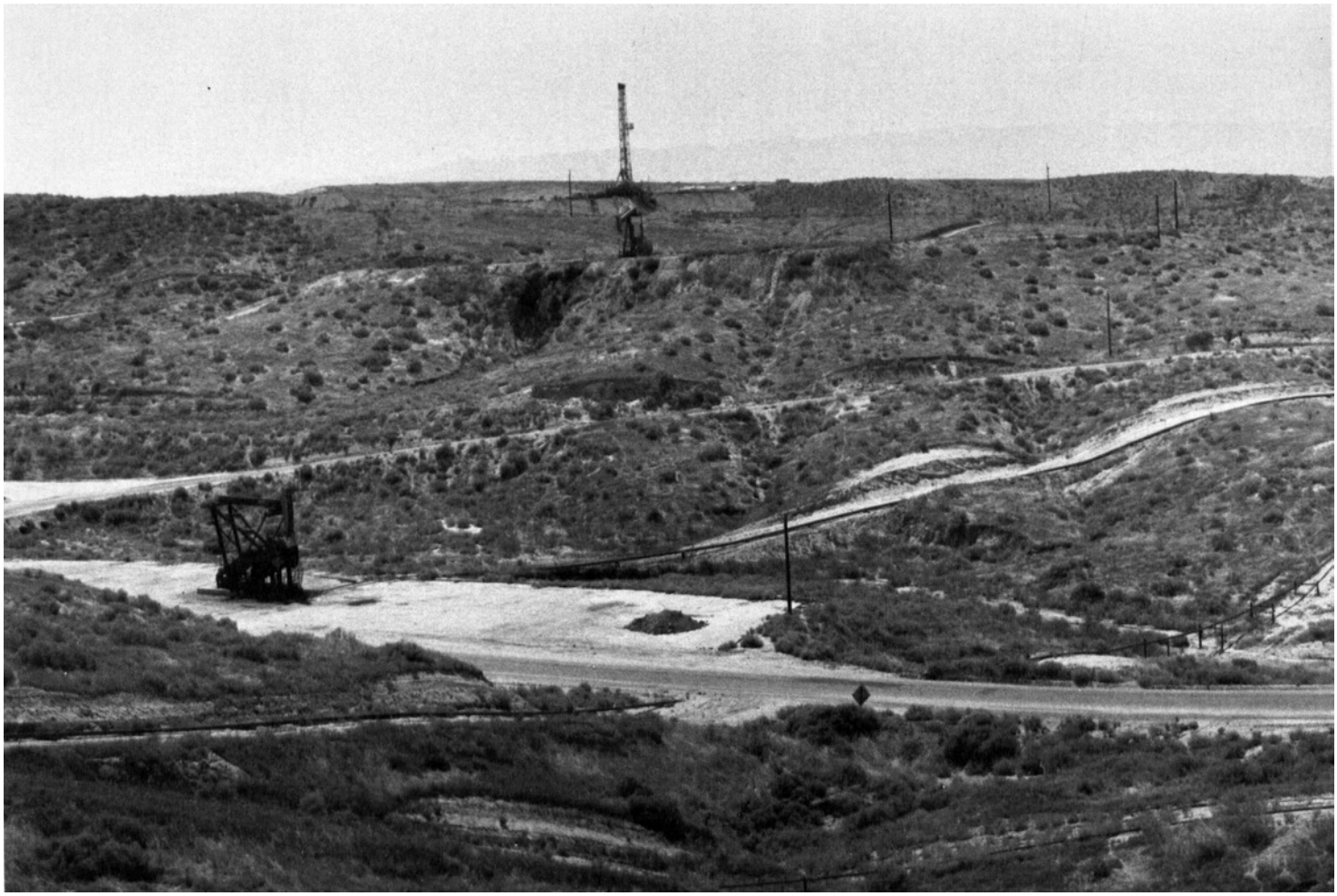
United States
Department of
Agriculture

Soil
Conservation
Service

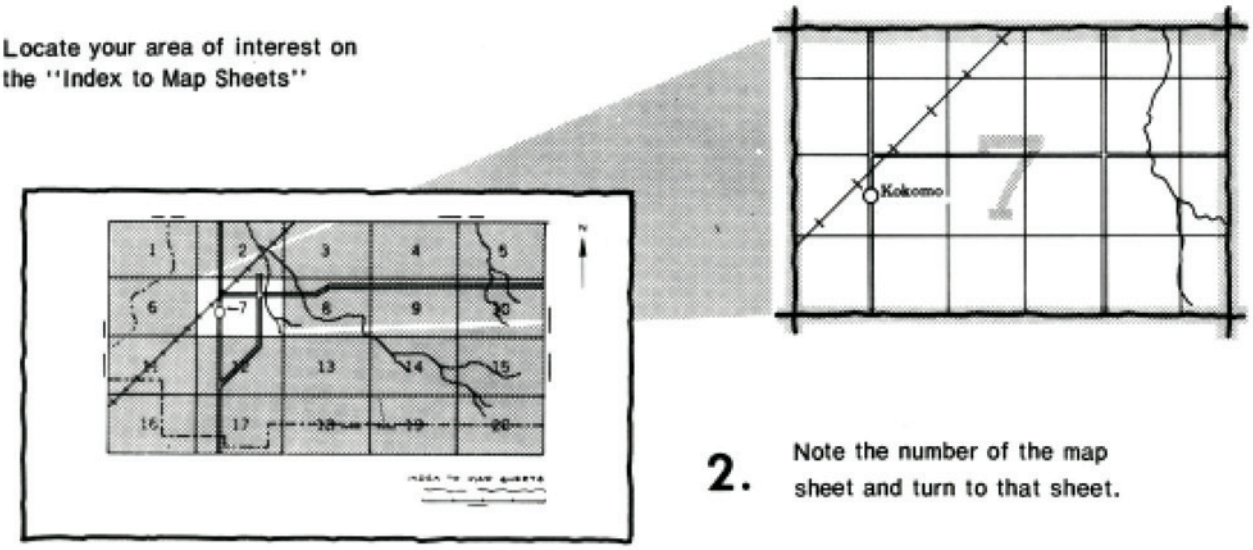
In cooperation with
The Regents of the
University of California
(Agricultural Experiment
Station)

Soil Survey of Kern County, California
Northwestern Part



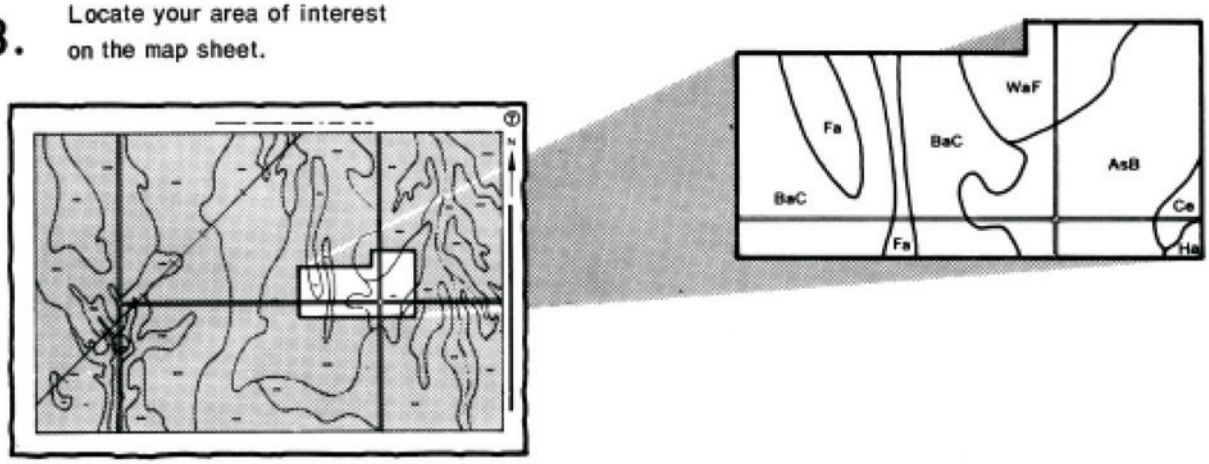
HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets"

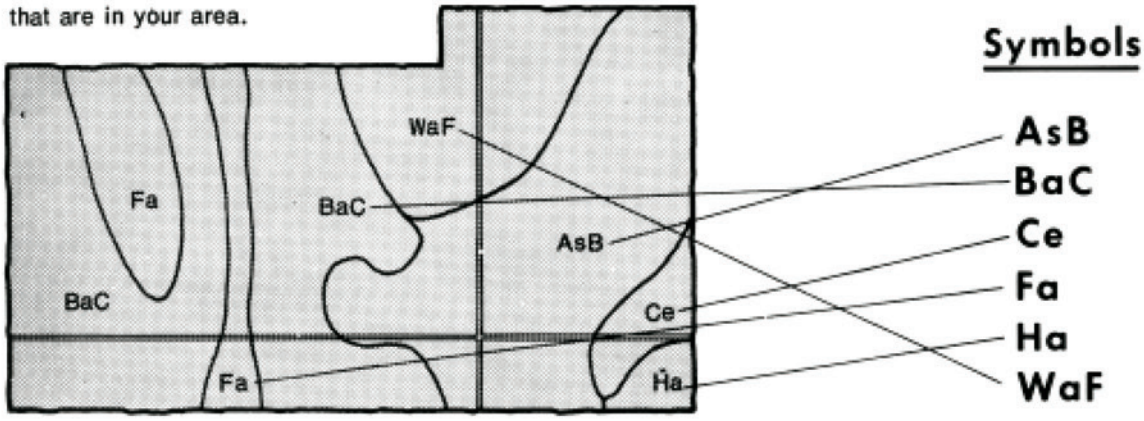


2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.

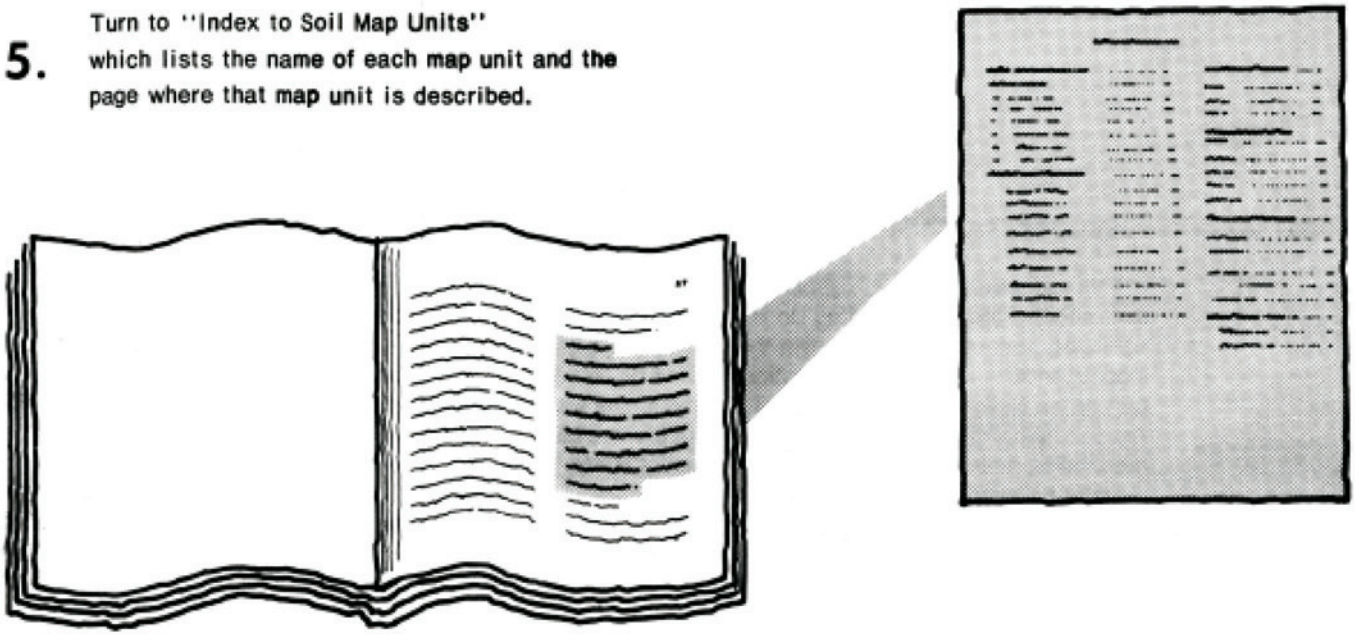


4. List the map unit symbols that are in your area.

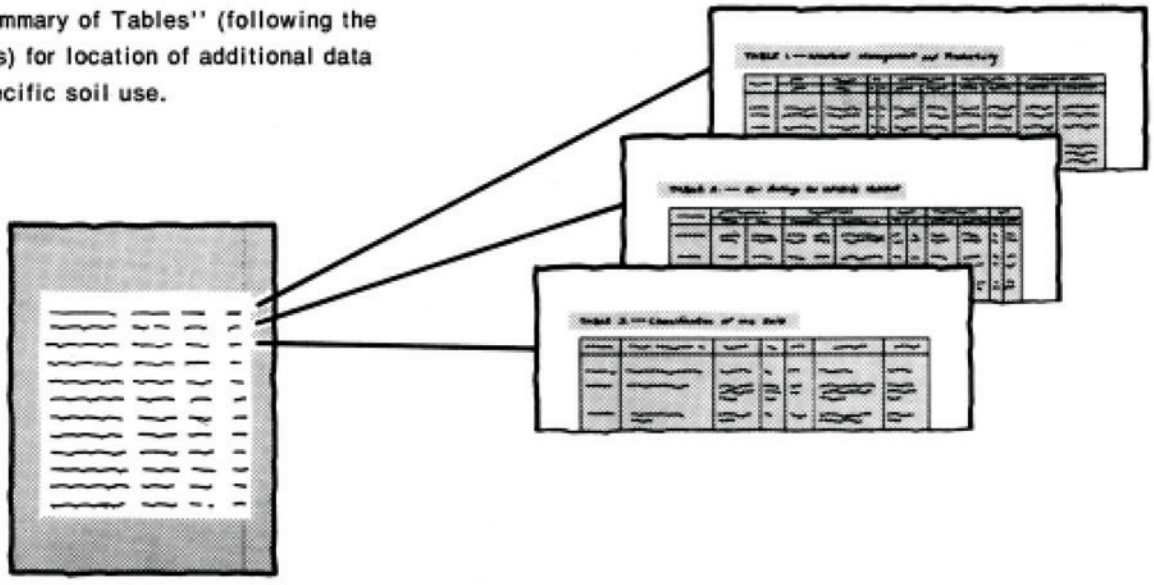


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, handicap, or age.

Major fieldwork for this soil survey was completed in 1981. Soil names and descriptions were approved in 1982. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1982. 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 Buena-Vista, Pond-Shafter-Wasco, and Rosedale-Rio Bravo Resource Conservation Districts.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Typical area of Elkhills sandy loam, 9 to 50 percent slopes, eroded.

Contents

Soil Series

Issued September 1988

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Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Kern County, California, Northwestern Part. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Eugene E. Andreuccetti
State Conservationist
Soil Conservation Service

Location of Kern County, Northwestern Part, in California.

Soil Survey of Kern County, California, Northwestern Part

By Kan Kim Chang, Soil Conservation Service

Fieldwork by Kan Kim Chang, Mario A. Valverde, Daniel E. Vaughn, John W. Key, V, James F. Regal, Richard F. Johnson, Terence L. Huff, and Kerry D. Arroues, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in cooperation with
The Regents of the University of California
(Agricultural Experiment Station)

KERN COUNTY, NORTHWESTERN PART, is at the southern end of the San Joaquin Valley. It has a total land area of about 2,144 square miles, or 1,371,900 acres. The survey area includes mountains, foothills, and valleys. Elevation ranges about 180 feet in the San Joaquin Valley to about 4,332 feet in the mountains.

Two earlier surveys cover parts of the present survey. The present survey, however, updates the earlier surveys and provides additional information and larger maps that show the soils in greater detail. The older surveys are "Soil Survey of the Wasco Area, California (*3*)" and "Soil Survey of the Bakersfield Area, California (*8*)." Parts of these older soil survey areas are in this survey area.

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

General Nature of the Survey Area

This section provides general information about the survey area. It discusses history and agricultural development; population trends; physiography, relief, and drainage; climate; water supply; and natural vegetation.

History and Agricultural Development

In 1851 the first permanent white settlers arrived in the survey area, attracted by the discovery of gold earlier that year.

Kern County was organized on April 2, 1866, from parts of Tulare and Los Angeles Counties. It was named after Edward M. Kern, the topographer of General John C. Fremont's third expedition through the Sierra Nevada in the winter of 1843-44 (*5*).

The first agricultural development on record in Kern County was in 1860, when cattle and sheep were brought into the area. Because of the low precipitation in the area, the growing of crops has depended largely upon the availability of irrigation water. Development of sources of water for irrigation, however, began with the growth of the mining industry. As miners came into the area, irrigation ditches were established and vegetable crops were grown.

The Kern County Land Company, which had a great influence on the development of agriculture in the area, was established in 1890. Many kinds of fruit and vegetables were grown. By 1914, electrical power had become available and more than 1,500 water pumping plants were operating in the area (*6*).

Agriculture is still one of the main industries in the survey area. Much of the nearly level to moderately sloping land in the San Joaquin Valley part of the survey area is used for alfalfa hay, carrots, citrus, cotton,

grapes, lettuce, nuts, potatoes, and sugar beets. The foothills and mountainous areas are used for livestock grazing.

Population Trends

The population of Kern County has grown considerably since 1870, when it was 2,925. In 1960 the population was 291,984, and in 1970 it was 330,234. In 1980 it had reached 403,089.

The major towns in the survey area are Bakersfield, population 105,599; Buttonwillow, 1,350; Delano, 16,491; McFarland, 5,151; Shafter 7,010; and Wasco, 9,613. Between 1970 and 1980 the population of the survey area increased about 28 percent. It generally is assumed that (1) the petroleum industry and agriculture, including the industries associated with them, will continue to provide a stable economic base for the survey area; (2) the decline in rural population that took place during the 1960's has halted; and (3) there will be a natural increase in population.

Physiography, relief, and drainage

The northwestern part of Kern County is mostly in the San Joaquin Valley, but parts of it are in the hills and mountains of the Diablo and Temblor Ranges. The San Joaquin Valley forms the southern half of the Central Valley, which is surrounded on all sides by mountains, except where the Sacramento and San Joaquin Rivers enter San Francisco Bay. The Coast Range forms a barrier on the western side of the valley.

The Diablo and Temblor Ranges, in the western part of the survey area, range in elevation from about 400 feet at the edge of the valley to about 4,332 feet on McKittrick Summit, in the southwestern part of the survey area. The nature of the general rock types in the area and the stream systems that drain it have contributed to the varied, undulating to steep, mountainous relief.

Several streams and small drainageways flow into the valley. In seasons of extreme rainfall, these streams and drainageways carry runoff into the Buena Vista Lake to the south or into Tulare Lake Basin to the north. The Kern River, which drains much of the southern part of the Sierra Nevada, enters the valley through a canyon in the mountains northeast of Bakersfield. The construction of Isabella Reservoir impounded the waters of the Kern River. Streams entering the valley on the east side include Rag Gulch and Poso Creeks and those on the west side include Franciscan, Packwood, Bitterwater, Media Aqua, Santos, and Temblor Creeks. Except for the Kern River, the streams mentioned carry only a small amount of runoff and flow intermittently, but only during the wet season.

The alluvial fans and plains on the west side of the valley have an indefinite drainage system. The alluvial material that formed this nearly level to gently rolling landscape was deposited entirely by runoff from the Coast Range. Drainage channels are distinct along the large stream bottoms but are shallow, temporary, and diverge fanlike from the main channels.

The uplifted, dissected areas of old valley fill that makes up the Elk Hills, south of Buttonwillow, have slopes of 9 to 50 percent. They are dissected by many intermittent streams. Because of extensive petroleum construction activities and past sheep grazing in this area, exposed erodible soil material has accumulated in the drainageways. During wet seasons, fresh soil material is deposited on the lower slopes.

In the trough of the basin, near the middle part of the survey area, are many channels that run northward. These channels formerly carried much water from the Kern River to the Tulare Lake Basin. Almost all of this water is now diverted to canals. In the basin areas near the King-Kern County lines, a perched water table is at a depth of 3 to 6 feet. Drainage in these areas has been altered by seepage from extensive irrigation in the area.

The alluvial fans and plains on the eastern side of the San Joaquin Valley are nearly level to gently rolling. The alluvial material that makes up this landscape was derived entirely from the Sierra Nevada. In this area, indistinct stream channels tend to run in parallel, water flows in a westerly direction, and the soils are well drained because the area has a pronounced westerly slope.

The alluvial terraces in the eastern part of the San Joaquin Valley have a complete dendritic drainage system which connects with stream channels that come from the higher foothills to the east. They are nearly level to hilly and are in higher positions on the landscape than are the alluvial fans, which commonly are west of them. The soils in this area formed in alluvial deposits that were laid down during times of heavy runoff from the Sierra Nevada during or following the Pleistocene.

Climate

Mario A. Valverde, soil scientist, Soil Conservation Service, helped prepare this section.

The survey area is at the extreme south end of the San Joaquin Valley. It is partially surrounded by a horseshoe-shaped rim of mountains.

The Sierra Nevada to the east shuts out most of the cold air that flows southward over the continent in winter. It also catches and stores snow, which provides irrigation water for use during the dry summer months. To the west is the Coast Range (*17*).

Because of the topography of the surrounding landforms, there are large climatic variations within relatively short distances. The zones of variations can be classified as valley and mountain areas. The overall climate, however, is warm and semiarid to arid. There is only one wet season during the year, insofar as 90 percent of all the precipitation falls during October

through April. Snow in the valley is infrequent, and there is only a trace in about 1 year in 7.

Summers are cloudless, hot, and dry. The average length of the growing season is 265 days. The valley area is suitable for specialized types of agriculture. Cotton, potatoes, grapes, and cattle are the principal agricultural products. There are considerable amounts of deciduous fruit, citrus fruit, grain, and vegetables. Severe freezes seldom occur, and there are occasional years with no frost at all in certain warm areas.

Winters are mild and fairly humid. December and January are characterized by frequent fog or low clouds which occur mostly at night. These conditions prevail when cold, moist air is trapped in the valley by a high pressure system. In extreme cases fogginess or cloudiness may occur continuously for 2 to 3 weeks. The depth of the fog or clouds is usually less than 3,000 feet. Under these conditions there usually are clear skies and mild temperatures in the surrounding foothill and mountain areas.

Temperatures in summer often exceed 100 degrees F and rarely are less than 51 degrees. Precipitation ranges from 5 to 7 inches in the San Joaquin Valley and from 7 to 12 inches on the terraces, foothills, and mountains. The climate in the survey area is mostly typified by data from Bakersfield, Buttonwillow, Middlewater, and Wasco.

Table 1 gives data on air temperature and precipitation as recorded at Bakersfield, Buttonwillow, Middlewater, and Wasco.

At Bakersfield, Buttonwillow, and Wasco, the mean maximum temperatures in summer are in the upper 90's and nights are fairly warm. Throughout the year, the mean temperatures vary from 47 degrees in January to 84 degrees in July at Bakersfield and from 45 degrees in January to 82 degrees in July at Buttonwillow and Wasco.

Middlewater is the station closest to the Coast Range. The center of the Temblor range is about 6 miles southwest of Middlewater. The elevation at this station is 803 feet, but the highest elevation in the mountains, 4,332 feet, is at McKittrick Summit. At Middlewater, summer mean maximum temperatures are in the upper 90's and nights are slightly cooler. Throughout the year the mean temperature varies from 46 degrees in January to 85 degrees in July.

Table 2 shows the probabilities of freezing temperatures and length of growing season at Bakersfield, Buttonwillow, Middlewater, and Wasco. Bakersfield has a growing season of 302 days at more than 32 degrees F; Buttonwillow, 255 days; Middlewater, 279 days; and Wasco, 262 days. In the San Joaquin Valley, the last frost in spring is in February or early in March and the first frost in fall is late in November or early in December. In the mountains, the last frost in spring is early in May and the first frost in fall for some areas is early in October.

A study of windspeed records suggests that windspeeds in the survey area are as much as 30 to 45 miles per hour about once in 2 years. As often as once in 50 years windspeeds reach 60 to 65 miles per hour, and at 100-year intervals they reach 65 to 75 miles per hour. Protected areas receive less, while exposed locations and those at higher elevation receive more.

Water Supply

Water of generally good to excellent quality is available in the survey area from a river, creeks, reservoirs, canals, an aqueduct, and rainfall. The natural source is runoff or accumulation of water from rainfall and snowfall from the Sierra Nevada. In winter accumulation of snow in the higher mountains provides a seasonal reservoir of water. The water flows to the area mainly through the Kern River and Poso Creek. These streams supply much of the surface water used for irrigation and much of the ground water pumped for irrigation and for domestic and industrial use.

Water is conveyed to the southern part of the San Joaquin Valley through the Friant-Kern Canal and the California Aqueduct. The Friant-Kern Canal is along the eastern edge of the valley. Water is diverted from the canal to irrigation districts, which in turn distribute water to farmers in the eastern part of the survey area. The California Aqueduct provides water for farmers on the western side of the valley.

The construction of the Isabella Dam has helped to control flooding. The dam also helps to regulate the use of surface and ground water. This is necessary because much farming in the county is done by irrigation.

Pumping of ground water provides needed water during seasons when the supply of surface water is low or during years when precipitation is not sufficient. The ground water is replenished by infiltration of rainfall and tailwater from irrigated fields; by seepage from streams, unlined canals, ditches, and ponds; and by underground flow of streams through permeable material in canyons (*9*).

In the hills and mountains, water is obtained from seasonally intermittent streams, from springs, and from shallow wells in pockets of alluvium or deeply weathered rock. Earth dams have been constructed in drainageways throughout the hills and mountains to intercept and impound water for use by livestock and wildlife.

Natural Vegetation

The valley areas are mostly cultivated and support a wide variety of crops under irrigation. Some natural vegetation remains in small unreclaimed areas of saline-alkali soils and on undeveloped alluvial fans and terraces. Much of the native vegetation in the survey

area has been replaced by introduced species or has been eliminated by cultivation and overgrazing.

In the hills and mountains, the vegetation ranges from open areas of annual grasses to dense areas of shrubs and trees. During the dry season, in summer and early in fall, the hazard of fire in the hills and mountains is serious. A fire lookout and control station is maintained during the fire season. Much of the native vegetation in the area has been replaced by introduced species or has been eliminated by local cultivation and by overgrazing.

The valley lands originally supported large herds of elk, antelope, and wild horses that grazed mainly on native grasses. Even as early as 1844, filaree, an introduced forb from the Mediterranean region, was widespread and well established (*10*). Marshes in the valley support large areas of bulrush, tule, and cattail. Trees and shrubs grew along many of the streams and rivers, as they do today. These include cottonwood, willow, wild rose, elderberry, and California blackberry.

The natural cover of the unreclaimed saline-alkali soils consists of poor stands of red brome, soft chess, foxtail barley, and foxtail fescue that tolerate salt and alkali. Among the plants that tolerate salt and alkali are saltgrass, alkali blite, iodinebush, and saltbush.

On the terraces the present vegetation consists mainly of red brome, soft chess, foxtail fescue, and filaree with scattered growth of allscale saltbush.

Weeds are a serious problem in many cultivated areas. Bermudagrass provides good forage in irrigated pasture and makes a durable lawn in this climate, but it is a serious pest in fields of row crops and in vineyards. Other pests are starthistle, nutsedge, sandbur, morningglory, puncturevine, Russian-thistle, mustard, fiddleneck, cocklebur, wild sunflower, and johnsongrass. These weeds can be controlled by weed killers and in places by clean cultivation or introduced insects. Tule, cattail, smartweed, and wild sunflower cause trouble in places along irrigation and drainage ditches.

At low elevations in the hills, where rainfall is low, the vegetation consists of annual grasses and forbs and a few shrubs. In the hills and mountains, where rainfall is higher, vegetation ranges from annual grasses and forbs to trees and shrubs.

The vegetation in the low hills is dominantly red brome, foxtail fescue, filaree, and foxtail barley. Formerly these hills were largely covered with saltbush, but fires have greatly reduced its extent. Many forbs, including such wild flowers as California poppy, lupine, brodiaea, and owlclover are conspicuous in spring. Three weeds that are abundant are Russian-thistle, turkeymullein, and fiddleneck.

The vegetation in the upper hills and mountains is dominantly annual grasses, forbs, trees, and shrubs. The dominant grasses are wild oat and soft chess. Many forbs, including such wild flowers as California poppy, lupine, brodiaea, burclover, buttercup, and owlclover are conspicuous in spring. The principle trees in the wooded areas are blue oak, digger pine, juniper, and California scrub oak. Cottonwood, willow, elderberry, and tree tobacco grow along many streams. The shrub cover consists mainly of chamise, ceanothus, California sagebrush, manzanita, California yerba-santa, black sage, and poison-oak.

How This Survey Was Made

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

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

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

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted color, texture, size, and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil

characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

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

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

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

General Soil Map Units

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

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

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

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

Map Unit Descriptions

Soils on hills and mountains of the Temblor and Diablo Ranges

Three map units are in this group. They make up about 9 percent of the survey area.

1. Aramburu-Reward

Moderately deep and deep, hilly to very steep, well drained shaly loam and very shaly clay loam

This map unit is in the Temblor Range, in the southwestern part of the survey area. The soils in this unit formed in residuum derived from shale or sandstone. Elevation ranges from 1,700 to 4,332 feet.

This unit makes up about 2 percent of the survey area. It is about 61 percent Aramburu soils and 18 percent Reward soils. The remaining 21 percent is soils of minor extent.

Aramburu soils are moderately deep and well drained. Slope ranges from 15 to 75 percent. Typically, the surface layer is very shaly clay loam. It is underlain by hard, fractured shale. Shale content ranges from 35 to 50 percent.

Reward soils are deep and well drained. Slope ranges from 15 to 50 percent. Typically, the surface layer is shaly loam. The underlying layer is shaly loam and shaly clay loam. It is underlain by fractured shale. Shale content ranges from 15 to 30 percent, commonly increasing with increasing depth.

Of minor extent in this unit are shallow, well drained Temblor and Hillbrick soils; moderately deep, well drained Kilmer soils; and deep, well drained Bitterwater soils. Also of minor extent are small areas of Typic Torriorthents.

This unit is used mainly as rangeland, watershed, and wildlife habitat. Restricted available water capacity and a hazard of water erosion on the steeper slopes are the main limitations.

2. Aido-Ayar-Hillbrick

Shallow to deep, rolling to very steep, well drained clay, silty clay, and sandy loam

This map unit is in drainageways and on rolling to very steep hillslopes of the Temblor and Diablo Ranges, in the western part of the survey area. The soils in this unit formed in residuum derived from shale or sandstone. Elevation ranges from 1,400 to 3,000 feet.

This unit makes up about 3 percent of the survey area. It is about 31 percent Aido soils, 21 percent Ayar soils, and 20 percent Hillbrick soils. The remaining 28 percent is soils of minor extent.

Aido soils are moderately deep and well drained. Slope ranges from 9 to 75 percent. Typically, the surface layer is clay. The underlying material is clay underlain by fractured, calcareous shale.

Ayar soils are deep and well drained. Slope ranges from 9 to 75 percent. Typically, the surface layer is silty clay. The underlying material is silty clay and clay underlain by fine grained sandstone.

Hillbrick soils are shallow and well drained. Slope ranges from 15 to 75 percent. Typically, the surface layer is sandy loam underlain by hard, fractured shale.

Of minor extent in this unit are moderately deep and deep, well drained Altamont, Balcom Variant, Choice, Los Osos Variant, Myers Variant, and Vaquero soils and shallow, well drained and somewhat excessively drained

Bluestone, Lodo Variant, and Millsholm Variant soils. Also included are small areas of Badland; Montara and Polonio soils; Xeralfs, Xerofluvents, and Xerorthents; and Rock outcrop.

The soils in this unit are used mainly as rangeland, for dry farmed grain, and as wildlife habitat and watershed. Steepness of slope and a hazard of erosion are the main limitations.

3. Hillbrick-Kilmer-Mendi

Shallow to deep, gently rolling to very steep, well drained sandy loam and loam

This map unit is on narrow ridgetops, rounded knolls, and side slopes of the Temblor and Diablo Ranges, in the western part of the survey area. The soils in this unit formed in residuum derived from shale or sandstone. Slope is 9 to 75 percent. Elevation ranges from 1,000 to 2,300 feet.

This unit makes up about 4 percent of the survey area. It is about 36 percent Hillbrick soils, 20 percent Kilmer soils, and 17 percent Mendi soils. The remaining 27 percent is soils of minor extent.

Hillbrick soils are shallow and well drained. Typically, the surface layer is sandy loam underlain by hard, fractured shale.

Kilmer soils are moderately deep and well drained. Typically, the surface layer and the underlying material are loam. Below this is calcareous shale.

Mendi soils are deep and well drained. Typically, the surface layer is loam and the underlying material is loam and silt loam. Below this is calcareous sandstone.

Of minor extent in this unit are moderately deep, well drained Aido and Nacimiento soils; shallow, somewhat excessively drained Lodo Variant soils; Badland; and Rock outcrop. Also of minor extent are small areas of Ayar, Capay, Los Osos Variant, Millsholm Variant, Montara, and Polonio soils and Xerofluvents.

This unit is mainly used as rangeland, wildlife habitat, and watershed. Steepness of slope and a hazard of erosion are the main limitations.

Soils on the foothills of the Temblor and Diablo Ranges

Two map units are in this group. They make up about 7 percent of the survey area.

4. Kettleman-Bitterwater-Delgado

Shallow to deep, rolling to very steep, somewhat excessively drained and well drained soils underlain by weathered sandstone or shale

This map unit is in the Temblor and Diablo Ranges. The soils in this unit formed in residuum derived mainly from sedimentary rock. Elevation ranges from 450 to 1,900 feet.

This unit makes up about 3 percent of the survey area. It is about 35 percent Kettleman soils, 25 percent Bitterwater soils, and 12 percent Delgado soils. The remaining 28 percent is soils of minor extent.

Kettleman soils are moderately deep and well drained. Slope ranges from 9 to 50 percent. Typically, the surface layer and the underlying material are sandy loam. Below this is weathered sandstone.

Bitterwater soils are deep and well drained. Slope ranges from 9 to 75 percent. Typically, the surface layer and underlying material are sandy loam. Below this is weathered sandstone.

Delgado soils are shallow and somewhat excessively drained. Slope ranges from 9 to 50 percent. Typically, the surface layer and underlying material are sandy loam. Below this is hard sandstone.

Of minor extent in this unit are moderately deep, well drained Aridic Calcixerolls and Carollo soils; shallow, well drained Cymric soils; deep, moderately well drained Kecksroad soils; and deep, well drained Typic Torriorthents and Twisselman soils. Also in this unit are small areas of Hillbrick, Kimberlina, Mendi, and Yribarren soils, Badland, and Rock outcrop.

This unit is used as rangeland. Oil wells are common on the unit. Steepness of slope, a hazard of erosion, and shallow depth are the main limitations.

5. Elkhills

Deep, rolling to steep, well drained soils that formed in mixed, stratified alluvium

This map unit is mainly in the Elk Hills area and partly along the foothills of the Temblor Range, in the southern part of the survey area. The soils in this unit formed in alluvium derived dominantly from sedimentary and granitic rock. Elevation ranges from 400 to 1,800 feet.

This unit makes up about 4 percent of the survey area. It is about 74 percent Elkhills soils. The remaining 26 percent is soils of minor extent.

Elkhills soils are deep and well drained. Slope ranges from 9 to 50 percent. Typically, the surface layer is sandy loam and the subsurface layer is fine sandy loam. The upper part of the underlying material is coarse sandy loam, and the lower part is stratified gravelly coarse sand, sand, and loamy sand.

Of minor extent in this unit are deep, somewhat excessively drained Cajon soils and moderately deep, well drained Kettleman soils. Also of minor extent are Rock outcrop and stratified, and eroded Torriorthents.

Most areas of this unit are used as rangeland. Oil wells are common on the unit. Steepness of slope and a hazard of erosion are the main limitations.

Soils in the mountain valleys of the Temblor Range

One map unit is in this group. It makes up about 1 percent of the survey area.

6. Pottinger-Polonio

Deep, undulating to rolling, well drained soils; on alluvial fans and terraces

Pottinger soils are on alluvial fans and terraces, mainly in little Santa Maria Valley, west of McKittrick. Polonio soils are on alluvial fans along the stream channels. Elevation ranges from 1,050 to 3,000 feet.

This unit makes up about 1 percent of the survey area. It is about 43 percent Pottinger soils and 42 percent Polonio soils. The remaining 15 percent is soils of minor extent.

Pottinger soils are deep and well drained. Slope ranges from 2 to 15 percent. Typically, the surface layer is loam and the underlying material is sandy clay loam.

Polonio soils are deep and well drained. Slope ranges from 2 to 9 percent. Typically, the surface layer is loam and the underlying material is sandy clay loam.

Of minor extent in this unit are deep, well drained and moderately well drained Capay and Reward soils and moderately deep, well drained Aramburu, Kilmer, and Nacimiento soils.

This unit is used mainly for dryfarmed grain, as a source of road material, and as rangeland, watershed, and wildlife habitat. Restricted available water capacity, shaly texture, and a hazard of erosion are the main limitations of the Pottinger soils. The Polonio soils have few limitations.

Soils mainly on alluvial fans, alluvial plains, and terraces in the western part of the San Joaquin Valley

Three map units are in this group. They make up about 25 percent of the survey area.

7. Panoche-Milham-Kimberlina

Deep, nearly level to moderately sloping, well drained clay loam, sandy loam, and fine sandy loam; on alluvial fans, alluvial plains, and terraces

This map unit is on the west side of the San Joaquin Valley. The soils in this unit formed in alluvium derived dominantly from sedimentary and granitic rock. Slope is 0 to 9 percent. Elevation ranges from 250 to 1,200 feet.

This unit makes up about 18 percent of the survey area. It is about 44 percent Panoche soils, 30 percent Milham soils, and 20 percent Kimberlina soils. The remaining 6 percent is soils of minor extent.

Panoche soils are deep and well drained. They are on alluvial fans and plains. Typically, the surface layer is clay loam. The underlying material is loam, sandy clay loam, and clay loam.

Milham soils are deep and well drained. They are on alluvial fans, alluvial plains, and terraces. Typically, the surface layer is sandy loam. The subsoil is loam and clay loam. The substratum is sandy loam.

Kimberlina soils are deep and well drained. They are on alluvial fans and plains. Typically, the surface layer is fine sandy loam. The upper part of the underlying material is fine sandy loam, and the lower part is silt loam.

Of minor extent in this unit are deep, well drained Twisselman and Lewkalb soils, Cajon soils, Pits, Millsholm Variant soils, Rock outcrop, and Yribarren soils.

Developed areas of this unit are used for irrigated crops and pasture. Undeveloped areas are used as rangeland. The major soils in this unit have few limitations.

8. Kimberlina

Deep, nearly level to moderately sloping, well drained fine sandy loam; on recent alluvial fans and alluvial plains

This map unit is on the lower parts of the landscape. The soils in this unit formed in alluvium derived from granitic or sedimentary rock. Elevation ranges from 250 to 1,000 feet.

This unit makes up about 5 percent of the survey area. It is about 69 percent Kimberlina soils. The remaining 31 percent is soils of minor extent.

Kimberlina soils are deep and well drained. Slope ranges from 0 to 9 percent. Typically, the surface layer is fine sandy loam. The upper part of the underlying material is fine sandy loam, and the lower part is silt loam.

Of minor extent in this unit are deep, well drained Panoche and Milham soils, Typic Gypsiorthids, and Twisselman soils; deep, well drained Lethent soils; deep, somewhat poorly drained Nahrub soils; and Pits used for gypsum mining.

This unit is used as rangeland and for irrigated crops.

The major soils in this unit have few limitations for most crops commonly grown in the survey area. The hazard of erosion in the steeper areas is the main limitation.

9. Twisselman-Yribarren-Panoche

Deep, nearly level to gently rolling, well drained clay, loam, and clay loam; on alluvial fans

This map unit is on the lower parts of the landscape in the northwestern part of the survey area. The soils in this unit formed in alluvium derived dominantly from sedimentary rock. Elevation ranges from 210 to 1,200 feet.

This unit makes up about 2 percent of the survey area. It is about 61 percent Twisselman soils, 21 percent Yribarren soils, and 15 percent Panoche soils. The remaining 3 percent is soils of minor extent.

Twisselman soils are deep and well drained. Slope ranges from 0 to 5 percent. Typically, the surface layer and the underlying material are clay.

Yribarren soils are deep and well drained. Slope ranges from 0 to 5 percent. Typically, the surface layer is loam. The subsoil is silty clay. The substratum is loam and silty clay. These soils are slightly alkali.

Panoche soils are deep and well drained. Slope ranges from 0 to 9 percent. Typically, the surface layer is clay loam. The upper part of the underlying material is loam, and the lower part is sandy clay loam and clay loam.

Of minor extent in this unit are deep, well drained Lewkalb soils. Also included are small areas of Kimberlina and Milham soils.

This unit is used for irrigated crops and as rangeland. The hazard of erosion in the steeper areas and fine soil texture are the main limitations.

Soils mainly on basins of the San Joaquin Valley

Two map units are in this group. They make up about 10 percent of the survey area.

10. Lokern-Buttonwillow

Deep, nearly level, somewhat poorly drained clay

This map unit is in one of the lowest positions in the survey area. It formed in alluvium weathered from granitic rock. Slope is 0 to 2 percent. Elevation ranges from 240 to 300 feet.

This unit makes up about 4 percent of the survey area. It is about 56 percent Lokern soils and 44 percent Buttonwillow soils.

Lokern soils are deep and somewhat poorly drained. Typically, the surface layer is clay. The upper part of the underlying material is clay, and the lower part is fine sandy loam.

Buttonwillow soils are deep and somewhat poorly drained. Typically, the surface layer is clay. The upper part of the underlying material is fine sandy loam, and the lower part is clay.

This unit is used for native and irrigated pasture, irrigated crops, wildlife habitat, and some urban development. The saline-alkali condition of the soils, restricted permeability, and fine texture are the main limitations.

11. Nahrub-Lethent-Twisselman

Deep, nearly level, well drained to somewhat poorly drained clay and silt loam

This map unit is in the lowest positions in the survey area. The soils in this unit formed in fine textured alluvium derived from granitic and sedimentary rock. Slope is 0 to 2 percent. Elevation ranges from 180 to 300 feet.

This unit makes up about 6 percent of the survey area. It is about 54 percent Nahrub soils, 19 percent Lethent soils, and 18 percent Twisselman soils. The remaining 9 percent is soils of minor extent.

Nahrub soils are deep and somewhat poorly drained. Typically, the surface layer is clay. The upper part of the underlying material is clay, and the lower part is clay loam and fine sandy loam. These soils are strongly saline-alkali.

Lethent soils are deep and moderately well drained. Typically, the surface layer is silt loam. The subsoil is silty clay loam, silty clay, and clay. The substratum is clay loam and loam. These soils are moderately to strongly saline-alkali.

Twisselman soils are deep and well drained. Typically, the surface layer is clay. The underlying material is clay and silty clay. These soils are moderately to strongly saline-alkali.

Of minor extent in this unit are deep, well drained Garces soils and deep, somewhat poorly drained Buttonwillow and Lokern soils. Also included are small areas of Houser and Lerdo soils.

This unit is used for irrigated salt tolerant crops, rangeland, wildlife habitat, and irrigated pasture. The saline-alkali condition of the soils, restricted permeability, and fine texture are the main limitations.

Soils mainly on alluvial fans, alluvial plains, basin rims, and flood plains in the eastern part of the San Joaquin Valley

Five map units are in this group. They make up about 35 percent of the survey area.

12. Garces-Panoche

Deep, nearly level, saline-alkali, well drained silt loam and clay loam; on basin rims, alluvial fans, and alluvial plains

This map unit is on the outer rim of basins in the San Joaquin Valley. The soils in this unit formed in alluvium weathered from various kinds of rock. Slope is 0 to 2 percent. Elevation ranges from 250 to 1,500 feet.

This unit makes up about 11 percent of the survey area. It is about 65 percent Garces soils and 23 percent Panoche soils. The remaining 12 percent is soils of minor extent.

Garces soils are deep and well drained. Typically, the surface layer is silt loam. The subsoil is clay loam and loam. The substratum is loam and fine sandy loam. In some areas the substratum is stratified and contains a brittle layer of weakly to moderately cemented material. These soils are moderately to strongly saline-alkali.

Panoche soils are deep and well drained. Typically, the surface layer and the underlying material are clay loam. These soils are moderately saline-alkali.

Of minor extent in this unit are moderately deep, well drained Jerryslu soils and deep, well drained Kimberlina and Milham soils. Also of minor extent are some areas of deep, moderately well drained Lethent soils and deep, somewhat poorly drained Lerdo soils.

This unit is mainly used for irrigated crops and pasture. The saline-alkali condition of the soils and very slow permeability are the main limitations.

13. Kimberlina-Wasco

Deep, nearly level, well drained fine sandy loam and sandy loam; on alluvial fans and alluvial plains

This map unit is on alluvial fans and plains on the San Joaquin Valley floor, near the towns of Wasco and Shafter. The soils in this unit formed in alluvium derived from granitic or sedimentary rock. Slope is 0 to 2 percent. Elevation ranges from 250 to 1,000 feet.

This unit makes up about 15 percent of the survey area. It is about 47 percent Kimberlina soils and 46 percent Wasco soils. The remaining 7 percent is soils of minor extent.

Kimberlina soils are deep and well drained. These soils are on alluvial fans and plains. Typically, the surface layer is fine sandy loam. The upper part of the underlying material is fine sandy loam, and the lower part is silt loam.

Wasco soils are deep and well drained. These soils are on alluvial fans. Typically, the surface layer and underlying material are sandy loam.

Of minor extent in this unit are deep, well drained Milham soils; deep, somewhat excessively drained Cajon soils; Excelsior, McFarland, and Panoche soils; and Pits, Riverwash, and Urban land.

This unit is mainly used for irrigated crops. A few areas where natural vegetation still remains are used as rangeland. The major soils in this unit have few limitations.

14. McFarland

Deep, nearly level, well drained loam; on alluvial fans and flood plains

This map unit is between the foothills of the Sierra Nevada and the San Joaquin River, at the eastern edge of the San Joaquin Valley. The soils in this unit formed in alluvium derived from granitic rock. Slope is 0 to 2 percent. Elevation ranges from 285 to 400 feet.

This unit makes up about 3 percent of the survey area. It is about 84 percent McFarland soils. The remaining 16 percent is soils of minor extent.

McFarland soils are deep and well drained. These soils are on flood plains and alluvial fans. Typically, the surface layer and underlying material are loam.

Of minor extent in this unit are deep, well drained Delano, Panoche, and Wasco soils and deep, somewhat excessively drained Cajon soils.

This unit is mainly used for irrigated crops and orchards. The major soils in the unit have few limitations.

15. Milham

Deep, nearly level, well drained sandy loam; on old alluvial fans and alluvial plains

This map unit is mainly on Semitropic and Buttonwillow Ridges, in the middle of the survey area. The soils in this unit formed in old alluvium derived from granitic and sedimentary rock. Slope is 0 to 2 percent. Elevation ranges from 250 to 1,000 feet.

This unit makes up about 2 percent of the survey area. It is about 94 percent Milham soils. The remaining 6 percent is soils of minor extent.

Milham soils are deep and well drained. Typically, the surface layer is sandy loam. The upper part of the subsoil is sandy loam, and the lower part is loam and clay loam. The substratum is sandy loam.

Of minor extent in this unit are deep, well drained Garces and Kimberlina soils.

This unit is mainly used for irrigated crops and orchards. Undeveloped areas are used mainly as rangeland. The major soils in this unit have few limitations.

16. Cajon-Westhaven

Deep, nearly level and gently sloping, well drained and somewhat excessively drained loamy sand and fine sandy loam; on flood plains and alluvial fans

This map unit is on lower positions adjacent to former drainageways in the San Joaquin Valley. It is in the southern part of the survey area. The soils in this unit formed in alluvium derived mainly from granitic rock. Elevation ranges from 200 to 550 feet.

This unit makes up about 4 percent of the survey area. It is about 45 percent Cajon soils and 16 percent Westhaven soils. The remaining 39 percent is soils of minor extent.

Cajon soils are deep and somewhat excessively drained. These soils are on alluvial fans. Slope is 0 to 5 percent. Typically, the surface layer is loamy sand. The upper part of the underlying material is sand, and the lower part is sandy loam.

Westhaven soils are deep and well drained. These soils are on alluvial fans and flood plains. Slope is 0 to 2 percent. Typically, the surface layer is fine sandy loam. The upper part of the underlying material is silt loam, and the lower part is clay and clay loam.

Of minor extent in this unit are deep, well drained Excelsior, Kimberlina, and Wasco soils; deep, somewhat poorly drained Lerdo soils; Pits; and Riverwash.

This unit is mainly used for irrigated crops. Low available water capacity and a hazard of soil blowing are the main limitations.

Soils on terraces in the eastern part of the San Joaquin Valley

Four map units are in this group. They make up about 13 percent of the survey area.

17. Delano-Chanac

Deep, nearly level to hilly, well drained sandy loam and clay loam

This map unit is in the higher positions on the eastern terraces of the San Joaquin Valley. The soils in this unit formed in alluvium derived from granitic rock. Elevation ranges from 260 to 1,000 feet.

This unit makes up about 7 percent of the survey area. It is about 40 percent Delano soils and 28 percent Chanac soils. The remaining 32 percent is soils of minor extent.

Delano soils are on alluvial plains and terraces. Slope ranges from 0 to 9 percent. Typically, the surface layer is sandy loam. The subsoil is clay loam, sandy clay loam, and sandy loam. The substratum is sandy loam.

Chanac soils are on alluvial fans and terraces. Slope ranges from 2 to 30 percent. Typically, the surface layer is clay loam. The subsoil is sandy clay loam and sandy loam. The substratum is sandy loam.

Of minor extent in this unit are deep, well drained Cuyama, Elkhills, Excelsior Variant, Hesperia, and Kimberlina soils, Torriorthents, and Premier soils. Also of minor extent are small areas of Cajon, Delano Variant, Wasco, and Whitewolf soils, Pits, dumps, Riverwash, stratified and eroded Torriorthents, and Urban land.

This unit is mainly used for irrigated crops, dry farmed grain, and rangeland. The main limitation of this unit is the hazard of erosion in the steeper areas.

18. Exeter

Moderately deep, nearly level to gently rolling, well drained sandy loam that has a cemented layer

This map unit is in intermediate positions on the eastern terraces of the San Joaquin Valley. The soils in this unit formed in alluvium derived from granitic rock. Elevation ranges from 300 to 700 feet.

This unit makes up about 1 percent of the survey area. It is about 98 percent Exeter soils. The remaining 2 percent is soils of minor extent.

Exeter soils are moderately deep and well drained. These soils are on broad alluvial terraces. Slope ranges from 0 to 9 percent. Typically, the surface layer is sandy loam. The subsoil is loam over a strongly cemented layer. Below the cemented layer is stratified material.

Of minor extent in this unit are deep, well drained Wasco soils.

This unit is mainly used for irrigated crops and dry-farmed grain. Low available water capacity and the lime- and silica-cemented layer are the main limitations.

19. Delano-Lewkalb-Driver

Deep, nearly level to moderately sloping, well drained sandy loam and coarse sandy loam

This map unit is in intermediate positions on the eastern terraces of the San Joaquin Valley. The soils in this unit formed in alluvium derived dominantly from granitic rock. Elevation ranges from 260 to 700 feet.

This unit makes up about 4 percent of the survey area. It is 36 percent Delano soils, 21 percent Lewkalb soils, and 19 percent Driver soils. The remaining 24 percent is soils of minor extent.

Delano soils are deep and well drained. These soils are on alluvial plains and terraces. Slope ranges from 0 to 9 percent. Typically, the surface layer is sandy loam. The subsoil is clay loam, sandy clay loam, and sandy loam. The substratum is sandy loam.

Lewkalb soils are deep and well drained. These soils are on alluvial terraces. Slope ranges from 0 to 2 percent. Typically, the surface layer is sandy loam. The underlying material is weakly silica-cemented sandy loam.

Driver soils are deep and well drained. These soils are on alluvial terraces. Slope ranges from 0 to 2 percent. Typically, the surface layer is coarse sandy loam. The subsoil is loam. The upper part of the substratum is weakly cemented coarse sandy loam, and the lower part is loam and loamy coarse sand.

Of minor extent in this unit are deep, well drained Panoche, Wasco, and Zerker soils and moderately deep, well drained Exeter soils.

This unit is used for irrigated field and orchard crops. A hazard of erosion in the steeper areas and the weakly cemented layer are the main limitations.

20. Premier

Deep, undulating to hilly, well drained coarse sandy loam

This map unit is in intermediate positions on the eastern terraces of the San Joaquin Valley. The soils in this unit formed in alluvium derived dominantly from granitic rock. Slope is 2 to 30 percent. Elevation ranges from 500 to 2,800 feet.

This unit makes up less than 1 percent of the survey area. It is about 78 percent Premier soils. The remaining 22 percent is soils of minor extent.

Premier soils are deep and well drained. These soils are on alluvial terraces. Typically, the surface layer and underlying material are coarse sandy loam.

Of minor extent in this unit are deep, well drained Chanac, Delano, and Wasco soils, Durorthids, and Pits.

This unit is used as rangeland and for irrigated orchard crops. Oil wells are common on the unit. Moderate available water capacity and a hazard of erosion in the steeper areas are the main limitations.

Detailed Soil Map Units

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

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

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the underlying layers. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Kimberlina fine sandy loam, saline-alkali, 0 to 2 percent slopes, is one of several phases in the Kimberlina series.

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

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Nahrub, drained-Lethent complex is an example.

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

Hillbrick-Kilmer association, 30 to 50 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Vaquero and Altamont clays, 15 to 50 percent slopes, is an example.

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

Table 3 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations and potentials for many uses. The Glossary defines many of the terms used in describing the soils or miscellaneous areas.

Map Unit Descriptions

101—Aido clay, 9 to 30 percent slopes. This moderately deep, well drained soil is on hills and mountains. It formed in residuum derived dominantly from shale or sandstone. The present vegetation in most areas is mainly annual grasses and forbs. Elevation is 1,400 to 2,700 feet. The average annual precipitation is about 9 inches, the average annual temperature is about 63 degrees F, and the average frost-free season is 200 to 260 days.

Typically, the surface layer is pale brown clay about 10 inches thick. The underlying material to a depth of 26 inches is brown clay. Fractured, calcareous shale is at a depth of 26 inches. In some areas the surface layer is silty clay loam or silty clay.

Included in this unit are small areas of Kilmer loam and Hillbrick sandy loam. Also included are small areas of Rock outcrop. Included areas make up about 15 percent of the total acreage.

Permeability of this Aido soil is slow. Available water capacity is low to moderate. Runoff is rapid, and the hazard of water erosion is moderate. Effective rooting depth is 20 to 40 inches.

This unit is used mainly for livestock grazing. It is also used for dryfarmed grain.

This unit is suited to livestock grazing. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Livestock grazing should be managed to protect the soil from erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion.

This unit is poorly suited to dryfarmed grain. It is limited mainly by low rainfall, steepness of slope, and the hazard of erosion. Because precipitation is not sufficient for annual cropping, a cropping system of grain, fallow, and then volunteer pasture is most suitable. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. The soil responds well to fertilizer in years when precipitation is adequate. Water erosion can be reduced by cultivating in summer and planting early in fall.

This map unit is in capability unit IVe-1 (15), nonirrigated.

102—Aido clay, 30 to 50 percent slopes. This moderately deep, well drained soil is on hills and mountains. It formed in residuum derived dominantly from shale or fine grained sandstone. The present vegetation in most areas is mainly annual grasses, but it is forbs with scattered oaks and junipers in areas on north-facing slopes. Elevation is 2,000 to 3,000 feet. The average annual precipitation is about 9 inches, the average annual temperature is about 62 degrees F, and the average frost-free season is 200 to 250 days.

Typically, the surface layer is pale brown clay about 10 inches thick. The underlying material to a depth of 26 inches is brown clay. Fractured, calcareous shale is at a depth of 26 inches. In some areas the surface layer is silty clay loam or silty clay.

Included in this unit are small areas of Kilmer loam and Hillbrick sandy loam. Also included are small areas of Rock outcrop. Included areas make up about 15 percent of the total acreage.

Permeability of this Aido soil is slow. Available water capacity is low to moderate. Runoff is very rapid, and the hazard of water erosion is high. Effective rooting depth is 20 to 40 inches.

This unit is used mainly for livestock grazing. It is also used as watershed and wildlife habitat.

This unit is suited to livestock grazing. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Livestock grazing should be managed to protect the soil from erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Cross-fencing and correctly placing livestock watering facilities help to distribute livestock grazing and to reduce overgrazing of the lower slopes.

This map unit is in capability subclass VIe (15), nonirrigated.

103—Aido clay, 50 to 75 percent slopes. This moderately deep, well drained soil is on mountains. It formed in residuum derived dominantly from shale or fine grained sandstone. The present vegetation in most areas is mainly annual grasses and forbs, but scattered oaks and junipers are on the north-facing slopes. Elevation is 2,000 to 3,000 feet. The average annual precipitation is about 9 inches, the average annual temperature is about 62 degrees F, and the average frost-free season is 200 to 250 days.

Typically, the surface layer is pale brown clay about 10 inches thick. The underlying material to a depth of 26 inches is brown clay. Fractured, calcareous shale is at a depth of 26 inches. In some areas the surface layer is silty clay loam or silty clay.

Included in this unit are small areas of Kilmer loam, Hillbrick sandy loam, and Rock outcrop. Included areas make up about 25 percent of the total acreage.

Permeability of this Aido soil is slow. Available water capacity is low or moderate. Runoff is very rapid, and the hazard of water erosion is very high. Effective rooting depth is 20 to 40 inches.

This unit is used mainly as watershed, wildlife habitat, and livestock grazing.

This unit is suited to livestock grazing. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Cross-fencing and correctly placing livestock watering facilities help to distribute livestock grazing and to reduce overgrazing of the lower slopes. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Removal of the plant cover results in extensive erosion.

This map unit is in capability subclass VIIe (15), nonirrigated.

104—Aramburu very shaly clay loam, 15 to 30 percent slopes. This moderately deep, well drained soil is on hills and mountains. It formed in residuum derived dominantly from shale or sandstone. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 1,700 to 4,000 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 61 degrees F, and the average frost-free season is 180 to 225 days.

Typically, the Aramburu soil is grayish brown very shaly clay loam about 26 inches deep over hard fractured shale. It is about 35 to 50 percent shale fragments.

Included in this unit are small areas of Temblor very shaly sandy loam, Reward shaly loam, and a soil that is similar to this Aramburu soil but is lighter in color. Also included are small areas of soils that are similar to this Aramburu soil but have slopes of less than 15 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Aramburu soil is moderate. Available water capacity is low or very low. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 20 to 40 inches.

Most areas of this unit are used for livestock grazing, watershed, and wildlife habitat. A few areas are used for dryfarmed grain.

This unit is suited to livestock grazing. If the unit is grazed by livestock when the soil is too moist, the productivity of the soil is reduced because the trampling of the surface compacts the soil and uproots plants. Grazing should be delayed until the soil has drained sufficiently and is firm enough to withstand trampling by livestock. If the range is overgrazed, the proportion of preferred foraged plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Springs and seeps on this unit can be developed as watering facilities for wildlife and to achieve better livestock distribution. A moderately dense stand of Alvord oak and California juniper is on 40 percent of this unit. The oak commonly is on north-facing slopes above 2,400 feet elevation.

This unit is poorly suited to dryfarmed grain. It is limited mainly by moderately steep slopes and the high hazard of erosion. Crops that tolerate drought are best suited because the available moisture is not adequate for good growth of most other plants. The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable rotation. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Because precipitation is not sufficient for annual cropping, a cropping system of grain, fallow, and then volunteer pasture is most suitable. All tillage should be on the contour or across the slope.

This map unit is in capability unit IVe-1 (15), nonirrigated.

105—Aramburu very shaly clay loam, 30 to 50 percent slopes. This moderately deep, well drained soil is on hills and mountains. It formed in residuum derived dominantly from shale or sandstone. The present vegetation in most areas is mainly annual grasses and forbs. Elevation is 1,900 to 4,000 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 61 degrees F, and the average frost-free season is 180 to 210 days.

Typically, the Aramburu soil is grayish brown very shaly clay loam about 26 inches deep over hard

fractured shale. It is about 35 to 50 percent shale fragments.

Included in this unit are small areas of Reward shaly loam, Temblor very shaly sandy loam, and a soil that is similar to this Aramburu soil but is lighter in color. Included areas make up about 25 percent of the total acreage.

Permeability of this Aramburu soil is moderate. Available water capacity is low or very low. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 20 to 40 inches.

This unit is used mainly for livestock grazing, watershed, and wildlife habitat.

This unit is suited to livestock grazing. If the unit is grazed by livestock when the soil is too moist, the productivity of the soil is reduced because the trampling of the surface compacts the soil and uproots plants. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Springs and seeps on this unit can be developed as watering facilities for wildlife and to achieve better livestock distribution. A moderately dense stand of Alvord oak and California juniper is on 35 percent of this unit. The oak commonly is on north-facing slopes above 2,400 feet elevation. Woody species should be retained in the drainageways and in the steeper areas to reduce erosion. Livestock grazing should be managed to protect the soil from erosion.

This map unit is in capability subclass VIe (15), nonirrigated.

106—Aramburu very shaly clay loam, 50 to 75 percent slopes. This moderately deep, well drained soil is on hills and mountains. It formed in residuum derived dominantly from shale or sandstone. The present vegetation in most areas is mainly annual grasses and forbs. Elevation is 2,000 to 4,300 feet. The average annual precipitation is about 11 inches, the average annual temperature is about 61 degrees F, and the average frost-free season is 180 to 210 days.

Typically, the Aramburu soil is grayish brown very shaly clay loam about 26 inches deep over fractured shale. It is about 35 to 50 percent shale fragments.

Included in this unit are small areas of Temblor very shaly sandy loam, Reward shaly loam, Rock outcrop, and a soil that is similar to this Aramburu soil but is lighter in color. Also included are small areas that go up to an elevation of 4,332 feet at McKittrick Summit. Included areas make up about 30 percent of the total acreage.

Permeability of this Aramburu soil is moderate. Available water capacity is low or very low. Runoff is very rapid, and the hazard of water erosion is very high. Effective rooting depth is 20 to 40 inches.

This unit is used mainly as watershed, wildlife habitat, and livestock grazing.

This unit is suited to livestock grazing. If the unit is grazed by livestock when the soil is too moist, the productivity of the soil is reduced because the trampling of the surface compacts the soil and uproots plants. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Trails or walkways can be constructed in places to encourage livestock grazing in areas where access is limited. Springs and seeps on this unit can be developed as watering facilities for wildlife and to achieve better livestock distribution. A moderately dense stand of Alvord oak and California juniper is on 35 percent of this unit. The oak commonly is on north-facing slopes above 2,400 feet elevation. Woody species should be retained in the drainageways and in the steeper areas to reduce erosion. Livestock grazing should be managed to reduce erosion.

This map unit is in capability subclass VIIe (15), nonirrigated.

107—Aramburu-Temblor complex, 30 to 50 percent slopes. This map unit is on hills and mountains. The present vegetation in most areas is mainly annual grasses and forbs. Elevation is 1,500 to 3,400 feet. The average annual precipitation is about 11 inches, the average annual temperature is about 61 degrees F, and the average frost-free season is 200 to 225 days.

This unit is 45 percent Aramburu very shaly clay loam and 40 percent Temblor very shaly sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of soils that are similar to this Aramburu soil but have a thin surface layer and soils that are similar to this Temblor soil but do not have a dark colored surface layer and have coarser textures. Included areas make up about 15 percent of the total acreage.

The Aramburu soil is moderately deep and well drained. It formed in residuum derived dominantly from shale or sandstone. Typically, the Aramburu soil is grayish brown very shaly clay loam about 26 inches deep over fractured shale. It is about 35 to 50 percent shale fragments.

Permeability of the Aramburu soil is moderate. Available water capacity is low or very low. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 20 to 40 inches.

The Temblor soil is shallow and well drained. It formed in residuum derived dominantly from diatomaceous shale. Typically, the surface layer is grayish brown very shaly sandy loam about 2 inches thick. The subsurface layer is grayish brown very shaly loam about 8 inches thick. The fractured shale is at a depth of 10 inches. In some areas the surface layer is very shaly loam.

Permeability of the Temblor soil is moderately rapid. Available water capacity is very low. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 10 to 20 inches.

This unit is used as watershed, wildlife habitat, and livestock grazing.

This unit is suited to livestock grazing. If the unit is grazed by livestock when the soil is too moist, the productivity of the soil is reduced because the trampling of the surface compacts the soil and uproots plants. The production of forage on the Aramburu soil has few limitations. Production on the Temblor soil is limited by shallow depth. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Springs and seeps on this unit can be developed as watering facilities for wildlife and to achieve better livestock distribution. A moderately dense stand of Alvord oak and California juniper is on 20 percent of this unit. The oak commonly is on north-facing slopes above 2,400 feet elevation. Woody species should be retained in the drainageways and in the steeper areas to reduce erosion. Livestock grazing should be managed to protect the unit from erosion.

This map unit is in capability subclass VIIe (15), nonirrigated.

108—Aramburu-Temblor complex, 50 to 75 percent slopes. This map unit is on hills and mountains. The present vegetation in most areas is mainly annual grasses and forbs. Elevation is 2,600 to 4,300 feet. The average annual precipitation is about 11 inches, the average annual temperature is about 61 degrees F, and the average frost-free season is 200 to 225 days.

This unit is 40 percent Aramburu very shaly clay loam and 40 percent Temblor very shaly sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of soils that are similar to this Aramburu soil but have a thin surface layer and soils that are similar to this Temblor soil but do not have a dark colored surface layer and have coarser textures. Included areas make up about 20 percent of this unit.

The Aramburu soil is moderately deep and well drained. It formed in residuum derived dominantly from shale or sandstone. Typically, the soil is grayish brown very shaly clay loam about 26 inches deep over fractured shale. It is about 35 to 50 percent shale fragments.

Permeability of the Aramburu soil is moderate. Available water capacity is low or very low. Runoff is very rapid, and the hazard of water erosion is high. Effective rooting depth is 20 to 40 inches.

The Temblor soil is shallow and well drained. It formed in residuum derived dominantly from diatomaceous shale. Typically, the surface layer is grayish brown very shaly sandy loam about 2 inches. The substratum is grayish brown very shaly loam about 8 inches thick. Fractured shale is at a depth of 10 inches. In some areas the surface layer is very shaly loam.

Permeability of the Temblor soil is moderately rapid. Available water capacity is very low. Runoff is very rapid, and the hazard of water erosion is very high. Effective rooting depth is 10 to 20 inches.

This unit is used mainly as watershed, wildlife habitat, and livestock grazing.

This unit is suited to livestock grazing. If the unit is grazed by livestock when the soil is too moist, the productivity of the soil is reduced because the trampling of the surface compacts the soil and uproots plants. The production of forage on the Aramburu soil has few limitations. Production on the Temblor soil is limited by shallow depth. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Springs and seeps on this unit can be developed as watering facilities for wildlife and to achieve better livestock distribution. Livestock grazing should be managed to protect the unit from erosion. Cross-fencing and correctly placing livestock watering facilities help to distribute livestock grazing and to reduce overgrazing of the lower slopes. A moderately dense stand of Alvord oak and California juniper is on 10 percent of this unit. The oak commonly is on north-facing slopes above 2,400 feet elevation. Woody species should be retained in the drainageways and in the steeper areas to reduce erosion.

This map unit is in capability subclass VIIe (15), nonirrigated.

109—Ayar silty clay, 5 to 9 percent slopes. This deep, well drained soil is on hills and mountains. It formed in residuum derived dominantly from shale or sandstone. The vegetation in areas not cultivated is mainly annual grasses and forbs with scattered oaks and junipers. Elevation is 2,500 to 3,000 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is 200 to 225 days.

Typically, the surface layer is brown silty clay about 11 inches thick. The underlying material to a depth of 44

inches is brown clay and silty clay. Fine grained sandstone is at a depth of 44 inches. In some areas the surface layer is silty clay loam or clay.

