

SOIL SURVEY OF

Mariposa County Area, California



United States Department of Agriculture
Soil Conservation Service
In cooperation with
University of California
Agricultural Experiment Station

Issued October 1974

Major fieldwork for this soil survey was done in the period 1957 to 1965. Soil names and descriptions were approved in 1967. Unless otherwise indicated, statements in the publication refer to conditions in the Area in 1966. This survey was made cooperatively by the Soil Conservation Service and the University of California Agricultural Experiment Station. It is part of the technical assistance furnished to the Mariposa and Coulterville-Greeley Resource Conservation Districts.

Copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

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 farming, industry, and recreation.

Locating Soils

All of the soils of Mariposa County Area 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 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 Area 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 page for the woodland suitability group or the range site 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 ma-

terial can be used as an overlay over the soil map and colored to show soils that have the same limitation 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 capability units, the range sites, and the woodland suitability groups.

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

Ranchers and others can find, under "Range," groupings of the soils according to their suitability for range, and also the names of many 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, Morphology, and Classification of the Soils."

Newcomers in Mariposa County Area may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the Area given in the section "General Nature of the Area."

Cover: Typical area of Auburn-Daulton association in foothills.

U. S. GOVERNMENT PRINTING OFFICE: 1974

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

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SOIL SURVEY OF MARIPOSA COUNTY AREA, CALIFORNIA

BY CHARLES S. BUTLER AND GRIFFITH S. JONES, SOIL CONSERVATION SERVICE

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

MARIPOSA COUNTY AREA is located in central California (fig. 1) on the western slopes of the central Sierra Nevada Range. The eastern part of the area is occupied by Yosemite National Park. The northern boundary is Tuolumne County, the southern boundary is Madera County, and the western boundary is Merced County.

tainous eastern part. In the survey area, however, few places have an elevation of more than 5,000 feet. The Area consists mostly of gently sloping to extremely steep foothills and mountains. Within this area of generally rough terrain are a number of alluvial valleys. Few of these valleys are more than 40 acres in extent, and many are 5 acres or less. A few terrace remnants where the topography is gently sloping to rolling are along or near the Mariposa-Merced county line.

Drainage is westward. The northern part of the county is drained by the Merced River system; the central part is drained by Dutchman, Deadman, Mariposa, Owens, Miles, Bear, and Burns Creeks; and the southern part is drained by the Chowchilla River system.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in the Mariposa County Area, where they are located, and how they can be used. The soil scientists went into the Area 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 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 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. Ahwahnee and Mariposa, 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 char-

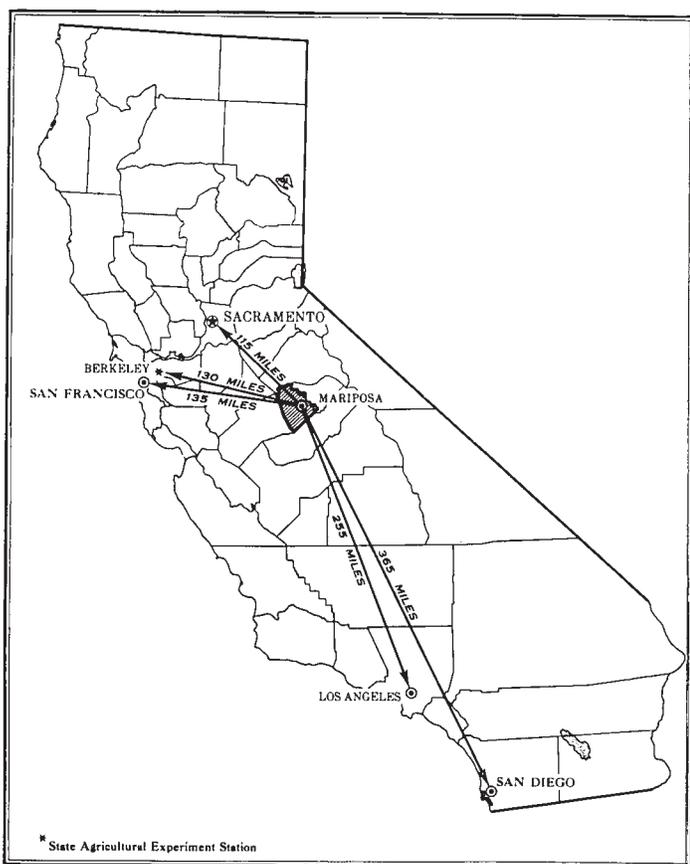


Figure 1.—Location of Mariposa County Area in California.

Mariposa County has an area of 1,455 square miles, or 931,200 acres, of which 478,852 acres is in the Mariposa County Area. The remaining 452,348 acres is Bureau of Land Management lands, Yosemite National Park, and the Sierra and Stanislaus National Forests.

Elevation in the county ranges from about 300 feet along the western boundary to 10,000 feet in the moun-

acteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer 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, Auburn loam, 2 to 15 percent slopes, is one of several phases within the Auburn 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 at the back of this publication was prepared from 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 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. One such kind of mapping unit is shown on the soil map of the Mariposa County Area: the soil complex.

A soil complex consists of areas of two or more soils, so intricately mixed 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. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Ahwahnee-Auberry sandy loams, 15 to 30 percent slopes, is an example.

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

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

Soil scientists observe how soils behave when used as a place for growing native and cultivated plants, and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soil. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or its high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil and they relate this failure to the high shrink-swell potential

of that soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. Then they 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 current 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 the Mariposa County Area. A soil association is a landscape that has a distinctive proportional pattern of soils or land types. In the survey area it consists of two or more major soils or land types and at least one minor soil or land type, and the association is named for the major soils or land types. The soils or land types in one association may be in another association, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils and land types 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 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 management 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.

The general soil map of the Mariposa County Area shows seven soil associations. The terms for texture used in the title apply to the dominant texture of the surface layer. For example, in the title of association 1, the words "sandy loam" refer to the dominant texture of the surface layer. The terms for slope are defined in the Glossary.

1. Ahwahnee-Auberry association

Well-drained, gently sloping to very steep sandy loams formed in material weathered from acid igneous rocks

This association is mainly in the southeastern part of the survey area. Elevation ranges from 800 to 2,800 feet. Slopes are 2 to 75 percent. Rock outcrops range from none to 25 percent of the surface area. The average annual precipitation is 15 to 35 inches, the average annual air temperature is about 60° F., and the frost-free season is 150 to 230 days. The vegetation is mainly annual grasses, forbs, oaks, and digger pine, but there are some species of brush at high elevations.

This association makes up about 14 percent of the survey area. It is about 45 percent Ahwahnee soils, 40

percent Auberry soils, and 15 percent San Andreas and Coarsegold soils and Rock land.

Ahwahnee soils have a surface layer of grayish-brown and dark grayish-brown sandy loam and a subsoil of brown sandy loam. The subsoil is underlain by weathered granitic bedrock at a depth of 24 to 40 inches.

Auberry soils have a surface layer of grayish-brown sandy loam and a subsoil of light brownish-gray sandy loam and yellowish-brown sandy clay loam. The subsoil is underlain by weathered granitic bedrock at a depth of 24 to 40 inches.

These soils are used for annual pasture, range, a few orchards, watershed, and wildlife habitat. Some areas are used for homesites and related nonfarm uses.

2. Musick-Boomer-Josephine association

Well-drained, gently sloping to very steep sandy loams, loams, cobbly loams, and gravelly loams formed in material weathered from basic and acid igneous rocks and schist

This association is mainly in the east-central part of the survey area. Elevation ranges from 2,000 to 5,000 feet. Slopes are 2 to 75 percent. Cobblestones and stones cover 15 to 30 percent of the surface area in some places, and rock outcrops cover 2 to 25 percent of the surface area in other places. In places there is no appreciable amount of cobblestones or rock outcrops. The average annual precipitation is 30 to 50 inches, the average annual air temperature is about 55° F., and the frost-free season is 140 to 200 days. The vegetation is mainly conifers and oaks, but there is a small amount of brush, grasses, and forbs.

This association makes up about 9 percent of the survey area. It is about 40 percent Musick soils, about 25 percent Boomer soils, and 20 percent Josephine soils. The remaining 15 percent is mostly Stump Springs soils that occur with Musick soils and a lesser amount of Ahwahnee, Auburn, and Mariposa soils.

Musick soils have a surface layer of gray, dark grayish-brown, grayish-brown, and light-brown sandy loam or loam and a subsoil of red and yellowish-red clay loam and sandy clay loam. The substratum is reddish-yellow heavy sandy loam. Acid igneous rock is at a depth of more than 60 inches.

Boomer soils have a surface layer of reddish-brown loam or cobbly loam and a subsoil of yellowish-red and red clay loam and cobbly clay loam. The subsoil is underlain by basic and metabasic igneous rocks at a depth of 40 inches to more than 60 inches.

Josephine soils have a surface layer of yellowish-brown and brown loam or gravelly loam and a subsoil of brown and yellowish-red clay loam. The subsoil is underlain by schist at a depth of 24 to 60 inches.

These soils are used for woodland, watershed, and limited grazing. Some small areas are used for orchards.

3. Auburn-Daulton association

Well-drained and somewhat excessively drained, gently sloping to very steep loams and stony loams formed in material weathered from schist and slate

This association is in areas scattered throughout the survey area. Elevation ranges from 300 to 3,000 feet.

Slopes are 2 to 75 percent. Rock outcrops range from none to 25 percent of the surface area. The average annual precipitation is 12 to 35 inches, the average annual air temperature is 60° to 62° F., and the frost-free season 150 to 275 days. The vegetation is mainly annual grasses and forbs, but there is an increasing amount of oaks and brush at higher elevations.

This association makes up about 42 percent of the survey area. It is about 60 percent Auburn soils, about 30 percent Daulton soils, and 10 percent Blasingame, Coarsegold, and San Andreas soils.

Auburn soils are well drained. These soils have a surface layer of brown loam or stony loam and a subsoil of yellowish-red heavy loam. The subsoil is underlain by weathered schist at a depth of 8 to 20 inches.

Daulton soils are somewhat excessively drained. These soils are grayish-brown loam that is underlain by schist and slate bedrock at a depth of 10 to 20 inches.

This association is used mainly for range. A few less sloping and less rocky areas are used for dryland grain.

4. Maymen-Mariposa association

Well-drained, moderately steep to extremely steep loams, gravelly loams, and gravelly silt loams formed in material weathered from schist and slate

This association is mostly in areas scattered throughout the northern half of the survey area. Elevation ranges from 1,000 to 3,500 feet. Slopes are 15 percent to more than 75 percent. Rock outcrops range from none to more than 25 percent of the surface area. The average annual precipitation is 20 to 45 inches, the average annual air temperature is 55° to 56° F., and the frost-free season is 140 to 225 days.

This association makes up about 11 percent of the survey area. It is about 70 percent Maymen soils, 20 percent Mariposa soils, and 10 percent Henneke, Josephine, Auburn, and Boomer soils.

Maymen soils are brown gravelly loam and are underlain by slate at a depth of 8 to 20 inches.

Mariposa soils have a surface layer of pale-brown and light-brown gravelly silt loam and a subsoil of reddish-yellow gravelly silty clay loam. The subsoil is underlain by schist bedrock at a depth of 12 to 20 inches.

Maymen soils are used for limited range, and Mariposa soils are used for limited woodland. Both soils are used for wildlife habitat and watershed.

5. Trabuco-San Andreas-Coarsegold association

Well-drained, gently sloping to steep clay loams, very fine sandy loams, and fine sandy loams formed in material weathered from basic igneous rocks and mica schist

This association is mainly Trabuco soils in the northern part of the survey area, and it is mainly San Andreas and Coarsegold soils in the southern part. Elevation ranges from 800 to 3,300 feet. Slopes are 2 to 50 percent. Rock outcrops range from none to 25 percent of the surface area. The average annual precipitation is 15 to 30 inches, the average annual air temperature is 50° to 60° F., and the frost-free season is 150 to 230 days. The vegetation is grasses and forbs at

lower elevations and grasses, forbs, oaks, digger pine, and brush at higher elevations.

This association makes up about 9 percent of the survey area. It is about 35 percent Trabuco soils, 30 percent San Andreas soils, and 20 percent Coarsegold soils. The remaining 15 percent is mostly Henneke soils but is also Ahwahnee, Auberry, Auburn, Blasingame, Boomer, and Daulton soils.

Trabuco soils have a surface layer of brown clay loam and a subsoil of reddish-brown and reddish-yellow clay loam and clay. The subsoil is underlain by igneous rock at a depth of 24 to 40 inches.

San Andreas soils are brown very fine sandy loam and are underlain by weathered mica schist at a depth of 20 to 40 inches.

Coarsegold soils have a surface layer of grayish-brown fine sandy loam and a subsoil of brown and reddish-brown gravelly loam and sandy clay loam. The subsoil is underlain by mica schist at a depth of 40 to 60 inches.

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

6. *Blasingame-Las Posas association*

Somewhat excessively drained and well-drained, gently sloping to very steep loams and clay loams formed in material weathered from basic igneous rocks

This association is in areas scattered throughout the survey area. Elevation ranges from 800 to 3,000 feet. Slopes are 2 to 75 percent. Rock outcrops range from none to 50 percent of the surface area. The average annual precipitation is 15 to 24 inches, the average annual air temperature is 60° to 61° F., and the frost-free season is 150 to 225 days. The vegetation is mainly annual grasses and forbs, but there is an increasing amount of brush, oaks, and digger pine at the higher elevations.

This association makes up 12 percent of the survey area. It is about 70 percent Blasingame soils, 20 percent Las Posas soils, and 10 percent Auburn and Trabuco soils.

Blasingame soils are somewhat excessively drained. These soils have a surface layer of brown loam and a subsoil of brown and yellowish-red clay loam and clay. The subsoil is underlain by igneous rocks at a depth of 24 to 40 inches.

Las Posas soils are well drained. These soils have a surface layer of brown loam and a subsoil of reddish-brown, dark reddish-brown, and dark-red clay loam and clay. The subsoil is underlain by coarse-grained basic igneous rocks (diorite) at a depth of 24 to 40 inches.

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

7. *Loamy alluvial land-Clayey alluvial land association*

Well-drained to somewhat poorly drained, gently sloping to strongly sloping sandy loams to clays formed in alluvium from a variety of materials

This association is in small valleys (fig. 2) in areas scattered throughout the survey area. Elevation ranges from 300 to 3,500 feet. Slopes are 2 to 15 percent in



Figure 2.—An area of alluvial land in small valley.

small valleys, on terraces, and in basins. Some areas contain a varying amount of gravel. Most of the areas are more than 60 inches deep, but some areas are underlain by an unrelated hardpan, by semiconsolidated alluvium, or by bedrock at a depth as shallow as 24 inches. The average annual precipitation is 12 to 45 inches, the average annual air temperature is 54° to 64° F., and the frost-free growing season is 150 to 275 days.

This association makes up about 3 percent of the survey area. It is about 70 percent Loamy alluvial land and 15 percent Clayey alluvial land. The remaining 15 percent is a variety of soils that formed on uplands or on the terraces surrounding areas of this association. Some of the minor soils are Redding, Positas, and San Joaquin soils.

These land types are used mainly for annual range. At higher elevations some small areas are used for orchards and pasture.

Descriptions of the Soils

This section describes the soil series, land types, and mapping units of the Mariposa County Area. The acreage and proportionate extent of each mapping unit is given in table 1.

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

Soil	Area	Extent	Soil	Area	Extent
	<i>Acres</i>	<i>Percent</i>		<i>Acres</i>	<i>Percent</i>
Ahwahnee sandy loam, 2 to 9 percent slopes	1,083	0.2	Josephine loam, 2 to 15 percent slopes, eroded	448	0.1
Ahwahnee sandy loam, 9 to 15 percent slopes	1,984	.4	Josephine loam, 15 to 30 percent slopes, eroded	347	.1
Ahwahnee-Auberry sandy loams, 15 to 30 percent slopes	602	.1	Josephine loam, 30 to 50 percent slopes, eroded	407	.1
Ahwahnee-Auberry rocky sandy loams, 9 to 30 percent slopes	23,916	5.0	Josephine gravelly loam, 2 to 15 percent slopes, eroded	391	.1
Ahwahnee-Auberry very rocky sandy loams, 30 to 75 percent slopes	9,373	2.0	Josephine gravelly loam, 15 to 30 percent slopes, eroded	1,023	.2
Auberry sandy loam, 9 to 15 percent slopes	371	.1	Josephine gravelly loam, 30 to 50 percent slopes, eroded	3,298	.7
Auberry rocky sandy loam, 2 to 15 percent slopes	4,550	1.0	Josephine rocky loam, 50 to 75 percent slopes, eroded	1,494	.3
Auberry rocky sandy loam, 15 to 30 percent slopes, eroded	3,293	.7	Josephine very rocky loam, 15 to 50 percent slopes, eroded	1,358	.3
Auberry very rocky sandy loam, 15 to 30 percent slopes	8,794	1.8	Las Posas very rocky clay loam, 9 to 30 percent slopes	917	.2
Auberry very rocky sandy loam, 30 to 75 percent slopes, eroded	3,096	.7	Las Posas extremely rocky clay loam, 5 to 50 percent slopes	1,202	.3
Auburn loam, 2 to 15 percent slopes	9,264	1.9	Loamy alluvial land	6,860	1.4
Auburn loam, 15 to 30 percent slopes, eroded	3,785	.8	Mariposa gravelly silt loam, 15 to 50 percent slopes, eroded	5,501	1.1
Auburn stony loam, 30 to 50 percent slopes, eroded	4,511	.9	Mariposa gravelly silt loam, 50 to 75 percent slopes, eroded	1,731	.4
Auburn rocky loam, 30 to 75 percent slopes, severely eroded	15,049	3.1	Maymen gravelly loam, 30 to 75 percent slopes, severely eroded	26,035	5.4
Auburn very rocky loam, 15 to 30 percent slopes	47,744	10.0	Maymen gravelly loam, over 75 percent slopes, eroded	12,180	2.5
Auburn very rocky loam, 30 to 75 percent slopes, eroded	38,204	8.0	Maymen rocky loam, 15 to 30 percent slopes	1,723	.4
Blasingame loam, 2 to 15 percent slopes	5,110	1.1	Maymen very rocky loam, 30 to 75 percent slopes, eroded	1,936	.4
Blasingame loam, 15 to 30 percent slopes	4,878	1.0	Musick loam, 9 to 15 percent slopes, eroded	531	.1
Blasingame rocky loam, 2 to 15 percent slopes	467	.1	Musick loam, 15 to 30 percent slopes, eroded	239	(1)
Blasingame rocky loam, 15 to 50 percent slopes	8,569	1.8	Musick rocky sandy loam, 9 to 15 percent slopes, eroded	1,314	.3
Blasingame extremely rocky loam, 50 to 75 percent slopes	1,998	.4	Musick rocky sandy loam, 15 to 50 percent slopes, eroded	8,260	1.7
Blasingame-Las Posas loams, 2 to 15 percent slopes	4,211	.9	Positas gravelly clay loam, 2 to 15 percent slopes	807	.2
Blasingame-Las Posas loams, 15 to 30 percent slopes	1,192	.2	Redding gravelly loam, 2 to 15 percent slopes	3,202	.7
Blasingame-Las Posas stony loams, 9 to 30 percent slopes, eroded	3,857	.8	Riverwash and Tailings	2,327	.5
Blasingame-Las Posas rocky loams, 2 to 15 percent slopes	5,316	1.1	Rock land	20,360	4.2
Blasingame-Las Posas rocky loams, 15 to 50 percent slopes	16,886	3.5	San Andreas-Coarsegold complex, 2 to 15 percent slopes	3,570	.7
Blasingame-Las Posas extremely rocky loams, 30 to 75 percent slopes, eroded	1,930	.4	San Andreas-Coarsegold complex, 15 to 30 percent slopes	4,105	.9
Boomer loam, 2 to 15 percent slopes	266	.1	San Andreas-Coarsegold complex, 30 to 50 percent slopes	8,672	1.8
Boomer loam, 30 to 50 percent slopes	508	.1	San Andreas-Coarsegold very rocky complex, 9 to 30 percent slopes	7,264	1.5
Boomer cobbly loam, 15 to 50 percent slopes, eroded	8,405	1.8	San Joaquin loam, 2 to 9 percent slopes	121	(1)
Boomer cobbly loam, 30 to 50 percent slopes, severely eroded	1,197	.2	Stump Springs-Musick sandy loams, 5 to 15 percent slopes, eroded	1,321	.3
Boomer cobbly loam, 50 to 75 percent slopes, eroded	1,394	.3	Stump Springs-Musick rocky sandy loams, 9 to 15 percent slopes, eroded	2,931	.6
Clayey alluvial land	2,065	.4	Stump Springs-Musick rocky sandy loams, 15 to 50 percent slopes, eroded	8,899	1.9
Daulton loam, 2 to 15 percent slopes	3,533	.7	Trabuco clay loam, 2 to 15 percent slopes, eroded	1,898	.4
Daulton loam, 15 to 30 percent slopes	17,496	3.6	Trabuco clay loam, 15 to 30 percent slopes, eroded	710	.2
Daulton very rocky loam, 15 to 30 percent slopes	23,625	5.0	Trabuco very rocky clay loam, 15 to 50 percent slopes, eroded	11,884	2.5
Daulton very rocky loam, 30 to 75 percent slopes	17,398	3.6	Whiterock rocky loam, 5 to 50 percent slopes	3,352	.7
Henneke extremely rocky clay loam, 15 to 75 percent slopes	4,942	1.0	Inland water areas	7,439	1.6
Hillgate very fine sandy loam, 2 to 9 percent slopes	448	.1			
Hornitos extremely stony sandy loam, 2 to 50 percent slopes	1,485	.3	Total	478,852	100.0

¹ Less than 0.1 percent.

The procedure in this section is first to describe the soil series and then the mapping units in that series. Thus, to get full information on any one mapping unit it is necessary to read the description of that unit and the description of the soil series to which it belongs. As was mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Clayey alluvial land, Loamy alluvial land, Riverwash and Tailings, and Rock land are miscellaneous land types and do not belong to a soil series but nevertheless are listed in alphabetic 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 is the capability unit and range site or woodland suitability group into which it has been placed. The page for the description of each capability unit and range site or woodland suitability group can be found readily by referring to the "Guide to Mapping Units" at the back of this survey.

All color terms are for dry soils unless otherwise stated. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (5).¹

Ahwahnee Series

The Ahwahnee series consists of well-drained soils on uplands. These soils are underlain at a depth of 24 to 40 inches by highly weathered acid igneous bedrock. Slopes are 2 to 75 percent. Elevation ranges from about 800 to 2,800 feet. Average annual precipitation is 15 to 30 inches, average annual air temperature is 60° F., and the frost-free season is about 175 to 230 days. Vegetation is mainly annual grasses, forbs, oaks, and digger pine.

In a representative profile the surface layer is medium acid, grayish-brown and dark grayish-brown sandy loam about 18 inches thick. The subsoil is medium acid, brown sandy loam about 16 inches thick. The substratum is medium acid, brown sandy loam about 3 inches thick. Soft, decomposed bedrock is at a depth of about 37 inches.

Permeability is moderately rapid. Available water capacity is 3.5 to 6.0 inches. The effective rooting depth is about 24 to 40 inches.

Ahwahnee soils are used mainly for annual pasture and range, but a few small areas are used for orchards or for nonfarm purposes.

Representative profile of Ahwahnee sandy loam, 9 to 15 percent slopes, about 3½ miles north of Preston Road and west of Ben Hur Road, central part of N½ NW¼ sec. 26, T. 7 S., R. 18 E., Mount Diablo Base Line and Meridian:

A11—0 to 8 inches, grayish-brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; massive; hard, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine

interstitial pores and many very fine, fine, and medium tubular pores; medium acid; clear, wavy boundary.

A12—8 to 18 inches, dark grayish-brown (10YR 4/2) sandy loam, dark brown (10YR 3/3) when moist; massive; hard, very friable, slightly sticky and slightly plastic; common fine and medium roots; many fine and medium tubular pores; few thin clay films lining pores near lower boundary; medium acid; clear, wavy boundary.

B2t—18 to 34 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) when moist; moderate, medium, subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; common fine and very fine roots; many very fine and fine interstitial pores and many fine and medium tubular pores; many very thin clay films bridging mineral grains; few thin clay films lining pores; common thin to moderately thick clay films on ped faces; medium acid; gradual, irregular boundary.

C1—34 to 37 inches, brown (10YR 5/3) sandy loam, dark yellowish brown (10YR 3/4) when moist; massive; very hard, friable, nonsticky and slightly plastic; common fine and medium roots; many very fine and fine tubular and interstitial pores; few very thin clay films bridging mineral grains; medium acid; abrupt, irregular boundary.

C2—37 inches, soft decomposed granodiorite and few small pockets of soil material from horizon above to a depth of 50 to 60 inches.

The A horizon is grayish-brown, dark grayish-brown, or dark-brown coarse sandy loam or sandy loam. It is slightly acid to medium acid. The B1 horizon, where present, is similar to the A horizon, except that it is dark yellowish brown and has slightly more clay in places. The B2t horizon is pale brown, brown, or yellowish brown. It is generally sandy loam but is gravelly loam in some places. It ranges from slightly acid to strongly acid. The C1 horizon is yellowish-brown or brown loamy sand or sandy loam. It is slightly acid or medium acid. Depth to decomposed granodiorite ranges from 24 to 40 inches.

Ahwahnee sandy loam, 2 to 9 percent slopes (AcC).—This soil is on uplands.

Included with this soil in mapping are small areas of Auberry soils.

Runoff is slow to medium, and the hazard of erosion is slight.

This soil is used for irrigated pasture, dryland hay, range, and watershed. Capability unit IIIe-1 (18); range site 3.

Ahwahnee sandy loam, 9 to 15 percent slopes (AcD).—This soil is on uplands. It has the profile described as representative for the series.

Included with this soil in mapping are small areas of soils that are shallower or deeper to bedrock than this Ahwahnee soil. Also included are small areas of Auberry soils.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for irrigated pasture and annual range. Capability unit IVe-1(18); range site 3.

Ahwahnee-Auberry sandy loams, 15 to 30 percent slopes (AbE).—These soils are on uplands. About 60 percent of this complex is Ahwahnee sandy loam, and 35 percent is Auberry sandy loam. The remaining 5 percent is included areas of a soil that has a subsoil of reddish-brown sandy clay.

Both major soils in this mapping unit have a profile similar to the one described as representative for their respective series. Rock outcrop covers less than 2 percent of the surface area.

¹ Italic numbers in parentheses refer to Literature Cited, p. 66.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

These soils are used for annual range, watershed, and wildlife habitat. Capability unit VIe-1(18); range site 3.

Ahwahnee-Auberry rocky sandy loams, 9 to 30 percent slopes (AcE).—These soils are on uplands. About 60 percent of this complex is Ahwahnee sandy loam, and about 35 percent is Auberry sandy loam. The remaining 5 percent is mostly included areas of a soil that has a subsoil of reddish-brown sandy clay.

Both major soils in this mapping unit have a profile similar to the one described as representative for their respective series. Rock outcrop covers 2 to 10 percent of the surface area.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

These soils are used for annual range, watershed, and wildlife habitat. Capability unit VIe-1(18); range site 3.

Ahwahnee-Auberry very rocky sandy loams, 30 to 75 percent slopes (AdG).—These soils are on uplands. About 60 percent of this complex is Ahwahnee sandy loam, and 35 percent is Auberry sandy loam. The remaining 5 percent is included areas of a soil that has a reddish-brown sandy clay subsoil and areas that are as much as 50 percent rock outcrop.

Both major soils in this mapping unit have a profile similar to the one described as representative for their respective series. Rock outcrop covers 10 to 25 percent of the surface area.

Runoff is rapid to very rapid, and the hazard of erosion is high to very high.

These soils are used for range, watershed, and wildlife habitat. Capability unit VIIs-1(18); range site 3.

Auberry Series

The Auberry series consists of well-drained soils on uplands. These soils are underlain at a depth of 24 to 40 inches by acid igneous rock. Slopes are 2 to 75 percent. Elevation ranges from about 800 to 2,800 feet. Average annual precipitation is 18 to 35 inches, average annual air temperature is 60° F., and the frost-free season is about 150 to 220 days. Vegetation is mainly annual grasses, forbs, oaks, and digger pine, but some small bushy areas are at higher elevations.

In a representative profile the surface layer is medium acid, grayish-brown sandy loam about 7 inches thick. The subsoil is medium acid, light brownish-gray sandy loam and yellowish-brown sandy clay loam about 25 inches thick. Highly weathered acid igneous rock is at a depth of about 32 inches.

Permeability is moderate. Available water capacity is about 3.5 to 7 inches. The effective rooting depth ranges from 24 to 40 inches.

Auberry soils are used mainly for annual range, but a few small areas are used for orchards or for nonfarm purposes.

Representative profile of Auberry sandy loam, from an area of Auberry very rocky sandy loam, 15 to 30 percent slopes, about 3 miles north from Mariposa-Madera County line on Oak Grove Road in the south-

west corner of NW $\frac{1}{4}$ sec. 35, T. 6 S., R. 19 E., Mount Diablo Base Line and Meridian:

A1—0 to 7 inches, grayish-brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; massive; slightly hard and hard, friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine interstitial pores and common very fine and fine tubular pores; medium acid; clear, wavy boundary.

B1—7 to 16 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) when moist; massive; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many very fine and fine interstitial pores and common very fine and fine tubular pores; few thin clay films lining pores and bridging mineral grains; some coarse gravel in the upper part of the horizon; many dark sand grains; medium acid; clear, wavy boundary.

B2t—16 to 23 inches, yellowish-brown (10YR 5/4) sandy clay loam, yellowish brown (10YR 5/4) when rubbed and brown (10YR 5/3) when moist; common, fine, faint, yellowish-brown (10YR 5/6) mottles; moderate, medium and coarse, angular blocky structure; extremely hard, firm, sticky and plastic; common very fine and fine roots; many very fine and fine interstitial pores; many thin clay films lining pores and bridging mineral grains and common moderately thick clay films on ped faces; medium acid; clear, wavy boundary.

B22t—23 to 32 inches, yellowish-brown (10YR 5/4) sandy clay loam, brown (7.5YR 5/4) when rubbed and yellowish brown (10YR 5/4) when moist; common, fine, faint, yellowish-brown (10YR 5/6) mottles; moderate, coarse, angular blocky structure; extremely hard, firm, sticky and plastic; common very fine and fine roots; many very fine and fine interstitial pores; many thin clay films lining pores and bridging mineral grains; medium acid; gradual, irregular boundary.

C—32 inches, highly weathered granitic rock; common thin to moderately thick clay films coating mineral grains but becoming fewer with depth; few fine roots in cracks.

The A horizon is grayish brown, very dark grayish brown, or brown. It is mainly sandy loam, but in some places it is loam. It is slightly acid or medium acid. The B1 horizon, where present, is light brownish-gray or pale-brown sandy loam, sandy clay loam, or clay loam. It is medium acid or slightly acid. The B2t horizon is brown or yellowish-brown light sandy clay loam or clay loam. It is neutral to medium acid. Decomposed bedrock is at a depth of 24 to 40 inches and limits root penetration.

Auberry sandy loam, 9 to 15 percent slopes (AeD).—This soil is on uplands. Rock outcrop covers less than 2 percent of the surface area.

Included with this soil in mapping are many small areas of soils that have a subsoil of reddish-brown sandy clay loam. Also included are small areas of Ahwahnee, Stump Springs, and Musick soils. Large areas of soils that are more than 40 inches deep to bedrock are also included.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used mostly for annual range. Small areas are used for hay, grain, or orchard crops. Capability unit IVe-1(18); range site 3.

Auberry rocky sandy loam, 2 to 15 percent slopes (AfD).—This soil is on uplands. Rock outcrop covers 2 to 10 percent of the surface area.

Included with this soil in mapping are small areas of Ahwahnee, Stump Springs, and Musick soils. Also

included are large areas of Auberry soils that are more than 40 inches deep to bedrock.

Runoff is very slow to medium, and the hazard of erosion is slight to moderate.

This soil is used mainly for annual range and pasture, but a few small areas are used for grain, hay, irrigated pasture, or orchard crops. Capability unit IVe-1(18); range site 3.

Auberry rocky sandy loam, 15 to 30 percent slopes, eroded (Afe2).—This soil is on uplands. Rock outcrop covers 2 to 10 percent of the surface area.

Included with this soil in mapping are many small areas of soils, especially on ridges, that have a subsoil of reddish-brown sandy clay loam. Also included are small areas of Ahwahnee, Stump Springs, and Musick soils and areas that are more than 10 percent rock outcrop. Large areas of soils that are more than 40 inches deep to bedrock are also included.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used mainly for annual range. Capability unit VIe-1(18); range site 3.

Auberry very rocky sandy loam, 15 to 30 percent slopes (AgE).—This soil is on uplands. It has the profile described as representative for the series. Rock outcrop covers 10 to 25 percent of the surface area.

Included with this soil in mapping are small areas of soils that have a subsoil of reddish-brown sandy clay loam. Also included are areas of soils that are less than 24 inches deep or more than 40 inches deep to bedrock. Also included are areas of Ahwahnee sandy loam and areas that are as much as 50 percent rock outcrop.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for annual range. Capability unit VIe-1(18); range site 3.

Auberry very rocky sandy loam, 30 to 75 percent slopes, eroded (AgG2).—This soil is on uplands. Rock outcrop covers 10 to 25 percent of the surface area.

Included with this soil in mapping are small areas of Ahwahnee, Stump Springs, and Musick soils and areas of soils that are more than 40 inches deep to bedrock. Also included are areas that are more than 25 percent rock outcrop.

Runoff is rapid to very rapid, and the hazard of erosion is high to very high.

This soil is used for limited annual range, watershed, and wildlife habitat. Capability unit VIIe-1(18); range site 3.

Auburn Series

The Auburn series consists of well-drained soils on uplands. These soils are underlain at a depth of 8 to 20 inches by basic igneous rock. Slopes are 2 to 75 percent. Elevation ranges from 300 to 3,000 feet. Average annual precipitation is 14 to 35 inches, average annual air temperature is 60° F., and the frost-free season is about 150 to 275 days. Vegetation is mainly annual grasses and forbs, but increasing amounts of oaks and brush (chamise) are at higher elevations. Several eroded areas generally are covered with chamise.

In a representative profile the surface layer is slightly acid brown loam about 3 inches thick. The subsoil is slightly acid, yellowish-red loam or heavy loam about 13 inches thick. Highly decomposed amphibolite schist bedrock is at a depth of 16 inches.

Permeability is moderate.

These soils are used for annual range (fig. 3), watershed, and wildlife habitat.

