SOIL SURVEY

Santa Barbara Area California

Series 1944, No. 8

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UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with the
UNIVERSITY OF CALIFORNIA AGRICULTURAL EXPERIMENT STATION

How to Use THE SOIL SURVEY REPORT

FARMERS who have worked with their soils for a long time know about differences among soils on their own farm, and perhaps about differences among soils on the farms of their immediate neighbors. What they do not know, unless soil surveys have been made, is how nearly their soils are like those on experiment stations or on other farms, either in their State or other States, where farmers have gained experience with new or different farming practices or farm enterprises. Farmers of the Santa Barbara Area can avoid some of the risk and uncertainty involved in trying new crop and soil management practices by using this report, for it maps and describes the soils of their Area and therefore allows them to compare soils on their farms with soils on which new developments have proved successful.

SOILS OF A PARTICULAR FARM

All the soils in the Santa Barbara Area are shown on the soil map accompanying this report. To learn what soils are on any farm, it is first necessary to locate this farm on the map. This is easily done by using landmarks such as roads, streams, villages, dwellings, township and section lines, and other features to locate the boundaries.

The next step is to identify the soils. Suppose, for example, you find on your farm an area marked with the symbol Aa. Look among the colored rectangles in the margin of the soil map and find the one with Aa printed on it; this symbol means Agueda clay loam, gently sloping. All areas of this soil, wherever they occur on the map, are identified by the color and symbol shown in this rectangle.

What is Agueda clay loam, gently sloping like, and to what uses is it suited? This information will be found in the section Soil Series, Types, and Phases. To learn what yields it will produce of the crops most commonly grown in the Area, turn to the section Crop Yields. Table 5 in the section Soil Ratings and Groupings shows how each soil compares with others of the Area and just what it is that makes it better or worse than the others for crops.

To find out what management practices may be necessary for each soil, find the capability unit it falls into by referring to the third column in the summary table of outstanding soil characteristics, which is in the jacket that holds this report. When you have found the description of the capability unit in the text, you can read about management of the soil. Additional information on management will be found in the section Control of Water on the Land and the section Alkali.

SOILS OF THE AREA AS A WHOLE

A general idea of the soils of the Area is given in the section Soils and in the section Classification of Soils into Higher Categories. These sections tell about the principal kinds of soils, where they are found, and how they are related to one another. After reading these sections, study the small soil association map in the margin of the large soil map and notice how the different kinds of soils tend to be arranged in different parts of the Area. These patterns are often associated with well-recognized differences in type of farming, land use, and land use problems.

A newcomer to the Area, especially if he considers purchasing a farm will want to know about the climate; land use; the principal farm products and how they are marketed; availability of roads, railroads, electric services, and water supplies; the industries of the Area; and cities, villages, and population characteristics. Information about all these will be found in the section General Nature of the Area and the section Agriculture.

Those interested in how the soils of the Area were formed and how they are related to the great soil groups of the world should read the section Morphology and Genesis of Soils.

This report on the soil survey of the Santa Barbara Area, California, is a cooperative contribution from the—

SOIL CONSERVATION SERVICE

and the

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SOIL SURVEY OF THE SANTA BARBARA AREA, CALIFORNIA

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United States Department of Agriculture in cooperation with the University of California Agricultural Experiment Station

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[1] Soil Survey was transferred to the Soil Conservation Service on November 15, 1952.

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MILD WINTERS, warm dry summers, and scenic mountains and coast have long attracted people to reside or vacation in the Santa Barbara Area. Mild climate has also favored the development of a distinctive agriculture based on the production of lemons and lima beans. Farming began in the area with the establishment of Mission Santa Barbara in 1786, but it was not until the early 1920's that the production of lemons under irrigation began on a large scale. The supply of irrigation water is limited in the area. A number of cultivated soils of the uplands are eroded, some of them severely. To provide a basis for the best agricultural uses of the soils this cooperative soil survey was begun in 1942 by the United States Department of Agriculture and the University of California Agricultural Experiment Station. Field work was completed in 1943. Unless otherwise stated, all information in this report refers to conditions in the Area in 1943.

GENERAL NATURE OF THE AREA

LOCATION AND EXTENT

The Santa Barbara Area is the narrow coastal strip of Santa Barbara County that extends from near Point Arguello on the west to Rincon Creek on the east (fig. 1). In the western part, the northern boundary of the Area borders the soil survey of the Santa Ynez Area (*2*).[2] From the east line of township 5 N., R. 27 W. to Rincon Creek, the northern boundary lies along the crest of the Santa Ynez Mountains. The Area covers about 381 square miles.

Santa Barbara, the county seat of Santa Barbara County, is the only incorporated city within the Area. It is about 85 miles northwest

[2] Italic numbers in parentheses refer to Literature Cited, p. 178.

FIGURE 1.—Location of the Santa Barbara Area in California.

of Los Angeles and 270 miles southeast of San Francisco. Other communities within the Area are Carpinteria, Summerland, Montecito, Goleta, Capitan, and Gaviota.

PHYSIOGRAPHY, RELIEF, AND DRAINAGE

The Area covers most of the southern slope of the Santa Ynez Mountains, which are one of the few sections of the Coast Range that lie east and west. These mountains consist almost entirely of unaltered and well-consolidated sandstones and shales. The only exceptions within the Area are the small patches of volcanic rock and of some metamorphosed sedimentary rock near Point Arguello. Most of the sandstones and shales are of marine formation; they are composed

of well-consolidated, light-colored sandstones and softer shales. Nevertheless, a continental formation of sandstones and shales is moderately extensive in the eastern part of the Area. In most places the rock strata are sharply tilted.

The crest of the Santa Ynez Mountains ranges from about 1,500 feet in the western part of the Area to an elevation of as much as 4,200 feet in the eastern part. The upper slopes of the Santa Ynez Mountains are rough, stony, and nearly precipitous in some places. The lower parts, or foothills, are smooth and gently sloping and have well-rounded ridges. Between the foothills and the ocean lies a narrow coastal plain composed mainly of marine and alluvial terraces, small alluvial fans, and a few small basinlike areas of tidal marsh. The elevation of this plain ranges from 25 feet near the coast to 500 feet at the base of the hills. Some of the alluvial fans extend down to the tidal marsh.

The coast line, for the most part, consists of narrow beaches below cliffs that have been cut into the terrace materials and underlying bedrock. Many short intermittent streams head in the mountains and flow to the ocean. They have cut deeply into the terrace materials or have built small alluvial fans. Several islands about 30 miles offshore tend to reduce the normal swell of the ocean along much of the coast, but there are no natural harbors.

CLIMATE

The climate is typical of that along the southern California coast. Winters are mild and rainy; summers are warm and dry, but may have some fog, especially in the mornings.

Both the climate and the geographic features of the Area have favored its development as a year-round resort center.

Normal monthly, seasonal, and annual temperatures considered representative for the Area are shown in table 1. The average January temperature is 53.0° F., and the average July temperature is 66.1° F. The lowest temperature that has been recorded is 23° F., and the highest 115° F. Based on a 40-year record, the average date of the last killing frost in spring is January 22, and the average date of the first killing frost in the fall is December 19. The latest recorded killing frost in spring occurred on March 22, and the earliest recorded killing frost in fall on November 7. On the average, the frost-free period is 331 days. Occasionally there is a winter without a killing frost.

Rainfall is least along the coast, increases with increasing elevation, and reaches a maximum near the crest of the Santa Ynez Mountains. At Santa Barbara, the average annual rainfall is 18 inches. At San Màrcos Pass (elev. 2,200 feet) it is more than 30 inches. More than 75 percent of the total rainfall comes in the months of December through March.

During this rainy season, the sun normally shines 6 to 6½ hours daily. Through the summer—June through August—there is normally 9 to 10 hours of sunshine a day. Practically no rain falls during the summer, but the hours of sunshine are reduced by foggy weather.

West or southwest winds prevail. About once a year, in summer or early in fall, hot, dry, northeast winds may blow for 3 to 5 days. It is only during these periods that the temperature rises much above 100 degrees.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Santa Barbara, Calif.*

[ELEVATION, 120 FEET]

Month	Temperature [1]			Precipitation [2]		
	Average	Absolute maximum	Absolute minimum	Average	Total for the driest year	Total for the wettest year
	°F.	°F.	°F.	Inches	Inches	Inches
December	54.8	86	23	3.27	37	9.53
January	53.0	90	27	3.91	60	15.67
February	54.3	90	27	3.73	76	7.92
Winter	54.0	90	23	10.91	1.73	33.12
March	55.9	95	32	2.94	1.80	6.91
April	58.1	98	34	1.15	.10	0
May	60.0	101	39	.42	.08	.03
Spring	58.0	101	32	4.51	1.98	6.94
June	62.6	115	40	.09	[3]	.08
July	66.1	108	45	.03	0	[3]
August	67.0	98	45	.03	.01	.01
Summer	65.2	115	40	.15	.01	.09
September	65.9	108	43	.30	.05	.17
October	62.8	100	36	.72	.22	.57
November	58.8	98	30	1.36	0	2.34
Fall	62.5	108	30	2.38	.27	3.08
Year	59.9	115	23	17.95	[4] 3.99	[5] 43.23

[1] Average temperature based on 69-year record in the period 1884 to 1953; highest and lowest temperatures on a 34-year record in the period 1896 to 1930.
[2] Average precipitation and wettest and driest years based on 86-year record, 1868 to 1953.
[3] Trace. [4] In 1947. [5] In 1909.

WATER SUPPLY

Inadequate water supply has been a serious problem at various times in the Santa Barbara Area. In the lower parts of the Carpinteria and Goleta Valleys, the water table is now close to sea level. Because the underlying material is fine textured, these areas hold little underground water. The watersheds are narrow and the slopes are steep, so that storm waters run off rapidly.

All of the south coastal area obtains water from wells. The Cachuma Project on the Santa Ynez River will provide supplemental water to all major consuming districts in its area. The Cachuma Project has a capacity of 210,000 acre-feet and a safe yield of 30,000 acre-feet.

In addition, Santa Barbara city obtains water from the Gibraltar Dam Reservoir on the Santa Ynez River. This reservoir has recently

been restored to its original capacity of about 15,000 acre-feet. The Montecito County Water District receives additional water from the Jamison Lake behind Juncal Dam, which is farther upstream on the Santa Ynez River. This dam is in good condition and is expected to continue to provide part of the water for the Montecito District. Water from the Santa Ynez River reservoirs is conveyed by tunnels through the Santa Ynez Mountains.

The Santa Ynez River probably can supply enough water for the future requirements of the Santa Ynez Valley and those of the south coastal strip, provided the water is efficiently used and adequate storage is built. The water from the Santa Ynez River is entirely satisfactory for irrigation; it is rather hard for household uses, but is suitable if water softeners are added.

Between Elwood and Gaviota is a series of coastal terraces incised by small creeks. Most of the terrace materials are cappings on consolidated bedrock; they offer little opportunity for developing water for irrigation. Small reservoirs might be built on some of the creeks to furnish water for the narrow stream bottoms, but the present supply would not be materially increased.

From Gaviota to Point Arguello, the area is used exclusively for range, and small creeks and springs furnish enough water for all the livestock that the range can carry.

Because of the frequent fogs, moderately high humidity, and moderate daytime temperatures, water requirements for crops in the Santa Barbara Area are not high. An annual supply of 1 or 1¼ acre-feet per acre is sufficient for most crops now grown.

Furrow irrigation is extensively practiced on the flat valley lands near Goleta and Carpinteria. Some of the terraces and hilly areas are also irrigated, mainly by sprinklers.

VEGETATION

Brush is the principal natural vegetation of the Area. It occurs in dense and, in many places, impenetrable stands in the mountainous sections. It consists chiefly of associations of chamise (*Adenostoma fasciculatum*), eastwood manzanita (*Arctostaphylos glandulosa*), wedgeleaf ceanothus (*Ceanothus cuneatus*), California scrub oak (*Quercus dumosa*), birchleaf mountain-mahogany (*Cercocarpus betuloides*), and Jim brush (*Ceanothus sorediatus*)

At the base of the mountains are a few small stands consisting largely of button sage or black sage (*Salvia mellifera*), California-sagebrush (*Artemisia californica*), and flat-top buckwheat brush (*Eriogonum fasciculatum*).

Woodlands occur along creeks and canyons and near the apexes of alluvial fans. They are composed largely of coast live oak (*Quercus agrifolia*), canyon live oak (*Quercus chrysolepis*), California-laurel (*Umbellularia californica*), alders (*Alnus* spp.), and California-sycamore (*Platanus racemosa*), and coyote-brush (*Baccharis pilularis*). Generally, in woodland areas there is a herbaceous undergrowth which includes poison-oak (*Rhus diverseloba*).

Near the mountain crests there are a few conifers, mainly bigcone spruce (*Pseudotsuga macrocarpa*) and Coulter pine (*Pinus coulteri*).

Between the base of the mountains and the coast lie grasslands covered chiefly by associations of deervetch (*Lotus scoparius*), giant

wild-rye (*Elymus condensatus*), wild oat (*Avena fatua*), soft chess (*Bromus mollis*), red brome (*Bromus rubens*), ripgut (*Bromus rigidus*), foxtail fescue (*Festuca megalura*), alfileria (*Erodium cicutarium*), burclover (*Medicago hispida*), purple stipa (*Stipa pulchra*), and mustard. Trees planted in the Area consist mainly of bluegum (*Eucalyptus globulus*).

WILDLIFE

Wildlife is abundant in the mountainous sections. Deer are most numerous but there are also black bear, raccoon, fox and other small animals, as well as quail, doves, and other game birds. There are a number of predatory animals, including coyotes and mountain lions. There is early fishing in some of the mountain streams, and ocean fishing for both commercial and recreational purposes. Game and bird refuges are located in Los Padres National Forest and near Santa Barbara.

ORGANIZATION AND POPULATION

The Santa Barbara coast was first explored by the Spanish in October 1542, but it was not until 1782 that the Presidio was established at Santa Barbara. The Mission was located there in 1786. It is the only one of the 21 Spanish missions in Alta California that has been in continuous service since its establishment.

Because of its isolated location, Santa Barbara was not much affected by the change from Spanish to Mexican rule in 1819, nor by the Mexican War, at the conclusion of which California, in February 1848, became a territory of the United States. In 1850, California was admitted to the Union as a State, and the county of Santa Barbara was organized with Santa Barbara city as the county seat.

The first county road was started in 1860 and finished in 1861. The first stagecoach from San Francisco arrived in Santa Barbara on April 1, 1861. Thereafter, daily schedules to San Francisco and Los Angeles were maintained. The route followed was essentially the same as the present United States Highway 101.

Beginning in 1869, wharves were built for loading and unloading coastal vessels, and for a while most of the freight and much of the passenger traffic moved by water.

Following the completion of the transcontinental railroad in 1869, efforts were made to have a railroad line from San Francisco to Los Angeles routed through Santa Barbara. In 1887, the Southern Pacific completed a branch line from Newhall to Santa Barbara, but it was not until 14 years later that the line following the coast between San Francisco and Los Angeles was built. Rail service to Santa Barbara opened up new markets for agricultural products and fostered the growth of the tourist trade. Tourists were attracted by the excellent climate and natural resources.

The population of Santa Barbara County has grown steadily, from 65,167 in 1930 to 98,220 in 1950. More than half of the inhabitants live in the coastal strip covered by this survey. The chief concentration is in Santa Barbara city, which has increased in population from 33,613 in 1930 to 44,913 in 1950.

Several small unincorporated communities are located in the Area. Carpinteria, a farming community about 12 miles east of Santa Bar-

bara on United States Highway 101, is supported almost entirely by the surrounding agricultural areas. Summerland, about 6 miles east of Santa Barbara on United States Highway 101, was founded as a real estate speculation. Oil was discovered here in 1887, but the oilfields are now almost entirely inactive.

Montecito, in the foothills 4 miles east of Santa Barbara along California Highway 150 is a community of beautiful homes and estates. Goleta, a farming community 6 miles west of Santa Barbara on United States Highway 101, is mainly supported by the surrounding farmland. It is also the site of the Santa Barbara airport.

Hope Ranch is a residential subdivision about 3 miles west of Santa Barbara, between United States Highway 101 and the coast. About 10 miles west of Santa Barbara on United States Highway 101 is the small community of Elwood, a center for local oil industry. Another oil center is Capitan, about 13 miles west of Santa Barbara. Gaviota, a community about 25 miles west of Santa Barbara near the mouth of Gaviota Creek, consists mainly of a store and schoolhouse, which serve the surrounding scattered farms.

INDUSTRIES

The principal industries in the Santa Barbara Area are those concerned with the developing and processing of oil and diatomaceous earth, the processing of agricultural products, and the manufacture of light industrials—plastics, electronic equipment, instruments, and the like.

Oil was first discovered in 1887, at Summerland, but present production in that locality is very small. Important producing oilfields are located at Elwood, Capitan, and Mesa. A field at Goleta has so far yielded only gas.

In the northwestern part of the Area, in San Miguelito Canyon, are large deposits of diatomaceous earth of unusual purity. This material has been mined continuously since 1896. Even at the present high rate of production, the supply will last for many years.

TRANSPORTATION

One railroad line, of the Southern Pacific coast route from San Francisco to Los Angeles, serves the Santa Barbara Area. A few tankers anchor offshore at Capitan and Elwood to load oil for transportation to refineries, but there is no other water transportation.

United States Highway 101 and State Highway 150 carry considerable passenger and freight traffic.

Scheduled airlines en route between San Francisco and Los Angeles, provide passenger, air mail, and air-express service from Santa Barbara airport at Goleta.

CULTURAL DEVELOPMENTS AND IMPROVEMENTS

Santa Barbara and the vicinity have many cultural and social advantages normally found only in larger urban centers. Recreational facilities include county and city parks, ocean beaches, mountain resorts, a yacht harbor, a polo field, golf courses, and municipal and private swimming pools.

Churches representing many denominations have been established in the Santa Barbara and the neighboring rural areas. There are a number of fraternal organizations and business and social clubs, both national and local.

Private and public schools are available. A campus of the University of California is now located near Goleta.

Santa Barbara has a well-endowed and well-maintained museum of natural history, a public library, an art institute, theatres, and other educational and cultural facilities.

In the rural sections, farm houses and outbuildings, as a rule, are very good, and many homes are luxurious. Most farms have electricity and many have natural gas. All farms have well-cared for roads and are easily accessible by motorcar or truck.

Except for the cattle-raising areas, there is little farm livestock except for riding horses.

AGRICULTURE

Spanish missionaries, the first permanent white settlers in the region of Santa Barbara, planted grain and fruits and raised sheep and cattle. The native Indians had grown no crops and had kept no domestic animals.

In 1833, the mission was secularized, and its extensive lands were distributed to prominent Mexican families, who established large cattle ranches. Cattle were raised for their hides and tallow, which were transported by ship to distant markets. In 1864, a ruinous drought practically destroyed the cattle industry and ended the dominance of the landed families. The value of rangeland dropped to as little as 10 cents an acre. The large land grants were divided, and for the first time land became available for small farms.

In the 1860's, 1870's and 1880's, substantial numbers of American families immigrated to the Area. Besides raising grain and fruits, hogs, sheep, and cattle, these settlers introduced many new crops and initiated irrigation.

CROPS

Crops with a high cash value predominate, particularly on land that can be irrigated. The moderate climate favors specialty crops. Lemons are the major crop. Other crops are lima beans, walnuts. avocados, grain hay, tomatoes, and cut flowers (see table 2).

The coastal climate, with its long frost-free period, mild wet winters, and warm but somewhat foggy summers, is ideal for lemons and some varieties of avocados. The summers are a bit cool and cloudy for oranges or grapefruit. English walnuts do very well. Lima beans seem particularly well suited to the moderately foggy climate of the coastal region. The climate does not favor most deciduous fruits. Winters are usually not cold enough to force the trees into their normal rest period.

Lemons.—The leading crop is lemons, both in acreage and in cash value. The lemon industry became important in the early 1920's, though many lemon trees were growing before that time. The lemon acreage has increased partly because land in walnuts and lima beans has been converted, and partly because land on terraces and slopes formerly covered with grass and brush has been cleared.

TABLE 2.—*Estimated acreage of principal crops in the south coastal area of Santa Barbara County, Calif., in stated years*

[Data are from County Agricultural Commissioner, Santa Barbara County; they cover all the area included in this survey except that part west of Gaviota Creek, where all the land, except for a small acreage in grain hay and Sudangrass, is used for cattle range]

Crop	1941	1944	1947	1950	1953
Lemons	8, 400	8, 907	9, 248	8, 280	9, 239
Avocados	350	357	487	748	1, 246
Walnuts	3, 130	3, 079	1, 938	1, 758	1, 717
Dry lima beans	6, 799	4, 447	1, 721	1, 200	1, 500
Green lima beans	298	549	228	12	----
Green peas	174	135	12	----	----
Tomatoes	1, 356	1, 904	2, 916	3, 209	2, 185
Grain hay	2, 000	1, 269	1, 007	1, 080	890
Oranges	261	261	219	120	88
Barley	200	305	44	450	268
Total	22, 968	21, 213	17, 820	16, 857	17, 133

The most common type is the Eureka, which accounts for about 90 percent of the acreage in lemons. This type produces the year round and can be picked every 6 or 8 weeks. The trees are not large and will not stand a great deal of cold weather. The fruit is smooth and of medium size.

In the past lemon trees in this Area had a shorter life than those in other lemon-producing sections. The short life was caused by diseases. Generally lemon trees start bearing the 4th year and reach their peak about the 10th to 12th year. There is a good deal of variation in productive life, depending on parentage.

Medium-textured alluvial soils are best for lemon trees. Commercial fertilizers, principally nitrogen and some phosphorus, are commonly used. Manure is generally applied to the cultivated orchards.

All lemon groves in this area are irrigated. The average yearly duty of water is about 1 acre-foot an acre per year, in addition to the annual rainfall of about 18 inches. Furrow irrigation is usual on the level valley land. Sprinkler systems are used exclusively on the sloping or hilly areas, and increasingly on the valley soils.

The lemon-growing industry is well organized. In all communities, there are growers' associations that take care of the spraying, harvesting, grading, and marketing of the crop.

Lemon groves in Santa Barbara County are attacked by a number of diseases and pests. Brown rot (gummosis), a fungus disease, invades the trunk and roots and kills the trees. The fungus lives in the soil and is splashed on the lower parts of the trees during the rainy season. The principal treatment is bordeaux mixture painted on the tree trunk from ground level to the fork. This same fungus causes fruit rot, which is prevented by spraying the lower parts of the trees and the ground. These treatments do not completely stop the disease, but they prevent serious damage.

Oak-root fungus attacks a small percentage of lemon trees in the Area. Treatment consists of removing the diseased trees, treating the soil with carbon bisulfide, and replanting.

Pests such as red scale, citrus-bud mite, and red spider are controlled partly or entirely by oil sprays. Snails and slugs are controlled by poison mash.

Most of the lemons are grown on sweet-orange rootstock. Trees budded on this rootstock are particularly susceptible to gummosis. On poorly drained soils, sour-orange rootstock is used. Rough lemon, grapefruit, and Sampson tangelo rootstock have been tried, but are generally undesirable in this Area (*10*).

Lima beans.—This crop was first grown in California in 1875. They were grown as a seed crop under contract. Success of the seed crop soon led to their use as a field crop, and in 1877 lima beans appeared on the California market as a commercial dry bean (*3*).

Lima beans are grown on smooth alluvial soils, on rolling or nearly level terraces, and on the lower foothills of the coastal section in the eastern part of the Area. They are grown under irrigation in the lower parts of the Carpinteria and Goleta Valleys, where the water table is too high for lemons. Though lima beans prefer better drained soils, they have fairly shallow roots and can be grown profitably where lemons are less suitable. On the terraces and uplands, lima beans are generally grown without irrigation. The limas are commonly grown between tree rows in young lemon, walnut, or avocado plantings. The Ventura is the principal variety.

The beans are usually planted in May and harvested late in August or early in September. On the more nearly level alluvial soils, they are pulled, raked into windrows, and threshed with pickup threshers. On hillsides they are pulled and piled by hand and hauled to stationary threshers.

Repeated growing of beans on the same field tends to increase the incidence of diseases. Nevertheless, the beans are not subject to many diseases, and for dry beans little or no treatment is necessary. Green limas for fresh market are dusted with sulfur for control of rust, and with cryolite (fluorine dust) to eliminate the lima-bean pod borer.

Little or no commercial fertilizer is used for lima beans, but it is common practice, especially on irrigated land, to scatter the bean straw and plow it under. General management practices for lima beans are given by Sullivan and others (*8*).

Walnuts.—The acreage is decreasing, but walnuts are an important crop in the Santa Barbara Area. The orchards are mainly on the smooth recent alluvial soils in the Goleta and Carpinteria Valleys and on the narrow flood plains that extend back into the hills along many streams. Plantings on old terrace soils have not been successful.

Only part of the walnut acreage is irrigated. In favorable seasons, nonirrigated orchards yield almost as well as those irrigated. During unfavorable seasons, the nonirrigated orchards produce very low yields.

Some irrigated orchards receive nitrogen fertilizer, but those not irrigated are seldom fertilized. Cover crops are commonly planted before the rainy season in both irrigated and nonirrigated orchards.

Most of the walnuts are of the soft-shell variety. The Santa Barbara soft-shelled walnut was developed in California from walnuts grown by Joseph Sexton on his ranch near Goleta. In 1867, Sexton planted a sack of walnuts bought in San Francisco and presumably imported from Chile. This sack of walnuts produced trees of both the soft- and hard-shell types. Among the second-generation trees from the Sexton planting was the superior Santa Barbara soft-shell type, which provided parent stock for most of the walnut plantings in southern California (*5*).

Walnuts are affected by a number of diseases and pests. The most serious is the codling moth, which is effectively controlled by spraying a mixture of 4 pounds of basic lead arsenate in 100 gallons of water. One spraying usually gives satisfactory control. Walnut aphids are controlled by using 4-percent nicotine dust. The spraying period extends from May to August. Red spiders cause occasional damage if the season is warm. They can be controlled by dusting.

Walnut blight causes some damage. The prevalence of this disease varies from year to year. Oak-root fungus can be controlled by carbon bisulfide. Additional information concerning walnut varieties and production is given in California Agricultural Experiment Station Circular 364 (*1*).

Walnuts are marketed chiefly through the California Walnut Growers Association, but unlike members of the lemon growers association, the walnut growers harvest their own crops.

Avocados.—The acreage of this crop is small but steadily increasing. Avocados grow well on the deep alluvial soils and on some of the upland soils, although lime-induced chlorosis may be a problem on the calcareous Nacimiento and Zaca soils. Avocados do less well and decline more quickly on the old claypan terrace soils.

The most common variety is the Fuerte, though the Nabal and Dickinson are other varieties of importance. Irrigation and fertilization are about the same as for lemons. The pests that most seriously affect avocados are thrips and brown mites, both of which are controlled by pyrethrum and rotenone oil sprays. Brown mite is sometimes controlled by dusting.

One of the main difficulties in growing avocados is that they bear heavily in alternate years. The average yield for avocados is not available because most plantings have not yet come into full bearing.

Tomatoes.—In the last few years, tomatoes for the fresh market have become increasingly important. The acreage varies because the crop is grown by produce firms on leased land. Tomatoes are grown mainly on the old terraces and hilly areas normally used for beans, between the rows in young citrus plantings, and on some of the imperfectly drained soils along the lower edges of the Goleta and Carpinteria Valleys. The crop normally is planted late in spring so that the main harvest will come after tomato harvesting in the interior valleys has passed its peak. The tomato harvest in the Santa Barbara Area usually continues through December and part of January. Yields are not high, but returns are fairly good because most of the crop reaches the market in an off season.

Tomatoes are subject to a few diseases and pests, including curlytop, spotted wilt, and late blight. Varieties resistant to some of the dis-

eases have been developed. Late blight can be prevented by spraying or dusting with copper-containing fungicides. Tomatoes are usually dusted about four times a year with 25-percent sulfur to control the tomato mite.

Yields of tomatoes are extremely variable. Occasionally, an early frost materially reduces the crop, and there is considerable variability in yield because the crop is planted on a wide variety of soils.

Grain hay.—The acreage of grain hay is fairly constant. It is grown on old terraces west of Goleta and as a fill-in crop or an occasional rotation crop on land used for beans or tomatoes. The hay is not irrigated. West of Gaviota—particularly in the upper drainage areas of Jalama, San Miguelito, and Canada Honda Creeks—grain hay is grown as supplemental cattle feed on the more gently sloping upland areas.

LIVESTOCK

Raising of beef cattle, the principal livestock enterprise, is concentrated in the western half of the Santa Barbara Area. Land used for livestock raising accounts for about half the acreage in the surveyed Area. A large part is held in three or four ownerships. These properties extend northward from the coast back into the hills.

The cattle, mostly grade Herefords, are raised on the range. The range starts to become green after the first rains late in fall or early in the winter. The range dries up late in May or in June, but the dry feed is well preserved and provides grazing until late in summer. Some Sudangrass pasture is used late in summer or in fall to supplement the range. Some cattle are taken from the range late in summer and moved to feedlots or pastured on beet tops and other crop residues in the Santa Ynez and Santa Maria Valleys.

The suitability of the soils for range and pasture varies. The fine-textured Los Osos, Climax, Cayucos, Zaca, and Nacimiento soils of the foothills region produce good forage composed mainly of bromegrass, alfileria, and burclover. The calcareous Zaca and Nacimiento soils are badly infested with wild mustard, which much reduces their value for grazing.

The brushy Santa Lucia, or Crow Hill, Los Trancos, and other shallow and stony soils, including those of the Gaviota and Maymen series, produce much less forage than those mentioned in the preceding paragraph.

The cattle are finished for market mainly in feedlots. Los Angeles is the major market for beef cattle. A few large dairies produce fresh milk for the local market, but additional milk is brought in from the Santa Ynez Valley. Poultry raising is a minor industry, but there are a few commercial growers. Eggs and fryers are the principal products. Much of the poultry feed is grown outside the Area. Saddle horses are kept for work on the cattle ranches and for recreation on many of the estates and small farms.

TYPES OF FARMS

Exact information on the distribution of farms by size in this Area was not obtainable. There are many small farms, or homes with a few acres of land, usually planted to lemons, located in the more closely

populated sections. Most individually owned lemon groves are small; the average size is 14 acres. At least 15 to 20 acres is considered the minimum that will provide an adequate income for a farm family. In the Hope Ranch subdivision, for example, holdings are usually less than 5 acres, and many of the groves are farmed and managed on a custom-work basis. The Montecito section is made up mostly of estates, and the land is planted to lemons or avocados, or is used to pasture saddle horses.

Because of the high price of land in the Goleta and Carpinteria Valleys, and the cost of setting out trees and installing irrigation systems, the investment per acre is substantial.

FARM EQUIPMENT

Tractors and trucks furnish nearly all of the mobile power on farms. Electric power is available to nearly all farms east of Gaviota. Other farm equipment consists mainly of tillage implements, bean threshers, and other miscellaneous equipment, such as sprayers and dusters for field and orchard crops. Most of the lemon-spraying equipment is owned by the lemon growers associations.

SOIL SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field and the recording of their characteristics, especially those that affect the growth of various crops, grasses, and trees.

The soils and the material beneath them are examined in many locations. Test pits are dug, borings are made, and exposures, such as those in road or railroad cuts, are studied. Each excavation exposes a series of soil layers, or horizons, called collectively the soil profile. Each layer of the soil, as well as the material beneath the soil, is studied in detail.

The color of each layer is noted. The darkness of the surface layer is usually related to its content of *organic matter;* streaks and spots of gray, yellow, and brown in lower layers generally mean *poor drainage* and *poor aeration.*

Texture, or the content of sand, silt, and clay in each layer, is determined by the "feel" when rubbed between the fingers. This is checked by mechanical analysis in the laboratory. Texture has much to do with the quantity of moisture the soil will hold available to plants, whether plant nutrients or fertilizers will be held by the soil in forms available to plants or will be washed out, and how easily the soil can be cultivated.

Structure, or the way the soil breaks apart, and the amount of pore or open space between particles show how easily plant roots can penetrate the soil and how easily water enters it.

Consistence, or the tendency of the soil to crumble or to stick together, shows whether the soil can be kept open and porous when cultivated. The kind of rocks and weathered rock material from which the soil has been developed affect the quantity and kind of plant nutrients the soil may have naturally. Simple chemical tests show how *acid* or *alkaline* the soil may be and how much lime or salts (alkali) it may have.

The depth to bedrock or to compact layers is determined. The drainage, both through the soil and over its surface is considered. The effects of soils and plants on one another is studied, and the amount of organic matter and roots. The quantity of gravel or stones that may interfere with cultivation, the steepness and kind of slope, the amount of soil lost by erosion, and other features are observed.

The soils are grouped into classification units on the basis of the characteristics observed. Special notice is taken of things that might influence the suitability of the land for crop plants, grasses, and trees. The principal groupings are the *series*, the *type*, and the *phase*.

The *soil series* includes soils having about the same kind, thickness, and arrangement of their layers, about the same natural drainage and general range in relief, and having developed from similar parent material. The texture of the upper layer of the soil, including the part commonly plowed, may vary within a series. Each soil series is given the name of a place or a geographic feature near which it was first mapped. Thus, Carpinteria is the name of a series of dark-brown soils of loam and clay loam surface soil texture that occur on small alluvial fans of minor drainageways in the Santa Barbara Area. Sorrento, Mocho, Gaviota, and Yolo are names of other important soil series in the Santa Barbara Area.

Within a soil series are one or more *soil types*, which are separated according to the texture of the upper layer of the soil. The class name of the soil texture, such as sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, or clay, is added to the series name to give the complete name of the soil type. For example, Mocho loam and Mocho loamy sand are soil types within the Mocho series. Except for the texture of the surface soil, these soil types are very much alike.

Phases of a soil type are similar in all layers, but differ in other ways that may affect their usefulness. Differences in relief, stoniness, amount of erosion, and depth to layers of clay frequently cause soil types to be separated into phases. For example, within the normal range of relief for a soil type, certain parts may have slopes gentle enough to permit the use of machinery and the growth of cultivated crops, and other parts may not. In such an instance the more sloping parts of the soil type may be shown on the map as a separate phase, as, for example, Gaviota fine sandy loam, steep. Similarly, areas of a soil differing in degree of erosion may be separated into phases, for example, Milpitas fine sandy loam, sloping, moderately eroded.

Where two or more series, types, or phases are in such a mixed pattern that they cannot be shown separately on a small-scale map, they are mapped as a *complex*. Thus, the complex of San Andreas-Tierra fine sandy loams is a mixed pattern of San Andreas fine sandy loam and Tierra fine sandy loam.

Miscellaneous land types such as tidal marsh, coastal beach, or rough broken or gullied land that have no true soil, are given names descriptive of their important characteristics.

The soil type, or, where the soil type is subdivided, the soil phase, is the unit of mapping in soil surveys. It is the unit in which the soil is most nearly uniform and shows the smallest variation in characteristics. For this reason, use and management practices can be more definitely suggested for a soil type or phase than for broader groups of soils that vary more.

We can say, for example, that soils of the Montezuma series are among the best soils for range in the Santa Barbara Area, and that they are also moderately well suited to field crops such as lima beans, tomatoes, and grain hay. The phases that usually produce the field crops, however, because their gentler slopes are less likely to erode and easier to cultivate, are the nearly level, gently sloping, and sloping phases of Montezuma clay (adobe) and the gently sloping phase of Montezuma clay loam. The moderately steep and steep phases of Montezuma clay (adobe) are used mostly for range because of the greater danger of erosion and the difficulty of cultivation and irrigation.

The soil surveyor makes a map of the area showing the location of each of the soil types, phases, complexes, and miscellaneous land types and the roads, houses, streams, lakes, and other features of the landscape. In the Santa Barbara Area, aerial photographs were used as a base for mapping. Topographic quadrangles of the United States Geological Survey were used for names of places, streams, and mountains, and as an aid in studying relief and land forms.

SOILS

Many different kinds of soil occur in the Santa Barbara Area because of the variety of parent materials. In general, the broad differences in parent material are associated with several distinct types of landscapes. The soils in this Area can be grouped by these types, as follows: (1) Soils of the recent alluvial fans and wind-deposited materials, (2) soils of the older alluvial fans, (3) soils of the basins, (4) soils of the terraces, and (5) soils of the uplands. A sixth group contains miscellaneous land types.

SOILS OF THE RECENT ALLUVIAL FANS AND WIND-DEPOSITED MATERIALS

This group contains the most productive soils in the Area. They occur mostly on nearly level or gently sloping recent alluvial fans or on recent wind-deposited material of the coastal plain. In general, the soils are deep, permeable, and rather easily worked. The group consists of the Agueda, Baywood, Botella, Carpinteria, Elder, Marina, Mocho, Sorrento, and Yolo series.

SOILS OF THE OLDER ALLUVIAL FANS

The soils of this group are not extensive. They occupy more conspicuous positions on older alluvial fans, generally bordering but higher than the recent or young alluvial fans. The subsoils are somewhat compact and not so permeable as those of the recent alluvial fans. Soil series of this group are the Arguello and Ballard.

SOILS OF THE BASINS

This group is made up of poorly drained dark-colored soils in basin positions. Though their area is small, such soils are important in this Area because they limit crop adaptation. The Alviso and Clear Lake series are in this group.

SOILS OF THE TERRACES

The soils of this group cover wide areas. They generally have either compact slowly permeable subsoils or cemented lenses in the subsoils. They normally occur on undulating or rolling old terraces of the coastal plain. Some of the most erodible soils of the area are included. Soil series of this group are the Aliso, Jalama, Milpitas, Montezuma, Olivenhain, Tangair, Tierra, and Watsonville.

SOILS OF THE UPLANDS

The soils of this group are by far the most common in the Area. They cover much of the southern and western slopes of the Santa Ynez Mountains. Large parts of these mountains are very steep and very stony. These areas are not separated into soil types, but are classed as rough broken and stony land. The soils of this group belong to the Cayucos, Climax, Crow Hill, Diablo, Gaviota, Los Osos, Los Trancos, Maymen, Montara, Nacimiento, San Andreas, Santa Lucia, Sespe, and Zaca series.

MISCELLANEOUS LAND TYPES

Areas where little or no true soil exists are classified as miscellaneous land types. These in the Santa Barbara Area are as follows: Coastal beach, Dune sand, Excavated land, Kitchen middens, Landslip, Made land, Riverwash, rough broken and stony land, rough gullied land, Terrace breaks, and Tidal marsh.

SOIL SERIES, TYPES, AND PHASES

Descriptions of soil series, types, phases, complexes, undifferentiated units, and miscellaneous land types are given in the following pages. The soils are arranged alphabetically according to soil series or miscellaneous land type, and then in order of slope. The approximate acreage and proportionate extent of each of these units are given in table 3.

TABLE 3.—*Approximate acreage and proportionate extent of the soils mapped in the Santa Barbara Area, Calif.*

Symbol	Soil type	Acres	Percent
	Agueda clay loam:		
Ab	Nearly level	264	0. 1
Aa	Gently sloping	500	. 2
Ac	Sloping	135	. 1
	Agueda gravelly clay loam:		
Ad	Gently sloping	237	. 1
Ae	Sloping	219	. 1
	Aliso fine sandy loam:		
Af	Gently sloping, moderately eroded	26	(1)
Ah	Sloping	235	. 1
Ak	Sloping, moderately eroded	799	. 3
Ag	Moderately steep, moderately eroded	145	. 1
Al	Steep, moderately eroded	98	(1)

[1] Less than 1/10 of 1 percent.

TABLE 3.—*Approximate acreage and proportionate extent of the soils mapped in the Santa Barbara Area, Calif.*—Continued

Symbol	Soil type	Acres	Percent
	Aliso loam:		
Am	Gently sloping, moderately eroded	75	(1)
Ap	Sloping, moderately eroded	198	0. 1
An	Moderately steep, moderately eroded	211	. 1
Ao	Moderately steep, severely eroded	84	(1)
Ar	Alviso soils, undifferentiated, nearly level	608	. 2
	Arguello shaly loam:		
As	Gently sloping	1, 027	. 4
At	Sloping	357	. 1
	Ballard fine sandy loam:		
Bb	Nearly level	302	. 1
Ba	Gently sloping	864	. 4
Bc	Sloping	268	. 1
Bd	Sloping, moderately eroded	30	(1)
Be	Ballard gravelly fine sandy loam, gently sloping	138	. 1
Bf	Ballard stony fine sandy loam, gently sloping and sloping	1, 099	. 5
	Baywood loamy fine sand:		
Bg	Gently sloping	264	. 1
Bh	Moderately steep	54	(1)
Bk	Baywood loamy fine sand, over Watsonville soils, gently sloping	331	. 1
	Baywood loamy sand:		
Bm	Nearly level	330	. 1
Bl	Gently sloping	624	. 3
Bp	Rolling	282	. 1
	Baywood loamy sand, over Watsonville soils:		
Bo	Nearly level	117	(1)
Bn	Gently sloping	597	. 2
	Botella clay loam:		
Bs	Nearly level	96	(1)
Br	Gently sloping	390	. 2
Bt	Sloping	44	(1)
	Carpinteria clay loam:		
Ca	Gently sloping	157	. 1
Cc	Sloping	174	. 1
Cb	Moderately steep	106	(1)
Cd	Carpinteria loam, gently sloping	132	. 1
	Cayucos clay:		
Cf	Sloping	39	(1)
Ce	Hilly	71	(1)
	Cayucos clay loam:		
Cg	Hilly, moderately eroded	195	. 1
Ch	Steep, moderately eroded	606	. 2
Ck	Cayucos shaly soils, undifferentiated, steep and very steep	79	(1)
Cl	Clear Lake clay, nearly level	64	(1)
	Climax clay (adobe):		
Cm	Hilly	78	(1)
Cn	Steep	92	(1)
	Coastal beach:		
Co	Sandy	848	. 3
Cp	Stony	491	. 2
	Crow Hill loam:		
Ct	Sloping	229	. 1
Cu	Sloping, moderately eroded	139	. 1
Cr	Hilly	323	. 1
Cs	Hilly, moderately eroded	103	(1)
Cv	Steep and very steep	916	. 4

[1] Less than 1/10 of 1 percent.

TABLE 3.—*Approximate acreage and proportionate extent of the soils mapped in the Santa Barbara Area, Calif.*—Continued

Symbol	Soil type	Acres	Percent
	Diablo clay (adobe):		
Dc	Sloping	65	(1)
Da	Hilly	592	0. 2
Db	Hilly, moderately eroded	480	. 2
Dd	Steep	331	. 1
De	Dune sand	645	. 3
Ea	Elder clay loam, gently sloping	197	. 1
Eb	Elder loam, gently sloping	223	. 1
Ec	Elder shaly clay loam, gently sloping	457	. 2
Ed	Elder shaly loam, sloping	106	(1)
Ee	Elder shaly sandy loam, gently sloping	171	. 1
Ef	Excavated land	219	. 1
	Gaviota fine sandy loam:		
Ga	Hilly	496	. 2
Gb	Hilly, moderately eroded	293	. 1
Gc	Hilly, severely eroded	81	(1)
Gd	Steep	351	. 1
	Gaviota sandy loam:		
Gf	Sloping	128	. 1
Gg	Sloping, moderately eroded	70	(1)
Ge	Hilly	28	(1)
Gh	Steep	362	. 1
Gk	Gaviota stony soils, undifferentiated, steep and very steep	6, 195	2. 5
	Jalama shaly sandy loam:		
Ja	Gently sloping and sloping	417	. 2
Jb	Moderately steep	76	(1)
Jc	Jalama stony soils, undifferentiated, hilly and steep	190	. 1
	Kitchen middens:		
Ka	Over permeable soil materials	139	. 1
Kb	Over relatively impermeable soil material	186	. 1
	Landslip:		
La	Climax soil material, moderately steep	63	(1)
Lb	Diablo soil material, moderately steep and steep	507	. 2
Lc	Los Osos soil material, moderately steep and steep	366	. 2
Ld	Nacimiento soil material, steep	312	. 1
	Los Osos clay:		
Le	Hilly	592	. 2
Lf	Steep	1, 693	. 7
Lg	Steep, moderately eroded	849	. 3
	Los Osos clay loam:		
Ll	Sloping, moderately eroded	22	(1)
Lh	Hilly	641	. 3
Lk	Hilly, moderately eroded	509	. 2
Lm	Steep	2, 732	1. 1
Ln	Steep, moderately eroded	1, 586	. 7
Lo	Very steep	1, 261	. 5
Lp	Los Osos stony soils, undifferentiated, steep and very steep	4, 285	1. 8
Lr	Los Trancos stony loam, hilly and steep	466	. 2
M	Made land	755	. 3
Ma	Marina sand, gently sloping	292	. 1
	Maymen fine sandy loam:		
Mb	Hilly	265	. 1
Mc	Hilly, moderately eroded	258	. 1
Md	Maymen stony fine sandy loam, hilly	763	. 3

[1] Less than 1/10 of 1 percent.

TABLE 3.—*Approximate acreage and proportionate extent of the soils mapped in the Santa Barbara Area, Calif.*—Continued

Symbol	Soil type	Acres	Percent
Me	Maymen stony soils, undifferentiated, steep and very steep	21, 249	8. 7
	Milpitas fine sandy loam:		
Mm	Nearly level	1, 197	. 5
Mv	Undulating	2, 053	. 8
Mh	Gently sloping, moderately eroded	876	. 4
Mi	Gently sloping, severely eroded	150	. 1
Mo	Rolling	969	. 4
Mp	Rolling, moderately eroded	726	. 3
Mq	Sloping	639	. 3
Mr	Sloping, moderately eroded	374	. 2
Ms	Sloping, severely eroded	238	. 1
Mj	Moderately steep	388	. 2
Mk	Moderately steep, moderately eroded	716	. 3
Ml	Moderately steep, severely eroded	121	(1)
Mt	Steep	219	. 1
Mu	Steep, moderately eroded	163	. 1
Mf	Deep, gently sloping and nearly level	161	. 1
Mg	Deep, sloping	182	. 1
Mn	Overwash, gently sloping and nearly level	54	(1)
	Milpitas gravelly fine sandy loam:		
Mx	Sloping, moderately eroded	246	. 1
Mw	Moderately steep and steep, moderately eroded	83	(1)
	Milpitas stony fine sandy loam:		
Mz	Sloping	1, 259	. 5
My	Moderately steep	900	. 4
MA	Steep	363	. 1
	Mocho fine sandy loam:		
MD	Nearly level	168	. 1
MC	Imperfectly drained, nearly level	280	. 1
ME	Over Clear Lake clay, nearly level	206	. 1
MB	Gently sloping	138	. 1
MF	Mocho gravelly fine sandy loam, gently sloping	278	. 1
	Mocho loam:		
MJ	Nearly level	394	. 2
MH	Imperfectly drained, nearly level	323	. 1
MG	Gently sloping	367	. 2
	Mocho loamy sand:		
ML	Nearly level	184	. 1
MK	Imperfectly drained, nearly level	274	. 1
MM	Montara stony soils, undifferentiated, hilly and steep	846	. 3
	Montezuma clay (adobe):		
MQ	Nearly level	227	. 1
MU	Undulating	448	. 2
MN	Gently sloping	423	. 2
MR	Sloping	801	. 3
MS	Sloping, moderately eroded	211	. 1
MO	Moderately steep	401	. 2
MP	Moderately steep, moderately eroded	156	. 1
MT	Steep, moderately eroded	131	. 1
MV	Montezuma clay loam, gently sloping	22	(1)
MW	Montezuma stony clay, sloping	42	(1)
	Nacimiento clay:		
Nc	Sloping	81	(1)
Na	Hilly	546	. 2
Nb	Hilly, moderately eroded	491	. 2

[1] Less than 1/10 of 1 percent.

TABLE 3.—*Approximate acreage and proportionate extent of the soils mapped in the Santa Barbara Area, Calif.*—Continued

Symbol	Soil type	Acres	Percent
	Nacimiento clay—Continned		
Nd	Steep	669	0. 3
Ne	Steep, moderately eroded	7, 018	2. 9
Nf	Very steep	413	. 2
Ng	Very steep, moderately eroded	380	. 2
	Nacimiento clay loam:		
Nh	Hilly	29	(1)
Nk	Steep	94	(1)
Nl	Nacimiento stony soils, undifferentiated, very steep	281	. 1
	Olivenhain fine sandy loam:		
Oc	Sloping	279	. 1
Od	Sloping, moderately eroded	91	(1)
Oa	Moderately steep	215	. 1
Ob	Moderately steep, moderately eroded	143	. 1
Oe	Olivenhain gravelly fine sandy loam, sloping, moderately eroded	113	(1)
	Olivenhain stony fine sandy loam:		
Of	Gently sloping	135	. 1
Oh	Sloping	714	. 3
Og	Moderately steep	534	. 2
Ok	Olivenhain stony soils, undifferentiated, steep	299	. 1
Ra	Riverwash	87	(1)
	Rough broken and stony land:		
Rb	Gaviota soil material	964	. 4
Rf	Los Trancos soil material	1, 623	. 7
Rc	Maymen soil material	55, 547	22. 8
Rd	Montara soil material	293	. 1
Re	Santa Lucia soil material	676	. 3
Rg	Sespe soil material	1, 904	. 8
	Rough gullied land:		
Rh	Los Osos soil material	96	(1)
Rk	Nacimiento soil material	1, 018	. 4
Rl	San Andreas soil material	109	(1)
Rm	Watsonville soil material	65	(1)
	San Andreas fine sandy loam:		
Sa	Sloping, moderately eroded	105	(1)
S	Hilly	87	(1)
Sb	Steep, moderately eroded	552	. 2
	San Andreas loamy sand:		
Se	Sloping	182	. 1
Sc	Hilly	254	. 1
Sd	Hilly, moderately eroded	234	. 1
Sf	Steep	798	. 3
Sg	Steep, moderately eroded	187	. 1
Sh	San Andreas stony soil, undifferentiated, very steep	516	. 2
	San Andreas-Tierra fine sandy loams:		
Si	Hilly	260	. 1
Sj	Steep	164	. 1
	Santa Lucia shaly clay loam:		
Sn	Sloping	509	. 2
Sk	Hilly	2, 845	1. 2
Sl	Hilly, moderately eroded	94	(1)
Sm	Hilly, severely eroded	132	. 1
So	Steep	3, 580	1. 5
Sp	Steep, moderately eroded	314	. 1

[1] Less than 1/10 of 1 percent.