Included in this unit are small areas of Aido clay and Bluestone clay. Included areas make up about 20 percent of the total acreage.

Permeability of this Ayar soil is slow. Available water capacity is moderate or high. Runoff is medium, and the hazard of water erosion is slight. Effective rooting depth is 40 to 60 inches.

This unit is used mainly for livestock grazing, watershed, and wildlife habitat. It is also used for dryfarmed grain.

This unit is poorly suited to dryfarmed grain. It is limited mainly by low rainfall and fine soil texture. Plants that tolerate drought are best suited because the available moisture is not adequate for good growth of most other plants. The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable rotation. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Because precipitation is not sufficient for annual cropping, a cropping system of grain, fallow, and then volunteer pasture is most suitable. All tillage should be on the contour or across the slope. Timing of cultivation is critical because of the high content of clay. Cultivation should be done when the content of soil moisture is low enough to prevent compaction but high enough to allow easy tillage.

This unit is suited to livestock grazing. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the soil has drained sufficiently and is firm enough to withstand trampling by livestock. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities.

This map unit is in capability unit IVe-1 (15), nonirrigated.

110—Ayar-Bluestone complex, 9 to 30 percent slopes. This map unit is on hills and mountains. The vegetation in areas not cultivated is mainly annual grasses and forbs with scattered oaks and junipers. Elevation is 2,500 to 3,000 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is 200 to 225 days.

This unit is 50 percent Ayar clay and 40 percent Bluestone clay. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Aido clay, Rock outcrop, and a soil that is similar to the Bluestone clay but has slopes of more than 30 percent. Included areas make up about 10 percent of the total acreage.

The Ayar soil is deep and well drained. It formed in residuum derived dominantly from shale or sandstone. Typically, the surface layer is brown silty clay about 11 inches thick. The underlying material to a depth of 44 inches is brown silty clay and clay. Fine grained sandstone is at a depth of 44 inches. Gravel and cobbles make up less than 10 percent of the soil. In some areas the surface layer is silty clay loam.

Permeability of the Ayar soil is slow. Available water capacity is moderate or high. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 40 to 60 inches.

The Bluestone soil is shallow and well drained. It formed in residuum derived dominantly from noncalcareous shale. Typically, the surface layer is brown clay about 12 inches thick. The underlying material to a depth of 16 inches is brown shaly clay. Fractured shale is at a depth of 16 inches. In some areas the surface layer is clay loam or silty clay loam.

Permeability of the Bluestone soil is slow. Available water capacity is low or very low. Runoff is medium or rapid, and the hazard of water erosion is moderate. Effective rooting depth is 10 to 20 inches.

This unit is used for dryfarmed wheat or barley.

This unit is poorly suited to dryfarmed grain. It is limited mainly by low rainfall, steepness of slope, the hazard of erosion, and the fine texture of the soils. Crops that tolerate drought are best suited because the available moisture is not adequate for good growth of most other plants. The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable rotation. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Because precipitation is not sufficient for annual cropping, a cropping system of grain, fallow, and then volunteer pasture is most suitable. All tillage should be on the contour or across the slope. Timing of cultivation is critical because of the high clay content. Cultivation is best done when the content of soil moisture is low enough to prevent compaction but high enough to allow easy tillage.

This map unit is in capability unit IVe-1 (15), nonirrigated.

111—Ayar-Hillbrick-Aido complex, 30 to 50 percent slopes. This map unit is on hills and mountains. The

present vegetation in most areas is mainly annual grasses and forbs with scattered junipers and oaks. Elevation is 2,000 to 3,000 feet. The average annual precipitation is about 9 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is about 200 to 225 days.

This unit is 35 percent Ayar clay, 25 percent Hillbrick sandy loam, and 20 percent Aido clay. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Bluestone clay and a shallow sandy soil that does not have carbonates. Included areas make up about 20 percent of the total acreage.

The Ayar soil is deep and well drained. It formed in residuum derived dominantly from shale or sandstone. Typically, the surface layer is brown silty clay about 11 inches thick. The underlying material to a depth of 44 inches is brown silty clay and clay. Fine grained sandstone is at a depth of 44 inches. In some areas the surface layer is silty clay loam or clay.

Permeability of the Ayar soil is slow. Available water capacity is moderate or high. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 40 to 60 inches.

The Hillbrick soil is shallow and well drained. It formed in residuum derived dominantly from shale or sandstone. Typically, the soil is pale brown sandy loam and shaly sandy loam about 15 inches deep over fractured shale.

Permeability of the Hillbrick soil is moderately rapid. Available water capacity is very low. Runoff is medium, and the hazard of water erosion is very high. Effective rooting depth is 10 to 20 inches.

The Aido soil is moderately deep and well drained. It formed in residuum derived dominantly from shale or sandstone. Typically, the surface layer is pale brown clay about 10 inches thick. The underlying material to a depth of 26 inches is brown clay. Fractured calcareous shale is at a depth of 26 inches. In some areas the surface layer is silty clay loam or silty clay.

Permeability of the Aido soil is slow. Available water capacity is low or moderate. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 20 to 40 inches.

This unit is used mainly for livestock grazing, watershed, and wildlife habitat.

This unit is suited to livestock grazing. It is mainly limited by low rainfall. The production of forage is limited by the shallow depth and very low available water capacity of the Hillbrick soil. The Ayar and Aido soils have few limitations. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Cross-fencing and correctly placing livestock watering facilities help to distribute livestock grazing and to reduce overgrazing of the lower slopes.

This map unit is in capability subclass VIe (15), nonirrigated.

112—Ayar-Hillbrick-Aido complex, 50 to 75 percent slopes. This map unit is on hills and mountains. The present vegetation in most areas is mainly annual grasses and forbs with junipers and oaks on some north-facing slopes. Elevation is 2,000 to 3,000 feet. The average annual precipitation is about 9 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is 200 to 225 days.

This unit is 30 percent Ayar clay, 30 percent Hillbrick sandy loam, and 20 percent Aido clay. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Bluestone clay and shallow sandy soils that do not have carbonates. Included areas make up about 20 percent of the total acreage.

The Ayar soil is deep and well drained. It formed in residuum derived dominantly from shale or sandstone. Typically, the surface layer is brown silty clay about 11 inches thick. The underlying material to a depth of 44 inches is brown silty clay and clay. Fine grained sandstone is at a depth of 44 inches. In some areas the surface layer is silty clay loam or clay.

Permeability of the Ayar soil is slow. Available water capacity is moderate or high. Runoff is rapid, and the hazard of water erosion is very high. Effective rooting depth is 40 to 60 inches.

The Hillbrick soil is shallow and well drained. It formed in residuum derived dominantly from shale or sandstone. Typically, the soil is pale brown sandy loam and shaly sandy loam about 15 inches deep over fractured shale.

Permeability of the Hillbrick soil is moderately rapid. Available water capacity is very low. Runoff is rapid, and the hazard of water erosion is very high. Effective rooting depth is 10 to 20 inches.

The Aido soil is moderately deep and well drained. It formed in residuum derived dominantly from sandstone or shale. Typically, the surface layer is pale brown clay about 10 inches thick. The underlying material to a depth of 26 inches is brown clay. Fractured calcareous shale is at a depth of 26 inches. In some areas the surface layer is silty clay loam or silty clay.

Permeability of the Aido soil is slow. Available water capacity is low or moderate. Runoff is very rapid, and the hazard of water erosion is high. Effective rooting depth is 20 to 40 inches.

This unit is used mainly for livestock grazing, watershed, and wildlife habitat.

This unit is suited to livestock grazing. It is mainly limited by low rainfall. The production of forage is limited

by shallow depth and very low available water capacity of the Hillbrick soil. The Ayar and Aido soils have few limitations. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Trails or walkways can be constructed in places to encourage livestock to graze in areas where access is limited. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Cross-fencing and correctly placing livestock watering facilities help to distribute livestock grazing and to reduce overgrazing of the lower slopes. Livestock grazing should be managed to protect the unit from erosion.

This map unit is in capability subclass VIIe (15), nonirrigated.

113—Badland. Badland consists of steep and very steep, barren land and deeply entrenched drainageways. It is made up of severely eroded bluffs, escarpments, and gullies. The barren land is mainly soft, highly erodible residuum that is covered in places with a thin mantle of unstable soil material. During periods of heavy rainfall, areas of Badland are sources of a large amount of sediment.

Included in this unit are small areas of shallow, loamy soils. Included areas make up about 10 percent of the total acreage.

This unit is used by wildlife to a limited extent. It is watershed that has a potential for deposition of material onto adjacent land.

This map unit is in capability subclass VIIIe (15) (17).

114—Balcom Variant clay loam, 5 to 30 percent slopes. This deep, well drained soil is on hills. It formed in residuum derived dominantly from soft, calcareous shale. The present vegetation in most areas is mainly annual grasses and forbs with scattered junipers. Elevation is 2,000 to 3,000 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is 200 to 225 days.

Typically, the surface layer is light brownish gray and pale brown clay loam about 20 inches thick. The upper 13 inches of the underlying material is pale brown clay, and the lower part to a depth of 50 inches is white loam. Soft fractured shale is at a depth of 50 inches. The upper 33 inches of the profile has 10 to 15 percent calcium carbonate, and the lower part has 15 to 20 percent.

Included in this unit are small areas of Mendi loam and Kilmer loam. Included areas make up about 10 percent of the total acreage.

Permeability of this Balcom Variant soil is slow. Available water capacity is moderate or high. Runoff is medium, and the hazard of water erosion is high. Effective rooting depth is 40 to 60 inches.

This unit is used mainly for livestock grazing. It is also used for dryfarmed grain such as barley or wheat.

This unit is poorly suited to dryfarmed grain. It is limited mainly by low rainfall and steepness of slope. Crops that tolerate drought are best suited because the available moisture is not adequate for good growth of most other plants. Because precipitation is not sufficient for annual cropping, a cropping system of grain, fallow, and then volunteer pasture is most suitable. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

This unit is suited to livestock grazing. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Correct placement of salt and supplemental feed helps to distribute livestock grazing and prevent overgrazing.

This map unit is in capability unit IVe-1 (15), nonirrigated.

115—Bitterwater sandy loam, 9 to 15 percent slopes. This deep, well drained soil is on foothills. It formed in residuum derived dominantly from sandstone. The present vegetation in most areas is mainly annual grasses and forbs with scattered shrubs. Elevation is 700 to 1,300 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 65 degrees F, and the average frost-free season is 225 to 275 days.

Typically, the surface layer is pale brown sandy loam about 23 inches thick. The underlying material to a depth of 60 inches is light yellowish brown and very pale brown sandy loam. Weathered sandstone is at a depth of 60 inches. The soil is 5 to 15 percent gravel. Content of gravel generally increases with increasing depth.

Included in this unit are small areas of Kettleman loam and Bitterwater gravelly sandy loam. Also included are small areas of soils that are similar to this Bitterwater soil but have bedrock at a depth of less than 40 inches and small areas of soils that have a subsoil. Included areas make up about 20 percent of the total acreage.

Permeability of this Bitterwater soil is moderately rapid. Available water capacity is low or moderate. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 40 to 60 inches.

This unit is used mainly for livestock grazing.

This unit is suited to livestock grazing. Because of low rainfall, forage production is low in most years. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce vegetation suitable for grazing. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the

production of forage. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities.

This map unit is in capability subclass VIIe (15), nonirrigated.

116—Bitterwater sandy loam, 15 to 50 percent slopes. This deep, well drained soil is on foothills. It formed in residuum derived dominantly from sandstone. The present vegetation in most areas is mainly annual grasses and forbs with scattered shrubs. Elevation is 700 to 1,300 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 65 degrees F, and the average frost-free season is 225 to 275 days.

Typically, the surface layer is pale brown sandy loam about 23 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown and very pale brown sandy loam. Weathered sandstone is at a depth of 60 inches. The soil is 5 to 15 percent gravel. Content of gravel generally increases with increasing depth. In some areas the surface layer is loam.

Included in this unit are small areas of Kettleman loam and Bitterwater gravelly sandy loam. Also included are small areas of soils that have a weakly developed subsoil. Included areas make up about 20 percent of the total acreage.

Permeability of this Bitterwater soil is moderately rapid. Available water capacity is low or moderate. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 40 to 60 inches.

Most areas of this unit are used for livestock grazing. Oil wells are common in some areas.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Overgrazing or operating off-road vehicles on this unit causes the natural plant community to deteriorate and increases soil erosion. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage. Livestock grazing should be managed to protect the soil from erosion.

This map unit is in capability subclass VIIe (15), nonirrigated.

117—Bitterwater gravelly sandy loam, 15 to 50 percent slopes. This deep, well drained soil is on foothills and dissected terraces. It formed in residuum derived dominantly from siliceous shale. The present vegetation in most areas is mainly annual grasses and forbs with scattered shrubs. Elevation is 800 to 1,300 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 65 degrees F, and the average frost-free season is about 225 to 250 days.

Typically, the surface layer is pale brown gravelly sandy loam about 23 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown and pale brown gravelly sandy loam. Below this is fractured shale. The soil is 15 to 35 percent gravel. In some areas the surface layer is gravelly loam.

Included in this unit are small areas of Kettleman gravelly loam and Bitterwater sandy loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Bitterwater soil is moderately rapid. Available water capacity is low or moderate. Runoff is medium, and the hazard of water erosion is high. Effective rooting depth is 40 to 60 inches or more.

Most areas of this unit are used for livestock grazing. Oil wells are common in some areas.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall and a high hazard of erosion. This unit supports sparse stands of plants that are suitable for grazing. Overgrazing or operating off-road vehicles on this unit causes the plant community to deteriorate and increases soil erosion. Reestablishing plant cover is difficult. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Livestock grazing should be managed to protect the soil from erosion. This soil is limited for livestock watering ponds and other water impoundments because of the moderately rapid permeability.

This map unit is in capability subclass VIIe (15), nonirrigated.

118—Bitterwater-Delgado association, 9 to 30 percent slopes. This map unit is on foothills. The present vegetation in most areas is mainly annual grasses and forbs with scattered shrubs. Elevation is 600 to 1,200 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 230 to 260 days.

This unit is 60 percent Bitterwater sandy loam and 30 percent Delgado sandy loam. The Bitterwater soil commonly is on north-facing hillsides. The Delgado soil commonly is on hilltops and some south-facing hillsides.

Included in this unit are small areas of Kettleman loam and Rock outcrop. Included areas make up about 10 percent of the total acreage.

The Bitterwater soil is deep and well drained. It formed in residuum derived dominantly from sandstone. Typically, the surface layer is pale brown sandy loam about 23 inches thick. The underlying material to a depth of 60 inches is light yellowish brown and very pale brown

sandy loam. Weathered sandstone is at a depth of 60 inches.

Permeability of the Bitterwater soil is moderately rapid. Available water capacity is low or moderate. Runoff is medium, and the hazard of water erosion is high. Effective rooting depth is 40 to 60 inches.

The Delgado soil is shallow and somewhat excessively drained. It formed in residuum derived dominantly from sandstone or shale. Typically, the soil is brown sandy loam about 14 inches deep over fractured sandstone.

Permeability of the Delgado soil is moderately rapid. Available water capacity is very low. Runoff is slow, and the hazard of water erosion is moderate. Effective rooting depth is 7 to 20 inches.

This unit is used for livestock grazing.

This unit is suited to livestock grazing. The production of forage on the Bitterwater soil is limited by low rainfall. Production on the Delgado soil is limited by shallow depth to rock and low rainfall. Because of the low rainfall, forage production is low in most years. If the plant cover is overgrazed, the soils become more susceptible to erosion. Livestock grazing should be managed to protect the unit from erosion.

The Bitterwater soil is in capability subclass VIIe (15), nonirrigated. The Delgado soil is in capability subclass VIIs (15), nonirrigated.

119—Bitterwater-Delgado association, 30 to 75 percent slopes. This map unit is on foothills. The present vegetation in most areas is mainly annual grasses and forbs with scattered brush. Elevation is 600 to 1,200 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 230 to 260 days.

This unit is 60 percent Bitterwater sandy loam and 25 percent Delgado sandy loam. The Bitterwater soil commonly is on north-facing hillsides. The Delgado soil commonly is on hilltops and some south-facing hillsides.

Included in this unit are areas of Kettleman loam and Rock outcrop. Included areas make up about 15 percent of the total acreage.

The Bitterwater soil is deep and well drained. It formed in residuum derived dominantly from sandstone. Typically, the surface layer is pale brown sandy loam about 23 inches thick. The underlying material to a depth of 60 inches is light yellowish brown and very pale brown sandy loam. Weathered sandstone is at a depth of 60 inches.

Permeability of the Bitterwater soil is moderately rapid. Available water capacity is low or moderate. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 40 to 60 inches.

The Delgado soil is shallow and somewhat excessively drained. It formed in residuum derived dominantly from sandstone or shale. Typically, the soil is brown sandy loam about 14 inches deep over fractured sandstone.

Permeability of the Delgado soil is rapid. Available water capacity is very low. Runoff is medium, and the hazard of water erosion is high. Effective rooting depth is 7 to 20 inches.

This unit is used for livestock grazing.

This unit is suited to livestock grazing. The production of forage on the Bitterwater soil is limited by low rainfall. Production on the Delgado soil is limited by shallow depth to rock and low rainfall. Because of low rainfall, forage production is low in most years. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Correct placement of salt and supplemental feed helps to distribute livestock grazing and prevent overgrazing. Livestock grazing should be managed to protect the unit from erosion.

The Bitterwater soil is in capability subclass VIIe (15), nonirrigated. The Delgado soil is in capability subclass VIIs (15), nonirrigated.

120—Bitterwater-Aridic Calcixerolls, loamy, complex, 9 to 15 percent slopes. This map unit is on dissected terraces and hills. The present vegetation in most areas is mainly annual grasses, forbs, and scattered shrubs. Elevation is 1,400 to 1,700 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 225 to 250 days.

This unit is 55 percent Bitterwater gravelly sandy loam and 25 percent Aridic Calcixerolls, loamy. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of soils that are similar to this Bitterwater soil but they have a dark-colored surface layer, are loam, and are 35 to 50 percent shale fragments. Also included are small areas of shallow, gravelly soils that have a light- or dark-colored surface layer and small areas of Kettleman loam. Included areas make up about 20 percent of the total acreage.

The Bitterwater soil is deep and well drained. It formed in residuum derived dominantly from siliceous shale. Typically, the surface layer is pale brown gravelly sandy loam about 23 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown and very pale brown gravelly sandy loam. Below this is fractured shale. The soil is 15 to 25 percent gravel. In some areas the surface layer is sandy loam or loam.

Permeability of the Bitterwater soil is moderately rapid. Available water capacity is low. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 40 to 60 inches or more.

The Aridic Calcixerolls are moderately deep and well drained. They formed in residuum derived dominantly from sandstone or shale. They are moderately coarse

textured to medium textured and are about 30 inches thick. Calcareous diatomaceous shale is at a depth of about 30 inches.

Permeability of the Aridic Calcixerolls is moderate or moderately rapid. Available water capacity is low. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 20 to 40 inches.

Oil wells are common in most areas of this unit. A few areas are used for livestock grazing.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall. If the plant cover is overgrazed, the soils become more susceptible to erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce vegetation suitable for grazing. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities.

This map unit is in capability subclass VIIe (15), nonirrigated.

121—Bitterwater-Typic Torriorthents, very gravelly, complex, 15 to 30 percent slopes. This map unit is on hills. The present vegetation in most areas is mainly annual grasses, forbs, and scattered shrubs. Elevation is 1,200 to 1,800 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is about 225 to 250 days.

This unit is about 60 percent Bitterwater gravelly sandy loam and about 20 percent Typic Torriorthents, very gravelly.

Included in this unit are small areas of shallow, very gravelly soils; moderately deep, gravelly soils that have a dark colored surface layer and are 15 to 30 percent carbonates; and Kettleman loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Bitterwater soil is deep and well drained. It formed in residuum derived dominantly from siliceous shale. Typically, the surface layer is pale brown gravelly sandy loam about 23 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown and very pale brown gravelly sandy loam. Below this is fractured shale. The soil is 15 to 25 percent gravel. In some areas the surface layer is loam or sandy loam.

Permeability of the Bitterwater soil is moderately rapid. Available water capacity is low. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 40 to 60 inches or more.

The Typic Torriorthents are deep and well drained. They formed in residuum derived dominantly from sandstone or shale. These soils are very pale brown or pale brown very gravelly loam to very gravelly sandy loam about 48 inches thick. Fractured shale is at a depth of 48 inches. The soils are about 35 to 50 percent gravel.

Permeability of the Typic Torriorthents is moderately rapid. Available water capacity is very low or low. Runoff is medium, and the hazard of water erosion is high. Effective rooting depth is 40 to 60 inches.

Oil wells are common in most areas of this unit. A few areas are used for livestock grazing.

This unit is suited to livestock grazing. The production of forage on the Bitterwater soil is limited by low rainfall. Production on the Typic Torriorthents is limited by low rainfall and the high hazard of erosion. Because of low the rainfall, forage production is low in most years. If the plant cover is overgrazed, the soils become more susceptible to erosion. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Livestock grazing should be managed to protect the unit from erosion.

This map unit is in capability subclass VIIe (15), nonirrigated.

122—Bitterwater-Typic Torriorthents, very gravelly, complex, 30 to 50 percent slopes. This map unit is on hills. The present vegetation in most areas is mainly annual grasses, forbs, and scattered shrubs. Elevation is 1,400 to 1,900 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 225 to 250 days.

This unit is 60 percent Bitterwater gravelly sandy loam and 20 percent Typic Torriorthents, very gravelly. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of shallow, very gravelly soils; moderately deep, gravelly soils that have a dark colored surface layer and are 15 to 30 percent carbonates; and Kettleman loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Bitterwater soil is deep and well drained. It formed in residuum derived dominantly from siliceous shale. Typically, the surface layer is pale brown gravelly sandy loam about 23 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown and very pale brown gravelly sandy loam. Below this is fractured shale. The soil 15 to 25 percent gravel. In some areas the surface layer is sandy loam or loam.

Permeability of the Bitterwater soil is moderately rapid. Available water capacity is low. Runoff is medium or rapid, and the hazard of water erosion is moderate. Effective rooting depth is 40 to 60 inches or more.

The Typic Torriorthents are deep and well drained. They formed in residuum derived dominantly from sandstone or shale. These soils are very pale brown and pale brown very gravelly loam to very gravelly sandy loam about 48 inches thick. Fractured shale is at a depth

of about 48 inches. The soils are about 35 to 50 percent gravel.

Permeability of the Typic Torriorthents is moderately rapid. Available water capacity is very low or low. Runoff is medium or rapid, and the hazard of water erosion is high. Effective rooting depth is 40 to 60 inches.

Oil wells are common in most areas of this unit. A few areas are used for livestock grazing.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall and steepness of slope. Production on the Typic Torriorthents is also limited by the high hazard of erosion. This unit supports sparse stands of plants that are suitable for grazing. Overgrazing or operating off-road vehicles on this unit causes the plant community to deteriorate and increases erosion. Reestablishing plant cover is difficult. Loss of surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Livestock grazing should be managed to protect the unit from erosion. This unit is limited for livestock watering ponds and other water impoundments because of the moderately rapid permeability of the soils.

This map unit is in capability subclass VIIe (15), nonirrigated.

123—Buttonwillow clay, drained. This deep, somewhat poorly drained soil is in basins. It formed in alluvium derived dominantly from granitic rock. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 250 to 300 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 63 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is dark gray clay about 28 inches thick. The upper 27 inches of the underlying material is light gray and gray fine sandy loam, and the lower part to a depth of 60 inches or more is very dark gray clay. In some areas the surface layer is silty clay or silty clay loam.

Included in this unit are small areas of Lokern clay, Lokern clay that is saline-alkali, and Lerdo clay loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Buttonwillow soil is moderately rapid between depths of 28 and 55 inches and slow below a depth of 55 inches. Available water capacity is moderate or high. Runoff is very slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more. This soil is subject to rare periods of flooding but is protected by dams or levees, or both.

Most areas of this unit are used for irrigated crops, mainly alfalfa, barley, cotton, and sugar beets. Among the other crops grown are wheat and milo. Some areas are used for irrigated pasture and homesite development.

This unit is suited to irrigated hay and pasture. It is limited mainly by the fine textures and slow permeability. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Proper grazing practices, weed control, and fertilizer are needed to ensure maximum quality of forage. Irrigation water can be applied by the border and sprinkler methods. Water needs to be applied at a slow rate over a long period to ensure that the root zone is properly wetted.

This unit is suited to irrigated crops. It is limited mainly by the fine texture of the soil and slow permeability. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Furrow, border, and sprinkler irrigation systems are suited to this unit. To avoid overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Because of the slow permeability of the surface layer, the application of water should be regulated so that water does not stand on the surface and damage the crops.

If this unit is used for homesite development, the main limitations are the fine texture of the soil, high shrink-swell potential, and rare periods of flooding. Selection of adapted vegetation is critical for the establishment of lawns, shrubs, trees, and vegetable gardens. Septic tank absorption fields do not function properly during rainy periods because of wetness and slow permeability. Buildings and roads should be designed to offset the effects of shrinking and swelling. If the soil in this unit is used as a base for roads and streets, the upper part of the soil can be mixed with the underlying sand and gravel to increase its strength and stability. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding.

This map unit is in capability unit IIs-5 (17), irrigated, and capability subclass VIIs, nonirrigated.

124—Buttonwillow clay, partially drained. This deep, somewhat poorly drained soil is in basins. The water table developed as a result of seepage resulting from extensive irrigation within the area. It formed in alluvium derived dominantly from granitic rock. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 250 to 280 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 63 degrees F, and the average frost-free season is 250 to 300 days.

The surface layer is dark gray clay about 28 inches thick. The upper 27 inches of the underlying material is grayish brown fine sandy loam, and the lower part to a depth of 60 inches or more is very dark gray clay. In some areas the surface layer is silty clay or silty clay loam.

Included in this unit are small areas of Lokern clay, Lokern clay that is saline-alkali, and Lerdo clay loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Buttonwillow soil is moderately rapid between depths of 28 and 55 inches and slow below a depth of 55 inches. Available water capacity is moderate or high. Effective rooting depth is limited by a high water table that is at a depth of 3 to 6 feet throughout the year. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to rare periods of flooding but is protected by dams or levees, or both.

Most areas of this unit are used for irrigated crops, mainly cotton, alfalfa, sugar beets, and barley. A few areas are used for irrigated pasture.

This unit is suited to irrigated crops. It is limited mainly by the high water table, the fine texture of the soil, and slow permeability. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Irrigation water management is very important. Excess irrigation water can cause the water table to rise nearer to the surface. Tile or open drains can be used to remove excess water if a suitable outlet is available. Most climatically adapted crops can be grown if artificial drainage is provided.

This unit is suited to hay and pasture. The main limitations are the high water table, the fine texture of the soil, and slow permeability. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Proper grazing practices, weed control, and fertilizer are needed to ensure maximum quality of forage. Irrigation water can be applied by the border or sprinkler methods. A livestock watering system, such as a pipeline, trough, or well, should be developed in areas where livestock are grazing. Irrigation water management is very important. Tile drainage can be used to lower the water table if a suitable outlet is available.

This map unit is in capability unit IIw-2 (17), irrigated, and capability subclass VIIw, nonirrigated.

125—Cajon loamy sand, 0 to 2 percent slopes. This deep, somewhat excessively drained soil in on alluvial fans. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 300 to 475 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is pale brown loamy sand about 9 inches thick. The upper 35 inches of the underlying material is light gray sand, and the lower part to a depth of 60 inches or more is stratified light brownish gray sandy loam. In some areas the surface layer is sand.

Included in this unit are small areas of Wasco sandy loam, Kimberlina fine sandy loam, and Garces silt loam. Included areas make up about 20 percent of the total acreage.

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

Most areas of this unit are used for irrigated crops, mainly alfalfa, cotton, grapes, and small grain. Among the other crops grown are onions and potatoes. Some areas are used for urban development.

This unit is suited to irrigated crops. It is limited mainly by low available water capacity and the high hazard of soil blowing. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and fertility. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the available water capacity. Soil blowing can be reduced by returning crop residue to the soil and practicing minimum tillage. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because the water intake rate is rapid, sprinkler irrigation is best suited to this unit. If furrow irrigation is used, water should be applied at frequent intervals and runs should be short. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Additions of organic matter are beneficial to this soil because of its low organic matter content.

This unit is suited to hay and pasture. The main limitations are low available water capacity and the high hazard of soil blowing. Fertilizer is needed to ensure optimum growth of grasses and legumes. Irrigation water can be applied by the furrow, border, and sprinkler methods. If furrow irrigation is used, water should be applied at frequent intervals and runs should be short. Because the water intake rate is rapid, sprinkler irrigation is best suited to the soil in this unit. All adapted pasture plants can be grown, but bunch-type species planted alone generally are not suitable because of the hazard of erosion.

If this unit is used for urban development, the main limitations are the hazard of soil blowing and rare periods of flooding. Revegetating disturbed areas around construction sites as soon as possible helps to control soil blowing. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Selection of adapted vegetation is critical for the establishment of lawns, shrubs, trees, and vegetable gardens. Buildings and roads should be designed to offset the limited ability of the soil in this unit to support a load. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability unit IIIs-4 (17), irrigated, and capability subclass VIIs, nonirrigated.

126—Cajon loamy sand, 2 to 5 percent slopes. This deep, somewhat excessively drained soil is on alluvial fans. It formed in alluvium derived dominantly from granitic rock. The present vegetation in most areas is mainly annual grasses, forbs, and shrubs. Elevation is 300 to 550 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is pale brown loamy sand about 9 inches thick. The upper 35 inches of the underlying material is light gray loamy sand, and the lower part to a depth of 60 inches or more is stratified light brownish gray sandy loam. The soil is about 5 to 15 percent gravel. In some areas the surface layer is sand.

Included in this unit are small areas of Kimberlina fine sandy loam, Kimberlina gravelly sandy loam, and Wasco sandy loam. Included areas make up about 15 percent of the total acreage.

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

Most areas of this unit are used for livestock grazing. If water is available, climatically suited crops can be grown. A few areas are used for mineral exploration. Oil wells are common on this unit.

This unit is suited to livestock grazing. The production of forage is limited by low available water capacity, the high hazard of soil blowing, and low rainfall. Because of low rainfall, forage production is low in most years. Management that improves or maintains the plant cover and promotes accumulation of litter on the surface reduces the risk of soil blowing. Overgrazing or operating off-road vehicles on this unit causes the natural plant community to deteriorate and increases soil erosion. Livestock grazing should be managed to protect the soil from erosion.

This map unit is in capability subclass VIIe (17), nonirrigated.

127—Cajon sandy loam, overblown, 0 to 2 percent slopes. This deep, somewhat excessively drained soil is on alluvial fans. It formed in alluvium derived dominantly from granitic sources. The vegetation in areas not cultivated is mainly shrubs, annual grasses, and forbs. Elevation is 320 to 400 feet. The average annual precipitation is 6 inches, the average annual temperature is 66 degrees F, and the average frost-free season is 275 to 300 days.

The surface layer is pale brown sandy loam about 10 inches thick. The upper 30 inches of the underlying material is light brownish gray loamy sand, and the lower part to a depth of 60 inches or more is light gray sand. In some areas the surface layer is loamy sand or fine sandy loam.

Included in this unit are small areas of Kimberlina fine sandy loam and Wasco sandy loam. Also included are small areas of soils that are highly stratified between depths of 10 and 40 inches. Included areas make up about 15 percent of the total acreage.

Permeability of this Cajon soil is rapid. Available water capacity is low or moderate. Runoff is very slow, and the hazard of water erosion is none to slight. The hazard of soil blowing is moderate. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for irrigated crops such as cotton, alfalfa, and sugar beets. Among the other crops grown are grapes and almonds. Some areas are used for homesite development. Oil wells are common.

This unit is suited to hay and pasture. The main limitations are restricted available water capacity and the moderate hazard of soil blowing. Fertilizer is needed to ensure optimum growth of grasses and legumes. Irrigation water can be applied by the furrow, border, and sprinkler methods. All adapted pasture plants can be grown, but bunch-type species planted alone generally are not suitable because of the hazard of erosion.

This unit is suited to irrigated crops. It is limited mainly by restricted available water capacity and the moderate hazard of soil blowing. Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. Soil blowing can be reduced by returning crop residue to the soil and practicing minimum tillage. Furrow, border, and sprinkler irrigation systems are suited to this unit. If furrow irrigation is used, water should be applied at frequent intervals and runs should be short. Because the water intake rate is rapid, sprinkler irrigation is best suited to the soil in this unit. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop

needs. Because the soil is droughty, applications of irrigation water should be light and frequent.

If this unit is used for homesite development, the main limitations are the hazard of soil blowing and rare periods of flooding. Revegetating disturbed areas around construction sites as soon as possible helps to control soil blowing. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite disposal systems from flooding. Selection of adapted vegetation is critical for the establishment of lawns, shrubs, trees, and vegetable gardens. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability unit IIIs-4 (17), irrigated, and capability subclass VIIs (17), nonirrigated.

128—Capay silty clay, 2 to 9 percent slopes. This deep, moderately well drained soil is on alluvial plains and in narrow mountain valleys. It formed in alluvium derived dominantly from shale. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 1,400 to 2,100 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is 200 to 240 days.

Typically, the surface layer is very dark grayish brown silty clay about 23 inches thick. The underlying material to a depth of 64 inches is dark brown and brown silty clay. In some areas the surface layer is clay loam or clay.

Included in this unit are small areas of Nacimiento silty clay loam and Aido clay. Included areas make up about 10 percent of the total acreage.

Permeability of this Capay soil is slow. Available water capacity is high. Runoff is medium, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for dryfarmed grain.

This unit is poorly suited to dryfarmed grain. It is limited mainly by low rainfall and the fine texture of the soil. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases water infiltration. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Because precipitation is not sufficient for annual cropping, a cropping system of grain, fallow, and then volunteer pasture is most suitable. Plants that tolerate drought are best suited because the available moisture is not adequate for good growth of most other plants.

The map unit is in capability unit IVe-5 (15), nonirrigated.

129—Carollo-Twisselman, saline-alkali, association, 2 to 15 percent slopes. This map unit is on hills and alluvial fans. The present vegetation in most areas is mainly annual grasses, forbs, and shrubs. Elevation is 400 to 700 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 65 degrees F, and the average frost-free season is 230 to 275 days.

This unit is 60 percent Carollo clay loam and 20 percent Twisselman clay, saline-alkali. The Carollo soil is on hilltops, and the Twisselman soil is on side slopes and in drainageways and has slopes of less than 5 percent.

Included in this unit are small areas of Kecksroad silty clay loam, Kettleman loam, and Bitterwater sandy loam. Also included are small areas of soils that are similar to the Carollo soil but have slopes of more than 15 percent. Included areas make up about 20 percent of the total acreage.

The Carollo soil is moderately deep and well drained. It formed in residuum derived dominantly from shale. Typically, the surface layer is pale brown clay loam about 2 inches thick. The subsoil is pale brown and brown clay about 13 inches thick. The substratum is pale brown clay loam about 15 inches thick over soft shale. The substratum has a layer of highly fractured crystalline gypsum. Depth to weathered shale ranges from 20 to 40 inches.

Permeability of the Carollo soil is very slow. Available water capacity is very low or low. Runoff is rapid, and the hazard of water erosion is moderate. Effective rooting depth is 20 to 40 inches.

The Twisselman soil is deep and well drained. It formed in alluvium derived dominantly from sedimentary rock. Typically, the surface layer is pale brown clay about 9 inches thick. The underlying material to a depth of 60 inches or more is yellowish brown silty clay. The soil is strongly saline-alkali. In some areas the surface layer is clay loam.

Permeability of the Twisselman soil is very slow. Available water capacity is very low or low. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more.

This unit is used for livestock grazing.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall, the saline-alkali condition of the Twisselman soil, and restricted available water capacity. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Only salt tolerant plants are suited to this unit. Production of forage is low. Removal of plant cover results in extensive erosion. Livestock grazing should be managed to protect the unit from erosion.

This map unit is in capability subclass VIIe (15, 17), nonirrigated.

130—Chanac clay loam, 2 to 9 percent slopes. This deep, well drained soil is on older alluvial fans and terraces. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 575 to 900 feet. The average annual precipitation is about 9 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 225 to 275 days.

Typically, the surface layer is brown clay loam about 18 inches thick. The subsoil is brown sandy clay loam and sandy loam about 28 inches thick. The substratum to a depth of 60 inches or more is light brown sandy loam. In some areas the surface layer is loam or sandy loam.

Included in this unit are small areas of Zerker loam and soils that are similar to this Chanac soil but do not have a subsoil. Included areas make up about 20 percent of the total acreage.

Permeability of this Chanac soil is moderately slow. Available water capacity is high. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for irrigated crops, mainly almonds, lemons, oranges, and pistachios. Among the other crops grown are dryfarmed barley and wheat. Some areas are used for livestock grazing.

This unit is suited to irrigated crops. It is limited mainly by undulating to rolling slopes and the moderate hazard of erosion. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Erosion can be reduced by planting a close growing cover crop. Diversions and grassed waterways may be needed. Because of the slope, sprinkler or drip irrigation is most suitable for orchard crops. Use of these methods permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Irrigation water needs to be applied at a rate that ensures optimum production without increasing deep percolation, runoff, and erosion.

This unit is suited to dryfarmed grain. The main limitations are low rainfall and the hazard of erosion. Because precipitation is not sufficient for annual cropping, a cropping system of grain, fallow, and then volunteer pasture is most suitable. All tillage should be on the contour or across the slope to reduce the hazard of erosion.

This unit is well suited to livestock grazing. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities.

This map unit is in capability units IIIe-1 (17), irrigated, and IVe-1, nonirrigated.

131—Chanac clay loam, 9 to 15 percent slopes. This deep, well drained soil is on older alluvial fans and terraces. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 575 to 1,000 feet. The average annual precipitation is about 9 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 225 to 275 days.

Typically, the surface layer is brown clay loam about 18 inches thick. The subsoil is brown sandy clay loam and sandy loam about 28 inches thick. The substratum to a depth of 60 inches or more is light brown sandy loam. In some areas the surface layer is loam or sandy loam.

Included in this unit are small areas of Delano Variant clay loam, Cuyama loam, and soils that are similar to this Chanac soil but do not have a subsoil. Included areas make up about 15 percent of the total acreage.

Permeability of this Chanac soil is moderately slow. Available water capacity is high. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for irrigated crops, mainly almonds, lemons, oranges, and pistachios. Among the other crops grown are dryfarmed barley and wheat. Some areas are used for livestock grazing.

This unit is suited to irrigated crops. It is limited by the strongly sloping and rolling slopes and the moderate hazard of erosion. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Erosion can be reduced by planting a close growing cover crop. Diversions and grassed waterways may be needed. Because of the slope, sprinkler or drip irrigation is most suitable for orchard crops. Use of these methods permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Irrigation water needs to be applied at a rate that ensures optimum production without increasing deep percolation, runoff, and erosion.

This unit is suited to dryfarmed grain. The main limitations are low rainfall and the moderate hazard of erosion. Because precipitation is not sufficient for annual cropping, a cropping system of grain, fallow, and then volunteer pasture is most suitable. All tillage should be done on the contour or across the slope to reduce the hazard of erosion.

This unit is well suited to livestock grazing. If the range is overgrazed, the proportion of preferred forage plants

decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities.

This map unit is in capability unit IVe-1 (17), irrigated and nonirrigated.

132—Chanac clay loam, 15 to 30 percent slopes. This deep, well drained soil is on alluvial fans and terraces. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 575 to 1,000 feet. The average annual precipitation is about 9 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 225 to 275 days.

Typically, the surface layer is brown clay loam about 18 inches thick. The subsoil is brown sandy clay loam and sandy loam about 28 inches thick. The substratum to a depth of 60 inches or more is light brown sandy loam. In some areas the surface layer is loam or sandy loam.

Included in this unit are small areas of Delano Variant clay loam, Cuyama loam, and soils that are similar to this Chanac soil but do not have a subsoil. Included areas make up about 15 percent of the total acreage.

Permeability of this Chanac soil is moderately slow. Available water capacity is high. Runoff is rapid, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for irrigated crops, mainly almonds, lemons, oranges, and pistachios. Among the other crops grown are dryfarmed barley and wheat. Some areas are used for livestock grazing.

This unit is suited to irrigated crops. It is limited mainly by the moderately steep and hilly slopes and the moderate hazard of erosion. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Erosion can be reduced by planting a close growing cover crop. Diversions and grassed waterways may be needed. Because of the slope, sprinkler or drip irrigation is most suitable for orchard crops. Use of these methods permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Irrigation water needs to be applied at a rate that ensures optimum production without increasing deep percolation, runoff, and erosion.

If this unit is used for dryfarmed grain, the main limitations are low rainfall and the moderate hazard of erosion. Because precipitation is not sufficient for annual cropping, a cropping system of grain, fallow, and then volunteer pasture is most suitable.

This unit is suited to livestock grazing. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Cross-fencing and correctly placing livestock watering facilities help to distribute livestock grazing and to reduce overgrazing of the lower slopes. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use improves water infiltration, promotes plant growth early in the season, and protects the soil from erosion. Livestock grazing should be managed to protect the soil from erosion.

This map unit is in capability unit IVe-1 (17), irrigated and nonirrigated.

133—Choice clay, 5 to 30 percent slopes. This deep, well drained soil is on hills and mountains. It formed in material derived dominantly from shale. The present vegetation in most areas is mainly annual grasses, forbs, and some goldenbush on north-facing hillsides. Elevation is 1,700 to 2,000 feet. The average annual precipitation is about 9 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is 200 to 250 days.

Typically, the surface layer is light brownish gray clay about 16 inches thick. The underlying material to a depth of 60 inches is variegated light brownish gray clay. Fractured shale is at a depth of 60 inches. Gypsum crystals are in the lower part of the underlying material. In some areas the surface layer is silty clay loam or silty clay.

Included in this unit are small areas of Kilmer loam and Balcom Variant clay loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Choice soil is slow. Available water capacity is high. Runoff is rapid, and the hazard of water erosion is moderate. Effective rooting depth is 55 to 60 inches.

This unit is used mainly for dryfarmed grain. It is also used for livestock grazing.

This unit is poorly suited to dryfarmed grain. It is limited mainly by the rolling to steep slopes, the moderate hazard of erosion, and the fine texture of the soil. Plants that tolerate drought are best suited because the available moisture is not adequate for good growth of most other plants. Because precipitation is not sufficient for annual cropping, a cropping system of grain, fallow, and then volunteer pasture is most suitable. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. The soil responds well to fertilizer in years when precipitation is adequate. All tillage should be on the

contour or across the slope. Water erosion can be reduced by cultivating in summer and planting early in fall.

This unit is suited to livestock grazing. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Correct placement of salt and supplemental feed helps to distribute livestock grazing and prevent overgrazing.

This map unit is in capability unit IVe-I (15), nonirrigated.

134—Cuyama loam, 2 to 9 percent slopes. This deep, well drained soil is on dissected alluvial fans and stream terraces. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 425 to 1,000 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 65 degrees F, and the average frost-free season is 275 to 325 days.

Typically, the surface layer is pale brown and light yellowish brown loam about 8 inches thick. The upper 10 inches of the subsoil is yellowish brown loam, and the lower 18 inches is reddish yellow gravelly clay loam. The upper 20 inches of the substratum is yellow very cobbly sandy clay loam, and the lower part to a depth of 65 inches is yellow sandy clay loam. In some areas the surface layer is sandy loam or coarse sandy loam.

Included in this unit are small areas of Chanac clay loam, Delano sandy loam, Delano Variant clay loam, and Premier coarse sandy loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Cuyama soil is moderately slow. Available water capacity is moderate or high. Runoff is slow or medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for livestock grazing. A few areas are used for homesite development.

This unit is suited to livestock grazing. It has no major limitations. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

If this unit is used for homesite development, the main limitations are slope, moderate shrink-swell potential, and the very cobbly substratum. Erosion is a hazard in the steeper areas. Only the part of the site that is used for construction should be disturbed. Structures to divert runoff are needed if buildings and roads are constructed. Removal of pebbles and cobbles in disturbed areas is needed for best results when landscaping, particularly in areas used for lawns. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees. Buildings and roads should be designed to offset the limited ability of the soil in this unit to support a load. Septic tank absorption fields do not function properly during rainy periods because of wetness and the moderately slow permeability. The limitation of moderately slow permeability can be overcome by increasing the size of the absorption field. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential.

This map unit is in capability subclass VIe (17), nonirrigated.

135—Cuyama loam, 9 to 15 percent slopes. This deep, well drained soil is on dissected alluvial fans and stream terraces. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 425 to 1,000 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 65 degrees F, and the average frost-free season is 275 to 325 days.

Typically, the surface layer is pale brown and light yellowish brown loam about 8 inches thick. The upper 10 inches of the subsoil is yellowish brown loam, and the lower 18 inches is reddish yellow gravelly clay loam. The upper 20 inches of the substratum is yellow cobbly sandy clay loam, and lower part to a depth of 65 inches is yellow sandy clay loam. In some areas the surface layer is sandy loam or coarse sandy loam.

Included in this unit are small areas of Chanac clay loam, Delano sandy loam, Delano Variant clay loam, and Premier coarse sandy loam. Included areas make up about 20 percent of the total acreage.

Permeability of this Cuyama soil is moderately slow. Available water capacity is moderate or high. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for livestock grazing. A few areas are used for homesite development.

This unit is suited to livestock grazing. It has no major limitations. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Grazing should be delayed until the soil is firm and the more desirable

forage plants have achieved sufficient growth to withstand grazing pressure.

If this unit is used for homesite development, the main limitations are the steepness of slope, moderate shrink-swell potential, and cobbly substratum. Removal of pebbles and cobbles in disturbed areas is needed for best results when landscaping, particularly in areas used for lawns. Buildings and roads should be designed to offset the limited ability of the soil in this unit to support a load. Septic tank absorption fields do not function properly during rainy periods because of wetness and moderately slow permeability. The limitation of moderately slow permeability can be overcome by increasing the size of the absorption field. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential.

This map unit is in capability subclass VIe (17), nonirrigated.

136—Cuyama-Urban land-Delano complex, 2 to 9 percent slopes. This map unit is on dissected alluvial fans and stream terraces. Elevation is 425 to 700 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 65 degrees F, and the average frost-free season is 275 to 325 days.

This unit is 30 percent Cuyama loam, 30 percent Urban land, and 20 percent Delano sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Premier coarse sandy loam and Hesperia sandy loam. Also included are small areas of Cuyama soils that have slopes of 9 to 15 percent and soils that are saline-alkali. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Cuyama soil is deep and well drained. It formed in alluvium derived dominantly from granitic rock. Typically, the surface layer is pale brown and light yellowish brown loam about 8 inches thick. The upper 10 inches of the subsoil is yellowish brown loam, and the lower 18 inches is reddish yellow gravelly clay loam. The upper 20 inches of the substratum is yellow very cobbly sandy clay loam, and the lower part to a depth of 65 inches is yellow sandy clay loam. In some areas the surface layer is sandy loam or coarse sandy loam.

Permeability of the Cuyama soil is moderately slow. Available water capacity is moderate or high. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

Urban land consists of areas where the soil surface is covered by asphalt, concrete, buildings, or other impervious surfaces. Examples are parking lots, shopping and business centers, industrial parks, and housing tracts.

The Delano soil is deep and well drained. It formed in alluvium derived dominantly from granitic rock. Typically, the surface layer is brown and pale brown sandy loam about 11 inches thick. The subsoil is light brown clay loam and sandy clay loam about 31 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown sandy loam.

Permeability of this Delano soil is moderately slow. Available water capacity is moderate or high. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

This unit is used for urban development.

If this unit is used for urban development, the main limitations are moderate shrink-swell potential and the content salts and cobbles in the substratum of the Cuyama soil. Drainage is needed if roads and building foundations are constructed. The risk of erosion is increased if the soil is left exposed during site development. Plans for homesite development should provide for the preservation of as many trees as possible. Because of the content of salts in the substratum, selection of adapted vegetation is critical for the establishment of lawns, trees, and vegetable gardens. Removal of pebbles and cobbles in disturbed areas is needed for best results when landscaping, particularly in areas used for lawns. Buildings and roads should be designed to offset the limited ability of the soils in this unit to support a load. Septic tank absorption fields do not function properly during rainy periods because of wetness and the moderately slow permeability. The limitation of moderately slow permeability can be overcome by increasing the size of the absorption field. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential.

137—Cymric loam, 5 to 30 percent slopes. This shallow, well drained soil is on stream terraces. It formed in alluvium derived dominantly from soft shale or sandstone. The present vegetation in most areas is mainly annual grasses and forbs with scattered shrubs. Elevation is 1,000 to 1,600 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is 200 to 225 days.

Typically, the surface layer is pale brown loam about 15 inches thick. The next layer is a lime- and silica-cemented layer about 6 inches thick. The underlying material to a depth of 60 inches or more is white, weakly

cemented sandy loam. The soil is about 5 to 10 percent gravel.

Included in this unit are small areas of Polonio loam and Kilmer loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Cymric soil is moderate above the cemented layer. Available water capacity is very low. Runoff is medium or rapid, and the hazard of water erosion is moderate. Effective rooting depth is 8 to 20 inches.

This unit is used for livestock grazing.

This unit is poorly suited to livestock grazing. The production of forage is limited by the very low available water capacity. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Removal of the plant cover results in extensive erosion.

This map unit is in capability subclass VIe (17), nonirrigated.

138—Delano sandy loam, 0 to 2 percent slopes. This deep, well drained soil is on alluvial plains and terraces. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 300 to 700 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 64 degrees F, and the average frost-free period is 260 to 290 days.

Typically, the surface layer is brown and pale brown sandy loam about 11 inches thick. The subsoil is light brown clay loam and sandy clay loam about 31 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown sandy loam. In some areas the surface layer is loam.

Included in this unit are small areas of Cuyama loam, Exeter sandy loam, Wasco sandy loam, Kimberlina fine sandy loam, and Zerker sandy clay loam. Included areas make up about 15 percent of the total acreage.

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

This unit is used mainly for irrigated crops such as alfalfa, cotton, grapes, and oranges. It is also used for urban development.

This unit is suited to irrigated row and orchard crops. It has few limitations. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Furrow, border, drip, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

If this unit is used for urban development, the main limitation is rare periods of flooding. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Septic tank absorption fields do not function properly during rainy periods because of wetness and the moderately slow permeability. The limitation of moderately slow permeability can be overcome by increasing the size of the absorption field.

This map unit is in capability class I (17), irrigated, and capability subclass VIc, nonirrigated.

139—Delano sandy loam, 2 to 5 percent slopes. This deep, well drained soil is on alluvial plains and terraces. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 300 to 700 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 260 to 290 days.

Typically, the surface layer is brown and pale brown sandy loam about 11 inches thick. The subsoil is light brown clay loam and sandy clay loam about 31 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown sandy loam. In some areas the surface layer is loam.

Included in this unit are small areas of Cuyama loam, Zerker loam, and Premier coarse sandy loam. Included areas make up about 10 percent of the total acreage.

Permeability of this Delano soil is moderately slow. Available water capacity is moderate or high. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

This unit is used mainly for irrigated crops such as alfalfa, almonds, cotton, and oranges. Other crops grown are barley, olives, and pistachios. The unit is also used for urban development.

This unit is suited to irrigated row and orchard crops. It has few limitations. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. Furrow, border, drip, and sprinkler irrigation systems are suited to this unit.

The method used generally is governed by the crop grown. If furrow irrigation systems are used, runs should be on the contour or across the slope. Irrigation water needs to be applied at a rate that ensures optimum production without increasing deep percolation, runoff, and erosion.

If this unit is used for urban development, the main limitation is rare periods of flooding. Dikes and channels that can be used to protect buildings and onsite sewage disposal systems from flooding. Septic tank absorption fields do not function properly during rainy periods because of wetness and the moderately slow permeability. The limitation of moderately slow permeability can be overcome by increasing the size of the absorption field.

This map unit is in capability unit IIe-1 (17), irrigated, and capability subclass VIe, nonirrigated.

140—Delano sandy loam, 5 to 9 percent slopes. This deep, well drained soil is on alluvial plains and terraces. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 300 to 700 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 260 to 290 days.

Typically, the surface layer is brown and pale brown sandy loam about 11 inches thick. The subsoil is light brown clay loam and sandy clay loam about 31 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown sandy loam. In some areas the surface layer is loam.

Included in this unit are small areas of Cuyama loam, Zerker loam, and Premier coarse sandy loam. Included areas make up about 15 percent of the total acreage.

Permeability of the Delano soil is moderately slow. Available water capacity is moderate or high. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

This unit is used mainly for irrigated crops such as alfalfa, almonds, cotton, and oranges. Other crops grown are barley, olives, and pistachios.

This unit is suited to irrigated row and orchard crops. It is limited mainly by moderate slopes and the moderate hazard of erosion. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Erosion can be reduced by planting a close growing cover crop. Because of the slope, sprinkler or drip irrigation is most suitable. Use of these methods permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Irrigation water needs to be applied at a rate that ensures optimum production without increasing deep percolation, runoff, and erosion.

This map unit is in capability unit IIe-1 (17), irrigated, and capability subclass VIe, nonirrigated.

141—Delano sandy clay loam, 0 to 2 percent slopes. This deep, well drained soil is on alluvial plains. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 260 to 290 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 260 to 290 days.

Typically, the surface layer is brown sandy clay loam about 16 inches thick. The subsoil is yellowish brown and brownish yellow sandy clay loam about 19 inches thick. The substratum to a depth of 60 inches or more is stratified, light yellowish brown sandy loam. In some areas the surface layer is loam.

Included in this unit are small areas of Delano sandy loam, Hesperia sandy loam, and Wasco sandy loam. Included areas make up about 15 percent of the total acreage.

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

Most areas of this unit are used for irrigated crops, mainly alfalfa, barley, cotton, onions, and potatoes. Among the other crops grown are almonds and oranges. Some areas are used for urban development.

This unit is suited to irrigated crops. In the mechanical harvesting of some crops, it is limited mainly by the sandy clay loam texture of the surface layer. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

If this unit is used for homesite development, the main limitation is periods of flooding. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Drainage is needed if roads and building foundations are constructed. The risk of erosion is increased if the soil is left exposed during site development. Revegetating disturbed areas around construction sites as soon as possible helps to control erosion. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees. The possibility of settlement can be minimized by compacting the building site before beginning construction. Septic tank absorption fields do not function properly during rainy periods because of wetness and the moderately

slow permeability. The limitation of moderately slow permeability can be overcome by increasing the size of the absorption field. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential.

This map unit is in capability class I (17), irrigated, and capability subclass VIc, nonirrigated.

142—Delano-Urban land complex, 0 to 5 percent slopes. This map unit is on alluvial plains and terraces. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 425 to 600 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 260 to 290 days.

This unit is 45 percent Delano sandy loam and 35 percent Urban land. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Delano sandy clay loam, Panoche clay loam, Kimberlina fine sandy loam, and Wasco sandy loam. Included areas make up about 20 percent of the total acreage.

The Delano soil is deep and well drained. It formed in alluvium derived dominantly from granitic rock. Typically, the surface layer is brown and pale brown sandy loam about 11 inches thick. The subsoil is light brown clay loam and sandy clay loam about 31 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown sandy loam. In some areas the surface layer is loam.

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

Urban land consists of areas covered by concrete, asphalt, buildings, or other impervious surfaces. In most areas some or all of the soil profile has been cut away or altered. The fill material is from adjacent areas of Kimberlina, Panoche, and Wasco soils that have been cut or graded.

This unit is used for urban development.

If this unit is used for urban development, the main limitation is rare periods of flooding. Flooding can be controlled only by use of major flood control structures. Drainage is needed if roads and building foundations are constructed. The risk of erosion is increased if the soil is left exposed during site development. Revegetating disturbed areas around construction sites as soon as possible helps to control erosion. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees. The possibility of settlement can be minimized by compacting the building site before beginning construction. Septic tank absorption fields do not function properly during rainy periods because of wetness and the moderately slow permeability. The limitation of moderately slow permeability can be overcome by increasing the size of the absorption field. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential.

143—Delano Variant clay loam, 0 to 9 percent slopes. This deep, well drained soil is on alluvial plains and terraces. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 500 to 1,000 feet. The average annual precipitation is about 9 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 200 to 250 days.

Typically, the surface layer is dark grayish brown clay loam about 8 inches thick. The subsoil is dark grayish brown and variegated grayish brown and brown clay loam and clay about 23 inches thick. The substratum to a depth of 60 inches or more is light brown sandy loam and coarse sandy loam.

Included in this unit are small areas of Cuyama loam, Delano sandy loam, Exeter sandy loam, and Chanac clay loam. Included areas make up 15 percent of the total acreage.

Permeability of this soil is slow. Available water capacity is high. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

This unit is used mainly for irrigated orchards and dryfarmed grain.

This unit is suited to irrigated orchards and dryfarmed grain. It is limited mainly by the hazard of erosion and the fine texture of the subsoil. Use of a cropping system that includes growing a cover crop, return of crop residue, and proper tillage is needed to improve soil tilth and to increase fertility and the water intake rate. Growing a cover crop in nontilled areas increases water infiltration and reduces runoff and erosion. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Because of the slope, sprinkler or drip irrigation is best suited to this unit. Irrigation water needs to be applied at a rate that ensures optimum production without increasing deep percolation, runoff, and erosion. Because precipitation is not sufficient for annual dry-farmed cropping, a cropping system of grain, fallow, and then volunteer pasture is most suitable.

This map unit is in capability units IIIe-1 (17), irrigated, and IVe-1 (17), nonirrigated.

144—Delgado sandy loam, 5 to 30 percent slopes. This shallow, somewhat excessively drained soil is on hills. It formed in residuum derived dominantly from sedimentary rock. The present vegetation in most areas is mainly annual grasses and forbs. Elevation is 450 to 1,200 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 230 to 275 days.

Typically, the surface layer is brown sandy loam about 2 inches thick. The underlying material to a depth of 10 inches is yellowish brown sandy loam. Below this is hard sandstone. In some areas the surface layer is loam.

Included in this unit are small areas of Bitterwater sandy loam, Kettleman loam, and Rock outcrop. Also included are small areas of soils that are similar to this Delgado soil but have slopes of more than 30 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Delgado soil is moderately rapid. Available water capacity is very low. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 7 to 20 inches.

This unit is used for livestock grazing.

This unit is poorly suited to livestock grazing. The production of forage is limited by low rainfall and depth to bedrock. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. This unit supports sparse stands of plants that are suitable for livestock grazing. Removal of the plant cover results in extensive erosion. Livestock grazing should be managed to protect the soil from erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce forage. The soil in this unit is limited for livestock watering ponds and other water impoundments because of moderately rapid permeability.

This map unit is in capability subclass VIIe (15), nonirrigated.

145—Driver coarse sandy loam, 0 to 2 percent slopes. This deep, well drained soil is on terraces. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 400 to 525 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is yellowish brown coarse sandy loam about 16 inches thick. The subsoil is yellowish brown loam about 11 inches thick. The upper 10 inches of the substratum is brown, weakly cemented coarse sandy loam, and the lower part to a depth of 65 inches is yellowish brown and pale brown, stratified loam and loamy coarse sand. In some areas the surface layer is sandy loam.

Included in this unit are small areas of Lewkalb sandy loam and Wasco sandy loam. Also included are small areas of soils that have a strongly cemented pan below a depth of 20 inches or a brittle layer below a depth of 40 inches. Included areas make up about 15 percent of the total acreage.

Permeability of the Driver soil is moderately slow in the subsoil and slow in the weakly cemented substratum. Available water capacity is moderate or high. Runoff is very slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more, but it is somewhat restricted by the weakly cemented substratum.

This unit is used for irrigated crops, mainly cotton and alfalfa.

This unit is suited to irrigated crops. Ripping and shattering the weakly cemented layer improves internal drainage and eases root penetration. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Using a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Irrigation water needs to be applied at a rate that ensures optimum production without increasing deep percolation, runoff, and erosion.

This map unit is in capability unit IIs-8 (17), irrigated, and capability subclass VIIs, nonirrigated.

146—Elkhills sandy loam, 9 to 50 percent slopes, eroded. This deep, well drained soil is primarily on uplifted, dissected old areas of valley fill. It formed in alluvium derived dominantly from sedimentary and granitic rock. The vegetation in areas not cultivated is mainly annual grasses, forbs, and scattered shrubs. Elevation is 600 to 1,800 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 63 degrees F, and the average frost-free season is about 240 to 300 days.

Typically, the surface layer is pale brown sandy loam about 7 inches thick. The subsurface layer is light yellowish brown fine sandy loam about 22 inches thick. The upper 20 inches of the underlying material is very pale brown coarse sandy loam, and the lower part to a depth of 65 inches or more is light gray, stratified gravelly coarse sand, sand, and loamy sand. In some areas the surface layer is loam or gravelly sandy loam.

Included in this unit are small areas of Torriorthents; stratified, very sandy soils; and soils that have loam or clay loam in the underlying material. Included areas make up about 20 percent of the total acreage. Each included area is less than 15 percent of the total inclusions.

Permeability of this Elkhills soil is moderately rapid. Available water capacity is moderate or high. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more. Road building, petroleum construction activities, and past sheep grazing have disturbed the vegetation and surface layer in parts of this unit. These activities have exposed highly erodible soil material and increased the rate of erosion. Recently eroded soil material has accumulated in drainageways. In some areas erosion is more extensive on south-facing slopes.

A few areas of this unit are used for livestock grazing. Oil wells are common on the unit.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall and steepness of slope. If the plant cover is overgrazed, the soil becomes more susceptible to soil erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce forage. Reestablishment of vegetation may be difficult if erosion has exposed material that is high in content of salt. Cross-fencing and correctly placing livestock watering facilities help to distribute livestock grazing and to reduce overgrazing of the lower slopes. This unit is limited for livestock watering ponds and other water impoundments because of the moderately rapid permeability of the soil.

This map unit is in capability subclass VIIe (17), nonirrigated.

147—Elkhills gravelly sandy loam, 9 to 15 percent slopes. This deep, well drained soil is in areas of uplifted, dissected, old valley fill. It formed in alluvium derived dominantly from sedimentary and granitic rock. The vegetation in areas not cultivated is mainly annual grasses and forbs with scattered shrubs. Elevation is 750 to 1,100 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 63 degrees F, and the average frost-free season is 240 to 300 days.

Typically, the surface layer is pale brown gravelly sandy loam about 29 inches thick. The upper 20 inches of the underlying material is very pale brown gravelly sandy loam, and the lower part to a depth of 65 inches or more is light gray, stratified gravelly sandy loam, sand, and loamy sand. The soil is about 20 to 30 percent gravel. Some cobbles are present. In some areas the surface layer is gravelly loam.

Included in this unit are small areas of Kimberlina gravelly sandy loam and Panoche clay loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Elkhills soil is moderately rapid. Available water capacity is low or moderate. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more. Sedimentation occurs in some drainageways.

This unit is used for livestock grazing. Oil wells are common on the unit.

This unit is suited to livestock grazing. Because of low rainfall, forage production is low in most years. If the plant cover is overgrazed, the soil becomes more susceptible to soil blowing and water erosion. Overgrazing or operating off-road vehicles on this unit causes the plant community to deteriorate and increases soil erosion. This unit is limited for livestock watering ponds and other water impoundments because of the moderately rapid permeability of the soil.

This map unit is in capability subclass VIIe (17), nonirrigated.

148—Elkhills gravelly sandy loam, 15 to 50 percent slopes. This deep, well drained soil is in areas of uplifted, dissected, old valley fill. It formed in alluvium derived dominantly from sedimentary and granitic rock. The vegetation in areas not cultivated is mainly annual grasses and forbs with scattered shrubs. Elevation is 750 to 1,200 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 63 degrees F, and the average frost-free season is 240 to 300 days.

Typically, the surface layer is pale brown gravelly sandy loam about 29 inches thick. The upper 20 inches of the underlying material is very pale brown gravelly sandy loam, and the lower part to a depth of 65 inches or more is light gray, stratified gravelly sandy loam, sand, and loamy sand. The soil is about 20 to 30 percent gravel. Some cobbles are present. In some areas the surface layer is gravelly loam.

Included in this unit are small areas of Kimberlina gravelly sandy loam and Panoche clay loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Elkhills soil is moderately rapid. Available water capacity is low or moderate. Runoff is medium or rapid, and the hazard of water erosion is moderate or high. Effective rooting depth is 60 inches or more. Sedimentation occurs in some drainageways.

This unit is used for livestock grazing. Oil wells are common on the unit.

This unit is suited to livestock grazing. Because of low rainfall, forage production is low in most years. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Overgrazing or operating off-road vehicles on this unit causes the plant community to deteriorate and increases soil erosion. In the steeper areas of this unit, use of mechanical treatment practices such as construction of access roads, drilling sites, and pipelines may increase the risk of erosion. Livestock grazing should be managed to protect the unit from erosion. This unit is limited for livestock watering ponds

and other water impoundments because of the moderately rapid permeability of the soil.

This map unit is in capability subclass VIIe (17), nonirrigated.

149—Elkhills-Bitterwater-Kettleman association, 9 to 50 percent slopes. This map unit is on hills and uplifted, dissected old valley fill. The present vegetation in most areas is mainly annual grasses, forbs, and shrubs. Elevation is 800 to 1,300 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 63 degrees F, and the average frost-free period is about 240 to 300 days.

This unit is 30 percent Elkhills sandy loam, 25 percent Bitterwater sandy loam, and 15 percent Kettleman loam. The Elkhills soil is on lower slopes, in drainageways, and on some side slopes. The Bitterwater and Kettleman soils are on hilltops and side slopes.

Included in this unit are small areas of a soil that is similar to the Elkhills soil but has a layer of common, large, rounded, very strongly cemented lime concretions at a depth of 20 to 40 inches. Also included are small areas of a soil that is similar to the Elkhills soil but has a layer that is moderately cemented by gypsum at a depth of 40 to 60 inches and small areas of Panoche loam. Included areas make up about 30 percent of the total acreage.

The Elkhills soil is deep and well drained. It formed in alluvium derived dominantly from sedimentary and granitic rock. Typically, the surface layer is pale brown sandy loam about 7 inches thick. The subsurface layer is light yellowish brown fine sandy loam about 22 inches thick. The upper 20 inches of the underlying material is very pale brown coarse sandy loam, and the lower part to a depth of 65 inches or more is light gray, stratified gravelly coarse sand, sand, and loamy sand. It is about 5 to 15 percent gravel.

Permeability of the Elkhills soil is moderately rapid. Available water capacity is moderate. Runoff is medium or rapid, and the hazard of water erosion is high. Effective rooting depth is about 60 inches. Sedimentation occurs in some drainageways.

The Bitterwater soil is deep and well drained. It formed in residuum derived dominantly from sandstone or shale. The surface layer is pale brown sandy loam about 23 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown and very pale brown sandy loam. Below the underlying material is weathered sandstone. The soil is 5 to 15 percent gravel.

Permeability of the Bitterwater soil is moderately rapid. Available water capacity is low or moderate. Runoff is medium, and the hazard of water erosion is high. Effective rooting depth is 40 to 60 inches or more.

The Kettleman soil is moderately deep and well drained. It formed in residuum derived dominantly from sedimentary rock. The surface layer is pale brown loam about 12 inches thick. The underlying material is light yellowish brown loam about 10 inches thick over weathered shale.

Permeability of the Kettleman soil is moderate. Available water capacity is low or moderate. Runoff is medium or rapid, and the hazard of water erosion is moderate. Effective rooting depth is 20 to 40 inches.

This unit is used mainly for livestock grazing. Oil wells are common on the unit.

This unit is suited to livestock grazing. Because of low rainfall, forage production is low in most years. If the range is overgrazed, the soil becomes more susceptible to erosion. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Uniform distribution of grazing can be achieved by the proper placement of salt and watering facilities. Overgrazing or operating off-road vehicles on this unit causes the plant community to deteriorate and increases soil erosion. In the steeper areas of this unit, use of mechanical treatment practices such as construction of access roads, drilling sites, and pipelines may increase the risk of erosion. Livestock grazing should be managed to protect the unit from erosion. This unit is limited for livestock watering ponds and other water impoundments because of the moderately rapid permeability of the Elkhills and Bitterwater soils.