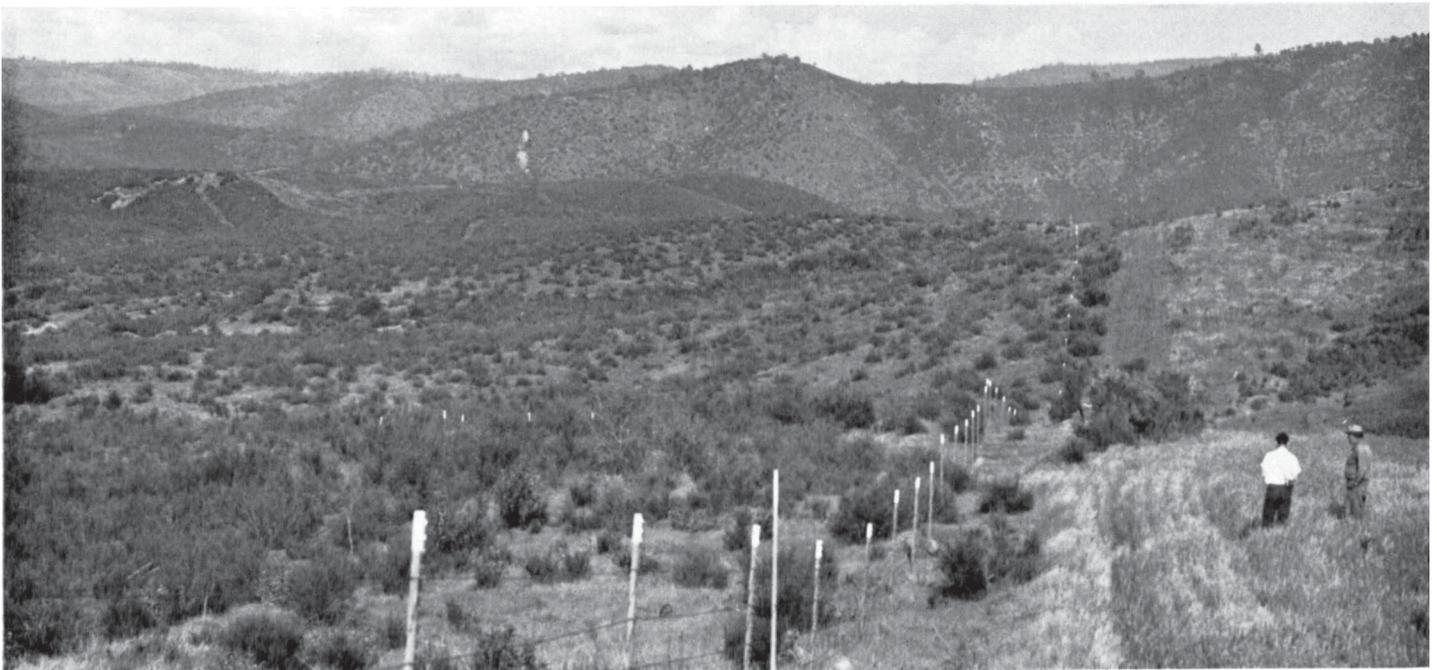


Figure 3.—Auburn loam, 2 to 15 percent slopes, converted from brushland to grassland.

Representative profile of Auburn loam, from an area of Auburn very rocky loam, 15 to 30 percent slopes, about $\frac{3}{8}$ mile southwest of Hornitos on side of Hornitos Road on west side of NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 17, T. 5 S., R. 16 E., Mount Diablo Base Line and Meridian:

- A1—0 to 3 inches, brown (7.5YR 5/4) loam, dark brown (7.5YR 3/2) when moist; medium, fine and coarse, granular structure; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; few very fine pores; slightly acid; clear, wavy boundary.
- B21—3 to 11 inches, yellowish-red (5YR 5/6) loam, dark reddish brown (5YR 3/4) when moist; massive; very hard, friable, sticky and slightly plastic; common very fine and fine roots; many very fine and fine tubular and interstitial pores; many worm holes and casts about $\frac{1}{8}$ to $\frac{1}{16}$ inch in diameter; few thin clay films lining pores and bridging mineral grains; slightly acid; clear, wavy boundary.
- B22—11 to 16 inches, yellowish-red (5YR 4/6) heavy loam, dark reddish brown (5YR 3/4) when moist; massive; very hard, friable, slightly sticky and plastic; common very fine and fine roots; many very fine and fine tubular and interstitial pores; many worm holes and casts $\frac{1}{16}$ and $\frac{1}{8}$ inch in diameter; few thin clay films lining pores and bridging mineral grains; some gravel and cobbles at top of horizon; slightly acid; abrupt, irregular boundary.
- R—16 inches, highly decomposed amphibolite schist; becomes harder with depth.

The A horizon is brown or reddish-brown loam or clay loam. It ranges from neutral to medium acid. The B horizon is similar to the A horizon, except that it is redder. It ranges from slightly acid to strongly acid. Depth to bedrock ranges from 8 to 20 inches.

Auburn loam, 2 to 15 percent slopes (AhD).—This soil is on uplands. Rock outcrop covers less than 2 percent of the surface area.

Included with this soil in mapping are small areas of Blasingame and Daulton soils.

Runoff is slow, and the hazard of erosion is slight. Available water capacity is 1.5 to 2.5 inches. The effective rooting depth is 10 to 16 inches.

This soil is used mainly for annual range, watershed, and wildlife habitat. Small areas are used for irrigated pasture. Capability unit IVE-8(18); range site 1.

Auburn loam, 15 to 30 percent slopes, eroded (AhE2).—This soil is on uplands. It has been subject to moderate sheet and rill erosion. Rock outcrop covers less than 2 percent of the surface area.

Included with this soil in mapping are small areas of Blasingame and Las Posas soils.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Available water capacity is 1.5 to 2.5 inches. Effective rooting depth is 10 to 16 inches.

This soil is used for annual range, watershed, and wildlife habitat. Capability unit VIe-1(18); range site 1.

Auburn stony loam, 30 to 50 percent slopes, eroded (AkF2).—This soil is on uplands. It is stony and has been subject to moderate sheet and rill erosion. Stones cover about 1 to 3 percent of the surface area.

Included with this soil in mapping are small areas of Blasingame and Las Posas stony soils.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 1.5 to 2.5 inches. The effective rooting depth is 10 to 16 inches.

This soil is used mostly for watershed and wildlife habitat. Small areas are used for limited annual range. Capability unit VIIe-1(18); range site 1.

Auburn rocky loam, 30 to 75 percent slopes, severely eroded (AmG3).—This soil is on uplands. It has been subject to severe sheet and rill erosion and has a few gullies. Rock outcrop covers 2 to 10 percent of the surface area.

Included with this soil in mapping are small areas of Blasingame and Las Posas stony soils.

Runoff is rapid to very rapid, and the hazard of erosion is high to very high. The available water capacity is 1.0 to 2.0 inches. Effective rooting depth is 8 to 14 inches.

This soil is used mostly for watershed and wildlife habitat. It is generally covered with brush (chamise). Capability unit VIIIs-1(18, 22).

Auburn very rocky loam, 15 to 30 percent slopes (AnE).—This soil is on uplands. It has the profile described as representative for the series. Rock outcrop covers 10 to 25 percent of the surface area.

Included with this soil in mapping are small areas of Blasingame, Daulton, and gravelly Whiterock and Maymen soils. Also included are small areas of Auburn soils that are deeper to bedrock than this soil and some areas of Auburn soils where rock outcrop covers as much as 50 percent of the surface area.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. The rooting depth is 10 to 20 inches, and the available water capacity is 1.5 to 3.0 inches.

This soil is used for annual range. Capability unit VIIs-1(18); range site 1.

Auburn very rocky loam, 30 to 75 percent slopes, eroded (AnG2).—This soil is on uplands. Rock outcrop covers 10 to 25 percent of the surface area. This soil has been subject to moderate erosion.

Included with this soil in mapping are small areas of Blasingame and Las Posas soils.

Runoff is rapid, and the hazard of erosion is high to very high. Available water capacity is 1.5 to 2.5 inches. Effective rooting depth is 10 to 16 inches.

This soil is used mostly for limited annual range, watershed, and wildlife habitat. Capability unit VIIIs-1(18); range site 1.

Blasingame Series

The Blasingame series consists of somewhat excessively drained soils on uplands. These soils are underlain at a depth of 24 to 40 inches by basic and meta-basic rocks. Slopes are 2 to 75 percent. Elevation ranges from about 800 feet to 3,000 feet. Average annual precipitation is 15 to 24 inches, average annual air temperature is 60° F., and the frost-free season is 150 to 225 days. Vegetation is mostly grasses and forbs, but there are some oaks and brush at the higher elevations.

In a representative profile the surface layer is slightly acid, brown loam about 3 inches thick. The subsoil is slightly acid and medium acid, brown and yellowish-red clay loam and clay about 33 inches thick. The substratum is highly weathered igneous rocks.

Permeability is moderately slow. The available water capacity is 4.0 to 7.5 inches. The effective rooting depth is 24 to 40 inches.

Blasingame soils are used mainly for annual range, watershed, wildlife habitat, and some homesites. The town of Mariposa is on these soils.

Representative profile of a Blasingame loam from an area of Blasingame rocky loam, 15 to 50 percent slopes, about 1 mile northeast of Mariposa, near State Route No. 140 on western side of NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 11, T. 5 S., R. 18 E., Mount Diablo Base Line and Meridian:

- A1—0 to 3 inches, brown (7.5YR 5/4) loam, dark brown (7.5YR 3/2) when moist; moderate, fine and medium, granular structure; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; few very fine interstitial pores, few fine tubular pores, and many fine and medium interstitial pores; slightly acid; abrupt, wavy boundary.
- B1—3 to 12 inches, brown (7.5YR 5/4) light clay loam, dark reddish brown (5YR 3/4) when moist; massive; very hard, friable, slightly sticky and plastic; many very fine and fine roots and few medium roots; many very fine and fine tubular and interstitial pores; few very thin clay films as bridges between mineral grains; common thin clay films lining pores; slightly acid; clear, wavy boundary.
- B2t—12 to 24 inches, yellowish-red (5YR 5/6) clay loam, dark reddish brown (5YR 3/4) when moist; weak, fine and medium, subangular blocky structure; extremely hard, firm, slightly sticky and plastic; common very fine, fine, and medium roots; many very fine and fine tubular and interstitial pores; many thin clay films lining pores and on ped faces; few thin clay films as bridges between mineral grains; slightly acid; clear, wavy boundary.
- B22t—24 to 30 inches, yellowish-red (5YR 5/6) clay, yellowish red (5YR 4/6) when moist; moderate, fine and medium, angular blocky structure; extremely hard, firm, sticky and very plastic; common very fine, fine, and medium roots; common very fine tubular and interstitial pores; continuous thick clay films on ped faces; many moderately thick and thick clay films lining pores and as bridges between mineral grains; medium acid; abrupt, irregular boundary.
- B23—30 to 36 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) when moist; strong, fine, angular blocky structure; extremely hard, firm, sticky and very plastic; common very fine, fine, and medium roots; common very fine tubular and interstitial pores; continuous thick clay films on ped faces; many moderately thick and thick clay films lining pores and as bridges between mineral grains; medium acid; abrupt, irregular boundary.
- C—36 inches, highly weathered basic and metabasic igneous rock; clay fills some cracks in upper part; rock becomes harder with depth; medium acid at top of horizon.

The A horizon is brown or reddish-brown fine sandy loam, loam, stony loam, or heavy loam. It is medium acid or slightly acid. The B1 horizon is brown or reddish brown and is slightly acid or medium acid. The B2t horizon is yellowish-red or dark reddish-brown light clay loam to clay. The finer textures are in the lower part of the horizon. This horizon is medium acid to neutral. The B3 horizon, where present, is similar to the B2 horizon but is commonly mixed with fragments of highly decomposed bedrock and has a little less clay. The C horizon generally is soft, highly decomposed bedrock that crushes under finger and thumb pressure to coarse sandy loam or silt loam, depending upon the texture of the bedrock material. Depth to bedrock is generally 24 to 40 inches.

Blasingame loam, 2 to 15 percent slopes (BdD).—This soil is on uplands. Rock outcrop covers less than 2 percent of the surface area.

Included with this soil in mapping are small areas of Auburn and Las Posas soils and soils that are similar to Blasingame soils but are as much as 60 inches deep to bedrock.

Runoff is slow to medium, and the hazard of erosion is moderate.

This soil is used for annual range, irrigated pasture, and dryland hay. Capability unit IIIe-8(18); range site 2.

Blasingame loam, 15 to 30 percent slopes (BdE).—This soil is on uplands. Rock outcrop covers less than 2 percent of the surface area.

Included with this soil in mapping are small areas of Auburn and Las Posas soils.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used mainly for annual range. Small areas are used for irrigated pasture. Capability unit IVe-8(18); range site 2.

Blasingame rocky loam, 2 to 15 percent slopes (BeD).—This soil is on uplands. Rock outcrop covers 2 to 10 percent of the surface area.

Included with this soil in mapping are small areas of Las Posas and Trabuco soils.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for annual range. Small areas are used for irrigated pasture. Capability unit IVe-8(18); range site 2.

Blasingame rocky loam, 15 to 50 percent slopes (Bef).—This soil is on uplands. It has the profile described as representative for the series. Rock outcrop covers 2 to 10 percent of the surface area.

Included with this soil in mapping are small areas of Las Posas, Auburn, Boomer, and Trabuco soils. Also included are areas of soils as shallow as 20 inches and as deep as 72 inches.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used for annual range, watershed, and wildlife habitat. Capability unit VIe-1(18); range site 2.

Blasingame extremely rocky loam, 50 to 75 percent slopes (BfG).—This soil is on uplands. Rock outcrop and stones cover 10 to 50 percent of the surface area.

Included with this soil in mapping are small areas of Las Posas and Trabuco soils.

Runoff is very rapid, and the hazard of erosion is very high.

This soil is used for limited range, watershed, wildlife habitat, and recreation. Capability unit VIIs-1(18); range site 2.

Blasingame-Las Posas loams, 2 to 15 percent slopes (BgD).—These soils are on uplands. About 70 percent of this complex is Blasingame loam, and about 30 percent in Las Posas loam. Blasingame soils have a profile similar to the one described as representative for the series. Las Posas soils have a profile similar to the one described as representative for the series, but the surface layer is loam.

Runoff is slow to medium, and the hazard of erosion is slight to moderate.

These soils are used for irrigated pasture, range, wildlife habitat, and watershed. Capability unit IIIe-8(18); range site 2.

Blasingame-Las Posas loams, 15 to 30 percent slopes (BgE).—These soils are on uplands. About 65 percent of this complex is Blasingame loam, and 30 percent is Las Posas loam. The remaining 5 percent is included areas of Auburn and Trabuco soils. Blasingame soils have a profile similar to the one described as representative for the series. Las Posas soils have a profile similar to the one described as representative for the series, but the surface layer of these Las Posas soils is loam.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

These soils are used for irrigated and dryland pasture and for range, watershed, and wildlife habitat. Capability unit IVe-8(18); range site 2.

Blasingame-Las Posas stony loams, 9 to 30 percent slopes, eroded (BkE2).—These soils are on uplands. About 55 percent of the complex is Blasingame stony loam, and about 40 percent is Las Posas stony loam. The remaining 5 percent is included areas of Auburn stony loam. Blasingame and Las Posas soils have a profile similar to the one described as representative for their respective series, but they have a surface layer of stony loam. Stones cover about 1 to 3 percent of the surface area.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

These soils are used for range, watershed, and wildlife habitat. Capability unit VIe-1(18); range site 2.

Blasingame-Las Posas rocky loams, 2 to 15 percent slopes (BID).—These soils are on uplands. About 65 percent of this complex is Blasingame loam, and about 30 percent is Las Posas loam. The remaining 5 percent is included areas of Clayey alluvial land, Loamy alluvial land, and Trabuco soils. Blasingame and Las Posas soils have profiles similar to those described for their respective series, except that these Las Posas soils have a loam surface layer. Rock outcrop covers about 2 to 10 percent of the surface area.

Runoff is slow to medium, and the hazard of erosion is slight to moderate.

These soils are used for irrigated and dryland pasture and for range, watershed, and wildlife habitat. Capability unit IVe-8(18); range site 2.

Blasingame-Las Posas rocky loams, 15 to 50 percent slopes (BIF).—About 70 percent of this complex is Blasingame loam, and about 25 percent is Las Posas loam. The remaining 5 percent is included areas of Auburn and Trabuco soils. Blasingame and Las Posas soils have profiles similar to those described for their respective series, except that these Las Posas soils have a loam surface layer. Rock outcrop covers 2 to 10 percent of the surface area.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

These soils are used for range, watershed, and wildlife habitat. Capability unit VIe-1(18); range site 2.

Blasingame-Las Posas extremely rocky loams, 30 to 75 percent slopes, eroded (BmG2).—These soils are on uplands. About 60 percent of this complex is Blasingame loam, and about 30 percent is Las Posas loam. The remaining 10 percent is included areas of Ahwahnee, Auberry, Auburn, and Boomer soils. The Blasingame soils have a profile similar to the one described as representative for the series. The Las Posas soils have a profile similar to the one described as representative of the series, except that the surface layer is loam. Rock outcrop covers 25 to 50 percent of the surface area of these soils.

Runoff is rapid to very rapid, and the hazard of erosion is high to very high.

These soils are used for range, watershed, and wildlife habitat. Capability unit VIIs-1(18); range site 2.

Boomer Series

The Boomer series consists of well-drained soils on uplands. These soils are typically underlain at a depth of 40 inches to more than 60 inches by basic and metabasic igneous rocks. Slopes are 2 to 75 percent. Elevation ranges from 2,500 to 3,500 feet. Average annual precipitation is more than 40 inches, average annual air temperature is 55° F., and the frost-free season is about 140 to 175 days. Vegetation is mainly pines, oaks, and brush, but there are some small areas of grass and forbs or brush (chamise).

In a representative profile the surface layer is slightly acid and medium acid, reddish-brown cobbly loam and loam about 9 inches thick. The subsoil is strongly acid and medium acid, yellowish-red and red clay loam and cobbly clay loam 32 inches thick. The substratum and bedrock are weathered igneous rock.

Permeability is moderate.

Boomer soils are used mainly for annual range and limited woodland, but many small areas, particularly near Midpines, are used for homesites and commercial developments. Other areas are used for family orchards.

Representative profile of a Boomer cobbly loam, from an area of Boomer cobbly loam, 15 to 50 percent slopes, eroded, about 1½ miles northwest of Midpines post office on center of east boundary of NW¼NE¼ sec. 25, T. 4 S., R. 18 E., Mount Diablo Base Line and Meridian:

A11—0 to 3 inches, reddish-brown (5YR 5/4) cobbly loam, dark reddish brown (5YR 3/4) when moist; moderate, fine, angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots and few medium and coarse roots; common very fine and fine tubular and interstitial pores; slightly acid; abrupt, smooth boundary.

A12—3 to 9 inches, reddish-brown (5YR 5/4) loam, yellowish red (5YR 5/6) when rubbed, dark red (2.5YR 3/6) moist, and dark reddish brown (5YR 3/4) rubbed; weak, medium and coarse, angular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots and few medium and coarse roots; common very fine and fine tubular and interstitial pores; many insect and worm holes ½ to ¼ inch in diameter; medium acid; clear, wavy boundary.

- B21—9 to 16 inches, yellowish-red (5YR 5/6) clay loam, reddish yellow (5YR 6/6) when rubbed, dark red (2.5YR 3/6) when moist, and red (2.5YR 4/6) when moist and rubbed; weak, coarse, angular blocky structure; very hard, friable, slightly sticky and plastic; many very fine, fine, and medium roots and few coarse roots; few very fine and many fine tubular and interstitial pores; many worm and insect holes $\frac{1}{32}$ to $\frac{1}{64}$ inch in diameter; many thin clay films on ped faces, in pores, and bridging mineral grains; about 5 percent cobblestones and gravel; strongly acid; gradual, irregular boundary.
- B22t—16 to 25 inches, red (2.5YR 5/6) cobbly clay loam, red (2.5YR 4/6) when moist; weak, coarse, subangular blocky structure; extremely hard, firm, sticky and plastic; many fine, medium, and coarse roots; many very fine and fine tubular and interstitial pores; nearly continuous moderately thick clay films on ped faces, lining pores, and bridging mineral grains; 15 percent cobblestones; strongly acid; gradual, irregular boundary.
- B23t—25 to 31 inches, red (2.5YR 5/6) cobbly clay loam, red (2.5YR 4/6) when moist; weak, coarse, subangular blocky structure; extremely hard, firm, sticky and plastic; common fine, medium, and coarse roots; many very fine and fine tubular and interstitial pores; continuous moderately thick clay films on ped faces, lining pores, and bridging mineral grains; 15 percent cobblestones; strongly acid; abrupt, wavy boundary.
- B24t—31 to 41 inches, red (2.5YR 5/6) clay loam, red (2.5YR 4/6) when moist; weak, coarse, subangular blocky structure; very hard and extremely hard, firm, sticky and plastic; common fine, medium, and coarse roots; very fine and fine tubular and interstitial pores; continuous moderately thick clay films on ped faces, lining pores, and bridging mineral grains; medium acid; clear, irregular boundary.

C—41 to 49 inches, weathered metabasic and basic bedrock, loam when pressed firmly between thumb and forefinger; slightly sticky and slightly plastic when wet; medium acid; upper part of horizon soil filled; clay films line bedrock fractures; gradual, irregular boundary.

R—49 inches, highly weathered bedrock of harder consistency than the C horizon.

The A horizon is brown, reddish-brown, or yellowish-red loam, gravelly loam, cobbly loam, or stony loam. The B2 horizon is red, reddish yellow, or yellowish red. This horizon contains various amounts of stones, cobblestones, or gravel. Depth to bedrock is typically 40 inches to more than 60 inches, but it is 20 to 40 inches in one severely eroded soil.

Boomer loam, 2 to 15 percent slopes (BoD).—This soil is on uplands. It contains 5 to 15 percent stones, cobblestones, and gravel.

Included with this soil in mapping are small areas of Josephine soils and small areas of a soil that is similar to Boomer cobbly loam, 15 to 50 percent slopes, eroded, except that it is 20 to 40 inches deep to bedrock.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. Available water capacity is 5.5 to 10.0 inches. Effective rooting depth is 40 inches to more than 60 inches.

This soil is used mainly for woodland. Some areas are used for grazing, and some for cultivation (fig. 4). Capability unit IIIe-1(22); woodland suitability group 4.

Boomer loam, 30 to 50 percent slopes (BoF).—This soil is on uplands. It has a profile similar to the one de-



Figure 4.—Small family orchard and range on Boomer loam, 2 to 15 percent slopes.

scribed as representative for the series, but the lower part of the subsoil is heavy clay loam or clay.

Included with this soil in mapping are small areas of a soil that is similar to cobbly loam, 15 to 50 percent slopes, eroded, except that it is 20 to 40 inches deep to bedrock.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Available water capacity is 5.5 to 10.0 inches. Effective rooting depth is 40 inches to more than 60 inches.

This soil is used mainly as woodland, but some areas are used for grazing. Capability unit VIe-1(22); woodland suitability group 5.

Boomer cobbly loam, 15 to 50 percent slopes, eroded (BrF2).—This soil is on uplands. It has the profile described as representative for the series. It contains about 15 to 30 percent stones, cobblestones, and gravel.

Included with this soil in mapping are small areas of Blasingame, Josephine, Las Posas, and Trabuco soils. Also included are small areas of a soil that is similar to this Boomer soil, except that it is 20 to 40 inches deep to bedrock.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Available water capacity is 4 to 9 inches. The effective rooting depth is 40 inches to more than 60 inches.

This soil is used mainly as woodland and for some grazing. Small acreages are used for homesites and related activities. Capability unit VIe-1(22); woodland suitability group 5.

Boomer cobbly loam, 30 to 50 percent slopes, severely eroded (BrF3).—This soil is on uplands. Stones and cobblestones cover about 15 to 30 percent of the surface area. It is 20 to 40 inches deep.

Included with this soil in mapping are small areas of Blasingame, Las Posas, and Trabuco soils. Also included are areas of less eroded Boomer soils that are deeper to bedrock.

Runoff is rapid, and the hazard of erosion is high. Available water capacity is 2.5 to 6.0 inches. Effective rooting depth is 20 to 40 inches.

This soil is used for very limited woodland, watershed, and wildlife habitat. It generally is covered by brush. Capability unit VIIe-1(22); woodland suitability group 7.

Boomer cobby loam, 50 to 75 percent slopes, eroded (BrG2).—This soil is on uplands. Cobblestones, stones, and gravel cover about 15 to 30 percent of the surface area.

Included with this soil in mapping are areas of a soil that is similar to Boomer cobbly loam, 15 to 50 percent slopes, eroded, except that it is 20 to 40 inches deep to bedrock.

Runoff is rapid to very rapid, and the hazard of erosion is very high. Available water capacity is 4 to 9 inches. Effective rooting depth is 40 inches to more than 60 inches.

This soil is used as woodland and for watershed and wildlife habitat. Capability unit VIIe-1(22); woodland suitability group 6.

Clayey Alluvial Land

Clayey alluvial land (CoC) consists of moderately well drained or well drained soils on terraces and uplands.

Slopes are 2 to 9 percent. The parent material is derived from igneous rock. Elevation ranges from 350 to 850 feet. Average annual precipitation is 15 to 20 inches, average annual air temperature is 61° to 64° F., and the frost-free season is about 250 days. Vegetation is mainly grasses and forbs, but a few scattered oaks are at the higher elevations.

The surface layer is very dark gray, gray, or dark grayish-brown clay loam or clay, generally 10 inches thick or less. The underlying material is generally similar to the surface layer, except that it is commonly pale brown, light yellowish brown, or light olive brown. The material is 24 inches to more than 60 inches deep. The shallower areas of this land type are underlain by rock or hardpan.

The soil material commonly has blocky structure and cracks deeply upon drying. It is sticky to very sticky and plastic to very plastic when wet and is medium acid to mildly alkaline.

Runoff is slow to rapid when the soil is saturated, and the hazard of erosion is slight to moderate. Permeability is slow or very slow. The available water capacity is 4 to 10 inches. The effective rooting depth is 24 inches to more than 60 inches.

This land type is used mainly for irrigated and dryland pasture, range, and wildlife habitat. Small areas are used for dryland hay. Capability unit IIIe-3(18); range site 7.

Coarsegold Series

The Coarsegold series consists of well-drained soils on uplands. These soils are underlain at a depth of 40 to 60 inches by weathered mica schist. Slopes are 2 to 50 percent. Elevation ranges from 800 to 2,400 feet. Average annual precipitation is 15 to 30 inches, average annual air temperature is 59° to 60° F., and the frost-free season is 180 to 220 days. Vegetation is mainly open stands of grasses and forbs, but oaks are at the lower elevations and an increasing amount of oaks and brush are at the higher elevations.

In a representative profile the surface layer is medium acid and slightly acid, grayish-brown fine sandy loam about 16 inches thick. The subsoil is slightly acid and strongly acid, brown and reddish-brown gravelly loam and sandy clay loam about 34 inches thick. Soft mica schist bedrock is at a depth of about 50 inches.

Permeability is moderately slow. Available water capacity is 4.5 to 9.0 inches. The effective rooting depth is 40 to 60 inches.

Coarsegold soils are used for pasture, range, wildlife habitat, and watershed.

Representative profile of Coarsegold fine sandy loam, from an area of San Andreas-Coarsegold very rocky complex, 9 to 30 percent slopes, about 1 mile east of Quick ranch house, south of fence near top of ridge, in the middle of SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 1, T. 7 S., R. 18 E., Mount Diablo Base Line and Meridian:

A1—0 to 7 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; massive; slightly hard, friable, nonsticky and slightly plastic; many very fine and fine roots; many very fine interstitial pores and common very fine and fine tubular pores; medium acid; clear, wavy boundary.

- A3—7 to 16 inches, grayish-brown (10YR 5/2) fine sandy loam, dark yellowish brown (10YR 3/4) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots and common medium roots; many very fine and fine interstitial pores and many very fine, fine, and medium tubular pores; few thin clay films bridging mineral grains; about 10 percent gravel in lower part of horizon; slightly acid; clear, wavy boundary.
- B1—16 to 22 inches, brown (7.5YR 5/4) gravelly loam, reddish brown (5YR 4/4) when moist; few, fine, faint, strong-brown (7.5YR 5/6) mottles; moderate, medium and coarse, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots and few coarse and medium roots; many very fine and fine interstitial pores and common fine and medium tubular pores; common thin clay films on ped faces and bridging mineral grains and few thin clay films lining pores; about 25 percent coarse gravel and cobblestones; slightly acid; clear, wavy boundary.
- B2t—22 to 39 inches, reddish-brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) when moist; moderate and strong, coarse, angular blocky structure; extremely hard, firm, sticky and plastic; common fine roots; many very fine interstitial pores and common fine tubular pores; many moderately thick and thick clay films on ped faces, many thin and moderately thick clay films bridging and coating mineral grains, and common thin clay films lining pores; slightly acid; clear, wavy boundary.
- B3t—39 to 50 inches, reddish-brown (5YR 5/4) light sandy clay loam, reddish brown (5YR 4/4) when moist; strong, medium and coarse, subangular blocky structure; extremely hard, firm, sticky and plastic; few fine roots; many very fine and fine interstitial pores and common very fine and fine tubular pores; continuous, moderately thick, red (2.5YR 4/6) clay films, dark red (2.5YR 3/6) when moist, bridging mineral grains and common thin clay films lining pores; strongly acid; gradual, irregular boundary.
- C—50 inches, soft mica schist bedrock, crushing to sand under thumb and finger pressure; nonsticky and nonplastic; strongly acid.

The A horizon is grayish-brown, dark yellowish-brown, or dark-gray fine sandy loam or silt loam. Some areas are gravelly in the lower part of this horizon. The Bt horizon is reddish-yellow, reddish-brown, or yellowish-red heavy loam, clay loam, or sandy clay loam. It is neutral to strongly acid. Depth to bedrock ranges from 40 to 60 inches.

Coarsegold soils are mapped only in complexes with San Andreas soils.

Daulton Series

The Daulton series consists of somewhat excessively drained soils of the lower foothills. These soils are underlain at a depth of 10 to 20 inches by metasedimentary rock. Slopes are 2 to 75 percent. Elevation ranges from about 300 to 2,000 feet. Average annual precipitation is about 12 to 25 inches, average annual air temperature is 62° F., and the frost-free season is about 200 to 275 days. Vegetation is mainly annual grasses and forbs, but a few oaks are at the higher elevations.

In a representative profile the soil is slightly acid, grayish-brown loam about 14 inches thick. Hard, dark-colored slate and schist bedrock is at a depth of 14 inches.

Permeability is moderate. Available water capacity is 1.5 to 3.5 inches. The effective rooting depth is 10 to 20 inches.

Daulton soils are used for annual range, wildlife habitat, and watershed.

Representative profile of Daulton loam, from an area of Daulton very rocky loam, 15 to 30 percent slopes, about $\frac{3}{4}$ mile toward Merced from Rocky Village Cafe on State Route No. 140, at the northeast corner of NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 30, T. 6 S., R. 17 E., Mount Diablo Base Line and Meridian:

Ap—0 to 4 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (2.5Y 3/2) when moist; moderate, fine and medium, crumb structure; slightly hard, friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine pores; about 10 percent slaty gravel; squirrel and gopher holes evident; slightly acid; clear, wavy boundary.

C1—4 to 7 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (2.5Y 3/2) when moist; massive; hard, friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine pores; about 10 percent slaty gravel; squirrel and gopher holes evident; slightly acid; clear, wavy boundary.

C2—7 to 14 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (2.5Y 3/2) when moist; massive; hard, friable, nonsticky and nonplastic; common very fine and fine roots; many very fine and fine tubular and interstitial pores; very few, very thin clay films bridging mineral grains; slightly acid; clear, irregular boundary.

R—14 inches, hard, dark-colored schist and slate bedrock.

The A horizon and the C horizon are gray, grayish-brown, or dark grayish-brown fine sandy loam, loam, or light clay loam. These horizons range from medium acid to neutral. Depth to bedrock ranges from 10 to 20 inches.

Daulton loam, 2 to 15 percent slopes (DcD).—This soil is on uplands.

Included with this soil in mapping are small areas of Loamy alluvial land.

Runoff is slow to medium, and the hazard of erosion is slight to moderate.

This soil is used mainly for annual range, watershed, and wildlife habitat. Small areas are used for irrigated pasture. Capability unit IVe-8(18); range site 1.

Daulton loam, 15 to 30 percent slopes (DcE).—This soil is on uplands.

Included with this soil in mapping are small areas of Coarsegold and San Andreas soils.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used for annual range, watershed, and wildlife-habitat. Capability unit VIe-1(18); range site 1.

Daulton very rocky loam, 15 to 30 percent slopes (DbE).—This soil is on uplands. It has the profile described as representative for the series. Rock outcrop covers 2 to 25 percent of the surface area.

Included with this soil in mapping are small areas of Coarsegold, San Andreas, and Whiterock soils.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used for range, wildlife habitat, and watershed. Capability unit VIIs-1(18); range site 1.

Daulton very rocky loam, 30 to 75 percent slopes (DbG).—This soil is on uplands. Rock outcrop covers 10 to 25 percent of the surface area.

Included with this soil in mapping are small areas of Whiterock soils.

Runoff is very rapid, and the hazard of erosion is very high.

This soil is used for annual range, watershed, and wildlife habitat. Capability unit VIIs-1(18); range site 1.

Henneke Series

The Henneke series consists of somewhat excessively drained soils on mountainous uplands. These soils are underlain at a depth of 10 to 20 inches by serpentine bedrock. Slopes are 15 to 75 percent. Elevation ranges from 1,000 to 2,800 feet. Average annual precipitation is 20 to 25 inches, average annual air temperature is 60° F., and the frost-free season is about 150 to 200 days. Vegetation is mainly annual grasses, forbs, and brush, but there are a few oaks and digger pines.

In a representative profile the surface layer is neutral, reddish-brown very gravelly loam about 1 inch thick. The subsoil is neutral, dark reddish-brown very gravelly clay loam and very gravelly clay about 10 inches thick. Fractured serpentine bedrock is at a depth of 11 inches.

Permeability is slow. Available water capacity is 1.0 to 3.0 inches. The effective rooting depth is 10 to 20 inches.

Henneke soils are used for watershed, wildlife habitat, and very limited range.

Representative profile of Henneke very gravelly clay loam, from an area of Henneke extremely rocky clay loam, 15 to 75 percent slopes, about 3 miles northwest of Bagby, above the road on State Route No. 49, 200 feet north of southeast corner sec. 24, T. 3 S., R. 16 E., Mount Diablo Base Line and Meridian:

- A1—0 to 1 inch, reddish-brown (5YR 4/3) very gravelly loam, dark reddish brown (5YR 2/2) when moist; strong, fine, crumb structure; hard, firm, sticky and plastic; many very fine, fine, and medium roots; many very fine and medium pore spaces between crumbs and common very fine interstitial pores within the crumbs; about 80 percent gravel on immediate surface decreasing to about 40 percent within horizon; neutral; clear, wavy boundary.
- B1t—1 to 4 inches, dark reddish-brown (5YR 3/4) very gravelly clay loam, dark reddish brown (5YR 3/2) when moist; strong, fine, subangular blocky structure; hard, firm, sticky and plastic; many very fine and fine roots; many very fine and fine interstitial pores; common thin clay films lining pores, on ped faces, and bridging mineral grains; about 30 percent gravel and about 30 percent stones and cobblestones; neutral; gradual, wavy boundary.
- B2t—4 to 11 inches, dark reddish-brown (5YR 3/4) very gravelly clay, dark reddish brown (5YR 2/2) when moist; strong, fine and medium, subangular blocky structure parting to strong, fine, granular structure; very hard, firm, sticky and very plastic; common very fine, fine, and medium roots; many very fine, fine, and medium interstitial pores and few fine tubular pores; continuous thick clay films on ped faces and lining pores and common thick clay films bridging mineral grains; 30 percent stones and cobblestones and 40 percent gravel; neutral; diffuse, wavy boundary.
- R—11 inches, serpentine rock, dark reddish-brown (5YR 3/4) clay loam in cracks.