TABLE 3.—*Approximate acreage and proportionate extent of the soils mapped in the Santa Barbara Area, Calif.*—Continued

Symbol	Soil type	Acres	Percent
	Santa Lucia shaly loam:		
Sq	Hilly	248.	0. 1
Sr	Steep	248	. 1
Ss	Very steep	7, 061	2. 9
St	Santa Lucia stony clay loam, hilly	195	. 1
Su	Santa Lucia stony soils, undifferentiated, steep and very steep	7, 921	3. 3
	Sespe clay:		
Sx	Sloping, moderately eroded	103	(1)
Sv	Hilly	472	. 2
Sw	Hilly, moderately eroded	464	. 2
Sy	Steep	825	. 3
Sz	Steep, moderately eroded	366	. 2
	Sespe clay loam:		
SD	Sloping	41	(1)
SA	Hilly	406	. 2
SB	Hilly, moderately eroded	212	. 1
SC	Hilly, severely eroded	135	. 1
SE	Steep	2, 142	. 9
SF	Steep, moderately eroded	1, 245	. 5
SG	Sespe nonstony soils, undifferentiated, very steep	10, 254	4. 2
SH	Sespe stony soils, undifferentiated, very steep	6, 482	2. 7
	Sorrento fine sandy loam:		
SM	Nearly level	2, 272	. 9
SL	Imperfectly drained, nearly level	232	. 1
SN	Over Clear Lake clay, nearly level	217	. 1
SK	Gently sloping	632	. 3
SJ	Channeled, sloping	85	(1)
	Sorrento gravelly fine sandy loam:		
SO	Nearly level	125	. 1
SP	Sloping	30	(1)
	Sorrento loam:		
SS	Nearly level	1, 468	. 6
SR	Imperfectly drained, nearly level	285	. 1
SQ	Gently sloping	614	. 3
ST	Sloping	27	(1)
	Sorrento loamy sand:		
SV	Nearly level	140	. 1
SU	Gently sloping	27	(1)
	Tangair loamy sand:		
Tb	Sloping	538	. 2
Tc	Sloping, moderately eroded	225	. 1
Ta	Moderately steep	348	. 1
	Tangair sand:		
Tf	Sloping	217	. 1
Tg	Sloping, moderately eroded	33	(1)
Th	Sloping, severely eroded	62	(1)
Td	Moderately steep	353	. 1
Te	Moderately steep, moderately eroded	180	. 1
Tk	Terrace breaks	1, 353	. 6
Tl	Tidal marsh	371	. 2
	Tierra fine sandy loam:		
To	Sloping, moderately eroded	181	. 1
Tm	Hilly, moderately eroded	186	. 1
Tn	Hilly, severely eroded	90	(1)
Tp	Steep, moderately eroded	98	(1)
Tr	Tierra soils, undifferentiated, steep	23	(1)

[1] Less than 1/10 of 1 percent.

TABLE 3.—*Approximate acreage and proportionate extent of the soils mapped in the Santa Barbara Area, Calif.*—Continued

Symbol	Soil type	Acres	Percent
	Watsonville fine sandy loam:		
We	Nearly level	297	0. 1
Wa	Gently sloping	370	. 2
Wb	Gently sloping, moderately eroded	518	. 2
Wf	Sloping	161	. 1
Wg	Sloping, moderately eroded	124	. 1
Wc	Moderately steep	41	(1)
Wd	Moderately steep, moderately eroded	122	. 1
	Watsonville loam:		
Wm	Nearly level	277	. 1
Wh	Gently sloping	1, 534	. 6
Wk	Gently sloping, moderately eroded	49	(1)
Wn	Sloping	219	. 1
Wo	Sloping, moderately eroded	171	. 1
Wl	Moderately steep, moderately gullied	406	. 2
	Watsonville sandy loam:		
Wp	Gently sloping	152	. 1
Ws	Sloping	159	. 1
Wr	Moderately steep, moderately eroded	47	(1)
Wt	Watsonville soils, undifferentiated, steep	354	. 1
	Yolo fine sandy loam:		
Yb	Nearly level	724	. 3
Ya	Gently sloping	387	. 2
Yc	Yolo gravelly fine sandy loam, gently sloping	492	. 2
	Yolo loam:		
Yg	Nearly level	1, 796	. 7
Yf	Imperfectly drained, nearly level	129	. 1
Ye	Gently sloping	936	. 4
Yd	Channeled, sloping	100	(1)
	Yolo sandy loam:		
Yk	Nearly level	15	(1)
Yh	Gently sloping	96	(1)
Yl	Yolo stony fine sandy loam, gently sloping	633	. 3
	Zaca clay:		
Zc	Sloping	283	. 1
Za	Hilly	894	. 4
Zb	Hilly, moderately eroded	325	. 1
Zd	Steep	608	. 2
Ze	Steep, moderately eroded	456	. 2
Zf	Steep, severely eroded	37	(1)
	Zaca clay loam:		
Zh	Sloping, moderately eroded	50	(1)
Zg	Hilly	331	. 1
Zk	Steep	418	. 2
Zl	Zaca nonstony soils, undifferentiated, very steep	1, 430	. 6
	Zaca shaly clay loam:		
Zp	Sloping	107	(1)
Zr	Sloping, moderately eroded	115	(1)
Zm	Hilly	808	. 3
Zn	Hilly, moderately eroded	568	. 2
Zo	Hilly, severely eroded	75	(1)
Zs	Steep	1, 251	. 5
Zt	Steep, moderately eroded	162	. 1
Zu	Steep, severely eroded	56	(1)
Zv	Zaca stony soils, undifferentiated, steep and very steep	4, 070	1. 7
	Water	89	(1)
	Total	243, 645	100. 0

[1] Less than 1/10 of 1 percent.

AGUEDA SERIES

The Agueda series is made up of recent alluvial soils of uniform profile. The parent material has washed mainly from Zaca and Nacimiento soils. The soils occur mostly on narrow stream bottoms and alluvial fans along some of the creeks. The flood plains are narrow, and in places the small fans have slopes as steep as 15 percent. Some of the soils contain gravel. The natural vegetation is annual grasses and herbs. Some trees, mostly sycamores, occur along the stream channels. The soils appear to be fairly resistant to erosion.

The surface soil is dark gray, moderately calcareous, and of moderately fine texture. It is friable when moist and readily breaks to a granular structure where it has not been cultivated. The structure is weak or indistinct when the soil is dry. Grass roots are numerous, particularly in the upper few inches, and there are many insect holes. This layer is moderately permeable to moisture and has a high water-holding capacity.

The subsoil is dark gray, calcareous, similar to the surface soil in texture, and friable and easily crumbled when moist. It has both disseminated and segregated lime. The segregated lime occurs in threadlike form or in thin seams. The subsoil contains fewer roots than the surface soil.

The parent materials are stratified and usually of moderately fine texture. They are calcareous, of grayish color, and massive.

Agueda clay loam, gently sloping (3 to 8 percent slopes) (AA).—This soil has formed on smoothly sloping small alluvial fans and narrow flood plains in the central and western parts of the Area. It has developed on alluvium washed mostly from Zaca and Nacimiento soils. Its profile is uniform throughout. Slopes are favorable for irrigation. This soil is the most extensive of the Agueda series, but not so extensive as some of the other soils occurring on recent alluvium.

Representative profile:

0 to 28 inches, dark-gray, moderately calcareous, hard, moderately basic clay loam;[3] checks and cracks somewhat on drying but does not develop adobe structure; material is porous and crumbles easily to granular structure; lime occurs in disseminated form.

28 to 49 inches, much like layer above; lime occurs in disseminated and segregated forms; segregated lime is in soft seams and nodules; this layer readily penetrated by roots and water.

49 to 60 inches, gray, moderately calcareous, hard, moderately basic massive clay loam; material less calcareous than that in layer above; lime is mostly disseminated; layer is moderately permeable to roots and water.

Use and management.—This soil is used for walnuts, lemons, lima beans, tomatoes, and grain hay, as well as for range pasture. All the lemons and some of the lima beans and tomatoes are irrigated. Cover crops and nitrogen fertilizer are used for lemons. The lime in the soil causes some chlorosis. Yields of grain hay vary with the season.

The areas used for range have good carrying capacity. A few areas are fallowed and planted to Sudangrass pasture. This pasture remains green most of the summer and furnishes feed long after the native range dries.

[3] Unless otherwise stated, the soil properties described in this report are those found when the soil is dry.

Agueda clay loam, nearly level (0 to 2 percent slopes) (AB).—This soil is much like Agueda clay loam, gently sloping. It occurs closer to the coast, however, and is used mostly for field crops, principally lima beans and tomatoes. The management for these crops is the same as that used on Agueda clay loam, gently sloping.

Agueda clay loam, sloping (9 to 15 percent slopes) (AC).—This soil usually occurs on the side slopes of small alluvial fans. Its profile is similar to that of Agueda clay loam, gently sloping. When this soil is used for trees or cultivated crops, it must be protected from erosion. Otherwise, it is suited to the same crops and needs the same management as Agueda clay loam, gently sloping.

Agueda gravelly clay loam, gently sloping (3 to 8 percent slopes) (AD).—The scattered areas of this inextensive soil occur on small alluvial fans along the coastal plains and along narrow alluvial flood plains that extend back into the canyons. The slopes are smooth and gentle. The alluvium has been washed principally from Zaca soils and has been carried only a short distance. The shale gravel is angular or only slightly rounded.

Except for shale fragments scattered throughout the profile, this soil is much like Agueda clay loam, gently sloping. On the coastal plain it is associated with soils of the Montezuma series, and in the canyons with soils of the Yolo, Sorrento, or Mocho series.

Use and management.—This soil needs management similar to that for Agueda clay loam, gently sloping. The gravel does not interfere with crop growth but makes the soil more difficult to work. Because this soil occurs where little irrigation water is available, most crops are grown without irrigation.

Agueda gravelly clay loam, sloping (9 to 15 percent slopes) (AE).—Except for its greater slopes, this soil is similar to Agueda gravelly clay loam, gently sloping. It usually occurs on narrow flood plains that extend back into the canyons. The slopes are short and toward the creeks.

The soil is used mostly for range. When it is used for field or orchard crops, erosion control is necessary. Crop yields are almost as much as those obtained on Agueda clay loam, sloping.

ALISO SERIES

Soils of the Aliso series have well-defined claypan subsoil layers and occupy low undulating terraces that fringe the upper parts of the Goleta and Carpinteria Valleys. The soils have formed on old alluvial deposits, but these are not so old as those of Santa Barbara formation from which the San Andreas soils have developed. Aliso soils are closely associated with Milpitas soils but are more reddish and do not have so compact a subsoil.

The surface soil is brown, slightly acid or neutral, and granular under virgin conditions. It is easily puddled if worked or pastured when too wet. Once puddled, the soil dries out hard and breaks into angular clods that are difficult to work down to a favorable seedbed. Under virgin growth, the upper few inches is slightly darker because it contains decayed grass roots. Grass roots penetrate the entire layer but most of them are in the upper part.

The upper subsoil is reddish-brown, very hard, noncalcareous, prismatic clay. The structural aggregates are roughly twice as long as they are broad and are heavily coated with colloids. The few roots extending into this layer tend to be concentrated on the vertical surfaces of the aggregates.

The lower subsoil is brown, slightly calcareous, blocky clay loam or clay. It is not so compact as the upper subsoil and has some soft nodules of lime. Few roots are in this layer.

The parent material is brown, stratified, and of medium texture. The upper part may or may not be calcareous. In places the layers are somewhat tilted. In general the material is massive and somewhat compact.

These soils are subject to considerable sheet erosion but have not gullied so much as the Milpitas, Watsonville, Tierra, and some other soils in the terraces.

Aliso fine sandy loam, gently sloping, moderately eroded (3 to 8 percent slopes) (AF).—Except for its more gentle slope, this soil is like the other Aliso fine sandy loams.

Most areas of this soil have been moderately sheet eroded. The erosion does not interfere with tillage, but it does reduce the amount of soil above the claypan. Because most of the plant roots are above the claypan, the loss of surface soil has reduced the zone where moisture can be stored and roots can grow. The loss of soil usually results in somewhat lower yields.

Aliso fine sandy loam, sloping (9 to 15 percent slopes) (AH).—Smoothly sloping or rolling old alluvial terraces are occupied by this soil. The small bodies fringe the upper edges of the Goleta and Carpinteria Valleys. The natural vegetation is annual grasses and herbs. The soil has strongly defined profile layers. It somewhat resembles the Milpitas soils and is closely associated with them.

Representative profile:

0 to 18 inches, brown, slightly acid or neutral, hard, granular fine sandy loam; under natural vegetation, grass roots are abundant and concentrated in the upper 2 or 3 inches; material puddles easily if worked or pastured when wet; puddled areas crust seriously on drying; lower part of layer is slightly softer and more porous than the rest.

18 to 39 inches, reddish-brown, very hard, noncalcareous, slightly acid to neutral clay that has a well-defined prismatic structure when dry; aggregates are well coated with colloidal material; few grass roots that extend into this layer are concentrated on the vertical surfaces of the aggregates; compactness of layer is pronounced but not so great as in the claypan layers of the Milpitas and Watsonville soils.

39 to 51 inches, brown, slightly calcareous, hard, slightly basic, blocky clay loam or clay; aggregates slightly coated with colloidal stains; variable amounts of lime occur in form of soft gray nodules.

51 to 60 inches, brown, hard, slightly basic, massive, stratified material of medium texture; may or may not be slightly calcareous; layers, in places, are slightly tilted.

Use and management.—Without irrigation, this soil is mainly in range. Under irrigation, some lemons are grown. Winter cover crops, nontillage weed control, and commercial fertilizer are used for lemons. From ½ to 1½ acre-feet of water is applied, usually by sprinkler irrigation. Lemons do not do so well as on some of the alluvial soils that have a much less compact subsoil.

Aliso fine sandy loam, sloping, moderately eroded (9 to 15 percent slopes) (AK).—Except for moderate erosion this soil is similar to Aliso fine sandy loan, gently sloping. Sheet erosion has removed some of the surface soil, and a few gullies have formed. This soil is used like Aliso fine sandy loam, gently sloping, but erosion has reduced its yields somewhat. The gullied areas are more difficult to work because most of them cannot be crossed with tillage implements, and the soil cannot be farmed up to the edge of the gullies. Effective soil conservation must be applied if more serious erosion is to be prevented.

Aliso fine sandy loam, moderately steep, moderately eroded (16 to 30 percent slopes) (AG).—Most areas of this soil are just west of Santa Barbara. Some are used for homesites, some for range, and others for field crops or lemons. The soil usually occurs as the sloping edge of a terrace, is moderately eroded, and is somewhat gullied. Farming is more difficult than on the more gently sloping Aliso soils, particularly where there are gullies that cannot be crossed by tillage implements. Yields are also somewhat less. Control of runoff and erosion is difficult on this soil, particularly if it is used for clean-cultivated field crops. The few citrus plantings on this soil are terraced. Citrus fruits yield about the same as on the other Aliso soils, but the costs of production are greater.

Aliso fine sandy loam, steep, moderately eroded (31 to 45 percent slopes) (AL).—This soil occupies the sloping edges of terraces. Its profile is not so distinct as that of the Aliso fine sandy loams in less sloping areas. In places the claypan is not very distinct in the subsoil. The soil is too steep for cultivated crops; it is used for range but yields somewhat less than Aliso fine sandy loams in less sloping areas.

Aliso loam, gently sloping, moderately eroded (3 to 8 percent slopes) (AM).—A few bodies of this soil are north of Goleta. The profile is similar to that for other Aliso fine sandy loams. The soil is used mostly for lemons, which yield about as they do on other Aliso soils. Control of runoff and erosion is not so difficult, but most of the areas are moderately eroded.

Aliso loam, sloping, moderately eroded (9 to 15 percent slopes) (AP).—Except for its finer surface texture, this soil is much like Aliso fine sandy loam, sloping, moderately eroded. It occurs on sloping to rolling terraces that fringe the upper parts of the Carpinteria and Goleta Valleys. The bodies are small and the slopes are smooth. The soil is associated with those of the Milpitas series.

Use and management.—Lima beans and tomatoes are grown to some extent without irrigation; lemons are irrigated. Moderate sheet erosion and some gullying make management more difficult and somewhat reduce yields. Effective control of erosion is necessary to prevent more serious deterioration of the soil.

Aliso loam, moderately steep, moderately eroded (16 to 30 percent slopes) (AN).—This soil occurs northeast of Shepard Mesa and a short distance northwest of Goleta. It lies along the sloping edges of terraces and its profile is more variable than that for the Aliso loams on the terrace tops.

The area northeast of Shepard Mesa is used mostly for lemons. The orchards are terraced and carefully managed to control erosion.

The cost of planting and operating orchards on these slopes is great. The area northwest of Goleta is used mostly for range or for field crops. The fields are difficult to cultivate because of the steep slopes. Great care is necessary to prevent further erosion.

Aliso loam, moderately steep, severely eroded (16 to 30 percent slopes) (Ao).—Most of this soil is sheet eroded, and it also has occasional gullies. Only a small amount of soil is left above the compact claypan. This soil is used mainly for field crops or lemons. The severe erosion is the result of cultivating such steep slopes.

ALVISO SERIES

Soils of the Alviso series have formed under the influence of a very high water table. They adjoin Tidal marsh and are only a foot or two above sea level. The water is strongly saline; consequently, the soils have strong concentrations of soluble salts. The high water table and salinity have prevented formation of distinct profile characteristics. The natural vegetation is saltgrass, pickleweed, inkweed, and other salt-tolerant plants. The soils occur as a fringe at the lower edges of the Goleta and Carpinteria Valleys and at the lower edges of some of the small valleys that have alluvial plains bordering the ocean.

The surface soil is gray and of medium to fine texture. A few small areas do have a sandy surface soil. The surface soil is slightly calcareous and mottled with rust-brown iron stains and dark-colored organic matter. The underlying material—stratified, slightly calcareous, and of variable texture—has light-gray iron stains caused by the constant high water table.

Alviso soils, undifferentiated, nearly level (0 to 3 percent slopes) (Ar).—Alviso soils, as they occur in the Santa Barbara Area, are not separated into types. The soils are of variable but generally medium to fine texture. They occur next to the Tidal marsh at the lower edge of the Carpinteria and Goleta Valleys and at the mouths of a few small streams on low-lying areas. They are only 1 to 2 feet above sea level; the water table varies from a few inches to 1 or 2 feet from the surface. The water is strongly saline. Evaporation concentrates salts in the soil above the water table. Except for variations in texture, the following description of Alviso clay loam is representative:

0 to 11 inches, gray, slightly calcareous, hard, moderately basic, massive clay loam; highly mottled with rust-brown iron stains; contains many coarse stolons and roots of saltgrass and other salt-tolerant weeds and grasses.

11 to 60 inches, stratified, highly mottled, light brownish-gray, moderately basic, slightly calcareous, variously textured materials; this layer lies below the water table, and the mottlings become more dull and light gray with depth.

Use and management.—The Alviso soils are used in a few places for range pasture, but the forage is of poor quality and has a low carrying capacity. Because they are so near sea level and so salty, it does not seem feasible to reclaim these soils.

ARGUELLO SERIES

Soils of the Arguello series have moderately distinct layers and compact subsoil. They have formed almost entirely on materials washed from Santa Lucia soils. They occur on older alluvial fans

and stream terraces along the coastal plains, mainly in the western part of the Area. The soil materials contain platy and somewhat angular fragments of Monterey shale. The natural vegetation is annual grasses and herbs. In profile characteristics these soils are similar to Lockwood soils, but are considerably darker in color. Layers in the Arguello soils are more distinct than those in the Elder soils, but less distinct than those in the Jalama soils. The soils of these three series are all derived mainly from the same kind of parent material.

The Arguello surface soil is dark gray, slightly to medium acid, and shaly. Under the natural grass cover, it is granular and friable when moist. It will puddle easily if worked or pastured at high moisture content.

The subsoil is dark gray, moderately compact, and medium acid. It contains shale fragments and has a slightly finer texture than the surface soil. The subsoil breaks to subangular blocky aggregates that crumble easily. It does not contain nearly so many grass roots as the surface soil. The compactness of the subsoil is greater than the slight increase in clay content would seem to indicate.

The parent material—medium-textured stratified slightly acid gravelly older alluvium—is slightly compact and massive in place.

The Arguello soils are used for range or for Sudangrass pasture.

Arguello shaly loam, gently sloping (3 to 8 percent slopes) (As).—Gently sloping or undulating old alluvial fans on the coastal plains are occupied by this soil. Most of it is found in the western part of the Area. The soil material has washed from areas of Santa Lucia soils; angular fragments of Monterey shale are scattered throughout the soil. The angular shape of the shale fragments indicates that the parent material has been carried only a short distance. The soil shows considerable distinctness of layers. Although the subsoil is compact, there is only a slight amount of clay accumulation. The natural vegetation is annual grasses and herbs.

Representative profile:

0 to 14 inches, dark-gray, medium acid, hard, shaly loam; granular but will puddle if worked or pastured when wet; many roots throughout, most of the grass roots in the upper 2 to 4 inches; variable amounts of shale fragments on the surface and throughout this layer.
14 to 27 inches, similar to layer above but slightly finer textured.
27 to 37 inches, dark-gray, medium acid, hard, subangular blocky shaly clay loam; contains less roots than the surface soil.
37 to 72 inches, gray, hard, slightly acid shaly clay loam that often extends to depths of 6 to 8 feet or more; massive in place but crumbles readily when dug out; compact, but porous enough to permit adequate drainage.

Use and management.—Most of this soil is in the Area where livestock raising is the only agricultural activity. The soil is used for range, Sudangrass pasture, and grain hay. It is one of the better range soils. A few bodies in the central part of the Area are used for lima beans and tomatoes. Under cultivation, the management is similar to that used on the coastal terrace soils of the Milpitas and Watsonville series. This soil is easier to handle, however, and in general produces slightly better yields.

Arguello shaly loam, sloping (9 to 15 percent slopes) (At).—This soil occurs on somewhat stronger slopes than Arguello shaly loam, gently sloping. It is in the western part of the Area, where it is associated with soils of the terraces and Arguello shaly loam gently

sloping. It has a profile similar to that of Arguello shaly loam, gently sloping, but in a few places its subsoil is slightly more compact.

On use and productivity, this soil is similar to Arguello shaly loam, gently sloping. None of it is irrigated. If irrigation water were available, the steeper slopes of this soil would necessitate more careful irrigation than is needed for Arguello shaly loam, gently sloping.

BALLARD SERIES

Soils of the Ballard series have moderately distinct profile layers. They have developed from older gravelly alluvial deposits derived from sandstone and shale and occur on smooth slopes. They are on old stream benches at higher elevations than the more recent alluvial deposits, yet are lower than the terrace deposits on which the Milpitas soils occur. Usually the Ballard soils occur in small bodies, mainly in the eastern part of the Area near Montecito and Summerland. The natural vegetation is annual grasses, herbs, and scattered oaks. The trees become more numerous near stream channels.

The surface soil is grayish brown, slightly acid, and of medium texture. Near the coast it is somewhat darker than farther inland. Generally it is gravelly, and in places it has a considerable quantity of large stones or boulders on the surface and embedded in the soil material. Under natural conditions, the soil is granular but it puddles easily if worked or pastured when too wet. As the puddled areas dry they produce a hard surface crust that is difficult to break. There are many grass roots in the surface layer, and generally there is a concentration of roots in the upper 2 or 3 inches. The lower part of the surface soil, below plow depth, is more friable when moist and in many places has many worm and root holes.

The subsoil is moderately compact, slightly acid, gravelly, and of somewhat finer texture than the surface soil. It is brown and becomes somewhat lighter with depth. The grass roots are not so numerous as in the surface layer, but some of the tree roots extend down into this horizon. The gravel obscures the structure, but when dry the soil breaks into subangular blocks that are slightly coated with colloidal stains.

The parent material is yellowish-brown stratified gravelly or stony older alluvial material of sandy loam or loam texture and of massive structure.

Ballard soils are used for range or field crops, principally lima beans and grain hay. Lemons are also grown. Yields are somewhat inferior to those on the Yolo and Sorrento soils but better than those on the Milpitas and related soils.

Ballard fine sandy loam, nearly level (0 to 2 percent slopes) (BB).—This soil occurs mainly in and around Montecito and Santa Barbara. Except for more gentle slope, it is much like Ballard fine sandy loam, gently sloping; is used and managed in the same way and produces similar yields. It is somewhat easier to prepare for irrigation, however, and runoff of irrigation water and rainfall is more easily controlled.

Ballard fine sandy loam, gently sloping (3 to 8 percent slopes) (BA).—This is the most extensive Ballard soil. It occurs in many places, but principally in the Montecito District. The areas are on alluvial fans at slightly higher elevations above the stream channels

than the Yolo, Sorrento, and Mocho soils, but are not so high as the Milpitas and Watsonville soils of the terraces. The profile has moderately defined or well defined layers, is moderately compact, and has an accumulation of clay in the subsoil. The lower subsoil and substratum are gravelly. The natural vegetation is annual grasses, herbs, and scattered oaks. Trees are more numerous close to stream channels.

Representative profile:

0 to 13 inches, grayish brown, slightly acid, granular fine sandy loam; easily puddled if worked when wet and dries out cloddy and hard to work to a good tilth; virgin areas have a concentration of grass roots in the upper 2 or 3 inches, but roots are plentiful throughout; layer frequently has a small quantity of sandstone gravel that does not interfere with tillage.

13 to 42 inches, brown, hard, slightly acid, subangular blocky loam or gravelly loam more compact than the surface soil; contains variable quantities of gravel and its structure is therefore not particularly evident; gravel and the weak soil aggregates are usually somewhat coated with colloidal stains.

42 to 56 inches, yellowish-brown, slightly hard, stratified gravelly, medium-textured material of slightly acid reaction; normally contains more gravel than the layers above.

Use and management.—This soil is used for lemons, avocados, a few walnut trees, and lima beans, all grown under irrigation. Tomatoes, grain hay, and range are not irrigated. Yields are good but somewhat inferior to those on the Sorrento and Yolo soils of similar texture. This soil is more difficult to manage than Sorrento and Yolo soils.

Ballard fine sandy loam, sloping (9 to 15 percent slopes) (Bc).—The slopes of this soil are slightly steeper than are typical for the Ballard series. The areas are in a number of small canyons that extend back into the hills in the central part of the Area. The profile is essentially the same as for Ballard fine sandy loam, gently sloping.

In the Montecito Area this soil produces good yields of lemons and field crops. Nevertheless, yields are not so good as those on the Sorrento or Yolo soils in the same general locality. Areas of this soil farther west are used either for range or for field crops, mainly lima beans or tomatoes. For nonirrigated field crops, there is very little difference in the yields obtained on this soil and on the Sorrento and Yolo soils. This soil is more difficult to manage than the gently sloping Ballard soil.

Ballard fine sandy loam, sloping, moderately eroded (9 to 15 percent slopes) (Bd).—The few small areas of this soil are associated with other Ballard soils. The soil has been affected by sheet or gully erosion. It has been or is now being used for lemons and lima beans. Yields are not so good as they are on soils that have not been eroded.

Ballard gravelly fine sandy loam, gently sloping (3 to 8 percent slopes) (Be).—There are a few small bodies of this soil, most of them near the Montecito and Carpinteria Valleys. They are near stream channels at slightly higher elevations than areas occupied by the Sorrento or Yolo soils, but not so high as those where soils of the Milpitas series are found. Except for its gravelly surface layer, this soil is very similar to Ballard fine sandy loam, gently sloping.

The soil puddles easily if worked when excessively moist. Because of the gravel, this soil has a lower water-holding capacity than the nongravelly Ballard soils. It is used for lemons and avocados or for

range. Yields are somewhat less than those obtained from Ballard fine sandy loam, gently sloping.

Ballard stony fine sandy loam, gently sloping and sloping (3 to 15 percent slopes) (BF).—This soil occupies stony alluvial fans. It occurs most frequently near Montecito. A few other bodies, located north and west of the Montecito Valley, are used mainly for range. Occasionally some small areas are cleared. The stones are removed at great expense, and lemons or avocados are planted. Such clearing is usually done in the Montecito District within estates. Removal of stones would be questionable on a commercial basis.

BAYWOOD SERIES

The Baywood series consists of soils with weakly defined profile layers. They have formed on windblown deposits that occupy terraces in many places along the coast (pl. 1). The natural vegetation—mostly annual grasses but brush in some places—is sufficient to prevent wind from moving the soil.

The surface soil is grayish-brown, single-grained loamy sand or loamy fine sand. The upper 2 or 3 inches has the greatest concentration of grass roots and is slightly darker than the rest of the layer. The reaction is medium acid. The subsoil consists of grayish-brown material similar to the surface soil in texture but slightly compact. Only a few grass roots appear in the subsoil, but it is not so compact that it inhibits penetration of roots and water. The reaction is medium acid. The underlying parent materials—loose light yellowish-brown sands or loamy sands—contain practically no roots and are medium acid in reaction.

Some areas of these soils have only a thin layer of sandy material over the old terraces on which Milpitas, Watsonville, or other soils have developed. These small bodies occur mostly from Drake eastward to Santa Barbara.

Baywood loamy fine sand, gently sloping (3 to 8 percent slopes) (BG).—Except for slightly finer texture throughout the profile, this soil is similar to Baywood loamy sand, gently sloping. It consists of gently sloping or undulating areas of wind-deposited sandy material along the coast. It is associated with soils of the Milpitas series. The natural vegetation is brush and grass. This soil has a little higher water-holding capacity than Baywood loamy sand, gently sloping.

Use and management.—Baywood loamy fine sand, gently sloping, is used for field crops and specialty crops, and, in a few places, for lemons. It is a little better than Baywood loamy sand, gently sloping. Moderately good yields of lima beans and truck crops are obtained from irrigated areas. Lemons also do fairly well. None of the crops yield so well as they do on Sorrento or Mocho soils.

Baywood loamy fine sand, moderately steep (16 to 30 percent slopes) (BH).—This moderately steep soil is mostly in the eastern part of the Area. Its profile is essentially the same as that of Baywood loamy fine sand, gently sloping. The soil is used for range or is planted to woodlots of eucalyptus trees. Its carrying capacity is less than that of Baywood loamy fine sand, gently sloping.

Baywood loamy fine sand, over Watsonville soils, gently sloping (3 to 8 percent slopes) (BK).—This soil consists of 1 to 5 feet of Bay-

wood loamy fine sand over older Watsonville soils. It occurs in the eastern part of the Area. Some of it is used for lima beans, but most of it is in range. The yields and management practices are similar to those for Baywood loamy fine sand, gently sloping.

Baywood loamy sand, nearly level (0 to 2 percent slopes) (Bm).—Areas of Baywood loamy sand leveled for agriculture are mapped in this unit. Except for a few bodies near Goleta, none of this soil is farmed. Lemons and field crops are grown. Lemons and beans do fairly well if irrigated; without irrigation the beans produce low yields. The soil does not hold enough water to allow good yields. Even when irrigated, the soil yields less than Mocho or Sorrento soils.

Baywood loamy sand, gently sloping (3 to 8 percent slopes) (Bl).—Several bodies of this windblown sandy soil are adjacent to the coast. The relief is gently sloping, and in a few places gently undulating. The soil is closely associated with those of the Tangair series but does not have so distinct profile layers as do the Tangair soils. It closely resembles soils of the Marina series in profile characteristics but is darker colored. The natural vegetation is mostly annual grasses.

Representative profile:

0 to 44 inches, grayish-brown, medium acid, loose, single-grained loamy sand; slight concentration of grass roots in the upper 2 or 3 inches, but roots occur throughout; material becomes slightly lighter colored with increasing depth but is otherwise very uniform.

44 to 67 inches, pale-brown, medium acid, loose, single-grained loamy sand; slightly compact when dry but softens and becomes less compact when moist; fewer roots than in layer above.

67 to 80 inches, light yellowish-brown, loose, medium acid, single-grained sand or loamy sand that contains few roots.

Use and management.—This soil is used mostly for range. The grass cover is not dense and has a low carrying capacity. A few areas along the coast south of Goleta are used for lemons and lima beans. Lemon yields are moderate, but bean yields are low and normally there are many bare spots in the fields. Some growers of cut flowers have selected this soil for use because of its favorable internal drainage.

Baywood loamy sand, rolling (9 to 15 percent slopes) (Br).—This soil occurs on rolling areas near the coast in association with soils of the terraces. Except for slope, it is similar to Baywood loamy sand, gently sloping.

In the far western part of the Area, all of this soil is used for range and has a moderately low carrying capacity. A few areas are planted to lima beans and produce rather low yields. Other areas are used for lemons, beans, and cut flowers grown under irrigation; yields are fair to good but not so good as those obtained on Sorrento and Mocho soil of comparable surface texture and slope.

Baywood loamy sand, over Watsonville soils, nearly level (0 to 2 percent slopes) (Bo).—Wind-accumulated sandy materials that have been deposited over soils of the Watsonville series are mapped in this unit. The areas are next to the coast. The deposit of Baywood loamy sand is 1 to 5 feet deep over the Watsonville soil.

Some leveling of this soil has been done in preparation for farming. Some areas are in Sudangrass or in annual grasses for pasture. Yields of forage are only fair. Sudangrass yields less than on

Watsonville fine sandy loam, nearly level. One body is used mainly for lima beans and produces fairly good yields under irrigation.

Baywood loamy sand, over Watsonville soils, gently sloping (3 to 8 percent slopes) (Bn).—Except for greater slope, this soil is very similar to Baywood loamy sand, over Watsonville soils, nearly level. Baywood loamy sand is 1 to 5 feet deep over soil of the Watsonville series. Except for one small body, this soil is used for range. The carrying capacities are similar to that of other Baywood soils. A small body near the coast south of Goleta is used for lima beans without irrigation and produces low yields.

BOTELLA SERIES

Soils of the Botella series have formed on slightly older alluvial fans and flood plains, usually along narrow valleys cutting through soils of the terraces or uplands. They occur most frequently in the western part of the Area in association with Elder and Arguello soils. The few bodies that occur near Santa Barbara have a more brownish cast because they have been influenced by material washed from the Sespe soils.

The surface soil is dark-gray neutral clay loam, granular but with some tendency to puddle if worked or pastured when too wet. If puddled, the surface dries to a hard crust that is difficult to work to a favorable tilth. Under the natural cover of annual grasses and herbs, grass roots are concentrated in the upper few inches, but many roots penetrate the entire layer.

The subsoil is dark-gray, neutral, slightly finer textured than the surface soil, and slightly compact. The structure is subangular blocky, the aggregates are hard and have a small amount of colloid on their surfaces. Some grass roots are seen throughout this layer, but not so many as in the surface soil. The number of roots decreases rapidly with depth.

The parent material is grayish brown, stratified, neutral to slightly basic, noncalcareous, and of variable but usually moderately fine texture. This material is softer than that of the subsoil.

Botella soils are highly productive and suited to a wide range of crops. They are used for lemons and various field crops. Near Point Conception they are mainly in Sudangrass pasture.

Botella clay loam, nearly level (0 to 2 percent slopes) (Bs).—Except for slopes this soil is similar to Botella clay loam, gently sloping. Most of it is in the western part of the Area and is used mainly for Sudangrass pasture. A few small bodies near Santa Barbara are used for lemons, walnuts, and lima beans. Yields are high. Management is similar to that for the Yolo and Sorrento soils. This soil is slightly more difficult to work, however, and puddles easily if tilled when it contains too much moisture.

Botella clay loam, gently sloping (3 to 8 percent slopes) (Br).—This inextensive soil occurs along some of the small creeks, mostly in the western part of the Area. A few bodies are located near Santa Barbara and Goleta. The relatively smooth benches are sufficiently far above the streams so that the soil does not receive deposits of fresh alluvium.

Representative profile:

0 to 13 inches, dark-gray, hard, granular clay loam; easily puddled when worked at excessive moisture content and may develop large hard clods difficult to reduce to favorable tilth; reaction, nearly neutral.

13 to 49 inches, dark-gray, hard, subangular blocky heavy clay loam; structural units are harder than those of the surface soil and thinly coated with colloidal stains; not compact enough to retard water and root penetration; reaction, nearly neutral.

49 to 60 inches, grayish-brown, hard, stratified soil material which is usually of moderately fine texture; massive and less compact than the horizon above; reaction is neutral or slightly basic; some rather angular sedimentary rock fragments may occur throughout parts of this layer; shape of fragments indicates they have not been transported far.

Use and management.—This soil is used mainly for Sudangrass pasture. The Sudangrass, grown without irrigation, produces pastures of good carrying capacity. The pastures are grazed in the summer and early in fall after the range grasses have dried. If irrigation water were available, alfalfa, Ladino clover, other forage crops, and a wide variety of field, truck, or orchard crops could be grown.

Near Santa Barbara and Goleta, this soil is used mostly for lemons or walnuts, but a few areas are in lima beans, tomatoes, or other field crops. Management for these crops is similar to that for Yolo and Sorrento soils, but this soil is not quite so easily worked.

Botella clay loam, sloping (9 to 15 percent slopes) (Bᴛ).—Except for stronger slopes, this soil is similar to Botella clay loam, gently sloping. It usually occurs as narrow bottoms further upstream than the Botella clay loam on more gentle slopes. The slopes are mostly short and towards the channels. The soil is located almost entirely in the western part of the Area. All of it is in Sudangrass pasture or unimproved range pasture. Management for Sudangrass pastures is similar to that for more gently sloping areas of Botella clay loam, but the soil is slightly more difficult to work. It appears to have about the same carrying capacity as other Botella soils.

CARPINTERIA SERIES

The soils of the Carpinteria series have formed in material eroded almost entirely from Sespe soils. They occur on small alluvial fans along minor drainageways that head back into the Sespe soils. Some of these fans have fairly steep slopes.

The surface soil is a dark grayish brown, noncalcareous, granular loam or clay loam that is neutral in reaction. Under proper management it keeps its good physical conditions, but when worked or pastured at high moisture content is easily puddled. Then, on drying, it becomes hard, compact, and difficult to handle. This layer contains many grass roots and holes left by roots and insects.

The subsoil, dark grayish brown grading to dark brown, has a slightly finer texture than the surface soil. It is a little more compact and shows slight colloidal staining on the surfaces of the weakly developed aggregates. Grass roots are not numerous, but coarser roots penetrate freely. The upper part of this layer is neutral or slightly basic and noncalcareous; the lower part is intermittently calcareous in some places.

The parent material is dark brown and similar to the surface soil in texture but may be somewhat stratified. It is softer and more open

than the subsoil material; neutral to slightly basic in reaction; and may contain small quantities of lime.

Carpinteria soils had a natural cover of annual grasses, herbs, and scattered oaks. The oaks and associated trees grew along the streamways. Most areas of the Carpinteria soils are now cultivated; a wide variety of crops are grown.

Carpinteria clay loam, gently sloping (3 to 8 percent slopes) (Ca).—This soil occurs on small smooth alluvial fans along small creeks that extend only a short distance back into the hills. The parent material has washed almost entirely from areas of Sespe soils. The profile has a slight accumulation of clay and is slightly compact in the subsoil. The natural vegetation is annual grasses, herbs, and scattered oaks. The soil occurs along the upper fringes of the Carpinteria and Goleta Valleys; it is associated with soils of the Sorrento, Yolo, and Sespe series.

Representative profile:

0 to 16 inches, dark grayish-brown, hard, neutral, noncalcareous clay loam; soil breaks to granules without difficulty, but if worked at unfavorable moisture content, it puddles easily and crusts on drying; crust is hard and is difficult to work to a favorable tilth.

16 to 50 inches, dark grayish-brown, grading to dark-brown, hard, neutral to slightly basic, heavy clay loam or light clay; somewhat compact and shows a weak subangular blocky structure when dry; irregularly shaped aggregates thinly coated with colloidal stains; layer not so compact as to materially reduce penetration of roots and water; upper part of layer is noncalcareous, but the lower part intermittently calcareous in places.

50 to 72 inches, dark-brown, hard, neutral to moderately basic, massive clay loam; may be slightly calcareous; material less compact than that in layer above.

Use and management.—This soil is used mostly for lemons. A few avocado and walnut orchards are kept, and some areas are in field crops, mostly lima beans. Much of it is irrigated, but some of the fields of lima beans are not irrigated. Lemons and avocados are always grown under irrigation, and cover crops or nontillage weed control and commercial fertilizers are commonly used.

Lemons yield almost as well as on the best soils of the Yolo and Sorrento series. Avocado yields are extremely variable but may be as high on this soil as on any other soil in the Area.

Carpinteria clay loam, sloping (9 to 15 percent slopes) (Cc).—Except for stronger slopes, this soil is very similar to Carpinteria clay loam, gently sloping. It is used almost entirely for lemons. If planted on the contour and carefully managed, lemons can be grown on this soil as successfully as on Carpinteria clay loam, gently sloping. The yields and quality of fruit are about the same, but the cost of setting out the orchards is normally higher. One or two areas have a few gullies that cannot be crossed by tillage implements.

Carpinteria clay loam, moderately steep (16 to 30 percent slopes) (Cb).—Except for stronger slopes, this soil is similar to Carpinteria clay loam, sloping. The soil occurs as very small bodies along the slopes that lead down to the creek channels. All of the slopes are near the lower limits of the slope range.

This soil is usually planted to lemons. Most lemon plantings are terraced to prevent erosion. The terracing takes up some space, but

the trees do well, and yields are only slightly less than on Carpinteria clay loam, sloping.

Carpinteria loam, gently sloping (3 to 8 percent slopes) (CD).—This inextensive soil occurs on smooth gently sloping small alluvial fans around the upper edges of Carpinteria Valley and is associated with soils of the Yolo, Sorrento, and Sespe series. Except for somewhat coarser texture throughout the profile, this soil is very similar to Carpinteria clay loam, gently sloping.

Use and management.—This soil is used for orchard fruits and field crops. Lemons, avocados, and walnuts are grown under irrigation, but lemons are the dominant fruit crop. Lemons and avocados commonly receive green manure and commercial fertilizer. Lemons yield only slightly less than on the better Sorrento and Yolo soils. Avocado yields are extremely variable but are as good as on other soils of this Area.

Walnuts are grown with irrigation. In most walnut orchards, cover crops are turned under regularly. The use of commercial fertilizers is not so common for walnuts as for lemons.

The major field crop is lima beans grown for dry beans or fresh market. The beans for fresh marketing are normally irrigated; the dry beans are not. Yields are similar to those produced on the most favorable Yolo and Sorrento soils.

CAYUCOS SERIES

In the Cayucos series are soils that have weakly developed layers over shale bedrock. They occur from Point Conception eastward to Drake in the lower foothills near the coast. They are found along the terrace escarpments. Closely associated with them are soils of the Santa Lucia and Watsonville series. In fact, near Point Conception, the Watsonville soils have developed on terrace material deposited as a capping over the shale from which the Cayucos soils have formed. The natural cover on Cayucos soils is annual grasses and herbs.

The surface soil is dark gray, slightly acid, blocky clay or clay loam. Grass roots are concentrated in the upper few inches but are plentiful in this layer.

The subsoil is dark gray, neutral or slightly acid, and of a texture similar to or slightly finer than that of the surface soil. The subsoil is slightly more compact and has fewer grass roots than the surface layer. It becomes a little lighter with depth, and has some angular shale fragments in the lower part.

The parent material is gray shale, which in the upper part is crumbly and has some soil material in the cracks. With increase in depth the shale becomes harder, but it normally is shattered to considerable depths.

The Cayucos soils are used entirely for grazing cattle.

Cayucos clay, sloping (9 to 15 percent slopes) (CF).—Except for having more gentle slopes, this soil is very similar to Cayucos clay, hilly. The few small areas occur on rounded knolls or moderately sloping ridgetops. Although the more nearly level tracts are suitable for grain hay, beans, or tomatoes, they are in an area used exclusively for livestock raising. Consequently, they are used for pasture and have a good carrying capacity.

Cayucos clay, hilly (16 to 30 percent slopes) (CE).—This soil occurs in a number of small bodies close to the coast near Drake. Except for finer texture throughout the profile, it is very similar to Cayucos clay loam, hilly, moderately eroded. It occupies smooth, hilly relief. Some of the slopes occur below terrace cappings of Watsonville or Tierra soils.

This soil is used entirely for range. It has a higher carrying capacity than the Cayucos clay loams.

Cayucos clay loam, hilly, moderately eroded (16 to 30 percent slopes) (CG).—This soil occurs on hilly relief. It is located in the western part of the Area, eastward from Point Conception. The natural vegetation is annual grasses and herbs.

Representative profile:

0 to 13 inches, dark-gray, slightly acid, hard clay loam containing some angular shale fragments; grass roots penetrate freely but are somewhat concentrated in the upper 2 or 3 inches; upper part of layer slightly darker in color than the rest; material has a coarse blocky structure when dry; blocks are porous and crumble to smaller blocks and granules.

13 to 25 inches, dark-gray, hard, blocky, slightly acid to neutral clay loam; slightly lighter in color than surface soil but of similar or slightly finer texture; number of grass roots decreases rapidly with depth; layer contains some shale fragments, which increase in number with depth.

25 inches +, gray, hard, massive, noncalcareous shale; upper part crumbled, shattered, intermixed with soil material, and penetrated by some grass roots; rock gradually becomes more massive with depth, but usually is not so hard as the bedrock under the Santa Lucia soils.

Use and management.—This soil is used entirely for range. Its carrying capacity is fairly good, but not so good as that of Cayucos clay soils or the Nacimiento and Zaca clays of the same locality. It is slightly more productive than the Santa Lucia soils.

The soil is overgrazed, as is shown by moderate sheet erosion. More carefully planned grazing probably would increase the carrying capacity.

Cayucos clay loam, steep, moderately eroded (31 to 45 percent slopes) (CH).—Except for stronger slopes, this soil is similar to Cayucos clay loam, hilly, moderately eroded. It has some gullies and is moderately sheet eroded.

This soil is used entirely for range. Most of it is overgrazed; that is the major reason why the soil is eroded. Careful range management would permit the range to recover from the effects of overgrazing. The carrying capacity would then increase.

Cayucos shaly soils, undifferentiated, steep and very steep (31+ percent slopes) (CK).—These undifferentiated soils occur on steep and very steep slopes. Except for textural variations and many shale fragments throughout, their profile is similar to that for the Cayucos soils with less steep slopes. Shale rock outcrops in many places. Some areas have grass vegetation and others have brush. This unit is used for range; its carrying capacity is much lower than that of Cayucos clays or Cayucos clay loams on more gentle slopes.

CLEAR LAKE SERIES

The Clear Lake soil is at the lower edges of alluvial fans and in interfan areas. It has formed in nearly level areas close to the sea

where drainage water accumulates. Drainage is poor. Water stands on the surface during the rainy season, and the water table is so high that water moves upward during the dry season.

The surface soil is a black, neutral clay of coarse or very coarse blocky structure. It is very hard when dry and is rather difficult to break into smaller blocks or granules. When wet it is sticky and plastic.

The upper subsoil is dark gray, slightly basic, and has a texture similar to or slightly finer than that of the surface soil. Cracks extend down into this layer when the soil is dry. The aggregates are large, blocky, and thinly coated with colloidal stains. Some soft white nodules of lime are present throughout but are more numerous in the lower part.

The lower subsoil is dark grayish brown and of somewhat variable texture. It is moderately calcareous and has many light-gray lime nodules. An appreciable amount of brownish iron mottling is apparent throughout.

The parent materials consist of moderately calcareous stratified layers that have a wide range in texture. There is considerable brownish iron mottling and some lime nodules.

Clear Lake soil, because of the high water table, is not suited for deep-rooted crops. It must have artificial drainage before it can be used extensively for field crops. In this Area the Clear Lake soil occurs so near sea level that adequate drainage is difficult to provide and to maintain. Some areas have saline salts in concentrations that reduce plant growth.

Clear Lake clay, nearly level (0 to 2 percent slopes) (CL).—The small bodies of this soil are in basins or depressions where water accumulates. Water accumulates during the rainy season, and the soil remains wet into the summer months. The water table, even at the end of the dry season, is at depths of about 3 to 5 feet. This soil is associated with those of the Sorrento and Mocho series. Artificial drainage is necessary before crops can be grown well.

Representative profile:

0 to 11 inches, black clay that develops a very hard, very coarse blocky structure when dry; relatively high organic-matter content; moderately easily worked to a good tilth but puddles easily if worked too wet; reaction, about neutral.

11 to 22 inches, dark-gray, very hard, slightly basic clay of coarse blocky structure; shrinkage cracks extend through layer and give it the appearance of a prismatic structure; some lime nodules occur in this layer, and the number increases with depth.

22 to 38 inches, dark grayish-brown, moderately hard, massive, moderately calcareous loam to clay; concentration of lime nodules and brownish iron stains give this layer a mottled appearance.

38 to 64 inches, light brownish-gray, hard, massive, mottled stratified material, mostly of medium texture; contains lime nodules, but not so many as the layer above.

Use and management.—This soil should be drained before it is cultivated. Drained areas are used mostly for lima beans and tomatoes. Some citrus fruits have been planted but are not doing well. The fields are somewhat spotted, as growth is poor in the wet spots. The bean fields are particularly spotted.

