oriented clay

films as bridges between mineral grains; moderately alkaline; clear, smooth boundary.

- B2t—6 to 21 inches, reddish-brown (2.5YR 4/4) gravelly clay, dark red (2.5YR 3/6) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, firm when moist, sticky and plastic when wet; common fine and very few medium roots; few very fine tubular pores; continuous thin clay films on ped faces; gravel consists of dark-colored, weathered cinders; moderately alkaline; clear, wavy boundary.
- C1—21 to 25 inches, reddish-yellow (7.5YR 6/8) and black (10YR 2/1) weathered cinders and ash; massive; 75 percent cinders; very slightly effervescent; moderately alkaline; clear, wavy boundary.
- C2—25 to 40 inches, yellowish-red (5YR 5/6) and black (5YR 2/1) extremely hard cinders; massive; slightly effervescent in pockets.

The solum ranges from 20 to 48 inches in thickness but averages between 20 and 30 inches. The deeper soils generally are on colluvium and the lower part of cinder cones.

In the A1 horizon hue is 7.5YR or 5YR, value is 3 to 5 dry and 2 or 3 moist, and chroma is 3 or 4. The A1 horizon is loam, silt loam, silty clay loam, or light clay loam, all of which are modified by gravel consisting of cinders.

In the B2t horizon hue is 2.5YR, value is 3 or 4 dry and 2 or 3 moist, and chroma is 3 to 6. The B2t horizon is dominantly gravelly clay but ranges to heavy clay loam and clay.

Waldroup-Cabezón association, hilly (WcC).—This association is about 55 percent Waldroup very gravelly loam and about 35 percent Cabezón very stony loam. These soils are in an intricate pattern on moderately steep basalt and cinder hills that are dissected by a few drainageways. Waldroup very gravelly loam is on smoother side slopes, and Cabezón very stony loam is on ridgetops and breaks where basalt outcrops are common.

Included with these soils in mapping, and making up about 10 percent of the acreage, are small scattered areas of Cross and Thunderbird gravelly clay loams and Springerville cobbly clays.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VIIIs-1. Waldroup part in Clay Loam Upland range site, 12- to 16-inch precipitation zone; Cabezón part in Clay Loam Hills range site, 12- to 16-inch precipitation zone. Waldroup part in wildlife group 10; Cabezón part in wildlife group 5.

Whitlock Series

The Whitlock series consists of deep, well-drained soils that have a zone of lime accumulation at a shallow to moderate depth. These soils formed in mixed alluvium that weathered from granite, basalt, sandstone, schist, and limestone. They are on nearly level to strongly sloping alluvial fans. Slopes range from 0 to 15 percent. Elevation ranges from 2,000 to 4,000 feet. The vegetation is dominantly desert shrubs and cactuses and an understory of annual grasses. Annual precipitation is 8 to 12 inches. The average annual air temperature is 57° to 65° F, and the frost-free period is 180 to 240 days.

In a representative profile the surface layer is pale-brown gravelly sandy loam about 2 inches thick. The

underlying layer is light yellowish-brown sandy loam about 14 inches thick. It is underlain by white sandy loam that is weakly lime-cemented and extends to a depth of 60 inches or more.

Permeability is moderately rapid. Available water capacity is moderate, and the effective rooting depth is 60 inches or more.

These soils are used for seasonal grazing, wildlife habitat, and watershed catchment areas.

Representative profile of Whitlock gravelly sandy loam, 0 to 15 percent slopes, 0.5 mile N. of the SW. corner, sec. 33, T. 10 N., R. 8 W.:

- A1—0 to 2 inches, pale-brown (10YR 6/3) gravelly sandy loam, dark brown (10YR 4/3) when moist; weak, very thin, platy structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; few very fine and fine roots; many very fine interstitial pores; strongly effervescent; moderately alkaline; abrupt, smooth boundary.
- C1—2 to 16 inches, light yellowish-brown (10YR 6/4) sandy loam, yellowish brown (10YR 5/4) when moist; massive; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; common very fine and fine roots; many very fine interstitial pores and very few fine tubular pores; violently effervescent; moderately alkaline; clear, irregular boundary.
- C2a—16 to 60 inches, white (10YR 8/2) light sandy loam, light gray (10YR 7/2) when moist; massive slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; very few fine roots; violently effervescent; weakly lime-cemented with thin, discontinuous laminar layers in places; moderately alkaline.

Depth to the zone of lime accumulation ranges from 10 to 28 inches. Content of coarse fragments at a depth of between 10 and 40 inches averages less than 15 percent by volume. Lime nodules range from none to many in the A and C horizons.

In the A horizon hue is 10YR to 5YR, value is 6 or 7 dry and 4 or 5 moist, and chroma is 2 to 4. The A horizon is loam, coarse sandy loam, or loamy sand gravelly phases. The Cca horizon is weakly cemented in most areas. The Cca horizon is sandy loam, gravelly sandy loam, or gravelly loam and contains few to many, medium to large lime nodules.

Whitlock gravelly sandy loam, 0 to 15 percent slopes (WgC).—This soil is on alluvial fans that are dissected by numerous long drainageways. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Continental gravelly sandy loam on ridges and Anthony gravelly sandy loam in the drainageways. Also included are small areas of Whitlock soils that have slopes of 15 to 30 percent along some of the deeper drainageways. These included soils make up about 15 percent of the acreage.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for seasonal grazing, wildlife habitat, and watershed catchment areas. Capability unit VIIe-1; Loam Upland range site, 8- to 12-inch precipitation zone; wildlife group 2.

Whitlock-Anthony gravelly sandy loams, 0 to 15 percent slopes (WhC).—This complex is about 60 percent Whitlock gravelly sandy loam, 0 to 15 percent slopes, and 30 percent Anthony gravelly sandy loam, 0 to 8 percent slopes. These soils are in an intricate pattern on gently sloping to strongly sloping alluvial fans that

are dissected by a few shallow and moderately deep drainageways. Anthony soils generally are on the lower parts of the fans and in the drainageways.

Included with these soils in mapping, and making up about 10 percent of the acreage, are small areas of Mohave sandy loam and Continental gravelly sandy loam.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used for seasonal grazing, wildlife habitat, and watershed catchment areas. Capability unit VIIe-1; Loam Upland range site, 8- to 12-inch precipitation zone; wildlife group 2.

Wilcoxson Series

The Wilcoxson series consists of well-drained soils. These soils formed in residuum weathered from limestone. They are on moderately steep and steep limestone hills and mountain slopes. Elevation ranges from 5,500 to 6,500 feet. The vegetation is mixed conifer and oak and an understory of brush and grass. Annual precipitation is 18 to 20 inches. The average annual air temperature is about 47° F, and the frost-free period is 120 to 160 days.

In a representative profile the surface layer is brown gravelly loam about 3 inches thick. The subsoil is reddish-gray gravelly clay loam and weak-red gravelly clay and clay about 21 inches thick overlying pale-red gravelly loam. It is underlain by reddish-gray fractured limestone at a depth of 27 inches.

Permeability is slow. Available water capacity is low, and the effective rooting depth is 10 to 40 inches.

These soils are used for trees, range, wildlife habitat, and watershed catchment areas.

Representative profile of Wilcoxson gravelly loam, 30 to 60 percent slopes, in the SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 9, T. 18 N., R. 6 W.:

- O1—Thin covering of pinyon and juniper litter on the surface.
- A1—0 to 3 inches, brown (7.5YR 5/2) gravelly loam, dark brown (7.5YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; common very fine and fine roots; many micro pores and very fine interstitial pores; slightly effervescent; moderately alkaline; abrupt, smooth boundary.
- B1—3 to 9 inches, reddish-gray (5YR 5/2) gravelly clay loam, dark reddish brown (5YR 3/3) when moist; weak, fine subangular blocky structure; slightly hard when dry, firm when moist, sticky and plastic when wet; common fine and medium roots; many micro pores and very fine interstitial pores; slightly effervescent; moderately alkaline; clear, smooth boundary.
- B21t—9 to 13 inches, weak-red (2.5YR 5/2) gravelly clay, dusky red (2.5YR 3/2) when moist; weak, fine, subangular blocky structure; hard when dry, firm when moist, sticky and plastic when wet; few fine, medium, and coarse roots; common micro pores and very fine interstitial pores, and common fine tubular pores; few thin clay films on ped faces; strongly effervescent; moderately alkaline; clear, smooth boundary.
- B22t—13 to 24 inches, weak-red (2.5YR 5/2) clay, weak red (2.5YR 4/2) when moist; moderate, medium and fine, subangular blocky structure; hard when dry, firm when moist, sticky and very plastic when wet; common fine, medium, and coarse roots; common

micro pores and very fine interstitial pores, and common fine tubular pores; common thin clay films on ped faces; violently effervescent; strongly alkaline; abrupt, wavy boundary.

Cca—24 to 27 inches, pale-red (10R 6/2) gravelly loam, weak red (10R 5/2) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; few fine and medium roots; common micro pores and fine interstitial pores; violently effervescent; strongly alkaline; clear, irregular boundary.

The solum ranges from 13 to 28 inches in thickness. Depth to bedrock ranges from 20 to 48 inches. Horizons are slightly effervescent to strongly effervescent throughout.

In the A1 horizon hue is 10YR or 7.5YR, and value is 4 or 5 dry and 2 or 3 moist. In the B2t horizon hue is 7.5YR to 2.5YR, value is 4 or 5 dry and 3 or 4 moist, and chroma is 2 to 4. The B2t horizon is gravelly clay loam, gravelly clay, or clay. Content of gravel in the B horizon ranges from 20 to 35 percent by volume. Lime is disseminated in the Cca horizon.

The Wilcoxson soils as mapped in this survey area have a thinner solum and are shallower over bedrock than is typical for other areas of Arizona. Use and management are otherwise similar.

Wilcoxson gravelly loam, 30 to 60 percent slopes (WIF).
—This soil is on limestone hills and mountains. Rock outcrops and cobblestones are common but make up less than 10 percent of the surface layer.

Included with this soil in mapping, and making up about 5 percent of the acreage, are small scattered areas of coarse-textured, shallow soils in drainageways.

Runoff is rapid on this soil. The hazard of erosion is high.

This soil is used for trees, wildlife habitat, and watershed catchment areas. Capability unit VIIe-2; timber group 2; wildlife group 11.

Wineg Series

The Wineg series consists of deep, well-drained soils that have a zone of lime accumulation at a shallow depth. These soils formed in mixed alluvium weathered from granite, basalt, schist, and sandstone. They are on nearly level to moderately sloping alluvial fans and plains. Slopes range from 0 to 8 percent. Elevation ranges from 4,000 to 6,000 feet. The vegetation is dominantly grass. Annual precipitation is 12 to 16 inches. The average annual air temperature is about 53° F, and the frost-free period is 140 to 200 days.

In a representative profile the surface layer is grayish-brown sandy loam about 2 inches thick. The subsoil is dark-brown clay loam and light-brown gravelly sandy clay loam about 12 inches thick. The substratum is pinkish-gray and pink sandy loam that is weakly cemented with lime to a depth of 64 inches or more in places.

Permeability slow. Available water capacity is moderate, and the effective rooting depth is 60 inches or more.

These soils are used for range, irrigated crops, homesites, wildlife habitat, and watershed catchment areas.

Representative profile of Wineg sandy loam, 0.2 mile E. and 0.1 mile S. of the NW. corner, sec. 9, T. 15 N., R. 2 W.:

- A1—0 to 2 inches, grayish-brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard when

dry, very friable when moist, nonsticky and nonplastic when wet; many fine and common very fine roots; many very fine interstitial pores; neutral; abrupt, smooth boundary.

B2t—2 to 8 inches, dark-brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; very few fine and common very fine roots; very few very fine tubular pores and common very fine interstitial pores; few thin clay films on ped faces and in pores; mildly alkaline; clear, smooth boundary.

B3t—8 to 14 inches, light-brown (7.5YR 6/4) gravelly sandy clay loam, dark brown (7.5YR 4/4) when moist; massive; hard when dry, friable when moist, slightly sticky and plastic when wet; few very fine roots; common very fine interstitial pores; few clay films as bridges between mineral grains; moderately alkaline; gradual, wavy boundary.

C1ca—14 to 38 inches, pinkish-gray (7.5YR 7/2) sandy loam, brown (7.5YR 5/4) when moist; massive; hard when dry, very friable when moist, slightly sticky and nonplastic when wet; few very fine roots; common very fine interstitial pores; violently effervescent; many medium, white (N 8/0), soft lime segregations; moderately alkaline; gradual, wavy boundary.

C2ca—38 to 52 inches, pinkish-gray (7.5YR 7/2) sandy loam, light brown (7.5YR 6/4) when moist; massive; hard when dry, very nonplastic when wet; common very fine interstitial pores and very few very fine tubular pores; violently effervescent; weakly lime-cemented in discontinuous strata; moderately alkaline; gradual, wavy boundary.

C3ca—52 to 64 inches, pink (7.5YR 7/4) coarse sandy loam, brown (7.5YR 5/4) when moist; massive; hard when dry, very friable when moist, slightly sticky and nonplastic when wet; common very fine interstitial pores and very few fine tubular pores; strongly effervescent; few discontinuous, weakly lime-cemented layers; moderately alkaline.

The solum ranges from 13 to 20 inches in thickness. Reaction ranges from neutral to slightly acid in the A horizon and to moderately alkaline in the Cca horizon.

The A horizon has value of 4 or 5 dry and 2 or 3 moist, and chroma is 2 or 3. The A horizon is sandy loam, loam, or gravelly sandy loam. Structure is weak or moderate granular. In the B2t horizon hue is 7.5YR or 10YR, value is 3 to 5 dry and 2 to 4 moist, and chroma is 2 to 4. The B2t horizon is clay loam, sandy clay loam, or gravelly sandy clay loam. The Cca horizon overlies unconformable gravelly alluvium or unrelated lakebed deposits below a depth of 48 inches in places.

Wineg sandy loam (W_m).—This nearly level to moderately sloping soil is on alluvial fans that are dissected by a few long drainageways. It has the profile described as representative of the series. In some areas the surface layer is gravelly.

Included with this soil in mapping, and making up about 15 percent of the acreage, are small areas of Abra gravelly loam on the fans and Lynx loam in the drainageways.

Runoff is slow on this soil. The hazard of erosion is slight.

This soil is used for range, wildlife, habitat, and watershed catchment areas. Some areas are used for irrigated crops and homesites. Capability unit VIs-1; Limy Upland range site 12- to 16-inch precipitation zone; wildlife group 7.

Wineg-Abra complex (W_n).—This complex is about 60 percent Wineg sandy loam and 30 percent Abra loam. These soils are in an intricate pattern on gently sloping to gently rolling alluvial plains. The Wineg soils have

slopes of less than 5 percent, and the Abra soils are on the steeper higher-lying areas.

Included with these soils in mapping, and making up about 10 percent of the acreage, are small areas of Lynx loam in drainageways or swales and Lonti gravelly loam on ridges.

Runoff is slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. A limited acreage is used for irrigated crops and homesites. Both parts in capability unit VIs-1; Limy Upland range site, 12- to 16-inch precipitation zone; wildlife group 7.

Wineg-Lynx association (W_o).—This association is about 60 percent Wineg sandy loam and 30 percent Lynx loam. These soils are in an intricate pattern on gently sloping ridges and in nearly level swales. A few deep gullies are entrenched in the swales.

Included with these soils in mapping, and making up about 10 percent of the acreage, are small areas of granite rock outcrops and small areas of granite boulders.

Runoff is slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. A limited acreage is used for irrigated crops and homesites. Both parts in capability unit VIs-1. Wineg part in Limy Upland range site, 12- to 16-inch precipitation zone; Lynx part in Loam Bottoms range site, 12- to 16-inch precipitation zone. Wineg part in wildlife group 7; Lynx part in wildlife group 6.

Wineg and Poley soils (W_p).—This undifferentiated group consists of Wineg and Poley soils that occur without regularity of pattern or proportion. These nearly level to undulating soils are on alluvial plains and swales.

Included with these soils in mapping are small areas of Lynx soils in the swale positions, Abra loam on ridges, and Cordes sandy loam in the swales. These included soils make up about 10 percent of the acreage.

Runoff is slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, homesites, and watershed catchment areas. A limited acreage is used for irrigated crops. Capability unit VIs-1; Limy Upland range site 12- to 16-inch precipitation zone; wildlife group 7.

Use and Management of the Soils

Certain soil characteristics are dominant in determining the behavior of any soil under defined use and management. When several soils have the same dominating characteristics they can be placed into special groupings for interpretations of their behavior under specified use and management. In Yavapai County, Western Part, the soils have been grouped into capability units, range sites, range productivity groups, timber groups, and wildlife sites. In addition to the discussion of the use and management of soils in these five groupings, properties of the soils related to engi-

neering interpretations are given in this section of the survey.

These interpretations should be used only as a general guide. Specialists or planning technicians should be consulted for detailed planning or individual problems concerning these soils.

Irrigated soils in this survey area are of limited extent. Interpretations for irrigated soils require more detailed information than can be obtained from a soil survey made at this intensity. Therefore, interpretations for irrigated soils are not given in this survey. Irrigated soils are Abra, Anthony, Cordes, Lonti, Lynx, Poley, and Wineg soils. The principal irrigated areas are in the Chino Valley along Big Chino Wash, and in the Dewey, Skull Valley, Kirkland, and Date Creek areas. Detailed information about irrigated areas can be obtained from the District Conservationist, Soil Conservation Service, Prescott, Arizona.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or for engineering.

In the capability system, the kinds of soil are grouped at three levels: the capability class, the subclass, and the unit. These are discussed in the following paragraphs.

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. (None in Yavapai County, Western Part.)

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices. (None in Yavapai County, Western Part.)

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both. (None in Yavapai County, Western Part.)

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both. (None in Yavapai County, Western Part.)

Class V soils are subject to little or no erosion but have other limitations, impractical to remove,

that limit their use largely to pasture, range, woodland, or wildlife habitat.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, or water supply, or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within the class; they are designated by adding a small letter *e*, *w*, *s*, or *c*, to the class numeral, for example, VIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, although they have other limitations that restrict their use largely to pasture, range, woodland, wildlife habitat, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, VIe-1 or VIIe-1. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

No soils in the survey area are in capability classes I through IV. The soils in classes VI and VII are used mainly for range and woodland. Specific suggestions for management of these soils are given in the appropriate descriptions of the range sites and timber groups.

The capability unit for each soil can be learned by referring to that soil in the section "Descriptions of the Soils," or to the "Guide to Mapping Units" at the back of this survey.

In the following pages the capability units in Yavapai County, Western Part, are described.

CAPABILITY UNIT Vw-1

Only Lynx soils, wet variant, are in this capability unit. These are somewhat poorly drained soils that have a loam surface layer. Slopes range from 0 to 1 percent. Average annual precipitation is 12 to 16 inches, and the frost-free period is 140 to 220 days.

Permeability is moderately slow. Available water capacity is high, and the effective rooting depth is 60 inches or more. Runoff is very slow. The hazard of erosion is slight. A seasonal high water table is at a depth of 2 to 3 feet for significant periods during the year.

These soils are used mainly for range, wildlife habitat, and watershed catchment areas.

Seeding, brush control, and rotation-deferred grazing are good range management practices that help to maintain or improve the plant cover.

CAPABILITY UNIT VIe-1

This unit consists of well-drained soils that have a sandy loam to clay loam surface layer that generally is gravelly or cobbly. These soils are on plains, alluvial fans, terraces, hills, and mountains. They are dominantly strongly sloping to moderately steep or rolling to hilly but range to nearly level. Average annual precipitation ranges from 10 to 18 inches, and the frost-free period is 140 to 200 days.

Permeability is moderately rapid to slow. Available water capacity ranges from low to high. Effective rooting depth is deep to shallow. Runoff is mainly medium but ranges from slow to rapid. The hazard of erosion is mainly moderate but ranges from slight to high.

These soils are used mainly for range and wildlife habitat. They are also used for recreation, watershed catchment areas, and mining.

Range management practices that include seeding, brush control, controlled burning, and water spreading can be used to improve the plant cover.

CAPABILITY UNIT VIe-2

This unit consists of timbered soils on alluvial fans, hills, ridges, and mountains. Elevations range from about 5,000 to 8,000 feet. These are shallow to deep, well-drained soils that have a gravelly loam and gravelly sandy loam surface layer. They range from nearly level to moderately steep, but are dominantly moderately sloping to moderately steep. Average annual precipitation ranges from 18 to 25 inches. The average annual temperature is 43° to 55° F.

Permeability is moderately rapid or slow. Available water capacity is low to high. Runoff ranges from slow to rapid, but it is medium to rapid in most areas. The hazard of erosion is moderate to high.

These soils are wooded. The understory grasses are grazed by livestock and wildlife. These soils are also used as watershed catchment areas.

CAPABILITY UNIT VIe-1

This unit consists of well-drained soils that have a sandy loam to clay surface layer that generally is either gravelly or cobbly, stony, very stony, rocky, or very rocky. The nearly level to moderately sloping soils are gravelly and cobbly, and the nearly level to moderately steep soils are stony and rocky (fig. 9). These soils are

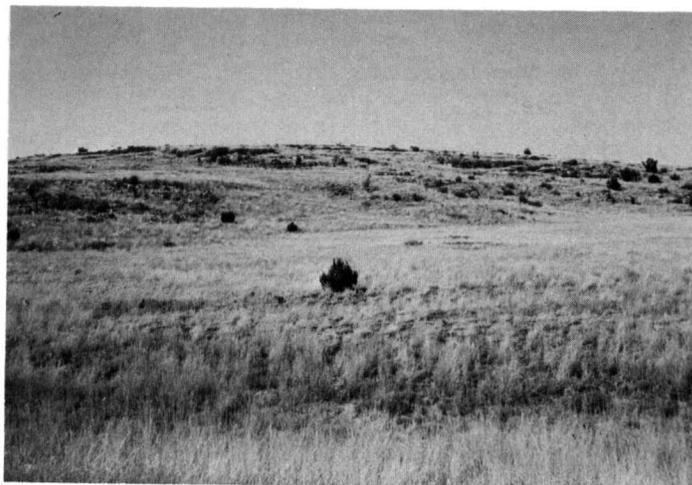


Figure 9.—Typical area of soils in capability class VI. Jacks very rocky loam is in the background and Apache gravelly loam is in the foreground.

on plains, alluvial fans, hills, and terraces. Average annual precipitation ranges from 12 to 18 inches, and the frost-free period is 115 to 235 days.

Permeability is moderately rapid to slow. Available water capacity is low to high. Effective rooting depth is shallow to deep. Runoff is mostly slow or medium but ranges to very slow. The hazard of erosion is mostly slight but ranges to moderate on steeper soils.

These soils are used mainly for range and wildlife habitat. They are also used for recreation and as watershed catchment areas.

Range management practices that include seeding, brush control, controlled burning, and water spreading can be used to improve the plant cover.

CAPABILITY UNIT VIe-2

This unit consists of timbered soils on uplands, hills, and ridges at elevations of about 6,200 to 7,600 feet. These are moderately deep and deep, well-drained soils that have a gravelly loam and very stony silt loam surface layer. Slopes are nearly level to hilly. Average annual precipitation is 18 to 22 inches. The average annual air temperature is about 44° F.

Permeability is slow. Available water capacity is low and moderate. Runoff is slow or medium. The hazard of erosion is slight or moderate.

These soils are wooded. The understory grasses are grazed by livestock and wildlife. These soils are also used as watershed catchment areas.

CAPABILITY UNIT VIc-1

This unit consists of well-drained soils that have a loam and clay loam surface layer. These soils are on alluvial fans and flood plains. Slopes are nearly level to gently sloping. Average precipitation is 10 to 20 inches or more. The frost-free period is 120 to 220 days.

Permeability is moderately slow. Available water capacity is high. The effective rooting depth is deep. Runoff is slow or medium. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas.

Range management practices that include seeding, brush control, controlled burning, and water spreading can be used to improve the plant cover.

CAPABILITY UNIT VIIe-1

This unit consists of well-drained soils that mostly have a gravelly or cobbly sandy loam to clay loam surface layer. These soils are on plains, alluvial fans, hills, ridges, and mountains. Slopes are mostly strongly sloping to very steep but range to nearly level. Average annual precipitation ranges from 8 inches at the lower elevations to 20 inches at the higher and steeper ones. The frost-free period is 120 to 240 days.

Permeability is moderately rapid to slow. Available water capacity is low to high. Effective rooting depth is shallow to deep. Runoff is mostly medium to rapid but ranges to slow in flatter areas. The hazard of erosion is mostly moderate to high but also ranges to slight in flatter areas.

These soils are used mainly for range and wildlife habitat. They are also used for recreation and for watershed catchment areas, and to a limited extent, for urban development.

These soils are not suitable for seeding or other mechanical practices because of low precipitation, steep or very steep slopes, or the severe hazard of erosion.

CAPABILITY UNIT VIIe-2

This unit consists of timbered soils on hills, mountains, and ridges at elevations of about 6,000 to 8,000 feet. These are moderately deep and shallow, well-drained soils that have a gravelly loam and gravelly sandy loam surface layer. Slopes are rolling to very steep. Average annual precipitation is 18 to 25 inches. The average annual air temperature is 43° to 44° F.

Permeability is moderately rapid or slow. Available water capacity is moderate or low. Runoff is rapid. The hazard of erosion is high.

These soils are wooded. Livestock and wildlife graze the understory grasses. These soils are also used for recreation, mining, and watershed catchment areas.

CAPABILITY UNIT VIIe-1

This unit consists of well-drained soils that are either nearly level to moderately sloping or gently sloping to very steep. The nearly level to moderately sloping soils have a sandy loam, gravelly sandy loam, or cobbly clay surface layer, and the gently sloping to very steep soils have a very stony, very rocky, extremely rocky, or very gravelly sandy loam to clay loam surface layer. Average annual precipitation ranges from 8 inches at the lower elevations to 18 inches at the higher ones. The frost-free period is about 118 to 270 days.

Permeability is moderately rapid to slow. Available water capacity is low to high. Effective rooting depth is very shallow to deep. Runoff is slow to medium on the more nearly level soils but ranges to rapid on the steeper soils. The hazard of erosion is slight to moderate on the more nearly level soils but ranges to high on the steeper soils.

These soils are used mainly for range and wildlife habitat. They are also used for recreation, for watershed catchment areas, and, to a limited extent, for urban development and mining.

These soils are not suitable for seeding or other mechanical management practices because of low precipitation, a very stony or very rocky surface layer, and steep to very steep slopes.

CAPABILITY UNIT VIIw-1

This unit consists of miscellaneous land types that are deep, stratified, and subject to periodic overflow. They are nearly level to moderately sloping and are in drainageway bottoms or immediately adjacent to shallow drainageways. Runoff is slow. The hazard of erosion is slight to high.

These land types are used for range and wildlife habitat. They are not suitable for seeding or other mechanical management practices because of low precipitation and periodic overflow.

CAPABILITY UNIT VIIe-1

This unit consists of well-drained soils that have a gravelly sandy loam, sandy loam, or silt loam surface layer. These soils are on flood plains, alluvial fans, and stream terraces. They are nearly level to moderately sloping. Average annual precipitation is 8 to 12 inches. The frost-free period is 200 to 260 days.

Permeability is moderate or moderately slow. Available water capacity is high. The effective rooting depth is deep. Runoff is slow. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. A few small included areas are used for crops if an adequate supply of good-quality water is available for irrigation. Average annual precipitation is insufficient for successful seeding.

CAPABILITY UNIT VIIIe-1

This unit consists of Badland. This is actively eroding fine- to coarse-textured lakebed sediment or highly dissected old alluvium. Slopes are complex and steep to very steep. Runoff is rapid or very rapid. The hazard of erosion is very high.

Range²

This section describes the principles of range management, defines range sites and condition classes, describes the range sites and range herbage groups, and names some of the common plants in the survey area. The soils in this survey area have been grouped into 12 range sites. In addition, those soils that are on National Forest lands have been placed into range herbage groups that are useful to users of National Forest lands. Correlation between the range herbage groups and range sites can be found in the Guide to Mapping Units at the end of this survey.

Range management

A high production of quality forage conserves and protects soil, moisture, and plant resources. A harvest

² By ALBERT P. THATCHER, range conservationist, Soil Conservation Service.

of high-quality forage can be insured by maintaining the native vegetation or by improving it to its highest potential. Grasses manufacture in their green leaves the food they need to grow, flower, and reproduce. If grasses are not overgrazed, the plants remain healthy and vigorous.

Livestock seek out and graze the more palatable plants. Generally, if only about half the grass produced yearly is eaten by livestock, damage to the desirable plants is minimized. The remaining forage is not wasted; it serves the following functions:

1. Serves as mulch and enhances intake and storage of water.
2. Allows roots to reach moisture deep in the soil.
3. Protects the surface from erosion by wind and water.
4. Allows the better grasses to crowd out weeds and other undesirable plants.
5. Enables plants to store in their roots the food they need for quick, vigorous growth in spring and after periods of drought.
6. Catches and holds snow and rain where it falls so that it soaks into the soil.
7. Provides a reserve of food for use in dry periods.

Range sites and condition classes

There are many differences in the soils and climate of Yavapai County, Western Part. For these reasons, there are several different kinds of range. These are called range sites.

Over the centuries, on undisturbed sites, a mixture of plants best adapted for growing on each range site has developed. This group of plants is called the potential or climax plant community for the site. This relationship between the potential plant community, climate, and soil is reasonably consistent. When this relationship is known, the potential plant community for an identified soil can be predicted, even though the vegetation is severely disturbed and completely different from potential.

Range conservationists and soil scientists, working together, group soils that naturally grow the same climax plant communities into range sites.

Repeated overuse by grazing animals, excessive burning, or plowing results in changes in the kinds, proportions, or amounts of climax plants in the plant community. Depending on the kind and degree of disturbance, some kinds of plants increase while others decrease. If disturbance is severe, plants which do not belong in the climax plant community may invade. Plant response to grazing use depends on the kind of grazing animal, the season of use, and how closely the plant is grazed. If good management follows disturbances, however, the climax plant community is gradually reestablished unless the soils have been seriously eroded.

Range condition is an expression of how the present plant community compares with the climax plant community for the range site. The more nearly the present kinds and amounts of plants are like the climax plant mixture, the higher the range condition.

The present range condition provides an index to changes which have taken place in the plant community. More important, however, range condition is a basis for predicting the kinds and amounts of changes in the present plant community. These changes are the result of management and treatment measures. Thus, the range condition rating indicates the nature of the present plant community and the climax cover for the range sites and represents a goal toward which range management may be directed.

Knowledge of the climax plant communities of range sites and the nature of present plant communities in relation to that potential is important in planning and applying conservation on range. Such information is the basis for selecting management objectives, design of grazing systems, managing for wildlife, determining potential for recreation, and rating watershed conditions.

Good management provides for a plant cover that will adequately protect or improve the soil and water resources and meet the needs of the operator. This generally involves increasing desirable plants and restoring the plant community to near climax conditions. Sometimes, however, a plant cover somewhat below climax condition better fits specific grazing needs, provides better wildlife habitat, or furnishes other benefits while still protecting the soil and water.

Descriptions of range sites

In the following pages, the range sites of Yavapai County, Western Part, are described, and the climax plants are listed for each site. Plant species most likely to invade are also shown. In addition, an estimate of the potential annual production of air-dry vegetation is indicated for each site. The soils in each range site may be determined by referring to that soil in the section "Descriptions of the Soils" or in the "Guide to Mapping Units" at the back of this survey.

LOAM BOTTOMS RANGE SITE, 8- TO 12-INCH PRECIPITATION ZONE

This range site consists of well-drained, nearly level to gently sloping soils on alluvial fans, flood plains, and swales. These deep soils receive extra moisture in the form of stream overflow and runoff from adjacent slopes. Texture of the surface layer ranges from fine sandy loam to clay. Permeability of the subsoil varies considerably from place to place. Most of these soils contain concentrations of lime, but most are free of excessive salts and alkalis.