The A horizon is dark reddish-gray or reddish-brown loam to clay loam. It contains 20 to 40 percent gravel and 5 to 30 percent stones and cobblestones. The B horizon is dark reddish-brown or dusky-red heavy clay loam to clay. It contains 30 to 40 percent gravel and 10 to 35 percent cobblestones and stones. Depth to bedrock is 10 to 20 inches.

Henneke extremely rocky clay loam, 15 to 75 percent slopes (HcG).—This soil is on uplands. It has the profile described as representative for the series. Rock outcrop covers 25 to 50 percent of the surface area.

Included with this soil in mapping are many small areas of Rock land and soils in alluvial positions that are similar to Henneke soils, except that they are as deep as 6 feet or more to bedrock.

Runoff is rapid to very rapid, and the hazard of erosion is high to very high.

This soil is used for limited range, watershed, and wildlife habitat. Capability unit VIIc-1(18); range site 5.

Hillgate Series

The Hillgate series consists of well-drained soils on old terraces. These soils are underlain at a depth of more than 60 inches by mica schist rock. Slopes are 2 to 9 percent. Elevation ranges from 400 to 1,100 feet. Average annual precipitation is 4 to 20 inches, average annual air temperature is 62° F., and the frost-free season is 225 to 275 days. Vegetation is annual grasses and forbs.

In a representative profile the surface layer is strongly acid, pale-brown and light yellowish-brown very fine sandy loam 18 inches thick. The subsoil is moderately alkaline, yellowish-brown light clay and clay loam 42 inches thick. Mica schist bedrock is at a depth of about 60 inches.

Permeability is very slow. Available water capacity is 3.0 to 4.5 inches, and only a small amount of water is available from the subsoil. The effective rooting depth is 18 to 26 inches and is restricted by the clayey subsoil.

Hillgate soils are used for pasture, range, wildlife habitat, and watershed.

Representative profile of Hillgate very fine sandy loam, 2 to 9 percent slopes, about 4 miles east of Hornitos and about ¼ mile south of Hornitos Road in an open field, on the southwest side of SW¼NW¼ sec. 23, T. 5 S., R. 16 E., Mount Diablo Base Line and Meridian:

- A11—0 to 10 inches, pale-brown (10YR 6/3) very fine sandy loam, dark brown (10YR 4/3) when moist; weak, medium, angular blocky structure; slightly hard, friable, nonsticky and slightly plastic; common very fine and fine roots; many very fine and fine interstitial pores; strongly acid; gradual, wavy boundary.
- A12—10 to 18 inches, light yellowish-brown (10YR 6/4) very fine sandy loam, dark yellowish brown (10YR 4/4) when moist; massive; very hard, friable, nonsticky and slightly plastic; common very fine and fine roots; many very fine and fine tubular and interstitial pores; strongly acid; abrupt, smooth boundary.
- B21t—18 to 26 inches, yellowish-brown (10YR 5/4) light clay, dark yellowish brown (10YR 4/4) when moist; strong, coarse, angular blocky structure; extremely hard, very firm, very sticky and very plastic; common very fine and fine roots along ped faces; many very fine and fine tubular and interstitial pores; continuous, moderately thick, yellowish-brown (10YR 5/4) clay films, dark yellowish brown (10YR 4/4) when moist, on ped faces and many thin and moderately thick clay films lining pores and bridging mineral grains; moderately alkaline; clear, wavy boundary.
- B22t—26 to 46 inches, yellowish-brown (10YR 5/4) heavy clay loam, dark brown (10YR 4/3) when moist; strong, coarse, angular blocky structure; extremely hard, firm, sticky and plastic; very few very fine roots; many very fine and fine tubular and interstitial pores; continuous, thick, dark-brown (10YR 4/3) clay films on ped faces, common moderately thick

clay films lining pores, and many very thin clay films bridging mineral grains; moderately alkaline; lime seams that appear somewhat dendritic on ped faces, in clay films, and a few as a 1- to 3-square-inch patch over the clay films on ped faces; lime seams not in the ped; visible lime effervesces readily in dilute acid; gradual, irregular boundary.

B23t—46 to 60 inches, yellowish-brown (10YR 5/4) clay loam, dark brown (10YR 4/3) when moist; strong, coarse, angular blocky structure; extremely hard, firm, sticky and plastic; very few very fine roots; many very fine interstitial pores and common fine tubular pores; continuous thick clay films on ped faces, common moderately thick clay films lining pores, and many very thin clay films bridging mineral grains; moderately alkaline; abrupt, irregular boundary.

IIR—60 inches, mica schist bedrock.

The A horizon is very pale brown, pale-brown, light yellowish-brown, or brown loam, very fine sandy loam, fine sandy loam, or silt loam. It is strongly acid to slightly acid. The B2t horizon is brown or yellowish-brown clay loam or light clay. The finer textures are mainly at the top of the horizon. This horizon is neutral to moderately alkaline. Depth to bedrock ranges from about 60 to 72 inches.

Hillgate very fine sandy loam, 2 to 9 percent slopes (HbC).—This soil is on terraces.

Included with this soil in mapping are small areas of Loamy alluvial land and small areas of soils that are 36 to 60 inches deep to bedrock.

Runoff is slow to medium, and the hazard of erosion is slight to moderate.

This soil is used for dryland hay, for irrigated and dryland pasture, and for range, watershed, and wildlife habitat. Capability unit IVE-3(18); range site 6.

Hornitos Series

The Hornitos series consists of somewhat excessively drained soils on the lower parts of uplands and on foothills. These soils are underlain at a depth of 6 to 20 inches by sandstone or conglomerate. Slopes are 2 to 50 percent. Elevation ranges from about 350 to 850 feet. Average annual precipitation is 12 to 18 inches, average annual air temperature is 62° F., and the frost-free season is about 240 days. Vegetation is mainly annual grasses and forbs, but there are some scattered oaks.

In a representative profile the surface layer is very strongly acid, grayish-brown extremely stony sandy loam and light yellowish-brown very gravelly sandy loam about 8 inches thick. The subsoil is very strongly acid, pink heavy loam about 3 inches thick. Sandstone bedrock is at a depth of 11 inches.

Permeability is moderately rapid. Available water capacity is 0.5 to 2.0 inches. The effective rooting depth is 6 to 20 inches.

Hornitos soils are used for annual range and watershed.

Representative profile of Hornitos extremely stony sandy loam, 2 to 50 percent slopes, about 1¼ miles northwest of where Preston Road touches the Merced County line on top of the hill, at an elevation of 575 feet, in the southwest corner of NE¼NW¼ sec. 22, T. 8 S., R. 17 E., Mount Diablo Base Line and Meridian:

A11—0 to 3 inches, grayish-brown (10YR 5/2) extremely stony sandy loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; soft, friable, nonsticky and slightly plastic; many very fine and

fine roots; common very fine interstitial pores; about 25 to 50 percent stones on the surface; very strongly acid; clear, wavy boundary.

A12—3 to 8 inches, light yellowish-brown (10YR 6/4) very gravelly sandy loam, dark yellowish brown (10YR 4/4) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many very fine and fine tubular and interstitial pores; 35 percent gravel and 15 percent cobbles and stones; very strongly acid; clear, wavy boundary.

B2—8 to 11 inches, pink (7.5YR 7/4) heavy loam, brown (7.5YR 5/4) when moist; weak, coarse, angular blocky structure; hard, friable, sticky and plastic; few very fine and fine roots; many very fine and fine interstitial and tubular pores; common moderately thick clay films on lower ped face against bedrock contact and very few thin clay films bridging mineral grains and lining pores; continuity of horizon interrupted by about 50 percent bedrock intrusions; very strongly acid; abrupt, irregular boundary.

R—11 inches, sandstone bedrock.

The A horizon is very pale brown, light yellowish-brown, or grayish-brown sandy loam or fine sandy loam. It is medium acid to very strongly acid and has cobbles, stones, and gravel. The B2 horizon is very pale brown, light reddish-brown, or pink fine sandy loam or heavy loam. It is medium acid to very strongly acid and has a variable content of stones, cobbles, and gravel. This horizon is intermittent because of the intrusive bedrock. Depth to sandstone, conglomerate, or mica schist bedrock is mostly between 6 and 20 inches. Cobbles and stones cover 25 to 50 percent of the surface area.

Hornitos extremely stony sandy loam, 2 to 50 percent slopes (HcF).—This soil is on uplands.

Included with this soil in mapping are small areas of Whiterock soils and soils that are similar to Hornitos soils, except that they have a clay subsoil.

Runoff is slow to rapid, and the hazard of erosion is slight to high.

This soil is used for annual range, watershed, and wildlife habitat. Capability unit VIIIs-1(18); range site 4.

Josephine Series

The Josephine series consists of well-drained soils on uplands. These soils are underlain at a depth of 24 inches to more than 60 inches by metasedimentary rock. Slopes are 2 to 75 percent. Elevation ranges from 2,500 to 3,000 feet. Average annual precipitation is 30 to 50 inches, average annual air temperature is 55° F., and the frost-free season is 140 to 200 days. Vegetation is mainly conifers, oaks, and brush.

In a representative profile the surface layer is medium acid, yellowish-brown and brown gravelly loam and gravelly light clay loam 4 inches thick. The subsoil is medium acid to very strongly acid, brown gravelly clay loam and yellowish-red clay loam 28 inches thick. Weathered schist bedrock is at a depth of 32 inches.

Permeability is moderate.

Josephine soils are used for woodland, watershed, wildlife habitat, limited grazing, and for some small orchards.

Representative profile of Josephine gravelly loam, 30 to 50 percent slopes, eroded, about 2 miles north of Greeley Hill Road on Ponderosa Way, in the N¼ NW¼SW¼ sec. 13, T. 2 S., R. 16 E., Mount Diablo Base Line and Meridian:

O1—2 inches to ½ inch, mostly slightly decomposed pine needles.

O2— $\frac{1}{2}$ inch to 0, mostly well-decomposed leaves and twigs.
 A1—0 to 2 inches, yellowish-brown (10YR 5/4) gravelly loam, dark brown (7.5YR 3/2) when moist; strong, medium and fine, crumb structure; soft, friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; common very fine, fine, and medium tubular and interstitial pores; about 25 percent gravel; medium acid; clear, irregular boundary.

A3—2 to 4 inches, brown (7.5YR 5/4) gravelly light clay loam, dark brown 7.5YR 3/2) when moist; few, fine, faint, strong-brown (7.5YR 5/6) mottles and few, fine, dark-brown (7.5YR 4/4) mottles when moist; weak, medium, angular blocky structure; slightly hard, friable, slightly sticky and plastic; many very fine, fine, and medium roots; common very fine, fine, and medium tubular and interstitial pores; about 25 percent gravel; medium acid; clear, irregular boundary.

B1—4 to 8 inches, brown (7.5YR 5/4) gravelly clay loam, dark brown (7.5YR 4/4) when moist; common, fine, faint, strong-brown (7.5YR 5/6) mottles and common, fine, faint, brown (7.5YR 5/4) mottles when moist; moderate, medium, subangular blocky structure; hard, slightly firm, sticky and plastic; many fine and medium roots; common very fine, fine, and medium tubular and interstitial pores; few thin clay films on ped faces; about 30 percent gravel; medium acid; clear, wavy boundary.

B21t—8 to 15 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) when moist; moderate, medium and fine, angular blocky structure; hard, firm, sticky and plastic; many fine, medium, and coarse roots; many very fine and fine tubular and interstitial pores; common thin clay films lining pores and bridging mineral grains; more clay than in B1 horizon; thin film of soil material from B1 horizon on some ped faces; strongly acid; clear, irregular boundary.

B22t—15 to 25 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) when moist; moderate, medium and fine, angular blocky structure; hard, firm, sticky and plastic; many, fine, medium, and coarse roots; many very fine and fine tubular and interstitial pores and few medium tubular pores; many thin clay films bridging mineral grains and lining pores and few moderately thick clay films on ped faces; little more clay than in B21 horizon; 5 percent gravel; very strongly acid; gradual, irregular boundary.

B23t—25 to 32 inches, yellowish-red (5YR 5/6) clay loam, dark reddish brown (5YR 3/4) when moist; strong, medium, angular blocky structure; hard, firm, sticky and plastic; many fine, medium, and coarse roots; many very fine and fine tubular and interstitial pores and few medium tubular pores; many moderately thick clay films lining pores and bridging mineral grains and common moderately thick and thick clay films on ped faces; 5 percent gravel; very strongly acid; abrupt, irregular boundary.

R—32 inches, weathered schist bedrock; soil material from B23t horizon penetrates into cracks as deep as 36 inches or more.

The A horizon is dark grayish-brown, brown, yellowish-brown, or light-brown loam or clay loam. It is as much as 30 percent gravel. It is slightly acid or medium acid. The B2 horizon is yellowish red or red. It is medium acid to very strongly acid. The underlying bedrock is shattered and weathered schist and ranges in depth from 24 inches to more than 60 inches.

In places these Josephine soils are 20 to 40 inches deep, which is more shallow than in the range defined for the series.

Josephine loam, 2 to 15 percent slopes, eroded (JbD2).—This soil is on uplands. It is less than 15 percent gravel and is 40 inches to more than 60 inches deep to bedrock.

Included with this soil in mapping are small areas of Loamy alluvial land and areas of Josephine soils that are 24 to 40 inches deep to bedrock.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. Available water capacity is 7 to 11 inches. Effective rooting depth is 40 inches to more than 60 inches.

This soil is used mainly as woodland and for watershed, wildlife habitat, and small orchards. It has some value for grazing. Small areas are used for irrigated pasture or dryland hay. Capability unit IIIe-1(22); woodland suitability group 1.

Josephine loam, 15 to 30 percent slopes, eroded (JbE2).—This soil is on uplands. It is less than 15 percent gravel and is 40 inches to more than 60 inches deep to bedrock.

Included with this soil in mapping are small areas of Boomer soils and areas of Josephine soils that are 24 to 40 inches deep to bedrock.

Runoff is moderate to high, and the hazard of erosion is moderate to high. Available water capacity is 7 to 11 inches. Effective rooting depth is 40 inches to more than 60 inches.

This soil is used as woodland and for watershed, wildlife habitat, and orchards. It has some value for grazing. Capability unit IVe-1(22); woodland suitability group 2.

Josephine loam, 30 to 50 percent slopes, eroded (JbF2).—This soil is on uplands. It contains less than 15 percent gravel and is 40 inches to more than 60 inches deep to bedrock.

Included with this soil in mapping are small areas of Boomer soils and areas of Josephine soils that are 24 to 40 inches deep to bedrock.

Runoff is rapid, and the hazard of erosion is high. Available water capacity is 7 to 11 inches. Effective rooting depth is 40 inches to more than 60 inches.

This soil is used as woodland and for watershed, wildlife habitat, and some grazing. Capability unit VIe-1(22); woodland suitability group 2.

Josephine gravelly loam, 2 to 15 percent slopes, eroded (JcD2).—This soil is on uplands.

Included with this soil in mapping are small areas of Boomer soils and areas of Josephine soils that are more than 40 inches deep to bedrock.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. Available water capacity is 4 to 7.0 inches. Effective rooting depth ranges from 24 to 40 inches.

This soil is used mainly as woodland and for watershed and wildlife habitat, but some areas are used for grazing. Also, small areas are used for irrigated pasture and dryland hay. Capability unit IIIe-1(22); woodland suitability group 4.

Josephine gravelly loam, 15 to 30 percent slopes, eroded (JcE2).—This soil is on uplands.

Included with this soil in mapping are small areas of Boomer and Mariposa soils and areas of Josephine soils that are 40 inches to more than 60 inches deep to bedrock.

Runoff is medium, and the hazard of erosion is moderate to high. Available water capacity is 4 to 7 inches. Effective rooting depth ranges from 24 to 40 inches.

This soil is used as woodland and for watershed, wildlife habitat, and some grazing. Capability unit IVe-1(22); woodland suitability group 5.

Josephine gravelly loam, 30 to 50 percent slopes, eroded (JcF2).—This soil is on uplands. It has the profile described as representative for the series.

Included with this soil in mapping are small areas of Boomer and Mariposa soils. Also included are areas of Josephine soils that are more than 40 inches deep to bedrock.

Runoff is rapid, and the hazard of erosion is high. Available water capacity is 4 to 7 inches. Effective rooting depth is 24 to 40 inches.

This soil is used as woodland and for watershed, wildlife habitat, and some grazing. Capability unit VIe-1(22); woodland suitability group 6.

Josephine rocky loam, 50 to 75 percent slopes, eroded (JdG2).—This soil is on uplands. Rock outcrop covers about 2 to 10 percent of the surface area.

Included with this soil in mapping are small areas of Boomer and Mariposa soils and areas of Josephine soils that are more than 40 inches deep to bedrock.

Runoff is very rapid, and the hazard of erosion is very high. Available water capacity is 4 to 7 inches. Effective rooting depth is 24 to 40 inches.

This soil is used as woodland and for watershed, wildlife habitat, and some grazing. Capability unit VIIe-1(22); woodland suitability group 6.

Josephine very rocky loam, 15 to 50 percent slopes, eroded (JeF2).—This soil is on uplands. Rock outcrop covers 10 to 25 percent of the surface area.

Included with this soil in mapping are small areas of Boomer and Mariposa soils and areas of Josephine soils that are more than 40 inches deep to bedrock.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Available water capacity is 4 to 7 inches. Effective rooting depth is 24 to 40 inches.

This soil is used as woodland and for watershed, wildlife habitat, and some grazing. Capability unit VIIs-1(22); woodland suitability group 5.

Las Posas Series

The Las Posas series consists of well-drained soils on uplands. These soils are underlain at a depth of 24 to 40 inches by basic and metabasic igneous rocks. Slopes are 5 to 50 percent. Elevation ranges from 800 to 2,000 feet. Average annual precipitation is mainly 15 to 22 inches, but some areas receive as much as 30 inches. Average annual air temperature is 61° F., and the frost-free season is 175 to 200 days. Vegetation is mainly annual grasses and forbs, but there is an increasing amount of oaks and brush as elevation increases. Some eroded areas are brush covered.

In a representative profile the surface layer is neutral, brown clay loam 4 inches thick. The subsoil is slightly acid, reddish-brown, dark reddish-brown, and dark-red clay loam and clay 32 inches thick. Highly weathered bedrock is at a depth of about 36 inches.

Permeability is moderately slow. The available water capacity is 4 to 7 inches. The effective rooting depth is 24 to 40 inches.

Las Posas soils are used for annual range and watershed.

Representative profile of Las Posas clay loam, from an area of Las Posas very rocky clay loam, 9 to 30 percent slopes, about 1 mile north-northwest of Cathey's

Valley California Division of Forestry Station in the northeast corner of SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 7, T. 6 S., R. 17 E., Mount Diablo Base Line and Meridian:

- A1—0 to 4 inches, brown (7.5YR 4/2) clay loam, dark reddish brown (5YR 3/3) when moist; weak, fine, granular structure; slightly hard, friable, nonsticky and slightly plastic; many very fine and fine roots and few medium roots; many very fine pores and common fine pores; neutral; abrupt, smooth boundary.
- B11—4 to 9 inches, reddish-brown (5YR 4/4) clay loam when rubbed, dark reddish brown (5YR 3/4) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many very fine pores and common fine pores; some krotovinas at top of horizon; slightly acid; clear, wavy boundary.
- B12t—9 to 16 inches, dark reddish-brown (2.5YR 3/4) heavy clay loam, dark reddish brown (2.5YR 3/4) when moist; weak, coarse, angular blocky structure; very hard, friable, sticky and plastic; common very fine roots; common very fine and fine pores; common thin clay films lining pores and on ped faces and very few thin clay films bridging mineral grains; slightly acid; clear, wavy boundary.
- B21t—16 to 22 inches, dark reddish-brown (2.5YR 3/4) heavy clay loam, dark reddish brown (2.5YR 3/4) when moist; moderate, medium, angular blocky structure; extremely hard, firm, sticky and plastic; common very fine and fine roots; many very fine and fine pores; common moderately thick clay films lining pores and bridging mineral grains and common moderately thick clay films and few thick clay films on ped faces; slightly acid; abrupt, smooth boundary.
- B22t—22 to 31 inches, dark reddish-brown (5YR 3/4) light clay, dark reddish brown (2.5YR 3/4) when moist; strong, medium and coarse, angular blocky structure; extremely hard, very firm, sticky and very plastic; common very fine and fine roots; many very fine and fine pores; continuous thick and moderately thick clay films on ped faces and continuous moderately thick clay films lining pores and bridging mineral grains; about 5 percent stones and cobblestones; slightly acid; gradual, irregular boundary.
- B23t—31 to 36 inches, dark-red (2.5YR 3/6) clay, dark reddish brown (2.5YR 3/4) when moist; strong, medium and coarse, angular blocky structure; extremely hard, very firm, sticky and very plastic; common very fine and fine roots; many very fine and fine pores; continuous moderately thick clay films and few thick clay films on ped faces and many moderately thick clay films lining pores and bridging mineral grains; about 5 percent stones and cobblestones; slightly acid; clear, irregular boundary.
- R—36 inches, weathered bedrock; some clay fills fractures in upper 2 to 4 inches.

The A horizon is brown or yellowish-red very fine sandy loam, loam, stony loam, or clay loam. It is neutral to medium acid. The B horizon is reddish brown, dark reddish brown, or dark red. It is slightly acid to mildly alkaline. Depth to bedrock ranges from 24 to 40 inches.

Las Posas very rocky clay loam, 9 to 30 percent slopes (IbE).—This soil is on uplands. It has the profile described as representative for the series. Rock outcrop covers about 10 to 25 percent of the surface area.

Included with this soil in mapping are small areas of Auburn, Blasingame, and Trabuco soils.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used for range, watershed, and wildlife habitat. Capability unit VIIs-1(18); range site 2.

Las Posas extremely rocky clay loam, 5 to 50 percent slopes (IcF).—This soil is on uplands. Rock outcrop covers about 25 to 50 percent of the surface area.

Included with this soil in mapping are small areas of Blasingame and Trabuco soils.

Runoff is medium to rapid, and the hazard of erosion is high.

This soil is used for annual range, wildlife habitat, and watershed. Capability unit VIIc-1(18); range site 2.

Loamy Alluvial Land

Loamy alluvial land (ldC) consists of well-drained to somewhat poorly drained alluvium on terraces and alluvial fans and in narrow valleys on uplands. Slopes are 2 to 9 percent. Elevation ranges from 300 to 3,500 feet, average annual air temperature is 54° to 64° F., average annual precipitation is 12 to 45 inches, and the frost-free season is about 150 to 275 days. Vegetation is mostly annual grasses and forbs, but there are a few scattered oaks and ponderosa pines and some willows in wetter areas.

The surface layer is neutral to strongly acid, gray to reddish-brown sandy loam, heavy sandy loam, or loam 4 to 15 inches thick. It is underlain by material that is darker gray or darker brown and is red in places. It is mottled in the more poorly drained areas. It ranges from loamy sand to clay loam and is gravelly or cobbly in places. This layer is moderately alkaline to strongly acid and is 10 to 40 inches thick.

Included with this land type in mapping are small areas of soils that have a slope of as much as 15 percent,

and soils that are less than 60 inches deep to a layer that stops root penetration.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. Permeability is rapid to moderately slow. The available water capacity ranges from 5.0 to 10.0 inches. Effective rooting depth is 60 inches or more.

This land type is used for annual pasture. Some areas are used for irrigated pasture (fig. 5), small orchards, and dryland hay. Capability unit IIc-1(18, 22); range site 2.

Mariposa Series

The Mariposa series consists of well-drained soils on uplands. These soils are underlain at a depth of 12 to 20 inches by metasedimentary rock. Slopes are 15 to 75 percent. Elevation ranges from 2,500 to 3,500 feet. Average annual precipitation is 30 to 45 inches, average annual air temperature is 55° F., and the frost-free season is 140 to 200 days. Vegetation is mainly brush, but scattered areas are in pines, oaks, and grass.

In a representative profile (fig. 6) the surface layer is strongly acid, pale-brown gravelly silt loam about 3 inches thick. The upper part of the subsoil is light-brown, strongly acid gravelly silt loam about 6 inches



Figure 5.—Loamy alluvial land in irrigated pasture.

thick. The lower part of the subsoil is very strongly acid, reddish-yellow gravelly silty clay loam 10 inches thick. Weathered schist that has nearly vertical cleavage planes is at a depth of 19 inches.

Permeability is moderate. The available water capacity is 1.5 to 3.0 inches. The effective rooting depth is mainly 12 to 20 inches, but it is as deep as 38 inches in places where pockets of soil are in cracks of the bedrock.

Mariposa soils are used mainly for watershed and wildlife habitat. Some areas are used for grazing and as woodland.



Figure 6.—Typical profile and plant cover of a Mariposa gravelly silt loam.

Representative profile of Mariposa gravelly silt loam, 15 to 50 percent slopes, eroded, about 3 miles west and ½ mile north of the intersection of State Route No. 140 and Colorado Road; 200 feet north and 200 feet east of the southwest corner of sec. 21, T. 4 S., R. 18 E., Mount Diablo Base Line and Meridian:

- O1—2 to 1½ inches, raw dried twigs and leaves of pines, yerba santa, ceanothus, and other plants.
- O2—1½ inches to 0, grayish-brown (2.5YR 5/2) decomposed organic matter mixed with dust and surface gravel forming a highly organic loam, very dark grayish brown (2.5Y 3/2) when moist; strong, fine, crumb structure; soft, very friable, nonsticky and nonplastic; many very fine, fine, and medium roots; many very fine interstitial pores; about 50 percent organic material and 20 percent gravel; strongly acid; abrupt, smooth boundary.
- A1—0 to 3 inches, pale-brown (10YR 6/3) gravelly silt loam, strong brown (7.5YR 5/6) when moist; massive; hard, friable, slightly sticky and slightly plastic; common fine roots and many very fine roots; many very fine and fine tubular and interstitial pores; about 20 percent gravel; strongly acid; clear, wavy boundary.
- B1—3 to 9 inches, light-brown (7.5YR 6/4) gravelly heavy silt loam, strong brown (7.5YR 5/6) when moist; weak, medium and fine, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine and medium roots and many very fine roots; many very fine and fine tubular and interstitial pores and common medium tubular and interstitial pores; very few thin clay films lining pores and bridging mineral grains; about 20 percent gravel; strongly acid; gradual, irregular boundary.
- B2t—9 to 19 inches, reddish-yellow (7.5YR 6/6) gravelly silty clay loam, strong brown (7.5YR 5/6) when moist; moderate, medium, subangular blocky structure; very hard, firm, sticky and plastic; common fine and medium roots and few coarse roots; many very fine and fine tubular and interstitial pores; many moderately thick clay films on ped faces, lining pores, and bridging mineral grains; some bedrock intrusion; about 20 percent gravel; very strongly acid; abrupt, irregular boundary.
- R—19 inches, more than 90 percent variably decomposed schist bedrock, B2t horizon continues to a depth of as much as 38 inches in vertical cracks of bedrock.

The A horizon is dark grayish-brown or pale-brown loam or silt loam. It is slightly acid to strongly acid. It is 15 to 25 percent gravel. The B2t horizon is brown, reddish-brown, or reddish-yellow loam or clay loam. It is medium acid to very strongly acid. It is 15 to 30 percent gravel. Depth to bedrock mainly ranges from 12 to 20 inches, but some areas are shallower or deeper to bedrock.

Mariposa gravelly silt loam, 15 to 50 percent slopes, eroded (Maf2).—This soil is on uplands. It has the profile described as representative for the series.

Included with this soil in mapping are small areas of soils that are similar to Mariposa soils, except that they have a clay subsoil, are less acid, or have no distinct subsoil. Also included are small areas of Josephine and Maymen soils.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used mainly for watershed and wildlife habitat. Some areas are used for grazing and as woodland. Capability unit VIIe-1(22); woodland suitability group 7.

Mariposa gravelly silt loam, 50 to 75 percent slopes, eroded (McG2).—This soil is on uplands. Most of the surface layer of this soil has been removed by erosion.

Included with this soil in mapping are small areas of Josephine and Maymen soils.

Runoff is very rapid, and the hazard of erosion is very high.

This soil is used for watershed and wildlife habitat. Capability unit VIIe-1(22); woodland suitability group 7.

Maymen Series

The Maymen series consists of well-drained soils on uplands. These soils are underlain at a depth of 8 to 20 inches by metasedimentary rock. Slopes are 30 percent to more than 75 percent. Elevation ranges from 1,000 to 3,000 feet. Average annual precipitation is 20 to 40 inches, average annual air temperature is 56° F., and the frost-free season is about 175 to 225 days. Vegetation is mainly brush, but some small areas are in grass, oaks, and digger pine.

In a representative profile the soil is medium acid, brown gravelly loam 9 inches thick. Slaty bedrock is at a depth of 9 inches.

Permeability is moderate. Available water capacity is 1.0 to 3.0 inches. The effective rooting depth is 8 to 20 inches.

Maymen soils are used mainly for watershed and wildlife habitat. Some areas are used for grazing.

Representative profile of Maymen gravelly loam, 30 to 75 percent slopes, severely eroded, about 1 mile west from State Route No. 140, on road adjacent to Trabucco Creek in the southeast corner of SW $\frac{1}{4}$ sec. 13, T. 4 S., R. 18 E., Mount Diablo Base Line and Meridian:

A1—0 to 4 inches, brown (7.5YR 5/4) gravelly loam, dark reddish brown (5YR 3/4) when moist; moderate, fine, granular structure and moderate, fine, subangular blocky structure; hard, friable, nonsticky and nonplastic; few medium roots and many fine roots; many very fine tubular pores and common fine tubular pores; medium acid; clear, wavy boundary.

B2—4 to 9 inches, brown (7.5YR 5/4) gravelly heavy loam, reddish brown (5YR 4/4) when moist; weak, fine, subangular blocky structure and weak, fine, granular structure; hard, friable, slightly plastic and slightly sticky; few medium and coarse roots and many fine roots; many very fine and fine tubular and interstitial pores; few, thin, discontinuous clay films bridging mineral grains; medium acid; clear, irregular boundary.

R—9 inches, about 90 to 95 percent slaty fragments and flagstones that have some bedrock intrusions, light brown (7.5YR 6/4) heavy sandy loam in cracks; variably decomposed slate and schist that have no soil material filling voids below a depth of 16 inches; medium acid.

The A horizon is brown or light yellowish-brown loam, fine sandy loam, or heavy loam. It is 10 to 25 percent gravel. It is slightly acid or medium acid. The B horizon is similar to the A horizon in color. It is heavy loam or light clay loam, and it is slightly acid or medium acid. It is 10 to 25 percent gravel. Depth to bedrock ranges from 8 to 20 inches.

Maymen gravelly loam, 30 to 75 percent slopes, severely eroded (MbG3).—This soil is on uplands. It has the profile described as representative for the series. Much of the surface layer has been removed by erosion. Gullies are common on this soil.

Included with this soil in mapping are soils that formed in colluvium and that are similar to Maymen soils but are 2 to 4 feet deep to bedrock. Also included are small areas of Mariposa soils, areas that have rock

outcrop, and areas of soils that are similar to Maymen soils but are 2 to 8 inches deep to bedrock.

Runoff is rapid to very rapid, and the hazard of erosion is high to very high.

This soil is used for watershed and wildlife habitat. Capability unit VIIIs-1(18, 22).

Maymen gravelly loam, over 75 percent slopes, eroded (MbH2).—This soil is on uplands.

Included with this soil in mapping are areas of Mariposa soils, soils that have rock outcrop, and soils that are similar to Maymen soils but are 2 to 8 inches deep to bedrock.

Runoff is very rapid, and the hazard of erosion is very high.

This soil is used for watershed and wildlife habitat. Capability unit VIIIs-1(18, 22).

Maymen rocky loam, 15 to 30 percent slopes (McE).—This soil is on uplands. Rock outcrop covers 2 to 10 percent of the surface area.

Included with this soil in mapping are small areas of Auburn soils and areas of soils that are similar to Maymen soils but are 2 to 8 inches deep to bedrock.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used mainly for watershed and wildlife habitat. Some areas are used for annual range. Capability unit VIIe-1(18); range site 1.

Maymen very rocky loam, 30 to 75 percent slopes, eroded (MdG2).—This soil is on uplands. Rock outcrop covers 10 to 25 percent of the surface area.

Included with this soil in mapping are small areas of Auburn soils and areas of soils that are similar to Maymen soils but are 2 to 8 inches deep to bedrock.

Runoff is rapid to very rapid, and the hazard of erosion is high to very high.

This soil is used mainly for watershed and wildlife habitat. Some areas are used for annual range. Capability unit VIIIs-1(18); range site 1.

Musick Series

The Musick series consists of well-drained soils on uplands. These soils are underlain at a depth of more than 60 inches by weathered acid igneous rock. Slopes are 9 to 50 percent. Elevation ranges from about 2,000 to 5,000 feet. Average annual precipitation is 35 to 45 inches, average annual air temperature is about 55° F., and the frost-free season is about 150 to 200 days. Vegetation is mainly conifers, oaks, and brush, but small areas are in grasses and forbs.

In a representative profile the surface layer is strongly acid or medium acid, gray, dark grayish-brown, grayish-brown, and light-brown sandy loam about 14 inches thick. The subsoil is strongly acid or very strongly acid, red and yellowish-red clay loam and sandy clay loam about 42 inches thick. The substratum is strongly acid, reddish-yellow heavy sandy loam about 19 inches thick. Massive acid igneous bedrock is at a depth of 75 inches.

Permeability is moderately slow. The available water capacity is 9.0 to 11.0 inches. Effective rooting depth is mostly more than 60 inches.

Musick soils are used mainly as woodland and for watershed. Some small areas are used for orchards.