The Elkhills soil is in capability subclass VIIe (17), nonirrigated, and the Bitterwater and Kettleman soils are in capability subclass VIIe (15), nonirrigated.

150—Elkhills-Torriorthents, stratified, complex, 9 to 15 percent slopes. This map unit is in areas of uplifted, dissected, old valley fill. The Elkhills soil supports a uniform plant cover of annual grasses, forbs, and scattered shrubs, and the Torriorthents support little if any plant cover. Elevation is 600 to 1,400 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 63 degrees F, and the average frost-free period is about 275 days.

This unit is 50 percent Elkhills sandy loam and 25 percent Torriorthents, stratified. The components of this unit are so intricately intermingled that is was not practical to map them separately at the scale used.

Included in this unit are small areas of soils that are similar to the Torriorthents but have slopes of less than 9 percent, Bitterwater gravelly sandy loam, very sandy soils, and soils that have a cemented layer below the subsoil. Included areas make up about 25 percent of the total acreage.

The Elkhills soil is deep and well drained. It formed in alluvium derived dominantly from sedimentary and granitic rock. Typically, the surface layer is pale brown sandy loam about 7 inches thick. The subsurface layer is light yellowish brown fine sandy loam about 22 inches thick. The upper 20 inches of the underlying material is very pale brown coarse sandy loam, and the lower part to a depth 65 inches or more is light gray, stratified gravelly coarse sand, sand, and loamy sand. It is about 5

to 15 percent gravel. In some areas the surface layer is loam.

Permeability of the Elkhills soil is moderately rapid. Available water capacity is moderate. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

The Torriorthents are deep and well drained. They formed in alluvium derived dominantly from sedimentary and granitic rock. The surface layer ranges from loamy sand to silt loam. The next layer is stratified silt loam to clay underlain by stratified gravelly sand to silty clay loam. Many areas are saline-alkali.

Permeability of the Torriorthents is moderate to slow. Available water capacity is moderate or high. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 60 inches or more. Sedimentation occurs in some drainageways.

This unit is used for livestock grazing. Oil wells are common on the unit.

This unit is suited to livestock grazing. The production of forage on the Elkhills soil is limited by low rainfall. Production on the Torriorthents is limited by low rainfall and the content of salts. Overgrazing or operating off-road vehicles on this unit causes the plant community to deteriorate and increases erosion. Reestablishing plant cover is difficult, especially if the surface layer has been lost through erosion, which exposes fine textured soil material that is high in content of salts. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage.

This map unit is in capability subclass VIIe (17), nonirrigated.

151—Elkhills-Torriorthents, stratified, eroded, complex, 15 to 50 percent slopes. This map unit is in areas of uplifted, dissected, old valley fill. The Elkhills soil supports a uniform plant cover of annual grasses, forbs, and scattered shrubs, and the Torriorthents support little if any cover. Elevation is 600 to 1,600 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 63 degrees F, and the average frost-free season is 240 to 300 days.

This unit is 50 percent Elkhills sandy loam and 25 percent Torriorthents, stratified, eroded. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of soils that are similar to these Torriorthents but have slopes of less than 15 percent, soils that have a silica-cemented layer below the subsoil, very sandy soils, and Bitterwater gravelly sandy loam. Included areas make up about 25 percent of the total acreage.

The Elkhills soil is deep and well drained. It formed in alluvium derived dominantly from sedimentary and granitic rock. Typically, the surface layer is pale brown sandy loam about 7 inches thick. The subsurface layer is light yellowish brown fine sandy loam about 22 inches thick. The upper 20 inches of the underlying material is very pale brown coarse sandy loam, and the lower part to a depth of 65 inches or more is light gray, stratified gravelly coarse sand, sand, and loamy sand. It is about 5 to 15 percent gravel.

Permeability of the Elkhills soil is moderately rapid. Available water capacity is moderate. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 60 inches or more.

Torriorthents are deep and well drained. They formed in alluvium derived dominantly from sedimentary and granitic rock. The surface layer of loamy sand to silt loam. The next layer is stratified silt loam to clay and is underlain by stratified gravelly sand to silty clay loam. Many areas are saline-alkali.

Permeability of the Torriorthents is moderate to slow. Available water capacity is moderate or high. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 60 inches or more. Road building, petroleum construction activities, and past sheep grazing have disturbed the vegetation and the surface layer in some areas of this unit. These activities have exposed highly erodible soil material and increased the rate of erosion. Recently eroded soil material has accumulated in drainageways. Erosion may be more extensive on south-facing slopes. In some areas erosion has exposed fine textured material that is high in content of salts.

Some areas of this unit are used for livestock grazing. Oil wells are common on the unit.

This unit is suited to livestock grazing. The production of forage on the Elkhills soil is limited by low rainfall, steepness of slopes, and the high hazard of erosion. Production on the Torriorthents is limited by low rainfall, the content of salts, and the high hazard of erosion. This unit supports sparse stands of plants that are suitable for grazing. Overgrazing or operating off-road vehicles on the unit causes the plant community to deteriorate and increases soil erosion. Reestablishing plant cover is difficult, especially if the surface layer has been lost through erosion, which exposes fine textured soil material that is high in content of salts. In some areas it may be necessary to replace the surface layer for revegetation to be successful. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Livestock grazing should be managed to protect the unit from erosion. This unit is limited for livestock watering ponds and other water impoundments because of the moderately rapid permeability of the Elkhills soils.

This map unit is in capability subclass VIIe (17), nonirrigated.

152—Excelsior sandy loam. This deep, well drained soil is on alluvial fans. It formed in alluvium derived dominantly from mixed rock sources. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 290 to 390 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 62 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is grayish brown sandy loam about 7 inches thick. The upper 25 inches of the underlying material is light brownish gray loamy sand, and the lower part to a depth of 60 inches or more is light gray sandy loam and silt loam. In some areas the surface layer is loamy sand or silt loam.

Included in this unit are small areas of Kimberlina fine sandy loam, Cajon loamy sand, Westhaven fine sandy loam, and Wasco sandy loam. Included areas make up about 20 percent of the total acreage.

Permeability of this Excelsior soil is slow. Available water capacity is low or moderate. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for irrigated crops such as cotton, sugar beets, potatoes, and alfalfa. A few areas are used for irrigated pasture. Oil wells are common on this unit.

This unit is suited to irrigated crops. It is limited mainly by restricted available water capacity. The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable rotation. Furrow, border, and sprinkler irrigation systems are suited to this unit. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion. In summer, irrigation is needed for maximum production of most crops. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

This unit is suited to irrigated pasture. The main limitation is restricted available water capacity. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Irrigation water can be applied by the furrow and border methods. Leveling helps to ensure the uniform application of water. In some years supplemental irrigation is also needed. Proper grazing use permits organic matter to accumulate in the soil, which increases water infiltration, promotes plant growth early in the season, and protects the soil from erosion.

This map unit is in capability unit IIs-3 (17), irrigated, and capability subclass VIs, nonirrigated.

153—Excelsior Variant silt loam. This deep, moderately well drained soil is on low stream terraces and flood plains. It formed in mixed alluvium derived dominantly from granitic rock. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly annual grasses, forbs, and a few perennial grasses. Elevation is 400 to 475 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 62 degrees F, and the average frost-free season is 240 to 270 days.

Typically, the surface layer is light brownish gray silt loam about 11 inches thick. The underlying material to a depth of 65 inches is stratified, light gray sand to silt loam. In some areas the surface layer is fine sandy loam or sandy loam.

Included in this unit are small areas of Cajon loamy sand, Premier coarse sandy loam, Hesperia sandy loam, and Kimberlina fine sandy loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Excelsior Variant soil is moderately rapid. Available water capacity is moderate. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more. This soil is subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks.

This unit is used for irrigated pasture, walnuts, and alfalfa. It is also used for limited livestock grazing. Oil wells are common on this unit.

This unit is suited to irrigated pasture. It has few limitations. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion.

This unit is suited to irrigated crops. It has few limitations. Furrow, border, and sprinkler irrigation systems are suited to this unit. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

This unit is suited to livestock grazing. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the soil has drained sufficiently and is firm enough to withstand trampling by livestock.

This map unit is in capability unit IIs-4 (17), irrigated, and capability subclass VIIs, nonirrigated.

154—Exeter sandy loam, 0 to 2 percent slopes. This moderately deep, well drained soil is on alluvial terraces. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 300 to 600

feet. The average annual precipitation is about 8 inches, the average annual temperature is about 63 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is pale brown sandy loam about 17 inches thick. The subsoil is brown loam about 7 inches thick. The next layer is a strongly lime- and silica-cemented layer about 14 inches thick. Stratified layers are below the pan. In some areas the surface layer is loam.

Included in this unit are small areas of Delano sandy loam and Zerker loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Exeter soil is moderate. Available water capacity is very low to moderate. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 20 to 40 inches.

Most areas of this unit are used for irrigated crops, mainly cotton, almonds, grapes, and oranges. Among the other crops grown are barley, alfalfa, and figs.

This unit is suited to irrigated row and orchard crops. It is limited mainly by the moderate depth to the cemented layer. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Ripping and shattering the cemented layer increases the effective rooting depth and improves internal drainage. Furrow, border, drip, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Irrigation water needs to be applied at a rate that ensures optimum production without increasing deep percolation, runoff, and erosion.

This map unit is in capability units IIIs-8 (17), irrigated, and IVs-8, nonirrigated.

155—Exeter sandy loam, 2 to 9 percent slopes. This moderately deep, well drained soil is on alluvial terraces. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 300 to 700 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 63 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is pale brown sandy loam about 17 inches thick. The subsoil is brown loam about 7 inches thick. The next layer is a strongly lime- and silica-cemented layer about 14 inches thick. Stratified layers are below the pan. In some areas the surface layer is loam.

Included in this unit are small areas of Delano sandy loam and Chanac clay loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Exeter soil is moderate. Available water capacity is very low to moderate. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 20 to 40 inches.

Most areas of this unit are used for irrigated orchard crops, mainly almonds and oranges.

This unit is suited to irrigated orchard crops. It is limited mainly by the moderate depth to the cemented layer and gently rolling slopes. Ripping and shattering the cemented layer increases the effective rooting depth and improves internal drainage. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Erosion can be reduced by planting a close growing cover crop. Border, drip, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the slope, sprinkler or drip irrigation is most suitable for orchard crops. Irrigation water needs to be applied at a rate that ensures optimum production without increasing deep percolation, runoff, and erosion.

This map unit is in capability units IIIe-8 (17), irrigated, and IVe-8, nonirrigated.

156—Garces silt loam. This deep, well drained, saline-alkali soil is on basin rims. It formed in alluvium derived dominantly from granitic rock. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly salt tolerant annual grasses, forbs, and shrubs (fig. 1). Elevation is 250 to 400 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 275 to 300 days.

Typically, the surface layer is pale brown silt loam about 2 inches thick. The subsurface layer is very pale brown silt loam about 3 inches thick. The subsoil is light yellowish brown clay loam and pale brown loam about 32 inches thick. The substratum to a depth of 60 inches or more is very pale brown loam and light gray fine sandy loam. In some areas the surface layer is sandy loam or loam. The soil is moderately to strongly saline-alkali.

Included in this unit are small areas of Kimberlina fine sandy loam, Milham sandy loam, Panoche clay loam that is saline-alkali, and Wasco sandy loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Garces soil is very slow. Available water capacity is low to high. Runoff is very slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more. Toxic levels of boron are present in places.

Most areas of this unit are used for irrigated crops, mainly barley, cotton, sorghum, and sugar beets. Among the other crops grown are almonds, alfalfa, and wheat. Some areas are used for irrigated pasture, livestock grazing, and urban development.

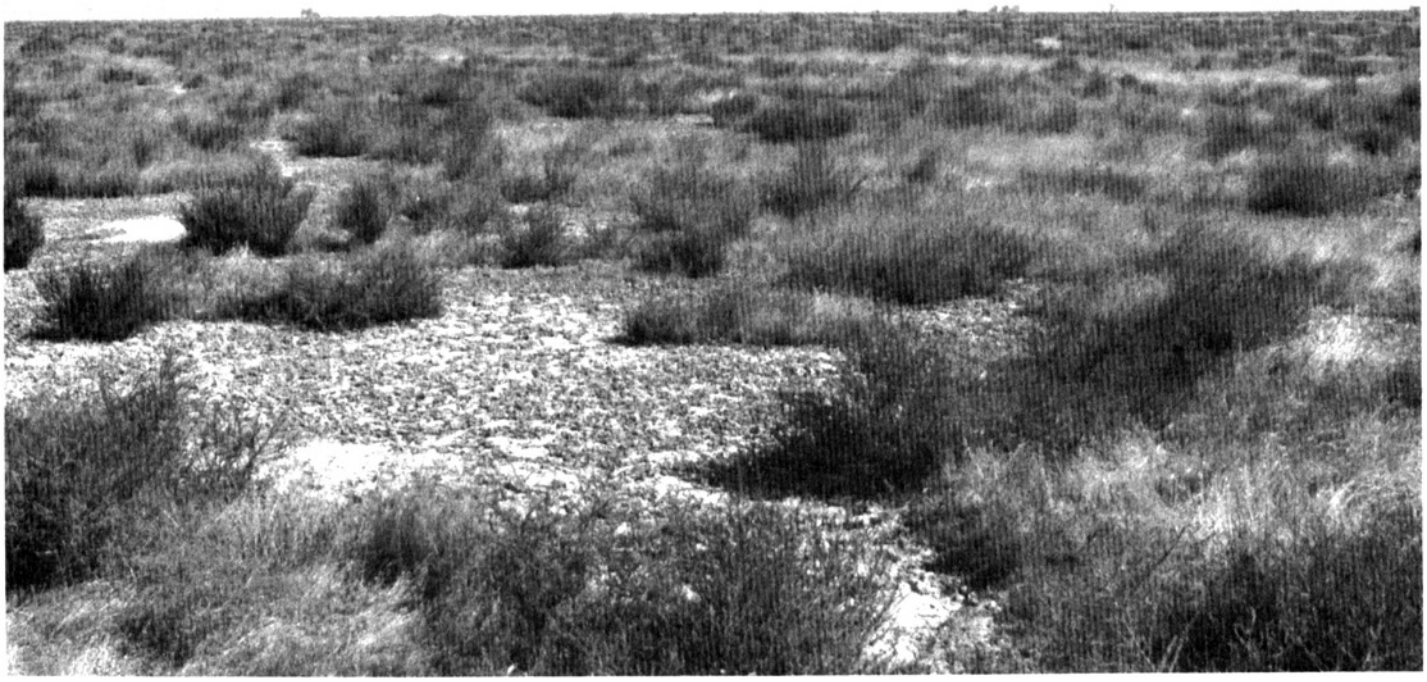

Figure 1.—Natural vegetation in an area of Garces silt loam.

This unit is suited to irrigated salt tolerant crops. It is limited mainly by the saline-alkali condition of the soil and the very slow permeability. Intensive management is required to reduce the salinity and to maintain soil productivity. Furrow, border, and sprinkler irrigation systems are suited to this unit. Irrigation water needs to be applied at a rate that ensures optimum production without increasing deep percolation and runoff. The method used generally is governed by the crop grown. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Subsoiling opens up the soil and allows water and salts to pass through. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. Salt tolerant crops should be grown while the soil is being reclaimed. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate.

This unit is poorly suited to livestock grazing. Low rainfall and the saline-alkali condition of the soil limit the production of forage plants. Production of forage is low. If the plant cover is overgrazed, the soil becomes more susceptible to soil blowing. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion.

This unit is suited to hay and pasture. The main limitations are the saline-alkali condition of the soil and very slow permeability. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Proper grazing practices, weed control, and fertilizer are needed to ensure maximum quality of forage. Irrigation water can be applied by the border and sprinkler methods. For the optimum production of crops, water should be applied in amounts sufficient to leach the salts from the root zone but at a rate that will not cause excessive runoff. Salt tolerant crops should be grown while the soil is being reclaimed.

If this unit is used for homesite development, the main limitations are the saline-alkali condition of the soil and rare periods of flooding. Selection of adapted vegetation is critical for the establishment of lawns, shrubs, trees, and vegetable gardens. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Septic tank absorption fields do not function properly during rainy periods because of wetness and the very slow permeability. Absorption lines should be placed below the very slowly permeable layer. Increasing the

size of the absorption area helps to compensate for the very slow permeability.

This map unit is in capability unit IIIs-6 (17), irrigated, and capability subclass VIIs, nonirrigated.

157—Garces silt loam, moderately wet. This deep, well drained, saline-alkali soil is on basin rims. The drainage has been altered by seepage resulting from extensive irrigation within the area. It formed in alluvium derived dominantly from granitic rock. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly salt tolerant annual grasses and forbs. Elevation is 250 to 400 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is very pale brown silt loam about 2 inches thick. The subsurface layer is very pale brown silt loam about 3 inches thick. The subsoil is light yellowish brown clay loam and pale brown loam about 35 inches thick. The substratum to a depth of 60 inches or more is very pale brown loam and light gray fine sandy loam. In some areas the surface layer is sandy loam or loam. The soil is moderately to strongly saline-alkali.

Included in this unit are small areas of Kimberlina fine sandy loam, Milham sandy loam, and Panoche clay loam. Included areas make up about 15 percent of the total acreage.

Permeability of this soil is slow. Available water capacity is low to high. Runoff is very slow, and the hazard of water erosion is slight. Effective rooting depth is limited by a high water table at a depth of 3 to 6 feet. Toxic levels of boron are present in places.

Most areas of this unit are used for irrigated crops, mainly barley, sugar beets, sorghum, and cotton. Among the other crops grown are alfalfa and wheat. Some areas are used for irrigated pasture.

This unit is suited to irrigated salt tolerant crops. It is limited mainly by the the saline-alkali condition of the soil, the very slow permeability, and depth to the water table. Use of a cropping system that includes growing a cover crop, return of crop residue, and proper tillage is needed to improve soil tilth and to increase the fertility and water intake rate. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Subsoiling opens up the soil and allows water and salts to pass through. The amount of salts present, the crops planted, and the reclamation procedures used all affect the yield of crops on this unit. Furrow, border, or sprinkler irrigation is suited to this unit. The method used generally is governed by the crop grown. Irrigation water management is very important. Excess irrigation water can cause the water table to rise nearer to the surface. Tile or open drains can be used to remove excess water and toxic salts if a suitable outlet is available. Most climatically adapted crops can be grown if artificial drainage is provided.

This unit is suited to hay and pasture. The main limitations are the saline-alkali condition of the soil, the very slow permeability, and the high water table. The concentration of salts and alkali in the surface layer limits the production of plants suitable for hay and pasture. Leaching the salts from the surface layer is limited by the high water table. Drainage and irrigation water management reduce the concentration of salts. Salt tolerant species are most suitable for planting. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Proper grazing practices, weed control, and fertilizer are needed to ensure maximum quality of forage. Irrigation water can be applied by the border or sprinkler methods. A livestock watering system, such as a pipeline, trough, or well, should be developed in areas where livestock are grazing. Irrigation water management is very important. Tile drainage can be used to lower the water table if a suitable outlet is available.

This map unit is in capability unit IIIw-2 (17), irrigated, and capability subclass VIIw, nonirrigated.

158—Garces silt loam, hard substratum. This deep, well drained, saline-alkali soil is on basin rims. It formed in alluvium derived dominantly from granitic rock. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly salt tolerant annual grasses, forbs, and shrubs. Elevation is 250 to 400 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 275 to 300 days.

Typically, the surface layer is light gray silt loam about 5 inches thick. The upper part of the subsoil is grayish brown silty clay loam about 10 inches thick, and the lower 27 inches is light yellowish brown loam and sandy clay loam. The substratum to a depth of 60 inches or more is stratified, weakly cemented, dark yellowish brown sandy loam and loam. In some areas the surface layer is sandy loam or loam. The soil is moderately to strongly saline-alkali.

Included in this unit are small areas of Jerryslu loam, Garces silt loam, Kimberlina fine sandy loam, and Panoche clay loam, saline-alkali. Included areas make up about 15 percent of the total acreage.

Permeability of this Garces soil is very slow. Available water capacity is low or moderate. Runoff is very slow, and the hazard of water erosion is slight. The effective rooting depth is 60 inches or more but is somewhat restricted by the weakly cemented substratum. Toxic levels of boron are present in places.

Most areas of this unit are used for livestock grazing. A few areas are used for irrigated crops, irrigated pasture, and urban development.

This unit is suited to irrigated salt tolerant crops. It is limited mainly by the saline-alkali condition of the soil, the very slow permeability, and depth to the weakly cemented layer. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves tilth, fertility, and the water intake rate. Intensive management is required to reduce the salinity and maintain soil productivity. The cemented substratum reduces the yield of deep-rooted plants. Where feasible, deep ripping of the cemented substratum helps to overcome this limitation. Furrow, border, and sprinkler irrigation systems are suited to this unit. Irrigation water needs to be applied at a rate that ensures optimum production without increasing runoff or allowing water to perch above the cemented substratum. The method used generally is governed by the crop grown. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Subsoiling opens up the soil and allows water and salts to pass through. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. Salt tolerant crops should be grown while the soil is being reclaimed.

This unit is poorly suited to livestock grazing. The production of forage is limited by low rainfall and the saline-alkali condition of the soil. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. This unit supports salt tolerant plants.

This unit is suited to hay and pasture. The main limitations are saline-alkali condition of the soil, the very slow permeability, and depth to the weakly cemented layer. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Proper grazing practices, weed control, and fertilizer are needed to ensure maximum quality of forage. Irrigation water can be applied by the border and sprinkler methods. For the optimum production of crops, water should be applied in amounts sufficient to leach the salts from the root zone but at a rate that will not cause excessive runoff. Salt tolerant crops should be grown while the soil is being reclaimed.

If this unit is used for urban development, the main limitations are depth to the weakly cemented layer, the saline-alkali condition of the soil, and rare periods of flooding. Selection of adapted vegetation is critical for the establishment of lawns, shrubs, trees, and vegetable gardens. Septic tank absorption fields do not function properly during rainy periods because of wetness and the very slow permeability. Absorption lines should be placed below the very slowly permeable layer. Increasing the size of the absorption area helps to compensate for the very slow permeability. The suitability of this unit for septic tank absorption fields can be improved by ripping the cemented layer to increase permeability. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding.

This map unit is in capability unit IIIs-6 (17), irrigated, and capability subclass VIIs, nonirrigated.

159—Hesperia sandy loam, 0 to 2 percent slopes. This deep, well drained soil is on low terraces and alluvial fans. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 300 to 700 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 63 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is brown sandy loam about 20 inches thick. The underlying material to a depth of 60 inches or more is pale brown and light yellowish brown sandy loam. In some areas the surface layer is loam or coarse sandy loam.

Included in this unit are small areas of Whitewolf coarse sandy loam and soils that are similar to this Hesperia soil but have thin strata of contrasting textures. Included areas make up about 20 percent of the total acreage.

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

Most areas of this unit are used for irrigated crops, mainly grapes, cotton, and potatoes. Oil wells are common in a few areas.

This unit is suited to irrigated crops. It is limited mainly by the moderate available water capacity. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

This map unit is in capability unit IIs-4 (17), irrigated, and capability subclass VIe, nonirrigated.

160—Hesperia sandy loam, 2 to 9 percent slopes. This deep, well drained soil is on low terraces and alluvial fans. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 500 to 600 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 63

degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is brown sandy loam about 20 inches thick. The underlying material to a depth of 60 inches or more is pale brown and light yellowish brown sandy loam. In some areas the surface layer is loam or coarse sandy loam.

Included in this unit are small areas of Whitewolf coarse sandy loam, Excelsior Variant silt loam, and Premier coarse sandy loam. Also included are small areas of soils that have a weakly cemented layer above a depth of 40 inches and soils that are similar to this Hesperia soil but have thin strata of contrasting textures below a depth of 40 inches. Included areas make up about 20 percent of the total acreage.

Permeability of this Hesperia soil is moderately rapid. Available water capacity is moderate. Runoff is slow, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

This unit is used for limited livestock grazing.

This unit is suited to livestock grazing. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities.

This map unit is in capability subclass VIe (17), nonirrigated.

161—Hillbrick-Aido association, 30 to 50 percent slopes. This map unit is on hills and mountains. The present vegetation in most areas is mainly annual grasses and forbs. Scattered oaks and shrubs grow on most north-facing slopes. Elevation is 1,200 to 3,500 feet. The average annual precipitation is about 9 inches, the average annual temperature is about 61 degrees F, and the average frost-free season is 200 to 250 days.

This unit is 60 percent Hillbrick sandy loam and 20 percent Aido clay. The Hillbrick soil is on south- and west-facing slopes, and the Aido soil is on north- and east-facing slopes.

Included in this unit are small areas of Bluestone clay, Kilmer loam, Rock outcrop, and soils that are similar to the Hillbrick soil but do not have carbonates. Included areas make up about 20 percent of the total acreage.

The Hillbrick soil is shallow and well drained. It formed in residuum derived dominantly from weathered sandstone or shale. Typically, the surface layer is pale brown sandy loam about 15 inches thick over fractured shale. The soil is 5 to 15 percent gravel. Content of gravel generally increases with increasing depth. In some areas the surface layer is loam or shaly loam.

Permeability of the Hillbrick soil is moderately rapid. Available water capacity is very low. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 10 to 20 inches.

The Aido soil is moderately deep and well drained. It formed in residuum derived dominantly from shale. Typically, the surface layer is pale brown clay about 10 inches thick. The underlying material is brown clay about 16 inches thick over shale. In some areas the surface layer is clay loam.

Permeability of the Aido soil is slow. Available water capacity is low or moderate. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 20 to 40 inches.

This unit is used for livestock grazing.

This unit is suited to livestock grazing. The production of forage on the Hillbrick soil is limited by the very low available water capacity. The Aido soil has few limitations. If the range is overgrazed, the proportion of less preferred forage plants increases. Cross-fencing and correctly placing livestock watering facilities help to distribute livestock grazing and to reduce overgrazing of the lower slopes. Livestock grazing should be managed to protect the unit from erosion.

The Hillbrick soil is in capability subclass VIIe (15), nonirrigated. The Aido soil is in capability subclass VIe (15), nonirrigated.

162—Hillbrick-Rock outcrop complex, 15 to 50 percent slopes. This map unit is on hills and mountains. The present vegetation in most areas is mainly annual grasses and forbs with a few small shrubs and scattered junipers. Elevation is 1,200 to 3,500 feet. The average annual precipitation is about 9 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is 200 to 250 days.

This unit is 75 percent Hillbrick sandy loam and 15 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Kilmer loam, Aido clay, and a soil that is similar to the Hillbrick soil but does not have carbonates. Included areas make up about 10 percent of the total acreage.

The Hillbrick soil is shallow and well drained. It formed in residuum derived dominantly from weathered sandstone or shale. Typically, the surface layer is pale brown sandy loam about 15 inches thick over fractured shale. The soil is 5 to 15 percent gravel. Content of gravel generally increases with increasing depth. In some areas the surface layer is loam or shaly sandy loam.

Permeability of the Hillbrick soil is moderately rapid. Available water capacity is very low. Runoff is medium or rapid, and the hazard of water erosion is high. Effective rooting depth is 10 to 20 inches.

Rock outcrop consists of exposures of hard sandstone or shale 5 to 300 feet wide. The vegetation is limited to the fractures in the rock. Runoff is very rapid.

This unit is used for livestock grazing.

This unit is suited to livestock grazing. The production of forage on the Hillbrick soil is limited by the very low available water capacity. Rock outcrop has little if any value for grazing. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Livestock grazing should be managed to protect the unit from erosion. Areas where brush is managed by prescribing burning or by chemical or mechanical methods may be subject to a greater risk of erosion. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Cross-fencing and correctly placing livestock watering facilities help to distribute livestock grazing and to reduce overgrazing of the lower slopes.

This map unit is in capability subclass VIIe (15), nonirrigated.

163—Hillbrick-Rock outcrop complex, 50 to 75 percent slopes. This map unit is on hills and mountains. The present vegetation in most areas is mainly annual grasses and forbs with a few small shrubs and scattered junipers. Elevation is 1,200 to 3,500 feet. The average annual precipitation is about 9 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is 200 to 250 days.

This unit is 65 percent Hillbrick sandy loam and 15 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Kilmer loam, Aido clay, and a soil that is similar to the Hillbrick soil but does not have carbonates. Included areas make up about 20 percent of the total acreage.

The Hillbrick soil is shallow and well drained. It formed in residuum derived dominantly from weathered sandstone or shale. Typically, the surface layer is pale brown sandy loam about 15 inches thick over fractured shale. The soil is 5 to 15 percent gravel. Content of gravel generally increases with increasing depth. In some areas the surface layer is loam or shaly sandy loam.

Permeability of the Hillbrick soil is moderately rapid. Available water capacity is very low. Runoff is rapid, and the hazard of water erosion is very high. Effective rooting depth is 10 to 20 inches.

Rock outcrop consists of exposures of hard sandstone or shale 5 to 300 feet wide. The vegetation is limited to the fractures in the rock. Runoff is very rapid.

This unit is used for livestock grazing.

This unit is suited to livestock grazing. The production of forage on the Hillbrick soil is limited by the very low available water capacity and steepness of slope. Rock outcrop has little if any value for grazing. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Correct placement of salt and supplemental feed helps to distribute livestock grazing and prevent overgrazing. Livestock grazing should be managed to protect the unit from erosion. Removal of the plant cover results in extensive erosion.

This map unit is in capability subclass VIIe (15), nonirrigated.

164—Houser fine sandy loam, partially drained. This deep, somewhat poorly drained, saline-alkali soil is on basin rims. The drainage has been altered by seepage resulting from extensive irrigation within the area. The soil formed in alluvium derived dominantly from granitic rock. Slope is 0 to 1 percent. Elevation is 190 to 220 feet. The vegetation in areas not cultivated is mainly annual grasses and forbs. The average annual precipitation is about 6 inches, the average annual temperature is about 65 degrees F, and the average frost-free season is 260 to 275 days.

Typically, the surface layer is light gray fine sandy loam about 4 inches thick. The upper 10 inches of the underlying material is light gray clay, and the lower part to a depth of 60 inches or more is light gray and light brownish gray silty clay. The soil is strongly saline-alkali.

Included in this unit are small areas of Nahrub clay and Lethent silt loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Houser soil is very slow. Available water capacity is very low to moderate, depending on the level of salinity. Effective rooting depth is limited by a seasonal high water table that is at a depth of 4 to 6 feet. The water table usually rises during the irrigation season. This soil is subject to flooding in February through March. Runoff is slow, and the hazard of water erosion is slight.

This unit is used for irrigated crops.

This unit is suited to irrigated crops that are saline-alkali tolerant. It is limited mainly by the saline-alkali condition of the soil, a seasonal high water table, very slow permeability, and periods of flooding. Use of a cropping system that includes growing a cover crop, return of crop residue, and proper tillage is needed to improve soil tilth and to increase the fertility and water intake rate. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Subsoiling opens up the soil and allows water and salts to pass through. The amount of salts present, the crops planted, and the reclamation procedures used all affect the yield of crops on this unit. Furrow, border, or sprinkler irrigation is suited to this unit. The method used generally is governed by the crop grown. Irrigation water management is very important. Excess irrigation water can cause rise in the water table. Tile or open drains can be used to remove excess water and toxic salts if a suitable outlet is available. Most climatically adapted crops can be grown if artificial drainage is provided.

This map unit is in capability unit IIIw-6 (17), irrigated, and capability subclass VIIw, nonirrigated.

165—Jerryslu loam. This moderately deep, well drained, saline-alkali soil is on basin rims. It formed in alluvium derived dominantly from granitic rock. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly annual grasses, forbs, and shrubs. Elevation is 250 to 325 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer, where mixed to a depth of 6 inches, is loam. The subsurface layer is light gray loam and white silt loam about 5 inches thick. The subsoil is pale brown clay loam about 9 inches thick. The upper 23 inches of the substratum is a strongly lime- and silica-cemented hardpan, and the lower part to a depth of 60 inches or more is very pale brown sandy loam. In some areas the surface layer is sandy loam. The soil is strongly saline-alkali.

Included in this unit are small areas of Milham sandy loam, Garces silt loam, Lerdo clay loam, and Kimberlina fine sandy loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Jerryslu soil is slow. Available water capacity is very low to moderate. Runoff is very slow or ponded, and the hazard of water erosion is slight. Effective rooting depth is 20 to 40 inches. If the lime- and silica-cemented layer is ripped, the effective rooting depth is 60 inches or more. Toxic levels of boron are present in places.

Areas of this unit that have been deep ripped and reclaimed are used for irrigated barley, cotton, and pasture. Some areas are used for livestock grazing.

This unit is suited to row and field crops that are saline-alkali tolerant. It is limited mainly by the saline-alkali condition of the soil and depth to cemented layer. Use of a cropping system that includes crop rotation, growing a cover crop, return of crop residue, and proper tillage improves soil tilth and increases the fertility and water intake rate. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Salt tolerant crops can be grown if the salt content is reduced by leaching. Subsoiling helps to open up the soil and thus facilitates leaching. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. For the optimum production of crops, water should be applied in amounts sufficient to leach the salts from the root zone but at a rate that will not cause excessive runoff. Tile or open drains can be used to remove excess water and provide an outlet for leached salts.

This unit is poorly suited to hay and pasture. The main limitations are depth to the cemented layer and the saline-alkali condition of the soil. For the optimum production of irrigated pasture, water should be applied in amounts sufficient to leach the salts from the root zone but at a rate that will not cause excessive runoff. Irrigation water can be applied by furrow or border methods. Fertilizer is needed for optimum growth of grasses and legumes. Leveling helps to ensure the uniform application of water.

This unit is poorly suited to livestock grazing. The production of forage is limited by low rainfall and the saline-alkali condition of the soil. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. This unit supports salt tolerant plants.

This map unit is in capability unit IVs-8 (17), irrigated, and capability subclass VIIs, nonirrigated.

166—Kecksroad silty clay loam, 5 to 15 percent slopes. This moderately deep, well drained soil is on hills. It formed in residuum derived dominantly from sedimentary rock. The present vegetation in most areas is mainly annual grasses and forbs. Elevation is 450 to 1,100 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 62 degrees F, and the average frost-free season is 225 to 275 days.

Typically, the surface layer is light yellowish brown silty clay loam about 2 inches thick. The subsurface layer is light yellowish brown clay loam about 9 inches thick. The upper 15 inches of the subsoil is light yellowish brown clay, and the lower 10 inches is light yellowish brown clay loam. Weathered shale is at a depth of 36 inches. In some areas the surface layer is clay loam.

Included in this unit are small areas of Twisselman clay, Kettleman loam, Bitterwater sandy loam, and Rock outcrop. Included areas make up about 10 percent of the total acreage.

Permeability of this Kecksroad soil is slow. Available water capacity is low or moderate. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 20 to 40 inches.

This unit is used for livestock grazing.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities.

This map unit is in capability subclass VIIe (15), nonirrigated.

167—Kecksroad silty clay loam, 15 to 50 percent slopes. This moderately deep, well drained soil is on hills. It formed in residuum derived dominantly from sedimentary rock. The present vegetation in most areas is mainly annual grasses and forbs. Elevation is 600 to 1,400 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 62 degrees F, and the average frost-free season is 225 to 275 days.

Typically, the surface layer is light yellowish brown silty clay loam about 2 inches thick. The subsurface layer is light yellowish brown clay loam about 9 inches thick. The upper 15 inches of the subsoil is light yellowish brown clay, and the lower 10 inches is light yellowish brown clay loam. Weathered shale is at a depth of 36 inches. In some areas the surface layer is clay loam.

Included in this unit are small areas of Twisselman clay, Kettleman loam, Bitterwater sandy loam, and Rock outcrop. Included areas make up about 10 percent of the total acreage.

Permeability of this Kecksroad soil is slow. Available water capacity is moderate. Runoff is rapid, and the hazard of water erosion is moderate. Effective rooting depth is 20 to 40 inches.

This unit is used for livestock grazing.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall. If the plant cover is overgrazed, the soil becomes more susceptible to soil blowing and water erosion. Cross-fencing and correctly placing livestock watering facilities help to distribute livestock grazing and to reduce overgrazing of the lower slopes. Livestock grazing should be managed to protect the soil from erosion.

This map unit is in capability subclass VIIe (15), nonirrigated.

168—Kettleman loam, 9 to 15 percent slopes. This moderately deep, well drained soil is on hills. It formed in residuum derived dominantly from sedimentary rock. The present vegetation in most areas is mainly annual grasses and forbs with a few scattered shrubs. Elevation is 500 to 1,100 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 63 degrees F, and the average frost-free season is 230 to 275 days.

Typically, the surface layer is pale brown loam about 12 inches thick. The underlying material is light yellowish brown loam about 10 inches thick over weathered shale. Gravel and cobbles make up less than 15 percent of the soil. In some areas the surface layer is sandy loam.

Included in this unit are small areas of Bitterwater sandy loam, Delgado sandy loam, soils that are similar to this Kettleman soil but have a subsoil, Panoche clay loam, and Rock outcrop. Included areas make up about 20 percent of the total acreage.

Permeability of this Kettleman soil is moderate. Available water capacity is low or moderate. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 20 to 40 inches.

This unit is used mainly for livestock grazing. Oil wells are common on the unit.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Livestock grazing should be managed to protect the soil from erosion.

This map unit is in capability subclass VIIe (15), nonirrigated.

169—Kettleman loam, 15 to 50 percent slopes. This moderately deep, well drained soil is on hills. It formed in residuum derived dominantly from sedimentary rock. The present vegetation in most areas is mainly annual grasses and forbs with a few scattered shrubs. Elevation is 500 to 1,400 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 63 degrees F, and the average frost-free season is 230 to 275 days.

Typically, the surface layer is pale brown loam about 12 inches thick. The underlying material is light yellowish brown loam about 10 inches thick over weathered shale. Gravel and cobbles make up less than 15 percent of the soil. In some areas the surface layer is sandy loam.

Included in this unit are small areas of Bitterwater sandy loam, Kettleman gravelly loam, Delgado sandy loam, and Rock outcrop. Included areas make up about 20 percent of the total acreage.

Permeability of this Kettleman soil is moderate. Available water capacity is low or moderate. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 20 to 40 inches.

This unit is used mainly for livestock grazing. Oil wells are common on the unit.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Cross-fencing and correctly placing livestock watering facilities help to distribute livestock grazing and to reduce overgrazing of the lower slopes. Proper grazing

use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage. Livestock grazing should be managed to protect the soil from erosion.

This map unit is in capability subclass VIIe (15), nonirrigated.

170—Kettleman gravelly loam, 15 to 50 percent slopes. This moderately deep, well drained soil is on hills. It formed in residuum derived dominantly from sedimentary rock. The present vegetation in most areas is mainly annual grasses and forbs with a few scattered shrubs. Elevation is 950 to 1,500 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 63 degrees F, and the average frost-free season is 230 to 260 days.

Typically, the surface layer is light brownish gray gravelly loam about 12 inches thick. The underlying material is pale brown gravelly loam about 28 inches thick over weathered shale. The soil is 15 to 35 percent gravel. Cobbles are present in some places. In some areas the surface layer is gravelly sandy loam.

Included in this unit are small areas of Bitterwater gravelly sandy loam, Bitterwater sandy loam, Delgado sandy loam, and Rock outcrop. Included areas make up about 20 percent of the total acreage.

Permeability of this Kettleman soil is moderate. Available water capacity is low or moderate. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 20 to 40 inches.

This unit is used mainly for livestock grazing. Oil wells are common on the unit.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall. If the plant cover is overgrazed, the soil becomes more susceptible to water erosion. Steepness of slope in some areas limits access by livestock and results in overgrazing of the less sloping areas. Cross-fencing and correctly placing livestock watering facilities help to distribute livestock grazing and to reduce overgrazing of the lower slopes. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage. Livestock grazing should be managed in the steeper areas to protect the soil from erosion.

This map unit is in capability subclass VIIe (15), nonirrigated.

171—Kettleman-Delgado-Rock outcrop complex, 15 to 50 percent slopes. This map unit is on hills. The present vegetation in most areas is mainly annual grasses, forbs, and a few scattered shrubs. Elevation is 600 to 1,500 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 230 to 260 days.

This unit is 45 percent Kettleman gravelly loam, 30 percent Delgado gravelly sandy loam, and 15 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Bitterwater sandy loam and soils that are similar to the Kettleman soil but are more than 40 inches deep. Included areas make up about 10 percent of the total acreage.

The Kettleman soil is moderately deep and well drained. It formed in residuum derived dominantly from sedimentary rock. Typically, the surface layer is pale brown gravelly loam about 12 inches thick. The underlying material is light yellowish brown gravelly loam about 10 inches thick over weathered shale. Gravel and cobbles make up 15 to 25 percent of the soil.

Permeability of the Kettleman soil is moderate. Available water capacity is low or moderate. Runoff is medium or rapid, and the hazard of water erosion is moderate. Effective rooting depth is 20 to 40 inches.

The Delgado soil is shallow and somewhat excessively drained. It formed in residuum derived dominantly from sedimentary rock. Typically, the surface layer is brown sandy loam about 2 inches thick. The underlying material to a depth of 10 inches is yellowish brown sandy loam. Below this is hard sandstone.

Permeability of the Delgado soil is moderately rapid. Available water capacity is very low. Runoff is medium or rapid, and the hazard of water erosion is moderate. Effective rooting depth is 7 to 20 inches.

Rock outcrop consists of exposures of hard sandstone or shale 5 to 300 feet wide. The vegetation is limited to the fractures in the rock. Runoff is very rapid.

This unit is used for livestock grazing.

This unit is poorly suited to livestock grazing. The production of vegetation suitable to livestock grazing on the Kettleman soil has few limitations. Production on the Delgado soil is limited by the very low available water capacity and shallow rooting depth. Rock outcrop has little if any value for grazing. Because of low rainfall, forage production is low in most years. Correct placement of salt and supplemental feed helps to distribute livestock grazing and prevent overgrazing. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. Livestock grazing should be managed to protect the unit from erosion.

This map unit is in capability subclass VIIe (15), nonirrigated.

172—Kilmer-Hillbrick complex, 15 to 50 percent slopes. This map unit is on hills and mountains. The present vegetation in most areas is mainly annual grasses and forbs with a few scattered shrubs. Elevation is 900 to 2,700 feet. The average annual precipitation is

about 9 inches, the average annual temperature is about 61 degrees F, and the average frost-free season is about 200 to 250 days.

This unit is 45 percent Kilmer loam and 40 percent Hillbrick sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Rock outcrop, soils that have slopes of less than 15 percent, soils that do not have carbonates, and Mendi loam. Included areas make up about 15 percent of the total acreage.

The Kilmer soil is moderately deep and well drained. It formed in residuum derived dominantly from shale or sandstone. Typically, the surface layer is pale brown loam about 14 inches thick. The underlying material is pale brown loam about 18 inches thick over shale. In some areas the surface layer is sandy loam.

Permeability of the Kilmer soil is moderately slow. Available water capacity is low or moderate. Runoff is medium or rapid, and the hazard of water erosion is moderate. Effective rooting depth is 20 to 40 inches.

The Hillbrick soil is shallow and well drained. It formed in residuum derived dominantly from shale or sandstone. Typically, the surface layer is pale brown sandy loam about 15 inches thick over fractured shale. The soil is 5 to 15 percent gravel and 5 percent cobbles.

Permeability of the Hillbrick soil is moderately rapid. Available water capacity is very low. Runoff is medium or rapid, and the hazard of water erosion is high. Effective rooting depth is 10 to 20 inches.

This unit is used for livestock grazing.

This unit is suited to livestock grazing. The production of forage on the Kilmer soil has no major limitations. Production on the Hillbrick soil is limited by the very low available water capacity. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. Livestock grazing should be managed to protect the unit from erosion.

This map unit is in capability subclass VIe (15), nonirrigated.

173—Kilmer-Hillbrick complex, 50 to 75 percent slopes. This map unit is on hills and mountains. The present vegetation in most areas is mainly annual grasses and forbs with scattered shrubs. Elevation is 1,200 to 2,800 feet. The average annual precipitation is about 9 inches, the average annual temperature is about 61 degrees F, and the average frost-free period is about 200 to 250 days.

This unit is 45 percent Kilmer loam and 45 percent Hillbrick sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Rock outcrop and soils that are similar to the Kilmer but are sandy loam. Included areas make up about 10 percent of the total acreage.

The Kilmer soil is moderately deep and well drained. It formed in residuum derived dominantly from shale or sandstone. Typically, the surface layer is pale brown loam about 14 inches thick. The underlying material is pale brown loam about 18 inches thick over shale. In some areas the surface layer is sandy loam.

Permeability of the Kilmer soil is moderately slow. Available water capacity is low or moderate. Runoff is very rapid, and the hazard of water erosion is high. Effective rooting depth is 20 to 40 inches.

The Hillbrick soil is shallow and well drained. It formed in residuum derived dominantly from shale or sandstone. Typically, the surface layer is pale brown sandy loam about 15 inches thick over fractured shale. The soil is 5 to 15 percent gravel and 5 percent cobbles.

Permeability of the Hillbrick soil is moderately rapid. Available water capacity is very low. Runoff is very rapid, and the hazard of water erosion is high. Effective rooting depth is 10 to 20 inches.

This unit is used for livestock grazing.

This unit is suited to livestock grazing. The production of forage on the Kilmer soil has no major limitations. Production on the Hillbrick soil is limited by the very low available water capacity. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Correct placement of salt and supplemental feed helps to distribute livestock grazing and prevent overgrazing. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. Proper grazing increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Livestock grazing should be managed to protect the unit from erosion.

This map unit is in capability subclass VIIe (15), nonirrigated.

174—Kimberlina fine sandy loam, 0 to 2 percent slopes. This deep, well drained soil is on alluvial fans and plains. It formed in alluvium derived dominantly from granitic and sedimentary rock. The vegetation in areas not cultivated is mainly annual grasses and forbs with few scattered shrubs. Elevation is 250 to 1,000 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is brown fine sandy loam about 9 inches thick. The upper 36 inches of the underlying material is pale brown fine sandy loam, and the lower part to a depth of 71 inches is pale brown silt loam. In some areas the surface layer is sandy loam or coarse sandy loam.

Included in this unit are small areas of Wasco sandy loam, Milham sandy loam, and Cajon loamy sand. Also included are small areas of soils that are similar to this Kimberlina soil but have a sandy clay loam surface layer. Included areas make up about 15 percent of the total acreage.

Permeability of this Kimberlina soil is moderate. Available water capacity is high. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for irrigated crops, mainly almonds, alfalfa, cotton, and grapes. Among the other crops grown are potatoes, sugar beets, pistachios, and onions. Some areas are used for irrigated pasture, limited livestock grazing, and urban development.

This unit is suited to irrigated crops. It has few limitations. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Use of a cropping system that includes crop rotation, growing a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

This unit is suited to hay and pasture. It has few limitations. Border and sprinkler irrigation systems are suited to this unit. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Proper grazing practices, weed control, and fertilizer are needed to ensure maximum quality of forage.

If this unit is used for urban development, the main limitation is rare periods of flooding. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding.

This map unit is in capability class I (17), irrigated, and capability subclass VIIc, nonirrigated.

175—Kimberlina sandy loam, 2 to 5 percent slopes. This deep, well drained soil is on alluvial fans and plains. It formed in alluvium derived dominantly from granitic and sedimentary rock. The vegetation in most areas not cultivated is mainly annual grasses and forbs with scattered shrubs. Elevation is 250 to 1,000 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is brown sandy loam about 9 inches thick. The upper 36 inches of the underlying material is pale brown fine sandy loam, and the lower part to a depth of 71 inches is pale brown silt loam. In some areas the surface layer is fine sandy loam or coarse sandy loam.

Included in this unit are small areas of Wasco sandy loam, Milham sandy loam, and Panoche clay loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Kimberlina soil is moderate. Available water capacity is high. Runoff is slow, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

This unit is used mainly for livestock grazing. It is also used for irrigated crops, urban development, and recreation.

This unit is suited to irrigated crops. It has few limitations. Furrow, border, drip, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. Salt tolerant crops should be grown while the soil is being reclaimed. Some areas are slightly saline-alkali in the native state. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Erosion can be reduced by planting a close growing cover crop.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This unit is suited to recreation. It has few limitations for this use. Erosion and sedimentation can be controlled and the beauty of the area enhanced by maintaining adequate plant cover. Areas used for recreation can be protected from erosion by maintaining plant cover.

If this unit is used for urban development, it has few limitations. If the density of housing is moderate to high,

community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability unit IIe-1 (17), irrigated, and capability subclass VIIe, nonirrigated.

176—Kimberlina sandy loam, 5 to 9 percent slopes. This deep, well drained soil is on alluvial fans and plains. It formed in alluvium derived dominantly from granitic and sedimentary rock. The vegetation in areas not cultivated is mainly annual grasses and forbs with scattered shrubs. Elevation is 300 to 1,000 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is brown sandy loam about 9 inches thick. The upper 36 inches of the underlying material is pale brown fine sandy loam, and the lower part to a depth of 71 inches is pale brown silt loam. In some areas the surface layer is fine sandy loam or coarse sandy loam.

Included in this unit are small areas of Elkhills sandy loam, Panoche clay loam, Milham sandy loam, and Kettleman loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Kimberlina soil is moderate. Available water capacity is high. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

This unit is used mainly for livestock grazing. It is also used for irrigated crops.

This unit is suited to irrigated crops. It is limited mainly by the steepness of slope and the moderate hazard of erosion. Use of a cropping system that includes crop rotation, growing a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Because of the slope, sprinkler or drip irrigation is most suitable for row crops. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Salt tolerant crops should be grown while the soil is being reclaimed. Enough water should be applied to leach the salts from the root zone. Erosion can be reduced by planting a close growing cover crop.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This map unit is in capability unit IIIe-1, irrigated, and capability subclass VIIe, nonirrigated.

177—Kimberlina gravelly sandy loam, 2 to 5 percent slopes. This deep, well drained soil is on alluvial fans and plains. It formed in alluvium derived dominantly from granitic and sedimentary rock. The vegetation in areas not cultivated is mainly annual grasses and forbs with few scattered shrubs. Elevation is 250 to 1,000 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free period is 250 to 300 days.

Typically, the surface layer is pale brown gravelly sandy loam about 25 inches thick. The underlying material to a depth of 60 inches or more is light gray gravelly sandy loam. The soil is 15 to 35 percent gravel. In some areas the surface layer is gravelly loam or sandy loam.

Included in this unit are small areas of a Kimberlina sandy loam or gravelly sandy loam that has slopes of less than 2 percent, Milham sandy loam, Panoche clay loam, and Wasco sandy loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Kimberlina soil is moderately rapid. Available water capacity is moderate. Runoff is slow, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

This unit is used for livestock grazing. If irrigation water is available, climatically suited crops can be grown.

This unit is suited to livestock grazing. Because of low rainfall, forage production is low in most years. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. This unit is limited for livestock watering ponds and other water impoundments because of the moderately rapid permeability of the soil.

This map unit is in capability subclass VIIe (17), nonirrigated.

178—Kimberlina gravelly sandy loam, 5 to 9 percent slopes. This deep, well drained soil is on alluvial fans and plains. It formed in alluvium derived dominantly from granitic and sedimentary rock. The vegetation in areas not cultivated is mainly annual grasses and forbs with scattered shrubs. Elevation is 300 to 1,000 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is pale brown gravelly sandy loam about 25 inches thick. The underlying material to a depth of 60 inches or more is light gray gravelly sandy loam. The soil is 15 to 35 percent gravel. Content of gravel increases with increasing depth. In some areas the surface layer is gravelly loam.

Included in this unit are small areas of Kimberlina sandy loam, Milham sandy loam, and Panoche clay loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Kimberlina soil is moderately rapid. Available water capacity is moderate. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

This unit is used for livestock grazing. If irrigation water is available, climatically suited crops can be grown.

This unit is suited to livestock grazing. Because of low rainfall, forage production is low in most years. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Livestock grazing should be managed to protect the soil from erosion. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage. This unit is limited for livestock watering ponds and other water impoundments because of the moderately rapid permeability of the soil.

This map unit is in capability subclass VIIe (17), nonirrigated.

179—Kimberlina fine sandy loam, saline-alkali, 0 to 2 percent slopes. This deep, well drained soil is on recent alluvial fans and plains. It formed in alluvium derived dominantly from granitic and sedimentary rock. The native vegetation is mainly salt tolerant annual grasses, forbs, and a few scattered shrubs. Elevation is 275 to 350 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is brown fine sandy loam about 9 inches thick. The upper 36 inches of the underlying material is brown fine sandy loam, and the lower part to a depth of 71 inches is pale brown silt loam. The soil is slightly to moderately saline-alkali. In some areas the surface layer is loamy sand or sandy loam.

Included in this unit are small areas of a Kimberlina fine sandy loam that has compacted sandy layers or is stratified above a depth of 35 inches and small areas of Cajon loamy sand. Included areas make up about 20 percent of the total acreage.

Permeability of this Kimberlina soil is moderately slow. Available water capacity is very low to moderate. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more.

This unit is used for row and field crops such as cotton, alfalfa, and barley. Oil wells are common in some areas.

This unit is well suited to irrigated crops that are saline-alkali tolerant. It is limited mainly by the saline-alkali condition of the soil. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. For the optimum production of crops, water should be applied in amounts sufficient to leach the salts from the root zone but at a rate that will not cause excessive runoff. Tile or open drains can be used to remove excess water and to provide an outlet for leached salts.

This map unit is in capability unit IIs-6 (17), irrigated, and capability subclass VIIs, nonirrigated.

180—Kimberlina-Urban land-Cajon complex, 0 to 2 percent slopes. This map unit is on alluvial fans and plains. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 370 to 400 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 250 to 300 days.

This unit is 35 percent Kimberlina fine sandy loam, 30 percent Urban land, and 20 percent Cajon loamy sand. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Wasco sandy loam, Kimberlina fine sandy loam that is saline-alkali, Excelsior sandy loam, and Panoche clay loam. Included areas make up about 15 percent of the total acreage.

The Kimberlina soil is deep and well drained. It formed in alluvium derived dominantly from granitic and sedimentary rock. Typically, the surface layer is brown fine sandy loam about 9 inches thick. The upper 36 inches of the underlying material is pale brown fine sandy loam, and the lower part to a depth of 71 inches is pale brown silt loam. In some areas the surface layer is sandy loam or coarse sandy loam.

Permeability of the Kimberlina soil is moderate. Available water capacity is high. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more.

Urban land consists of areas covered by concrete, asphalt, buildings, or other impervious surfaces. In most areas some or all of the profile has been cut away or altered. The fill material is from adjacent areas of Kimberlina or Cajon soils that have been cut or graded.

The Cajon soil is deep and somewhat excessively drained. It formed in alluvium derived dominantly from granitic rock. Typically, the surface layer is pale brown loamy sand about 9 inches thick. The upper 35 inches of the underlying material is light gray loamy sand, and the lower part to a depth of 60 inches or more is stratified, light brownish gray sandy loam.

Permeability of the Cajon soil is rapid. Available water capacity is low or moderate. Runoff is slow, and the hazard of water erosion is none to slight. The hazard of soil blowing is high. Effective rooting depth is 60 inches or more.

This unit is used for urban development.

If this unit is used for urban development, the main limitation is rare periods of flooding. Flooding can be controlled only by use of major flood control structures. The risk of erosion is increased if the soil is left exposed during site development. Revegetating disturbed areas around construction sites as soon as possible helps to control soil blowing on the Cajon soil. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

181—Lerdo clay loam, saline-alkali, partially drained. This deep, somewhat poorly drained soil is on alluvial plains and in basins. The drainage has been altered by seepage resulting from extensive irrigation within the area. The soil formed in alluvium derived dominantly from granitic and sedimentary rock. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly annual grasses, forbs, and saltbush. Elevation is 235 to 275 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is about 250 to 300 days.

Typically, the surface layer is gray clay loam and loam about 7 inches thick. The subsurface layer is gray loam about 15 inches thick. The underlying material to a depth of 60 inches or more is light gray loam. This soil is moderately saline-alkali.

Included in this unit are small areas of Lokern clay, Garces silt loam, and Jerryslu loam. Included areas make up about 10 percent of the total acreage.

Permeability of the Lerdo soil is slow. Available water capacity is moderate or high. Effective rooting depth is limited by a high water table that is at a depth of 3 to 6 feet. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to rare periods of flooding, but it is protected by dams or levees, or both. Toxic levels of boron are present in places.

Most areas of this unit are used for irrigated salt tolerant crops, mainly alfalfa, barley sugar beets, and rice. Among the other crops grown are cotton, sorghum, and wheat. Some areas are used for irrigated pasture.

This unit is suited to irrigated crops. It is limited mainly by the high water table, the saline-alkali condition of the soil, and slow permeability. Use of a cropping system that includes growing a cover crop, return of crop residue, and proper tillage is needed to improve soil tilth and to increase the fertility and water intake rate. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Subsoiling opens up the soil and allows water and salts to pass through. The amount of salts present, the crops planted, and the reclamation procedures used all affect the yield of crops on this unit. Furrow, border, and sprinkle irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Irrigation water management is very important. Excess irrigation water can cause the water table to rise nearer to the surface. Tile or open drains can be used to remove excess water and toxic salts if a suitable outlet is available. Most climatically adapted crops can be grown if artificial drainage is provided.

This unit is suited to hay and pasture. The main limitations are the saline-alkali condition of the soil, the high water table, and slow permeability. The concentration of salts and alkali in the surface layer limits the production of plants suitable for hay and pasture. Leaching the salts from the surface layer is limited by the high water table. Drainage and irrigation water management reduce the concentration of salts. Salt tolerant species are most suitable for planting. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Proper grazing practices, weed control, and fertilizer are needed to ensure maximum quality of forage. Irrigation water can be applied by the sprinkler and border methods. A livestock watering system, such as a pipeline, trough, or well, should be developed. Irrigation water management is very important. Tile drainage can be used to lower the water table if a suitable outlet is available.

This map unit is in capability unit IIIw-6 (17), irrigated, and capability subclass VIIs, nonirrigated.

182—Lerdo complex, drained. This map unit is on alluvial plains and in basins. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly annual grasses, forbs, and saltbush. Elevation is 235 to 275 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 250 to 300 days.

This unit is 70 percent Lerdo clay loam, saline-alkali, and 20 percent Lerdo clay loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Lokern clay, Garces silt loam, and Jerryslu loam. Included areas make up about 10 percent of the total acreage.

The Lerdo soil, saline-alkali, is deep and somewhat poorly drained. It formed in alluvium derived dominantly from granitic or sedimentary rock. Typically, the surface layer is gray clay loam about 7 inches thick. The subsurface layer is gray loam about 15 inches thick. The underlying material to a depth of 60 inches or more is light gray loam. This soil is moderately saline-alkali.

Permeability of the Lerdo soil, saline-alkali, is slow. Available water capacity is moderate or high. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more. This soil is subject to rare periods of flooding, but it is protected by dams or levees, or both. Toxic levels of boron are present in places.

The Lerdo soil is deep and somewhat poorly drained. It formed in alluvium derived dominantly from granitic or sedimentary rock. Typically, the surface layer is gray clay loam about 7 inches thick. The subsurface layer is gray loam about 15 inches thick. The underlying material to a depth of 60 inches or more is light gray loam.

Permeability of the Lerdo soil is moderately slow. Available water capacity is high. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more. This soil is subject to rare periods of flooding, but it is protected by dams or levees, or both.

Most areas of this unit are used for irrigated salt tolerant crops, mainly alfalfa, cotton, sorghum, and sugar beets. Among the other crops grown are barley, wheat, and rice. Some areas are used for livestock grazing and irrigated pasture.

This unit is suited to irrigated crops. It is limited mainly by the saline-alkali condition of the soil and the slow permeability. Salinity influences the choice of crops. Subsoiling increases the water intake rate and allows salts to be leached downward. Salt tolerant crops can be grown if the salt content is reduced by leaching. Subsoiling helps to open up the soil and thus facilitates leaching. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Maintaining crop residue on or near the surface reduces runoff and helps to maintain soil tilth and organic matter content. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Irrigation water needs to be applied at a rate that ensures optimum production without increasing deep percolation, runoff, and erosion. Enough water should be applied to leach the salts from the root zone.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall and by the concentration of salts in the surface layer. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This unit is suited to hay and pasture. The main limitations are the saline-alkali condition of the soil and the slow permeability. Salt tolerant grasses can be grown. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Use of proper stocking rates, pasture rotation, and restricted grazing during wet periods helps to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Furrow, border, and sprinkler irrigation systems are suited to this unit. Irrigation water can be applied by the border and sprinkler methods. For the optimum production of crops, water should be applied in amounts sufficient to leach the salts from the root zone but at a rate that will not cause excessive runoff.

This map unit is in capability unit IIIs-6 (17), irrigated, and capability subclass VIIs, nonirrigated.

183—Lethent silt loam. This deep, moderately well drained, saline-alkali soil is on basin rims. It formed in alluvium derived dominantly from granitic and sedimentary rock. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly salt tolerant grasses, forbs, and shrubs. Elevation is 190 to 500 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 260 to 300 days.

Typically, the surface layer is light brownish gray silt loam about 3 inches thick. The subsoil is light brownish gray, light gray, and grayish brown silty clay loam, silty clay, and clay about 50 inches thick. The substratum to a depth of 60 inches or more is light brownish gray clay loam. It is moderately to strongly saline-alkali. In some areas gypsum crystals are present in the lower part of the soil.

Included in this unit are small areas of Garces silt loam and Twisselman clay that is saline-alkali. Included areas make up about 15 percent of the total acreage.

Permeability of this Lethent soil is very slow. Available water capacity is low or moderate. Runoff is very slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more. Toxic levels of boron are present in places.

Most areas of this unit are used for livestock grazing. A few areas are used for irrigated crops and pasture.

This unit is suited to irrigated salt tolerant crops. It is limited mainly by the saline-alkali condition of the soil

and the very slow permeability. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Salt tolerant crops can be grown if the salt content is reduced by leaching. Subsoiling helps to open up the soil and thus facilitates leaching. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Furrow, border, and sprinkler irrigation systems are suited to this unit. Enough water should be applied to leach the salts from the root zone. Tile or open drains can be used to remove excess water and provide an outlet for leached salts. Because of the very slow permeability of the soil, the application of water should be regulated so that water does not stand on the surface and damage the crops. Intensive management is required to reduce the salinity and maintain soil productivity.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall and low available water capacity. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Grazing should be delayed until the soil has drained sufficiently and is firm enough to withstand trampling by livestock. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities.

This unit is suited to irrigated hay and pasture. The main limitations are the saline-alkali condition of the soil and the very slow permeability. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Proper grazing practices, weed control, and fertilizer are needed for maximum quality of forage. Irrigation water can be applied by the border and sprinkler methods. For the optimum production of crops, water should be applied in amounts sufficient to leach the salts from the root zone but at a rate that will not cause excessive runoff. Intensive management is required to reduce the salinity and maintain soil productivity. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

This map unit is in capability unit IIIs-6 (17), irrigated, and capability subclass VIIs, nonirrigated.

184—Lewkalb sandy loam, 0 to 2 percent slopes. This deep, well drained soil is on low terraces. It formed in alluvium derived dominantly from granitic rock. The native vegetation is mainly annual grasses and forbs. Elevation is 300 to 600 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is light brownish gray and pale brown sandy loam about 23 inches thick. The upper 17 inches of the underlying material is weakly silica-cemented light gray sandy loam, and the lower part to a depth of 65 inches is light gray loamy sand. In some areas the surface layer is gravelly sandy loam or loam.

Included in this unit are small areas of Wasco sandy loam and soils that have a weakly silica-cemented layer below a depth of 48 inches. Included areas make up about 15 percent of the total acreage.

Permeability of this Lewkalb soil is moderately rapid in the surface layer and slow in the underlying cemented layer. Available water capacity is moderate. Runoff is very slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more but is somewhat limited by the weakly silica-cemented layer.

This unit is used for irrigated crops, mainly cotton, potatoes, and alfalfa.

This unit is suited to irrigated row crops. It is limited mainly by the weakly silica-cemented layer. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Ripping and shattering the weakly cemented layer improve drainage. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Irrigation water needs to be applied at a rate that ensures optimum production without increasing deep percolation, runoff, and erosion.

This map unit is in capability unit IIs-8 (17), irrigated, and capability subclass VIIs, nonirrigated.

185—Lewkalb, saline-alkali-Milham-Kimberlina complex, 0 to 5 percent slopes. This map unit is on low terraces, alluvial fans, and plains. The native vegetation is mainly annual grasses and forbs. Elevation is 500 to 1,000 feet. The average annual precipitation is about 7 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 250 to 300 days.

This unit is 40 percent Lewkalb sandy loam, 30 percent Milham sandy loam, and 20 percent Kimberlina sandy loam. This area has many small drainageways that drain to the east or northeast. The Kimberlina soil is in these drainageways. The Lewkalb, Kimberlina, and Milham soils occur in a complex pattern on the low ridge between the drainageways. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Cajon loamy sand and Panoche clay loam. Included areas make up about 10 percent of the total acreage.

The Lewkalb soil is deep and well drained. It formed in alluvium derived dominantly from sedimentary and granitic rock. Typically, the surface layer is light brownish gray and pale brown sandy loam about 23 inches thick. The upper 17 inches of the underlying material is weakly silica-cemented, light gray sandy loam, and the lower part to a depth of 65 inches is light gray loamy sand. The soil is moderately saline-alkali. In some areas the surface layer is loam.

Permeability of the Lewkalb soil is moderately rapid in the surface layer and slow in the underlying cemented layer. Available water capacity is low or moderate. Runoff is very slow or slow, and the hazard of water erosion is slight. The effective rooting depth is 60 inches or more but is somewhat limited by the weakly silica-cemented layer.

The Milham soil is deep and well drained. It formed in alluvium derived dominantly from granitic and sedimentary rock. Typically, the surface layer is light brownish gray sandy loam about 4 inches thick. The upper 6 inches of the subsoil is pale brown sandy loam, and the lower 39 inches is yellowish brown loam and clay loam. The substratum to a depth of 60 inches or more is pale olive sandy loam. In some areas the surface layer is loam.

Permeability of the Milham soil is moderately slow. Available water capacity is high. Runoff is very slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more.

The Kimberlina soil is deep and well drained. It formed in alluvium derived dominantly from granitic and sedimentary rock. Typically, the surface layer is pale brown sandy loam about 10 inches thick. The underlying material to a depth of 60 inches or more is pale brown sandy loam.

Permeability of the Kimberlina soil is moderately rapid. Available water capacity is moderate or high. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more.

This unit is used for livestock grazing.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Proper grazing use improves water infiltration, promotes plant growth early in the season, and protects the soil from erosion. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This map unit is in capability subclass VIIe (17), nonirrigated.

186—Lodo Variant clay loam, 15 to 50 percent slopes. This shallow, somewhat excessively drained soil is on hills and mountains. It formed in residuum derived dominantly from sandstone or shale. The present vegetation in most areas is mainly annual grasses, forbs, and a few shrubs. Elevation is 1,100 to 2,600 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is about 225 to 275 days.

Typically, the soil is grayish brown clay loam about 9 inches thick over hard shale.

Included in this unit are small areas of Aramburu very shaly clay loam, Temblor very shaly sandy loam, and Los Osos Variant clay loam. Also included are small areas of Hillbrick sandy loam and Reward shaly loam. Included areas make up about 20 percent of the total acreage.

Permeability of this Lodo Variant soil is moderate. Available water capacity is very low or low. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 6 to 20 inches.

This unit is used for livestock grazing, watershed, and wildlife habitat.

This unit is poorly suited to livestock grazing. The production of forage is limited by shallow depth to bedrock. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Livestock grazing should be managed to protect the unit from erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage.

This map unit is in capability subclass VIIe (15), nonirrigated.

187—Lokern clay, drained. This deep, somewhat poorly drained soil is in basins. It formed in alluvium derived from mixed rock sources, dominantly granitic rock. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly annual grasses, forbs, and shrubs. Elevation is 240 to 300 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 63 degrees F, and the average frost-free season is 260 to 310 days.

Typically, the surface layer is dark gray clay about 21 inches thick. The upper 27 inches of the underlying material is gray and dark gray clay, and the lower part to a depth of 60 inches or more is light brownish gray fine sandy loam. In some areas the surface layer is silty clay.

Included in this unit are small areas of Buttonwillow clay, Lerdo clay loam, and Lokern clay that is saline-alkali. Included areas make up about 20 percent of the total acreage.