A few small areas in the lower part of the Carpinteria Valley are slightly affected by salts but otherwise have the same profile. The

high water table permits the accumulation of salts. These salty areas are used only for field crops. They yield slightly less than the areas not affected by salts, and the growth of crops is more spotted. The major crops are lima beans and tomatoes.

CLIMAX SERIES

The soils of the Climax series rest on soft light-colored volcanic ash. They are hilly to steep and have smooth slopes and rounded ridges. They are in the western part of the Area, mostly on the south slopes of El Tranquillon. A few bodies also occur northeast of this mountain. Associated with these soils are Montara and Los Trancos soils, both of which are developed on hard rocks, and also the Los Osos and Santa Lucia soils. Climax soils have developed in a belt where the yearly rainfall is 13 to 24 inches. Winters are mild and wet; summers are rainless but cool and foggy. The natural cover is annual grasses and herbs.

The surface soil is a dark-gray, slightly basic, noncalcareous clay of blocky structure. This layer is hard when dry but sticky when wet. Grass roots are concentrated near the surface, but many roots go through this layer.

The subsoil is gray, moderately basic, moderately calcareous clay of blocky structure. It is a little more compact than the surface soil. Some grass roots occur throughout, but the number decreases with depth. The lower subsoil is gray, moderately basic, moderately calcareous clay that is softer than the upper subsoil. It has a mottled appearance because it contains nodules of lime. Only a few grass roots reach the lower subsoil.

The upper part of the underlying rock is a whitish, slightly calcareous volcanic ash that is mottled with lime nodules and yellowish to brownish iron stains. The lime and iron stains decrease with depth.

Climax soils are used only for range. The grass cover is good and has a moderately high carrrying capacity.

Climax clay (adobe), hilly (16 to 30 percent slopes) (CM).—This hilly soil occurs on the southern and northeastern slopes of El Tranquillon in the western part of the Area. It has developed from light-colored volcanic ash. The vegetation is annual grasses and some burclover and "filaree."

Representative profile:

0 to 11 inches, dark-gray, hard, slightly basic, noncalcareous clay of very coarse blocky (adobe) structure; contains a moderate amount of organic matter.

11 to 21 inches, gray, hard, moderately basic, moderately calcareous clay; shrinkage cracks extend from the layer above and give this layer a blocky appearance when dry; lime occurs in small soft nodules.

21 to 33 inches, gray, hard, moderately basic, massive clay intermixed with whitish lime nodules and fragments of calcareous volcanic ash; some brownish iron stains.

33 inches +, whitish, massive, weathered volcanic ash with some yellowish and brownish iron stainings; has some segregated lime in the upper part of layer, but the unweathered lower part is noncalcareous.

Use and management.—This soil is used entirely for range and is grazed almost entirely by cattle. It has a moderately high carrying capacity. A number of springs and seeps occur throughout this soil. It is necessary to avoid overgrazing, otherwise gullies will develop.

Climax clay (adobe), steep (31 to 45 percent slopes) (CN).—Except for greater slope, this soil is similar to Climax clay (adobe), hilly. The soil is used entirely for range. It has good carrying capacity and is considered one of the better range soils of this Area. Overgrazing has caused some reduction in carrying capacity and some local erosion.

COASTAL BEACH

Coastal beach, sandy (Co).—These narrow sandy beaches are covered or nearly covered by waves during high tide and exposed during low tide. Along parts of the coast, bluffs 10 to 50 feet in height are back of the narrow beaches or rise abruptly from the sea. The beaches have no agricultural value but are used for recreation.

Coastal beach, stony (CP).—These stretches of coastal beach occur mainly at the mouths of streams that cross the narrowest part of the coastal plain, where well-rounded stones are deposited. These stony beaches are not so desirable for recreation as the sandy beaches. Coastal beaches are not stable; they may change from sandy to stony, or the reverse, during storms.

CROW HILL SERIES

The soils of the Crow Hill series have developed from white diatomaceous earth that has a low bulk density. Aside from their somewhat darker colored surface soil, their profile changes little with increasing depth. The soils are sloping to steep. They occur entirely in the western part of the Area on both sides of San Miguelito Creek south of the town of Lompoc, which is a short distance north of the Santa Barbara Area. The annual rainfall is 14 to 20 inches. The climate is typical of the coastal area—mild rainy winters and cool dry summers with considerable fog.

The surface soil is gray, neutral or slightly acid, of low bulk density, and of loam texture. Where the land has been cleared the surface layer becomes lighter in color. Many cultivated fields have light-gray surface soil because the original surface layer has been mixed with the lighter colored subsoil. A low bulk density is caused by the extreme porosity of the parent material.

Except for its light-gray color, the subsoil is very similar to the surface soil. The parent material consists of white, soft, diatomaceous earth of low bulk density. Roots and water can penetrate this layer almost as well as the soil above.

Crow Hill soils are used for range or grain hay.

Crow Hill loam, sloping (9 to 15 percent slopes) (CT).—Except for more gentle slopes, this soil is very similar to Crow Hill loam, hilly. It is more favorable for farming, however, and is used for growing grain hay. Yields are not noticeably different, but the soil is more easily worked. Where it is not farmed the natural vegetation on this soil is mostly brush. The uncultivated areas provide range of low carrying capacity.

Crow Hill loam, sloping, moderately eroded (9 to 15 percent slopes) (CU).—Except for its lighter surface color caused by erosion, this soil is very similar to Crow Hill loam, sloping.

This soil is farmed to grain hay. Management practices and yields are similar to those for Crow Hill loam, hilly, but this soil is more

difficult to work because it has a few gullies that are not readily crossed with tillage implements.

Crow Hill loam, hilly (16 to 30 percent slopes) (CR).—This soil occurs in the northwestern part of the Area on both sides of San Miguelito Creek. It has formed from the underlying soft beds of diatomaceous earth. The moderately large bodies are closely associated with soils of the Santa Lucia series, which have developed on Monterey shales.

Representative profile:

0 to 6 inches, gray, soft, slightly acid to neutral loam of very low bulk density, normally less than 1.0; contains many very fine pores, is very friable when moist, and crumbles readily to very fine granules; under virgin conditions soil is somewhat darker gray, but where cultivated it bleaches rapidly to a gray or light gray.

6 to 24 inches, light-gray, soft, slightly acid, very fine granular to massive loam.

24 inches +, white, soft, massive diatomaceous earth; material has about the same bulk density and porosity as the soil material above; roots and water penetrate to considerable depth.

Use and management.—This soil is used for grain hay or for range. The natural cover of brush and some grass affords fair pasture. In some areas the diatomaceous earth is being mined.

Crow Hill loam, hilly, moderately eroded (16 to 30 percent slopes) (Cs).—Except for a lighter gray surface soil caused by moderate erosion, this soil is very similar to Crow Hill loam, hilly. Because the bedrock is soft and permeable, erosion does not decrease the zone in which water is stored. In a few places there are a few gullies not easily crossed with tillage implements.

Most of this soil is farmed to grain hay. Yields are only slightly less than on the Crow Hill soils that are not eroded.

Crow Hill loam, steep and very steep (31+ percent slopes) (Cv).—This soil is very similar to Crow Hill loam, hilly, but it has steeper slopes not suitable for farming. The brush cover and grass understory furnish some grazing, but the carrying capacity is low.

DIABLO SERIES

Soils of the Diablo series have formed on shale bedrock. They occupy sloping to steep areas on rounded ridgetops or on smooth side slopes. They occur entirely in the western part of the Area, mostly along San Miguelito Creek and the upper part of Canada Honda Creek. Closely associated with them are soils of the Los Osos, Santa Lucia, Montara, and Tierra series. The natural vegetation is annual grasses, herbs, and brush. Diablo soils erode to considerable extent and have some slide areas.

The surface soil is a dark gray to very dark gray noncalcareous clay with a well-defined blocky (adobe) structure. When dry the soil is hard, breaks readily to smaller blocks or granules, and shows large shrinkage cracks. Secondary cracks develop within the aggregates formed by the major cracks. Many grass roots penetrate the whole layer, but the greater concentration is in the upper part.

The upper subsoil—a dark-gray, slightly to moderately calcareous clay—develops a blocky structure when dry. It is more compact than the surface soil. Shrinkage cracks extend through this horizon, but

there is not the secondary cracking that appears in the surface soil. The aggregates are coarse and hard when dry. Grass roots occur throughout, but the number decreases rapidly with depth. Small amounts of segregated lime are found, particularly in the lower part.

The lower subsoil consists of gray calcareous clay mottled with brownish iron stains and containing gray shale fragments. This layer becomes lighter in color with depth.

The upper part of the parent material consists of crumbled highly weathered gray shale. Considerable soil material and segregated lime are intermixed in this shale. The platy shale layers become more distinct, harder, and more massive with depth.

Diablo soils are used mainly for range. They have a good carrying capacity. Small areas are used for grain hay.

Diablo clay (adobe), sloping (9 to 15 percent slopes) (Dc).—Except for more gentle slopes, this soil is similar to Diablo clay (adobe), hilly. It lies mostly along San Miguelito and Canada Honda Creeks. One small body along Canada Honda Creek has a few small gullies that cut back from the main drainage channel.

This soil is used mainly for range. The carrying capacity is good.

Diablo clay (adobe), hilly (16 to 30 percent slopes) (Da).—This soil occurs in the western part of the Area. It is associated with soils of the Santa Lucia, Montara, Tierra, and Los Osos series. The comparatively small bodies are well intermingled with soils of other series. The region of most frequent occurrence is along the watershed of San Miguelito Creek and southward beyond the divide to the coastal drainage. Some areas are found in the Canada Honda Creek watershed. The soil rests on shale bedrock at depths ranging from 2 to 4 feet. Internal drainage is slow, but because of the blocky (adobe) structure, the soil has a rapid rate of infiltration when dry.

Representative profile:

0 to 10 inches, dark gray or very dark gray, hard, neutral, noncalcareous clay of pronounced very coarse blocky (adobe) structure; contains moderate amount of organic matter.

10 to 31 inches, dark gray, hard, moderately basic, slightly to moderately calcareous clay; blocky structure; surface shrinkage cracks extend into layer; material becomes lighter gray and has more lime with increasing depth.

31 inches +, upper bedrock consists of broken and highly weathered shale fragments intermixed with some soil material from the layer above; shale particles are gray and the soil material is darker gray or grayish brown; some brownish iron stains and soft lime nodules intensify the mottled appearance; shale becomes more massive and harder with depth.

Use and management.—This soil is used mainly for range, but small areas are in grain hay. The range has a good carrying capacity. The yields of grain hay depend upon seasonal rainfall. The soil produces a fairly heavy grass cover and is moderately resistant to erosion if not overgrazed. The most common form of erosion is gullying, but landslips occur in some areas.

Diablo clay (adobe), hilly, moderately eroded (16 to 30 percent slopes) (Db).—Except for moderate erosion, this soil is very similar to Diablo clay (adobe), hilly.

The soil is used for grain hay and range, yields of which are somewhat reduced by erosion. Much of the erosion could be controlled by better management.

Diablo clay (adobe), steep (31 to 45 percent slopes) (Dd).—Except for steeper slopes, this soil is similar to Diablo clay (adobe), hilly. In some areas the soil mantle over the bedrock is not so deep as in areas of less slope. In these shallow areas the cover is mainly brush, whereas the usual cover is grass.

The soil is used for range, and management is the same as for Diablo clay (adobe), hilly.

DUNE SAND

Dune sand (De) is a land type consisting of loose shifting sand. It occurs in a number of small and large areas along the coast. The most extensive areas are northward from Point Pedernalis. This land type has no agricultural use.

ELDER SERIES

Soils of the Elder series have uniform profiles. They occupy narrow valleys and smooth sloping alluvial fans near the coast, mainly in the western part of the Area. They have formed on alluvium derived from areas of Santa Lucia soils and are closely associated with soils of the Botella and Arguello series. Usually some shale fragments are in the surface. The subsoil, in all places, contains some shale fragments. The natural vegetation is mainly annual grass and herbs. Some oak trees and brush occur near the streams.

The surface soil is sandy loam to clay loam—dark gray, hard, neutral to slightly acid, and granular. In many places it contains some shale fragments. Grass roots are most abundant near the surface but occur throughout the layer. The soil does not puddle easily and under usual management it retains its good tilth.

The underlying material consists of stratified layers that contain shale fragments and have a texture similar to that of the surface soil. The layers are neutral in reaction and show no profile development. The soil material is friable when moist and becomes lighter colored with increasing depth.

Elder soils are used mostly for Sudangrass pasture or grain hay. They are suitable for a wide range of crops but usually occur in small narrow bodies that are not easily farmed.

Elder clay loam, gently sloping (3 to 8 percent slopes) (Ea).—Except for a clay loam surface soil and considerably less shale throughout the profile, this soil is similar to Elder shaly clay loam, gently sloping. A few areas occur in the east-central part of the Area or scattered in the western part. The soil is found along small streams and on small alluvial fans. The natural vegetation is mostly oaks and shrubs along the streamways, and grass on the small alluvial fans.

Use and management.—Two bodies of this soil on small alluvial fans are cultivated. Yields of lima beans are favorable, or about the same as on the Yolo and Sorrento soils. Several small bodies a short distance from Drake are used entirely for range and have good carrying capacity. One small body surrounded by Elder loam and Yolo loamy sand occupies a depressional area just above the fork of Jalama Creek. This depressional area receives some seepage. It stays wet later in the spring than the surrounding soils and is used for grain hay and pasture. The grain hay does not grow so well as on the better drained

soils. This seepy area has considerable forage throughout the year so it probably produces as much, or more, feed than the surrounding soils.

Elder loam, gently sloping (3 to 8 percent slopes) (EB).—Except for a loam surface texture, this soil is similar to Elder shaly clay loam, gently sloping. It occurs in the western part of the Area either on small alluvial fans along the coastal plain, or on narrow flood plains along some of the streams. The relief is mostly smooth and gently sloping, but two areas along Canada Honda Creek are undulating. The variable amounts of shale fragments cause considerable stratification. The natural vegetation is oak trees and brush. The alluvial fans along the coast have a grass cover.

Use and management.—This soil is capable of producing a wide variety of field, orchard, and truck crops but, because it occurs where livestock raising dominates, it is used almost entirely for grain hay and Sudangrass pasture. Yields of grain hay are variable, but slightly better than on some of the coastal terrace soils. Sudangrass is grown mostly along the coast and produces summer pasture of high carrying capacity.

Elder shaly clay loam, gently sloping (3 to 8 percent slopes) (EC).—The many small bodies of this soil occur along drainageways and on small alluvial fans in the western part of the Area. They were derived mainly from areas of Santa Lucia soils and have many angular shale fragments throughout.

Along stream channels that extend back from the coastal plain to the hills, this soil is associated with soils of the Watsonville, Arguello, and Tangair series. The profile is recent, undeveloped, and highly stratified. The natural vegetation is annual grasses and herbs. Along the stream channels oaks and brush occur.

Representative profile:

0 to 14 inches, dark-gray, hard, granular, shaly clay loam, neutral or slightly acid in reaction; shale consists almost entirely of angular platy fragments of Monterey shale.

14 to 38 inches, dark-gray, hard, granular shaly loam or shaly clay loam; reaction, neutral.

38 to 72 inches, grayish-brown, hard, massive, stratified shaly material of loam or clay loam texture; stratification caused largely by different amounts of shale fragments intermixed with the more or less uniform clay loam or loam soil material; reaction, nearly neutral.

Use and management.—Nearly all of this soil occurs where livestock raising is the only agricultural enterprise. Where cultivated, it is used either for Sudangrass pasture or grain hay. Yields are good. This soil is productive enough to be used for a wide variety of field or orchard crops.

Elder shaly loam, sloping (9 to 15 percent slopes) (ED).—Except for having a shaly loam surface soil and steeper slopes, this soil is similar to Elder loam, gently sloping. It occurs in the west and west-central parts of the Area, mostly as narrow stringers along the streamways. A few small triangular bodies occur along the coast on recent alluvium deposited on the old terraces. The profile is stratified and contains variable amounts of angular Monterey shale fragments. The natural vegetation is mostly oaks and brush on the narrow flood plains, and grass on the alluvial fans along the coast.

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Use and management.—All of this soil occurs in the region used entirely for livestock raising. It is grazed or planted to forage crops such as grain hay or Sudangrass. Forage crops yield slightly less than they do on Elder loam, gently sloping, but do better than on the Watsonville soils of the coastal plain.

Elder shaly sandy loam, gently sloping (3 to 8 percent slopes) (Ee).—This soil is highly stratified and shaly throughout, but generally conforms with Elder shaly loam in everything except its sandier texture. Most of it is in the extreme northwestern part of the Area. It lies along small streams that drain directly into the Pacific Ocean, or along streams that flow into the lower Santa Ynez Valley west of Lompoc. The areas are small.

Because of its many shale fragments and moderately coarse texture, this soil has a lower water-holding capacity than others of the Elder series. At the time of the survey it was not being used for agriculture because it was on the Camp Cook Military Reservation. The soil is suitable for orchard and field crops, but yields would be lower than for the finer textured Elder soils on comparable slopes.

EXCAVATED LAND

Excavated land (Ef) represets areas where soil, soil material, and rock have been removed by excavation. Some of these areas are closely associated with Made land and occur as part of construction projects. Others represent excavations made in mining. These areas have no agricultural use.

GAVIOTA SERIES

The soils of the Gaviota series are shallow over hard, light-colored Vaqueros sandstone of the Lower Miocene age. In places where the profile is slightly deeper than normal, the subsoil has a slight accumulation of clay. The soils occur in narrow bands that parallel the coast in the central part of the Area. They are of more irregular occurrence in the western part. The natural vegetation is annual grasses, herbs, and brush. Much of the area of Gaviota soils is steep and very steep. Only a few areas occur on more gentle slopes.

The surface soil is brown, slightly hard, slightly to moderately acid sandy loam or fine sandy loam. This layer is very friable when moist and has a granular structure. A small amount of litter from the brush is on the surface. The uppermost 2 or 3 inches is somewhat darker in color than the rest of the layer. Roots are numerous throughout.

The subsoil is light yellowish brown and has about the same texture as the surface layer. It is slightly hard, contains many worm and root holes, and, except for its lighter color, is much like the surface soil. Where the soil profile is deeper than normal, the subsoil has a finer texture and occasionally shows a thin clay layer just above the bedrock. The reaction throughout is slightly to moderately acid.

The parent material is pale-brown sandstone. In most areas the sandstone is hard and has only a thin zone of weathering above the massive rock.

Gaviota soils are used mainly for range or as recreational areas.

Gaviota fine sandy loam, hilly (16 to 30 percent slopes) (Ga).—This soil occurs in many parts of the Area. In the central part, it occurs as narrow bands, roughly parallel to the coast, usually between the

Sespe soils and the soils of the Zaca and Nacimiento series. The soil follows the bands of geologic formations and is derived almost entirely from Vaqueros sandstone. In the western part of the Area, the pattern is more complex, and the soil is associated mostly with soils of the Los Osos series and occasionally with those of the Nacimiento or Zaca series. There is little or no profile development. The profiles are normally shallow, and the depth to bedrock is usually less than 2 feet. The natural vegetation is mostly grass, herbs, or brush. Some areas have rock outcrop.

Representative profile:

0 to 7 inches, brown, slightly hard, slightly to moderately acid, granular fine sandy loam; under natural vegetation the surface 1 or 2 inches is slightly darker because of accumulated litter and the concentration of grass roots near the surface.

7 to 17 inches, light yellowish-brown, slightly hard, massive fine sandy loam or loam; some angular sandstone fragments often intermixed; reaction similar to that of the surface soil.

17 inches +, very pale brown sandstone, upper part shattered, crumbled, and somewhat intermixed with the soil material above; stone becomes less shattered and more massive within a few inches.

Use and management.—With few exceptions, this soil is used for range. The carrying capacity of the grass-covered areas is moderate, and that of the brushy areas is very low. A few small areas are used for grain hay. Yields are variable.

Gaviota fine sandy loam, hilly, moderately eroded (16 to 30 percent slopes) (GB).—Except for moderate erosion, this soil is very similar to Gaviota fine sandy loam, hilly.

The soil is used mostly for range. The cover consists of grass and a small amount of brush. Erosion has reduced the yields of forage to some extent. A few areas are used for grain hay.

Gaviota fine sandy loam, hilly, severely eroded (16 to 30 percent slopes) (GC).—This soil has been severely sheet eroded or severely gullied. Whichever the case, considerable soil has been removed from a profile that was originally shallow. The erosion resulting from overgrazing or cultivation has greatly reduced the forage produced. Most of the soil is used for range, and the carrying capacity is very low.

Gaviota fine sandy loam, steep (31 to 45 percent slopes) (GD).—The soil is shallower and has more rock outcrops but is otherwise similar to Gaviota fine sandy loam, hilly. A greater part of this soil is covered with brush. The soil is used only for range or recreational purposes; it produces a small amount of forage.

Gaviota sandy loam, sloping (9 to 15 percent slopes) (GF).—Except for more gentle slopes, this soil is similar to Gaviota sandy loam, hilly. It occurs on the lower foothills or the more nearly level ridgetops. The cover is mainly grass. This soil is used for lima beans, grain hay, and range. The yields are only fair. The carrying capacity is higher than on Gaviota fine sandy loam, hilly.

Gaviota sandy loam, sloping, moderately eroded (9 to 15 percent slopes) (GG).—Except for moderate erosion, this soil is similar to Gaviota sandy loam, sloping. These are areas which are being or have been cultivated. The soils are shallower than in uneroded areas, and the yields of lima beans and grain hay are somewhat less. There

is one small lemon orchard, but the trees are small for their age. This soil is too shallow for lemons.

Gaviota sandy loam, hilly (16 to 30 percent slopes) (GE).—This soil occurs mostly in narrow bands that run practically parallel to the coast. Normally it appears just above the Zaca or Nacimiento soils and just below soils of the Sespe series. This sequence is particularly true in the central part of the Area.

The soil is usually a sandy loam, from the surface down to the bedrock; otherwise it is similar to Gaviota fine sandy loam, hilly. Occasionally, there is a thin layer of clay just above the bedrock. The natural vegetation is annual grasses, herbs, or brush.

The soil is used for range but has a moderately low carrying capacity because of many brushy areas and rock outcrops.

Gaviota sandy loam, steep (31 to 45 percent slopes) (GH).—This soil is shallower and has more rock outcrops, but otherwise it is similar to Gaviota sandy loam, hilly. The cover is grass and brush.

The soil is used entirely for range or as recreational areas. The carrying capacity is very low.

Gaviota stony soils, undifferentiated, steep and very steep (31+ percent slopes) (GK).—These undifferentiated soils occur on steep and very steep slopes. They have shallow stony profiles of variable texture. Rock outcrops are numerous. The areas are mainly brush covered and are used as range or for recreational purposes. Their carrying capacity is very low.

JALAMA SERIES

Soils of the Jalama series are moderately to strongly acid, shaly and underlain by compact layers of shaly hardpan. They occur on gently sloping to steep terraces that have steep-sided escarpments. Hardpan layers usually are exposed on the escarpments. The soils are along the upper part of the coastal plain in the western part of the Area between Jalama and Point Arguello. The rock fragments are angular platy pieces of Monterey shale. The soils appear to have formed on old alluvial material derived from areas of Santa Lucia soils. They are somewhat older and more developed than the Arguello soils, though they are associated with those soils, which are derived from the same type of parent material.

The surface soil is dark-gray, medium acid, shaly sandy loam. It is slightly hard, granular, and readily penetrated by roots and moisture. Under the natural grass cover, some roots are concentrated in the upper 2 or 3 inches of the surface soil.

The upper subsoil is dark grayish brown, subangular blocky, and similar to or slightly finer than the surface soil in texture.

The lower subsoil is a dark grayish-brown very fine blocky shaly clay loam hardpan. Where exposed along the edges of the terraces, this layer dries very hard and rocklike. In place it is compact, but when removed it is brittle and crumbles rather easily. Water does not stand on it during wet periods. There is no mottling or other indication of a perched water table immediately above the hardpan.

The underlying parent material is a moderately compact, stratified, medium to strongly acid shaly material of loam or clay loam texture.

Jalama soils have annual grasses and herb vegetation and are normally used for range. Some small areas are used for grain hay or Sudangrass pasture.

Jalama shaly sandy loam, gently sloping and sloping (3 to 15 percent slopes) (JA).—This soil occurs in the western part of the Area on the higher terraces of the narrow coastal plain between Jalama and Point Arguello. It is associated with soils of the Arguello series and occurs just below the soils of the Santa Lucia series. The relief is gently sloping to sloping. The profile is strongly developed and characterized by a shaly hardpan. There is no claypan layer above the hardpan. The natural vegetation is annual grasses and herbs.

Representative profile:

0 to 18 inches, dark-gray, medium acid, slightly hard, granular shaly sandy loam; contains angular pieces of Monterey shale in numbers that appreciably affect water-holding capacity and workability.

18 to 33 inches, dark grayish-brown, slightly hard, medium acid, subangular blocky shaly loam or shaly sandy loam; slightly more acid than surface layer.

33 to 50 inches, dark grayish-brown, very hard, medium to strongly acid shaly very fine blocky clay loam hardpan, which crumbles rather easily when dug out; layer allows water to penetrate; no mottlings appear in the upper part of this pan or in the layer above it; where exposed along the edges of the terraces this material is hard and rocklike.

50 to 72 inches, dark grayish-brown, medium to strongly acid, massive shaly clay loam or shaly loam; material much like layer above except it is not so hard and crumbles more easily.

Use and management.—This soil is used mostly for range. A few small areas are used for grain hay. The carrying capacity is fair. Grain hay produces extremely variable yields.

Jalama shaly sandy loam, moderately steep (16 to 30 percent slopes) (JB).—This soil normally occurs on higher terraces adjacent to the upland soils of the Santa Lucia series. It is similar to Jalama shaly sandy loam, gently sloping and sloping, but is slightly more variable in depth to the hardened subsoil. It is used entirely for range. The carrying capacity is about the same as for Jalama shaly sandy loam, gently sloping and sloping.

Jalama stony soils, undifferentiated, hilly and steep (16 to 45 percent slopes) (JC).—These undifferentiated stony soils occur as moderately steep or steep breaks of old terrace material. They are not so steep as Terrace breaks, are more stable, and have a higher range carrying capacity. The stones consist of fragments of Monterey shale and pieces of hardpan broken from higher lying exposures. The soils are not suited to cultivation and are used for range.

KITCHEN MIDDENS

Kitchen middens, over permeable soil materials (KA).—This miscellaneous land type consists of areas where the Indians made campgrounds on permeable recent soil materials. The campgrounds are darker in color than the surrounding soil, calcareous, and contain shell fragments. In some places these campsites appear as mounds, but in others they are at about the same level as the surrounding soil. In

all places the soil material is more friable when moist than that of the surrounding soils, and is not so easily puddled. One of the largest areas occurs on a sandy terrace overlooking Rincon Creek in the southeastern part of the Area.

Where they occur on alluvial soils and are cultivated, these middens usually produce as well as the surrounding soil, or sometimes better. Lemons, however, may show chlorosis caused by lime.

Kitchen middens, over relatively impermeable soil material (KB).—In a number of places on the coastal plain Indian campgrounds have been made on older terrace soils that have a compact subsoil and substratum. These areas are calcareous and have numerous shell fragments throughout. Normally, the surrounding soils are acid and of lighter color. Indian activity so disturbed the soil or added new material that the profile, to depths of 5 or 6 feet in some places, is more friable when moist. Seldom is claypan encountered, though the surrounding soils had well developed claypan subsoils at depths of 20 to 36 inches. Where these campsite areas occur in cultivated fields, the crops grow better than on the surrounding soils. Lime from the shell fragments may cause chlorosis of lemon trees.

Most areas are small. They are often less than an acre in size, but some cover 5 to 10 acres. Commonly the areas occur on terrace edges near the coast or where fresh water was available. These areas appear to have been used many years both as campsites and burial grounds.

LANDSLIP

These miscellaneous land types are the result of a specialized type of erosion. Large quantities of soil and its parent material have moved down the slope by the force of gravity. Although these soils were originally members of various soil series of the Area, the slipping action tends to mix and distort the profile layers.

Soils are particularly unstable and likely to slide in zones of transition from one type of parent material to another. This weakness is more apparent when the soil material is wet.

Landslip, Climax soil material, moderately steep (16 to 30 percent slopes) (LA).—This miscellaneous land type occurs in small isolated areas, usually along the contact line between volcanic ash and harder rocks. Usually there are springs or seepage areas. The relief is somewhat hummocky, or not so smooth as that typical for the Climax soils. The fairly dense vegetation is annual grasses and herbs. Grass remains green around the seeps and springs after the surrounding areas have dried. This higher moisture content increases the range carrying capacity.

The slipping prevents development of a typical profile. Usually the soil is somewhat deeper to the bedrock than the Climax soils. The bedrock is shattered and crumbled.

These slide areas may or may not be the result of overgrazing. They are now less stable than the surrounding soils and present a particularly difficult problem in erosion control. The grass is green on these slopes when grass on surrounding areas is dry. Livestock tend to concentrate on these areas and overgraze them. Water tends to cut deeply into the crumbling bedrock and form large gullies that are hard to control.

Landslip, Diablo soil material, moderately steep and steep (16 to 45 percent slopes) (LB).—This miscellaneous land type is associated with the Diablo soils. It usually occurs on concave slopes where Diablo soils join soils that have developed from other parent materials. The slides often contain springs or seepage areas.

This land is used entirely for range. Because it is near springs or seepage areas, the grass is usually green after that on surrounding areas has dried. The carrying capacity is probably slightly higher than on Diablo clay (adobe). Gullies that are deep and difficult to control sometimes develop.

Landslip, Los Osos soil material, moderately steep and steep (16 to 45 percent slopes) (LC).—A number of landslips occur in areas of Los Osos soils. These slides usually are found in faulted areas or along contact zones between geologic formations. The slides have folded or hummocky microrelief. They are often associated with springs or seepage areas. The bedrock is crushed and crumbled, and the soil profile has been warped and twisted by the land movement. The soil material is not stable and in places it is subject to deep and destructive gullying.

This miscellaneous land type is used only for range. Those areas near springs and seepage places are often wet enough to keep the grass green long after it is dry on the surrounding areas. This permits a somewhat longer grazing season. The areas where the grass is green are more heavily grazed than the surrounding areas, and this increases the hazard of gullying.

Landslip, Nacimiento soil material, steep (31 to 45 percent slopes) (LD).—Landslips occur in areas of Nacimiento soils. These slides are usually small and occur on slightly concave slopes. The relief is somewhat hummocky and irregular. There is no profile that can be called typical. In general, the soil material is deep and somewhat colluvial, and the bedrock is badly shattered and crumbled. These slide areas in many places mark the location of springs or seeps. The grass remains green near the springs and seeps for some time after that on the surrounding soils has dried.

This miscellaneous land type is used exclusively for range. Livestock tend to concentrate on these slide areas until they have badly overgrazed them. Because the slides are relatively unstable, gully erosion takes place. In some places the gullies are very deep.

LOS OSOS SERIES

Soils of the Los Osos series rest on bedrock of shale or clayey sandstone. They occupy sloping to very steep areas where ridgetops are rounded and slopes are smooth. They are in the western part of the Area. The vegetation consists of annual grass, herbs, and scattered oaks. Associated with Los Osos soils are soils of the Santa Lucia, Tierra, Diablo, Los Trancos, and Climax series.

The Los Osos surface soil is gray, slightly acid, blocky, and of moderately fine to fine texture. The moderately fine textures predominate. Grass roots are concentrated in the upper 2 or 3 inches but are plentiful throughout the entire layer.

The subsoil is dark grayish brown, neutral to slightly basic, and of finer texture than the surface soil. This layer is compact and of

blocky structure. The aggregates are coated with colloidal materials. The greatest profile development occurs in saddles, where the parent materials are somewhat softer. In some locations the subsoil is intermittently calcareous.

The parent materials are olive-gray shales or clayey sandstones. The upper part is weathered and crumbled and intermixed with soil materials. The material becomes more massive with depth.

Los Osos soils are used mostly for range (pl. 2). They have good carrying capacity. Small areas are used for grain hay.

Los Osos clay, hilly (16 to 30 percent slopes) (LE).—This soil occurs almost entirely in the western part of the Area. It is associated with soils of the Zaca, Nacimiento, Santa Lucia, Diablo, Climax, Los Trancos, Montara, and Tierra series. The slopes are smooth and the ridges and hilltops are well rounded. The soil profile is moderately deep and shows some development of the subsoil. In places, the subsoil is intermittently calcareous. Except for finer texture throughout the profile, the soil is similar to Los Osos clay loam, hilly. The shale bedrock is shattered and crumbled in the upper part but it becomes increasingly massive and hard with depth. The weathered rock usually is 1 to 5 feet deep; then the unweathered shale begins. The natural vegetation is annual grasses and herbs.

Use and management.—This soil is used for grain hay or range. Yields of grain hay are somewhat better than on Los Osos clay loams; they compare favorably with yields on Diablo, Nacimiento, Zaca, and similar soils.

Los Osos clay, steep (31 to 45 percent slopes) (LF).—This soil is used almost exclusively for range. It has a slightly lower carrying capacity than Los Osos clay, hilly.

This soil is similar to Los Osos clay, hilly, but it is more variable in depth, steeper, and normally slightly shallower.

Los Osos clay, steep, moderately eroded (31 to 45 percent slopes) (LG).—Except for moderate erosion this soil is similar to Los Osos clay, steep. Erosion resulting from overgrazing has slightly decreased the carrying capacity.

Los Osos clay loam, sloping, moderately eroded (9 to 15 percent slopes) (LL).—Except for more gentle slopes, this soil is similar to Los Osos clay loam, hilly, moderately eroded. It occurs in the western part of the Area on the Canada Honda Creek watershed. It is used entirely for range. Erosion caused by overgrazing has slightly reduced the carrying capacity. Better grazing management should permit this soil to recover its original carrying capacity.

Los Osos clay loam, hilly (16 to 30 percent slopes) (LH).—This soil is hilly; slopes are smooth and the ridges are well rounded. It occurs entirely in the western part of the Area. The profile shows some development in the subsoil, and the shale or clayey sandstone bedrock is weathered to moderate depths. The natural vegetation is grass, herbs, and scattered oaks. Some of this soil has a small amount of lime in the subsoil.

Representative profile:

0 to 11 inches, gray, slightly acid, hard, blocky clay loam; many grass roots occur throughout layer but greatest concentration is in the upper 2 or 3 inches.

11 to 41 inches, dark grayish-brown, hard heavy clay loam; neutral to slightly basic in reaction and in a few places has a small amount of lime; layer develops a blocky structure when dry, and the aggregates are a little more compact than those in the surface soil; lower part of layer is lighter colored and a little softer than the upper part.

41 inches +, olive-gray shale or clayey sandstone bedrock; shattered and intermixed with soil material in upper part but gradually becomes harder and more massive with depth.

Use and management.—This soil is used almost entirely for range. A few small areas are used for small grains for hay or harvesting. Considerable forage is produced, but the carrying capacity is not quite so high as that of Los Osos clay, hilly. Yields of grain are variable and greatly dependent on the season.

Los Osos clay loam, hilly, moderately eroded (16 to 30 percent slopes) (LK).—Except for moderate erosion, this soil is similar to Los Osos clay loam, hilly. It is managed in much the same manner as noneroded soil. The erosion has resulted from overgrazing or growing of grain hay. The erosion does not affect the use of the soil but it does reduce yields slightly. Gullied areas are more difficult to cultivate for grain hay, as the gullies are not readily crossed with tillage implements.

Los Osos clay loam, steep (31 to 45 percent slopes) (LM).—Except for steeper slopes and more variable depth, this soil is similar to Los Osos clay loam, hilly. It is used entirely for range. The carrying capacity is about the same as on the more gently sloping Los Osos clay loams. Because of its steep slopes, this soil should only be used for range.

Los Osos clay loam, steep, moderately eroded (31 to 45 percent slopes) (LN).—Except for moderate erosion, this soil is similar to Los Osos clay loam, steep. Erosion caused by overgrazing has slightly decreased the carrying capacity. Better range management should restore this soil to its original carrying capacity.

Los Osos clay loam, very steep (46+ percent slopes) (LO).—These are bodies of Los Osos clay loam on very steep slopes. The soil is more variable in depth than those on more gentle slopes. Slopes are too steep for cultivation. The soil is used entirely for range. Its carrying capacity appears to be almost as high as that of the more gently sloping Los Osos clay loams.

Los Osos stony soils, undifferentiated, steep and very steep (31+ percent slopes) (LP).—This unit consists of Los Osos soils on slopes of 31 percent or more. They have shallow stony profiles and a considerable number of rock outcrops. The soils are of variable texture, and the underlying bedrock is harder than that under most areas of Los Osos soils. This unit is usually grass covered, but some areas are brushy. It is used entirely for range. The carrying capacity is seldom more than half that of the other Los Osos soils. Because the soils are shallow and stony, range is the only suitable use for them.

LOS TRANCOS SERIES

The soil of the Los Trancos series has little or no profile development and is usually shallow over rhyolitic bedrock. It is on the hilly to steep, rather rugged, north and south slopes of El Tranquillon.

The soil is stony and has many areas of rock outcrop. Many rock fragments are on the surface and imbedded in the soil. The natural vegetation is mainly brush, but a few areas have some grass.

The surface soil is a dark-gray slightly or medium acid loam that contains many hard, angular fragments of rhyolitic rock. The soil is friable when moist and well permeated with roots.

The subsoil is dark gray and has a texture similar to or very slightly finer than that of the surface soil. The subsoil contains more rock fragments but not so many roots as the surface soil.

The parent material consists of hard, shattered, rhyolitic rocks and a small amount of soil material in the cracks between the rocks. The bedrock becomes less shattered and more massive with depth.

The Los Trancos soil is used entirely for range.

Los Trancos stony loam, hilly and steep (16 to 45 percent slopes) (LR).—This soil occurs on hilly or steep relief. The ridges are sharp, and there are many outcroppings of hard rhyolitic rock. The soil is generally shallow, or between 15 and 24 inches deep to bedrock. The depth is extremely variable, however, and may range from only a few inches to about 30 inches. The soil occurs in the western part of the Area on the slopes of El Tranquillon. It is associated with soils of the Climax, Montara, Los Osos, and Santa Lucia series. The natural vegetation is brush, and occasionally grass on the ridgetops.

Representative profile:

0 to 7 inches, dark-gray, slightly granular, hard, slightly to medium acid stony loam; many angular rock fragments on the surface and throughout the profile; immediate surface of layer slightly darker than the rest.

7 to 15 inches, dark-gray, hard, slightly to medium acid stony loam or clay loam; structure and texture similar to that of the surface soil; number of rock fragments increases with depth.

15 inches +, light-gray rhyolitic bedrock; upper part often shattered, broken, and intermixed with some soil material; lower part hard and massive.

Use and management.—This soil is used entirely for range. The carrying capacity is very low, as there is only a small amount of grass under the heavy cover of brush.

MADE LAND

Made land (M) consists of areas of soil material used to fill swamps or other areas during construction of highways, railways, and airfields. It usually has no agricultural use.

MARINA SERIES

The soil of the Marina series has developed from windblown deposits of very sandy material. It is inextensive and occurs close to the coast on undulating or dunelike relief. The vegetation is normally grass or brush. This soil is closely associated with other terrace soils, particularly the Baywood and Watsonville.

The surface soil is pale-brown, medium acid, loose sandy material of single-grain structure. Many grass and brush roots occur throughout. The subsoil is pale brown, sandy, and medium acid. It is slightly compact but breaks readily to a loose single-grain structure. Grass and brush roots decrease rapidly with depth.

The windblown parent materials are light yellowish brown, medium acid, and sandy; they have slight compactness or none at all. Few roots extend into the parent materials.

Marina sand, gently sloping (3 to 8 percent slopes) (MA).—This soil occurs in the western part of the Area, mostly near Point Conception. It is similar to the Baywood soils except it has a lighter colored surface soil.

Representative profile:

0 to 20 inches, pale-brown, loose, medium acid sand of single-grain structure; many roots occur throughout the layer, but under natural conditions grass roots are concentrated in upper 4 to 6 inches.
20 to 40 inches, pale-brown, medium acid, loose, single-grain sand or loamy sand; layer very slightly compact when dry but shows no compactness when moist.
40 inches +, light yellowish-brown, loose, single-grained, medium acid sand or loamy sand.

Use and management.—This soil has a low water-holding capacity and is droughty. It is used for range and Sudangrass pasture. The carrying capacity is very low.

MAYMEN SERIES

Soils of the Maymen series occur mostly in rough mountainous areas where ridges are sharp and there are many rock outcrops. The soils are shallow to moderately deep and have little or no profile development. They occur from Rincon Creek westward to beyond Gaviota Pass. The natural vegetation is mostly brush.

The surface soil is brown, soft, slightly to medium acid, and sandy. It is very friable when moist and has a weak granular structure. Appreciable amounts of sandstone fragments are on the surface and imbedded in the soil. Under the native cover of brush, a variable amount of litter occurs on the surface. The upper 2 or 3 inches of the layer is slightly darker than the rest.

The subsoil is very pale brown and medium acid; otherwise it is similar to the surface soil.

The parent material—weathered pale yellow sandstone—usually is at shallow depths. The zone of weathered sandstone is rather thin. Below it is hard massive sandstone, principally the Tejon formation of Eocene age.

Maymen soils are used for range. They normally have a low carrying capacity. Some of these soils occur in the Los Padres National Forest and are used for recreational purposes.

Maymen fine sandy loam, hilly (16 to 30 percent slopes) (MB).—The small bodies of this soil are in draws or on protected slopes. The soil is moderately deep, or considerably deeper than the steeper areas of Maymen soils. It has little or no profile development and has formed on moderately hard sandstone of the Tejon formation. Small bodies are along the crest and upper slopes of the Santa Ynez Mountains between the eastern edge of the Area and Gaviota Pass. The natural cover consists of brush or trees. The trees grow in sheltered places and on north slopes; the brush grows on more exposed slopes. This soil is the best of the Maymen series. It is far less extensive than Maymen stony soils, undifferentiated.

Representative profile:

0 to 14 inches, brown, soft, granular fine sandy loam of medium acid reaction; under a natural cover of brush or trees, layer contains a small amount of moderately well decomposed leaf litter; in many places fires have destroyed much of the litter; upper 2 or 3 inches of this layer somewhat darker and contains more roots than rest; roots, however, are numerous throughout entire horizon.

14 to 24 inches, very pale brown, soft, granular to massive fine sandy loam of medium acid reaction; many brush or tree roots throughout but decreasing with depth; increasing number of rock fragments with depth.

24 inches+, a thin layer of somewhat broken pale-yellow standstone, which is replaced within a very few inches by standstone bedrock.

Use and management.—This soil occurs in hilly and mountainous areas and is used mainly for range or recreation. The carrying capacity of the range is very low. The few small fields that are used for grain hay produce low yields. The soil has a low water-holding capacity. A number of summer cabins and mountain homes have been built on this soil.

Maymen fine sandy loam, hilly, moderately eroded (16 to 30 percent slopes) (Mc).—Except for moderate erosion, this soil is similar to Maymen fine sandy loam, hilly. Most of these bodies have been overgrazed. A few areas are used for grain hay; they produce slightly lower yields of hay than the noneroded areas. On a few acres near San Marcos Pass apples are grown for home use and sale at roadside stands.

Maymen stony fine sandy loam, hilly (16 to 30 percent slopes) (Md).—Except for stones in the profile, shallower depth, and some sandstone rock outcrops, this soil is similar to Maymen fine sandy loam, hilly.

The soil is used almost entirely for range or recreation. The natural vegetation is mostly brush, but there are a few grass clearings and some trees near the drainage channels or on north slopes. The carrying capacity is less than that of the nonstony Maymen fine sandy loam, hilly.

Maymen stony soils, undifferentiated, steep and very steep (31+ percent slopes) (Me).—These steep or very steep, stony, undifferentiated soils occur very extensively in the Santa Ynez Mountains. Many of the slopes exceed 45 percent. The soils are shallow, and there are numerous rock outcrops. Most of the soils are brush covered; only a few areas near creek channels or on north slopes have trees.

These soils are used entirely for range or for recreational purposes. Their carrying capacity is very low.

MILPITAS SERIES

The soils of the Milpitas series have formed on old terraces along the coastal plain in the eastern half of the Area. They occupy low, rolling or gently undulating terraces that are dissected in many places by small creek channels.

The surface soil is brown, slightly to medium acid, granular fine sandy loam. It puddles readily if worked or pastured when too moist. Once it is puddled, it dries out hard and is difficult to return to favorable tilth. Under the annual grass cover, roots are concentrated in

the upper half of the surface layer, but some roots occur throughout. Just above the claypan subsoil this surface layer has a thin light-gray horizon with a pronounced visicular porosity.

The subsoil is yellowish-brown compact clay, slightly to medium acid in reaction. The upper part of this layer has a definite prismatic structure when dry. The prismatic aggregates, about twice as long as they are broad, are heavily coated with colloidal stains. The few grass roots that extend into this layer are concentrated along the surfaces of the aggregates. The lower subsoil is a blocky clay. The aggregates of this clay are somewhat less compact and less heavily coated with colloidal material than those in the upper part of the subsoil.

Soils of the Milpitas series have developed through the weathering of light yellowish brown, stratified, variably textured, moderately compact old alluvial material of sedimentary origin. The soils are subject to erosion, particularly gullying. Gullying starts at the lower parts of the terraces, works up the slopes, and eventually causes deep, vertical-sided gullies.

Where water is not available, Milpitas soils are used mostly for lima beans, grain hay, tomatoes, and pasture. Irrigated areas produce fair yields of lemons and many other kinds of crops (pl. 3).

Milpitas fine sandy loam, nearly level (0 to 2 percent slopes) (MM).—This nearly level soil occurs throughout the areas of Milpitas soils on the lower part of the coastal plain. It has essentially the same profile as Milpitas fine sandy loam, sloping.

This nearly level soil is used for a wide variety of field and orchard crops; yields are generally similar to those on Milpitas fine sandy loam, sloping. Because of its more level relief and compact subsoil, this soil may stay wet a little longer in the spring and have some water standing on the surface during wet weather. Such a condition makes this soil a little more difficult to manage than the more sloping Milpitas soils.

Milpitas fine sandy loam, undulating (3 to 8 percent slopes) (Mv).—Except for undulating relief, this soil is similar to Milpitas fine sandy loam, sloping. The undulating relief is favorable for dry-farmed field crops. The slopes have a sufficient fall to carry away surface runoff water, yet are not so steep as to present a serious erosion hazard. The yields of field crops on this soil are as good as for any of the other Milpitas soils. Even for irrigated crops, these slopes are not so steep as to make irrigation impractical. Yields of lemons and avocados are good, but generally are only about half as high as on better Sorrento or Yolo soils.

Milpitas fine sandy loam, gently sloping, moderately eroded (3 to 8 percent slopes) (MH).—Except for more gentle slopes and moderate erosion, this soil is similar to Milpitas fine sandy loam, sloping. It occurs along the eastern half of the coastal plain.

The soil is used for lima beans, tomatoes, grain hay, some truck crops, lemons, and avocados. Use and management is about the same as on noneroded Milpitas soils, but the yields are slightly lower. Because of its dense claypan subsoil, this soil is not well suited to the deep-rooted tree crops.

Milpitas fine sandy loam, gently sloping, severely eroded (3 to 8 percent slopes) (MI).—Except for more gentle slope and severe erosion, this soil is similar to Milpitas fine sandy loam, sloping. It occurs only in a few areas around the fringe of the Carpinteria Valley. The soil consists of areas that have been cultivated a long time and have been eroded as a result. For the most part, the soil is farmed to lima beans or is in pasture. Yields are very low.

Milpitas fine sandy loam, rolling (9 to 15 percent slopes) (MO).—This soil consists of rolling areas of Milpitas fine sandy loam in which the direction of the slope changes frequently. The profile is otherwise similar to that of Milpitas fine sandy loam, sloping. That soil, however, has longer, smoother slopes and generally is a little easier to work. In management practices and crop yields, there is little difference between the two. Erosion is more easily controlled on this soil because the changes in slope do not permit runoff to build up so much force.

Milpitas fine sandy loam, rolling, moderately eroded (9 to 15 percent slopes) (MP).—Except for moderate erosion, this soil is similar to Milpitas fine sandy loam, rolling. It occurs mainly around the fringes of the Goleta Valley. The slopes are short and change direction frequently. Yields are somewhat lower than on noneroded Milpitas fine sandy loam, rolling, but the crops grown and management practices are similar. The erosion has reduced the amount of surface soil. This is a serious loss for a soil that has a heavy claypan subsoil.

Milpitas fine sandy loam, sloping (9 to 15 percent slopes) (MQ).—This soil occurs on the coastal plain on low terraces that extend from the eastern edge of the Area westward to beyond Elwood. It occurs in small bodies and is associated with other Milpitas soils and those of the Watsonville and Montezuma series. It has developed under a coastal climate and receives 15 or 20 inches of rainfall yearly. The winters are mild and wet, and the summers are cool with considerable fog.

Representative profile:

0 to 12 inches, brown, slightly to medium acid fine sandy loam; very friable and of weak granular structure when moist but puddles easily if worked or pastured when too wet; puddled soil dries to a hard mass and is difficult to work; under natural vegetation, grass roots are concentrated in upper part of layer, but many roots occur throughout.

12 to 23 inches, similar to surface soil but a medium acid fine sandy loam containing many pores and insect holes; lower part of layer just above the clay subsoil is light gray and has a distinct vesicular structure.

23 to 38 inches, yellowish-brown, very hard, medium acid clay that has distinct prismatic structure when dry; aggregates are heavily coated with colloidal stains; the few roots extending into this layer tend to concentrate on the surfaces of the aggregates; insides of aggregates may have some brownish iron mottlings.