Representative profile of Musick sandy loam, from an area of Musick rocky sandy loam, 15 to 50 percent slopes, eroded, about $\frac{1}{4}$ mile east of Triangle store on Triangle Road, in the southwest corner of NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 20, T. 5 S., R. 20 E., Mount Diablo Base Line and Meridian:

- A11—0 to $1\frac{1}{2}$ inches, gray (10YR 5/1) sandy loam, very dark gray (10YR 3/1) when moist; weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine interstitial pores; medium acid; clear, wavy boundary.
- A12— $1\frac{1}{2}$ to 5 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; massive; soft, very friable, nonsticky and nonplastic; few medium and coarse roots and many very fine and fine roots; many very fine interstitial pores; medium acid; clear, wavy boundary.
- A13—5 to 9 inches, grayish-brown (10YR 5/2) sandy loam, dark brown (10YR 3/3) when moist; massive; soft, friable, nonsticky and nonplastic; few medium and coarse roots and common very fine and fine roots; many very fine and fine interstitial pores; medium acid; gradual, irregular boundary.
- A3—9 to 14 inches, light-brown (7.5YR 6/4) sandy loam, brown (7.5YR 4/4) when moist; massive; slightly hard, friable, nonsticky and nonplastic; few medium roots and common very fine and fine roots; many very fine and fine interstitial pores; few thin clay films bridging mineral grains; strongly acid; clear, wavy boundary.
- B21t—14 to 34 inches, red (2.5YR 5/6) clay loam, yellowish red (5YR 5/8) when rubbed and dark red (2.5YR 3/6) when moist; moderate, medium and coarse, subangular blocky structure; very hard, firm, sticky and plastic; few fine and medium roots; few very fine and fine interstitial pores; many thin and moderately thick clay films lining pores and bridging mineral grains and common moderately thick clay films on ped faces; strongly acid; gradual, irregular boundary.
- B22t—34 to 48 inches, red (2.5YR 5/6) clay loam, dark red (2.5YR 3/6) when moist; moderate, medium and coarse, subangular blocky structure; extremely hard, very firm, sticky and plastic; very few fine and medium roots; few very fine and fine interstitial pores, many moderately thick clay films lining pores, bridging mineral grains, and on ped faces; more coarse sand than in B21t horizon; very strongly acid; gradual, irregular boundary.
- B3—48 to 56 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when rubbed and moist; massive; extremely hard, firm, slightly sticky and plastic; very few fine roots and common coarse roots; quartz and hornblende mineral grains mask colors; strongly acid; clear, irregular boundary.
- C1—56 to 75 inches, reddish-yellow (5YR 6/6) heavy sandy loam, yellowish red (5YR 4/6) when rubbed and moist; massive; extremely hard, very firm, nonsticky and slightly plastic; few medium and coarse roots; few and common thin and moderately thick clay films in cracks and bridging some mineral grains; strongly acid; gradual, irregular boundary.
- C2—75 inches, massive bedrock crushing to fine sand and loamy fine sand.

The A1 horizon is sandy loam or loam that is generally not more than 10 inches thick. It is slightly acid or medium acid. The A3 horizon, where present, is dark-gray, light-brown, or light yellowish-brown sandy loam or loam. It is slightly acid to strongly acid. The B1 horizon, where present, is brown or reddish-brown loam or clay loam. It is medium acid or strongly acid. The B2 horizon is dark-red, red, or reddish-yellow heavy clay loam or sandy clay that becomes coarser with depth. It is medium acid to very strongly acid. The B3 horizon, where present, is reddish-brown, yellowish-red, or reddish-yellow loam, sandy clay loam, or clay loam. It is medium acid or strongly acid. The C1 horizon is reddish-

yellow or light-brown sandy loam or loam. It is medium acid or strongly acid. Depth to bedrock generally is more than 72 inches.

Musick loam, 9 to 15 percent slopes, eroded (MeD2).—This soil is on uplands. It has a profile similar to the one described as representative of the series, except that the surface layer is thinner and is loam.

Included with this soil in mapping are small areas of Stump Springs soils and soils that have rock outcrop.

Runoff is slow to medium, and the hazard of erosion is moderate.

This soil is used mainly as woodland. Some areas are used for grazing, orchards, and dryland hay. Capability unit IIIe-1(22); woodland suitability group 2.

Musick loam, 15 to 30 percent slopes, eroded (MeE2).—This soil is on uplands. It has a profile similar to the one described as representative of the series, except that the surface layer is thinner and is loam.

Included with this soil in mapping are small areas of Stump Springs and Musick sandy loams. Also included are small areas of soils that have rock outcrop.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used mainly as woodland. Some areas are used for grazing. Capability unit IVe-1(22); woodland suitability group 3.

Musick rocky sandy loam, 9 to 15 percent slopes, eroded (MfD2).—This soil is on uplands. Rock outcrop covers 2 to 10 percent of the surface area.

Included with this soil in mapping are small areas of Stump Springs soils.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly as woodland. Some areas are used for grazing and orchards. Capability unit IVe-1(22); woodland suitability group 5.

Musick rocky sandy loam, 15 to 50 percent slopes, eroded (MfE2).—This soil is on uplands. It has the profile described as representative for the series. Rock outcrop covers 2 to 10 percent of the surface area.

Included with this soil in mapping are small areas of Stump Springs, Ahwahnee, and Auberry soils.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used mainly as woodland and for watershed and wildlife habitat. Some areas are used for grazing. Capability unit VIe-1(22); woodland suitability group 6.

Positas Series

The Positas series consists of well-drained soils on terraces on the lower foothills. These soils formed in alluvium derived mostly from basic igneous and meta-sedimentary rocks. Slopes are 2 to 15 percent. Elevation ranges from about 500 to 800 feet. Average annual precipitation is 12 to 16 inches, average annual air temperature is about 62° F., and the frost-free season is about 250 days. Vegetation is annual grasses and forbs.

In a representative profile the surface layer is medium acid and slightly acid, reddish-brown gravelly clay loam about 5 inches thick. The upper part of the

subsoil is medium acid, yellowish-red very cobbly clay loam 6 inches thick. The lower part of the subsoil is medium acid, red and reddish-brown clay about 9 inches thick. The substratum is mixed alluvium of sand, gravel, cobblestones, stones, and some clay.

Permeability is very slow. Available water capacity is 1.5 to 3.0 inches. Effective rooting depth for most plants is about 10 to 18 inches and is limited by the clay subsoil.

Positas soils are used for annual range.

Representative profile of Positas gravelly clay loam, 2 to 15 percent slopes, about $2\frac{1}{2}$ miles west-southwest of Webb Station, in the NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 8, T. 4 S., R. 15 E., Mount Diablo Base Line and Meridian:

- Ap1—0 to 1 inch, reddish-brown (5YR 5/4) gravelly heavy loam, dark reddish brown (5YR 3/3) when moist; common, fine, faint, yellowish-red (5YR 5/6) mottles, dark reddish brown (5YR 3/4) when moist; moderate, fine, crumb structure; hard, slightly firm, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine interstitial pores; about 25 percent rounded gravel; medium acid; abrupt, smooth boundary.
- Ap2—1 to 5 inches, reddish-brown (5YR 5/4) gravelly clay loam, dark reddish brown (2.5YR 3/4) when moist; moderate, medium and coarse, angular blocky structure; very hard, firm, sticky and plastic; many very fine and fine roots; many very fine and fine tubular and interstitial pores; many thin clay films on ped faces, lining pores, and bridging mineral grains; about 20 percent subrounded gravel; slightly acid; clear, wavy boundary.
- B1t—5 to 11 inches, yellowish-red (5YR 4/6) very cobbly clay loam, dark reddish brown (2.5YR 3/4) when moist; moderate, medium, angular blocky structure; very hard, firm, sticky and plastic; many very fine and fine roots; many very fine and fine tubular and interstitial pores; many thin and moderately thick clay films on ped faces, lining pores, and bridging mineral grains; about 35 percent subrounded cobblestones, 15 percent subangular and subrounded stones, and 15 percent gravel; medium acid; abrupt, wavy boundary.
- B21t—11 to 15 inches, red (2.5YR 4/6) clay, dark red (2.5YR 3/6) when moist; strong, coarse, angular blocky and prismatic structure; extremely hard, firm, very plastic and very sticky; few very fine and fine roots along vertical ped faces; common very fine tubular and interstitial pores and few fine tubular and interstitial pores; continuous thick clay films on ped faces, lining pores, and bridging and coating mineral grains; medium acid; gradual, wavy boundary.
- B22t—15 to 20 inches, reddish-brown (5YR 4/4) clay, reddish brown (5YR 4/4) when moist; many, coarse, faint, brown (7.5YR 4/4) mottles; strong, coarse, angular blocky and prismatic structure; extremely hard, firm, very sticky and very plastic; few very fine and fine roots along vertical ped faces; common very fine tubular and interstitial pores and few fine tubular and interstitial pores; continuous thick clay films on ped faces, lining pores, and bridging and coating mineral grains; medium acid; abrupt, wavy boundary.
- IIC—20 to 60 inches, mixed, compact, mostly basic and meta-basic igneous and some metasedimentary alluvium of stones, gravel, cobblestones, coarse sand, and small amounts of clay.

The A horizon is reddish brown or reddish yellow. It has 15 to 25 percent gravel or cobblestones. A line of cobblestones commonly separates the A and B horizons. The B2 horizon is red, reddish-brown, or yellowish-red clay or gravelly clay. It is slightly acid or medium acid. The C horizon commonly is stratified and is compact. It is yellowish red or light olive brown. Texture is highly variable and depends upon the texture of the local sediment.

Positas gravelly clay loam, 2 to 15 percent slopes (PcD).—This soil is on terraces.

Included with this soil in mapping are small areas of Auburn and Redding soils and Clayey alluvial land. Also included are soils that are similar to Positas soils, except that the surface layer is light yellowish brown or brownish yellow. Also included are some soils that are similar to Positas soils, except that they are at an elevation as low as 350 feet.

Runoff is slow to medium, and the hazard of erosion is slight to moderate.

This soil is used for annual range and irrigated pasture. Capability unit IVE-3(18); range site 6.

Redding Series

The Redding series consists of well-drained soils on old terraces. These soils are underlain at a depth of 14 to 30 inches by an indurated iron-silica hardpan. Slopes are 2 to 15 percent. Elevation ranges from 300 to 800 feet. Average annual precipitation is 12 to 20 inches, average annual air temperature is 62° F., and the frost-free season is about 250 days. Vegetation is annual grasses and forbs.

In a representative profile the surface layer is slightly acid or medium acid, dark reddish-gray or reddish-brown gravelly loam 7 inches thick. The subsoil is strongly acid, is reddish brown, and is about 10 inches thick. It is gravelly clay loam in the upper part and gravelly clay in the lower part. The substratum is an indurated, iron-silica-cemented hardpan that contains variable amounts of gravel, stones, and cobblestones. It ranges from 3 inches to many feet in thickness.

Permeability is very slow to the nearly impervious hardpan. Available water capacity is 1.5 to 4.0 inches. Effective rooting depth is generally 14 to 30 inches, but many plant roots are somewhat restricted by the gravelly clay subsoil.

Redding soils are used for annual range.

Representative profile of Redding gravelly loam, 2 to 15 percent slopes, about $\frac{1}{2}$ mile east of Merced County line on State Route No. 140, in the northeast corner sec. 9, T. 7 S., R. 16 E., Mount Diablo Base Line and Meridian:

- Ap1—0 to 1 inch, dark reddish-gray (5YR 4/2) gravelly loam, dark reddish brown (5YR 3/2) when moist; moderate, fine, crumb structure; very hard, friable, slightly sticky and slightly plastic; many very fine and fine roots along ped faces; many very fine interstitial pores; about 20 percent gravel; medium acid; abrupt, smooth boundary.
- Ap2—1 to 7 inches, reddish-brown (5YR 4/4) gravelly loam, dark reddish brown (5YR 3/2) when moist; massive; very hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine tubular and interstitial pores; 30 percent gravel; slightly more clay than in Ap1 horizon; slightly acid; clear, wavy boundary.
- B21t—7 to 16 inches, reddish-brown (5YR 4/4) gravelly clay loam, dark reddish brown (5YR 3/3) when moist; moderate, medium and coarse, angular blocky structure; extremely hard, firm, plastic and sticky; common very fine and fine roots along ped faces; many very fine and fine tubular and interstitial pores and few medium tubular and interstitial pores; many moderately thick clay films on ped faces and many thin clay films bridging mineral grains; 35 percent gravel; strongly acid; clear, wavy boundary.

B22t—16 to 17 inches, reddish-brown (5YR 4/3) gravelly clay, dark reddish brown (5YR 3/3) when moist; few, medium, dark-red (2.5YR 3/6) mottles, many, medium, faint, dark reddish-brown (5YR 3/4) mottles and few, medium, distinct, dark-red (10R 3/6) mottles when moist; massive; extremely hard, firm, very sticky and very plastic; common very fine and fine roots in cracks; many very fine and fine tubular and interstitial pores and few medium tubular and interstitial pores; common moderately thick clay films bridging and coating mineral grains; horizon is thin and discontinuous horizontally; strongly acid; abrupt, wavy boundary.

Cm—17 to 60 inches, iron-silica-cemented, stony, gravelly, and cobbly alluvium; clay fills cracks for about 2 inches in places; duripan is about 2 feet thick and has strata of highly compacted sandy alluvium; more hardpan below.

The A horizon is reddish-brown, yellowish-red, brown, or dark reddish-gray gravelly sandy loam or gravelly loam. It has 20 to 30 percent gravel. It is slightly acid to strongly acid. A B1 horizon is in places. The B2t horizon is reddish-brown or dark-red clay loam or clay. It is commonly gravelly and is 10 to 35 percent gravel. It is strongly acid or medium acid. The B22t horizon generally is intermittent and ranges from 1 to 4 inches in thickness. The Cm horizon ranges from 3 inches to many feet in thickness. Depth to the duripan ranges from 14 to 30 inches.

In the Mariposa Area, the Redding series is generally not so red as in the range defined for this series elsewhere in California.

Redding gravelly loam, 2 to 15 percent slopes (RcD).—This sloping soil is on terraces. The relief is somewhat hummocky.

Included with this soil in mapping are small areas of soils that are similar to Redding gravelly loam, except that they are browner in color. Also included are small areas of soils that have more than one layer of hardpan.

Runoff is slow to medium, and water often stands in the intermound areas. The hazard of erosion is slight to moderate.

This soil is used for annual range and irrigated pasture. Capability unit IVe-8(18); range site 6.

Riverwash and Tailings

Riverwash and Tailings (Rb) consists of somewhat poorly drained to excessively drained, mostly gravelly, cobbly, and stony mixed alluvium adjacent to stream and gully channels. Elevation ranges from about 310 to 3,500 feet. Average annual precipitation is 12 to 45 inches, and average annual air temperature is 55° to 63° F. Vegetation is mostly oaks, willows, and conifers, but small areas are in annual grasses and forbs.

Riverwash consists mostly of gravel, cobblestones, or stones and some sand, loam, or clay loam. The areas within channels are subject to a high hazard of water erosion and are unstable. Areas of Riverwash adjacent to channels are mostly stable. Much of the mine Tailings consist of Riverwash that has been worked for gold.

Included with this land type in mapping are small areas of hard rock mine waste, much of which has been crushed in stamp mills and dumped into gullies.

This land type is used as a source of construction materials, and the area in this mapping unit is used for wildlife habitat, watershed, and recreation. Capability unit VIIIw-1(18, 22).

Rock Land

Rock land (RcG) consists of excessively drained rock outcrop in 50 to 80 percent of the mapping unit. All major bedrock types in the area are represented. Slopes are 2 percent to more than 75 percent. This land type is on uplands. Elevation ranges from about 750 to 3,500 feet. Average annual precipitation is 14 to 45 inches, and average annual air temperature is 54° to 63° F. Vegetation is mostly a few sparse clumps of annual grasses and forbs, but there is some oak, digger pine, ponderosa pine, and brush. A few small pockets of soil have a thick cover of vegetation.

Included with this land type in mapping are areas of stony land.

Rock land is used for wildlife habitat, watershed, and recreation. Capability unit VIIIs-1(18, 22).

San Andreas Series

The San Andreas series consists of well-drained soils on uplands. These soils are underlain at a depth of 20 to 40 inches by metasedimentary rock. Slopes are 2 to 50 percent. Elevation ranges from 800 to 2,400 feet. Average annual precipitation is 15 to 30 inches, average annual air temperature is 59° to 60° F., and the frost-free season is 180 to 230 days. Vegetation is an open stand of grasses and forbs at the lower elevations, but there is an increasing amount of oaks and some brush or digger pine at high elevations.

In a representative profile the surface layer is medium acid, brown very fine sandy loam about 21 inches thick. The next layer is medium acid, brown very fine sandy loam 12 inches thick. Weathered mica schist bedrock is at a depth of about 33 inches.

Permeability is moderate. The available water capacity is about 3.0 to 7.0 inches. The effective rooting depth is 20 to 40 inches.

San Andreas soils are used for pasture, range, watershed, and wildlife habitat.

Representative profile of a San Andreas very fine sandy loam from an area of San Andreas-Coarsegold complex, 15 to 30 percent slopes, about 400 feet west of Hidden Valley Road on the Rauch Ranch, in the SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 25, T. 6 S., R. 18 E., Mount Diablo Base Line and Meridian:

Ap—0 to 8 inches, brown (10YR 5/3) very fine sandy loam, very dark grayish brown (10YR 3/2) when moist; massive; slightly hard, friable, nonsticky and nonplastic; many very fine roots and common fine roots; many very fine interstitial pores and common fine tubular pores; hoof-packed, which may have caused structure breakdown; medium acid; clear, wavy boundary.

A11—8 to 16 inches, brown (10YR 5/3) very fine sandy loam, dark grayish brown (10YR 3/2) when moist; massive; slightly hard, friable, nonsticky and nonplastic; common very fine roots; many very fine interstitial pores and common fine tubular pores; medium acid, clear, wavy boundary.

A12—16 to 21 inches, brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) when moist; massive; hard, friable, nonsticky and nonplastic; few very fine and fine roots; many very fine and fine tubular and interstitial pores; medium acid; clear, wavy boundary.

C—21 to 33 inches, brown (7.5YR 5/4) very fine sandy loam, dark brown (7.5YR 4/4) when rubbed and dark

brown (7.5YR 3/2) when moist; massive; hard, friable, nonsticky and nonplastic; few very fine and fine roots; many very fine and fine tubular and interstitial pores; medium acid; clear, irregular boundary.

R—33 inches, soft to hard mica schist bedrock.

The A horizon generally is brown, but it is yellowish brown in the lower part in places. It is very fine sandy loam or loam and is slightly acid or medium acid. The C horizon is similar to the A horizon, except that it is somewhat redder or yellower. The lower part of the A horizon and the C horizon have about 5 to 30 percent gravel. Depth to bedrock ranges from 20 to 40 inches.

San Andreas soils in the Mariposa Area are mapped only in complexes with Coarsegold soils.

San Andreas-Coarsegold complex, 2 to 15 percent slopes (ScD).—These soils are on uplands. About 50 percent of the complex is San Andreas very fine sandy loam, and about 40 percent is Coarsegold fine sandy loam. The remaining 10 percent is included areas of Ahwahnee, Auberry, and Daulton soils. San Andreas and Coarsegold soils have a profile similar to the one described as representative for their respective series.

Runoff is slow to medium, and the hazard of erosion is slight to moderate.

These soils are used mainly for range, watershed, and wildlife habitat. Small areas are used for orchards. Capability unit IVE-8(18); range site 2.

San Andreas-Coarsegold complex, 15 to 30 percent slopes (ScE).—These soils are on uplands. About 50 percent of this complex is San Andreas very fine sandy loam, and about 40 percent is Coarsegold fine sandy loam. The remaining 10 percent is included areas of Ahwahnee, Auberry, and Daulton soils. San Andreas soils have the profile described as representative for the San Andreas series. Coarsegold soils have a profile similar to the one described as representative for the Coarsegold series.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

These soils are used mainly for range, wildlife habitat, and watershed. Small areas are used for apple orchards. Capability unit IVE-8(18); range site 2.

San Andreas-Coarsegold complex, 30 to 50 percent slopes (ScF).—These soils are on uplands. About 50 percent of this complex is San Andreas very fine sandy loam, and 40 percent is Coarsegold fine sandy loam. The remaining 10 percent is included areas of Ahwahnee, Auberry, and Daulton soils. San Andreas and Coarsegold soils have a profile similar to the one described as representative for their respective series.

Runoff is rapid, and the hazard of erosion is high.

These soils are used for range, watershed, and wildlife habitat. Capability unit VIe-1(18); range site 2.

San Andreas-Coarsegold very rocky complex, 9 to 30 percent slopes (SbE).—These soils are on uplands. About 50 percent of the complex is San Andreas very fine sandy loam, and about 40 percent is Coarsegold fine sandy loam. The remaining 10 percent is included areas of Ahwahnee, Auberry, and Daulton soils. San Andreas soils have a profile similar to the one described as representative for the San Andreas series. Coarsegold soils have the profile described as representative for the Coarsegold series. Rock outcrop covers 2 to 25 percent of the surface area.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

These soils are used for range, watershed, and wildlife habitat. Capability unit VIe-1(18); range site 2.

San Joaquin Series

The San Joaquin series consists of well-drained soils on old terraces. These soils are underlain at a depth of 14 to 27 inches by an indurated, iron-silica-cemented hardpan. Slopes are 2 to 9 percent. Elevation ranges from about 350 to 400 feet. Average annual precipitation is 12 to 16 inches, average annual air temperature is 61° F., and the frost-free season is about 250 days. Vegetation is annual grasses and forbs.

In a representative profile the surface layer is medium acid, brown loam about 1 inch thick. The subsoil is medium acid, brown gravelly loam and reddish-brown loam in the upper 21 inches and medium acid, red clay in the lower 5 inches. The substratum is an indurated, iron-silica-cemented hardpan that ranges from a few inches to several feet in thickness.

Permeability is very slow above the hardpan. The hardpan is nearly impervious. Available water capacity is 2 to 5 inches. The effective rooting depth ranges from about 14 to 27 inches.

San Joaquin soils are used for annual range.

Representative profile of San Joaquin loam, 2 to 9 percent slopes, about 2 miles south of State Route No. 140 near Merced County line, about 1,320 feet west, 2,260 feet south of northeast corner sec. 22, T. 7 S., R. 16 E., Mount Diablo Base Line and Meridian:

- A1—0 to 1 inch, brown (7.5YR 4/4) loam, dark reddish brown (5YR 3/4) and reddish-brown (5YR 4/4) when rubbed and moist; moderate, fine and medium, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine interstitial pores; medium acid; about 15 percent gravel; clear, smooth boundary.
- B11t—1 to 3 inches, brown (7.5YR 4/4) gravelly loam, dark reddish brown (5YR 3/3) when moist; moderate, medium and coarse, angular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine interstitial pores and common fine tubular pores; many thin and moderately thick clay films on ped faces; few thin clay films lining pores and as bridges between mineral grains; slightly more clay than in A1 horizon; medium acid; about 25 percent gravel; clear, wavy boundary.
- B12t—3 to 12 inches, reddish-brown (5YR 4/4) loam, dark reddish brown (5YR 3/3) when moist; weak, medium and coarse, angular blocky structure; extremely hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine tubular and interstitial pores; common thin clay films on ped faces, lining pores, and as bridges between mineral grains; slightly more clay than in B11t horizon; medium acid; about 15 percent gravel; gradual, wavy boundary.
- B13t—12 to 22 inches, reddish-brown (5YR 4/4) heavy loam, dark reddish brown (5YR 3/4) when rubbed and (5YR 3/3) moist; moderate, medium and coarse, subangular blocky structure; extremely hard, friable, sticky and plastic; common very fine and fine roots; many very fine and fine tubular and interstitial pores; common thin clay films on ped faces, lining pores, and as bridges between mineral grains; medium acid; about 15 percent gravel; abrupt, wavy boundary.

B2t—22 to 27 inches, red (2.5YR 3/6) clay, dark red (2.5YR 3/6) when moist; strong, coarse, angular blocky structure; extremely hard, very firm, very plastic and very sticky; few very fine and fine roots; common very fine, fine, and medium tubular pores and many very fine and fine interstitial pores; continuous thick clay films on ped faces; many thick and moderately thick clay films lining pores and as bridges between mineral grains; medium acid; about 15 percent gravel; abrupt, wavy boundary.

Cm—27 to 60 inches, iron-silica-cemented duripan; less cemented with depth.

The A1 horizon is dark grayish-brown or brown sandy loam or loam. The content of gravel ranges from 0 to 15 percent, by volume. This horizon is neutral to medium acid. The B1 horizon is brown, reddish-brown, or yellowish-red loam or clay loam. The content of gravel ranges from 0 to 25 percent, by volume. This horizon is slightly acid or medium acid. The B2t horizon is dark reddish brown, yellowish red, or red. The content of gravel is 15 percent or less. This horizon is medium acid to neutral. It ranges from 1 to 5 inches in thickness. Depth to the duripan ranges from 14 to 27 inches.

San Joaquin loam, 2 to 9 percent slopes. (ScB).—This soil is on old terraces and has a hummocky relief.

Included with this soil in mapping are small areas of a soil that is similar to this San Joaquin soil, except that it is underlain by granitic bedrock rather than by a hardpan.

Runoff is slow to medium, and some ponding occurs in the intermountain areas. The hazard of erosion is slight to moderate.

This soil is used mainly for annual range. Small areas are used for irrigated pasture and dryland hay. Capability unit IVe-8(18); range site 6.

Stump Springs Series

The Stump Springs series consists of well-drained soils on uplands. These soils are underlain at a depth of 40 inches to more than 60 inches by acid igneous rock. Slopes range from 5 to 50 percent. Elevation ranges from 3,000 to 5,000 feet. Average annual precipitation is 35 to 48 inches, average annual air temperature is 54° to 57° F., and the frost-free season is about 150 to 185 days. Vegetation is mainly conifers and brush, but there are small areas in annual grasses and forbs.

In a representative profile the surface layer is medium acid and strongly acid, grayish-brown and pale-brown sandy loam 12 inches thick. The upper 11 inches of the subsoil is strongly acid, pale-brown coarse sandy loam. The lower 34 inches is strongly acid, light yellowish-brown and light-brown heavy sandy loam and light sandy clay loam. The substratum is strongly acid, light yellowish-brown coarse sandy loam that extends to a depth of more than 60 inches.

Permeability is slow. Available water capacity is 5 to 9 inches. The effective rooting depth is 40 inches to more than 60 inches.

Stump Springs soils are used for woodland, watershed, wildlife habitat, and some grazing.

Representative profile of a Stump Springs coarse sandy loam, from an area of Stump Springs-Musick sandy loams, 5 to 15 percent slopes, eroded, on Westfall Road within ½ mile of U.S. Forest Service lands, at southwest corner of SE¼NE¼ sec. 21, T. 5 S., R. 20 E., Mount Diablo Base Line and Meridian:

O—1 inch to 0, variably decomposed pine tree litter.

A11—0 to 4 inches, grayish-brown (10YR 5/2) coarse sandy loam, very dark grayish brown (10YR 3/2) when moist; massive; slightly hard, friable, nonsticky and plastic; many fine and medium roots; common medium tubular pores, few very fine and fine tubular pores, and many very fine and fine interstitial pores; medium acid; clear, wavy boundary.

A12—4 to 12 inches, pale-brown (10YR 6/3) sandy loam, dark grayish brown (10YR 4/2) when moist; massive; hard, friable, slightly sticky and nonplastic; many medium roots and common fine and coarse roots; many very fine and fine interstitial pores and common fine tubular pores; strongly acid; clear, wavy boundary.

B1—12 to 23 inches, pale-brown (10YR 6/3) coarse sandy loam, dark yellowish brown (10YR 4/4) when moist; common, medium, faint, yellowish-brown (10YR 5/4) mottles; massive; very hard, friable, slightly sticky and slightly plastic; many medium roots and common fine roots; many very fine and fine interstitial and tubular pores; few thin clay films lining pores and bridging mineral grains; strongly acid; gradual, irregular boundary.

B21t—23 to 34 inches, light yellowish-brown (10YR 6/4) heavy sandy loam, brown (10YR 4/3) and dark yellowish brown (10YR 4/4) when rubbed and moist; moderate, medium and coarse, subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; common fine and medium roots; many very fine and fine tubular and interstitial pores; many thin clay films on ped faces and common thin clay films lining pores and bridging mineral grains; strongly acid; gradual, irregular boundary.

B22t—34 to 57 inches, light-brown (7.5YR 6/4) light sandy clay loam, brown (7.5YR 4/4) when moist; moderate, medium and coarse, subangular blocky structure; extremely hard, friable, slightly sticky and slightly plastic; few fine roots; many very fine and fine tubular and interstitial pores; many thin films lining pores and bridging mineral grains and common thin and moderately thick clay films on ped faces; strongly acid; gradual, irregular boundary.

C—57 to 65 inches, light yellowish-brown (10YR 6/4) coarse sandy loam, dark yellowish brown (10YR 4/4) when moist; massive; hard, friable, nonsticky and nonplastic; few fine roots; many very fine and fine tubular and interstitial pores; few thin clay films bridging mineral grains; strongly acid.

The A horizon is coarse sandy loam to fine sandy loam and is slightly acid to strongly acid. The B1 horizon is pale-brown or brown coarse sandy loam or heavy sandy loam. It is slightly acid to strongly acid. The B2t horizon is light brown, pale brown, brown, light yellowish brown, or yellowish brown. It is medium acid to very strongly acid. The C horizon becomes deeply weathered parent rock at a depth of about 40 inches to more than 60 inches.

In the Mariposa Area the Stump Springs soils are mapped only in complexes with Musick soils.

Stump Springs-Musick sandy loams, 5 to 15 percent slopes, eroded (SdD2).—These soils are on uplands. About 70 percent of this complex is Stump Springs sandy loam, and about 20 percent is Musick sandy loam. The remaining 10 percent is included areas of Ahwahnee and Auberry soils and Loamy alluvial land. Stump Springs soils have the profile described as representative for the Stump Springs series. Musick soils have a profile similar to the one described as representative of the Musick series.

Runoff is slow to medium, and the hazard of erosion is slight to moderate.

These soils are used mainly as woodland and for wildlife habitat and watershed. Small areas are used for apple orchards, dryland hay, or grazing. Capability unit IIIe-1(22); woodland suitability group 2.

Stump Springs-Musick rocky sandy loams, 9 to 15 percent slopes, eroded (SeD2).—These soils are on uplands. About 60 percent of this complex is Stump Springs sandy loam, and about 30 percent is Musick sandy loam. The remaining 10 percent is included areas of Ahwahnee and Auberry soils and Loamy alluvial land. Stump Springs and Musick soils have a profile similar to the one described as representative for their respective series. Rock outcrop covers 2 to 10 percent of the surface area.

Runoff is medium, and the hazard of erosion is moderate.

These soils are used mainly as woodland and for watershed and wildlife habitat. Some areas are used for orchards or grazing. Capability unit IVe-1(22); woodland suitability group 2.

Stump Springs-Musick rocky sandy loams, 15 to 50 percent slopes, eroded (SeF2).—These soils are on uplands. About 75 percent of this complex is Stump Springs sandy loam, and about 20 percent is Musick sandy loam. The remaining 5 percent is included areas of Ahwahnee and Auberry soils and Loamy alluvial land. Stump Springs and Musick soils have a profile similar to the one described as representative for their respective series. Rock outcrop covers 2 to 10 percent of the surface area.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

These soils are used as woodland and for watershed and wildlife habitat. Capability unit VIe-1(22); woodland suitability group 6.

Trabuco Series

The Trabuco series consists of well-drained soils on uplands. These soils are underlain at a depth of 24 to 40 inches by weathered basic rock. Slopes are 2 to 50 percent. Elevation ranges from about 1,500 to 3,300 feet. Average annual precipitation is 20 to 30 inches, average annual air temperature is 59° F., and the frost-free season is about 150 to 225 days. Vegetation is oaks, grasses, forbs, and some digger pines.

In a representative profile the surface layer is slightly acid, brown light clay loam 9 inches thick. The subsoil is about 27 inches thick. It is slightly acid, reddish-brown clay loam in the upper part and medium acid reddish-yellow clay in the lower part. The substratum is medium acid, reddish-yellow clay loam about 3 inches thick. Bedrock is at a depth of 39 inches.

Permeability is slow. Available water capacity is 4.0 to 7.5 inches. Effective rooting depth is 24 to 40 inches.

Trabuco soils are used for annual range, watershed, and some dryfarmed grain.

Representative profile of Trabuco clay loam, from an area of Trabuco very rocky clay loam, 15 to 50 percent slopes, eroded, about 1 mile up Mount Bullion Youth Camp road from State Route No. 49, in the NW¼SE¼ sec. 1, T. 5 S., R. 17 E., Mount Diablo Base Line and Meridian:

A1—0 to 4 inches, brown (7.5YR 5/4) light clay loam, dark brown (7.5YR 3/2) when moist; strong, fine, crumb structure; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; few very

fine tubular pores; about 15 percent gravel; some krotovinas; many small rodent burrows; slightly acid; abrupt, wavy boundary.

A3—4 to 9 inches, brown (7.5YR 4/4) light clay loam, dark reddish brown (5YR 3/4) when moist; massive; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many very fine and fine tubular and interstitial pores; slightly acid; abrupt, wavy boundary.

B1t—9 to 17 inches, reddish-brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) when moist; moderate, fine, angular blocky structure; very hard, firm, sticky and plastic; common very fine and fine tubular and interstitial pores; common thin clay films lining pores and bridging mineral grains and many thin clay films on ped faces; about 5 percent each of stones, cobblestones, and gravel in lower part; slightly acid; abrupt, wavy boundary.

B21t—17 to 29 inches, reddish-yellow (5YR 6/6) clay; dark reddish brown (7.5YR 5/6) moist; massive; very hard, very firm, very sticky and very plastic; common very fine and fine roots; many very fine tubular and interstitial pores and common fine tubular and interstitial pores; continuous thick clay films lining pores and bridging and coating mineral grains; about 5 percent each of stones, cobblestones, and gravel at top of horizon; about 20 percent increase in clay within 1 inch below B1t horizon; medium acid; clear, wavy boundary.

B22t—29 to 36 inches, reddish-yellow (7.5YR 6/6) clay, strong brown (7.5YR 5/6) when moist; massive; extremely hard, very firm, very sticky and very plastic; common very fine and fine roots; common very fine and fine tubular and interstitial pores; continuous thick clay films lining pores and bridging and coating mineral grains; medium acid; clear, wavy boundary.

C—36 to 39 inches, reddish-yellow (7.5YR 7/8) clay loam, strong brown (7.5YR 5/6) when moist; massive; hard, firm, sticky and plastic; common very fine and fine roots; many very fine tubular and interstitial pores; medium acid; clear, irregular boundary.

R—39 inches, variably decomposed basic igneous rock.

The A horizon is brown or yellowish-red heavy loam or light clay loam. It is neutral or slightly acid. The B2t horizon is yellowish-red, reddish-brown, or reddish-yellow heavy clay loam or clay. It is slightly acid to strongly acid. Depth to bedrock ranges from 24 to 40 inches. The soil is 0 to 5 percent stones and cobblestones and 0 to 15 percent gravel throughout.

In the Mariposa Area the Trabuco soils tend to be yellower and the depth to bedrock is shallower than in the range defined for the series elsewhere in California.

Trabuco clay loam, 2 to 15 percent slopes, eroded (TcD2).—This sloping soil is on uplands. It contains no stones, cobblestones, or gravel, and rock outcrop covers less than 2 percent of the surface area.

Included with this soil in mapping are small areas of Las Posas and Auburn soils.

Runoff is slow to medium, and the hazard of erosion is slight to moderate.

This soil is used mostly for annual range. Small areas are used for irrigated pasture and dryland hay or grain. Capability unit IIIe-3(18); range site 2.

Trabuco clay loam, 15 to 30 percent slopes, eroded (TcE2).—This soil is on uplands. It has a profile similar to the one described as representative of the series, except that it lacks coarse fragments in the profile. Rock outcrop covers less than 2 percent of the surface area.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

Included with this soil in mapping are small areas of Las Posas and Auburn soils.