The climax plant community is 10 to 20 percent big galleta; 10 to 15 percent, each, bush muhly and three-awn; 0 to 25 percent tobosa; 0 to 5 percent, each, slim tridens, Arizona cottontop, ratany, and desert broom; 5 to 10 percent, each, cane beardgrass, burrobrush, creosotebush, Mormon tea, and ironwood; and 20 to 30 percent native annuals.

In excellent condition, this range site yields about 400 pounds of herbage per acre during unfavorable years. During favorable years, the annual yield is about 1,000 pounds per acre. Wide variations in the amount of water received cause large differences in the amount

of herbage produced. About 80 percent of the herbage on this site can be used by cattle and wildlife.

Under continued heavy grazing, such plants as bush muhly, big galleta, Arizona cottontop, and four-wing saltbush decrease in the plant community; and such plants as creosotebush, bursage, mesquite, and annuals increase.

Good management practices on this site are range seeding, brush control, and range renovation.

LOAM UPLAND RANGE SITE, 8- TO 12-INCH
PRECIPITATION ZONE

This range site consists of nearly level to moderately sloping soils on uplands. Rainfall is the only source of moisture. The soils are deep to moderately deep. The surface layer ranges from sandy loam to coarse sandy clay loam. Slight salt concentrations and weak alkaline reactions are characteristic of these soils. Accumulations of carbonates either in zones or throughout the soil are common.

The climax plant community is 10 to 20 percent bush muhly; 30 to 50 percent black grama; 5 to 10 percent, each, Arizona cottontop, Cholla cactus, desert thorn, three-awn, paloverde, and bursage; 20 to 30 percent, each, big galleta and native annuals; 0 to 5 percent, each, Indian ricegrass, cane beardgrass, fluff grass, wolfberry, and burrobrush; 10 to 15 percent creosotebush; and 0 to 10 percent Joshua tree.

In excellent condition, this range site yields about 300 pounds of herbage per acre during unfavorable years. During favorable years, the annual yield is about 600 pounds per acre. About 50 percent of the herbage on this site can be used by cattle and wildlife.

Under continued heavy grazing, such plants as bush muhly, black grama, Indian ricegrass, and Arizona cottontop decrease in the plant community; and such plants as annuals, creosotebush, bursage, and three-awn increase.

Good management practices on this site are proper grazing use and deferred grazing.

CALICHE UPLAND RANGE SITE, 8- TO 12-INCH
PRECIPITATION ZONE

This range site consists of gently sloping soils on alluvial fans that are dissected by numerous drainages. The surface layer of these soils is highly calcareous gravelly sandy loam. A shallow zone of indurated carbonate accumulation distinguishes the soils of this range site from other calcareous soils of the desert.

The climax plant community is 15 to 20 percent bush muhly; 5 to 10 percent, each, desert needlegrass, three-awn, paloverde, bursage, cholla cactus, and perennial forbs; 10 to 25 percent black grama; 10 to 15 percent big galleta; 0 to 5 percent, each, fluffgrass and slim tridens; 15 to 25 percent creosotebush; and 20 to 30 percent native annuals.

In excellent condition, this range site yields about 150 pounds per acre during unfavorable years. During favorable years, the annual yield is about 400 pounds per acre. About 50 percent of the herbage on this site can be used by cattle and wildlife.

Under continued heavy grazing, such plants as bush muhly, desert needlegrass, and black grama decrease

in the plant community; and such plants as creosotebush, annuals, and bursage increase.

Good management practices on this site are brush control, range seeding, and range renovation.

LOAM HILLS RANGE SITE, 8- TO 12-INCH
PRECIPITATION ZONE

This range site consists of moderately sloping to steep soils. These soils are shallow and have a surface layer of sandy loam to clay loam. Rock and gravel are commonly mixed throughout the soil and on the surface. Bedrock generally is granitic, but volcanic and sedimentary outcrops generally are present throughout the landscape.

The climax plant community is 5 to 10 percent, each, three-awn, mutton bluegrass, fairy duster, ratany, desert ceanothus, paloverde, cholla, perennial forbs, and creosotebush; 10 to 15 percent, each, bush muhly, desert needlegrass, and native annuals; 0 to 10 percent, each, tobosa and side-oats grama; 5 to 15 percent big galleta; 10 to 25 percent black grama; 0 to 5 percent, each, cane beardgrass, desert thorn, and yucca; and 0 to 20 percent coffeeberry.

In excellent condition, this range site yields about 300 pounds of herbage per acre during unfavorable years. During favorable years, the annual yield is about 500 pounds per acre. About 45 percent of the herbage on this site can be used by cattle and wildlife.

Under continued heavy grazing, such plants as bush muhly, black grama, big galleta, and desert needlegrass decrease in the plant community; and such plants as desert thorn, cholla, annuals, and creosotebush increase.

Good management practices on this site are brush control, range seeding, and range renovation. Because of steep slopes, livestock distribution is a major problem.

CLAY LOAM HILLS RANGE SITE, 12- TO 16-INCH
PRECIPITATION ZONE

This range site consists of moderately sloping to steep soils on uplands. Outcrops of basaltic material or other related material are common. The surface layer is medium textured to fine textured. These are shallow soils that formed in place in material weathered from basalt. Reaction in these soils is slightly alkaline to moderately alkaline. Calcium carbonate accumulations and slight concentrations of soluble salts are common to the soils in this range site.

The climax plant community is 25 to 50 percent side-oats grama; 5 to 10 percent, each, vine mesquite, mutton bluegrass, tobosa, chamiza, juniper, winterfat, cliffrose, and perennial forbs; 0 to 5 percent, each, spike muhly, prairie junegrass, Halls panic, and algerita; 0 to 10 percent western wheatgrass; and 10 to 15 percent blue grama.

In excellent condition, this range site yields about 500 pounds of herbage per acre during unfavorable years. During favorable years, the annual yield is about 800 pounds per acre. About 70 percent of the herbage on this site can be used by cattle and wildlife.

Under continued heavy grazing, such plants as side-oats grama, vine mesquite, mutton bluegrass, four-wing saltbush, and winterfat decrease in the plant commu-

nity; and such plants as blue grama, tobosa, and low-value perennial forbs increase. In poor condition, annuals and three-awns dominate the plant community. In the absence of frequent natural fires, juniper and other woody plants tend to increase regardless of the range-management practices applied.

Juniper control is feasible on some of the deeper soils of the site, where slopes are moderate and where grasses are adequate to reoccupy the site. Good management practices on this range site are brush control, range seeding, and range renovation. The steep and rough terrain make the proper distribution of livestock grazing difficult.

GRANITIC LOAM HILLS RANGE SITE, 12- TO 16-INCH
PRECIPITATION ZONE

This range site consists of moderately sloping to steep soils on uplands. Outcrops of granite, schist, and tuff bedrock are common. The soils are shallow and have a gravelly loam surface layer. Reaction is neutral to slightly acid. These soils have little or no accumulation of calcium carbonates.

The climax plant community is 25 to 50 percent black grama; 15 to 25 percent side-oats grama; 0 to 5 percent, each, Halls panic, sprangletop, dropseeds, and manzanita; 5 to 10 percent, each, prairie junegrass, squirreltail, plains lovegrass, cane beardgrass, desert needlegrass, mutton bluegrass, and perennial forbs; and 10 to 20 percent, each, blue grama, hairy grama, curly mesquite, and turbinella oak.

In excellent condition, this range site yields about 600 pounds per acre during unfavorable years. During favorable years, the annual yield is about 1,000 pounds per acre. About 60 to 70 percent of the herbage on this site can be used by cattle and wildlife.

Under continued heavy grazing, such midgrasses as side-oats grama, Halls panic, prairie junegrass, cane beardgrass, and desert needlegrass decrease in the plant community; and low-growing grasses and unpalatable forbs increase. Shrubs, mainly turbinella oak, increase in size as the grass competition decreases. Reduction of natural fires permits increase of shrubs.

Good management practices on this site are range renovation, range seeding on the deeper soils, and brush control. Because of steep slopes and rough surfaces, livestock distribution is a major problem on this site.

LIMY HILLS RANGE SITE, 12- TO 16-INCH
PRECIPITATION ZONE

This range site consists of moderately sloping to strongly sloping soils. Outcrops of sedimentary bedrock are common. These shallow soils have a surface layer that ranges from sandy loam to coarse sandy clay loam. Gravel is on the surface of the soil and is mixed throughout the soil profile. Reaction is mildly alkaline or moderately alkaline throughout. Content of soluble salt is slight. Content of calcium carbonate is moderately high in some horizons of the soil profiles.

The climax plant community is 25 to 50 percent side-oats grama; 5 to 10 percent, each, squirreltail, junegrass, mutton bluegrass, cane beardgrass, four-wing saltbush, cliffrose, desert ceanothus, mountainmahogany, and perennial forbs; 10 to 15 percent, each, needle-andthread and black grama; 15 to 30 percent, each, blue

grama and hairy grama; 0 to 5 percent, each, algerita, pinyon, and fernbush; and 5 to 15 percent juniper.

In excellent condition, this range site yields about 500 pounds of herbage per acre during unfavorable years. During favorable years the annual yield is 900 pounds per acre. About 75 percent of the herbage on this site can be used by cattle and wildlife.

Under continued heavy grazing, such midgrasses and palatable shrubs as side-oats grama, mutton bluegrass, needleandthread, four-wing saltbush, cliffrose, and mountainmahogany decrease in the plant community; and such plants as blue grama, hairy grama, algerita, pinyon, and juniper increase. Absence of fire allows juniper and pinyon to increase regardless of grazing management.

Good management practices on this site are brush control, range seeding, and range renovation. Juniper control is successful on most soils of this site where there is enough grass in the understory to become potentially reestablished. Good livestock distribution is difficult because of the steep, rough topography.

LOAM BOTTOMS RANGE SITE, 12- TO 16-INCH
PRECIPITATION ZONE

This range site consists of nearly level to gently sloping soils on alluvial fans or flood plains and nearly level soils in swales. These deep soils receive extra moisture in the form of stream overflow and runoff from adjacent slopes. The surface layer is sandy loam to clay loam. Reaction ranges from neutral to moderately alkaline. Only minor amounts of soluble salt accumulations are present.

The climax plant community is 15 to 25 percent side-oats grama; 15 to 20 percent western wheatgrass; 10 to 20 percent blue and hairy grama; 10 to 15 percent, each, cane beardgrass and vine mesquite; 5 to 10 percent, each, squirreltail, wolftail, sedges and rushes, and four-wing saltbush; 5 to 20 percent tobosa; 0 to 20 percent alkali sacaton; 0 to 10 percent Kentucky bluegrass; and 0 to 5 percent, each, mat muhly, Apache plume, turbinella oak, and juniper.

In excellent condition, this range site yields about 1,200 pounds of herbage per acre during unfavorable years. During favorable years, the annual yield is about 1,800 pounds per acre. About 90 percent of the herbage on this site can be used by cattle and wildlife.

Under continued heavy grazing, such plants as side-oats grama, cane beardgrass, and vine mesquite decrease in the plant community; and such plants as blue and hairy grama, tobosa, and mat muhly increase. Annuals, low-value forbs, and many three-awns dominate the plant community when the site is in poor condition. In the absence of frequent natural fires, such woody plants as juniper, turbinella oak, algerita, and Apache plume dominate the site in places.

Good management practices on this site are brush control, range seeding, contour furrowing, range pitting, and range renovation.

LIMY UPLAND RANGE SITE, 12- TO 16-INCH
PRECIPITATION ZONE

This range site consists of nearly level soils on plains, gently sloping soils on fans, and moderately sloping soils on rolling hills. These deep to moderately deep

soils have a surface layer that ranges from sandy loams to coarse sandy clay loam. Reaction is mildly alkaline or moderately alkaline. The content of soluble salt is slight. Calcium carbonate concentrations can be found throughout the soil profile or in zones within the rooting depth of most plants. Gravel and cobbles are on the surface or scattered through the soil profile in places.

The climax plant community is 25 to 50 percent side-oats grama; 10 to 15 percent, each, needleandthread and blue grama; 5 to 10 percent, each, squirreltail, wolftail, Indian ricegrass, four-wing saltbush, and twinberry; 0 to 5 percent, each, cane beardgrass, prairie junegrass, sand dropseed, slender tridens, and cliffrose; 10 to 25 percent black grama; 5 to 15 percent juniper and 0 to 15 percent pinyon.

In excellent condition, this range site yields about 600 pounds of herbage per acre during unfavorable years. During favorable years, the annual yield is about 1,000 pounds per acre. About 70 percent of the herbage on this site can be used by cattle and wildlife.

Under continued heavy grazing, such midgrasses as side-oats grama, needleandthread, and Indian ricegrass and such palatable shrubs as four-wing saltbush and cliffrose decrease in the plant community; and such plants as blue grama, annuals, and forbs of low palatability increase. In the absence of fire, juniper and pinyon dominate the site in places.

Good management practices on this site are juniper control, range seeding, range renovation, contour furrowing, and range pitting.

LOAM UPLAND RANGE SITE, 12- TO 16-INCH PRECIPITATION ZONE

This range site consists of gently rolling soils on hills, and nearly level soils on fans and plains. These deep to moderately deep soils have a surface layer that ranges from fine sandy loam to coarse sandy clay loam. The subsoil is fine textured in places. The underlying material generally is granite, schist, tuff, or basalt. Gravel and stones generally are present on the surface and scattered throughout the soil profile. Reaction is neutral to acid in the upper 2 feet of the profile.

The climax plant community is 25 to 50 percent black grama; 15 to 25 percent side-oats grama; 10 to 20 percent, each, blue grama and turbinella oak; 10 to 15 percent wolftail; 5 to 10 percent, each, plains lovegrass, spike muhly, mutton bluegrass, hairy grama, sprangle-top, desert ceanothus, manzanita, perennial forbs, and twinberry; and 0 to 5 percent Halls panic.

In excellent condition, this range site yields about 700 pounds of herbage per acre during unfavorable years. During favorable years, the annual yield is about 1,200 pounds per acre. About 80 percent of the herbage on this site can be used by cattle and wildlife.

Under continued heavy grazing, such grasses as black grama, plains lovegrass, and side-oats grama decrease in the plant community; and such plants as blue grama and hairy grama increase. Also turbinella oak clumps increases in size. Elimination of fire on this site also allows for an increase in chaparral-type shrubs.

Good management practices on this site are range seeding, brush control, contour furrowing, and controlled grazing.

CLAY UPLAND RANGE SITE, 12- TO 16-INCH PRECIPITATION ZONE

This range site consists of nearly level to gently sloping soils on uplands. These soils formed in material weathered from basalt, and they are deep and very fine textured. Cinders and bombs are common on the soil surface and throughout the soil profile. Deep wide cracks occur when the soil dries out, resulting in high initial infiltration rates. Reaction in the soil is slightly alkaline. Little or no soluble salts are present. Calcium carbonate accumulations are in the subsoil.

The climax plant community is 15 to 25 percent, each, side-oats grama and tobosa; 10 to 20 percent blue grama; 10 to 15 percent western wheatgrass; 5 to 10 percent, each, squirreltail and perennial forbs; 0 to 15 percent juniper; and 0 to 5 percent, each, mat muhly, cliffrose, mountainmahogany, and pinyon.

In excellent condition, this range site yields about 400 pounds of herbage per acre during unfavorable years. During favorable years, the annual yield is about 800 pounds per acre. About 90 percent of the herbage on this site can be used by cattle and wildlife.

Under continued heavy grazing, such plants as side-oats grama and western wheatgrass decrease in the plant community; and such plants as tobosa, blue grama, and mat muhly increase. In the absence of fire, juniper and pinyon increase. If the site is in poor condition, tumble grass, annuals, cactus, and snakeweed dominate.

Good management practices on this site are range seeding, juniper control, contour furrowing, and range pitting.

CLAY LOAM UPLAND RANGE SITE, 12- TO 16-INCH PRECIPITATION ZONE

This range site consists of nearly level to moderately sloping soils on uplands. These soils formed in material weathered from basalt. These deep or moderately deep soils have basalt stones or cinders on the surface or scattered throughout the profile in places. Reaction is mildly alkaline to moderately alkaline. Accumulations of lime are present in places.

The climax plant community is 25 to 50 percent side-oats grama; 10 to 15 percent, each, western wheatgrass, blue grama, and tobosa; 15 to 25 percent black grama; 5 to 10 percent, each, squirreltail, curlymesquite, wolftail, mutton bluegrass, Indian ricegrass, Halls panic, slim tridens, four-wing saltbush, and perennial forbs; and 0 to 5 percent, each, vine mesquite and cliffrose.

In excellent condition, this range site yields about 600 pounds of herbage per acre during unfavorable years. During favorable years, the annual yield is about 1,100 pounds per acre. About 90 percent of the herbage on this site can be used for cattle and wildlife.

Under continued heavy grazing, such plants as side-oats grama, mutton bluegrass, and Indian ricegrass decrease in the plant community; and such plants as curlymesquite, blue grama, and tobosa increase. If the site is in poor condition, annuals, three-awn, cactus, and snakeweed dominate. Juniper and other woody plants become of major importance if natural fires are eliminated.

Good management practices on this range site are range seeding, brush control, contour furrowing, and range renovation.

Range herbage groups³

The soils in the West Division of the Prescott National Forest have been placed in five groups based on estimated productivity for range herbage (fig. 10). The relative productivity of the groups in terms of pounds of herbage per acre is given in table 2.

These estimates are based on studies of clippings made from range on soils in the National Forest Area and on studies of similar soils in other areas. The ratings apply only to the soils in the National Forest, and

³ By L. D. WHEELER, JR., and J. A. WILLIAMS, soil scientists, Forest Service.

the productivity values consider the normal rainfall. The Guide to Mapping Units at the back of this survey shows the range herbage groups to which the soils have been assigned.

TABLE 2.—Range herbage

Range herbage group	Estimated production on range in—	
	Good condition	Fair to poor condition
	Lbs. per acre	Lbs. per acre
Group 1.....	1,200 to 1,800.....	700 to 1,100.
Group 2.....	750 to 1,100.....	450 to 600.
Group 3.....	400 to 700.....	250 to 400.
Group 4.....	200 to 400.....	150 to 250.
Group 5.....	Less than 200....	Less than 100.

The soils in groups 1, 2, and 3 make up about 70 percent of the National Forest lands. They are medium to

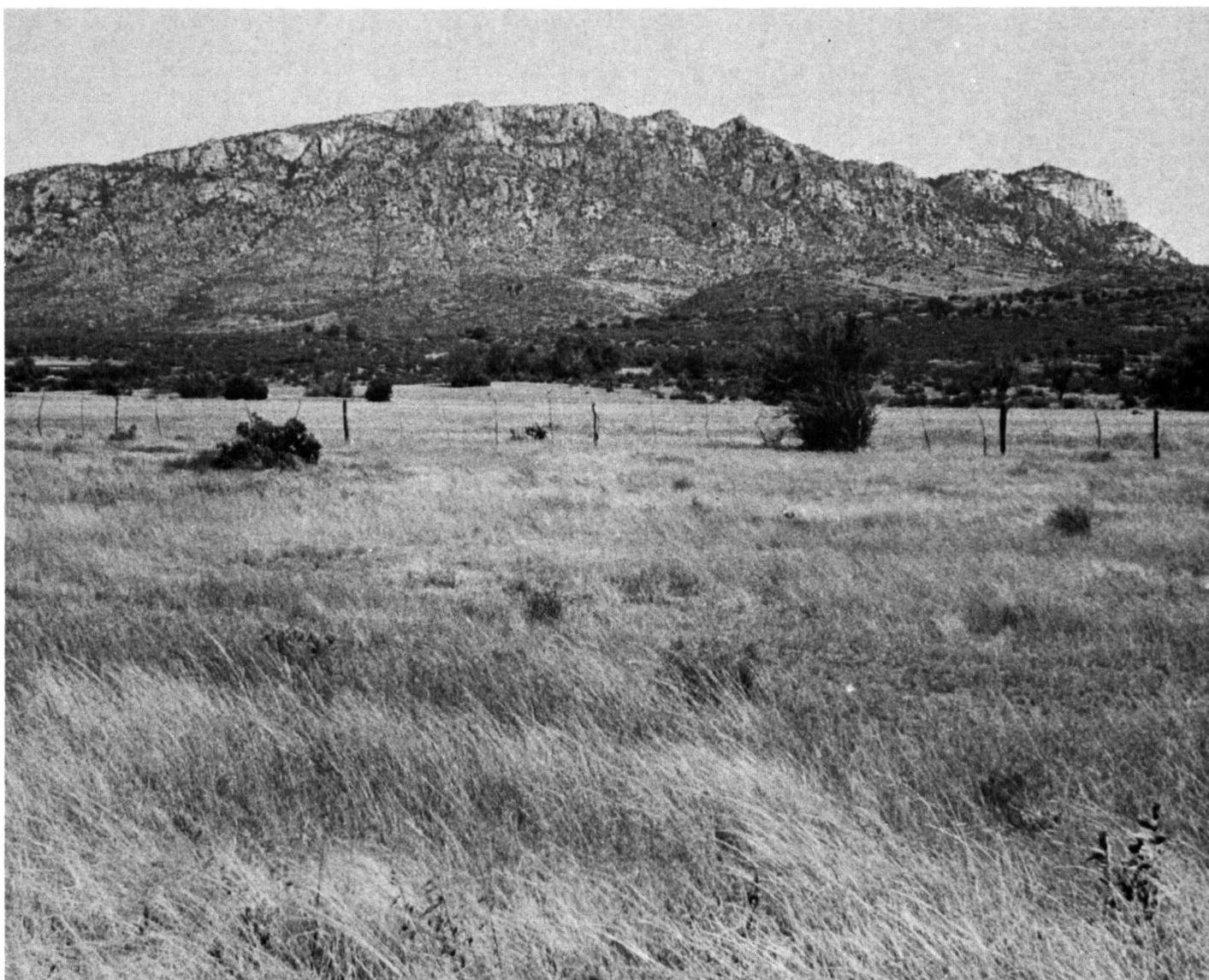


Figure 10.—The Lynx soil in the foreground is the range herbage group 1; the Lonti soils on the low, brush hills are in group 2; and the granite Rock land in the background is in group 5.

high in productivity, but their productivity could be improved by more intensive management. The soils in groups 1 and 2 respond particularly well suited to revegetation, control of nonforage plants, and water spreading (fig. 11).

The Lynx soils in group 1 and the Springerville soils in groups 1 and 2 deserve special mention. Establishment of grass on these soils is difficult, but methods of establishment are being tested in the Prescott National Forest and in the Beaver Creek area.

Group 4 includes rocky, stony, steep, and shallow soils. Revegetation and control of nonforage plants is costly and difficult and produces only small returns.

Group 5 includes land types that are poorly suited to the production of herbage. Plants generally grow only in pockets where water accumulates and where some soil has formed. Many of the land types are steep, and

the ledges and escarpments limit the movement of livestock.

Woodland⁴

Nearly three percent of Yavapai County, Western Part, or about 106,000 acres, is commercial woodland. The commercial forests are at higher elevations where the environment is favorable for tree growth. Only those soils used for commercial forest are discussed in this section.

Ponderosa pine is the main timber species. Douglas-fir and white fir are interspersed chiefly on north-facing slopes at higher elevations in the ponderosa pine forest.

⁴ By L. D. WHEELER, JR., and J. A. WILLIAMS, soil scientists, Forest Service.



Figure 11.—Area in range herbage group 1. The soil is Thunderbird cobbly clay loam.

The timber on National Forest lands is mostly at elevations ranging from about 6,000 feet to nearly 8,000 feet.

Most of the forested areas have been partly cut over for sawtimber. Saplings and pole-size trees make up most of the present stands, but isolated areas of virgin sawtimber remain.

The area covered by forests was once probably much larger than it now is. Large, uncontrolled wildfires that burned over most sections of the forest occurred before Forest Service administration. Slow restocking by natural regeneration and invasion of nontimber species have resulted in a reduction of forest.

The Dandrea, Broliar, and Mirabal soils are the major timber-producing soils. Other forested soils are Hogg, Wilcoxson, and areas of the Lonti soils at high elevations. Soil depth, texture, elevation, and aspect influence the growth of ponderosa pine in this survey area. Table 3 gives the site index range for each timber group and the relative severity of some of the factors affecting ponderosa pine production. The groups are based on site index values determined from curves developed by Meyer (4). Generally, soils that have higher site indexes show greater yields of timber per acre.

Forest management includes protection against fire, insects, and disease; thinning and pruning to improve the quality of the stands; reforestation; cutting to improve the stocking level and age class distribution of the stands; and good management of the watershed.

The woodland in the area is under sustained-yield management. Mature and excess trees are cut, and proper stocking levels are maintained to stimulate growth and to sustain yields. Fire protection is provided through a system of lookouts and fire patrol and through practices that reduce the fire hazard. Proper silvicultural practices and direct-control methods provide protection against insects and disease. Pruning, noncommercial thinning, and commercial cutting improve the quality of the timber and increase growth potential. Reforestation is achieved through natural regeneration and by planting and seeding. Cross-ditching, seeding grass, scattering slash, and constructing water bars are practices used to control the erosion of skid trails, roads, and landings.

Woody species competition.—Sites that have been disturbed by fire, cutting, or other factors are apt to be invaded by brush, undesirable trees, and other plants. Such competition hinders the establishment and growth of desirable species. A rating of *slight* indicates that invasion by undesirable species will have little ef-

fect on the growth of desirable species. A rating of *moderate* indicates that invasion by undesirable species will not seriously affect establishment of adequate stands of commercial-quality timber. A rating of *severe* indicates that competition by invasion of undesirable plants will seriously affect reestablishment of timber stands. Shrub live oak at lower elevations and Gambel oak at higher elevations are the chief competing species.

Equipment limitations.—Forest management may be hampered by soil characteristics or topographic features that restrict or prevent the use of equipment. The principal factors affecting equipment use on most of the soils in the area are slope, stoniness, and the hazard of erosion.

An equipment limitation of *slight* indicates that there is no special problem in the use of equipment. A rating of *moderate* indicates certain problems in the use of equipment may arise. For short periods after a frost, and occasionally after summer storms, the forested soils are too wet and soft to support equipment. A rating of *severe* indicates serious limitations to the use of conventional equipment. Excessively steep slopes and high amounts of Rock outcrop are such limitations.

Windthrow hazard.—Soil characteristics affect the development of tree roots and consequently the resistance of trees to the force of the wind. A rating of *slight* indicates that the roots hold the tree firmly against a normal wind, and windthrow is not common. A rating of *moderate* indicates that root development is not adequate for stability and that windthrow may occur when the wind velocity is high and the soils are wet.

Erosion hazard.—The hazard of erosion is rated according to inherent soil characteristics and such environmental factors as slope, aspect, and surface stones and cobbles. Ratings of *slight*, *moderate*, and *severe* are used to indicate susceptibility to erosion if the soil lacks a protective cover of vegetation. A rating of *slight* indicates that only a small loss of soil occurs where there has been disturbance or depletion of plant cover. A rating of *moderate* indicates that disturbance of the surface layer and loss of protective vegetation results in conditions conducive to erosion. Careful planning and construction of roads, skid trails, and landings are necessary to prevent soil loss. A rating of *severe* indicates that the soils are susceptible to serious erosion and soil loss. Timber must be harvested carefully, and special logging methods that minimize soil disturbance are advisable. All roads and skid trails should be care-

TABLE 3.—*Timber groups*

Timber group	Site index ¹ for ponderosa pine	Woody competition	Equipment limitation	Windthrow hazard	Erosion hazard	Acres	Percentage of timberland
Group 1.....	75 or more....	Slight.....	Slight to moderate...	Slight.....	Moderate.....	27,115	6.8
Group 2.....	55 to 74.....	Moderate.....	Moderate to severe ..	Slight to moderate...	Moderate to severe ..	64,836	61.3
Group 3.....	54 or less.....	Moderate to severe ..	Moderate to severe ..	Slight to moderate...	Moderate to severe ..	33,961	31.9

¹ The average height, in feet, of the dominant and codominant trees at 100 years of age.

² Made up of small, isolated areas on the high parts of north-facing slopes and in drainageways, depressions, and small basin-like areas.

fully located and constructed. They must be adequately drained to control excessive runoff. After logging has been completed, the roads, skid trails, and landings must be seeded to reduce runoff and to curb erosion.

Timber groups

Most of the woodland soils of the survey area are under Forest Service administration. They have been placed in three timber groups in order of their relative productivity potential. Group 1 soils produce the best timber and Group 3 soils produce the poorest trees. The Guide to Mapping Units at the back of the survey shows the suitability group assigned to the timbered soils.

TIMBER GROUP 1

Timber group 1 designates soils of a medium site-quality class. These soils are in the Dandrea, Lonti, and Mirabal series. Nearly two-thirds of the areas of timbered soils in the survey area are in this medium-quality class. The best overall timber-producing soil is Dandrea gravelly loam. The most extensive soils in this group are Mirabal gravelly sandy loam, 8 to 20 percent slopes, and Mirabal gravelly sandy loam, 20 to 60 percent slopes. Mirabal-Dandrea complex, 20 to 60 percent slopes, also makes up a substantial acreage in this suitability group. Another soil in this group is Lonti gravelly sandy loam, high rainfall, 0 to 15 percent slopes. The Dandrea and Lonti soils have a silt loam, gravelly loam, and gravelly sandy loam surface layer and a clay loam or clay subsoil. The Mirabal soils have a weakly developed profile of sandy loam and large amounts of gravel. The soils in this group are on mesa tops, ridges, sides of mountains and canyons, and in broad drainageways.

Competition from woody plants is moderate. Equipment limitations are severe on the steep Dandrea and Mirabal soils. The use of equipment on the Lonti soils is limited during wet periods. The hazard of windthrow is slight, except on exposed ridgetops. The hazard of erosion is moderate where the slopes are more gentle, and severe where slopes are steeper.

TIMBER GROUP 2

Timber group 2 designates soils of a low site-quality class. These soils are in the Hogg, Wilcoxson, and Broliar series. The low site index Hogg gravelly loam, 0 to 8 percent slopes, and Hogg gravelly loam, 8 to 30 percent slopes, have a thin gravelly loam surface layer that is underlain by a clay subsoil and limestone. These soils are on mesa tops and the sides of canyons. The low site index Wilcoxson gravelly loam, 30 to 60 percent slopes, is on the sides of very steep canyons. It has a thin gravelly loam surface layer over a clay subsoil. The moderately steep Broliar very stony silt loam, 15 to 30 percent slopes, is on the edges and ends of basalt flows. The timber suitability of these soils is low because of a slowly permeable clay subsoil near the soil surface.

Competition from woody plants is moderate to severe. The hazard of windthrow is slight to moderate. The hazard of erosion is moderate to severe.

Wildlife

The suitability of the soil to produce a given kind of habitat relates soils to wildlife production.

Yavapai County, Western Part, ranges from desert in the southwestern part to coniferous forests at higher elevations. Annual precipitation ranges from 8 to 30 inches, and its distribution is such that there are lengthy dry periods. Because of the amount and distribution of precipitation, management of the soils for wildlife habitat is difficult. Only small areas are cultivated to alfalfa and hay crops.

Because of the dominant influence climate has on native plant production, only slight differences in wildlife habitat can be attributed to the soil. The soils of this survey area, therefore, have been grouped into five wildlife habitat suitability groups.

There are few direct relationships between the kinds of soil and wildlife species. Therefore, this guide deals with relationships between kinds of soil and kinds of plant and water developments that make up wildlife habitat. Each soil is rated for its suitability for the improvement, maintenance, or creation of specific wildlife habitat elements.

A combination of the ratings for the applicable habitat elements approximates the suitability of a soil for producing a desirable habitat for a given kind of wildlife. Such suitability ratings are general and not so meaningful or useful as are the ratings for the specific habitat elements.

Elements of wildlife habitat

Soils of Yavapai County, Western Part, are rated for their suitability for producing open land wildlife habitat, woodland wildlife habitat, and rangeland wildlife habitat. Soils are rated for rangeland wildlife habitat only if native range plants are a dominant part of the natural plant community. They are rated for woodland wildlife habitat if trees are a dominant part of the natural plant community.