Permeability of this Lokern soil is slow. Available water capacity is high. Runoff is very slow, and the hazard of water erosion is slight. Effective rooting depth is 60

inches or more. This soil is subject to rare periods of flooding, but it is protected by dams or levees, or both.

Most areas of this unit are used for irrigated crops. Among the crops grown are cotton, alfalfa, sugar beets, sorghum, barley, rice, and wheat. Some areas are used for irrigated pasture, duck ponds, and homesite development.

This unit is suited to irrigated row and field crops. It is limited mainly by the slow permeability of the soil. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the permeability of this unit, the length of runs should be adjusted to permit adequate infiltration of water. Irrigation water needs to be applied at a rate that ensures optimum production without increasing deep percolation, runoff, and erosion.

This unit is suited to irrigated pasture. The main limitation is slow permeability. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Furrow, border, and sprinkler irrigation systems are suited to this unit. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

If this unit is used for urban development, the main limitations are slow permeability and rare periods of flooding. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Septic tank absorption fields do not function properly during rainy periods because of wetness and slow permeability. Increasing the size of the absorption area helps to compensate for the slow permeability. Absorption lines should be placed below the slowly permeable layer.

This map unit is in capability unit IIs-5 (17), irrigated, and capability subclass VIIs, nonirrigated.

188—Lokern clay, saline-alkali, drained. This deep, somewhat poorly drained soil is in basins. It formed in alluvium derived dominantly from mixed rock sources, dominantly granitic rock. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly annual grasses, forbs, and shrubs. Elevation is 240 to 300 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 63 degrees F, and the average frost-free season is 260 to 310 days.

Typically, the surface layer is dark gray clay about 21 inches thick. The upper 27 inches of the underlying material is gray and dark gray clay, and the lower part to a depth of 60 inches or more is light brownish gray fine sandy loam. In some areas the surface layer is silty clay. The soil is moderately to strongly saline-alkali.

Included in this unit are small areas of Buttonwillow clay, Lokern clay, and Lerdo clay loam. Included areas make up about 20 percent of the total acreage.

Permeability of this Lokern soil is very slow. Available water capacity is moderate or high. Runoff is very slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more. This soil is subject to rare periods of flooding, but it is protected by dams or levees, or both. Toxic levels of boron are present in places.

Most areas of this unit are used for irrigated crops, mainly cotton and alfalfa. Among the other crops grown are sorghum and barley. Some areas are used for wildlife habitat and irrigated pasture.

This unit is suited to irrigated pasture. It is limited mainly by the saline-alkali condition of the soil and very slow permeability. Salt tolerant grasses can be grown. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. For the optimum production of crops, water should be applied in amounts sufficient to leach the salts from the root zone but at a rate that will not cause excessive runoff. Subsoiling opens up the soil and allows water and salts to pass through. Tile or open drains can be used to remove excess water and provide an outlet for leached salts.

This unit is suited to irrigated row and field crops that are salt tolerant. It is limited mainly by the saline-alkali condition of the soil and very slow permeability. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Salt tolerant crops can be grown if the salt content is reduced by leaching. Subsoiling helps to open up the soil and thus facilitates leaching. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Intensive management is required to reduce the salinity and maintain soil productivity. Furrow, border, and sprinkler irrigation systems are suited to this unit. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. For the optimum production of crops, water should be applied in amounts sufficient to leach the salts from the root zone but at a rate that will not cause excessive runoff. Tile or open drains can be used to remove excess water and provide an outlet for leached salts.

This map unit is in capability unit IIIs-6 (17), irrigated, and capability subclass VIIs, nonirrigated.

189—Lokern clay, saline-alkali, partially drained. This deep, somewhat poorly drained soil is in basins. The drainage has been altered by seepage resulting from extensive irrigation within the area. The soil formed in alluvium derived from mixed rock sources, mainly granitic rock. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly salt tolerant annual grasses, forbs, and shrubs. Elevation is 240 to 300 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 63 degrees F, and the average frost-free season is 260 to 310 days.

Typically, the surface layer is dark gray clay about 21 inches thick. The upper 27 inches of the underlying material is gray or dark gray clay, and the lower part to a depth of 60 inches or more is light brownish gray fine sandy loam. In some areas the surface layer is silty clay. The soil is moderately to strongly saline-alkali.

Included in this unit are small areas of Lokern clay that is not saline-alkali, Buttonwillow clay, and Lerdo clay loam. Included areas make up about 20 percent of the total acreage.

Permeability of this Lokern soil is very slow. Available water capacity is moderate or high. Effective rooting depth is limited by a high water table at a depth of 3 to 6 feet. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to rare periods of flooding, but it is protected by dams or levees, or both. Toxic levels of boron are present in places.

Most areas of this unit are used for irrigated crops, mainly cotton and alfalfa. Among the other crops grown are sorghum, barley, and rice. Some areas are used for wildlife habitat and limited livestock grazing.

This unit is suited to irrigated row and field crops that are salt tolerant. It is limited mainly by the water table, the saline-alkali condition of the soil, and very slow permeability. Use of a cropping system that includes growing a cover crop, return of crop residue, and proper tillage is needed to improve soil tilth and to increase the fertility and water intake rate. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Subsoiling opens up the soil and allows water and salts to pass through. The amount of salts present, the crops planted, and the reclamation procedures used all affect the yield of crops on this unit. Furrow, border, or sprinkler irrigation is suited to this unit. The method used generally is governed by the crop grown. Irrigation water management is very important. Excess irrigation water can cause a rise in the water table. Tile or open drains can be used to remove excess water and toxic salts if a suitable outlet is available. Most climatically adapted crops can be grown if artificial drainage is provided.

This map unit is in capability unit IIIw-3 (17), irrigated, and capability subclass VIIw, nonirrigated.

190—Los Osos Variant clay loam, 30 to 50 percent slopes. This moderately deep, well drained soil is on hills and mountains. It formed in residuum derived dominantly from sandstone or shale. The present vegetation in most areas is mainly annual grasses and forbs with scattered oaks. Elevation is 1,000 to 3,500 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 60 degrees F, and the average frost-free period is 225 to 275 days.

Typically, the surface layer is dark brown clay loam about 7 inches thick. The upper 26 inches of the subsoil is dark brown clay, and the lower 5 inches is dark yellowish brown clay loam. Very pale brown soft sandstone is at a depth of 38 inches.

Included in this unit are small areas of Lodo Variant clay loam, Aramburu very shaly clay loam, and Kilmer loam. Also included are small areas of Rock outcrop, Aido clay, Hillbrick sandy loam, Millsholm Variant sandy loam, Nacimiento silty clay loam, and a soil that is similar to this Los Osos Variant soil but has slopes of 15 to 30 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Los Osos Variant soil is slow. Available water capacity is low or moderate. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 25 to 40 inches.

This unit is used for livestock grazing, watershed, and wildlife habitat.

This unit is suited to livestock grazing. The production of forage is limited by low or moderate available water capacity. Proper grazing use improves water infiltration, promotes plant growth early in the season, and protects the soil from erosion. Cross-fencing and correctly placing livestock watering facilities help to distribute livestock grazing and to reduce overgrazing of the lower slopes. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This map unit is in capability subclass VIe (15), nonirrigated.

191—Los Osos Variant-Rock outcrop-Lodo Variant complex, 15 to 50 percent slopes. This map unit is on hills and mountains. The present vegetation in most areas is mainly annual grasses, forbs, and some shrubs. Elevation is 1,000 to 3,400 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is about 225 to 275 days.

This unit is 40 percent Los Osos Variant clay loam, 30 percent Rock outcrop, and 15 percent Lodo Variant clay loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Hillbrick loam, Kilmer loam, and Ayar silty clay. Included areas make up about 15 percent of the total acreage.

The Los Osos Variant soil is moderately deep and well drained. It formed in residuum derived dominantly from sandstone or shale. Typically, the surface layer is dark brown clay loam about 7 inches thick. The upper 26 inches of the subsoil is dark brown clay, and the lower 5 inches is dark yellowish brown clay loam. Very pale brown soft sandstone is at a depth of 38 inches.

Permeability of this Los Osos Variant soil is slow. Available water capacity is low or moderate. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 25 to 40 inches.

Rock outcrop consists of exposures of hard sandstone or shale 5 to 300 feet wide. The vegetation is limited to the fractures in the rock. Runoff is very rapid.

The Lodo Variant soil is shallow and somewhat excessively drained. It formed in residuum derived dominantly from shale or sandstone. Typically, the soil is grayish brown clay loam about 9 inches thick over hard shale. Depth to bedrock ranges from 6 to 20 inches.

Permeability of the Lodo soil is moderate. Available water capacity is very low or low. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 6 to 20 inches.

This unit is used for livestock grazing, watershed, and wildlife habitat.

This unit is poorly suited to livestock grazing. The production of vegetation suitable for livestock grazing on the Los Osos Variant soil is limited by restricted available water capacity. Production on the Lodo Variant soil is limited by restricted shallow depth to bedrock. Rock outcrop has little if any value for grazing. This unit supports sparse stands of plants that are suitable for grazing. The herbaceous plant cover readily deteriorates if it is overgrazed. Livestock grazing should be managed to protect the unit from erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. Correct placement of salt and supplemental feed helps to distribute livestock grazing and prevent overgrazing.

This map unit is in capability subclass VIIe (15), nonirrigated.

192—McFarland loam. This deep, well drained soil is on alluvial fans and flood plains. It formed in alluvium derived dominantly from granitic rock. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 285 to 400 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free period is 250 to 275 days.

Typically, the surface layer is grayish brown and brown loam about 24 inches thick. The upper 31 inches of the underlying material is pale brown and brown loam, and the lower part to a depth of 64 inches or more is light gray loam. In some areas the surface layer is clay loam and the lower part of the underlying material is fine sandy loam or sandy loam.

Included in this unit are small areas of Wasco sandy loam, Kimberlina fine sandy loam, and Panoche clay loam. Included areas make up about 15 percent of the total acreage.

Permeability of this McFarland soil is moderate. Available water capacity is high. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for irrigated crops, mainly alfalfa, cotton, and grapes. Among the other crops grown are milo, walnuts, and roses. Some areas are used for homesite developments.

This unit is suited to irrigated crops. It has few limitations. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Maintaining crop residue on or near the surface reduces runoff and helps to maintain soil tilth and organic matter content. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

If this unit is used for homesite development, the main limitation is rare periods of flooding. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Selection of adapted vegetation is critical for the establishment of lawns, shrubs, trees, and vegetable gardens. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability class I (17), irrigated, and capability subclass VIIc, nonirrigated.

193—Mendi-Hillbrick-Kilmer association, 9 to 30 percent slopes. This map unit is on hillsides, ridgetops, and mountains. The present vegetation in most areas is mainly annual grasses, forbs, and shrubs. Elevation is 1,400 to 2,000 feet. The average annual precipitation is about 9 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is 210 to 250 days.

This unit is 50 percent Mendi loam, 20 percent Hillbrick loam, and 15 percent Kilmer loam. The Mendi and Kilmer soils are mainly on north-facing slopes, and the Hillbrick soil is on south-facing slopes and on ridgetops.

Included in this unit are small areas of Bluestone clay, Aido clay, and Rock outcrop. Included areas make up about 15 percent of the total acreage.

The Mendi soil is deep and well drained. It formed in residuum derived dominantly from sandstone or shale. Typically, the surface layer is pale brown loam about 20 inches thick. The upper 20 inches of the underlying material is light yellowish brown loam, and the lower part to a depth of 72 inches is light yellowish brown silt loam. Below this is highly weathered, calcareous sandstone.

Permeability of the Mendi soil is moderate. Available water capacity is high or very high. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

The Hillbrick soil is shallow and well drained. It formed in residuum derived dominantly from weathered sandstone or shale. Typically, the surface layer is pale brown loam about 15 inches thick over fractured shale.

Permeability of the Hillbrick soil is moderately rapid. Available water capacity is very low. Runoff is medium, and the hazard of water erosion is high. Effective rooting depth is 10 to 20 inches.

The Kilmer soil is moderately deep and well drained. It formed in residuum derived dominantly from shale or sandstone. Typically, the surface layer is pale brown loam about 14 inches thick. The underlying material is pale brown loam about 18 inches thick over shale. In some areas the surface layer is sandy loam.

Permeability of the Kilmer soil is moderately slow. Available water capacity is low or moderate. Runoff is medium or rapid, and the hazard of water erosion is moderate. Effective rooting depth is 20 to 40 inches.

This unit is used mainly for livestock grazing, watershed, and wildlife habitat.

This unit is suited to livestock grazing. The Mendi and Kilmer soils have few limitations for the production of forage. Production on the Hillbrick soil is limited by the shallow depth to bedrock and very low available water capacity. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soils in this unit to produce vegetation suitable for grazing. Grazing should be delayed until the soils are firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities.

The Mendi and Kilmer soils are in capability unit IVe-1 (15), nonirrigated. The Hillbrick soil is in capability subclass VIIe (15), nonirrigated.

194—Mendi-Hillbrick-Kilmer association, 30 to 50 percent slopes. This map unit is on hillsides, ridgetops, and mountains. The present vegetation in most areas is mainly annual grasses, forbs, and shrubs. Elevation is 1,600 to 2,000 feet. The average annual precipitation is about 9 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is 210 to 250 days.

This unit is 45 percent Mendi loam, 25 percent Hillbrick loam, and 15 percent Kilmer loam. The Mendi and Kilmer soils are mainly on north-facing slopes, and the Hillbrick soil is on ridgetops and south-facing slopes.

Included in this unit are small areas of Bluestone clay, Aido clay, Choice clay, and Rock outcrop. Included areas make up about 15 percent of the total acreage.

The Mendi soil is deep and well drained. It formed in residuum derived dominantly from sandstone or shale. Typically, the surface layer is pale brown loam about 20 inches thick. The upper 20 inches of the substratum is light yellowish brown loam, and the lower part to a depth of 72 inches is light yellowish brown silt loam. Below this is highly weathered, calcareous sandstone.

Permeability of the Mendi soil is moderate. Available water capacity is high or very high. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 60 inches or more.

The Hillbrick soil is shallow and well drained. It formed in residuum derived dominantly from weathered sandstone or shale. Typically, the surface layer is pale brown loam about 15 inches thick over fractured shale.

Permeability of the Hillbrick soil is moderately rapid. Available water capacity is very low. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 10 to 20 inches.

The Kilmer soil is moderately deep and well drained. It formed in residuum derived dominantly from shale or sandstone. Typically, the surface layer is pale brown loam about 14 inches thick. The underlying material is pale brown loam about 18 inches thick over shale. In some areas the surface layer is sandy loam.

Permeability of the Kilmer soil is moderately slow. Available water capacity is low or moderate. Runoff is medium or rapid, and the hazard of water erosion is moderate. Effective rooting depth is 20 to 40 inches.

This unit is used for livestock grazing, watershed, and wildlife habitat.

This unit is suited to livestock grazing. The Mendi and Kilmer soils have few limitations for the production of forage. Production on the Hillbrick soil is limited by the very low available water capacity and shallow depth to bedrock. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Cross-fencing and correctly placing livestock watering facilities help to distribute livestock grazing and to reduce overgrazing of the lower slopes. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage.

Livestock grazing should be managed to protect the unit from erosion.

The Mendi and Kilmer soils are in capability subclass VIe (15), nonirrigated. The Hillbrick soil is in capability subclass VIIe (15), nonirrigated.

195—Mendi-Hillbrick-Kilmer association, 50 to 75 percent slopes. This map unit is on hillsides, ridgetops, and mountains. The present vegetation in most areas is mainly annual grasses, forbs, and shrubs. Elevation is 1,600 to 2,000 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is 200 to 250 days.

This unit is 35 percent Mendi loam, 35 percent Hillbrick loam, and 15 percent Kilmer loam. The Mendi and Kilmer soils are mainly on north-facing slopes, and the Hillbrick soil is on south-facing slopes and ridgetops.

Included in this unit are small areas of Bluestone clay, Aido clay, and Rock outcrop. Included areas make up about 15 percent of the total acreage.

The Mendi soil is deep and well drained. It formed in residuum derived dominantly from sandstone or shale. Typically, the surface layer is pale brown loam about 20 inches thick. The upper 20 inches of the substratum is light yellowish brown loam, and the lower part to a depth of 72 inches is light yellowish brown silt loam. Below this is highly weathered, calcareous sandstone.

Permeability of the Mendi soil is moderate. Available water capacity is high or very high. Runoff is very rapid, and the hazard of water erosion is very high. Effective rooting depth is 60 inches or more.

The Hillbrick soil is shallow and well drained. It formed in residuum derived dominantly from weathered sandstone or shale. Typically, the surface layer is pale brown loam about 15 inches thick over fractured shale.

Permeability of the Hillbrick soil is moderately rapid. Available water capacity is very low. Runoff is very rapid, and hazard of water erosion is very high. Effective rooting depth is 10 to 20 inches.

The Kilmer soil is moderately deep and well drained. It formed in residuum derived dominantly from shale or sandstone. Typically, the surface layer is pale brown loam about 14 inches thick. The underlying material is pale brown loam about 18 inches thick over shale. In some areas the surface layer is sandy loam.

Permeability of the Kilmer soil is moderately slow. Available water capacity is low or moderate. Runoff is very rapid, and the hazard of water erosion is high. Effective rooting depth is 20 to 40 inches.

This unit is used for livestock grazing, watershed, and wildlife habitat.

This unit is suited to livestock grazing. The Mendi and Kilmer soils have few limitations for the production of forage. Production on the Hillbrick soil is limited by the very low available water capacity and shallow depth to bedrock. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Cross-fencing and correctly placing livestock watering facilities help to distribute livestock grazing and to reduce overgrazing of the lower slopes. Trails or walkways can be constructed in places to encourage livestock to graze in areas where access is limited. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage.

This map unit is in capability subclass VIIe (15), nonirrigated.

196—Milham sandy loam, 0 to 2 percent slopes. This deep, well drained soil is on alluvial fans, plains, and low terraces. It formed in alluvium derived dominantly from granitic and sedimentary rock. The vegetation in areas not cultivated is mainly annual grasses and forbs with scattered shrubs. Elevation is 250 to 1,000 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free period is 260 to 300 days.

Typically, the surface layer is light brownish gray sandy loam about 4 inches thick. The upper 6 inches of the subsoil is pale brown sandy loam, and the lower 39 inches is yellowish brown loam and clay loam. The substratum to a depth of 60 inches or more is pale olive sandy loam. In some areas the surface layer is loam.

Included in this unit are small areas of Garces silt loam, Panoche clay loam, and Kimberlina fine sandy loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Milham soil is moderately slow. Available water capacity is high. Runoff is very slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for irrigated crops, mainly cotton, alfalfa, almonds, barley, grapes, pistachios, black beans, carrots, olives, onions, peppers, potatoes, sorghum, and wheat. Some areas are used for irrigated pasture or livestock grazing.

This unit is suited to hay and pasture. It has few limitations. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Furrow, border, and sprinkler irrigation systems are suited to this unit. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

This unit is suited to irrigated crops. It has few limitations. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and water infiltration. Maintaining crop residue on or near

the surface reduces runoff and helps to maintain soil tilth and organic matter content. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

The map unit is in capability class I (17), irrigated, and capability subclass VIIc, nonirrigated.

197—Milham sandy loam, 2 to 5 percent slopes. This deep, well drained soil is on alluvial fans, plains, and low terraces. It formed in alluvium derived dominantly from granitic and sedimentary rock. The vegetation in areas not cultivated is mainly annual grasses and forbs with scattered shrubs. Elevation is 250 to 1,000 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is light brownish gray sandy loam about 4 inches thick. The upper 6 inches of the subsoil is pale brown sandy loam, and the lower 39 inches is yellowish brown loam or clay loam. The substratum to a depth of 60 inches or more is pale olive sandy loam. In some areas the surface layer is loam.

Included in this unit are small areas of Panoche clay loam, Kimberlina fine sandy loam, and a soil that has a moderately coarse textured subsoil. Included areas make up about 20 percent of the total acreage.

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

Most areas of this unit are used for irrigated crops, mainly cotton, almonds, barley, grapes, pistachios, sorghum, and wheat. Some areas are used for livestock grazing.

This unit is suited to irrigated crops. It has few limitations. A cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Maintaining crop residue on or near the surface reduces runoff and helps to maintain soil tilth and organic matter content. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

The map unit is in capability unit IIe-1 (17), irrigated, and capability subclass VIIe, nonirrigated.

198—Milham sandy loam, 5 to 9 percent slopes. This deep, well drained soil is on alluvial fans, plains, and low terraces. It formed in alluvium derived dominantly from granitic and sedimentary rock. The vegetation in areas not cultivated is mainly annual grasses and forbs with scattered shrubs. Elevation is 250 to 1,200 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free period is 250 to 290 days.

Typically, the surface layer is light brownish gray sandy loam about 4 inches thick. The upper 6 inches of the subsoil is pale brown sandy loam, and the lower 39 inches is yellowish brown loam and clay loam. The substratum to a depth of 60 inches or more is pale olive sandy loam. In some areas the surface layer is loam.

Included in this unit are small areas of Panoche clay loam and Kimberlina fine sandy loam. Included areas make up about 10 percent of the total acreage.

Permeability of this Milham soil is moderately slow. Available water capacity is high. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for livestock grazing. A few areas are used for irrigated crops.

This unit is suited to irrigated crops. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases fertility and the water intake rate. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Because of the slope, sprinkler or drip irrigation is best suited to this unit. Irrigation water needs to be applied at a rate that ensures optimum production without increasing deep percolation, runoff, and erosion.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall. If the range is overgrazed, the proportion of preferred forage plants

decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

The map unit is in capability unit IIIe-1 (17), irrigated, and capability subclass VIIe, nonirrigated.

199—Millsholm Variant-Ayar association, 50 to 75 percent slopes. This map unit is on hills and mountains. The present vegetation in most areas is mainly annual grasses, forbs, shrubs, and scattered junipers and oaks. Elevation is 1,500 to 2,800 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is 200 to 240 days.

This unit is 50 percent Millsholm Variant sandy loam and 30 percent Ayar clay. The Ayar soil commonly is on north-facing slopes, and the Millsholm soil commonly is on south-facing slopes.

Included in this unit are small areas of Kilmer loam, Rock outcrop, Aido clay, and Bluestone clay. Included areas make up about 20 percent of the total acreage.

The Millsholm Variant soil is shallow and well drained. It formed in residuum derived dominantly from sandstone or shale. Typically, the surface layer is light brownish gray sandy loam about 5 inches thick. The subsoil is pale brown sandy loam about 6 inches thick. Fractured shale is at a depth of 11 inches. The soil is about 5 to 15 percent gravel. In some areas the surface layer is loam.

Permeability of the Millsholm Variant soil is moderate. Available water capacity is very low. Runoff is very rapid, and the hazard of water erosion is very high. Effective rooting depth is 10 to 20 inches.

The Ayar soil is deep and well drained. It formed in residuum derived dominantly from shale or sandstone. Typically, the surface layer is brown silty clay about 11 inches thick. The underlying material to a depth of 44 inches is brown silty clay and clay. Below this is fine grained sandstone. In some areas the surface layer is silty clay loam or clay.

Permeability of the Ayar soil is slow. Available water capacity is moderate or high. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 40 to 60 inches.

This unit is used for limited livestock grazing and wildlife habitat.

This unit is poorly suited to livestock grazing. The production of forage on the Millsholm Variant soil is limited by the shallow depth to bedrock and very low available water capacity. The Ayar soil has no major limitations. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Overgrazing or operating off-road vehicles on this unit causes the plant community to deteriorate and increases soil erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Livestock grazing should be managed to protect the unit from excessive erosion.

This map unit is in capability subclass VIIe (15), nonirrigated.

200—Millsholm Variant-Montara complex, 15 to 30 percent slopes. This map unit is on hills and mountains. The present vegetation in most areas is mainly annual grasses, forbs, and shrubs. Elevation is 1,500 to 2,800 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 60 degrees F, and the average frost-free season is about 200 to 250 days.

This unit is 45 percent Millsholm Variant sandy loam and 40 percent Montara clay loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Nacimiento silty clay loam and Ayar silty clay. Included areas make up about 15 percent of the total acreage.

The Millsholm Variant soil is shallow and well drained. It formed in residuum derived dominantly from sandstone or shale. Typically, the surface layer is light brownish gray sandy loam about 5 inches thick. The subsoil is pale brown sandy loam about 6 inches thick. Fractured shale is at a depth of 11 inches. The soil is about 5 to 15 percent gravel. In some areas the surface layer is loam or clay loam.

Permeability of the Millsholm Variant soil is moderate. Available water capacity is very low. Runoff is rapid, and the hazard of water erosion is moderate. Effective rooting depth is 10 to 20 inches.

The Montara soil is shallow and well drained. It formed in residuum derived dominantly from serpentine. Typically, the soil is gray and grayish brown clay loam about 14 inches thick over serpentine.

Permeability of the Montara soil is moderately slow. Available water capacity is very low or low. Runoff is rapid, and the hazard of water erosion is moderate. Effective rooting depth is 10 to 20 inches.

This unit is used for livestock grazing.

This unit is poorly suited to livestock grazing. The production of forage on the Millsholm Variant soil is limited by the very low available water capacity and shallow depth to bedrock. Production on the Montara soil is limited by a calcium to magnesium imbalance and the restricted available water capacity. This unit supports sparse stands of plants that are suitable for grazing. The herbaceous plant cover readily deteriorates if it is

overgrazed. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This map unit is in capability subclass VIIe (15), nonirrigated.

201—Millsholm Variant-Rock outcrop complex, 15 to 50 percent slopes. This map unit is on hills and mountains. The present vegetation in most areas is mainly annual grasses, forbs, shrubs, and junipers with scattered oaks. Elevation is 2,000 to 3,000 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is about 200 to 250 days.

This unit is 50 percent Millsholm Variant and 30 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Hillbrick loam and Kilmer loam. Included areas make up about 20 percent of the total acreage.

The Millsholm Variant soil is shallow and well drained. It formed in residuum derived dominantly from sandstone or shale. Typically, the surface layer is light brownish gray sandy loam about 5 inches thick. The subsoil is pale brown sandy loam about 6 inches thick. Fractured shale is at a depth of 11 inches. The soil is about 5 to 15 percent gravel. In some areas the surface layer is loam.

Permeability of the Millsholm Variant soil is moderate. Available water capacity is very low. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 10 to 20 inches.

Rock outcrop consists of exposures of hard sandstone or shale 5 to 300 feet wide. The vegetation is limited to the fractures in the rock. Runoff is very rapid.

This unit is used for livestock grazing, watershed, and wildlife habitat.

This unit is poorly suited to livestock grazing. The production of forage on the Millsholm Variant soil is limited by the shallow depth to bedrock and very low available water capacity. Rock outcrop has little if any value for grazing. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage. Livestock grazing should be managed to protect the unit from erosion.

This map unit is in capability subclass VIIe (15), nonirrigated.

202—Millsholm Variant-Rock outcrop complex, 50 to 75 percent slopes. This map unit is on hills and mountains. The present vegetation in most areas is mainly annual grasses, forbs, shrubs, and junipers with scattered oaks. Elevation is 2,000 to 3,000 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is about 200 to 250 days.

This unit is 50 percent Millsholm Variant and 30 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Hillbrick loam, Aido clay, and Kilmer loam. Included areas make up about 20 percent of the total acreage.

The Millsholm Variant soil is shallow and well drained. It formed in residuum derived dominantly from sandstone or shale. Typically, the surface layer is light brownish gray sandy loam about 5 inches thick. The subsoil is pale brown sandy loam about 6 inches thick. Fractured shale is at a depth of 11 inches. The soil is about 5 to 15 percent gravel. In some areas the surface layer is loam.

Permeability of the Millsholm Variant soil is moderate. Available water capacity is very low. Runoff is very rapid, and the hazard of water erosion is very high. Effective rooting depth is 10 to 20 inches.

Rock outcrop consists of exposures of hard sandstone or shale 5 to 300 feet wide. The vegetation is limited to the fractures in the rock. Runoff is rapid.

This unit is used for livestock grazing, watershed, and wildlife habitat.

This unit is poorly suited to livestock grazing. The production of forage on the Millsholm Variant soil is limited by the shallow depth to bedrock and very low available water capacity. Rock outcrop has little if any value for grazing. This unit supports sparse stands of plants that are suitable for grazing. Removal of the plant cover results in extensive erosion. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Overgrazing or operating off-road vehicles on this unit causes the plant community to deteriorate and increases soil erosion. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage. Mechanical treatment is not practical because of the stony surface layer and the steepness of slope. Livestock grazing should be managed to protect the unit from erosion.

This map unit is in capability subclass VIIe (15), nonirrigated.

203—Montara-Rock outcrop complex, 15 to 50 percent slopes. This map unit is on hills and mountains. The present vegetation in most areas is mainly annual

grasses and forbs with scattered shrubs. Elevation is 1,325 to 2,450 feet. The average annual precipitation is about 11 inches, the average annual temperature is about 62 degrees F, and the average frost-free season is about 225 to 275 days.

This unit is 60 percent Montara clay loam and 20 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Nacimiento silty clay loam, Hillbrick loam, and Aido clay. Included areas make up about 20 percent of the total acreage.

The Montara soil is shallow and well drained. It formed in residuum derived dominantly from serpentine. Typically, the soil is gray and grayish brown clay loam about 14 inches thick over serpentine. In some areas the soil is loam.

Permeability of the Montara soil is moderately slow. Available water capacity is very low or low. Runoff is medium or rapid, and the hazard of water erosion is moderate. Effective rooting depth is 10 to 20 inches.

Rock outcrop is mostly exposed areas of serpentine. Runoff is very rapid.

This unit is used for livestock grazing.

This unit is poorly suited to livestock grazing. The production of forage on the Montara soil is limited by a calcium to magnesium imbalance, shallow depth to bedrock, and the restricted available water capacity. Rock outcrop has little if any value for grazing. This unit supports sparse stands of plants that are suitable for grazing. The herbaceous plant cover readily deteriorates if it is overgrazed. Slope limits access by livestock and results in overgrazing of the less sloping areas. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage. Livestock grazing should be managed to protect the unit from erosion.

This map unit is in capability subclass VIIs (15), nonirrigated.

204—Myers Variant clay, 2 to 9 percent slopes. This deep, well drained soil is on terraces. It formed in alluvium derived dominantly from sedimentary rock. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 2,000 to 2,600 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is 200 to 225 days.

Typically, the surface layer is brown clay about 6 inches thick. The underlying material to a depth of 61 inches or more is brown and yellowish brown clay. Gypsum crystals are in the lower part of the underlying material.

Included in this unit are small areas of soils that have slopes of more than 9 percent. Included areas make up about 10 percent of the total acreage.

Permeability of this Myers Variant soil is very slow. Available water capacity is high. Runoff is slow, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

This unit is used mainly for dryfarmed grain. It is also used for gypsum mining.

This unit is suited to dryfarmed grain. It is limited mainly by low rainfall, gently rolling slopes, and the very slow permeability of the soil. Because precipitation is not sufficient for annual cropping, a cropping system of grain, fallow, and then volunteer pasture is most suitable. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

This map unit is in capability unit IVe-1 (15), nonirrigated.

205—Nacimiento-Kilmer complex, 9 to 30 percent slopes. This map unit is on hills and mountains. The present vegetation in most areas is mainly annual grasses and forbs with scattered shrubs. Elevation is 1,200 to 2,500 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is 200 to 240 days.

This unit is 40 percent Nacimiento silty clay loam and 25 percent Kilmer loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of a soil that is similar to the Nacimiento soil but is 40 to 60 inches deep and small areas of a soil that is similar to the Kilmer soil but has highly weathered bedrock and a rippable, fractured, cemented layer at a depth of 20 to 40 inches. Also included are small areas of Montara clay loam, Mendi loam, and Lodo Variant clay loam. Included areas make up about 35 percent of the total acreage.

The Nacimiento soil is moderately deep and well drained. It formed in residuum derived dominantly from calcareous sandstone or shale. Typically, the surface layer is brown silty clay loam about 13 inches thick. The underlying material to a depth of 26 inches is yellowish brown and pale brown silty clay loam. Below this is weathered shale.

Permeability of the Nacimiento soil is moderately slow. Available water capacity is low or moderate. Runoff is medium or rapid, and the hazard of water erosion is moderate or high. Effective rooting depth is 20 to 40 inches.

The Kilmer soil is moderately deep and well drained. It formed in residuum derived dominantly from calcareous sandstone or shale. Typically, the surface layer is pale brown loam about 14 inches thick. The underlying material is pale brown loam about 18 inches thick over shale. In some areas the surface layer is sandy loam.

Permeability of the Kilmer soil is moderately slow. Available water capacity is low or moderate. Runoff is medium or rapid, and the hazard of water erosion is moderate. Effective rooting depth is 20 to 40 inches.

Most areas of this unit are used for livestock grazing and wildlife habitat. A few areas are used for dryfarmed grain.

This unit is poorly suited to dryfarmed grain. It is limited mainly by low rainfall and steepness of slope. Because precipitation is not sufficient for annual cropping, a cropping system of grain, fallow, and then volunteer pasture is most suitable. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. All tillage should be on the contour or across the slope.

This unit is suited to livestock grazing. If the plant cover is overgrazed, the unit becomes more susceptible to erosion. Cross-fencing and correctly placing livestock watering facilities help to distribute livestock grazing and to reduce overgrazing of the lower slopes. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage.

This map unit is in capability unit IVe-1 (15), nonirrigated.

206—Nacimiento-Kilmer complex, 30 to 50 percent slopes. This map unit is on hills and mountains. The present vegetation in most areas is mainly annual grasses and forbs with scattered shrubs. Elevation is 1,200 to 2,500 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is 200 to 240 days.

This unit is 40 percent Nacimiento silty clay loam and 25 percent Kilmer loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of a soil that is similar to the Nacimiento soil but is 40 to 60 inches deep and small areas of a soil that is similar to the Kilmer soil but has a rippable, fractured, cemented layer at a depth of 20 to 40 inches. Also included are small areas of Montara clay loam and Hillbrick loam. Included areas make up about 35 percent of the total acreage.

The Nacimiento soil is moderately deep and well drained. It formed in residuum derived dominantly from calcareous sandstone or shale. Typically, the surface layer is brown silty clay loam about 13 inches thick. The underlying material to a depth of 26 inches is yellowish brown and pale brown silty clay loam. Below this is weathered shale.

Permeability of the Nacimiento soil is moderately slow. Available water capacity is low or moderate. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 20 to 40 inches.

The Kilmer soil is moderately deep and well drained. It formed in residuum derived dominantly from calcareous sandstone or shale. Typically, the surface layer is pale brown loam about 14 inches thick. The underlying material is pale brown loam about 18 inches thick over shale. In some areas the surface layer is sandy loam.

Permeability of the Kilmer soil is moderately slow. Available water capacity is low or moderate. Runoff is rapid, and the hazard of water erosion is moderate. Effective rooting depth is 20 to 40 inches.

This unit is used for livestock grazing and wildlife habitat.

This unit is suited to livestock grazing. Livestock grazing should be managed to protect the unit from erosion. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Uniform distribution of grazing can be achieved by the proper placement of salt and watering facilities. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage.

This map unit is in capability subclass VIe (15), nonirrigated.

207—Nahrub clay, drained. This deep, somewhat poorly drained soil is in basins. It formed in alluvium derived dominantly from granitic and sedimentary rock. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly salt tolerant grasses, forbs, and saltbush. Elevation is 180 to 250 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 240 to 300 days.

Typically, the surface layer is gray clay about 18 inches thick. The upper 34 inches of the underlying material is pale brown and light brownish gray clay, and the lower part to a depth of about 61 inches is pale yellow clay loam and light olive gray fine sandy loam. The soil is strongly saline-alkali.

Included in this unit are small areas of Twisselman clay, Lokern clay, and Lethent silt loam. Included areas make up about 25 percent of the total acreage.

Permeability of this Nahrub soil is very slow. Available water capacity is moderate or high. Runoff is very slow or ponded, and the hazard of water erosion is none to slight. Effective rooting depth is 60 inches or more. This soil is subject to rare periods of flooding, but it is protected by dams or levees, or both. Toxic levels of boron are present in places.

Most areas of this unit are used for livestock grazing and irrigated crops. A few areas are used for wetland wildlife habitat.

This unit is suited to irrigated row and field crops that are salt tolerant. It is limited mainly by the saline-alkali

condition of the soil and very slow permeability. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases the fertility and water intake rate. Salt tolerant crops can be grown if the salt content is reduced by leaching. Subsoiling helps to open up the soil and thus facilitates leaching. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Intensive management is required to reduce the salinity and maintain soil productivity. Furrow, border, and sprinkler irrigation systems are suited to this unit. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. For the optimum production of crops, water should be applied in amounts sufficient to leach the salts from the root zone but at a rate that will not cause excessive runoff. Tile or open drains can be used to remove excess water and provide an outlet for leached salts.

This unit is poorly suited to livestock grazing. The production of forage is limited by low rainfall and the saline-alkali condition of the soil. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. This unit supports salt tolerant plants.

The map unit is in capability unit IIIs-6 (17), irrigated, and capability subclass VIIs, nonirrigated.

208—Nahrub clay, partially drained. This deep, somewhat poorly drained soil is in basins. The drainage has been altered by seepage resulting from extensive irrigation within the area. The soil formed in alluvium derived dominantly from granitic and sedimentary rock. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly salt tolerant grasses, forbs, and shrubs. Elevation is 180 to 250 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 240 to 300 days.

Typically, the surface layer is gray clay about 18 inches thick. The upper 34 inches of the underlying material is pale brown and light brownish gray clay, and the lower part to a depth of about 61 inches is pale yellow clay loam and light olive gray fine sandy loam. The soil is strongly saline-alkali.

Included in this unit are small areas of Twisselman clay, Lokern clay, and Lethent silt loam. Included areas make up about 10 percent of the total acreage.

Permeability of this Nahrub soil is very slow. Available water capacity is moderate or high. Runoff is very slow, and the hazard of water erosion is slight. Effective rooting depth is limited by a high water table that is at a depth of 3 to 6 feet. This soil is subject to rare periods of flooding, but it is protected by dams or levees, or both. Toxic levels of boron are present in places.

Most areas of this unit are used for irrigated crops. A few areas are used for hay and pasture, wetland wildlife habitat, and limited livestock grazing.

This unit is suited to irrigated, salt tolerant crops. It is limited mainly by the saline-alkali condition of the soil, the high water table, and very slow permeability. Use of a cropping system that includes growing a cover crop, return of crop residue, and proper tillage is needed to improve soil tilth and to increase the fertility and water intake rate. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Subsoiling opens up the soil and allows water and salts to pass through. The amount of salts present, the crops planted, and the reclamation procedures used all affect the yield of crops on this unit. Furrow, border, or sprinkler irrigation is suited to this unit. The method used generally is governed by the crop grown. Irrigation water management is very important. Excess irrigation water can cause the water table to rise nearer to the surface. Tile or open drains can be used to remove excess water and toxic salts if a suitable outlet is available. Most climatically adapted crops can be grown if artificial drainage is provided.

This unit is suited to hay and pasture. The main limitations are the saline-alkali condition of the soil and the high water table. The concentration of salts and alkali in the surface layer limits the production of plants suitable for hay and pasture. Leaching the salts from the surface layer is limited by the high water table. Drainage and irrigation water management reduce the concentration of salts. Salt tolerant species are most suitable for planting. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Proper grazing practices, weed control, and fertilizer are needed to ensure maximum quality of forage. Irrigation water can be applied by the border or sprinkler method. A livestock watering system, such as a pipeline, trough, or well, should be developed in grazing areas. Irrigation water management is very important. Tile drainage can be used to lower the water table if a suitable outlet is available.

This map unit is in capability unit IIIw-3 (17), irrigated, and capability subclass VIIw, nonirrigated.

209—Nahrub, drained-Lethent complex. This map unit is in basins. Slope is 0 to 2 percent. The present vegetation in most areas is mainly salt tolerant annual grasses, forbs, and shrubs. Elevation is 210 to 250 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 275 to 300 days.

This unit is about 70 percent Nahrub clay and about 20 percent Lethent silt loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Buttonwillow clay, Lerdo clay loam, Lokern clay, Twisselman clay that is saline-alkali, and Twisselman sandy loam that is saline-alkali. Included areas make up about 10 percent of the total acreage.

The Nahrub soil is deep and somewhat poorly drained. It formed in alluvium derived dominantly from granitic and sedimentary rock. Typically, the surface layer is gray clay about 18 inches thick. The upper 34 inches of the underlying material is pale brown and light brownish gray clay, and the lower part to a depth of 61 inches is pale yellow clay loam and light olive gray fine sandy loam. The soil is moderately saline-alkali.

Permeability of the Nahrub soil is very slow. Available water capacity is moderate or high. Runoff is very slow, and the hazard of water erosion is none or slight. Effective rooting depth is 60 inches or more. This soil is subject to rare periods of flooding, but it is protected by dams or levees, or both. Toxic levels of boron are present in places.

The Lethent soil is deep and moderately well drained. It formed in alluvium derived dominantly from granitic and sedimentary rock. Typically, the surface layer is light brownish gray silt loam about 6 inches thick. The subsoil is light brownish gray clay about 36 inches thick. The substratum to a depth of 60 inches or more is grayish brown loam. The soil is moderately saline-alkali.

Permeability of the Lethent soil is very slow. Available water capacity is low or moderate. Runoff is very slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more. Toxic levels of boron are present in places.

Most areas of this unit are used for livestock grazing and wetland wildlife habitat. A few areas are used for irrigated salt tolerant crops and pasture.

This unit is suited to irrigated salt tolerant row and field crops if the soil is reclaimed. It is limited mainly by the saline-alkali condition of the soil and the very slow permeability. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases the fertility and water intake rate. Salt tolerant crops can be grown if the salt content is reduced by leaching. Subsoiling helps to open up the soil and thus facilitates leaching.

This unit is poorly suited to livestock grazing. The production of forage is limited by low rainfall and the saline-alkali condition of the soil. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. This unit supports salt tolerant plants.

The map unit is in capability unit IIIs-6 (17), irrigated, and capability subclass VIIs, nonirrigated.

210—Nahrub, partially drained-Lethent complex. This map unit is in basins. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly salt tolerant grasses, forbs, and shrubs. Elevation is 210 to 250 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 275 to 300 days.

This unit is about 75 percent Nahrub clay and 15 percent Lethent silt loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Buttonwillow clay, Lerdo clay loam, Lokern clay that is saline-alkali, Twisselman clay that is saline-alkali, and Twisselman sandy loam that is saline-alkali. Included areas make up about 10 percent of the total acreage.

The Nahrub soil is deep and somewhat poorly drained. It formed in alluvium derived dominantly from granitic and sedimentary rock. Typically, the surface layer is gray clay about 18 inches thick. The upper 34 inches of the underlying material is pale brown and light brownish gray clay, and the lower part to a depth of 61 inches is pale yellow sandy clay loam and light olive gray fine sandy loam. The soil is moderately saline-alkali.

Permeability of this Nahrub soil is very slow. Available water capacity is moderate or high. Effective rooting depth is limited by a high water table that is at a depth of 3 to 6 feet. Runoff is very slow, and the hazard of water erosion is none or slight. This soil is subject to rare periods of flooding, but it is protected by dams or levees, or both. Toxic levels of boron are present in places.

The Lethent soil is deep and moderately well drained. It formed in alluvium derived dominantly from granitic and sedimentary rock. Typically, the surface layer is light brownish gray silt loam about 6 inches thick. The subsoil is light brownish gray clay about 36 inches thick. The substratum to a depth of 60 inches or more is grayish brown loam. The soil is moderately saline-alkali.

Permeability of this Lethent soil is very slow. Available water capacity is low or moderate. Runoff is very slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more. Toxic levels of boron are present in places.

Most areas of this unit are used for livestock grazing and wetland wildlife habitat. A few areas are used for irrigated salt tolerant crops.

This unit is poorly suited to irrigated crops. It is limited mainly by the saline-alkali condition of the soils, the very slow permeability, and the high water table in the Nahrub soil. Use of a cropping system that includes growing a cover crop, return of crop residue, and proper tillage is needed to improve soil tilth and to increase the fertility and water intake rate. Salt tolerant crops can be grown if the salt content is reduced by leaching. Subsoiling helps to open up the soil and thus facilitates leaching. The amount of salts present, the crops planted, and the reclamation procedures used all affect the yield of crops on this soil. Furrow, border, or sprinkler irrigation systems are suited to this unit. The method used

generally is governed by the crop grown. Irrigation water management is very important. Excess irrigation water can cause the water table to rise nearer to the surface. Tile or open drains can be used to remove excess water and toxic salts if a suitable outlet is available. Most climatically adapted crops can be grown if artificial drainage is provided.

This unit is poorly suited to livestock grazing. The production of forage is limited by low rainfall and the saline-alkali condition of the soils. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soils from erosion. This unit supports salt tolerant plants.

The map unit is in capability unit IIIw-3 (17), irrigated, and capability subclass VIIw, nonirrigated.

211—Panoche clay loam, 0 to 2 percent slopes. This deep, well drained soil is on alluvial fans and plains. It formed in alluvium derived dominantly from granitic or sedimentary rock. The vegetation in areas not cultivated is mainly annual grasses and forbs with scattered shrubs. Elevation is 250 to 1,000 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is pale brown clay loam about 16 inches thick. The upper 20 inches of the underlying material is pale brown loam, and the lower part to a depth of 60 inches or more is light yellowish brown sandy clay loam and clay loam. In some areas the surface layer is loam.

Included in this unit are small areas of Milham sandy loam, Wasco sandy loam, and Kimberlina fine sandy loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Panoche soil is moderate. Available water capacity is high or very high. Runoff is very slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for irrigated crops, mainly cotton, alfalfa, almonds, grapes, and pistachios. Among the other crops grown are barley, oranges, blackeye beans, potatoes, sugar beets, and sorghum. Some areas are used for livestock grazing and as homesites.

This unit is suited to hay and pasture. It has few limitations. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Furrow, border, and sprinkler irrigation systems are suited to this unit. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

This unit is suited to irrigated crops. It has few limitations. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases the fertility and water intake rate. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities.

If this unit is used for urban development, the main limitation is rare periods of flooding. Dikes and channels that have outlets for floodwater can protect buildings and onsite sewage disposal systems from flooding. Revegetating disturbed areas around construction sites as soon as possible helps to control erosion.

The map unit is in capability class I (17), irrigated, and capability subclass VIIc, nonirrigated.

212—Panoche clay loam, 2 to 5 percent slopes. This deep, well drained soil is on alluvial fans and plains. It formed in alluvium derived dominantly from granitic or sedimentary rock. The vegetation in areas not cultivated is mainly annual grasses and forbs with scattered shrubs. Elevation is 350 to 1,000 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free period is 250 to 300 days.

Typically, the surface layer is pale brown clay loam about 16 inches thick. The upper 20 inches of the underlying material is pale brown loam, and the lower part to a depth of 60 inches or more is light yellowish brown sandy clay loam and clay loam. In some areas the surface layer is loam.

Included in this unit are small areas of Milham sandy loam and Kimberlina fine sandy loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Panoche soil is moderate. Available water capacity is high or very high. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for irrigated crops, mainly cotton, alfalfa, almonds, and pistachios. Among the other crops grown are oranges and sorghum. Some areas are used for livestock grazing.

This unit is suited to irrigated crops. It has few limitations. A cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases the fertility and water intake rate. Maintaining crop residue on or near the surface reduces runoff and helps to maintain soil tilth and organic matter content. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities.

The map unit is in capability unit IIe-1 (17), irrigated, and capability subclass VIIe, nonirrigated.

213—Panoche clay loam, 5 to 9 percent slopes. This deep, well drained soil is on alluvial fans and plains. It formed in alluvium derived dominantly from granitic or sedimentary rock. The vegetation in areas not cultivated is mainly annual grasses and forbs with scattered shrubs. Elevation is 450 to 1,200 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is pale brown clay loam about 16 inches thick. The upper 20 inches of the underlying material is pale brown loam, and the lower part to a depth of 60 inches or more is light yellowish brown sandy clay loam and clay loam. In some areas the surface layer is loam.

Included in this unit are small areas of Milham sandy loam and Kimberlina fine sandy loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Panoche soil is moderate. Available water capacity is high or very high. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for livestock grazing. A few areas are used for irrigated crops such as almonds, oranges, and lemons.

This unit is suited to irrigated crops. It is limited mainly by slope. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases the fertility and water intake rate. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Because of the slope, sprinkler or drip irrigation is best suited to this unit. Irrigation water needs to be applied at a rate that ensures optimum production without increasing deep percolation, runoff, and erosion.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

The map unit is in capability unit IIIe-1 (17), irrigated, and capability subclass VIIe, nonirrigated.

214—Panoche clay loam, saline-alkali, 0 to 2 percent slopes. This deep, well drained soil is on alluvial fans and plains. It formed in alluvium derived dominantly from granitic or sedimentary rock. The vegetation in areas not cultivated is mainly salt tolerant annual grasses, forbs, and shrubs. Elevation is 250 to 330 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is grayish brown clay loam about 21 inches thick. The subsurface layer is light brownish gray clay loam about 6 inches thick. The underlying material to a depth of 60 inches or more is pale brown clay loam. The soil is moderately saline-alkali. In some areas the surface layer is loam.

Included in this unit are small areas of Kimberlina fine sandy loam, Twisselman clay that is saline-alkali, and Garces silt loam. Included areas make up about 10 percent of the total acreage.

Permeability of this Panoche soil is moderately slow. Available water capacity is moderate or high. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more. Toxic levels of boron are present in places.

This unit is used for irrigated salt tolerant crops such as cotton, alfalfa, barley, sorghum, and sugar beets and for irrigated pasture. Some areas are used for livestock grazing.

This unit is suited to irrigated pasture. It is limited mainly by the saline-alkali condition of the soil. Salt tolerant grasses can be grown. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. The concentration of salts and alkali in the surface layer limits the production of plants suitable for hay and pasture. Leaching the salts from the surface layer is

limited by the high water table. Drainage and irrigation water management reduce the concentration of salts. Salt tolerant species are most suitable for planting. Border and sprinkler irrigation systems are suited to this unit. For the optimum production of crops, water should be applied in amounts sufficient to leach the salts from the root zone but at a rate that will not cause excessive runoff. Subsoiling opens up the soil and allows water and salts to pass through. Tile or open drains can be used to remove excess water and provide an outlet for leached salts.

This unit is suited to irrigated row and field crops that are salt tolerant. It is limited mainly by the saline-alkali condition of the soil. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases the fertility and water intake rate. Salt tolerant crops can be grown if the salt content is reduced by leaching. Subsoiling helps to open up the soil and thus facilitates leaching. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Intensive management is required to reduce the salinity and maintain soil productivity.

Furrow, border, and sprinkler irrigation systems are suited to this unit. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. For the optimum production of crops, water should be applied in amounts sufficient to leach the salts from the root zone but at a rate that will not cause excessive runoff. Tile or open drains can be used to remove excess water and provide an outlet for leached salts.

This unit is poorly suited to livestock grazing. The production of vegetation suitable for livestock grazing is limited by low rainfall and the saline-alkali condition of the soil. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. The unit supports salt tolerant plants.

This map unit is in capability unit IIs-6 (17), irrigated, and capability subclass VIIs, nonirrigated.

215—Panoche clay loam, saline-alkali, moderately wet, 0 to 2 percent slopes. This deep, well drained soil is on alluvial fans and plains. The drainage has been altered by seepage resulting from extensive irrigation within the area. The soil formed in alluvium derived dominantly from granitic or sedimentary rock. The vegetation in areas not cultivated is mainly salt tolerant annual grasses, forbs, and shrubs. Elevation is 250 to 330 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is grayish brown clay loam about 21 inches thick. The subsurface layer is light brownish gray clay loam about 6 inches. The underlying material to a depth of 60 inches or more is pale brown clay loam. The soil is moderately saline-alkali. In some areas the surface layer is loam.

Included in this unit are small areas of Garces silt loam, Twisselman clay this is saline-alkali, and Kimberlina fine sandy loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Panoche soil is moderately slow. Available water capacity is moderate or high. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is limited by a high water table that is at a depth of 3 to 6 feet. Toxic levels of boron are present in places.

This unit is used mainly for irrigated salt tolerant crops such as cotton, alfalfa, barley, sorghum, and sugar beets. It is also used for irrigated pasture.

This unit is suited to irrigated salt tolerant crops. It is limited mainly by the saline-alkali condition of the soil and the high water table. Use of a cropping system that includes growing a cover crop, return of crop residue, and proper tillage is needed to improve soil tilth and to increase the fertility and water intake rate. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Subsoiling opens up the soil and allows water and salts to pass through. The amount of salts present, the crops planted, and the reclamation procedures used all affect the yield of crops on this unit. Furrow, border, or sprinkler irrigation is suited to this unit. The method used generally is governed by the crop grown. Irrigation water management is very important. Excess irrigation water can cause the high water table to rise nearer to the surface. Tile or open drains can be used to remove excess water and toxic salts if a suitable outlet is available. Most climatically adapted crops can be grown if artificial drainage is provided.

This unit is suited to hay and pasture. The main limitations are the saline-alkali condition of the soil and the high water table. The concentration of salts and alkali in the surface layer limits the production of plants suitable for hay and pasture. Leaching the salts from the surface layer is limited by the high water table. Drainage and irrigation water management reduce the concentration of salts. Salt tolerant species are most suitable for planting. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Proper grazing practices, weed control, and fertilizer are needed to ensure maximum quality of forage. Irrigation water can be applied by the border or sprinkler methods. A livestock watering system, such as a pipeline, trough, or well, should be developed in grazing areas. Irrigation water management is very

important. Tile drainage can be used to lower the water table if a suitable outlet is available.

This map unit is in capability unit IIIw-6 (17), irrigated, and capability subclass VIIw, nonirrigated.

216—Panoche-Urban land complex, 0 to 2 percent slopes. This map unit is on alluvial fans and plains. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 375 to 425 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free period is 250 to 300 days.

This unit is 45 percent Panoche clay loam and 35 percent Urban land. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Panoche clay loam that is saline-alkali, Kimberlina fine sandy loam, and Wasco sandy loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Panoche soil is deep and well drained. It formed in alluvium derived dominantly from granitic rock. Typically, the surface layer is pale brown clay loam about 16 inches thick. The upper 20 inches of the underlying material is pale brown loam, and the lower part to a depth of 60 inches or more is light yellowish brown sandy clay loam and clay loam. In some areas the surface layer is loam.

Permeability of the Panoche soil is moderate. Available water capacity is high or very high. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more.

Urban land consists of areas covered by concrete, asphalt, buildings, or other impervious surfaces. In most areas some or all of the profile has been cut away or altered. The fill material is from adjacent areas of Kimberlina or Wasco soils that have been cut or graded.

This unit is used for urban development.

If this unit is used for urban development, the main limitation is rare periods of flooding. Flooding can be controlled only by use of major flood control structures. Drainage is needed if roads and building foundations are constructed. The risk of erosion is increased if the soil is left exposed during site development. Revegetating disturbed areas around construction sites as soon as possible helps to control erosion. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees. The possibility of settlement can be minimized by compacting the building site before beginning construction. If the unit is used for septic tank absorption fields, the limitation of moderate permeability can be overcome by increasing the size of the absorption field. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential.

217—Pits. This map unit consists of open excavations from which most of the soil material has been removed. In many places rock, sand, gravel, or gypsum are exposed. These areas support little if any vegetation. The areas are irregular in shape and are 10 to 500 acres in size. Elevation is 350 to 1,500 feet. Slope is 0 to 5 percent.

Sand and gravel pits are mainly along the Kern River, north of Bakersfield, and north of Oildale, near the junction of James Road and California Highway 65. Most of these pits are in use and are increasing in size as the sand and gravel are excavated.

Borrow pits are widely scattered throughout the survey area. These pits have provided material ranging in texture from sand to clay loam. The material is used for building roads, for building earth dams or levees, as fill for building sites, and for farming.

Gypsum mines are mainly along Holloway Road, between California Highway 46 and Twisselman Road, northwest of Lost Hills. After the gypsum has been excavated, the quarries are very large and deep. Usually, sparse vegetation is observed within a few months.

218—Pits and dumps. These areas are sanitary landfill pits or open excavations from which the surface layer and, commonly, the underlying material have been removed, exposing either rock or other material that supports few if any plants. The Pits are being filled with solid waste in successive layers. The Dumps are smoothed or uneven piles of waste rock and general refuse that without major reclamation are incapable of supporting plants. The refuse is covered with a layer of soil material that was excavated from areas of Pits.

Areas of this unit are mainly in or near the city of Bakersfield. A large area is about 1 mile northeast of Bakersfield Junior College.

Included in this unit are small areas of Cajon loamy sand, Cuyama loam, Delano sandy loam, Kimberlina fine sandy loam, and Wasco sandy loam.

219—Polonio loam, 2 to 9 percent slopes. This deep, well drained soil is on alluvial fans. It formed in calcareous alluvium derived dominantly from sedimentary rock. The vegetation is mainly annual grasses and forbs. Elevation is 1,050 to 1,500 feet. The average annual precipitation is about 9 inches, the average annual temperature is about 61 degrees F, and the average frost-free season is 200 to 250 days.

Typically, the surface layer is brown loam about 16 inches thick. The underlying material to a depth of 60 inches or more is brown sandy clay loam.

Included in this unit are small areas of Milham sandy loam and soils that are similar to this Polonio soil but are

sandy loam. Included areas make up about 10 percent of the total acreage.

Permeability of this Polonio soil is moderately slow. Available water capacity is high or very high. Runoff is medium, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more.

This unit is used for livestock grazing.

This unit is suited to livestock grazing. It has no major limitations. Overgrazing or operating off-road vehicles on this unit causes the natural plant community to deteriorate and increases soil erosion. Proper grazing use improves water infiltration, promotes plant growth early in the season, and protects the soil from erosion. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities.

This map unit is in capability unit IVe-1 (15), nonirrigated.

220—Pottinger very shaly clay loam, 2 to 9 percent slopes. This deep, well drained soil is on alluvial fans and terraces. It formed in alluvium derived dominantly from shale. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 1,500 to 2,700 feet. The average annual precipitation is about 9 inches, the average annual temperature is about 62 degrees F, and the average frost-free season is 200 to 250 days.

Typically, the surface layer is grayish brown and brown very shaly clay loam about 23 inches thick. The underlying material to a depth of 60 inches or more is pale brown and light brownish gray very shaly clay loam. The soil is about 35 to 60 percent shale fragments. In some areas the surface layer is very shaly sandy clay loam.

Included in this unit are small areas of Aramburu very shaly clay loam and a soil that is similar to this Pottinger soil but has slopes of more than 15 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Pottinger soil is moderately slow. Available water capacity is low or moderate. Runoff is slow or medium, and the hazard of water erosion is slight or moderate. Effective rooting depth is 60 inches or more.

This unit is used mainly for dryfarmed grain. It is also used as a source of road-covering material because of the high shale content or for limited livestock grazing.

This unit is poorly suited to dryfarmed grain. It is limited mainly by low rainfall and restricted available water capacity. Because precipitation is not sufficient for annual cropping, a cropping system of grain, fallow, and then volunteer pasture is most suitable. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. All tillage should be on the contour or across the slope.

If this unit is used for livestock grazing, it has no major limitations. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage.

This map unit is in capability unit IVe-1 (15), nonirrigated.

221—Pottinger very shaly clay loam, 9 to 15 percent slopes. This deep, well drained soil is on alluvial fans and terraces. It formed in alluvium derived dominantly from shale. The vegetation in areas not cultivated is mainly grasses and forbs. Elevation is 1,700 to 3,000 feet. The average annual precipitation is about 9 inches, the average annual temperature is about 62 degrees F, and the average frost-free season is 200 to 250 days.

Typically, the surface layer is grayish brown and brown very shaly clay loam about 23 inches thick. The underlying material to a depth of 60 inches or more is pale brown and light brownish gray very shaly clay loam. The soil is about 35 to 60 percent shale fragments. In some areas the surface layer is very shaly sandy clay loam.

Included in this unit are small areas of Aramburu very shaly clay loam and Temblor very shaly clay loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Pottinger soil is moderately slow. Available water capacity is low or moderate. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

This unit is used mainly for dryfarmed grain. It is also used as a source of road-covering material because of the high shale content. Some areas are used for limited livestock grazing.

This unit is poorly suited to dryfarmed grain. It is limited mainly by low rainfall and restricted available water capacity. Because precipitation is not sufficient for annual cropping, a cropping system of grain, fallow, and then volunteer pasture is most suitable. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. All tillage should be on the contour or across the slope.

This unit is suited to livestock grazing. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce forage. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities.

This map unit is in capability unit IVe-1 (15), nonirrigated.

222—Premier coarse sandy loam, 2 to 5 percent slopes. This deep, well drained soil is on terraces. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 500 to 650 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 63 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is grayish brown and pale brown coarse sandy loam about 12 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown and brown coarse sandy loam. In some areas the surface layer is sandy loam or loam.

Included in this unit are small areas of Delano sandy loam and Zerker loam. Included areas make up about 15 percent of the total acreage.

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

Most areas of this unit are used for livestock grazing. Oil wells are common on this unit. A few areas are used for irrigated crops such as citrus fruit, almonds, and cotton and for homesite development.

This unit is suited to irrigated row and orchard crops. It is limited mainly by undulating slopes. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases the fertility and water intake rate. Growing a cover crop in nontilled areas increases the water intake rate and reduces runoff and erosion. Because of the slope, sprinkler or drip irrigation is best suited to this unit. Irrigation water needs to be applied at a rate that ensures optimum production without increasing deep percolation, runoff, and erosion.

This unit is suited to livestock grazing. It has no major limitations. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Correct placement of salt and supplemental feed helps to distribute livestock grazing and prevent overgrazing. This unit is limited for livestock watering ponds and other water impoundments because of the moderately rapid permeability of the soil.

If this unit is used for homesite development, it has few limitations. Preserving the existing plant cover during construction helps to control erosion. Plant cover can be established and maintained through proper fertilizing, seeding, mulching, and shaping of the slopes. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees.

This map unit is in capability units IIe-1 (17), irrigated, and IVe-1, nonirrigated.

223—Premier coarse sandy loam, 5 to 9 percent slopes. This deep, well drained soil is on terraces. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 500 to 700 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 63 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is grayish brown and pale brown coarse sandy loam about 12 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown and brown coarse sandy loam. In some areas the surface layer is sandy loam or loam.

Included in this unit are small areas of Delano sandy loam and Zerker loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Premier soil is moderately rapid. Available water capacity is moderate. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for livestock grazing. A few areas are used for irrigated crops such as almonds or citrus fruit. Oil wells are common on this unit.

This unit is suited to orchard crops. It is limited mainly by gently rolling slopes. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases the fertility and water intake rate. Growing a cover crop in nontilled areas increases water infiltration and reduces runoff and erosion. Because of the slope, sprinkler or drip irrigation is best suited to this unit. Irrigation water needs to be applied at a rate that ensures optimum production without increasing deep percolation, runoff, and erosion.

This unit is suited to livestock grazing. It has no major limitations. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Correct placement of salt and supplemental feed helps to distribute livestock grazing and prevent overgrazing. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

If this unit is used for homesite development, it has few limitations. Excavation for roads and buildings increases the hazard of erosion. Revegetating disturbed areas around construction sites as soon as possible helps to control erosion. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees.

The map unit is in capability units IIIe-1 (17), irrigated, and IVe-1, nonirrigated.

224—Premier coarse sandy loam, 9 to 15 percent slopes. This deep, well drained soil is on terraces. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 600 to 700 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 62 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is grayish brown and pale brown coarse sandy loam about 12 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown and brown coarse sandy loam. In some areas the surface layer is sandy loam or loam.

Included in this unit are small areas of Delano sandy loam and Zerker loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Premier soil is moderately rapid. Available water capacity is moderate. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for livestock grazing. A few areas are used for irrigated crops such as almonds or oranges. Oil wells are common on this unit.

This unit is suited to irrigated orchard crops. It is limited mainly by rolling slopes. Use of a cropping system that includes growing a cover crop, return of crop residue, and proper tillage is needed to improve soil tilth and to increase fertility and the water intake rate. Growing a cover crop in nontilled areas increases water infiltration and reduces runoff and erosion. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Because of the slope, sprinkler or drip irrigation is best suited to this unit. Irrigation water needs to be applied at a rate that ensures optimum production without increasing deep percolation, runoff, and erosion.

This unit is suited to livestock grazing. It has no major limitations. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Correct placement of salt and supplemental feed helps to distribute livestock grazing and prevent overgrazing. This unit is limited for livestock watering ponds and other impoundments because of the moderately rapid permeability of the soil.

This map unit is in capability unit IVe-1 (17), irrigated, and IVe-1, nonirrigated.

225—Premier-Durorthids association, 9 to 15 percent slopes. This map unit is on alluvial terraces. The vegetation in areas not cultivated is mainly annual grasses and forbs with scattered shrubs. Elevation is 500 to 800 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 62 degrees F, and the average frost-free season is about 250 to 300 days.

This unit is about 60 percent Premier coarse sandy loam and about 30 percent Durorthids. The Premier soils are on side slopes, and the Durorthids are on ridgetops.

Included in this unit are small areas of Delano sandy loam and a soil that is similar to this Premier soil but has a cemented layer at a shallow depth. Included areas make up about 10 percent of the total acreage.

The Premier soil is deep and well drained. It formed in alluvium derived dominantly from granitic rock. Typically, the surface layer is grayish brown and pale brown coarse sandy loam about 12 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown and brown coarse sandy loam. In some areas the surface layer is sandy loam or loam.

Permeability of the Premier soil is moderately rapid. Available water capacity is moderate. Runoff is slow, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

The Durorthids are moderately deep and well drained. They formed in alluvium derived dominantly from granitic rock. The surface layer is coarse sandy loam, sandy loam, and loam about 20 to 40 inches thick. The next layer is a lime- and silica-cemented layer about 18 to 40 inches thick. Below this to a depth of 60 inches or more is sandy loam or fine sandy loam. Gravel content throughout the profile is 0 to 15 percent.

Permeability of the Durorthids is moderately rapid. Available water capacity is low. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 20 to 40 inches.

Most areas of this unit are used for livestock grazing. A few areas are used for irrigated almonds and oranges orchards. Oil wells are common on this unit.

This unit is suited to irrigated orchard crops. The Premier soil is limited mainly by rolling slopes. The Durorthids are limited mainly by shallow depth to a cemented layer, rolling slopes, and low available water capacity. Use of a cropping system that includes growing a cover crop, return of crop residue, and proper tillage is needed to improve soil tilth and to increase the fertility and water intake rate. Growing a cover crop in nontilled areas increases water infiltration and reduces runoff and erosion. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Ripping and shattering the cemented layer in the Durorthids increases the effective rooting depth and improves internal drainage. Because of the slope, sprinkler or drip irrigation is best suited to this unit. Irrigation water needs to be applied at a rate that ensures optimum production without increasing deep percolation, runoff, and erosion.

This unit is suited to livestock grazing. It has no major limitations. If the plant cover is overgrazed, the unit becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. This unit is limited for livestock watering ponds and other water impoundments because of the moderately rapid permeability of the soil.

The Premier soil is in capability unit IVe-1 (17), irrigated, and IVe-1, nonirrigated. The Durorthids are in capability unit IVe-8 (17), irrigated, and IVe-8, nonirrigated.

226—Premier-Durorthids association, 15 to 30 percent slopes. This map unit is on alluvial terraces. It formed in alluvium derived dominantly from granitic rock. The present vegetation in most areas is mainly annual grasses and forbs with scattered shrubs. Elevation is 650 to 800 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 62 degrees F, and the average frost-free season is about 250 to 300 days.

This unit is about 55 percent Premier coarse sandy loam and about 30 percent Durorthids. The Premier soils are on side slopes, and the Durorthids are on ridgetops.

Included in this unit are small areas of Delano sandy loam and a soil that is similar to the Premier soil but has a hardpan at a shallow depth. Included areas make up about 15 percent of the total acreage.

The Premier soil is deep and well drained. It formed in alluvium derived dominantly from granitic rock. Typically, the surface layer is grayish brown and pale brown coarse sandy loam about 12 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown and brown coarse sandy loam. In some areas the surface layer is sandy loam or loam.