This soil is used mostly for annual range. Small areas are used for irrigated pasture. Capability unit IVe-3(18); range site 2.

Trabuco very rocky clay loam, 15 to 50 percent slopes, eroded (TbF2).—This soil is on uplands. It has the profile described as representative for the series. Rock outcrop covers 2 to 25 percent of the surface area.

Included with this soil in mapping are small areas of Boomer and Las Posas soils.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used for annual range. Capability unit VIIs-1(18); range site 2.

Whiterock Series

The Whiterock series consists of excessively drained soils on uplands of the foothills. These soils are underlain at a depth of 5 to 12 inches by metasedimentary rock. Slopes are 5 to 50 percent. Elevation ranges from about 350 to 2,500 feet. Average annual precipitation is 12 inches to about 25 inches, average annual air temperature is about 61° F., and the frost-free season is about 150 to 220 days. Vegetation is mainly oaks, but there are some digger pines and annual grasses and forbs.

In a representative profile the soil is medium acid, brown gravelly loam 9 inches thick. Schist and slate bedrock is at a depth of 9 inches.

Permeability is moderate. Available water capacity is about 0.5 to 1.5 inches. Effective rooting depth is 5 to 12 inches.

Whiterock soils are used for wildlife habitat, watershed, and some range.

Representative profile of Whiterock gravelly loam, from an area of Whiterock rocky loam, 5 to 50 percent slopes, on Pendola Gardens Road, about 1½ mile southwest of intersection with State Route No. 49, center of S½NE¼ sec. 32, T. 4 S., R. 17 E., Mount Diablo Base Line and Meridian:

A1—0 to 9 inches, brown (10YR 5/3) gravelly loam, dark brown (7.5YR 3/2) when moist; thin, weak, fine, crumb structure over weak, fine, angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine tubular and interstitial pores; very few thin clay films linking pores and bridging mineral grains in lower part of horizon; about 20 percent fine slaty gravel in the upper 5 inches, most breaking down to sand under constant thumb pressure, increasing to 30 percent slaty gravel mixed with some slaty fragments and flagstones in the lower part; medium acid; clear, irregular boundary.

R—9 inches, variably decomposed schist and slate bedrock, variable small amounts of light clay loam and light silty clay loam fill narrow spaces between vertically inclined rock.

The A horizon is brown or light yellowish-brown loam or silt loam. It generally has 15 to 30 percent slaty gravel. It is medium acid or strongly acid. A thin B horizon is present in some places. Depth to bedrock ranges from 5 to 12 inches. Pockets of soil in cleavage planes sometimes extend to a depth of as much as 32 inches.

Whiterock rocky loam, 5 to 50 percent slopes (WcF).—This soil is on uplands. Rock outcrop covers 2 to 10 percent of the surface area.

Included with this soil in mapping are soils that are similar to Whiterock soils, except that they are neutral or slightly acid throughout. Also included are areas of soils that have more than 10 percent rock outcrop and soils that are similar to Whiterock soils, except that they are 12 to 24 inches deep to bedrock.

Runoff is slow to rapid, and the hazard of erosion is slight to high.

This soil is used for wildlife habitat, watershed, and for some range. Capability unit VIIIs-1(18); range site 4.

Use and Management of the Soils

The soils of the Mariposa County Area are used mainly for range and improved pasture. Some areas are used for timber production or for small orchards. This section tells how the soils can be used for these purposes, as well as for various engineering works.

First described is the system of capability classification used by the Soil Conservation Service and modifications made necessary because of climatic and use differences in the two land resource areas in the Area. The capability units in the Mariposa County Area are described, and management for these units is suggested. Following this, in table 2, are listed the estimated average yields per acre of the principal crops in the Area. Then range sites are described, and production of air-dry forage for each site is estimated. This is followed by a discussion of the woodland suitability group in the Area. The last part of this section describes engineering uses of the soils. Much of the engineering data is listed in tables.

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 so 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 rice, cranberries, horticultural crops, or other 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, for engineering, or for other uses.

In the capability system, the kinds of soils are grouped at three levels: the capability class, subclass, and 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 the Mariposa County Area.)

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife. (None in the Mariposa County Area.)

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.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture, range, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main 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 some parts of the United States, but not in the Mariposa Area, 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, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, 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 in classes I through IV in California are given Arabic numbers that suggest the chief kind of limitation responsible for placement of a soil in a given capability class and subclass. For this reason, some of the units within the subclasses are not numbered consecutively, and their symbols are a partial key to some of the soil features. Except for class I the numerals used to designate units within the classes and subclasses are these:

0. A problem or limitation caused by sand and gravel in the substratum that limits root penetration.
1. An actual or potential erosion hazard.
2. A problem or limitation of wetness caused by poor drainage or flooding.
3. A problem or limitation caused by slow or very slow permeability of the subsoil or substratum.
4. A problem or limitation caused by coarse soil texture or excessive gravel.
5. A problem or limitation caused by a fine or very fine textured surface layer.
6. A problem or limitation caused by salt or alkali.
7. A problem or limitation caused by cobblestones, stones, or rocks.
8. A problem or limitation caused by nearly impervious bedrock or by a hardpan within the effective rooting depth.
9. A problem or limitation caused by low fertility or by toxicity.

Soils in classes V through VIII are given the single nonconnotative unit number 1. Specific discussions of the soils in these classes if used for range or woodland are given in those sections.

Land Resource Areas

In the Mariposa County Area, capability classification is further refined by designating the land resource area in which the soils in a capability unit occur. A land resource area is a broad geographic area that has a distinct combination of soils, climate, management needs, and cropping system (7). The 48 conterminous states of the nation have been divided into 156 land resource areas. Parts of two of these areas are in the Mariposa County Area. These areas and their numbers are the Sierra Nevada Foothills (18) and the Sierra Nevada Range (22). The number of the resource area is added to the capability unit designation for complete identification of the capability unit. An example is IIIe-1 (18).

A very brief discussion of the two resource areas in the Mariposa County Area is given in the paragraphs that follow.

Land Resource Area 18.—This area covers most of the survey area. It is an area of foothills along the western foot slopes of the Sierra Nevada and Cascade Ranges. It is characterized by rolling to hilly relief and is dissected by numerous streams flowing into the valley. Elevation ranges from about 300 feet to about 3,300 feet. The climate becomes cooler and wetter with increasing elevation. The average precipitation ranges from 12 to 40 inches, and the frost-free season ranges from 150 to 275 days.

The soils in this resource area are used mainly for range, watershed, and as wildlife habitat. A few small areas are farmed to dryland grain at the lower elevations. Many areas are covered by dense brush.

Land Resource Area 22.—This area covers the rest of the Mariposa County Area. It is characterized by hilly to steep mountains and valleys, and it ranges from 2,000 feet to 5,000 feet in elevation. The climate varies with changes in elevation. The precipitation ranges

from about 30 inches to 50 inches; some of it is snow. The frost-free season is 140 to 200 days.

Enterprises are mostly lumbering and recreation and some livestock grazing. There are a few small apple orchards. The forested areas consist of pines, firs, and oaks.

Management by Capability Units

In the following pages, the capability units of the Mariposa County Area are described and management for the soils in these units is suggested. The mention of a soil series in these descriptions does not mean that all the soils of that series are in the capability unit in which it is mentioned. To determine the soils in each unit, refer to the "Guide to Mapping Units" at the back of this survey.

In the following descriptions of the capability units, available water capacity applies to the effective root zone, which is the depth to which plant roots generally penetrate.

CAPABILITY UNIT IIe-1(18, 22)

Only Loamy alluvial land is in this unit. This is a well-drained to somewhat poorly drained soil on low benches, on alluvial fans, and in small valleys. It ranges from sandy loam to clay loam throughout. This soil is typically more than 60 inches deep. Slopes are 2 to 5 percent. Available water capacity is 5 to 10 inches. Permeability is rapid to moderately slow. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Elevation ranges from 300 to 3,500 feet. Average annual precipitation is 12 to 45 inches, and the frost-free season is 150 to 275 days.

This soil is used for range, pasture, and small orchards. Where water is available, the soil is suited to all locally grown crops.

Grazing should be controlled so that an average of 2 inches of stubble remains at the end of the grazing season. Salt and water should be used to control the amount of grazing. Some areas are suitable for reseeding to grasses and legumes.

If this soil is cultivated, the cropping system should include grasses and legumes to maintain tilth and organic-matter content and to control erosion. A system for collecting excess water should be used. Irrigation systems, where used, should be designed and operated to prevent erosion. Sprinklers are most suitable because of the slope, but other methods may be used if farming is on the contour. This soil responds to nitrogen and phosphorus.

CAPABILITY UNIT IIIe-1(18)

Only Ahwahnee sandy loam, 2 to 9 percent slopes, is in this unit. This is a well-drained soil on uplands. It is sandy loam throughout. Weathered rock is at a depth of 24 to 40 inches. Available water capacity is 3.5 to 6.0 inches. Permeability is moderately rapid. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Elevation ranges from 800 to 2,800 feet. Average annual precipitation is 15 to 30 inches, and the frost-free season is 175 to 230 days.

This soil is used for range, pasture, and orchards, and is suited to most locally grown crops.

Good range management practices are required on this soil. The soil is suited to seeding and fertilizing to im-

prove forage production and quality. If this soil is in pasture, needed conservation practices are water management, rotation grazing, weed control, and fertilization.

If this soil is cultivated, a needed conservation cropping system includes contour farming, crop residue, cover and green-manure crops, and minimum tillage. The soil responds to applications of nitrogen and phosphorus.

CAPABILITY UNIT IIIe-1(22)

In this unit are soils of the Boomer, Josephine, Musick, and Stump Springs series. These are well-drained soils on uplands. The surface layer is loam, sandy loam, or gravelly loam, and the subsoil is sandy clay loam, clay loam, or cobbly clay loam. Bedrock generally is at a depth of 40 inches to more than 60 inches, but it is at 24 to 40 inches in some areas. Slopes are 2 to 15 percent. Available water capacity is 4 to 11 inches. Permeability generally is moderate to moderately slow, but the Stump Spring soils, mapped in complexes with Musick soils, have slow permeability. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Elevation ranges from 2,500 to 5,000 feet. Average annual precipitation is 30 to 50 inches, and the frost-free season is 140 to 200 days.

These soils are used as woodland, for limited grazing, and for small local orchards. They are suited to all locally grown crops.

Needed woodland conservation practices are pruning, thinning, harvesting, tree planting, controlling brush if necessary, and constructing firebreaks. These soils should be reseeded to grass immediately after fire to control erosion and then replanted to trees. Nitrogen and phosphorus promote fast growth of grass. Trees also benefit from fertilizer carryover.

Permanent or temporary cover should be maintained in orchards to control erosion. Tillage should be across the slope or on the contour. If a seasonal cover crop is used, it should be returned to the soil to improve organic-matter content, fertility, tilth, and infiltration rates and to reduce runoff.

CAPABILITY UNIT IIIe-3(18)

In this unit are soils of the Trabuco series and Clayey alluvial land. These are well-drained and moderately well drained soils on alluvial fans, in valleys, or on uplands. They are clay loam to clay throughout. Bedrock or an unrelated hardpan is at a depth of 24 inches to more than 60 inches. Slopes are 2 to 15 percent. Available water capacity is 4 to 10 inches. Permeability is slow or very slow in the subsoil. Runoff is slow to rapid, and the hazard of erosion is slight to moderate. Elevation ranges from 350 to 3,300 feet. Average annual precipitation is 15 to 30 inches, and the frost-free season is 150 to 250 days.

These soils are used for annual range and pasture and some dryland grain. They are suited to all shallow-rooted crops grown in the area.

Grazing should be managed so that about 2 inches of stubble remains at the end of the grazing season. Salt, water, and fencing should be used to control grazing.

If these soils are cultivated, needed management practices include leaving crop residue and stubble at or near

the surface to help control erosion and to improve soil structure. Cultivation should be across the slope. Under dryland conditions a cropping system that includes fallow, grain, and 2 or 3 years of annuals is better suited to these soils than other systems. Native vegetation should be left in waterways. These soils respond to nitrogen and phosphorus.

CAPABILITY UNIT IIIe-3(18)

In this unit are soils of the Blasingame and Las Posas series. These are somewhat excessively drained and well-drained soils on uplands. The surface layer is loam, and the subsoil is clay loam and clay. Hard bedrock is at a depth of 24 to 40 inches. Slopes are 2 to 15 percent. Available water capacity is 4.0 to 7.5 inches. Permeability is moderately slow in the subsoil. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Elevation ranges from 800 to 3,000 feet. Average annual precipitation is 15 to 24 inches, and the frost-free season is 150 to 225 days.

These soils are used mostly for range and pasture. They are suited to dryland hay and grain. If irrigation water is available, they are suited to all but the deeper-rooted orchard trees grown in the area.

Grazing should be managed so that stubble an average of 2 inches in height remains at the end of the growing season. Salt and water should be used to control grazing. Selected sites are suitable for reseeding to grasses and legumes. Brush and weed control should be done.

If these soils are used for orchards, cover and green-manure crops should be grown and minimum tillage should be used. All tillage should be on the contour. If these soils are irrigated, sprinklers should be used and water should be carefully managed to reduce erosion. These soils respond to nitrogen and phosphorus.

CAPABILITY UNIT IVe-1(18)

In this unit are soils of the Ahwahnee and Auberry series. These are well-drained soils on uplands. The surface layer is sandy loam, and the subsoil is sandy loam or sandy clay loam. Weathered bedrock is at a depth of 24 to 40 inches. Slopes are 2 to 15 percent. Available water capacity is 3.5 to 7.0 inches. Permeability is moderately rapid to moderate. Runoff is very slow to medium, and the hazard of erosion is slight to moderate. Elevation ranges from 800 to 2,800 feet. Average annual precipitation is 15 to 35 inches, and the frost-free season is 150 to 230 days. Rock outcrop typically covers less than 2 percent of the surface area, but in some areas it covers 2 to 10 percent of the surface area.

These soils are used mainly for annual pasture and range. A few areas are used for small orchards. If management is intensive, these soils can be used for dryland grain.

Grazing should be managed so that an average of 2 inches of stubble remains at the end of the growing season. Salt, water, and fencing should be used to control grazing. The soils are suitable for reseeding to grasses and legumes. Fertilizer improves the forage production and quality. Brush and weed control should be used.

If these soils are used for orchards, cover and green-manure crops should be grown and minimum tillage should be used. All tillage should be on the contour. If these soils are irrigated, sprinklers should be used and water should be carefully managed to reduce erosion. These soils respond to nitrogen and phosphorus.

CAPABILITY UNIT IVe-1(22)

In this unit are soils of the Josephine, Musick, and Stump Springs series. These are well-drained soils on uplands. The surface layer is sandy loam, loam, or gravelly loam, and the subsoil is clay loam or sandy clay loam. Bedrock is at a depth of 24 inches to more than 60 inches. Slopes are 9 to 30 percent. Available water capacity is 4 to 11 inches. Permeability is generally moderately slow, but it is slow in the Stump Springs soils. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Elevation ranges from 2,500 to 5,000 feet. Average annual precipitation is 30 to 50 inches, and the frost-free season is 140 to 200 days. In some areas rock outcrops cover less than 2 percent of the surface area, but in other areas rock outcrop covers 2 to 10 percent of the surface area.

These soils are used as woodland and for watershed, wildlife habitat, and orchards. They are suited to these uses. They have some grazing value.

Needed woodland conservation practices are pruning, thinning, harvesting, tree planting, fire protection, and the like. If used as watershed, these soils should be protected from fire and reseeded immediately after a fire. If these soils are cleared and used for orchards, cover crops should be grown.

Minimum tillage should be practiced, and all operations should be on the contour. Grassed waterways should be maintained. If these soils are irrigated, sprinklers should be used and water should be carefully managed to prevent erosion. These soils respond favorably to nitrogen and phosphorus.

CAPABILITY UNIT IVe-3(18)

In this unit are soils of the Hillgate, Positas, and Trabuco series. These are well-drained soils. Hillgate and Positas soils are on terraces, and Trabuco soils are on uplands. The surface layer is very fine sandy loam, clay loam, or gravelly clay loam, and the subsoil is clay. The soils on terraces are 10 to 24 inches deep to the clay subsoil, which restricts many plant roots. The soils on uplands are 24 to 40 inches deep to bedrock. The soils on terraces have slopes of 2 to 15 percent, and the soils on uplands have slopes of 15 to 30 percent. Available water capacity is 1.5 to 4.0 inches in the soils on terraces and 4 to 7 inches in the soils on uplands. Permeability is very slow or slow. Runoff is slow to rapid, and the hazard of erosion is slight to high, depending upon slope. Elevation ranges from 400 to 3,300 feet. Average annual precipitation is 12 to 30 inches, and the frost-free season is 150 to 275 days.

These soils are used for pasture and range. They are marginally suited to dryland hay or grain. Because of the slowly or very slowly permeable clay subsoil, deep-rooted crops or trees are not well suited to these soils.

Grazing should be managed so that 2 inches of stubble remains at the end of the grazing season. Salt, water,

fencing, and deferred grazing should be used to control grazing. These soils should be protected from fire and reseeded immediately after a fire. They respond to seeding of annual grasses and legumes.

The soils should not be cultivated more than 1 year out of 3. All tillage should be on the contour to reduce erosion. Crop residue should be returned to the soil, leaving a coarse stubble to help slow runoff water and to improve soil structure and fertility. These soils respond favorably to nitrogen and phosphorus.

CAPABILITY UNIT IVe-8(18)

In this unit are soils of the Auburn, Blasingame, Coarsegold, Daulton, Las Posas, Redding, San Andreas, and San Joaquin series. These are well-drained or somewhat excessively drained soils on uplands or terraces. The surface layer is fine sandy loam to loam and is gravelly in places, and the subsoil is very fine sandy loam to clay. Bedrock or a hardpan is at a depth of 10 inches to more than 60 inches. Slopes are 2 to 30 percent. Available water capacity ranges from 1.5 to 9.0 inches but generally is more than 2 inches. Permeability is moderate to very slow. Runoff is slow to rapid, and the hazard of erosion is slight to high. Elevation ranges from 300 to 3,000 feet. Average annual precipitation is 12 to 35 inches, and the frost-free season is 150 to 275 days. Rock outcrop covers 2 to 10 percent of the surface area in a few places.

These soils are used for annual range and watershed. They are suited to pasture and limited grain and hay production.

Grazing should be managed so that 2 inches of stubble is left at the end of the grazing season. Salt and water should be used to control grazing. Fencing is needed in places. Brush control should be used. The soils are suitable for reseeding to grasses and legumes. Burned areas should be reseeded as soon as possible. Firebreaks should be used to protect these soils from fire.

If these soils are used for hay or grain, all cultivation should be on the contour. Crop residue should be returned to the soil, and a stubble mulch and a cloddy or rough surface should be left to help slow runoff and reduce erosion. Using crop residue also helps to improve fertility and the structure of the surface layer.

CAPABILITY UNIT VIe-1(18)

In this unit are soils of the Ahwahnee, Auberry, Auburn, Blasingame, Coarsegold, Daulton, Las Posas, and San Andreas series. These are well-drained or somewhat excessively drained soils on uplands. The surface layer is sandy loam or loam, and the subsoil is sandy loam to clay. Bedrock is at a depth of 10 to 60 inches. Slopes are 9 to 50 percent. Available water capacity is 1.5 to 9.0 inches. Permeability is moderately rapid to moderately slow. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Elevation ranges from 300 to 3,000 feet. Average annual precipitation is 12 to 35 inches, and the frost-free season is 150 to 275 days.

These soils are better suited to annual range, watershed, and wildlife habitat than to most other uses. They are used for these purposes.

Grazing should be managed so that about 2 inches of stubble remains at the end of the grazing season. Forage production is high in years of adequate and favorably

spaced rainfall if management is good. Some areas are suitable for reseeding to grasses and legumes. Nitrogen and phosphorus increase forage production and extend the green-feed season. These soils should be protected from fire and reseeded after any fire.

CAPABILITY UNIT VIe-1(22)

In this unit are soils of the Boomer, Josephine, Musick, and Stump Springs series. These are well-drained soils that formed on uplands. The surface layer is sandy loam or loam and is gravelly or cobbly in places. The subsoil is sandy clay loam, clay loam, or cobbly clay loam. Bedrock is at a depth of more than 60 inches. Slopes are 15 to 50 percent. Available water capacity is 4 to 11 inches. Permeability is moderate to slow. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Elevation ranges from 2,500 to 5,000 feet. Average annual precipitation is 30 to 50 inches, and the frost-free season is 140 to 200 days. Rock outcrop covers from 0 to 2 percent of the surface area.

These soils are used as woodland and for watershed and some limited grazing.

If these soils are used as woodland, needed conservation practices are thinning, pruning, harvesting, tree planting, and fire protection. If they are used for grazing, adequate residue should be left to control erosion.

CAPABILITY UNIT VIe-1(18)

In this unit are soils of the Auberry, Auburn, Coarsegold, Las Posas, San Andreas, and Trabuco series. These are well-drained soils on uplands. The surface layer is sandy loam to clay loam, and the subsoil is very fine sandy loam to clay. Bedrock is at a depth of 10 to 60 inches. Slopes are 9 to 50 percent. Available water capacity is 1.5 to 9.0 inches. Permeability is moderate to slow. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Elevation ranges from 300 to 3,000 feet. Average annual precipitation is 14 to 35 inches, and the frost-free season is 150 to 275 days. Rock outcrop covers 2 to 25 percent of the surface area.

These soils are used for annual range.

Grazing should be managed so that 2 inches of stubble remains at the end of the grazing season. Salt, water, and fencing should be used to control grazing. Brush control should be used. These soils are suitable for reseeding to grasses and legumes, but the use of ground equipment is limited by the rock outcrops. These soils should be protected from fire and reseeded immediately after fire.

CAPABILITY UNIT VIe-1(22)

Only Josephine very rocky loam, 15 to 50 percent slopes, eroded, is in this unit. This is a well-drained soil. The surface layer is gravelly loam, and the subsoil is clay loam. Bedrock is at a depth of 24 to 40 inches. Available water capacity is 4 to 7 inches. Permeability is moderate. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Elevation ranges from 2,500 to 3,000 feet. Average annual precipitation is 30 to 50 inches, and the frost-free season is 140 to 200 days. Rock outcrop covers 10 to 25 percent of the surface area.

This soil is used as woodland and for watershed and wildlife habitat. It has some grazing value.

Needed woodland conservation practices are pruning, thinning, harvesting, and tree planting. This soil should be protected from fire and reseeded to grasses after fire to prevent erosion. It should then be replanted to trees. The use of ground equipment is limited by the rock outcrops.

CAPABILITY UNIT VIIe-1(18)

In this unit are soils of the Auburn and Maymen series. They are well-drained soils on uplands. The surface layer is stony loam or gravelly silt loam, and the subsoil is heavy loam to gravelly silty clay loam. Bedrock is at a depth of 8 to 20 inches. Slopes are 15 to 50 percent. The available water capacity is 0.5 to 2.5 inches. Permeability is moderate. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Elevation ranges from 300 to 3,000 feet. Average annual precipitation is 14 to 40 inches, and the frost-free season is 150 to 275 days. Rock outcrop covers 2 to 10 percent of the surface area in some places, and stones cover 1 to 3 percent of the surface area in other places.

These soils are used for annual range.

Grazing should be managed so that 2 inches of stubble remains at the end of the grazing season. Salt, water, and fencing should be used to control grazing. Brush control should be used. These soils should be protected from fire and reseeded after fire to reduce erosion.

CAPABILITY UNIT VIIe-1(22)

In this unit are soils of the Boomer, Josephine, and Mariposa series. These are well-drained soils that formed on uplands. The surface layer is cobbly loam, gravelly loam, or gravelly silt loam. The subsoil is cobbly clay loam, clay loam, or gravelly silty clay loam. Bedrock is at a depth of 12 to 60 inches or more. Slopes are 15 to 75 percent. Available water capacity is 1.5 to 9.0 inches. Permeability is moderate. Runoff is medium to very rapid, and the hazard of erosion is moderate to very high. Elevation ranges from 2,500 to 3,500 feet. Average annual precipitation is 30 to 50 inches, and the frost-free season is 140 to 200 days. Rock outcrop covers as much as 2 to 10 percent of the surface area in some places.

These soils are used as woodland and for watershed and wildlife habitat.

Needed conservation practices are protection from fire, pests, disease, overgrazing, and erosion.

CAPABILITY UNIT VIIs-1(18)

In this unit are soils of the Ahwahnee, Auberry, Auburn, Blasingame, Daulton, Henneke, Hornitos, Las Posas, Maymen, and Whiterock series. These are well-drained to excessively drained soils on uplands. The surface layer is sandy loam to clay loam and is gravelly or very gravelly in places. The subsoil is sandy loam to clay and is also gravelly or very gravelly in places. Bedrock is at a depth of 5 to 40 inches. Slopes are 2 to 75 percent. Available water capacity ranges from 0.5 inch to 7.5 inches. Permeability is moderately rapid to slow. Elevation ranges from 300 to 3,000 feet. The hazard of erosion is high. Average annual precipitation is 12 to 40 inches, and the average frost-free season is 150 to 275 days. Rock outcrop, cobbles, and stones cover 2 to 50 percent of the surface area.

These soils are used for limited range, watershed, and wildlife habitat. They should be carefully managed to control erosion.

Grazing should be managed so that 3 inches of stubble remains at the end of the grazing season. Uniform grazing is difficult to obtain on the very steep soils. Salt and water should be used to control grazing. During years of extremely adverse weather conditions, it is necessary to exclude grazing from the steeper soils in places. These soils should be protected from fire and reseeded immediately after any fire to reduce erosion.

CAPABILITY UNIT VIIIs-1(18, 22)

In this unit are soils of the Auburn and Maymen series and Rock land. These are well-drained to excessively drained soils. They are loam or gravelly loam. Depth to bedrock ranges from 8 to 20 inches. Slopes are 30 percent to more than 75 percent. Available water capacity is 0.5 to 2.0 inches. Permeability is mostly moderate. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. The soils in this unit are severely eroded or have slopes of more than 75 percent. Rock outcrops cover 2 to 10 percent of the surface area in places. Rock land has very little soil material. Rock outcrop covers 50 percent or more of the surface area. Elevation ranges from 300 to 3,500 feet. Average annual precipitation is 14 to 45 inches, and the frost-free season is 150 to 275 days.

These soils and this land type are used mainly for watershed, wildlife habitat, and recreational purposes.

These soils need to be protected from fire. If left barren they produce silt and other debris to be deposited on lower lying areas or in streams and reservoirs.

CAPABILITY UNIT VIIIw-1(18, 22)

Only Riverwash and Tailings is in this unit. This is an excessively drained land type. The soil material is a mixture of cobbles, gravel, sand, and clay or silt in some areas. It is in piles of tailings left over from the gold mining days. Permeability, available water capacity, and rooting depth are all highly variable. Elevation ranges from 310 to 3,500 feet. Average annual precipitation is 14 to 45 inches.

This land type is used as a source of sand and gravel for construction purposes, as wildlife habitat, for recreational purposes, and as watershed. The sparse cover on this land type needs to be protected for wildlife habitat and for recreational uses.

Estimated Yields

This section gives estimated yields of the principal crops grown in the Area and some of the management practices used to obtain those yields. Yields listed in table 2 are for irrigated pasture and apples and for dryland hay. These estimates are based on observations made by the soil scientists who surveyed the Area, on information furnished by farmers and ranchers, and on data from the Agricultural Extension Service, the Soil Conservation Service, the University of California Agricultural Experiment Station, and the Mariposa County Agricultural Commissioner. For crops on some soils, detailed information was available. If little or no information was available about the yield on a par-

ticular kind of soil, estimates were made by comparing that soil with similar soils. Only soils used for crops are listed in table 2.

The yields in table 2 are averages, and in any one year actual yields may be higher or lower than those listed. Also, the yield estimates do not apply to individual parcels of a soil; and in the Mariposa County Area the weather, especially annual rainfall for dry-land crops, has a great effect on yields.

Yield estimates are of greatest use when the management practices under which the yields can be produced are specified. The yields given in table 2 can be obtained by using the best known management practices that give the highest returns, as indicated by experience, field trials, and research findings. This information on yields and management practices is most useful immediately after the release of this survey. New developments in crop breeding, in control of insects and diseases, and in the use of fertilizers, tillage, and irrigation may replace much of the information in this section. The latest information can be obtained from county, State, and Federal agricultural agencies or publications.

In the following paragraphs are given some of the management practices assumed when the yields specified in table 2 were estimated.

Irrigated pasture.—About 30 to 40 acre-inches of water per growing season is used to produce 1 acre of good pasture. Where water is available for irrigation, whether diverted from streams or from storage reservoirs, long-term stands of irrigated pasture plants have been established.

Grazing generally begins in spring when plants are 8 to 10 inches high and the ground is firm. Best results are obtained when the pasture area is divided into two to four separate fields that are grazed alternately. A minimum of 30 pounds per acre of phosphorus is applied per year, and 120 to 150 pounds per acre of nitrogen is divided into three or four applications during the growing season. The phosphorus and one-quarter of the nitrogen generally are applied early in spring. After the first grazing, another application of nitrogen is made, followed by the first irrigation of the season. Additional applications of nitrogen are made during the season just prior to an irrigation.

After removing livestock and before irrigation, pasture plants are clipped to control rank growth and manure droppings are spike-harrowed to break them up. At least a 21-day regrowth period is desirable.

Grasses and legumes of high quality can be maintained only by adjusting the stocking rates or season of use to favor maximum growth. At the beginning of the growing season, it may be necessary to cut one or two pastures for hay to be fed during the nonproductive winter months.

Orchards.—Most orchard soils are in small acreages and are of the family type. Just a few acreages are used for commercial production. Native annual grass is allowed to grow for soil protection. Some disking is done around the trees prior to harvest. Minimum tillage is a common practice.

Annual hay.—Bumper crops of annual forage are often cut and made into hay for use during lean years. The annual grasses are cut from the less sloping soils

TABLE 2.—*Estimated average yields per acre of principal crops*

[No estimates are given for soils on which a particular crop is not grown or for soils to which a crop is not suited. Only soils commonly cropped in the area are listed]

Soil	Irrigated		Dryland
	Pasture	Apples	Hay
	A. U. M. ¹	Tons	Tons
Ahwahnee sandy loam, 2 to 9 percent slopes	14		2.0
Ahwahnee sandy loam, 9 to 15 percent slopes	14		
Auberry sandy loam, 9 to 15 percent slopes	14	8	2.0
Auberry rocky sandy loam, 2 to 15 percent slopes	14	7	1.5
Auburn loam, 2 to 15 percent slopes	8		
Blasingame loam, 2 to 15 percent slopes	14		2.0
Blasingame loam, 15 to 30 percent slopes	14		
Blasingame rocky loam, 2 to 15 percent slopes	13		
Blasingame-Las Posas loams, 2 to 15 percent slopes	14		
Blasingame-Las Posas loams, 15 to 30 percent slopes	14		
Blasingame-Las Posas rocky loams, 2 to 15 percent slopes	13		
Boomer loam, 2 to 15 percent slopes	10		2.0
Clayey alluvial land	14		2.0
Daulton loam, 2 to 15 percent slopes	8		
Hillgate very fine sandy loam, 2 to 9 percent slopes	12		1.5
Josephine loam, 2 to 15 percent slopes, eroded	10	20	2.0
Josephine loam, 15 to 30 percent slopes, eroded	10	20	
Josephine gravelly loam, 2 to 15 percent slopes, eroded	10		2.0
Josephine gravelly loam, 15 to 30 percent slopes, eroded	10		
Loamy alluvial land	16	8	2.0
Musick loam, 9 to 15 percent slopes, eroded	10	12	2.0
Musick loam, 15 to 30 percent slopes, eroded	10	12	
Musick rocky sandy loam, 9 to 15 percent slopes, eroded	10	12	
Positas gravelly clay loam, 2 to 15 percent slopes	12		
Redding gravelly loam, 2 to 15 percent slopes	16		
San Andreas-Coarsegold complex, 2 to 15 percent slopes		8	
San Andreas-Coarsegold complex, 15 to 30 percent slopes		8	
San Joaquin loam, 2 to 9 percent slopes	16		2.0
Stump Springs-Musick sandy loams, 5 to 15 percent slopes, eroded	10	8	2.0
Stump Springs-Musick rocky sandy loams, 9 to 15 percent slopes, eroded	10	12	
Trabuco clay loam, 2 to 15 percent slopes, eroded	11		1.5
Trabuco clay loam, 15 to 30 percent slopes, eroded	11		

¹An A. U. M. (animal-unit-month) is the amount of forage produced by the pasture required to support one animal unit (1,000 pounds live weight) for 1 month without damage to the pasture.

in the soft dough stage. The cuttings are windrowed and usually stacked loose, but sometimes they are baled. Improved dryland pasture grasses and legumes make excellent hay. When haying the improved seed varieties, cut areas are alternated so as not to cut the same area each year. This assures a good seed source and perpetuates the desired plants.

Range ²

About 70 percent of the Mariposa County Area is used for range. The Daulton and Auburn series are the most extensive soils used for range. The soils used for range are mainly in the western two-thirds of the Area, but they extend eastward to areas where elevation is about 3,000 feet. Areas from about 350 to 1,000 feet are open grassland marked by scattered oaks. Above 1,000 feet a gradual transition occurs from open grassland to oak forest.

Generally, the soils used for range are too steep, too shallow, or too rocky for cultivated crops. Large acreages once used for the production of hay and grain are now used for grazing. Also, areas along stream channels and meadows and on shallow, stony ridgetops in timbered areas have value for grazing. Some timbered areas have been cleared of trees and are used to provide forage.

Most of the important range forage plants in the survey area are introduced. The original forage plants were a mixture of perennials and annuals, but the introduced plants are mainly cool-weather annuals. These annuals, taking full advantage of the soil moisture while it is there, produce seed and mature by the time the moisture is gone. They furnish highly nutritious feed in spring when they are green and growing. After maturity, however, their nutritional value is low.

The forage-producing plants of the Area are grouped into three classes: desirable, less desirable, and undesirable. Livestock graze selectively. They seek out the more palatable and nutritious plants. If grazing is not carefully regulated, the better, more desirable plants are weakened or eliminated because they are not allowed to produce seed. Then less desirable plants increase. If grazing pressure is continued, even the second-choice plants are thinned out or eliminated, and undesirable, unpalatable plants take their place or the soil is left bare.

Experiences of ranchers and studies by research workers show that if only part of the current yearly growth of grass is grazed, damage to the more desirable plants is minimized and higher production is attained. This plant material left at the end of the grazing season—

1. Serves as a mulch that encourages rapid intake and storage of water. The more water stored in the soil, the better forage grows.
2. Protects the soil from wind and water erosion.
3. Reduces year-to-year fluctuation in forage production, because vigorous plants make more efficient use of soil moisture.
4. Holds moisture near the surface after the first rains in fall so that seeds can germinate at an earlier time.