The levels of suitability are expressed by an adjective rating as follows:

Good: Habitats are easily improved, maintained, or created. There are few or no soil limitations in habitat management, and satisfactory results can be expected.

Fair: Habitats can be improved, maintained, or created on these soils, but moderate soil limitations affect habitat management or development. A moderate intensity of management and fairly frequent attention may be required to ensure satisfactory results.

Poor: Habitats can be improved, maintained, or created on these soils; but the soil limitations are severe. Habitat management may be difficult and expensive and require intensive effort. Results are questionable.

Very poor: Under the prevailing soil conditions, it is impractical to attempt to improve, maintain, or create habitats. Unsatisfactory results are probable.

The ratings of wildlife habitat are made by assigning weighted factors to the elements that make up the kind of wildlife habitat. For example, grain and seed crops, domestic grasses and legumes, and wild her-

baceous plants are given greater weight than hardwood trees as habitat elements for open land wildlife.

Similar soils are then grouped together into 11 wildlife groups.

Kinds of wildlife

Definitions, examples, and weighing factors of the kinds of wildlife in the survey area are these:

Open land wildlife consists of birds and mammals of cultivated land, pasture, meadows, lawns, and areas overgrown with grasses, herbs, shrubs, and vines. Examples are ringnecked pheasant, quail, mourning dove, cottontail rabbit, and songbirds.

Woodland wildlife consists of birds and mammals of wooded areas containing either hardwood or coniferous trees and shrubs, or a mixture of both. Examples are blue grouse, ruffed grouse, woodpeckers, squirrels, porcupine, mule deer, elk, and black bear.

Rangeland wildlife consists of birds and mammals of natural range. Examples are mule deer, coyote, antelope, quail, jackrabbits, and songbirds.

Wildlife food and cover

The kind of habitat needed by wildlife depends on the species. Some live in woodland, some live in the open, and others live in range. Ducks, geese, beaver, and muskrats need an aquatic habitat. Some eat insects and other animal foods, some eat only plant foods, and others eat a combination of the two.

Following is a brief summary of the food and cover needed by the kinds of wildlife in the survey area.

Bald eagle.—Occasionally seen in the survey area, its food is mainly fish.

Bear.—A large, powerful animal that inhabits extensive forested lands that have medium to low human population. The black bear is largely vegetarian, but it also eats such meats as insects, small mammals, and fish. It sometimes preys on livestock if they are readily available. Bears eat berries, other fleshy fruits, and acorns.

Beaver.—A large, amphibious, flat-tailed rodent that lives in streams, rivers, and ponds that have an adequate food supply. The beaver is a vegetarian. It mainly feeds on bark or twigs, branches, and trunks of aspen, willow, and cottonwood.

Blue grouse.—This bird inhabits mountain areas during winter and lower elevations during the nesting and brood-rearing period. The food is needles, flowers, fruits, and seeds of a wide variety of plants. It also eats ants, beetles, and grasshoppers. The chicks mostly eat insects during their first month. This bird gets most of its water from vegetation.

Gambel quail.—This bird inhabits the irrigated valley or wherever mesquite is found. Its food in spring consists of tender green leaves. During the summer, fall, and winter, it eats seeds. It eats insects when they are available, because insects are an important source of food for young birds. It needs water daily. Only a few Gambel quail inhabit the survey area.

Desert cottontail.—The cottontail rabbit is the most popular small-game animal in the United States. It thrives on farm lands where crops, grass, and brush are about equally represented and are well distributed.

The cottontail rabbit is a vegetarian and eats grass, clover, small grain, tree bark, and many kinds of shrubs. Brush piling is a good means of habitat improvement for this small animal.

Ducks.—These birds inhabit ponds, reservoirs, lakes, sloughs, and creeks. Water is essential for all duck species. Special plant cover is needed during seasons of nesting, rearing broods, and adult moult. Ducks eat water-tolerant plants and aquatic insects. Ducks also feed extensively on domestic grain. Ducks are migratory and respond to habitat development.

Elk.—The elk prefers grass and forbs. It also eats shrubs, tender parts of trees, and farm crops. It needs easy access to water or snow. The elk finds cover in dense woods.

Abert squirrel.—A tree squirrel that lives in ponderosa pine forests. Its diet is mainly twigs and bark of the ponderosa pine.

Ground squirrels.—Two species of ground squirrels that inhabit the survey area are Golden Manteled and Spotted squirrels. They eat some insects but they are primarily vegetarians.

Jackrabbits (Blacktailed and Antelope).—These rabbits typically inhabit the open areas of plains, deserts, and foothills. Jackrabbits are vegetarians. They eat shrubs, grasses, forbs, and almost any available green plants.

Mourning dove.—This bird inhabits open areas but uses a variety of habitats. It lives mostly in irrigated valleys, but it is also common in nonirrigated areas. It nests in trees or shrubs, or on the ground. It is mainly a seed eater and it needs water daily. It is migratory.

Mule deer.—This deer eats a wide variety of shrubs, forbs, and grasses. It also eats acorns, fruits, tender parts of trees, and farm crops. The mule deer drinks frequently, and it uses snow for water at times. It also likes salt. It finds cover in woodland, bushy areas, and canyons. The mule deer feeds from early in the evening through the night and early in the morning.

Predators.—Some of the more important predatory animals in the survey area include cougar, coyote, bobcat, weasel, and golden eagle.

Ringnecked pheasant.—This bird inhabits the irrigated valleys. It uses well-drained uplands and poorly drained areas for cover. Roadsides, weed patches, fence rows, ditchbanks, willow patches, grass and brush areas, hayfields, and grainfields are all used for cover and nesting. The ringnecked pheasant eats weed seeds, grains, tender plants, fruits, berries, and insects. Water is important and may be taken from plants and insects or dew unless open water is available.

Skunk (Spotted, Hooded, Hognose).—These animals feed on adult and larval insects, particularly grasshoppers, grubs, crickets, beetles, and wasps. They commonly eat spiders, toads, frogs, lizards, mice, gophers, and bird eggs. Plant material ordinarily constitutes only a small part of their diet.

Songbirds and nongame birds.—Many species of these birds live in the survey area. Habitat and food requirements vary between species. Some species are migratory and some are not.

Wildlife groups

Soils of Yavapai County, Western Part, have been placed in 11 wildlife groups. These groups are described in the following pages, and the ratings assigned for applicable wildlife habitats are shown in table 4. Wetland wildlife habitat was assumed to be nonapplicable to this area because of the climate and lack of water.

The wildlife group each soil is in can be learned by referring to that soil in the section "Descriptions of the Soils" or the "Guide to Mapping Units" at the back of this survey.

WILDLIFE GROUP 1

In this group are deep, well-drained soils along major drainageways and in swales in the hot, dry part of the survey area. Permeability ranges from slow to moderate. The available water capacity is high. The surface layer ranges from loam to clay loam. Slopes range from 0 to 2 percent.

The average annual precipitation ranges from 8 to 12 inches. The average temperature is 62° to 68° F, and the frost-free period ranges from 200 to 250 days. The vegetation is desert shrubs and grasses.

Important wildlife are quail, deer, javelina, dove, and cottontail rabbits.

The major concern in the management of wildlife habitat is the development and proper use of the water resources on these soils. Care should be exercised in locating water-storage facilities. Features of these soils affecting their use for pond reservoirs are given in table 6 in the section "Engineering Uses of the Soils."

WILDLIFE GROUP 2

In this group are deep, well-drained soils on fans and terraces in the hot, dry, desert part of the survey area. Permeability ranges from slow to moderately rapid. The available water capacity is moderate or high. The surface layer ranges from gravelly sandy loam and sandy loam to gravelly sandy clay loam and sandy clay loam.

The average annual precipitation ranges from 8 to 12 inches. The average temperature is 57° to 68° F, and the frost-free period ranges from 170 to 260 days. The vegetation is desert shrubs and grasses.

Important wildlife are quail, deer, javelina, dove, and cottontail rabbits.

The major concern in the management of wildlife habitat is the development and proper use of the water resources on these soils. Care should be exercised in locating water-storage facilities. Features of these soils affecting their use for pond reservoirs are presented in table 6 in the section "Engineering Uses of the Soils."

WILDLIFE GROUP 3

In this group are very shallow and shallow, well-drained, limy soils that are underlain by an indurated lime pan or limestone bedrock. These are gently sloping to strongly sloping soils on alluvial fans and gently sloping to moderately steep soils on limestone hills. Permeability is moderate. Available water capacity is low. The surface layer ranges from gravelly sandy loam to gravelly loam.

The average annual precipitation ranges from 8 to 12 inches. The average annual air temperature is 59° to 68° F, and the frost-free period ranges from 180 to 230 days.

Important wildlife are quail, deer, javelina, dove, and cottontail rabbits.

The major concern in the management of wildlife habitat is the development and proper use of the water resources on these soils. These are shallow and very shallow soils, so pond reservoir developments need to be located on deeper soils included in this group. Onsite investigation of individual locations is needed.

WILDLIFE GROUP 4

In this group are very shallow to moderately deep, well-drained soils on basalt, granite, tuff, and related rocks. Permeability ranges from moderately rapid to slow. Available water capacity ranges from low to moderate. The surface layer ranges from gravelly sandy loam to clay.

The average annual precipitation ranges from 8 to 12 inches. The average temperature ranges from 57° to 69° F, and the frost-free period ranges from 170 to 270 days. The vegetation is desert shrubs and grasses.

Important wildlife are quail, deer, javelina, dove, and cottontail rabbits.

The major concern in the management of wildlife habitat is the development and proper use of the water resources on these soils. These are shallow and very shallow soils, so pond reservoir developments need to be located on deeper soils included in this group. Onsite investigation of individual locations is needed.

WILDLIFE GROUP 5

In this group are very shallow to moderately deep, well-drained soils over basalt, granite, schist, sandstone, and indurated lime pans. These soils range from nearly level to very steep. Permeability ranges from moderately rapid to moderately slow. The available water capacity is low but ranges to moderate in places. The surface layer ranges from sandy loam to clay loam and generally is gravelly, cobbly, stony, or rocky.

The average annual precipitation ranges from 12 to 20 inches. The average temperature is 47° to 58° F, and the frost-free period ranges from 118 to 220 days.

Important wildlife are mule deer, turkey, antelope, dove, and cottontail rabbits.

The major concerns in the management of wildlife habitat include proper range use, rotation-deferred grazing, brush eradication, and revegetation on these soils. Development and proper use of water resources are of prime importance. They need to be located on deep soils included in units of these soils. Onsite investigation of individual locations is needed.

WILDLIFE GROUP 6

In this group are deep, well-drained soils except for Lynx, wet variant, soils which are somewhat poorly drained. These soils are along drainageways, in swales, and in depressions. They are nearly level to gently sloping. These soils formed in alluvium that weathered from a wide variety of materials including acid and basic igneous rocks, schist, sandstone, and shale rocks.

TABLE 4.—*Suitability of the soils for elements*

Wildlife group	Elements of wildlife habitat						
	Grain and seed crops		Grasses and legumes		Wild herbaceous plants		Conifers
	Irrigated	Dry	Irrigated	Dry	Irrigated	Dry	Irrigated
Group 1.....	Poor.....	Poor.....	Poor.....	Poor.....	Fair.....	Good.....	.....
Group 2.....	Good.....	Very poor.....	Good.....	Very poor.....	Good.....	Fair.....	.....
Group 3.....	Fair.....	Very poor.....	Fair.....	Very poor.....	Fair.....	Fair.....	.....
Group 4.....	Fair.....	Very poor.....	Fair.....	Very poor.....	Fair.....	Fair.....	.....
Group 5.....	.....	Poor.....	.....	Poor.....	.....	Fair.....	.....
Group 6.....	Good.....	Poor.....	Good.....	Poor.....	Good.....	Fair.....	.....
Group 7.....	Good.....	Poor.....	Good.....	Poor.....	Good.....	Good.....	.....
Group 8.....	.....	Poor.....	.....	Poor.....	.....	Fair.....	.....
Group 9.....	.....	Poor.....	.....	Poor.....	.....	Poor.....	.....
Group 10.....	.....	Poor.....	.....	Poor.....	.....	Fair.....	.....
Group 11.....	.....	Poor.....	.....	Fair.....	.....	Poor.....	.....

Permeability ranges from moderately rapid to moderately slow. Available water capacity is moderate to high. The surface layer ranges from sandy loam to clay loam.

The average annual precipitation ranges from 10 to 20 inches. The average temperature is 46° to 57° F, and the frost-free period ranges from 140 to 220 days. The vegetation is dominantly grass.

Important wildlife are turkey, Abert squirrel, band-tailed pigeons, mule deer, and black bear.

The major concerns in the management of wildlife habitat are practices that produce more food in the woodland and open areas in this group, that provide dependable and well-distributed sources of water, and that maintain favorable cover and protect wildlife from predators and illegal hunting.

WILDLIFE GROUP 7

In this group are shallow to deep, well-drained soils that formed in alluvial materials that weathered from a variety of rocks including limestone and sandstone. These soils are generally nearly level to moderately sloping but are steep in places. Permeability ranges from moderately rapid to moderately slow. The available water capacity ranges from low to high. The surface layer ranges from sandy loam to clay loam and is gravelly, cobbly, or stony in many places.

The average annual precipitation ranges from 11 to 19 inches. The average temperature ranges from 47° to 57° F, and the frost-free period ranges from 117 to 160 days. The dominant vegetation is grass and some pinyon and juniper.

Important wildlife are turkey, Abert squirrel, band-tailed pigeons, mule deer, and black bear.

The major concerns in the management of wildlife habitat are practices that produce more food in the woodland and open areas in this group, that provide dependable and well distributed sources of water, and that maintain favorable cover and protect wildlife from predators and illegal hunting.

WILDLIFE GROUP 8

In this group are deep and moderately deep, well-drained soils that formed in place from schist or in alluvium that weathered from a variety of rocks including granite, schist, basalt, and sandstone. These

soils generally are nearly level to moderately sloping but are very steep along some drainageways. Permeability ranges from moderately slow to slow. The available water capacity is moderate or high. The surface layer ranges from sandy loam to clay loam and is generally gravelly or cobbly.

The average annual precipitation ranges from 12 to 18 inches. The average temperature is 50° to 57° F, and the frost-free period ranges from 140 to 225 days. The vegetation is brush-grass.

Important wildlife are mule deer, turkey, antelope, dove, and cottontail rabbits.

The major concerns in the management of wildlife habitat are practices that include proper range use, rotation-deferred grazing, water development, brush eradication, and revegetation on these soils. Features of these soils affecting their use for pond reservoirs are presented in table 6 in the section "Engineering Uses of the Soils."

WILDLIFE GROUP 9

In this group are deep, well-drained soils on basalt flows, cinders, and bombs. These soils are nearly level to gently rolling. Permeability is slow, and available water capacity is moderate. The surface layer ranges from silty clay loam to clay and is gravelly, cobbly, or stony in places.

The average annual precipitation ranges from 12 to 18 inches. The average temperature is 45° to 57° F, and the frost-free period ranges from 115 to 225 days. The vegetation is grass along with pinyon and juniper at higher elevations.

Important wildlife are turkey, Abert squirrel, band-tailed pigeons, mule deer, and black bear.

The major concerns in the management of wildlife habitat are practices that produce more food in the woodland and open areas in this group, that provide dependable and well-distributed sources of water, and that maintain favorable cover and protect wildlife from predators and illegal hunting.

WILDLIFE GROUP 10

In this group are moderately deep and deep, well-drained soils on basalt plains and slopes and on the steeper sides of cinder cones. Slopes range from nearly

of wildlife habitat and for kinds of wildlife

Elements of wildlife habitat—Continued			Kinds of wildlife					
Conifers	Shrubs		Open land		Woodland		Rangeland	
Dry	Irrigated	Dry	Irrigated	Dry	Irrigated	Dry	Irrigated	Dry
-----	Fair	Good	Good	Fair	-----	-----	-----	Good.
-----	Fair	Fair	Good	Poor	-----	-----	-----	Fair.
-----	Fair	Fair	Fair	Poor	-----	-----	-----	Fair.
-----	Fair	Fair	Fair	Poor	-----	-----	-----	Fair.
-----	Fair	Fair	Fair	Poor	-----	Fair	-----	Fair.
-----	Fair	Fair	Good	Poor	Good	Fair	Fair	Fair.
-----	Good	Good	Good	Poor	-----	Good	-----	Good.
-----	-----	Fair	-----	Poor	-----	Fair	-----	Fair.
-----	-----	Poor	-----	Poor	-----	Fair	-----	Poor.
-----	-----	Fair	-----	Poor	-----	Fair	-----	Fair.
Good	-----	-----	-----	Fair	-----	Fair	-----	-----

level to steep. Permeability is slow. The available water capacity is moderate. The surface layer ranges from loam to clay loam, and is gravelly or cobbly in places.

The average annual precipitation ranges from 12 to 18 inches. The average temperature is 52° to 56° F, and the frost-free period ranges from 120 to 210 days. The vegetation is mainly grass at the lower elevations and juniper and a grass understory at the higher elevations.

Important wildlife are turkey, Abert squirrel, band-tailed pigeons, mule deer, and black bear.

The major concerns in the management of wildlife habitat are practices that produce more food in the woodland and open areas, that provide dependable and well-distributed sources of water, and that maintain favorable cover and protect wildlife from predators and illegal hunting.

WILDLIFE GROUP 11

In this group are shallow to deep, well-drained soils in the coolest and dampest part of the survey area. Permeability ranges from moderately rapid to slow. The available water capacity ranges from low to moderate. The surface layer ranges from sandy loam to clay loam and is gravelly, cobbly, or stony in places. Rock outcrop is common in many places.

The average annual precipitation ranges from 18 to 25 inches or more. The average temperature is 43° to 47° F, and the frost-free period ranges from 120 to 175 days.

Important wildlife are deer, turkey, Abert squirrel, and black bear.

The major concerns in the management of wildlife habitat are practices that produce more food in the woodland and open areas, that provide dependable and well-distributed sources of water, and that maintain favorable cover and protect wildlife from predators and illegal hunting.

Engineering Uses of the Soils⁵

This section is useful to those who need information about soils used as structural material or as foundation

⁵ C. E. PARSONS, engineer, Soil Conservation Service, assisted in the preparation of this section.

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

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and soil 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, commercial and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 5, 6, and 7, which show, respectively, several estimated soil properties significant to engineering; interpretations for various engineering uses; and results of engineering laboratory tests on soil samples.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in table 6, and it also can be used to make other useful maps.

TABLE 5.—*Estimated 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. Carefully the instructions for referring to other series that appear in the first column of this table. Absence of data

Soil series and map symbols	Depth to bedrock or hardpan	Depth from surface	USDA texture	Classification	
				Unified	AASHO
	<i>Feet</i>	<i>Inches</i>			
*Abra: AaB, AbB, AeB, AIC, AID, AmC, AnC... For Lonti part of AbB see Lonti series; for Poley part of AeB, see Poley series; for Balon part of AIC and AID, see Balon series; for Lynx part of AmC, see Lynx series; for Wineg part of AnC; see Wineg series.	>5	0-60	Loam.....	CL	A-6
*Anthony: AoC, ApB, ArA..... For Mohave part of ArA, see Mohave series.	>5	0-60	Gravelly sandy loam.....	SM, SC-SM or SC	A-1 or A-2
Apache: As, At.....	½-1½	0-12 12	Gravelly loam..... Basalt.	CL	A-6
*Arp: AuC, AvD, AwE, AxD, AyC..... For Moano part of AxD, see Moano series; for Lynx part of AyC, see Lynx series.	1½-3½	0-18 18-34 34	Gravelly clay loam or clay..... Gravelly loam..... Schist.	CH or CL SC	A-7 A-7 or A-2
Badland: Ba..... No valid estimates can be made other than for depth.	>5	0-60			
*Balon: BdC, BgD, BIC..... For Lynx part of BIC, see Lynx series.	>5	0-23 23-60	Gravelly clay loam and gravelly sandy loam. Gravelly sandy loam.	SC SC or GC	A-2 A-2
Barkerville: BmF, BnD, BoF.....	1-2	0-25 25	Gravelly sandy loam..... Granite.	SM or SP-SM	A-1 or A-2
Boysag..... Mapped only in complex with Purner soils.	1-1½	0-19 19	Clay..... Sandstone.	CL	A-6
Bridge: BrD.....	1½-3	0-30 30-54	Gravelly loam and sandy clay loam. Weathered tuff.	CL or SC	A-6 or A-7
Brolliar: BsC, BsD.....	2-3½	0-8 8-35 35	Very stony silt loam and silt loam. Gravelly clay and gravelly clay loam. Basalt.	ML CH	A-4 A-7
*Cabezon: CaD, CbC, CdC, CeE..... For Springerville part of CaD and CbC, see Springerville series; for Thunderbird part of CdC, see Thunderbird series.	½-1½	0-12 12	Cobbly clay, cobbly clay loam... Basalt.	CH	A-7
*Cave: CgC, CID..... For Continental part of CID, see Continental series.	½-1½	0-11 11-23	Gravelly sandy loam..... Lime cemented pan.	SM	A-2, A-1
*Cellar: CmD, CnC, CnF, CoD, CrF..... For Chiricahua part of CoD, see Chiricahua series.	1-1½	0-8 8	Gravelly sandy loam..... Granite.	GM or SM	A-1
Chiricahua..... Mapped only in complex with Cellar soils.	1-1½	0-18 18	Gravelly sandy loam and gravelly clay. Granite.	CH	A-7
*Continental: CsC, CtD, CuC, CvB, CwD..... For Cave part of CtD, see Cave series; for Whitlock part of CuC, see Whitlock series; Loamy alluvial land part of CvB is too variable to rate.	>5	0-27 27-60	Light clay and clay loam..... Gravelly sandy loam.....	CH or SC SC-SM, SC or CL	A-7 or A-6 A-2 or A-6
Cordes: Cx.....	>5	0-60	Sandy loam, loamy sand.....	SM	A-2
Cordes, red variant: Cy.....	>5	0-60	Sandy loam.....	SM	A-2

significant in engineering

The soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow indicates that the soil is too variable to be rated or that no estimate was made. The symbol > means greater than]

Coarse fraction greater than 3 inches	Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity of uncoated steel
	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							
<i>Percent</i>							<i>Inches per hour</i>	<i>Inches per inch of soil</i>	<i>pH</i>		
0	80-100	75-95	70-90	55-75	30-40	15-25	0.6-2.0	0.16-0.18	7.9-8.4	Moderate...	High.
0	60-100	50-75	35-55	20-35	20-30	2-10	2.0-6.0	0.10-0.12	6.6-8.4	Low.....	High.
0-45	75-90	70-85	70-80	50-60	30-40	20-30	0.6-2.0	0.10-0.12	7.9-8.4	Moderate...	Low
10-20 20-35	75-100 65-85	70-95 55-65	65-80 35-55	60-75 30-40	45-85 35-75	30-60 15-45	0.06-0.2 0.2-0.6	0.12-0.16 0.09-0.11	5.6-7.3 5.6-7.3	High..... Low.....	High. High.
0	75-85	50-70	25-55	25-35	45-55	25-35	0.2-0.6	1.15-0.17	5.6-7.8	Moderate ..	Moderate.
0	55-85	50-70	30-45	15-25	40-50	20-30	2.0-6.0	0.07-0.09	6.6-7.3	Low.....	Moderate.
0-45	75-95	35-85	25-55	10-25	NP	NP	2.0-6.0	0.05-0.09	6.1-7.3	Low.....	Moderate.
0	90-100	80-95	80-90	75-85	40-50	25-35	0.06-0.2	0.14-0.16	6.6-8.4	High.....	High.
10-25	75-95	70-90	65-80	35-60	35-45	25-35	0.6-2.0	0.14-0.16	7.9-8.4	Moderate ..	High.
10-45	80-95	75-90	70-80	60-75	30-40	NP	0.06-0.2	0.15-0.17	6.1-7.3	Low.....	Moderate.
0-10	80-90	65-75	65-75	55-60	60-70	40-50	0.06-0.2	0.14-0.16	6.1-7.3	High.....	High.
10-30	85-95	80-90	80-90	75-85	50-60	35-45	0.06-0.2	0.13-0.15	6.6-7.8	Moderate ..	High.
9-10	65-75	60-70	40-50	20-35	25-35	NP	0.6-2.0	0.07-0.09	7.9-8.4	Low.....	High.
0-45	50-70	35-45	25-35	15-25	20-30	NP	2.0-6.0	0.07-.09	6.6-8.4	Low.....	Moderate.
10-20	80-95	60-70	55-65	50-60	50-60	35-45	0.06-0.2	0.11-0.13	6.1-7.8	High.....	High.
0-25 0-25	85-100 90-100	70-95 60-70	60-90 50-60	45-75 30-65	30-60 25-35	15-40 5-15	0.06-0.2 2.0-6.0	0.13-0.16 0.07-0.09	6.6-8.4 7.9-8.4	Moderate .. Low.....	High. High.
0	85-100	55-90	40-55	25-35	25-35	NP	2.0-6.0	0.07-0.09	6.6-8.4	Low.....	Moderate.
0-15	80-100	70-85	40-55	25-35	30-40	NP	2.0-6.0	0.11-0.13	7.9-8.4	Low.....	Moderate.

TABLE 5.—Estimated soil properties

Soil series and map symbols	Depth to bedrock or hardpan	Depth from surface	USDA texture	Classification	
				Unified	AASHO
	<i>Feet</i>	<i>Inches</i>			
*Cross: CzC For Cabezon and Apache parts, see Cabezon and Apache series.	½-1½	0-19 19	Clay Basalt.	CH	A-7
Dandrea: DaF	1-3	0-7 7-29 29	Gravelly loam Gravelly clay Weathered schist.	GC CH or GC	A-6 A-7
Dye: DgC, DrC	1-1½	0-20 20	Clay Limestone.	CL or GC	A-6
*Faraway: FaC, FIE, FIF For Luzena part of FIE, and FIF, see Luzena series.	½-1½	0-7 7	Gravelly loam, very stony loam. Andesite.	SM	A-2
Gaddes: GdD	1½-3½	0-24 24	Gravelly sandy clay loam and gravelly loam. Weathered granite.	SC	A-2 or A-6
Gila: Go	>5	0-15 15-60	Fine sandy loam Silt loam and very fine sandy loam.	SM ML	A-4 A-4
*Graham: GrB, GsE For Rimrock part of GrB, see Rimrock series.	½-1½	0-12 12	Clay Basalt.	CH	A-7
Hogg: HgB, HgD	1½-5	0-30 30	Clay loam and clay Limestone.	CL	A-6
House Mountain: HmE	½-1½	0-7 7	Gravelly loam Basalt.	GM or SM	A-4
Jacks: JaC, JaD	1½-4	0-30 30	Gravelly clay Sandstone.	CL	A-6
*Latene: La, Lc For Mohave part of Lc, see Mohave series.	>5	0-43 43-60	Gravelly sandy loam and loam Gravelly sandy loam	ML SM	A-4 A-2 or A-1
Lehmans: Le, Lh	1-1½	0-14 14	Gravelly clay Andesite.	CH	A-7
*Lonti: LkD, LIC, LID, LmB, LnC, LnF, LoD, LpB, LrD, LsC, LtB, LuC, LvE. For Abra part of LpB and LrD, see Abra series; for Pastura part of LsC, see Pastura series; for Cordes part of LtB, see Cordes series; for Wineg part of LuC; see Wineg series; Rock land part of LvE is too variable to rate.	>5	0-26 26-68	Gravelly clay Gravelly and very gravelly sandy clay loam.	SC SC or GC	A-7 A-2
Luzena: LwD, LxD	½-1½	0-14 14	Very stony loam and gravelly clay. Andesite.	SC	A-7
Lynx: Ly, Ly2	>5	0-68	Clay loam	CL	A-6
Lynx, wet variant: Lz	>5	0-72	Clay loam	CL	A-6
*Mirabal: MbC, MbF, MdF For Dandrea part of MdF, see Dandrea series.	1-1½	0-14 14	Gravelly sandy loam Weathered granite.	SM or GM	A-1 or A-2
*Moano: MgD, MkF, MoD, MrC For Lynx part of MrC, see Lynx series.	½-1½	0-9 9	Gravelly loam Weathered schist.	SM	A-2 or A-4
Moenkopie: MsB	½-1	0-9 9	Fine sandy loam Sandstone.	SM	A-4
Mohave: Mt	>5	0-55 55-60	Sandy clay loam Gravelly loamy coarse sand	CL SP-SM, SM	A-6 A-1
Palma: PaB	>5	0-60	Sandy loam	SM	A-4 or A-2

significant in engineering—Continued

Coarse fraction greater than 3 inches	Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity of uncoated steel
	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							
<i>Percent</i>							<i>Inches per hour</i>	<i>Inches per inch of soil</i>	<i>pH</i>		
5-15	65-90	60-75	60-70	50-65	50-60	30-40	0.06-0.2	0.14-0.16	7.9-8.4	High-----	High.
0-10	65-80	55-70	45-60	35-50	30-40	10-20	0.06-0.2	0.12-0.14	6.6-7.3	Low-----	Moderate.
0-10	65-80	55-70	50-65	45-60	45-60	25-35	0.06-0.2	0.14-0.16	6.6-7.3	High-----	Moderate.
0-10	55-90	50-90	50-85	45-75	30-40	15-25	0.06-0.2	0.10-0.16	6.6-8.4	Moderate ..	High.
45-55	40-60	35-50	30-40	20-30	25-35	NP-10	0.6-2.0	0.07-0.09	6.6-7.3	Low-----	Moderate.
0-5	65-95	60-75	40-60	25-40	30-50	10-30	0.06-0.2	0.08-0.10	6.1-7.3	Moderate ..	Moderate.
0	95-100	95-100	90-100	40-50	20-30	NP	2.0-6.0	0.13-0.15	7.4-7.8	Low-----	Moderate.
0	95-100	95-100	95-100	60-80	25-35	NP	0.6-2.0	0.15-0.17	7.4-9.0	Low-----	High.
5-50	75-85	70-80	60-80	50-75	50-60	30-35	0.06-0.2	0.11-0.13	7.4-8.4	High-----	High.
5-20	80-90	75-85	70-80	55-65	30-40	15-25	0.06-0.2	0.14-0.16	7.4-8.4	High-----	High.
10-20	65-90	60-75	50-60	35-50	30-40	NP-10	0.6-2.0	0.10-0.12	7.4-8.4	Low-----	High.
10-35	85-95	75-85	60-70	50-60	30-40	15-25	0.06-0.2	0.12-0.14	6.6-7.8	High-----	High.
0	85-95	80-90	65-80	50-60	25-40	NP-5	0.6-2.0	0.15-0.17	7.9-8.4	Low-----	High.
0	65-85	65-80	45-55	20-30	25-40	NP-5	2.0-6.0	0.07-0.09	7.9-8.4	Low-----	High.
0-15	85-95	65-85	70-80	50-70	50-60	30-40	0.06-0.2	0.11-0.13	6.6-8.4	High-----	High.
0-10	60-70	50-75	45-65	35-50	55-80	40-60	0.06-0.2	0.13-0.15	6.1-8.4	High-----	High.
0-5	50-65	40-60	30-50	15-30	30-60	15-40	0.2-0.6	0.12-0.14	7.4-8.4	Moderate ..	High.
15-25	70-90	65-85	45-55	45-50	50-60	30-40	0.06-0.2	0.13-0.15	7.4-8.4	High-----	High.
0	85-100	75-100	65-85	55-75	30-40	15-25	0.2-0.6	0.19-0.21	6.6-8.4	Moderate ..	High.
0	100	95-100	80-95	70-80	30-40	10-20	0.2-0.6	0.19-0.21	7.4-8.4	Moderate ..	High.
5-15	75-85	35-75	30-45	20-30	NP	NP	2.0-6.0	0.07-0.09	5.6-7.3	Low-----	Moderate.
5-10	65-75	55-65	40-55	30-40	NP	NP	0.6-2.0	0.14-0.16	6.1-8.4	Low-----	Moderate.
0-20	90-100	85-95	75-90	35-50	NP	NP	0.6-2.0	0.13-0.15	7.9-8.4	Low-----	High.
0	95-100	85-100	60-75	50-60	25-35	10-15	0.2-0.6	0.14-0.16	7.4-8.4	Moderate ..	High.
0	55-80	50-75	25-40	10-20	NP	NP	6.0-20.0	0.06-0.08	7.9-8.4	Low-----	Moderate.
0	95-100	90-100	60-70	30-40	25-35	NP	2.0-6.0	0.13-0.15	6.6-8.4	Low-----	High.