38 to 53 inches, light yellowish-brown, hard, medium acid clay; develops a blocky structure when dry; aggregates not quite so compact as those in the layer above but are heavily coated with colloidal stains; insides of aggregates usually mottled with brownish iron stains.

53 to 72 inches, light yellowish-brown, hard, neutral, stratified, massive loam, clay loam, or sandy clay loam; few if any roots.

Use and management.—Without irrigation most of the area is in annual grass pasture. A few areas are used for lima beans or tomatoes but yields are low. Occasionally, grain and grain hay are produced.

Lemons and specialty crops are grown under irrigation and receive commercial fertilizer. Nontillage weed control or cover crops are used on the lemons. Fruit yields are not so good as on the Sorrento, Yolo, or related soils. Management and irrigation problems are greater on this soil than on the recent alluvial soils.

Milpitas fine sandy loam, sloping, moderately eroded (9 to 15 percent slopes) (MR).—Except for moderate erosion, this soil is similar to Milpitas fine sandy loam, sloping. A number of areas occur along the eastern half of the coastal plain.

Nearly all of this soil is now cultivated to field crops, mainly lima beans, but also tomatoes and grain hay. Some lemons, walnuts, and avocados and a few specialty crops are grown. The erosion has been caused by farming. The claypan horizon is at depths of 1½ to 3 feet. Any loss of surface soil decreases the zone in which plant roots can grow, as they cannot penetrate the dense claypan to any useful extent. Gullies may cut deeply into the subsoil and become uncrossable. Yields are somewhat less than those obtained from Milpitas fine sandy loam, sloping.

Milpitas fine sandy loam, sloping, severely eroded (9 to 15 percent slopes) (Ms).—Except for severe erosion, this soil is similar to Milpitas fine sandy loam, sloping. It occurs in a few scattered areas and is associated with other Milpitas soils. Erosion has removed much of the surface soil, thus effectively reducing the zone in which roots can grow and water can be held.

This soil yields approximately half as much as Milpitas fine sandy loam, sloping. A few tomatoes and lima beans and some grain hay are grown. Some areas are now in pasture.

Milpitas fine sandy loam, moderately steep (16 to 30 percent slopes) (MJ).—Except for stronger slopes, this soil is similar to Milpitas fine sandy loam, rolling. It occupies the side slopes of the terraces. It varies in depth to the claypan and in compactness of the claypan. The soil is used mainly for range or homesites. Lima beans are grown in a few places, but yields are not so good as on Milpitas fine sandy loam, sloping; furthermore, the fields are much more difficult to work and erosion is harder to control.

Milpitas fine sandy loam, moderately steep, moderately eroded (16 to 30 percent slopes) (MK).—Except for moderate erosion, this soil is similar to Milpitas fine sandy loam, moderately steep. It occurs on the side slopes of the terraces. Some of these side slopes have been farmed but are now in pasture. Some areas are still being farmed; others have never been farmed. The erosion has resulted from cultivation or overgrazing. Use and management is the same as for noneroded Milpitas fine sandy loam, moderately steep, but the yields of crops or forage are somewhat less.

Milpitas fine sandy loam, moderately steep, severely eroded (16 to 30 percent slopes) (ML).—Except for severe erosion, this soil is similar to Milpitas fine sandy loam, moderately steep. It occurs on the sloping sides of terraces. About half of it is used for field crops. A few areas are in lemons. The other areas are in grass or brush. Erosion has removed a considerable part of the surface soil. The crop yields and forage production are materially less than on uneroded areas of Milpitas fine sandy loam, moderately steep.

Milpitas fine sandy loam, steep (31 to 45 percent slopes) (MT).—This soil is found on the steeper side slopes of the terraces. Its profile is more variable than those of the less steep areas of Milpitas fine sandy loam. There is greater variation in depth to the claypan and also considerable variability in the thickness and compactness of the claypan. This soil is all in grass or brush. It produces considerably less forage than soils on the terrace tops.

Milpitas fine sandy loam, steep, moderately eroded (31 to 45 percent slopes) (MU).—Except for moderate erosion, this soil is similar to Milpitas fine sandy loam, steep. It is more extensive however. Most of it has a grass or brush cover and is used for range. Such steep slopes are easily overgrazed, and erosion is difficult to control. One or two small areas are used for lemons. Yields of lemons and the amount of forage are low.

Milpitas fine sandy loam, deep, gently sloping and nearly level (0 to 8 percent slopes) (MF).—This soil occupies a few scattered areas on low terraces along the coastal plain. It is similar to Milpitas fine sandy loam, sloping, but its claypan occurs at greater depths of 3 to 5 feet and in places is not so compact. This soil originally had an annual grass cover but all of it is now being farmed.

Use and management.—This soil is used both for field and orchard crops, principally lima beans and lemons. Because of greater depth to the claypan, and because the claypan is often not so compact as in the normal Milpitas profiles, this soil produces better yields. The yields are not so good, however, as those obtained on the Sorrento and Yolo soils of the same locality.

Milpitas fine sandy loam, deep, sloping (9 to 15 percent slopes) (MG).—Except for stronger relief, this soil is similar to Milpitas fine sandy loam, deep, gently sloping and nearly level. It is in sloping terrace positions similar to those occupied by Milpitas fine sandy loam, sloping. In some places the claypan has about the same compactness and texture as that in the shallower Milpitas profile, but in others it is not so fine textured nor so compact. Consequently, this soil permits freer movement of water and roots. Only a few bodies are mapped, and they are in the eastern part of the Area fringing the Carpinteria Valley.

This soil is used mainly for lemons. It yields about the same as Milpitas fine sandy loam, deep, gently sloping and nearly level. It is more difficult to irrigate by the furrow system. Sprinkler irrigation of lemons is common and is used to good advantage. The yield of lemons, although superior to yields on the shallower Milpitas soils, is still not so good as on the soils of the Sorrento and Yolo series.

Milpitas fine sandy loam, overwash, gently sloping and nearly level (0 to 8 percent slopes) (MN).—The few small bodies of this soil fringe the eastern edge of the Carpinteria Valley and occur along the northeastern part of the Goleta Valley. This unit consists of Milpitas soils on which more recent soil material has been deposited. The overwash, usually 8 to 18 inches thick, comes from nearby higher areas. As a rule, the overwash improves the soil because it deepens the profile above the claypan horizon. The soil is used mainly for lemons. A small area of this soil lying between two higher terraces

near the southeastern corner of the Santa Barbara Area is not very well drained. The trees have been removed from this area. Field crops have been planted and do fairly well.

Milpitas gravelly fine sandy loam, sloping, moderately eroded (9 to 15 percent slopes) (Mx).—This soil differs from Milpitas fine sandy loam, sloping, principally in being gravelly throughout the profile and in being moderately eroded. It occurs along the coastal plain throughout the areas of Milpitas soils. The natural cover was grass, but most of the soil is now cultivated.

Use and management.—Most of this soil is used for field crops or grain hay grown without irrigation. The water-holding capacity is a little less than that of the nongravelly Milpitas fine sandy loam, and yields may be slightly lower. A very small area near Montecito is used for lemons. The trees appear to be equal to those on the nongravelly Milpitas soils. Some of this soil is used for range; it produces moderate yields of forage.

Milpitas gravelly fine sandy loam, moderately steep and steep, moderately eroded (16 to 45 percent slopes) (Mw).—Except for moderate erosion and steeper slopes, this soil is similar to Milpitas gravelly fine sandy loam, sloping. It occurs on the sloping sides of terraces. The profile characteristics are not so well developed as is typical for Milpitas fine sandy loams, and the surface soil is more variable. The claypan varies in depth and compaction. Erosion has reduced the soil depth above the claypan horizon.

Some of this soil is used for lemons or avocados, and a few areas for lima beans. The remainder is range. The yields are not so good as on the terrace tops, the slopes are more difficult to work, and erosion and runoff of water are more difficult to control.

Milpitas stony fine sandy loam, sloping (9 to 15 percent slopes) (Mz).—This soil occurs in scattered areas close to the hills along the coastal plain. Many well-rounded stones up to 18 inches in diameter are on the surface and throughout the profile, but the soil is otherwise similar to Milpitas fine sandy loam, sloping. The stones are not so large as those on the Olivenhain stony soils. The soil is strongly developed and has a well-defined claypan subsoil. The natural cover is grass, but a few trees grow near some of the streamways. There are more trees near Montecito than elsewhere.

Use and management.—This soil is used almost entirely for range, except for homesites in and around Montecito. It produces about as much forage as Milpitas gravelly fine sandy loam, sloping, and a little less than the nonstony Milpitas soils.

Milpitas stony fine sandy loam, moderately steep (16 to 30 percent slopes) (My).—This soil occurs on the terrace side slopes. The profile is similar to but more variable than that of Milpitas stony fine sandy loam, sloping.

This soil is used mainly for range. The carrying capacity is comparable to that of Milpitas stony fine sandy loam, sloping.

Milpitas stony fine sandy loam, steep (31 to 45 percent slopes) (MA).—This soil occurs on the steep sides of the stony terraces. It is similar to Milpitas stony fine sandy loam, moderately steep, but

varies more in profile. The claypan layer varies in depth and other characteristics and may even be very thin or nonexistent.

This soil is used for range. The forage produced is less than on the terrace tops or more gentle side slopes.

MOCHO SERIES

Soils of the Mocho series occur on smooth gently sloping alluvial fans and flood plains, fairly close to stream channels. They have formed from material washed mostly from Sespe, Maymen, and Gaviota soil areas. Most Mocho soils are in the Goleta and Carpinteria Valleys and along Rincon Creek.

The surface soils are brown, slightly hard, and slightly calcareous; they range in texture from loamy sand to loam.

The underlying materials are stratified brown to pale brown, calcareous and of wide range in texture. They are very friable when moist and are easily penetrated by roots and water.

These soils are suited to most crops climatically adapted to the Area. They produce high yields of a wide variety of crops. They are closely associated with soils of the Sorrento, Yolo, and Agueda series.

Mocho fine sandy loam, nearly level (0 to 2 percent slopes) (MD).—This soil is similar to Mocho loamy sand, nearly level, except that the surface soil is weakly granular and the profile has finer texture throughout. It occurs on smooth nearly level relief in the Carpinteria and Goleta Valleys and near the mouth of Rincon Creek. It is closer to the present stream channels than the associated Sorrento and Yolo soils. This soil has a recent profile with no development but much stratification. The soil material washed from upland soils of the nearby hills, all of which were developed from sedimentary rocks. The natural vegetation is annual grasses and a few scattered trees.

Use and management.—This soil is used mostly for lemons, but in a few places for lima beans. Management for lemons and beans is the same as on the Yolo and Sorrento soils of similar texture, but the yields of lemons are slightly lower. The trees develop a yellowing of the leaves which indicates chlorosis, a characteristic of lemons grown on calcareous soils. The chlorosis appears to affect yields only slightly, but lemon trees tend to go into decline a little earlier on this soil.

Mocho fine sandy loam, imperfectly drained, nearly level (0 to 2 percent slopes) (MC).—This soil is on nearly level relief on the lower edges of the Carpinteria and Goleta Valleys. The profile is similar to that of Mocho fine sandy loam, nearly level; but, because the elevation is only a few feet above sea level, the water table is never deeper than 4 to 6 feet. During the rainy season, the entire profile is saturated, and water often stands on the surface. The subsoils have somewhat grayer colors and considerable amounts of rust-brown iron stains caused by the fluctuating water table. Areas of this soil may be affected by slight to moderate amounts of salts.

Most of this soil is used for lima beans, and yields are fair. The few areas in lemon orchards produce low yields, and the trees vary in size or may die out entirely. In some areas the trees are being replaced by lima beans.

The slightly saline areas are more spotted in bean growth than the salt-free areas, and yields are lower. One small area near the mouth

of Atascadero Creek south of Goleta is moderately saline. Here, nearly half of the area in beans appears to be bare of vegetation.

Mocho fine sandy loam, over Clear Lake clay, nearly level (0 to 2 percent slopes) (ME).—This soil occurs on the lower edges of the Carpinteria and Goleta Creek fans on nearly level relief. It consists of an overwash of Mocho fine sandy loam from 1½ to 4 feet thick over dark gray or very dark gray clayey basin soils of the Clear Lake series. The drainage is poor, mainly because the water table is high, or 3 to 6 feet from the surface during the dry season. During winter, water may stand on the surface for some time.

This soil is used mainly for lima beans or range. The yields of beans are fair. The range is usually on the lower lying areas where drainage is poorest. These areas produce good yields of forage and have a high carrying capacity. This soil has proven unsatisfactory for lemons, but a few small orchards remain. Yields are low, and trees may be stunted or missing. This soil also may be used for irrigated tomatoes.

Some areas of this soil contain saline spots. These areas are used only for beans. Yields are somewhat reduced, and growth is spotty. The low-lying position and poor drainage of this soil make the salts difficult to leach out.

Mocho fine sandy loam, gently sloping (3 to 8 percent slopes) (MB).—Except for steeper slopes, this soil is similar to Mocho fine sandy loam, nearly level. It occurs in the upper part of Carpinteria and Goleta Valleys and along Gaviota Creek in the west central part of the Area. In the Carpinteria and Goleta Valleys, it is used mainly for lemons. In a few areas lima beans are grown. The use, management, and yields of this soil are similar to those of Mocho fine sandy loam, nearly level. Along Gaviota Creek this soil is used only for range. It has a good carrying capacity.

Mocho gravelly fine sandy loam, gently sloping (3 to 8 percent slopes) (MF).—This soil occurs in narrow strips along the stream channels in the Carpinteria Valley. The profile is nearly the same as that of Mocho fine sandy loam, nearly level, but there are variable amounts of gravel and a few cobblestones throughout the profile. The gravel noticeably reduces the moisture-holding capacity of the soil.

This soil is used entirely for lemons, which are managed the same as on other Mocho soils. Because of the lower water-holding capacity, this soil needs more frequent irrigation than Mocho fine sandy loam, nearly level. The trees look as healthy, but do not yield so well as on the nongravelly Mocho soils.

Mocho loam, nearly level (0 to 2 percent slopes) (MJ).—Except for finer texture throughout the profile, this soil is similar to Mocho fine sandy loam, nearly level. Most of it is in the Goleta Valley, but one or two small areas are in the Carpinteria Valley, and another at the mouth of Tajiguas Creek. It occurs next to streamways in association with Sorrento and Yolo soils and with other Mocho soils. These soils have no development because they were recently formed on alluvium derived from sedimentary rocks.

Use and management.—Small acreages are in walnuts and lima beans, but most of this soil in the Goleta and Carpinteria Valleys is

used for lemons. They are managed the same as on Sorrento fine sandy loams, but lemon trees on this soil may show chlorosis. The yields seem to be as good as those from Sorrento and Yolo loams of the same locality.

Bean and walnut yields are not affected by the lime content, and the management and yields are the same as for Sorrento and Yolo loams. Along Tajiguas Creek, this soil is used for beans and walnuts.

Mocho loam, imperfectly drained, nearly level (0 to 2 percent slopes) (MH).—This soil occurs in the lower parts of the Carpinteria and Goleta Valleys. The profile characteristics are similar to those of well-drained Mocho loam, nearly level. The water table during the dry season is about 4 to 6 feet from the surface. During the rainy season, water sometimes stands on the surface. The subsoil is grayer, and has some rust-brown iron stains as a result of the fluctuating water table. Some areas of this soil are slightly to moderately saline.

The use, management, and yields obtained are the same as those on the imperfectly drained Sorrento and Yolo soils of similar textures. The stand of crops on the slightly saline areas are more uneven than where there are no salts. On areas of moderate salt concentrations, the crops are still more stunted and less dependable in growth.

Mocho loam, gently sloping (3 to 8 percent slopes) (MG).—This soil occurs in the larger valleys near the streamways and along some of the narrow valleys which extend back into the hills. The soil profile is similar to that of the Mocho loam, nearly level, and the use, management, and yields are almost the same. In the larger valleys where irrigation is available, this soil is used mostly for lemons. In the smaller valleys without irrigation, it is used mainly for lima beans and tomatoes.

Mocho loamy sand, nearly level (0 to 2 percent slopes) (ML).—This soil occurs mainly in the Carpinteria Valley and along Rincon Creek. It is close to the stream channels, being very recently deposited as alluvium from sedimentary rocks. The profile is deep, but the water-holding capacity is low. The natural vegetation is mainly annual grasses and trees.

Representative profile:

0 to 14 inches, brown, slightly hard, slightly calcareous, moderately basic loamy sand of single-grained structure.
14 to 72 inches, brown to pale-brown stratified layers of slightly calcareous, moderately basic, slightly hard, massive loamy sands and sands.

Use and management.—This soil is used mostly for lemons, which are managed the same as on other recent alluvial soils nearby. Because of the coarse texture and low water-holding capacity, the soil must be irrigated more frequently than the fine sandy loams and loams of the Mocho, Yolo, and Sorrento series. The yields of lemons are slightly less than are obtained on Sorrento loamy sand. Lemon trees may show chlorosis if overwatered. This tendency is not so pronounced on this Mocho loamy sand as on the more limy Mocho fine sandy loams and loams. Bean yields are similar to those on Sorrento loamy sands.

Mocho loamy sand, imperfectly drained, nearly level (0 to 2 percent slopes) (MK).—This soil on nearly level relief on the lower

edges of the Carpinteria and Goleta Valleys lies only a few feet above sea level. The water table is near the surface most of the year. The soil profile is almost the same as that of Mocho loamy sand, nearly level, which is higher on the alluvial fans. The high water table causes the color of the subsoil to be grayer and more mottled with rust-brown iron stains. A permanent water table exists at depths of 4 to 6 feet, but during the rainy season water saturates the entire profile, and often stands on the surface. Some areas are slightly affected by salts.

The soil is used mainly for truck crops and lima beans. The yields are slightly less than on better drained areas, and a few bare spots show in the fields. The few areas in lemon orchards are spotted with missing trees, and the size of the trees varies. Chlorosis is more pronounced and the yields are somewhat lower in the saltier places.

MONTARA SERIES

Soils of the Montara series normally rest at shallow depths on dark-colored, massive, hard, serpentinaceous bedrock, which outcrops in many places. The natural vegetation is annual grasses and herbs. These soils are found only in the western part of the Area, mostly on the north side of Canada Honda Creek.

The surface soil is very dark gray, neutral clay loam or clay. When dry, the clay soil develops a very prominent blocky (adobe) structure. Grass roots are numerous throughout but are more concentrated near the surface.

The subsoil is similar to the surface soil but it has a lighter color and fewer grass roots. The rock fragments increase in number with depth.

The parent material of serpentinaceous rock lies at shallow depths, usually from 1 to 2 feet. About 1 to 3 inches is weathered rock above the massive hard bedrock.

Montara stony soils, undifferentiated, hilly and steep (16 to 45 percent slopes) (MM).—These undifferentiated stony soils occur entirely in the western part of the Area on hilly and steep relief. The profiles are shallow, and outcrops of serpentinaceous rock are numerous. The hard bedrock has only a thin zone of decomposed or crumbling upper bedrock. The cover is annual grasses and herbs.

Representative profile:

0 to 8 inches, very dark gray, hard, neutral, noncalcareous stony clay or stony clay loam of blocky structure. The clay develops a well-defined blocky (adobe) structure and large cracks extend down to the bedrock; grass roots are numerous throughout but are more concentrated in the upper 2 to 4 inches.

8 to 17 inches, very similar to above, but the color is slightly lighter, and there are a few angular fragments of serpentinaceous rock; number of rock fragments increases with depth.

17 inches +, greenish serpentinaceous rock; upper few inches may be somewhat crumbled and somewhat intermixed with soil material; lower bedrock is hard, massive, and serpentinaceous.

Use and management.—These soils are used entirely for range. The grass cover between the rock outcrops is fairly good. The carrying capacity of the soils is less than that of the nearby Climax, Diablo, and Los Osos soils.

MONTEZUMA SERIES

The Montezuma series consists of fine-textured soils on old low terraces of rolling relief. They are associated with soils of the Milpitas, Watsonville, and Arguello series along the entire coastal plain. The natural vegetation is annual grasses and herbs.

The surface soils are very dark gray, hard, noncalcareous, and generally of clay texture. A few areas are clay loam. The surface layers develop an adobe structure of large blocks with wide shrinkage cracks. These large blocks break further along secondary cracks to a finer blocky structure. Roots penetrate this horizon freely, but grass roots are concentrated in the upper 2 or 3 inches.

The subsoils are dark gray, slightly calcareous compact clays in the upper part, but are lighter in color and more calcareous with depth. The wide surface cracks extend through this material, but there is no secondary cracking. When the subsoil is dry, it develops a coarse blocky structure. It is hard when dry and very sticky when wet. The lower part of the subsoil is massive and not so hard as the upper part. The number of roots decreases rapidly with depth. Lime occurs usually in seams and nodules, but some is disseminated.

Parent materials consist of grayish-brown clay loam or clay that is usually noncalcareous. Drainage is slow because of the fine texture and compact subsoil. Some areas are used for range, walnuts, or lemons, but the major crops are lima beans, tomatoes, grain hay, and Sudangrass. Walnuts do only fairly well, and lemons somewhat better. Dry-farmed lima beans and tomatoes are grown successfully.

Montezuma clay (adobe), nearly level (0 to 2 percent slopes) (MQ).—The soil is like Montezuma clay (adobe), gently sloping, except that it is more nearly level.

This soil is used for the same crops and returns about the same yields as gently sloping Montezuma clay (adobe). The nearly level slopes are more easily worked, but the surface drainage is slower. This, especially during seasons of high rainfall, may delay the working of this soil longer than on more sloping areas.

Montezuma clay (adobe), undulating (3 to 8 percent slopes) (MU).—This soil is closely associated with, but is not so extensive as Montezuma clay (adobe) on gently sloping relief. The profile characteristics are similar, and the use, management, and yields are the same for field crops.

This undulating soil cannot be irrigated except by sprinkler systems, whereas the gently sloping soil may be furrow irrigated for orchards.

Montezuma clay (adobe), gently sloping (3 to 8 percent slopes) (MN).—This soil occurs on gently sloping and slightly undulating terraces in many places along the coastal plain from Summerland to Point Arguello. It is associated with soils of the Milpitas, Watsonville, and Arguello series, and in many places it is next to Zaca and Santa Lucia soils. The natural vegetation is annual grasses and herbs.

Representative profile:

0 to 21 inches, very dark gray, neutral, noncalcareous clay; very sticky when wet, but develops wide shrinkage cracks and a blocky (adobe) structure on drying; between the wide shrinkage cracks, there are many secondary cracks; soil breaks to a finer blocky structure of smaller aggregates that are hard and difficult to break; soil is easily puddled

if worked too wet, and when puddled it breaks to hard angular clods on drying; despite the fine texture, this layer absorbs water fairly rapidly.

21 to 32 inches, dark-gray, hard, moderately basic, slightly calcareous clay; surface cracks extend into this layer when it is dry, and it develops a coarse blocky structure; layer more compact than the surface soil and less permeable to roots and water.

32 to 44 inches, grayish-brown, slightly calcareous clay; massive in place and moderately compact, but not so hard as the layer above; lime occurs in soft nodules; fewer roots than in the layers above.

44 to 72 inches, grayish brown, hard, neutral to slightly basic clay; massive but not so fine-textured nor so compact as the subsoil layers above; may or may not be slightly calcareous.

Use and management.—This soil is used mainly for such field crops as lima beans, grain hay, tomatoes, and Sudangrass and for range. The Sudangrass pastures and range have very good carrying capacities and are among the best in the Area. Some lemon orchards grow where irrigation water is available. The yields are not more than half those on the Yolo and Sorrento soils, and the trees go into decline more quickly. This soil has proved unsatisfactory for avocados.

Montezuma clay (adobe), sloping (9 to 15 percent slopes) (MR).—This soil is almost as extensive as the gently sloping Montezuma clay (adobe) and is closely associated with it. It has similar profile characteristics, and the use, management, and yields are the same. The more uneven terrain is slightly harder to work and to protect from erosion.

Montezuma clay (adobe), sloping, moderately eroded (9 to 15 percent slopes) (MS).—This soil is almost the same as Montezuma clay (adobe), sloping, but has been moderately eroded. The scattered areas of this soil usually have been cultivated for a long time, mostly to lima beans and grain hay. The areas which are not gullied are not difficult to work, and the erosion is not severe enough to affect the yields greatly.

Montezuma clay (adobe), moderately steep (16 to 30 percent slopes) (MO).—This soil is associated with other soils of the Montezuma series and with other terrace soils along the coastal plain. It occupies the side slopes of the terraces. The profile is less uniform than that on the more gentle slopes but is otherwise similar.

Much of the soil is used for range, and it has a good carrying capacity. Some areas are cultivated to lima beans, grain hay, and tomatoes, but the yields are slightly less than those on the more gently sloping Montezuma soils. It is more difficult to work this soil and to care for and harvest the crops.

Montezuma clay (adobe), moderately steep, moderately eroded (16 to 30 percent slopes) (MP).—Except for moderate erosion, this soil is like Montezuma clay (adobe), moderately steep. It occurs mostly in the east central part of the Area between Summerland and Tajiguas, on the side slopes of terraces. It is now or has been cultivated for lima beans or grain hay. Erosion has resulted from this cultivation or from overgrazing. The yields are somewhat less than on noneroded Montezuma clay (adobe), moderately steep.

Montezuma clay (adobe), steep, moderately eroded (31 to 45 percent slopes) (MT).—This soil occurs in small, narrow bodies along the

steep sides of the terraces. The surface soil is clay. The depths to and compaction of the subsoil vary greatly. Most of this soil is in the eastern part of the Area between Summerland and Capitan, but one small body is about 1½ miles north of Point Conception.

This soil is used mainly for range. Brush covers about half of it, and the carrying capacity is low. Those areas with grass cover have a good carrying capacity but not so good as the range on the terrace tops has. One field near Summerland, used for lima beans, is very hard to work because of the steep slopes, and the yields are low. That north of Point Conception is in Sudangrass, which furnishes better pasture than the natural grasses.

Montezuma clay loam, gently sloping (3 to 8 percent slopes) (MV).—Except for a clay loam or heavy clay loam surface texture, this soil is like Montezuma clay (adobe) on similar slopes. The subsoil and substratum texture may vary from heavy clay loam to clay. A few areas of this soil are scattered on gently sloping or undulating low terraces in the eastern end of the Area.

Use and management.—The soil is used mainly for nonirrigated field crops. Lima beans are the most important crop, but some grain hay and tomatoes are also grown. The few lemon orchards yield about half the amounts obtained on Sorrento or Yolo soils. Some of this soil used for range has a good carrying capacity.

Montezuma stony clay, sloping (9 to 15 percent slopes) (MW).—This soil occurs in a few isolated areas, usually near upland soils. It differs from other Montezuma soils by having many stones on the surface and throughout the profile. The stones are not so large nor so numerous as on the Olivenhain soils. This soil is used mostly for range, but a few areas are used for field crops. Some of the stones have been cleared from cultivated areas, but those remaining interfere somewhat with tillage. The yields of forage and field crops are less than on the nonstony Montezuma clay (adobe), sloping.

NACIMIENTO SERIES

Soils of the Nacimiento series have formed over soft calcareous shale bedrock. The soils are sloping to very steep and have well-rounded crests and smooth slopes. The soils occur near the coast, usually next to the Zaca soils and sometimes the Santa Lucia soils on the seaward side, and next to the Gaviota soils on the landward side. They are somewhat like the Zaca soils. Both the Nacimiento and Zaca soils formed over bedrock of the Rincon geological formation, but on parent rock different in color and mineralogical characteristics. The profiles are relatively deep for residual soils, and the underlying shale bedrock is easily weathered. The natural vegetation is annual grasses, herbs, and burclover.

The Nacimiento surface soils are dark grayish brown, slightly calcareous, and mostly of clay texture, although a few areas are of clay loam. The soils tend to crack but do not have a pronounced blocky (adobe) structure like that of the Montezuma soils. They are friable when moist and break easily to a finer blocky structure. Roots are plentiful throughout the surface soil, but more concentrated in the upper 2 or 3 inches. The lime is disseminated.

The subsoils are light olive-gray clay. They are moderately calcareous, and some lime is segregated in soft seams or nodules. This horizon appears mottled because the soft well-weathered shale fragments show brownish iron stains.

The parent material is light olive-gray, soft, slightly calcareous shale. Considerable soil material and segregated lime are intermixed with the upper part, but these decrease with depth. The shales remain soft to a considerable depth.

These soils are used for range, lima beans, tomatoes, grain hay, avocados, and lemons.

Nacimiento clay, sloping (9 to 15 percent slopes) (Nc).—Except for more gentle slope this soil is very similar to Nacimiento clay, hilly. It is on the rounded ridge tops in the lower foothills where slopes are more gentle than are typical for the Nacimiento soils.

This soil is used mostly for lima beans or tomatoes, which do well without irrigation. The tomatoes are marketed fresh. Avocados are grown where irrigation is possible. Several areas in the western part are used for range. The profile is slightly deeper and erosion is more easily controlled than on Nacimiento clay, hilly.

Nacimiento clay, hilly (16 to 30 percent slopes) (Na).—This soil is hilly but has smooth slopes. It is on the hills in the central part of the Area. It is associated on the seaward side with Zaca or Santa Lucia soils, and the landward side with the Gaviota soils. It occupies a broad band about parallel to the ocean, westward from Goleta Valley almost to Jalama Creek. The soil formed on a soft calcareous shale of the Rincon formation. The profile is 3 to 4 feet deep. The natural vegetation is annual grasses, alfilaria, and burclover.

Representative profile:

0 to 11 inches, dark grayish-brown, hard, slightly calcareous, moderately basic blocky clay; soil is friable when moist, but very sticky when wet; roots numerous throughout the horizon but more concentrated in the upper few inches.

11 to 26 inches, dark grayish-brown, hard, moderately basic, slightly calcareous blocky clay, mottled with brownish-yellow and yellowish-brown stains; lime is disseminated or in very fine seams and nodules.

26 to 48 inches, light olive-gray, hard, subangular blocky, moderately basic, moderately calcareous clay mottled with brownish-yellow and yellowish-brown stains; some decomposing shale fragments present in the lower part; both disseminated and nodular lime occur.

48 to 60 inches, light olive-gray, slightly calcareous, massive shale; shale soft and highly weathered and somewhat mixed with soil material in the upper part; shale becomes more massive yet remains soft for many feet; roots and water penetrate readily.

Use and management.—The commonest use of this soil is for range, and it has a high carrying capacity. It is also used for lima beans, grain hay, and tomatoes without irrigation, and for avocados, walnuts, and lemons. Lima beans are harder to manage on these steeper slopes, because they cannot be pulled, windrowed, and combined on the site, but must be hauled to stationary threshers. Tomatoes are grown for fresh market. Yields vary. Grain hay is cut and baled in the field. Avocados have been planted in a number of places. Walnut yields are fair, but are less than those on the deeper alluvial soils. Lemon trees may be chlorotic, and they may go into decline more quickly than on less calcareous soils.

Nacimiento clay, hilly, moderately eroded (16 to 30 percent slopes) (NB).—Except for moderate erosion, and some gullying, this soil is very similar to Nacimiento clay, hilly.

The soil is used mainly for lima beans, tomatoes, and grain hay. Erosion has not reduced yields much. The soil is deep, and the bedrock is soft and deeply weathered. This soil normally resists erosion, but once gullies become established they cut rapidly and deeply because the underlying parent rock is soft. Careful management is needed to prevent erosion and destructive gullying (see section on erosion).

Nacimiento clay, steep (31 to 45 percent slopes) (ND).—This soil is like Nacimiento clay, hilly, except that it is steeper. The slopes are smooth and the ridges have rounded tops. This soil is closely associated with other Nacimiento soils.

It is used mainly for range. Some lima beans, tomatoes, and grain hay are grown without irrigation. Yields are similar to those on Nacimiento clay, hilly. These steeper slopes are harder and more expensive to work and to harvest. Erosion is harder to control.

Nacimiento clay, steep, moderately eroded (31 to 45 percent slopes) (NE).—This soil is like Nacimiento clay, steep, except that it is moderately eroded and has a few gullies. Normally these slopes are too steep for cultivation, but many areas have been farmed for years. They are used for lima beans, tomatoes, or grain hay. The sheet erosion appears to affect yields adversely. The gully erosion is more serious because the gullies cannot be crossed by tillage implements. Gullies are deep and hard to control because of the soft deeply weathered parent rock. Many areas formerly cultivated are now used only for range. Erosion must be controlled if this soil is to produce field crops.

Nacimineto clay, very steep (46+ percent slopes) (NF).—The slopes on this soil are very steep, but they are smooth and the ridgetops are somewhat rounded. Otherwise, the soil is like Nacimiento clay, hilly. It is used mostly for range. Grasses grow well, and the carrying capacity is high. On a few areas, lima beans and tomatoes are grown. Their yields and management are similar to those on the more gentle slopes, but it is harder to work this soil and to care for and harvest the crops. Sheet erosion and gullying must be guarded against.

Nacimiento clay, very steep, moderately eroded (46+ percent slopes) (NG).—Except for moderate erosion and some gullying, this soil is very similar to Nacimiento clay, very steep. It is associated with other Nacimiento soils on more gentle slopes in the central part of the Area.

This soil is used mainly for range, but a few areas were formerly in lima beans and tomatoes.

Nacimiento clay loam, hilly (16 to 30 percent slopes) (NH).—Except for a clay loam texture throughout the profile, this soil is similar to Nacimiento clay, hilly. In general, it is shallower than the Nacimiento clay soils, and the bedrock is slightly harder. The parent rock is mainly clayey sandstone. The soil is in small areas, mostly on the Hope Ranch and in the foothills north of Goleta. It is usually asso-

ciated with Nacimiento clay soils on side slopes below terrace cappings on which Milpitas soils have developed. Some areas are covered with brush, and others have an annual grass-and-herb cover.

Use and management.—This soil is used for lima beans, lemons, or range. Beans are usually grown without irrigation. Lemon yields are somewhat reduced by chlorosis. Range carrying capacities are less than those on Nacimiento clay, hilly.

Nacimiento clay loam, steep (31 to 45 percent slopes) (NK).—Except for steeper slopes, this soil is like Nacimiento clay loam, hilly, and its use and management are similar. It occurs mostly in small bodies in the central part of the Area, and is used as the associated soils require.

Nacimiento stony soils, undifferentiated, very steep (46+ percent slopes) (NL).—These stony undifferentiated Nacimento soils vary in texture. Bedrock outcrops in many places. Depths vary extremely, but are generally shallow. The parent material is less weathered and considerably harder than that under most Nacimiento soils.

These soils are used almost entirely for range. The carrying capacity is about half that of the more gently sloping Nacimiento soils. Some of the soils are covered with brush, and others with grass. A few lemon trees have been planted on these soils to square orchards predominantly on smoother relief.

OLIVENHAIN SERIES

Soils of the Olivenhain series have clay subsoils resting on semiconsolidated stratified old terrace material. Some areas have many large hard cobblestones and boulders on the surface and imbedded throughout the profile. Most of these soils are near Santa Barbara, but a few smaller areas are farther to the west and on Sheppard Mesa in the extreme southeastern part of the Area. The natural cover is annual grasses and herbs, with some trees or brush along the steep escarpments. The soils are associated with but higher than the Milpitas soils.

The surface soils are brown, hard, slightly to medium acid fine sandy loams or loams. A few included areas have grayish-brown or pale brown surface colors. Gravel or boulders are sometimes present. Under natural grass cover, the soils are very friable when moist, but they are easily puddled if worked or pastured when too wet. Roots are plentiful throughout the surface soil, but more concentrated in the upper few inches. The lower part of the surface soil is somewhat more porous, and a thin layer of light gray material lies just above the claypan subsoil.

The subsoils are yellowish brown, grading to a mixture of yellowish brown and light brownish gray, medium acid, very hard and compact clay, which may be stony or gravelly in places. Where not stony or gravelly, a well defined columnar structure has developed in the upper part and a more subangular blocky structure in the lower part. The aggregates are heavily coated with colloidal strains.

The underlying materials are hard, stratified, medium acid, and vary in texture but are often gravelly or stony. They have about the same color as the subsoils.

These soils are used for range, to which they are best suited. They are also used for grain hay and tomatoes without irrigation, and for lemons or avocados under irrigation.

Olivenhain fine sandy loam, sloping (9 to 15 percent slopes) (Oc).—This soil occurs in many small bodies in and around Santa Barbara. It has developed on sloping to undulating old, high, alluvial terrace material. Profile characteristics are similar to those of the associated Milpitas soils, but Olivenhain soils usually occupy the older high terraces, and the Milpitas soils occupy lower terraces. The profile is strongly developed and has a claypan subsoil that rests on semiconsolidated terrace deposits. The natural vegetation is annual grasses and herbs, with some oak trees on the steep side slopes, especially the northern slopes.

Representative profile:

0 to 7 inches, brown, hard, granular, slightly to medium acid fine sandy loam; when moist, is very friable and easily worked, but if worked when too wet it puddles easily; puddling destroys the natural structure, and the soil dries to a hard crust that is difficult to work to a good tilth.

7 to 16 inches, material is very similar to that described above but may be slightly lighter in color and in places slightly finer in texture; has fewer grass roots and is somewhat more porous; lower ¼ to 1 inch is a thin light-gray layer.

16 to 26 inches, yellowish-brown, columnar, medium acid clay; this is the horizon of greatest clay accumulation; clay very sticky when wet but very hard and compact when dry; columnar soil aggregates heavily coated with slightly darker colloidal films; few grass roots that extend down into this horizon tend to concentrate along the surfaces of the aggregates.

26 to 38 inches, yellowish-brown and light brownish-gray, hard, medium acid, subangular blocky clay loam.

38 to 60 inches, yellowish-brown and light brownish-gray, hard, massive, medium acid, semiconsolidated material often containing some gravel or stone; texture and degree of consolidation vary, but material is not very porous.

Use and management.—This soil is used mostly for homesites, gardens, and small family orchards, including many small lemon and avocado plantings. These are not managed the same as commercial plantings, and returns depend greatly on the skill of the operator and the management. Avocado trees are not well suited to the soil, and they decline rather rapidly after only a few years of bearing. The few commercial plantings of lemons yield about half as much as on the better soils of the Yolo and Sorrento series.

Olivenhain fine sandy loam, sloping, moderately eroded (9 to 15 percent slopes) (Od).—Except for moderate erosion, this soil is like Olivenhain fine sandy loam, sloping. Both sheet and gully erosion occur. These areas are located at the eastern edge of the survey and in the western part of the Area.

The soil on Sheppard Mesa is used for lemons. The orchards are terraced and irrigated by sprinklers. The erosion is fairly well stabilized by the terraces. The orchards are planted to cover crops and receive commercial fertilizers. Nontillage weed control or winter cover crops are used. The soil on Jalama Creek is used for grain hay without irrigation.

Olivenhain fine sandy loam, moderately steep (16 to 30 percent slopes) (Oa).—Except for steeper slopes, this soil is similar to

Olivenhain fine sandy loam, sloping. It occurs in small areas in and near Santa Barbara. Most of them are used for homesites. As these terraces are higher than the surrounding country, they make attractive homesites because of the view.

A few areas of this soil are used for field crops, mostly lima beans, tomatoes, or grain hay. Yields are similar to or slightly lower than those on the Olivenhain fine sandy loam, sloping.

Olivenhain fine sandy loam, moderately steep, moderately eroded (16 to 30 percent slopes) (OB).—Except for moderate erosion, this soil is similar to Olivenhain fine sandy loam, moderately steep. Sheet erosion has decreased the depth of the surface soil over the claypan subsoil. Gully erosion has made vertical-sided deep gullies that are uncrossable with tillage implements. Most of this soil occurs in the western part of the Area on terraces at the headwaters of Jalama and Canada Honda Creeks.

The areas in the western part are used mainly for range or grain hay. Grain hay yields less than on Olivenhain fine sandy loam, moderately steep. One small body near Montecito is used for lemons. Lemons are managed as on other soils, and yields are fair. Irrigation is by sprinkler.

Olivenhain gravelly fine sandy loam, sloping, moderately eroded (9 to 15 percent slopes) (OE).—This soil is similar to Olivenhain fine sandy loam, sloping, but is gravelly throughout.

This soil is used for field crops. The sheet erosion has lowered yields irregularly.

Olivenhain stony fine sandy loam, gently sloping (3 to 8 percent slopes) (OF).—Except for more gentle slopes, this soil is similar to Olivenhain stony fine sandy loam, sloping. There are only a few small areas, and these are used for residences or for range. The carrying capacity is somewhat less than for Olivenhain fine sandy loam, sloping.

Olivenhain stony fine sandy loam, sloping (9 to 15 percent slopes) (OH).—This soil is like Olivenhain fine sandy loam, sloping, except for stones throughout the profile, and many large stones and boulders on the surface. It occurs mostly in Santa Barbara, and between Santa Barbara and Montecito, on higher terraces above the Milpitas soils. The cover is mostly annual grasses and herbs on the smoother slopes, and some brush or oaks on the steeper side slopes.

Use and management.—Nearly all of this soil is used for homesites or estates. Many small plantings of avocados and lemons have been made within estates, and the surface stones have been removed at considerable cost. It is not economical to clear these soils of stones for commercial farming. The elevated relief and the location near Santa Barbara and Montecito make residential use best for this soil. The only agricultural use would be for range.

Olivenhain stony fine sandy loam, moderately steep (16 to 30 percent slopes) (OG).—Except for stronger slopes, this soil is similar to Olivenhain stony fine sandy loam, sloping. Most of it is near Santa Barbara and Montecito and is used for homesites.

Olivenhain stony soils, undifferentiated, steep (31 to 45 percent slopes) (OK).—Because of steep slope and stony profiles, these

Olivenhain soils were not separated into types. For the most part, their brush cover provides meager range.

RIVERWASH

Riverwash (Ra).—This consists of sandy and gravelly deposits in the bottom of stream channels. These are constantly shifted about during periods of high water. When water is low, livestock may get a little feed from the few forage plants that may grow.

ROUGH BROKEN AND STONY LAND

Rough broken and stony land, Gaviota soil material (Rb).—This miscellaneous land type has outcroppings of sandstone rock over 60 percent or more of the surface. The soil material between the rock outcrops is like that of the Gaviota soils but is very shallow. The natural vegetation is mainly brush, which affords only meager range. Some of this is recreational area.

Rough broken and stony land, Los Trancos soil material (Rf).—On this miscellaneous land type, the outcroppings of rhyolite rock cover more than 60 percent of the surface. A little soil material between the rocks is similar to that of the Los Trancos soils. These areas are mostly brush covered and produce very little range. They are mostly on the steep slopes in the western part of the Area.

Rough broken and stony land, Maymen soil material (Rc).—This miscellaneous land type has outcroppings of sandstone and shale bedrock on 60 percent or more of the surface. The material between the rocks is like that of the Maymen soils but is very shallow and stony. The natural vegetation is mostly brush. This very extensive land type occupies most of the upper western slopes of the Santa Ynez Mountains from west of Gaviota Creek to Rincon Creek. Most of it is recreational land in the Los Padres National Forest. The range is very meager. Protection of the brush cover is important because these areas are part of the valuable watersheds above Santa Barbara and the Carpinteria and Goleta Valleys.

Rough broken and stony land, Montara soil material (Rd).—This miscellaneous land type is rough, steep, and broken and nearly covered by rock outcroppings. The rocks are serpentinaceous. The material between the rocks is like that of the Montara soils but is very shallow. Some grass growing between the rocks affords a meager grazing.

Rough broken and stony land, Santa Lucia soil material (Re).—On this miscellaneous land type the outcroppings of Monterey shale cover more than 60 percent of the surface. The steep and very steep slopes have a very little material like that of the Santa Lucia soils between the rock outcrops. The land supports a thin cover of brush and a very meager amount of range. It occurs mainly on the San Miguelito Creek watershed and southward to the coastal plain near Rocky Point.

Rough broken and stony land, Sespe soil material (Rg).—More than 60 percent of the surface of this miscellaneous land type consists of outcroppings of shale or sandstone rock of the Sespe geologic formation. The material between the rock outcrops is like that of the

Sespe soils but is very shallow and often stony. This land type is moderately extensive and occurs on steep slopes just below areas of Rough broken and stony land, Maymen soil material. It has a denser brush cover than that land type and furnishes slightly better range. Much of this miscellaneous land type occurs in the Los Padres National Forest and is used for recreational purposes. Protection of the brush cover is important in the management of the watersheds above Santa Barbara and the Carpinteria and Goleta Valleys.

ROUGH GULLIED LAND

Rough gullied land, Los Osos soil material (RH).—This miscellaneous land type consists of badly gullied areas within areas of Los Osos soils. Some of the areas have been completely destroyed by gullies many feet deep, and in these places the underlying shale is badly shattered. In other areas the destruction is not so extensive, but the gullies are so numerous and close together that there is little soil between the gullies. This miscellaneous land type is inextensive and occurs in the western part of the Area.

Rough gullied land, Nacimiento soil material (RK).—This miscellaneous land type consists of areas of deep gullies cut into the soft or badly shattered shale bedrock that underlies Nacimiento soils. The gullied areas have practically no soil left and are of no agricultural value. They often occur where different geologic formations contact, where landslips have occurred, or where the underlying shale is particularly soft or shattered.

Rough gullied land, San Andreas soil material (RL).—This miscellaneous land type occurs within areas of San Andreas soils that have been almost completely destroyed by gullies. The underlying material is normally only slightly consolidated; where it is especially soft it is easily gullied, particularly after the surface soil has been eroded. Most of the gullies are V-shaped, 10 to 30 feet deep, and many feet wide. These gullies are particularly serious because they are starting points for wide gullies that extend a considerable distance back into ungullied areas. Once started, these large gullies are extremely difficult to stabilize.

Rough gullied land, Watsonville soil material (RM).—This miscellaneous land type, consisting of gullied areas in soils of the Watsonville series, is worthless for any agricultural use. The gullies are usually 10 to 30 feet deep and many have nearly vertical sides. They have cut deeply into the old marine terrace materials from which the Watsonville soils have developed, and in places have cut completely through to the underlying Monterey shale.

SAN ANDREAS SERIES

The soils of the San Andreas series have developed from softly consolidated sandstones of the Santa Barbara formation. They occupy hilly to steep areas on smooth slopes and well-rounded ridgetops. The natural vegetation is scattered oaks and annual grasses and herbs. The trees are more numerous near the draws and creek channels. The soils occur near Santa Barbara around the north side of Goleta Valley and along Jalama Creek in the western part of the Area. They are closely associated with soils of the Tierra series.

The surface soils are grayish-brown, soft, granular, medium acid loamy sand to fine sandy loam. Under natural vegetation, the color may be considerably darker than it is in cultivated areas. Grass roots concentrate in the upper 2 or 3 inches but are plentiful throughout this layer.

The subsoils are light brownish-gray, loose, single-grained, medium acid loamy sands. Where there is a little more clay, the subsoil is slightly compact. The clay layers seem to develop where the soft sandstone provides clayey material. There are fewer roots in the subsoil, and the number decreases with depth.

The parent material is light-gray massive sandstone that is softly consolidated to considerable depths so that both roots and water penetrate freely.

San Andreas soils are used for range, grain hay, lemons, and avocados. The orchards are located in the Hope Ranch area west of Santa Barbara.

San Andreas fine sandy loam, sloping, moderately eroded (9 to 15 percent slopes) (SA.).—Except for more gentle slopes and moderate erosion, this soil is similar to San Andreas fine sandy loam, hilly. It occurs in the western part of the Area and in two small tracts on the Hope Ranch.

In the western part of the Area this soil is used entirely for range. On the Hope Ranch it is used for lima beans and homesites. Erosion has not noticeably affected yields or management. This soil is more easily managed than the steeper San Andreas soils.

San Andreas fine sandy loam, hilly (16 to 30 percent slopes) (S).—Except for finer texture throughout the profile, this soil is much like San Andreas loamy sand, hilly. The slopes are short but smooth and the ridges are well rounded. The soil occurs mainly in the western part of the Area, primarily on the Canada Honda and San Miguelito Creek watersheds. A few small bodies occur in the Hope Ranch area. In a few places clay layers occur in the subsoil just above the soft bedrock.

This soil is closely associated with soils of the Tierra series. The natural cover is annual grasses, herbs, brush, and some trees along the drainageways and on the north slopes.

In the western part of the Area this soil is used mostly for range. In the Hope Ranch area a few small tracts are being used for lemons. Crops and forage yield somewhat better than on San Andreas loamy sand, hilly.

San Andreas fine sandy loam, steep, moderately eroded (31 to 45 percent slopes.) (SB).—Except for stronger slopes and moderate erosion, this soil is similar to San Andreas fine sandy loam, hilly. Grass covers most of it, but some areas are brushy. Nearly all of this soil is in the western part of the Area. All of it is used for range. Erosion resulting from overgrazing has reduced the carrying capacity.

San Andreas loamy sand, sloping (9 to 15 percent slopes) (SE).—Except for more gentle slopes, this soil is similar to San Andreas loamy sand, hilly. It occupies a few small areas in the Hope Ranch section near Santa Barbara. It is associated with the Tierra soils. The soil is generally a little deeper than the hilly San Andreas loamy sand, and a clay layer in the subsoil is more common.