5. Provides a reserve of feed for years when growing conditions are unfavorable.

Among other range improvement practices that can materially increase production are removing trees and brush and fertilizing and seeding adapted grasses and legumes, or a combination of these practices. Sound forage management requires that grazing be adjusted from season to season according to the amount of forage produced. Because of the growth habits of annual forage plants, proper use of all the forage when it is most nutritious is very difficult. If forage is used as dry feed in summer or held for early feed in fall, the livestock will need protein supplements. Maintaining adequate reserves of feed and forage permits proper use of vegetation.

Because of variable rainfall and temperature patterns, forage production in the Area varies greatly. The condition of the range, a reflection of past management, considerably influences production. Estimates of total potential annual production are given for each range site for favorable and unfavorable years. Stocking rates and carrying capacities should not be computed from the estimated total annual production of forage. As the operator becomes familiar with seasonal grazing readiness and production of his range by range sites, his judgment will determine the current grazing management plan. Local Soil Conservation Service technicians or farm advisors can assist in determining initial stocking rates, which should be made only after onsite inspection.

Range sites

Range sites are groups of soils that produce significantly different kinds or amounts of vegetation. Each site has a different potential for production of forage and presents different management concerns. The rangelands in the Mariposa County Area have been grouped into seven range sites. The following range site descriptions include a brief description of the acreage and general location of the site; a brief description of the most extensive soils, as a group, that make up the site; a listing of the important desirable, less desirable, and undesirable forage plants; and a statement giving the estimated production potential of each site. Total annual production is on an air-dry basis for each site, based on a limited number of clippings and estimates. Extremes in weather conditions can cause even greater fluctuations in production. These data are for unfertilized range. They are not to be interpreted as usable forage.

1. SHALLOW LOAMY

This site is in the western one-third of the survey area, parallel to the Merced County line. Elevation ranges from 300 feet to more than 2,000 feet. The average annual precipitation ranges from 12 to 40 inches. Slopes generally range from 9 to 30 percent. About one-third of the total area has slopes of more than 30 percent. In these steeper areas, the hazard of erosion is greater and potential production is lower. This site occupies about 170,000 acres.

The soils in this range site are loams and stony loams that are 8 to 20 inches deep to bedrock. They are somewhat excessively drained and well drained. Available water capacity is 0.5 to 3.5 inches. Permeability of the

² By ROCHE D. BUSH, State resource conservationist, Soil Conservation Service.

subsoil is moderately slow to moderate. Runoff is slow to very rapid. The hazard of erosion is slight to very high. The content of organic matter is moderate. Rock outcrops cover 0 to 25 percent of the surface area but do not appreciably impede livestock movement nor lower forage production.

In the western part of the survey area, this site typically is covered by grass. Eastward, precipitation and elevation increase and the plant cover gradually changes to grass-oak and some brush and digger pine. At higher elevations are areas of dense stands of oak and brush.

If this site is producing at maximum, approximately 70 percent of the herbage is a mixture of soft chess, wild oats, burclover, filaree, and other desirable plants, including remnant perennial grasses in the open or under the trees. Approximately 20 percent of the vegetation is ripgut brome, annual fescue, annual lupine, and other less desirable plants. The rest consists of nit-grass, silver hairgrass, tarweed, popcornflower, turkey-mullein, or other undesirable plants.

The soils in units AhD, AhE2, AnE, DaD, and DaE in this site are well suited to seeding to adapted annual grasses and legumes. In selected areas, forage plants respond well to the application of nitrogen, phosphorus, and sulfur. Repeated applications of phosphorus are needed to maintain good stands of legumes. Removal of trees and brush, where needed, increases production on this site (fig. 7).

The estimated total potential annual production of air-dry herbage on this site in the 12- to 16-inch precipitation zone, is 3,000 pounds per acre in favorable years and 1,000 pounds per acre in unfavorable years. In the 16- to 40-inch precipitation zone, production is 3,600 pounds per acre in favorable years and 1,300 pounds per acre in unfavorable years. About 80 percent of this production can be used by cattle and sheep.

2. LOAMY

This site is in a belt that runs from southeast to northwest from the Madera to Tuolumne County lines. It is mainly in the Cathey Valley area. Elevation ranges from 300 to 3,300 feet. The average annual precipitation ranges from 15 to 30 inches. Slopes range from 2 to 75 percent. About 5 percent of this site is severely eroded or extremely rocky (fig. 8). This site occupies about 97,000 acres.

The soils in this range site are loams, stony loams, fine sandy loams, very fine sandy loams, and clay loams that are 24 inches to more than 60 inches deep to bed-rock. The subsoil has more clay than the surface layer in places. These soils are somewhat excessively drained to well drained. The available water capacity is 3 to 9 inches. Permeability is moderate to slow. The content of organic matter is moderate. Runoff is slow to very rapid, and the hazard of erosion is slight to very high. Rock outcrop and stones typically cover from 0 to 25



Figure 7.—Auburn loam, 15 to 30 percent slopes, eroded, in Shallow Loamy range site. Brush and smaller trees being cleared.

percent of the surface area, but they cover as much as 50 percent in some areas.

This site typically has a cover of grass-oak. There is some brush and digger pine. Some areas have a dense stand of brush.

If the site is producing at maximum, approximately 70 percent of the herbage is a mixture of soft chess, wild oats, burclover, filaree, and other desirable plants, including remnant perennial grasses in the open or under the trees. Approximately 20 percent is riggut brome, annual fescue, annual lupine, and other less desirable plants. The rest consists of nitgrass, silver hairgrass, tarweed, popcornflower, turkeymullein, or other undesirable plants.

The soils in this site, except those in units BfG, BmG2, and LcF, are suited to seeding to Hardinggrass if an adequate seedbed can be prepared. They are also well suited to seeding to adapted annual grasses and legumes. Forage plants respond well to applications of nitrogen, phosphorus, and sulfur. Repeated applications of phosphorus are needed to maintain good stands of legumes on the soils in this site. Removal of trees and brush increases production on applicable soils of this site.

The estimated total potential annual production of air-dry herbage on this site, in the 15- to 20-inch precipitation zone, is 3,800 pounds per acre in favorable

years and 1,400 pounds per acre in unfavorable years. In the 20- to 30-inch precipitation zone, production increases to 4,400 pounds per acre in favorable years and 1,600 pounds per acre in unfavorable years. About 80 percent of this production can be used by cattle and sheep.

3. GRANITIC

This site is in a block in the southeast quarter of the survey area adjacent to the Madera County line. Elevation ranges from 800 to 2,800 feet. The average annual precipitation ranges from 15 to 35 inches. Slopes range from 2 to 50 percent (fig. 9). About 20 percent of the area in this site has slopes of more than 50 percent. This site occupies about 57,000 acres.

The soils in this range site are sandy loams. Depth to granitic bedrock is about 24 to 40 inches. These soils are well drained. Available water capacity is 3.5 to 7.0 inches. Permeability is moderate to moderately rapid. The content of organic matter is moderate to low. Rock outcrops cover 2 to 25 percent of the surface area, but they do not appreciably impede livestock movement or detract from forage production.

This site typically has a cover of open grass and grass-oak. The oak and brush species generally increase as rainfall and elevation increase.

If this site is producing at maximum, about 70 per-



Figure 8.—Brush clearing and range improvement on Blasingame loam, 2 to 15 percent slopes, in Loamy range site.

cent of the herbage is a mixture of soft chess, wild oats, filaree, and other desirable plants, including remnant perennials. Very little burclover is present on this site, but other annual clovers thrive during favorable years. Approximately 20 percent of the vegetation is ripgut brome, annual fescue, mouse barley, annual lupines, annual forbs, and other less desirable plants. The rest is fiddleneck, tarweed, dogtail, nitgrass, turkeymullein, and other undesirable plants.

All soils in this site, except those in units AdG and AgG2, are suited to seeding to adapted annual grasses and legumes. Forage plants respond well to applications of nitrogen, phosphorus, and sulfur. Repeated applications of phosphorus are necessary to maintain good stands of introduced legumes on these soils. Legumes also respond to applications of sulfur. Removal of trees and brush increases forage production on most soils in this site.

The estimated total potential annual production of air-dry herbage on this site, in the 15- to 20-inch precipitation zone, is 2,600 pounds per acre in favorable years and 1,000 pounds per acre in unfavorable years. In areas that receive more than 20 inches of precipitation annually, production increases to 3,200 pounds per acre in favorable years and 1,300 pounds per acre in unfavorable years. About 80 percent of this production can be used by cattle and sheep.

4. VERY SHALLOW LOAMY

This site is in scattered, small areas along the Merced County line and in a block just west of State Route No. 49 in Bear Valley. Elevation ranges from 350 feet to 2,500 feet. The average annual precipitation ranges from

12 to 25 inches. Slopes range from 2 to 50 percent. This site occupies about 9,900 acres.

The soils in this range site are stony sandy loams or loams that are generally 5 to 12 inches deep to slate, schist, or weathered sandstone. They are as much as 20 inches deep in places. They are somewhat excessively drained or excessively drained. Available water capacity is 0.5 to 2 inches. The vegetation on these soils dries up early in spring or during extended periods of drought in winter. Runoff is slow to rapid, and the hazard of erosion is slight to high. The content of organic matter is very low. Rock outcrop or stones are in a variable pattern.

This site typically has a cover of open grass and some scattered oaks or shrubs. At higher elevations are areas of oak, grass, and digger pine and dense stands of brush.

If this site is producing at maximum, approximately 70 percent of the herbage is soft chess and filaree and other desirable plants. Approximately 20 percent of the vegetation is red brome, mouse barley, lupine, and other less desirable plants. The rest consists of nitgrass, silver hairgrass, owl clover, goldfields, popcornflower, and other undesirable plants.

The soils in this site are not suitable for seeding or fertilizing. Generally it would not be practical to remove brush and attempt to control regrowth.

The estimated total potential annual production of air-dry herbage on this site is 1,400 pounds per acre in favorable years and 500 pounds per acre in unfavorable years. This production is for all precipitation zones, because the available water capacity of the soils is so low that the timing of the rains is far more im-



Figure 9.—Ahwahnee and Auberry sandy loams in Granitic range site. Clearing brush and reseeding where slopes are 2 to 15 percent.

portant than the total amount of rain received. About 70 percent of this production can be used by cattle and sheep.

5. SERPENTINE

This site is in a narrow intermittent belt from Mariposa to the county line north of Coulterville. Elevation ranges from 1,000 to 2,900 feet. The average annual precipitation ranges from 20 to 25 inches. Slopes range from 15 to 75 percent.

Only Henneke extremely rocky clay loam, 15 to 75 percent slopes, is in this site. This soil is 10 to 20 inches deep to ultrabasic serpentine rock. It is somewhat excessively drained. The available water capacity is 1 to 3 inches. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. Permeability is slow. The content of organic matter is low. Rock outcrop covers 25 to 50 percent of the surface area.

This site typically has a cover of brush or brush and grass and some digger pine. Chamise, yerba santa, toyon, and deer brush are the dominant brush species.

If the site is producing at maximum, about 50 percent of the herbage is a mixture of soft chess, filaree, and other desirable plants. It includes remnants of needlegrass, pine bluegrass, and squirreltail. Little or no burclover is present. Approximately 35 percent of the understory cover is red brome, mouse barley, annual lupine, large amounts of annual fescue, and other less desirable plants. The rest consists of owl clover, goldfields, brodiaea, popcornflower, vinegarweed, and other undesirable plants.

Plants on these soils do not respond well to applications of fertilizer. Clearing and seeding are not considered feasible.

The estimated total potential annual production of air-dry herbage on this site is 1,000 pounds per acre in favorable years and 400 pounds per acre in unfavorable years. About 55 percent of this production can be used by livestock.

6. CLAYPAN

This site is in a narrow belt adjacent to or close to the Merced County line. Elevation ranges from 300 to 1,100 feet. The average annual precipitation is 12 to 20 inches. Slopes range from 2 to 15 percent.

The soils in this site are very fine sandy loams, loams, gravelly loams, or gravelly clay loams that are 10 to 30 inches deep to clay or to a hardpan. The soils are well drained. Available water capacity is 1.5 to 4.0 inches. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Permeability is very slow. The content of organic matter is low.

This site typically has a cover of open grass and a few scattered blue oak.

If the site is producing at maximum, about 70 percent of the herbage is a mixture of soft chess, wild oats, filaree, annual clovers, and other desirable plants. A few spots have good stands of burclover. Approximately 20 percent of the vegetation is ripgut brome, annual fescue, annual forbs, and other less desirable plants. The rest consists of fiddleneck, tarweed, nitgrass, turkeymullein, and other undesirable plants.

The soils in this site are suited to seeding to adapted annual grasses and legumes.

The estimated total potential annual production of

air-dry herbage on this site is 2,200 pounds per acre in favorable years and 1,000 pounds per acre in unfavorable years. About 85 percent of this production can be used by livestock.

7. CLAYEY

This site is in the western part of the survey area. Elevation ranges from 350 to 850 feet. The average annual precipitation ranges from 15 to 20 inches. The topography is gently rolling, and slopes range from 2 to 9 percent. This is the least extensive site in the survey area, and it occupies only 2,000 acres.

Only Clayey alluvial land is in this site. It is clay loam or clay that is 24 to 40 inches deep to bedrock, to an unrelated hardpan, or to tuffaceous rock. It is moderately well drained or well drained. Available water capacity ranges from 4 to 10 inches. Permeability is slow to very slow. Runoff at first is slow, and then it becomes rapid because the cracks tend to swell closed when wet.

This site typically has a cover of open grass.

If this site is producing at maximum, approximately 70 percent of the herbage is a mixture of salt chess, oats, filaree, and heavy stands of burclover in good clover years. Approximately 20 percent is ripgut, annual fescue, annual lupine, and other less desirable plants. The rest consists of nitgrass, silver hairgrass, turweed, and turkeymullein or other undesirable plants.

The soils in this site are well suited to seeding to adapted annual grasses and legumes. Forage plants respond well to applications of nitrogen, phosphorus, and sulfur. Repeated applications of phosphorus are needed to maintain good stands of legumes. Brush is not a concern on this site.

The estimated total potential annual production of air-dry herbage on this site is 4,000 pounds per acre in favorable years and 1,500 pounds per acre in unfavorable years. About 85 percent of this production can be used by livestock.

Woodland³

Woodland is one of the important resources of the Mariposa County Area. It supplies raw material for one of the major industries, provides recreation for many people, provides food and cover for many forms of wildlife, protects the watershed, and contributes much to the beauty of the area. About 51,000 acres, a little more than 9 percent of the total acreage, is capable of growing commercial trees in the Area.

Trees grow on most of the soils, but commercial conifers grow mainly on specific soils. The most widespread of the commercial conifers is ponderosa pine. Other conifers of commercial importance are sugar pine, incense-cedar, and Douglas-fir. Digger pine, knob-cone pine, and other conifers also grow in the Area. Black oak and canyon live oak, found throughout the Area, grow on soils suited to commercial conifers, generally in association with them. Among several other species of oak are interior live oak, blue oak, and valley oak. Other hardwoods, such as cottonwoods, willows, alders, bigleaf maple, and Oregon ash, grow along many streams.

³ By R. E. DELLBERG, forester, Soil Conservation Service.

Woodland suitability groups

To assist woodland owners in planning the use of their soils, the soils have been placed in woodland suitability groups. Each group is made up of soils that have similar characteristics, show similar response to management, and are subject to similar hazards if used for wood crops. Soils not in a woodland suitability group are either not suited to trees or are better suited to other uses. If a soil has been placed in a woodland suitability group, its number is indicated in the Guide to Mapping Units at the back of this survey.

Each group is rated for site quality, erosion hazard, limitations to use of equipment, pest and disease hazards, windthrow hazard, and manageability. These are discussed in the paragraphs that follow. Each woodland suitability group is then described, and factors that affect its management are discussed.

Site quality, the measure of productivity of the soil for growing trees, is expressed by a site index. It is measured by determining the height and age of a representative species and relating this to a standard age, such as 50 or 100 years. In this survey, site quality refers only to the site quality for ponderosa pine because, of the species that grow in the Area, only ponderosa pine has adequate published site tables available (4). Studies show that associated conifers on similar soils have about the same relationship in height and age as ponderosa pine. Site index for ponderosa pine is based on the height, in feet, of the average dominant and codominant trees at 100 years of age. The ratings used for site quality in this survey are high, medium, and low. The rating *high* means that the site index is more than 115; the rating *medium* means that it ranges from 75 to 115; and the rating *low* means that it is less than 75.

Average production of wood in board feet per acre per year over a 100-year period for fully stocked, unmanaged stands of trees in soils having a site quality rating of high is 700 board feet or more. International log rule (1/8-inch kerf). Under the same conditions, average yearly production for trees in soils having a site quality rating of medium ranges from 300 to 700 board feet per acre. For soils having a site quality rating of low, production is less than 300 board feet per acre. Proper management increases production, but experimental data that would indicate extent are lacking.

In the Mariposa County Area, effective soil depth is the most important soil factor affecting site quality. The effective depth is the depth to bedrock or to a layer that prevents or restricts root penetration. If a soil horizon is sufficiently impermeable to prevent root penetration or restrict drainage, it also influences effective depth. Generally, moderate amounts of loose rocks or cobblestones in the profile have little effect on tree growth, particularly if the soil is deep. At lower elevations, lack of precipitation reduces growth rates.

The hazard of erosion refers to the potential hazard of erosion on bare soils. The length and steepness of slope and texture and stability of the soil aggregates are considered in rating the hazard of erosion. If soils are kept under a protective cover of forest litter and duff, they generally do not erode. Consequently, the soils are rated according to their susceptibility to ero-

sion if the cover is removed through fire, logging, trampling by animals, or other disturbances. The susceptibility of forest soils to erosion if they are cultivated is not considered in rating the hazard of erosion in this section. The hazard of erosion is rated as slight, moderate, or high.

Equipment limitations refer to the characteristics of the soils that restrict or prevent the use of equipment commonly used in tending and harvesting trees. For example, Boomer loam, 2 to 15 percent slopes, has few equipment limitations, except when it is wet. When this soil is wet, which could be as much as 5 months per year, heavy equipment mires down. Tree-planting machines can be used on this soil, however, at carefully selected times. Steep slopes and large boulders on the surface increase the limitations on the use of equipment; sand or gravel, on the other hand, decreases it. Equipment limitations are rated as slight, moderate, or severe.

The hazards of pest and disease depend on many properties and qualities of the soil. Depth, texture, and inherent fertility are probably the three most important factors. Observations indicate that on shallow, rocky soils, pests and disease make the greatest inroads. The hazard of pests and disease is rated slight, moderate, or severe.

Windthrow hazard generally is not serious in this area, except on shallow soils derived from schist rock material. It is rated slight, moderate, or severe.

Ratings for manageability are based on a summary of all the qualities of a soil relating to the growth and management of forest trees. These qualities include the qualities already listed. Manageability is rated as high, medium, or low.

All soils suitable for commercial timber production have been placed in a woodland suitability group. These groups are described on the following pages.

WOODLAND SUITABILITY GROUP 1

Josephine loam, 2 to 15 percent slopes, eroded, is the only soil in this group. This soil is well drained and has moderate permeability. It is 40 inches to more than 60 inches deep to schist bedrock. The surface layer is loam, and the subsoil is clay loam. The available water capacity is 7 to 11 inches. Elevation ranges from 2,500 to 3,000 feet. Average annual precipitation is 30 to 50 inches.

This soil has high site quality. The hazard of erosion is slight, equipment limitations are moderate, the hazard of pests and diseases is slight, the hazard of windthrow is slight, and suitability for management is high.

The soil in this group is the best soil for trees in the survey area, and it is suited to very intensive management. Seedlings become established fairly easily after logging if seed sources are near. Trees grow rapidly until maturity, and reasonable economic returns can be expected at an early age. Thinning and pruning can be done even after the trees have become fairly large. Logging is fairly easy, but in low or level areas, equipment is likely to bog down in wet weather. At times snow is sufficient to hinder or prevent the use of equipment in places.

Locating and building roads is fairly easy. They need to be gravelled for year-round use. Roads and skid trails should be protected from runoff. Larger roads require bridges, ditches, and culverts. Temporary and minor roads should be outsloped, and grades should slope downward toward the watercourse for a short distance on both sides of draws or creeks. Grades should not exceed 10 percent.

Fire is relatively easy to control, mainly because of easy access, but also because of gentle slopes.

Areas where trees have been removed by fire or other causes can be prepared for planting fairly easily. Planting can be done by machine.

WOODLAND SUITABILITY GROUP 2

The soils in this group are well drained and have moderate to slow permeability. They are 40 inches to more than 60 inches deep to bedrock. The surface layer is sandy loam or loam, and the subsoil is sandy clay loam or clay loam. Slopes are 5 to 50 percent. Available water capacity is 5 to 11 inches. Elevation ranges from 2,000 to 5,000 feet. Average annual precipitation is 30 to 50 inches.

These soils have high site quality. The hazard of

erosion is moderate, the equipment limitations are moderate, the hazard of pests and diseases is slight, the hazard of windthrow is slight, and suitability for management is high.

The soils in this group are suited to intensive management (fig. 10). Seedlings become established easily after logging if a seed source is near. Trees grow rapidly, and reasonable economic returns can be expected at an early age. Thinning and pruning can be done even after the trees have become fairly large. Logging is difficult on the steeper soils. It is impractical in wet weather, except on the gentler slopes.

Locating and building roads is fairly difficult. They need to be gravelled for year-round use. Roads and skid trails should be protected from runoff. Larger roads need bridges, ditches, and culverts. Temporary and minor roads should be outsloped, and grades should slope downward toward the watercourse for a short distance on both sides of creeks and draws. Grades should not exceed 10 percent on Josephine soils and 8 percent on the Stump Springs or Musick soils.

Fire is difficult to control.

Areas where trees have been removed by fire or other causes can be prepared for planting only with difficulty.



Figure 10.—Josephine loam, 15 to 30 percent slopes, eroded, in woodland suitability group 2, after clearing brush.

If planting is to be done by machine, the steeper areas need terracing. Terraces should be outsloped.

WOODLAND SUITABILITY GROUP 3

Musick loam, 15 to 30 percent slopes, eroded, is the only soil in this group. This soil is well drained and has moderately slow permeability. The effective rooting depth is more than 60 inches. The surface layer is loam, and the subsoil is heavy clay loam. The available water capacity is 7.5 to 10 inches. Elevation ranges from 2,000 to 5,000 feet. Average annual precipitation is 35 to 46 inches.

This soil has high site quality. The hazard of erosion is high, equipment limitations are severe, hazard of pests and diseases is slight, hazard of windthrow is slight, and suitability for management is medium.

The soil in this group is an excellent soil for trees, but it is suited to only moderately intensive management because of steepness. Seedlings become established fairly easily after logging if seed sources are near. Trees grow rapidly, and reasonable economic returns can be expected at an early age. Thinning and pruning can be done even after the trees have become fairly large. Logging is difficult on these soils.

Locating and building roads is difficult. They need to be gravelled for year-round use. Roads and skid trails should be protected from runoff. Larger roads require bridges, ditches, and culverts. Temporary or minor roads should be outsloped, and grades should slope downward toward the watercourse for a short distance on both sides of creeks or draws. Grades should not exceed 8 percent.

Fire is difficult to control because of slopes.

Areas where trees have been removed by fire or other causes can be prepared for planting only with difficulty. If planting is to be done by machine, terracing is necessary. Terraces should be outsloped.

WOODLAND SUITABILITY GROUP 4

The soils in this group are well drained and have moderate permeability. They are 24 to 60 inches deep to bedrock. The surface layer is loam or gravelly loam, and the subsoil is clay loam or cobbly clay loam. Slopes are 2 to 15 percent. The available water capacity is 4 to 10 inches. Elevation ranges from 2,500 to 3,500 feet. Average annual precipitation is 30 to 50 inches.

These soils have medium site quality. The hazard of erosion is slight, the equipment limitations are moderate, the hazard of pests and diseases is slight to moderate, the hazard of windthrow is slight to moderate, and suitability for management is medium.

The soils in this group are suited to moderately intensive management. Tree growth rates are moderate. Thinning should be done only at an early age, and trees should be pruned before they reach a diameter of 15 inches at breast height. Damage from pests can be expected, but it should not be excessive except in extremely dry years. Logging is fairly easy, but heavy equipment bogs down in some low or flat areas in wet weather. At times, snow is sufficient to hinder or prevent the use of equipment.

Locating and building roads is fairly easy. They

need to be gravelled in places for year-round use. Roads and skid trails should be protected from runoff. Larger roads require bridges, ditches, and culverts. Temporary or minor roads should be outsloped, and grades should be sloped toward the watercourse for a short distance on both sides of creeks or draws. Grades should not exceed 10 percent on Josephine soils or 8 percent on Boomer soils.

Fire is relatively easy to control, mainly because of easy access, but also because of gentle slopes.

Areas where trees have been removed by fire or other causes can be prepared for planting fairly easily. Planting can be done by machine.

WOODLAND SUITABILITY GROUP 5

The soils in this group are well drained. They have moderate permeability. They are 24 to 60 inches deep to bedrock. The surface layer is loam, gravelly loam, or cobbly loam, and the subsoil is clay loam or cobbly clay loam. Slopes are 15 to 50 percent. Available water capacity is 4 to 9 inches. Elevation ranges from 2,500 to 3,500 feet. Average annual precipitation is 30 to 50 inches.

The soils have medium site quality. The hazard of erosion is moderate, the equipment limitations are severe, the hazard of pests and diseases is moderate to slight, the hazard of windthrow is slight to moderate, and suitability for management is medium.

The soils in this group are suited to moderately intensive management, but management is more difficult than on woodland suitability group 4. Growth rates are moderate. Thinning should be done at an early age, and trees should be pruned before they reach a diameter of 15 inches at breast height. Damage from pests can be expected on some soils most years, but it should not be excessive except in extremely dry years. Logging is more difficult on soils in this group than in woodland suitability group 4 because of steeper slopes. In wet weather, logging is impractical.

Locating and building roads is fairly difficult. In most places, they need to be gravelled for year-round use. Roads and skid trails should be protected from runoff. Larger roads need bridges, ditches, and culverts. Temporary or minor roads should be outsloped, and grades should be sloped downward toward the watercourse for a short distance on both sides of creeks or draws. Grades should not exceed 10 percent on Josephine soils and 12 percent on Boomer soils.

Fire is difficult to control.

Areas where trees have been removed by fire or other causes can be prepared for planting only with difficulty. If planting is to be done by machine, the steeper areas need terracing. Terraces should be outsloped.

WOODLAND SUITABILITY GROUP 6

The soils in this group are well drained and have moderate to slow permeability. The effective rooting depth is 24 to 60 inches or more. The surface layer is loam, sandy loam, gravelly loam, or cobbly loam. Rock outcrop covers 0 to about 25 percent of the surface area. Slopes are 15 to 75 percent. The available water capacity is 4 to 10 inches. Elevation ranges from 2,000

to 5,000 feet. Average annual precipitation is 30 to 50 inches.

The soils have medium site quality, the hazard of erosion is high, equipment limitations are severe, the hazard of pests and diseases is moderate, the hazard of windthrow is mostly moderate to slight, and suitability for management is medium to low.

The soils in this group are suited to medium intensity management, but management practices can be applied only with considerable difficulty. Growth rates are moderate. Thinning should be done at an early age, and trees should be pruned before they reach a diameter of 15 inches at breast height. Damage from pests and disease can be expected, but it should not be excessive except in extremely dry years. Logging is difficult, and in wet weather it is almost impossible.

Locating and building roads is difficult. In places roads need to be gravelled for year-round use. Roads and skid trails should be protected from runoff. Larger roads need bridges, ditches, and culverts. Temporary or minor roads should be outsloped, and grades should be sloped downward toward the watercourse for a short distance on both sides of creeks and draws. Grades should not exceed 8 percent on Musick or Stump Springs soils, 10 percent on Josephine soils, or 12 percent on Boomer soils.

Fire is difficult to control because of steep slopes.

Areas where trees have been removed by fire or other causes can be prepared for planting only with difficulty. If planting is done by machine, terracing is necessary. Terraces should be outsloped.

WOODLAND SUITABILITY GROUP 7

The soils in this group are well drained. They are moderately permeable. Parent rock is at a depth of 12 to 40 inches. The surface layer is cobbly loam or gravelly silt loam, and the subsoil is cobbly clay loam or gravelly silty clay loam. Slopes are 15 to 75 percent. The soils are moderately to severely eroded. Available water capacity is 1.5 to 6 inches. Elevation ranges from 2,500 to 3,500 feet. Average annual precipitation is 35 to 45 inches.

The soils have low site quality. The hazard of erosion is high to moderate, equipment limitations are severe, the hazard of pests and disease is severe to moderate, the hazard of windthrow is severe to moderate, and suitability for management is low.

The soils in this group are the poorest for woodland use, and only extensive management practices, such as protection from fire, pests and diseases, overgrazing, and erosion, are practical at the present time. More intensive measures might be warranted if they increase the value for recreation or wildlife food and cover.

Engineering Uses of the Soils

This section presents information useful to engineers, planners, contractors, and others interested in the engineering properties of soils. Engineers are interested in soil properties that affect the ability of the soil to support various types of structures or to be used as a construction material from which structures are built.

Included are such structures as roads, buildings, pipelines, channels, dams, and water impoundments.

Among the soil properties that determine the stability of soil as a building material and that place limitations or special requirements for its use in construction are shear strength, permeability, compaction characteristics, shrink-swell potential, depth to limiting layers, available water capacity, mechanical analysis, plasticity, piping and cracking potential, reaction, slope, and rate of infiltration. Laboratory analyses are needed to determine some of these properties. Laboratory analyses, however, commonly are limited or are not available for many soils. In such cases it is necessary to estimate the physical and chemical characteristics by comparing these soils with similar soils for which such data are available.

The information in this section can be used to—

1. Make preliminary estimates of the engineering properties of soils for determining the feasibility of irrigation and drainage systems, small dams and reservoirs, soil and water conservation structures, and similar works.
2. Make preliminary evaluations of soils that will aid in selecting locations for highways, airports, rural roads, pipelines, and cables, and in planning detailed investigations at selected locations.
3. Locate probable sources of sand and gravel.
4. Locate probable sources of borrow material for roadfill and for the construction of dams, dikes, levees, and other embankments.
5. Determine the suitability of soils for cross-country movement of vehicles and construction equipment.
6. Develop other preliminary estimates used in construction or pertinent to a particular area.
7. Supplement the information in other published maps and reports.
8. Correlate performance of engineering structures with individual soils to develop information for overall planning that will be useful in designing and maintaining engineering practices and structures.

The estimated properties of the soils in this section are based on a limited number of soils tested in the laboratory. All references are to the soil at a depth of 5 feet, or to bedrock if it is present at a depth of less than 5 feet. Engineering interpretations are general and are not intended to eliminate onsite investigations or sampling and testing of soils for the design and construction of specific engineering works or uses. These interpretations are usable in broad planning by engineers, planners, and others; they are also usable for planning detailed field investigations to determine the behavior of the soil at the site of proposed engineering works.

Users of this soil survey may not be familiar with some of the terms used by soil scientists. These and other terms are defined in the Glossary. Most of the information about engineering is given in tables 3, 4, and 5.

TABLE 3.—*Engineering*
[Tests performed by California]

Soil name and location	Parent material	Report No.	Depth	Moisture-density ¹	
				Maximum dry density	Optimum moisture
Auburn very rocky loam: W. side of NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 17, T. 5 S., R. 16 E.	Basic igneous rock.	65-4990	<i>Inches</i> 0-3	<i>Lbs. per cu. ft.</i> 117	<i>Percent</i> 15
		65-4991	3-11	130	9
		65-5026	11-16	130	11
Blasingame rocky loam: W. side of NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 11, T. 5 S., R. 18 E.	Metabasic igneous rock.	65-5014	3-12	122	15
		65-5015	12-24	123	13
		65-5016	24-36	124	13
Boomer cobbly loam: Middle of E. boundary of NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 25, T. 4 S., R. 18 E.	Basic igneous rock.	65-5017	0-9	116	16
		65-5018	9-16	123	14
		65-5019	16-25	124	13
		65-5020	25-37	123	15
Coarsegold rocky fine sandy loam: S. middle of SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 1, T. 7 S., R. 18 E.	Mica schist.	65-5008	0-16	127	10
		65-5009	22-39	132	10
Daulton very rocky loam: NE. corner of NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 30, T. 6 S., R. 17 E.	Schist and slate.	65-5010	0-4	118	13
		65-5011	4-14	122	13
Henneke extremely rocky clay loam: 200 feet N. of SE. corner sec. 24, T. 3 S., R. 16 E.	Serpentine.	65-5012	0-4	120	14
		65-5013	4-25	113	17
Las Posas loam: NE. corner of SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 7, T. 6 S., R. 17 E.	Basic igneous rock.	65-5021	0-4	125	12
		65-5022	9-22	133	10
		65-5023	22-31	129	11
		65-5024	31-36	122	14
San Andreas very fine sandy loam: SE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 25, T. 6 S., R. 18 E., near Hidden Valley Rd., Rauch Ranch.	Mica schist.	65-5004	0-8	123	11
		65-5005	8-16	127	11
		65-5006	16-21	127	10
		65-5007	21-33	129	9
Trabuco very rocky clay loam: NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 1, T. 5 S., R. 17 E.	Basic igneous rock.	65-4987	0-9	119	15
		65-4988	17-29	108	19
		65-4989	29-36	108	20
Whiterock rocky loam: Middle of S $\frac{1}{2}$ NE $\frac{1}{4}$ sec. 32, T. 4 S., R. 17 E.	Slate and schist.	65-5025	0-9	115	15

¹ Based on the method of test for relative compaction of untreated and treated soils and aggregates, test method No. Calif. 216 E.

² Mechanical analyses by the California Division of Highways methods 202 and 203. Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the California 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 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 use in naming textural classes for soil.

test data

Division of Highways]

Mechanical analysis ²												Liquid limit	Plasticity index	Classification	
Percentage passing sieve—								Percentage smaller than—						AASHO ³	Unified ⁴
1½ in.	1 in.	¾ in.	⅜ in.	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.				
		100	99	97	94	83	70	59	40	14	10	Percent 31	4	A-4(7)	ML
		100	99	98	94	83	69	62	40	20	14	32	12	A-6(8)	CL
			100	99	95	84	68	62	46	19	14	24	4	A-4(7)	CL-ML
100	99	99	98	96	92	84	66	62	47	28	14	28	4	A-4(6)	ML
	100	99	97	95	93	86	68	63	48	31	21	32	10	A-4(7)	CL
		100	99	98	93	87	69	63	49	30	24	31	11	A-6(7)	CL
			100	99	97	85	69	62	46	22	12	30	4	A-4(7)	ML
100	99	99	98	98	95	87	72	67	46	24	12	31	7	A-4(7)	ML
			99	97	94	84	71	65	51	31	21	32	11	A-6(7)	CL
			99	99	96	88	73	65	53	34	24	34	11	A-6(8)	CL
⁵ 98	98	98	97	96	94	83	35	33	24	14	10	-----	(⁶)	A-2-4	SM
				99	90	90	44	38	33	27	20	24	8	A-4(2)	SC
	100	99	96	91	88	77	58	49	31	9	2	-----	(⁶)	A-4(5)	ML
			100	98	88	88	66	59	36	14	6	-----	(⁶)	A-4(6)	ML
		100	97	87	69	50	37	33	27	17	12	35	11	A-6(0)	SC-SM
		100	97	90	78	62	49	47	42	31	23	44	22	A-7-6(7)	SC
				100	97	83	45	35	25	15	8	-----	(⁶)	A-4(2)	SM
	100	99	99	98	96	84	47	41	31	23	20	23	7	A-4(2)	SC-SM
	100	99	98	97	93	84	51	50	40	32	27	31	16	A-6(5)	CL
100	99	98	98	98	95	82	56	54	44	35	30	36	21	A-6(8)	CL
					99	94	46	39	24	13	8	-----	(⁶)	A-4(2)	SM
						94	47	39	27	13	10	-----	(⁶)	A-4(2)	SM
					99	94	44	39	25	15	8	-----	(⁶)	A-4(2)	SM
				100	98	90	41	30	22	15	10	-----	(⁶)	A-4(1)	SM
100	99	98	92	89	86	79	65	60	50	30	25	36	11	A-6(6)	ML
	100	99	99	99	97	95	89	87	80	62	44	60	33	A-7-6(20)	CH
						98	92	91	82	63	45	55	28	A-7-6(18)	CH
	100	99	98	96	86	60	37	35	30	18	10	32	4	A-4(0)	SM

³ Based on AASHO Designation M 145-49 (1).
⁴ Based on the Unified soil classification system (8).
⁵ 99 percent passed the 2-inch sieve.
⁶ Nonplastic.