Permeability of the Premier soil is moderately rapid. Available water capacity is moderate. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

The Durorthids are moderately deep and well drained. They formed in alluvium derived dominantly from granitic rock. The surface layer is coarse sandy loam, sandy loam, and loam about 20 to 40 inches thick. The next layer is a lime- and silica-cemented layer about 18 to 40 inches thick. Below this to a depth of 60 inches or more is sandy loam or fine sandy loam. Gravel content throughout the profile is 0 to 15 percent.

Permeability of the Durorthids is moderately rapid. Available water capacity is low. Runoff is slow, and the hazard of water erosion is moderate. Effective rooting depth is 20 to 40 inches.

This unit is used for livestock grazing.

This unit is suited to livestock grazing. It has no major limitations. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Correct placement of salt and supplemental feed helps to distribute livestock grazing and prevent overgrazing. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. This unit is limited for livestock watering ponds and other water impoundments because of the moderately rapid permeability of the soil.

This map unit is in capability subclass VIe (17), nonirrigated.

227—Reward shaly loam, 15 to 30 percent slopes. This deep, well drained soil is on hills and mountains. It formed in residuum derived dominantly from calcareous shale or sandstone. The present vegetation in most areas is mainly annual grasses and forbs. Elevation is 1,200 to 2,500 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 61 degrees F, and the average frost-free season is 200 to 260 days.

Typically, the surface layer is grayish brown shaly loam about 24 inches thick. The upper 15 inches of the underlying material is grayish brown shaly loam, and the lower part to a depth of 60 inches or more is pale brown shaly clay loam. Below this is calcareous fractured shale. The soil is 15 to 30 percent gravel, and the content of gravel generally increases with increasing depth.

Included in this unit are small areas of Aramburu very shaly clay loam, Temblor very shaly loam, and a soil that is similar to this Reward soil but is lighter in color or has slopes of less than 15 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Reward soil is moderate. Available water capacity is low or moderate. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 40 to 60 inches or more.

This unit is used mainly for livestock grazing.

This unit is suited to livestock grazing. It has no major limitation. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Springs and seeps are present on this unit. They can be developed as watering facilities for wildlife and to achieve better livestock distribution. Oak and California juniper commonly grow on the north-facing slopes above 2,400 feet elevation. Grazing should be delayed until the soil has drained sufficiently and is firm enough to withstand trampling by livestock.

This map unit is in capability subclass VIe (15), nonirrigated.

228—Reward shaly loam, 30 to 50 percent slopes. This deep, well drained soil is on hills and mountains. It formed in residuum derived dominantly from calcareous shale or sandstone. The present vegetation in most areas is mainly annual grasses and forbs. Elevation is 2,000 to 3,800 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is 200 to 225 days.

Typically, the surface layer is grayish brown shaly loam about 24 inches thick. The upper 15 inches of the underlying material is grayish brown shaly loam, and the lower part to a depth of 60 inches or more is pale brown shaly clay loam. Below this is calcareous fractured shale. The soil is 15 to 30 percent gravel, and the content of gravel generally increases with increasing depth.

Included in this unit are small areas of Aramburu very shaly clay loam, Temblor very shaly loam, and a soil that is similar to this Reward soil but is lighter in color or has slopes of more than 50 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Reward soil is moderate. Available water capacity is low or moderate. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 40 to 60 inches or more.

This unit is used for livestock grazing.

This unit is suited to livestock grazing. It has no major limitations. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Springs and seeps are present on this unit. They can be developed as watering facilities for wildlife and to achieve better livestock distribution. Oak and California juniper commonly grow on the north-facing slopes above 2,400 feet elevation. Woody species should be retained in the drainageways and in the steeper areas to reduce erosion. Livestock grazing should be managed to protect the soil from erosion.

This map unit is in capability subclass VIe (15), nonirrigated.

229—Riverwash. Riverwash consists of areas of sand and gravel that are adjacent to or occur as islands within the Kern River and small intermittent streams. During periods when the water level is normal, parts of these areas are inundated. Under flood conditions, nearly all of these areas are flooded. At present, however, floods on the Kern River generally are controlled by a large dam.

Riverwash supports little if any vegetation, but in places there are a few scattered annual grasses, forbs, and willows and some brushy plants. This unit has limited value for livestock grazing and has no value for farming. The unit has its greatest value as recreational sites and as a source of aggregate material for roadbuilding or general construction.

This map unit is in capability subclass VIIIw (17).

230—Rock outcrop-Lodo Variant complex, 15 to 50 percent slopes. This map unit is on hills and mountains. The present vegetation in most areas is mainly annual grasses and forbs. Elevation is 1,400 to 2,400 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is about 225 to 275 days.

This unit is about 40 percent Rock outcrop and about 35 percent Lodo Variant clay loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Los Osos Variant clay loam, Hillbrick loam, and a soil that is similar to this Lodo Variant soil but has slopes of less than 15 percent. Included areas make up about 25 percent of the total acreage.

Rock outcrop consists of exposures of hard sandstone or shale 5 to 300 feet wide. The vegetation is limited to the fractures in the rock. Runoff is very rapid.

The Lodo Variant soil is shallow and somewhat excessively drained. It formed in residuum derived dominantly from shale or sandstone. Typically, the soil is grayish brown clay loam about 9 inches deep over hard shale.

Permeability of the Lodo Variant soil is moderate. Available water capacity is very low or low. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 6 to 20 inches.

This unit is used for limited livestock grazing, watershed, and wildlife habitat.

This unit is poorly suited to livestock grazing. The production of forage on the Lodo Variant soil is limited by low available water capacity and shallow depth to bedrock. Rock outcrop has little if any value for grazing. Livestock grazing should be managed to protect the unit from erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. Correct placement of salt and supplemental feed helps to distribute livestock grazing and prevent overgrazing.

This map unit is in capability subclass VIIe (15), nonirrigated.

231—Rock outcrop-Lodo Variant complex, 50 to 75 percent slopes. This map unit is on hills and mountains. The present vegetation in most areas is mainly annual grasses, forbs, and some shrubs. Elevation is 1,400 to 2,400 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 60 degrees F, and the average frost-free period is about 225 to 275 days.

This unit is 40 percent Rock outcrop and 35 percent Lodo Variant clay loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Los Osos Variant clay loam and Hillbrick loam. Included areas make up about 25 percent of the total acreage.

Rock outcrop consists of exposures of hard sandstone or shale 5 to 300 feet wide. The vegetation is limited to the fractures in the rock. Runoff is very rapid.

The Lodo Variant soil is shallow and somewhat excessively drained. It formed in residuum derived dominantly from sandstone or shale. Typically, the soil is grayish brown clay loam about 9 inches deep over hard shale.

Permeability of the Lodo Variant soil is moderate. Available water capacity is very low or low. Runoff is rapid, and the hazard of water erosion is very high. Effective rooting depth is 6 to 20 inches.

This unit is used as limited rangeland, watershed, and wildlife habitat.

This unit is poorly suited to livestock grazing. The production of forage on the Lodo Variant soil is limited by very restricted available water capacity and shallow depth to bedrock. Rock outcrop has little if any value for grazing. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. Livestock grazing should be managed to protect the unit from erosion. Correct placement of salt and supplemental feed helps to distribute livestock grazing and prevent overgrazing.

This map unit is in capability subclass VIIe (15), nonirrigated.

232—Torriorthents, stratified, eroded-Elkhills complex, 9 to 50 percent slopes. This map unit is in areas of uplifted, dissected valley fill and on hills. Torriorthents support little if any vegetation. The Elkhills soil supports a uniform plant cover of annual grasses, forbs, and scattered shrubs. Elevation is 400 to 1,400 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 63 degrees F, and the average frost-free season is 240 to 300 days.

This unit is 50 percent Torriorthents, stratified, eroded, and 30 percent Elkhills sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of sandy soils that are mainly on hilltops and in drainageways; soils that have strongly cemented layers exposed on the side slopes of hills; and disturbed, eroded soils that have an exposed subsurface layer. Included areas make up about 20 percent of the total acreage.

The Torriorthents are deep and well drained. They formed in alluvium derived dominantly from sedimentary and granitic rock. The surface layer ranges from loamy sand to silt loam. The next layer is stratified silt loam to clay over stratified gravelly sand to silty clay loam. Many areas are saline-alkali.

Permeability of the Torriorthents is moderate to slow. Available water capacity is moderate to high. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 60 inches or more. Roadbuilding, petroleum construction activities, and sheep grazing have disturbed the vegetation and surface layer in some areas of this unit. These activities have exposed highly erodible soil material and increased the risk of erosion. Recently eroded soil material has accumulated in drainageways. Erosion is more extensive on some south-facing slopes. In some areas erosion has exposed fine textured material that is high in content of salt.

The Elkhills soil is deep and well drained. It formed in alluvium derived dominantly from sedimentary and granitic rock. The surface layer is pale brown sandy loam about 7 inches thick. The subsurface layer is light yellowish brown fine sandy loam about 22 inches thick. The upper 20 inches of the underlying material is very pale brown coarse sandy loam, and the lower part to a depth of 65 inches or more is light gray, stratified gravelly coarse sand, sand, and loamy sand. In some areas the surface layer is coarse sandy loam, gravelly sandy loam, or loam.

Permeability of the Elkhills soil is moderately rapid. Available water capacity is moderate. Runoff is medium or rapid, and the hazard of water erosion is moderate or high. Effective rooting depth is 60 inches or more.

Some areas of this unit are used for livestock grazing. Oil wells are common on the unit.

This unit is poorly suited to livestock grazing. The production of forage on the Torriorthents is limited by low rainfall, the hazard of erosion, and salt content. Production on the Elkhills soil is limited by low rainfall. Overgrazing or operating off-road vehicles on this unit causes the plant community to deteriorate and increases soil erosion. Reestablishing plant cover is difficult, especially if the surface layer has been lost through erosion and exposed fine textured soil material that is high in content of salts. In some areas it may be necessary to replace the surface layer in order for revegetation to be successful. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Livestock grazing should be managed to protect the unit from erosion. Removal of plant cover results in extensive erosion.

This map unit is in capability subclass VIIe (17), nonirrigated.

233—Twisselman sandy loam, saline-alkali, 0 to 2 percent slopes. This deep, well drained soil is on alluvial fans and basin rims. It formed in alluvium derived dominantly from sedimentary rock. The vegetation in areas not cultivated is mainly annual grasses, forbs, and salt tolerant shrubs. Elevation is 210 to 300 feet. The average annual precipitation is about 5 inches, the average annual temperature is about 66 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is light brownish gray sandy loam about 8 inches thick. The underlying material to a depth of 60 inches or more is very pale brown clay. The soil is strongly saline-alkali. In some areas the surface layer is fine sandy loam or loam.

Included in this unit are small areas of Twisselman clay, Twisselman clay that is saline-alkali, Panoche clay loam that is saline-alkali, and Lethent silt loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Twisselman soil is very slow. Available water capacity is low. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth

is 60 inches or more. Toxic levels of boron are present in places.

This unit is used for livestock grazing. It is also used for irrigated crops after the soil has been reclaimed.

This unit is suited to irrigated row and field crops that are salt tolerant. It is limited mainly by the saline-alkali condition of the soil and the very slow permeability of the underlying material. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases the fertility and water intake rate. Salt tolerant crops can be grown if the salt content is reduced by leaching. Subsoiling helps to open up the soil and thus facilitates leaching. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Intensive management is required to reduce the salinity and maintain soil productivity. Furrow, border, and sprinkler irrigation systems are suited to this unit. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. For the optimum production of crops, water should be applied in amounts sufficient to leach the salts from the root zone but at a rate that will not cause excessive runoff. Tile or open drains can be used to remove excess water and provide an outlet for leached salts.

This unit is poorly suited to livestock grazing. The production of vegetation forage is limited by low rainfall and the saline-alkali condition of the soil. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. This unit supports salt tolerant plants.

The map unit is in capability unit IIIs-6 (17), irrigated, and capability subclass VIIs, nonirrigated.

234—Twisselman sandy loam, saline-alkali, moderately wet, 0 to 2 percent slopes. This deep, well drained soil is on alluvial fans and basin rims. The drainage has been altered by seepage resulting from extensive irrigation within the area. This soil formed in alluvium derived dominantly from sedimentary rock. The vegetation in areas not cultivated is mainly salt tolerant grasses and forbs. Elevation is 210 to 300 feet. The average annual precipitation is about 5 inches, the average annual temperature is about 66 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is light brownish gray sandy loam about 8 inches thick. The underlying material to a depth of 60 inches or more is very pale brown clay. The soil is moderately to strongly saline-alkali. In some areas the surface layer is fine sandy loam or loam.

Included in this unit are small areas of Panoche clay loam that is saline-alkali, Lethent silt loam, and Twisselman clay that is saline-alkali. Included areas make up about 15 percent of the total acreage.

Permeability of this Twisselman soil is very slow. Available water capacity is low. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is limited by a high water table that is at a depth of 3 to 6 feet. Toxic levels of boron are present in places.

Most areas of this unit are used for irrigated crops after the soil has been reclaimed. A few areas are used for livestock grazing.

This unit is suited to irrigated row and field crops that are salt tolerant. It is limited mainly by the high water table, the saline-alkali condition of the soil, and very slow permeability. Use of a cropping system that includes growing a cover crop, return of crop residue, and proper tillage is needed to improve soil tilth and to increase the fertility and water intake rate. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Subsoiling opens up the soil and allows water and salts to pass through. The amount of salts present, the crops planted, and the reclamation procedures used all affect the yield of crops on this unit. Furrow, border, or sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Irrigation water management is very important. Excess irrigation water can cause the water table to rise nearer to the surface. Crops that require good drainage can be grown if a properly designed tile drainage system is installed.

This unit is poorly suited to livestock grazing. The production of forage is limited by low rainfall and the saline-alkali condition of the soil. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. This unit supports salt tolerant plants.

This map unit is in capability unit IIIw-3 (17), irrigated, and capability subclass VIIw, nonirrigated.

235—Twisselman clay, 0 to 2 percent slopes. This deep, well drained soil is on alluvial fans. It formed in alluvium derived dominantly from sedimentary rock. The vegetation in areas not cultivated is mainly annual grasses, forbs, and salt tolerant shrubs. Elevation is 240 to 1,000 feet. The average annual precipitation is about 5 inches, the average annual temperature is about 65 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is light brownish gray and pale brown clay about 14 inches thick. The upper 37 inches of the underlying material is brown and very pale brown clay, and the lower part to a depth of 60 inches or more is brown silty clay. In some areas the surface layer is silty clay.

Included in this unit are small areas of Panoche clay loam, Yribarren loam, Milham sandy loam, and

Twisselman clay that is saline-alkali. Included areas make up about 15 percent of the total acreage.

Permeability of this Twisselman soil is slow. Available water capacity is high. Runoff is slow, and the hazard of erosion is slight. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for irrigated crops, mainly alfalfa, almonds, cotton, and barley. Among the other crops grown are sugar beets and grapes. Some areas are used for livestock grazing.

This unit is suited to irrigated crops. It is limited mainly by the slow permeability of the soil. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases the fertility and water intake rate. Crusting of the surface and compaction of the soil can be reduced by returning crop residue to the soil and by using minimum tillage. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Water needs to be applied at a slow rate over a long period to ensure that the root zone is properly wetted. For the efficient application and removal of irrigation water, leveling is needed in sloping areas.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall. Grazing should be delayed until the soil has drained sufficiently and is firm enough to withstand trampling by livestock. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities.

The map unit is in capability unit IIs-5 (17), irrigated, and capability subclass VIIs, nonirrigated.

236—Twisselman clay, 2 to 5 percent slopes. This deep, well drained soil is on alluvial fans. It formed in alluvium derived dominantly from sedimentary rock. The vegetation in areas not cultivated is mainly annual grasses, forbs, and salt tolerant shrubs. Elevation is 350 to 900 feet. The average annual precipitation is about 5 inches, the average annual temperature is about 65 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is light brownish gray and pale brown clay about 14 inches thick. The upper 37 inches of the underlying material is brown and very pale brown clay, and the lower part to a depth of 60 inches or more is brown silty clay. In some areas the surface layer is silty clay.

Included in this unit are small areas of Panoche clay loam, Yribarren loam, and Milham sandy loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Twisselman soil is slow. Available water capacity is high. Runoff is medium, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for irrigated crops. Among the crops grown are mainly alfalfa, cotton, almonds, and pistachios. Some areas are used for livestock grazing.

This unit is suited to irrigated crops. It is limited mainly by slow permeability and slope. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases the fertility and water intake rate. Crusting of the surface and compaction of the soil can be reduced by returning crop residue to the soil and using minimum tillage. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Water needs to be applied at a slow rate over a long period to ensure that the root zone is properly wetted. For the efficient application and removal of irrigation water, leveling is needed in sloping areas.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall. Grazing should be delayed until the soil has drained sufficiently and is firm enough to withstand trampling by livestock. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities.

This map unit is in capability unit IIe-1 (17), irrigated, and capability subclass VIIe, nonirrigated.

237—Twisselman clay, saline-alkali, 0 to 2 percent slopes. This deep, well drained soil is on basin rims. It formed in alluvium derived dominantly from sedimentary rock. The vegetation in areas not cultivated is mainly annual grasses and salt tolerant shrubs. Elevation is 210 to 300 feet. The average annual precipitation is about 5 inches, the average annual temperature is about 66 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is pale brown clay about 9 inches thick. The underlying material to a depth of 60 inches or more is yellowish brown silty clay. This soil is moderately to strongly saline-alkali.

Included in this unit are small areas of Lethent silt loam, Panoche clay loam that is saline-alkali, and Twisselman clay. Included areas make up about 15 percent of the total acreage.

Permeability of this Twisselman soil is very slow. Available water capacity is very low or low. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more. Toxic levels of boron are present in places.

This unit is used mainly for livestock grazing. It is also used for irrigated crops after the soil has been reclaimed.

This unit is suited to irrigated row and field crops that are salt tolerant. It is limited mainly by the saline-alkali condition of the soil and very slow permeability. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases the fertility and water intake rate. Salt tolerant crops can be grown if the salt content is reduced by leaching. Subsoiling helps to open up the soil and thus facilitates leaching. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Intensive management is required to reduce the salinity and maintain soil productivity. Furrow, border, and sprinkler irrigation systems are suited to this unit. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. For the optimum production of crops, water should be applied in amounts sufficient to leach the salts from the root zone but at a rate that will not cause excessive runoff. Tile or open drains can be used to remove excess water and provide an outlet for leached salts.

This unit is poorly suited to livestock grazing. The production of forage is limited by low rainfall and the saline-alkali condition of the soil. Only salt tolerant plants are suited to this unit. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. This unit supports salt tolerant plants.

This map unit is in capability unit IIIs-6 (17), irrigated, and capability subclass VIIs, nonirrigated.

238—Twisselman clay, saline-alkali, moderately wet, 0 to 2 percent slopes. This deep, well drained soil is on basin rims. The drainage has been altered by seepage resulting from extensive irrigation within the area. The soil formed in alluvium derived dominantly from sedimentary rock. Elevation is 210 to 300 feet. The average annual precipitation is about 5 inches, the average annual temperature is about 66 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is pale brown clay about 9 inches thick. The underlying material to a depth of 60 inches or more is yellowish brown silty clay. The soil is moderately to strongly saline-alkali.

Included in this unit are small areas of Panoche clay loam that is saline-alkali, Lethent silt loam, and Twisselman clay. Included areas make up about 15 percent of the total acreage.

Permeability of this Twisselman soil is very slow. Available water capacity is very low or low. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is limited by a seasonal high water table that is at a depth of 3 to 6 feet. Toxic levels of boron are present in places.

This unit is used mainly for livestock grazing. It is also used for irrigated crops after the soil has been reclaimed.

This unit is suited to irrigated row and field crops that are salt tolerant. It is limited mainly by the high water table, the saline-alkali condition of the soil, and very slow permeability. Use of a cropping system that includes growing a cover crop, return of crop residue, and proper tillage is needed to improve soil tilth and to increase the fertility and water intake rate. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Subsoiling opens up the soil and allows water and salts to pass through. The amount of salts present, the crops planted, and the reclamation procedures used all affect the yield of crops on this unit. Furrow, border, or sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Irrigation water management is very important. Excess irrigation water can cause the water table to rise nearer to the surface. Tile or open drains can be used to remove excess water and toxic salts if a suitable outlet is available. Most climatically adapted crops can be grown if artificial drainage is provided.

This unit is poorly suited to livestock grazing. The production of forage is limited by low rainfall and the saline-alkali condition of the soil. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. This unit supports salt tolerant plants.

This map unit is in capability unit IIIw-6 (17), irrigated, and capability subclass VIIw, nonirrigated.

239—Typic Gypsiorthids-Kimberlina association, 0 to 5 percent slopes. This map unit is on alluvial fans and plains. The present vegetation in most areas is mainly annual grasses, forbs, and scattered shrubs. Elevation is 425 to 490 feet. The average annual precipitation is about 5 inches, the average annual temperature is about 65 degrees F, and the average frost-free season is 250 to 300 days.

This unit is 40 percent Typic Gypsiorthids and 40 percent Kimberlina sandy loam. The Kimberlina soil is in drainageways, and the Typic Gypsiorthids are on hilltops and hillsides.

Included in this unit are small areas of Milham sandy loam and Yribarren clay loam. Also included are small areas of soils that are similar to the Typic Gypsiorthids but have a hard, cemented gypsum layer at a depth of about 12 inches. Included areas make up about 20 percent of the total acreage.

The Typic Gypsiorthids are deep and well drained. They formed in alluvium derived dominantly from

sedimentary rock. These soils have a surface layer of pale brown sandy loam about 12 inches thick. The underlying material is white, very pale brown and yellowish brown sandy loam to loam to a depth of 60 inches or more. The underlying material is about 50 percent gypsum.

Permeability of the Typic Gypsiorthids is moderate or moderately rapid. Available water capacity is moderate. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more. The high content of gypsum may restrict the growth of some plants.

The Kimberlina soil is deep and well drained. It formed in alluvium derived dominantly from granitic and sedimentary rock. Typically, the surface layer is brown sandy loam about 9 inches thick. The upper 36 inches of the underlying material is pale brown sandy loam, and the lower part to a depth of 60 inches or more is pale brown silt loam.

Permeability of the Kimberlina soil is moderate. Available water capacity is moderate to high. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for mining gravel or gypsum. A few areas are used for livestock grazing. Oil wells are common on this unit.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall. Because of the low rainfall, forage production is low in most years. If the plant cover is overgrazed, the soil becomes more susceptible to erosion. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Livestock grazing should be managed to protect the unit from erosion.

This map unit is in capability unit IIe-1 (17), irrigated, and capability subclass VIIe, nonirrigated.

240—Urban land. This map unit consists of areas covered by asphalt, concrete, buildings, or other impervious surfaces. Examples are parking lots, shopping and business centers, and industrial parks. These areas are mainly located near the downtown business district in the city of Bakersfield.

Included in this unit are small areas of soils that are similar to the Kimberlina fine sandy loam, Cajon loamy sand, and Wasco sandy loam that have either been cut or filled for foundations, roads, buildings, or other structures. Included areas make up about 5 percent of the total acreage.

Examination and identification of soils or soil like material in this unit are impractical.

241—Vaquero and Altamont clays, 15 to 50 percent slopes. This map unit is on hills and mountains. The native vegetation is mainly annual grasses and forbs. Elevation is 1,250 to 2,000 feet. The average annual precipitation is about 12 inches, the average annual temperature is 60 degrees F, and the average frost-free season is 200 to 240 days.

This unit is 45 percent Vaquero clay and 40 percent Altamont clay. The percentage varies from one area to another.

Included in this unit are small areas of Aido clay, Altamont clay, and Vaquero clay that have slopes of more than 50 percent. Also included are small areas of Hillbrick loam and Rock outcrop. Included areas make up about 15 percent of the total acreage.

The Vaquero soil is moderately deep and well drained. It formed in residuum derived dominantly from shale. Typically, the surface layer is yellowish brown and brown clay about 17 inches thick. The underlying material to a depth of 36 inches is brown, and variegated brown, brownish yellow, and yellowish brown clay. Variegated yellowish brown, brownish yellow, and gray, highly fractured shale is at a depth of 36 inches. This soil is alkali below a depth of 17 inches.

Permeability of the Vaquero soil is slow. Available water capacity is low or moderate. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 20 to 40 inches.

The Altamont soil is deep and well drained. It formed in residuum derived dominantly from sandstone or shale. Typically, the surface layer is grayish brown and dark grayish brown clay about 31 inches thick. The underlying material to a depth of 55 inches is yellowish brown clay. Variegated pale yellow and strong brown, weathered sandstone is at a depth of 55 inches.

Permeability of the Altamont soil is slow. Available water capacity is moderate or high. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 40 to 55 inches.

This unit is used for livestock grazing, wildlife habitat, and watershed.

This unit is suited to livestock grazing. The production of forage is limited by the risk of landslides on the steeper slopes. This unit is difficult to fence. Excessive shrinking and swelling of the soils cause fenceposts to be lifted out of the ground. Livestock grazing should be managed to protect the unit from erosion. Grazing should be delayed until the soil has drained sufficiently and is firm enough to withstand trampling by livestock. Correct placement of salt and supplemental feed helps to distribute livestock grazing and prevent overgrazing. Watering troughs and tanks should be provided for livestock because of the limited supply of water.

This map unit is in capability subclass VIe (15), nonirrigated.

242—Vaquero and Altamont clays, 50 to 75 percent slopes. This map unit is on hills and mountains. The native vegetation is mainly annual grasses and

forbs. Elevation is 1,300 to 2,300 feet. The average annual precipitation is about 12 inches, the average annual temperature is about 60 degrees F, and the average frost-free season is 200 to 240 days.

This unit is 45 percent Vaquero clay and 40 percent Altamont clay. The percentage varies from one area to another.

Included in this unit are small areas of Altamont clay and Vaquero clay that have slopes of less than 50 percent and Hillbrick loam. Also included are small areas of Aido clay and Rock outcrop. Included areas make up about 15 percent of the total acreage.

The Vaquero soil is moderately deep and well drained. It formed in residuum derived dominantly from shale. Typically, the surface layer is yellowish brown and brown clay about 17 inches thick. The underlying material to a depth of 36 inches is brown and variegated brown, brownish yellow and yellowish brown clay. Variegated brown, yellowish brown, brownish yellow, and gray, highly fractured shale is at a depth of 36 inches. This soil is alkali below a depth of 17 inches.

Permeability of the Vaquero soil is slow. Available water capacity is low or moderate. Runoff is rapid, and the hazard of water erosion is high or very high. Effective rooting depth is 20 to 40 inches.

The Altamont soil is deep and well drained. It formed in residuum derived dominantly from sandstone or shale. Typically, the surface layer is grayish brown and dark grayish brown clay about 31 inches thick. The underlying material to a depth of 55 inches is yellowish brown clay. Variegated pale yellow and strong brown, weathered sandstone is at a depth of 55 inches.

Permeability of the Altamont soil is slow. Available water capacity is moderate or high. Runoff is rapid, and the hazard of water erosion is high or very high. Effective rooting depth is 40 to 55 inches.

This unit is used for livestock grazing, wildlife habitat, and watershed.

This unit is poorly suited to livestock grazing. The production of forage is limited by the risk of landslides. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. This unit is difficult to fence. Excessive shrinking and swelling of the soils cause fenceposts to be lifted out of the ground. Livestock grazing should be managed to protect the unit from erosion. Grazing should be delayed until the soil has drained sufficiently and is firm enough to withstand trampling by livestock. Correct placement of salt and supplemental feed helps to distribute livestock grazing and prevent overgrazing. Watering troughs and tanks should be provided for livestock because of the limited supply of water.

This map unit is in capability subclass VIIe (15), nonirrigated.

243—Wasco sandy loam. This deep, well drained soil is on recent alluvial fans and flood plains. It formed in alluvium derived dominantly from granitic rock. Slope is 0 to 2 percent. Before this unit was cultivated, the vegetation was annual grasses, forbs, and scattered shrubs. Elevation is 250 to 500 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is brown and yellowish brown sandy loam about 15 inches thick. The underlying material to a depth of 60 inches or more is brown and pale brown sandy loam. In some areas the surface layer is fine sandy loam.

Included in this unit are small areas of Kimberlina fine sandy loam, Milham sandy loam, Panoche clay loam, and Lewkalb sandy loam. Included areas make up about 20 percent of the total acreage.

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

Most areas of this unit are used for a wide variety of irrigated crops, mainly cotton, alfalfa, grapes, potatoes, onions, almonds, pistachios, sugar beets, walnuts, and blackeye beans. Some areas are used for specialty crops, ornamentals, and homesite development.

This unit is suited to irrigated crops. It has few limitations. A cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases the fertility and water intake rate. Maintaining crop residue on or near the surface reduces runoff and helps to maintain soil tilth and organic matter content. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

If this unit Wasco soil is used for homesite development, the main limitation is rare periods of flooding. Flooding can be controlled only by use of major flood control structures. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability unit IIs-4 (17), irrigated, and capability subclass VIIs, nonirrigated.

244—Wasco fine sandy loam. This deep, well drained soil is on recent alluvial fans and flood plains. It formed in alluvium derived dominantly from granitic rock. Slope is 0 to 2 percent. Before this soil was cultivated, the vegetation was annual grasses, forbs, and scattered shrubs. Elevation is 300 to 400 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 65 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is brown fine sandy loam about 30 inches thick. The underlying material to a depth of 60 inches or more is yellowish brown sandy loam and fine sandy loam. In some areas the surface layer is sandy loam.

Included in this unit are small areas of Kimberlina fine sandy loam and Cajon loamy sand. Included areas make up about 10 percent of the total acreage.

Permeability of this Wasco soil is moderately rapid. Available water capacity is high. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for irrigated crops, mainly cotton, alfalfa, sugar beets, and grapes. Among the other crops grown are almonds and pistachios. Oil wells are common on this unit.

This unit is suited to irrigated crops. It has few limitations. A cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage is needed to improve soil tilth and to increase the fertility and water intake rate. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Water should be applied in amounts sufficient to wet the root zone but in amounts small enough to minimize the leaching of plant nutrients.

This map unit is in capability class I (17), irrigated, and capability subclass VIIc, nonirrigated.

245—Westhaven fine sandy loam. This deep, moderately well drained soil is on flood plains and alluvial fans. It formed in alluvium derived dominantly from granitic rock. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly annual grasses and forbs. Elevation is 200 to 400 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 64 degrees F, and the average frost-free season is 260 to 300 days.

Typically, the surface layer is light brownish gray fine sandy loam about 11 inches thick. The upper 17 inches of the underlying material is pale brown silt loam, and the lower part to a depth of 61 inches is brown clay and white clay loam. In some areas the surface layer is loamy fine sand or silt loam.

Included in this unit are small areas of Cajon loamy sand, Lokern clay, Lerdo clay loam, and Kimberlina fine sandy loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Westhaven soil is moderately slow. Available water capacity is high or very high. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more.

Most of this unit are used for irrigated crops, mainly cotton, alfalfa, and sugar beets. Some areas are used for duck ponds.

This unit is suited to irrigated crops. It has few limitations. A cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases the fertility and water intake rate. Maintaining crop residue on or near the surface reduces runoff and helps to maintain soil tilth and organic matter content. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

This map unit is in capability class I (17), irrigated, and capability subclass VIIc, nonirrigated.

246—Whitewolf coarse sandy loam. This deep, somewhat excessively drained soil is on flood plains and alluvial fans. It formed in alluvium derived dominantly from granitic rock. Slope is 0 to 2 percent. The native vegetation is mainly annual grasses and forbs. Elevation is 400 to 700 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 65 degrees F, and the average frost-free season is 200 to 250 days.

Typically, the surface layer is brown coarse sandy loam about 11 inches thick. The upper 32 inches of the underlying material is pale brown loamy sand, and the lower part to a depth of 65 inches is pale brown loamy coarse sand and coarse sand. In some areas the surface layer is loamy sand or sandy loam.

Included in this unit are small areas of Hesperia sandy loam and Cajon loamy sand. Included areas make up about 10 percent of the total acreage.

Permeability of this Whitewolf soil is rapid. Available water capacity is low. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for irrigated crops, mainly grapes. Among the other crops grown are cotton, onions, and potatoes.

This unit is suited to irrigated crops. It is limited mainly by the rapid permeability and low available water capacity of the soil. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth, reduces crusting, and increases the fertility and water intake rate. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because the water intake rate is rapid, sprinkler irrigation is best suited to this unit. If furrow irrigation is used, water should be applied at frequent intervals and runs should be short. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

This map unit is in capability unit IIIs-4 (17), irrigated, and capability subclass VIIs, nonirrigated.

247—Xeralfs, loamy. This deep, well drained soil is on uplifted terraces. It formed in alluvium derived dominantly from shale. Slope is 2 to 5 percent. The present vegetation in most areas is mainly annual grasses and forbs. Elevation is 2,000 to 2,600 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 61 degrees F, and the average frost-free season is 200 to 250 days.

The surface layer is brown and grayish brown loam to clay loam about 6 inches thick. The upper 14 inches of the subsoil is brown loam. The lower 20 inches is light yellowish brown loam to very pale brown clay loam. The substratum to a depth of 60 inches or more is white and brown sandy loam to loam. The soil has about 5 to 15 percent gravel. In some areas the surface layer is silty clay loam.

Included in this unit are small areas of soils that are similar to these Xeralfs but are lighter in color and have a sandy subsoil. Gullies are present in some areas. Included areas make up about 10 percent of the total acreage.

Permeability of the Xeralfs is moderate or moderately slow. Available water capacity is moderate or high. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

This unit is used for livestock grazing and dryfarmed grain.

This unit is suited to dryfarmed grain. It is limited mainly by low rainfall. Plants that tolerate drought are best suited because the available moisture is not adequate for good growth of most other plants.

This unit is suited to livestock grazing. It has no major limitations. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. Proper grazing use is essential. Leaving an adequate plant cover helps to control erosion and promotes the production of forage.

This map unit is in capability unit IVe-1 (15), nonirrigated.

248—Xeric Torriorthents, stratified-Cuyama complex, 15 to 50 percent slopes. This map unit is on dissected alluvial fans and stream terraces. The present vegetation in most areas is mainly annual grasses and forbs. Elevation is 425 to 1,000 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 65 degrees F, and the average frost-free season is 275 to 325 days.

This unit is 60 percent Xeric Torriorthents and 20 percent Cuyama loam. The Xeric Torriorthents are on the steeper slopes that have been changed by deposition or erosion. The Cuyama soils have slopes of less than 30 percent. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Chanac clay loam, Delano sandy loam, and Elkhills sandy loam. Also included are small areas of soils that have been used for gravel exploration and soils that are cobbly throughout the profile. Included areas make up about 20 percent of the total acreage.

The Xeric Torriorthents are deep and well drained. They formed in alluvium derived dominantly from granitic rock. The surface layer ranges from loamy sand to loam. The next layer is stratified loamy sand to silt loam over stratified sand to silty clay loam. These soils are 5 to 40 percent gravel and 5 to 30 percent cobbles.

Permeability of the Xeric Torriorthents is moderately slow to rapid. Available water capacity is low to high. Runoff is rapid, and the hazard of water erosion is high. Effective rooting depth is 60 inches or more.

The Cuyama soil is deep and well drained. It formed in alluvium derived dominantly from granitic rock. Typically, the surface layer is pale brown and light yellowish brown loam about 8 inches thick. The upper 10 inches of the subsoil is yellowish brown loam, and the lower 18 inches is reddish yellow gravelly clay loam. The upper 20 inches of the substratum is yellow very cobbly sandy clay loam, and the lower part to a depth of 65 inches is yellow sandy clay loam. In some areas the surface layer is sandy loam or coarse sandy loam.

Permeability of this Cuyama soil is moderately slow. Available water capacity is moderate or high. Runoff is medium, and the hazard of water erosion is high. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for livestock grazing. A few areas are used for homesite development.

This unit is suited to livestock grazing. It has a few limitations. The main limitations are steepness of slope and susceptibility to erosion when the soil surface is disturbed. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities. Overgrazing or operating off-road vehicles on this unit causes the natural plant community to deteriorate and increases soil erosion. Grazing should be delayed until the soil has drained sufficiently and is firm enough to withstand trampling by livestock.

If this unit is used for homesite development, the main limitations are steepness of slope, moderate shrink-swell potential, and the very cobbly substratum. Erosion is a hazard in the steeper areas. Only the part of the site that is used for construction should be disturbed. Preserving the existing plant cover during construction helps to control erosion. Access roads should be designed to provide adequate cut-slope grade. Drains are needed to control surface runoff and keep soil losses to a minimum. Removal of gravel in disturbed areas is

needed for best results when landscaping, particularly in areas used for lawns. Buildings and roads should be designed to offset the limited ability of the soils in this unit to support a load. Septic tank absorption fields do not function properly during rainy periods because of wetness and the moderately slow permeability. The limitation of moderately slow permeability can be overcome by increasing the size of the absorption field. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential.

This map unit is in capability subclass VIIe (17), nonirrigated.

249—Xerofluvents, loamy. These deep, well drained soils are on flood plains. They formed in alluvium derived dominantly from sedimentary rock. Slope is 0 to 2 percent. The present vegetation in most areas is mainly annual grasses, forbs, and scattered junipers. Elevation is 1,500 to 2,000 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 63 degrees F, and the average frost-free season is 200 to 260 days.

The surface layer is pale brown and grayish brown sandy loam to clay loam about 15 inches thick. The underlying material to a depth of 60 inches or more is pale brown, light yellowish brown, and grayish brown fine sandy loam to very shaly or very gravelly clay loam. The content of gravel ranges from about 10 to 35 percent.

Included in this unit are small areas of Kilmer loam and Mendi loam. Included areas make up about 20 percent of the total acreage.

Permeability of these soils is moderately rapid or moderate. Available water capacity is slight. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more.

This unit is used mainly as watershed and wildlife habitat. It is also used for livestock grazing.

This unit is poorly suited to livestock grazing. The production of forage is limited by low rainfall. Because of low rainfall, forage production is low in most years. If the plant cover is disturbed, protection from flooding is needed to control gullying, streambank cutting, and sheet erosion. Livestock grazing should be managed to protect the unit from erosion.

This map unit is in capability unit IVe-1 (15), nonirrigated.

250—Xerorthents, very gravelly, 50 to 75 percent slopes. These deep, somewhat excessively well drained soils are on hills and mountains. They formed in residuum derived dominantly from shale. The present vegetation in most areas is mainly annual grasses and forbs with scattered junipers and oaks. Elevation is 2,000 to 3,000 feet. The average annual precipitation is about 10 inches, the average annual temperature is about 59 degrees F, and the average frost-free season is 200 to 250 days.

The surface layer is pale brown and dark grayish brown very shaly coarse sandy loam about 2 inches thick. The underlying material is pale brown and dark brown very shaly loam to very shaly clay loam about 40 inches thick over hard, noncalcareous shale. These soils are about 40 to 50 percent shale fragments.

Included in this unit are small areas of Hillbrick sandy loam, Aido clay, and Ayar silty clay. Included areas make up about 15 percent of the total acreage.

Permeability of these Xerorthents is moderately rapid or rapid. Available water capacity is very low or low. Runoff is very rapid, and the hazard of water erosion is very high. Effective rooting depth is 40 to 60 inches.

This unit is used for wildlife habitat and livestock grazing.

This unit is poorly suited to livestock grazing. The production of forage is limited by the restricted available water capacity. Livestock grazing should be managed to protect the unit from erosion. Mechanical treatment is not practical because of the stony surface layer and the steepness of slope. If the plant cover is overgrazed, the soil becomes more susceptible to erosion.

This map unit is in capability subclass VIIe (15), nonirrigated.

251—Yribarren loam, 0 to 2 percent slopes. This deep, well drained soil is on alluvial fans and plains. It formed in alluvium derived dominantly from sedimentary rock. The vegetation in areas not cultivated is mainly annual grasses, forbs, and shrubs. Elevation is 300 to 1,100 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 65 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is pale brown loam about 7 inches thick. The subsoil is pale brown and light yellowish brown silty clay about 12 inches thick. The upper 3 inches of the substratum is pale brown loam, and the lower part to a depth of 60 inches or more is stratified, very pale brown silty clay. The soil is slightly saline-alkali and contains gypsum crystals below a depth of 15 inches. In some areas the surface layer is clay loam.

Included in this unit are small areas of Milham sandy loam and Twisselman clay. Included areas make up about 15 percent of the total acreage.

Permeability of this Yribarren soil is very slow. Available water capacity is low to high. Runoff is very slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more. Toxic levels of boron are present in places. Some pedons do not have gypsum crystals in the subsoil.

Most areas of this unit are used for irrigated crops, mainly cotton, barley, alfalfa, and sugar beets. A few areas are used for limited livestock grazing.

This unit is suited to irrigated crops. It is limited mainly by the very slow permeability and saline-alkali condition of the soil. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases the fertility and water intake rate. Salt tolerant crops should be grown while the soil is being reclaimed. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. For the optimum production of crops, water should be applied in amounts sufficient to leach the salts from the root zone but at a rate that will not cause excessive runoff. Because of the very slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

This map unit is in capability unit IIIs-5 (17), irrigated, and capability subclass VIIs, nonirrigated.

252—Yribarren clay loam, 0 to 2 percent slopes. This deep, well drained soil is on alluvial fans and plains. It formed in alluvium derived dominantly from sedimentary rock. The vegetation in areas not cultivated is mainly annual grasses, forbs, and shrubs. Elevation is 300 to 800 feet. The average annual precipitation is about 5 inches, the average annual temperature is about 65 degrees F, and the average frost-free season is about 250 to 300 days.

Typically, the surface layer is pale brown clay loam about 8 inches thick. The upper 17 inches of the subsoil is very pale brown clay loam, and the lower 12 inches is pale brown clay. The substratum to a depth of 60 inches or more is pale brown silty clay loam. In some areas the surface layer is loam.

Included in this unit are small areas of Garces silt loam, Panoche clay loam, and Kimberlina sandy loam. Included areas make up about 20 percent of the total acreage.

Permeability of this Yribarren soil is very slow. Available water capacity is low to high. Runoff is very slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more.

Most areas of this unit are used for irrigated crops such as almonds, barley, and pistachios. A few areas are used for limited livestock grazing.

This unit is suited to irrigated crops. It is limited mainly by the very slow permeability of the subsoil. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases the fertility and water intake rate. Maintaining crop residue on or near the surface reduces runoff and helps to maintain soil tilth and organic matter content. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown.

The map unit is in capability unit IIIs-5 (17), irrigated, and capability subclass VIIs, nonirrigated.

253—Yribarren clay loam, 2 to 5 percent slopes. This deep, well drained soil is on alluvial fans and plains. It formed in alluvium derived dominantly from sedimentary rock. The vegetation in areas not cultivated is mainly annual grasses, forbs, and shrubs. Elevation is 350 to 1,200 feet. The average annual precipitation is about 6 inches, the average annual temperature is about 65 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is pale brown clay loam about 7 inches thick. The subsoil is pale brown and light yellowish brown silty clay about 12 inches thick. The upper 3 inches of the substratum is pale brown loam, and the lower part to a depth of 60 inches or more is stratified, very pale brown and light yellowish brown silty clay. The soil contains gypsum crystals below a depth of 15 inches. In some areas the surface layer is loam.

Included in this unit are small areas of Milham sandy loam, Twisselman clay, and Yribarren loam. Included areas make up about 10 percent of the total acreage.

Permeability of this Yribarren soil is very slow. Available water capacity is low to high. Runoff is slow, and the hazard of water erosion is slight. Effective rooting depth is 60 inches or more. Some pedons do not have gypsum crystals in the subsoil.

Most areas of this unit are used for irrigated crops, mainly cotton, almonds, and pistachios. Among the other crops grown are grapes. Some areas are used for livestock grazing.

This unit is suited to irrigated crops. It is limited mainly by gently rolling slopes and the very slow permeability of the soil. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases the fertility and water intake rate. Maintaining crop residue on or near the surface reduces runoff and helps to maintain soil tilth and organic matter content. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the very slow permeability of the soil in this unit, the application of water should be regulated to control runoff and erosion.

This unit is suited to livestock grazing. The production of forage is limited by low rainfall. Grazing should be delayed until the soil has drained sufficiently and is firm enough to withstand trampling by livestock. Proper grazing use increases the water intake rate, promotes plant growth early in the season, and protects the soil from erosion. Uniform distribution of grazing can be achieved by the proper placement of salt and livestock watering facilities.

This map unit is in capability unit IIIe-1 (17), irrigated, and capability subclass VIIe, nonirrigated.

254—Zerker loam, 2 to 5 percent slopes. This deep, well drained soil is on terraces and alluvial fans. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses, forbs, and scattered shrubs. Elevation is 475 to 550 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 62 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is dark yellowish brown and brown loam about 17 inches thick. The upper 11 inches of the underlying material is brownish yellow clay loam, and the lower part to a depth of 62 inches is yellowish brown and light yellowish brown sandy clay loam. In some areas the surface layer is sandy loam or sandy clay loam.

Included in this unit are small areas of Delano sandy loam, Premier coarse sandy loam, and Lewkalb sandy loam. Included areas make up about 10 percent of the total acreage.

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

This unit is used mainly for irrigated orchard crops such as almonds and oranges. It is also used for dryfarmed grain.

This unit is suited to irrigated crops. It has few limitations. A cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage improves soil tilth and increases the fertility and water intake rate. Maintaining crop residue on or near the surface reduces runoff and helps to maintain soil tilth and organic matter content. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

This map unit is in capability unit IIe-1 (17), irrigated, and capability subclass VIe, nonirrigated.

255—Zerker loam, 5 to 9 percent slopes. This deep, well drained soil is on terraces and alluvial fans. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses, forbs, and scattered shrubs. Elevation is 450 to 800 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 62 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is dark yellowish brown and brown loam about 17 inches thick. The upper 11 inches of the underlying material is brownish yellow clay loam, and the lower part to a depth of 62 inches is yellowish brown and light yellowish brown sandy clay loam. In some areas the surface layer is sandy loam or sandy clay loam.

Included in this unit are small areas of Delano sandy loam, Premier coarse sandy loam, and Lewkalb sandy loam. Also included are small areas of a soil that is similar to this Zerker soil but has a subsoil below a depth of 60 inches. Included areas make up about 15 percent of the total acreage.

Permeability of this Zerker soil is moderately slow. Available water capacity is high. Runoff is medium, and the hazard of water erosion is moderate. Effective rooting depth is 60 inches or more.

This unit is used mainly for irrigated orchard crops such as almonds and oranges.

This unit is suited to irrigated crops. It is limited mainly by the steepness of slope. Use of a cropping system that includes growing a cover crop, return of crop residue, and proper tillage improves soil tilth and increases the fertility and water intake rate. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Because of the slope, sprinkler or drip irrigation is most suitable. Irrigation water needs to be applied at a rate that ensures optimum production without increasing deep percolation, runoff, and erosion.

The map unit is in capability unit IIIe-1 (17), irrigated, and capability subclass VIe, nonirrigated.

256—Zerker sandy clay loam, 0 to 2 percent slopes. This deep, well drained soil is on terraces and alluvial fans. It formed in alluvium derived dominantly from granitic rock. The vegetation in areas not cultivated is mainly annual grasses, forbs, and scattered shrubs. Elevation is 475 to 550 feet. The average annual precipitation is about 8 inches, the average annual temperature is about 62 degrees F, and the average frost-free season is 250 to 300 days.

Typically, the surface layer is dark yellowish brown and brown sandy clay loam about 17 inches thick. The upper 11 inches of the underlying material is brownish yellow clay loam, and the lower part to a depth of 62 inches is yellowish brown and light yellowish brown sandy clay loam. In some areas the surface layer is sandy loam or loam.

Included in this unit are small areas of Delano sandy loam and Premier coarse sandy loam. Included areas make up about 15 percent of the total acreage.

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

This unit is used for irrigated crops such as alfalfa, cotton, almonds, and oranges.

This unit is suited to irrigated crops. It has few limitations. Use of a cropping system that includes crop rotation or a cover crop, return of crop residue, and proper tillage is needed to improve soil tilth and to increase the fertility and water intake rate. Furrow, border, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

This map unit is in capability class I (17), irrigated, and capability subclass VIc, nonirrigated.

Prime Farmland

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

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

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

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

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

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

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

About 764,785 acres, or nearly 56 percent of the survey area, would meet the requirements for prime farmland if an adequate and dependable supply of irrigation water were available.

The following map units meet the soil requirements for prime farmland if water for irrigation is available. Some of the map units included in the list have slopes of as much as 9 percent; only the areas of these units that have slopes of 6 percent or less are considered prime farmland. On some soils measures should be used to overcome a hazard or limitation, such as flooding, wetness, or droughtiness. The location of each map unit is shown on the detailed soil maps at the back of this soil survey. Soil qualities that affect use and management are described in the section "Detailed Soil Map Units." This list does not constitute a recommendation for a particular land use.

123 Buttonwillow clay, drained
124 Buttonwillow clay, partially drained
125 Cajon loamy sand, 0 to 2 percent slopes
126 Cajon loamy sand, 2 to 5 percent slopes
127 Cajon sandy loam, overblown, 0 to 2 percent slopes
130 Chanac clay loam, 2 to 9 percent slopes
138 Delano sandy loam, 0 to 2 percent slopes
139 Delano sandy loam, 2 to 5 percent slopes
140 Delano sandy loam, 5 to 9 percent slopes
141 Delano sandy clay loam, 0 to 2 percent slopes
143 Delano Variant clay loam, 0 to 9 percent slopes
145 Driver coarse sandy loam, 0 to 2 percent slopes
152 Excelsior sandy loam
153 Excelsior Variant silt loam
159 Hesperia sandy loam, 0 to 2 percent slopes
160 Hesperia sandy loam, 2 to 9 percent slopes
174 Kimberlina fine sandy loam, 0 to 2 percent slopes
175 Kimberlina sandy loam, 2 to 5 percent slopes
177 Kimberlina gravelly sandy loam, 2 to 5 percent slopes

178 Kimberlina gravelly sandy loam, 5 to 9 percent slopes
184 Lewkalb sandy loam, 0 to 2 percent slopes
187 Lokern clay, drained
192 McFarland loam
196 Milham sandy loam, 0 to 2 percent slopes
197 Milham sandy loam, 2 to 5 percent slopes
211 Panoche clay loam, 0 to 2 percent slopes
212 Panoche clay loam, 2 to 5 percent slopes
222 Premier coarse sandy loam, 2 to 5 percent slopes
235 Twisselman clay, 0 to 2 percent slopes
236 Twisselman clay, 2 to 5 percent slopes
243 Wasco sandy loam
244 Wasco fine sandy loam
245 Westhaven fine sandy loam
246 Whitewolf coarse sandy loam
251 Yribarren loam, 0 to 2 percent slopes
252 Yribarren clay loam, 0 to 2 percent slopes
253 Yribarren clay loam, 2 to 5 percent slopes
254 Zerker loam, 2 to 5 percent slopes
256 Zerker sandy clay loam, 0 to 2 percent slopes

Use and Management of the Soils

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

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

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

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

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

By William T. Neikirk, soil conservationist, and Clarence U. Finch, conservation agronomist, Soil Conservation Service.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service and the Storie index ratings used by the University of California, Agricultural Experiment Station are explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

In the following paragraphs, the main management practices for the soils in the survey that are suitable for crops and pasture are briefly discussed. The major concerns when farming the soils are maintaining and improving their production capacity and controlling erosion. Needed management practices include conservation cropping systems, using crop residue, proper tillage, irrigation water management, using cover crops, erosion control, removing excess water, pasture management, and chiseling and subsoiling.

Soil improvement practices that can be used in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. They also include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Many different cropping systems are used in the survey area. A typical 6-year cropping system is cotton, barley, or sorghum grain, and hay. Residue from these crops should be returned to the soil, and minimum tillage should be used.

Soil compaction is a hazard in this survey area. Tillage destroys the structure of the soil, reduces the organic matter content, and commonly creates a plowpan below the depth of tillage. Tillage increases the risk of erosion, and the plowpan limits permeability and restricts the penetration of roots. The length of time required for the plowpan to develop can be increased by varying the depth of tillage. Combining tillage operations to reduce the number of trips over the field and delaying tillage when the soils are wet also help to prevent compaction and to maintain soil tilth. Chiseling to a shallow depth helps to break up the pan once it has formed.

Irrigation water management is needed to control the rate, amount, and timing of applications of irrigation water. Furrow, border, sprinkler, and drip irrigation are

used in this survey area. Furrow and border irrigation are suitable where slopes are 2 percent or less. Sprinkler irrigation is suited to all the tillable soils in the survey area. Drip irrigation is used in this survey area mainly on orchards and vineyards. Irrigation water should be applied at a rate and in amounts needed to meet the requirements of the crop grown and the characteristics of the soils without excessive runoff or deep percolation. Additional irrigation water is needed on the saline-alkali soils in order to meet their leaching requirements.

Cover crops should be grown in orchards and vineyards and in other areas where the soils are left fallow during the rainy season. Cover crops provide protection from erosion and help to maintain or improve the penetration of water, tilth, and fertility. The main cover crops in the survey area are volunteer native plants. If a seeded cover crop is needed or desired, grasses such as barely, brome, ryegrass, or annual fescue can be seeded alone. If a legume cover crop is used, plants such as clover, vetch, or birdsfoot trefoil can be seeded alone. Cover crops can be managed by mowing or disking. If a continuous cover is desired, the cover crop should be mowed or disked after the annual grass or legume seed crop has matured.

Many different practices can be used to control erosion in the survey area. Among these are land leveling or smoothing, selecting the best method of irrigation, and controlling irrigation to reduce erosion of irrigated soils. Other practices that can be used to control erosion are use of crop residue, use of a cover crop in the rotation, minimum tillage, and cross-slope farming. Structures can also be used to control erosion. These include grassed waterways, diversions, grade stabilization structures, water retention structures, or streambank stabilization structures.

Excess surface water, either from rainfall or irrigation, is a concern in some low-lying areas, in swales, or at the lower end of irrigated fields. Excess water results in decreased crop production and can provide a habitat for weeds or mosquitoes. Excess water on the surface can be controlled by properly leveling the land, constructing irrigation tailwater return systems, and properly managing irrigation water. Diversions, dikes, or canals may be needed to divert and control floodwater in low-lying areas such as the Goose Lake Basin and areas near major streams.

A perched water table is present in most of the soils in the Goose Lake Basin and in the area to the north that is near the County line and is included in the Tulare Lake Basin. Some areas of these soils may need subsurface drainage systems. Among these soils are those of the Buttonwillow, Houser, Lerdo, Lokern, Nahrub, Panoche, and Twisselman series. Subsurface drainage is needed to keep the water below the primary rooting zone of plants and to leach salts from the soil profile. Subsurface drainage can be accomplished by constructing open drainage ditches and installing tile drains or other perforated drainage systems. The poor quality water that is collected by the drainage systems needs to be disposed of by use of proper waste water disposal methods.

Management of irrigated pasture is needed to prevent soil compaction, maintain a desirable plant community, extend the life of the pasture, and provide for maximum production. A suitable pasture management program can include irrigation water management, rotation grazing, fertilization, harrowing or dragging to scatter droppings, and clipping as needed to maintain uniform growth. Grazing should be started when the plants are 8 to 10 inches high, and livestock should be removed when a minimum of 3 to 4 inches of stubble remains.

Selection of a suitable plant mixture when establishing a pasture is important. For most of the soils in the survey area, suitable mixtures contain orchardgrass or tall fescue together with birdsfoot trefoil, strawberry clover, or ladino clover. If proper pasture management is used, these species can produce an abundance of high quality forage.

Chiseling or subsoiling is needed on the soils in the area that have a plowpan or hardpan. Chiseling the plowpan and deep ripping the hardpan will increase the permeability of the soils, improve internal drainage, help to prevent development of a perched water table, and allow roots to penetrate to a greater depth. Chiseling also temporarily benefits the soils that have a clay subsoil; however, the clay subsoil will eventually return to its original condition. Soils that commonly develop a plowpan include those of the Buttonwillow and Lokern series. The soils in the area that have a hardpan are those of the Exeter and Jerryslu series. The depth to which a soil is ripped should be based on the depth to the bottom of the hardpan.

The coarse textured soils in the survey area are very susceptible to soil blowing. Difficulty may be encountered during land leveling for irrigation and preparation for planting and establishing a crop. In dryfarmed areas, soil blowing often damages the plants by abrasion when they are young. If feasible, cultivation should be done during the months when the possibility of damage from the wind is least. Full use should be made of crop residue, cover crops, and minimum tillage. Ordinarily, the coarse textured soils that are erodible by the wind are too droughty for dryland cultivation; if they are cultivated, however, soil blowing can be partially controlled by leaving stubble and crop residue on the surface, keeping the surface cloddy, and using surface tillage or cultivating in alternate strips. Stripcropping at right angle to the prevailing wind also reduces soil blowing.

The properties of the soils in the survey area strongly influence the kind of pasture plants that can be grown. Where the climate and topography are about the same, the kind of crops that can be grown is related closely to the kind of soil present. The main crops that are suited

to the soils in the survey area are fruit and nut crops and field crops.

The fruit and nut crops that are suited to the soils in the survey are include peaches, citrus fruit, figs, pistachios, kiwis, plums, apricots, grapes, walnuts, and almonds. Most of these crops are grown in the north-central and northeastern parts of the area. The ability of a plant to tolerate salts and alkali is an important factor in determining it's adaptability to the soils. Most of the fruit and nut crops in the survey area are not salt and alkali tolerant; therefore, their use generally is limited to the well drained, nonsaline-alkali soils such as those of the Chanac, Delano, Kimberlina, McFarland, Milham, Panoche, Twisselman, Wasco, and Yribarren series.

The field crops suited to the soils in the survey area where water is available for irrigation include cotton, alfalfa, barley, wheat, corn, potatoes, onions, safflower, grain sorghum, sugar beets, and pasture. All of these field crops can be grown on any of the irrigated soils in the area; however, the fine textured Buttonwillow and Lokern soils are best suited to cotton, sugar beets, grain sorghum, alfalfa, and pasture. The saline-alkali soils in the area, such as the Garces, Lethent, and Panoche soils, are best suited to alfalfa, cotton, barley, corn, grain sorghum, sugar beets, and pasture. Coarse textured and moderately coarse textured soils such as Hesperia, Wasco, Kimberlina, and Cajon series are best suited to potatoes and onions as well as to other crops.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 4. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 4 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. These levels are defined 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. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

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

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

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

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless

close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIIe-8. The numbers used to designate units within the subclasses are as follows:

0. Indicates limitations caused by stony, cobbly, or gravelly material in the substratum.
1. Indicates limitations caused by slope or by an actual or potential erosion hazard.
2. Indicates a limitation of wetness caused by poor drainage or flooding.
3. Indicates a limitation of slow or very slow permeability of the subsoil or substratum is caused by a clayey subsoil or by a substratum that is semiconsolidated.
4. Indicates a low available water capacity in sandy or gravelly soils.
5. Indicates limitations caused by a fine-textured or very fine-textured surface layer.
6. Indicates limitations caused by salts or alkali.
7. Indicates limitations caused by rocks, stones, or cobblestones.
8. Indicates that the soil has a very low or low available water capacity because the root zone generally is less than 40 inches deep over massive bedrock.
9. Indicates limitations caused by low or very low fertility, acidity, or toxicity that cannot be corrected by adding normal amounts of fertilizer, lime, or other amendments.
10. Indicates a high organic matter content, peats, and mucks.

No unit designations are shown for class I soils because soil characteristics are similar for all soils in the class. Unit designations are not given for soils in classes V through VIII because these soils normally are not intensively managed as cropland.

Capability groupings are given in the description of each map unit in the section "Detailed Soil Map Units."

Storie Index Rating

By Gordon L. Huntington, lecturer and soil specialist, Department of Land, Air, and Water Resources, University of California, Davis.

The soils in the survey area are rated in table 5 according to the Storie index (*13, 14*). This index expresses numerically the relative degree of suitability of a soil for general intensive agricultural use as it exists at the time of evaluation. The rating is based on soil characteristics only and is obtained by evaluating factors such as soil depth, surface soil texture, subsoil characteristics, drainage, salts and alkali, and relief. Other factors, such as availability of water for irrigation, climate, and distance to markets, that might determine the desirability of growing certain plants in a given locality are not considered. Therefore, in itself, the index should not be used as a direct indicator of land value. However, where economic factors are known to the user, the Storie index provides additional objective information for land tract value comparisons.

Four general factors are used in determining the index rating; *A*, the permeability of the soil profile and soil depth; *B*, the texture of the surface soil; *C*, the dominant slope of the soil body; and *X*, other factors more readily subject to management or modification. In this survey area the X factors include drainage, hazard of flooding, nutrient level, and salts and alkali. For some soils more than one of the X factors are used in rating. Each of the four general factors is evaluated on the basis of 100 percent. A rating of 100 percent expresses the most favorable, or ideal, condition for general crop production. Lower percentage ratings are assigned for conditions that are less favorable. Factor ratings are selected from tables prepared from data and observations that relate soil properties to plant growth and crop yield (*12*). In the tables currently used, certain soil properties are allowed ranges of values to conform with variations of the properties in relation to their effect on the suitability of the soil for general agricultural purposes; for example, soil depth or proportion of gravel present in a gravelly loam surface layer. The modal condition of a soil property, as it is described in a soil map unit, is used to select a value for rating when a range of tabular values exists.

The index rating for a soil is obtained by multiplying the rating values given to its four factors, A, B, C, and X. If more than one X factor exists for a soil, the values for the additional factor, or factors, act as additional multipliers. Thus, any factor may dominate or control the final rating. For example, consider a soil such as Panoche clay loam, saline-alkali, moderately wet, 0 to 2 percent slopes. It is a deep soil with a moderately permeable profile. This warrants a rating of 95 for factor A. It has a workable clay loam surface layer texture that requires some care in tillage for seedbed preparation, warranting a rating of 85 for factor B. The smooth, nearly level surface of the soil justifies a rating of 100 for factor

C. However, it has a perched water table at a depth of 3 to 6 feet, warranting a value of 70, and is moderately saline-alkali affected, warranting a value of 60. Multiplied together, this produces a rating of 42 for factor X. Multiplying A, B, C, and X gives a Storie index of 34 for this soil. If, in time, the water table can be controlled and the saline-alkali condition improved, the Storie index can be increased by assigning appropriate higher values to the X factors to reflect the changed conditions. Complete reclamation would result in a rating close to 85, which has been determined for Panoche clay loam, 0 to 2 percent slopes.

Soil complexes in the survey area, such as Kettleman-Cantua complex, 30 to 50 percent slopes, are rated to reflect the proportion of the dominant soils described in the unit. Each of the dominant soils in such complexes is rated separately and the values shown in table 5. Storie index shown for the complex unit is a proportionally weighted average of the separate ratings. In undifferentiated groups, such as Vaquero and Altamont clays, 15 to 50 percent slopes, the dominant soils are rated separately and respectively in accordance with the map unit name. Miscellaneous area map units, such as Badlands, Pits and Dumps, Riverwash, Rock outcrop, and Urban land, are not evaluated in terms of the factors A, B, C, or X. They have features that are very severely limiting for agricultural use of any kind. As such, they are assigned an index value of zero.

Soils are placed in grades according to their suitability for general intensive agriculture as shown by their Storie index ratings. The six grades and their range in index ratings are:

	Index rating
Grade 1	80 to 100
Grade 2	60 to 79
Grade 3	40 to 59
Grade 4	20 to 39
Grade 5	10 to 19
Grade 6	Less than 10

In this area, soils in *Grade 1* are well suited to intensive use for irrigated crops that are climatically adapted to the region. *Grade 2* soils are good agricultural soils, although they are not so desirable as soils in Grade 1 because of coarser surface or subsoil textures, a somewhat less permeable subsoil, or moderate soil depth, gentle to moderate slopes, or slight accumulations of salts and alkali. *Grade 3* soils are only fairly well suited to agriculture and are limited in their use because of moderate to steep slopes, moderate soil depth, a less permeable subsoil, clayey surface soil texture, poor drainage, or accumulations of salts and alkali. *Grade 4* soils are poorly suited. They are severely limited in their agricultural potential because of shallower depth, steeper slopes, more salts and alkali, flooding, or poorer drainage than for soils in Grade 3. *Grade 5* soils are very poorly suited to agriculture, are seldom cultivated, and are more commonly used for grazing. *Grade 6* consists of soils and miscellaneous areas that are not suited at all because of very severe to extreme limitations with regard to the aforementioned properties. Table 5 lists the grade for each soil in this area.

Land Resource Areas

In this survey area, capability classification is further refined by designating the land resource area in which the soil occurs. A land resource area is a broad geographic area that has a distinct combination of climate, topography, vegetation, land use, and general type of farming. Parts of two of these nationally designated areas are in the survey area. These areas and their numbers are: Sacramento and San Joaquin Valleys (17); and Central California Coast Range (15). The number of the resource area is added in parentheses to the class, subclass, and capability unit designation for complete identification of the capability unit.

A soil in one resource area may have characteristics similar to those of a soil in another resource area and the same capability symbol, but the climate, vegetation, and crops that are suited and management practices needed may differ. For example, both capability subclass VIe (17) and VIe (15) contain deep, well drained soils. The soils in capability subclass VIe (17) are in the Sacramento and San Joaquin Valleys and are suited to irrigated crops, but those in capability subclass VIe (15) are in the Central California Coast Range and are suited to use as rangeland.

Land resource area 17.—About 85 percent of the survey area is in this land resource area. It consists of lands dominantly on alluvial fans, in basins, and on terraces in the San Joaquin Valley. Natural vegetation is mainly annual grasses and forbs. Elevation ranges from 180 to 1,600 feet. The average annual precipitation is 5 to 9 inches. The average annual temperature is 60 to 66 degrees F, and the average frost-free season ranges from 200 to 325 days.

Within this survey area, about 90 percent of this resource area is used for agriculture, 4 percent for urban and industrial development, 5 percent for wildlife habitat, and 1 percent for mineral exploration. All cropland in this area is irrigated. Water used for irrigation is from wells and canals. The main crops are cotton, grapes, almonds, and sugar beets.

Land resource area 15.—About 15 percent of the survey area is in this land resource area. It consists of lands mainly on mountainous uplands and foothills in the Temblor and Diablo Ranges. Natural vegetation is mainly annual grasses, forbs, and some oak and juniper at the higher elevations. Elevation ranges from 400 to 4,332 feet. The average annual precipitation is 6 to 12 inches. The average annual temperature is 59 to 65 degrees F. The average frost-free season is 180 to 300 days.

The entire area is used primarily for livestock grazing, but there are some areas used for extraction of crude oil. A few small areas are used for dryland farming. The main crops are barley or wheat.

Saline-Alkali Soils

In areas of low rainfall, as in this survey area, salts that formed by the weathering of minerals are not leached from the soil profile. During periods of higher than average precipitation and flooding from the Sierra Nevada, the soluble salts are leached from the more permeable, higher lying soils. This water, carrying salts, moves downslope and enters the strata of soils at lower elevations. The ground water at these lower elevations becomes saline as a result of evapotranspiration from the surface of the soil. The soluble salts that accumulate in these soils consist principally of sodium sulfate, along with smaller quantities of calcium and magnesium sulfate. Smaller amounts of sodium carbonate, sodium chloride, and calcium chloride are also present in most of the soils in the survey area.

About 22 percent of the soils in the survey area are saline-alkali to some degree; a few soils are just alkali. Because of the high content of sodium sulfate in the shallow ground water, saline soils are rare in the area.

Saline soils are soils that contain sufficient soluble salts to interfere with the growth of most crop plants but that lack sufficient sodium to alter the soils physical properties. A saline soil is defined as a soil that has a conductivity of the saturation extract greater than 4 millimhos per centimeter and an exchangeable sodium percentage of less than 15.

Saline-alkali soils are soils containing soluble salts in sufficient quantity to interfere with the growth of most crop plants and sufficient exchangeable sodium to adversely affect the physical properties of the soil and plant growth. The exchangeable sodium percentage is greater than 15, and the conductivity of the saturation extract exceeds 4 millimhos per centimeter.

Nonsaline-alkali soils are soils containing sufficient exchangeable sodium to interfere with the growth of most crop plants and to affect their physical properties. The exchangeable sodium percentage is greater than 15, and the conductivity of the saturation extract is less than 4 millimhos per centimeter.

Saline-alkali and alkali soils can be improved by adding soil amendments and leaching the soil with more water than the soil can hold. This provides deep percolation of the water and moves the salts to a lower level in the soil profile. When leaching salts from the soil, water of good quality is needed. The water used should be low in total content of salts, and the salts should be mostly calcium instead of sodium. The importance of low sodium content of the water is that as salts pass through the soil profile sodium attaches itself to the clay particles. This causes the soil to become dispersed, which in turn reduces the permeability of the soil and makes leaching of the salts very difficult.