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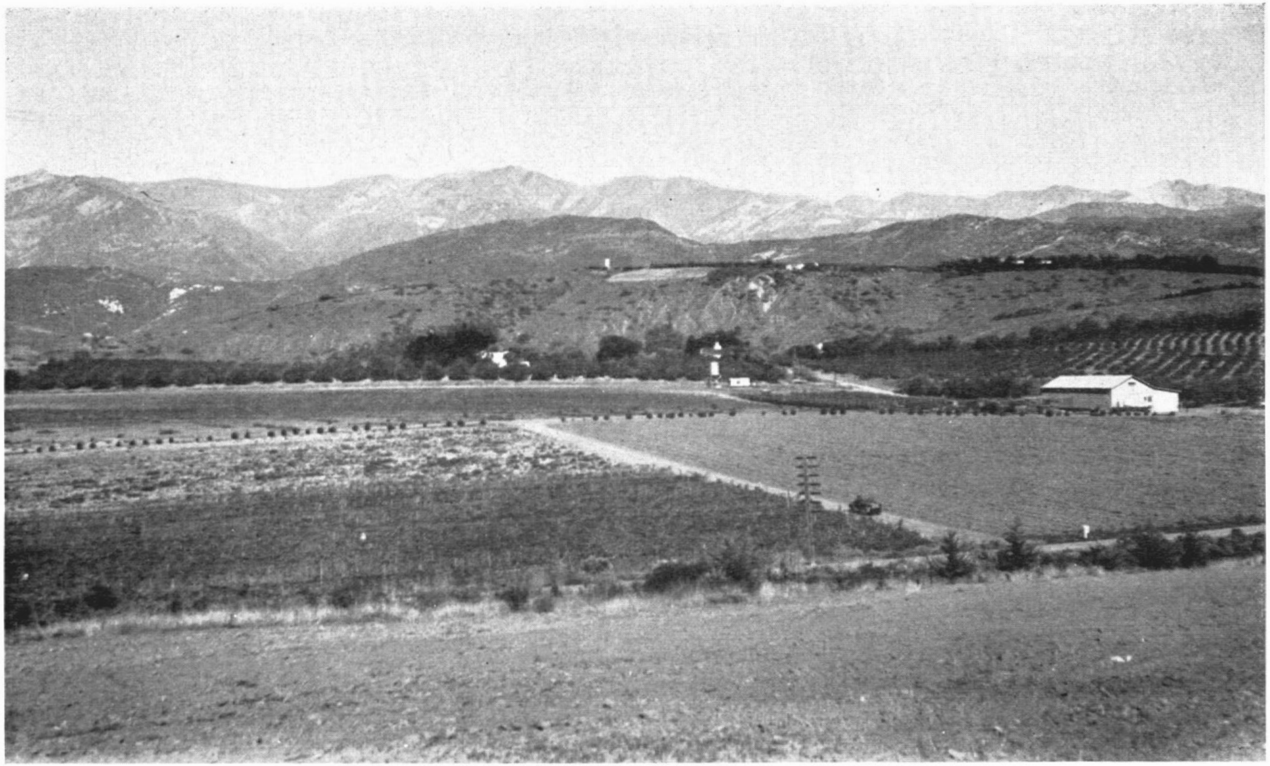
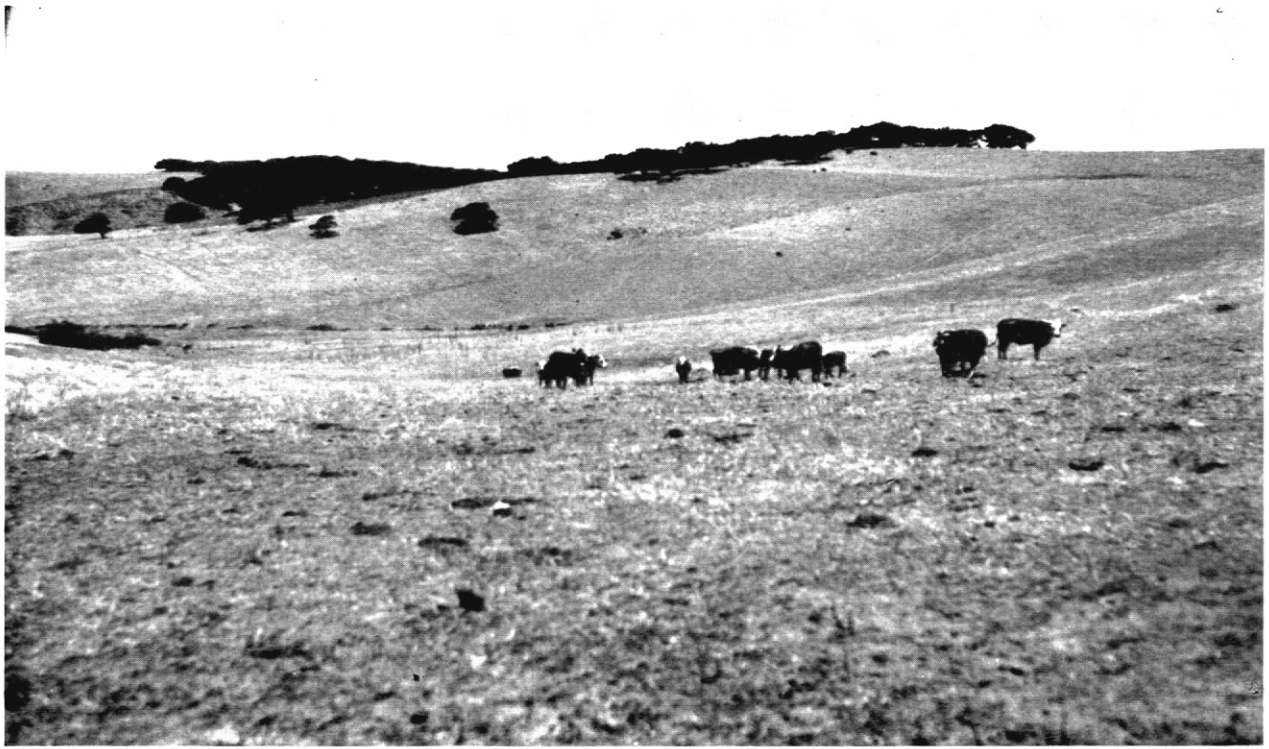
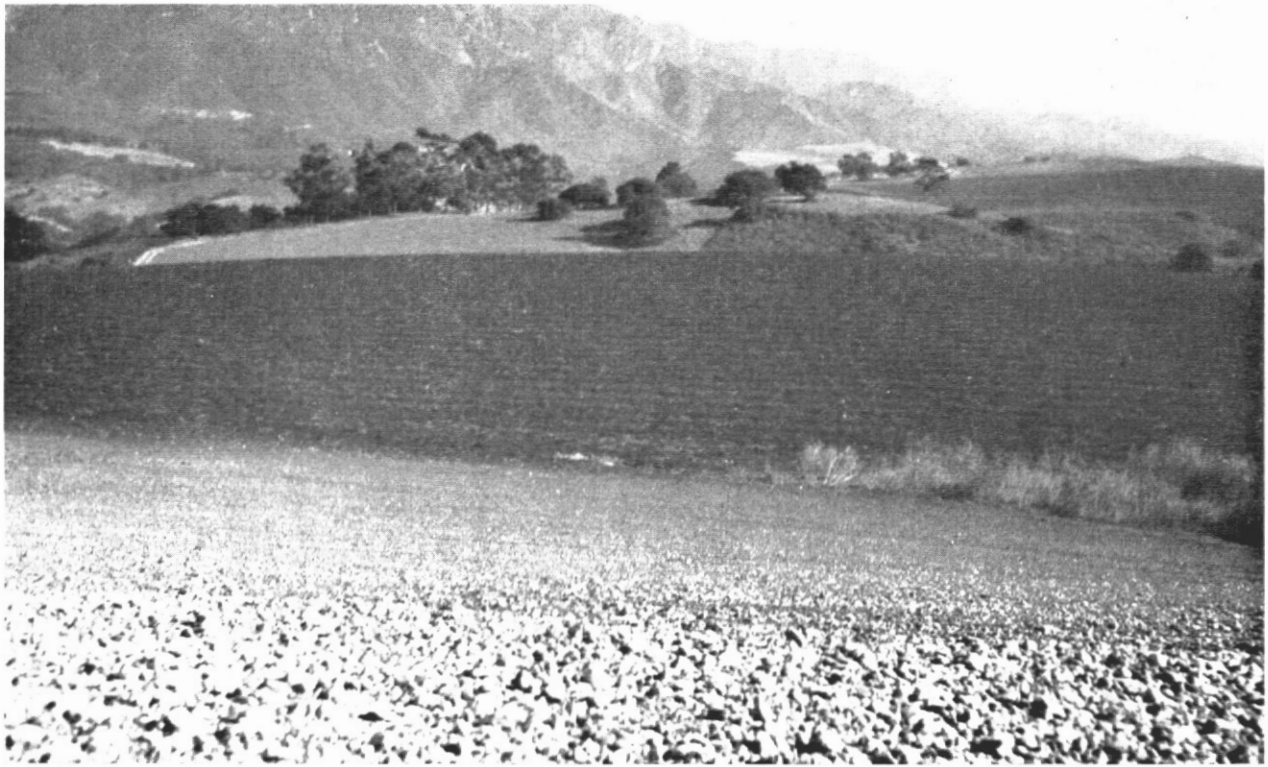


Baywood loamy fine sand, gently sloping, in small valley is planted to peas and lima beans; Milpitas fine sandy loam, rolling, on higher land in foreground; Santa Ynez Mountains in far background.

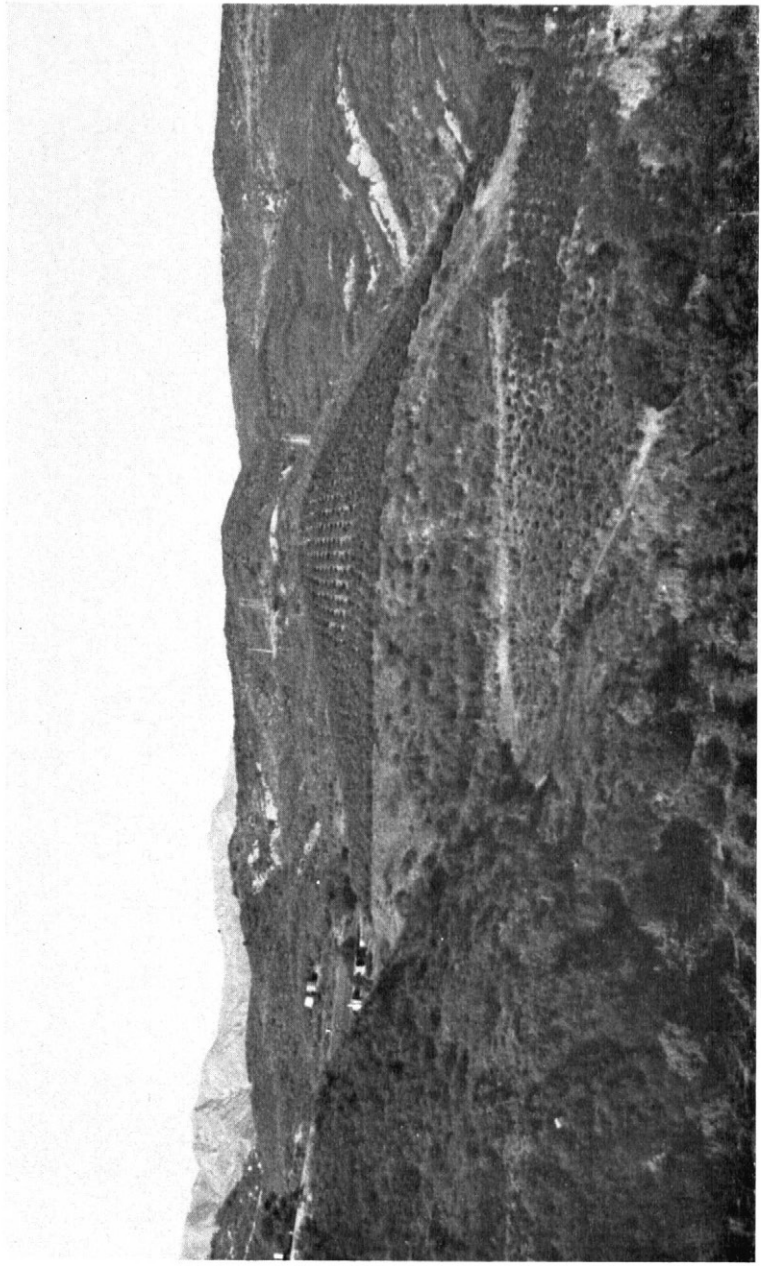


Beef cattle grazing on Los Osos soils in western part of the Santa Barbara Area.

Milpitas fine sandy loam, moderately steep, that has been recently terraced and planted to lemons; established lemon orchard in background.



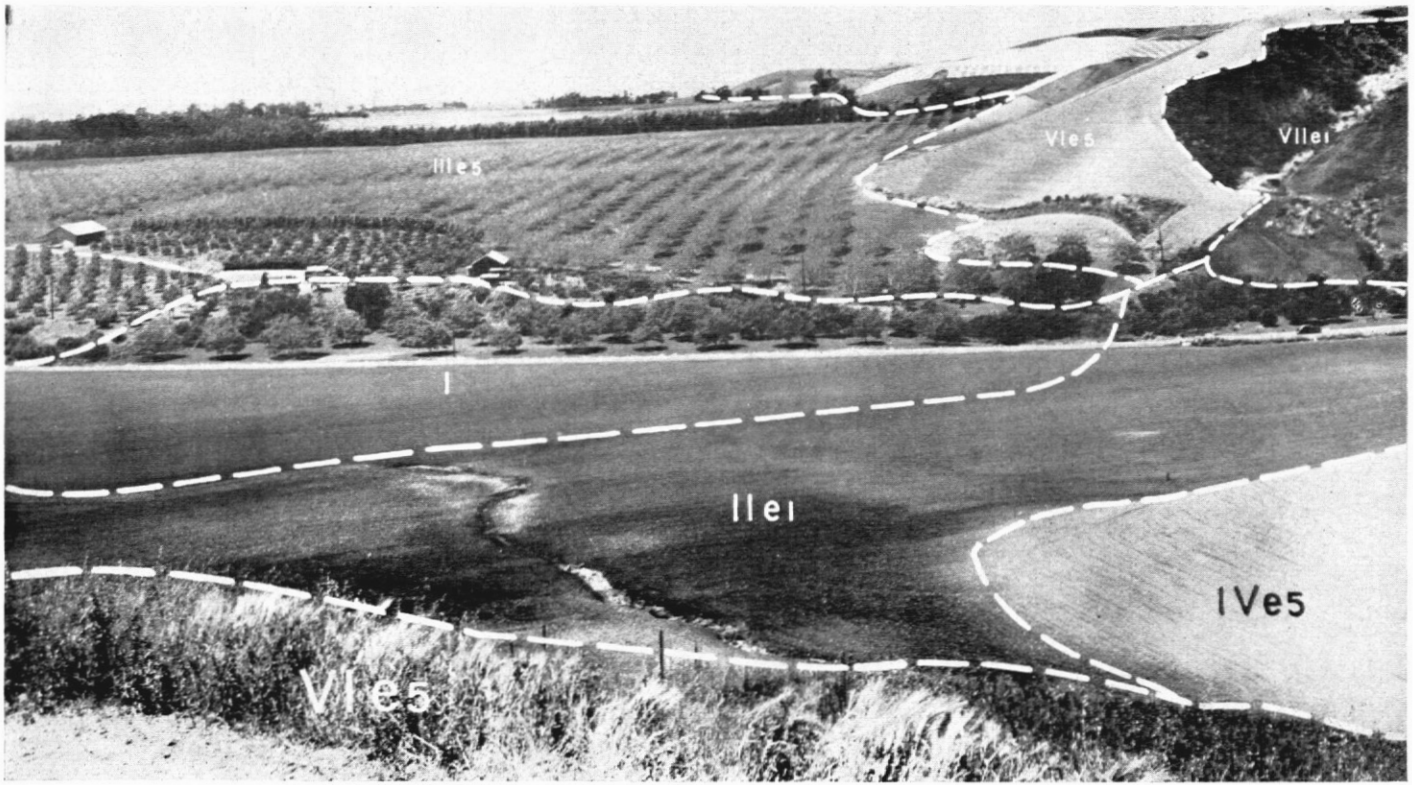
Two soils developed from different parent materials; light-colored noncalcareous Santa Lucia clay in foreground, and dark-colored calcareous Zaca soil on slope in near background.



Orchards and brush on Sespe soils in center; rough broken and stony lands in distant background.

Lemon orchard on Yolo fine sandy loam, nearly level, an excellent soil for orchard, truck, and field crops.

Road cut, about 8 feet deep, showing Zaca clay over its light-colored, mainly soft, calcareous parent material.



Representative land capability units in the Santa Barbara Area; symbols indicate class, subclass, and unit as explained in the section Land Capability Classification.

This soil is used almost entirely for field and truck crops and lemon and avocado orchards. It is more easily protected from erosion than the hilly San Andreas loamy sand, is much easier to work, and gives slightly higher yields.

San Andreas loamy sand, hilly (16 to 30 percent slopes) (Sc).—This soil occupies smooth slopes and well rounded hills. It is associated with the Tierra, Los Osos, and Gaviota soils.

This soil has formed on softly consolidated sandstone. In places it has some clay in the subsoil that probably came from the parent material. The clay apparently did not accumulate in the subsoil as a result of soil-forming processes. The natural vegetation is annual grasses, herbs, and a few scattered oak trees.

Representative profile:

0 to 22 inches, grayish-brown, soft, medium acid loamy sand, weak very fine granular; readily crushed to single-grain structure; in undisturbed places layer is rather dark colored, but it becomes lighter under cultivation.

22 to 45 inches, light brownish-gray, loose, medium acid, single-grained loamy sand or loamy fine sand; lighter color and fewer roots with increasing depth.

45 to 72 inches, light-gray, massive sandstone, softly consolidated to considerable depth; roots and water penetrate freely.

Use and management.—In the Las Positas Hills and north of Goleta, this soil is used for lemons, avocados, and truck crops if irrigation water is available. Avocados are grown in small plantings. Some of this land is also used for range. In the western part, it is used almost entirely for range, although grain hay is grown in a few small areas. The range areas do not provide so good forage as the finer textured soils. Truck crops yield only about half as much as they do on recent alluvial soils such as the Sorrento and Yolo. Cover crops, commercial fertilizer, and barnyard manure are commonly used.

San Andreas loamy sand, hilly, moderately eroded (16 to 30 percent slopes) (Sd).—Except for moderate erosion, this soil is similar to San Andreas loamy sand, hilly. All of it is near Hope Ranch and Goleta. It is used for range or homesites. Erosion may be the result of overgrazing or of cultivation at some time in the past. Range on this soil has a somewhat lower carrying capacity than on the uneroded hilly San Andreas loamy sand.

San Andreas loamy sand, steep (31 to 45 percent slopes) (Sf).—Except for stronger slopes, this soil is similar to San Andreas loamy sand, hilly. It occurs in two localities, one on the Hope Ranch and the other along Jalama Creek in the western part of the Area.

On the Hope Ranch, except for a few small lemon groves that are extensions of orchards on less steep slopes, this soil is in brush or is used for homesites.

Along Jalama Creek there are two areas of this soil, both on north slopes, where there are trees and an undergrowth of grass. These areas are used for range. Although their carrying capacity is low, they provide shade in summer.

San Andreas loamy sand, steep, moderately eroded (31 to 45 percent slopes) (Sg).—Except for moderate erosion, this soil is similar to San Andreas loamy sand, steep. The few small areas are south and southwest of Santa Barbara.

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Most of this soil is used for range. A number of areas previously used for beans have reverted to range because of gully erosion.

San Andreas stony soils, undifferentiated, very steep (46+ percent slopes) (SH).—These stony soils on very steep slopes have not been differentiated. They occur mostly in the western part of the Santa Barbara Area. A few areas are located south of Santa Barbara. These soils are shallower than those typical of the San Andreas series and have many outcrops of a rock formation that is, in general, somewhat harder than is typical for San Andreas soils. The natural vegetation is brush and a little grass. The soils are used entirely for range and have a very low carrying capacity.

San Andreas-Tierra fine sandy loams, hilly (16 to 30 percent slopes) (SI).—The San Andreas and Tierra soils are so intricately associated in this complex that separation is not practical. The profiles are typical of those for the same two soils where they occur separately. The complex is entirely on the Hope Ranch west of Santa Barbara.

These soils are used principally for lemons. Small acreages are in lima beans, range, or homesites. Lemon groves are irrigated, and cover crops are grown during winter to supply organic matter and to control erosion. Commercial fertilizers are also used. The holdings in the Hope Ranch are small, but the groves are well kept. Range pasture has a fairly good carrying capacity but not so good as that of the finer textured upland soils.

San Andreas-Tierra fine sandy loams, steep (31 to 45 percent slopes) (SJ).—Except for stronger slopes, this complex is similar to San Andreas-Tierra fine sandy loams, hilly. It occurs entirely on the Hope Ranch and is closely associated with the hilly San Andreas-Tierra fine sandy loams. Management requirements and yields are similar to those for San Andreas-Tierra fine sandy loams, hilly, but a higher percentage of this complex is used for range.

SANTA LUCIA SERIES

Soils of the Santa Lucia series have shallow depths to hard, light-colored, siliceous or diatomaceous shales of the Monterey formation. They are widely distributed throughout the Santa Barbara Area but are most extensive in the western part. The soil areas are hilly to very steep and are characterized by V-shaped canyons that have no alluvium along the creeks. The steep canyon sides are brush covered; the more gently sloping ridges and hilltops are normally covered by annual grasses and herbs.

The surface soils are dark-gray, hard, medium acid loams and clay loams that contain a considerable amount of platy shale fragments (pl. 4). Grass roots freely penetrate the entire horizon but are thickest in the upper 2 or 3 inches.

The subsoils are similar to the surface soils but they become lighter in color with increasing depth. There are not so many roots as in the surface soils, and these decrease in number with depth. The number and size of shale fragments increase with depth.

The parent material—hard light-gray Monterey shale—usually lies at depths of less than 2 feet. The upper part of the shale is shattered and platy and has some soil material in the cracks.

These soils are used mainly for range, but a few areas are planted to grain hay or lima beans. Yields are low.

Santa Lucia shaly clay loam, sloping (9 to 15 percent slopes) (SN).—Except for more gentle slopes, this soil is similar to Santa Lucia shaly clay loam, hilly. It is located mainly in the western part of the Area. The profile is generally less than 2 feet deep to parent rock. In places where a brush cover grows, the soil is particularly shallow.

This soil is used for grain hay and range. Its carrying capacity is slightly higher than that of the steeper Santa Lucia soils.

Santa Lucia shaly clay loam, hilly (16 to 30 percent slopes) (SK).—This soil occurs mostly in the western part of the Area, both along the coast and inland. It is underlain by light-gray Monterey shale at depths of 15 to 20 inches. Along the coast it is somewhat darker colored than farther inland. The natural cover is mostly annual grasses and herbs and, in a few areas, brush or oaks. This soil is associated with nearly all the other upland soils in the western part of the Area.

Representative profile:

0 to 6 inches, dark-gray, hard, medium acid, granular shaly clay loam; platy light-gray shale fragments occur on the surface and are intermixed with the soil material; grass roots throughout layer but mostly in the upper few inches.

6 to 14 inches, similar to the surface soil but a little lighter colored and contains fewer grass roots; greater number and larger shale fragments with increasing depth.

14 inches +, light-gray massive shale bedrock; upper few inches shattered and intermixed with soil material; lower part hard and somewhat mottled.

Use and management.—Practically all of this soil is used for range. The grass-covered areas have a fair carrying capacity, but not so good as that of Los Osos clay loam. The brush-covered areas have low carrying capacity.

Santa Lucia shaly clay loam, hilly, moderately eroded (16 to 30 percent slopes) (SL).—Except for moderate erosion, this soil is similar to Santa Lucia shaly clay loam, hilly. Erosion is either the sheet or gully kind, or a combination of the two. Most of this soil is grass covered and is used for range. A few areas are in field crops. Erosion has decreased the yield of field crops and the carrying capacity of the range. As this soil is normally shallow, the loss of a small amount of surface soil may seriously affect yields.

Santa Lucia shaly clay loam, hilly, severely eroded (16 to 30 percent slopes) (SM).—This soil is similar to Santa Lucia shaly clay loam, hilly, but severe erosion resulting from cultivation has removed some of the surface soil and reduced the depth of the soil profile. The areas are usually small and are used for field crops, principally lima beans. Yields are 30 to 40 percent less than on Santa Lucia shaly clay loam, hilly.

Santa Lucia shaly clay loam, steep (31 to 45 percent slopes) (SO).—Except for steeper slopes, this soil is similar to Santa Lucia shaly clay loam, hilly. It occurs mostly in the western part of the Santa Barbara Area. The relief is rugged and the ridges are fairly

sharp. The soil is shallow to bedrock, and some outcrops of Monterey shale occur. The vegetation is grasses and brush, and a few small areas of trees.

This soil is used almost entirely for range. Its carrying capacity is low.

Santa Lucia shaly clay loam, steep, moderately eroded (31 to 45 percent slopes) (SP).—Except for moderate erosion, this soil is similar to Santa Lucia shaly clay loam, steep. Except for one small area near Santa Barbara, all of this soil is in the western part of the Area. Generally the natural vegetation is grass, but in a few places it is brush.

This soil is used for range. The carrying capacity is low, but erosion damage is not so severe that the original carrying capacity could not be recovered by careful management.

Santa Lucia shaly loam, hilly (16 to 30 percent slopes) (SQ).—Except for a shaly loam texture, this soil is similar to Santa Lucia shaly clay loam, hilly. It is widely distributed on the ridges and lower foothills of the western part of the Area, principally in association with steeper areas of Santa Lucia soils. It is a shallow soil, seldom more than 24 inches to bedrock, and has no profile development. Some rocks crop out, but not so many as on the steeper Santa Lucia soils. Annual grasses and herbs and a few areas of brush are the natural vegetation.

Use and management.—Most of this soil is used for range. The carrying capacity is fair, but inferior to that of Los Osos or Cayucos soils in the same general locality. A few scattered areas are cultivated for grain hay. Yields are variable. Yields are lower than on the Zaca and Nacimiento soils in the same general locality.

Santa Lucia shaly loam, steep (31 to 45 percent slopes) (SR).—Except for having steeper slopes, this soil is similar to Santa Lucia shaly loam, hilly. It occurs in the western part of the Area. The soil is usually shallower than on the more gently sloping Santa Lucia soils and has some outcrops of Monterey shale. The vegetation is mostly brush. A few trees grow near stream channels and on north slopes, and grass covers a few small areas. This soil is entirely in range that has low carrying capacity.

Santa Lucia shaly loam, very steep (46+ percent slopes) (SS).—Except for steeper slopes, this soil is similar to Santa Lucia shaly loam, steep. It occurs principally on the very steep sides of V-shaped canyons. The soil is very shallow and has many rock outcrops. The vegetation is mainly brush; a few trees grow on the north slopes. All of this soil is used for range that has very low carrying capacity.

Santa Lucia stony clay loam, hilly (16 to 30 percent slopes) (ST).—Except for its stony clay loam texture, this soil is similar to Santa Lucia shaly clay loam, hilly. It occurs only in the western part of the Area as small isolated or scattered bodies, usually on ridgetops where there are rock outcrops or a considerable number of loose stones. The soil is shallow. The vegetation is mainly grasses, but there are some areas of brush. This soil contains so many shale fragments that it cannot be cultivated. It is used only for range and has a very low carrying capacity.

Santa Lucia stony soils, undifferentiated, steep and very steep (31+ percent slopes) (Su).—These soils occur on rough steep and very steep mountainous relief characterized by sharp ridges, ravines, and many rock outcrops. The soils are shallow to very shallow. The vegetation is mostly brush, but grass and a few trees grow in a few spots on sheltered north slopes or along drainageways. These soils are used only for range, which has very low carrying capacity.

SESPE SERIES

Soils of the Sespe series rest on shale bedrock of the Sespe formation, a continental (nonmarine) formation of Oligocene age. The soils are hilly to very steep and generally are next to but at a lower elevation than the Maymen soils. They are extensive in this Area, especially in the eastern half. The natural vegetation is mainly brush, but there are some grassy areas and a few oaks and other trees close to stream channels and on north slopes.

The surface soils are brown to dark-brown, neutral to slightly acid clay loams and clays. Under virgin conditions they are friable when moist and have a granular structure. The upper 3 or 4 inches is slightly darker colored than the rest of the layer. Roots are plentiful throughout but most numerous in the top 3 or 4 inches.

The upper subsoils are dark-brown to dark reddish-brown, hard, neutral, subangular blocky clay loams or clays. The aggregates have some colloidal coating on the surfaces. There are fewer grass roots than in the surface soils, but some of the coarser roots extend to this layer. The lower subsoils are moderately basic; they contain lime in both disseminated and segregated form.

The parent material is light brownish-gray, hard shale or clayey sandstone bedrock, somewhat shattered and crumbled in the upper part, and mixed with considerable lime and soil. The shale becomes massive and harder with depth. In some places, strata of shale are interbedded with thin layers of sandstone.

These soils are used without irrigation for a wide variety of crops, including lima beans, grain hay, and tomatoes. Under irrigation, lemons, avocados, and some truck crops are grown (pl. 5). Some areas are used for range.

Sespe clay, sloping, moderately eroded (9 to 15 percent slopes) (Sx).—This soil is similar to Sespe clay, hilly, except that it occupies gentler slopes and is moderately eroded. It occurs on the lower foothills in association with other Sespe soils. This soil is used for field crops and range. It is easier to work, care for, and harvest than Sespe clay, hilly. Erosion has not been serious enough to interfere with tillage or to reduce yields materially.

Sespe clay, hilly (16 to 30 percent slopes) (Sv).—Except for its blocky clay surface soil and subsoil, this soil is similar to Sespe clay loam, hilly. It occurs in hilly areas and is closely associated with Sespe clay loam, hilly, which it approximately equals in acreage. Generally it is at lower elevations than Sespe clay loam, hilly. Also, the shale bedrock is weathered to a greater depth in this soil. The natural vegetation is mostly brush. Grass grows in some areas, and a few trees are near drainageways and on some of the north slopes.

Use and management.—With irrigation, this soil is used for lemons, avocados, and truck crops; without irrigation, it is used for lima

beans, grain hay, and range. Lemons and avocados probably yield slightly more, and field crops definitely more, than on Sespe clay loam, hilly.

Sespe clay, hilly, moderately eroded (16 to 30 percent slopes) (Sw).—This soil is similar to Sespe clay, hilly, except it has been moderately eroded as a result of farming. A few gullies have formed. Where there has been only sheet erosion, management, workability, and yields are not materially different from those described for Sespe clay loam, hilly. Moderate losses of soil apparently are of no great consequence. Areas that have been subjected to both sheet and gully erosion, however, are more difficult to cultivate.

Sespe clay, steep (31 to 45 percent slopes) (Sy).—Except for steeper slopes, this soil is similar to Sespe clay, hilly. It occurs throughout the area of Sespe soils. Most of the acreage has a cover of brush and grass and is used for range. The carrying capacity is good in grassy areas but low in the brush areas. Field crops are grown in a few places. Yields are comparable to those obtained from Sespe clay, hilly.

Sespe clay, steep, moderately eroded (31 to 45 percent slopes) (Sz).—This soil is similar to Sespe clay, steep, except for moderate erosion resulting from farming. Some areas are now cultivated and some were once cultivated and are now in range. There are a few small lemon orchards on small homesites and estates near Santa Barbara. It is difficult to work this soil and to care for and harvest crops on its steep slopes, particularly where gullies have formed.

Sespe clay loam, sloping (9 to 15 percent slopes) (SD).—This soil is similar to Sespe clay loam, hilly, except it has gentler slopes and is slightly shallower. There are only a few small scattered bodies of this soil, and most of them are associated with steeper Sespe soils.

One area of this soil along Arroyo Parida south of Toro Canyon is used for lemons and field crops. Yields appear to be similar to those obtained on Sespe clay loam, hilly. The other areas are used for range. Where there is a grass cover, the carrying capacity is fair to good. One brush covered area near Painted Rocks has a low carrying capacity.

Sespe clay loam, hilly (16 to 30 percent slopes) (SA).—This soil occupies smooth hilly areas and well-rounded ridgetops. It occurs in many places from the eastern edge of the Area to the central part. In general, this soil parallels the coast, at an elevation lower than that of the Maymen soils and above the level of the Gaviota and Nacimiento soils. North of the Goleta Valley it borders the valley terraces. The natural vegetation is mainly brush, but some oaks and associated trees grow near stream channels and on north slopes.

Representative profile:

0 to 13 inches, brown to dark-brown granular clay loam; hard; neutral to slightly acid; numerous roots.

13 to 29 inches, dark-brown to dark reddish-brown, hard, neutral, subangular blocky heavy clay loam or light clay; more blocky than surface soil but not so compact as to noticeably hinder root penetration.

29 to 40 inches, clay loam, similar to the layer above but moderately basic; contains lime, both disseminated and segregated in seams and nodules; somewhat weaker structure than that of layer above.

40 to 60 inches, light brownish-gray hard shale or clayey sandstone bedrock, cracked and shattered, and intermixed with soil materials in the upper part; fragments are lime coated; rock becomes massive and noncalcareous with depth.

Use and management.—This soil is used without irrigation for field crops such as lima beans, tomatoes, and grain hay. Lemons and avocados are grown under irrigation. They are irrigated by sprinkler systems, heavily fertilized with nitrogen, and protected by cover crops. Some areas high in lime give trouble with chlorosis. In some places this soil is used for range. The brushy and woody areas have a low carrying capacity.

Sespe clay loam, hilly, moderately eroded (16 to 30 percent slopes) (SB).—Except for moderate erosion, this soil is similar to Sespe clay loam, hilly. It occurs in a number of small bodies, mainly in the central part of the Area.

This soil is used for a variety of crops. Lemons, tomatoes, and lima beans are grown, and a number of areas are in range. Sheet erosion has not been serious enough to increase the difficulty of farming but has slightly lowered yields.

Sespe clay loam, hilly, severely eroded (16 to 30 percent slopes) (SC).—This soil is similar to Sespe clay loam, hilly, but it is severely eroded. It occurs south of Eagle Canyon in the central part of the Area.

This soil is used for lima beans, tomatoes, and range. Erosion has materially reduced yields, and numerous gullies make continued farming difficult. The range areas were once farmed to field crops but are now in grass.

Sespe clay loam, steep (31 to 45 percent slopes) (SE).—Except for having steeper slopes, this soil is similar to Sespe clay loam, hilly. It occurs in a number of areas in association with other Sespe soils. The natural vegetation is mainly brush or grass. The brushy areas do not have so good a carrying capacity as the grassy areas. Lemons, avocados, and field crops are grown on this soil. Because of steeper slopes, fewer areas are cultivated, the fields are more difficult to work, and yields are slightly less than on Sespe clay loam, hilly.

Sespe clay loam, steep, moderately eroded (31 to 45 percent slopes (SF).—Except for moderate erosion, this soil is similar to Sespe clay loam, steep. The few scattered areas are associated with areas of other Sespe soils. Most of the areas are in brush or grass range. Erosion has not materially reduced the carrying capacity but, in general, the range is overgrazed. A small acreage is farmed, mainly to field crops. Yields are reduced somewhat by erosion. One small body of this soil just north of Carpinteria Creek is planted to lemons. Yields are fair, but because of the steep slopes, it is difficult to care for and harvest the crops. Farming is difficult on all of this soil because of scattered gullies.

Sespe nonstony soils, undifferentiated, very steep (46+ percent slopes (SG).—Because of the very steep slopes, these soils were not differentiated. They usually lie at the higher elevations next to the Maymen soils. Much of the area is covered with brush and provides very poor range. There are some grassy areas which are better as rangeland, but not so good as the Zaca, Nacimiento, and Los Osos soils.

Sespe stony soils, undifferentiated, very steep (46+ percent slopes) (SH).—Because of the very steep slopes, shallow profiles, and numerous rock outcrops, these soils were not differentiated. They occur throughout the area of Sespe soils, especially at higher elevations adjacent to the Maymen soils. These areas are almost entirely covered with brush and are used only for range. The carrying capacity is very low.

SORRENTO SERIES

The soils of the Sorrento series were derived from alluvium that washed principally from the Maymen, Sespe, and Gaviota soils. They occur on smooth gently sloping recent alluvial fans and narrow flood plains. They are associated with the Yolo, Mocho, and Carpinteria soils. The natural cover is annual grasses, herbs, and scattered oaks. The trees normally grow close to the streamways. The Sorrento soils of the valley area cover the greatest acreage and are all intensively farmed.

The surface soils are dark grayish brown, neutral to slightly basic, and vary from loamy sands to loam. They are very friable to friable when moist, and easily worked.

The subsoils are pale brown, slightly calcareous, moderately basic, and similar to the surface soil in texture. Roots and water easily penetrate. Lime occurs in both disseminated and thin threadlike forms. It is stratified in places.

The parent material is similar to the subsoil but slightly lighter in color and slightly more basic in reaction. It is somewhat stratified but does not vary a great deal in texture.

Sorrento soils in this area generally have a slightly darker colored surface layer than is typical of the Sorrento soils in other areas, particularly those in the western part of the San Joaquin Valley. They are intensively farmed to a wide variety of crops and are suited to any crop that is climatically adapted. Yields are high and the quality is good.

Sorrento fine sandy loam, nearly level (0 to 2 percent slopes) (SM).—This soil occurs in the Carpinteria and Goleta Valleys and to a smaller extent along the flood plains of some of the minor streams. Except for some segregated lime in the subsoil, profile development is not evident. The natural cover is annual grasses and herbs, and scattered oak trees near the streamways.

Representative profile:

0 to 37 inches, dark grayish-brown fine sandy loam; slightly hard; neutral to slightly basic; noncalcareous; weak granular structure; layer readily penetrated by roots and water and in places lower part is stratified with material of slightly different texture.

37 to 54 inches, pale-brown, soft, massive fine sandy loam; moderately basic; slightly calcareous; somewhat stratified but the textures do not vary a great deal.

54 to 72 inches, stratified fine sandy loam similar to layer above but slightly lighter colored.

Use and management.—This deep uniform soil, one of the best in the Area, is suitable for any climatically adapted crop. Lemons, walnuts, avocados, tomatoes, and lima beans are the important crops. Some cut flowers and vegetables are also grown. All crops are irrigated. Some commercial fertilizer is used. Because of the good returns from

lemons on this soil and on similar Mocho and Yolo soils, there has been a tendency to force land values so high that farmers can afford to raise only crops of high cash value.

Sorrento fine sandy loam, imperfectly drained, nearly level (0 to 2 percent slopes) (SL).—This soil occurs in a few small bodies 4 to 6 feet above sea level at the lower edges of the Carpinteria Valley. The subsoil is mottled with brownish iron stains. The water table is 3 to 5 feet below the surface. Otherwise, the profile is similar to that of Sorrento fine sandy loam, nearly level. During winter, water may stand on the surface several days during or following heavy rainfall.

Use and management.—Lima beans are the major crop. Yields are fair but less than on better drained Sorrento areas. Lemon orchards are very spotty. Yields are low, and the trees go into decline much sooner than on the better drained Sorrento soils.

Slight elevation makes it difficult to establish gravity drainage. Drainage by pumping has not been tried but might be profitable because well-drained Sorrento soils have high value for lemons. Frost damage is a severe hazard to lemons.

Sorrento fine sandy loam, over Clear Lake clay, nearly level (0 to 2 percent slopes) (SN).—This soil occurs along the lower edge of the Carpinteria Valley. It consists of material similar to that of the Sorrento soils but overlies very dark gray, fine-textured materials of the Clear Lake series. The overlying Sorrento soil is 18 to 36 inches deep. Internal drainage is slow. The water table is usually 4 to 6 feet below the surface. During the rainy season water stands on the surface.

Use and management.—Because of imperfect drainage, this soil is not suitable for lemons or other permanent crops. Many trees are missing from the few lemon orchards that extend onto this soil, and the remaining trees are inferior. Lima beans do fairly well, but there are bare spots in most fields because the soil is too wet at planting time. The seed rots in these wet spots before the soil is warm enough to allow germination.

Sorrento fine sandy loam, gently sloping (3 to 8 percent slopes) (SK).—Except for having stronger slopes, this soil is similar to Sorrento fine sandy loam, nearly level. It occurs near the upper edges of the Carpinteria Valley and extends back into the uplands along the flood plains of a number of small streams.

Use and management.—This soil is similar to Sorrento fine sandy loam, nearly level, in yields, use, and management. The areas along streams are usually narrow and often have no irrigation water. Where irrigation water is available, lemons and avocados are the principal crops. Lima beans and tomatoes are grown without irrigation. Yields are better than on the terrace and upland soils of the same general locality.

Sorrento fine sandy loam, channeled, sloping (9 to 15 percent slopes) (SJ).—The only body of this soil lies where San Antonio Creek enters Maria Ygnacia Creek. The profile is typical of that for Sorrento soils, but slopes are steeper. The slope is toward the creek channels.

Practically all of this soil is used for lemons. Yields are almost as good as on the nearly level and gently sloping Sorrento soils, but this

soil is more difficult to work and operating costs are considerably higher. Also, some waste areas along the stream channels cannot be farmed.

Sorrento gravelly fine sandy loam, nearly level (0 to 2 percent slopes) (SO).—Partly rounded pieces of sandstone and shale seldom larger than 2 inches in diameter are the principal difference between this soil and Sorrento fine sandy loam, nearly level. This gravel in the surface soil and subsoil somewhat reduces the water-holding capacity and slightly interferes with tillage. This soil occurs in a few small areas near stream channels in the Carpinteria Valley. The profile is highly stratified.

All of this soil is used for lemons. The management is about the same as for Sorrento fine sandy loam, nearly level, and lemon yields are not appreciably less.

Sorrento gravelly fine sandy loam, sloping (9 to 15 percent slopes) (SP).—Except for steeper slope, this soil is similar to Sorrento gravelly fine sandy loam, nearly level. It occupies a few small areas near Carpinteria Creek east of Carpinteria.

This soil is used entirely for lemons. The yields are almost as good as on Sorrento gravelly fine sandy loam, nearly level, but the cost of caring for and harvesting the crop is slightly greater.

Sorrento loam, nearly level (0 to 2 percent slopes) (SS).—Except for a loam surface texture and a somewhat finer textured stratified subsoil and substratum, this soil is similar to Sorrento fine sandy loam, nearly level. It occurs almost entirely in the Carpinteria and Goleta Valleys. The natural vegetation is annual grasses and herbs, and scattered oaks next to the stream channel.

Use and management.—This soil has the same use and management as Sorrento fine sandy loam, nearly level, and other recent alluvial soils of similar texture in the Carpinteria and Goleta Valleys. Lemons are the principal crop. Smaller acreages are used for walnuts and avocados. Lima beans are grown, some for dry beans and some for the fresh market. Tomatoes are also grown, often as an orchard intercrop. Yields are comparable to those obtained on Sorrento fine sandy loam, nearly level.

Sorrento loam, imperfectly drained, nearly level (0 to 2 percent slopes) (SR).—This soil occurs in the lower part of the Carpinteria and Goleta Valleys at elevation of 4 to 6 feet above sea level. The water table is within 4 to 6 feet of the surface. During the rainy season water sometimes stands on the surface. The subsoil is mottled with brownish iron stains, but the profile is otherwise similar to that of Sorrento loam, nearly level.

Some of this soil is in lemon orchards, but the trees are not vigorous. Many trees are missing in the orchards, and yields are low. Irrigated lima beans and tomatoes are the major crop. Usually there are a few bare spots in the bean fields. This soil presents a drainage problem similar to that of Sorrento fine sandy loam, imperfectly drained, nearly level.

Sorrento loam, gently sloping (3 to 8 percent slopes) (SQ).—Except for stronger slopes, this soil is similar to Sorrento loam, nearly level. It occurs to a small extent along the upper edges of the Carpin-

teria and Goleta Valleys and extends back into the hills along the long narrow flood plains of some of the streams.

In the Carpinteria and Goleta Valleys, this soil is used mainly for lemons. On the flood plains, lemons are grown where irrigation water is available. Without irrigation, this soil is used mainly for walnuts, lima beans, and tomatoes for fresh market. The long narrow bodies are more difficult to work than the larger valley areas and usually require smaller machinery.

Sorrento loam, sloping (9 to 15 percent slopes) (ST).—A few small areas of this soil occur at the upper ends of flood plains that extend back into the hills along stream courses. The slopes are toward the creek. The soil is more difficult to work than the more gently sloping Sorrento loams in the larger valleys but has a similar profile.

One small body of this soil on San Roque Creek and one along Elwood Canyon are used for field crops, mostly lima beans grown without irrigation. Along Tajiguas Creek a very small area of this soil is in walnuts.

Sorrento loamy sand, nearly level (0 to 2 percent slopes) (SV).—Except for its loamy sand surface soil and highly stratified coarse-textured subsoil and substratum, this soil is similar to Sorrento fine sandy loam, nearly level. It occurs near drainageways in the Goleta Valley in association with the Mocho, Yolo, and other Sorrento soils. The total acreage is very small. Annual grasses, herbs, and scattered oaks along the stream channel make up the natural cover.

Use and management.—This soil is coarse-textured but highly productive. It is used for both lemons and lima beans under irrigation. Annual cover crops and commercial fertilizers are commonly used in lemon groves. Lemons yield somewhat less than on Sorrento fine sandy loam, nearly level. Lima beans yield very well.

Lemons, tomatoes, and lima beans are the principal crops at present, but this soil is suitable for a wide variety of orchard, field, and truck crops. Because of its coarse texture, however, its water-holding capacity is low and its fertility is somewhat lower than that of the finer textured Sorrento soils.

Sorrento loamy sand, gently sloping (3 to 8 percent slopes) (SU).—Except for stronger slopes, this phase is similar to Sorrento loamy sand, nearly level. In use, management, and yields, this soil is similar to Sorrento loamy sand, nearly level.

TANGAIR SERIES

Soils of the Tangair series have iron-silica cemented hardpans. They have developed on medium to strongly acid windblown sandy material and occupy high terrace positions near the coast. They occur mostly in the western part of the Area, from Point Arguello northward. The natural vegetation is annual grasses and weeds, with brush along the terrace escarpments.

The surface soil is dark grayish-brown, medium to strongly acid, loose sand of single-grained structure. It contains a few small rounded fragments of hardpan. Roots are concentrated in the upper 2 or 3 inches but there are some roots throughout. The subsoil is a brown iron-silica cemented hardpan with yellowish-brown mottlings. It is similar to the surface soil in texture, but is cemented into a rock-

like mass. The hardpan is not continuous. The parent material is light yellowish-brown, loose, strongly acid, single-grained sand.

These soils are used exclusively for range. The carrying capacity and nutrient level are low.

Tangair loamy sand, sloping (9 to 15 percent slopes) (TB).—Except for its loamy sand texture, this soil is similar to Tangair sand, sloping. It occurs on old terraces along the western coastal terraces, mostly south of Canada Honda Creek. It was derived from wind-blown sandy deposits. The vegetation is annual grasses and a little brush.

Use and management.—This soil is somewhat more productive than Tangair sand, sloping. It has a better grass cover and furnishes more forage. Its carrying capacity is low compared to that of the better soils in the Area. At the time of survey all of this soil was within the Camp Cooke Military Reservation and was used exclusively for range.

Tangair loamy sand, sloping, moderately eroded (9 to 15 percent slopes) (TC).—Except for moderate erosion, this soil is similar to Tangair loamy sand, sloping. It occurs in a few small spots near Canada Honda Creek in the northwestern part of the Area. The soil has been used primarily for range, and the erosion has resulted from overgrazing. At the time of survey this soil was all within the Camp Cooke Military Reservation.

Tangair loamy sand, moderately steep (16 to 30 percent slopes) (TA).—Except for its stronger slopes, this soil is similar to Tangair loamy sand, sloping. It usually occupies the side slopes of terraces and is normally brush covered. It is more variable in depth to the hardpan than the sloping Tangair loamy sands. This soil is used only for range and has a low carrying capacity. Only a small amount of grass grows among the brush.

Tangair sand, sloping (9 to 15 percent slopes) (TF).—This soil occurs along the coastal plain in the western part of the Area, particularly on either side of the mouth of Canada Honda Creek. It also appears a few miles inland, as terrace cappings on hills where the Santa Lucia soils have developed. The ridgetops on which these terrace cappings occur form the divide between drainage into Canada Honda Creek and drainage directly into the ocean. The sandy parent materials were deposited by wind action. The natural vegetation is annual grasses, weeds, and brush. The outstanding characteristic of the profile is the strongly developed iron-silica cemented hardpan.

Representative profile:

0 to 35 inches, dark grayish-brown, loose, single-grained sand; medium to strongly acid; some fragments of hardpan usually on the surface; lower part may be slightly compact when dry; grass roots concentrated in the upper 3 to 5 inches but decrease in number rapidly with increasing depth.

35 to 52 inches, very hard, brown, massive iron-silica cemented hardpan; medium acid; hardpan consists of sand similar in texture to the surface material but cemented into a rocklike mass; hardpan not continuous.

52 to 72 inches, light yellowish-brown, loose, strongly acid, single-grained sand.

Use and management.—This soil is all in the Camp Cooke Military Reservation and is leased for range. The forage is meager and of very low carrying capacity.

Tangair sand, sloping, moderately eroded (9 to 15 percent slopes) (TG).—Except for moderate erosion, this soil is similar to Tangair sand, sloping. The erosion is caused by wind and water after the cover of vegetation has been removed. At the time of survey this soil was all within the Camp Cooke Military Reservation and was not used for agriculture.

Tangair sand, sloping, severely eroded (9 to 15 percent slopes) (TH).—This soil occurs along the northern edge of the western coastal plain. It is similar to Tangair sand, sloping, but has been severely eroded. Gullies have formed, and many extend through the hardpan. The erosion apparently took place during previous attempts to grow grain hay. At the time of survey this soil was within the Camp Cooke Military Reservation and not used for agriculture.

Tangair sand, moderately steep (16 to 30 percent slopes) (TD).—Except for stronger slopes, this soil is similar to Tangair sand, sloping. Its depth to the hardpan layer is more variable than in the sloping Tangier sands. The soil occurs along terrace escarpments. For the most part, it is brush covered and it is used only for range. A little grass grows with the brush.