TABLE 5.—Estimated soil properties

Soil series and map symbols	Depth to bedrock or hardpan	Depth from surface	USDA texture	Classification	
				Unified	AASHO
	<i>Feet</i>	<i>Inches</i>			
Palos Verdes: PcE.....	>5	0-8 8-60	Gravelly clay loam..... Weakly cemented gravelly sandy loam.	GC GM	A-6 A-1
*Partri: Pd, Pe, Pf..... For Abra part of Pf, see Abra series.	>5	0-28 28-60	Clay..... Gravelly clay loam.....	CL GC	A-7 A-6
*Pastura: PgB, PhD, PIB, PmB, PnB..... For Poley part of PIB, see Poley series; for Lynx part of PmB, see Lynx series; for Rune part of PnB, see Rune series.	½-1½	0-11 11-60	Loam and gravelly loam..... Lime indurated hardpan.	CL	A-6
*Poley: Po, Pp..... For Partri part of Pp, see Partri series.	>5	0-24 24-60	Clay and sandy clay loam..... Weakly cemented very cobbly coarse sandy loam.	CL GM	A-7 A-2
*Purner: PrC, PsC, PsD, PuC, PvD, PwD..... For Boysag part of PuC, see Boysag series; for Dye part of PvD, see Dye series; for Moenkopie part of PwD, see Moenkopie series.	½-1½	0-10 10	Gravelly loam..... Limestone.	GM	A-4
Retriever: ReD.....	½-1½	0-8 8	Gravelly loam..... Limestone.	GM	A-2 or A-4
*Rimrock: Rk, Rm, Rn..... For Cave part of Rm, see Cave series; for Graham part of Rn, see Graham series.	2-5	0-34 34	Clay..... Basalt.	CH	A-7
Rock land: Ro. Too variable to rate.					
Rock land, low rainfall: Rr. Too variable to rate.					
Rough broken land: Rs. Too variable to rate.					
Rune: Rt.....	>5	0-23 23-60	Clay loam..... Clay.....	CL CH	A-6 A-7
Sandy and gravelly alluvial land: Sa. Too variable to rate.					
Showlow: ShB.....	>5	0-16 16-46 46-60	Loam..... Gravelly clay..... Very gravelly clay loam.....	SM CL or GC GC	A-4 A-7 A-2
*Springerville: SiB, SmB, SnD, SpB, StB, SuB..... For Cabezon part of SnD, see Cabezon series; for Pastura part of SpB, see Pastura series; for Thunderbird part of StB, see Thunderbird series; for Lonti part of SuB, see Lonti series.	3-5	0-39 39	Clay..... Basalt.	CH	A-7
*Tajo: TaB, TcC..... For Springerville part of TcC, see Springerville series.	1½-3	0-40 40-63 63	Clay loam..... Hardpan. Basalt.	CL	A-6
*Thunderbird: TdC, TdE, ThC..... For Cabezon part of ThC, see Cabezon series.	1½-3	0-31 31	Cobbly clay loam and clay..... Basalt.	CH	A-7
Tortugas: TiB, TmD, TnF.....	½-1½	0-9 9	Very stony loam..... Limestone.	GM	A-2
Tours: To.....	>5	0-60	Clay loam and loam.....	CL	A-6

significant in engineering—Continued

Coarse fraction greater than 3 inches	Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity of uncoated steel
	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							
<i>Percent</i>							<i>Inches per hour</i>	<i>Inches per inch of soil</i>	<i>pH</i>		
0-10	55-70	50-65	45-55	35-50	30-40	15-25	0.6-2.0	0.15-0.17	7.4-8.4	Moderate ..	High.
5-10	25-40	30-40	15-30	15-20	NP	NP	0.6-2.0	0.06-0.08	7.9-8.4	Low	High.
0-5	100	90-100	80-95	70-85	40-50	20-25	0.06-0.2	0.14-0.16	6.6-8.4	High	High.
10-20	60-70	50-60	40-50	35-45	30-40	15-25	0.2-0.6	0.15-0.17	7.9-8.4	Moderate ..	High.
0-5	85-100	80-95	75-90	60-70	30-40	15-25	0.6-2.0	0.10-0.16	7.9-8.4	Moderate ..	High.
0-5	95-100	90-100	75-90	60-75	40-50	25-35	0.06-0.2	0.14-0.16	6.6-8.4	High	High.
35-50	35-45	30-40	15-25	10-20	30-40	NP	0.2-0.6	0.04-0.06	7.9-8.4	Low	High.
5-20	60-70	55-65	50-65	35-45	30-40	NP-10	0.6-2.0	0.10-0.12	7.9-8.4	Low	Moderate.
10-20	60-85	55-80	50-70	30-50	25-35	NP	0.6-2.0	0.09-0.11	7.9-8.4	Low	Moderate.
10-25	75-100	75-100	85-95	70-90	60-70	40-50	0.06-0.2	0.14-0.16	7.9-8.4	High	High.
0-5	95-100	90-100	80-90	55-70	30-40	10-20	0.6-2.0	0.16-0.18	7.4-8.4	Moderate ..	High.
0-5	95-100	90-100	85-95	70-80	50-60	30-40	0.06-0.2	0.14-0.16	7.4-8.4	High	High.
0-5	75-85	70-80	55-70	45-50	30-40	NP	0.6-2.0	0.14-0.16	6.1-7.3	Low	Moderate.
0-5	55-85	50-80	45-70	40-60	40-60	25-35	0.06-0.2	0.12-0.14	6.6-8.4	High	High.
0-15	30-55	25-50	20-40	15-35	30-40	10-20	0.2-0.6	0.09-0.11	7.9-8.4	Moderate ..	High.
10-40	90-100	80-100	80-100	60-85	50-65	25-35	0.06-0.2	0.14-0.16	6.6-8.4	High	High.
0-10	90-95	75-90	70-80	60-75	30-40	20-30	0.2-0.6	0.18-0.20	7.9-8.4	Moderate ..	High.
15-25	90-95	75-90	70-85	60-75	70-95	40-70	0.06-0.2	0.12-0.14	6.6-8.4	High	High.
15-40	45-65	40-60	35-55	25-35	20-30	NP	0.6-2.0	0.14-0.16	7.9-8.4	Low	High.
0-5	90-100	90-100	80-95	60-70	30-40	15-25	0.2-0.6	0.17-0.21	7.4-8.4	Moderate ..	High.

TABLE 5.—*Estimated soil properties*

Soil series and map symbols	Depth to bedrock or hardpan	Depth from surface	USDA texture	Classification	
				Unified	AASHO
*Tres Hermanos: TwC----- For Whitlock part of TwC, see Whitlock series.	<i>Feet</i> >5	<i>Inches</i> 0-15 15-60	Gravelly sandy clay loam----- Gravelly sandy loam and gravelly loamy sand.	SC or GC GM or SM	A-2 A-1 or A-2
*Vekol: Vm----- For Mohave part of Vm, see Mohave series.	>5	0-33 33-60	Clay, clay loam----- Gravelly sandy loam-----	CH GM	A-7 A-1
*Venezia: VnD, VrF, VsC, VtC, VtE----- For Springerville part of VsC, see Springerville series; for Thunderbird part of VtC and VtE, see Thunderbird series.	½-1½	0-10 10	Gravelly loam----- Basalt.	SM or GM	A-4
*Waldroup: WcC----- For Cabezon part of WcC, see Cabezon series.	1½-5	0-21 21-60	Gravelly clay----- Cinders-----	CL GP	A-7 A-1
*Whitlock: WgC, WhC----- For Anthony part of WhC, see Anthony series.	>5	0-60	Stratified gravelly sandy loam and sandy loam that is weakly cemented with lime.	SM	A-2
Wilcoxson: WIF-----	1-1½	0-27 27	Clay loam and clay----- Limestone.	CH or GC	A-7
*Wineg: Wm, Wn, Wo, Wp----- For Abra part of Wn, see Abra series; for Lynx part of Wo, see Lynx series; for Poley part of Wp, see Poley series.	3-5	0-14 14-60	Clay loam----- Sandy loam and coarse sandy loam that are weakly cemented with lime.	CL SM	A-6 A-2

¹ NP = Nonplastic.

significant in engineering—Continued

Coarse fraction greater than 3 inches	Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity of uncoated steel
	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							
<i>Percent</i>							<i>Inches per hour</i>	<i>Inches per inch of soil</i>	<i>pH</i>		
0-5	75-85	55-75	45-55	25-35	25-35	10-15	0.2-0.6	0.1-0.14	7.9-9.0	Moderate ..	Low.
0-5	55-75	50-70	30-50	15-35	20-30	NP	0.6-2.0	0.07-0.09	7.9-9.0	Low	High.
0	100	100	90-100	75-85	70-80	45-55	0.06-0.2	0.14-0.21	7.4-8.4	High	High.
0	50-60	45-55	30-45	15-25	20-30	NP	2.0-6.0	0.10-0.13	7.9-8.4	Low	High.
15-50	55-80	50-70	40-70	35-50	30-40	NP	0.6-2.0	0.10-0.12	6.6-8.4	Low	Moderate.
5-15	80-90	60-70	60-70	50-60	40-50	20-25	0.6-0.2	0.10-0.12	6.6-7.8	High	High.
10-20	40-50	30-40	15-25	0-5	NP	NP	6.0-20.0	0.06-0.08	6.6-8.4	Low	Moderate.
0-5	80-95	65-75	50-60	25-35	20-30	NP	2.0-6.0	0.07-0.10	7.9-8.4	Low	High.
0-5	55-90	50-75	45-65	40-55	50-60	25-35	0.06-0.2	0.13-0.15	6.6-9.0	High	High.
0-2	90-95	80-90	70-85	60-70	30-40	15-25	0.2-0.6	0.17-0.19	6.6-7.8	Moderate ..	High.
0-5	85-95	70-80	50-65	25-35	25-35	NP	2.0-6.0	0.06-0.08	7.9-8.4	Low	High.

² Water table is at a depth of 2 to 3 feet.

TABLE 6.—Engineering

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more it is necessary to follow carefully the instructions for referring

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Shallow excavations	Dwellings without basements	Sanitary landfill ¹ (trench method)	Local roads and streets
*Abra: AaB, AbB, AeB, AIC, AID, AmC, AnC. For Lonti part of AbB, see Lonti series; for Poley part of AeB, see Poley series; for Balon part of AIC, and AID, see Balon series; for Lynx part of AmC, see Lynx series; for Wineg part of AnC, see Wineg series.	Moderate: moderately slow permeability.	Slight.....	Moderate: CL material; moderately low shear strength.	Slight.....	Severe: CL material; high plasticity index (A-6).
*Anthony: AoC, ApB, ArA. For Mohave part of ArA, see Mohave series.	Slight if slope is 0 to 8 percent, moderate if 8 to 15.	Slight if slope is 0 to 8 percent, moderate if 8 to 15.	Slight if slope is 0 to 8 percent, moderate if 8 to 15.	Slight.....	Slight if slope is 0 to 8 percent, moderate if 8 to 15.
Apache: As, At.....	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.	Severe: bedrock at a depth of less than 20 inches.
*Arp: AuC, AvD, AwE, AxD, AyC. For Moano part of AxD, see Moano series; for Lynx part of AyC, see Lynx series.	Severe: bedrock at a depth of less than 40 inches; slow permeability; slope.	Severe: bedrock at a depth of less than 40 inches; slope.	Severe: high shrink-swell potential; bedrock at a depth of 20 to 40 inches; slope.	Severe: bedrock at a depth of less than 40 inches; slope.	Severe: high shrink-swell potential bedrock at a depth of 20 to 40 inches; CH material has high plasticity index; slope.
Badland: Ba.....	Severe: moderately steep slope.	Severe: variable texture; moderately steep slope.	Severe: variable texture; moderately steep slope.	Severe: variable texture; moderately steep slope.	Severe: variable texture; moderately steep slope.
*Balon: BdC, BgD, BIC. For Lynx part of BIC, see Lynx series.	Severe: moderately slow permeability, slope is more than 15 percent in places.	Moderate: gravelly; severe if slope is more than 15 percent.	Moderate: moderate shrink-swell potential; severe if slope is more than 15 percent.	Slight if slope is less than 15 percent, moderate if 15 to 25, severe if more than 25.	Slight if slope is less than 8 percent, moderate if 8 to 15, severe if more than 15.

interpretations

kinds of soil. The soils in such mapping units may have different properties and limitations, and for this reason to other series that appear in the first column of this table]

Suitability as a source of—			Soil features affecting—		
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Poor: CL material; high plasticity index (A-6).	Unsuitable: excessive fines; fair where underlain by sand and gravel.	Fair: high content of lime.	Moderately slow permeability; rapid permeability where underlain by sand and gravel.	Medium to low shear strength; medium compressibility; good resistance to piping.	High available water capacity; high erosion hazard where slope is more than 5 percent.
Good	Poor to unsuitable: excessive fines.	Fair: gravel	Moderately rapid permeability; slope is as steep as 15 percent.	Medium permeability when compacted; fair to good compaction characteristics; slight compressibility; medium susceptibility to piping.	Moderately high available water capacity; moderate to high erosion hazard where slope is more than 3 percent.
Poor: CL material; high plasticity index (A-6).	Unsuitable: excessive fines; bedrock at a depth of less than 20 inches.	Poor: gravelly; bedrock at a depth of less than 20 inches.	Very shallow; gravelly.	Bedrock within a depth of 20 inches; medium shear strength; low susceptibility to piping.	Low available water capacity; bedrock within a depth of 20 inches; gravelly.
Poor: high shrink-swell potential; slope is more than 25 percent.	Unsuitable: excessive fines.	Poor: gravelly; steep slopes; clay at a depth of 2 inches.	Slow permeability; bedrock at a depth of 20 to 40 inches; slope is 0 to 60 percent.	Low to medium shear strength; fair compaction characteristics; shear strength; fair compaction characteristics; high compressibility; steep slope.	Moderate available water capacity; generally steep slope.
Good to poor: variable texture.	Poor to unsuitable: variable texture.	Good to poor: variable texture.	Permeability rapid to slow; moderately steep slope.	Variable texture; moderately steep slope.	Variable texture; variable permeability; low to high available water capacity; moderately steep slope.
Good if slope is 0 to 15 percent, fair if 15 to 25, poor if more than 25.	Unsuitable: excessive fines.	Fair to poor: gravel; slope is 0 to 15 percent; poor if slope is more than 15 percent.	Moderately slow permeability; slope is 0 to 30 percent; gravelly material.	Medium to high shear strength; good compaction characteristics; high resistance to piping; low compacted permeability.	High available water capacity; slope generally is 2 to 25 percent; erosion hazard.

TABLE 6.—Engineering

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Shallow excavations	Dwellings without basements	Sanitary landfill ¹ (trench method)	Local roads and streets
Barkerville: BmF, BnD, BoF.	Severe: bedrock at a depth of 20 to 40 inches.	Severe: bedrock at a depth of 20 to 40 inches.	Moderate: bedrock at a depth of 20 to 40 inches; slope is 15 percent; severe if slope is more than 15 percent.	Severe: bedrock at a depth of 20 to 40 inches; slope is more than 25 percent in places.	Moderate if slope is 0 to 15 percent; bedrock at a depth of 20 to 40 inches; severe if slope is more than 15 percent.
Boysag..... Mapped only in complex with Puvnev soils.	Severe: slow permeability; bedrock at a depth of 20 inches or less.	Severe: bedrock at a depth of 20 inches or less; clay.	Severe: bedrock at a depth of 20 inches or less; high shrink-swell potential.	Severe: bedrock at a depth of 20 inches or less; clay.	Severe: bedrock at a depth of 20 inches or less; CL material has high plasticity index.
Bridge: BrD.....	Severe: bedrock at a depth of 20 to 38 inches.	Severe: bedrock at a depth of 20 to 38 inches.	Moderate: bedrock at a depth of 20 to 38 inches; CL material; severe if slope is more than 15 percent.	Severe: bedrock at a depth of 20 to 38 inches.	Moderate: bedrock at a depth of 20 to 38 inches; CL material; severe if slope is more than 15 percent.
Brolliar: BsC, BsD.....	Severe: slow permeability; slope.	Severe: clay texture; bedrock at a depth of 24 to 40 inches.	Severe: CH material; high shrink-swell potential; slope.	Severe: clay texture; bedrock at a depth of 24 to 40 inches.	Severe: CH material; high shrink-swell potential.
*Cabezon: CaD, CbC, CdC, CeE. For Springerville part of CaD and CbC, see Springerville series; for Thunderbird part of CdC, see Thunderbird series.	Severe: bedrock at a depth of less than 20 inches; permeability.	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; stony and cobbly.
*Cave: CgC, CID For Continental part of CID, see Continental series.	Severe: indurated pan at a depth of less than 20 inches.	Moderate: gravel; slope is 0 to 15 percent.	Slight if slope is 0 to 8 percent, moderate if 8 to 15.	Severe: hardpan at a depth of 20 inches or less.	Slight if slope is 0 to 8 percent; moderate if 8 to 15.
*Cellar: CmD, CnC, CnF, CoD, CrF. For Chiricahua part of CoD, see Chiricahua series.	Severe: bedrock at a depth of 4 to 15 inches; slope is as much as 60 percent.	Severe: bedrock at a depth of 4 to 15 inches; slope is as much as 60 percent.	Severe: bedrock at a depth of 4 to 15 inches; slope is as much as 60 percent.	Severe: bedrock at a depth of 4 to 15 inches; slope is as much as 60 percent.	Severe: bedrock at a depth of 4 to 15 inches; slope is as much as 60 percent; stony and cobbly in places.
Chiricahua..... Mapped only in complex with Cellar soils.	Severe: slow permeability; bedrock at a depth of 20 to 30 inches; slope is as much as 30 percent.	Severe: bedrock at a depth of 20 to 30 inches; clay subsoil.	Moderate if slope is 8 to 15 percent; CL material; severe if slope is more than 15 percent.	Severe: bedrock at a depth of 20 to 30 inches; clay subsoil.	Severe: CL material has high plasticity index; slope is as much as 30 percent; bedrock at a depth of 20 to 30 inches.

interpretations—Continued

Suitability as a source of—			Soil features affecting—		
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Good if slope is 0 to 15 percent, moderate if 15 to 25, severe if more than 25.	Poor: excessive fines.	Poor: gravel; slope is more than 15 percent.	Moderately rapid permeability; slope is 5 to 50 percent; bedrock at a depth of 20 to 40 inches.	Medium to high shear strength; fair compaction characteristics; medium compacted permeability.	Low available water capacity; slope is 5 to 50 percent; bedrock at a depth of 20 to 40 inches; gravel.
Poor: CL material has high plasticity index; high shrink-swell potential.	Unsuitable: excessive fines.	Poor: clay at a depth of 5 inches; gravelly in places.	Bedrock at a depth of less than 20 inches; slope is 0 to 5 percent.	Bedrock at a depth of less than 20 inches; clay at a depth of 5 inches; low shear strength.	Low available water capacity; bedrock at a depth of less than 20 inches.
Poor: CL material has high plasticity index; severe if slope is more than 25 percent.	Unsuitable: excessive fines.	Poor: gravel; limited material.	Bedrock at a depth of 20 to 38 inches; slope is more than 8 percent.	Medium to low shear strength; low permeability when compacted; fair to good compaction characteristics.	High available water capacity; slope is 2 to 30 percent.
Poor: CH material; high shrink-swell potential.	Unsuitable: excessive fines; clay.	Poor: stony; some slopes are more than 15 percent.	Stony surface layer; slowly permeable; bedrock at a depth of 24 to 40 inches; slope is 0 to 30 percent.	Low shear strength; poor compaction characteristics; high compressibility.	High available water capacity; clay in subsoil.
Poor CH material; moderate shrink-swell potential; slope is as much as 50 percent.	Unsuitable: excessive fines; clay at a depth of 1 inch.	Poor: stony and cobbly; clay.	Very shallow and shallow soil; slope is as much as 50 percent; stony and cobbly.	Very shallow and shallow soil; stony and cobbly; slope is as much as 50 percent; low shear strength.	Low available water capacity; stony and cobbly; clay at a depth of 1 inch; slope is as much as 50 percent.
Slight: slope is as much as 15 percent.	Poor: 20 inches or less depth to hardpan.	Poor: gravelly material; hardpan at a depth of 20 inches or less.	Hardpan at a depth of 20 inches or less; gravelly material.	Medium shear strength; hardpan at a depth of 20 inches or less; fair compaction characteristics; moderate permeability when compacted.	Low available water capacity; gravelly or cobbly in places; slope is as much as 15 percent; highly calcareous.
Poor: bedrock at a depth of 4 to 15 inches; slope is as much as 60 percent.	Unsuitable: bedrock at a depth of 4 to 15 inches.	Poor: gravelly or very gravelly; bedrock at a depth of 4 to 15 inches.	Bedrock at a depth of 4 to 15 inches; gravelly or very gravelly; stony, cobbly, or rocky; slope is as much as 60 percent.	Limited material; slope is as much as 60 percent; gravelly, cobbly, and stony.	Low available water capacity; very shallow soil; gravelly, cobbly, stony, and rocky.
Poor: limited material; CL material has high plasticity index.	Unsuitable: excessive fines; limited material.	Poor: gravelly; clay at a depth of 5 inches.	Bedrock at a depth of 20 to 30 inches; slow permeability; slope is as much as 30 percent.	Clay subsoil; bedrock at a depth of 20 to 30 inches; slope is as much as 30 percent; very stony in places.	Low available water capacity; clay subsoil; slope is as much as 30 percent; very stony in places.

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Shallow excavations	Dwellings without basements	Sanitary landfill ¹ (trench method)	Local roads and streets
*Continental: CsC, CtD, CuC, CvB, CwD. For Cave part of CtD, see Cave series; for Whitlock part of CuC, see Whitlock series; Loamy alluvial land part of CvB is too variable for valid interpretations.	Slight if slope is 0 to 8 percent; moderately rapid permeability below a depth of 27 inches; moderate if slope is 8 to 15 percent; severe if more than 15.	Severe: clay subsoil; very gravelly below a depth of 27 inches; slope is as much as 30 percent in places.	Moderate if slope is 0 to 15 percent; moderate shrink-swell potential; severe if slope is more than 15 percent.	Slight if slope is 0 to 15 percent, moderate if 15 to 25, severe if more than 25.	Moderate: SC or CL material; excessive fines; severe if plasticity index is high and slopes exceed 15 percent.
Cordes: Cx.....	Severe: flood hazard.	Severe: loamy sand at a depth of 30 to 60 inches; gravelly; flood hazard.	Severe: flood hazard.	Severe: flood hazard.	Severe: flood hazard.
Cordes, red variant: Cy.	Severe: flood hazard.	Severe: loamy sand at a depth of 30 to 60 inches; gravelly; flood hazard.	Severe: flood hazard.	Severe: flood hazard.	Severe: flood hazard.
*Cross: CzC..... For Cabezon part, see Cabezon series; for Apache part, see Apache series.	Severe: bedrock at a depth of 8 to 20 inches.	Severe: bedrock at a depth of 8 to 20 inches.	Severe: bedrock at a depth of 8 to 20 inches.	Severe: bedrock at a depth of 8 to 20 inches.	Severe: bedrock at a depth of 8 to 20 inches.
Dandrea: DaF.....	Severe: slow permeability; slope is 15 to 60 percent.	Severe: bedrock at a depth of 15 to 40 inches; slope is 15 to 60 percent.	Severe: slope is 15 to 60 percent; bedrock at a depth of 15 to 40 inches.	Severe: bedrock at a depth of 15 to 40 inches.	Severe: slope is 15 to 60 percent; bedrock at a depth of 15 to 40 inches.
Dye: DgC, DrC.....	Severe: bedrock at a depth of 12 to 20 inches.	Severe: bedrock at a depth of 12 to 20 inches.	Severe: bedrock at a depth of 12 to 20 inches.	Severe: bedrock at a depth of 12 to 20 inches.	Severe: bedrock at a depth of 12 to 20 inches.
*Faraway: FaC, FIE, FIF. For Luzena part of FIE and FIF, see Luzena series.	Severe: bedrock at a depth of 5 to 15 inches; slope is as much as 60 percent.	Severe: bedrock at a depth of 5 to 15 inches; gravelly, cobbly, and stony.	Severe: bedrock at a depth of 5 to 15 inches; slope is as much as 60 percent; gravelly, cobbly, and stony.	Severe: bedrock at a depth of 5 to 15 inches; slope is as much as 60 percent; gravelly, cobbly, and stony.	Severe: bedrock at a depth of 5 to 15 inches; slope is as much as 60 percent; gravelly, cobbly, and stony.
Gaddes: GdD.....	Severe: slow permeability; bedrock at a depth of 20 to 40 inches.	Severe: gravelly and very gravelly material.	Slight if slope is 0 to 8 percent, moderate if 8 to 15, severe if more than 15.	Severe: bedrock at a depth of 20 to 40 inches; slope is as much as 35 percent.	Moderate if slope is 0 to 15 percent; fines; bedrock at a depth of 20 to 40 inches; severe if slope is more than 15 percent.

interpretations—Continued

Suitability as a source of—			Soil features affecting—		
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Fair: SC material has excessive fines (A-6, A-7); severe if CL material that has high plasticity index and slope is more than 25 percent.	Unsuitable to a depth of 27 inches; excessive fines; poor for sand and gravel below a depth of 27 inches; excessive fines.	Poor: gravel; limited material.	Slow permeability to a depth of 27 inches; moderately rapid below 27 inches; sand and gravel at a depth of 27 inches.	Clayey material to a depth of 27 inches; poor compaction characteristics; sand and gravel below a depth of 27 inches; medium to low shear strength; moderate susceptibility to piping.	High available water capacity and slow permeability above a depth of 18 inches; gently sloping to steep.
Good.....	Poor: excessive fines.	Good.....	Moderately rapid permeability; loamy sand at a depth of 30 to 60 inches.	Medium shear strength; loamy sand at a depth of 30 to 60 inches; high susceptibility to piping.	Low to moderate available water capacity; moderately rapid permeability.
Good.....	Poor: excessive fines.	Good.....	Moderately rapid permeability; loamy sand at a depth of 30 to 60 inches.	Medium shear strength; loamy sand at a depth of 30 to 60 inches; high susceptibility to piping.	Low to moderate available water capacity; moderately rapid permeability.
Poor: CH material (A-7); bedrock at a depth of 8 to 20 inches.	Unsuitable: excessive fines.	Poor: excessive fines; gravelly and cobbly; bedrock at a depth of 8 to 20 inches.	Bedrock at a depth of 8 to 20 inches; gravelly and cobbly.	Low shear strength; poor compaction characteristics; bedrock at a depth of 8 to 20 inches.	Low available water capacity; gravelly and cobbly; bedrock at a depth of 8 to 20 inches; slope is as much as 15 percent.
Poor: CL material (A-6 or A-7); high shrink-swell potential; slope is 15 to 60 percent.	Unsuitable: excessive fines.	Poor: gravelly and cobbly material; excessive fines; slope is 15 to 60 percent.	Slowly permeable; gravelly and cobbly; slope is 15 to 60 percent.	Low shear strength; high shrink-swell potential; poor compaction characteristics.	Moderately high available water capacity; slope is 15 to 60 percent; high hazard of erosion.
Poor: CL material (A-6); 12 to 20 inches thick.	Unsuitable: excessive fines; 12 to 20 inches thick.	Poor: clay at a depth of 5 inches; 12 to 20 inches thick.	Slowly permeable; bedrock at a depth of 12 to 20 inches; slope is as much as 15 percent.	Medium to low shear strength; fair compaction characteristics; 12 to 20 inches thick; impervious when compacted.	Low available water capacity; clayey subsoil; 12 to 20 inches deep to bedrock; slope is as much as 15 percent.
Poor: 5 to 15 inches thick; slope is as much as 60 percent; cobbly and stony.	Unsuitable: excessive fines; 5 to 15 inches thick.	Poor: gravelly, cobbly, and stony; 5 to 15 inches thick; slope is as much as 60 percent.	Moderate permeability; gravelly, cobbly, and stony; bedrock at a depth of 5 to 15 inches; slope is as much as 60 percent.	Medium to high shear strength; fair compaction characteristics; 5 to 15 inches deep to bedrock.	Low available water capacity; gravelly, cobbly, and stony; slope is as much as 60 percent.
Fair if slope is 0 to 25 percent; fines; severe if slope is more than 25 percent.	Unsuitable: excessive fines.	Poor: gravel content; limited material; slope is as much as 35 percent.	Slow permeability; gravelly; bedrock at a depth of 20 to 40 inches; slope is as much as 35 percent.	Medium shear strength; fair compaction characteristics; low susceptibility to piping.	Moderate available water capacity; slope is as much as 35 percent.