Good drainage is needed to improve these saline-alkali soils. Some saline-alkali soils, however, have a water table that is well below a depth of 6 feet and thus artificial drainage is not needed. Under these conditions salts can leached to a depth that will allow room for root development. A very small acreage of the saline-alkali soils in the survey area has poor drainage, and in these soils the water table is near the surface. Artificial drainage of these soils is needed. Open ditches and drain tiles are the two most common methods used to lower the water table. Salts can be leached out of the soil profile with the downward movement of water. More than 2 percent of the survey area's irrigated soils have a high water table and require the installation of some kind of artificial drainage system. Movement of the water and the rate at which it moves through the soil profile depend on its permeability. Coarse textured or moderately coarse textured soils such as sands, loamy sands, and sandy loams have permeability rates that range from 2 to 20 inches per hour. Medium textured soils such as fine sandy loams, loams, and silty loams have permeability of 0.5 inch to 2 inches per hour. Moderately fine textured or fine textured soils such as clay loams, sand, clay loams, and clays have slow to very slow permeability. When soils are leached of the soluble salts, sodium remains attached to the clay particles in the soil. The soil particles then become dispersed, and the soil behaves as if it were clay, regardless of the texture. Downward movement of water in the soil is very slow.

A soil amendment commonly is added to the soils before they are leached. The amendments that are most commonly used are gypsum, sulfuric acid, and sulfur. The choice of amendment depends on the kind of soil. Sulfuric acid and sulfur are most effective on calcareous soils. Sulfur, oxygen, and water combine to form sulfuric acid in the soil. Sulfuric acid reacts with the lime to form gypsum. Gypsum supplies calcium to the clay particles, replacing the attached sodium. With this action, soil permeability is improved. Sodium can be leached from the root zone by the application of excessive amounts of water. Generally, 1 acre-foot of water will remove half of the soluble salts from 1 acre-foot of soil. Gypsum is added to noncalcareous soils to supply a soluble form of calcium to replace the sodium on the clay particles.

No attempt has been made to map the degrees of salinity of alkalinity in this survey area because of the dynamic state of the saline-alkali condition of the soil. This is a result of the addition of soil amendments and fertilizer in the process of crop production. Amendments such as sulfur and sulfuric acid, if used for a time, lower the reaction of the soil at its surface. Fertilizers such as ammonium sulfate, ammonium nitrate, and ammonium phosphate all have acid reaction. Although it takes a

considerable amount of time to change the soil's saline-alkali status, small changes occur yearly.

Rangeland

By Franklyn E. Archuleta, range conservationist, Soil Conservation Service.

About 20 percent of the survey area is rangeland. Commercial cow-calf and stocker operations are dominant in the eastern and western parts of the area. Sheep operations generally are concentrated in the drier, lower lying areas. Rangeland continues to be converted to irrigated farmland but at a slower rate than in the past.

In fall and late in summer, forage commonly is supplemented by hay or protein concentrate. The period when the supply of green feed is adequate usually starts about February and lasts until the middle of May.

The properties of soils strongly influence the natural vegetation that grows. Soil reaction influences fertility by limiting the availability of critical elements required by certain plant species. Saltbush plant communities are adapted to saline-alkali soils. These soils are loamy and generally are on alluvial plains in the central part of the survey area. Soil texture greatly influences the type of vegetation that grows. Forage production on moderately fine textured soils is higher than that on shallow, coarse textured soils. Medium to moderately fine textured soils can provide more available water to plants. Drought tolerant plant communities are restricted to shallow, coarser textured soils and are commonly on south exposures. These conditions are common in the Temblor and Diablo Ranges.

Woodland areas are located on northerly facing slopes in the northwestern part of the survey area. The soils in these areas are moderately coarse textured to moderately fine textured. In transition zones, blue oak (*Quercus x alvordeana*) merges with the western fringe of pinyon-juniper woodland. Effective management is based on the relationship between soils, vegetation, and water. Local soil conditions often control woodland distribution. Soil temperatures are cooler on north-facing slopes and are an important factor in determining the characteristic plant community that grows there.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil.

Table 6 shows, for each kind of soil, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as rangeland or are suited to use as rangeland are listed. Explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community.

Proper grazing use is grazing at an intensity that maintains enough cover to protect the soil and maintains or improves the quality and quantity of desirable vegetation. It is necessary to allow a part of the desirable species to set seed if they are to be maintained in the plant community, and it is necessary to control grazing if a desirable plant community is to be maintained. If grazing is not controlled, only the unpalatable species will be allowed to reproduce. Leaving the dry vegetation on the rangeland at the beginning of fall and during winter helps to promote the growth of green forage. A desirable amount of stubble left at the end of the grazing season allows for faster establishment and better winter growth of new seedlings. The stubble protects the new plants from drying winds and sun. The decomposing plant material partially intermixed with the soil conserves moisture and

promotes establishment and early growth of each year's seedlings (*4*).

The amount of residue left should be between 700 and 1,000 pounds of air-dry vegetation per acre in areas that have slopes of less than 30 percent and between 1,000 and 1,200 pounds per acre in areas that have slopes of more than 30 percent. Determination of the amount of residue to be left should be done just prior to the beginning of the rainy season, normally about November 1.

Proper season of use is based on the characteristics of the plant community. It means grazing only during seasons when the range is best adapted for grazing. In this survey area three seasons are recognized—the dry forage season, the inadequate green feed season, and the adequate green feed season. The dry forage season is from about June through October. Some of the current year's growth should be left to conserve soil moisture, to protect the soil from erosion, and to provide humus for soil fertility. The inadequate green feed season is usually between November and January. Most of the plant growth occurs during short rainy periods; supplemental feeding is necessary during the dry periods. The adequate green feed season lasts from about February through May. Enough forage is available to feed the livestock during the grazing season and to leave enough of the current year's growth of desirable forage plants to provide protection of the plants and to encourage growth the following year (*4*). Spring grazing should be delayed until the desirable forage species are ready for grazing and the soil conditions are such that no damage will occur as a result of equipment use.

Distribution of livestock grazing involves all the practices that can be used to encourage livestock to spread out and graze the forage in an area as uniformly as possible. The objectives are to minimize overuse and wasted forage and maximize proper use. Grazing efficiency varies because of differences in water distribution, topography, kinds of forage available, type of livestock, and season of use. The proper placement of salt to obtain uniform grazing is important. Salt should be placed wherever grazing is desired; however, it should be placed next to watering facilities.

In the areas grazed by sheep, it generally is practical to haul water. This results in improved grazing distribution. Open herding of sheep is an effective means of distributing grazing pressure and reducing the incidence of plant poisoning. Close herding keeps the animals bunched up so that forage is trampled. A one-night bedding system should be used. Continued bedding in the same area results in severe trampling of the vegetation and compaction of the soil. This restricts the rate of water absorption by the soil and promotes erosion.

Cattle are not ordinarily herded on a range; however, in rough or poorly watered areas a rider is beneficial to guide cattle movements. Calf crops are increased by keeping bulls and cows properly distributed. Grazing units are more efficiently used by pushing cattle from bottom land areas to underused, steeper areas (*11*).

Proper distribution of livestock watering developments, wherever economically or physically feasible, helps to distribute grazing pressure. If animals are required to travel long distances to and from water, weight gain and distribution are greatly reduced. It also encourages overgrazing of forage in areas adjacent to watering areas. The number of watering areas needed depends on the kind of livestock, climate, and topography.

Proper location of livestock trails and walkways is effective in distributing grazing. In steep, rocky places and in areas of dense brush, establishment of livestock trails helps to provide access to forage.

A *planned grazing system* is a harvest procedure in which two or more grazing units are alternately rested from grazing in a planned sequence over a period of years. The period of rest can be throughout the year or during the growing season of desirable plants. A system may be designed to help achieve several objectives—the composition of the plant community can be maintained or improved, the supply of forage can be better stabilized throughout the grazing season, and watershed and wildlife habitat can be protected. The system is designed to help meet the objectives of individual range managers.

When management of vegetation does not achieve the desired objectives within a reasonable length of time, one or more conservation practices may be applied to help meet the objectives more quickly. Use of these practices commonly results in dramatic changes in the plant community. If protective measures are not taken, livestock tend to overgraze areas where these practices have been applied. These practices include rangeland seeding, brush management, and fencing. Cross-fencing and fertilization of rangeland soils in the survey area generally are not economically feasible.

Range seeding improves existing rangeland by establishing forage plants and increasing production, or it can be used to convert cropland to rangeland. Seeding improves the natural beauty of rangeland and reduces soil erosion.

Brush management can be used to reduce competition from woody plants and to help establish or reestablish a desirable grass cover to limit soil and water losses, thus increasing forage production and controlling runoff. Brush management also improves the habitat for some species of wildlife, improves recreation sites, and enhances esthetic value.

The objective in range management is to control grazing to provide for adequate residue to protect the soil from erosion and ensure that plants produced are palatable and nutritious. Such management generally results in the maximum production of vegetation, reduction of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a

plant community somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Technical assistance in planning rangeland management can be obtained from local offices of the Soil Conservation Service or from the Kern County Resource Conservation Districts.

Windbreaks

Windbreaks protect livestock, buildings, and yards from troublesome winds. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Properly located windbreaks along with other cultural practices can effectively reduce wind erosion. Energy savings are also a recognized benefit of a well planned windbreak.

Supplemental watering is necessary during the life of the windbreak to ensure establishment and survival. Windbreaks need to be protected from fire and grazing. Control of weed competition is another key element for survival of the plantings.

Key shrub species for windbreaks in this area are toyon, oleander, hollyleaf cherry, casa quailbush, and pyracantha. Important trees suitable for use as in windbreaks are Arizona cypress, black locust, Eldarica pine, Athel, river she-oak, red gum, and Manna gum. Actual species selection should be based on site requirements.

Field windbreaks are narrow plantings made at right angles, where possible, to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from damaging wind.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from either local offices of the Soil Conservation Service, from the Cooperative Extension Service, from the California Department of Forestry, or from a nursery.

Drainage and Perched Water

Drainage is used to describe the ability of the soil to allow excess water to pass through. Poor drainage may occur in a soil if a layer in the soil restricts the movement of water, and in some instances excess salts, through the soil. Layers that have a very high clay content or which are dense, compacted, or cemented and comparatively nonporous can cause reduced drainage. Poor drainage can have a very harmful effect on crops, especially when associated with an increase in salt content, if it is within the major part of the root zone of the crop.

During normal, healthy plant growth, it is necessary for plant roots to take in oxygen from the pores in the soil and give off carbon dioxide to the soil. In wet soils with a drainage problem, this gas exchange is restricted to varying degrees, which damages plant roots. Also, a buildup of excess toxic salts is often associated with poor drainage. Some of these excess salts can be taken into the plant with water, which causes additional damage to the plant. In this soil survey, reference to drainage problems applies to soils that have reduced drainage within 5 feet of the surface.

Perched water is water that tends to remain fairly close to the soil surface and does not percolate down through the soil within a few days following application. In this survey area, water is perched within 6 feet of the surface during some part of the year in some years. A perched water table can develop when excess irrigation water is added to soils that have reduced or poor drainage; for example, if a soil has a restrictive layer at a depth of 5 feet and has a water capacity of 1 foot of water, a temporary perched water table may develop if the soil is irrigated with 3 feet of water. The excess water may slowly percolate through the soil over a period of several weeks or it might remain longer. This can especially be a problem in soils with excess salts. These saline-alkali soils require excess irrigation water to flush out the toxic salts. One method which has been used successfully to remove perched water is to install a tile or open drain system with a suitable outlet to carry away excess water and salts.

Within the boundaries of the soil survey area, there are two major areas with a perched water table. These areas generally are located around the Goose Lakebed, west of Semitropic Ridge, and around the Kern Wildlife Refuge. The perched water is within 6 feet of the surface in some months, usually during the irrigation season. It is difficult to determine the number of acres affected because the depth to water fluctuates throughout the year. At the time this report is being written, it is estimated that more than 40,000 acres is affected. The affected area seems to be increasing as more acreage of land becomes irrigated and more water is used to leach salts out of saline-alkali soils.

The areas near Goose Lake and the Kern Wildlife Refuge that are affected by a perched water generally have an elevation of less than 250 feet. Excess water and salts tend to accumulate in low lying areas. Seasonal variations in the depth to the perched water of 2 to 5 feet are common. During the irrigation season, perched water typically is about 3 feet closer to the surface than it is in winter. Additional information about perched water can be obtained from the Kern County Water Agency.

Recreation

Demand for recreational facilities within the survey area will increase as population and leisure time increase. Some of this increased demand can be met by private recreational development.

Private recreational facilities can be developed as a supplemental enterprise to farming or ranching. The hills and mountains of the Temblor and Diablo Ranges have good potential for the development of such private recreational facilities as Upland game hunting clubs, campgrounds, and guest ranches. Lake Ming and Lake Woollomes furnish good opportunities for fishing, boating, and swimming. The Kern National Wildlife Refuge and associated private duck clubs provide opportunities for hunting ducks and geese. The Kern River furnishes excellent facilities for fishing, boating, rafting, and swimming. The California Aqueduct also provides good fishing opportunities. In addition, the survey area has several golf courses and community parks.

The soils of the survey area are rated in table 7 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

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

The information in table 7 can be supplemented by other information in this survey, for example, interpretations for dwellings without basements and for local roads and streets in table 9 and interpretations for septic tank absorption fields in table 10.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

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

Wildlife Habitat

By Larry H. Norris, biologist, Soil Conservation Service.

area. Fish and wildlife improve the quality of the environment, act as early indicators of pollution, and provide numerous opportunities for recreation. Wildlife related activities, such as nature study, bird watching, hunting, and fishing, have an effect on the area's economy. Many kinds of wildlife help in the natural control of weed, insect, and animal pests.

Warmwater game fish, including largemouth bass, smallmouth bass, black crappie, catfish, and sunfish, inhabit the rivers and ponds in the area. In addition to fish habitat, the rivers, creeks, and drainageways also provide important riparian habitat corridors for mammals, birds, reptiles, and insects. In the areas developed for intensive agriculture, these riparian corridors often account for the only wildlife habitat left.

The Kern National Wildlife Refuge and associated private duck clubs and the privately owned Goose Lake

area provide important habitat for wintering waterfowl such as ducks, geese, and shore birds. These areas are especially important to early waterfowl migrants.

Man's activities have varied effects on the wildlife population. Many species, such as sparrows, blackbirds, and ground squirrels, can tolerate man's activities and actually thrive in close association with man. In contrast, the existence of some species has been threatened by man and his activities.

The following wildlife species that have been designated as rare or endangered are in this survey area (*7*). The San Joaquin kit fox, which is listed as an endangered species by both the federal and state governments, is present primarily in the areas of native vegetation on the San Joaquin Valley floor and in the foothills. Conversion of valley land to irrigated agriculture is reducing its range, thus confining it to valley areas that are unsuited to agriculture and to rolling foothills and canyons. Two other forms of wildlife on the endangered species list that are present in the survey area are the bluntnosed leopard lizard and California condor. Each of these species populations is on the decline because of the loss of natural habitat.

In the following paragraphs wildlife habitat is discussed according to the general soil map unit group in which it occurs.

Soils on hills and mountains of the Temblor and Diablo Ranges.—With the exception of Nacimiento, the soils in this group have fair to poor potential for developing rangeland habitat for wildlife. There are two factors that limit the rangeland wildlife potential. These are the generally low available water capacity of the soils and the low rainfall in the area. These factors limit the growth of both the wild herbaceous plants and the shrubs that provide food and cover for rangeland wildlife. Management for wildlife in this group consists mainly of maintaining the existing habitat. The development of watering facilities such as small ponds and guzzlers produces excellent results in increasing the value of the habitat for wildlife on the soils in this group. Slopes of more than 3 percent greatly limit this group for wetland development.

Soils on the foothills of the Temblor and Diablo Ranges.—Soils in this group have very poor or poor potential for developing rangeland habitat for wildlife. The primary limitation for the production of wildlife habitat in this group is the low precipitation. In areas where the parent material is soft or highly fractured, as in soils of the Kettleman series, the land can be managed and improved for growth of shrubs. Otherwise, management for wildlife habitat in this group consists primarily of maintaining the existing vegetation. The development of watering facilities such as small ponds and guzzlers can produce good results in increasing the value of the habitat for wildlife when plants that provide cover are nearby.

Soils of the mountain valleys and streams of the Temblor Range.—Soils in this group have fair to poor potential for developing rangeland and openland habitat for wildlife. Two factors that limit the habitat potential of the soils in this group are the low precipitation and the very shaly texture of the Pottinger soils. These factors limit the growth of shrubs and wild herbaceous plants that provide food and cover for livestock and wildlife and the availability of drinking water.

The development of water facilities such as irrigation systems, small ponds, and guzzlers can produce good results in increasing the rangeland and openland habitat values if combined with the establishment of permanent vegetation for cover. Slopes of more than 3 percent limit this group for wetland development.

Soils mainly on alluvial fans, alluvial plains, and terraces in the western part of the San Joaquin Valley.—Soils in this group are rated fair to poor and very poor in their potential for developing rangeland and nonirrigated openland wildlife habitat. The main limitation for both rangeland and openland habitat is the low precipitation. This greatly limits the availability of water for drinking and the diversity and production of wild herbaceous plants and shrubs that provide food and cover for wildlife.

The development of water facilities, such as irrigation systems, small ponds, and guzzlers can improve the habitat for wildlife, both rangeland and openland. Irrigated cropland, which makes up much of this group, can provide food, water, and seasonal cover if managed properly; however, oddly shaped vegetated areas, irrigation ditches, and drainage ditches greatly improve attractiveness of the area for openland wildlife by providing year-round hiding, resting, and nesting areas.

The potential for wetland habitat on the soils in this group is low because they are well drained and somewhat excessively drained and are moderately permeable to very slow permeability; however, if enough water is available, many of these soils can be developed for wetland habitat.

Soils mainly in basins of the San Joaquin Valley.—Soils in this group have very poor potential for developing openland habitat for wildlife. The primary limitation is low precipitation and the strong saline-alkali condition of the Twisselman, Lethent, and Nahrub soils. These two factors combined greatly affect the availability of drinking water and the diversity and production of the wild herbaceous plants and shrubs that provide food and cover for wildlife.

The development of water facilities such as irrigation systems, small ponds, and guzzlers can produce good results on the Lokern and Buttonwillow soils; however, on the Twisselman, Lethent, and Nahrub soils only fair results are achieved even when saline-alkali tolerant plants are grown.

The potential is good to develop wetland wildlife habitat if sufficient water is available.

Soils mainly on alluvial fans, alluvial plains, basin rims, and flood plains in the eastern part of the San Joaquin Valley.—Soils in this group have fair to very poor potential for developing rangeland habitat and poor to very poor potential for openland habitat. The main limitations for both rangeland and openland habitat are the limited amount of precipitation and the saline-alkali condition. As such, they are moist not more than 90 consecutive days in winter and receive 7 inches or less of rain annually. These factors combined greatly affect the availability of drinking water and the diversity and production of the wild herbaceous plants and shrubs that provide food cover for wildlife.

The development of water facilities, such as irrigation systems, small ponds, and guzzlers, can improve the habitat for wildlife, both rangeland and openland. The irrigated cropland that makes up much of this group can provide food, water, and seasonal cover if managed properly; however, oddly shaped vegetated areas, irrigation ditches, and drainage ditches greatly improve the attractiveness of the area for openland wildlife by providing year-round hiding, resting, and nesting areas.

The potential for wetland habitat on the soils in this group is low because they are well drained and somewhat excessively drained and are rapidly permeable to very slowly permeable; however, many of these soils can be developed for wetland habitat if a sufficient quantity of water is available.

Soils on terraces in the eastern part of the San Joaquin Valley.—Soils in this group have fair to good potential for development of openland and rangeland habitat. For openland wildlife the primary limitation to growth is the limited amount of precipitation.

The development of water facilities, such as irrigation systems, small ponds, and guzzlers, can improve the habitat for wildlife, both rangeland and openland. Crops and irrigation water in many areas of this group can provide food, water, and seasonal cover if managed properly; however, oddly shaped vegetated areas, irrigation ditches, and drainage ditches greatly improve the attractiveness of the area for openland wildlife by providing year-round hiding, resting, and nesting areas.

The soils in this group have poor potential for development of wetland habitat because they are well drained and nearly level to hilly.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 8, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

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

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, vetch, wheatgrass, and wild oat.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for

planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are chamise, manzanita, black sage, and saltbush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, saltgrass, rushes, sedges, and cattails.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include California valley quail, pheasant, meadowlark, field sparrow, cottontail, and coyote.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, rufted grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, and bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, and muskrat.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include California mule, deer, red-tail hawk, meadowlark, and horned lark.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building Site Development, Sanitary Facilities, Construction Materials, and Water Management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

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

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

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

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps and soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 9 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

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

Sanitary Facilities

Table 10 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 10 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath

the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 10 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage because of rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 10 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

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

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

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 11 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and

stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 11, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a *probable* source has a layer of clean sand or gravel or a layer of sand or gravel that is as much as 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an *improbable* source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 12 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content

of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features listed in tables are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 13 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

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

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the system adopted by the American Association of State Highway and Transportation Officials (*1*) and the Unified soil classification system (*2*).

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

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

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

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

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

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

Physical and Chemical Properties

Table 14 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

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

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

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

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of the soil if used as construction material, and the potential of the soil to corrode metal and concrete.

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

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

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, very fine sand, sand, and organic matter (up to 4 percent) and on soil structure and permeability. The estimates are modified by the presence of rock fragments. Values of K range from 0.02 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the amount of stable aggregates 0.84 millimeters in size. These are represented idealistically by USDA textural classes. Soils containing rock fragments can occur in any group.

1. Sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.
5. Loamy soils that are less than 20 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.
6. Loamy soils that are 20 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.
7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.
8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 14, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

Soil and Water Features

Table 15 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay that has high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

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

Table 15 gives the frequency and duration of flooding and the time of year when flooding is most likely to occur.

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

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

The information on flooding is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in

organic matter content with increasing depth; and absence of distinctive horizons, which are characteristic of soils that are not subject to flooding.

Also considered are local information about the extent and level of flooding and the relation of each soil on the landscape to historic flood. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 15 are the depth to the seasonal high water table; the kind of water table—that is, *perched, artesian,* or *apparent*; and the months of the year that the water table usually is highest. A water table that is seasonally high for less than 1 month is not indicated in the table.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An *artesian* water table is under hydrostatic head, generally below an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower water table by a dry zone.

The two numbers in the column "High water table" indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. "More than 6.0" indicates that the water table is below a depth of 6 feet or that the water table exists for less than a month.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

A cemented pan is a cemented or indurated subsurface layer at a depth of 5 feet or less. Such a pan causes difficulty in excavation. Pans are classified as thin or thick. A *thin* pan is one that is less than 3 inches thick if continuously indurated or less than 18 inches thick if discontinuous or fractured. Excavations can be made by trenching machines, backhoes, or small rippers. A *thick* pan is one that is more than 3 inches thick if continuously indurated or more than 18 inches thick if it is discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed in excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

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

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

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*16*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 16 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Orthents (*Orth*, meaning true, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Torriorthents (*Torri*, meaning hot and dry, plus *orthents*, the suborder of the Entisols are common).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Torriorthents.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is coarse loamy, mixed, nonacid, thermic Typic Torriorthents.

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

Soil Series and Their Morphology

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

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*15*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*16*). Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

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

Aido Series

The Aido series consists of moderately deep, well drained soils on hills and mountains. These soils formed in residuum derived dominantly from shale or fine grained sandstone. Slope is 9 to 75 percent.

Soils of the Aido series are fine, montmorillonitic, thermic Entic Chromoxererts.

Typical pedon of Aido clay, 9 to 30 percent slopes; about 3.5 miles northwest of Kecks Corner, 1,950 feet west and 1,050 feet south of the northeast corner of sec. 34, T. 25 S., R. 17 E., Sawtooth Ridge Quadrangle.

A1—0 to 10 inches; pale brown (10YR 6/3) clay, brown (10YR 4/3) moist; moderate medium angular blocky

structure; slightly hard, friable, very sticky and very plastic; many very fine roots; many very fine interstitial pores; moderately alkaline; clear wavy boundary.

C1—10 to 26 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; strong very coarse prismatic structure; hard, friable, very sticky and very plastic; common very fine roots; common very fine tubular pores and many very fine interstitial pores; about 7 percent pebbles; visible cracks more than 1 centimeter in diameter; many pressure faces; few weak slickensides; strongly effervescent; disseminated lime and a few fine soft masses of lime; moderately alkaline; clear wavy boundary.

C2r—26 inches; weathered fractured shale; fractures are 1 to 5 centimeters apart, have no rotational displacement, and can be dug with difficulty with a spade when moist; violently effervescent; many medium irregularly shaped soft masses of lime and lime coatings on fracture faces.

Depth to paralithic contact is 20 to 40 inches. Depth to calcium carbonate is 10 to 40 inches. The profile is less than 15 percent calcium carbonate.

The A horizon has dry color of 10YR 5/3, 5/4, 6/3, or 6/4 and moist color of 10YR 4/3, 5/3, or 5/4. Clay content is 40 to 55 percent. Pebble content is 1 to 5 percent.

The C horizon has dry or moist color similar to that of the A horizon. The C horizon is silty clay or clay. Clay content is 40 to 60 percent. Pebble content is 5 to 15 percent.

Altamont Series

The Altamont series consist of deep, well drained soils on hills and mountains. These soils formed in residuum derived from sandstone or shale. Slope is 15 to 75 percent.

Soils of the Altamont series are fine, montmorillonitic, thermic Typic Chromoxererts.

Typical pedon of Altamont clay in an area of Vaquero and Altamont clays, 15 to 50 percent slopes; about 40 feet southeast of the road; in the SW1/4NW1/4SW1/4 of sec. 26, T. 23 S., R. 16 E.; Garza Peak Quadrangle.

A11—0 to 3 inches; grayish brown (10YR 5/2) clay, dark brown (10YR 3/3) moist; strong medium angular blocky structure parting to strong thick platy structure; very hard, firm, sticky and plastic; many very fine roots; many very fine tubular pores; slightly acid; abrupt wavy boundary.

A12—3 to 11 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; strong medium angular blocky structure; very hard, firm, sticky and plastic; many very fine roots; many very fine tubular pores; common intersecting slickensides; neutral; clear wavy boundary.

A13—11 to 31 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; strong very coarse angular blocky structure; very hard, very firm, sticky and very plastic; many very fine roots; common very fine tubular pores; common intersecting slickensides; neutral; clear wavy boundary.

C1ca—31 to 55 inches; yellowish brown (10YR 5/4) clay, brown (10YR 4/3) moist; massive; very hard, firm, sticky and plastic; few very fine roots; few very fine tubular pores; slightly effervescent; common fine soft masses of lime; moderately alkaline; clear wavy boundary.

C2r—55 inches; variegated pale yellow (2.5Y 7/4) and strong brown (7.5YR 5/6) highly weathered fractured sandstone; strongly effervescent; many fine filaments and seams of lime between fractures.

Depth to paralithic contact of shale or sandstone is 40 to 55 inches. Vertical cracks close in November or December and remain closed until April or May; they remain open the rest of the year.

The A horizon has dry color of 10YR 5/2 or 4/2 and moist color of 10YR 3/3 or 3/2. Clay content is 40 to 60 percent.

The C horizon has dry color of 10YR 5/4 or 5/2 or 2.5Y 6/2 and moist color of 10YR 4/3 or 4/2 or 2.5Y 4/2. Clay content is 40 to 60 percent. Reaction is mildly alkaline or moderately alkaline.

Aramburu Series

The Aramburu series consists of moderately deep, well drained soils on hills and mountains (fig. 2). These soils formed in residuum derived dominantly from sandstone or shale. Slope is 15 to 75 percent.

Soils of the Aramburu series are loamy-skeletal, mixed, thermic Pachic Haploxerolls.

Typical pedon of Aramburu very shaly clay loam, 50 to 75 percent slopes; about 2 miles east of Galainena Ranch, 2,400 feet east and 100 feet south of the northwest corner of sec. 23, T. 30 S., R. 20 E.; McKittrick Summit Quadrangle.

A11—0 to 4 inches; grayish brown (10YR 5/2) very shaly clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable, slightly sticky and plastic; many very fine roots; many very fine interstitial and tubular pores; about 45 percent distinct angular shale fragments; moderately alkaline; abrupt smooth boundary.

A12—4 to 26 inches; grayish brown (10YR 5/2) very shaly clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine interstitial and tubular pores; about 40 percent distinct angular

Figure 2.—Profile of Aramburu very shaly clay loam, 30 to 50 percent slopes.

shale fragments; moderately alkaline; clear smooth boundary.

R—26 inches; hard, fractured and folded, dark grayish brown (10YR 4/2) shale; fractures are 1 to 4 centimeters apart; some of the fractures are filled with soil material and weathered shale fragments.

Depth to lithic contact of shale or sandstone is 20 to 40 inches. The profile is 35 to 50 percent coarse fragments.

The A horizon has dry color of 10YR 5/2 or 4/2 and moist color of 10YR 3/2 or 3/3. Clay content is 27 to 35 percent. Organic matter content is 1.0 to 2.5 percent and decreases regularly as depth increases. Reaction is neutral to moderately alkaline.

Some pedons have a C horizon.

Ayar Series

The Ayar series consists of deep, well drained soils on hills and mountains. These soils formed in residuum derived dominantly from shale or fine grained sandstone. Slope is 5 to 75 percent.

Soils of the Ayar series are fine, montmorillonitic, thermic Typic Chromoxererts.

Typical pedon of Ayar silty clay in an area of Ayar-Hillbrick-Aido complex, 30 to 50 percent slopes; about 1.5 miles west of Orchard Peak, 2,050 feet east and 1,400 feet south of the northwest corner of sec. 20, T. 25 S., R. 17 E.; Orchard Peak Quadrangle.

A11—0 to 0.5 inch; brown (7.5YR 4/4) silty clay, dark brown (10YR 3/3) moist; strong fine granular structure; very hard, firm, very sticky and very plastic; common very fine roots; many very fine interstitial pores; mildly alkaline; abrupt smooth boundary.

A12—0.5 to 11 inches; brown (7.5YR 4/4) silty clay, dark brown (10YR 3/3) moist; strong medium and coarse subangular blocky structure; very hard, firm, very sticky and very plastic; common very fine roots; many very fine and fine interstitial pores and few very fine tubular pores; mildly alkaline; gradual smooth boundary.

C1—11 to 27 inches; brown (7.5YR 4/4) silty clay, dark brown (10YR 3/3) moist; strong very coarse prismatic structure parting to moderate very coarse subangular blocky; very hard, firm, very sticky and very plastic; few very fine roots; few very fine tubular pores; mildly alkaline; gradual irregular boundary.

C2—27 to 44 inches; brown (7.5YR 4/4) clay, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; very hard, firm, very sticky and very plastic; few very fine roots; few very fine interstitial pores; few slickensides; mildly alkaline; gradual irregular boundary.

R—44 inches; fine grained sandstone.

Depth to sandstone or shale is 40 to 60 inches. Cracks extend from the surface to a depth of 40 inches or to lithic contact and are 1 to 3 centimeters wide.

The A horizon has dry color of 7.5YR 4/4 or 10YR 5/3 and moist color 10YR 3/3 or 3/2. Clay content is 40 to 50 percent.

The color of the C horizon is the same as that of the A horizon. The C horizon is clay or silty clay. Clay content is 40 to 50 percent. Reaction is mildly alkaline to moderately alkaline. Few fine seams of lime that is violently effervescent are present in some pedons. Few to many slickensides are present in the lower part of the C horizon. Angular cobbles or pebbles are present in some pedons.

The Ayar soils in this survey area are taxadjunct to the Ayar series because they receive an average of less than 12 inches of precipitation annually and cracks in the soils remain open for more than 200 days. These differences, however, do not significantly affect their use and management.

Balcom Variant

The Balcom Variant consists of deep, well drained soils on hills. These soils formed in residuum derived dominantly from shale. Slope is 5 to 30 percent.

Soils of the Balcom Variant are fine, mixed, thermic Calcixerollic Xerochrepts.

Typical pedon of Balcom Variant clay loam, 5 to 30 percent slopes; about 2.75 miles southeast of Bitterwater Spring, 2,550 feet south and 1,500 feet west of the northeast corner of sec. 10, T. 28 S., R. 18 E., Packwood Creek Quadrangle.

A11—0 to 2 inches; light brownish gray (10YR 6/2) clay loam, dark brownish gray (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, very firm, sticky and plastic; common very fine roots; common very fine tubular pores and few very fine interstitial pores; violently effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

A12—2 to 20 inches; pale brown (10YR 6/3) clay, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, very firm, sticky and plastic; common very fine roots; common very fine and few fine tubular pores; violently effervescent; disseminated lime; moderately alkaline; clear wavy boundary.

C1ca—20 to 33 inches; pale brown (10YR 6/3) clay, brown (10YR 4/3) moist; massive; slightly hard, very firm, sticky and plastic; common very fine roots; violently effervescent; common very fine irregularly shaped filaments of lime and disseminated lime; moderately alkaline; clear irregular boundary.

C2ca—33 to 50 inches; white (10YR 8/1) loam, very pale brown (10YR 8/3) moist; massive; slightly hard, very firm, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; violently effervescent; common medium irregularly shaped seams of lime and disseminated lime; moderately alkaline; clear irregular boundary.

C3r—50 inches; very pale brown (10YR 8/3) weathered shale.

Depth to paralithic contact is 40 to 60 inches. Depth to the calcic horizon is less than 40 inches.

The A horizon has dry color of 10YR 6/2, 6/3, or 5/3 and moist color of 10YR 4/2 or 4/3. Clay content is 35 to 50 percent. Calcium carbonate equivalent is 10 to 15 percent.

The C horizon has dry color of 10YR 8/1, 6/2, 6/3, or 5/4 and moist color of 10YR 4/3, 5/3, 5/4, or 8/3. It is clay loam, clay, or loam. Clay content is 25 to 50 percent. Lime is disseminated or segregated, and calcium carbonate equivalent is 15 to 20 percent.

Bitterwater Series

The Bitterwater series consists of deep, well drained soils on hills. These soils formed in residuum derived dominantly from sandstone or shale. Slope is 9 to 75 percent.

Soils of the Bitterwater series are coarse-loamy, mixed (calcareous), thermic Typic Torriorthents.

Typical pedon of a Bitterwater sandy loam in an area Bitterwater-Delgado association, 9 to 30 percent slopes; about 0.75 mile southeast of Wagon Wheel Mountain, 900 feet north and 150 feet west of the southeast corner of sec. 36, T. 25 S., R. 18 E.; Emigrant Hill Quadrangle.

A11—0 to 10 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; many very fine roots; common very fine tubular pores and many very fine interstitial pores; 5 percent pebbles; strongly effervescent; disseminated lime; moderately alkaline; clear smooth boundary.

A12—10 to 23 inches; pale brown (10YR 6/3) sandy loam, dark yellowish brown (10YR 4/4) moist; moderate coarse subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; many very fine roots; many very fine interstitial pores and few very fine tubular pores; 5 percent pebbles; strongly effervescent; disseminated lime; moderately alkaline; clear smooth boundary.

C1—23 to 41 inches; light yellowish brown (10YR 6/4) sandy loam, dark yellowish brown (10YR 4/4) moist; weak very coarse subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; common very fine interstitial pores; 10 percent pebbles; violently effervescent; disseminated lime and common fine filaments of lime; moderately alkaline; clear wavy boundary.

C2—41 to 60 inches; very pale brown (10YR 7/4) sandy loam, yellowish brown (10YR 5/4) moist; weak coarse subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; common very fine interstitial pores; 10 percent pebbles; violently effervescent; disseminated lime and common fine filaments of lime; moderately alkaline; clear wavy boundary.
C3r—60 inches; soft, slightly weathered sandstone.

Depth to paralithic contact is 40 to 60 inches. Organic matter content is less than 1 percent.

The A horizon has dry color of 10YR 5/3, 6/3, or 7/3 and moist color 10YR 4/3, 4/4, 5/3, or 5/4. Clay content is 5 to 10 percent, and pebble content is 2 to 25 percent.

The C horizon has dry color of 10YR 6/4, 7/3, 7/4, 8/2, or 8/3 and moist color of 10YR 4/4, 5/3, 5/4, 6/4, 7/3, or 7/4. Texture is sandy loam or gravelly sandy loam. Clay content is 5 to 10 percent. Pebble content is 0 to 35 percent.

The Bitterwater soils in map units 117, 120, 121, and 122, which make up about 56 percent the Bitterwater soils in this survey area, are taxadjunct to the Bitterwater series because they are underlain by diatomaceous and porcelaneous bedrock, have a mollic epipedon and an ochric epipedon, and have a moisture regime that borders between xeric and aridic. These differences, however, do not significantly affect their use and management.

Bluestone Series

The Bluestone series consists of shallow, well drained soils on hills and mountains. These soils formed in residuum derived dominantly from noncalcareous shale. Slope ranges from 9 to 30 percent.

Soils of the Bluestone series are clayey, montmorillonitic, nonacid, thermic Lithic Xerorthents.

Typical pedon of a Bluestone clay in an area of Ayar-Bluestone complex, 9 to 30 percent slopes; about 1.5 miles southeast of Las Yeguas Ranch, 2,500 feet west and 1,800 feet south of the northeast corner of sec. 33, T. 28 S., R. 19 E.; Las Yeguas Quadrangle.

A11—0 to 1 inch; brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, very sticky and very plastic; few very fine roots; many very fine interstitial pores; about 10 percent shale fragments; mildly alkaline; abrupt smooth boundary.
A12—1 to 12 inches; brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; moderate coarse prismatic structure parting to moderate coarse subangular blocky; very hard, firm, very sticky and very plastic; few very fine roots; few very fine interstitial and tubular pores; about 10 percent shale fragments; mildly alkaline; clear wavy boundary.
C—12 to 16 inches; brown (7.5YR 5/4) shaly clay, dark brown (7.5YR 4/4) moist; massive; hard, firm, very sticky and very plastic; few very fine roots; few very fine interstitial pores; about 20 percent shale fragments; mildly alkaline; clear wavy boundary.
R—16 inches; hard, fractured, noncalcareous shale.

Depth to lithic contact is 10 to 20 inches. In some pedons are 5 to 10 percent cobble-sized shale fragments.

The A horizon has dry color of 7.5YR 5/4 or 10YR 5/3 or 5/4 and moist color of 7.5YR 4/4 or 10YR 3/4. Clay content is 40 to 60 percent. Shale fragment content is 0 to 15 percent.

The C horizon has dry or moist color similar to that of the A horizon. It is shaly clay or shaly clay loam. Clay content is 35 to 60 percent. Shale content is 15 to 35 percent.

Buttonwillow Series

The Buttonwillow series consists of deep, somewhat poorly drained soils in basins. These soils formed in alluvium derived dominantly from granitic rock. Slope is 0 to 2 percent.

Soils of the Buttonwillow series are clayey over loamy, montmorillonitic, nonacid, thermic Vertic Torrifluvents.

Typical pedon of Buttonwillow clay, drained; about 2 miles south of Buttonwillow, 100 feet north and 100 feet west of the southeast corner of sec. 25, T. 29 S., R. 23 E.; East Elk Hills Quadrangle.

Ap—0 to 13 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; weak and moderate very coarse and medium prismatic structure; very hard, firm, very sticky and plastic; many very fine roots; many very fine tubular pores; moderately alkaline; clear wavy boundary.
A1—13 to 28 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate very coarse prismatic structure; very hard, firm, very sticky and very plastic; few very fine roots; common very fine tubular pores and few very interstitial pores; moderately alkaline; abrupt smooth boundary.
IIC1—28 to 45 inches; light gray (5Y 7/1) fine sandy loam, gray (5Y 5/1) moist; massive; slightly hard, friable, slightly sticky and nonplastic; few very fine roots; common very fine tubular pores and many very fine interstitial pores; moderately alkaline; abrupt smooth boundary.
IIC2—45 to 55 inches; gray (5Y 6/1) fine sandy loam, dark gray (5Y 4/1) moist; massive; slightly hard, friable, slightly sticky and nonplastic; few very fine roots; many very fine tubular and interstitial pores; moderately alkaline; abrupt wavy boundary.

IIIC3—55 to 64 inches; very dark gray (5Y 3/1) clay, black (5Y 2/1) moist; massive; very hard, firm, sticky and slightly plastic; few very fine roots; many very fine tubular pores; moderately alkaline.

Thickness of the clayey material overlying the loamy material is 20 to 35 inches. Organic matter content is 1 to 3 percent to a depth of more than 20 inches, and it decreases irregularly with increasing depth.

The A horizon has dry color of 10YR 4/1, 4/2, or 5/1 and moist color 10YR 2/1, 2/2, 3/1, or 3/2. Clay content is 40 to 55 percent.

The IIC horizon has dry color of 2.5Y 7/2, 6/2, or 5/2 or 5Y 7/2, 7/1, 6/1, or 6/2 and moist color of 2.5Y 3/2 or 4/2 or 5Y 3/2, 4/1, 4/2, or 5/1. Where present, mottles are distinct and prominent. Texture ranges from loamy sand to sandy clay loam but commonly is sandy loam or fine sandy loam. Clay content is 8 to 25 percent.

The IIIC horizon, where present, has dry color of 2.5Y 6/2 or 5Y 3/1 and moist color of 2.5Y 3/2 or 5Y 3/1 or 2/1. Where present, mottles are distinct or prominent. Texture is clay loam to clay. Clay content is 35 to 50 percent.

Cajon Series

The Cajon series consists of deep, somewhat excessively drained soils on alluvial fans. These soils formed in alluvial material derived dominantly from granitic rock. Slope is 0 to 5 percent.

Soils of the Cajon series are mixed, thermic Typic Torripsamments.

Typical pedon of Cajon loamy sand, 0 to 2 percent slopes; about 2 miles north of Buena Vista Ranch, 100 feet south and 1,850 feet east of the northwest corner of sec. 34, T. 29 S., R. 25 E.; Tupman Quadrangle.

A1—0 to 9 inches; pale brown (10YR 6/3) loamy sand, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; many medium roots and few very fine roots; many medium interstitial pores; moderately alkaline; clear wavy boundary.

C1—9 to 44 inches; light gray (10YR 7/2) sand, grayish brown (10YR 5/2) moist; massive; loose, very friable, nonsticky and nonplastic; many medium and very fine roots and few fine roots; few medium tubular pores and many medium interstitial pores; moderately alkaline; abrupt smooth boundary.

IIC2—44 to 60 inches; light brownish gray (2.5Y 6/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; common medium roots and few very fine roots; many medium tubular and interstitial pores; moderately alkaline.

The A horizon has dry color of 10YR 6/3 or 7/2 and moist color of 10YR 3/2, 4/2, 5/3, or 6/2. Disseminated lime is present in some pedons. Texture is loamy sand or sandy loam. Clay content is 5 to 18 percent.

The C horizon has dry color of 10YR 6/2, 7/2, or 7/3 and moist color 10YR 4/2, 4/3, 5/3, or 5/2. Texture is loamy sand or sand. Clay content is 0 to 5 percent.

The IIC horizon, where present, has dry color of 2.5Y 6/2 or 6/4 and moist color of 2.5Y 4/2 or 4/4. Texture is stratified sandy loam or fine sandy loam. Clay content is 5 to 10 percent.

Capay Series

The Capay series consists of deep, moderately well drained soils on alluvial plains and in narrow mountain valleys. These soils formed in alluvial material derived dominantly from shale. Slope is 2 to 9 percent.

Soils of the Capay series are fine, montmorillonitic, thermic Typic Chromoxererts.

Typical pedon of Capay silty clay, 2 to 9 percent slopes; about 2 miles north of Annette, 400 feet east and 2,300 feet south of the northwest corner of sec. 7, T. 26 S., R. 17 E.; Orchard Peak Quadrangle.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silty clay, black (10YR 2/1) moist; moderate fine subangular blocky structure; extremely hard, firm, sticky and plastic; many very fine roots; common very fine tubular pores; neutral; clear smooth boundary.

A1—9 to 23 inches; very dark grayish brown (10YR 3/2) silty clay, very dark brown (10YR 2/2) moist; weak fine angular blocky structure; extremely hard, firm, sticky and plastic; many very fine roots; common very fine tubular pores; mildly alkaline; gradual smooth boundary.

C1—23 to 36 inches, dark brown (10YR 3/3) silty clay, very dark grayish brown (10YR 3/2) moist; weak medium angular blocky structure; extremely hard, firm, sticky and plastic; common very fine roots; few very fine tubular pores; slightly effervescent; disseminated lime; mildly alkaline; gradual smooth boundary.

C2—36 to 64 inches; brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; weak medium angular blocky structure; extremely hard, firm, sticky and plastic; common very fine roots; many very fine pores; violently effervescent; common fine irregularly shaped filaments of lime; mildly alkaline.

The A horizon has dry color of 10YR 3/1 or 3/2 and moist color of 10YR 2/1 or 2/2. Reaction is neutral to moderately alkaline. Clay content is 40 to 60 percent.

The C horizon has dry color of 10YR 3/3, 5/3, 5/4, 6/3, 6/4, or 7/4 and moist color of 10YR 2/1, 2/2, 3/2, or 4/3. Texture is clay loam or silty clay. Clay content is 40 to 60 percent.

The Capay soils in this survey area are taxadjunct to the Capay series because they are at elevations of more than 1,200 feet and cracks in them remain open for more than 150 days. These differences, however, do not significantly affect their use and management.

Carollo Series

The Carollo series consists of moderately deep, well drained soils on hills. These soils formed in residuum derived dominantly from shale. Slope is 5 to 15 percent.

Soils of the Carollo series are fine, montmorillonitic, thermic Typic Natrargids.

Typical pedon of a Carollo clay loam in an area of Carollo-Twisselman, saline-alkali, association, 2 to 15 percent slopes; about 4 miles east of Devils Den and 1 mile south of the Kings County line, 500 feet south and 1,400 feet east of the northwest corner of sec. 10, T. 25 S., R. 19 E.; Avenal Gap Quadrangle.

A1—0 to 2 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; hard, friable, sticky and very plastic; many very fine roots; many very fine tubular pores; common very fine interstitial and vesicular pores; moderately alkaline; clear smooth boundary.

B21tcs—2 to 6 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; moderate coarse angular blocky structure; very hard, friable, very sticky and very plastic; many very fine roots; common very fine interstitial and tubular pores; few thin clay films in pores and on peds; few fine irregularly shaped gypsum crystals; moderately alkaline; clear wavy boundary.

B22tcssa—6 to 15 inches; brown (10YR 5/3, dry or moist) clay; strong coarse columnar structure; very hard, friable, very sticky and very plastic; few very fine roots; many very fine tubular pores and few very fine interstitial pores; many thin clay films on peds and many thin and few moderately thick clay films in pores; few fine irregularly shaped gypsum crystals; moderately alkaline; clear wavy boundary.

C1cs—15 to 30 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak coarse angular blocky structure; very hard, friable, very sticky and very plastic; few very fine roots; common very fine tubular pores and few very fine vesicular pores; common fine irregularly shaped gypsum crystals; moderately alkaline; gradual wavy boundary.

C2r—30 inches; light gray (2.5Y 7/2) and reddish yellow (7.5YR 6/6) soft highly weathered shale fragments that retain rock structure and are in about normal orientation with some soil material in fractures of the rock.

Depth to weathered shale is 20 to 40 inches.

The A horizon has dry color of 10YR 5/2, 5/4, or 6/3 and moist color of 10YR 4/2, 4/3, 5/2, or 5/3. Reaction is neutral to moderately alkaline. Clay content is 27 to 32 percent.

The B2t horizon has dry color of 10YR 5/3, 5/4, 6/2, 6/3, or 6/4 and moist color of 10YR 4/2, 4/3, 5/2, 5/3, or 5/4. Texture is clay or silty clay. Clay content is 40 to 60 percent. Accumulation of calcium sulfate is more than 2 percent. The exchangeable sodium percentage is 15 to 40.

The C horizon has dry color of 10YR 6/3 or 6/4 or 2.5Y 7/2 and moist color of 10YR 5/3 or 5/3 or 2.5Y 5/2. Clay content is 30 to 40 percent. Mottles, where present, are common in the profile. In most pedons a layer of clear, nearly pure, highly fractured, crystalline gypsum one-eight to one-half inch thick overlays the C horizon.

Chanac Series

The Chanac series consists of deep, well drained soils on old alluvial fans and terraces (fig. 3). These soils formed in alluvial material derived dominantly from granitic rock. Slope is 2 to 30 percent.

Soils of the Chanac series are fine-loamy, mixed, thermic Calcixerollic Xerochrepts.

Typical pedon of Chanac clay loam, 2 to 9 percent slopes; about 3 miles southeast of Richgrove; 100 feet west and 1,650 feet south of the northeast corner of sec. 4, T. 25 S., R. 27 E.; Richgrove Quadrangle.

Ap—0 to 4 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and common fine roots; few very fine tubular pores and common very fine interstitial pores; mildly alkaline; abrupt smooth boundary.

A1—4 to 18 inches; brown (10YR 5/3) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; few very fine tubular pores and common very fine interstitial pores; strongly effervescent; common irregularly shaped fine filaments of lime; moderately alkaline; abrupt wavy boundary.

B2tca—18 to 36 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; moderate coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine interstitial pores; few moderately thick clay films on peds and in pores; violently effervescent; many irregularly shaped medium-sized soft masses of lime and many filaments and concretions of lime; moderately alkaline; clear wavy boundary.

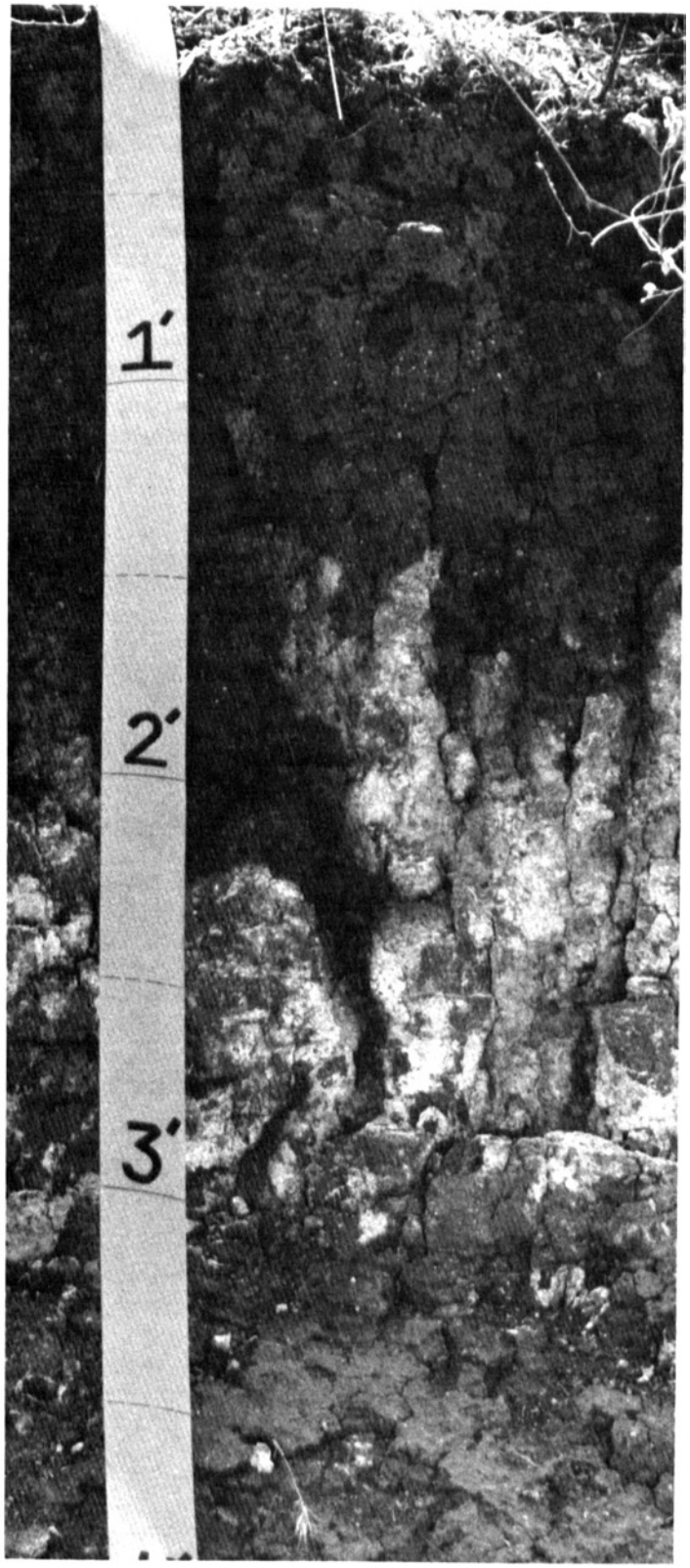

Figure 3.—Profile of Chanac clay loam, 9 to 15 percent slopes. Accumulations of lime are at a depth of 18 inches.

B3tca—36 to 46 inches; brown (7.5YR 5/4) sandy loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine interstitial pores; many moderately thick clay films on peds and in pores; violently effervescent; many irregularly shaped medium-sized soft masses of lime and many filaments and concretions of lime; moderately alkaline; clear wavy boundary.

C—46 to 60 inches; light brown (7.5YR 6/4) sandy loam, dark brown (7.5YR 4/4) moist; few medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine interstitial pores; slightly effervescent; common irregularly shaped fine soft masses of lime and common concretions of lime; moderately alkaline.

The A horizon has dry color of 10YR 5/2 or 5/3 and moist color of 10YR 3/2 or 3/3. Clay content is 27 to 35 percent.

The B horizon has dry color of 10YR 5/3, 6/4, or 7/4 or 7.5YR 5/4 and moist color of 10YR 3/3, 4/4, or 5/4 or 7.5YR 4/4 or 5/4. Texture is sandy loam, sandy clay loam, or clay loam. Clay content is 18 to 35 percent.

The C horizon has dry color of 10YR 5/4 or 6/4 or 7.5YR 6/4 or 6/6 and moist color of 10YR 3/3, 4/3, or 4/4 or 7.5YR 4/4 or 5/6. Texture is coarse sandy loam, sandy loam, or loam. Clay content is 15 to 20 percent.

Choice Series

The Choice series consists of deep, well drained soils on hills and mountains. These soils formed in residuum derived dominantly from shale. Slope is 5 to 30 percent.

Soils of the Choice series are fine, mixed (calcareous), thermic Typic Xerorthents.

Typical pedon of Choice clay, 5 to 30 percent slopes; about 0.25 mile south of Bitterwater Spring, 200 feet north and 1,000 feet east of the southwest corner of sec. 5, T. 28 S., R. 18 E.; Packwood Creek Quadrangle.

A11—0 to 2 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; strong fine and medium granular structure; slightly hard, friable, very sticky and very plastic; many very fine roots; many fine and medium interstitial pores; violently effervescent; disseminated lime; moderately alkaline; clear smooth boundary.

A12—2 to 16 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; moderate subangular blocky structure; slightly hard, friable, very sticky and very plastic; common very fine roots; many very fine tubular pores and common very fine interstitial pores; violently effervescent; disseminated lime; moderately alkaline; clear wavy boundary.

C1—16 to 23 inches; variegated light brownish gray (10YR 6/2) and light gray (10YR 7/2) clay, grayish brown (10YR 5/2) and light gray (10YR 7/2) moist; strong coarse and very coarse prismatic structure; slightly hard, friable, very sticky and very plastic; common very fine roots; common very fine tubular pores; violently effervescent; disseminated lime; many large seams of gypsum; moderately alkaline; clear wavy boundary.

C2—23 to 60 inches; variegated light brownish gray (10YR 6/2) and light gray (10YR 7/2) clay, dark grayish brown (10YR 4/2) and light gray (10YR 7/2) moist; few fine distinct brown (10YR 5/3) mottles, dark brown (10YR 4/3) moist; weak coarse angular blocky structure; slightly hard, friable, very sticky and very plastic; few very fine roots; few very fine tubular pores; violently effervescent; disseminated lime; common medium soft masses of gypsum and a few crystals of gypsum as much as 3 centimeters in diameter; moderately alkaline; clear wavy boundary.

C3r—60 to 65 inches; weathered fractured shale; fractures are 1 to 5 centimeters apart and have no rotational displacement; can be dug with difficulty with a spade when moist.

Depth to paralithic contact is 55 to 60 inches. Shale content is 0 to 5 percent and fragments commonly are less than 2 centimeters in diameter.

The A horizon has dry color of 10YR 6/2 or 5/2 or 2.5Y 6/2 and moist color of 10YR 4/2 or 3/2 or 2.5Y 5/2. Clay content is 40 to 60 percent.

The C horizon has dry color of 10YR 6/2 or 7/2, 2.5Y 6/2, or 5Y 5/2 or 7/2 and moist color of 10YR 4/2, 4/3, 5/2, or 7/2, 2.5Y 5/2, or 5Y 4/3. Texture is clay or silty clay. Clay content is 40 to 60 percent. Gypsum crystals commonly are present in the C horizon.

Cuyama Series

The Cuyama series consists of deep, well drained soils on dissected alluvial fans and stream terraces. These soils formed in alluvium derived dominantly from granitic rock. Slope is 2 to 30 percent.

Soils of the Cuyama series are fine-loamy, mixed, thermic Xeralfic Haplargids.

Typical pedon of Cuyama loam, 2 to 9 percent slopes; about 1.5 miles east of Bakersfield Country Club, 1,800 feet east and 2,300 feet south of the northwest corner of sec. 19, T. 29 S., R. 29 E.; Oil Center Quadrangle.

A11—0 to 3 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; moderate coarse subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common very fine roots; many very fine interstitial pores and common fine tubular pores; violently effervescent; disseminated lime; 10 percent pebbles; moderately alkaline; abrupt wavy boundary.

A12—3 to 8 inches; light yellowish brown (10YR 6/4) loam, brown (10YR 4/3) moist; weak moderate subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common very fine roots; many very fine interstitial pores and common fine tubular pores; violently effervescent; disseminated lime; 10 percent pebbles; moderately alkaline; clear wavy boundary.

B1tca—8 to 18 inches; yellowish brown (10YR 5/4) loam, dark yellowish brown (10YR 4/4) moist; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; few very fine roots; many very fine tubular pores and few very fine interstitial pores; few thin clay films on ped faces, in pores, and bridging sand grains; violently effervescent; disseminated lime and many large filaments and soft masses of lime; 10 percent pebbles; moderately alkaline; clear wavy boundary.

B2tca—18 to 36 inches; reddish yellow (7.5YR 6/6) gravelly clay loam, strong brown (7.5YR 5/6) moist; weak fine prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular and interstitial pores; many thin clay films bridging sand grains, on ped faces, and in pores; violently effervescent; disseminated lime and common fine filaments and soft masses of lime; 20 percent pebbles and 5 percent cobbles; moderately alkaline; clear wavy boundary.

IIC1—36 to 56 inches; yellow (10YR 7/6) very cobbly sandy clay loam, dark yellowish brown (10YR 4/6) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; few very fine roots; common very fine tubular pores and many very fine interstitial pores; violently effervescent; disseminated lime and few fine soft masses of lime; 20 percent cobbles and 20 percent pebbles; moderately alkaline; clear wavy boundary.

IIC2—56 to 65 inches; yellow (10YR 7/6) sandy clay loam, dark yellowish brown (10YR 4/6) moist; massive; slightly hard, friable, nonsticky and nonplastic; few very fine roots; common very fine tubular pores and many very fine interstitial pores; violently effervescent; disseminated lime and few fine soft masses of lime; 10 percent pebbles; moderately alkaline.

Thickness of the solum is 26 to 46 inches, but it averages 39 inches. Cobbles are absent in the A horizon surface layer but generally are present in the Btca and IIC horizons.

The A horizon has dry color of 10YR 4/3, 5/3, 5/4, 5/6, 6/3, or 6/4 and moist color of 10YR 3/4, 4/3, or 4/4. Clay content is 10 to 20 percent. Pebble content is 0 to 10 percent. Organic carbon content is less than 0.5 percent, and it decreases regularly with increasing depth. Reaction is mildly alkaline or moderately alkaline.

The B2tca horizon has dry color of 10YR 4/6, 5/6, or 6/6 or 7.5YR 5/4, 5/6, or 6/6 and moist color of 10YR 3/6 or 4/6 or 7.5YR 4/6, 5/6, or 6/6. It is sandy clay loam, loam, or clay loam. Clay content is 20 to 35 percent. Pebble content is 5 to 30 percent. Cobble content is 0 to 10 percent. Reaction is mildly alkaline or moderately alkaline.

The C horizon has dry color of 10YR 6/4, 6/6, or 7/6 or 7.5YR 5/6 and moist color of 10YR 4/4, 4/6, or 5/6 or 7.5YR 4/6 or 5/6. It is sandy clay loam, silt loam, loam, sandy loam, or loamy sand. Clay content is 10 to 30 percent. The horizon is 5 to 20 percent cobbles and 5 to 20 percent gravel. In some pedons this horizon is stratified. Exchangeable sodium percentage is 10 to 25.

Cymric Series

The Cymric series consists of shallow, well drained soils on stream terraces. These soils formed in alluvium derived dominantly from sedimentary rock. Slope is 5 to 30 percent.

Soils of the Cymric series are loamy, mixed, thermic, shallow Xerollic Durorthids.

Typical pedon of Cymric loam, 5 to 30 percent slopes; about 2.5 miles south of Gould Hill, 1,450 feet south and 910 feet west from the northeast corner of sec. 25, T. 29 S., R. 20 E.; Carneros Rocks Quadrangle.

A11—0 to 5 inches; pale brown (10YR 6/3) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial and tubular pores; 10 percent pebbles; violently effervescent; disseminated lime; moderately alkaline; clear smooth boundary.

A12—5 to 15 inches; pale brown (10YR 6/3) loam, dark brown (10YR 3/3) moist; moderate coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial and tubular pores; 10 percent pebbles; violently effervescent; disseminated lime; moderately alkaline; abrupt wavy boundary.

C1sicam—15 to 21 inches; white (10YR 8/2) indurated silica-lime duripan, very pale brown (10YR 7/3) moist; extremely hard; upper 0.5 inch of duripan consists of a very pale brown (10YR 7/3) laminar layer or opalized band, 0.5 to 2.0 millimeters thick, with fine roots matted on the surface of the layer; violently effervescent; moderately alkaline; abrupt wavy boundary.

C2ca—21 to 61 inches; white (10YR 8/2) sandy loam, very pale brown (10YR 7/3) moist; moderate medium platy structure; weakly cemented; hard, friable, nonsticky and nonplastic; 10 percent pebbles; violently effervescent; seams and common medium concretions of lime; moderately alkaline.

Depth to the duripan is 8 to 20 inches. Organic matter content in the upper 16 inches is 1.0 to 2.5 percent.

The A horizon has dry color of 10YR 6/2, 6/3, 7/2, or 7/3 and moist color of 10YR 3/2, 3/3, 4/2, 4/3, or 5/3. Pebble content is 5 to 10 percent. Clay content is 12 to 25 percent.

The C1sicam horizon has dry color of 10YR 7/3, 8/1, 8/2, or 8/3 and moist color of 10YR 7/3 or 7/2. This horizon is stratified with thin laminar layers and strongly to weakly silica cemented material. The uppermost 0.5 to 1.0 inch is a 10YR 7/3 laminar capping containing no pores.

The C2ca horizon is weakly cemented sandy loam or loamy sand that has color similar to that of the C1sicam horizon. Clay content is 5 to 15 percent. Pebble content is 10 to 15 percent.

Delano Series

The Delano series consists of deep, well drained soils on alluvial fans, plains, and terraces. These soils formed in alluvium derived dominantly from granitic rock. Slope is 0 to 9 percent.

Soils of the Delano series are fine-loamy, mixed, thermic Xeralfic Haplargids.

Typical pedon of Delano sandy loam, 0 to 2 percent slopes; about 2 miles west of Famoso-Woody Road and Highway 65, 70 feet west and 550 feet south of the northeast corner of sec. 12, T. 27 S., R. 26 E.; north of Oildale Quadrangle.

Ap1—0 to 6 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; moderate subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine interstitial and tubular pores; slightly effervescent; disseminated lime; moderately alkaline; abrupt wavy boundary.

Ap2—6 to 11 inches; pale brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) moist; moderate medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; many very fine interstitial and tubular pores; strongly effervescent; disseminated lime; moderately alkaline; abrupt wavy boundary.

B21tca—11 to 22 inches; light brown (7.5YR 6/4) clay loam, dark brown (7.5YR 4/4) moist; moderate medium prismatic structure parting to moderate medium angular blocky; hard, firm, sticky and plastic; common very fine roots; few very fine interstitial pores and common very fine tubular pores; continuous moderately thick clay films on peds and in pores; violently effervescent; common irregularly shaped fine filaments of lime; moderately alkaline; abrupt wavy boundary.

B22tca—22 to 36 inches; light brown (7.5YR 6/4) sandy clay loam, dark brown (7.5YR 4/4) moist; strong coarse prismatic structure parting to moderate coarse subangular blocky; very hard, very firm, slightly sticky and plastic; common very fine roots; common very fine interstitial and tubular pores; many moderately thick clay films on peds and in pores; violently effervescent; common irregularly shaped fine filaments and seams of lime; moderately alkaline; abrupt smooth boundary.

B3tca—36 to 42 inches; light brown (7.5YR 6/4) heavy sandy loam, dark brown (7.5YR 4/4) moist; moderately coarse and medium subangular blocky structure; hard, firm, slightly sticky and plastic; common very fine roots; common very fine interstitial and tubular pores; common moderately thick clay films on peds and in pores; violently effervescent; common irregularly shaped fine filaments or threads of lime; moderately alkaline; abrupt smooth boundary.

C—42 to 63 inches; light yellowish brown (10YR 6/4) sandy loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine interstitial pores and few very fine tubular pores; strongly effervescent; few irregularly shaped fine filaments of lime; moderately alkaline.

Content of rock fragments, commonly less than 0.5 inch in diameter, is 0 to 5 percent. The solum is more than 40 inches thick.

The A horizon has dry color of 10YR 5/4, 5/3, 6/3, or 6/4 and moist color of 10YR 3/3, 4/2, 4/3, or 4/4. Reaction is mildly alkaline or moderately alkaline. Texture is sandy loam or sandy clay loam. Clay content is 10 to 27 percent.

The B2t horizon has dry color of 10YR 5/2, 5/4, 6/3, 6/4, or 6/6 or 7.5YR 5/4, 5/6, or 6/4 and moist color of 10YR 4/3, 4/4, or 5/4 or 7.5YR 4/4. Texture is loam, clay loam, or sandy clay loam that is 20 to 35 percent clay. Few to common thin clay films or common to many moderately thick clay films are on peds and in pores.

The C horizon has dry color of 10YR 5/3, 6/3, 6/4, or 7/3 or 7.5YR 5/6 or 6/4 and moist color of 10YR 4/3, 4/4, 5/3, or 5/4 or 7.5YR 4/4. Texture is sandy loam or loam. Clay content is 10 to 27 percent. Some pedons have gypsum crystals in the C horizon.

Delano Variant

The Delano Variant consists of deep, well drained soils on alluvial plains and terraces. These soils formed in alluvium material derived dominantly from granitic rock. Slope is 0 to 9 percent.

The Delano Variant soils are fine, mixed, thermic Typic Haploxeralfs.

Typical pedon of Delano Variant clay loam, 0 to 9 percent slopes; about 3 miles southeast of Richgrove, 2,150 feet east and 2,400 feet south of the northwest corner of sec. 4, T. 25 S., R. 27 E.; Richgrove Quadrangle.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate coarse subangular blocky structure; extremely hard, very firm, sticky and very plastic; few very fine roots; few very fine tubular pores; slightly effervescent; disseminated lime; mildly alkaline; clear wavy boundary.

B1t—8 to 23 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate coarse subangular blocky structure; extremely hard, very firm, sticky and very plastic; few very fine roots; few very fine tubular pores; many thin clay films on peds and in pores; slightly effervescent; disseminated lime; mildly alkaline; clear wavy boundary.