Tangair sand, moderately steep, moderately eroded (16 to 30 percent slopes) (TE).—Except for the results of moderate erosion, this soil is similar to Tangair sand, moderately steep. It is mostly brush covered and is used entirely for range. Erosion does not significantly affect the use of this soil, as its natural carrying capacity is very low.

TERRACE BREAKS

Terrace breaks (TK) consist of nearly vertical bluffs above the coastal beaches, or more commonly, of very steep slopes of terrace material along narrow drainageways. Slopes are usually steeper than 45 percent. For the most part, these areas are covered with brush. In a few places there is a little grass. This land has no agricultural use except for very meager grazing.

TIDAL MARSH

Tidal marsh (TL) consists of swampy areas along the coast, mainly at mouths of streams. They are nearly covered by sea water during high tides and almost completely exposed at low tide. This land has no agricultural use.

TIERRA SERIES

The soils of the Tierra series have claypan subsoils that rest on semiconsolidated old terrace material. They occupy high coastal plain terraces that have rolling tops and steep escarpments. Near Santa Barbara they occur in association with the San Andreas soils; in the western part of the Area they are associated with soils of the Diablo and Los Osos series. The natural vegetation is annual grasses, herbs, and brush. These soils are especially susceptible to gully erosion. Many large gullies have cut deeply into the underlying parent material.

The surface soil, a dark-gray medium to strongly acid fine sandy loam, is very friable when moist but tends to puddle if worked or pastured when it is very wet. Once puddled, the soil becomes hard and difficult to work after it dries out. Under virgin conditions grass roots are plentiful throughout the horizon but are most numerous in the upper 2 or 3 inches. The lower part of the layer, just above the claypan, is gray and strongly leached.

The subsoil is gray, medium acid, blocky clay. The aggregates are heavily coated with colloidal materials and are very hard when dry. The few roots that extend into this layer are concentrated on the surfaces of the aggregates.

The parent material is grayish-brown, stratified, semiconsolidated marine sediments of medium to fine texture.

These soils are used mostly for range. A few areas are cultivated to lima beans and grain hay. In the Hope Ranch area, lemons and avocados are grown to some extent.

Tierra fine sandy loam, sloping, moderately eroded (9 to 15 percent slopes) (To).—This soil occupies sloping or undulating terraces and has been moderately eroded. It is associated with San Andreas soils in the eastern part of the Area on the Hope Ranch and in the Las Positas Hills. In the northwestern part, on the watershed of Canada Honda Creek, it is associated with the Los Osos and Diablo Soils. The vegetation on the terrace tops is chiefly grasses. Some brush grows along the terrace slopes.

Representative profile:

0 to 15 inches, dark-gray hard granular fine sandy loam; medium to strongly acid; very friable when moist but easily puddled if worked or pastured when wet; puddled soil dries out hard and is difficult to get back into good condition.

15 to 19 inches, gray, hard, medium acid fine sandy loam; somewhat vesicular structure; ranges from a fraction of an inch to 3 inches thick and is abruptly replaced by the claypan.

19 to 34 inches, very hard, gray, blocky clay; medium acid; very sticky when wet; aggregates heavily coated with colloidal stains; roots do not penetrate layer readily, and those that do are concentrated along the vertical surfaces of the aggregates.

34 to 52 inches, similar to layer above but slightly lighter colored, neutral, and of weaker blocky structure.

52 to 70 inches, grayish-brown, very hard, massive marine sediments of clay loam to clay texture, usually somewhat consolidated.

Use and management.—This soil is mostly used for range. A few small areas are in field crops, principally grain hay. Yields are low. The soil is difficult to work and to protect from erosion. Gully erosion is particularly hard to control. Gullies commonly start on the side slopes of terraces and work back rapidly. In many places gullies have cut deeply into the semiconsolidated terrace material and have nearly vertical sides. Tillage implements cannot cross the gullies, and there is some loss of area because it is difficult to work up to the edge of them. The range has a carrying capacity about the same as that on Watsonville and Olivenhain soils of comparable slope.

Tierra fine sandy loam, hilly, moderately eroded (16 to 30 percent slopes) (Tm).—Except for stronger slopes, this soil is similar to Tierra fine sandy loam, sloping, moderately eroded. It occurs on the edges of the higher terraces. A few deep gullies with vertical

sides have developed. They are difficult to control once started. The natural cover is mainly grasses, mixed with a little brush. This soil is used mostly for range. The carrying capacity is low.

Tierra fine sandy loam, hilly, severely eroded (16 to 30 percent slopes) (TN).—Except for the extent of erosion, this soil is similar to Tierra fine sandy loam, hilly, moderately eroded. It is limited in acreage and occurs in the western part of the Area. Some of this soil was once farmed but it is now used only for range. Erosion has removed most of the surface soil, and some areas are also badly gullied. This soil is suitable only for range and its carrying capacity is low.

Tierra fine sandy loam, steep, moderately eroded (31 to 45 percent slope) (TP).—Except for stronger slopes, this soil is similar to Tierra fine sandy loam, hilly, moderately eroded. It occurs on the steep slopes of the higher terraces. Most of it is in the western part of the Area, but a few bodies are in the eastern part. The profile is more variable than that of the sloping or hilly Tierra fine sandy loams. This is used entirely for range. The erosion results from overgrazing.

Tierra soils, undifferentiated, steep (31 to 45 percent slopes) (TR).—Because of steep slopes and variable textures, these soils were not differentiated. They occur on the edges of the terraces in the western part of the Area. They are usually brush covered and are used entirely for range.

WATSONVILLE SERIES

Soils of the Watsonville series have claypan subsoils that rest on the unconsolidated material of low marine terraces. The terrace tops are smooth and rolling or undulating and generally break abruptly to steep terrace escarpments. These soils occur close to the ocean along the coastal plain and are associated with soils of the Milpitas, Montezuma, Marina, and Baywood series. The natural vegetation is annual grasses and herbs, with some brush along the terrace escarpments.

The surface soil is dark-gray, hard, medium acid sandy loam to loam, very friable to friable when moist, and weakly granular. It puddles easily if worked or pastured when too wet. Where the soil has been puddled, it is difficult to restore it to condition favorable for tillage. The 3 or 4 inches just above the claypan is light gray and distinctly vesicular. Grass roots are numerous throughout the surface soil, but are most abundant in the upper 3 or 4 inches.

The subsoil is dark-gray to dark grayish-brown, very hard, medium acid, compact clay. The color becomes a little lighter with increasing depth. The upper subsoil is distinctly prismatic, and the lower part tends to be blocky. The aggregates are heavily coated with colloids and inside they are often mottled brownish and grayish. The few roots that reach into this layer are concentrated on the surfaces of the aggregates.

The parent material is gray, hard, massive, medium acid sandy clay loam to sandy clay.

These soils are used for range and field crops. Flowers and ornamental crops are the principal uses in the eastern part of the Area. Grain hay, Sudangrass pasture, and range are the major uses in the western part.

Watsonville fine sandy loam, nearly level (0 to 2 percent slopes) (WE).—This soil occurs on terrace tops in the east-central part of the Area. It is similar to the gently sloping Watsonville fine sandy loan in profile and in use suitability and gives about the same yields. It is less favorable for irrigation because it is nearly level. Removing waste water and preventing temporary waterlogging are difficult.

Watsonville fine sandy loam, gently sloping (3 to 8 percent slopes) (WA).—This soil occurs mainly on old marine terraces in the east-central and central parts of the Area. It is associated with Milpitas, Montezuma, and Baywood soils. The profile is strongly developed and has a compact claypan in the subsoil. The natural vegetation on the terrace tops consists of annual grasses and herbs. Some brush grows on the side slopes of the terraces.

Representative profile:

0 to 18 inches, dark-gray, medium acid, granular fine sandy loam; very friable when moist but tends to puddle if worked or pastured when too wet; becomes hard upon drying and is difficult to restore to good tilth; lower part a little more porous and, in places, slightly finer in texture than the rest; contains a few small iron pellets in some places.

18 to 24 inches, gray, hard, massive sandy loam or fine sandy loam of distinctly vesicular structure; contains small iron pellets; layer is only a fraction of an inch thick in some places.

24 to 37 inches, dark-gray to dark grayish-brown, very hard, medium acid, prismatic clay; interiors of the aggregates mottled with brownish and grayish stains and exteriors well coated with colloids; few roots that penetrate are concentrated along the surfaces of the aggregates.

37 to 50 inches, hard, medium acid, massive sandy clay loam to sandy clay, gray with brownish iron mottlings.

Use and management.—Because of climate and nearness to the ocean, tracts of this soil in the eastern part of the Area are used mainly for flowers and ornamentals. Lima beans, grain hay, and tomatoes are also grown to some extent. In the western part, the soil is used for range, Sundangrass pasture, and grain hay. A few lemons and avocados are grown, but yields are low, salinity is a problem, and the bearing capacity of the trees declines early.

Watsonville fine sandy loam, gently sloping, moderately eroded (3 to 8 percent slopes) (WB).—This soil is similar to Watsonville fine sandy loam, gently sloping, except for the effects of moderate sheet erosion and a few gullies. It occurs principally in the central and east-central parts of the Area. Nearly all of this soil is used for specialty crops and ornamentals grown under irrigation. Erosion has reduced the effective rooting and water-storage zones above the claypan.

Watsonville fine sandy loam, sloping (9 to 15 percent slopes) (WF).—Except for stronger slopes, this soil is similar to Watsonville fine sandy loam, gently sloping. It occurs in a number of places along the coastal plain.

This soil is used for field crops and range. It is more difficult to manage than the nearly level and gently sloping Watsonville fine sandy loams, but yields are about the same. Somewhat more than half of this soil is in range.

Watsonville fine sandy loam, sloping, moderately eroded (9 to 15 percent slopes) (WG).—This soil occurs in a few places in the east-central part of the Area. It is similar to Watsonville fine sandy

loam, sloping, except for the effects of moderate sheet erosion and a few gullies. Sheet erosion reduces the limited rooting zone above the compact claypan subsoil, which has little value for crop growth. Yields on this soil are less than those on Watsonville fine sandy loam, sloping.

Watsonville fine sandy loam, moderately steep (16 to 30 percent slopes) (WC).—This soil occupies the side slopes of terraces. Its profile is more variable than that for less strongly sloping Watsonville fine sandy loams. The depth to claypan and its degree of compactness vary within short distances. This soil is used almost entirely for range. The carrying capacity is somewhat less than that for Watsonville soils that occur on the tops of terraces.

Watsonville fine sandy loam, moderately steep, moderately eroded (16 to 30 percent slopes) (WD).—Except for moderate erosion, this soil is similar to Watsonville fine sandy loam, moderately steep. It occurs in a few places in the east-central part of the coastal plain, on moderately steep slopes along the terraces edges. It is used exclusively for range. The carrying capacity is less than that of Watsonville fine sandy loam, sloping. Overgrazing is the principal cause of erosion.

Watsonville loam, nearly level (0 to 2 percent slopes) (WM).—Except for more gentle relief, this soil is similar to Watsonville loam, gently sloping. It occupies nearly level terrace tops.

This soil is used largely for field crops, but to some extent for ornamentals. In use, management, and yields it is about the same as Watsonville loam, gently sloping. In wet seasons, runoff is sluggish and the land is difficult to work after rains. Only a few acres in the Hope Ranch district are irrigable, and internal drainage is a problem.

Watsonville loam, gently sloping (3 to 8 percent slopes) (WH).—Except for the loam texture of the surface layer, this soil is similar to Watsonville fine sandy loam, gently sloping. It occupies the terrace tops in association with Milpitas, Arguello, Baywood, and Montezuma soils. The natural vegetation is mostly annual grasses and herbs. A little brush grows on the terrace slopes.

Use and management.—This soil has essentially the same uses and management requirements as Watsonville fine sandy loam, gently sloping, and produces about the same yields. In the western part of the Area, much of this soil is used for Sudangrass pasture. Sudangrass grows well and increases the carrying capacity substantially. Yields of Sudangrass are even better, however, on the Elder, Botella, and Arguello soils of the same general area.

Watsonville loam, gently sloping, moderately eroded (3 to 8 percent slopes) (WK).—Except for moderate sheet erosion and a few gullies, this soil is similar to Watsonville loam, gently sloping. Sheet erosion is particularly serious because it decreases the rooting zone. This soil is used for field crops or Sudangrass pasture. Yields are somewhat less than on Watsonville loam, gently sloping.

Watsonville loam, sloping (9 to 15 percent slopes) (WN).—Except for stronger slopes, this phase is similar to Watsonville loam, gently sloping. It occurs on sloping or rolling terrace tops on the coastal plain, mainly in the eastern part of the Area.

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This soil is used mainly for range. A few pastures are planted to Sudangrass. Yields of Sudangrass are similar to those on Watsonville loam, gently sloping, but the danger of erosion from overgrazing is greater.

Watsonville loam, sloping, moderately eroded (9 to 15 percent slopes) (Wo).—Except for moderate sheet erosion, this soil is similar to Watsonville loam, sloping. A number of small bodies occur in the east-central and western parts of the coastal plain. A few gullies have developed. Field crops are the major use in the east-central part, and Sudangrass pasture in the western part. Because sheet erosion has reduced the rooting zone, yields are somewhat less than on Watsonville loam, sloping.

Watsonville loam, moderately steep, moderately gullied (16 to 30 percent slopes) (Wl).—This soil occurs as narrow bodies near the tops of moderately steep terrace slopes. It is somewhat affected by sheet erosion, and by gullies. In places there is some brush cover. This soil is used almost entirely for range. The carrying capacity is low.

Watsonville sandy loam, gently sloping (3 to 8 percent slopes) (Wp).—Except for its sandy loam surface layers, this soil is similar to Watsonville fine sandy loam, gently sloping. It occurs in the western part of the Area along the coastal plain, from Point Conception to Point Arguello. It occupies the rather smooth tops of old marine terraces in association with Baywood, Arguello, and Tangair soils, and with other Watsonville soils. The vegetation on the terrace tops is mainly grass, but the sides of the terraces are generally brush covered.

This soil is used entirely for range, but the forage is not so good as that on Watsonville fine sandy loam, gently sloping.

Watsonville sandy loam, sloping (9 to 15 percent slopes) (Ws).—Except for stronger slopes, this soil is similar to Watsonville sandy loam, gently sloping. In places, its rolling relief appears to have been modified somewhat by wind. There are only a few small bodies of this soil and they are in the western part of the Area. This soil is used for range. The carrying capacity is about the same as for Watsonville sandy loam, gently sloping.

Watsonville sandy loam, moderately steep, moderately eroded (16 to 30 percent slopes) (Wr).—This soil occurs on the side slopes of terraces. It has been affected by moderate sheet erosion, and a few gullies have formed. Profile characteristics are more varied than in the more gently sloping Watsonville soils of the terrace tops, particularly in depth to and compactness of the claypan. This soil is used only for range. The erosion results from overgrazing. The carrying capacity is less than that of other Watsonville sandy loams.

Watsonville soils, undifferentiated, steep (31 to 45 percent slopes) (Wt).—These undifferentiated soils occur on the sides of steep terraces. They are entirely in ranges that have low carrying capacity. Some areas are brush covered. The land has been overgrazed, and some erosion, mainly gullying, has taken place. This is not serious on the steep side slopes but it threatens damage to more productive soils on the more nearly level terrace tops.

YOLO SERIES

Soils of the Yolo series occur on nearly level to sloping recent alluvial fans in the Goleta and Carpinteria Valleys and on narrow flood plains of small creeks in the eastern part of the Area. They are similar to and closely associated with soils of the Sorrento series. They are also associated with Mocho, Carpinteria, and Agueda soils. The natural cover probably was annual grasses, herbs, and scattered oak trees, but nearly all of the soils are now cultivated.

The surface soil is dark-gray neutral sandy loam or loam. It has a weak granular structure that puddles easily if worked when too wet. The subsoil is dark grayish-brown and neutral, and similar to the surface soil in texture. The parent material is much like the subsoil but more highly stratified.

Yolo soils in this Area are in general slightly darker colored than the associated Sorrento soils or the Yolo soils in the lower western Sacramento Valley. Yolo soils are used for and are suited to a wide variety of crops (pl. 6).

Yolo fine sandy loam, nearly level (0 to 2 percent slopes) (Yʙ).—This soil occurs almost entirely in the Carpinteria and Goleta Valleys in association with Sorrento and Mocho soils, and other soils of the Yolo series. It was derived from recent stratified alluvium that was washed from adjacent upland soils that developed from sedimentary rocks. The natural vegetation is annual grasses, herbs, and scattered oaks. Most of this soil is now cultivated.

Representative profile:

0 to 20 inches, dark-gray, hard, neutral, granular fine sandy loam; very friable when moist and easily kept in favorable tilth.
20 to 53 inches, dark grayish-brown, hard, neutral, stratified fine sandy loam; very weakly granular to massive.
53 to 72 inches, similar to the subsoil but massive and more stratified.

Use and management.—This soil is used and managed in much the same way as Sorrento fine sandy loam, nearly level. Lemons are the major crop; walnuts, lima beans, and tomatoes are also grown. Yields and quality are very good.

Yolo fine sandy loam, gently sloping (3 to 8 percent slopes) (Yᴀ).—Except for stronger slopes, this soil is similar to Yolo fine sandy loam, nearly level. It occurs in the upper parts of the Carpinteria and Goleta Valleys and extends back into the hills along many of the streamways.

In the Carpinteria and Goleta Valleys, and in the irrigated parts of the stream valleys, the use, management, and yields are similar to those described for Yolo fine sandy loam, nearly level. Efficient irrigation is somewhat more difficult on this soil. Areas not irrigated are used for walnuts, lima beans, and tomatoes. Management and yields are similar to those described for Sorrento fine sandy loam, gently sloping.

Yolo gravelly fine sandy loam, gently sloping (3 to 8 percent slopes) (Yᴄ).—Except for having gravel throughout the profile, this soil is similar to Yolo fine sandy loam, gently sloping. The gravel reduces the water-holding capacity materially and somewhat interferes with tillage. This soil occurs near streamways, mainly in the upper parts of the Carpinteria and Goleta Valleys.

This soil is used in much the same way as the Yolo and Sorrento fine sandy loams, gently sloping, but the yields are not so good. Lemons, tomatoes, and lima beans are the principal crops.

Yolo loam, nearly level (0 to 2 percent slopes) (Yg).—Except for a loam surface soil and a stratified loam and clay loam subsoil and substratum, this soil is similar to Yolo fine sandy loam, nearly level. It occurs on gentle slopes in the Carpinteria and Goleta Valleys and extends back into the hills along a number of narrow flood plains. Most of it is in the eastern and central parts. The natural vegetation is annual grasses, herbs, and scattered oaks. Trees are more numerous along the streamways of the narrow flood plains than on the more extensive alluvial fans.

Use and management.—In the Carpinteria and Goleta Valleys and along some of the narrow valleys in the central and eastern parts of the Area, this soil is used and managed much the same as Yolo and Sorrento soils of the same texture and slope. Yields are about the same. In the western part it is used for grain hay or Sudangrass pasture.

Yolo loam, imperfectly drained, nearly level (0 to 2 percent slopes) (Yf).—This soil occurs in parts of the Carpinteria and Goleta Valleys that lie only a few feet above sea level. During the dry season the water table is only 4 to 6 feet below the surface, and in the rainy season water frequently stands on the surface. The subsoil is grayer than is typical of the Yolo series and it has rust-brown iron mottlings.

Lima beans and tomatoes do moderately well on this soil but it is not well suited to permanent crops. There are some lemon groves, but the trees are not vigorous, many are missing, and yields are lower than on the better drained Yolo soils. There are also some bare spots in the bean and tomato fields.

Yolo loam, gently sloping (3 to 8 percent slopes) (Ye).—Except for stronger slopes, this soil is similar to Yolo loam, nearly level. It occurs in the same general localities, and in use, management, and yields it is essentially the same. Efficient irrigation is somewhat more difficult.

Yolo loam, channeled, sloping (9 to 15 percent slopes) (Yd).—This soil occurs along the upper flood plains of a few creeks and on irregular slopes, principally along Canāda Honda Creek and in Tecolote Canyon. The profile is similar to that of Yolo loam, nearly level, but the soil is channeled by the main and side creeks. Along Canāda Honda Creek the soil was not used for agriculture at the time of survey, but in Tecolote Canyon it was used without irrigation for lima beans. The fields cut up by the channels are difficult to work.

Yolo sandy loam, nearly level (0 to 2 percent slopes) (Yk).—Except for a sandy loam texture throughout the profile, this soil is similar to Yolo fine sandy loam, nearly level. It occurs in the Carpinteria and Goleta Valleys, principally in association with other Yolo soils and with soils of the Sorrento and Mocho series. The natural vegetation was annual grasses, herbs, and scattered oaks.

Use and management.—Most of this soil is cultivated. Lemons and walnuts are the major crops. In some places the walnut trees are

being replaced by lemons. The management for lemons is much the same as on the other recent alluvial soils. Yields are only slightly less than are obtained on Yolo fine sandy loam, nearly level. On most of the acreage not used for orchards, lima beans and tomatoes are grown, usually under irrigation.

Yolo sandy loam, gently sloping (3 to 8 percent slopes) (YH).—Except for stronger slopes, this soil is similar to Yolo sandy loam, nearly level. It occurs on a number of small narrow flood plains that extend back into the mountains along small creeks. In many of these small valleys no irrigation water is available. Where it is available, lemons are the principal crop. Without irrigation, the principal crops are lima beans and tomatoes. Yields and management are similar to those described for Yolo sandy loam, nearly level.

Yolo stony fine sandy loam, gently sloping (3 to 8 percent slopes) (YL).—Except for many stones on the surface and throughout the profile, this soil is similar to Yolo fine sandy loam, gently sloping. The stones range from a few inches to 3 feet in diameter. Most of this soil is in the Carpinteria and Goleta Valleys on gently sloping alluvial fans of short streams that have steep grades. In a few places the slopes are slightly greater than 8 percent.

For the most part, this soil is too stony for cultivation. In a few places the surface stones have been removed at considerable expense and lemons have been planted. The trees do well but yield somewhat less than on Yolo fine sandy loam, gently sloping. The rest of this land is in range of fairly good carrying capacity.

ZACA SERIES

The soils of the Zaca series rest on soft calcareous shales (pl. 7). The slopes range from hilly to very steep, are smooth, and have well-rounded crests. The soils occur in many parts of the Santa Barbara Area and are associated with Nacimiento, Santa Lucia, Tierra, Watsonville, and Montezuma soils. The natural vegetation consists of annual grasses, herbs, and burclover.

The surface soil is very dark gray, moderately basic, moderately calcareous clay loam and clay. In places it is shaly. The structure is weakly blocky. Despite the fine texture, the soil is usually porous and easily crumbled. Grass roots are plentiful throughout this layer, but are concentrated in the upper 2 or 3 inches.

The subsoil is dark-gray, moderately basic, moderately calcareous, and of subangular blocky structure. Lime occurs mostly in the form of soft seams and nodules. This layer contains a few fragments of shale; the number increases with depth.

The parent material consists of pale-yellow, massive, strongly calcareous shale. This shale is soft and deeply weathered, and a little soil material is intermixed with it. The upper part is somewhat mottled with brownish iron stains.

Zaca soils are used for range and for field crops, mainly lima beans, tomatoes, and grain hay. A few lemons and avocados are grown in some places.

Zaca clay, sloping (9 to 15 percent slopes) (Zo).—Except for gentler slopes, this soil is similar to Zaca clay, hilly. It occupies hill crests in the central and eastern parts of the Area. Lima beans and

tomatoes are the major crops. In use and management it is similar to Zaca clay, hilly, but it is more easily worked and crops are more easily cared for and harvested.

Zaca clay, hilly (16 to 30 percent slopes) (ZA).—Except for the clay texture, this soil is similar to Zaca clay loam, hilly. It occupies the lower hills adjacent to the terraces in the central part of the Area. It is associated with Zaca, Santa Lucia, Nacimiento, and Los Osos soils. The slopes are smooth and the hill crests are rounded. The profile is typically slightly deeper than that of Zaca clay loam, hilly. The natural vegetation is annual grasses, herbs, and burclover.

Use and management.—This soil is used mostly for range or field crops. It is one of the better range soils, and one of the best soils for the field crops grown without irrigation. Grasses grow luxuriantly, and the forage includes considerable burclover. In the western part of the Area, however, mustard has decreased the value of the forage. Mustard seems to grow mostly on calcareous soils, and areas of Zaca and Nacimiento soils are most seriously affected.

Lima beans and tomatoes are the major field crops. A small amount of grain hay is also grown. Yields of lima beans and hay are good. Tomatoes are grown only for fresh market and produce extremely variable yields. Lemon and avocado plantings are small and are usually on estates or homesites. Avocados appear to do fairly well, but the lemon trees are usually chlorotic and probably will go into decline earlier than those grown on less calcareous soils.

Zaca clay, hilly, moderately eroded (16 to 30 percent slopes) (ZB).—Except for moderate sheet erosion, and a few gullies, this soil is similar to Zaca clay, hilly. It occurs in the central part of the Santa Barbara Area. Lima beans and tomatoes are the major crops. Land use and management are not, as yet, materially affected by erosion. Where only sheet erosion has taken place, management and yields are similar to those described for Zaca clay, hilly. Where gullies have developed, farming is more difficult.

Zaca clay, steep (31 to 45 percent slopes) (ZD).—Except for stronger slopes, this soil is similar to Zaca clay, hilly. It occurs rather extensively in the central and western parts of the Area. Most of it is used for range. It has a good carrying capacity, comparable to that of the hilly phase. In the western part of the Area mustard has reduced the value of the forage in places.

Zaca clay, steep, moderately eroded (31 to 45 percent slopes) (ZE).—Except for moderate erosion, this soil is similar to Zaca clay, steep. It occurs extensively in the central and western parts of the Area. The erosion is the result of cultivation. The soil is used mainly for field crops. The few gullies that have formed make farming more difficult and reduce the tillable area. Because the parent material is soft, the loss of some surface soil by sheet erosion is not so critical as for other soils.

Zaca clay, steep, severely eroded (31 to 45 percent slopes) (ZF).—This soil is similar to Zaca clay, steep, but has been severely eroded as a result of cultivation. It occurs in a few places in the east-central part of the Area. All of this soil is used for lima beans and tomatoes. Erosion is so severe that yields are materially reduced and farming

is made difficult. Careful management is needed to check erosion on these steep slopes. Conversion to range or grain hay would simplify erosion control.

Zaca clay loam, sloping, moderately eroded (9 to 15 percent slopes) (ZH).—This soil is similar to Zaca clay loam, hilly, but has gentler slopes and has been moderately eroded. Most of this soil occurs in the eastern part of the Area. It is farmed to lima beans, lemons, or avocados. Bean fields are not irrigated, but irrigation water is essential for lemons or avocados. Yields are nearly the same as on uneroded areas. The loss of some surface soil by sheet erosion is not so serious as on other soils in the Area, because the parent material is soft. One small body of this soil in the western part of the Area is used only for range. Its carrying capacity is good, but not so good as that of uneroded areas.

Zaca clay loam, hilly (16 to 30 percent slopes) (ZG).—This soil occurs along the foothills adjoining or close to the coastal terraces, particularly between Elwood and Point Arguello. It is generally shallower than Zaca clay soils, or only 2 or 3 feet deep to soft calcareous shale. The natural vegetation is annual grasses, herbs, and burclover.

Representative profile:

0 to 12 inches, very dark gray, hard, moderately basic, moderately calcareous, blocky clay loam; many grass roots throughout layer but most numerous in the upper few inches in uncultivated areas.

12 to 36 inches, dark-gray, hard, moderately basic, moderately calcareous, subangular blocky clay loam; lime occurs in thin threads, soft nodules, or both; color becomes lighter and the amount of lime increases with depth.

36 inches +, pale-yellow, massive, strongly calcareous shale bedrock; upper part intermixed with a little soil material; shale soft and weathered to considerable depth but harder than the shale under Zaca clays.

Use and management.—Much of this soil is used for range. The carrying capacity is good but less than that of Zaca clay, hilly. Field crops such as lima beans, tomatoes, and grain hay are grown without irrigation in some areas. Yields are slightly less than on the Zaca clay soils which are somewhat deeper and hold more moisture. Where irrigation water is available, this soil is used for lemons and avocados, but these crops are subject to lime-induced chlorosis. Yields are less than half as much as on the better alluvial soils, and some orchards have been removed.

Zaca clay loam, steep (31 to 45 percent slopes) (ZK).—Except for stronger slopes, this soil is similar to Zaca clay loam, hilly. It is a little shallower and more variable in depth to bedrock. It occurs in many small bodies from Santa Barbara westward. The slopes are smooth and steep and their crests are well rounded. Most of this soil is used for range. The carrying capacity is good, or comparable to that on Zaca clay loam, hilly. Lima beans or grain hay are grown to some extent in the central part of the Area, but in general the slopes are too steep for cultivated crops.

Zaca nonstony soils, undifferentiated, very steep (46+ percent slopes) (ZL).—These nonstony soils are similar to the other Zaca soils but are, as a rule, somewhat shallower. Because of their very steep slopes and variable surface textures, they were not differentiated. They are scattered throughout the Area where other Zaca soils occur.

They are too steep for cultivation. They are used only for range. The carrying capacity is somewhat lower than that of other Zaca soils.

Zaca shaly clay loam, sloping (9 to 15 percent slopes) (ZP).—Except for more gentle slopes, this soil is similar to Zaca shaly clay loam, hilly. It occurs mainly in small bodies on nearly level ridge crests, mostly in the central part of the Area.

This soil is used mainly for lima beans, tomatoes, or grain hay. Yields compare with those obtained on Zaca clay loam, hilly. One or two small areas in the western part are used entirely for range. The carrying capacity is slightly less than on Zaca clay loam of comparable slopes.

Zaca shaly clay loam, sloping, moderately eroded (9 to 15 percent slopes) (ZR).—Except for moderate erosion, this soil is similar to Zaca shaly clay loam, sloping. The few small bodies occur on the low hills on either side of Conada Refugio Creek and near Capitan. The erosion is the result of farming. The soil is used entirely for field crops. Yields are slightly lower than on Zaca shaly clay loam, sloping.

Zaca shaly clay loam, hilly (16 to 30 percent slopes) (ZM).—Except for angular and platy shale fragments on the surface and throughout the profile, this soil is similar to Zaca clay loam, hilly. It occurs in the lower hills just inland from the coastal plain. It extends from Capitan westward almost to Point Arguello. It is closely associated with Santa Lucia soils and other Zaca soils, and on the inland side it borders mostly on Nacimiento soils. The profile is slightly shallower than that of the Zaca clay loams or clays. The natural cover is annual grasses and herbs.

This soil is used mainly for range. Its carrying capacity is only slightly lower than that of Zaca clay loam, hilly. A few small areas are in lima beans, tomatoes, and grain hay. Yields of these crops are slightly less than those obtained on Zaca clay loam, hilly.

Zaca shaly clay loam, hilly, moderately eroded (16 to 30 percent slopes) (ZN).—This soil is similar to Zaca shaly clay loam, hilly, except for the effects of moderate sheet erosion and a few gullies. The erosion is a result of cultivation practices. The soil occurs mostly in the lower hills on either side of Conada Refugio Creek. It is used for field crops. Yields are reduced by erosion. Gullies reduce the amount of soil that can be farmed and make farming difficult.

Zaca shaly clay loam, hilly, severely eroded (16 to 30 percent slopes) (ZO).—This soil is similar to Zaca shaly clay loam, hilly, but has been severely damaged by sheet wash and gully erosion. It is used for field crops. Yields are low because of the erosion, and some fields have been taken out of cultivation.

Zaca shaly clay loam, steep (31 to 45 percent slopes) (ZS).—Except for stronger slopes, this soil is similar to Zaca shaly clay loam, hilly. It occurs in the central and western parts of the Area on smooth but steep slopes. The depth to bedrock is somewhat more variable and the profile is slightly shallower than for the hilly Zaca shaly clay loam. Range is the principal use for this soil. The carrying capacity compares with that of Zaca shaly clay loam, hilly. Field crops are grown in a few places. Yields are less than on the hilly soil, and tillage is more difficult.

Zaca shaly clay loam, steep, moderately eroded (31 to 45 percent slopes) (ZT).—Except for the effects of moderate erosion, mainly the result of farming, this soil is similar to Zaca shaly clay loam, steep. A few small bodies are in the central part of the Area. Field crops are the principal use. Yields are rather low. The steep slopes make tillage and control of erosion difficult. Where gullies have developed, cultivation is particularly difficult and some of the tillable acreage is lost.

Zaca shaly clay loam, steep, severely eroded (31 to 45 percent slopes) (ZU).—This soil occurs in the central part of the Santa Barbara Area. It is similar to Zaca shaly clay loam, steep, but has been damaged by severe sheet erosion caused by continued cultivation. Gullies have developed in some places. All of the soil is farmed to field crops. Yields are low because much of the surface soil has been lost. The effects of erosion make farming difficult. Some fields are being taken out of cultivation.

Zaca stony soils, undifferentiated, steep and very steep (31+ percent slopes) (Zv).—Because of their stony variable surface texture and steep to very steep slopes, these soils were not differentiated. The profiles are shallow, rock outcrops are common, and many shale fragments are on the surface and throughout the profile. The bedrock and the loose rocks in the profile are somewhat harder than is typical for the Zaca series. These stony soils occur throughout the general area occupied by Zaca soils, but in proportionately greater acreage in the western part of the Area. The vegetation is grass or brush. The land is used entirely for range. The forage is meager and has low carrying capacity.

CROP YIELDS

Yields of various crops on the soils of this Area were estimated from information received from many sources (see table 4). Most of the information came from the County Farm Advisor and his staff and the County Agricultural Commissioner. Other information came from other local, State, and Federal officials and from individual farmers and ranchers. The ranges in the yields of crops are due to differences in management and variations in rainfall and weather over the years.

Yields of each crop are reported in the standard unit of measurement for the crop. Lemon yields are reported in packed boxes, regardless of how they were marketed. A packed box of lemons contains approximately 79 pounds of fruit. The yields are calculated as averages over the productive period of the tree. Lemon trees start to produce in their fourth year and continue for 25 years or more. The maximum production comes in the tenth to the fifteenth years, after which production declines slowly. This period of high production is somewhat shorter than is common for lemons in other parts of the State, particularly inland areas such as Riverside and San Bernardino Counties.

No satisfactory estimate on yields of avocados could be made for lack of data. Most orchards are not yet in full bearing; there are more nonbearing than bearing trees. The characteristic of this fruit to bear heavily in alternate years makes average production hard to estimate.

TABLE 4.—*Estimated range in yields for principal crops on soils of the Santa Barbara Area, Calif.*

Soils	Lemons	Walnuts	Lima beans		Tomatoes		Grain hay (non-irrigated)	Sudangrass pasture (non-irrigated)	Range pasture (non-irrigated)
			Irrigated	Non-irrigated	Irrigated	Non-irrigated			
	Boxes	*Cwt.*	*Cwt.*	*Cwt.*	*Tons*	*Tons*	*Tons*	*Cow-acre-days* [1]	*Cow-acre-days* [1]
Agueda clay loam:									
Nearly level	300–500	12–24	12–18	8–10	6–10	3–6	1–1½		25–40
Gently sloping	300–500	12–24	12–18	8–10	6–10	3–6	1–1½		25–40
Sloping	250–450	10–20	12–18	8–10	6–10	3–6	1–1½		25–40
Agueda gravelly clay loam:									
Gently sloping	250–500	10–20	(2)	8–10		3–6	1–1½		20–30
Sloping	200–450	10–20		8–10		3–6	1–1½		20–30
Aliso fine sandy loam:									
Gently sloping, moderately eroded	150–300	6–14		4– 7		2–5			20–30
Sloping	150–300	6–14		4– 7		2–5			20–30
Sloping, moderately eroded	100–250	6–14		4– 7		2–4			20–30
Moderately steep, moderately eroded	100–250			3– 6		1–3			20–30
Steep, moderately eroded	100–200								20–30
Aliso loam:									
Gently sloping, moderately eroded	150–300	6–14		4– 7		3–5			20–30
Sloping, moderately eroded	100–250	6–14		4– 7		2–4			20–30
Moderately steep, moderately eroded	150–250			4– 7		1–3			20–30
Moderately steep, severely eroded	100–200			2– 4		1–2			5–15
Alviso soils, undifferentiated, nearly level									2–10
Arguello shaly loam:									
Gently sloping								50– 90	20–34
Sloping								50– 90	20–34
Ballard fine sandy loam:									
Nearly level	200–500	9–20	14–18	7– 9	6– 8	3–5	1–1½		20–40
Gently sloping	200–500	9–20	14–18	7– 9	6– 8	3–5	1–1½		20–40

Sloping	150–450	9–20	12–15	6– 8		3–5	1–1½		20–40
Sloping, moderately eroded	150–400	8–16	12–15	6– 8		2–4	1–1½		15–35
Ballard gravelly fine sandy loam, gently sloping	200–400	8–18	12–15	6– 8	5– 8	3–5	1–1½		15–35
Ballard stony fine sandy loam, gently sloping and sloping	150–350								15–30
Baywood loamy fine sand:									
Gently sloping	150–350		7–12	3– 7	4– 7				10–20
Moderately steep	100–300		7–12	3– 7	3– 6				5–15
Over Watsonville soils, gently sloping	250–450		7–12	3– 7	4– 7				10–20
Baywood loamy sand:									
Nearly level	100–300		6–10	2– 6	2– 6				5–15
Gently sloping	100–300		6–10	2– 6	2– 6				5–15
Rolling	100–300		6–10	2– 6	2– 6				5–15
Over Watsonville soils, nearly level			6–10	2– 6	2– 6			30– 80	5–15
Over Watsonville soils, gently sloping			6–10	2– 6	3– 6			30– 80	5–15
Botella clay loam:									
Nearly level	250–500	10–25	16–20	8–10	7–10	3–6	1–1½	125–200	25–40
Gently sloping	250–500	10–25	16–20	8–10	7–10	3–6	1–1½	125–200	25–40
Sloping	250–500	10–25	16–20	8–10	6– 9	3–6	1–1½	–200	25–40
Carpinteria clay loam:									
Gently sloping	250–550	10–20	16–20	8–10	7–10	3–6			20–40
Sloping	250–450	10–20	14–18	8–10	6– 9	3–6			20–40
Moderately steep	200–450								20–40
Carpinteria loam, gently sloping	250–550	10–20	16–20	8–10	7–10	3–6			20–40
Cayucos clay:									
Sloping									12–30
Hilly									12–30
Cayucos clay loam:									
Hilly, moderately eroded									10–20
Steep, moderately eroded									10–20
Cayucos shaly soils, undifferentiated, steep and very steep									6–15
Clear Lake clay, nearly level			7–11		5– 8				30–50
Climax clay (adobe):									
Hilly									12–30
Steep									10–20

See footnotes at end of table.

TABLE 4.—*Estimated range in yields for principal crops on soils of the Santa Barbara Area, Calif.*—Continued

Soils	Lemons	Walnuts	Lima beans		Tomatoes		Grain hay (non-irrigated)	Sudangrass pasture (non-irrigated)	Range pasture (non-irrigated)
			Irrigated	Non-irrigated	Irrigated	Non-irrigated			
	Boxes	*Cwt.*	*Cwt.*	*Cwt.*	*Tons*	*Tons*	*Tons*	*Cow-acre-days* [1]	*Cow-acre-days* [1]
Coastal beach:									
Sandy									
Stony									
Crow Hill loam:									
Sloping							½–1		5–15
Sloping, moderately eroded									5–15
Hilly							½–1		5–15
Hilly, moderately eroded							½–1		5–15
Steep and very steep									5–15
Diablo clay (adobe):									
Sloping							1–1½		15–35
Hilly							1–1½		12–30
Hilly, moderately eroded							1–1½		12–25
Steep							1–1½		10–20
Dune sand									
Elder clay loam, gently sloping							1–1½	125–200	20–40
Elder loam, gently sloping							1–1½	125–200	20–40
Elder shaly clay loam, gently sloping							1–1½	100–200	20–40
Elder shaly loam, sloping							1–1½	100–175	20–40
Elder shaly sandy loam, gently sloping							¾–1¼	75–150	20–40
Excavated land									
Gaviota fine sandy loam:									
Hilly				3– 7			¾–1		5–15
Hilly, moderately eroded				3– 6			¾–1		5–15
Hilly, severely eroded									5–10
Steep									5–10

Gaviota sandy loam:									
Sloping				3– 6			¾–1		5–15
Sloping, moderately eroded	100–200			3– 6			¾–1		5–15
Hilly				2– 5			¾–1		5–15
Steep									5–15
Gaviota stony soils, undifferentiated, steep and very steep									5–10
Jalama shaly sandy loam:									
Gently sloping and sloping							¾–1		10–30
Moderately steep							¾–1		10–30
Jalama stony soils, undifferentiated, hilly and steep									5–15
Kitchen middens:									
(Over permeable soil materials)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
(Over relatively impermeable soil material)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Landslip:									
Climax soil material, moderately steep									10–40
Diablo soil material, moderately steep and steep									10–50
Los Osos soil material, moderately steep and steep									20–40
Nacimiento soil material, steep									20–50
Los Osos clay:									
Hilly							1–1½		12–30
Steep							¾–1		10–25
Steep, moderately eroded							¾–1		10–20
Los Osos clay loam:									
Sloping, moderately eroded							1–1½		12–30
Hilly							1–1½		12–30
Hilly, moderately eroded							1–1¼		12–30
Steep							¾–1		12–30
Steep, moderately eroded							¾–1		10–25
Very steep									10–25
Los Osos stony soils, undifferentiated, steep and very steep									5–15
Los Trancos stony loam, hilly and steep									5–15

See footnotes at end of table.

TABLE 4.—*Estimated range in yields for principal crops on soils of the Santa Barbara Area, Calif.*—Continued

Soils	Lemons	Walnuts	Lima beans		Tomatoes		Grain hay (non-irrigated)	Sudangrass pasture (non-irrigated)	Range pasture (non-irrigated)
			Irrigated	Non-irrigated	Irrigated	Non-irrigated			
	Boxes	*Cwt.*	*Cwt.*	*Cwt.*	*Tons*	*Tons*	*Tons*	*Cow-acre-days* [1]	*Cow-acre-days* [1]
Made land									
Marina sand, gently sloping								30–60	5–15
Maymen fine sandy loam:									
Hilly							½–1		5–20
Hilly, moderately eroded							½–1		5–20
Maymen stony fine sandy loam, hilly									5–15
Maymen stony soils, undifferentiated, steep and very steep									
Milpitas fine sandy loam:									
Nearly level	100–300	5–10	8–12	4–6		1–3	3–5		20–40
Undulating	100–300	5–10	8–12	4–6		1–3	3–5		20–40
Gently sloping, moderately eroded	100–300	5–10	8–12	4–6		1–2	2–4		15–30
Gently sloping, severely eroded	75–150			2–4		1–2	1–3		10–20
Rolling	100–300			2–4		1–3	2–4		20–40
Rolling, moderately eroded	100–250	5–10	6–10	3–5		1+	1–4		15–30
Sloping	100–300	5–10	8–12	4–6		1–3	2–4		20–40
Sloping, moderately eroded	100–250	5–10	8–12	4–6		1–3	1–4		20–40
Sloping, severely eroded	75–150			2–4		3	1–2		10–20
Moderately steep	75–200			3–5			¾–1		15–30
Moderately steep, moderately eroded	75–150			3–5			¾–1		10–25
Moderately steep, severely eroded	75–125			2–4			½–¾		5–15
Steep	75–125			3–5			¾–1		10–20
Steep, moderately eroded	75–125			3–5			¾–1		5–15
Deep, gently sloping and nearly level	150–350	7–12	8–15	3–7		1–3	1–1¼		20–40

Deep, sloping	150–350	7–12	8–15	3– 7		1–3	1–1¼		20–40
Overwash, gently sloping and nearly level	150–350	7–12	7–12	5– 7		1–3	1–1¼		20–40
Milpitas gravelly fine sandy loam:									
Sloping, moderately eroded	100–250	5–10	6–12	3– 6		1–2	1–1¼		20–40
Moderately steep and steep, moderately eroded			6–10	3– 5			¾–1		15–35
Milpitas stony fine sandy loam:									
Sloping									10–30
Moderately steep									10–30
Steep									10–25
Mocho fine sandy loam:									
Nearly level	300–600	10–25	18–20		7–10				20–40
Imperfectly drained, nearly level			12–16						25–60
Slight alkali			10–15						20–50
Moderate alkali			7– 9						15–40
Over Clear Lake clay, nearly level			12–16		7–10				20–50
Slightly alkali			10–16		6– 8				15–40
Gently sloping	300–600	10–25	18–20		7–10				20–40
Mocho gravelly fine sandy loam, gently sloping	250–500	10–20	16–18						20–40
Mocho loam:									
Nearly level	300–600	12–20	18–20	8–10	7–10				20–40
Imperfectly drained, nearly level			14–16						25–60
Slight alkali			13–15						20–50
Moderate alkali			7– 9						15–30
Gently sloping	300–600	10–25	18–20		7–10				20–40
Mocho loamy sand:									
Nearly level	200–450		15–17		5– 8				15–30
Imperfectly drained, nearly level			13–15						20–40
Montara stony soils, undifferentiated, hilly and steep									5–20
Montezuma clay (adobe):									
Nearly level	100–250	6–10		4– 8		3–5	1–1½	75–150	20–40
Undulating	100–250	6–10		4– 8		3–5	1–1½	75–150	20–40
Gently sloping	100–250	6–10		4– 8		3–5	1–1½	75–150	20–40
Sloping	100–250	6–10		4– 8		3–5	1–1½		10–40

See footnotes at end of table.

TABLE 4.—*Estimated range in yields for principal crops on soils of the Santa Barbara Area, Calif.*—Continued

Soils	Lemons	Walnuts	Lima beans		Tomatoes		Grain hay (non-irrigated)	Sudangrass pasture (non-irrigated)	Range pasture (non-irrigated)
			Irrigated	Non-irrigated	Irrigated	Non-irrigated			
	Boxes	*Cwt.*	*Cwt.*	*Cwt.*	*Tons*	*Tons*	*Tons*	*Cow-acre-days* [1]	*Cow-acre-days* [1]
Montezuma clay (adobe)—Continued									
Sloping, moderately eroded	100–250	6–10		4– 6		3–5	1–1½		20–40
Moderately steep				3– 5		2–4	1–1¼	60–100	15–30
Moderately steep, moderately eroded				3– 5		1–4	1–1¼		10–25
Steep, moderately eroded									10–20
Montezuma clay loam, gently sloping	100–300	6–10		4– 8		3–5	1–1½		20–40
Montezuma stony clay, sloping									10–20
Nacimiento clay:									
Sloping	100–200	7–11		4– 8		3–5	1–1½		15–30
Hilly	100–200	7–11		4– 8		3–5	1–1½		12–30
Hilly, moderately eroded	75–200	6–10		4– 6		2–4	1–1½		10–25
Steep				3– 6		2–4	1–1½		10–20
Steep, moderately eroded				2– 5		1–4	1–1¼		5–25
Very steep									5–25
Very steep, moderately eroded				2– 4		1–3			5–20
Nacimiento clay loam:									
Hilly	100–200	7–11		4– 8		3–5	1–1½		10–25
Steep				3– 6		3–5	1–1½		10–20
Nacimiento stony soils, undifferentiated, very steep									5–20
Olivenhain fine sandy loam:									
Sloping	100–250			3– 6					10–25
Sloping, moderately eroded	100–200			3– 6			½–1		10–20
Moderately steep	100–200			3– 6					15–30
Moderately steep, moderately eroded	100–200			3– 5					10–25

Olivenhain gravelly fine sandy loam, sloping, moderately eroded	100–200			3– 5					10–25
Olivenhain stony fine sandy loam:									
Gently sloping									10–20
Sloping									10–20
Moderately steep									10–20
Olivenhain stony soils, undifferentiated, steep									5–20
Riverwash									
Rough broken and stony land:									
Gaviota soil material									
Los Trancos soil material									
Maymen soil material									
Montara soil material									
Santa Lucia soil material									
Sespe soil material									
Rough gullied land:									
Los Osos soil material									
Nacimiento soil material									
San Andreas soil material									
Watsonville soil material									
San Andreas fine sandy loam:									
Sloping, moderately eroded	100–200		8–10	4– 8					7–15
Hilly	100–250		8–10	4– 7					8–18
Steep, moderately eroded									5–15
San Andreas loamy sand:									
Sloping	100–250		7– 9	4– 6					10–20
Hilly	100–200		7– 9	4– 6					7–15
Hilly, moderately eroded	100–200		7– 9	4– 6					5–15
Steep									5–15
Steep, moderately eroded									5–15
San Andreas stony soils, undifferentiated, very steep									5–10
San Andreas-Tierra fine sandy loams:									
Hilly	100–250		8–10	3– 7					10–20
Steep	100–200			3– 5					10–20
Santa Lucia shaly clay loam:									
Sloping				3– 8			¾–1½		10–20
Hilly				3– 7			¾–1¼		8–18

See footnotes at end of table.