TABLE 6.—Engineering

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Shallow excavations	Dwellings without basements	Sanitary landfill ¹ (trench method)	Local roads and streets
Gila: Go.....	Moderate: moderate permeability.	Slight.....	Moderate: SM and ML material.	Slight.....	Moderate: SM and ML material; (A-4).
*Graham: GrB, GsE. For Rimrock part of GrB, see Rimrock series.	Severe: 8 to 20 inches deep to rock; slope is as much as 45 percent.	Severe: bedrock at a depth of 8 to 20 inches; slope is as much as 45 percent.	Severe: bedrock at a depth of 8 to 20 inches; slope is as much as 45 percent; stony or cobbly in places.	Severe: bedrock at a depth of 8 to 20 inches; slope is as much as 45 percent; stony or cobbly in places.	Severe: bedrock at a depth of 8 to 20 inches; slope is as much as 45 percent; high shrink-swell potential; A-7 material.
Hogg: HgB, HgD.....	Severe: slow permeability; slope is as much as 30 percent; bedrock at a depth of 20 to 60 inches.	Severe: clay at a depth of 6 inches; bedrock at a depth of 20 to 60 inches.	Severe: high shrink-swell potential; slope is as much as 30 percent.	Severe: bedrock at a depth of 20 to 60 inches; clayey; slope is as much as 30 percent.	Severe: high shrink-swell potential; CL material has high plasticity index (A-6).
House Mountain: HmE.	Severe: bedrock at a depth of 4 to 20 inches; slope is 15 to 40 percent.	Severe: bedrock at a depth of 4 to 20 inches; slope is 15 to 40 percent.	Severe: bedrock at a depth of 4 to 20 inches; slope is 15 to 40 percent.	Severe: bedrock at a depth of 4 to 20 inches; slope is 15 to 40 percent.	Severe: bedrock at a depth of 4 to 20 inches; slope is 15 to 40 percent.
Jacks: JaC, JaD.....	Severe: slow permeability; bedrock at a depth of 20 to 50 inches; slope is 3 to 30 percent.	Severe: clay subsoil; bedrock at a depth of 20 to 50 inches; slope is 3 to 30 percent.	Moderate: bedrock at a depth of 20 to 50 inches; CL material; slope is 3 to 15 percent; severe if slope is more than 15 percent.	Severe: bedrock at a depth of 20 to 50 inches; clay subsoil; slope is 3 to 30 percent.	Moderate: A-6 material; slope is 0 to 15 percent; bedrock at a depth of 20 to 50 inches; severe if slope is more than 15 percent.
Latene: La, Lc.....	Slight to moderate: moderate permeability.	Slight.....	Moderate: ML or CL material.	Slight.....	Moderate: some A-4 material.
Lehmans: Le, Lh.....	Severe: bedrock at a depth of 10 to 20 inches; slope is 8 to 60 percent.	Severe: bedrock at a depth of 10 to 20 inches; slope is 8 to 60 percent.	Severe: bedrock at a depth of 10 to 20 inches; slope is 8 to 60 percent.	Severe: bedrock at a depth of 10 to 20 inches; slope is 8 to 60 percent.	Severe: bedrock at a depth of 10 to 20 inches; slope is 8 to 60 percent; A-7 material.

interpretations—Continued

Suitability as a source of—			Soil features affecting—		
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Fair: ML and SM material; (A-4).	Unsuitable: excessive fines.	Good.....	Moderate permeability; slope is as much as 0 to 5 percent.	Fair compaction characteristics; moderate to low compacted permeability; medium shear strength; high susceptibility to piping.	High available water capacity; deep effective rooting depth; moderate intake and permeability rates.
Poor: CH material (A-7); limited depth; stony or cobbly in places; slope is as much as 45 percent.	Unsuitable: excessive fines.	Poor: clayey material; cobbly and stony in places; slope is as much as 45 percent.	Slow permeability; 8 to 20 inches deep to bedrock; slope is as much as 45 percent.	Low shear strength; poor compaction characteristics; high compressibility.	Moderately low water capacity; bedrock at a depth of 8 to 20 inches; cobbly and stony in places; slope is as much as 45 percent.
Poor: CL material has high plasticity index (A-6).	Unsuitable: excessive fines.	Poor: clay at a depth of 6 inches.	Slow permeability; bedrock at a depth of 20 to 60 inches; slope is as much as 30 percent.	Low shear strength; clayey material; high volume change; poor compaction characteristics.	Moderate to high available water capacity; clay at a depth of 6 inches; slope is as much as 30 percent.
Poor: bedrock at a depth of 4 to 20 inches; A-4 material.	Unsuitable: excessive fines.	Poor: gravelly, cobbly, or stony; slope is 15 to 40 percent.	Moderate permeability; bedrock at a depth of 4 to 20 inches; slope is 15 to 40 percent.	Fair compaction characteristics; subject to piping; medium shear strength.	Moderately low available water capacity; slope is 15 to 40 percent; bedrock at a depth of 4 to 20 inches; gravelly, cobbly, or stony in places.
Fair: A-6 material; slope is 0 to 25 percent; moderate shrink-swell potential; severe if slope is more than 25 percent.	Unsuitable: excessive fines.	Poor: clay at a depth of 5 inches; cobbly and stony in places; slope is as much as 30 percent.	Slow permeability; cobbly or stony in places; slope is 3 to 30 percent.	Low shear strength; low permeability; cobbly and stony in places.	Moderate available water capacity; slope is 3 to 30 percent; cobbly or stony in places.
Fair: A-4 material.	Unsuitable: excessive fines.	Poor: gravel.....	Moderate permeability; gravelly sandy loam at a depth of 43 inches.	Medium shear strength; fair compaction characteristics; high susceptibility to piping.	High available water capacity above a depth of 43 inches; deep effective rooting depth; high content of calcium carbonate; moderate permeability.
Poor: A-7 material; 10 to 20 inches thick.	Unsuitable: excessive fines; limited material.	Poor: clayey material; limited material.	Slow permeability; stony in places; 10 to 20 inches depth to bedrock.	Clayey material; limited material; stony in places; low shear strength.	Low available water capacity; 10 to 20 inches depth to bedrock; slope is 8 to 60 percent.

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Shallow excavations	Dwellings without basements	Sanitary landfill ¹ (trench method)	Local roads and streets
*Lonti: LkD, LIC, LID, LmB, LnC, LnF, LoD, LpB, LrD, LsC, LtB, LuC, LvE. For Abra part of LpB and LrD, see Abra series; for Pastura part of LsC, see Pastura series; for Cordes part of LtB, see Cordes series; for Wineg part of LuC, see Wineg series; for Rock land part of LvE, see Rock land.	Severe: slow permeability.	Severe: clayey and gravelly material.	Moderate if slope is 0 to 15 percent; high to moderate shrink-swell potential.	Severe: clayey and gravelly material.	Moderate to high shrink-swell potential; A-2 material below a depth of 28 inches.
Luzena: LwD, LxD.....	Severe: bedrock at a depth of 7 to 20 inches; slope is 0 to 60 percent.	Severe: bedrock at a depth of 7 to 20 inches; slope is 0 to 60 percent.	Severe: bedrock at a depth of 7 to 20 inches; slope is 0 to 60 percent.	Severe: bedrock at a depth of 7 to 20 inches; slope is 0 to 60 percent.	Severe: bedrock at a depth of 7 to 20 inches; slope is 0 to 60 percent; A-7 material.
Lynx: Ly, Ly2.....	Severe: moderately slow permeability; subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding; A-6 material has high plasticity index.
Lynx, wet variant: Lz.	Severe: moderately slow permeability; seasonal high water table at a depth of 2 to 3 feet; subject to flooding.	Severe: subject to flooding; seasonal high water table at a depth of 2 to 3 feet.	Severe: subject to flooding; seasonal high water table at a depth of 2 to 3 feet.	Severe: subject to flooding; seasonal high water table at a depth of 2 to 3 feet.	Severe: subject to flooding; A-6 material; seasonal high water table at a depth of 2 to 3 feet.
*Mirabal: MbC, MbF, MdF. For Dandrea part of MdF, see Dandrea series.	Severe: bedrock at a depth of 10 to 30 inches.	Severe: bedrock at a depth of 10 to 30 inches.	Moderate to severe: bedrock at a depth of 10 to 30 inches; slope is 5 to 60 percent.	Severe: bedrock at a depth of 10 to 30 inches.	Moderate to severe: bedrock at a depth of 10 to 30 inches; slope is 5 to 60 percent.
*Moano: MgD, MkF, MoD, MrC. For Lynx part of MrC, see Lynx series.	Severe: bedrock at a depth of 6 to 20 inches.	Severe: bedrock at a depth of 6 to 20 inches.	Severe: bedrock at a depth of 6 to 20 inches.	Severe: bedrock at a depth of 6 to 20 inches.	Severe: bedrock at a depth of 6 to 20 inches.

interpretations—Continued

Suitability as a source of—			Soil features affecting—		
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Fair: high to moderate shrink-swell potential; A-2 material below a depth of 28 inches.	Unsuitable: excessive fines.	Poor: high clay content; gravelly.	Slow permeability; gravelly; slope is 0 to 60 percent.	Medium to high shear strength; fair to good compaction characteristics; gravelly.	High available water capacity; slope is 0 to 60 percent; slow permeability; gravelly.
Poor: limited material; high shrink-swell potential; slope is 0 to 60 percent; A-7 material.	Unsuitable: excessive fines; limited material.	Poor: gravelly, clayey material; limited material; slope is 0 to 60 percent.	Slow permeability; bedrock at a depth of 7 to 20 inches; cobbly and stony in places; slope is 0 to 60 percent.	Low shear strength; high compressibility; limited material; cobbly and stony in places.	Low available water capacity; slope is 0 to 60 percent.
Poor: A-6 material has high plasticity index.	Unsuitable: excessive fines.	Fair: clay loam material.	Moderately slow permeability.	Low shear strength; fair compaction characteristics; medium compressibility.	Moderately high available water capacity; moderately slow permeability; subject to occasional flooding.
Poor: A-6 material has high plasticity index; somewhat poorly drained.	Unsuitable: excessive fines; high seasonal water table at a depth of 2 to 3 feet.	Fair: clay loam material; seasonal high water table at a depth of 2 to 3 feet.	Moderately slow permeability; seasonal high water table at a depth of 2 to 3 feet.	Low shear strength; fair compaction characteristics; medium compressibility.	Moderately high available water capacity; moderately slow permeability; subject to occasional flooding; seasonal high water table at a depth of 2 to 3 feet.
Poor: limited material; bedrock at a depth of 10 to 30 inches.	Unsuitable: excessive fines.	Poor: gravelly to very gravelly; very stony in places; slope is 5 to 60 percent.	Moderately rapid permeability; gravelly and very gravelly or stony; bedrock at a depth of 10 to 30 inches.	High shear strength; moderate compacted permeability; high susceptibility to piping.	Low available water capacity; bedrock at a depth of 10 to 30 inches gravelly, very gravelly or stony; slope is 5 to 60 percent.
Poor: bedrock at a depth of 6 to 20 inches; rocky or extremely rocky in places.	Unsuitable: bedrock at a depth of 6 to 20 inches.	Poor: gravelly or very gravelly; stony and rocky; limited material.	Moderate permeability; rocky or very rocky in places; slope is 0 to 30 percent.	Limited material; stony or rocky in places; medium shear strength; high susceptibility to piping.	Low available water capacity; bedrock at a depth of 6 to 20 inches; slope is 0 to 30 percent; or very gravelly, stony, and rocky.

TABLE 6.—Engineering

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Shallow excavations	Dwellings without basements	Sanitary landfill ¹ (trench method)	Local roads and streets
Moenkopie: MsB.....	Severe: bedrock at a depth of 3 to 14 inches.	Severe: bedrock at a depth of 3 to 14 inches.	Severe: bedrock at a depth of 3 to 14 inches.	Severe: bedrock at a depth of 3 to 14 inches.	Severe: bedrock at a depth of 3 to 14 inches.
Mohave: Mt.....	Severe: moderately slow permeability; slight where gravelly loamy sand is within a depth of 30 inches.	Moderate: clay loam; severe where gravelly loamy sand is within a depth of 30 inches.	Moderate: moderate shrink-swell potential; CL material.	Moderate: clay loam subsoil and gravelly loamy sand substrata.	Moderate: moderate shrink-swell potential; A-6 material.
Palma: PaB.....	Slight.....	Slight.....	Slight.....	Slight.....	Slight.....
Palos Verdes: PcE....	Slight if slope is 0 to 8 percent, moderate if 8 to 15, severe if more than 15.	Moderate: gravelly; severe if slope is more than 15 percent.	Slight if slope is 0 to 8 percent, moderate if 8 to 15, severe if more than 15.	Slight if slope is 0 to 8 percent, moderate if 15 to 25, severe if more than 25.	Slight if slope is 0 to 8 percent, moderate if 8 to 15, severe if more than 15.
*Partri: Pd, Pe, Pf.... For Abra part of Pf, see Abra series.	Severe: slow permeability.	Severe: clay subsoil; gravel and cobbles in substratum.	Severe: high to moderate shrink-swell potential.	Moderate: clay loam and gravelly clay loam to a depth of 60 inches or more.	Severe: high shrink-swell potential; A-6 and A-7 material.
*Pastura: PgB, PhD, PIB, PmB, PnB. For Poley part of PIB, see Poley series; for Lynx part of PmB, see Lynx series; for Rune part of PnB, see Rune series.	Severe: 8 to 20 inches depth to hardpan; slope is as much as 30 percent.	Severe: hardpan at a depth of 8 to 20 inches.	Severe: hardpan at a depth of 8 to 20 inches; slope is as much as 30 percent.	Severe: hardpan at a depth of 8 to 20 inches; slope is as much as 30 percent.	Moderate: hardpan at a depth of 8 to 20 inches; severe if slope is more than 15 percent.
*Poley: Po, Pp..... For Partri part of Pp, see Patri series	Moderate: moderate permeability below a depth of 24 inches.	Severe: clayey subsoil; cobbly substratum.	Severe: high shrink-swell potential.	Severe: clayey subsoil; cobbly or marly substratum.	Moderate below a depth of 24 inches; A-2 material; severe if A-7 material; high shrink-swell potential.

interpretations—Continued

Suitability as a source of—			Soil features affecting—		
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Poor: bedrock at a depth of 3 to 14 inches.	Unsuitable: limited material; bedrock at a depth of 3 to 14 inches.	Poor: limited material; gravelly or rocky in places.	Moderate permeability; limited depth; gravelly or rocky in places.	Limited material; gravelly or rocky in places; medium shear strength; extremely high susceptibility to piping.	Low available water capacity; bedrock at a depth of 3 to 14 inches; slope is 0 to 10 percent.
Moderate: moderate shrink-swell potential; A-6 material.	Unsuitable: excessive fines.	Moderate: clay loam at a depth of 11 inches.	Moderately slow permeability.	Medium shear strength; fair compaction characteristics; low permeability when compacted.	High available water capacity; moderately slow permeability effective rooting depth is 50 inches or more.
Fair: A-2 or A-4 material.	Poor: excessive fines.	Good.....	Moderately rapid permeability.	Medium shear strength; good compaction characteristics; extremely high susceptibility to piping.	Moderately high available water capacity; effective rooting depth is 60 inches or more; moderately rapid permeability.
Good below a depth of 8 inches; A-1 material.	Poor: fines in sand and gravel layer.	Poor: gravel.....	Moderate permeability; slope is 5 to 40 percent.	High shear strength; moderate piping hazard; medium permeability.	Moderate available water capacity; somewhat restricted rooting depth; slope is 5 to 40 percent.
Poor: A-6 and A-7 material; clayey.	Unsuitable: excessive fines.	Poor: limited material.	Slow permeability; gravelly and cobbly material below a depth of 28 inches.	Clayey material above a depth of 28 inches; fair compaction characteristics; medium shear strength below a depth of 28 inches.	Moderately high available water capacity; slow permeability; deep effective rooting depth.
Poor: hardpan at a depth of 8 to 20 inches; slope is as much as 30 percent.	Unsuitable: limited material; excessive fines.	Poor: gravelly; limited material.	Moderate permeability; hardpan at a depth of 8 to 20 inches; gravelly material.	Limited material; fair compaction characteristics; low shear strength.	Low available water capacity; gravelly; moderate permeability; hardpan at a depth of 8 to 20 inches.
Poor: clayey subsoil; high shrink-swell potential above a depth of 24 inches; good to fair below a depth of 24 inches; A-2 material.	Unsuitable: clayey subsoil; cobbly and marly substratum.	Poor: gravelly; limited material; clay at a depth of 6 inches.	Slow permeability; cobbly and marly at a depth of 24 inches.	Clayey material above a depth of 24 inches; fair compaction characteristics; low shear strength; gravelly material below a depth of 24 inches; high shear strength; good compaction characteristics.	Slow permeability; moderately high available water capacity; moderately deep rooting zone.

TABLE 6.—Engineering

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Shallow excavations	Dwellings without basements	Sanitary landfill (trench method)	Local roads and streets
*Purner: PrC, PsC, PsD, PuC, PVD, PwD. For Boysag part of PuC; see Boysag series; for Dye part of PVD, see Dye series; for Moenkopie part of PwD, see Moenkopie series.	Severe: bedrock at a depth of 7 to 18 inches.	Severe: bedrock at a depth of 7 to 18 inches.	Severe: bedrock at a depth of 7 to 18 inches.	Severe: bedrock at a depth of 7 to 18 inches.	Severe: bedrock at a depth of 7 to 18 inches.
Retriever: ReD.....	Severe: bedrock at a depth of 5 to 18 inches.	Severe: bedrock at a depth of 5 to 18 inches.	Severe: bedrock at a depth of 5 to 18 inches.	Severe: bedrock at a depth of 5 to 18 inches.	Severe: bedrock at a depth of 5 to 18 inches.
*Rimrock: Rk, Rm, Rn. For Cave part of Rm, see Cave series; for Graham part of Rn, see Graham series.	Severe: slow permeability.	Severe: clay; bedrock at a depth of 28 to 60 inches; cobbly and stony in places.	Severe: high shrink-swell potential; cobbly and stony in places.	Severe: clayey material; bedrock at a depth of 28 to 60 inches.	Severe: high shrink-swell potential; cobbly and stony in places.
Rock land: Ro.....	Severe: very shallow over bedrock.	Severe: very shallow over bedrock.	Severe: very shallow over bedrock.	Severe: very shallow over bedrock.	Severe: very shallow over bedrock; rock outcrops are common.
Rock land, low rainfall: Rr.	Severe: very shallow over bedrock.	Severe: very shallow over bedrock.	Severe: very shallow over bedrock.	Severe: very shallow over bedrock.	Severe: very shallow over bedrock; rock outcrops are common.
Rough broken land: Rs.	Severe: steep slope; variable material.	Severe: slope is 15 to 60 percent; variable material.	Severe: slope is 15 to 60 percent; variable material.	Severe: slope is 15 to 60 percent; variable material.	Severe: slope is 15 to 60 percent; variable material.
Rune: Rt.....	Severe: slow permeability; subject to flooding.	Severe: clayey profile; subject to flooding.	Severe: high shrink-swell potential; subject to flooding.	Severe: clayey profile; subject to flooding.	Severe: A-7 material; subject to flooding.
Sandy and gravelly alluvial land: Sa.	Severe: subject to frequent flooding.	Severe: subject to frequent flooding.	Severe: subject to frequent flooding.	Severe: subject to frequent flooding.	Severe: subject to frequent flooding.

interpretations—Continued

Suitability as a source of—			Soil features affecting—		
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Poor: limited material.	Unsuitable: limited material; excessive fines.	Poor: gravelly; limited material.	Moderate permeability; bedrock at a depth of 7 to 18 inches.	Fair compaction characteristics; limited material; medium susceptibility to piping; medium shear strength.	Medium available water capacity; moderate permeability; bedrock at a depth of 7 to 18 inches; slope is 2 to 30 percent.
Poor: bedrock at a depth of 5 to 18 inches.	Unsuitable: limited material; excessive fines.	Poor: gravelly; cobbly or stony.	Moderate permeability; bedrock at a depth of 5 to 18 inches; slope is 0 to 30 percent.	Fair compaction characteristics; limited material; gravelly, cobbly, or stony; medium to high shear strength.	Low available water capacity; moderate permeability; 5 to 18 inches deep to bedrock; slope is 0 to 30 percent.
Poor: clay; cobbly and stony in places.	Unsuitable: clay.	Poor: clay; cobbly and stony in places.	Slow permeability; cobbly and stony in places.	Clayey material; poor compaction characteristics; low shear strength; high compressibility; limited material.	Moderately low to moderate available water capacity; slow permeability; cobbly and stony in places.
Poor: limited material; rock outcrops are common.	Unsuitable: limited material.	Poor: limited material.	Very shallow soils; rock outcrops are common.	Limited material.....	Very shallow material; very shallow rooting depth; rock outcrops are common; very low available water capacity.
Poor: limited material; rock outcrops are common.	Unsuitable: limited material.	Poor: limited material.	Very shallow soils; rock outcrops are common.	Limited material.....	Very shallow material; very shallow rooting depth; rock outcrops are common; very low available water capacity.
Good to poor: variable material.	Good to unsuitable: variable material.	Poor: variable material; slope is 15 to 60 percent.	Highly variable material; slope is 15 to 60 percent.	Highly variable material; slope is 15 to 60 percent.	Low to high available water capacity; slope is 15 to 60 percent; high erosion hazard.
Poor: clayey material; high shrink-swell potential; A-7 material.	Unsuitable: excessive fines; clay.	Fair for loam and clay surface; poor for clay surface.	Slow permeability.....	Clayey material; poor compaction characteristics; low shear strength; high compressibility.	High available water capacity; slow permeability; deep effective rooting depth.
Too variable to rate.	Too variable to rate.	Too variable to rate.	Subject to frequent flooding.	Highly variable.....	Subject to frequent overflow.

TABLE 6.—Engineering

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Shallow excavations	Dwellings without basements	Sanitary landfill (trench method)	Local roads and streets
Showlow: ShB.....	Severe: slow permeability.	Severe: clay; gravelly in places.	Severe: high shrink-swell potential.	Severe: clay subsoil; gravelly in places.	Severe: high shrink-swell potential; A-7 material.
*Springerville: S1B, SmB, SnD, SpB, StB, SuB. For Cabezon part of SnD, see Cabezon series; for Pastura part of SpB, see Pastura series; for Thunderbird part of StB, see Thunderbird series; for Lonti part of SuB, see Lonti series.	Severe: slow permeability.	Severe: clay; bedrock at a depth of 28 to 70 inches.	Severe: high shrink-swell material.	Severe: clay; bedrock at a depth of 28 to 70 inches.	Severe: high shrink-swell potential.
*Tajo: TaB, TcC..... For Springerville part of TcC, see Springerville series.	Severe: moderately slow permeability; hardpan at a depth of 20 to 34 inches.	Moderate: clay loam subsoil; gravelly substratum; hardpan at a depth of 20 to 34 inches.	Moderate: moderate shrink-swell potential; hardpan at a depth of 20 to 34 inches.	Severe: hardpan at a depth of 20 to 34 inches; bedrock at a depth of 20 to 65 inches.	Severe: A-6 material; high plasticity; bedrock at a depth of 20 to 65 inches.
*Thunderbird: TdC, TdE, ThC. For Cabezon part of ThC, see Cabezon series.	Severe: slow permeability; bedrock at a depth of 20 to 44 inches.	Severe: clayey; bedrock at a depth of 20 to 44 inches.	Severe: high shrink-swell potential; slope is 0 to 40 percent.	Severe: clay; bedrock at a depth of 20 to 44 inches; slope is 0 to 40 percent.	Severe: high shrink-swell potential; slope is 0 to 40 percent.
Tortugas: T1B, TmD, TnF.	Severe: bedrock at a depth of 6 to 20 inches; slope is 0 to 60 percent.	Severe: bedrock at a depth of 6 to 20 inches; slope is 0 to 60 percent.	Severe: bedrock at a depth of 6 to 20 inches; slope is 0 to 60 percent.	Severe: bedrock at a depth of 6 to 20 inches; slope is 0 to 60 percent.	Severe: bedrock at a depth of 6 to 20 inches; slope is 0 to 60 percent.
Tours: To.....	Severe: moderately slow permeability.	Moderate: clay loam material; severe where subject to flooding.	Moderate: moderate shrink-swell potential; severe where subject to flooding.	Moderate: clay loam material; severe where subject to flooding.	Moderate: moderate shrink-swell potential; A-6 material; severe where subject to frequent flooding.
*Tres Hermanos: TwC. For Whitlock part of TwC, see Whitlock series.	Slight.....	Moderate: gravelly sandy loam at a depth of 15 inches.	Slight if slope is 0 to 8 percent; moderate if 8 to 15.	Slight.....	Slight if slope is 0 to 8 percent, moderate if 8 to 15.

interpretations—Continued

Suitability as a source of—			Soil features affecting—		
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Poor: high shrink-swell potential; A-7 material.	Unsuitable: clayey material.	Fair if surface is gravel free; sandy loam is 16 inches thick; poor if gravel; less than 8 inches deep to clay.	Slow permeability; clay subsoil; gravelly in places.	Clayey material; poor compaction characteristics; low shear strength; high compressibility.	High available water capacity; effective rooting depth is 40 inches or more.
Poor: A-7 material; high shrink-swell potential.	Unsuitable: clayey material.	Poor: clayey material.	Slow permeability; high shrink-swell potential; clayey material.	Clayey material; poor compaction characteristics; low shear strength; medium compressibility; limited material.	Moderately high available water capacity; slow permeability; slope is 0 to 10 percent.
Poor: A-7 material; high plasticity.	Poor to unsuitable: excessive fines; coarse fragments (cinders).	Moderate: clay loam material is 14 inches thick.	Moderately slow permeability; hardpan at a depth of 20 to 34 inches.	Moderately pervious; limited material in places; low shear strength above a depth of 28 inches; hardpan below a depth of 28 inches.	Moderate available water capacity; moderately slow permeability; effective rooting depth is 20 to 34 inches.
Poor: high shrink-swell potential.	Unsuitable: clay; excessive fines.	Poor: clay; limited material.	Slow permeability; bedrock at a depth of 20 to 44 inches; slope is 0 to 40 percent.	Clayey material; fair compaction characteristics; low shear strength; medium compressibility.	Slow permeability; moderately high available water capacity; bedrock at a depth of 20 to 44 inches; slope is 0 to 40 percent.
Poor: limited material; cobbly and stony in places.	Unsuitable: limited material; excessive fines.	Poor: limited material; gravelly, cobbly, or stony.	Moderate permeability; bedrock is at a depth of 6 to 20 inches; slope is 0 to 60 percent.	Fair compaction characteristics; gravelly, cobbly, or stony; medium susceptibility to piping.	Low available water capacity; effective rooting depth is 6 to 20 inches; slope is 0 to 60 percent; cobbly or stony.
Poor: A-6 material; plasticity.	Unsuitable: clay loam material; excessive fines.	Fair: clay loam material.	Moderately slow permeability.	Fair compaction characteristics; low permeability when compacted; low shear strength.	High available water capacity; slow permeability; effective rooting depth is 50 inches more.
Good: A-1 or A-2 material.	Poor: excessive fine material.	Poor: gravelly.....	Moderately slow permeability.	Good stability and compaction characteristics; moderate permeability; medium susceptibility to piping.	Moderately high available water capacity; moderate permeability; effective rooting depth is 60 inches or more.

TABLE 6.—Engineering

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Shallow excavations	Dwellings without basements	Sanitary landfill (trench method)	Local roads and streets
*Vekol: Vm..... For Mohave part of Vm, see Mohave series.	Severe: slow permeability.	Severe: clay material; gravelly strata in places.	Severe: high shrink-swell potential.	Severe: clay material.	Severe: high plasticity; A-7 material.
*Venezia: VnD, VrF, VsC, VtC, VtE. For Springerville part of VsC, see Springerville series; for Thunderbird part of VtC and VtE, see Thunderbird series.	Severe: bedrock at a depth of 5 to 16 inches; slope is 2 to 50 percent.	Severe: bedrock at a depth of 5 to 16 inches; slope is 2 to 50 percent.	Severe: bedrock at a depth of 5 to 16 inches; slope is 2 to 50 percent.	Severe: bedrock at a depth of 5 to 16 inches; slope is 2 to 50 percent.	Severe: bedrock at a depth of 5 to 16 inches; slope is 2 to 50 percent.
*Waldroup: WcC..... For Cabezon part of WcC, see Cabezon series.	Slight if slope is 0 to 8 percent, moderate if 8 to 15, severe if 15 to 30.	Severe: clayey subsoil; cinders in substratum; slope is 2 to 30 percent.	Severe: high shrink-swell potential above a depth of 2 feet; slope is 2 to 30 percent.	Severe: clayey subsoil; cinders in substratum; slope is 2 to 30 percent.	Severe: high shrink-swell potential above a depth of 2 feet; slope is 2 to 30 percent.
*Whitlock: WgC, WhC. For Anthony part of WhC, see Anthony series.	Slight if slope is 0 to 8 percent, moderate if 8 to 15.	Slight if slope is 0 to 8 percent, moderate if 8 to 15.	Slight if slope is 0 to 8 percent, moderate if 8 to 15.	Slight.....	Slight; moderate if slope is 8 to 15 percent; A-2 material.
Wilcoxson: WIF.....	Severe: slow permeability; steep slope; bedrock at a depth of 20 to 48 inches.	Severe: steep slope; bedrock at a depth of 20 to 48 inches; clayey material.	Severe: high shrink-swell potential; steep slope.	Severe: clayey material; steep slope; bedrock at a depth of 20 to 48 inches.	Severe: slope is 30 to 60 percent; A-7 material.
*Wineg: Wm, Wn, Wo, Wp. For Abra part of Wn, see Abra series; for Lynx part of Wo, see Lynx series; for Poley part of Wp, see Poley series.	Severe: moderately slow permeability; slight where underlain by sandy loam.	Slight.....	Moderate: moderate shrink-swell potential; slight where underlain by sandy loam.	Slight; moderate where underlain by lake sediments.	Moderate: moderate shrink-swell potential; A-6 material.

¹ Onsite deep studies of the underlying strata, water table, and hazards of aquifer pollution and drainage into ground water need to be made for landfills deeper than 5 or 6 feet.

interpretations—Continued

Suitability as a source of—			Soil features affecting—		
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Irrigation
Poor: high plasticity; A-7 material; high shrink-swell potential.	Unsuitable: clayey material; excessive fines.	Poor: limited material; clayey material.	Slow permeability; gravel strata locally; permeability moderately rapid below a depth of 33 inches.	Clayey material; fair compaction characteristics; high compressibility; low shear strength.	High available water capacity; slow permeability; effective rooting depth is 60 inches or more.
Poor: bedrock at a depth of 5 to 16 inches; slope is 2 to 50 percent.	Unsuitable: limited material; bedrock at a depth of 5 to 16 inches.	Poor: gravelly and stony; limited material; slope is 2 to 50 percent.	Moderately permeability; bedrock at a depth of 5 to 16 inches; slope is 2 to 50 percent.	Medium shear strength; limited material; many stones and cobbles; high susceptibility to piping.	Low available water capacity; moderate permeability; effective rooting depth is 5 to 16 inches; slope is 2 to 50 percent; many stones and cobbles.
Poor: high shrink-swell potential; highly plastic material above a depth of 2 feet; good below 2 feet.	Unsuitable: 20 to 60 inches of gravel (cinders) in substratum.	Poor: gravel (cinders); clay at a depth of 6 inches.	Slow permeability above 2 feet; gravel (cinders) at a depth of 20 to 60 inches; slope is 2 to 30 percent.	Clayey; low shear strength; poor compaction characteristics from a depth of 20 to 60 inches; gravel (cinders) in substratum.	Moderately high available water capacity; slow permeability; slope is 2 to 30 percent; effective rooting depth is 20 to 60 inches.
Good: A-2 material.	Poor: excessive fines.	Fair to poor: gravel content.	Moderately rapid permeability; slope is 0 to 15 percent.	Sandy material; rapid seepage rate; difficult to establish plant cover; extremely high susceptibility to piping.	Moderate available water capacity; moderately rapid permeability; effective rooting depth is 60 inches and more; slope is 0 to 15 percent.
Poor: high shrink-swell potential; slope is 30 to 60 percent; A-7 material.	Unsuitable: clayey material; excessive fines.	Poor: gravel slope is 30 to 60 percent.	Slow permeability; bedrock at a depth of 20 to 48 inches; slope is 30 to 60 percent.	Clayey material; poor compaction characteristics; low to medium shear strength; medium to high compressibility.	Moderate available water capacity; slow permeability; slope is 30 to 60 percent; effective rooting depth is 20 to 48 inches.
Good: A-2 material below a depth of 15 inches; fair where underlain by lake sediment.	Poor: for sand; unsuitable where underlain by lake sediment; pockets of gravel locally.	Poor: clay loam at a depth of 2 inches; gravelly below a depth of 8 inches.	Moderate permeability to a depth of 14 inches; moderately rapid below a depth of 14 inches except where underlain by lake sediment.	Sandy material at a depth of 14 inches; rapid seepage rate; low permeability where underlain by lake sediment; high susceptibility to piping where underlain by sandy loam.	Moderately high available water capacity; effective rooting depth is 60 inches or more; moderately slow permeability.