B2tca—23 to 31 inches; variegated grayish brown (10YR 5/2) and brown (7.5YR 5/4) clay, dark grayish brown (10YR 4/2) and dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; extremely hard, very firm, sticky and very plastic; few very fine roots; few very fine tubular pores; common thin clay films on peds and in pores; violently effervescent; few fine filaments and soft masses of lime; moderately alkaline; gradual irregular boundary.

IIC1ca—31 to 57 inches; light brown (7.5YR 6/4) sandy loam, dark brown (7.5YR 4/4) moist; massive; hard, firm, nonsticky and slightly plastic; few very fine roots; common very fine interstitial pores; many thin clay bridges; violently effervescent; few fine filaments and common medium soft masses of lime; moderately alkaline; gradual wavy boundary.

IIC2—57 to 69 inches; light brown (7.5YR 6/4) coarse sandy loam, brown (7.5YR 5/4) moist; massive; soft, loose, nonsticky and nonplastic; few very fine roots; many very fine and fine interstitial pores; moderately alkaline.

The profile is 1 to 5 percent granitic gravel.

The A horizon has dry color of 10YR 5/3, 4/3, or 4/2 and moist color of 10YR 4/2 or 3/2. Reaction is slightly acid to mildly alkaline. Clay content is 27 to 35 percent.

The B2t horizon has dry color of 10YR 5/2, 4/2, or 4/3 or 7.5YR 5/4 or 6/4 and moist color of 10YR 4/2 or 3/2 or 7.5YR 4/4. Texture is clay loam or clay. Clay content is 30 to 45 percent. Reaction is mildly alkaline to moderately alkaline.

The IIC horizon has dry color of 7.5YR 6/4 or 5/6 and moist color 7.5YR 5/4 or 4/4. Texture is dominantly coarse sandy loam, sandy loam, or loam, but clay loam is present in some pedons. Clay content is 10 to 20 percent.

Delgado Series

The Delgado series consists of shallow, somewhat excessively drained soils on hills. These soils formed in residuum derived dominantly from sedimentary rock. Slope is 5 to 75 percent.

Soils of the Delgado series are loamy, mixed (calcareous), thermic Lithic Torriorthents.

Typical pedon of Delgado sandy loam in an area of Kettleman-Delgado-Rock outcrop complex, 15 to 50 percent slopes; about 5 miles northeast of Kecks Corner, 2,200 feet west and 1,000 feet south of the northeast corner of sec. 27, T. 25 S., R. 18 E.; Sawtooth Ridge Quadrangle.

A1—0 to 2 inches; brown (10YR 5/3) sandy loam, brown (10YR 4/3) moist; weak coarse subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many very fine roots; few very fine tubular pores and common very fine interstitial pores; slightly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

C1—2 to 6 inches; yellowish brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 4/4) moist; massive; hard, friable, slightly sticky and nonplastic; many very fine roots; few very fine tubular pores and common very fine interstitial pores; slightly effervescent; disseminated lime; moderately alkaline; clear smooth boundary.

C2—6 to 10 inches; yellowish brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 4/4) moist; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common very fine roots; common very fine tubular pores and few very fine interstitial pores; slightly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

R—10 inches; hard sandstone that does not slake in water; 4 to 9 inches between cracks and no soil in cracks.

Depth to sandstone or shale is 7 to 20 inches. The profile is 0 to 30 percent rock fragments 2 millimeters to 7 centimeters in diameter.

The A horizon has dry color of 10YR 5/3, 5/4, 5/6, 6/3, or 6/4 and moist color of 10YR 4/4, 4/3, or 3/3. Clay content is 8 to 20 percent. Reaction is mildly alkaline to moderately alkaline.

The C horizon has color of 10YR 5/4, 6/3, or 6/4 and moist color of 10YR 5/3, 4/4, or 4/3. Texture is sandy loam or fine sandy loam. Clay content is 8 to 20 percent.

Driver Series

The Driver series consists of deep, well drained soils on alluvial terraces. These soils formed in alluvium material derived dominantly from granitic rock. Slope is 0 to 2 percent.

Soils of the Driver series are fine-loamy, mixed, thermic Duric Haplargids.

Typical pedon of Driver coarse sandy loam, 0 to 2 percent slopes; about one-eighth mile northeast of Merced Avenue and Highway 99, 250 feet east and 250 feet north of the southwest corner of sec. 33, T. 27 S., R. 26 E.; Famoso Quadrangle.

Ap—0 to 16 inches; yellowish brown (10YR 5/4) coarse sandy loam, dark yellowish brown (10YR 3/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; few very fine interstitial pores; 10 percent pebbles; slightly effervescent; disseminated lime; mildly alkaline; clear smooth boundary.

B21t—16 to 23 inches; yellowish brown (10YR 5/6) loam, dark yellowish brown (10YR 4/6) moist; weak medium angular blocky structure; hard, firm, slightly sticky and plastic; few fine and very fine roots; few very fine interstitial and tubular pores; common thin clay films on ped faces and in pores; 5 percent pebbles; violently effervescent; common medium soft masses of lime; moderately alkaline; clear smooth boundary.

B22t—23 to 27 inches; yellowish brown (10YR 5/6) loam, dark yellowish brown (10YR 4/6) moist; weak medium angular blocky structure; hard, firm, slightly sticky and plastic; few fine and very fine roots; common very fine tubular pores; common thin and few moderately thick clay films on ped faces and lining pores; 5 percent pebbles; violently effervescent; few medium soft masses of lime; moderately alkaline; gradual smooth boundary.

C1si—27 to 37 inches; brown (7.5YR 5/4) coarse sandy loam, dark yellowish brown (10YR 3/6) moist; massive; very hard, firm, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; 10 percent pebbles; slightly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

IIC2—37 to 44 inches; yellowish brown (10YR 5/6) loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; 2 percent pebbles; moderately alkaline; abrupt smooth boundary.

IIIC3—44 to 65 inches; pale brown (10YR 6/3) loamy coarse sand, brown (10YR 4/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; common very fine interstitial pores; 15 percent pebbles; slightly effervescent; disseminated lime; moderately alkaline.

Thickness of solum is 22 to 35 inches. Pebble content is 0 to 15 percent.

The A horizon has dry color of 10YR 6/4, 6/3, 5/4, or 5/3 and moist color of 10YR 5/3, 4/4, 4/3, or 3/4. Clay content is 8 to 20 percent.

The B2t horizon has dry color of 10YR 5/4, 5/6, or 6/4 or 7.5YR 5/4 or 5/6 and moist color of 10YR 3/6, 4/4, or 4/6 or 7.5YR 4/4. Texture is loam or clay loam. Clay content is 20 to 35 percent. The Bt horizon has 5 to 20 percent more clay than does the A horizon. In some pedons the lower part of the Bt horizon is weakly cemented with silica.

The upper part of the C horizon has dry color of 7.5YR 5/4 or 10YR 5/6 or 6/4 and moist color of 10YR 3/6, 4/3, or 4/4. The weakly silica cemented material crushes to sandy loam or coarse sandy loam. Clay content is 8 to 15 percent. Structure is massive or moderate subangular blocky. Content of rock fragments is 5 to 10 percent throughout the horizon.

The lower part of the C horizon has dry color of 10YR 5/4, 5/6, 6/3, or 6/4 and moist color of 10YR 4/3 or 4/4. It commonly is stratified with loam, sandy loam, coarse sandy loam, or loamy coarse sand. Clay content is 5 to 20 percent. Pebbles content is 2 to 15 percent.

Elkhills Series

The Elkhills series consists of deep, well drained soils on terraces and hills. These soils formed in alluvium derived dominantly from weathered sedimentary and granitic rock. Slope is 9 to 50 percent.

Soils of the Elkhills series are coarse-loamy, mixed (calcareous), thermic Typic Torriorthents.

Typical pedon of an Elkhills sandy loam in an area of Torriorthents, stratified, eroded-Elkhills complex, 9 to 50 percent slopes; about 1.5 miles northwest of the junction of Skyline Road and Elk Hills Road, near oil well number 372; 1,150 feet west and 550 feet south of the northeast corner of sec. 27, T. 30 S., R. 23 E.; East Elk Hills Quadrangle.

A11—0 to 7 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; weak coarse subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; few very fine interstitial pores and common very fine tubular pores; strongly effervescent; disseminated lime; moderately alkaline; clear smooth boundary.

A12—7 to 29 inches; light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; weak coarse subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; few very fine interstitial pores and common very fine tubular pores; violently effervescent; disseminated lime; moderately alkaline (pH 8.0); gradual smooth boundary.

IIC1—29 to 49 inches; very pale brown (10YR 7/4) coarse sandy loam, yellowish brown (10YR 5/4) moist; massive; very hard, friable, slightly sticky and slightly plastic; about 10 percent of horizon is weakly cemented and brittle and firm when moist; few very fine roots; few very fine interstitial and tubular pores; 5 percent pebbles; violently effervescent; disseminated lime; moderately alkaline; clear smooth boundary.

IIIC2—49 to 65 inches; light gray (10YR 7/2) stratified gravelly coarse sand, sand, and loamy sand, light yellowish brown (10YR 6/4) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; many very fine interstitial pores; 20 percent pebbles; strongly effervescent; disseminated lime; moderately alkaline.

The profile is slightly effervescent to violently effervescent throughout. Lime commonly is disseminated, but it is segregated in some areas. Rounded pebbles make up 0 to 30 percent of the profile.

The A horizon has dry color of 10YR 7/4, 7/3, 6/4, 6/3, or 5/4 and moist color of 10YR 5/4, 5/3, 4/4, 4/3, or 3/3. Clay content is 6 to 18 percent.

The C horizon has dry color of 10YR 8/3, 8/2, 7/4, 7/3, 7/2, or 6/3 and moist color of 10YR 7/4, 7/3, 6/4, 5/6, 5/4, 5/3, or 5/2. Texture is sandy loam, coarse sandy loam, gravelly sandy loam, or loam. Clay content is 5 to 18 percent. The lower part of the C horizon is stratified with gravelly coarse sand to silt loam.

Excelsior Series

The Excelsior series consists of deep, well drained soils on alluvial fans. These soils formed in alluvium derived from mixed rock sources. Slope is 0 to 2 percent.

Soils of the Excelsior series are coarse-loamy, mixed (calcareous), thermic Typic Torrifluvents.

Typical pedon of Excelsior sandy loam that has slopes of 1 percent; about 0.5 mile southwest of Stevens, 100 feet north and 100 feet west of the southeast corner of sec. 17, T. 29 S., R. 26 E.; Stevens Quadrangle.

Ap—0 to 7 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine and fine roots; many very fine interstitial pores and common fine tubular pores; slightly effervescent; disseminated lime; moderately alkaline; clear smooth boundary.

C1—7 to 32 inches; light brownish gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) moist; massive; loose, nonsticky and nonplastic; few very fine roots; many very fine interstitial pores and few very fine tubular pores; slightly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

IIC2—32 to 44 inches; light gray (5Y 7/2) silt loam, dark olive gray (5Y 3/2) moist; common fine distinct very pale brown (10YR 7/4), mottles dark yellowish

brown (10YR 4/6) moist; weak coarse subangular blocky structure; slightly hard, friable, sticky and slightly plastic; few very fine roots; many very fine tubular pores and common very fine interstitial pores; slightly effervescent; disseminated lime; moderately alkaline; clear smooth boundary.

IIIC3—44 to 50 inches; light gray (2.5Y 7/2) sandy loam, dark grayish brown (10YR 4/2) moist; common moderate distinct strong brown (7.5YR 4/6) mottles, dark yellowish brown (10YR 4/6) moist; weak coarse subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; many very fine interstitial and tubular pores; slightly effervescent; disseminated lime; moderately alkaline; clear smooth boundary.

IVC4—50 to 61 inches; light olive gray (5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; few fine prominent brownish yellow (10YR 6/6) mottles, dark yellowish brown (10YR 4/6) moist; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores and few very fine interstitial pores; slightly effervescent; disseminated lime; moderately alkaline.

The organic matter content is less than 1 percent at the surface and decreases irregularly with increasing depth.

The A horizon has dry color of 10YR 5/2, 5/3, 7/1, or 7/2 or 2.5Y 6/2 or 6/3 and moist color of 10YR 4/2, 4/3, or 5/2. Clay content is 5 to 15 percent.

The upper part of the C horizon has dry color of 10YR 6/2 or 7/3, 5Y 6/2, or 2.5Y 6/2 and moist color of 2.5Y 4/2 or 4/4, 5Y 4/1, or 4/2, 5YR 4/1, or 10YR 4/2 or 4/3. It is loamy sand or sandy loam. The lower part is stratified and has dry color of 2.5Y 4/2 or 4/4, 5Y 3/2, 4/2, 4/3, 5/1, 5/2, or 7/2, or 10YR 3/1, 4/2, or 5/2 and moist color of 10YR 4/2 or 4/3, 2.5Y 4/2 or 4/4, or 5Y 3/2 or 4/2. Mottles have moist color of 10YR 4/2 or 4/6. Texture is stratified sandy loam to silt loam. Clay content is 8 to 18 percent.

Excelsior Variant

The Excelsior Variant consists of deep, moderately well drained soils on low stream terraces and flood plains. These soils formed in alluvial material derived dominantly from granitic rock. Slope is 0 to 2 percent.

Excelsior Variant soils are coarse-loamy, mixed, nonacid, thermic Xeric Torrifluvents.

Typical pedon of Excelsior Variant silt loam on a flood plain where slopes are 2 percent; about 900 feet north of Kern River, 3,200 feet west and 1,000 feet north of the southeast corner of sec. 8, T. 29 S., R. 28 E.; Oil Center Quadrangle.

A11—0 to 11 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak very coarse subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; many very fine and few fine roots; many very fine tubular pores and common very fine interstitial pores; slightly effervescent; disseminated lime and few fine irregularly shaped soft masses of lime; moderately alkaline; clear smooth boundary.

IIC1—11 to 18 inches; light gray (10YR 7/2) loamy fine sand, dark brown (10YR 3/3) moist; weak moderate subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; many very fine and few fine roots; many very fine tubular pores and common very fine interstitial pores; moderately alkaline; clear smooth boundary.

IIIC2—18 to 20 inches; light gray (10YR 7/2) fine sand, very dark grayish brown (10YR 3/2) moist; massive; loose, nonsticky and nonplastic; common very fine and few fine roots; common very fine tubular and interstitial pores; mildly alkaline; clear smooth boundary.

IVC3—20 to 25 inches; light gray (10YR 7/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; common fine prominent yellowish brown (10YR 5/6) mottles, dark yellowish brown (10YR 3/6) moist; weak coarse subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common very fine and few fine roots; common very fine interstitial and tubular pores; neutral; clear wavy boundary.

VC4—25 to 32 inches; light gray (10YR 7/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; common fine prominent yellowish brown (10YR 5/6) mottles, dark yellowish brown (10YR 3/6) moist; weak fine subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few fine and very fine roots; few fine and very fine tubular pores and common very fine interstitial pores; slightly acid; clear wavy boundary.

VC5—32 to 38 inches; very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) moist; common fine prominent yellowish brown (10YR 5/6) mottles, dark yellowish brown (10YR 3/6) moist; weak moderate subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common very fine roots; common very fine interstitial and tubular pores; slightly acid; clear smooth boundary.

VIC6—38 to 40 inches; brownish yellow (10YR 6/6) loamy fine sand, dark yellowish brown (10YR 4/6) moist; many moderate prominent very pale brown (10YR 8/3) mottles, brown (10YR 5/3) moist; massive; loose, nonsticky and nonplastic; common very fine and fine roots; common very fine and fine tubular pores and many very fine interstitial pores; slightly acid; clear smooth boundary.

VIIC7—40 to 48 inches; light gray (10YR 7/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; common fine prominent brownish yellow (10YR 6/6)

mottles, dark yellowish brown (10YR 4/6) moist; weak fine subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; many very fine and few fine roots; common very fine and few fine tubular pores and many very fine interstitial pores; neutral; clear wavy boundary.

VIIIC8—48 to 56 inches; white (10YR 8/1) silt loam, gray (10YR 5/1) moist; common medium prominent brownish yellow (10YR 6/8) mottles, dark yellowish brown (10YR 4/6) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; many very fine and common fine roots; many very fine and common fine tubular pores and common very fine interstitial pores; neutral; clear wavy boundary.

IXC9—56 to 65 inches; very pale brown (10YR 8/3) sand, grayish brown (10YR 5/2) moist; few fine prominent brownish yellow (10YR 6/8) mottles, dark yellowish brown (10YR 4/6) moist; single grain; loose, nonsticky and nonplastic; many very fine interstitial pores; neutral.

The soil is noneffervescent below a depth of 11 to 20 inches.

The A horizon has dry color of 10YR 5/2, 5/3, 6/2, or 6/3 and moist color of 10YR 4/2, 4/3, or 5/3. Clay content is 10 to 18 percent.

The C horizon has dry color of 10YR 6/2, 6/3, 6/6, 7/2, 7/3, 8/1, or 8/3 or 2.5Y 6/2 and moist color of 10YR 3/2, 3/3, 4/2, 4/6, 5/1, 5/2, or 5/3 or 2.5Y 4/2 or 6/2. Mottles have dry color of 10YR 5/6, 6/6, 6/8, or 8/3 or 7.5YR 5/4 and moist color of 10YR 3/6, 4/6, or 5/3 or 7.5YR 5/4. Texture is stratified sand, loamy sand, loamy fine sand, sandy loam, fine sandy loam, loam, or silt loam. Clay content is 10 to 18 percent. Reaction is slightly acid to moderately alkaline.

Exeter Series

The Exeter series consists of moderately deep, well drained soils on broad alluvial terraces. These soils formed in alluvium derived dominantly from granitic rock. Slope is 0 to 9 percent.

Soils of the Exeter series are fine-loamy, mixed, thermic Typic Durixeralfs.

Typical pedon of Exeter sandy loam, 0 to 2 percent slopes (fig. 4); on an alluvial terrace where slopes are 1 percent; about 3 miles west of Highway 65 on Highway 155, 150 feet north and 200 feet west of the southeast corner of sec. 7, T. 25 S., R. 27 E.; Richgrove Quadrangle.

Ap—0 to 4 inches; pale brown (10YR 6/3) sandy loam, dark brown (10YR 3/3) moist; weak very coarse platy structure; very hard, friable, nonsticky and nonplastic; common very fine roots; many very fine interstitial pores and few very fine tubular pores; neutral; clear smooth boundary.

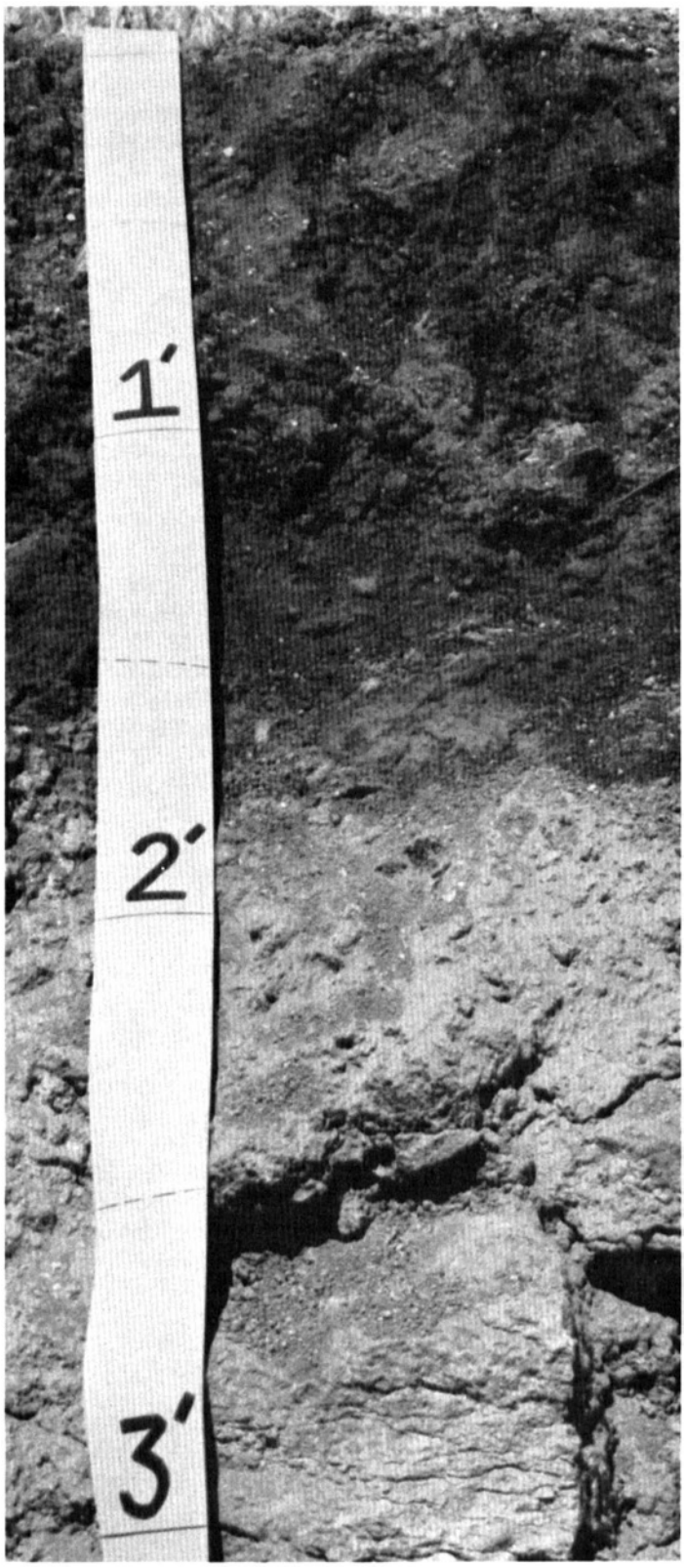

Figure 4.—Profile of Exeter sandy loam, 0 to 2 percent slopes. A duripan is at a depth of about 24 inches.

A1—4 to 17 inches; pale brown (10YR 6/3) sandy loam, dark brown (10YR 3/3) moist; massive; very hard, friable, nonsticky and nonplastic; common very fine roots; common very fine tubular pores and many very fine interstitial pores; neutral; clear wavy boundary.

B2t—17 to 24 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; strong medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine interstitial pores and common very fine tubular pores; continuous moderately thick clay films on peds and in pores; moderately alkaline; clear wavy boundary.

Csicam—24 inches; yellowish brown (10YR 5/4) duripan, dark yellowish brown (10YR 4/4) moist; lime occurs in seams; moderately alkaline; Stratified material occur below the pan.

Depth to the duripan is 20 to 40 inches. The duripan is indurated in the upper part and becomes weakly cemented with increasing depth. Lime caps the pan in some pedons.

The A horizon has dry color of 10YR 5/3, 5/4, or 6/3 or 7.5YR 5/4 or 6/4 and moist color of 10YR 3/3, 4/2, or 4/3 or 7.5YR 4/4. Clay content is 10 to 20 percent. Reaction is slightly acid or neutral.

The B2t horizon has dry color of 7.5YR 5/2 or 5/4 and moist color of 7.5YR 4/2 or 4/4. Texture is loam, clay loam, or sandy clay loam. Clay content is 22 to 35 percent. Reaction is neutral to moderately alkaline. Where present, lime is disseminated or in seams.

Garces Series

The Garces series consists of deep, well drained, saline-alkali soils on basin rims. These soils formed in alluvium derived dominantly from granitic rock. Slope is 0 to 2 percent.

Soils of the Garces series are fine-loamy, mixed, thermic Typic Natrargids.

Typical pedon of Garces silt loam on a nearly level alluvial fan; about 2.5 miles north of Semitropic School, 2,550 feet south and 1,300 feet west of the northeast corner of sec. 30, T. 26 S., R. 23 E.; Lost Hills Northeast Quadrangle.

A11—0 to 0.5 inch; pale brown (10YR 6/3) silt loam, yellowish brown (10YR 5/4) moist; strong thin platy structure; slightly hard, friable, nonsticky and slightly plastic; common very fine roots; many very fine interstitial and tubular pores; common very fine and fine vesicular pores in some areas; slightly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

A12—0.5 to 2 inches; pale brown (10YR 6/3) silt loam, yellowish brown (10YR 5/4) moist; strong coarse subangular blocky structure; slightly hard, friable, nonsticky and slightly plastic; common very fine roots; many very fine tubular and interstitial pores; strongly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

A2—2 to 5 inches; very pale brown (10YR 8/3) silt loam, dark brown (10YR 3/3) moist; moderate coarse subangular blocky structure; hard, friable, nonsticky and slightly plastic; common very fine roots; many very fine and few fine and medium tubular pores and many very fine interstitial pores; moderately alkaline; abrupt wavy boundary.

B21t—5 to 9 inches; light yellowish brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; strong medium columnar structure; extremely hard, friable, sticky and plastic; many very fine roots; many very fine tubular and interstitial pores; many thin clay films on peds and few thin clay films in pores; slightly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

B22tca—9 to 23 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; strong coarse prismatic structure; slightly hard, friable, sticky and plastic; common very fine roots; common very fine tubular pores and many very fine interstitial pores; few thin clay films on peds and in pores; violently effervescent; fine irregularly shaped soft masses of lime; very strongly alkaline; gradual smooth boundary.

B3tca—23 to 37 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores and many very fine interstitial pores; very few thin clay films as bridges between mineral grains; strongly effervescent; fine irregularly shaped soft masses of lime; very strongly alkaline; clear smooth boundary.

C1ca—37 to 55 inches; very pale brown (10YR 7/3) loam, light brownish gray (10YR 6/2) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and plastic; few very fine roots; many very fine tubular and interstitial pores; strongly effervescent; fine irregularly shaped filaments of lime; very strongly alkaline; clear smooth boundary.

C2—55 to 60 inches; light gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable, nonsticky and nonplastic; many very fine interstitial pores; strongly alkaline.

The A horizon has dry color of 10YR 5/2, 5/3, 6/2, 6/3, 6/4, or 7/2 or 2.5Y 6/2 or 6/4 and moist color of 10YR 3/3, 4/2, 4/3, 5/3, 5/4, or 6/3 or 2.5Y 4/2 or 4/4. Clay content is 10 to 18 percent. Reaction is moderately alkaline or strongly alkaline. The exchangeable sodium percentage is 2 to 25. The electrical conductivity is 2 to 8 millimhos per centimeter.

Color of the B2t horizon is similar to that of the A horizon in hue of 10YR. Texture is loam, clay loam, sandy clay loam, or silty clay loam. Clay content is 20 to 35 percent. Structure is weak to strong, coarse or very coarse prismatic or columnar. Reaction is moderately alkaline to very strongly alkaline. The exchangeable sodium percentage is 15 to 80. The electrical conductivity is more than 8 millimhos per centimeter.

The C horizon has dry color of 10YR 5/2, 6/2, 6/3, 7/2, or 7/3 or 2.5Y 6/2 or 7/2 and moist color of 10YR 4/2, 4/3, 5/2, 5/3, 6/2, or 6/3 or 2.5Y 4/2 or 5/2. Some pedons have a weakly cemented layer below a depth of 40 inches. Texture is loam, sandy loam, fine sandy loam, or silt loam. Stratification in these textures is common. Clay content is 10 to 27 percent. The horizon is massive or has moderate or strong subangular blocky structure. Reaction is moderately alkaline to very strongly alkaline. The exchangeable sodium percentage is 15 to 80. Electrical conductivity is 4 to 16 millimhos per centimeter.

Hesperia Series

The Hesperia series consists of deep, well drained soils on low terraces and alluvial fans. These soils formed in alluvium derived dominantly from granitic rock. Slope is 0 to 9 percent.

Soils of the Hesperia series are coarse-loamy, mixed, nonacid, thermic Xeric Torriorthents.

Typical pedon of Hesperia sandy loam, 0 to 2 percent slopes; about 1 mile southeast of Fuller Acres, 1,000 feet south and 250 feet east of the northwest corner of sec. 29, T. 30 S., R. 29 E.; Lamont Quadrangle.

Ap—0 to 10 inches; brown (10YR 5/3) sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; few very fine tubular pores; moderately alkaline; clear smooth boundary.

A1—10 to 20 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; few very fine tubular pores; moderately alkaline (pH 8.0); abrupt smooth boundary.

C1—20 to 36 inches; pale brown (10YR 6/3) sandy loam, yellowish brown (10YR 5/4) moist; massive; soft, loose, nonsticky and nonplastic; few very fine root; few very fine interstitial pores; violently effervescent; disseminated lime; moderately alkaline; gradual wavy boundary.

C2—36 to 60 inches; light yellowish brown (10YR 6/4) sandy loam, yellowish brown (10YR 5/4) moist; massive; soft, loose, nonsticky and nonplastic; few very fine interstitial pores; violently effervescent; disseminated lime; moderately alkaline.

The organic carbon content is less than 0.5 percent. The profile commonly is effervescent below a depth of 20 inches.

The A horizon has dry color of 10YR 5/2, 5/3, 5/4, 6/2, 6/3, or 6/4 and moist color of 10YR 3/2, 3/3, 4/2, 4/3, or 4/4. Clay content is 8 to 18 percent.

The C horizon has dry color of 10YR 5/2, 5/3, 5/4, 6/2, 6/3, or 6/4 and moist color of 10YR 3/2, 3/3, 3/4, 4/2, 4/3, 4/4, or 5/4. Texture is fine sandy loam, sandy loam, or coarse sandy loam. Clay content is 8 to 18 percent. In some pedons weakly defined strata of loamy sand, sandy clay loam, or clay loam are below a depth of 40 inches.

Hillbrick Series

The Hillbrick series consists of shallow, well drained soils on hills and mountains. These soils formed in residuum derived dominantly from calcareous shale or sandstone. Slope is 9 to 75 percent.

Soils of the Hillbrick series are loamy, mixed (calcareous), thermic Lithic Xerorthents.

Typical pedon of a Hillbrick sandy loam in an area of Ayar-Hillbrick-Aido complex, 30 to 50 percent slopes; about 0.5 mile southwest of Acebedo Ranch, 1,500 feet east and 2,500 feet north of the southwest corner of sec. 6, T. 25 S., R. 17 E.; Tent Hills Quadrangle.

A11—0 to 2 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and slightly plastic; common very fine roots; many very fine interstitial pores and common very fine tubular pores; 5 percent shale fragments 2 to 10 millimeters in diameter; violently effervescent; disseminated lime; moderately alkaline; clear wavy boundary.

A12—2 to 15 inches; pale brown (10YR 6/3) shaly sandy loam, brown (10YR 4/3) moist; weak fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine interstitial pores and few very fine tubular pores; 15 percent shale fragments 2 to 10 millimeters in diameter; violently effervescent; disseminated lime; moderately alkaline; clear irregular boundary.

R—15 inches; light brownish gray (10YR 6/2) moist, fractured calcareous shale; fractures are 1 to 5 centimeters apart and have no rotational displacement.

Depth to fractured shale or sandstone is 10 to 20 inches. Clay content is 8 to 18 percent throughout the profile.

The A horizon has dry color of 10YR 5/3, 6/3, 6/4, or 7/2 and moist color is 10YR 4/2, 4/3, or 5/3. It is sandy loam, loam, or shaly sandy loam. Clay content is 8 to 18

percent. Shale or pebble content is 5 to 30 percent. Rock fragments are 2 millimeters to 2 centimeters in diameter. Some pedons are as much as 5 percent angular cobbles.

Houser Series

The Houser series consists of deep, somewhat poorly drained soils on basin rims. These soils formed in alluvium material derived dominantly from igneous rock. Slope is 0 to 1 percent.

Soils of the Houser series are fine, montmorillonitic (calcareous), thermic Vertic Fluvaquents.

Typical pedon of Houser fine sandy loam, partially drained; about 14 miles northwest of Lost Hills; about 1.5 miles north of Kern County line; in the NE1/4NW1/4SE1/4 of sec. 25, T. 24 S., R. 20 E.; West Camp Quadrangle.

A1—0 to 4 inches; light gray (5Y6/1) fine sandy loam, olive gray (5Y 4/2) moist; moderate very coarse platy structure; hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores and common very fine tubular pores; strongly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

IIC1—4 to 14 inches; light gray (5Y 6/1) clay, olive gray (5Y 5/2) moist; few fine prominent strong brown (7.5YR 5/6) mottles, brown (7.5YR 4/4) moist; strong coarse prismatic structure; extremely hard, firm, sticky and plastic; many very fine, few fine, and few medium roots; many very fine interstitial and tubular pores; violently effervescent; disseminated lime; strongly alkaline; clear smooth boundary.

IIIC2—14 to 24 inches; light gray (5Y 6/1) silty clay, dark gray (5Y 4/1) moist; many fine prominent very pale brown (10YR 7/3) mottles, yellowish brown (10YR 5/4) moist; massive; hard, friable, sticky and very plastic; few very fine and medium roots; many very fine interstitial and tubular pores; violently effervescent; disseminated lime; very strongly alkaline; abrupt smooth boundary.

IVC3—24 to 60 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; many fine distinct light yellowish brown (10YR 6/4) mottles, yellowish brown (10YR 5/6) moist; massive; extremely hard, firm, very sticky and very plastic; few very fine roots; many very fine interstitial pores; strongly effervescent; disseminated lime; strongly alkaline.

The profile is more than 60 inches deep and is stratified. Vertical cracks extend from the surface and are 1 to 3 centimeters wide at a depth of 50 centimeters at some time in most years. A few slickensides are present in some pedons, but they do not intersect. The organic matter content is 1 percent or less at the surface and decreases irregularly with increasing depth. Gypsum crystals may occur in some or all horizons below the A1 horizon. Salic horizons occur below a depth of 30 inches in some pedons. Few to many, fine or medium, distinct mottles are common in the lower part of the A horizon and in the C horizon.

The A horizon has dry color of 5Y 7/1, 6/1, or 6/2 and moist color of 5Y 3/2, 4/2, 5/2, or 4/3. Clay content is 6 to 18 percent. This horizon is moderately alkaline or strongly alkaline. Electrical conductivity is less than 4 millimhos per centimeter. Exchangeable sodium percentage is 4 to 10.

The C horizon has dry color of 5Y 5/1, 6/1, 7/1, 5/2, or 6/2, 2.5Y 6/2, or 10YR 7/3 and moist color of 5Y 4/1, 4/2, 5/2, 5/3, or 4/3, 2.5Y 4/2, or 10YR 5/4. It is clay or silty clay and has thin strata of silt loam or silty clay loam. Clay content is 40 to 60 percent. This horizon is moderately alkaline to very strongly alkaline. Electrical conductivity is 8 to 30 millimhos per centimeter. Exchangeable sodium percentage is 30 to 150.

Jerryslu Series

The Jerryslu series consists of moderately deep, well drained, saline-alkali soils on basin rims. These soils formed in alluvium derived dominantly from granitic rock. Slope is 0 to 2 percent.

Soils of the Jerryslu series are fine-loamy, mixed, thermic Typic Nadurargids.

Typical pedon of Jerryslu loam, about 5 miles northeast of Buttonwillow, 1,400 feet south and 1,900 feet east of the northwest corner of sec. 19, T. 28 S., R. 24 E.; Buttonwillow Quadrangle.

A11—0 to 1 inch; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores and few very fine interstitial pores; slightly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

A12—1 to 4 inches; light gray (10YR 7/2) loam, grayish brown (10YR 5/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular and interstitial pores; strongly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

A2—4 to 11 inches; white (10YR 8/2) silt loam, pale brown (10YR 6/3) moist; moderate coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular and interstitial pores; violently effervescent; disseminated lime; strongly alkaline; clear smooth boundary.

B2tca—11 to 20 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; moderate medium

subangular blocky structure; hard, friable, sticky and plastic; many very fine roots; many very fine tubular and interstitial pores; few moderately thick and many thin clay films on peds and in pores; violently effervescent; common irregularly shaped fine soft masses and filaments of lime; strongly alkaline; abrupt smooth boundary.

C1casim—20 to 28 inches; very pale brown (10YR 8/3) strongly cemented lime-silica duripan, brown (10YR 5/3) moist; strong thick platy structure; silica caps 1 to 3 millimeters thick on the surface of the duripan; violently effervescent; disseminated lime and soft masses and seams of lime; strongly alkaline; clear wavy boundary.

C2cam—28 to 43 inches; very pale brown (10YR 8/3) lime duripan consisting of many thin discontinuous indurated strata, brown (10YR 5/3) moist; strong medium platy structure; violently effervescent; disseminated lime and soft masses and seams of lime; strongly alkaline; abrupt smooth boundary.

C3—43 to 60 inches; very pale brown (10YR 7/3) sandy loam, brown (10YR 5/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; few very fine roots; common very fine tubular pores and many very fine interstitial pores; moderately alkaline.

Depth to the duripan is 20 to 40 inches.

The A horizon is 8 to 16 inches thick. It has dry color of 10YR 6/2, 6/3, 7/2, or 8/2 or 2.5Y 7/2 and moist color of 10YR 4/2, 4/3, 5/2, 5/3, or 6/3 or 2.5Y 5/2. Reaction is moderately alkaline or strongly alkaline. Clay content is 10 to 22 percent. Electrical conductivity ranges from 0.9 to 45 millimhos per centimeter, but it averages 16. Exchangeable sodium percentage is 30 to 50.

The Bt horizon has dry color of 10YR 5/4, 6/3, 7/3, or 7/4 or 2.5Y 6/2 and moist color of 10YR 3/3, 4/3, 4/4, 5/3, or 5/4 or 2.5Y 4/2. Texture is loam, clay loam, or sandy clay loam. Clay content is 20 to 35 percent. Reaction is strongly alkaline or very strongly alkaline. Electrical conductivity is 3 to 63 millimhos per centimeter. Exchangeable sodium percentage is 30 to 50.

The Cm horizon varies in hardness but commonly is strongly cemented. It has dry color of 10YR 5/4, 6/3, 7/2, 7/3, or 8/3 or 2.5Y 6/2 and moist color of 10YR 3/3, 4/2, 4/3, 4/4, 5/3, or 5/4 or 2.5Y 4/2. The horizon commonly has platy structure or is massive.

The C horizon has dry color of 10YR 6/2, 7/2, 7/3, or 8/3 or 2.5Y 4/2 or 5/2 and moist color of 10YR 4/2, 4/3, or 5/3 or 2.5Y 3/2 or 4/2. Texture commonly is loamy sand or sandy loam that is 5 to 18 percent clay.

Kecksroad Series

The Kecksroad series consists of moderately deep, well drained soils on hills. These soils formed in residuum derived dominantly from sedimentary rock. Slope is 5 to 50 percent.

Soils of the Kecksroad series are fine, mixed, thermic Typic Camborthids.

Typical pedon of Kecksroad silty clay loam, 15 to 50 percent slopes; about 5.5 miles northeast of Kecks Corner, 2,600 feet east and 1,600 feet south of the northwest corner of sec. 21, T. 25 S., R. 18 E.; Sawtooth Ridge Quadrangle.

A11—0 to 2 inches; light yellowish brown (10YR 6/4) silty clay loam, brown (10YR 4/3) moist; moderate medium prismatic structure and moderately medium subangular blocky; very hard, friable, sticky and very plastic; many very fine roots; many very fine tubular and interstitial pores and few very fine vesicular pores; strongly effervescent; disseminated lime; moderately alkaline; clear smooth boundary.

A12—2 to 11 inches; light yellowish brown (10YR 6/4) clay loam, dark yellowish brown (10YR 4/4) moist; moderate coarse prismatic structure and weak medium subangular blocky; hard, friable, sticky and very plastic; many very fine roots; few fine and many very fine tubular pores; few pressure faces; strongly effervescent; disseminated lime; moderately alkaline; gradual smooth boundary.

B21t—11 to 26 inches; light yellowish brown (10YR 6/4) clay, dark yellowish brown (10YR 4/4) moist; weak coarse subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; few fine tubular pores and common very fine interstitial and tubular pores; few thin clay films in pores; violently effervescent; disseminated lime and few fine irregularly shaped soft masses of lime; moderately alkaline; gradual smooth boundary.

B22tca—26 to 36 inches; light yellowish brown (10YR 6/4) clay loam, dark yellowish brown (10YR 4/4) moist; moderate coarse subangular blocky structure; hard, very friable, sticky and very plastic; few very fine roots; common very fine tubular pores and few very fine interstitial pores; common thin clay films in pores and on peds; 10 percent pebbles; violently effervescent; disseminated lime and common fine irregularly shaped soft masses of lime; moderately alkaline; clear wavy boundary.

Cr—36 inches; white (5Y 8/1) slightly hard weathered shale fragments, light olive gray (5Y 6/2) moist; firm when moist; 5 to 20 millimeters in size; angular or subangular in shape; noncalcareous but lime-coated; fragments are in approximately normal orientation with some soil material in vertical cracks.

Depth to paralithic contact is 20 to 40 inches. The profile is slightly effervescent to violently effervescent throughout. Pebble content is 0 to 10 percent; pebbles commonly are less than 25 millimeters in diameter.

The A horizon has dry color of 10YR 7/3, 6/4, 6/3, 5/4, or 5/3 and moist color of 10YR 5/4, 5/3, 4/4, or 4/3. Clay content is 30 to 40 percent. Reaction is mildly alkaline or moderately alkaline.

The B2t horizon has dry color of 10YR 7/3, 6/6, 6/4, 6/3, or 5/4 and moist color of 10YR 5/6, 5/4, 5/3, 4/4, or 4/3. It is clay loam, silty clay loam, or clay. It is 35 to 50 clay.

The C horizon, where present, has dry color of 10YR 7/3, 6/6, 6/4, or 5/4 and moist color of 10YR 5/6, 5/4, 4/4, or 4/3. It is clay loam, silty clay, or clay. It is 35 to 50 percent clay.

Kettleman Series

The Kettleman series consists of moderately deep, well drained soils on hills. These soils formed in residuum derived dominantly from shale or sandstone. Slope is 9 to 50 percent.

Soils of the Kettleman series are fine-loamy, mixed (calcareous), thermic Typic Torriorthents.

Typical pedon of Kettleman loam, 9 to 15 percent slopes; about 5 miles northwest of Cottonwood Pumping Station, 100 feet south and 1,300 feet east of the northwest corner of sec. 14, T. 25 S., R. 18 E.; Pyramid Hills Quadrangle.

A11—0 to 6 inches; pale brown (10YR 6/3) loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine roots; many very fine interstitial pores and few very fine tubular pores; strongly effervescent; disseminated lime and few fine irregularly shaped filaments of lime; moderately alkaline; clear smooth boundary.

A12—6 to 12 inches; pale brown (10YR 6/3) loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine roots; many very fine interstitial pores and few very fine tubular pores; strongly effervescent; disseminated lime and few fine irregularly shaped filaments of lime; moderately alkaline; clear smooth boundary.

C1ca—12 to 22 inches; light yellowish brown (10YR 6/4) loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; few very fine tubular pores; violently effervescent; common fine irregularly shaped filaments or threads of lime; moderately alkaline; clear wavy boundary.

C2r—22 inches; light gray (10YR 7/1) highly weathered, coarse grained, calcareous shale.

The depth to highly weathered sandstone or shale is 20 to 40 inches. Gravel content is 0 to 35 percent.

The A horizon has dry color of 10YR 5/3, 5/4, 6/2, or 6/3 and moist color of 10YR 3/3, 4/2, 4/3, or 5/3. It is loam or gravelly loam. Clay content is 19 to 27 percent.

The C horizon has dry color of 10YR 6/2, 6/3, 6/4, or 7/1 and moist color 10YR 4/3, 4/4, 5/3, 5/4, or 5/6. It is loam, clay loam, or gravelly loam. Clay content is 20 to 30 percent. Gypsum crystals are present in places.

Kilmer Series

The Kilmer series consists of moderately deep, well drained soils on hills and mountains. These soils formed in residuum derived from shale or sandstone. Slope is 9 to 75 percent.

Soils of the Kilmer series are fine-loamy, mixed (calcareous), thermic Typic Xerorthents.

Typical pedon of Kilmer loam in an area of Kilmer-Hillbrick complex, 15 to 50 percent slopes; about 1.75 miles south of Cottonwood Pumping Station, 3,250 feet south and 1,300 feet east of the northwest corner of sec. 13, T. 25 S., R. 17 E.; Pyramid Hills Quadrangle.

A11—0 to 5 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; moderate medium and coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine interstitial and tubular pores; slightly effervescent; disseminated lime; moderately alkaline; gradual smooth boundary.

A12—5 to 14 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak coarse subangular blocky structure; slightly hard, very friable, sticky and slightly plastic; common very fine interstitial pores; violently effervescent; disseminated lime; moderately alkaline; clear smooth boundary.

C—14 to 32 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, very friable, sticky and plastic; few very fine roots; many very fine tubular pores and common very fine interstitial pores; violently effervescent; many fine irregularly shaped filaments of lime; moderately alkaline; abrupt wavy boundary.

R—32 inches; brown (10YR 5/3), calcareous shale, dark brown (10YR 3/3) moist; fractures are more than 12 inches apart.

Depth to shale or sandstone is 20 to 40 inches.

The A horizon has dry color of 10YR 6/2 or 6/3 and moist color of 10YR 4/2, 4/3, or 4/4. Clay content is 15 to 35 percent. Reaction is mildly alkaline or moderately alkaline.

The C horizon has dry color of 10YR 6/3, 7/3, or 7/4 and moist color of 10YR 4/3, 4/4, 5/3, or 5/4. Texture is loam or clay loam. Clay content is 18 to 35 percent.

Kimberlina Series

The Kimberlina series consists of deep, well drained soils on recent alluvial fans and plains. These soils

formed in alluvium derived dominantly from sedimentary or granitic rock. Slope is 0 to 9 percent.

Soils of the Kimberlina series are coarse-loamy, mixed (calcareous), thermic Typic Torriorthents.

Typical pedon of Kimberlina fine sandy loam, 0 to 2 percent slopes; about 7 miles northwest of Shafter, about 1,800 feet west and 100 feet north of the southeast corner of sec. 33, T. 27 S., R. 24 E.; Wasco Southwest Quadrangle.

Ap—0 to 9 inches; brown (10YR 5/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and nonplastic; many very fine roots; many fine tubular and interstitial pores; moderately alkaline; clear smooth boundary.

C1—9 to 31 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; many very fine roots; many very fine tubular and interstitial pores; slightly effervescent; disseminated lime; moderately alkaline; clear smooth boundary.

C2—31 to 45 inches; pale brown (10YR 6/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine and many fine roots; many very fine tubular and interstitial pores; slightly effervescent; disseminated lime; moderately alkaline; abrupt wavy boundary.

IIC3—45 to 71 inches; pale brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, common very fine roots; many very fine tubular pores and few very fine interstitial pores; strongly effervescent; fine irregularly shaped filaments of lime; moderately alkaline.

The profile is 0 to 35 percent gravel.

The A horizon has dry color of 10YR 6/3, 5/3, 6/2, or 6/4 and moist color of 10YR 3/2, 4/2, 4/3, 5/3, or 5/4. Texture is fine sandy loam, sandy loam, or gravelly sandy loam. Clay content is 6 to 18 percent. Reaction is neutral to moderately alkaline.

The C horizon has dry color of 10YR 5/3, 6/3, or 6/4 or 2.5Y 7/2 and moist color of 10YR 4/2, 4/3, 5/3, 5/4, 6/4, or 6/6. Texture is sandy loam or fine sandy loam. Clay content is 10 to 18 percent. Reaction is moderately alkaline or strongly alkaline. A substratum of unrelated stratified material commonly is at a depth of 50 inches. Texture of the substratum is sandy clay loam, loam, or silt loam.

Lerdo Series

The Lerdo series consists of deep, somewhat poorly drained soils on alluvial plains and in basins. These soils formed in alluvium derived dominantly from granitic and sedimentary rock. Slope is 0 to 2 percent.

Soils of the Lerdo series are fine-loamy, mixed (calcareous), thermic Typic Torrifluvents.

Typical pedon of Lerdo clay loam in an area of Lerdo complex, drained; about 0.5 mile northeast of intersection of Rowlee Road and Lerdo Highway, 1,400 feet east and 2,500 feet south of the northwest corner of sec. 11, T. 28 S., R. 23 E.; Wasco Southwest Quadrangle.

Ap—0 to 7 inches; gray (10YR 5/1) clay loam, very dark gray (10YR 3/1) moist; moderate coarse and medium angular blocky structure; hard, firm, sticky and plastic; many very fine roots; many very fine interstitial and tubular pores; slightly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

A1—7 to 22 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; weak coarse angular blocky structure; slightly hard, firm, sticky and plastic; common very fine and few fine roots; many very fine interstitial and tubular pores; slightly effervescent; disseminated lime; moderately alkaline; clear smooth boundary.

C1—22 to 50 inches; light gray (10YR 6/1) loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure and moderate coarse angular blocky; slightly hard, firm, sticky and plastic; common very fine and few fine roots; many very fine and few fine tubular pores; strongly effervescent; disseminated lime; strongly alkaline; abrupt smooth boundary.

C2ca—50 to 60 inches; light gray (10YR 7/1) loam, pale brown (10YR 6/3) moist; massive; very hard, friable, sticky and slightly plastic; few very fine and fine roots; many very fine interstitial pores and many very fine tubular pores; few thin clay films lining pores; violently effervescent; disseminated lime; strongly alkaline.

The A horizon has dry color of 10YR 5/1 or 5/2 and moist color of 10YR 3/1 or 3/2. Clay content is 27 to 35 percent. Organic matter content is 1 to 3 percent to a depth of more than 20 inches and decreases irregularly with increasing depth. Electrical conductivity is less than 3 millimhos per centimeter. Exchangeable sodium percentage is less than 11.

The C horizon has dry color of 10YR 5/1, 6/1, 6/2, 7/1, or 7/2 of 2.5Y 6/2 or 7/2 and moist color of 10YR 3/1, 4/2, 5/3, or 6/3 or 2.5Y 4/2 or 5/2. Texture is loam or clay loam. Clay content is 20 to 30 percent. Reaction is moderately alkaline or strongly alkaline. Electrical conductivity is 1 to 8 millimhos per centimeter, but it averages 6. Exchangeable sodium percentage is 1 to more than 70, but it averages 30.

Lethent Series

The Lethent series consists of deep, moderately well drained soils in basins and on basin rims. These soils formed in alluvium derived dominantly from granitic and sedimentary rock. Slope is 0 to 2 percent.

Soils of the Lethent series are fine, montmorillonitic, thermic Typic Natrargids.

Typical pedon of Lethent silt loam; about 10 miles west of Delano; 3,700 feet south and 400 feet east of the southwest corner of sec. 14, T. 25 S., R. 23 E.; Allensworth Quadrangle.

A1—0 to 3 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; moderate medium platy structure; slightly hard, friable, sticky and slightly plastic; many very fine roots; many very fine tubular pores and few very fine interstitial pores; violently effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

B1t—3 to 11 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; moderate medium columnar structure and moderate medium angular blocky; hard, friable, sticky and plastic; many very fine roots; many very fine tubular pores and few very fine interstitial pores; few thin clay films in pores and on peds; violently effervescent; disseminated lime; strongly alkaline; abrupt smooth boundary.

B21tca—11 to 17 inches; light brownish gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; weak medium prismatic structure and moderate medium subangular blocky; hard, friable, sticky and plastic; few very fine roots; common very fine tubular pores and few very fine interstitial pores; common thin clay films in pores and on peds; violently effervescent; disseminated lime; strongly alkaline; clear smooth boundary.

B22t—17 to 28 inches; light gray (2.5Y 7/2) silty clay, grayish brown (2.5Y 5/2) moist; weak coarse subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; few very fine tubular and interstitial pores; common thin clay films in pores and on peds; strongly effervescent; disseminated lime; strongly alkaline; clear smooth boundary.

B23t—28 to 42 inches; light brownish gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; weak coarse subangular blocky structure; very hard, firm, very sticky and plastic; few very fine roots; few very fine tubular and interstitial pores; many moderately thick and common thin clay films in pores and on peds; strongly effervescent; disseminated lime; strongly alkaline; gradual smooth boundary.

B3tca—42 to 53 inches; grayish brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) moist; weak coarse angular blocky structure; very hard, firm, very sticky and slightly plastic; common very fine tubular pores; violently effervescent; disseminated lime and common fine soft masses of lime; strongly alkaline; abrupt smooth boundary.

C1—53 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; massive; hard, friable, sticky and plastic; few very fine tubular pores and common very fine interstitial pores; strongly effervescent; disseminated lime; common gypsum crystals; strongly alkaline; abrupt smooth boundary.

C2—60 to 67 inches; pale yellow (5Y 7/3) heavy loam, pale olive (5Y 6/3) moist; massive; slightly hard, friable, sticky and slightly plastic; common very fine interstitial pores; violently effervescent; fine irregularly shaped soft masses of lime; moderately alkaline.

The A horizon has dry color of 2.5Y 6/2 or 7/2 or 10YR 6/2 or 6/3 and moist color of 2.5Y 4/2 or 10YR 4/2 or 3/3. Clay content is 20 to 27 percent. Electrical conductivity is more than 4 millimhos per centimeter. Exchangeable sodium percentage is more than 25.

The Bt horizon has dry color of 2.5Y 5/2, 6/2, 7/2, or 6/4 or 10YR 6/2, 6/4, 5/3, 5/4, or 4/3 and moist color of 2.5Y 3/2, 4/2, 4/4, 5/2, or 6/2 or 10YR 4/2. Texture is clay loam, silty clay loam, silty clay, or clay. Clay content is 35 to 55 percent. Electrical conductivity is 4 to 20 millimhos per centimeter. Exchangeable sodium percentage is 17 to 64.

The C horizon has dry color of 2.5Y 6/2 or 7/4, 5Y 7/3 or 6/2, or 10YR 6/4, 6/2, 5/3, or 5/2 and moist color of 2.5Y 3/2, 4/2, 4/4 or 5/2, 5Y 6/3, or 10YR 4/2 or 4/4. Mottles are present in places. Texture is sandy loam, loam, silt loam, clay loam, or silty clay loam. Clay content is 10 to 30 percent. In some pedons gypsum crystals commonly are present.

Lewkalb Series

The Lewkalb series consists of deep, well drained soils on low terraces. These soils formed in alluvium derived dominantly from sedimentary and granitic rock. Slope is 0 to 5 percent.

Soils of the Lewkalb series are coarse-loamy, mixed (calcareous), thermic Durorthidic Torriorthents.

Typical pedon of Lewkalb sandy loam in an area of Lewkalb, saline-alkali-Milham-Kimberlina complex, 0 to 5 percent slopes; about 2.5 miles southeast of Shale Point, 900 feet east and 100 feet north of the southwest corner of sec. 10, T. 27 S., R. 19 E.; Shale Point Quadrangle.

A11—0 to 2 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse platy structure; slightly hard, very friable, nonsticky and nonplastic; many very fine roots; common very fine tubular and interstitial pores; about 5 percent pebbles; slightly

effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

A12—2 to 23 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; few very fine tubular pores and many very fine interstitial pores; about 5 percent pebbles; violently effervescent; disseminated lime; moderately alkaline; abrupt wavy boundary.

C1casi—23 to 40 inches; light gray (2.5Y 7/2) sandy loam, light brownish gray (2.5Y 6/2) moist; white (10YR 8/1) lime coatings on peds, light gray (10YR 7/1) moist; strong medium and coarse angular blocky structure; hard, firm, nonsticky and nonplastic; few very fine roots; few very fine tubular and interstitial pores; common thin clay films as bridges; about 5 percent pebbles; brittle and weakly cemented with silica; violently effervescent; disseminated lime and many fine seams and filaments of lime; strongly alkaline; gradual wavy boundary.

C2casi—40 to 65 inches; light gray (2.5Y 7/2) loamy sand, light brownish gray (2.5Y 6/2) moist; moderate medium and coarse angular blocky structure; hard, firm, nonsticky and nonplastic; few very fine roots; few very fine interstitial and tubular pores; common thin clay bridges; brittle and weakly cemented with silica; about 5 percent pebbles; violently effervescent; disseminated lime and few fine seams of lime; mildly alkaline.

Depth to the firm, brittle layer is 10 to 26 inches, and the thickness of the layer is 12 to 42 inches. Pebble content throughout the profile is 0 to 15 percent. Organic matter content is less than 0.5 percent. In some areas these soils are underlain by a buried B horizon.

The A horizon has dry color of 10YR 5/3, 6/2, or 6/3 and moist color of 10YR 4/2, 4/3, 4/4, 5/3, or 5/4. Clay content is 6 to 18 percent. Structure ranges from weak platy in the surface to weak subangular blocky below the surface, or it is massive. Electrical conductivity is less than 2 millimhos per centimeter.

The C horizon has dry color of 2.5Y 7/2 or 7/4 or 10YR 6/4, 7/3, or 7/4 and moist color of 2.5Y 6/2 or 6/4 or 10YR 5/4 or 6/4. The firm brittle layer crushes to sandy loam, loam, or loamy sand; peds do not slake in hydrochloric acid. Texture below the firm brittle layer is sandy loam or loam. Clay content is 6 to 18 percent. The C horizon is nonsaline or moderately saline and is alkali in some pedons. Exchangeable sodium percentage is 0 to 40.

Lodo Variant

The Lodo Variant consists of shallow, somewhat excessively drained soils on hills and mountains. These soils formed in residuum derived dominantly from hard shale or fine grained sandstone. Slope is 15 to 75 percent.

Lodo Variant soils are loamy, mixed, thermic Lithic Haploxerolls.

Typical pedon of Lodo Variant clay loam, 15 to 50 percent slopes; about 1.75 miles north of Bitterwater Pumping Station, 300 feet east and 300 feet north of the southwest corner of sec. 7, T. 27 S., R. 18 E.; Packwood Creek Quadrangle.

A1—0 to 9 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate coarse subangular blocky structure; slightly hard, very friable, sticky and plastic; many very fine roots; many very fine interstitial and tubular pores; mildly alkaline; abrupt wavy boundary.

R—9 inches; hard fractured shale; cracks are 2 to 9 centimeters apart, measured horizontally in any direction.

Depth to bedrock is 6 to 20 inches. Texture throughout the profile is clay loam. Clay content is 27 to 35 percent. Organic matter content is more than 1 percent. Rock fragments are mostly angular or subangular pebbles and make up 3 to 15 percent of the profile.

The A horizon has dry color of 10YR 4/2, 4/3, 5/2, 5/3, or 5/4 and moist color of 10YR 3/2 or 3/3. The clay content is 27 to 35 percent.

Lokern Series

The Lokern series consists of deep, somewhat poorly drained soils in valley basins. These soils formed in alluvium derived dominantly from mixed rock, mainly granite. Slope is 0 to 2 percent.

Soils of the Lokern series are fine, montmorillonitic, nonacid, thermic Vertic Torrifluvents.

Typical pedon of Lokern clay, drained; about 1.5 miles north of Corn Camp, 2,600 feet west and 50 feet north of the southeast corner of sec. 5, T. 29 S., R. 23 E.; Lokern Quadrangle.

Ap—0 to 7 inches; dark gray (10YR 4/1) clay, black (10YR 2/1) moist; moderate medium prismatic structure and moderate coarse angular blocky; very hard, friable, very sticky and very plastic; common very fine and few fine roots; few very fine tubular pores; moderately alkaline; abrupt smooth boundary.

A1—7 to 21 inches; dark gray (10YR 4/1) clay, black (10YR 2/1) moist; moderate coarse prismatic structure; extremely hard, firm, very sticky and very plastic; common very fine and few fine roots; common very fine tubular pores; slickensides on 50 percent of ped faces; moderately alkaline; clear smooth boundary.

C1—21 to 35 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; many medium

prominent yellowish brown (10YR 5/6) mottles, brown (10YR 4/3) moist; moderate coarse angular blocky structure and moderate medium subangular blocky; extremely hard, firm, very sticky and very plastic; common very fine and few fine roots; common very fine tubular pores; slickensides on 50 to 75 percent of ped faces; slightly effervescent; few fine rounded soft masses of lime; moderately alkaline; abrupt smooth boundary.

C2—35 to 48 inches; gray (10YR 5/1) clay, very dark gray (10YR 3/1) moist; common fine faint yellowish brown (10YR 5/4) mottles; strong medium prismatic structure; extremely hard, very firm, very sticky and very plastic; common very fine roots; common very fine tubular pores; slickensides on 90 percent of ped faces; slightly effervescent; few fine rounded soft masses of lime; moderately alkaline; abrupt smooth boundary.

IIC3—48 to 66 inches; light brownish gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable, sticky and slightly plastic; few very fine roots; many very fine tubular pores and common very fine interstitial pores; slightly effervescent; disseminated lime; moderately alkaline.

Depth to the IIC horizon ranges from 42 to 70 inches but commonly is about 48 inches.

The A horizon has dry color of 10YR 4/1, 4/2, or 5/1 and moist color of 10YR 2/1, 3/1, or 3/2. The horizon is 40 to 55 percent clay. Unless the soils are irrigated, cracks are less than 1 to 2 centimeters wide on the surface and average about 2 millimeters to a depth of at least 20 inches. Slickensides do not intersect. Organic matter content is 1 to 3 percent to a depth of 20 inches and decreases irregularly with increasing depth.

The C horizon has dry color of 10YR 4/1, 5/1, 5/2, or 6/2, 2.5Y 5/2 or 6/2, or 5Y 6/1 or 7/2 and moist color of 10YR 2/1, 3/1, 3/2, 4/1, 4/2 or 6/2, 2.5Y 3/2 or 4/2, or 2.5Y 4/1 or 5/3. Some pedons have faint to prominent mottles that have dry color of 10YR 5/6 and moist color of 10YR 4/4 or 5/6. Depth to mottles is 20 to 24 inches. Texture is dominantly clay. Clay content is 40 to 60 percent.

The IIC horizon has dry color of 2.5Y 6/2 or 7/2 or 5Y 7/2, 6/3, or 6/6 and moist color of 2.5Y 4/2, 5/2, or 6/4 or 5Y 5/2, 5/3, or 6/2. Texture consists of stratified layers of sandy loam, fine sandy loam, silt loam, and sandy clay loam. Clay content is 10 to 26 percent.

Los Osos Variant

The Los Osos Variant consists of moderately deep, well drained soils on hills and mountains. These soils formed in residuum derived dominantly from sandstone or shale. Slope is 15 to 50 percent.

Los Osos Variant soils are fine, montmorillonitic, thermic Typic Argixerolls.

Typical pedon of Los Osos Variant clay loam, 30 to 50 percent slopes; about 3.5 miles south of Carneros Rocks, 700 feet east and 2,500 feet north of the southwest corner of sec. 21, T. 29 S., R. 20 E.; Carneros Rocks Quadrangle.

All—0 to 1 inch; dark brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; strong fine and medium granular structure; slightly hard, very firm, sticky and plastic; many very fine roots; many very fine interstitial pores; cracks on surface I centimeter wide and 13 centimeters apart; moderately alkaline; abrupt smooth boundary.

A12—1 to 7 inches; dark brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate very coarse and coarse subangular blocky structure; hard, very firm, sticky and plastic; common very fine roots; many very fine tubular pores; cracks about I centimeter wide and 13 centimeters apart; moderately alkaline; gradual wavy boundary.

BIt—7 to 12 inches; dark brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; moderate medium and coarse subangular blocky structure; hard, very firm, very sticky and very plastic; common very fine roots and few fine and medium roots; many fine and common medium tubular pores; very few thin clay films in pores; cracks about 1 centimeter wide and 13 centimeters apart; moderately alkaline; gradual wavy boundary.

B21t—12 to 27 inches; dark brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; moderate coarse subangular blocky structure; slightly hard, very firm, very sticky and very plastic; few very fine, fine, and medium roots; many medium tubular pores; common thin clay films on peds and in pores; cracks about I centimeter wide and 13 centimeters apart; moderately alkaline; gradual wavy boundary.

B22t—27 to 33 inches; dark brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; moderate coarse subangular blocky structure; hard, very firm, very sticky and very plastic; few fine, medium, and coarse roots; many medium and common coarse tubular pores; many thin clay films on peds and in pores; moderately alkaline; gradual wavy boundary.

B3t—33 to 38 inches; dark yellowish brown (10YR 4/4) clay loam, dark brown (10YR 4/3) moist; moderate coarse subangular blocky structure; hard, very firm, sticky and plastic; few medium and coarse roots; common very fine and medium tubular pores; many thin clay films on peds and in pores; moderately alkaline; abrupt wavy boundary.

Cr—38 inches; very pale brown (10YR 7/3) soft sandstone.

Depth to weathered sandstone or shale is 25 to 40 inches.

The A horizon has dry color of 10YR 4/2, 4/3, 5/2, or 5/3 and moist color of 10YR 3/2 or 3/3. Clay content is 27 to 35 percent. Pebble content is 0 to 10 percent.

The B2t horizon has dry color of 7.5YR 4/4, 5/2, 5/4, or 5/6 or 10YR 4/2, 4/3, 5/2, 5/3, or 6/3. It has moist color of 7.5YR 4/2 or 4/4 or 10YR 3/3, 4/2, 4/3, 4/4, 5/2, 5/3, or 5/4. Texture is clay loam or clay, and clay content is 35 to 48 percent. Some pedons have a B3t horizon or C horizon of loam or clay loam between the B2t horizon and the bedrock.

McFarland Series

The McFarland series consists of deep, well drained soils on flood plains and alluvial fans. These soils formed in alluvium derived dominantly from granitic rock. Slope is 0 to 2 percent.

Soils of the McFarland series are fine-loamy, mixed, nonacid, thermic Typic Torriorthents.

Typical pedon of McFarland loam; about 2.5 miles northeast of Wasco, 2,500 feet north and 1,450 feet west of the southeast corner of sec. 32, T. 26 S., R. 25 E.; Wasco Quadrangle.

Ap—0 to 11 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine interstitial pores and few very fine tubular pores; neutral; clear smooth boundary.

A12—11 to 24 inches; brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, friable, sticky and slightly plastic; common very fine and few fine roots; many very fine interstitial and tubular pores; mildly alkaline; clear smooth boundary.

Cl—24 to 48 inches; pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine interstitial and tubular pores; mildly alkaline; abrupt smooth boundary.

C2—48 to 55 inches; brown (10YR 5/3) loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; few very fine roots; many very fine interstitial and tubular pores; slightly effervescent; disseminated lime; mildly alkaline; abrupt smooth boundary.

IIC3—55 to 64 inches; gray (2.5Y 7/2) loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; very few very fine roots; many very fine interstitial and tubular pores; strongly effervescent; disseminated lime; moderately alkaline.

Depth to lime is 20 to 48 inches and commonly is more than 40 inches.

The A horizon has dry color of 10YR 5/2, 5/3, or 5/4 or 2.5Y 5/2 and moist color of 10YR 3/2, 3/3, or 4/2 or 2.5Y 4/2. Clay content is 20 to 27 percent. Structure near the surface in some pedons is granular or blocky but commonly is massive, and the lower part of the A horizon is dominantly massive. Reaction is slightly acid to moderately alkaline.

The C horizon has dry color of 10YR 5/3, 6/2, 6/3, or 7/3 or 2.5Y 6/2 or 7/2 and moist color of 10YR 4/2, 4/3, 5/2, or 6/3 or 2.5Y 4/2 or 5/2. Texture is sandy loam, fine sandy loam, loam, or clay loam. Clay content is 15 to 35 percent. Reaction is neutral to moderately alkaline.

Mendi Series

The Mendi series consists of deep, well drained soils on foothills and mountains. These soils formed in residuum derived dominantly from sandstone or shale. Slope is 9 to 75 percent.

Soils of the Mendi series are fine-loamy, mixed (calcareous), thermic Typic Xerorthents.

Typical pedon of Mendi loam in an area of Mendi-Hillbrick-Kilmer association, 30 to 50 percent slopes; about 1 mile east of Cedar Canyon, 600 feet east and 900 feet north of the southwest corner of sec. 26, T. 27 S., R. 18 E.; Packwood Creek Quadrangle.

A11—0 to 7 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; strong coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregularly shaped interstitial and tubular pores; violently effervescent; disseminated lime; moderately alkaline; gradual smooth boundary.

A12—7 to 20 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; moderate very fine roots; many very fine interstitial and tubular pores and few medium tubular pores; violently effervescent; disseminated lime; moderately alkaline; gradual wavy boundary.

C1ca—20 to 40 inches; light yellowish brown (10YR 6/4) loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine interstitial and tubular pores; many fine and few medium tubular pores; common pressure faces; violently effervescent; disseminated lime and fine irregularly shaped filaments and soft masses of lime; moderately alkaline; gradual irregular boundary.