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TABLE 4.—*Estimated range in yields for principal crops on soils of the Santa Barbara Area, Calif.*—Continued

Soils	Lemons	Walnuts	Lima beans		Tomatoes		Grain hay (non-irrigated)	Sudangrass pasture (non-irrigated)	Range pasture (non-irrigated)
			Irrigated	Non-irrigated	Irrigated	Non-irrigated			
Santa Lucia shaly clay loam—Continued	*Boxes*	*Cwt.*	*Cwt.*	*Cwt.*	*Tons*	*Tons*	*Tons*	*Cow-acre-days* [1]	*Cow-acre-days* [1]
Hilly, moderately eroded				3–6			¾–1		5–15
Hilly, severely eroded									3–10
Steep									8–18
Steep, moderately eroded									5–15
Santa Lucia shaly loam:									
Hilly							¾–1¼		8–18
Steep									5–15
Very steep									5–15
Santa Lucia stony clay loam, hilly									5–15
Santa Lucia stony soils, undifferentiated, steep and very steep									3–10
Sespe clay:									
Sloping, moderately eroded	100–300			4–8			1–1½		10–20
Hilly	125–300			4–8			1–1½		10–20
Hilly, moderately eroded	100–300			3–7			¾–1¼		8–18
Steep	100–250			2–6			¾–1		8–18
Steep, moderately eroded	100–250			2–5			½–1		5–15
Sespe clay loam:									
Sloping	125–300			4–8			1–1½		10–20
Hilly	100–250			4–7			1–1½		10–20
Hilly, moderately eroded	100–250			3–7			¾–1¼		10–20
Hilly, severely eroded	75–150			2–5			½–1		5–15
Steep	100–250			2–5			¾–1		8–18
Steep, moderately eroded	100–200			2–5			¾–1		5–15

Sespe nonstony soils, undifferentiated, very steep									5–15
Sespe stony soils, undifferentiated, very steep					5– 8				2–10
Sorrento fine sandy loam:									
Nearly level	300–600	10–25	18–20		8–10				20–40
Imperfectly drained, nearly level			12–16		6– 9				20–50
Over Clear Lake clay, nearly level	200–400		12–16		7–10				20–50
Gently sloping	300–600	10–20	18–20	8–10	8–10	3–7			20–40
Channeled, sloping	200–400								20–40
Sorrento gravelly fine sandy loam:									
Nearly level	250–500	10–20	16–18		7– 9				20–40
Sloping	200–450	10–20	14–16		7– 9				20–40
Sorrento loam:									
Nearly level	300–600	10–25	18–20		8–10				20–40
Imperfectly drained, nearly level			12–16		6– 9				20–50
Gently sloping	300–600	12–20	18–20	8–10	8–10	3–7			20–40
Sloping	250–550	12–20	16–18	8–10	7– 9				20–40
Sorrento loamy sand:									
Nearly level	300–500		16–18		5– 8				15–40
Gently sloping	250–450		16–18		5– 8				15–40
Tangair loamy sand:									
Sloping									5–20
Sloping, moderately eroded									5–15
Moderately steep									5–15
Tangair sand:									
Sloping									5–15
Sloping, moderately eroded									5–15
Sloping, severely eroded									2–10
Moderately steep									5–15
Moderately steep, moderately eroded									3–15
Terrace breaks									
Tidal marsh									
Tierra fine sandy loam:									
Sloping, moderately eroded				3– 5			½–1		15–30
Hilly, moderately eroded									20–40
Hilly, severely eroded									5–15
Steep, moderately eroded									10–25
Tierra soils, undifferentiated, steep									5–20

See footnotes at end of table.

TABLE 4.—*Estimated range in yields for principal crops on soils of the Santa Barbara Area, Calif.*—Continued

Soils	Lemons	Walnuts	Lima beans		Tomatoes		Grain hay (non-irrigated)	Sudangrass pasture (non-irrigated)	Range pasture (non-irrigated)
			Irrigated	Non-irrigated	Irrigated	Non-irrigated			
	Boxes	*Cwt.*	*Cwt.*	*Cwt.*	*Tons*	*Tons*	*Tons*	*Cow-acre-days* [1]	*Cow-acre-days* [1]
Watsonville fine sandy loam:									
Nearly level				4– 6		3–5	1–1¼	75–150	20–45
Gently sloping				3– 6		2–5	1–1¼	75–150	20–45
Gently sloping, moderately eroded				3– 5		2–4	¾–1	60–125	20–45
Sloping				4– 6		2–5	1–1¼	60–125	20–45
Sloping, moderately eroded				3– 5		2–4	1–1¼	50–100	20–40
Moderately steep				2½– 4½		1–4	¾–1	50–100	20–40
Moderately steep, moderately eroded				2– 4		1–3	½–1	40– 80	15–35
Watsonville loam:									
Nearly level				4– 6		3–5	1–1¼	75–150	20–45
Gently sloping				4– 6		3–5	1–1¼	75–150	20–45
Gently sloping, moderately eroded				3– 5		2–4	1–1¼	60–125	20–40
Sloping				4– 6		2–5	1–1¼	60–125	20–45
Sloping, moderately eroded				3– 5		2–4	¾–1	40– 80	20–35
Moderately steep, moderately gullied				2– 4			¾–1		20–35
Watsonville sandy loam:									
Gently sloping								60–125	20–40
Sloping								60–125	20–40
Moderately steep, moderately eroded								50–100	20–30
Watsonville soils, undifferentiated, steep									10–30
Yolo fine sandy loam:									
Nearly level	300–600	10–25	18–20		7–10				20–40
Gently sloping	300–600	10–25	18–20		7–10				20–40
Yolo gravelly fine sandy loam, gently sloping	250–550	10–22	17–19		6– 9				15–35

Yolo loam:									
Nearly level	300–600	10–25	18–20		7–10				20–40
Imperfectly drained, nearly level			16–18		6– 9				20–50
Gently sloping	300–600	10–25	18–20		7–10				20–40
Channeled, sloping				5– 9					20–40
Yolo sandy loam:									
Nearly level	300–600	10–22	17–19		7–10				15–40
Gently sloping	300–600	10–22	17–19		7–10				15–40
Yolo stony fine sandy loam, gently sloping	200–350								10–30
Zaca clay:									
Sloping				5– 9		3–6	1–1½		15–30
Hilly				5– 9		3–6	1–1½		12–25
Hilly, moderately eroded				5– 8		2–5	1–1½		10–20
Steep				4– 8		2–5	1–1½		10–20
Steep, moderately eroded				4– 7		2–4	1–1½		8–18
Steep, severely eroded				3– 5		¾–3	½–1		5–10
Zaca clay loam:									
Sloping, moderately eroded	100–250			5– 7		3–5	1–1½		10–20
Hilly	100–250			5– 7		3–6	1–1½		10–20
Steep				3– 7		1–4	1–1½		10–20
Zaca nonstony soils, undifferentiated, very steep									5–15
Zaca shaly clay loam:									
Sloping				5– 7		3–6	1–1½		12–25
Sloping, moderately eroded				5– 7		3–5	1–1½		10–20
Hilly				5– 7		2–5	1–1½		10–20
Hilly, moderately eroded				4– 6		2–4	1–1½		10–20
Hilly, severely eroded				3– 5		1–3	½–1		5–10
Steep				4– 6		2–5	1–1¼		8–18
Steep, moderately eroded				3– 5		2–4	1–1½		8–18
Steep, severely eroded				2– 4		1–3	½–1		5–10
Zaca stony soils, undifferentiated, steep and very steep									12–10

[1] The term cow-acre-days is used to express the carrying capacity of pasture land. It is the product of the number of animal units carried per acre multiplied by the number of days that animals can be grazed without injury to the pasture. For example, a soil supporting 1 animal unit per acre for 360 days rates 360; a soil supporting 1 animal unit on 4 acres for 100 days rates 25. One animal unit equals 1 mature cow, steer, or horse, 5 hogs, or 7 sheep or goats.

[2] Absence of figures indicates that crop is not irrigated or not grown, or that soil is unsuited.

[3] Yields on these areas are as good as or better than those on the associated soil.

Walnut and lima bean yields are reported by the hundredweight and tomatoes and grain hay by the ton. Tomatoes are usually marketed fresh and sold in crates. However, tomato yields were reported in tons, because crate sizes vary considerably, and all tomatoes for canning are sold in tons. Most tomatoes grown in this Area are planted late to take advantage of the off-season market. The bulk of this crop is harvested in October, November, and December after the normal summer crop has been marketed. The yields are low as compared to yields that could be obtained if the crop were grown during its best growing season. However, the difference in price received for the off-season crop usually more than makes up for the difference in yields.

Carrying capacity of pasture is listed in cow-acre-days. This unit represents the number of days a mature animal, such as a cow or horse, can be supported on one acre without injury to the pasture. Sudangrass is pastured in late summer and fall after the range grasses have dried.

SOIL RATINGS AND GROUPINGS

The nature of a large number of soils is more easily remembered if the soils having similar properties are grouped. This section groups the soils by kind of profile, by grade, and by management needs. It also provides ratings that indicate the relative productivity of the soils. The type of profile, the index rating, and the grade are given for each soil in table 5. An explanation of the grouping, rating, and grading factors follows the table.

SOIL PROFILE GROUPS

Soil profile groups are made on the basis of (1) degree to which profile development is expressed and (2) the kind of underlying material. The groups are useful to soil scientists and may be useful to engineers concerned with irrigation and construction.

Nine profile groups are recognized in table 5. Group I soils are from recent alluvium and have no differentiation of profile layers. The next five groups, though also from alluvium, have increasing compaction and increasing amounts of clay in the subsoil. Group II soils have moderately expressed clayey subsoils, or B horizons, and Group III soils have such horizons strongly expressed. Group IV soils have claypan subsoils, and Group V soils have hardpan subsoils. Group VI soils have hardpans or claypans underlain by partially consolidated substrata.

In groups VII, VIII, and IX are soils of the uplands. The group number indicates the nature of the underlying rock. Group VII soils are underlain by moderately hard igneous rocks. Group VIII soils by moderately hard sedimentary rocks, and Group IX soils by relatively soft rocks of all kinds.

TABLE 5.—*Profile group, index ratings, and grade for soils of the Santa Barbara Area, Calif.*

Soils	Soil profile group	Soil rating factors				Soil index rating	Grade
		Factor A (profile)	Factor B (texture)	Factor C (slope)	Factor X (other conditions)		
						Percent	
Agueda clay loam:							
Nearly level	I	100	85	100	100	85	1
Gently sloping	I	100	85	95	100	81	1
Sloping	I	100	85	85	100	72	2
Agueda gravelly clay loam:							
Gently sloping	I	100	70	95	100	67	2
Sloping	I	100	70	85	100	60	2
Aliso fine sandy loam:							
Gently sloping, moderately eroded	IV	60	100	95	80	46	3
Sloping	IV	60	100	85	100	51	3
Sloping, moderately eroded	IV	60	100	85	70	36	4
Moderately steep, moderately eroded	IV	60	100	75	80	36	4
Steep, moderately eroded	IV	60	100	40	80	19	5
Aliso loam:							
Gently sloping, moderately eroded	IV	60	100	95	80	46	3
Sloping, moderately eroded	IV	60	100	85	80	41	3
Moderately steep, moderately eroded	IV	60	100	75	80	36	4
Moderately steep, severely eroded	IV	60	100	75	50	23	4
Alviso soils, undifferentiated, nearly level [1]	I					3	6
Arguello shaly loam:							
Gently sloping	III	70	70	95	100	47	3
Sloping	III	70	70	85	100	42	3
Ballard fine sandy loam:							
Nearly level	III	80	100	100	100	80	1
Gently sloping	III	80	100	95	100	76	2
Sloping	III	80	100	85	100	68	2
Sloping, moderately eroded	III	80	100	85	70	48	3

See footnotes at end of table.

TABLE 5.—*Profile group, index ratings, and grade for soils of the Santa Barbara Area, Calif.*—Continued

Soils	Soil profile group	Soil rating factors				Soil index rating	Grade
		Factor A (profile)	Factor B (texture)	Factor C (slope)	Factor X (other conditions)		
						Percent	
Ballard gravelly fine sandy loam, gently sloping	III	80	70	95	100	53	3
Ballard stony fine sandy loam, gently sloping and sloping	III	80	40	90	100	29	4
Baywood loamy fine sand:							
Gently sloping	II	95	80	95	100	72	2
Moderately steep	II	95	80	75	100	57	3
Baywood loamy fine sand, over Watsonville soils, gently sloping [3]	II	70	80	95	100	53	3
Baywood loamy sand:							
Nearly level	II	95	70	100	100	66	2
Gently sloping	II	95	70	95	100	63	2
Rolling	II	95	70	85	100	57	3
Baywood loamy sand, over Watsonville soils:							
Nearly level [3]	II	70	70	100	100	49	3
Gently sloping [3]	II	70	70	95	100	47	3
Botella clay loam:							
Nearly level	II	95	85	100	100	81	1
Gently sloping	II	95	85	95	100	77	2
Sloping	II	95	85	85	100	69	2
Carpinteria clay loam:							
Gently sloping	II	95	85	95	100	77	2
Sloping	II	95	85	85	100	69	2
Moderately steep [3]	II	95	85	75	100	61	2
Carpinteria loam, gently sloping	II	95	100	95	100	90	1
Cayucos clay:							
Sloping	VIII	60	70	85	100	36	4
Hilly	VIII	60	70	75	100	32	4

Cayucos clay loam:							
Hilly, moderately eroded	VIII	40	85	75	80	20	4
Steep, moderately eroded	VIII	40	85	40	80	11	5
Cayucos shaly soils, undifferentiated, steep and very steep [4]	VIII					10	5
Clear Lake clay, nearly level	II	95	60	100	60	34	4
Slight alkali	II	95	60	100	48	27	4
Climax clay (adobe):							
Hilly	VII	60	60	75	100	27	4
Steep	VII	60	60	40	100	14	5
Coastal beach:							
Sandy [4]						2	6
Stony [4]						2	6
Crow Hill loam:							
Sloping	IX	50	100	85	100	43	3
Sloping, moderately eroded	IX	50	100	85	80	34	4
Hilly	IX	50	100	75	100	38	4
Hilly, moderately eroded	IX	50	100	75	80	30	4
Steep and very steep	IX	50	100	30	100	15	5
Diablo clay (adobe):							
Sloping	VIII	70	70	85	100	42	3
Hilly	VIII	70	70	75	100	37	4
Hilly, moderately eroded	VIII	70	70	75	70	26	4
Steep	VIII	70	70	40	100	20	4
Dune sand [4]						2	6
Elder clay loam, gently sloping	I	100	80	95	100	76	2
Elder loam, gently sloping	I	100	100	95	100	95	1
Elder shaly clay loam, gently sloping	I	100	70	95	100	67	2
Elder shaly loam, sloping	I	100	70	85	100	60	2
Elder shaly sandy loam, gently sloping	I	100	70	95	100	67	2
Excavated land [4]						2	6
Gaviota fine sandy loam:							
Hilly	VIII	40	100	75	100	30	4
Hilly, moderately eroded	VIII	40	100	75	70	21	4
Hilly, severely eroded	VIII	40	100	75	50	15	5
Steep	VIII	40	100	40	100	16	5

See footnotes at end of table.

TABLE 5.—*Profile group, index ratings, and grade for soils of the Santa Barbara Area, Calif.*—Continued

Soils	Soil profile group	Soil rating factors				Soil index rating	Grade
		Factor A (profile)	Factor B (texture)	Factor C (slope)	Factor X (other conditions)		
						Percent	
Gaviota sandy loam:							
Sloping	VIII	40	95	85	100	32	4
Sloping, moderately eroded	VIII	40	95	85	70	23	4
Hilly	VIII	40	95	75	100	29	4
Steep	VIII	40	95	40	100	15	5
Gaviota stony soils, undifferentiated, steep and very steep [4]	VIII					5	6
Jalama shaly sandy loam:							
Gently sloping and sloping	V	50	70	90	100	32	4
Moderately steep	V	50	70	75	100	26	4
Jalama stony soils, undifferentiated, hilly and steep [5]	V					5	6
Kitchen middens:							
Over permeable soil materials [4]						70	2
Over relatively impermeable soil materials [4]						50	3
Landslip:							
Climax soil material, moderately steep [4]						5	6
Diablo soil material, moderately steep and steep [4]						5	6
Los Osos soil material, moderately steep and steep [4]						5	6
Nacimiento soil material, steep [4]						5	6
Los Osos clay:							
Hilly	VIII	70	70	75	100	37	4
Steep	VIII	70	70	40	100	20	4
Steep, moderately eroded	VIII	70	70	40	70	14	5
Los Osos clay loam:							
Sloping, moderately eroded	VIII	60	85	85	70	30	4
Hilly	VIII	60	85	75	100	38	4

Hilly, moderately eroded	VIII	60	85	75	70	27	4
Steep	VIII	60	85	40	100	20	4
Steep, moderately eroded	VIII	60	85	40	70	14	5
Very steep	VIII	60	85	20	100	10	5
Los Osos stony soils, undifferentiated, steep and very steep [4]	VIII					8	6
Los Trancos stony loam, hilly and steep	VII	40	60	30	100	7	6
Made land [4]						2	6
Marina sand, gently sloping [6]	VIII	95	60	95	80	43	3
Maymen fine sandy loam:							
Hilly	VIII	40	100	75	100	30	4
Hilly, moderately eroded	VIII	40	100	75	80	24	4
Maymen stony fine sandy loam, hilly	VIII	40	40	75	100	12	5
Maymen stony soils, undifferentiated, steep and very steep [4]	VIII					5	6
Milpitas fine sandy loam:							
Nearly level	IV	50	100	100	100	50	3
Undulating	IV	50	100	90	100	45	3
Gently sloping, moderately eroded	IV	50	100	95	70	33	4
Gently sloping, severely eroded	IV	50	100	95	40	19	5
Rolling	IV	50	100	80	100	40	3
Rolling, moderately eroded	IV	50	100	80	70	28	4
Sloping	IV	50	100	85	100	43	3
Sloping, moderately eroded	IV	50	100	85	70	30	4
Sloping, severely eroded	IV	50	100	85	40	17	5
Moderately steep	IV	50	100	75	100	38	4
Moderately steep, moderately eroded	IV	50	100	75	70	26	4
Moderately steep, severely eroded	IV	50	100	75	40	15	5
Steep	IV	50	100	40	100	20	4
Steep, moderately eroded [7]	IV	50	100	40	70	14	5
Deep, gently sloping and nearly level	IV	65	100	100	100	65	2
Deep, sloping	IV	65	100	85	100	55	3
Overwash, gently sloping and nearly level	IV	65	100	100	80	52	3
Milpitas gravelly fine sandy loam:							
Sloping, moderately eroded	IV	50	70	85	70	21	4
Moderately steep and steep, moderately eroded	IV	50	70	50	70	12	5

See footnotes at end of table.

TABLE 5.—*Profile group, index ratings, and grade for soils of the Santa Barbara Area, Calif.*—Continued

Soils	Soil profile group	Soil rating factors				Soil index rating	Grade
		Factor A (profile)	Factor B (texture)	Factor C (slope)	Factor X (other conditions)		
						Percent	
Milpitas stony fine sandy loam:							
Sloping	IV	50	40	85	100	17	5
Moderately steep	IV	50	40	75	100	15	5
Steep	IV	50	40	40	100	8	6
Mocho fine sandy loam:							
Nearly level	I	100	100	100	100	100	1
Imperfectly drained, nearly level [3]	I	100	100	100	50	50	3
Slight alkali [3]	I	100	100	100	40	40	3
Moderate alkali [3]	I	100	100	100	20	20	4
Over Clear Lake clay, nearly level	I	100	100	100	50	50	3
Slight alkali	I	100	100	100	40	40	3
Gently sloping	I	100	100	95	100	95	1
Mocho gravelly fine sandy loam, gently sloping	I	100	70	95	100	67	2
Mocho loam:							
Nearly level	I	100	100	100	100	100	1
Imperfectly drained, nearly level [3]	I	100	100	100	50	50	3
Slight alkali [3]	I	100	100	100	40	40	3
Moderate alkali [3]	I	100	100	100	20	20	4
Gently sloping	I	100	100	95	100	95	1
Mocho loamy sand:							
Nearly level	I	100	80	100	100	80	1
Imperfectly drained, nearly level [3]	I	100	80	100	50	40	3
Slight alkali [3]	I	100	80	100	40	32	5
Montara stony soils, undifferentiated, hilly and steep [4]	VII					10	5
Montezuma clay (adobe):							
Nearly level	III	80	60	100	100	48	3
Undulating	III	80	60	90	100	43	3

Gently sloping	III	80	60	95	100	46	3
Sloping	III	80	60	85	100	41	3
Sloping, moderately eroded	III	80	60	85	70	29	4
Moderately steep	III	80	60	75	100	36	4
Moderately steep, moderately eroded	III	80	60	75	70	25	4
Steep, moderately eroded	III	80	60	40	70	13	5
Montezuma clay loam, gently sloping	III	80	60	95	100	46	3
Montezuma stony clay, sloping	III	80	40	85	100	27	4
Nacimiento clay:							
Sloping	IX	70	75	85	100	45	3
Hilly	IX	70	75	75	100	39	4
Hilly, moderately eroded	IX	70	75	75	70	28	4
Steep	IX	70	75	40	100	21	4
Steep, moderately eroded	IX	70	75	40	60	13	5
Very steep	IX	70	75	20	100	11	5
Very steep, moderately eroded	IX	70	75	20	70	7	6
Nacimiento clay loam:							
Hilly	IX	60	85	75	100	38	4
Steep	IX	60	85	40	100	20	4
Nacimiento stony soils, undifferentiated, very steep [4]	IX					10	5
Olivenhain fine sandy loam:							
Sloping	VI	40	100	85	100	34	4
Sloping, moderately eroded	VI	40	100	85	70	24	4
Moderately steep	VI	40	100	75	100	30	4
Moderately steep, moderately eroded	VI	40	100	75	70	21	4
Olivenhain gravelly fine sandy loam, sloping, moderately eroded	VI	40	70	85	70	17	5
Olivenhain stony fine sandy loam:							
Gently sloping	VI	40	40	95	100	15	5
Sloping	VI	40	40	85	100	14	5
Moderately steep	VI	40	40	75	100	12	5
Olivenhain stony soils, undiffentiated, steep [4]	VI					5	6
Riverwash [4]						2	6
Rough broken and stony land:							
Gaviota soil material [4]						5	6
Los Trancos soil material [4]						5	6
Maymen soil material [4]						5	6
Montara soil material [4]						5	6

See footnotes at end of table.

TABLE 5.—*Profile group, index ratings, and grade for soils of the Santa Barbara Area, Calif.*—Continued

Soils	Soil profile group	Soil rating factors				Soil index rating	Grade
		Factor A (profile)	Factor B (texture)	Factor C (slope)	Factor X (other conditions)		
Rough broken and stony land—Continued						*Percent*	
Santa Lucia soil material [4]						3	6
Sespe soil material [4]						5	6
Rough gullied land:							
Los Osos soil material [4]						5	6
Nacimiento soil material [4]						5	6
San Andreas soil material [4]						5	6
Watsonville soil material [4]						2	6
San Andreas fine sandy loam:							
Sloping, moderately eroded	IX	60	100	85	70	36	3
Hilly	IX	60	100	75	100	45	3
Steep, moderately eroded	IX	60	100	40	70	17	5
San Andreas loamy sand:							
Sloping	IX	60	80	85	100	41	3
Hilly	IX	60	80	75	100	36	4
Hilly, moderately eroded	IX	60	80	75	70	25	4
Steep	IX	60	80	40	100	19	5
Steep, moderately eroded	IX	60	80	40	70	13	5
San Andreas stony soils, undifferentiated, very steep [4]	IX					5	6
San Andreas-Tierra fine sandy loams:							
Hilly [4]	IX–VI					35	4
Steep [4]	IX–VI					15	5
Santa Lucia shaly clay loam:							
Sloping	VIII	50	70	85	100	30	4
Hilly	VIII	50	70	75	100	26	4
Hilly, moderately eroded	VIII	50	70	75	70	18	5
Hilly, severely eroded	VIII	50	70	75	60	16	5

Steep	VIII	50	70	40	100	14	5
Steep, moderately eroded	VIII	50	70	40	70	10	5
Santa Lucia shaly loam:							
Hilly	VIII	50	80	75	100	30	4
Steep	VIII	50	80	40	100	16	5
Very steep	VIII	50	80	20	100	8	6
Santa Lucia stony clay loam, hilly	VIII	50	40	75	100	15	5
Santa Lucia stony soils, undifferentiated, steep and very steep [4]	VIII					5	6
Sespe clay:							
Sloping, moderately eroded	VIII	70	70	85	80	33	4
Hilly	VIII	70	70	75	100	37	4
Hilly, moderately eroded	VIII	70	70	75	70	26	4
Steep	VIII	70	70	40	100	20	4
Steep, moderately eroded	VIII	70	70	40	70	14	5
Sespe clay loam:							
Sloping	VIII	60	85	85	100	43	3
Hilly	VIII	60	85	75	100	38	4
Hilly, moderately eroded	VIII	60	85	75	70	27	4
Hilly, severely eroded	VIII	60	85	75	40	15	5
Steep	VIII	60	85	40	100	20	4
Steep, moderately eroded	VIII	60	85	40	70	14	5
Sespe nonstony soils, undifferentiated, very steep	VIII	60	70	20	100	8	6
Sespe stony soils, undifferentiated, very steep	VIII					5	6
Sorrento fine sandy loam:							
Nearly level	I	100	100	100	100	100	1
Imperfectly drained, nearly level [8]	I	100	100	100	50	50	3
Over Clear Lake clay, nearly level	I	100	100	100	50	50	3
Gently sloping	I	100	100	95	100	95	1
Channeled, sloping [9]	I	100	100	85	80	68	2
Sorrento gravelly fine sandy loam:							
Nearly level	I	100	70	100	100	70	2
Sloping	I	100	70	85	100	60	2
Sorrento loam:							
Nearly level	I	100	100	100	100	100	1
Imperfectly drained, nearly level [8]	I	100	100	100	50	50	3
Gently sloping	I	100	100	95	100	95	1
Sloping	I	100	100	85	100	85	1

See footnotes at end of table.

TABLE 5.—*Profile group, index ratings, and grade for soils of the Santa Barbara Area, Calif.*—Continued

Soils	Soil profile group	Soil rating factors				Soil index rating	Grade
		Factor A (profile)	Factor B (texture)	Factor C (slope)	Factor X (other conditions)		
Sorrento loamy sand:						*Percent*	
Nearly level	I	100	80	100	100	80	1
Gently sloping	I	100	80	95	100	76	2
Tangair loamy sand:							
Sloping	V	40	70	85	100	24	4
Sloping, moderately eroded	V	40	70	85	70	17	5
Moderately steep	V	40	70	75	100	21	4
Tangair sand:							
Sloping	V	40	60	85	100	20	4
Sloping, moderately eroded	V	40	60	85	80	16	5
Sloping, severely eroded	V	40	60	85	40	8	6
Moderately steep	V	40	60	75	100	18	5
Moderately steep, moderately eroded	V	40	60	75	80	14	5
Terrace breaks [4]						5	6
Tidal marsh [4]						2	6
Tierra fine sandy loam:							
Sloping, moderately eroded	VI	40	100	85	70	24	4
Hilly, moderately eroded	VI	40	100	75	70	21	4
Hilly, severely eroded	VI	40	100	75	40	12	5
Steep, moderately eroded	VI	40	100	40	60	10	5
Tierra soils, undifferentiated, steep [4]	VI					15	5
Watsonville fine sandy loam:							
Nearly level	IV	40	100	100	100	40	3
Gently sloping	IV	40	100	95	100	38	4
Gently sloping, moderately eroded	IV	40	100	95	70	27	4
Sloping	IV	40	100	85	100	34	4
Sloping, moderately eroded	IV	40	100	85	70	24	4

Moderately steep	IV	40	100	75	100	30	4
Moderately steep, moderately eroded	IV	40	100	75	60	18	5
Watsonville loam:							
Nearly level	IV	40	100	100	100	40	3
Gently sloping	IV	40	100	95	100	38	4
Gently sloping, moderately eroded	IV	40	100	95	70	27	4
Sloping	IV	40	100	85	100	34	4
Sloping, moderately eroded	IV	40	100	85	70	24	4
Moderately steep, moderately gullied	IV	40	100	75	70	21	4
Watsonville sandy loam:							
Gently sloping	IV	40	95	95	100	36	4
Sloping	IV	40	95	85	100	32	4
Moderately steep, moderately eroded	IV	40	95	75	70	20	4
Watsonville soils, undifferentiated, steep [4]	IV					15	5
Yolo fine sandy loam:							
Nearly level	I	100	100	100	100	100	1
Gently sloping	I	100	100	95	100	95	1
Yolo gravelly fine sandy loam, gently sloping	I	100	80	95	100	76	2
Yolo loam:							
Nearly level	I	100	100	100	100	100	1
Imperfectly drained, nearly level [8]	I	100	100	100	50	50	3
Gently sloping	I	100	100	95	100	95	1
Channeled, sloping [9]	I	100	100	85	80	68	2
Yolo sandy loam:							
Nearly level	I	100	95	100	100	95	1
Gently sloping	I	100	95	95	100	90	1
Yolo stony fine sandy loam, gently sloping	I	100	40	95	100	38	4
Zaca clay:							
Sloping	IX	70	75	85	100	45	3
Hilly	IX	70	75	75	100	39	4
Hilly, moderately eroded	IX	70	75	75	70	28	4
Steep	IX	70	75	40	100	21	4
Steep, moderately eroded	IX	70	75	40	70	15	5
Steep, severely eroded	IX	70	75	40	50	11	5
Zaca clay loam:							
Sloping, moderately eroded	IX	60	85	85	80	35	4
Hilly	IX	60	85	75	100	38	4
Steep	IX	60	85	40	100	20	4

See footnotes at end of table.

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TABLE 5.—*Profile group, index ratings, and grade for soils of the Santa Barbara Area, Calif.*—Continued

Soils	Soil profile group	Soil rating factors				Soil index rating	Grade
		Factor A (profile)	Factor B (texture)	Factor C (slope)	Factor X (other conditions)		
						Percent	
Zaca nonstony soils, undifferentiated, very steep [4]	IX					10	5
Zaca shaly clay loam:							
Sloping	IX	60	70	85	100	36	4
Sloping, moderately eroded	IX	60	70	85	70	25	4
Hilly	IX	60	70	75	100	32	4
Hilly, moderately eroded	IX	60	70	75	70	22	4
Hilly, severely eroded	IX	60	70	75	50	16	5
Steep	IX	60	70	40	100	17	5
Steep, moderately eroded	IX	60	70	40	70	12	5
Steep, severely eroded	IX	60	70	40	50	8	6
Zaca stony soils, undifferentiated, steep and very steep [4]	IX					5	6

[1] Water logged and high in salts. Soil index rating estimated; rating factors not determined.

[2] Underlain at depths of 2½ to 5 feet by old terrace deposits.

[3] Higher parts of small alluvial fans, usually on slopes of less than 20 percent.

[4] Index rating estimated; rating factors not determined.

[5] Terrace slopes with pieces of hardpan. Soil index rating estimated; rating factors not determined.

[6] Low fertility level.

[7] Subsoils generally not so compact as typical for Milpitas soils.

[8] Occasional high water table; soil occurs at low elevation.

[9] Channeled by small drainageways.

STORIE INDEX

The Storie index comparatively evaluates the overall suitability of a soil for agriculture (*6*, *7*). The four factors considered in arriving at this index are:

A. Profile characteristics.
B. Texture of the surface soil.
C. Slope.
X. Other conditions.

Each factor is evaluated in terms of percentage of ideal, or 100 percent; the index is then obtained by multiplying together the values of the four factors.

The following explains how each of the four factors is evaluated.

FACTOR A (profile characteristics) expresses relative favorability of the profile to growth of plant roots. Soils with deep friable profiles are rated 100 percent. Those with compact clay layers, hardpan, or bedrock at shallow depths are rated less than 100 percent. The actual rating depends upon the extent to which root penetration is limited.

FACTOR B (texture of the surface soil) is graded according to the texture of the surface soil, which is important in determining how easily the soil can be worked and how easily crops can be established. The medium textures—fine sandy loam, loam, and silt loam—are most favorable and they are rated as 100 percent. Soils of coarser or finer surface texture are rated less. Soils that have extremes of textures, such as coarse sands and heavy clays, have comparatively low ratings.

FACTOR C (slope) particularly important if the land is irrigated. Smooth very gently sloping soils rate 100 percent because they are easily worked, irrigated, and harvested and are easily protected from erosion. The rating decreases as the slope increases.

FACTOR X (other conditions) is used to evaluate any handicaps to the use of the soil not covered by the other three factors. Salts or alkali, poor drainage, low natural fertility, or unfavorable microrelief are considered in this factor if they lower the productivity of the soil or make it more difficult to work. If more than one handicap exists, the values for the separate conditions are multiplied together to get the rating for the X factor.

The Storie index is calculated on the basis of soil properties alone. It does not take into account land value, climate, location, markets, or similar factors.

SOIL GRADES

Soils are arranged 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 follow:

	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

Soils of grades 1 and 2 are suitable for a fairly wide range of crops and have few special management needs. They commonly give large returns for investments in fertilizer and irrigation water.

Soils of grade 3 are suited to fewer crops or only to special crops. In comparison with soils of grades 1 and 2, they require more care in irrigation and erosion control and commonly return less for equivalent investments in fertilizer and irrigation water.

Grade 4 soils are suited mainly to range, although where need for land is great or in periods of high prices they may be used profitably for crops. When used for crops, they are exacting in requirements for erosion control and irrigation. Returns from investments in fertilizers and irrigation water are also commonly less than for the soils of grades 1, 2, or 3.

Grade 5 soils are usually suited only to range. They produce fair to good grazing but some care is required to prevent overgrazing.

Grade 6 soils are generally poor to fair for range. They commonly furnish less grazing than grade 5 soils, and more care is needed to prevent overgrazing. Some of the miscellaneous land types that fall in this grade have no value for agriculture.

LAND-CAPABILITY CLASSIFICATION

The 281 soil units mapped in the Santa Barbara Area vary widely in profile, depth, slope and degree of erosion, presence or absence of salts, wetness, and other factors. The land-capability classification is used so that the uses and management of these soils may be discussed conveniently.

The land-capability classification systematically groups different kinds of soil according to those properties that determine their ability to produce permanently under specified uses and management. The classification levels, ranging from the most general to the most specific, are *class*, *subclass*, and *unit*.

CLASS

All soils are placed in eight broad capability *classes*. These classes are based on *degree* of *limitation* and on general suitability for agriculture. The classes are designated by numerals (I to VIII). The eight classes range from the best, most easily farmed soils to soils having no value for cultivation, grazing, or forestry but of possible value for wildlife, recreation, or watershed protection. Following is a definition of each of the eight classes.

CLASS I: Very good cultivable soils, from all points of view. Soils are nearly level, do not erode readily, and are deep and easy to work; hold water well and are fairly well supplied with plant nutrients; suitable for continuous cultivation and require only normal good management practices.

CLASS II: Good cultivable soils that have minor limitations if used for continuous cultivation; certain physical conditions make soils not quite so good as those in class I; may be on a slight slope, or naturally wet and require drainage, or have reduced water-holding capacity; each deficiency either limits the use of the soils to some extent, or makes necessary some special management year after year.

CLASS III: Moderately good cultivable soils that have major limitations if used for continuous cultivation; more limited in use than soils of class II and have one or more natural features that require special treatment; soils may be more steeply sloping than those in class II, shallower, coarser in texture, wetter, or a combination of any of these.

CLASS IV: Fairly good soils; good enough for occasional cultivation under careful management but not suitable for continuous production of cultivated crops; soils often too steep or too shallow for continuous cultivation because of the danger of erosion; in Santa Barbara Area soils in this class are used for citrus fruits and avocados, which are grown with permanent cover and sprinkler irrigation.

CLASS V: Well suited to grazing or forestry. (No class V soils occur in the Santa Barbara Area.) Soils not suited to cultivation because of stoniness or rock outcrop, wetness, overflow hazard, or climatic limitation.

CLASS VI: Well suited to grazing or forestry; soils have minor limitations, such as shallowness, moderately steep slopes, excessive wetness, excessive salts or alkali, and the like, that cannot be corrected; in the Santa Barbara Area some soils of class VI are used for citrus and avocados, which are grown with permanent cover and sprinkler irrigation.

CLASS VII: Fairly well suited to grazing or forestry; soils have major limitations in use; extreme care required to prevent erosion where very steep slopes or very shallow depth are the limitations.

CLASS VIII: Not suited to cultivation, grazing, or forestry; soils may be used for wildlife, recreation, or watershed purposes; usually soils are extremely rough, steep, stony, sandy, wet, severly eroded, or severly affected by salts or alkali.

SUBCLASS

The kind of problems or limitations may vary considerably in any one of the capability classes except class I. For example, one area may be in class II because of a drainage problem, but another may be in class II because of slope that brings about an erosion problem. Practices for correcting drainage are distinctly different from those needed to control erosion, so it is helpful to divide a capability class into subclasses according to the *kinds* of *limitations* or *hazards* encountered in use and management. The four subclasses recognized are shown by a lower case letter as follows:

e=erosion, or slope, or both.
w=excessive water in the soil, or flood hazard.
s=unfavorable soil conditions such as shallowness, very coarse or very fine texture, alkalinity or salinity, and the like.
c=adverse climatic conditions. (None recognized in this area.)

UNIT

The soils in the subclasses are placed in *capability units*, which are groups of soils that are nearly similar in major crop adaptability, need practically the same kind of management, and are able to produce similar kinds and amounts of vegetation. The capability unit shows the *specific* condition or combination of conditions that limit the use of the soil. The kinds of soils within a capability unit may differ slightly in the management practices they need and in the crop yields they produce. In range or woodland areas, the capability unit expresses the range or woodland site. In the Santa Barbara area the capability units are identified by number as follows:

1=erosion hazard, actual or potential.
2=problem or limitation resulting from wetness.
3=problem or limitation resulting from shallow soil depth.
4=problem or limitation caused by very coarse soil texture, ex- excessive gravel, or rock outcrop.
5=problem or limitation caused by very fine texture.

Plate 8 shows how capability units fit the land in the Santa Barbara Area, and how symbols are used to designate the capability class, subclass, and unit.

CAPABILITY CLASS I

Very deep, moderately coarse to moderately fine textured, moderately permeable, nearly level, well-drained soils of the recent alluvial fans

This class consists of very deep, permeable soils that have no physical features limiting root and moisture penetration. Generally the profiles are fairly uniform throughout. Any stratification present

in the subsoil is not sufficient to cause serious management problems. The soils are fairly easy to till and fairly retentive of moisture; they range from sandy loam to clay loam. Slopes are very gentle, and erosion is seldom a problem. These are well-drained recent alluvial soils. Botella clay loam, nearly level, has slight profile development but is included because, in management and use, it more closely resembles soils of this unit than those of other units. The following soils are in this group:

(AB) Agueda clay loam, nearly level.
(BS) Botella clay loam, nearly level.
(MD) Mocho fine sandy loam, nearly level.
(MJ) Mocho loam, nearly level.
(SN) Sorrento fine sandy loam, nearly level.
(SS) Sorrento loam, nearly level.
(YB) Yolo fine sandy loam, nearly level.
(YG) Yolo loam, nearly level.
(YK) Yolo sandy loam, nearly level.

Use and management.—These soils, the best in the Area, are well suited to a wide range of crops, including lemons, walnuts, avocados, lima beans, tomatoes, and various specialty crops. Good yields of all crops can be expected, although fertilization is necessary for best returns. Despite the quality of these soils, they present some management problems. They are in level valleys at low elevations, so frost protection is generally necessary for sensitive crops such as lemons and avocados. Lime-induced chlorosis may be a problem in lemon and avocado orchards, particularly on the Agueda and Mocho soils if they are kept overly moist. Alternate-middle irrigation and careful moisture control usually alleviate the problem.

Tillage pans have formed in many of the sandy loam and loam soils. In orchards the pan may be alleviated by nontillage weed control, and in open fields by subsoiling. Preventive measures consist of tillage when the soil is relatively dry, insofar as that is possible, and by varying the depth of tillage from time to time. Orchards not under nontillage weed control usually are seeded to winter-growing cover crops, which supply organic matter. Volunteer cover crops may also be used. Vetch planted alone is the most common legume used as a cover crop, although a large volume of organic matter may be supplied by planting vetch and a cereal grain together or by the use of mustard.

Most crops respond well to nitrogen fertilizer. Lemons receive the heavy applications. Small scattered areas have minor-element deficiencies. These are most economically corrected by applying the needed element in foliage sprays. This method is especially desirable for lemon orchards.

Most of these soils have been leveled in the past, but the soil profiles are such that they present no problems in leveling, even where deep cuts may be needed. Furrow irrigation is well suited, but sprinklers can be used where preference so dictates. Erosion is not a problem. In some places, however, runoff water from higher lying areas may need to be routed to adequate channels.

CAPABILITY CLASS II

Capability unit IIe–1: Very deep, moderately coarse to moderately fine textured, moderately permeable, gently sloping, well-drained soils of the recent alluvial fans

This unit is made up of very deep permeable soils having subsoils that obstruct deep penetration of roots and water little or not at all.

The soils are very similar to those of class 1 but are on slopes of 3 to 8 percent. They range from sandy loam to clay loam and present no unusual problems of droughtiness, moisture penetration, or drainage. Nearly all of the soils are recent alluvial soils. The Ballard, Botella, and Carpinteria, however, have subsoils that slightly restrict movement of air, water, and roots.

Soils of this unit are suitable for a wide range of crops. They present minor problems in irrigation because they are sloping, and there is some hazard of erosion. The following soils are in this group:

(AA) Agueda clay loam, gently sloping.
(AD) Agueda gravelly clay loam, gently sloping.
(AS) Arguello shaly loam, gently sloping.
(BA) Ballard fine sandy loam, gently sloping.
(BB) Ballard fine sandy loam, nearly level.
(BE) Ballard gravelly fine sandy loam, gently sloping.
(BR) Botella clay loam, gently sloping.
(CA) Carpinteria clay loam, gently sloping.
(CD) Carpinteria loam, gently sloping.
(EA) Elder clay loam, gently sloping.
(EB) Elder loam, gently sloping.
(EC) Elder shaly clay loam, gently sloping.
(EE) Elder shaly sandy loam, gently sloping.
(KA) Kitchen middens over permeable soil materials.
(MB) Mocho fine sandy loam, gently sloping.
(MF) Mocho gravelly fine sandy loam, gently sloping.
(MG) Mocho loam, gently sloping.
(SK) Sorrento fine sandy loam, gently sloping.
(SQ) Sorrento loam, gently sloping.
(YA) Yolo fine sandy loam, gently sloping.
(YE) Yolo loam, gently sloping.
(YH) Yolo sandy loam, gently sloping.

Use and management.—In the eastern part of the Area, most of these soils are used for lemons, avocados, walnuts, tomatoes, and field and specialty crops grown under irrigation. In the western half of the Area, the soils are dry-farmed or used for grazing. The soils have high fertility, and good yields are to be expected. On the Ballard soils walnuts, in particular, will not develop large trees, and the more shallow-rooted lemon and avocado trees may be affected to a slight extent by the less permeable subsoil. Nitrogen is the only fertilizer that brings crop response at this time. In small spots lemons show zinc deficiency, which can be corrected by including zinc in the pesticide spray.

Sheet erosion can be controlled by cross-slope tillage, stubble mulching, and similar measures fairly easy to apply. Concentrated flows from canyon mouths and other higher lying areas may require building of diversion and disposal structures to prevent gullying. Cross-slope planting of orchards on a 0.5 to 1.0 percent irrigation grade helps to control erosion. This kind of planting is a good guide for cross-slope tillage. Additional erosion control may be obtained in orchards by the use of nontillage weed control or the growing of a good winter cover crop. A system for collecting excess water and conducting it to a safe outlet is necessary in some places. Irrigation can be controlled by grade furrows or by sprinklers. The deep soils permit the deep cuts needed to smooth irregularities in slope.

Most areas are slightly elevated above the valley floor and have fairly good air drainage. Frost protection is seldom needed for sensitive crops. If the soils are kept overly moist, lime-induced chlorosis may show up on lemons, particularly on the Agueda and Mocho soils. Alternate-middle irrigation and careful control of quantities of water

applied take care of the chlorosis problem. A tillage pan has developed in some areas, particularly on the Sorrento and Yolo soils. In orchards the pan may be alleviated by nontillage weed control or by cultivating when the soil is fairly dry. Open cropland may be subsoiled to break up the pan.

Capability unit IIe–3: Moderately deep, moderately coarse to medium textured, nearly level claypan soils of the older terraces

Soils of this unit have a tight very slowly permeable claypan subsoil. Water penetrates the claypan so slowly that the zone above the clay may be saturated for a fairly long time following heavy rains or overirrigation. Little root growth takes place in the claypan. Slopes range from 0 to 2 percent. Topsoils range from sandy loam to loam. Actual depths of soil over claypan may range from as little as 12 inches to more than 30 inches. The average is near 24 inches. The following soils are in this group:

(MF) Milpitas fine sandy loam, deep, gently sloping and nearly level.
(MM) Milpitas fine sandy loam, nearly level.
(WE) Watsonville fine sandy loam, nearly level.
(WM) Watsonville loam, nearly level.

Use and management.—If they are not fertilized and otherwise carefully managed, these soils will produce only fair yields of most crops. A fairly wide range of crops can be grown, but walnuts or other deep-rooted crops are entirely unsuited. Lemons and avocados can be grown with fair success. The soils do not hold enough moisture for good yields of dry-farmed, summer-growing crops of tomatoes or beans. If dry-farmed, the soils are better used for winter crops such as hay or grain.

Topsoils are fairly easy to till and respond to good management. If excessively tilled they become powdery, and if worked too wet they become hard, cloddy, and difficult to till. Where irrigation water is available, these soils are used for lemons, some avocados, and field crops such as tomatoes.

Restricted internal drainage may lead to the buildup of salts in the soils and to root rot. Avocados are particularly susceptible to root rot. The quality and quantity of irrigation water, and the time applied, are particularly important on these soils. Good yields of lemons can be obtained by careful management, but yields are not so good as on the soils of class I. Irrigation water is applied in controlled-grade furrows plowed across the slope, or by sprinklers. If carefully managed, sprinklers give better control of quantity and more even distribution and thus avoid waterlogging. Nontillage weed control is best, considering the limited depth of favorable soil material. Where nontillage weed control is not used, tillage should be shallow and cover crops are needed to check erosion and to improve soil structure.

These soils are on benches somewhat above the valley bottoms and along the foothills, so air drainage is fairly good. Winter frosts are less common and less severe than on the valley areas, such as those occupied by soils of class I. Exposure of the tight clay subsoil is to be avoided, so leveling or smoothing is seldom advisable.

Favorable response to nitrogen and phosphorus fertilizers is to be expected. Parts of these soils show deficiency in minor elements.

The shortage of minor elements is particularly evident in lemon orchards.

These soils are erodible and need protection, even though they are rather gently sloping. A system for collecting excess water and safely conducting it off these benches is often needed to prevent deep gullies from cutting back into the nearly level areas.

Capability unit IIw-2: Deep, moderately coarse to medium textured, rapidly to moderately permeable, imperfectly drained soils of the recent alluvial fan and basin areas

Soils in this unit have imperfect drainage; the water table is 2 to 5 feet below the surface during much of the year. The soils are all recent alluvial, and most of them are moderately permeable. Root penetration is restricted by the wetness of the subsoils. The soils are nearly level, with slopes of 0 to 2 percent. Nearly all are of sandy loam or loam texture. The Clear Lake clay, nearly level, and Mocho loamy sand, imperfectly drained, nearly level, strikingly differ from the other soils in surface texture. They are placed in this unit because their drainage problems make their management more similar to those for soils of this unit than those for soils of any other capability unit. Limited areas of soils of this group are also affected by varying amounts of salts. Crop production is adversely affected by salts, but the salts are readily leached out of the soil if adequate drainage is achieved and enough water is applied. The following soils are in this group:

(CL) Clear Lake clay, nearly level.
(MC) Mocho fine sandy loam, imperfectly drained, nearly level.
(ME) Mocho fine sandy loam, over Clear Lake clay, nearly level.
(MH) Mocho loam, imperfectly drained, nearly level.
(MK) Mocho loamy sand, imperfectly drained, nearly level.
(SL) Sorrento fine sandy loam, imperfectly drained, nearly level.
(SN) Sorrento fine sandy loam, over Clear Lake clay, nearly level.
(SR) Sorrento loam, imperfectly drained, nearly level.
(YF) Yolo loam, imperfectly drained, nearly level.

Use and management.—Orchards are not well suited to these soils in their present drainage condition, although a number of lemon orchards have been planted around the higher fringe of these low-lying soils. These soils are used mostly for lima beans, tomatoes, and other specialty crops. Most of the soils are quite permeable, and their drainage would improve readily if suitable tile drains or open drains were provided. As these soils occur at slight elevation above sea level, sump pumps would be necessary to provide drainage outlets. The Clear Lake clay, the Sorrento soil over Clear Lake clay, and the Yolo soil are not so permeable as the rest of the soils of this unit. Generally, however, they have more permeable lower subsoils and would not present a difficult drainage problem.

Frost damage is a serious hazard to sensitive winter-growing crops, but these crops are seldom on the soils during the colder winter months. In unusually wet winters, a considerable area may be inundated for brief periods, which is a further hazard to permanent crops. Erosion is not a problem, although limited areas may receive deposits of less favorable soil material.

These soils are productive, and good yields may be expected. Nonleguminous crops respond to nitrogen fertilizer. Furrow irrigation

is commonly used and is well suited. Sprinklers may also be used. Overirrigation is to be avoided, as it will raise the already high water table and encourage chlorosis of lemons. Tillage pans are not well developed in the imperfectly drained soils. Such pans are more easily controlled on the open cropland through subsoiling and by varying the depth of tillage.

Capability unit IIs–4: Very deep, coarse-textured, rapidly permeable, nearly level to gently sloping soils of the recent alluvial fans

Soils of capability unit IIs–4 are loamy sands or gravelly fine sandy loams. Slopes are fairly gentle, or from 0 to 8 percent. These are all recent alluvial soils, and roots and water may penetrate to great depths. Moisture-holding capacity is relatively low. Dry-farmed field crops do not produce well, especially on the loamy sands. Under irrigation and moderate fertilization, however, good yields can be obtained. The following soils are in this group:

(ML) Mocho loamy sand, nearly level.
(SO) Sorrento gravelly fine sandy loam, nearly level.
(SU) Sorrento loamy sand, gently sloping.
(SV) Sorrento loamy sand, nearly level.
(Yc) Yolo gravelly fine sandy loam, gently sloping.