TABLE 7.—Engineering

[Most tests performed by the Arizona Highway Department. An asterisk in the first column indicates that

Soil name and location	Parent material	Depth	Moisture density ¹		Mechanical analysis ²			
			Maximum dry density	Optimum moisture	Percentage passing sieve			
					3 inch	2 inch	1½ inch	1 inch
		<i>Inches</i>	<i>Lb per cu ft</i>	<i>Percent</i>				
Anthony sandy loam: 0.2 mile W. and 0.1 mile S. of NE. corner of sec. 32, T. 10 N., R. 6 W. (Modal)	Granitic alluvium.	6-49	128	9				
Anthony gravelly sandy loam: 0.3 mile N. and 1.0 mile E. of SW. corner of sec. 33, T. 10 N., R. 5 W. (Non-modal; excess gravel in soil material)	Granitic alluvium.	1-54	129	9			100	99
Arp gravelly clay loam: 0.3 mile S. and 0.1 mile E. of NW. corner of sec. 4, T. 12 N., R. 1 E. (Modal)	Schist.	4-16 16-30	99 109	24 20	100	99 100	96 98	92 96
Arp gravelly clay loam: 0.6 mile W. and 0.3 mile S. of NE. corner of sec. 8, T. 12 N., R. 1 E. (Non-modal; less than 0.6 percent organic carbon in upper 15 inches)	Schist.	5-18 18-34	105 113	20 16		100	100 97	99 94
Balon gravelly sandy clay loam: 0.4 mile W. and 0.3 mile S. of NE. corner of sec 5, T. 12 N., R. 1 E. (Modal)	Mixed alluvium, schist, phyllite, and granite.	7-23 36-54	113 118	16 14		100 100	99 96	93 90
Balon gravelly sandy clay loam: 0.5 mile S. and 0.4 mile W. of NE. corner of sec. 10, T. 13 N., R. 1 E. (Non-modal; excessive amount of gravel in profile)	Mixed alluvium, schist, phyllite, and granite.	7-25 53-80	118 119	13 12		100	100 99	99 97
Barkerville cobbly sandy loam: 0.2 mile S. of NE. corner of sec. 5, T. 9 N., R. 2 W. (Non-modal; slightly shallower to granite)	Granite.	0-3 3-8 8-25						
Continental gravelly sandy loam: 0.6 mile E. and 200 feet S. of NE. corner of sec. 26, T. 9 N., R. 6 W. (Non-modal; subsoil coarser textured than modal)	Granitic alluvium.	4-29 29-46	124 114	10 14				
Gaddes gravelly sandy loam: 0.5 mile S. and 0.12 mile E. of NW. corner of sec. 5, T. 9 N., R. 2 W. (Modal)	Granite.	5-24 24-36	119 125	12 10	100 95	93 95	93 95	92 95
Lonti gravelly loam: 0.4 mile N. and 0.1 mile W. of SE. corner of sec. 35, T. 14 N., R. 1 E. (Non-modal; higher chroma and gravel content than modal)	Alluvium from granite, schist, and phyllite.	5-22 29-76	112 124	11 11		100 100	93 99	86 98
Lonti gravelly loam: NW¼ sec. 3, T. 15 N., R. 4 W. (Modal)	Alluvium from granite, schist, and basalt.	5-26 45-68	109 123	15 9		100 100	99 99	95 88
Lynx loam: Sec. 3, T. 12 N., R. 6 W. (Non-modal)	Mixed alluvium, granite, schist, and basalt.	0-144		15				
*Mirabal gravelly sandy loam: SE¼ NW¼ sec. 9, T. 10 N., R. 1 W. (Non-modal; low gravel content)	Granite.	0-3 3-9 9-26			93 93 88			

test data

the tests were performed by the Soil Conservation Service, Soil Survey Laboratory, Riverside, California]

Mechanical analysis ² —Con.										Liquid limit	Plasticity index	Classification		
Percentage passing sieve—Con.						Percentage smaller than—						AASHO	Unified	
¾ inch	⅜ inch	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.02 mm	0.005 mm	0.002 mm					
										Percent				
	100	99	90	53	35		15	10	6	27	9	A-2-4(0)	SC	
	99	99	95	76	38		11	7	6	22	4	A-1-b(0)	SM	
88	83	79	74	69	62		55	45	34	81	58	A-7-6(16)	CH	
92	79	68	62	48	36		28	18	11	70	44	A-7-6(4)	SC	
99	98	97	93	80	69		50	33	26	48	30	A-7-6(16)	CL	
88	86	85	58	38	28		16	8	6	38	15	A-2-6(1)	SC	
90	86	82	70	46	29		17	11	6	47	28	A-2-7(3)	SC	
83	68	56	50	33	19		10	4	3	42	22	A-2-7(1)	GC	
96	88	76	61	37	26		15	11	8	54	35	A-2-7(2)	SC	
95	89	81	68	41	23		13	6	5	43	24	A-2-7(1)	SC	
100	92	83	68	37	16	14	10	7	6	NP	NP	A-1 or A-2	SM	
100	97	92	82	52	18	14	10	7	6	NP	NP	A-2	SM	
100	96	89	76	43	15	13	10	6	3	NP	NP	A-1 or A-2	SM	
		100	84	56	43		16	11	9	34	18	A-6(3)	SC	
		100	95	73	62		58	28	22	46	30	A-7-6(14)	CL	
92	92	88	74	46	27		18	14	14	47	29	A-2-7(2)	SC	
95	94	65		28	11		6	5	5	33	14	A-2-6(0)	SP-SC	
83	77	63		46	37		32	26	23	63	44	A-7-6(6)	SC	
96	91	86	75	49	23		14	8	5	29	12	A-2-6(0)	SC	
93	91	89	77	54	41		30	27	24	80	60	A-7-6(7)	SC	
83	75	70	55	30	16		11	6	6	59	33	A-2-7(0)	SC	
			100		86					31	15	A-6(10)	CL	
90	87	82	76	44	21	18	7	6	5	NP	NP	A-1	SM	
88	86	82	76	46	26	23	17	10	7	NP	NP	A-2	SM	
69	63	57	48	29	22	21	19	14	9	NP	NP	A-1	GM	

TABLE 7.—Engineering

Soil name and location	Parent material	Depth	Moisture density ¹		Mechanical analysis ²			
			Maximum dry density	Optimum moisture	Percentage passing sieve			
					3 inch	2 inch	1½ inch	1 inch
*Moano gravelly loam: 0.2 mile W. and 0.3 mile S. of NE. corner of sec. 8, T. 12 N., R. 1 E. (Modal)	Schist.	0-9			100			
Mohave sandy loam: 0.4 mile W. and 0.3 mile N. of SE. corner of sec. 32, T. 10 N., R. 6 W. (Modal)	Granitic alluvium.	4-28 39-55	123 117	11 14				
Thunderbird cobbly clay loam: NE¼ sec. 12, T. 15 N., R. 4 W. (Non-modal; underlain by cinders at a depth of 40 inches)	Basalt and cinders.	12-29 40-81	85	33	100	94	91	80
Thunderbird cobbly clay loam: NE¼ sec. 11, T. 15 N., R. 4 W. (Modal)	Basalt and cinders.	7-28	95	25	95	95	95	95

¹ Based on AASHO Designation T 99-57, Method A (1).

² Mechanical analyses according to AASHO Designation: T 88-57 (1). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that

This information, however, does not eliminate need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitability or limitations for soil engineering.

Some of the terms used in this soil survey have special meaning to soil scientists but are not known to all engineers. The Glossary defines many of these terms commonly used in soil science.

Engineering classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (10) used by the SCS engineers, Department of Defense, and others, and the AASHO system (1) adopted by the American Association of State Highway Officials.

The Unified system is used to classify soils according to those properties that affect use of the soil as a construction material, as in a dam, or when used as a foundation material for a structure, such as a building.

In this system soils are classified according to particle-size distribution, plasticity, liquid limit, and organic-matter content. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils. The dominantly gravelly soils are identified as GW, GP, GM, and GC; and the dominantly sandy soils are SW, SP, SM, and SC. There are six classes of fine-grained soils. Those with low liquid limits are identified as ML, CL, and

OL; and those with high liquid limits are MH, CH, and OH. There is 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 AASHO system 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 AASHO classification for tested soils, with group index numbers in parentheses, is shown in table 7; the estimated classification, without group index numbers, is given in table 5 for all soils mapped in the survey area.

USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter. "Sand," "silt," "clay," and some of the other terms used in the USDA textural classification are defined in the Glossary.

Soil properties significant in engineering

Several estimated soil properties significant in engineering are given in table 5. These estimates are made

test data—Continued

Mechanical analysis ² —Con.										Liquid limit	Plasticity index	Classification	
Percentage passing sieve—Con.						Percentage smaller than—						AASHO	Unified
¾ inch	⅜ inch	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.02 mm	0.005 mm	0.002 mm				
87	80	70	59	42	30	27	16	9	6	Percent NP	NP	A-2	SM
100	100 99	99 99	92 91	70 62	50 45	----- -----	21 26	14 19	10 16	30 43	13 27	A-6(4) A-7-6(7)	CL SC
67	31	100 17	99 12	95 8	91 4	----- -----	84 3	70 1	61 1	95 52	72 21	A-7-6(20) A-2-7(0)	CH GP
95	9	95	92	90	85	-----	72	54	42	73	53	A-7-6(20)	CH

coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for naming textural classes of soils.

³ Nonplastic.

for typical soil profiles, by layers sufficiently different to have different significance for 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.

Depth to bedrock or hardpan is distance from the surface of the soil to the upper surface of the rock layer or hardpan.

Soil texture is described in the Glossary 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, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are also defined in the Glossary.

The depth to a water table was not included in table 5 because the depth is not significant in the management of most of the soils in the survey area. Lynx, wet variant, has a seasonal water table at a depth of 2 to 3 feet.

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, but in table 7 the data on liquid limit and plasticity index are based on tests of soil samples.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on basis of those soil characteristics observed in the field, particularly structure 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 in the amount of water in the soil at field capacity and the amount at the wilting point in 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.

Shrink-swell potential is the relative change in volume to be expected of soil material 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 cause 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 materials having this rating.

Corrosivity, as used in table 5, pertains to potential soil-induced chemical action that corrodes or weakens

uncoated steel. Corrosivity for uncoated steel is closely related to the physical, chemical, and biological characteristics of the soil. A corrosivity rating of *low* means that there is a low probability of soil-induced corrosion damage. A rating of *high* means that there is a high probability of damage, so that protective measures should be used to avoid or minimize damage.

Engineering interpretations

The estimated 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 Yavapai County, Western part. In table 6, ratings are used to summarize limitations or the suitability of the soils for all listed purposes other than for pond reservoir areas, embankments, dikes and levees, and irrigation. For these particular uses, table 6 lists those soil features not to be overlooked in planning, installation, and maintenance.

Soil limitations are indicated by the ratings slight, moderate, and severe. *Slight* means soil properties generally favorable for the rated use, or in other words, limitations that are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means soil properties so unfavorable and so difficult or expensive to correct or overcome as to require major soil reclamation, special designs, or intensive maintenance.

Soil suitability is rated by the terms *good*, *fair*, and *poor*, which have, respectively, meanings approximately parallel to the terms slight, moderate, and severe.

Following are explanations of some of the columns in table 6.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material from a depth of 18 inches to 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope is a soil property that affects difficulty of layout and construction and also the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Limitations for shallow excavations are determined mainly by soil slope, depth to bedrock, and soil texture.

Dwellings without basements, as rated in table 6, are not more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to support load and resist settlement under load, and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Limitations for sanitary landfill (trench method) are determined mainly by permeability rate, hazard of flooding, depth to bedrock, and soil texture.

Local roads and streets, as rated in table 6, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Soil properties that most affect design and construction of roads and streets are load supporting capacity and stability of the subgrade, and the workability and quantity of cut and fill material available. The AASHO and Unified classifications of the soil material, and also the shrink-swell potential, indicate traffic supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Road fill is soil material used in embankments and as subgrades for roads. The suitability ratings reflect the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage, and the relative ease of excavating the material at borrow areas.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 6 provide guidance about where to look for probable sources. A soil rated as a *good* or *fair* source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, and neither do they indicate quality of the deposit.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as for preparing a seedbed; natural fertility of the material, or its response of plants when fertilizer is applied; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability, but also considered in the ratings is damage that will result at the area from which topsoil is taken.

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. Presence of stones or organic material in a soil are among factors that are unfavorable.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, water erosion, or soil blowing; soil texture; content of stones; accumulations of salts and alkali; depth of root zone;

rate of water intake at the surface; permeability of soil layers below the surface layer and in fragipans or other layers that restrict movement of water; amount of water held available to plants; and need for drainage, or depth to water table or bedrock.

Engineering test data

Table 7 contains engineering test data for some of the major soil series in Yavapai County, Western Part. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods.

Compaction (or moisture-density) data are important in earthwork. If a soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material increases until the *optimum moisture content* is reached. After that, density decreases with increase in moisture content. The highest dry density obtained in the compactive test is termed *maximum dry density*. As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material, as has been explained for table 5.

Formation and Classification of the Soils

This section describes the factors of soil formation and their effects on the development of the soils in Yavapai County, Western Part. It also lists the soil series and gives their placement in the classification system at the subgroup and family levels. In addition, chemical and physical laboratory data are presented in tables 8 and 9 for selected soils.

Factors of Soil Formation

Soil is a natural, dynamic body on the surface of the earth in which plants grow. The soil mantle on the earth's surface is far from uniform, but all soils have some things in common (3). They all consist of mineral material, organic matter, living organisms, water, and air, all of which occur in varying amounts in different soils.

Soil is the result of an accumulation of parent materials and the action of environmental forces upon this material to form distinctive layers or horizons. These forces work independently or together in various combinations to bring about the end result, the soil.

The soil properties are determined by the interaction of five major soil-forming factors. These factors are parent material, climate, relief or topography, plants and animals, and time. The influence of these soil-forming factors varies widely over the surface of the earth. Variations in climate, combinations of living organisms, kinds of rock, topography, and age of land surfaces result in thousands of combinations

of the soil-forming factors. The resulting combinations control the basic changes that determine the character of the soil. These changes, including removals, transfers, additions, and transformations, depend on physical and chemical processes that are continuously taking place.

These changes within the soil determine the horizon differentiation in the profile. The degree of horizon development determines the age, or maturity, of the soil. Thus, a soil lacking horizon development is a young, or immature, soil. On the other hand, a soil that has well-expressed horizons is an older or more mature soil.

The five major soil-forming factors and their influence on the basic soil changes and the development of soils in Yavapai County, Western Part, are described below.

Parent material

Parent material must be weathered to produce soil material. The rate of weathering and kinds of material produced are determined by the composition and structure of the original rock. Most rocks are a mixture of many minerals. Plant nutrients and clay minerals generally are formed upon weathering, but in some minerals, such as quartz, little besides mechanical breakdown results from weathering processes.

The released elements in turn influence fertility levels, kinds of plants that grow, color, chemical reactions, and various other soil properties that help determine the horizon development of the soil.

About two-thirds of the soils in Yavapai County, Western Part, formed in place in various types of bedrock. These are quite variable in composition and include granite, basalt, schist, andesite, rhyolite, tuffs, quartzite, gneiss, limestone, sandstone, and lakebed deposits. The rest of the soils formed in alluvial materials, most of which weathered from a mixture of several of the kinds of rock listed above.

Many of the physical properties of the parent materials are strongly reflected, especially in the younger or immature soils. The shallow Cellar, Barkerville, Venezia, Moano, and similar soils are examples of this. In places these soils have horizons that exhibit rock structure that is very similar to that of the parent rock. In such other, more mature soils as the Springerville, Thunderbird, and Lonti soils, most of the physical characteristics of the parent material have been erased through weathering. Such other older soils as the Pastura and Cave soils that have cemented lime pans reflect the residual effect of the mineralogical properties of limestone or calcareous parent materials.

These examples show that the parent materials have had a strong influence on the formation and development of many of the soils in this area.

Climate

Climate is quite variable within this survey area, mainly because of the abrupt changes in topography and elevation within short distances. In general there are three climatic zones and the accompanying transition zones between them.

The southern and southwestern parts, making up about 25 percent of the survey area, have a dry, hot, arid or semiarid climate. Elevations are dominantly between 2,000 and 3,500 feet and the average annual precipitation ranges from 9 to 12 inches. The average annual soil temperature ranges from 59° to 72° F. This climatic effect is reflected in the soils that have a light-colored surface layer and low organic-matter content. Examples of these are the Continental, Cellar, Cave, Whitlock, and Gila soils and associated soils of the desert areas.

Small areas having a cool, subhumid climate are in the south-central, central, and north-central parts of the survey area. These are at elevations above 5,500 feet, where annual precipitation is between 18 and 30 inches. The average annual soil temperature is less than 47° F. These areas comprise about 5 percent of the survey area. The leaching of bases in the Hogg and Broliar soils and the accumulation of organic matter in the Mirabal and Dandrea series are soil characteristics that reflect the influence of this kind of climate.

About 70 percent of the area is characterized by a warm, semiarid climate. Elevations range from 3,500 to 5,500 feet, average annual precipitation is 11 to 18 inches, and the average annual soil temperature ranges from 47° to 59° F. In this climate, such soils as Lonti, Balon, Poley, and Thunderbird soils have more organic matter at the surface than the desert soils, and in some cases they have a thick, dark-colored surface layer.

The soils in Yavapai County, Western Part, formed at least partly in a different climate than the one in which they exist today. The soils have been influenced by a climate that had significantly more rainfall and cooler temperature (3). The higher rainfall and cooler temperatures were the result of the influence of Pleistocene glaciers north of this area. Remnants or fossil evidence of vegetation that require this kind of climate for growth are found in this and similar areas (5).

It is probable that each climatic zone described above has become warmer and drier at proportional rates of change. Therefore, the present climate and plant cover do not reflect the conditions that existed during earlier stages in the formation of the soils. A more humid climate could explain the presence of the strong degree of horizon development and clay movement in the subsoils of such soils as the Continental and Mohave series. Such development would not be expected under the present climate of the drier regions.

Previous and present climates have had a marked influence on the formation of the different horizons of the soils in this area.

Relief

Relief controls runoff and drainage. In general, steeper slopes are related to increased runoff and thereby to the rate of weathering, because moisture is essential in the weathering process. Many young soils are the result of the influence of relief. In some cases where steep slopes exist, soil material is removed from the surface at about the same rate as it is weathered from the parent rock. This results in a soil

that is shallow over bedrock and that has little chance for any basic soil changes to take place or for only thin horizons to develop. Such soils as Cellar, House Mountain, Faraway, and Cabezon soils reflect this influence of steep relief.

On the other hand, on more level relief or topography, water enters the profile, weathering takes place, nutrients are released, plants grow, micro-organisms thrive, and distinct horizons develop and in time mature. Such older soils as the Thunderbird, Partri, and Mohave soils result.

Recent alluvium has been deposited along and in the larger drainageways and has formed such soils as the Cordes, Lynx, and Gila soils.

The topography of Yavapai County, Western Part, today consists of mountains and plains that are dissected by numerous drainageways. Elevations range from 2,000 to nearly 8,000 feet, and the soils range from nearly level to very steep.

Plants and animals

Living organisms include plants, animals, insects, bacteria, and fungi. Gains and losses of organic matter and plant nutrients because of these plants and organisms are reflected mainly in the formation of different horizons. The kinds and numbers of these organisms help determine the kinds, amounts, and location of organic matter and plant nutrients in the soil.

In areas of limited rainfall, hot temperatures, and a sparse cover of shrubs or grass, little organic matter accumulates in the soil. Such desert soils as the Cellar, Anthony, Whitlock, and Mohave soils reflect this. In cooler areas that have more rainfall and a good cover of grass, brush, or juniper, organic matter tends to accumulate in the surface layer. The dark-colored surface layers of the Partri and Thunderbird soils are a result of more organic matter being returned to the soil. At higher elevations where temperatures are cooler and rainfall is higher, thin, undecomposed organic horizons are accumulating on the surface of such soils as the Mirabal and Dandrea soils.

The overall rate of this soil-forming process has been reduced in Yavapai County, Western Part, as a result of the present drier and warmer climate. Losses of organic matter and nutrient elements have resulted from the change in the kinds and amounts of plants and animals in and on the soil.

Time

The soils of the survey area are of different ages. The time available for a soil to form in unconsolidated sediment is the time that has elapsed since the final deposition of the parent material. Soils on the consolidated sediment and igneous rocks began to develop after the parent rocks weathered into permeable material. In general it takes much more time for the accumulation of parent material than it does for the horizons in the soil to develop.

The unconsolidated sediment was deposited during the late Tertiary and Quaternary periods, ranging from mid-Pliocene, more than one million years ago,

to the present. Such older soils as the Lonti, Poley, and Continental soils were forming during the Pleistocene activity. Such younger soils as the Anthony, Gila, Tours, Cordes, Lynx, and Rune soils still receive periodic depositions of material on the surface. Hence, soil formation in these soils has barely begun.

The igneous rocks and consolidated sediment range in age from the Older Precambrian Yavapai Schists to the recent volcanics. The older rocks were not exposed, however, for the formation of present-day soils until the Tertiary Period or later. The formation of such older well-developed soils as the Arp and Hogg series were strongly influenced by the climatic and other soil-forming factors during the Pleistocene Period.

Although some parent material has been exposed for a long time, such soils as the Cellar, Moano, and Moenkopie soils have been kept young by the influence of relief and other soil-forming factors. These are shallow, immature soils that exhibit little development.

Such shallow soils as the House Mountain, Venezia, and Cabezon soils formed in the recent basalt flows in this area. In comparison, little or no soil formation has been observed on Sunset Crater near Flagstaff, Arizona, where a volcano erupted about 900 years ago.

Thus, it can be seen that time has played an important part in the formation of the soils in Yavapai County, Western Part. How fast and how much a soil forms depends upon the interaction of time with the other soil-forming factors.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, 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 (2, 6, 7, 9).

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 criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped. In table 8, the soil series

of Yavapai County, Western Part, are placed in three categories of the current system. Classes of the current system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different climates. Each order is named with a word of three or four syllables ending in *sol* (Ent-i-sol).

SUBORDER. Each order is subdivided into suborders that are based primarily on those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging, or soil differences resulting from the climate or vegetation. The names of suborders have two syllables. The last syllable indicates the order. An example is *Aquent* (*Aqu*, meaning water or wet, and *ent*, from Entisol).

GREAT GROUP. Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated; those that have pans that interfere with growth of roots, movement of water, or both; and those that have thick, dark-colored surface horizons. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark-red and dark-brown colors associated with basic rocks, and the like. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is *Haplaquents* (*Hapl*, meaning simple horizons, *aqu* for wetness or water, and *ent*, from Entisols).

SUBGROUP. Great groups are subdivided into subgroups, one representing the central (typic) segment of the group, and others called intergrades that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is *Typic Haplaquents* (a typical Haplaquent).

FAMILY. Soil families are separated within a subgroup primarily on the basis of properties important to the growth of plants or on the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on, that are used as family differentiae (see table 8). An example is the coarse-loamy, mixed, mesic family of *Cumulic Haplustolls*.

TABLE 8.—*Soil series classified according to the current system of classification*

Series	Family	Subgroup	Order
Abra	Fine-loamy, mixed, mesic	Ustollic Calciorthids	Aridisols.
Anthony	Coarse-loamy, mixed (calcareous), thermic	Typic Torrifluvents	Entisols.
Apache	Loamy, mixed, mesic	Lithic Haplustolls	Mollisols.
Arp	Fine, montmorillonitic, mesic	Ustollic Haplargids	Aridisols.
Balon	Fine-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Barkerville	Loamy, mixed, mesic, shallow	Udorthentic Haplustolls	Mollisols.
Boysag	Clayey, mixed, mesic	Lithic Ustollic Haplargids	Aridisols.
Bridge	Fine-loamy, mixed, thermic	Typic Calciorthids	Aridisols.
Brolliar	Fine, montmorillonitic	Argic Cryoborolls	Mollisols.
Cabezon	Clayey, montmorillonitic, mesic	Lithic Argiustolls	Mollisols.
Cave	Loamy, mixed, thermic, shallow	Typic Paleorthids	Aridisols.
Cellar	Loamy-skeletal, mixed, nonacid, thermic	Lithic Torriorthents	Entisols.
Chiricahua	Clayey, mixed, thermic, shallow	Ustollic Haplargids	Aridisols.
Continental	Fine, mixed, thermic	Typic Haplargids	Aridisols.
Cordes	Coarse-loamy, mixed, mesic	Cumulic Haplustolls	Mollisols.
Cordes, red variant	Coarse-loamy, mixed, (calcareous,) mesic	Typic Torrifluvents	Entisols.
Cross	Clayey, montmorillonitic, mesic	Lithic Argiustolls	Mollisols.
Dandrea	Fine, montmorillonitic	Mollic Eutroboralfs	Alfisols.
Dye	Clayey, mixed, mesic	Lithic Haplustalfs	Alfisols.
Faraway	Loamy-skeletal, mixed, mesic	Lithic Haplustolls	Mollisols.
Gaddes	Fine-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Gila	Coarse-loamy, mixed (calcareous), thermic	Typic Torrifluvents	Entisols.
Graham	Clayey, montmorillonitic, thermic	Lithic Argiustolls	Mollisols.
Hogg	Fine, mixed	Mollic Eutroboralfs	Alfisols.
House Mountain	Loamy, mixed, nonacid, thermic	Lithic Torriorthents	Entisols.
Jacks	Fine, mixed, mesic	Udic Haplustalfs	Alfisols.
Latene	Coarse-loamy, mixed, thermic	Typic Calciorthids	Aridisols.
Lehmans	Clayey, montmorillonitic, thermic	Lithic Haplargids	Aridisols.
Lonti	Fine, mixed, mesic	Ustollic Haplargids	Aridisols.
Luzena	Clayey, montmorillonitic, mesic	Lithic Argiustolls	Mollisols.
Lynx	Fine-loamy, mixed, mesic	Cumulic Haplustolls	Mollisols.
Lynx, wet variant	Fine-loamy, mixed, mesic	Cumulic Haplustolls	Mollisols.
Mirabal	Loamy-skeletal, mixed, nonacid, frigid	Typic Ustorthents	Entisols.
Moano	Loamy, mixed, nonacid, mesic	Lithic Torriorthents	Entisols.
Moenkopie	Loamy, mixed (calcareous), mesic	Lithic Torriorthents	Entisols.
Mohave	Fine-loamy, mixed, thermic	Typic Haplargids	Aridisols.
Palma	Coarse-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Palos Verdes	Fine-loamy, mixed, thermic	Typic Haplargids	Aridisols.
Partri	Fine, mixed, mesic	Typic Argiustolls	Mollisols.
Pastura	Loamy, mixed, mesic, shallow	Ustollic Paleorthids	Aridisols.
Poley	Fine, mixed, mesic	Ustollic Haplargids	Aridisols.
Purner	Loamy, mixed, mesic	Lithic Haplustolls	Mollisols.
Retriever	Loamy, carbonatic, thermic	Lithic Torriorthents	Entisols.
Rimrock	Fine, montmorillonitic, thermic	Typic Chromusterts	Vertisols.
Rune	Fine, mixed, mesic	Cumulic Haplustolls	Mollisols.
Showlow	Fine, montmorillonitic, mesic	Typic Argiustolls	Mollisols.
Springerville	Fine, montmorillonitic, mesic	Typic Chromusterts	Vertisols.
Tajo	Fine-loamy, mixed, mesic	Petrocalcic Paleustolls	Mollisols.
Thunderbird	Fine, montmorillonitic, mesic	Typic Argiustolls	Mollisols.
Tortugas	Loamy-skeletal, carbonatic, mesic	Lithic Haplustolls	Mollisols.
Tours	Fine-silty, mixed (calcareous), mesic	Typic Torrifluvents	Entisols.
Tres Hermanos	Fine-loamy, mixed, thermic	Typic Haplargids	Aridisols.
Vekol	Fine, mixed, thermic	Typic Haplargids	Aridisols.
Venezia	Loamy, mixed, mesic	Lithic Haplustolls	Mollisols.
Waldroup	Fine, montmorillonitic, mesic	Udic Rhodustalfs	Alfisols.
Whitlock	Coarse-loamy, mixed, thermic	Typic Calciorthids	Aridisols.
Wilcoxson	Fine, mixed	Typic Argiborolls	Mollisols.
Wineg	Fine-loamy, mixed, mesic	Typic Argiustolls	Mollisols.

SERIES. The series consists of a group of soils that formed in a particular kind of parent material and have genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, structure, reaction, consistency, and mineralogical and chemical composition.

Laboratory Data

Tables 9 and 10 shows the results of mechanical and chemical analyses of eleven selected soil profiles in Yavapai County, Western Part.

All samples were collected from pits. If fragments larger than 2 millimeters in diameter were present, the weight of the 19- to 76-millimeter fraction was determined in the field by sieving a 15- to 25-kilogram sample. The volume of the fraction larger than 76 millimeters was visually estimated and recorded in the profile description, but does not appear in the tables. The laboratory samples were taken from the sieved fraction smaller than 19 millimeters, air dried, and manually rolled or crushed to reduce soil aggregates to less than 2 millimeters in diameter. Only material that does not slake in water is reported as a fraction larger than 2 millimeters. The fraction smaller than 2 millimeters was used for all other analyses except fabric-related analyses, such as bulk density, that require the use of natural soil clods. Fabric-related analyses were made on clods of the whole soil, but the results are expressed on a smaller than 2 millimeters basis. Linear extensibility is expressed both on a whole soil (COLE) and on a smaller than 2 millimeters (COLEf) basis. All results are expressed on an oven-dry basis.

The two Gaddes profiles contained partly weathered gravel and sand, part of which could be crushed, depending on the force applied. Gravel and sand, therefore, were determined by shaking overnight in a hexametaphosphate solution. Silt and clay, all chemical determinations, and 15-bar water retention were determined on crushed samples of the whole soil. All data were recalculated to percent of milliequivalent per 100 grams of the fraction smaller than 2 millimeters.

The methods used in the laboratory were as follows:

Particle-size distribution analysis: Pipette method—organic matter and soluble salts removed—dispersion with sodium hexametaphosphate and mechanical shaking.

Bulk density, 1/3-bar, desorption, < 2-millimeter fraction (Dbm): Saran-coated clods, equilibrated at 1/3-bar on pressure plates, volume by water displacement.

Bulk density, oven-dry, < 2-millimeter fraction (Dbd): Similar to bulk density, 1/3-bar, except volume of oven-dry clod.

Water content, 1/3-bar: Water content of Saran-coated clod prepared for bulk-density measurement.

Water content, 15-bar: Water content of < 2-millimeter sieved sample, pressure membrane apparatus.

Linear extensibility: Coefficient for whole soil containing gravel (COLE) and the 2 millimeter fraction (COLEf). Calculated from the bulk density, 1/3-bar, and the bulk density, oven-dry.

COLE = COLEf x correction for > 2 mm. fragments.

$$\text{COLEf} = \frac{3 \sqrt{\text{Bulk density (oven-dry)}}}{\sqrt{\text{Bulk density (moist)}}} - 1$$

Cation-exchange capacity: NH₄OAc (pH 7.0) saturation, direct distillation of absorbed MH₄+

Base saturation: NH₄OAc, pH. 7.0.

Organic carbon: Wet combustion; 1 meq. K₂Cr₂O₇ equivalent to 3.9 mgrm. C.

Percent organic matter = percent organic carbon x 1.7

Total nitrogen: Kjeldahl, modified A.O.A.C. method.

Carbonate, as CaCO₃: Measurement of volume of CO₂ evolved.

Ca++: EDTA after precipitation in ethanol.

Mg++: EDTA after separation from Ca++ in alcohol.

Na+: Flame spectrophotometry.

K+: Flame spectrophotometry.

Clay mineralogy: From area of characteristic x-ray peaks; oriented clay; K+ saturated clay at room temperature and after heating to 250° C. and 500° C., and Mg++ saturated clay with and without glycolation. The amounts of the clay minerals are thought to be related to the areas of their first order x-ray diffraction peaks. Some exceptions are known. Hence, only relative amounts are given.

pH: Glass electrode, soil-water and soil-salt ratios as indicated.

The methods are identified by code in tables 9 and 10.

Details of the methods used are described in Soil Survey Investigations Report #1, Soil Survey Laboratory Methods and Procedures for Collecting Soil Samples; Soil Conservation Service USDA, 1967.

Climate of the Survey Area⁶

In Yavapai County, Western Part, maximum precipitation occurs during summer, and a secondary maximum occurs during winter. Precipitation in summer generally is associated with thunderstorms that form when moist tropical air moves over the area from the Gulf of Mexico. Winter precipitation generally is of longer duration and is caused when large Pacific storms move into the State from the west. Between the periods of maximum precipitation in summer and winter are relatively dry months late in spring and in autumn. Information relating to annual precipitation, including temperatures, is given in tables 11, 12, 13, 14, and 15. Following is a breakdown of significant weather characteristics in this area by season.

⁶ By PAUL C. KANGIESER, climatologist for Arizona, National Weather Service, U.S. Department of Commerce.