C2—40 to 72 inches; light yellowish brown (10YR 6/4) silt loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine interstitial and tubular pores; violently effervescent;

disseminated lime; moderately alkaline, abrupt wavy boundary.
Cr—72 to 75 inches; weathered calcareous fine-grained sandstone.

Depth to sandstone or shale is more than 60 inches. Pebble content is 0 to 10 percent throughout the profile.

The A horizon has dry color of 10YR 6/3 or 6/4 and moist color of 10YR 4/3, 4/4, or 5/3. Clay content is 20 to 27 percent.

The C horizon has dry color of 10YR 6/3, 6/4, 7/2, 7/3, or 8/2 and moist color of 10YR 4/4, 5/3, 5/4, 6/2, or 6/3. It is loam, silt loam, or clay loam. Clay content is 18 to 30 percent. A few gypsum crystals are present in some pedons.

Milham Series

The Milham series consists of deep, well drained soils on older alluvial fans, plains, and low terraces. These soils formed in alluvial material derived dominantly from granitic and sedimentary rock. Slope is 0 to 9 percent.

Soils of the Milham series are fine-loamy, mixed, thermic Typic Haplargids.

Typical pedon of Milham sandy loam, 0 to 2 percent slopes; about 0.5 mile east of intersection Jackson Avenue and Rowlee Road, 2,500 feet east and 500 feet north of the southeast corner of sec. 14, T. 27 S., R. 23 E.; Wasco Southwest Quadrangle.

Ap—0 to 4 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak medium platy structure; soft, very friable, nonsticky and nonplastic; common very fine and few medium roots; common medium interstitial pores and common very fine tubular pores; slightly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.
B1t—4 to 10 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; strong very coarse prismatic structure; hard, friable, slightly sticky and slightly plastic; many very fine and few fine roots; few medium and many very fine interstitial pores and many very fine tubular pores; strongly effervescent; disseminated lime; moderately alkaline; clear smooth boundary.
B21tca—10 to 22 inches; yellowish brown (10YR 5/4) loam, dark yellowish brown (10YR 4/4) moist; strong very coarse prismatic structure; hard, friable, sticky and slightly plastic; many very fine and few fine roots; few fine and many very fine tubular pores; few thin clay films in pores and on peds; violently effervescent; disseminated lime; few fine rounded soft masses of lime; moderately alkaline; clear smooth boundary.
B22tca—22 to 49 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; medium coarse subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; common very fine tubular pores; common thin clay films in pores and on peds; violently effervescent; disseminated lime; few fine regularly shaped soft masses of lime; moderately alkaline; clear smooth boundary.
IICca—49 to 62 inches; pale olive (5Y 6/3) sandy loam, olive (5Y 5/3) moist; massive; hard, very friable, nonsticky and nonplastic; few very fine roots; few very fine interstitial and tubular pores; strongly effervescent; disseminated lime; few fine rounded soft masses of lime; moderately alkaline.

Rock fragment content of the profile is 0 to 5 percent. Total sand content of the profile is 35 to 60 percent, and silt content is 10 to 35 percent. The profile commonly is calcareous throughout and effervescence commonly increases with increasing depth. Some pedons have a slight or moderate saline-alkali condition in noncultivated areas.

The A horizon has dry color of 10YR 7/3, 7/2, 6/4, 6/3, 6/2, 5/4, or 5/3 and moist color of 10YR 6/3, 5/4, 4/4, 4/3, 4/2, 3/4, or 3/3. Clay content is 5 to 20 percent.

The B2t horizon has dry color of 10YR 7/4, 7/3, 6/6, 6/4, 6/3, 6/2, 5/4, or 5/3 and moist color of 10YR 6/3, 5/6, 5/4, 5/3, 4/4, or 4/3. Texture is loam, sandy clay loam, or clay loam that is 20 to 35 percent clay.

The C horizon has dry color of 10YR 7/4, 7/3, 6/4, 6/3, 6/2, or 5/4, 2.5Y 7/2, 6/4, or 6/2, or 5Y 6/3 and moist color of 10YR 5/4, 5/3, 5/2, 4/4, 4/3, or 4/2, 2.5Y 5/4, 5/2, or 4/2, or 5Y 5/3 or 4/3. Texture is sandy loam, fine sandy loam, loam, or sandy clay loam. Clay content is 5 to 25 percent. In some pedons the C horizon is weakly stratified or is moderately saline.

Millsholm Variant

The Millsholm Variant consists of shallow, well drained soils on hills and mountains. These soils formed in residuum derived dominantly from sandstone or shale. Slope is 15 to 75 percent.

Millsholm Variant soils are loamy, mixed, thermic Lithic Xerochrepts.

Typical pedon of Millsholm Variant sandy loam in an area of Millsholm Variant-Rock outcrop complex, 50 to 75 percent slopes; about 3 miles west of Orchard Peak, 2,500 feet north and 200 feet east of the southwest corner of sec. 19, T. 25 S., R. 17 E.; Orchard Peak Quadrangle.

All—0 to 1 inch; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; moderate fine and medium granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine interstitial pores; mildly

alkaline; 10 percent pebbles; abrupt smooth boundary.
A12—1 to 5 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine roots; common very fine tubular pores; mildly alkaline; 10 percent pebbles; clear smooth boundary.
B2—5 to 11 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine roots; common very fine tubular pores; few thin clay films in pores; mildly alkaline; 10 percent pebbles; abrupt smooth boundary.
R—11 inches; fractured shale.

Pebble content of the profile is 5 to 15 percent and commonly increases with increasing depth. Depth to lithic contact is 10 to 20 inches.

The A horizon has dry color of 10YR 6/2, 6/3, or 5/2 and moist color of 10YR 4/2 or 4/3. Clay content is 8 to 20 percent. Most of the pebbles are 2 millimeters to 2 centimeters in diameter. Reaction is neutral or mildly alkaline.

The B horizon has dry color of 10YR 6/3 or 6/4 and moist color of 10YR 4/3 or 4/4. Texture is sandy loam or loam. Clay content is 8 to 20 percent. Reaction is neutral or mildly alkaline.

Montara Series

The Montara series consists of shallow, well drained soils on hills and mountains. These soils formed in residuum derived dominantly from serpentine. Slope is 15 to 50 percent.

Montara soils are loamy, serpentinitic, thermic Lithic Haploxerolls.

Typical pedon of a Montara clay loam in an area of Montara-Rock outcrop complex, 15 to 50 percent slopes; about 1.75 miles south of McGovern Gap, 1,200 feet east and 2,400 feet north of the southwest corner of sec. 16, T. 26 S., R. 17 E.; Orchard Peak Quadrangle.

A11—0 to 4 inches; gray (10YR 5/1) clay loam, very dark grayish brown (10YR 3/2) moist; strong medium subangular blocky structure; slightly hard, friable, slightly sticky and plastic; common very fine roots; many very fine tubular pores and few very fine interstitial pores; 5 percent serpentine fragments 2 to 10 millimeters in diameter; moderately alkaline; gradual smooth boundary.
A12—4 to 14 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate coarse subangular blocky structure; hard, friable, slightly sticky and plastic; few very fine roots; common very fine tubular pores and few very fine interstitial pores; 10 percent serpentine fragments 2 to 10 millimeters in diameter; moderately alkaline; clear wavy boundary.
R—14 inches; hard fractured serpentine; fractures 1 to 10 centimeters apart; little soil material in fractures; the few roots present follow vertical fractures; little to no rotational displacement.

Depth to rock is 10 to 20 inches. Rock fragment content of the profile is less than 15 percent; the fragments are fractured pieces of serpentine. The profile is neutral to moderately alkaline but does not effervesce.

The A horizon has dry color of 10YR 5/1, 5/2, 4/1, or 4/2 and moist color of 10YR 3/1, 3/2, or 3/3. Clay content is 27 to 35 percent.

The Montara soils in this survey area are taxadjunct to the Montara series because they are drier by about 30 to 50 days than is defined as the range for the series. This difference, however, does not significantly affect their use and management.

Myers Variant

The Myers Variant consists of deep, well drained soils on terraces. These soils formed in alluvium derived dominantly from sedimentary rock. Slope is 2 to 9 percent.

Myers Variant soils are very fine, montmorillonitic, thermic Entic Chromoxererts.

Typical pedon of Myers Variant clay, 2 to 9 percent slopes; about 2,400 feet west and 1,600 feet north of the southeast corner of sec. 36, T. 28 S., R. 18 E.; Las Yeguas Ranch Quadrangle.

A11—0 to 1 inch; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; strong fine and medium granular structure; slightly hard, very firm, very sticky and very plastic; common very fine roots; many very fine interstitial and tubular pores; violently effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.
A12—1 to 6 inches; brown (10YR 5/3) clay, brown (10YR 5/3) moist; strong very coarse prismatic structure parting to moderate medium subangular blocky; hard, very firm, very sticky and very plastic; common very fine roots; many very fine interstitial pores and few very fine tubular pores; cracks 1 to 2 centimeters wide with horizontal spacing of 20 to 30 centimeters; violently effervescent; disseminated lime; moderately alkaline; clear wavy boundary.
C1—6 to 18 inches; brown (10YR 5/3) clay, brown (10YR 5/3) moist; strong very coarse prismatic structure parting to moderate coarse subangular blocky; very hard, very firm, very sticky and very plastic; few very fine roots; common very fine interstitial pores and few very fine tubular pores; cracks 1 to 2 centimeters wide with horizontal

spacing of 20 to 30 centimeters; violently effervescent; disseminated lime; moderately alkaline; gradual wavy boundary.

C2—18 to 61 inches; yellowish brown (10YR 5/4) clay, dark brown (10YR 4/3) moist; common medium yellowish brown (10YR 5/6) mottles, dark yellowish brown (10YR 4/4) moist; strong fine and medium angular blocky structure; hard, very firm, very sticky and very plastic; few very fine roots; few very fine tubular pores; cracks 1 to 2 centimeters wide with horizontal spacing of 20 to 30 centimeters and extending to a depth of 60 centimeters; strongly effervescent; disseminated lime; many fine seams and soft masses of gypsum; moderately alkaline.

Deep cracks are present in the profile from April to November. The cracks are 1 to 2 centimeters wide, extend to a depth of 50 to 130 centimeters, and have a horizontal spacing of 20 to 50 centimeters. Microgilgai commonly are present and have an amplitude of 4 to 5 centimeters.

The A horizon has dry color of 10YR 5/3 or 5/4 and moist color of 10YR 4/3 or 5/3. Clay content is 60 to 75 percent. In some pedons the A horizon contains small bodies of natural gypsum.

The C horizon has dry color of 10YR 5/3, 5/4, or 7/2 and moist color of 10YR 4/3, 4/4, 5/3, or 7/2. Color of dry mottles is 10YR 5/6, 7.5YR 6/6, or 2.5Y 7/6. Clay content is 60 to 70 percent. Gypsum is present as seams or soft masses.

Nacimiento Series

The Nacimiento series consists of moderately deep, well drained soils on hills and mountains. These soils formed in residuum derived dominantly from calcareous sandstone or shale. Slope ranges from 9 to 50 percent.

Soils of the Nacimiento series are fine-loamy, mixed, thermic Calcic Haploxerolls.

Typical pedon of Nacimiento silty clay loam in an area Nacimiento-Kilmer complex, 9 to 30 percent slopes; about 2 miles east of Choice Valley, 75 feet west and 2,700 feet north of the southeast corner of sec. 33, T. 26 S., R. 17 E.; Holland Canyon Quadrangle.

A11—0 to 6 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure and moderate coarse subangular blocky; slightly hard, friable, sticky and plastic; many very fine roots; many fine and very fine tubular pores and common very fine interstitial pores; strongly effervescent; disseminated lime; moderately alkaline; clear smooth boundary.

A12—6 to 13 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; weak coarse subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine roots; few fine and many very fine tubular pores; violently effervescent; disseminated lime; moderately alkaline; gradual smooth boundary.

C1ca—13 to 17 inches; yellowish brown (10YR 5/4) silty clay loam, dark brown (10YR 3/3) moist; weak very coarse subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine roots; common very fine interstitial pores and many very fine tubular pores; violently effervescent; common fine filaments of lime; moderately alkaline; gradual wavy boundary.

C2ca—17 to 26 inches; pale brown (10YR 6/3) silty clay loam, dark yellowish brown (10YR 3/4) moist; massive; slightly hard, very friable, sticky and plastic; common very fine roots; common very fine interstitial pores and many very fine tubular pores; violently effervescent; common soft masses of lime; moderately alkaline; clear irregular boundary.

C3r—26 inches; very pale brown (10YR 7/3) weathered shale, light yellowish brown (10YR 6/4) moist; cracks 1 to 3 centimeters apart; little soil material in cracks; few roots present follow cracks and have no rotational displacement.

The A horizon has dry color of 10YR 4/2, 4/3, 5/2, or 5/3 and moist color of 10YR 3/2 or 3/3. Clay content is 27 to 35 percent. Pebble content is 0 to 15 percent.

The C horizon has dry color of 10YR 5/4, 6/3, 7/3, 7/4, or 8/2 and moist color of 10YR 3/3, 3/4, 4/3, 4/4, 5/4, 6/4, or 7/3. Shale fragments make up 0 to 15 percent of the soil profile. Texture is loam, clay loam, or silty clay loam. Clay content is 20 to 35 percent.

Nahrub Series

The Nahrub series consists of deep, somewhat poorly drained, saline-alkali soils in basins. These soils formed in alluvium derived dominantly from granitic and sedimentary rock. Slope is 0 to 2 percent.

Soils of the Nahrub series are fine, montmorillonitic (calcareous), thermic Vertic Torriorthents.

Typical pedon of Nahrub clay, drained; about 7.5 miles north of Lost Hills; 2,500 feet east and 1,400 feet north of the southwest corner of sec. 26, T. 25 S., R. 21 E.; Lost Hills Northwest Quadrangle.

Ap—0 to 6 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; few very fine roots; few very fine tubular pores; strongly effervescent; disseminated lime; surface cracks are 1 centimeter wide and 20 to 25 inches apart; strongly alkaline; gradual smooth boundary.

A1—6 to 18 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; strong very coarse prismatic structure; extremely hard, firm, sticky and plastic; few very fine roots; few very fine tubular pores; strongly effervescent; disseminated lime; cracks are

1 centimeter wide and 20 to 25 inches apart; strongly alkaline; clear smooth boundary.

C2—18 to 29 inches; pale brown (10YR 6/3) clay, grayish brown (10YR 5/2) moist; strong very coarse prismatic structure; very hard, friable, very sticky and very plastic; few very fine roots; few very fine tubular pores; slightly effervescent; few fine seams and soft masses of lime; visible pressure faces; very strongly alkaline; clear smooth boundary.

C3—29 to 43 inches; light brownish gray (2.5Y 6/2) clay, olive (5Y 5/3) moist; strong very coarse prismatic structure; very hard, friable, very sticky and very plastic; few very fine roots; few very fine tubular pores; slightly effervescent; disseminated lime; visible pressure faces; very strongly alkaline; clear smooth boundary.

IIC4—43 to 52 inches; pale yellow (5Y 7/3) clay loam, olive gray (5Y 5/2) moist; common fine distinct yellowish red (5Y 5/8) mottles, dry or moist; massive; slightly hard, friable, sticky and plastic; few very fine roots; few very fine tubular pores; slightly effervescent; disseminated lime; strongly effervescent; few fine soft masses of lime; very strongly alkaline; gradual smooth boundary.

IIC5—52 to 61 inches; light olive gray (5Y 6/2) fine sandy loam, olive gray (5Y 5/2) moist; common fine distinct yellowish red (5Y 5/8) mottles, dry or moist; massive; slightly hard, friable, slightly sticky and slightly plastic; strongly effervescent; disseminated lime; very strongly alkaline.

The organic carbon content is less than 0.5 percent at a depth of 10 inches and decreases regularly with increasing depth. The profile is slightly or strongly saline-alkali. Cracks extend to a depth of 20 inches or more in summer, are 1 to 2 centimeters wide, and are 20 to 25 inches apart.

The A horizon has dry color of 10YR 5/1, 5/2, 4/1, or 4/2 or 2.5Y 6/2 and moist color of 10YR 3/1, 3/2, 4/1, or 4/2 or 2.5Y 4/2. Clay content is 40 to 50 percent. Electrical conductivity is 4 to 8 millimhos per centimeter. Exchangeable sodium percentage is 15 to 45. The upper part of the A horizon is strongly effervescent to noneffervescent. Calcium carbonate equivalent is less than 14 percent. The horizon is moderately alkaline to very strongly alkaline.

The C horizon has dry color of 10YR 5/1, 6/2, or 6/3, 2.5Y 5/2, 6/2, or 7/4, or 5Y 7/3, 6/1, or 6/2 and moist color of 10YR 5/2 or 5/3, 2.5Y 3/2, 4/2, or 5/2, or 5Y 5/2 or 5/3. Texture is clay, clay loam, or fine sandy loam. Clay content is 15 to 50 percent. Salinity commonly increases with increasing depth. Electrical conductivity is 8 to 16 millimhos per centimeter. Exchangeable sodium percentage is 45 to 80. In some pedons toxic amounts of boron or arsenic are present. Durinodes commonly are present in the lower part of the C horizon. Many pressure faces are present in the upper part of the C horizon. Calcium carbonate equivalent is 1 to 10 percent throughout the horizon. The horizon is strongly alkaline or very strongly alkaline.

Panoche Series

The Panoche series consists of deep, well drained soils on alluvial fans and flood plains. These soils formed in alluvium derived dominantly from granitic or sedimentary rock. Slope is 0 to 9 percent.

Soils of the Panoche series are fine-loamy, mixed (calcareous), thermic Typic Torriorthents.

Typical pedon of Panoche clay loam, 0 to 2 percent slopes; about 7 miles southwest of Lost Hills; 100 feet east and 2,500 feet south of the northwest corner of sec. 4, T. 28 S., R. 21 E.; Lost Hills Quadrangle.

Ap—0 to 6 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; strong medium subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; many very fine interstitial pores and common very fine tubular pores; violently effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

A1—6 to 16 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; massive; slightly hard, friable, sticky and plastic; few fine and very fine roots; many very fine interstitial pores and common very fine tubular pores; violently effervescent; disseminated lime; moderately alkaline; gradual smooth boundary.

C1—16 to 23 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; massive; slightly hard, friable, sticky and plastic; few very fine roots; many very fine interstitial and tubular pores; violently effervescent; disseminated lime and few fine filaments of lime; moderately alkaline; clear smooth boundary.

C2—23 to 36 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; massive; slightly hard, friable, sticky and plastic; many very fine roots; many very fine interstitial pores and many very fine and few fine tubular pores; violently effervescent; disseminated lime; moderately alkaline; abrupt wavy boundary.

C3—36 to 47 inches; light yellowish brown (10YR 6/4) sandy clay loam, brown (10YR 4/3) moist; massive; slightly hard, friable, sticky and plastic; few very fine roots; many very fine interstitial and tubular pores; violently effervescent; disseminated lime; few fine filaments of lime; moderately alkaline; gradual wavy boundary.

C4—47 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, friable, sticky and plastic; few very fine roots; many very fine interstitial pores and many very fine tubular pores; violently effervescent;

disseminated lime; few fine filaments of lime; strongly alkaline.

The A horizon has dry color of 10YR 5/2, 5/3, 5/4, 6/2, 6/3, 6/4, 7/3, or 7/4 or 2.5Y 5/2 or 6/2 and moist color of 10YR 3/3, 4/2, 4/3, 4/4, 5/2, 5/3, or 5/4 or 2.5Y 4/2 or 4/4. Clay content is 27 to 35 percent.

The C horizon has dry color of 10YR 5/2, 5/4, 6/3, 6/4, 7/3, or 7/4 or 2.5Y 6/4 and moist color of 10YR 4/3, 4/4, 5/3, or 5/4 or 2.5Y 5/4. Texture is loam, clay loam, silty clay loam, or sandy clay loam. Clay content is 18 to 35 percent. Structure is massive to weak or moderate angular blocky or subangular blocky.

Polonio Series

The Polonio series consists of deep, well drained soils on alluvial fans. These soils formed in alluvium derived dominantly from sedimentary rock. Slope is 2 to 9 percent.

Soils of the Polonio series are fine-loamy, mixed (calcareous), thermic Xeric Torriorthents.

Typical pedon of Polonio loam, 2 to 9 percent slopes; about 0.5 mile southeast of Highway 46 and San Luis Obispo County line, 1,800 fee east and 900 feet north of the southwest corner of sec. 30, T. 25 S., R. 17 E.; Orchard Peak Quadrangle.

All—0 to 16 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; strong medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial and tubular pores; mildly alkaline; clear smooth boundary.

A12—16 to 26 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; weak coarse angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine interstitial pores and common fine tubular pores; slightly effervescent; few fine filaments of lime; moderately alkaline; gradual wavy boundary.

Cl—26 to 43 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine interstitial pores and common very fine and fine tubular pores; slightly effervescent; disseminated lime; moderately alkaline; clear smooth boundary.

C2—43 to 60 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine interstitial pores; violently effervescent; disseminated lime and few fine filaments and seams of lime; moderately alkaline.

The A horizon has dry color of l0YR 5/2, 5/3, or 6/3 and moist color of l0YR 4/2 or 4/3. Some pebbles and cobbles are present in some pedons. Clay content is 18 to 30 percent.

The C horizon has dry color of 10YR 5/3 or 6/3 and moist color of 10YR 4/2 or 4/3. Texture is sandy loam, sandy clay loam, or loam. Clay content is 15 to 30 percent. A lithological discontinuity exists in some pedons below a depth of 30 inches, and the texture below this depth generally is gravelly sandy loam or gravelly loamy sand. Some pedons have pebbles and cobbles throughout the horizon.

Pottinger Series

The Pottinger series consists of deep, well drained soils on alluvial fans and terraces. These soils formed in alluvium derived dominantly from sedimentary rock. Slope is 2 to 15 percent.

Soils of the Pottinger series are loamy-skeletal, mixed, thermic Pachic Haploxerolls.

Typical pedon of Pottinger very shaly clay loam, 2 to 9 percent slopes; about 3.5 miles west of Reward, 1,900 feet south and 1,900 feet east of the northwest corner of sec. 17, T. 30 S., R. 21 E.; Reward Quadrangle.

Ap—0 to 5 inches; grayish brown (10YR 5/2) very shaly clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine roots; many very fine tubular and interstitial pores; 45 percent shale fragments 2 to 4 centimeters in diameter; moderately alkaline; clear smooth boundary.

A1—5 to 23 inches; brown (10YR 5/3) very shaly clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine roots; many very fine tubular and interstitial pores; 40 percent shale fragments, 2 to 4 centimeters in diameter; moderately alkaline; clear smooth boundary.

Cl—23 to 38 inches; pale brown (10YR 6/3) very shaly clay loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; slightly hard, very friable, sticky and plastic; few very fine roots; many very fine tubular and interstitial pores; 40 percent shale fragments 2 to 4 centimeters in diameter; moderately alkaline; clear smooth boundary.

C2—38 to 60 inches; light brownish gray (10YR 6/2) very shaly clay loam, dark grayish brown (10YR 4/2) moist; weak very fine subangular blocky structure; slightly hard, very friable, sticky and plastic; common very fine tubular pores and many very fine interstitial pores; 45 percent shale fragments 2 to 4 centimeters in diameter; moderately alkaline.

Organic matter content is I to 3 percent to a depth of 20 inches and decreases regularly with increasing depth. Shale fragments make up 35 to 60 percent of the soil profile.

The A horizon has dry color of 10YR 4/2, 5/3, or 5/2 and moist color of 10YR 2/2 or 3/2. Clay content is 27 to 35 percent.

The C horizon has dry color of 10YR 6/2, 6/3, or 6/4 and moist color of 10YR 4/2 or 4/3. The structure is weak, fine or very fine subangular blocky, or it is massive. Texture is very shaly clay loam or very shaly sandy clay loam. Clay content is 27 to 37 percent.

Premier Series

The Premier series consists of deep, well drained soils on terraces. These soils formed in alluvium derived dominantly from granitic rock. Slope is 2 to 30 percent.

Soils of the Premier series are coarse-loamy, mixed (calcareous), thermic Xeric Torriorthents.

Typical pedon of Premier coarse sandy loam in an area Premier-Durorthids association, 9 to 15 percent slopes, about 5 miles northwest of Oildale, 550 feet east and 350 feet south of the northwest corner of sec. 21, T. 28 S., R. 27 E.; Oildale Quadrangle.

A11—0 to 1 inch; grayish brown (10YR 5/2) coarse sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many fine and very fine interstitial pores and many very fine tubular pores; about 5 percent pebbles 2 to 5 millimeters in diameter; neutral; abrupt wavy boundary.

A12—1 to 12 inches; pale brown (10YR 6/3) coarse sandy loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine roots; many very fine interstitial pores and common very fine tubular pores; about 5 percent pebbles 2 to 5 millimeters in diameter; strongly effervescent; disseminated lime; moderately alkaline; gradual wavy boundary.

C1—12 to 33 inches; variegated light yellowish brown (10YR 6/4) and brown (10YR 5/3) coarse sandy loam, yellowish brown (10YR 5/4) and dark brown (10YR 3/3) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; few very fine roots; many very fine interstitial pores and few very fine tubular pores; about 5 percent pebbles 5 to 40 millimeters in diameter; strongly effervescent; disseminated lime; moderately alkaline; diffuse smooth boundary.

C2—33 to 61 inches; light yellowish brown (10YR 6/4) coarse sandy loam, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; many very fine interstitial pores and few very fine tubular pores; 5 percent pebbles 5 to 40 millimeters in diameter; violently effervescent; disseminated lime; moderately alkaline.

Rock fragments make up 0 to 5 percent of the profile and are 2 to 40 millimeters in diameter.

The A horizon has dry color of 10YR 5/2, 5/3, 5/4, 6/3, or 6/4 and moist color of 10YR 3/2, 3/3, 4/3, or 4/4. Only the upper 2 inches of the A horizon has moist color of 10YR 3/2 or 3/3. The horizon has weak or moderate subangular blocky structure, or it is massive. The upper part of the A horizon is neutral, and the lower part is mildly alkaline or moderately alkaline. Typically, the A horizon is noncalcareous to a depth of 2 inches and is strongly or violently effervescent and has disseminated lime below a depth 2 inches. Clay content is 5 to 18 percent.

The C horizon has dry color of 10YR 5/3, 6/3, 6/4, 7/3, or 7/4 and moist color of 10YR 3/3, 4/3, 4/4, 5/3, 5/4, or 6/4. Texture is coarse sandy loam, sandy loam, or loam. Clay content is 5 to 18 percent.

Reward Series

The Reward series consists of deep, well drained soils on hills and mountains. These soils formed in residuum derived dominantly from shale or sandstone. Slope is 15 to 50 percent.

Soils of the Reward series are fine-loamy, mixed, thermic Pachic Haploxerolls.

Typical pedon of Reward shaly loam, 30 to 50 percent slopes; about 4 miles southwest of McKittrick, 700 feet north and 2,150 feet east of the southwest corner of sec. 35, T. 30 S., R. 21 E.; Reward Quadrangle.

A11—0 to 10 inches; grayish brown (10YR 5/2) shaly loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular and interstitial pores; 15 percent shale fragments; strongly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

A12—10 to 24 inches; grayish brown (10YR 5/2) shaly loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine and fine tubular pores and many very fine interstitial pores; 15 percent shale fragments; strongly effervescent; disseminated lime; moderately alkaline; clear wavy boundary.

C1—24 to 39 inches; grayish brown (10YR 5/2) shaly loam, very dark grayish brown (10YR 3/2) moist; few prominent pockets of light brownish gray (10YR 6/2) loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine and

fine tubular pores and many very fine interstitial pores; 15 percent shale fragments; strongly effervescent; disseminated lime and filaments or threads of lime; moderately alkaline; clear smooth boundary.

C2—39 to 60 inches; pale brown (10YR 6/3) shaly clay loam, dark brown (10YR 3/3) moist; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine and fine tubular pores and many very fine interstitial pores; 20 percent shale fragments; strongly effervescent; disseminated lime and filaments or threads of lime; moderately alkaline; abrupt wavy boundary.

R—60 to 65 inches; fractured calcareous shale.

Depth to lithic contact is 40 to 60 inches. Organic matter content of the profile is 1.0 to 2.5 percent to a depth of 20 inches and decreases regularly with increasing depth.

The A horizon has dry color of 10YR 5/2 or 5/3 and moist color of 10YR 3/2 or 3/3. Structure is weak medium granular to weak coarse angular blocky, or it is massive. Some cobbles are present in the A horizon and on the surface. Clay content is 18 to 25 percent. Shale content is 15 to 30 percent.

The C horizon has dry color of 10YR 5/3, 5/2, 6/3, or 6/2 and moist color of 10YR 3/3 or 3/2. It is loam or clay loam and is 18 or 35 percent clay. Few cobble-sized fragments are present in some pedons. Shale content is 15 to 35 percent.

Temblor Series

The Temblor series consists of shallow, well drained soils on hills and mountains. These soils formed in residuum derived dominantly from diatomaceous shale. Slope is 30 to 75 percent.

Temblor soils are loamy-skeletal, mixed, thermic Lithic Haploxerolls.

Typical pedon of Temblor very shaly sandy loam in an area of Aramburu-Temblor complex, 50 to 75 percent slopes; about 0.75 mile south of McKittrick Summit, 3,200 feet east and 1,250 feet north of the southwest corner of sec. 30, T. 30 S., R. 21 E.; McKittrick Summit Quadrangle.

A11—0 to 2 inches; grayish brown (10YR 5/2) very shaly sandy loam, very dark grayish brown (10YR 3/2) moist; moderate very fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine interstitial and tubular pores; about 40 percent shale fragments; moderately alkaline; abrupt smooth boundary.

A12—2 to 10 inches; grayish brown (10YR 5/2) very shaly loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial and tubular pores; about 40 percent shale fragments; moderately alkaline; abrupt smooth boundary.

R—10 inches; hard fractured very pale brown (10YR 7/3) shale; fractures are 1 to 10 inches apart and 0.25 to 1.0 inch wide; some soil material fills the fractures.

Depth to shale is 10 to 20 inches. Rock fragments, mostly angular, make up 35 to 50 percent of the profile. The fragment are mostly 2 to 5 millimeters in diameter. Organic matter content is 1 to 2 percent and decreases regularly with increasing depth.

The A horizon has dry color of 10YR 4/3, 5/2, or 5/3 and moist color 10YR 3/2 or 3/3. Clay content is 15 to 20 percent. Reaction is neutral to moderately alkaline.

Twisselman Series

The Twisselman series consists of deep, well drained soils on alluvial fans and basin rims. These soils formed in alluvium derived dominantly from sedimentary rock. Slope is 0 to 5 percent.

Soils of the Twisselman series are fine, mixed (calcareous), thermic Typic Torriorthents.

Typical pedon of Twisselman clay, 0 to 2 percent slopes, about 1 mile east of Kettleman Hills, 1,500 feet north and 100 feet west of the southeast corner of sec. 15, T. 25 S., R. 19 E.; Emigrant Hill Quadrangle.

Ap—0 to 5 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; hard, firm, very sticky and plastic; many very fine roots; few very fine interstitial pores and common very fine tubular pores; strongly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

A1—5 to 14 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; moderate coarse subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; few very fine interstitial pores and common very fine tubular pores; strongly effervescent; disseminated lime; moderately alkaline; clear smooth boundary.

C1—14 to 27 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; moderate coarse subangular blocky structure; hard, firm, very sticky and very plastic; few very fine roots; common very fine tubular pores; strongly effervescent; few irregularly shaped fine filaments or threads of lime; moderately alkaline; clear smooth boundary.

C2—27 to 51 inches; very pale brown (10YR 7/3) clay, brown (10YR 5/3) moist; moderate medium platy structure; hard, firm, sticky and plastic; few very fine roots; common very fine interstitial pores and few very fine tubular pores; strongly effervescent; few

irregularly shaped fine filaments or threads of lime; moderately alkaline; clear smooth boundary.

C3—51 to 63 inches; brown (10YR 5/3) silty clay, brown (10YR 4/3) moist; moderate coarse subangular blocky structure; hard, firm, very sticky and plastic; few very fine roots; common very fine interstitial pores and few very fine tubular pores; strongly effervescent; few irregularly shaped fine filaments or threads of lime; moderately alkaline.

The A horizon has dry color of 10YR 5/3, 6/2, or 6/3 and moist color of 10YR 4/2, 4/3, or 5/3. Clay content is 40 to 60 percent. Some pedons have been overblown with sandy loam or fine sandy loam and consequently have a clay content of 5 to 20 percent. Structure in the upper part of the A horizon is moderate and platy in some pedons, but it is more commonly moderate and subangular blocky in the lower part. Electrical conductivity is 0.5 to 8 millimhos per centimeter. Exchangeable sodium percentage is 1 to 20 or more.

The C horizon has dry color of 10YR 5/3, 5/4, 6/3, 6/4, or 7/3 and moist color of 10YR 4/2, 4/3, 4/4, 5/3, or 5/4. Texture is clay, silty clay, or silty clay loam. Where the profile is stratified, texture is sandy loam to clay. Clay content is 10 to 60 percent. Structure is commonly moderate subangular blocky and prismatic parting to moderate angular blocky or moderate platy, but some pedons are massive. Gypsum crystals, where present, make up 2 to 30 percent of the soil at a depth of 12 to 34 inches. Electrical conductivity is 2 to 50 millimhos per centimeter. Exchangeable sodium percentage is 2 to 100. Some areas have moderate to high levels of boron.

Vaquero Series

The Vaquero series consists of moderately deep, well drained soils on hills and mountains. These soils formed in residuum derived dominantly from shale. Slope is 15 to 75 percent.

Soils of the Vaquero series are fine, montmorillonitic, thermic Entic Chromoxererts.

Typical pedon of Vaquero clay in an area of Vaquero and Altamont clays, 15 to 50 percent slopes; about 2.75 miles northwest of Highway 41 via the airstrip; 1,900 feet east and 200 feet south of the center of sec. 36, T. 24 S., R. 16 E.; Tent Hills Quadrangle.

A11—0 to 1 inch; yellowish brown (10YR 5/4) clay, brown (10YR 4/3) moist; strong medium subangular blocky structure parting to strong very fine subangular blocky; very hard, very friable, sticky and very plastic; many very fine roots; common very fine tubular pores; common intersecting slickensides; slightly effervescent; disseminated lime; neutral; abrupt wavy boundary.

A12—1 to 11 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; strong medium subangular blocky structure; very hard, very friable, sticky and very plastic; many very fine roots; common very fine tubular pores; common intersecting slickensides; slightly effervescent; disseminated lime; mildly alkaline; abrupt smooth boundary.

A13—11 to 17 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; strong medium subangular blocky structure; extremely hard, very friable, sticky and very plastic; many very fine roots; common very fine tubular pores; common intersecting slickensides; slightly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

C1—17 to 25 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; strong medium subangular blocky structure; extremely hard, friable, sticky and very plastic; many very fine roots; common very fine tubular pores; common intersecting slickensides; strongly effervescent; common medium irregularly shaped soft masses and seams of lime; moderately alkaline; abrupt smooth boundary.

C2—25 to 36 inches; variegated brown (10YR 5/3), brownish yellow (10YR 6/6), and yellowish brown (10YR 5/6) clay, brown (10YR 4/3), yellowish brown (10YR 5/6), and dark yellowish brown (10YR 4/6) moist; strong medium subangular blocky structure; extremely hard, friable, sticky and plastic; few very fine roots; common very fine tubular pores; common intersecting slickensides; violently effervescent; common medium irregularly shaped soft masses, filaments, and seams of lime; moderately alkaline; abrupt smooth boundary.

C3r—36 inches; variegated brown (10YR 5/3), yellowish brown (10YR 5/6), brownish yellow (10YR 6/6), and gray (10YR 5/1) highly fractured calcareous shale with some soil material in the fractures; violently effervescent; many medium irregularly shaped soft masses, concretions, and filaments of lime; strongly alkaline.

Depth to paralithic contact of shale is 20 to 40 inches. Vertical cracks extend from the surface and are 0.5 to 3.0 inches wide at a depth of 20 inches. The cracks commonly close from January through March and remain closed at least 60 consecutive days.

The A horizon has dry color of 10YR 5/2, 5/3, 5/4, 6/2, or 6/3 or 2.5Y 5/2 or 6/2 and moist color of 10YR 4/2 or 4/3 or 2.5Y 4/2, 4/4, or 5/4. Clay content is 40 to 60 percent. It is neutral to moderately alkaline.

The C horizon has dry color of 10YR 5/3, 5/6, 6/3, 6/4, or 6/6 or 2.5Y 6/2 or 7/4 and moist color of 10YR 4/3, 4/6, 5/4, 5/6, 6/6, or 6/8 or 2.5Y 4/4 or 7/4. Mottles are present in some pedons and have moist color of 7.5YR 5/8 or 10YR 3/3. It commonly is clay but is silty clay in some pedons. Clay content is 40 to 60 percent. The horizon commonly is alkali in some part and is saline-alkali in some pedons. The horizon is moderately alkaline or strongly alkaline.

Wasco Series

The Wasco series consists of deep, well drained soils on recent alluvial fans and flood plains. These soils formed in alluvium derived dominantly from granitic rock. Slope is 0 to 5 percent.

Soils of the Wasco series are coarse-loamy, mixed, nonacid, thermic Typic Torriorthents.

Typical pedon of Wasco sandy loam; about 3.5 miles southeast of Wasco, 300 feet east and 2,550 feet south of the northwest corner of sec. 32, T. 27 S., R. 25 E.; Wasco Quadrangle.

Ap1—0 to 9 inches; brown (10YR 5/3) sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; very few very fine roots; many very fine interstitial pores; slightly acid; abrupt smooth boundary.

Ap2—9 to 15 inches; yellowish brown (10YR 5/4) sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; very few fine roots; few very fine tubular pores and many very fine interstitial pores; neutral; abrupt smooth boundary.

C1—15 to 32 inches; brown (10YR 5/3) sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; very few very fine roots; common very fine tubular pores and many very fine interstitial pores; neutral; abrupt smooth boundary.

C2—32 to 65 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; common very fine tubular pores and many very fine interstitial pores; slightly effervescent; disseminated lime; moderately alkaline.

Carbonates are not present in all pedons to a depth of 16 to 40 inches. Lime is disseminated below a depth of 16 to 40 inches. The profile is less than 15 percent rock fragments to a depth of 40 inches or more. Rock fragments are less than 0.5 inch in diameter.

The A horizon has dry color of 10YR 5/2, 5/3, 5/4, 6/2, or 6/3 or 2.5Y 5/2 or 6/2 and moist color of 10YR 3/2, 3/3, 3/4, 4/2, or 5/3. Clay content is 8 to 18 percent. The A horizon commonly is massive, but it is blocky or platy in some pedons. Reaction is slightly acid to mildly alkaline.

The C horizon has dry color of 10YR 5/3, 5/4, 6/3, 6/4, or 7/2 or 2.5Y 5/4 and moist color of 10YR 4/2, 4/3, 4/4, 5/2, 5/3, or 6/1 or 2.5Y 4/4. Texture is mainly sandy loam or fine sandy loam, but it is stratified loamy sand to silt loam below a depth of 40 inches in some pedons. Clay content is 8 to 18 percent. Reaction is neutral to moderately alkaline.

Westhaven Series

The Westhaven series consists of deep, moderately well drained soils on flood plains and alluvial fans. These soils formed in alluvium derived dominantly from granitic rock. Slope is 0 to 2 percent.

Soils of the Westhaven series are fine-silty, mixed (calcareous), thermic Typic Torrifluvents.

Typical pedon of Westhaven fine sandy loam; about 8 miles southwest of Shafter; 2,600 feet west and 2,550 feet south of the northeast corner of sec. 29, T. 29 S., R. 25 E.; Rio Bravo Quadrangle.

Ap—0 to 11 inches; light brownish gray (10YR 6/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common medium, fine, and very fine roots; few very fine tubular pores; slightly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

IIC1—11 to 24 inches; pale brown (10YR 6/3) silt loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and many very fine roots; many very fine tubular pores; slightly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

IIC2—24 to 28 inches; pale brown (10YR 6/3) silt loam, very dark grayish brown (10YR 3/2) moist; few fine and medium prominent mottles, strong brown (7.5YR 5/6) and dark brown (7.5YR 4/4) moist; massive; hard, friable, sticky and slightly plastic; common very fine roots; common very fine tubular pores and few very fine interstitial pores; strongly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

IIIC3—28 to 43 inches; brown (10YR 5/3) light clay, very dark brown (10YR 2/2) moist; weak fine angular blocky structure; very hard, friable, very sticky and plastic; common very fine roots; few fine and many very fine tubular pores; strongly effervescent; disseminated lime; moderately alkaline; gradual smooth boundary.

IVC4—43 to 61 inches; white (10YR 8/2) clay loam, light yellowish brown (10YR 6/4) moist; weak fine angular blocky structure; very hard, friable, sticky and plastic; common very fine roots; many very fine tubular pores; violently effervescent; disseminated lime; common fine rounded soft masses of lime; moderately alkaline.

The A horizon has dry color of 10YR 5/3, 5/4, 6/2, 6/3, 6/4, or 7/4 and moist color of 10YR 3/2, 3/3, 4/3, or 4/4. Clay content is 12 to 20 percent. Reaction is mildly alkaline or moderately alkaline.

The C horizon has dry color of 10YR 4/2, 4/3, 5/2, 5/3, 6/2, 6/3, 7/2, 7/3, or 8/2 and moist color of 10YR

2/1, 2/2, 3/1, 3/2, 4/2, 4/3, 5/3, 5/4, or 6/4. Texture is stratified loamy fine sand, sandy loam, or silt loam in the upper part and silty clay loam, clay loam, or clay in the lower part. Clay content is 3 to 25 percent in the upper part and 30 to 50 percent in the lower part. Where present, mottles are distinct or prominent.

Whitewolf Series

The Whitewolf series consists of deep, somewhat excessively drained soils on alluvial fans and flood plains. These soils formed in alluvium derived dominantly from granitic rock. Slope is 0 to 2 percent.

Soils of the Whitewolf series are mixed, thermic Xeric Torripsamments.

Typical pedon of Whitewolf coarse sandy loam; about 1 mile northwest of Lamont; 550 feet north and 50 feet west of the southeast corner of sec. 31, T. 30 S., R. 29 E.; Lamont Quadrangle.

Ap—0 to 11 inches; brown (10YR 5/3) coarse sandy loam, dark brown (10YR 3/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few fine and common very fine roots; common very fine interstitial pores; slightly effervescent; disseminated lime; moderately alkaline; clear smooth boundary.

IIC1—11 to 43 inches; pale brown (10YR 6/3) loamy sand, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky and nonplastic; few fine and very fine roots, few very fine interstitial pores; slightly effervescent; disseminated lime; moderately alkaline; abrupt wavy boundary.

IIC2—43 to 49 inches; pale brown (10YR 6/3) coarse sand, dark yellowish brown (10YR 3/4) moist; single grain; loose, nonsticky and nonplastic; few very fine roots; few very fine interstitial pores; slightly effervescent; disseminated lime; moderately alkaline; clear wavy boundary.

IIIC3—49 to 65 inches; pale brown (10YR 6/3) loamy coarse sand, dark brown (10YR 3/3) moist; massive; loose, nonsticky and nonplastic; few very fine roots; few very fine interstitial pores; slightly effervescent; disseminated lime; moderately alkaline.

The A horizon has dry color of 10YR 5/2 or 5/3 and moist color of 10YR 3/2 or 3/3. Clay content is 5 to 10 percent.

The C horizon has dry color of 10YR 5/3 or 6/3 and moist color of 10YR 3/3 or 3/4. Texture is loamy sand, coarse sand, or loamy coarse sand. Clay content is 2 to 5 percent.

Yribarren Series

The Yribarren series consists of deep, well drained soils on alluvial fans and plains. These soils formed in alluvium derived dominantly from sedimentary rock. Slope is 0 to 5 percent.

Soils of the Yribarren series are fine, mixed, thermic Typic Haplargids.

Typical pedon of Yribarren clay loam, 2 to 5 percent slopes; about 3.5 miles east of Wagon Wheel Mountain, 1,100 feet south and 300 feet west of the northeast corner of sec. 33, T. 25 S., R. 19 E.; Emigrant Hill Quadrangle.

A1—0 to 7 inches; pale brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; moderate coarse angular blocky structure parting to medium platy; slightly hard, very friable, sticky and plastic; many very fine roots; few fine and common very fine tubular pores; violently effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

B21t—7 to 15 inches; pale brown (10YR 6/3) silty clay, brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, friable, very sticky and very plastic; many very fine roots; common fine and many very fine tubular pores; common thin clay films in pores and on faces of peds; violently effervescent; disseminated lime; moderately alkaline; clear wavy boundary.

B22tca—15 to 19 inches; light yellowish brown (10YR 6/4) silty clay, brown (10YR 4/3) moist; strong medium prismatic structure parting to medium subangular blocky; hard, friable, very sticky and very plastic; few very fine roots; few fine and common very fine tubular pores; many thin clay films in pores and on faces of peds; violently effervescent; disseminated lime and many fine irregularly shaped seams of lime; many fine irregularly shaped seams and soft masses of gypsum crystals; moderately alkaline; clear wavy boundary.

C1—19 to 22 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; massive; slightly hard, friable, sticky and plastic; few very fine roots; many very fine interstitial pores; violently effervescent; disseminated lime; few fine irregularly shaped seams of gypsum crystals; moderately alkaline; abrupt wavy boundary.

IIC2—22 to 49 inches; very pale brown (10YR 7/3) silty clay, brown (10YR 4/3) moist; massive; slightly hard, very friable, very sticky and very plastic; few very fine roots; common very fine tubular pores; violently effervescent; disseminated lime; few fine irregularly shaped seams of gypsum crystals; moderately alkaline; clear wavy boundary.

IIC3—49 to 60 inches; light yellowish brown (10YR 6/4) silty clay, brown (10YR 4/3) moist; massive; hard, friable, very sticky and plastic; few very fine roots; few very fine tubular pores; violently effervescent; disseminated lime and few fine irregular seams of lime; moderately alkaline.

The A horizon has dry color of 10YR 5/3, 6/3, 6/4, 7/3, or 7/4 and moist color of 10YR 4/2, 4/3, 5/3, or 5/4. Texture is loam or clay loam. Clay content is 20 to 35 percent. Electrical conductivity is 0.5 to 4.0 millimhos per centimeter. Exchangeable sodium percentage is less than 10.

The B2t horizon has dry color of 10YR 5/4, 6/3, 6/4, 7/2, 7/3, or 7/4 and moist color of 10YR 4/3, 5/3, 4/4, 5/4, or 6/3 or 2.5Y 5/4. Texture is clay loam, silty clay, or clay. Clay content is 35 to 55 percent. Structure is moderate prismatic to moderate, subangular blocky. Electrical conductivity is O.5 to 4.0 millimhos per centimeter. Exchangeable sodium percentage is less than 15. Some pedons do not have gypsum crystals in the B2t horizon.

The C horizon has dry color of 10YR 6/3, 6/4, 7/3, or 8/2 and moist color of 10YR 4/3, 5/3, 5/4, 6/3, or 7/3. Texture is heavy loam, clay loam, silty clay, or silty clay loam. The lower part of the C horizon has stratified layers of fine sandy loam, loam, silt loam, and clay loam. Clay content is 12 to 50 percent. Electrical conductivity is 0.8 to 8.0 millimhos per centimeter. Exchangeable sodium percentage is 10 to 20.

Zerker Series

The Zerker series consists of deep, well drained soils on alluvial fans and terraces. These soils formed in alluvium derived dominantly from granitic rock. Slope is 0 to 9 percent.

Soils of the Zerker series are fine-loamy, mixed (calcareous), thermic Xeric Torriorthents.

Typical pedon of Zerker sandy clay loam, 0 to 2 percent slopes; about 2 miles east of Cawelo; 90 feet east and 480 feet south of the northwest corner of sec. 12, T. 28 S., R. 26 E.; Famoso Quadrangle.

Ap1—0 to 8 inches; dark yellowish brown (10YR 4/4) sandy clay loam, dark brown (10YR 4/3) moist; strong very coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine and common very fine roots; many very fine tubular pores and few very fine interstitial pores; strongly effervescent; disseminated lime; moderately alkaline; clear smooth boundary.

Ap2—8 to 17 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; massive; hard, friable, slightly sticky and plastic; common very fine roots; few fine and many very fine tubular pores; violently effervescent; common fine soft masses of lime; moderately alkaline; clear smooth boundary.

C1—17 to 28 inches; brownish yellow (10YR 6/6) clay loam, dark yellowish brown (10YR 4/6) moist; massive; hard, friable, slightly sticky and plastic; common very fine roots; common very fine tubular pores and few very fine interstitial pores; violently effervescent; disseminated lime and common medium soft masses of lime; moderately alkaline; clear smooth boundary.

IIC2—28 to 43 inches; yellowish brown (10YR 5/6) sandy clay loam, dark yellowish brown (10YR 4/6) moist; massive; hard, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular and interstitial pores; strongly effervescent; disseminated lime and few fine soft masses of lime; moderately alkaline; clear wavy boundary.

IIC3ca—43 to 62 inches; light yellowish brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable, slightly sticky and plastic; few very fine roots; few fine and common very fine tubular pores and few fine interstitial pores; violently effervescent; disseminated lime and many medium soft masses of lime; moderately alkaline.

Subrounded granitic pebbles make up 5 to 15 percent the soil volume. Stratification is present in the lower part of the profile.

The A horizon has dry color of 10YR 4/3, 4/4, 5/2, 5/3, 6/3, or 6/4 and moist color of 10YR 3/4, 4/2, 4/3, 4/4, or 5/3. Texture is sandy clay loam or loam. Clay content is 15 to 28 percent. Reaction is mildly alkaline or moderately alkaline.

The C horizon has dry color of 10YR 5/2, 5/3, 5/4, 5/6, 6/3, 6/4, 6/6, or 7/3 or 7.5YR 5/4 or 5/6 and moist color of 10YR 4/3, 4/4, 4/6, 5/2, 5/3, 5/4, 5/6, 6/3, or 6/4 or 7.5YR 4/4 or 5/4. Texture is sandy loam, loam, sandy clay loam, or clay loam. Clay content is 18 to 30 percent.

Formation of the Soils

James F. Regal, soil scientist, Soil Conservation Service, helped to prepare this section.

Soils are natural bodies on the surface of the earth in which plants grow. They are composed of organic matter, minerals, water, and air. This section discusses the major factors and processes that have affected the formation of soils in the survey area.

Soils are formed through the interaction of five major factors: 1) The physical and chemical composition of the parent material; 2) the climate; 3) the biological forces that act upon the soil material; 4) the relief, or lay of the land; and 5) the length of time the forces of soil formation have acted on the soil material. The relative importance of each factor differs from place to place, and each soil-forming factor includes many variables that affect the character of the soil and tend to modify the effectiveness of the factors. For example, Wasco and Exeter soils formed in the same parent material but have striking profile differences because of differences in relief and time.

The influence of each soil-forming factor on the soils in the survey area are summarized in the following pages.

Parent Material

Parent material is the unconsolidated organic and mineral material in which soils form. The soils in this survey area formed mostly in residuum, alluvium, or colluvium.

The dominant parent material in the Temblor and Diablo Ranges, on the west side of the San Joaquin Valley, weathered from shale or sandstone and in places contains other sedimentary rock. Aramburu and Temblor soils formed in this type of parent material; they commonly have shale fragments throughout the profile. The soils that formed in colluvium, such as those of the Pottinger series, commonly formed at the base of steep slopes.

On the west side of the San Joaquin Valley, the soils formed in alluvium derived from granitic and sedimentary rock and in mixed alluvium derived from other rock of the Tulare Formation. Kimberlina, Milham, and Panoche soils formed in this type of parent material. Soils in the Elk Hills area formed in alluvial or lacustrine deposits of similar parent material but were subsequently uplifted.

On the lower basin floor, or trough, of the San Joaquin Valley, the soils formed mainly in fine textured alluvium derived from granitic rock. Buttonwillow, Lokern, and Nahrub are examples of the clayey soils that formed in this area.

On the eastern side of the San Joaquin Valley, the soils formed mainly in granitic alluvium from the Sierra Nevada Range. Typical of the moderately coarse textured soils that formed in the recent granitic alluvium of this area are the Kimberlina and Wasco soils. Medium textured soils of this area are the McFarland and Panoche soils. Garces and Milham soils formed in older granitic alluvium.

On the terraces of the Sierra Nevada Range, on the east side of the valley, the dominant parent material is recent or older granitic alluvium. Soils of the Premier series are an example of moderately coarse textured soils that formed in this recent alluvium. Delano and Driver are medium textured soils that formed in older alluvium.

Climate

Climate has a strong influence on soil formation. Moisture and temperature are two important elements of climate because they influence the kind and amount of vegetation that grows, the rate at which organic matter decomposes, biological activity, the rate that minerals weather, and the removal of material from the different soil horizons or the accumulation of material in them.

The climate varies from the hot dry summers and mild, somewhat moist winters of the San Joaquin Valley to the slightly cooler and more moist conditions of the surrounding hills in the Temblor Range and the lower terraces of the Sierra Nevada Range.

Differences in rainfall and temperature are influenced by the topographic change from the low terraces at the base of the Sierra Nevada Range across the San Joaquin Valley to the Temblor Range. Mean annual precipitation ranges from 5 inches in the middle of the valley to 12 inches in the Temblor Range. The average annual temperature ranges from 60 to 66 degrees F in the valley to about 59 to 65 degrees in the mountains.

Effects of higher precipitation and lower temperatures are evident in the vegetation and soils in the Temblor Range. In this area woody and herbaceous vegetation is more abundant and the content of organic matter is

higher. Aramburu and Reward are examples of the soils in this area.

In the central part of the San Joaquin Valley, the soils have developed slowly because of the warm, dry climate, which reduces the rate of weathering and results in decreased biological activity. Panoche and Kimberlina are examples of the soils in this area.

Biological Activity

Vegetation, burrowing animals, insects, and micro-organisms such as bacteria and fungi are important in the formation of soils. These organisms are involved in the formation and destruction of organic matter, the consumption and release of plant nutrients, and changes in soil structure.

Much of the survey area has very low rainfall and sparse vegetation. The vegetation in the San Joaquin Valley consists of drought tolerant desert shrubs such as saltbush and a sparse cover of annual grasses and forbs. The soils in these areas typically have low organic matter content and a light colored surface layer. Cajon, Kimberlina, and Panoche are examples of these soils.

Rainfall is slightly higher along the southeastern edge of the San Joaquin Valley than in the central part. Because of this, there is a greater amount of biological activity in the soils of this area. Chanac, Delano, Exeter, and Premier soils are representative of those in this area.

The higher areas in the Temblor Range and southern Diablo Mountains support the greatest amount of rainfall and vegetation in the survey area. Shrubs and oaks, with an understory of grasses and forbs at the highest elevations, are the dominant kinds of vegetation, and a dark colored, mollic surface layer is common. Aramburu, Temblor, and Reward are examples of the soils in this area.

Rodents, earthworms and micro-organisms mix organic matter into the soil. Earthworms and micro-organisms help break down plant and animal residue. Their action improves the soil's permeability to water and air. Lichens, bacteria, actinomycetes, and other micro-organisms help to weather the rock and mineral parts of the soil and decompose the organic matter to produce humus.

In the San Joaquin Valley and along the terraces on the east side of the San Joaquin Valley, man is changing the character of the soils through land leveling, cultivation, irrigation, and livestock grazing. Texture changes as a result of the mixing of soil horizons, and duripans are destroyed by ripping. Irrigation causes changes in the chemical content and the amount of organic matter in the soil. Man's activities affect the micro-organism population through the use of fertilizer, soil amendments, and irrigation water. Overgrazing can expose the soil to erosion and reduce the content of organic matter. Cover crops reduce erosion and help to retain organic matter and biological activity.

Time

The length of time that the soil's parent material has been in place and exposed to the active forces of climate and plant and animal life strongly influences the nature of the soil. In general, the degree of development of differentiation between horizons within the soil is related to the age of a soil. Thus, a soil that exhibits little or no development is said to be young and one that has strongly expressed horizons is considered old. The soils in the survey area range from young soils on recent alluvial fans to older soils on terraces and mountainous uplands.

Older soils may exhibit characteristics not seen in young soils that are unfavorable to the growth of crops. Leaching of bases, increases in acidity, accumulation of clay to form a B2t horizon, and the formation of a duripan are more pronounced in older soils. The B2t horizon may reduce root growth and permeability. In addition, cementation of the subsoil into a hardpan is more likely and less phosphorus may be available.

Soils in the same locality that have different degrees of profile development commonly are of different ages. For instance, the Milham soils have a well developed B horizon and are older soils than the nearby Kimberlina soils, which do not have a B horizon. The presence of a duripan in the Exeter and Jerryslu soils indicates that these soils have been in place for a considerable amount of time.

Relief

The relief in this survey area can be divided into 3 prominent areas, each having one or more physiographic units.

The first area includes the mountains, foothills, and associated small valleys on the west side in the southern part of the San Joaquin Valley. The east side of the Temblor Range and the southern tip of the Diablo Range are included in this area. The steep and very steep slopes and the more pronounced northern and southern aspects in the mountainous area have influenced the thickness and amount of organic matter in the surface layer and, in some places, the depth of the soil. Aramburu and Temblor are examples of the shaly soils in the Temblor Range. Hillbrick and Kilmer soils are in the Diablo Range, and they do not have the high organic matter and shale content of the Aramburu and Temblor soils. Runoff and erosion from the mountains formed the small valleys and plains at the base of the hills. Polonio and Pottinger are examples of the colluvial and alluvial valley soils that formed near the hills. The relief of Elk Hills is hilly and mountainous like that of the Temblor and Diablo Ranges, but the Elkhills soils are not residual.

They formed in former lacustrine and alluvial deposits derived from granitic and sedimentary rock on a playa or basin landform. These deposits were subsequently uplifted to form the highly stratified soils in the Elk Hills area.

The second area is made up of two physiographic units: 1) Alluvial fans and plains; and 2) the lower basin floor or trough with associated playas in the San Joaquin Valley. Relief, through its effects on drainage and erosion, had an important effect on soil formation. The Kimberlina, Milham, and Panoche soils formed on alluvial fans and plains. Lokern, Buttonwillow, and Nahrub are examples of clayey soils in playas and on the nearly level basin floor. The Lokern and Nahrub soils commonly have a moderate or high content of salts.

The third area includes the alluvial and colluvial fans and dissected terraces in the Sierra Nevada foothills. The Chanac and Delano soils formed on the granitic, rolling terraces in this area. These soils are more stable and developed than those on recent alluvial fans. Because of the slightly higher rainfall in this area, additional leaching has caused translocation of clay and the development of a B2t horizon. The Premier and Wasco soils formed in the lower lying granitic alluvium. These are recent, undeveloped, moderately coarse textured soils.

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Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvial fan. The fanlike deposit of a stream where it issues from a gorge upon a plain or of a tributary stream near or at its junction with its main stream.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Animal-unit-month (AUM). The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Arroyo. The flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in alluvium.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 2.5
Low	2.5 to 5.0
Moderate	5.0 to 7.5
High	7.5 to 10.0
Very high	More than 10.0

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many hillsides. Back slopes in profile are commonly steep, are linear, and may or may not include cliff segments.

Basal area. The area of a cross section of a tree, generally referring to the section at breast height and measured outside the bark. It is a measure of stand density, commonly expressed in square feet.

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedding planes. Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Breaks. The steep to very steep broken land at the border of an upland summit that is dissected by ravines.

Breast height. An average height of 4 1/2 feet above the ground surface; the point on a tree where diameter measurements are ordinarily taken.

Broad-base terrace. A ridge-type terrace built to control erosion by diverting runoff along the contour at a nonscouring velocity. The terrace is 10 to 20 inches high and 15 to 30 feet wide and has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. It may be nearly level or have a grade toward one or both ends.

Brush management. Use of mechanical, chemical, or biological methods to reduce or eliminate competition of woody vegetation to allow understory grasses and forbs to recover, or to make conditions favorable for reseeding. It increases production of

forage, which reduces erosion. Brush management may improve the habitat for some species of wildlife.

Butte. An isolated small mountain or hill with steep or precipitous sides and a top variously flat, rounded, or pointed that may be a residual mass isolated by erosion or an exposed volcanic neck.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of a standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Canopy. The leafy crown of trees or shrubs.

Canyon. A long, deep, narrow, very steep sided valley with high, precipitous walls in an area of high local relief.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

Chemical treatment. Control of unwanted vegetation by use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter, in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Clay skin. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay film.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax plant community. The plant community on a given site that will be established if present environmental conditions continue to prevail and the site is properly managed.

Coarse fragments. Mineral or rock particles larger than 2 millimeters in diameter.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Very cobbly soil material is 35 to 60 percent of these rock fragments, and extremely cobbly soil material is more than 60 percent.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conglomerate. A coarse grained, clastic rock composed of rounded to subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer material. Conglomerate is the consolidated equivalent of gravel.

Conservation cropping system. Growing crops in combination with needed cultural and management practices. If soil improving crops and practices used in the system more than offset the soil depleting crops and deteriorating practices, then it is a good conservation cropping system. Cropping systems are needed on all tilled soils. Soil improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure

crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—
Loose.—Noncoherent when dry or moist; does not hold together in a mass.
Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.
Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—Readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—Adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cropping system. Growing crops using a planned system of rotation and management practices.

Cross-slope farming. Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

Delta. A body of alluvium whose surface is nearly flat and fan shaped, deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Desert pavement. A layer of gravel or coarser fragments on a desert soil surface that was emplaced by upward movement of fragments from underlying sediment or remains after finer particles have been removed by running water or wind.

Dip slope. A slope of the land surface, roughly determined by and approximately conforming with the dip of underlying bedded rock.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Divided-slope farming. A form of field stripcropping in which crops are grown in a systematic arrangement of two strips, or bands, across the slope to reduce water erosion. One strip is in a close-growing crop that provides protection from erosion, and the other strip is in a crop that provides less protection from erosion. This practice is used where slopes are not long enough to permit a full stripcropping pattern to be used.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—These soils have very high and high hydraulic conductivity and low water holding capacity. They are not suited to crop production unless irrigated.
Somewhat excessively drained.—These soils have high hydraulic conductivity and low water holding capacity. Without irrigation, only a narrow range of crops can be grown and yields are low.
Well drained.—These soils have intermediate water holding capacity. They retain optimum amounts of moisture, but they are not wet close enough to the surface or long enough during the growing season to adversely affect yields.
Moderately well drained.—These soils are wet close enough to the surface or long enough that planting or harvesting operations or yields of some field crops are adversely affected unless artificial drainage is provided. Moderately well drained soils commonly have a layer with low hydraulic

conductivity, a wet layer relatively high in the profile, additions of water by seepage, or some combination of these.

Somewhat poorly drained.—These soils are wet close enough to the surface or long enough that planting or harvesting operations or crop growth is markedly restricted unless artificial drainage is provided. Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, a wet layer high in the profile, additions of water through seepage, or a combination of these.

Poorly drained.—These soils commonly are so wet at or near the surface during a considerable part of the year that field crops cannot be grown under natural conditions. Poorly drained conditions are caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these.

Very poorly drained.—These soils are wet to the surface most of the time. They are wet enough to prevent the growth of important crops (except rice) unless artificially drained.

Drainage, surface. Runoff, or surface flow of water, from an area.

Draw. A small stream valley, generally more open and with broader bottom land than a ravine or gulch.

Duff. A term used to identify a generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature; for example, fire that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and produced by erosion or faulting. Synonym: scarp.

Excess alkali (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Excess sulfur (in tables). Excessive amount of sulfur in the soil. The sulfur causes extreme acidity if the soil is drained, and the growth of most plants is restricted.

Extrusive rock. Igneous rock derived from deep-seated molten matter (magma) emplaced on the earth's surface.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fan terrace. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts

and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fill slope. A sloping surface consisting of excavated soil material from a road cut. It commonly is on the downhill side of the road.

Fine textured soil. Sandy clay, silty clay, and clay.

Firebreak. Area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of men and equipment in fire fighting. Designated roads also serve as firebreaks.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flaggy soil material. Material that is, by volume, 15 to 35 percent flagstones. Very flaggy soil material is 35 to 60 percent flagstones, and extremely flaggy soil material is more than 60 percent flagstones.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Fluvial. Of or pertaining to rivers; produced by river action, as a fluvial plain.

Foothill. A steeply sloping upland that has relief of as much as 1,000 feet (or 300 meters) and fringes a mountain range or high-plateau escarpment.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type. A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai. Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of Vertisols—clayey soils having a high coefficient of expansion and contraction with changes in moisture content.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Graded stripcropping. Growing crops in strips that grade toward a protected waterway.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard rock. Rock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Head out. To form a flower head.

High-residue crops. Crops such as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the

next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well-defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the number 2 precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—
Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Light textured soil. Sand and loamy sand.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low-residue crops. Crops such as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Low strength. The soil is not strong enough to support loads.

Marl. An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal amounts.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mesa. A broad, nearly flat topped and commonly isolated upland mass characterized by summit widths that are more than the heights of bounding erosional scarps.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

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

Mountain. A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides and considerable bare-rock surface. A mountain can occur as a single, isolated mass or in a group forming a chain or range.

Mudstone. Sedimentary rock formed by induration of silt and clay in approximately equal amounts.

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color in hue of 10YR, value of 6, and chroma of 4.

Narrow-base terrace. A terrace no more than 4 to 8 feet wide at the base. A narrow-base terrace is similar to a broad-base terrace, except for the width of the ridge and channel.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Observed rooting depth. Depth to which roots have been observed to penetrate.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Playa. The generally dry and nearly level lake plain that occupies the lowest parts of closed depressional areas, such as those on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation and runoff.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Post and piling outlet. A market location where posts and pilings are bought, processed, and sold.

Potential native plant community. The plant community on a given site that will be established if present environmental conditions continue to prevail and the site is properly managed. (See climax plant community.)

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning. The application of fire to land under such conditions of weather, soil moisture, and time of day as presumably will result in the intensity of heat and spread required to accomplish specific forest management, wildlife, grazing, or fire hazard reduction purposes.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

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

Proper grazing use. Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This increases the vigor and reproduction of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

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

Red beds. Sedimentary strata mainly red in color and composed largely of sandstone and shale.

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Road cut. A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Salty water (in tables). Water that is too salty for consumption by livestock.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Saprolite (soil science). Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Scarification. The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Site class. A grouping of site indexes into 5 to 7 production capability levels. Each level can be represented by a site curve.

Site curve (50-year). A set of related curves on a graph that shows the average height of dominant trees for the range of ages on soils that differ in productivity. Each level is represented by a curve. The basis of the curves is the height of dominant trees that are 50 years old or are 50 years old at breast height.

Site curve (100-year). A set of related curves on a graph that show the average height of dominant and codominant trees for a range of ages on soils that differ in productivity. Each level is represented by a curve. The basis of the curves is the height of dominant and codominant trees that are 100 years old or are 100 years old at breast height.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey the following slope classes are recognized:

	Percent
Nearly level	0 to 2
Gently sloping	2 to 5
Moderately sloping	5 to 9
Strongly sloping	9 to 15
Moderately steep	15 to 30
Steep	30 to 50
Very steep	50 to 75
Extremely steep	75 and higher

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodic (alkali) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium absorption ratio (SAR) of a saturation extract, or the ratio of Na^+ to $Ca^{++} + Mg^{++}$. The degrees of sodicity are—

	SAR
Slight	Less than 13:1
Moderate	13-30:1
Strong	More than 30:1

Soft rock. Rock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5

Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 6 to 15 inches (15 to 38 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below the A horizon.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the E horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon," technically the A horizon excluding the A2 horizon. Usually that part of the profile that is highest in organic matter and is darkest in color.

Tail water. The water just downstream of a structure.

Talus. Rock fragments of any size or shape, commonly coarse and angular, derived from and lying at the base of a cliff or very steep, rock slope. The accumulated mass of such loose, broken rock formed chiefly by falling, rolling, or sliding.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

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

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Too arid (in tables). The soil is dry most of the time, and vegetation is difficult to establish.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Toxicity (in tables). Excessive amount of toxic substances, such as sodium or sulfur, that severely hinder establishment of vegetation or severely restrict plant growth.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow. The action of uprooting and tipping over trees by the wind.