TABLE 4.—*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. The soils in for referring to other soil series that appear in the first

Soil series and map symbols	Depth to bedrock	Depth from surface (typical profile)	Classification			Coarse fraction greater than 3 inches
			USDA texture	Unified	AASHO	
*Ahwahnee: AaC, AaD, AbE, AcE, AdG. For Auberry part of AbE, AcE, and AdG, see Auberry series.	<i>Feet</i> 2-3½	<i>Inches</i> 0-37 37	Sandy loam Decomposed granodiorite.	SM	A-2	<i>Percent</i> 0
Auberry: AeD, AfD, AfE2, AgE, AgG2	2-3½	0-16 16-32 32	Sandy loam Sandy clay loam Weathered granitic rock.	SM SC	A-2 A-6	0 0
Auburn: AhD, AhE2, AkF2, AmG3, AnE, AnG2.	½-1½	0-16 16	Loam Amphibolite schist.	ML or CL	A-4 or A-6	10
*Blasingame: BdD, BdE, BeD, BeF, BfG, BgD, BgE, BkE2, BID, BIF, BmG2. For Las Posas part of BgD, BgE, BkE2, BID, BIF, and BmG2, see Las Posas series.	2-3½	0-36 36	Clay loam and clay Basic and metabasic rock.	ML or CL	A-4 or A-6	20
Boomer: BoD, BoF, BrF2, BrF3, BrG2	3-5+	0-37 37	Cobbly loam, loam, cobbly clay loam, and clay loam. Basic and metabasic rock.	ML or CL	A-4 or A-6	5-45
Clayey alluvial land: CaC. Properties too variable to rate.						
Coarsegold Mapped only in complexes with San Andreas soils.	3½-5	0-22 22-50 50	Fine sandy loam (gravelly in places). Sandy clay loam (gravelly in places). Mica schist.	SM SM or SC	A-2 A-4 or A-6	0 0
Daulton: DaD, DaE, DbE, DbG	1-1½	0-14 14	Loam Schist and slate.	ML	A-4	0
Henneke: HaG	1-1½	0-11 11	Very gravelly clay loam and very gravelly clay. Serpentine.	SC or GC	A-2	5-50
Hillgate: HbC	5+	0-18 18-60	Very fine sandy loam Light clay and clay loam.	ML or CL CL or ML	A-4 or A-6 A-7	0 0
Hornitos: HcF	½-1½	0-11 11	Extremely stony and very gravelly sandy loam. Sandstone.	SM	A-1	40-65
Josephine: JbD2, JbE2, JbF2	3½-5+	0-12 12-42 42	Loam Clay loam Schist.	ML or CL ML	A-4 A-7	0 0
JcD2, JcE2, JcF2, JdG2, JcF2	2-3½	0-8 8-32 32	Gravelly loam and gravelly clay loam. Clay loam Schist.	SM ML	A-2 A-7	0 0

significant to engineering

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions column of this table. The symbol < means less than]

Percentage less than 3 inches passing sieve—				Atterberg values		Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity uncoated steel
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Liquid limit	Plasticity index					
100	90-100	70-80	25-35	20-30	0-5	<i>Inches per hour</i> 2.0-6.0	<i>Inches per inch of soil</i> 0.13-0.15	<i>pH</i> 5.1-6.5	Low.....	Low.
100 100	90-100 95-100	70-80 65-85	25-35 40-50	20-30 30-40	0-5 10-20	2.0-6.0 0.6-2.0	0.11-0.13 0.15-0.17	5.6-6.5 5.6-7.3	Low..... Moderate.....	Moderate. Moderate.
95-100	90-100	80-90	65-75	20-35	0-15	0.6-2.0	0.15-0.17	5.1-7.3	Low.....	Low.
90-100	85-95	80-90	65-75	25-35	0-15	0.2-0.6	0.17-0.19	5.6-7.3	Moderate.....	Moderate.
90-100	85-95	80-90	65-75	30-40	0-15	0.6-2.0	0.13-0.17	5.1-6.5	Moderate.....	Moderate.
85-100	60-95	65-80	20-35	(³)	(³)	0.6-2.0	0.11-0.15	5.6-6.5	Low.....	Low.
90-100	75-100	70-90	35-50	20-30	5-15	0.2-0.6	0.12-0.16	5.1-7.3	Moderate.....	Moderate.
90-100	80-100	75-90	55-70	0-20	0-5	0.6-2.0	0.16-0.18	5.6-7.3	Low.....	Low.
60-75	45-65	35-50	25-35	35-45	10-25	0.06-0.2	0.10-0.12	6.6-7.3	Low.....	Moderate.
100 100	95-100 95-100	80-90 85-95	55-65 70-80	30-40 40-50	5-15 15-25	0.6-2.0 <0.06	0.16-0.18 0.03-0.05	5.1-6.5 6.6-8.4	Low..... High.....	Low. High.
60-80	50-70	30-50	15-25	0-20	0-5	2.0-6.0	0.08-0.10	4.5-6.0	Low.....	Moderate.
90-100 100	85-95 95-100	75-85 85-95	65-75 75-85	20-30 40-50	0-10 10-20	2.0-6.0 0.6-2.0	0.16-0.18 0.18-0.20	5.6-6.5 4.5-6.0	Low..... Moderate.....	Moderate. Moderate.
70-85	55-70	40-50	25-35	20-30	0-10	2.0-6.0	0.12-0.14	5.6-6.5	Low.....	Moderate.
100	95-100	85-95	75-85	40-50	10-20	0.6-2.0	0.18-0.20	4.5-6.0	Moderate.....	Moderate.

TABLE 4.—Estimated soil properties

Soil series and map symbols	Depth to bedrock	Depth from surface (typical profile)	USDA texture	Classification		Coarse fraction greater than 3 inches
				Unified	AASHO	
Las Posas: LbE, LcF.....	Feet 2-3½	Inches 0-22 22-36 36	Clay loam..... Clay..... Diorite.	SM or ML CL	A-4 A-6	Percent 0-5 0-5
Loamy alluvial land: LdC. Properties too variable to rate.						
Mariposa: MaF2, MaG2.....	1-1½	0-9 9-19 19	Gravelly silt loam..... Gravelly silty clay loam.. Schist.	SM or SC SM or SC	A-4 or A-6 A-7	0 0
Maymen: MbG3, MbH2, McE, MdG2.....	½-1½	0-9 9	Gravelly loam..... Slate.	SM or SC	A-4 or A-6	0
Musick: MeD2, MeE2, MfD2, MfF2.....	5+	0-14 14-48 48-75 75	Sandy loam..... Clay loam..... Sandy clay loam and sandy loam. Acid igneous rock.	SM CL ML	A-4 A-7 A-7	0 0 0
Positas: PaD.....	5+	0-11 11-20 20-60	Gravelly clay loam..... Clay..... Mixed sediment.	CL CH	A-7 A-7	0-45 0-5
Redding: RaD.....	5+	0-7 7-17 17-60	Gravelly loam..... Gravelly clay loam..... Hardpan.....	SM or SC SC or CL	A-4 or A-6 A-7	0-5 0-5
Riverwash and Tailings: Rb. Properties too variable to rate.						
Rock land: RcG. Properties too variable to rate.						
*San Andreas: SaD, SaE, SaF, SbE..... For Coarsegold part, see Coarsegold series.	2-3½	0-33 33	Very fine sandy loam..... Mica schist.	SM	A-4	0
San Joaquin: ScB.....	5+	0-22 22-27 27-60	Loam and gravelly loam.. Clay..... Hardpan.....	ML or CL CL	A-4 or A-6 A-7	0 0
*Stump Springs: SdD2, SeD2, SeF2..... For Musick part, see Musick series.	3½-5+	0-23 23-57 57-65	Sandy loam..... Sandy loam and sandy clay loam. Coarse sandy loam.....	SM SC or CL	A-4 A-6	0 0
Trabuco: TaD2, TaE2, TbF2.....	2-3½	0-17 17-39 39	Clay loam..... Clay..... Basic igneous rock.	CL or ML CH	A-6 A-7	0-10 0-10
Whiterock: WaF.....	½-1.	0-9 9	Gravelly loam..... Slate and schist.	SM	A-4	0-5

¹ 1 to 3 percent in AkF2.

² 1 to 3 percent in BkE2.

significant to engineering—Continued

Percentage less than 3 inches passing sieve—				Atterberg values		Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity uncoated steel
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Liquid limit	Plasticity index					
95-100 95-100	90-100 90-100	75-85 80-90	45-55 50-60	0-25 30-40	0-10 15-25	<i>Inches per hour</i> 0.6-2.0 0.2-0.6	<i>Inches per inch of soil</i> 0.17-0.19 0.17-0.19	<i>pH</i> 5.6-7.3 6.1-7.8	Moderate----- High-----	Moderate. High.
70-90 65-85	60-80 55-80	50-70 50-70	35-50 35-50	30-40 40-50	5-15 10-20	2.0-6.0 0.6-2.0	0.10-0.12 0.14-0.16	5.1-6.5 4.5-6.0	Low----- Low-----	Low. Low.
75-90	60-85	50-70	35-50	10-20	5-15	0.6-2.0	0.12-0.14	5.6-6.5	Low-----	Low.
100 100 100	95-100 95-100 95-100	80-90 80-90 80-90	35-50 60-70 50-65	20-30 40-50 40-50	0-5 25-35 10-20	2.0-6.0 0.2-0.6 0.2-0.6	0.11-0.13 0.18-0.20 0.16-0.18	5.1-6.5 4.5-6.0 5.1-6.0	Low----- Moderate----- Low-----	High. High. Moderate.
75-90 90-100	65-80 85-100	60-75 80-95	50-65 70-85	40-50 50-60	15-25 25-35	0.2-0.6 <0.06	0.10-0.12 0.03-0.05	5.6-6.5 5.6-6.5	Moderate----- High-----	Moderate. High.
65-80 60-80	55-70 50-80	50-65 45-70	35-50 35-60	10-20 40-50	5-15 15-25	2.0-6.0 <0.06 <0.06	0.12-0.14 0.03-0.05	5.1-6.5 5.1-6.0	Low----- Moderate-----	Low. High.
75-100	60-100	50-90	35-50	(³)	(³)	0.6-2.0	0.15-0.17	5.6-6.5	Low-----	Low.
70-100 90-100	65-95 80-100	60-75 75-90	50-70 65-80	20-30 40-50	5-15 15-25	0.6-2.0 <0.06 <0.06	0.14-0.18 0.14-0.16	5.6-7.3 5.6-7.3	Low----- Moderate-----	Low. Moderate.
100 100	95-100 95-100	70-80 80-90	35-45 45-55	0-10 30-40	0-5 10-20	2.0-6.0 0.06-0.2	0.11-0.13 0.14-0.16	5.1-6.5 4.5-6.0	Low----- Moderate-----	Low. Moderate.
100	95-100	70-80	40-50	25-35	5-15	0.2-6.0	0.10-0.12	5.1-5.5	Low-----	Low.
85-100 95-100	80-95 85-100	75-85 80-100	55-65 75-95	30-40 50-65	10-20 25-35	0.2-0.6 0.06-0.2	0.18-0.20 0.14-0.16	6.1-7.3 5.1-6.5	Moderate----- High-----	Moderate. High.
90-100	55-80	40-50	35-45	25-35	0-10	0.6-2.0	0.12-0.14	5.1-6.0	Low-----	Low.

³ Nonplastic.

TABLE 5.—*Interpretations of*

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

Soil series and map symbols	Suitability as source of—		
	Topsoil	Sand and gravel	Road fill
*Ahwahnee: AaC, AaD, AbE, AcE, AdG----- For Auberry part of AbE, AcE, and AdG, see Auberry series.	Good for AaC. Fair for AaD: slope. Poor for AbE, AcE, AdG: slope; rock outcrop.	Poor: SM-----	Good-----
Auberry: AeD, AfD, AfE2, AgE, AgG2-----	Fair for AeD: sandy clay loam subsoil; slope. Poor for AfD, AfE2, AgE, AgG2: slope; rock outcrop.	Poor: SM or SC-----	Good to poor: A-2 or A-4.
Auburn: AhD, AhE2, AkF2, AmG3, AnE, AnG2-----	Poor: rock at a depth of ½ to 1½ feet; slope.	Unsuited: ML or CL-	Fair to poor: A-4 or A-6.
*Blasingame: BdD, BdE, BeD, BeF, BfG, BgD, BgE, BkE2, BID, BIF, BmG2. For Las Posas part of BgD, BgE, BkE2, BID, BIF, and BmG2, see Las Posas series.	Poor: clay subsoil; slope; rock outcrop.	Unsuited: ML or CL-	Fair to poor: A-4 or A-6.
Boomer: BoD, BoF, BrF2, BrF3, BrG2-----	Fair for BoD: loam over clay loam. Poor for BoF, BrF2, BrF3, BrG2; slope; cobbly.	Unsuited: ML or CL-	Fair to poor: A-4 or A-6.
Clayey alluvial land: CaC. Properties too variable for interpretations to be made.			
Coarsegold----- Mapped only in complexes with San Andreas soils.	Fair for SaD: slope. Poor for SaE, SaF, SbE: slope; some rock outcrop.	Poor: SM or SC-----	Good to poor: A-2, A-4, or A-6.

engineering properties of the soils

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

Soil features affecting—			Soil limitations for septic tank filter fields	Hydro-logic soil group	
Road location	Farm ponds				Irrigation
	Embankments	Reservoir areas			
Rock at a depth of 2 to 3½ feet; slopes of 2 to 75 percent; low shrink-swell potential; 0 to 25 percent rock outcrop.	Medium strength; medium to low permeability when compacted; medium to high susceptibility to piping.	Moderately rapid permeability; slopes of 2 to 75 percent; rock at a depth of 2 to 3½ feet; 0 to 25 percent rock outcrop.	Low available water capacity; moderately rapid intake rate and permeability; slopes of 2 to 75 percent; rock at a depth of 2 to 3½ feet.	Severe: rock at a depth of 2 to 3½ feet; slope.	C
Rock at a depth of 2 to 3½ feet; slopes of 2 to 75 percent; moderate shrink-swell potential; 0 to 25 percent rock outcrop.	Medium strength; medium to low permeability when compacted; low to high susceptibility to piping.	Moderate permeability; slopes of 2 to 75 percent; rock at a depth of 2 to 3½ feet; 0 to 25 percent rock outcrop.	Moderate available water capacity; moderately rapid intake rate; moderate permeability; slopes of 2 to 75 percent; rock at a depth of 2 to 3½ feet.	Severe: rock at a depth of 2 to 3½ feet; slope.	B
Rock at a depth of ½ to 1½ feet; slopes of 2 to 75 percent; low shrink-swell potential; 0 to 25 percent rock outcrop; 1 to 3 percent stones.	Medium to low strength; medium to low permeability when compacted; high to low susceptibility to piping.	Moderate permeability; slopes of 2 to 75 percent; rock at a depth of ½ to 1½ feet; 0 to 25 percent rock outcrop; 1 to 3 percent stones.	Very low available water capacity; moderate intake rate and permeability; slopes of 2 to 75 percent; rock at a depth of ½ to 1½ feet.	Severe: rock at a depth of ½ to 1½ feet; slope.	C/D
Rock at a depth of 2 to 3½ feet; slopes of 2 to 75 percent; moderate shrink-swell potential; 0 to 50 percent rock outcrop; 1 to 3 percent stones.	Medium to low strength; medium to low permeability when compacted; high to low susceptibility to piping.	Moderately slow permeability; slopes of 2 to 75 percent; rock at a depth of 2 to 3½ feet; 0 to 50 percent rock outcrop.	Moderate available water capacity; moderate intake rate; moderately slow permeability; slopes of 2 to 75 percent; rock at a depth of 2 to 3½ feet.	Severe: moderately slow permeability; rock at a depth of 2 to 3½ feet; slope.	C
Rock at a depth of 3 feet to more than 5 feet; slopes of 2 to 75 percent; moderate shrink-swell potential; 5 to 45 percent cobblestones.	Medium to low strength; medium to low permeability when compacted; high to low susceptibility to piping.	Moderate permeability; slopes of 2 to 75 percent; rock at a depth of 3 feet to more than 5 feet; 5 to 45 percent cobblestones.	Moderate to high available water capacity; moderate intake rate and permeability; slopes of 2 to 75 percent; rock at a depth of 3 feet to more than 5 feet.	Moderate for BoD: rock at a depth of 3 feet to more than 5 feet; slope. Severe for BoF, BrF2, BrF3, BrG2: slope.	B
Rock at a depth of 3½ to 5 feet; slopes of 2 to 50 percent; moderate shrink-swell potential; 0 to 25 percent rock outcrop.	Medium strength; medium to low permeability when compacted; low to high susceptibility to piping.	Moderately slow permeability; slopes of 2 to 50 percent; rock at a depth of 3½ to 5 feet; 0 to 25 percent rock outcrop.	Moderate to high available water capacity; moderate intake rate; moderately slow permeability; slopes of 2 to 50 percent; rock at a depth of 3½ to 5 feet.	Severe: moderately slow permeability; slope.	B/C

TABLE 5.—*Interpretations of*

Soil series and map symbols	Suitability as source of—		
	Topsoil	Sand and gravel	Road fill
Daulton: DaD, DaE, DbE, DbG.....	Poor: rock at a depth of 1 to 1½ feet; slope; rock outcrop.	Unsuited: ML.....	Fair: A-4.....
Henneke: HaG.....	Poor: rock at a depth of 1 to 1½ feet; slope; rock outcrop.	Poor: GC.....	Fair: A-4.....
Hillgate: HbC.....	Poor: clay subsoil.....	Unsuited: ML or CL.....	Fair to poor: A-4, A-6, or A-7.
Hornitos: HcF.....	Poor: rock at a depth of ½ to 1½ feet; slope; extremely stony.	Poor: SM.....	Good.....
Josephine: JbD2, JbE2, JbF2.....	Fair for JbD2: clay loam subsoil; slope. Poor for JbE2, JbF2: slope.	Unsuited: ML or CL.....	Fair to poor: A-4 or A-7.
JcD2, JcE2, JcF2, JdG2, JeF2.....	Poor: gravelly; rock outcrop; slope.	Poor to unsuited: SM or ML.	Good to poor: A-2 or A-7.
Las Posas: LbE, LcF.....	Poor: clay subsoil; slope.	Poor to unsuited: SM, ML, or CL.	Fair to poor: A-4 or A-6.
Loamy alluvial land: LdC. Properties too variable for interpretations to be made.			

engineering properties of the soils—Continued

Soil features affecting—			Soil limitations for septic tank filter fields	Hydrologic soil group	
Road location	Farm ponds				Irrigation
	Embankments	Reservoir areas			
Rock at a depth of 1 to 1½ feet; slopes of 2 to 75 percent; low shrink-swell potential; 2 to 25 percent rock outcrop.	Medium to low strength; medium to low permeability when compacted; high susceptibility to piping.	Moderate permeability; slopes of 2 to 75 percent; rock at a depth of 1 to 1½ feet; 2 to 25 percent rock outcrop.	Very low available water capacity; moderate intake rate and permeability; slopes of 2 to 75 percent; rock at a depth of 1 to 1½ feet.	Severe: rock at a depth of 1 to 1½ feet; slope.	D
Rock at a depth of 1 to 1½ feet; slopes of 15 to 75 percent; low shrink-swell potential; 25 to 50 percent rock outcrop.	Medium strength; low permeability when compacted; medium to low susceptibility to piping.	Slow permeability; slopes of 15 to 75 percent; rock at a depth of 1 to 1½ feet; 25 to 50 percent rock outcrop.	Very low available water capacity; moderately slow intake rate; slow permeability; slopes of 15 to 75 percent; rock at a depth of 1 to 1½ feet.	Severe: slow permeability; rock at a depth of 1 to 1½ feet; slope.	D
Slopes of 2 to 9 percent; high shrink-swell potential.	Medium to low strength; medium to low permeability when compacted; high to low susceptibility to piping.	Very slow permeability; slopes of 2 to 9 percent.	Low available water capacity; moderate intake rate; very slow permeability; slopes of 2 to 9 percent; clay subsoil at a depth of 1½ to 2 feet.	Severe: very slow permeability.	D
Rock at a depth of ½ to 1½ feet; slopes of 2 to 50 percent; low shrink-swell potential; 25 to 65 percent cobbles and stones.	Medium strength; medium to low permeability when compacted; medium to high susceptibility to piping.	Moderately rapid permeability; slopes of 2 to 50 percent; rock at a depth of ½ to 1½ feet; 25 to 65 percent cobbles.	Very low available water capacity; moderately rapid intake rate and permeability; slopes of 2 to 50 percent; rock at a depth of ½ to 1½ feet.	Severe: rock at a depth of ½ to 1½ feet; slope.	D
Rock at a depth of 3½ feet to more than 5 feet; slopes of 2 to 50 percent; moderate shrink-swell potential.	Medium to low strength; medium to low permeability when compacted; high to low susceptibility to piping.	Moderate permeability; slopes of 2 to 50 percent; rock at a depth of 3½ feet to more than 5 feet.	High available water capacity; moderate intake rate and permeability; slopes of 2 to 50 percent; rock at a depth of 3½ feet to more than 5 feet.	Moderate for JbD2: moderate permeability; slope. Severe for JbE2, JbF2: slope; shallow to bedrock.	B
Rock at a depth of 2 to 3½ feet; slopes of 2 to 75 percent; moderate shrink-swell potential; 0 to 25 percent rock outcrop.	Medium to low strength; medium to low permeability when compacted; high to low susceptibility to piping.	Moderate permeability; slopes of 2 to 75 percent; rock at a depth of 2 to 3½ feet; 0 to 25 percent rock outcrop.	Moderate available water capacity; moderate intake rate and permeability; slopes of 2 to 75 percent; rock at a depth of 2 to 3½ feet.	Severe: rock at a depth of 2 to 3½ feet; slope.	C
Rock at a depth of 2 to 3½ feet; slopes of 2 to 75 percent; high shrink-swell potential; 0 to 50 percent rock outcrop.	Medium to low strength; medium to low permeability when compacted; high to low susceptibility to piping.	Moderately slow permeability; slopes of 2 to 75 percent; rock at a depth of 2 to 3½ feet; 0 to 50 percent rock outcrop.	Moderate available water capacity; moderately slow intake rate and permeability; slopes of 2 to 75 percent; rock at a depth of 2 to 3½ feet.	Severe: moderately slow permeability; rock at a depth of 2 to 3½ feet; slope.	C

TABLE 5.—*Interpretations of*

Soil series and map symbols	Suitability as source of—		
	Topsoil	Sand and gravel	Road fill
Mariposa: MaF2, MaG2.....	Poor: rock at a depth of 1 to 1½ feet; slope; gravelly.	Poor: SM or SC.....	Fair to poor: A-4, A-6, or A-7.
Maymen: MbG3, MbH2, McE, MdG2.....	Poor: rock at a depth of ½ to 1½ feet; slope; gravelly; rock outcrop.	Poor: SM or SC.....	Fair to poor: A-4 or A-6.
Musick: MeD2, MeE2, MfD2, MfF2.....	Fair for MeD2: clay loam subsoil; slope. Poor for MeE2, MfD2, MfF2: slope; rock outcrop.	Poor to unsuited: SM, CL, or ML.	Fair to poor: A-4 or A-7.
Positas: PaD.....	Poor: gravelly; clay subsoil.	Unsuited: CL or CH..	Poor: A-7.....
Redding: RaD.....	Poor: gravelly clay loam over hardpan.	Poor to unsuited: SM, SC, or CL.	Fair to poor: A-4, A-6, or A-7.
Riverwash and Tailings: Rb. Properties too variable for interpretations to be made.			
Rock land: RcG. Properties too variable for interpretations to be made.			

engineering properties of the soils—Continued

Soil features affecting—				Soil limitations for septic tank filter fields	Hydrologic soil group
Road location	Farm ponds		Irrigation		
	Embankments	Reservoir areas			
Rock at a depth of 1 to 1½ feet; slopes of 15 to 75 percent; low shrink-swell potential.	Medium strength; medium to low permeability when compacted; high to low susceptibility to piping.	Moderate permeability; rock at a depth of 1 to 1½ feet; 15 to 75 percent rock outcrop.	Low available water capacity; moderate intake rate and permeability; slopes of 15 to 75 percent; rock at a depth of 1 to 1½ feet.	Severe: rock at a depth of 1 to 1½ feet; slope.	C
Rock at a depth of ½ to 1½ feet; slopes of 15 to more than 75 percent; low shrink-swell potential; 0 to 25 percent rock outcrop.	Medium strength; medium to low permeability when compacted; high to low susceptibility to piping.	Moderate permeability; slopes of 15 percent to more than 75 percent; rock at a depth of ½ to 1½ feet; 0 to 25 percent rock outcrop.	Very low available water capacity; moderately rapid intake rate; moderate permeability; slopes of 15 percent to more than 75 percent; rock at a depth of ½ to 1½ feet.	Severe: rock at a depth of ½ to 1½ feet; slope.	D
Rock at a depth of more than 5 feet; slopes of 5 to 50 percent; moderate shrink-swell potential; 0 to 10 percent rock outcrop.	Medium to low strength; medium to low permeability when compacted; high to low susceptibility to piping.	Moderately slow permeability; slopes of 5 to 50 percent; rock at a depth of more than 5 feet; 0 to 10 percent rock outcrop.	High available water capacity; moderate intake rate; moderately slow permeability; slopes of 5 to 50 percent; rock at a depth of more than 5 feet.	Severe: moderately slow permeability; slope.	B
Slopes of 2 to 15 percent; high shrink-swell potential; 0 to 45 percent cobbles.	Medium to low strength; low permeability when compacted; low to medium susceptibility to piping.	Very slow permeability; slopes of 2 to 15 percent; 0 to 45 percent cobbles.	Low available water capacity; moderately slow intake rate; very slow permeability; slopes of 2 to 15 percent; clay subsoil at a depth of 1 to 1½ feet.	Severe: very slow permeability.	D
Hardpan at a depth of 1 to 2½ feet; slopes of 2 to 15 percent; moderate shrink-swell potential; 0 to 5 percent cobbles.	Medium strength; medium to low permeability when compacted; high to low susceptibility to piping.	Very slow permeability; slopes of 2 to 15 percent; hardpan at a depth of 1 to 2½ feet; 0 to 5 percent cobbles.	Low available water capacity; moderate intake rate; very slow permeability; slopes of 2 to 15 percent; hardpan at a depth of 1 to 2½ feet.	Severe: very slow permeability; hardpan at a depth of 1 to 2½ feet.	D

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Suitability as source of—		
	Topsoil	Sand and gravel	Road fill
*San Andreas: SaD, SaE, SaF, SbE..... For Coarsegold part, see Coarsegold series.	Fair for SaD: slope. Poor for SaE, SaF, SbE: slope; some rock outcrop.	Poor: SM.....	Fair: A-4.....
San Joaquin: ScB.....	Poor: clay over hardpan.	Unsuited: ML or CL.	Fair to poor: A-4, A-6, or A-7.
*Stump Springs: SdD2, SeD2, SeF2..... For Musick part, see Musick series.	Fair for SbD2: sandy clay loam subsoil; slope. Poor for SeD2, SeF2. slope; rock outcrop.	Poor to unsuited: SM, SC, or CL.	Fair to poor: A-4 or A-6.
Trabuco: TaD2, TaE2, TbF2.....	Poor: clay subsoil; slope; some rock outcrop.	Unsuited: CL, ML, or CH.	Poor: A-6 or A-7.....
Whiterock: WaF.....	Poor: rock at a depth of ½ to 1 foot; slope; rock outcrop.	Poor: SM.....	Fair: A-4.....

properties of the soils—Continued

Soil features affecting—				Soil Limitations for septic tank filter fields	Hydrologic soil group
Road location	Farm Ponds		Irrigation		
	Embankments	Reservoir areas			
Rock at a depth of 2 to 3½ feet; slopes of 2 to 50 percent; low shrink-swell potential; 0 to 25 percent rock outcrop.	Medium strength; medium to low permeability when compacted; medium to high susceptibility to piping.	Moderate permeability; slopes of 2 to 50 percent; rock at a depth of 2 to 3½ feet; 0 to 25 percent rock outcrop.	Low to moderate available water capacity; moderate intake rate and permeability; slopes of 2 to 50 percent; rock at a depth of 2 to 3½ feet.	Severe: rock at a depth of 2 to 3½ feet; slope.	C
Hardpan at a depth of 1 to 2 feet; slopes of 2 to 9 percent; moderate shrink-swell potential.	Medium to low strength; medium to low permeability when compacted; high to low susceptibility to piping.	Very slow permeability; slopes of 2 to 9 percent; hardpan at a depth of 1 to 2 feet.	Low available water capacity; moderate intake rate; very slow permeability; slopes of 2 to 9 percent; hardpan at a depth of 1 to 2 feet.	Severe: very slow permeability; hardpan at a depth of 1 to 2 feet; slope.	D
Rock at a depth of 3½ feet to more than 5 feet; slopes of 2 to 50 percent; moderate shrink-swell potential; 0 to 10 percent rock outcrop.	Medium to low strength; medium to low permeability when compacted; high to low susceptibility to piping.	Slow permeability; slopes of 2 to 50 percent; rock at a depth of 3½ feet to more than 5 feet; 0 to 10 percent rock outcrop.	Moderate to high available water capacity; moderately rapid intake rate; slow permeability; slopes of 2 to 50 percent; rock at a depth of 3½ feet to more than 5 feet.	Severe: slow permeability; slope.	B
Rock at a depth of 2 to 3½ feet; slopes of 2 to 50 percent; high shrink-swell potential; 0 to 25 percent rock outcrop.	Medium to low strength; medium to low permeability when compacted; low to high susceptibility to piping.	Slow permeability; slopes of 2 to 50 percent; rock at a depth of 2 to 3½ feet; 0 to 25 percent rock outcrop.	Moderate available water capacity; moderately slow intake rate; slow permeability; slopes of 2 to 50 percent; rock at a depth of 2 to 3½ feet.	Severe: slow permeability; rock at a depth of 2 to 3½ feet; slope.	C
Rock at a depth of ½ to 1 foot; slopes of 5 to 50 percent; low shrink-swell potential; 2 to 10 percent rock outcrop.	Medium strength; medium to low permeability when compacted; medium to high susceptibility to piping.	Moderate permeability; slopes of 5 to 50 percent; rock at a depth of ½ to 1 foot; 2 to 10 percent rock outcrop.	Very low available water capacity; moderate intake rate and permeability; slopes of 5 to 50 percent; rock at a depth of ½ to 1 foot.	Severe: rock at a depth of ½ to 1 foot; slope.	D

Engineering classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system used by Soil Conservation Service engineers, the Department of Defense, and others, and the AASHO system, adopted by the American Association of State Highway officials.

The AASHO system (1) is used to classify soils according to 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 to 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. At the other extreme, in group A-7, are clayey soils that have low strength when wet. Thus, the best soils for subgrade are classed as A-1, the next best A-2, and so on to A-7, 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 an 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 Unified system (8) identifies soils according to their grain-size distribution and plasticity and groups them according to their performance as engineering construction materials. In this system GP and GW and SP and SW are clean gravels and sands. GM and GC and SM and SC are gravels and sands that have a significant amount of nonplastic and plastic fines respectively. ML and CL are nonplastic and plastic fine materials that have a low liquid limit, whereas MH and CH are nonplastic and plastic fine-textured soils that have a high liquid limit. Organic soils and peat are designated by the symbols OL, OH, and Pt. A joint classification symbol, such as ML-CH, is used for soils that have characteristics bordering on two groups.

The estimated classifications of all soils in this survey area are according to the AASHO and Unified systems and are given in tables 3 and 4.

Engineering test data

Selected horizons from 10 soils in the Mariposa County Area were tested in the laboratory to help evaluate the soil properties significant to engineering. Results from these tests are shown in table 3. Location designations are in relation to the Mount Diablo Base Line and Meridian.

Moisture-density is determined by compacting a soil several times, using a constant compactive effort, each time at a successively higher content of moisture. The density of the compacted soil increases as the moisture content increases until the optimum moisture content is reached; beyond this point, density decreases with an increase in moisture content. The maximum dry density and associated optimum moisture are thus determined.

By mechanical analysis the size and proportions of soil particles that affect the behavior of soils for various engineering uses are determined. The California Division of Highways uses the sieve and hydrometer method in making the mechanical analysis.

Liquid limit and plasticity index measure the effect

of water on the consistence of the soil. As the moisture content of a plastic (clayey) soil increases from a dry state, the soil changes from a semisolid to a plastic. As the moisture content is further increased, the material changes from a plastic to a liquid. The plastic limit is the moisture content at which the material passes from a semisolid to a plastic, and the liquid limit is the moisture content at which the soil passes from a plastic to a liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range in moisture content within which the soil is in a plastic condition. Moisture content, limits, and index are expressed as a percentage of the dry weight of the soil.

Estimated properties

Table 4 lists the soil series in the survey area, lists the map symbols for each mapping unit, and gives estimates of soil properties significant to engineering. It also lists the depth to bedrock, depth from surface of the typical profile, the USDA texture, the Unified and AASHO classifications, mechanical analysis, liquid limit, plasticity index, permeability, available water capacity, reaction, shrink-swell potential, and corrosivity to uncoated steel. These estimates are based on test results given in table 3, field examination, and experience with soils in the Area or similar soils in other places. Since these estimates are for the typical soils, variations from the listed values should be anticipated.

Soil scientists determine soil texture by using the system of classification of the U.S. Department of Agriculture. Soil texture in this system is determined by the relative proportions of sand, silt, and clay in the soil material smaller than 2.0 millimeters in diameter. Modifiers, such as gravelly, stony, or cobbly, are used as needed for materials larger than 2.0 millimeters in diameter.

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

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

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

Shrink-swell potential, or behavior, of a soil describes its volume change with change in moisture content. The volume change of a soil is influenced by the amount and kind of clay in the soil, as well as the amount of moisture change.