TABLE 9.—*Chemical characteristics*
 [Tests performed by Soil Survey Laboratory, Riverside,

Soil and location	Horizon	Depth	Reaction	Organic carbon	Nitrogen
		<i>Inches</i>	<i>pH</i>	<i>Percent</i>	<i>Percent</i>
Arp gravelly clay loam: 0.3 mile S. and 0.1 mile E. of the NW. corner of sec. 4, T. 12 N., R. 1 E.; Survey No. S65 Ariz-13-4-(1-6); Lab. No. 65183-65187.	A1	0-2	6.7	0.82	0.063
	B1t	2-4	6.7	1.02	0.086
	B21t	4-11	6.9	0.81	0.066
	B22t	11-16	7.0	0.91	0.071
	C	16-30	7.3	0.20	-----
Balon gravelly sandy clay loam: 0.4 mile W. and 0.3 mile S. of the NE. corner of sec. 5, T. 12 N., R. 1 E.; Survey No. S65 Ariz-13-6-(1-7); Lab. No. 65193-65199.	A1	0-3	6.5	0.64	0.057
	B1t	3-7	6.7	0.53	0.050
	B21t	7-15	6.7	0.38	-----
	B22t	15-23	6.7	0.16	-----
	B3t	23-36	6.7	0.09	-----
	C1	36-54	6.7	0.09	-----
	C2	54-73	6.9	0.04	-----
Barkerville cobbly sandy loam: 0.2 mile S. of the NE. corner of sec. 5, T. 9 N., R. 2 W.; Survey No. S65 Ariz-13-2-(1-3); Lab. No. 65210-65213.	A1	0-3	7.0	0.45	0.36
	C1	3-8	6.7	0.25	-----
	C2	8-25	6.7	0.04	-----
	Composite A	-----	6.2	1.29	0.100
Cellar very stony sandy loam: 0.25 mile W. of the SE. corner of sec. 20, T. 8 N., R. 7 W.; Survey No. S65 Ariz-13-21-(1-3); Lab. No. 65393-65394.	A1	0-1	7.2	1.69	0.128
	C1	1-8	7.4	0.35	0.032
Gaddes gravelly sandy loam: 150 feet NE. of the W. ¼ corner of sec. 6, T. 13 N., R. 2 E.; Survey No. S65 Ariz-13-8-(1-6); Lab. No. 65225-65230.	A1	0-3	6.9	1.42	0.094
	B21t	3-11	6.4	0.54	0.029
	B31t-C1	11-24	7.8	0.22	-----
	B32t-C2	24-36	7.6	0.21	-----
	B33t-C3	36-45	7.5	0.14	-----
	C4	45-54	7.6	0.16	-----
Gaddes gravelly sandy loam: 0.5 mile S. and ¼ mile E. of the NW. corner of sec. 5, T. 9 N., R. 2 W.; Survey No. S65 Ariz-13-16-(1-6); Lab. No. 65231-65237.	A1	0-2	6.8	0.87	0.064
	B21t	2-5	6.9	0.57	0.054
	B22t	5-11	6.7	0.35	0.035
	B23t	11-24	6.8	0.30	-----
	B3t-C1	24-36	7.2	0.09	-----
	C2	36-51	7.6	0.04	-----
	Composite A	-----	7.0	1.16	0.072
Lonti gravelly loam: 1.5 miles S. of the junction of Rancho Moana and Williamson Valley roads on the county road between Skull Valley and Williamson Valley, then 300 feet W. NE¼ sec. 14, T. 15 N., R. 1 W.; Survey No. S65 Ariz-13-12-(1-7); Lab. No. 65269-65275. N., R. 1 W.; Survey No. S65 Ariz-13-12-(1-7); Lab. No. 65269-65275.	A1	0-2	6.9	1.65	0.112
	B1t	2-6	6.7	1.08	0.087
	B21t	6-15	6.4	0.42	0.039
	B22t	15-23	6.8	0.18	-----
	B3t	23-41	7.5	0.06	-----
	C1	41-63	8.2	0.03	-----
	C2ca	63-74	8.1	0.03	-----
	-----	-----	-----	-----	-----
Mirabal gravelly sandy loam: 2.3 miles SE. of Wagoner turnoff on Senator Highway on east side of road, SE¼ NW¼ sec. 9, T. 10 N., R. 1 W.; Survey No. S65 Ariz-13-14-(1-3); Lab. No. 65218-65220.	A1	0-3	5.0	1.66	0.066
	C1	3-9	4.5	0.58	0.028
	C2	9-26	4.9	0.39	-----
Moano gravelly loam: 0.2 mile W. and 0.3 mile S. of the NE. corner of sec. 8, T. 12 N., R. 1 E.; Survey No. S65 Ariz-13-19-(1-3); Lab. No. 65242-65243.	A1	0-4	7.1	2.79	0.145
	AC	4-9	6.9	0.91	0.059
Thunderbird cobbly clay loam: 2 miles E. of the junction of Rancho Moana and Williamson Valley Roads on county road between Skull Valley and Williamson Valley, NE¼ sec. 11, T. 15 N., R. 4 W.; Survey No. S65 Ariz-13-13-(1-6); Lab. No. 65246-65251.	A1	0-3	6.8	1.35	0.104
	B1t	3-12	6.8	1.08	0.086
	B21t	12-21	7.5	0.65	0.064
	B22t	21-29	7.9	0.54	0.049
	IIB3tca	29-40	8.1	0.20	-----
	IIC	40-81	8.0	0.06	-----
	-----	-----	-----	-----	-----
Thunderbird cobbly clay loam: 0.2 mile SE. of the junction of Rancho Moana and Williamson Valley Roads on county road between Skull Valley and Williamson Valley, then 300 feet E. of road, NE¼ sec. 11, T. 15 N., R. 4 W.; Survey No. S65 Ariz-13-17-(1-6); Lab. No. 65252-65255.	A1	0-2	6.8	2.85	0.198
	B1t	2-7	6.8	1.17	0.100
	B2t	7-28	7.5	0.70	0.064
	Cca	28-31	8.0	0.37	-----
	-----	-----	-----	-----	-----

¹ Underlain by bedrock.

of representative soils

California. Dashes indicate that values were not determined]

Carbon-nitrogen ratio	CaCO ₃ equivalent	Cation-exchange capacity <i>Meg per 100 grams of soil</i>	Extractable bases (Meq per 100 grams of soil)				Total	Base saturation
			Ca	Mg	Na	K		Percent
13:1	0	29.5	17.4	9.0	0.2	0.5	27.1	92
12:1	0	43.2	26.5	11.8	0.2	0.5	39.0	90
12:1	0	54.3	35.4	14.2	0.4	0.3	50.3	93
13:1	0	56.3	38.0	15.6	0.4	0.2	54.2	96
-----	0	59.5	33.8	13.2	0.6	0.3	47.9	97
11:1	0	20.6	12.9	5.8	0.1	0.4	19.2	93
11:1	0	35.4	23.3	9.2	0.2	0.3	33.0	93
-----	0	37.7	25.4	9.6	0.3	0.3	35.6	94
-----	0	33.2	22.2	9.0	0.3	0.2	31.7	95
-----	0	32.0	21.7	8.6	0.3	0.2	30.8	96
-----	0	34.9	23.4	9.4	0.5	0.3	33.6	96
-----	0	34.3	23.4	9.6	0.5	0.3	33.8	98
13:1	0	9.9	6.6	2.3	0.1	0.2	9.2	93
-----	0	15.4	12.5	3.1	0.1	0.1	15.8	100+
-----	0	11.3	9.4	1.9	0.2	0.1	11.6	100+
13:1	0	14.9	10.5	3.2	0.2	0.4	14.3	96
13:1	0	12.0	10.5	2.2	0.1	0.7	13.5	100+
11:1	0	9.1	7.1	2.2	0.1	0.5	9.9	100+
15:1	0	12.8	11.9	1.9	0.2	0.4	12.9	100+
18:1	0	18.3	12.7	3.3	0.1	0.3	16.4	90
-----	0	23.2	17.0	5.1	0.3	0.3	22.7	98
-----	0	41.3	29.4	10.8	0.4	0.4	41.0	99
-----	0	31.4	22.0	8.2	0.4	0.2	30.8	98
-----	0	24.7	16.9	5.8	0.4	0.2	23.3	94
14:1	0	9.9	5.8	2.9	0.1	1.0	9.8	100+
11:1	0	24.4	16.0	6.7	0.3	0.5	23.5	96
10:1	0	28.3	18.7	7.1	0.4	0.4	26.6	94
-----	0	51.4	34.6	13.2	1.6	0.4	49.8	97
-----	0	29.6	19.2	6.4	1.7	0.4	27.7	94
-----	0	11.7	7.5	2.1	0.1	0.1	9.8	84
16:1	0	15.6	10.4	3.8	0.1	0.1	14.4	92
15:1	0	15.9	10.2	3.6	0.1	0.5	14.4	91
12:1	0	25.5	15.4	6.7	0.2	0.6	22.9	90
11:1	0	33.8	20.2	9.6	0.3	0.4	30.5	90
-----	0	28.6	16.8	8.7	0.6	0.3	26.4	92
-----	0	25.8	14.8	8.1	1.2	0.3	24.4	94
-----	1	23.9	21.2	7.7	2.4	0.2	31.5	100+
-----	2	20.5	16.2	6.5	2.4	0.4	25.5	100+
25:1	0	12.2	3.6	1.2	0.1	0.8	5.7	47
21:1	0	9.2	1.2	1.1	0.1	0.6	3.0	33
-----	0	11.6	6.3	1.9	0.2	0.4	8.8	76
19:1	0	31.3	22.5	7.1	0.1	0.2	29.9	96
15:1	0	38.3	26.5	9.5	0.2	0.1	36.3	95
13:1	0	20.2	11.7	5.5	0.2	0.7	18.1	90
13:1	0	31.3	18.1	9.2	0.6	0.9	28.8	92
10:1	0	50.5	29.4	17.5	2.1	0.9	49.9	99
11:1	1	58.2	40.7	21.7	3.1	0.8	66.3	100+
-----	2	35.3	30.1	12.7	3.1	0.5	46.4	100+
-----	1	33.0	28.4	8.9	2.5	0.4	40.2	100+
14:1	0	23.2	13.4	6.3	0.2	.4	21.3	92
12:1	0	33.1	20.5	10.5	0.2	0.7	31.9	96
11:1	0	42.2	25.6	15.8	1.0	0.7	43.1	100+
-----	9	54.3	41.9	24.7	3.4	0.6	70.6	100+

² Trace.

TABLE 10.—Physical characteristics
[Tests performed by Soil Survey Laboratory, Riverside,

Soil and location	Horizon	Depth	Particle-size distribution						
			Sand					Silt 0.05- 0.002 mm	Clay less than 0.002 mm
			Very coarse 2-1 mm	Coarse 1-0.5 mm	Medium 0.5-0.25 mm	Fine 0.25-0.1 mm	Very fine 0.1-0.05 mm		
<i>Inches</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>		
Arp gravelly clay loam: 0.3 mile S. and 0.1 mile E. of the NW. corner of sec. 4, T. 12 N., R. 1 E.; Survey No. S65 Ariz- 13-4-(1-6); Lab. No. 65183-65187.	A1	0-2	6.6	6.5	4.6	9.8	8.3	37.3	26.9
	B1t	2-4	3.1	4.1	3.5	6.6	5.7	33.5	43.5
	B21t	4-11	2.1	2.7	2.0	4.5	3.9	31.4	53.4
	B22t	11-16	1.8	2.1	1.4	3.0	2.9	34.5	54.3
	C	16-30	7.1	5.7	2.5	4.4	4.4	50.1	25.8
Balon gravelly sandy clay loam: 0.4 mile W. and 0.3 mile S. of the NE. corner of sec. 5, T. 12 N., R. 1 E.; Survey No. S65 Ariz- 13-6-(1-7); Lab. No. 65193-65199.	A1	0-3	6.4	12.4	10.8	18.5	9.0	22.3	20.6
	B1t	3-7	5.2	10.5	7.8	12.2	6.9	24.2	33.2
	B21t	7-15	5.9	11.8	7.6	11.1	6.9	27.7	29.0
	B22t	15-23	8.6	14.4	8.8	12.4	8.2	29.0	18.6
	B3t	23-36	10.9	17.0	9.5	12.2	7.3	27.7	15.4
	C1	36-54	12.5	14.7	7.3	10.6	7.3	33.1	14.5
	C2	54-73	16.8	18.6	8.4	9.9	5.3	24.8	16.2
	Composite A								
Barkerville cobbly sandy loam: 0.2 mile S. of the NE. corner of sec. 5, T. 9 N., R. 2 W.; Survey No. S65 Ariz-13-2-(1-3); Lab. No. 65210-65213.	A1	0-3	21.5	21.7	12.4	18.8	6.8	10.6	8.2
	C1	3-8	14.6	21.5	13.4	23.5	9.4	10.3	7.3
	C2	8-25	19.7	24.6	12.5	22.2	7.8	8.6	4.6
Cellar very stony sandy loam: 0.25 mile W. of the NE. corner of sec. 20, T. 8 N., R. 7 W.; Survey No. S65 Ariz-13-21- (1-3); Lab. No. 65393-65394.	A1	0-1							
	C1	1-8							
Gaddes gravelly sandy loam: 150 feet NE. of the W. ¼ corner of sec. 6, T. 13 N., R. 2 E.; Survey No. S65 Ariz-13-8- (1-6); Lab. No. 65225-65230.	A1	0-3	18.3	18.0	9.6	13.8	6.6	23.2	10.5
	B21t	3-11	16.4	15.1	8.2	11.9	6.1	24.2	18.1
	B31t-C1	11-24	26.2	17.1	6.8	9.2	4.4	20.5	15.8
	B32t-C2	24-36	26.9	12.5	4.2	5.9	3.0	22.8	24.7
	B33t-C3	36-45	30.2	16.2	5.8	8.2	4.0	18.8	16.8
	C4	45-54	32.9	17.4	5.7	7.6	4.0	17.8	14.6
Gaddes gravelly sandy loam: 0.5 mile S. and ¼ mile E. of the NW. corner of sec. 5, T. 9 N., R. 2 W.; Survey No. S65 Ariz-13-16-(1-6); Lab. No. 65231-65237.	A1	0-2	10.4	11.8	9.5	21.1	13.9	24.8	8.5
	B21t	2-5	10.9	9.7	7.1	14.4	8.3	22.9	26.7
	B22t	5-11	13.2	9.6	5.3	10.8	6.3	23.0	31.8
	B23t	11-24	15.3	9.6	4.5	8.9	5.1	21.8	34.8
	B3t-C1	24-36	26.3	15.6	6.7	10.9	4.3	19.1	17.1
	C2	36-51	25.3	19.0	10.8	18.5	7.1	13.6	5.7
	Composite A								
Lonti gravelly loam: 1.5 miles S. of the junction of Rancho Moana and Williamson Valley roads on the county road between Skull Valley and Williamson Valley, then 300 feet W. NE¼ sec. 14, T. 15 N., R. 1 W.; Survey No. S65 Ariz-13-12-(1-7); Lab. No. 65269-65275.	A1	0-2	7.9	12.4	9.5	18.9	10.5	22.6	18.2
	B1t	2-6	5.1	9.1	9.0	16.8	8.8	20.5	30.7
	B21t	6-15	10.0	8.9	6.4	15.0	9.1	13.9	36.7
	B22t	15-23	15.3	12.3	7.6	16.2	9.3	13.4	25.9
	B3t	23-41	13.5	13.2	8.4	17.8	10.2	16.0	20.9
	C1	41-63	14.7	14.3	8.5	16.8	10.0	16.8	18.9
	C2ca	63-74	13.1	13.5	8.5	19.6	12.5	15.3	17.5
	Composite A								
Mirabal gravelly sandy loam: 2.3 miles SE. of Wagoner turnout on Senator Highway on east side of road, SE¼ NW¼ sec. 9, T. 10 N., R. 1 W.; Survey No. S65 Ariz-13-14-(1-3); Lab. No. 65218-65220.	A1	0-3	15.7	21.0	11.7	18.8	8.0	18.0	6.8
	C1	3-9	14.3	20.4	10.8	16.6	7.4	21.2	9.3
	C2	9-26	18.7	19.3	7.0	8.3	3.8	25.2	17.7

of representative soils

California. Dashes indicate that values were not determined]

Particle-size distribution			Bulk density		Extensibility		Water content		Quantity of clay minerals ¹			
Int. II 0.2-0.02 mm	Int. III 0.02- 0.002 mm	Gravel 2-76 mm	1/3 bar	Oven dry	COLE ^f	COLE	1/3 bar	15 bar	Montmor- illonite	Vermic- ulite	Mica	Kaolin
Percent	Percent	Percent	Grams per cubic centi- meter	Grams per cubic centi- meter	Inch per inch	Inch per inch	Percent	Percent				
33.4	18.0	42						11.3	5	0	0	2
22.8	20.1	29	1.30	1.60	0.071	0.058	28.4	18.7	5	0	0	2
16.7	21.2	19	1.25	1.79	0.127	0.111	37.8	27.0	5	0	0	2
14.0	25.0	12	1.21	1.64	0.106	0.098	40.1	29.2	5	0	0	2
18.6	38.4	37	1.36	1.73	0.085	0.062	34.3	22.1	5	0	0	2
28.8	11.8	42						8.6	5	0	0	1
22.6	14.4	12	1.34	1.54	0.049	0.045	22.8	15.5	5	0	0	1
23.0	17.2	26	1.35	1.61	0.061	0.051	26.7	16.2	5	0	0	1
25.7	18.0	31	1.49	1.65	0.034	0.027	22.4	12.7	5	0	0	0
22.6	18.6	34	1.49	1.62	0.028	0.021	22.7	11.6	5	0	0	0
23.2	22.8	55						12.4	5	0	0	0
17.8	17.4	48						11.6	5	0	0	0
21.3	5.4	32						3.8	4	0	0	1
26.1	5.1	18						4.6	5	0	0	1
23.4	3.8	24						2.9	5	0	3	1
		27						5.6				
								5.2	5		3	2
								3.7	5		3	1
25.5	11.3	10						5.6	4	0	3	3
23.7	12.8	18	1.53	1.58	0.010	0.009	14.5	7.7	4	0	3	3
19.9	9.7	16	1.74	1.81	0.012	0.008	13.5	8.3	5	0	0	3
16.8	12.1	25	1.56	1.67	0.021	0.014	20.0	14.5				
18.7	8.4	17	1.54	1.60	0.014	0.009	16.8	9.6	5	0	0	3
18.1	7.4	15	1.77	1.81	0.006	0.004	12.6	8.0	3	4	0	2
40.8	9.7	8						4.8				
29.5	9.7	27						10.6				
24.8	10.0	32						13.0				
21.6	10.0	35						16.8				
19.9	8.5	17						9.4				
22.9	6.5	6						6.5				
34.2	9.0	39	1.52	1.56	0.008	0.006	12.8	8.1	4		3	2
30.0	8.4	39	1.45	1.61	0.036	0.026	18.9	12.7				
24.0	7.5	40	1.41	1.61	0.047	0.034	24.4	16.2	5		1	2
24.5	7.4	29	1.53	1.73	0.041	0.033	23.5	12.8				
26.4	9.9	37	1.52	1.68	0.033	0.024	22.5	11.9				
25.5	10.9	38	1.55	1.69	0.029	0.021	18.8	11.5	5		2	0
30.0	9.0	47	1.61	1.68	0.014	0.009	14.9	10.2				
25.7	9.8	18	1.13	1.16	0.008	0.007	11.9	5.1	4		2	3
23.1	13.7	18	1.40	1.42	0.004	0.003	9.3	5.3	3		2	4
11.9	21.1	30	1.67	1.70	0.005	0.003	13.2	7.2	4		1	4

TABLE 10.—Physical characteristics

Soil and location	Horizon	Depth	Particle-size distribution						
			Sand					Silt 0.05– 0.002 mm	Clay less than 0.002 mm
			Very coarse 2–1 mm	Coarse 1–0.5 mm	Medium 0.5–0.25 mm	Fine 0.25–0.1 mm	Very fine 0.1–0.05 mm		
<i>Inches</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>		
Moano gravelly loam: 0.2 mile west and 0.3 mile S. of the NE. corner of sec. 8, T. 12 N., R. 1 E.; Survey No. S65 Ariz-13-19-(1-3); Lab. No. 65242-65243.	A1	0-4	13.1	14.2	6.5	12.4	8.1	35.0	10.7
	AC	4-9	12.0	14.1	6.3	10.9	9.1	37.2	10.4
Thunderbird cobbly clay loam: 2 miles E. of the junction of Rancho Moana and Williamson Valley roads on county road between Skull Valley and Williamson Valley, NE¼ sec. 11, T. 15 N., R. 4 W.; Survey No. S65 Ariz-13-13-(1-6); Lab. No. 65246-65251.	A1	0-3	1.4	2.2	1.2	2.8	7.6	65.9	18.9
	B1t	3-12	0.8	0.8	0.7	1.7	4.3	55.0	36.7
	B21t	12-21	0.3	0.7	0.5	1.1	1.9	35.6	59.9
	B22t	21-29	0.6	1.5	1.1	1.7	2.2	33.0	59.9
	IIB3tca	29-40	13.4	14.6	7.4	11.4	5.7	28.2	19.3
	IIC	40-81	20.8	20.0	9.3	14.3	6.7	21.5	7.4
Thunderbird cobbly clay loam: 0.2 mile SE. of the junction of Rancho Moana and Williamson Valley Roads on county road between Skull Valley and Williamson Valley, then 300 feet E. of road, NE¼ sec. 11, T. 15 N., R. 4 W.; Survey No. S65 Ariz-13-17-(1-6); Lab. No. 65252-65255.	A1	0-2	5.5	5.5	2.7	3.8	4.4	56.7	21.4
	B1t	2-7	1.7	2.5	1.4	2.4	3.5	50.7	37.8
	B2t	7-28	1.4	2.0	1.2	1.9	2.3	42.1	49.1
	Cca	28-31	5.8	6.2	3.5	9.2	10.7	38.4	26.2

¹ The number 5 means that the quantity of the clay mineral is very large; 4, large; 3, moderate; 2, small; 1, a trace; and 0, not present.

of representative soils—Continued

Particle-size distribution			Bulk density		Extensibility		Water content		Quantity of clay minerals ¹			
Int. II 0.2-0.02 mm	Int. III 0.02- 0.002 mm	Gravel 2-76 mm	1/3 bar	Oven dry	COLE ²	COLE	1/3 bar	15 bar	Montmor- illonite	Vermei- ulite	Mica	Kaolin
Percent	Percent	Percent	Grams per cubic centi- meter	Grams per cubic centi- meter	Inch per inch	Inch per inch	Percent	Percent				
32.9	16.7	41	0.81	0.91	0.040	0.032	26.4	10.4	5	2	0	2
33.9	18.1	41	1.33	1.39	0.014	0.011	18.3	10.3	5	3	0	2
44.8	30.2	22						9.8	4		3	2
35.4	24.8	5	1.35	1.60	0.059	0.055	26.4	16.8	4		3	2
20.2	17.9	2	1.21	1.78	0.137	0.135	41.6	26.4	5		1	2
16.7	19.4	2	1.13	1.56	0.113	0.112	46.3	29.0	5		1	2
21.7	18.4	2	0.95	1.10	0.049	0.049	45.1	14.7	5		0	1
22.2	13.6	4	0.97	0.98	0	0	44.1	11.5	5		0	0
34.6	28.4	17						12.3				
26.4	29.1	6						16.6				
18.2	27.2	3						22.6				
27.5	27.4	10						29.2				

² Underlain by bedrock.

TABLE 11.—*Temperature and precipitation*

[All data from Prescott, Arizona; elevation 5,410 feet. Period of record: 1936-65]

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 1 inch or more	Average depth of snow on days with snow cover
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Less than—	More than—		
	°F	°F	°F	°F	Inches	Inches	Inches		Inches
January.....	50	21	64	7	1.71	0.2	4.4	5	1
February.....	54	24	66	12	1.67	.3	3.5	2	1
March.....	58	27	71	17	1.48	.1	3.5	3	2
April.....	68	34	81	25	.92	(¹)	1.9	(²)	1
May.....	76	40	87	31	.35	(¹)	.9	0	0
June.....	86	48	96	38	.46	0	1.2	0	0
July.....	90	57	98	48	2.72	.6	5.1	0	0
August.....	86	55	94	47	3.36	.9	6.9	0	0
September.....	82	48	91	38	1.61	(¹)	3.4	0	0
October.....	73	37	83	27	1.08	0	3.3	(²)	(¹)
November.....	60	27	72	16	.95	(¹)	2.2	1	1
December.....	53	23	65	12	1.93	(¹)	4.5	3	1
Year.....	70	37	399	42	18.24	11.5	23.8	14	1

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*

[All data from Prescott, Arizona. Period of record: 1946-65]

Probability	Dates for given probability and temperature				
	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
1 year in 10 later than.....	April 2.....	April 18.....	May 1.....	May 22.....	June 8.....
2 years in 10 later than.....	March 26.....	April 11.....	April 26.....	May 16.....	June 3.....
5 years in 10 later than.....	March 10.....	March 27.....	April 15.....	May 3.....	May 23.....
Fall:					
1 year in 10 earlier than.....	October 29.....	October 26.....	October 19.....	October 6.....	September 22.....
2 years in 10 earlier than.....	November 5.....	October 31.....	October 24.....	October 11.....	September 27.....
5 years in 10 earlier than.....	November 21.....	November 12.....	November 4.....	October 23.....	October 8.....

Winter precipitation normally reaches its peak from December through March. Winter storms last for several days, and snow is common above elevations of about 5,000 feet. In a normal year, the total annual snowfall near the 7,000-foot level is about 6 feet, although more than 5 feet of snow have been left on the ground by a single storm at that elevation. At lower elevations in the western part of the area, however, snow accounts for only a small fraction of the total winter precipitation. Winter temperatures near Bagdad (elevation 3,750 feet) and Wickenburg (elevation 2,095 feet) show an average high in the low and mid sixties and a low temperature near freezing, whereas near the 7,000-foot level the high temperature averages in the middle forties, and the low is in the middle teens. Temperatures as low as -25° F have been recorded at elevations of about 7,000 feet.

Precipitation generally slackens during April, and monthly averages of less than half an inch have been

recorded during May and June over most of the area. Snow is rare after May 1st at even the highest elevations. At elevations near 4,000 feet in the western section, the average date of the last temperature as low as 32° F is about April 1st, and the average date at stations near 7,000 feet is about June 10th.

About one-third of the total annual precipitation falls in July and August. Thunderstorms develop almost every afternoon over the mountains, with a peak probability of occurrence at about 4 p.m. These showers generally last only a few hours and are frequently followed by clear skies shortly after sunset. These thunderstorms can be locally heavy and are often accompanied by hail and strong winds.

Precipitation of highest intensity over a short period of time generally occurs during summer. As much as 2.25 inches of rain falls in one hour about once every 100 years, and about 5 inches can be expected in 24 hours about once every 100 years. Thunderstorm

TABLE 13.—*Temperature and precipitation*
[All data from Bagdad, Arizona; elevation 3,750 feet]

Month	Temperature				Precipitation		
	Average daily maximum ¹	Average daily minimum ¹	Two years in 10 will have at least 4 days with—		Average monthly total	One year in 10 will have—	
			Maximum temperature equal to or higher than— ²	Minimum temperature equal to or lower than— ²		Less than—	More than—
	°F	°F	°F	°F	Inches	Inches	Inches
January.....	58	33	70	24	1.4	0.1	3.4
February.....	61	35	73	26	1.4	.1	3.1
March.....	66	38	76	29	1.3	(³)	4.1
April.....	75	45	85	35	.8	(³)	3.2
May.....	83	52	92	42	.2	0	.6
June.....	92	61	101	52	.3	0	1.0
July.....	97	69	103	62	1.4	(³)	3.9
August.....	95	67	100	61	2.1	.7	4.7
September.....	91	62	98	54	1.4	0	3.4
October.....	80	51	90	40	.8	(³)	1.9
November.....	68	40	79	30	.9	0	2.6
December.....	61	36	71	26	1.4	(³)	3.4
Year.....	77	49	⁴ 104	⁵ 19	13.4	7.6	21.7

¹ Based on 1936-65 data.
² Based on 1949-65 data.
³ Trace.

⁴ Average annual highest temperature.
⁵ Average annual lowest temperature.

TABLE 14.—*Temperature and precipitation*
[All data from Wickenburg, Arizona; elevation 2,095 feet. Period of record: 1936-65]

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—	
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Less than—	More than—
	°F	°F	°F	°F	Inches	Inches	Inches
January.....	63	30	76	21	1.0	Trace	2.5
February.....	66	33	80	25	1.0	0.1	2.2
March.....	72	37	83	30	1.0	0	2.8
April.....	81	44	94	36	.5	0	1.9
May.....	90	50	101	42	.2	0	.6
June.....	99	58	110	48	.2	0	.6
July.....	103	70	111	58	1.2	.1	3.2
August.....	100	69	108	60	2.2	.5	4.3
September.....	96	60	105	50	1.0	0	2.6
October.....	86	48	96	39	.6	0	1.8
November.....	73	36	85	28	.7	0	2.3
December.....	66	32	77	24	1.2	0	3.6
Year.....	83	47	¹ 112	² 20	10.8	6.0	17.6

¹ Average annual highest temperature.

² Average annual lowest temperature.

precipitation is usually of a scattered nature and any one point can expect to receive significant rainfall on relatively few days each month. At Prescott, one-tenth of an inch or more of rain falls on about 7 days in each July and August, and Bagdad averages about 4 such days during each of those months. Above 5,000

feet, temperatures above 100° F are unusual. At Wickenburg, the temperatures generally reach 100° F or more during summer.

Fall generally is a period of clear skies and low precipitation. Snow can be expected at elevations above 5,000 feet after about the middle of November. At

TABLE 15.—Probabilities of last freezing temperatures in spring and first in fall

[All data from Wickenburg, Arizona. Period of record: 1936–65]

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.....	February 12.....	March 15.....	April 3.....	April 16.
2 years in 10 later than.....	January 31.....	March 4.....	March 25.....	April 9.
5 years in 10 later than.....		February 7.....	March 4.....	March 24.
Fall:				
1 year in 10 earlier than.....	December 22.....	November 13.....	November 1.....	October 30.
2 years in 10 earlier than.....	December 31.....	November 26.....	November 8.....	November 4.
5 years in 10 earlier than.....		December 21.....	November 24.....	November 15.

elevations near 4,000 feet, the average date of the first temperature as low as 32° F is about November 10th, and the average date at stations near 7,000 feet is about September 25th.

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Glossary

- Alluvium.** Soil material, such as sand, silt, or clay, that has been deposited on land by streams.
- Available water capacity** (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.
- Calcareous soil.** A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.
- Caliche.** A more or less cemented deposit of calcium carbonate in many soils of warm-temperature areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.
- Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil

material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

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

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

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

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

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a “wire” when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Erosion. The wearing away of the land surface by wind (sand-blast), running water, and other geological agents.

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.

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

Forage. Plant material that can be used as feed by domestic animals; it may be grazed or cut for hay.

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.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Internal soil drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by height of the water table, either permanent or perched. Relative terms for expressing internal drainage are none, very slow, slow, medium, rapid, and very rapid.

Miscellaneous land type. A mapping unit for areas of land that have little or no natural soil; or that are too nearly inaccessible for orderly examination; or that occur where, for other reasons, it is not feasible to classify the soil.

Montmorillonite. A fine, platy, aluminosilicate clay mineral that expands and contracts with the absorption and loss of water. It has a high cation-exchange capacity and is plastic and sticky when moist.

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 prominent. 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.

Mycelia. The threadlike bodies of simple organisms, such as the common bread mold.

Nutrient, plant. Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil and carbon, hydrogen, and oxygen obtained largely from the air and water, are plant nutrients.

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

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.

Phase, soil. A subdivision of a soil, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil series, for example, may be

divided into phases because of differences in slope, stoniness, thickness, or some other characteristics that affect its management but its behavior in the natural landscape.

pH value. A numerical means for designating acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Physiographic province. One of the major geographic divisions of the continent.

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

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are either single grained (each grain by itself, as in dune sand) or massive (the particles adhering 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.

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.

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, 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."

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.

Wilting point (or permanent wilting point). The moisture content of soil, on an oven-dry basis, at which plants (specifically sunflower) wilt so much that they do not recover when placed in a dark, humid atmosphere.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and the soil series to which the mapping unit belongs. In referring to a capability unit, read the introduction to the section it is in for general information about management. Other information is given in tables as follows:

Acreeage and extent, table 1, page 8.
 Range herbage, table 2, page 68.
 Timber groups, table 3, page 70.

Engineering, tables 5, 6, and 7, pages 76, 84, and 102.
 Classification of the soils, table 8, page 110.
 Chemical and physical characteristics, tables 9 and 10,
 pages 112 and 114.

Map symbol	Mapping unit	Page	Capability unit	Range site	Range herbage group	Timber group	Wildlife group
			Symbol	Name	Number	Number	Number
AaB	Abra gravelly sandy loam, 0 to 8 percent slopes-----	7	VIs-1	Limy Upland, 12- to 16-inch precipitation zone	--	--	7
AbB	Abra-Lonti loams, 0 to 5 percent slopes-----	9	VIs-1	Limy Upland, 12- to 16-inch precipitation zone	--	--	--
	Abra soil-----	--	----	-----	--	--	7
	Lonti soil-----	--	----	-----	--	--	8
AeB	Abra-Poley loams, 0 to 5 percent slopes-----	9	VIs-1	Limy Upland, 12- to 16-inch precipitation zone	3	--	7
A1C	Abra-Balon association, rolling-----	9	VIe-1	-----	--	--	--
	Abra soil-----	--	----	Limy Upland, 12- to 16-inch precipitation zone	3	--	7
	Balon soil-----	--	----	Loam Upland, 12- to 16-inch precipitation zone	--	--	8
A1D	Abra-Balon association, hilly- Abra soil-----	9 --	VIe-1 ----	----- Limy Upland, 12- to 16-inch precipitation zone	-- 3	-- --	-- 7
	Balon soil-----	--	----	Loam Upland, 12- to 16-inch precipitation zone	--	--	8
AmC	Abra-Lynx association, rolling-----	10	VIe-1	-----	--	--	--
	Abra soil-----	--	----	Limy Upland, 12- to 16-inch precipitation zone	2	--	7
	Lynx soil-----	--	----	Loam Bottoms, 12- to 16-inch precipitation zone	--	--	6
AnC	Abra-Wineg association, rolling-----	10	VIe-1	Limy Upland, 12- to 16-inch precipitation zone	--	--	7
	Abra soil-----	--	----	-----	3	--	--
	Wineg soil-----	--	----	-----	--	--	--
AoC	Anthony gravelly loamy sand, 8 to 15 percent slopes-----	10	VIIe-1	Loam Upland, 8- to 12-inch precipitation zone	--	--	2
ApB	Anthony gravelly sandy loam, 0 to 8 percent slopes-----	10	VIIIs-1	Loam Upland, 8- to 12-inch precipitation zone	--	--	2
ArA	Anthony-Mohave sandy loams, 1 to 3 percent slopes-----	10	VIIIs-1	Loam Upland, 8- to 12-inch precipitation zone	--	--	2
As	Apache gravelly loam-----	11	VIs-1	Limy Hills, 12- to 16-inch precipitation zone	--	--	5
At	Apache very stony loam-----	11	VIIIs-1	Limy Hills, 12- to 16-inch precipitation zone	--	--	5

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit	Range site	Range herbage group	Timber group	Wildlife group
			Symbol	Name	Number	Number	Number
AuC	Arp gravelly clay loam, 0 to 20 percent slopes-----	12	VIe-1	Loam Upland, 12- to 16-inch precipitation zone	3	--	8
AvD	Arp cobbly clay loam, 10 to 25 percent slopes-----	12	VIe-1	Loam Upland, 12- to 16-inch precipitation zone	--	--	8
AwE	Arp very rocky clay loam, 20 to 40 percent slopes-----	12	VIIIs-1	Loam Upland, 12- to 16-inch precipitation zone	--	--	8
AxD	Arp-Moano complex, 0 to 30 percent slopes-----	12	VIe-1	-----	--	--	--
	Arp soil-----	--	-----	Loam Upland, 12- to 16-inch precipitation zone	3	--	8
	Moano soil-----	--	-----	Granitic Loam Hills, 12- to 16-inch precipitation zone	--	--	5
AyC	Arp-Lynx association, rolling- Arp soil-----	13 --	VIe-1 -----	----- Loam Upland, 12- to 16-inch precipitation zone	-- --	-- --	-- 8
	Lynx soil-----	--	-----	Loam Bottoms, 12- to 16-inch precipitation zone	--	--	6
				-----	--	--	--
Ba	Badland-----	13	VIIIe-1	-----	--	--	--
BdC	Balon sandy loam, 0 to 15 percent slopes-----	14	VIe-1	Loam Upland, 12- to 16-inch precipitation zone	--	--	8
BgD	Balon gravelly sandy clay loam, 5 to 30 percent slopes-----	14	VIe-1	Loam Upland, 12- to 16-inch precipitation zone	3	--	8
BlC	Balon-Lynx association, rolling-----	14	VIe-1	-----	--	--	--
	Balon soil-----	--	-----	Loam Upland, 12- to 16-inch precipitation zone	--	--	8
	Lynx soil-----	--	-----	Loam Bottoms, 12- to 16-inch precipitation zone	--	--	6
BmF	Barkerville cobbly sandy loam, 20 to 60 percent slopes-----	14	VIIe-1	Granitic Loam Hills, 12- to 16-inch precipitation zone	3	--	5
BnD	Barkerville very stony sandy loam, 5 to 25 percent slopes-----	15	VIIIs-1	Granitic Loam Hills, 12- to 16-inch precipitation zone	3	--	5
BoF	Barkerville extremely rocky sandy loam, 20 to 60 percent slopes-----	15	VIIIs-1	Granitic Loam Hills, 12- to 16-inch precipitation zone	3	--	5
BrD	Bridge gravelly loam, 0 to 25 percent slopes-----	16	VIe-1	Loam Hills, 8- to 12-inch precipitation zone	--	--	4
BsC	Brolliar very stony silt loam, 0 to 15 percent slopes-----	17	VIIs-2	-----	3	2	10
BsD	Brolliar very stony silt loam, 15 to 30 percent slopes-----	17	VIIs-2	-----	3	2	10

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit Symbol	Range site Name	Range herbage group Number	Timber group Number	Wildlife group Number
CaD	Cabezon-Springerville complex, 5 to 25 percent slopes-----	17	VIIs-1	-----	--	--	--
	Cabezon soil-----	--	-----	Clay Loam Hills, 12- to 16-inch precipitation zone	--	--	5
	Springerville soil-----	--	-----	Clay Upland, 12- to 16-inch precipitation zone	--	--	9
CbC	Cabezon-Springerville cobbly complex, 5 to 15 percent slopes-----	18	VIe-1	-----	--	--	--
	Cabezon soil-----	--	-----	Clay Loam Hills, 12- to 16-inch precipitation zone	--	--	5
	Springerville soil-----	--	-----	Clay Upland, 12- to 16-inch precipitation zone	--	--	9
CdC	Cabezon-Thunderbird complex, 5 to 15 percent slopes-----	18	VIIs-1	-----	3	--	--
	Cabezon soil-----	--	-----	Clay Loam Hills, 12- to 16-inch precipitation zone	--	--	5
	Thunderbird soil-----	--	-----	Clay Loam Upland, 12- to 16-inch precipitation zone	--	--	10
CeE	Cabezon soils, 8 to 45 per- cent slopes-----	18	VIIIs-1	Clay Loam Hills, 12- to 16- inch precipitation zone	3	--	5
CgC	Cave gravelly sandy loam, 2 to 15 percent slopes-----	18	VIIe-1	Caliche Upland, 8- to 12- inch precipitation zone	--	--	3
ClD	Cave-Continental gravelly sandy loams, 2 to 30 percent slopes-----	18	VIIe-1	-----	--	--	--
	Cave soil-----	--	-----	Caliche Upland, 8- to 12- inch precipitation zone	--	--	3
	Continental soil-----	--	-----	Loam Upland, 8- to 12-inch precipitation zone	--	--	2
CmD	Cellar very gravelly sandy loam, 8 to 30 percent slopes-----	19	VIIIs-1	Loam Hills, 8- to 12-inch precipitation zone	--	--	4
CnC	Cellar very rocky sandy loam, 2 to 15 percent slopes-----	19	VIIIs-1	Loam Hills, 8- to 12-inch precipitation zone	--	--	4
CnF	Cellar very rocky sandy loam, 15 to 60 percent slopes-----	19	VIIIs-1	Loam Hills, 8- to 12-inch precipitation zone	--	--	4
CoD	Cellar-Chiricahua complex, 8 to 30 percent slopes-----	19	VIIIs-1	Loam Hills, 8- to 12-inch precipitation zone	--	--	4
CrF	Cellar soils, 20 to 60 percent slopes-----	20	VIIIs-1	Loam Hills, 8- to 12-inch precipitation zone	--	--	4
CsC	Continental gravelly sandy loam, 2 to 15 percent slopes-----	21	VIIe-1	Loam Upland, 8- to 12-inch precipitation zone	--	--	2

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit Symbol	Range site Name	Range herbage group Number	Timber group Number	Wildlife group Number
CtD	Continental-Cave gravelly sandy loams, 8 to 30 percent slopes-----	21	VIIe-1	-----	--	--	--
	Continental soil-----	--	-----	Loam Upland, 8- to 12-inch precipitation zone	--	--	2
	Cave soil-----	--	-----	Caliche Upland, 8- to 12-inch precipitation zone	--	--	3
CuC	Continental-Whitlock gravelly sandy loams, 2 to 15 percent slopes-----	21	VIIe-1	Loam Upland, 8- to 12-inch precipitation zone	--	--	2
CvB	Continental-Loamy alluvial land association, sloping---	22	-----	-----	--	--	--
	Continental soil-----	--	VIIIs-1	Loam Upland, 8- to 12-inch precipitation zone	--	--	2
	Loamy alluvial land-----	--	VIIW-1	Loam Bottoms, 8- to 12-inch precipitation zone	--	--	1
CwD	Continental soils, 3 to 30 percent slopes-----	22	VIIIs-1	Loam Upland, 8- to 12-inch precipitation zone	--	--	2
Cx	Cordes sandy loam-----	22	VIIs-1	Loam Bottoms, 12- to 16-inch precipitation zone	2	--	6
Cy	Cordes fine sandy loam, red variant-----	23	VIIs-1	Loam Bottoms, 12- to 16-inch precipitation zone	--	--	6
CzC	Cross, Cabezon, and Apache soils, 2 to 15 percent slopes-----	23	VIe-1	-----	--	--	5
	Cross soil-----	--	-----	Clay Loam Hills, 12- to 16-inch precipitation zone	--	--	--
	Cabezon soil-----	--	-----	Clay Loam Hills, 12- to 16-inch precipitation zone	--	--	--
	Apache soil-----	--	-----	Limy Hills, 12- to 16-inch precipitation zone	--	--	--
DaF	Dandrea gravelly loam, 20 to 60 percent slopes-----	24	VIIe-2	-----	3	1	11
DgC	Dye gravelly loam, 2 to 15 percent slopes-----	25	VIe-1	Limy Upland, 12- to 16-inch precipitation zone	2	--	7
DrC	Dye very rocky loam, 2 to 15 percent slopes-----	25	VIIs-1	Limy Upland, 12- to 16-inch precipitation zone	--	--	7
FaC	Faraway very rocky loam, 0 to 15 percent slopes-----	25	VIIs-1	Clay Loam Hills, 12- to 16-inch precipitation zone	--	--	5
F1E	Faraway-Luzena complex, 20 to 40 percent slopes-----	26	VIIIs-1	Clay Loam Hills, 12- to 16-inch precipitation zone	--	--	5
F1F	Faraway-Luzena complex, 40 to 60 percent slopes-----	26	VIIIs-1	Clay Loam Hills, 12- to 16-inch precipitation zone	--	--	5
GdD	Gaddes gravelly sandy loam, 3 to 25 percent slopes-----	26	VIe-1	Granitic Loam Hills, 12- to 16-inch precipitation zone	3	--	8
Go	Gila soils-----	27	VIIc-1	Loam Bottoms, 8- to 12-inch precipitation zone	--	--	1
GrB	Graham-Rimrock complex, 0 to 8 percent slopes-----	27	VIIIs-1	Loam Hills, 8- to 12-inch precipitation zone	--	--	4

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit	Range site	Range herbage group	Timber group	Wildlife group
			Symbol	Name	Number	Number	Number
GsE	Graham soils, 8 to 45 percent slopes-----	28	VIIIs-1	Loam Hills, 8- to 12-inch precipitation zone	--	--	4
HgB	Hogg gravelly loam, 0 to 8 percent slopes-----	28	VIIs-2	-----	3	2	11
HgD	Hogg gravelly loam, 8 to 30 percent slopes-----	28	VIe-2	-----	3	2	11
HmE	House Mountain soils, 15 to 40 percent slopes-----	29	VIIIs-1	Loam Hills, 8- to 12-inch precipitation zone	--	--	4
JaC	Jacks very rocky loam, 3 to 15 percent slopes-----	29	VIIs-1	Limy Upland, 12- to 16-inch precipitation zone	3	--	7
JaD	Jacks very rocky loam, 15 to 30 percent slopes-----	30	VIIs-1	Limy Upland, 12- to 16-inch precipitation zone	3	--	7
La	Latene gravelly sandy loam----	31	VIIc-1	Loam Upland, 8- to 12-inch precipitation zone	--	--	2
Lc	Latene-Mohave complex-----	31	VIIc-1	Loam Upland, 8- to 12-inch precipitation zone	--	--	2
Le	Lehmans gravelly clay loam, 8 to 45 percent slopes-----	31	VIIe-1	Loam Hills, 8- to 12-inch precipitation zone	--	--	4
Lh	Lehmans extremely rocky clay loam, 8 to 60 percent slopes-----	32	VIIIs-1	Loam Hills, 8- to 12-inch precipitation zone	--	--	4
LkD	Lonti gravelly sandy loam, 15 to 30 percent slopes-----	33	VIe-1	Loam Upland, 12- to 16-inch precipitation zone	2	--	8
LlC	Lonti gravelly sandy loam, high rainfall, 0 to 15 percent slopes-----	33	VIe-2	-----	3	1	11
LlD	Lonti gravelly sandy loam, high rainfall, 15 to 30 percent slopes-----	33	VIe-2	-----	3	1	11
LmB	Lonti gravelly loam, 0 to 8 percent slopes-----	33	VIIs-1	Loam Upland, 12- to 16-inch precipitation zone	2	--	8
LnC	Lonti cobbly loam, 0 to 15 percent slopes-----	33	VIe-1	Loam Upland, 12- to 16-inch precipitation zone	2	--	8
LnF	Lonti cobbly loam, 30 to 60 percent slopes-----	33	VIIe-1	Loam Upland, 12- to 16-inch precipitation zone	3	--	8
LoD	Lonti complex, 2 to 30 percent slopes-----	33	VIe-1	Loam Upland, 12- to 16-inch precipitation zone	--	--	8
LpB	Lonti-Abra gravelly sandy loams, 0 to 8 percent slopes-----	34	VIIs-1	-----	--	--	--
	Lonti soil-----	--	-----	Loam Upland, 12- to 16-inch precipitation zone	--	--	8
	Abra soil-----	--	-----	Limy Upland, 12- to 16-inch precipitation zone	--	--	7

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit	Range site	Range herbage group	Timber group	Wildlife group
			Symbol	Name	Number	Number	Number
LrD	Lonti-Abra complex, 8 to 30 percent slopes-----	34	VIe-1	-----	--	--	--
	Lonti soil-----	--	-----	Loam Upland, 12- to 16-inch precipitation zone	--	--	8
	Abra soil-----	--	-----	Limy Upland, 12- to 16-inch precipitation zone	--	--	7
LsC	Lonti-Pastura complex, 0 to 20 percent slopes-----	34	VIe-1	-----	--	--	--
	Lonti soil-----	--	-----	Loam Upland, 12- to 16-inch precipitation zone	--	--	8
	Pastura soil-----	--	-----	Limy Hills, 12- to 16-inch precipitation zone	--	--	5
LtB	Lonti-Cordes association, undulating-----	34	VIIs-1	-----	--	--	--
	Lonti soil-----	--	-----	Loam Upland, 12- to 16-inch precipitation zone	--	--	8
	Cordes soil-----	--	-----	Loam Bottoms, 12- to 16-inch precipitation zone	--	--	6
LuC	Lonti-Wineg complex, 3 to 15 percent slopes-----	34	VIe-1	-----	--	--	--
	Lonti soil-----	--	-----	Loam Upland, 12- to 16-inch precipitation zone	--	--	8
	Wineg soil-----	--	-----	Limy Upland, 12- to 16-inch precipitation zone	--	--	7
LvE	Lonti-Rock land association, hilly-----	34	-----	-----	--	--	--
	Lonti soil-----	--	VIe-1	Loam Upland, 12- to 16-inch precipitation zone	--	--	8
	Rock land-----	--	VIIIs-1	-----	--	--	--
LwD	Luzena cobbly loam, 0 to 30 percent slopes-----	35	VIe-1	Clay Loam Hills, 12- to 16-inch precipitation zone	2	--	5
LxD	Luzena very rocky loam, 10 to 30 percent slopes-----	35	VIIs-1	Clay Loam Hills, 12- to 16-inch precipitation zone	--	--	5
Ly	Lynx soils-----	36	VIc-1	Loam Bottoms, 12- to 16-inch precipitation zone	1	--	6
Ly2	Lynx soils, eroded-----	36	VIe-1	Loam Bottoms, 12- to 16-inch precipitation zone	--	--	6
Lz	Lynx soils, wet variant-----	37	Vw-1	Loam Bottoms, 12- to 16-inch precipitation zone	--	--	6
MbC	Mirabal gravelly sandy loam, 8 to 20 percent slopes-----	37	VIe-2	-----	4	1	11
MbF	Mirabal gravelly sandy loam, 20 to 60 percent slopes-----	38	VIIe-2	-----	4	1	11
MdF	Mirabal-Dandrea complex, 20 to 60 percent slopes-----	38	VIIe-2	-----	4	--	11
	Mirabal soil-----	--	-----	-----	--	1	--
	Dandrea soil-----	--	-----	-----	--	--	--
MgD	Moano gravelly loam, 0 to 30 percent slopes-----	38	VIIe-1	Granitic Loam Hills, 12- to 16-inch precipitation zone	3	--	5
MkF	Moano very rocky loam, 15 to 60 percent slopes-----	38	VIIIs-1	Granitic Loam Hills, 12- to 16-inch precipitation zone	3	--	5

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit Symbol	Range site Name	Range herbage group Number	Timber group Number	Wildlife group Number
MoD	Moano extremely rocky loam, 15 to 30 percent slopes-----	38	VIIs-1	Granitic Loam Hills, 12- to 16-inch precipitation zone	--	--	5
MrC	Moano-Lynx association, rolling-----	39	VIIe-1	-----	3	--	--
	Moano soil-----	--	-----	Granitic Loam Hills, 12- to 16-inch precipitation zone	--	--	5
	Lynx soil-----	--	-----	Loam Bottoms, 12- to 16-inch precipitation zone	--	--	6
MsB	Moenkopie association, undulating-----	39	VIIs-1	Limy Hills, 12- to 16-inch precipitation zone	--	--	5
Mt	Mohave sandy loam-----	40	VIIc-1	Loam Upland, 8- to 12-inch precipitation zone	--	--	2
PaB	Palma sandy loam, 1 to 8 percent slopes-----	40	VIe-1	Limy Upland, 12- to 16-inch precipitation zone	--	--	7
PcE	Palos Verdes gravelly sandy loam, 8 to 40 percent slopes-	41	VIIe-1	Loam Hills, 8- to 12-inch precipitation zone	--	--	4
Pd	Partri loam-----	42	VIIs-1	Limy Upland, 12- to 16-inch precipitation zone	--	--	7
Pe	Partri gravelly clay loam-----	42	VIIs-1	Limy Upland, 12- to 16-inch precipitation zone	--	--	7
Pf	Partri-Abra loams-----	42	VIIs-1	Limy Upland, 12- to 16-inch precipitation zone	--	--	7
PgB	Pastura gravelly loam, 0 to 8 percent slopes-----	43	VIIs-1	Limy Hills, 12- to 16-inch precipitation zone	3	--	5
PhD	Pastura complex, 1 to 30 percent slopes-----	43	VIe-1	Limy Hills, 12- to 16-inch precipitation zone	3	--	5
P1B	Pastura-Poley complex, 2 to 8 percent slopes-----	43	VIIs-1	-----	--	--	--
	Pastura soil-----	--	-----	Limy Hills, 12- to 16-inch precipitation zone	--	--	5
	Poley soil-----	--	-----	Limy Upland, 12- to 16-inch precipitation zone	--	--	7
PmB	Pastura-Lynx association, undulating-----	43	VIIs-1	-----	3	--	--
	Pastura soil-----	--	-----	Limy Hills, 12- to 16-inch precipitation zone	--	--	5
	Lynx soil-----	--	-----	Loam Bottoms, 12- to 16-inch precipitation zone	--	--	6
PnB	Pastura-Rune association, undulating-----	43	VIIs-1	-----	3	--	--
	Pastura soil-----	--	-----	Limy Hills, 12- to 16-inch precipitation zone	--	--	5
	Rune soil-----	--	-----	Loam Bottoms, 12- to 16-inch precipitation zone	--	--	6
Po	Poley gravelly sandy loam-----	44	VIIs-1	Limy Upland, 12- to 16-inch precipitation zone	2	--	7
Pp	Poley-Partri loams-----	44	VIIs-1	Limy Upland, 12- to 16-inch precipitation zone	--	--	7

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit	Range site	Range herbage group	Timber group	Wildlife group
			Symbol	Name	Number	Number	Number
PrC	Purner gravelly loam, 2 to 15 percent slopes-----	45	VIe-1	Limy Hills, 12- to 16-inch precipitation zone	--	--	5
PsC	Purner very stony loam, 2 to 15 percent slopes-----	45	VIIs-1	Limy Hills, 12- to 16-inch precipitation zone	--	--	5
PsD	Purner very stony loam, 15 to 30 percent slopes-----	45	VIIs-1	Limy Hills, 12- to 16-inch precipitation zone	--	--	5
PuC	Purner-Boysag complex, 2 to 15 percent slopes-----	45	VIe-1	-----	--	--	--
	Purner soil-----	--	-----	Limy Hills, 12- to 16-inch precipitation zone	--	--	5
	Boysag soil-----	--	-----	Limy Upland, 12- to 16-inch precipitation zone	--	--	7
PvD	Purner and Dye soils, 2 to 30 percent slopes-----	45	VIIs-1	-----	--	--	--
	Purner soil-----	--	-----	Limy Hills, 12- to 16-inch precipitation zone	--	--	5
	Dye soil-----	--	-----	Limy Upland, 12- to 16-inch precipitation zone	--	--	7
PwD	Purner and Moenkopie soils, 8 to 30 percent slopes-----	46	VIIs-1	Limy Hills, 12- to 16-inch precipitation zone	--	--	5
ReD	Retriever gravelly loam, 2 to 30 percent slopes-----	46	VIIe-1	Caliche Upland, 8- to 12-inch precipitation zone	--	--	3
Rk	Rimrock cobbly clay-----	47	VIIIs-1	Loam Hills, 8- to 12-inch precipitation zone	--	--	4
Rm	Rimrock-Cave complex-----	47	VIIIs-1	-----	--	--	--
	Rimrock soil-----	--	-----	Loam Hills, 8- to 12-inch precipitation zone	--	--	4
	Cave soil-----	--	-----	Caliche Upland, 8- to 12-inch precipitation zone	--	--	3
Rn	Rimrock-Graham complex, 3 to 15 percent slopes-----	47	VIIe-1	Loam Hills, 8- to 12-inch precipitation zone	--	--	4
Ro	Rock land-----	47	VIIIs-1	-----	5	--	--
Rr	Rock land, low rainfall-----	47	VIIIs-1	-----	--	--	--
Rs	Rough broken land-----	47	VIIe-1	-----	--	--	--
Rt	Rune loam-----	49	VIe-1	Loam Bottoms, 12- to 16-inch precipitation zone	--	--	6
Sa	Sandy and gravelly alluvial land-----	49	VIIw-1	-----	4	--	1,6
ShB	Showlow gravelly sandy loam, 0 to 8 percent slopes-----	49	VIIs-1	Limy Upland, 12- to 16-inch precipitation zone	1	--	7
SlB	Springerville cobbly clay, 0 to 8 percent slopes-----	50	VIIs-1	Clay Upland, 12- to 16-inch precipitation zone	1	--	9
SmB	Springerville very stony clay, 0 to 8 percent slopes-----	50	VIIs-1	Clay Upland, 12- to 16-inch precipitation zone	--	--	9
SnD	Springerville-Cabazon complex, 3 to 30 percent slopes-----	51	VIIs-1	-----	2	--	--
	Springerville soil-----	--	-----	Clay Upland, 12- to 16-inch precipitation zone	--	--	9
	Cabazon soil-----	--	-----	Clay Loam Hills, 12- to 16-inch precipitation zone	--	--	5

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit	Range site	Range herbage group	Timber group	Wildlife group
			Symbol	Name	Number	Number	Number
SpB	Springerville-Pastura complex, 1 to 5 percent slopes-----	51	VIIs-1	-----	--	--	--
	Springerville soil-----	--	-----	Clay Upland, 12- to 16-inch precipitation zone	--	--	9
	Pastura soil-----	--	-----	Limy Hills, 12- to 16-inch precipitation zone	--	--	5
StB	Springerville-Thunderbird complex, 0 to 8 percent slopes-----	51	VIIs-1	-----	.2	--	--
	Springerville soil-----	--	-----	Clay Upland, 12- to 16-inch precipitation zone	--	--	9
	Thunderbird soil-----	--	-----	Clay Loam Upland, 12- to 16-inch precipitation zone	--	--	10
SuB	Springerville-Lonti association, undulating-----	51	VIIs-1	-----	--	--	--
	Springerville soil-----	--	-----	Clay Upland, 12- to 16-inch precipitation zone	--	--	9
	Lonti soil-----	--	-----	Loam Upland, 12- to 16-inch precipitation zone	--	--	8
TaB	Tajo gravelly loam, 0 to 8 percent slopes-----	52	VIIs-1	Clay Loam Hills, 12- to 16-inch precipitation zone	2	--	5
TcC	Tajo-Springerville complex, 0 to 15 percent slopes-----	52	VIe-1	-----	2	--	--
	Tajo soil-----	--	-----	Clay Loam Hills, 12- to 16-inch precipitation zone	--	--	5
	Springerville soil-----	--	-----	Clay Upland, 12- to 16-inch precipitation zone	--	--	9
TdC	Thunderbird cobbly clay loam, 0 to 15 percent slopes-----	53	VIe-1	Clay Loam Upland, 12- to 16-inch precipitation zone	1	--	10
TdE	Thunderbird cobbly clay loam, 15 to 40 percent slopes-----	53	VIe-1	Clay Loam Upland, 12- to 16-inch precipitation zone	2	--	10
ThC	Thunderbird-Cabazon complex, 0 to 15 percent slopes-----	53	VIe-1	-----	3	--	--
	Thunderbird soil-----	--	-----	Clay Loam Upland, 12- to 16-inch precipitation zone	--	--	10
	Cabazon soil-----	--	-----	Clay Loam Hills, 12- to 16-inch precipitation zone	--	--	5
TlB	Tortugas gravelly loam, 2 to 8 percent slopes-----	54	VIIs-1	Limy Hills, 12- to 16-inch precipitation zone	3	--	5
TmD	Tortugas very rocky loam, 8 to 30 percent slopes-----	54	VIIs-1	Limy Hills, 12- to 16-inch precipitation zone	4	--	5
TnF	Tortugas extremely rocky loam, 15 to 60 percent slopes-----	54	VIIIs-1	Limy Hills, 12- to 16-inch precipitation zone	4	--	5
To	Tours loam-----	54	VIc-1	Loam Bottoms, 12- to 16-inch precipitation zone	2	--	6
TwC	Tres Hermanos-Whitlock gravelly sandy loams, 0 to 15 percent slopes-----	55	VIIe-1	Loam Upland, 8- to 12-inch precipitation zone	--	--	2

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit	Range site	Range herbage group	Timber group	Wildlife group
			Symbol	Name	Number	Number	Number
Vm	Vekol-Mohave complex-----	56	VIIIs-1	-----	--	--	--
	Vekol soil-----	--	-----	Loam Bottoms, 8- to 12-inch precipitation zone	--	--	2
	Mohave soil-----	--	-----	Loam Upland, 8- to 12-inch precipitation zone	--	--	1
VnD	Venezia cobbly loam, 0 to 30 percent slopes-----	56	VIe-1	Granitic Loam Hills, 12- to 16-inch precipitation zone	3	--	5
VrF	Venezia very stony loam, 30 to 60 percent slopes-----	56	VIIIs-1	Granitic Loam Hills, 12- to 16-inch precipitation zone	--	--	5
VsC	Venezia-Springerville complex, 0 to 20 percent slopes-----	57	VIIs-1	-----	3	--	--
	Venezia soil-----	--	-----	Granitic Loam Hills, 12- to 16-inch precipitation zone	--	--	5
	Springerville soil-----	--	-----	Clay Upland, 12- to 16-inch precipitation zone	--	--	9
VtC	Venezia-Thunderbird complex, 5 to 15 percent slopes-----	57	VIe-1	-----	--	--	--
	Venezia soil-----	--	-----	Granitic Loam Hills, 12- to 16-inch precipitation zone	--	--	5
	Thunderbird soil-----	--	-----	Clay Loam Upland, 12- to 16-inch precipitation zone	--	--	10
VtE	Venezia-Thunderbird complex, 15 to 40 percent slopes-----	57	VIIe-1	-----	3	--	--
	Venezia soil-----	--	-----	Granitic Loam Hills, 12- to 16-inch precipitation zone	--	--	5
	Thunderbird soil-----	--	-----	Clay Loam Upland, 12- to 16-inch precipitation zone	--	--	10
WcC	Waldroup-Cabezon association, hilly-----	58	VIIIs-1	-----	--	--	--
	Waldroup soil-----	--	-----	Clay Loam Upland, 12- to 16-inch precipitation zone	--	--	10
	Cabezon soil-----	--	-----	Clay Loam Hills, 12- to 16-inch precipitation zone	--	--	5
WgC	Whitlock gravelly sandy loam, 0 to 15 percent slopes-----	58	VIIe-1	Loam Upland, 8- to 12-inch precipitation zone	--	--	2
WhC	Whitlock-Anthony gravelly sandy loams, 0 to 15 percent slopes-----	58	VIIe-1	Loam Upland, 8- to 12-inch precipitation zone	--	--	2
WIF	Wilcoxson gravelly loam, 30 to 60 percent slopes-----	59	VIIe-2	-----	3	2	11
Wm	Wineg sandy loam-----	60	VIIs-1	Limy Upland, 12- to 16-inch precipitation zone	2	--	7
Wn	Wineg-Abra complex-----	60	VIIs-1	Limy Upland, 12- to 16-inch precipitation zone	3	--	7
Wo	Wineg-Lynx association-----	60	VIIs-1	-----	--	--	--
	Wineg soil-----	--	-----	Limy Upland, 12- to 16-inch precipitation zone	--	--	7
	Lynx soil-----	--	-----	Loam Bottoms, 12- to 16-inch precipitation zone	--	--	6
Wp	Wineg and Poley soils-----	60	VIIs-1	Limy Upland, 12- to 16-inch precipitation zone	--	--	7

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