Damage to building foundations, roads, and other structures may result from soils shrinking on drying and swelling on wetting. The shrink-swell potential ratings are an indication of the hazard to structures resulting from this volume change. The three degrees of potential are low, moderate, and high. Soils rated low have few problems from shrinking and swelling and are more suitable for construction sites if other

features are favorable. Ratings of moderate and high indicate a greater shrink-swell potential. These ratings do not mean that structures cannot be built; they are warnings that a shrink-swell problem exists. The three shrink-swell potential ratings are based on the kind and amount of clay and the coefficient of linear extensibility. These ratings are for each soil horizon listed in the table.

Corrosivity of untreated steel refers to the extent untreated steel may corrode or deteriorate if buried in the soil. The rate at which this occurs depends largely upon the physical, chemical, and biological characteristics of the soil and the physical and chemical characteristics of the steel. The corrosion probability generally is greater for extensive installations that intersect soil boundaries or soil horizons than for installations in one kind of soil or one soil horizon. The depth at which a pipe or other steel item is buried can affect the rate and extent of corrosion.

Ratings for corrosivity are based on soil as it is in its natural state and does not consider the effects of other factors, such as the amount of soil water, or the addition of materials to the soil. Corrosion to untreated steel pipes or other steel items is likely to be increased by electrical leaks from underground cables and by electrical charges resulting from dissimilar metals or metal composition.

Limitation ratings of low, moderate, and high are based on the texture and drainage class of the soil, the total acidity, and the conductivity of the saturation extract.

Depth to water table was not included for the soils in the Mariposa Area, because the water table is at a depth so great that it does not affect engineering uses of the soils.

Engineering interpretations

Table 5 rates the soils according to their suitability as a source of topsoil, sand and gravel, and road fill. It also lists those soil features that affect road location, water-retention structures, and irrigation. These features are also important for construction, operation, or maintenance of the structure or practice shown. Soil limitations for septic tank filter fields and hydrologic soil groups are also rated.

The suitability rating for topsoil is for use as a source of topsoil for slopes, for shoulders of roads, in areas along waterways, and on lawns or golf courses or similar areas. The ratings reflect suitability of a soil for growth of vegetation. The ratings of good, fair, and poor are based on such soil features as texture, the presence of gravel or rock outcrops, thickness, and slope.

Soils are rated on their suitability as a source of sand and gravel for use in construction. Gradation, mineral quality, and accessibility of coarse material are not considered. The ratings used are based on the Unified classification and are good, fair, poor, and unsuitable.

Soils are rated on the basis of their suitability as a source of road fill when excavated and for use as fill for road subgrade material. Accessibility of the source material is not considered. The ratings are based on the AASHO classification system and are good, fair, and poor.

The soil features of interest to the engineer in selecting a road location are soil depth, slope, rockiness or stoniness, and shrink-swell potential. Where excavation to depths greater than 5 feet is anticipated, onsite inspection and tests are necessary.

Various soil features affecting the construction of water-retention structures, such as irrigation reservoirs, fish ponds, stock-water ponds, recreation lakes, and sewage lagoons, are listed. Two separate ratings are required for two functions of the structure, a rating as a floor for impoundment areas and a rating as a source of embankment material. Those soil properties that relate to the watertightness of both the impoundment area and embankment, and to the stability and safety of the embankment, are given. Soil properties considered significant for the floor of an impoundment area include presence of coarse fragments, permeability, slope, and soil depth. Soil properties considered significant for an embankment include strength, permeability when compacted, and susceptibility to piping. Onsite investigations are necessary to determine the type, amount, and availability of borrow materials, and to obtain data for design.

Soil features pertinent to the design and management of irrigation systems include basic intake rate of the soil, available water capacity, depth to restrictive layers, slope, and permeability. The quantity and quality of irrigation water available are not considered but need to be determined before designing an irrigation system.

Septic tank filter fields are subsurface tile systems designed in such a way that the effluent from the septic tank is distributed with reasonable uniformity into the natural soil. Soil limitation ratings of slight, moderate, and severe are based on permeability, natural drainage class, depth to impervious layers, slope, and the hazard and duration of overflow. Results of percolation tests, if available, should also be considered. Limitation ratings are for the most limiting soil horizon or for the 10- to 40-inch zone. Rapidly permeable, coarse-textured or gravelly soils may allow contamination of ground water supplies.

Hydrologic soil groups are used for estimating the runoff potential of soils. Groupings are based on potential runoff at the end of a long storm occurring after prior wetting and opportunity for swelling. This grouping assumes the absence of a protective plant cover.

Four groups are used—A, B, C, and D. Group A has the least runoff and highest infiltration potential, and Group D has the highest runoff and lowest infiltration potential. Groups B and C are intermediate. Hydrologic soil groups are based on such soil properties as soil texture, the presence of restrictive layers, depth, subsoil permeability, and natural drainage class.

Formation, Morphology, and Classification of the Soils

This section has three main parts. The first part discusses the major factors of soil formation as they relate to the formation of soils in the Mariposa County Area. The second part describes the system for classi-

fying soils and places the soils in the system. The third part discusses the morphology of soils.

Formation of Soils

The characteristics of a soil at any given time are determined by the interaction of the five factors of soil formation: climate, plants and animals, parent material, relief, and time. Each of these factors affects the formation of every soil, and each modifies the effects of the other four. The importance of each factor varies from place to place.

Climate and vegetation are the active factors that change parent material and gradually form soil. Relief modifies the effects of climate and vegetation, mainly by its influence on runoff and temperature. The nature of the parent material also affects the kind of soil that is formed. Finally, time is needed for changing a parent material into soil; generally a long time is required for distinct soil horizons to develop. The interactions among these factors are more complex for some soils than for others.

Climate

Climate affects soil formation primarily from the standpoint of moisture. In a moist climate more moisture is available to speed the chemical weathering of rocks into their primary minerals. Moisture also makes a more favorable environment for living organisms, from trees to bacteria, to exist. As a by-product of their living, they aid in the mechanical and chemical decomposition of rocks into soil material and, finally, into soils.

Parent material

Parent material is the unconsolidated mass from which soil forms. It determines the limits of chemical and mineralogical composition for the soil. Parent material in Mariposa County Area varies widely and includes alluvium, sandstone, shale, acid igneous rock, basic igneous rock, serpentine, and metamorphosed rocks.

The northern half and southwestern half of the Area, except for Cathey's Valley and the vicinity, is underlain chiefly by metasedimentary and metavolcanic rocks of Paleozoic and Upper Jurassic age (2). The main metasedimentary rocks are slate, quartz-biotite hornblende, and quartz-biotite-graphite schist, but some areas contain limestone, chert, dolomite, and quartzite. The main metavolcanic rocks are greenstone and green schist derived from submarine-laid pyroxene andesite and basalt.

Cathey's Valley and vicinity and the southeastern half of the survey area are underlain mainly by intrusive granitic rock of Later Jurassic or Early Cretaceous age. The rock ranges in composition from hornblende gabbros and hornblende quartz diorite in Cathey's Valley and vicinity to hornblende quartz granodiorite, biotite quartz monzonite, and biotite granite in the eastern part of the survey area.

The soils that formed over a few small areas of volcanic detritus of early and middle Pliocene age appear to be mostly shallow alluvium over residuum. The topographic position of these areas in relation to residual

soils at higher elevations show evidence that these presently alluvium-capped residual soils will be deeply buried in the future.

Rocks on uplands are mainly of Upper Jurassic age, but small areas of rocks of middle Eocene age are at lower elevations, and rocks of Carboniferous age are at higher elevations in the Area.

Remnant, flat-topped hills of the Ione sandstone and conglomerate rock formation of Eocene age, underlain by Paleozoic metasedimentary and, to a lesser degree, by Jurassic metavolcanic rocks, are near the Mariposa-Merced County line. Pediments veneered with metamorphic gravel of late Pliocene and early Pleistocene age are geographically associated with the Ione Formation at a lower elevation. These areas of gravelly deposits have undulating to hilly relief, and the gravelly deposits are underlain by andesitic tuff and gravel of early and middle Pliocene age, and occasionally by Jurassic metamorphic rocks. Only a few small areas of granitic sediment of middle Pleistocene age are at slightly lower elevations than the pediments. Recently deposited alluvium occupies many widely scattered areas throughout the survey area.

Fine-grained rocks tend to form soils that are higher in silt and lower in sand particles when weathered than the coarser grained rocks. The clay content of soils that formed in material derived from bedrock varies and appears to be a factor of rock composition and decomposition processes.

Ahwahnee, Auberry, Stump Springs, and Musick soils generally formed in granitic rocks. Auburn, Blasingame, Las Posas, Trabuco, Positas, and Henneke soils formed in material derived from basic and metabasic igneous rocks. Coarsegold, Josephine, Mariposa, Maymen, and White-rock soils formed in material derived from metasedimentary rocks.

Soils that formed in alluvium have textural characteristics similar to the parent rock or the soils from which the alluvium was derived. The soils that formed on pediments tend to be gravelly and cobbly and have a highly stratified substratum.

The metamorphic rocks generally are in broad, northwest-trending belts. They are distributed in this manner because they have been thrown into a series of acute, commonly isoclinal, northwest-trending folds by compressional forces acting essentially from the northwest and southwest. The Mother Lode is a thrust-fault system, approximately 1 mile wide, that consists of quartz veins of widely variable gold content in a series of essentially parallel to enechelon breaks. The veins range from large, white quartz masses 150 feet wide to stringers less than the thickness of a little finger.

The Mother Lode thrust-fault system trends northwest from west Mariposa through Coulterville and divides Paleozoic and Upper Jurassic rocks in most places. Those on the east are mainly Paleozoic, and those on the west are Upper Jurassic. Another group of intrusive igneous rocks, emplaced somewhat earlier than the granitic series but also of Upper Jurassic age, is the peridotite group. Most areas of this group are thoroughly serpentized. They are in areas that are somewhat lenticular in shape and variable in size, and they are roughly parallel or adjacent to the east side of the Mother Lode (2).

Living organisms

Plants, animals, insects, bacteria, and fungi are important in the formation of soils. Among the changes they cause are gains in organic matter and nitrogen in soil, gains or losses in plant nutrients, and changes in structure and porosity.

Most of the residual soils in the Area appear to be between the age of soils on recent alluvium and soils on the old terraces. Trabuco soils and some deep Boomer soils that have a clay subsoil above bedrock appear to be the oldest soils, and San Andreas and Daulton soils that have no profile development are among the younger soils.

Plants generally have a greater effect on soil formation than other living organisms. In the lower foothills of Mariposa County, the dominant vegetation is annual grasses, digger pines, and brush. As elevation and rainfall increase, the dominant vegetation becomes mainly conifers and lesser amounts of oaks, brush, and grass.

Relief

Relief, or the shape of the landscape, affects soil formation through its influence on drainage, erosion, plant cover, and soil temperature. Slopes in Mariposa County Area range from nearly level to very steep.

Time

Time appears to be the most important factor in the development of soil profiles, but weatherability of the parent material of the soil is also important. If erosion is an active force, the age of the soil does not necessarily correlate with the age of the parent material.

The soils of the survey area differ in age. The time available for a soil to develop on unconsolidated sediment is the time that has elapsed since the final deposition of parent material. Soils on consolidated sediment, metamorphic rock, and igneous rock began to develop after the parent rock weathered into parent material. Under conditions of erosion and continuing weathering processes, however, the age of the soil correlates with the age of parent rock only in a few places.

The alluvium in the narrow upland valleys is the result of comparatively recent deposits of soil material washed from the surrounding uplands. The soils that formed in these valleys have undeveloped profiles and are generally deep and permeable, but some areas are clayey and have slow permeability. These soils range from medium acid to slightly acid in the surface layer and from medium acid to mildly alkaline in the subsoil.

The alluvial terraces on the foot slopes of the Sierra Nevada probably date from the late Pliocene to the middle Pleistocene. The older Redding and San Joaquin soils on these terraces tend to have strongly developed profiles, as shown by a cemented hardpan substratum that is nearly impermeable. These soils have a medium acid or slightly acid surface layer and generally have a strongly acid to slightly acid or neutral or mildly alkaline subsoil.

Morphology of Soils

This subsection gives brief definitions of terms used in naming soil horizons, and it discusses the processes responsible for their development.

The characteristics produced by soil-forming processes are recorded in the soil profile—a vertical section of the soil through all its horizons, or layers, to the underlying rock. Horizons may differ in one or more properties, such as color, texture, structure, consistence, porosity, and reaction. A soil horizon may be thick or thin.

Most soil profiles contain three major horizons, called A, B, and C. The B horizon has not developed in young soils. The A horizon can be either the horizon of maximum organic matter, called the A₁, or the horizon of maximum leaching of dissolved or suspended materials, called the A₂. The B horizon lies immediately beneath the A horizon and is a horizon of maximum accumulation of dissolved or suspended materials, such as iron or clay. The B horizon normally is firmer than the horizons immediately above and below it and commonly has a blocky structure.

Beneath the B horizon is the C horizon. This horizon is relatively little affected by soil-forming processes; however, it can be somewhat modified by weathering.

Several processes have been involved in the formation of soil horizons in the soils of Mariposa County Area. These processes are: (1) accumulation of organic matter, (2) leaching of carbonates and bases, (3) reduction and transfer of iron, and (4) formation and translocation of silicate clay minerals. In most soils more than one of these processes have been active in the development of horizons. The soils in Mariposa County Area range from medium to very low in organic-matter content.

Classification of the Soils

Soils are classified so that we may more easily remember their significant characteristics, assemble knowledge about them, see their relationships to one another and to the whole environment, and develop principles that help us to understand their behavior and response to manipulation. First through classification, and then through the use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The system of classification used in this soil survey is that adopted as standard for all soil surveys in the United States (3, 6). In table 6 the soils of Mariposa County Area are classified according to the new system.

The current system of classification defines classes in terms of observable or measurable properties of soils. The properties chosen are primarily those that permit grouping soils that are similar in genesis. Genesis, or mode of soil origin, does not appear in the definitions of the classes; nevertheless, it is the basis for the classes. This classification, designed to accommodate all soils, has six categories. Beginning with the most inclusive, the categories are the order, suborder, great group, subgroup, family, and series. Following are brief descriptions of some categories in the system. The series is defined in the section "How This Survey Was Made."

TABLE 6.—*Classification of soil series*

Series	Family	Subgroup	Order
Ahwahnee	Coarse-loamy, mixed, thermic	Mollic Haploxeralfs	Alfisols.
Auberry	Fine-loamy, mixed, thermic	Ultic Haploxeralfs	Alfisols.
Auburn	Loamy, mixed, thermic	Ruptic-Lithic Xerochrepts	Inceptisols.
Blasingame	Fine-loamy, mixed, thermic	Typic Haploxeralfs	Alfisols.
Boomer	Fine-loamy, mixed, mesic	Ultic Haploxeralfs	Alfisols.
Coarsegold	Fine-loamy, mixed, thermic	Mollic Haploxeralfs	Alfisols.
Daulton	Loamy, mixed, nonacid, thermic	Lithic Xerorthents	Entisols.
Henneke	Clayey-skeletal, serpentinitic, thermic	Lithic Argixerolls	Mollisols.
Hillgate	Fine, montmorillonitic, thermic	Typic Palexeralfs	Alfisols.
Hornitos	Loamy, mixed, thermic	Dystric Lithic Xerochrepts	Inceptisols.
Josephine	Fine-loamy, mixed, mesic	Typic Haploxerults	Ultisols.
Las Posas	Fine, montmorillonitic, thermic	Typic Rhodoxeralfs	Alfisols.
Mariposa	Fine-loamy, mixed, mesic	Ruptic-Lithic-Xerochreptic Haploxerults	Ultisols.
Maymen	Loamy, mixed, mesic	Dystric Lithic Xerochrepts	Inceptisols.
Musick	Fine-loamy, mixed, mesic	Ultic Haploxeralfs	Alfisols.
Positas	Fine, montmorillonitic, thermic	Mollic Palexeralfs	Alfisols.
Redding	Fine, kaolinitic, thermic	Abruptic Durixeralfs	Alfisols.
San Andreas	Coarse-loamy, mixed, thermic	Typic Haploxerolls	Mollisols.
San Joaquin	Fine, kaolinitic, thermic	Typic Durixeralfs	Alfisols.
Stump Springs	Fine-loamy, mixed, mesic	Ultic Haploxeralfs	Alfisols.
Trabuco	Fine, mixed, thermic	Mollic Haploxeralfs	Alfisols.
Whiterock	Loamy, mixed, acid, thermic	Lithic Xerorthents	Entisols.

ORDER: Ten soil orders are recognized. The properties used to differentiate among the orders are those that tend to give broad climatic groupings of soils. Each order is named with a word of three or four syllables ending in *sol*, for example, Ent-i-sol.

As shown in table 6, five soil orders are in the Mariposa County Area—Alfisols, Entisols, Mollisols, and Ultisols.

Alfisols have been in place for a sufficient length of time for the movement and accumulation of silica clays. They have a light-colored, massive, and hard surface horizon, and clay increases in the subsoil.

Entisols either lack natural genetic horizons or have only the beginnings of such horizons. They are young, recent soils.

Inceptisols are soils that occur most commonly on young, but not recent, land surfaces. Their name is derived from the Latin word *inceptum*, for beginning.

Mollisols are soils that have a dark-colored, thick surface layer that is relatively high in organic matter and have a high base saturation throughout the profile.

Ultisols are mineral soils that have a very small amount of weatherable material, have an argillic horizon, and develop on old landforms.

SUBORDER: Each order is divided into suborders that are based primarily on those 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 the suborders are mainly those that reflect either the presence or absence of waterlogging, or soil differences resulting from the climate or the vegetation. The names of the suborders have two syllables. The last syllable indicates the order. An example is Xeralfs (*Xer*, meaning dry or annual dry season, and *alf*, from Alfisols).

GREAT GROUP: Each suborder is divided into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make these divisions are those in which clay,

iron, or humus have accumulated; those that have pans that interfere with growth of roots or movement of water, or both; and dark-colored surface horizons. Among the soil features used are soil temperature and moisture regime, major differences in chemical composition, and color. 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 Durixeralf (*Duri*, meaning duripan or hardpan, added to the Xeralf suborder).

SUBGROUP: Great groups are divided into subgroups. One of these subgroups represents the central (typic) segment of the great group, and the others, called intergrades, have properties of the group and one or more properties of another great group, subgroup, or order. Extragrades have properties that are not in any known order, suborder, or great group. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Durixeralf (a typical Durixeralf).

FAMILY: Families are divided within a subgroup mainly on the basis of properties important to the growth of plants or the behavior of soils when used for engineering. Among properties considered are texture, mineralogy, reaction, and soil temperature. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and other soil characteristics that are used as family differentia. An example is the fine, kaolinitic, thermic family of Typic Durixeralfs.

General Nature of the Area

This section discusses the history, population, and climate of the Mariposa County Area and gives information about farming and industry.

History

Before 1849 few people except Indians had been in the survey area. Trees, mostly oaks and conifers, were abundant. Wildlife was plentiful, as was trout in the streams. In old mound areas, Indian artifacts are still found, but the only permanent markers or monuments the Indians left were their distinctively carved mortar rocks, used for crushing acorns.

In 1806 Gabriel Moraga and his men came to a creek where they found swarms of butterflies, so they named the creek "Mariposa," which means butterfly. Eventually the county was named after the creek.

On February 18, 1850, Mariposa County became one of California's 27 original counties. Part of its land area, once 30,000 square miles, is now in Merced, Madera, Mono, Inyo, Fresno, Kings, Kern, Ventura, San Benito, and Tulare counties. The county seat, Agua Fria, was a gold miners' town near the head of Agua Fria Creek. On November 10, 1851, the county seat was moved about 4 miles east, to Mariposa, where the courthouse was built in 1854.

The impetus created in 1849 by the gold rush continued unabated into the late 1850's in the present Mariposa County Area. There is evidence that the towns of Mariposa and Coulterville had populations of more than 3,000 and that the town of Hornitos may have had as many as 15,000. Most people, however, had moved elsewhere by 1860.

The economy up to this time had been based almost entirely on mining, but after 1860 farming developed, and reached its economic apex in the 1890's.

The two most important industries in the survey area were agriculture and mining until about 1950. Since then, mining has declined because of the high cost of labor. Agriculture is based predominantly on livestock, mainly cattle. Poultry, however, was important in the 1950's.

By 1960 Mariposa County had been reduced to 1,884 square miles. The county is now 1,455 square miles.

Population

Mariposa, the county seat, is the main town in the Area. It had a population of 1,017 in 1965. Other communities are Coulterville, which had a population of 150; Midpines, which had 392; Cathey's Valley, which had 323; and Hornitos, which had 73. Much of the population lives outside the survey area on U.S. Forest Service lands and in Yosemite National Park. Some people live at El Portal, Yosemite Valley, Greeley Hill, and Fish Camp.

The population has changed little in the last 110 years. It was estimated to be 5,900 in 1965. Since the late 1950's, many people have kept second homes in the area but are registered elsewhere.

Industry

Business activity in Mariposa County Area is gradually increasing. Most trade and service transactions are the result of tourism and recreation. Within the Area, sales and services are influenced by the tourists who travel

through the Area to visit Yosemite National Park. More than 1,000,000 tourist-days per year are recorded for the park.

Raising livestock, including poultry, is the main farming activity of the Area. Some commercial timber is raised in the Area, but most is raised on lands outside the survey area that are administered by the U.S. Forest Service. Mining has become a lesser industry because prices of mined products are relatively low and cost of extraction is high.

The rapidly increasing population of California will result in thousands of people looking to scenic areas, such as Mariposa County Area, for recreation and vacation activities, country living, and retirement.

Transportation

Mariposa County is located away from the main State Highway network and away from all major railroad lines. Present airport facilities are too small for commercial transport planes. For the present, roads adequately serve the agricultural, recreational, and residential needs. Light industry, requiring a relatively small supply of semiskilled labor and producing a small volume of light-weight products, would not be handicapped by present transportation facilities.

A total of 114.1 miles of State highway is in Mariposa County. County roads, a total of 507.47 miles, include 144.53 miles of primary roads, 108.1 miles of which are oiled. A total of 362.94 miles is secondary roads, 86.5 miles of which are oiled.

Climate ⁴

The climate of Mariposa County Area is varied. Summers are hot and winters are mild at low elevations, and summers are mild and winters are cold at high elevations. This results in a long growing season near the San Joaquin Valley and a rather short season at high elevations. Precipitation in the western part of the Area is light, but it increases with elevation to fairly heavy amounts in the mountains. There is heavy snowfall in the higher mountains, but little or none falls near the San Joaquin Valley. Winds generally are light, although exposed locations occasionally experience strong or damaging wind. There is abundant sunshine during summer but a considerable amount of cloudiness during winter.

Elevation influences temperature to such an extent that isotherms generally parallel the contours of elevation and do not run from west to east, as would be the case if solar insolation and latitude were the controlling factors. The terrain is sufficiently irregular, however, that local influences are often dominant. Drainage or blocking of cold air often results in local areas being considerably warmer or colder than surrounding areas.

Elevation also influences the amount of precipitation received. From a very light annual total in the San Joaquin Valley, rainfall increases with elevation to a maximum between 6,000 and 7,000 feet. Rainfall tends to diminish above that level.

⁴By ROBERT C. ELFORD, climatologist for California, National Weather Service, U.S. Department of Commerce.

Summers are warm to hot, and winters are moderate to cold. The maximum temperature in July averages about 95° F. at lower elevations in the county, but it drops to about 90° near 5,000 feet. Temperatures in summer commonly cool off at night. The average minimum for July ranges from 60° at the lower elevations to less than 40° at the higher ones.

In January the average minimum temperature is about 35° at 500 feet elevation, but it diminishes to about 28° at 5,000 feet level and to less than 20° at the higher elevations. Average maximum readings range from 55° in the Valley to below 45° in the mountains. At the lower elevations only 30 to 40 days per year have a minimum temperature of 32° or less, but at the higher elevations, the figure reaches 150 days or more. Tempera-

ture data for two stations in the Mariposa County Area are given in table 7.

It is likely that some of the higher points in the survey area are subject to freezes almost every month of the year. The average date of the first 32° temperature in fall ranges from early in September in the mountains to as late as the end of November at low elevations. Based on the average dates for 32° readings, the growing season is more than 250 days in the Valley and more than 100 days in the mountains.

The average seasonal precipitation is less than 15 inches in the southern corner of the Area. As moist air is lifted over the Sierras, precipitation increases with elevation to about 50 inches.

Most of the precipitation falls in winter, 85 percent

TABLE 7.—Temperature data

Month	Wawona ranger station					Exchequer reservoir				
	Highest	Average maximum	Average	Average minimum	Lowest	Highest	Average maximum	Average	Average minimum	Lowest
January	67	50.5	35.0	19.9	-21	73	56.3	46.8	37.3	23
February	70	51.1	37.3	23.8	-10	80	63.0	52.3	41.5	24
March	77	59.5	42.9	26.5	-3	84	68.2	55.9	43.5	30
April	84	64.8	47.4	30.7	13	93	73.9	60.8	47.6	36
May	92	73.0	54.0	35.0	21	99	80.1	66.2	52.2	38
June	97	78.6	58.7	38.7	24	112	90.1	75.1	60.1	43
July	102	89.4	65.9	42.4	31	114	96.2	80.3	64.4	52
August	101	90.7	65.8	40.9	28	106	95.9	79.9	63.9	51
September	99	82.7	59.4	36.0	24	110	91.6	75.7	59.8	48
October	90	70.3	50.1	29.9	14	101	85.4	70.4	55.4	36
November	79	59.7	40.9	22.1	4	89	74.3	59.5	42.7	28
December	76	54.1	37.9	21.6	2	80	58.3	48.4	38.5	28
Year	102	68.7	49.6	30.6	-21	114	77.8	64.3	50.6	23

to 90 percent of the annual total falling from November through April. Normally, 60 to 90 days per year have a precipitation of 0.01 inch or more, 30 to 50 days have 0.10 inch or more, and 10 to 25 days per year have 0.50 inch. Rain occurs on the greater number of days at higher elevations. Thunderstorms occur less than 3 days per year in the valley and more than 20 days per year at high elevations.

Snow falling at high elevations and melting in spring and early in summer provides irrigation water for the San Joaquin Valley. The Merced River normally provides more than 830,000 acre-feet of water per year, much of it from melting snow.

On the valley floor snowfall is infrequent, and when it does fall, it melts almost immediately. Precipitation and snowfall data for three stations in the Mariposa County Area are given in table 8.

At low elevations in the vicinity of the San Joaquin Valley, winds tend to orient themselves northwesterly or southeasterly along the major axis of the valley. The predominant wind direction by a substantial margin is from the northwest. In the mountains wind directions are dominated by the local topography, the winds usually blowing up and down major valleys and canyons.

Winds are usually light to moderate, except for in-

frequent strong winds associated with one of three situations. In summer, thunderstorms can cause strong winds within local areas, particularly at higher elevations. In winter, migrant low-pressure areas occasionally result in strong winds over the entire county, except for local, sheltered areas. Occasionally, at various times of the year, high-pressure areas over Nevada and Utah and low-pressure areas to the west result in strong, warm, dry winds down the slope of the Sierras. These winds are drying to crops, timber, and grasslands, and this often produces a serious fire hazard.

In moderately exposed areas, winds reach 45 to 50 miles per hour on an average of once in 2 years and 80 miles per hour on an average of once in 50 years. In sheltered areas speeds are less, and in exposed areas speeds are greater.

Water Supply

The earliest major structure for water supply was the dam for Benton Mills, where Bagby is now. This dam was destroyed by floods long ago. Many other ambitious water projects were built, however, such as dams on lesser creeks for diversions and water ditches for mining operations; but by today's standards, these were relatively

TABLE 8.—*Precipitation data*

Month	Average precipitation at—			Average snowfall at—		
	Exchequer reservoir	Mariposa	Wawona ranger station	Exchequer reservoir	Mariposa	Wawona ranger station
	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>
January.....	3.48	5.68	8.13	(¹)	3.9	24.8
February.....	3.50	5.83	6.75	0	1.2	17.4
March.....	3.21	4.58	5.47	(¹)	.1	16.3
April.....	1.80	2.49	3.75	0	(¹)	3.8
May.....	.65	1.01	1.67	0	0	.1
June.....	.15	.16	.35	0	0	0
July.....	0	.01	.09	0	0	0
August.....	(¹)	.01	.04	0	0	0
September.....	.26	.39	.47	0	0	0
October.....	.79	1.35	1.78	0	0	.1
November.....	1.79	2.80	4.25	0	0	.6
December.....	3.52	5.64	7.49	0	.5	11.0
Year.....	19.16	29.95	40.24	(¹)	5.7	74.1

¹ Trace.

small. Only remnants remain of some of them. Most domestic water was obtained from the numerous springs throughout the Area, but in some places water was obtained from wells, which were wind- or hand-pumped. No other large undertaking was begun until the 1920's.

In the 1920's Exchequer Dam was built about 5 miles from Merced Falls. In 1965 and 1966 the capacity of the Exchequer reservoir (McClure Lake) was enlarged from less than 400,000 acre-feet and about 2,600 surface acres to over 1,000,000 acre-feet and 7,200 acres. Irrigation water for Merced Irrigation District in Merced County is supplied from this reservoir. Boating, camping, and fishing facilities are being developed at this lake and at the reservoir of the much smaller McSwain Dam, which is below the Exchequer Dam. McSwain Dam was developed mainly for recreation.

Flood control dams were built on Mariposa, Owens, Bear, and Burns Creeks to prevent storm damage to lands in Merced County.

Three privately owned dams, which have a combined capacity of more than 1,100 acre-feet and a surface area of about 75 acres, and Mariposa Public Utility Reservoir, which has a capacity of about 560 acre-feet and an area of 40 acres, have been built in the last few years.

Over a thousand smaller water-storage reservoirs, including irrigation and stock-water pits and reservoirs and fish ponds, dot the Mariposa County Area. Tanks and several hundred developed and undeveloped springs are used to water grazing animals. These water developments also have helped waterfowl and generally have improved wildlife habitat.

Most homes outside the town of Mariposa are supplied by either wells or springs.

Plans include several single- and multiple-purpose dams and reservoirs that have a capacity of 50 to 415,000 acre-feet and a surface area of about 10 acres to more than 1,600 acres. Many small stock-water and fish ponds are built every year.

Lack of developed water facilities for the Mariposa County Area handicaps the development of homesites, industry, and agriculture.

Vegetation

Because of heavy grazing and the introduction of hardy annual plants, some of the native grasses, such as melic-grasses (*Melica* spp.), needlegrasses (*Stipa* spp.), and pine bluegrass (*Poa scabrella*), are only scattered individual plants or clusters. The predominant grasses in the area are wild oats (*Avena* spp.), soft chess (*Bromus mollis*), ripgut (*Bromus rigidus*), red brome (*Bromus rubens*), and wild barley (*Hordeum* spp.). Frequently found but less desirable plants are nitgrass (*Gastridium ventricosum*), fescue (*Festuca* spp.), quakinggrasses (*Briza major* and *B. minor*), and annual bluegrass (*Poa annua*). Along streambanks at elevations below 2,000 feet, bermudagrass (*Cynodon dactylon*) helps slow erosion. In areas at higher elevations where grazing has been light, grasses are wild ryes (*Elymus* spp.) and California brome (*Bromus carinatus*).

Important forbs are filaree (*Erodium* spp.), burclover (*Medicago hispida*), tomcat clover (*Trifolium tridentatum*), tarweeds (*Hemizonia* and *Madia* spp.), popcorn-flower (*Plagiobothrys tenellus*), and lupines (*Lupinus* spp.).

Prominent brushy plants are deerbrush (*Ceanothus intergerrimus*), buckbrush (*Ceanothus cuneatus*), white-thorn (*Ceanothus leucodermis*), poison-oak (*Rhus diversiloba*), square bush (*Rhus trilobata*), manzanita (*Arctostaphylos* spp.), chamise (*Adenostoma* spp.), christmas-berry or toyon (*Photinia arbutifolia*), redbud (*Cercis occidentalis*), and yerba-santa, locally called wild peach, (*Eriodictyon californicum*).

The main deciduous trees are oaks (*Quercus* spp.), willow (*Salix* spp.), alder (*Alnus tenuifolia* and *A. rubra*), and buckeye or horsechestnut (*Aesculus californica*). The evergreens are live oak (*Quercus wislizenii* and *Q. chrysolepis*), ponderosa pine (*Pinus ponderosa*),

Digger pine (*Pinus sabiniana*), sugar pine (*Pinus lambertiana*), knobcone pine (*Pinus attenuata*), and incense-cedar (*Libocedrus decurrens*).

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Glossary

Acre-foot. The quantity of water, soil, or other material that will cover 1 acre to a depth of 1 foot.

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

Alluvial fan. A fan-shaped deposit of sand, gravel, and fine material dropped by a stream where its gradient lessens abruptly.

Alluvial plain. A plain resulting from the deposition of alluvium by streams.

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.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

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 have 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.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

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

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

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.

Igneous rock. Rock that has been formed by the cooling of molten mineral material. Examples: Granite, diorite, and gabbro.

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.

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

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to relatively level plots surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops, or in orchards, to confine the flow of water to one direction.

Furrow.—Water is applied in small ditches made by cultivation implements used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Irrigation water, released at high points, flows onto the field without controlled distribution.

Leaching. The removal of soluble materials from soils or other material by percolating water.

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.

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

Organic matter. A general term for plant and animal material, in or on the soil, in all stages of decomposition. Readily decomposed organic matter is often distinguished from the more stable forms that are past the stage of rapid decomposition.

Pan. A layer in a soil that is firmly compacted or very rich in clay. Frequently the word “pan” is combined with other words that more explicitly indicate the nature of the layers; for example, *hardpan*, *claypan*, and *traffic pan*.

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

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

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

pH 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.

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

Poorly graded. A soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles in poorly graded soil material, density can be increased only slightly by compaction.

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:

<i>pH</i>		<i>pH</i>	
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

Relief. The elevations or inequalities of a land surface, considered collectively.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Sedimentary rock. Rock composed of particles deposited from suspension in water. The chief sedimentary rocks are conglomerate, from gravel; sandstone, from sand; shale, from clay; and limestone, from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sands have been consolidated into sandstone.

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.

Slope class. As used in this survey, the slope classes are:

<i>Class</i>	<i>Percent</i>	<i>Class</i>	<i>Percent</i>
Gently sloping----	2 to 9	Steep -----	30 to 50
Strongly sloping--	9 to 15	Very steep-----	50 to 75
Moderately steep--	15 to 30	Extremely steep---	over 75

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles, less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand* (2.0 to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV (less than 0.002 millimeter).

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

Subgrade (engineering). The substratum, consisting of in-place material or fill material, that is prepared for highway construction; does not include stabilized base course or actual paving material.

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 layer. A term used in nontechnical soil descriptions for one or more layers above the subsoil. It includes the A horizon and part of the B horizon and has no depth limit.

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*, *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.

Well-graded soil. A soil or soil material consisting of particles that are well distributed over a wide range in size or diameter.

Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an oven-dry basis, at which plants (specifically sunflower) wilt so much that they do not recover when placed in a dark, humid atmosphere.

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