Use and management.—These soils are suitable for a wide range of crops, particularly if irrigated. Yields, however, are not quite so good as on the soils of capability class I, or the capability unit IIe–1. Lemons and, to lesser extent, avocados and vegetables are the main crops. Wind erosion and soil blowing could be a problem if large areas were exposed to the wind at one time. Under the present cropping pattern, wind erosion is more of a threat than an active hazard. Lack of moisture storage is the main problem, and most areas are irrigated. Irrigation runs should be short to prevent excessively deep percolation and consequent leaching of the soil. Sprinkler irrigation is more commonly used in the orchards; penetration, loss of water, and distribution may be more evenly controlled by this method.

Water erosion is not a serious problem, because slopes are gentle and the soils are permeable. Runoff from higher lying areas or canyons may require the interception of storm water and routing it to suitable channels.

In orchards, winter-growing cover crops are desirable and are commonly used. The soils are benefited by adding organic matter. Response to fertilizer is better if the supply of organic matter is maintained. Generally, all crops show favorable response to nitrogen fertilizer, and there is some indication of favorable response to phosphorus. Soils of this group at lower elevations and on the valley floor may need frost protection if used for lemons and avocados.

Capability unit IIs–5: Deep, fine and moderately fine textured, slowly permeable, nearly level to gently sloping soils of the older terraces

Soils of this unit are nearly black clays of considerable depth; they occupy nearly level to gently sloping benches above the stream bottoms. Slopes range from 1 to 8 percent and average near 4 percent. Large deep cracks develop in the soils upon drying. When dry, the soils take in water rapidly but they swell after wetting, the cracks close, and penetration of water becomes slow. Undisturbed soil does

not detach readily under running water. Slopes are gentle and erosion is not a serious problem. Tillage is most easily accomplished within a narrow moisture range. When the soils are dry, much power is required to work them, and few of the large clay blocks shatter. When tilled too wet, poor granulation takes place and the soils become even more difficult to work, and remain that way for several seasons. Large blocks of soil turned up in the fall will granulate or "slake" down fairly well after a period of alternate wetting and drying during the winter. The following soils are in this group:

(MN) Montezuma clay (adobe), gently sloping.
(MQ) Montezuma clay (adobe), nearly level.
(MU) Montezuma clay (adobe), undulating.
(MV) Montezuma clay loam, gently sloping.

Use and management.—Natural fertility is fairly high, but lemons do not yield so well on these soils as on those of capability class I and capability unit IIe–1. Roots penetrate these clays with some difficulty, and aeration becomes poor after they are wet. The soils dry out slowly. Avocados are particularly affected by the tight soil. They are not extensively planted because root troubles soon develop. In general, air drainage is fairly good and frost damage is seldom serious. Some walnuts have been planted, but the trees do not attain the size or yield they do on the more permeable soils of capability class I and capability unit IIe–1.

So far, nitrogen is the only crop fertilizer that has brought a favorable response. Erosion may occur on tilled areas after a prolonged rainfall. The cracks all close during a heavy rain, so considerable water runs off and the soil may erode. In orchards erosion of the sloping areas can be controlled by growing winter cover crops or practicing nontillage weed control. Cross-slope planting of grades of 0.5 to 1.5 percent will provide furrows or tillage marks deep enough to intercept surface flow and lead it to suitable outlets. An occasional diversion may be needed on long slopes or where water from higher areas flows across these soils.

A considerable acreage is used for dry-farmed late tomatoes, and to a lesser extent for lima beans. The soils store considerable moisture, and yields are as high as those obtained on any dry-farmed soils in the Area. Occasionally some tomatoes receive one supplemental irrigation, which is applied by sprinklers. In the western part of the Area some of the soils are in native range. Forage production is quite high. Sudangrass is also grown and produces good yields. Soil management for Sudangrass is similar to that used on dry-farmed tomatoes or beans. Crop residues and cross-slope tillage are normally sufficient for erosion control. As in orchards, an occasional diversion may be needed.

CAPABILITY CLASS III

Capability unit IIIe–1: Moderately deep to very deep, moderately coarse to moderately fine textured, moderately permeable, sloping soils

Much of this unit is made up of small scattered bodies of very deep, moderately permeable, recent alluvial soils, as well as alluvial soils having slightly restricted subsoil permeability. A few upland soils are included. Textures range from sandy loam to clay loam, and

slopes from 9 to 15 percent. All of the soils have good air and water drainage, sufficient moisture storage, and other favorable features that together make them desirable for cropping. Erosion hazard and the problems of operating on slopes are the main limitations to cropping. The following soils are in this group:

(Ac) Agueda clay loam, sloping.
(Ag) Agueda gravelly clay loam, sloping.
(At) Arguello shaly loam, sloping.
(Bo) Ballard fine sandy loam, sloping.
(Bd) Ballard fine sandy loam, sloping, moderately eroded.
(Bt) Botella clay loam, sloping.
(Co) Carpinteria clay loam, sloping.
(Ct) Crow Hill loam, sloping.
(Cu) Crow Hill loam, sloping, moderately eroded.
(Ed) Elder shaly loam, sloping.
(Gf) Gaviota sandy loam, sloping.
(SJ) Sorrento fine sandy loam, channeled, sloping.
(ST) Sorrento loam, sloping.
(Yd) Yolo loam, channeled, sloping.

Use and management.—Most areas of these soils are cultivated. A few areas scattered in the hills are used for range along with more extensive areas of grasslands. Most of the included alluvial soils in the eastern part of the Area are used for lemons and, to small extent, for avocados. Elsewhere these soils are used for dry-farmed hay, lima beans, tomatoes, Sudangrass, and grain. As most of the dry-farmed crops require winter fallow, erosion is a particular hazard. All tillage before the rainy season should be at or near the contour. Subsoiling on the contour when the soils are dry will aid infiltration and decrease runoff. Crop residues and stubble left at or near the surface will help check erosion and maintain organic matter. Diversion terraces designed to intercept surface flow are needed for all sizable areas.

Essentially all irrigated areas are in orchards. Cross-slope planting on a grade of 0.5 to 1.0 percent will provide a permanent guide for tillage and for irrigation furrows. Safe application of water to orchards that are square-planted requires sprinkler irrigation. Many contoured orchards are also sprinkled. If the slopes are more than a few hundred feet long, diversion terraces may be combined with haul roads to remove excess water and to provide access. Winter-growing cover crops or nontillage weed control is necessary in checking sheet erosion. Bench terraces can be used but they have no special advantages. The use of such terraces depends upon the operator's preferance. Citrus fruits, avocados and dry-farmed field crops respond favorably to nitrogen fertilizers. In some places these crops show favorable response to phosphorus.

Capability unit IIIe–3: Shallow to moderately deep, moderately coarse to medium textured, gently sloping claypan soils of the older terraces

Soils of this unit have tight claypan subsoils and slopes of 3 to 8 percent. The topsoils—sandy loam or fine sandy loam—are readily penetrated by roots and water. The claypan subsoils begin at depths of 10 to 24 inches, or at an average depth of 20 inches. They are a distinct barrier to roots and moisture.

Soils in this unit are very similar to those in unit IIe–3, but are gently sloping rather than nearly level. If irrigation or rainfall supply more water than the topsoil will hold, runoff is rapid and the topsoil becomes temporarily waterlogged. The coarser textured Baywood

soils over Watsonville soils are placed in this unit because of the claypan in their subsoil. This claypan makes them perform more like the soils of this unit than any other. The following soils are in this unit:

(Af) Aliso fine sandy loam, gently sloping, moderately eroded.
(Am) Aliso loam, gently sloping, moderately eroded.
(Bk) Baywood loamy fine sand, over Watsonville soils, gently sloping.
(Bn) Baywood loamy sand, over Watsonville soils, gently sloping.
(Bo) Baywood loamy sand, over Watsonville soils, nearly level.
(Ja) Jalama shaly sandy loam, gently sloping and sloping.
(Kb) Kitchen middens over relatively impermeable soil material.
(Mh) Milpitas fine sandy loam, gently sloping, moderately eroded.
(Mn) Milpitas fine sandy loam, overwash, gently sloping and nearly level.
(Mv) Milpitas fine sandy loam, undulating.
(Wa) Watsonville fine sandy loam, gently sloping.
(Wb) Watsonville fine sandy loam, gently sloping, moderately eroded.
(Wh) Watsonville loam, gently sloping.
(Wk) Watsonville loam, gently sloping, moderately eroded.
(Wp) Watsonville sandy loam, gently sloping.

Use and management.—Slow permeability of the claypan subsoils creates a number of management problems. Despite gentle slopes, erosion may be active on tilled areas. Not enough readily available moisture is stored in the soil to produce good yields of summer-grown dry-farmed crops. Grain or hay grown in winter make better use of the rainfall. The natural structure of the topsoils is fairly good. The soils are easily worked, but their structure is readily destroyed by working them to a powder when dry, or by working them when too moist.

In the eastern part of the Area many of these soils are irrigated. They are used mostly for lemons, but to some extent for avocados and tomatoes. West of Santa Barbara, the Watsonville soils are used intensively for flowers and other specialty crops. Nontillage weed control is advantageous in orchards because it allows roots better use of the limited depth of soil over the claypan. Where nontillage weed control is not used, winter cover crops are needed to control erosion and to add organic matter.

Sprinkler irrigation is generally preferred. Nevertheless, irrigation furrows aligned on a grade of 0.5 percent will give satisfactory results. For furrow irrigation, cross-slope planting is advisable. Square-planted orchards require sprinklers; otherwise, soil erosion will be excessive. Overirrigation is to be avoided. Waterlogging of the soil above the claypan damages tree roots and encourages root rot, particularly in avocados. Salts from irrigation water tend to build up to damaging levels because the subsoil restricts the normal leaching action that removes salts. On the longer slopes diversions are needed to intercept surface flow and lead it safely to suitable outlets. As the soils lie at some elevation above the valley floor, air drainage is generally good. Frost seldom damages crops. Crops show good response to nitrogen, and generally a response to phosphorus. Lemons show that minor elements are deficient, but they can be applied to the trees in sprays. Walnuts are very poorly suited because the soils do not have a deep enough root zone.

On dry-farmed cropland, crop residues and stubble left at and near the surface aid in controlling erosion and in maintaining organic matter and soil structure. Diversion terraces, if they have suitable

outlets, perform satisfactorily on these soils on slopes of up to 8 percent. A rotation of grain or hay with a summer-growing crop will provide stubble for soil protection during winter. Deep subsoiling is not so helpful on these soils as on those of capability unit IIIe–5.

Capability unit IIIe–5: Moderately deep to deep, fine-textured, slowly permeable, sloping soils of the uplands

Mostly clay textures and slopes of 9 to 15 percent are the main features of the soils in this unit. Most of the soils are on uplands and are 32 to 48 inches deep. The clay-terrace soils of the Montezuma series are included because, in their main features, they are very similar to other soils of the unit.

All the soils are relatively stable. The soil material is not easily detached by running water. Upon drying the soils develop large cracks. Initial water intake is rapid, but the soils swell when wet, the cracks close, and water intake becomes slow. Most of the soils have a good granular structure, despite their high clay content. The following soils are in this group:

(CF) Cayucos clay, sloping.
(DC) Diablo clay (adobe), sloping.
(LL) Los Osos clay loam, sloping, moderately eroded.
(MR) Montezuma clay (adobe), sloping.
(MS) Montezuma clay (adobe), sloping, moderately eroded.
(NC) Nacimiento clay, sloping.
(SN) Santa Lucia shaly clay loam, sloping.
(SX) Sespe clay, sloping, moderately eroded.
(SD) Sespe clay loam, sloping.
(ZC) Zaca clay, sloping.
(ZH) Zaca clay loam, sloping, moderately eroded.
(ZP) Zaca shaly clay loam, sloping.
(ZR) Zaca shaly clay loam, sloping, moderately eroded.

Use and management.—These soils are scattered throughout the Area, often in places where irrigation water is not available. Most areas are dry-farmed, particularly for summer-grown tomatoes, lima beans, and Sudangrass. Grain and hay are grown to some extent. Less accessible areas are used for range along with extensive areas of hilly grasslands; they produce good yields of forage.

These fine-textured, moderately deep soils have good moisture storage, which favors the growing of summer crops. Winter fallow is necessary for growing dry-farmed crops. The soils are therefore bare in the rainy season and may erode seriously during intense or prolonged storms. All crop residues and stubble should be left at or near the surface to aid in controlling erosion. A crop rotation that provides straw or stubble will aid in protecting the soil during the winter fallow period.

Diversion terraces have worked well on these soils, and many have been built. Contour subsoiling in the fall helps to check erosion on open cropland and improves intake of water. To avoid severe rill erosion, all other cultivation done before the rainy season should be as near the contour as possible. Except for a little supplemental sprinkler irrigation for some areas in tomatoes, all the irrigated lands are in orchards.

Lemons produce fairly well, but the problems of management associated with hillside culture must be met. Lime-induced chlorosis is a problem. It is particularly evident on the Zaca soils and the more limy ridges in the Nacimiento soil, and occasionally occurs on the Sespe

soils. The main methods of combating chlorosis are (1) alternate-middle irrigation and (2) preventing the soils from staying wet for long periods.

Prebuilt bench terraces can be cut in the slopes, but the generally accepted and preferred practice is to plant orchards on the contour and to avoid excessive soil movement, even where the middles are cultivated.

Either nontillage weed control or winter cover crops are used to check erosion in orchards. Diversion terraces with outlet systems are used in many orchards and are needed in others, particularly on the longer slopes. Wet winters or overirrigation may seriously damage avocado roots on these fine-textured, slowly permeable soils. Irrigation is by sprinklers or by furrows on a grade of 0.5 to 1.5 percent. The general preference is for sprinklers. Moving portable sprinklers off the wet clay is troublesome unless the soils have had 24 hours or more to drain and dry. Air drainage is good, and frost damage is seldom a problem. Few walnuts are grown because the soils are not deep enough and have unfavorable texture. Nitrogen fertilizer is used on lemons and avocados with good results, but so far, phosphorus has not produced a favorable response.

Capability unit IIIs–4: Very deep, coarse-textured, rapidly permeable, gently sloping soils of the recent alluvial fans and terraces

Soils of this capability unit are distinguished by their coarse texture, low moisture-storage capacity, and gentle slopes. Most of the soils are the very deep loamy sands of the Baywood series and occur along the ocean bluffs. Limited areas of gravelly and stony alluvial soils and of San Andreas loamy sand, sloping, are included because their physical features are similar to those of other soils in the unit.

The fertility level of soils in this unit is not particularly high, and they do not store enough moisture to permit good yields of dry-farmed field crops. Roots and moisture readily penetrate the soils to considerable depths. These soils are not extensive. They are:

(Bg) Baywood loamy fine sand, gently sloping.
(Bl) Baywood loamy sand, gently sloping.
(Bm) Baywood loamy sand, nearly level.
(Se) San Andreas loamy sand, sloping.
(SP) Sorrento gravelly fine sandy loam, sloping.
(Yl) Yolo stony fine sandy loam, gently sloping.

Use and management.—Where irrigation water is available, these soils are used for lemons, a few avocados, cut flowers, specialty crops, and nurseries. Irrigation is by sprinklers. The intake rate of the soils is so high that furrow irrigation is not practical. Winter cover crops are used in the orchards to provide needed organic matter and to control erosion. Nitrogen fertilizers give good response, and some crops also respond to phosphorus. Wind erosion is seldom a problem under irrigation, as large areas are seldom without a plant cover for a long time. Intake rates are sufficiently high that water erosion is seldom a problem. The somewhat excessive drainage is an advantage in growing some flower, nursery, and specialty crops.

Dry-farming areas need to be protected by crop residues or stubble left on the surface. Winter-growing crops are generally better suited to these soils because they use moisture at the time it is most plentiful.

CAPABILITY CLASS IV

Capability unit IVe–1: Shallow to moderately deep, moderately coarse to medium-textured, moderately rapid to moderately permeable, moderately steep and hilly soils of the uplands

Soils of this capability unit are loams to sandy loams, usually 18 to 30 inches deep, that rest on one of several kinds of bedrock. Most of the soils have slopes of 16 to 30 percent, but some less sloping eroded areas are included because their management and potential productivity are similar. Moisture storage is not high; it is better than for soils of unit IIIs–4 and not so good as for soils of IIIe–5. The soils are:

(CR) Crow Hill loam, hilly.
(CS) Crow Hill loam, hilly, moderately eroded.
(GA) Gaviota fine sandy loam, hilly.
(GE) Gaviota sandy loam, hilly.
(GG) Gaviota sandy loam, sloping, moderately eroded.
(S) San Andreas fine sandy loam, hilly.
(SA) San Andreas fine sandy loam, sloping, moderately eroded.
(SC) San Andreas loamy sand, hilly.
(SQ) Santa Lucia shaly loam, hilly.

Use and management.—These soils occur mostly as scattered bodies in the hills and foothills throughout the survey area. Nearly all areas are without irrigation water. They are used mostly for hay, grain, or Sudangrass, or grazed with the more extensive steep rangelands. Yields are only fair because the soils have moderate fertility and moisture-holding capacity. Running water detaches soil materials rather easily, and slopes are strong. This condition makes sustained cropping of these soils questionable. The soils can be used once in 4 or 5 years for a tilled crop, if crop residues and contour operations are employed. More frequent use causes excessive erosion and, eventually, lower yields. Generally, these soils are best used for range. Their slope permits ready seeding of grass and fertilization. Forage production is good, but not quite so good as on the finer textured soils in capability unit IVe–5 that are used for range.

Small areas of San Andreas soils located near Santa Barbara are accessible to irrigation water. These soils are deep and moderately permeable. They are used for avocados or lemons and produce fairly well. Desirable practices for orchards are nontillage weed control or growing of winter cover crops, use of diversions or other means of safely disposing of excess water, fertilization, and sprinkler irrigation. Small claypan spots in these soils may have undesirable internal drainage.

Capability unit IVe–3: Shallow to moderately deep, moderately coarse to medium textured, sloping claypan soils of the older terraces

Soils in this capability unit have claypan subsoils at a depth of 24 inches. On bald eroded ridges they may have only a few inches of topsoil. The soils are much like those in capability unit IIIe–3, but are sloping rather than gently sloping. Nearly all slopes range from 9 to 16 percent. A soil of lesser slope, Milpitas fine sandy loam, gently sloping, severely eroded, is included because its potential for production is similar to that of the other soils. Slightly and moderately eroded areas are also included.

The topsoils are mostly fine sandy loam, although a few loams and sandy loams are included. Use and management problems result mainly from the claypan subsoils and sloping topography. The following soils are in this unit:

(AH) Aliso fine sandy loam, sloping.
(AK) Aliso fine sandy loam, sloping, moderately eroded.
(AP) Aliso loam, sloping, moderately eroded.
(MC) Milpitas fine sandy loam, deep, sloping.
(MI) Milpitas fine sandy loam, gently sloping, severely eroded.
(MO) Milpitas fine sandy loam, rolling.
(MP) Milpitas fine sandy loam, rolling, moderately eroded.
(MQ) Milpitas fine sandy loam, sloping.
(MR) Milpitas fine sandy loam, sloping, moderately eroded.
(MX) Milpitas gravelly fine sandy loam, sloping, moderately eroded.
(OC) Olivenhain fine sandy loam, sloping.
(OD) Olivenhain fine sandy loam, sloping, moderately eroded.
(OE) Olivenhain gravelly fine sandy loam, sloping, moderately eroded.
(TO) Tierra fine sandy loam, sloping, moderately eroded.
(WF) Watsonville fine sandy loam, sloping.
(WG) Watsonville fine sandy loam, sloping, moderately eroded.
(WN) Watsonville loam, sloping.
(WO) Watsonville loam, sloping, moderately eroded.
(WS) Watsonville sandy loam, sloping.

Use and management.—Topsoils are easy to till and respond to good management. Excessive tillage quickly destroys the structure of the surface layers. They are then powdery before wetting and cloddy afterward. The tight claypans admit moisture very slowly, so runoff is excessive after the topsoil is wet. Few roots grow into the subsoil.

Where irrigation water is available, most of the soils are used for lemons, but an increasing acreage is being used for avocados. Irrigation is done by furrows plowed on a gentle grade, or by sprinklers. Some of the older fields have spots of claypan at or near the surface. Sprinkler irrigation is better for them because the flow and quantity of water can be more closely regulated.

Any buildup of water or seepage over the claypan encourages root damage, particularly root rot of avocados. Water of poor quality may lead to a buildup of salts in the soils. Diversions, along with a suitable system for disposal of excess water, are particularly desirable for orchards. In orchards nontillage weed control is desirable, as it permits best use of the limited depth of soil favorable for root development and also aids in erosion control. Undisturbed soil under nontillage management is not readily detached by running water. Winter cover crops are needed in orchards if nontillage weed control is not used.

A limited area is used for sprinkler irrigated field crops, mostly tomatoes grown between trees in the orchards. Other field crops—mostly grain or hay—are dry-farmed. Small acreages of lima beans and tomatoes are grown without irrigation.

Dry-farmed field crops do not produce well, particularly the summer growing crops, because the soils do not store enough moisture and do not have high fertility. Erosion hazards are high under cultivation.

Diversion terraces are difficult to maintain on any but the more gentle slopes. Erodibility and moderate yields oppose continued cultivation. An occasional crop can be grown without undue erosion if contour tillage and stubble mulching are practiced.

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Over a long period, areas of these soils not in orchards give the best returns if they are kept in pasture. The slopes permit fairly easy seeding or reseeding and the spreading of fertilizer. Heavy applications of nitrogen and phosphorus will bring a good response from forage on these soils.

Capability unit IVe–5: Moderately deep to deep, fine-textured, slowly permeable, moderately steep and hilly soils of the uplands

The soils of this capability unit are fine textured and hilly. They occur in the foothills the full length of the survey area. Most of the soils are clay, although some clay loams are included. All of the soils except the Montezuma have shale bedrock at depths of 28 to 42 inches.

Soils in this unit are very similar to those in capability unit IIIe-5, but are moderately steep and hilly. Slopes range from 16 to 30 percent, and erosion ranges from slight to moderate. Moisture storage and inherent fertility are fairly high. Textures are fine and somewhat difficult to work, but the main management problems arise from the erosion hazard and tillage difficulties of the relatively steep slopes.

The dry soils take in water rapidly because they contain large cracks, and the soils swell upon wetting and after a time infiltration becomes slow. Generally the soils have good structure and granulate well, despite their fine texture. This unit is made up of the following soils:

(CB) Carpinteria clay loam, moderately steep.
(CE) Cayucos clay, hilly.
(CG) Cayucos clay loam, hilly, moderately eroded.
(CM) Climax clay (adobe), hilly.
(DA) Diablo clay (adobe), hilly.
(DB) Diablo clay (adobe), hilly, moderately eroded.
(LE) Los Osos clay, hilly.
(LH) Los Osos clay loam, hilly.
(LK) Los Osos clay loam, hilly, moderately eroded.
(MO) Montezuma clay (adobe), moderately steep.
(MP) Montezuma clay (adobe), moderately steep, moderately eroded.
(NA) Nacimiento clay, hilly.
(NB) Nacimiento clay, hilly, moderately eroded.
(NH) Nacimiento clay loam, hilly.
(SK) Santa Lucia shaly clay loam, hilly.
(SL) Santa Lucia shaly clay loam, hilly, moderately eroded.
(SV) Sespe clay, hilly.
(SW) Sespe clay, hilly, moderately eroded.
(SA) Sespe clay loam, hilly.
(SB) Sespe clay loam, hilly, moderately eroded.
(ZA) Zaca clay, hilly.
(ZB) Zaca clay, hilly, moderately eroded.
(ZG) Zaca clay loam, hilly.
(ZM) Zaca shaly clay loam, hilly.
(ZN) Zaca shaly clay loam, hilly, moderately eroded.

Use and management.—Most of the soils occur where irrigation water is not available. Many of the areas, particularly in the eastern half, are used for dry-farmed crops grown in summer. Moisture storage and financial return favor these crops. Winter fallow is required for these crops. This practice over a long period has resulted in slight to moderate erosion, even though these soils are relatively stable.

The soils are capable of producing good quantities of nutritious range pasture. Over a long period, they probably give best returns when used for range grazing. An occasional crop can be grown without undue erosion hazard if precautions are taken. Among the safeguards required is that the soils not be tilled more than two consecutive years before returning them to grass. Where these soils are used for grain or hay, management should be about the same as

for crops requiring winter fallow, and the length of the period of cropping should be about the same. The larger quantities of crop residue from hay or grain and season of growth make the erosion hazard somewhat less than for the summer-grown crops.

Many of the soils are associated with steeper range hills and are used along with them for grazing. These soils generally support some burclover, along with wild oats, soft chess, annual ryegrass, and some less desirable species. When used for range, this is one of the highest producing *range sites*[4] of the survey Area.

In the eastern part of the Area, where irrigation water is available, lemons and some avocados are grown. Yields may be nearly as good as those on soils of capability class I or capability unit IIe–1. Frost is seldom a problem. Management of the hillside orchards presents various problems. Lime-induced chlorosis may be a problem, particularly on lemons. In decreasing order of severity, chlorosis is a problem on some of the Zaca, Nacimiento, and Sespe soils.

Diversions combined with haul roads are needed to intercept surface flow before it builds up to the point where it causes erosion. Contour planting is generally desirable and is necessary if furrow irrigation is used. Sprinklers are a more common method of applying water, and square planting is then suitable if diversions are used. Generally, the soils are deep enough for precut bench terraces, but these are not generally recommended. Winter cover crops or nontillage weed control is also needed for erosion control. Nontillage weed control is easier to manage on these slopes and is economical after the trees are large enough to shade a large part of the ground.

Capability unit IVs–4: Moderately deep, coarse-textured, moderately permeable, gently sloping and sloping soils of the older terraces

Most of the soils in this capability unit are sandy and droughty. Roots may penetrate to considerable depths, but total moisture-supplying capacity and the fertility level are quite low. Slopes range from 3 to 15 percent, but characteristics of the soils other than slope dominate in determining their suitability for agriculture. Though the gently sloping and sloping Ballard stony fine sandy loams are considerably different from the others in this unit, their potential for intensive use is similar. The following soils are in this unit:

(BF) Ballard stony fine sandy loam, gently sloping and sloping.
(BH) Baywood loamy fine sand, moderately steep.
(BP) Baywood loamy sand, rolling.
(MA) Marina sand, gently sloping.
(TB) Tangair loamy sand, sloping.
(TC) Tangair loamy sand, sloping, moderately eroded.
(TF) Tangair sand, sloping.
(TG) Tangair sand, sloping, moderately eroded.

Use and management.—Except for some areas of the Baywood soils, the soils of this unit do not have irrigation water. The soils are used mostly for grazing, along with more extensive range areas, some of them in capability unit VIIe–4. They are part of a sandy range site that does not produce well, as many of the species have a short growing period and provide little nourishment. Brush tends to encroach on the range. Some areas are occasionally used for hay or grain,

[4] Range site means the soils in a given kind of geographic location and the climate, drainage, water supply, and other factors of the environment in that location.

though yields are well below average for the survey Area. This cropping is desirable, as it checks the invasion of brush. Some new grasses give promise that they can grow well and produce much more feed than is now obtained. These soils will blow readily if large areas are left open to the wind without some mulch on the surface. Water erosion is seldom a problem because the soils absorb it rapidly.

A few areas of the Baywood soils in the eastern part of the Area are irrigated with sprinklers, the only suitable method on such permeable soils. Lemons, flowers, and some specialty crops are grown. They receive frequent light irrigations and liberal applications of nitrogen and phosphorus. Yields are fairly good and depend mostly on the amount of fertilizer used and the care given the crop. Frost is not a problem.

CAPABILITY CLASS VI

Capacibity unit VIe–3: Shallow to moderately deep, moderately coarse to medium textured, sloping and moderately steep claypan soils of the older terraces

These are moderately steep soils around the edges of mesas and along drainageways. Most of the soils have a claypan subsoil, and the Jalama soil has a hardpan. The surface soils are largely fine sandy loams, and some are gravelly and stony. Some areas are moderately or severely eroded.

A few areas of stony upland soil are included with the lower lying claypan soils of this unit because they have similar use and productivity. Slopes range mostly from 16 to 30 percent, although a few severely eroded less sloping soils and a few more steeply sloping soils are included.

Moisture-holding capacity and fertility are low. The soils are not suited to cultivation because they are too sloping and erode rapidly during the rainy season if they do not have a plant cover. Many of the eroded soils of this unit were once cultivated but have been allowed to return to natural vegetation. The soils are:

(Ag) Aliso fine sandy loam, moderately steep, moderately eroded.
(An) Aliso loam, moderately steep, moderately eroded.
(Jb) Jalama shaly sandy loam, moderately steep.
(Lr) Los Trancos stony loam, hilly and steep.
(Mb) Maymen fine sandy loam, hilly.
(Md) Maymen stony fine sandy loam, hilly.
(Mj) Milpitas fine sandy loam, moderately steep.
(Mk) Milpitas fine sandy loam, moderately steep, moderately eroded.
(Ms) Milpitas fine sandy loam, sloping, severely eroded.
(Mt) Milpitas fine sandy loam, steep.
(Mw) Milpitas gravelly fine sandy loam, moderately steep and steep, moderately eroded.
(Mz) Milpitas stony fine sandy loam, sloping.
(Oa) Olivenhain fine sandy loam, moderately steep.
(Ob) Olivenhain fine sandy loam, moderately steep, moderately eroded.
(Of) Olivenhain stony fine sandy loam, gently sloping.
(Oh) Olivenhain stony fine sandy loam, sloping.
(Si) San Andreas-Tierra fine sandy loams, hilly.
(Wc) Watsonville fine sandy loam, moderately steep.
(Wd) Watsonville fine sandy loam, moderately steep, moderately eroded.

Use and management.—Most of these soils are without irrigation and are used for range. They are moderately productive but do not provide so much forage as the soils of capability unit VIe–5. These

soils are favorable for perennial grasses, particularly purple stipa. Any more than moderate grazing will destroy the perennial grass and may cause erosion. The soils and topography favor erosion. California-sage and coyote-brush generally take over the eroded areas.

Where irrigation is available in the eastern part of the Area, some of these soils are used for lemons and avocados. Some of these orchards have lost much of their topsoil. Part of the loss took place when the soils were used for cultivated crops before orchards were planted. Rainfall and improper irrigation of the orchards account for the rest of the loss. The soils can be used for orchards if carefully managed, but are not suitable for cultivation in the usual sense.

Nontillage weed control, possibly supplemented by hand hoeing, is necessary to minimize disturbance. Permanent cover crops could be used, but buying the extra water needed to grow them is seldom economical. Diversions are needed at strategic locations, and with them, a disposal system to intercept runoff flowing from the mesa tops.

The claypans are not quite so tight nor so continuous as in soils of capability units IIe–3 and IIIe–3, but internal drainage and root penetration are critical problems. Air drainage is such that frost damage seldom occurs. Because of the many problems and costs involved in fruit production, the soils should be considered borderline for such use, although careful management may bring relatively good yields.

Capability unit VIe–5: Moderately deep to deep, fine-textured, slowly permeable, steeply sloping soils of the uplands

These soils occur as an irregular band throughout the length of the Area. The same soil series are in this unit as are in capability unit IVe–5, but the series are represented by mapping units on steeper slopes, namely, 30 to 45 percent. Most of the soils are clays, though some clay loams are included. The slightly different Montezuma soils, particularly Montezuma stony clay, sloping, are included because they are not suited to cultivation but are productive of forage. Soils having both slight and moderate erosion are included. Many of the moderately eroded areas have been cultivated in the past.

Soil depths range from 28 to 42 inches, and moisture storage is good. Severe erosion hazard caused by steep slopes, and difficulties of tilling them, make these soils unsuitable for cultivation. The following soils are in this group:

(CH) Cayucos clay loam, steep, moderately eroded.
(CN) Climax clay (adobe), steep.
(DD) Diablo clay (adobe), steep.
(LF) Los Osos clay, steep.
(LG) Los Osos clay, steep, moderately eroded.
(LM) Los Osos clay loam, steep.
(LN) Los Osos clay loam, steep, moderately eroded.
(MT) Montezuma clay (adobe), steep, moderately eroded.
(MW) Montezuma stony clay, sloping.
(ND) Nacimiento clay, steep.
(NE) Nacimiento clay, steep, moderately eroded.
(NK) Nacimiento clay loam, steep.
(SY) Sespe clay, steep.
(SZ) Sespe clay, steep, moderately eroded.
(SE) Sespe clay loam, steep.
(SF) Sespe clay loam, steep, moderately eroded.
(ZD) Zaca clay, steep.
(ZE) Zaca clay, steep, moderately eroded.
(ZK) Zaca clay loam, steep.
(ZS) Zaca shaly clay loam, steep.
(ZT) Zaca shaly clay loam, steep, moderately eroded.

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Use and management.—As all the soils are fine textured and many of them are calcareous, burclover, a desirable range plant, is commonly present in large quantities. The fertility level of the soils is fairly high, and production of forage is good. In addition to burclover there are other desirable species such as wild oats, soft chess, and alfilaria. Heavy grazing results in an increase of red brome and other less desirable grasses. In some seasons mustard is especially plentiful on the calcareous soils and materially reduces the carrying capacity of the range for that particular season. This is the highest producing range site in the Area. Only the less sloping parts of unit IVe–5 used for range exceed this site in forage production.

A small acreage in the eastern part of the Area is used for lemons and avocados grown under irrigation. Yields, production methods, and management problems are similar to those for capability unit IVe–5. Careful attention is needed to control erosion and to manage orchards on such steep slopes. In the past, considerable areas were used for dry-farmed lima beans along with some tomatoes and grain or hay. Most of these areas have been returned to range. Small areas still being farmed may eventually be retired because of reduced yields caused by excessive soil loss.

CAPABILITY CLASS VII

Capability unit VIIe–1: Shallow to moderately deep, moderately coarse to medium textured, moderately rapid to moderately permeable, steep and very steep soils of the uplands

Slopes generally range from 30 to 45 percent, although some eroded poorer soils have slopes of less than 30 percent, and a few soils have slopes of more than 45 percent. The surface soils are mostly sandy loams to loams, and depths of the soils generally range from 10 to 22 inches. Moisture storage is low, although fertility is fairly good. Because of severe erosion hazard and great difficulties involved in tillage, these soils are not suited to cultivation. They are:

(CK) Cayucos shaly soils, undifferentiated, steep and very steep.
(CV) Crow Hill loam, steep and very steep.
(GB) Gaviota fine sandy loam, hilly, moderately eroded.
(GC) Gaviota fine sandy loam, hilly, severely eroded.
(GD) Gaviota fine sandy loam, steep.
(GH) Gaviota sandy loam, steep.
(LP) Los Osos stony soils, undifferentiated, steep and very steep.
(MC) Maymen fine sandy loam, hilly, moderately eroded.
(NL) Nacimiento stony soils, undifferentiated, very steep.
(SB) San Andreas fine sandy loam, steep, moderately eroded.
(SD) San Andreas loamy sand, hilly, moderately eroded.
(SF) San Andreas loamy sand, steep.
(SG) San Andreas loamy sand, steep, moderately eroded.
(SO) Santa Lucia shaly clay loam, steep.
(SP) Santa Lucia shaly clay loam, steep, moderately eroded.
(SR) Santa Lucia shaly loam, steep.
(SS) Santa Lucia shaly loam, very steep.
(ST) Santa Lucia stony clay loam, hilly.
(SG) Sespe nonstony soils, undifferentiated, very steep.
(ZV) Zaca stony soils, undifferentiated, steep and very steep.

Use and management.—These soils produce fair to low quantities of forage. They do not store enough moisture to allow heavy growth of grass, so they are covered mostly with black sage, some California-sage, and lesser amounts of coyote-brush, buckwheat, chamise, poison-oak, and deervetch. Areas of deeper soil in protected slopes and

draws have glades of annual grass and live oak. Some purple stipa survives underneath and near the base of the shrubs.

Moderate grazing and varying season of use will aid recovery of the better forage species. Heavy grazing will result in accelerated erosion, soil movement, and a loss of the better forage grasses. Little burclover is present. Little of this unit is used for crops, and the areas so used are minor parts of larger areas consisting of more productive soils.

Capability unit VIIe–3: Shallow to moderately deep, moderately coarse to medium textured, hilly and steeply sloping claypan soils of the older terraces

Soils in this unit are mostly on slopes of 30 to 45 percent. Included, however, are some soils on slopes of less than 30 percent. These are included because they are eroded or stony and therefore have use suitability and productivity about the same as the other soils of the unit.

Surface soils are mostly sandy loams. They overlie claypan subsoils for the most part. The occurrence of the claypan is spotty, however, and in some places it is lacking. Moisture storage is low, although some plants are able to use some of the less readily available moisture from the claypan and substrata. Erosion hazard is particularly severe, as this unit occurs on steep "breaks" below capability units IIe–3, IIIe–3 and IVe–3 where excess waters may accumulate, spill over the side, and cause severe gullying. The following soils are in this group:

(AL) Aliso fine sandy loam, steep, moderately eroded.
(AO) Aliso loam, moderately steep, severely eroded.
(JC) Jalama stony soils, undifferentiated, hilly and steep.
(ML) Milpitas fine sandy loam, moderately steep, severely eroded.
(MU) Milpitas fine sandy loam, steep, moderately eroded.
(MY) Milpitas stony fine sandy loam, moderately steep.
(MA) Milpitas stony fine sandy loam, steep.
(OG) Olivenhain stony fine sandy loam, moderately steep.
(OK) Olivenhain stony soils, undifferentiated, steep.
(SJ) San Andreas-Tierra fine sandy loams, steep.
(TM) Tierra fine sandy loam, hilly, moderately eroded.
(TN) Tierra fine sandy loam, hilly, severely eroded.
(TP) Tierra fine sandy loam, steep, moderately eroded.
(TR) Tierra soils, undifferentiated, steep.
(WL) Watsonville loam, moderately steep, moderately gullied.
(WR) Watsonville sandy loam, moderately steep, moderately eroded.
(WT) Watsonville soils, undifferentiated, steep.

Use and management.—Much of this unit has a brush cover composed of California-sage, some scrub oak and live oak in the draws, and some annual grasses and a little purple stipa among the brush. Forage production is lower than on the similar but less sloping unit VIe–3, and the erosion hazard is more severe if the soils are overgrazed or their cover is burned off.

Good air drainage and available water have encouraged growing of avocados or lemons in a few areas. Cultivation is difficult, and impractical because of steep slope and severe erosion hazard. Nontillage weed control with varying degrees of permanent cover, are necessary to protect the surface soil. Diversions are needed, particularly to intercept runoff from higher lying areas. Irrigation is by sprinkler,

and rates and quantities of application are carefully controlled. Bench terraces have not been satisfactory. It is better to plant with as little soil disturbance as possible. With no cultivation and very careful management, erosion may be held to a low level, but the careful management needed and the costs involved do not encourage much planting.

Capability unit VIIe–4: Moderately deep, coarse-textured, moderately steep soils of the older terraces

This range unit occurs in the western part of the survey area along the drainageways below benches of capability unit IVs–4. The soils are sands or loamy sands of considerable depth, but they have low moisture-storage capacity and low fertility. They are subject to wind and water erosion if the natural cover is removed or disturbed to any great extent. Most of the unit is on slopes of 16 to 30 percent, though the more eroded slopes are not so steep. The following soils are in this group:

(TA) Tangair loamy sand, moderately steep.
(TD) Tangair sand, moderately steep.
(TE) Tangair sand, moderately steep, moderately eroded.
(TH) Tangair sand, sloping, severely eroded.

Use and management.—The cover is mostly brush of moderate height. Some annuals are scattered through the brush but they are mostly of low value for forage. Some ripgut brome is present but it is suitable for grazing only a short time. This is one of the lower producing units in the Area. The limitations imposed by the soils are so great that there is not much opportunity for increasing forage production economically.

Capability unit VIIe–5: Moderately deep to deep, fine-textured, slowly permeable, very steeply sloping soils of the uplands

This capability unit is similar to VIe–5 but the soils are shallower and slopes are often more than 45 percent. Landslips of various soil-forming materials are included, along with some stony and steep eroded soils. The textures are mainly clay loams to clay, and soil depths range from 15 to 28 inches. Some areas of the landslips are much deeper. Erosion hazard is severe because slopes are strong and the soils are unstable. These soils and miscellaneous land types are not cultivated, nor is cultivation practical. The members of this unit are:

(LA) Landslip, Climax soil material, moderately steep.
(LB) Landslip, Diablo soil material, moderately steep and steep.
(LC) Landslip, Los Osos soil material, moderately steep and steep.
(LD) Landslip, Nacimiento soil material, steep.
(LO) Los Osos clay loam, very steep.
(MM) Montara stony soils, undifferentiated, hilly and steep.
(NF) Nacimiento clay, very steep.
(NG) Nacimiento clay, very steep, moderately eroded.
(RK) Rough gullied land, Nacimiento soil material.
(SM) Santa Lucia shaly clay loam, hilly, severely eroded.
(SC) Sespe clay loam, hilly, severely eroded.
(ZF) Zaca clay, steep, severely eroded.
(ZL) Zaca nonstony soils, undifferentiated, very steep.
(ZO) Zaca shaly clay loam, hilly, severely eroded.
(ZU) Zaca shaly clay loam, steep, severely eroded.

Use and management.—Most of this unit has a grass-and-herb cover. Patches of black sage and California-sage are on the more shallow areas. The soils are more productive of forage than those of any other unit in capability class VII. Moisture storage is fair. Burclover and a good stand of the better annual grasses are generally present. Grazing is hindered by the very steep slopes and broken surface of the landslips. It is necessary to have more plant residues to control erosion than it is on unit VIe–5.

CAPABILITY CLASS VIII

Miscellaneous nonagricultural soils and land types

The soils and miscellaneous land types in this class are not suitable for cropping or grazing. The most extensive acreage, nearly a third of the survey Area, is occupied by Rough broken and stony lands, Maymen, Sespe, and Gaviota soil materials, which are on the slopes of the Santa Ynez Mountains. Scattered throughout the district are smaller bodies of steep rocky brushland that have similar soil characteristics. Elsewhere, scattered through the survey Area, are bodies of rough gullied land not suitable for use. Along the coast are other nonagricultural land types, such as Coastal beach, Dune sand, and Made land. These have recreational or industrial value but are not suited to agriculture. The following miscellaneous land types and soils are in this class:

(Ar) Alviso soils, undifferentiated, nearly level.
(Co) Coastal beach, sandy.
(Cp) Coastal beach, stony.
(De) Dune sand.
(Ef) Excavated land.
(Gk) Gaviota stony soils, undifferentiated, steep and very steep.
(M) Made land.
(Me) Maymen stony soils, undifferentiated, steep and very steep.
(Ra) Riverwash.
(Rb) Rough broken and stony land, Gaviota soil material.
(Rc) Rough broken and stony land, Maymen soil material.
(Rd) Rough broken and stony land, Montara soil material.
(Re) Rough broken and stony land, Santa Lucia soil material.
(Rf) Rough broken and stony land, Los Trancos soil material.
(Rg) Rough broken and stony land, Sespe soil material.
(Rh) Rough gullied land, Los Osos soil material.
(Rl) Rough gullied land, San Andreas soil material.
(Rm) Rough gullied land, Watsonville soil material.
(Sh) San Andreas stony soils, undifferentiated, very steep.
(Su) Santa Lucia stony soils, undifferentiated, steep and very steep.
(SH) Sespe stony soils, undifferentiated, very steep.
(Tk) Terrace breaks.
(Tl) Tidal marsh.

Use and management.—The extensive areas occupied by Rough broken and stony lands have a heavy brush cover of chamise, scrub oak, wedgeleaf ceanothus, Jim brush, eastwood manzanita, and many other shrubs. Though this vegetation has no direct value except for honey bees, it does protect the soil and check rapid runoff. These brushlands need fire protection, as debris and floodwaters from fire-denuded slopes are a threat to the highly developed agricultural areas and populated valleys below. In some instances, considerable effort to vegetate Rough gullied lands is justified by the benefit to downstream areas.

CONTROL OF WATER ON THE LAND

Soil characteristics and slope vary widely in this Area. Most of the Area consists of the crest and the southern slopes of the Santa

Ynez Mountains. The higher areas are very steep, and in many places precipitous. The lower areas are more rolling or hilly. Fringing the edge of the hills is a narrow coastal plain composed mainly of old alluvial and marine terraces. Two large valleys have gently sloping recent alluvial soils. Soils along the lower edges of these valleys are only a few feet above sea level. Tidal marsh and Coastal beaches edge the Pacific Ocean.

The Area has deep permeable soils, soils with compact claypans or hardpan subsoils, rolling or hilly soils only a few feet deep over bedrock, and soils with a water table within a few feet of the surface. These soils differ greatly in their need for erosion control and the possible value of irrigation or drainage measures.

EROSION

This section discusses, in a general way, erosion control for soils of the Area. Methods of control vary according to the nature of the soils and the way in which they are normally used. Additional information on erosion control will be found in the section Land Capability Classification.

The relief of these terrace soils is generally less smooth and the slopes are more steep than those of the recent alluvial soils. Most of these older terrace soils have a medium-textured surface layer 10 to 30 inches deep and average 20 inches in the less eroded areas. The surface soil is normally friable when moist, however, if it is worked when too wet, it puddles easily and becomes much less permeable to water. Beneath the surface soil is fine-textured compact clay, which is more difficult for roots and water to penetrate. Only the surface soil above the claypan is permeable enough to serve as a water-storage reservoir or an effective rooting zone. On sloping eroded areas the clay subsoil is exposed on the surface over 20 to 50 percent of the Area.

Contour operations and subsoiling before winter rains will help control erosion. Stripcropping—planting strips of grain on the contour in the bean fields—might be useful. The grain would grow during the rainy season when the beans were not growing. Bean straw incorporated into the soil would help to absorb and hold water. Lined channels or pipe collection and disposal systems will prevent runoff water from eroding and cutting deep gullies. Some broad-based terracing has been done on some of the claypan soils, and is satisfactory on slopes up to 6 percent.

Some of the finer textured terrace soils, such as Montezuma clay loam and clay (adobe), are used mainly for lima beans, grain hay, or tomatoes. Erosion is easier to control on these soils. They have a higher water-holding capacity than do the coarser textured soils of the terraces. Deep surface cracks allow water to penetrate quickly.

Cultivated recent alluvial soils.—Erosion control on recent alluvial soils is comparatively simple. Most of the more nearly level areas need no erosion control at all except disposal of excess water that runs off steeper adjacent land.

The recent alluvial soils are used mainly for permanent crops, mostly lemons. If erosion danger exists, the trees are planted on a controlled grade and irrigated by sprinkling. One practice commonly used in citrus or avocado orchards is nontillage weed control and no culti-

vation. Weeds are controlled by spraying with petroleum oils at an early stage of growth.

Another common practice in lemon, walnut, or avocado orchards is the growing of cover crops, either seeded or volunteer. They grow during the rainy season and protect the soil against loss of water and soil material in runoff. If the rains are late, a light irrigation is given to start the cover crop before the heavy rains begin.

Cultivated soils of the older terraces.—These soils are used mostly for Sudangrass, grain, grain hay, or pasture without irrigation. They are used also for lemons, avocados, vegetables, flowers, tomatoes, and specialty crops with irrigation, although yields of the major crops average only 50 to 60 percent of those on the better alluvial soils. Control of runoff and prevention of erosion are very important on these soils.

Cultivated rolling and hilly uplands.—Control of runoff and erosion on rolling and hilly cultivated upland areas is somewhat similar to that on the soils of the terraces. The soil and underlying rocks of the upland soils absorb water better than the surface soil and underlying claypans of the terrace soils, but the slopes are generally steeper.

The upland soils have bedrock of varying degrees of hardness, at depths of 1½ to 4 feet. This bedrock is usually cracked, shattered, and somewhat permeable to water. The soils above the rock are more friable and permeable to roots and water than terrace soils.

Lemons are usually planted on the contour or on broad-base or bench terraces. Only the less sloping parts of the terraces are cultivated; the steep sides are grassed over. Cover crops are planted on the terrace tops for protection during the rainy season, or nontillage weed control is used. More recently, combined haul roads and diversion terraces, with nontillage weed control and a minimum of soil disturbance in the intervening areas, is a favored practice on steep slopes.

Runoff and erosion of soils planted to lima beans, tomatoes, and other field and truck crops is harder to control. Contour tillage before the rainy period, stripcropping, and terracing are needed, depending on the soil. Steep hillsides now in cultivation and badly eroded should be retired from cultivation. Seeding grass will result in quicker growth and control than natural reseeding. It is important that a protective cover for the soil be produced in the shortest possible time.

Erosion control practices must be used consistently and structures maintained in good working order to provide adequate protection for soils of the uplands or the terraces. Normally, the losses by surface runoff are small, and the effects are not noticed over a short period. The fact that bean yields have not increased—or are even decreasing in spite of improved crop varieties and better farm machinery—shows the damage done to these soils by erosion.

Soils used for range.—Erosion is easier to control on soils that are not cultivated. Rangelands in this Area need mostly an adequate protective cover during the rainy season. Most of the serious erosion takes place early in the year before the grass is well established.

Overgrazing is a serious problem. "Trailing" by livestock between grazing areas and water holes or salt licks should be reduced. Proper spacing of fences, development of more watering places, and distribu-

tion of salt so that stock will have to move as little as possible will allow more even and effective grazing. Fertilization of rangeland has been tried, with encouraging results.

Delaying grazing in the early part of winter until the grass gets a better growth would allow a thicker and more protective sod to form. It is difficult to delay grazing, however, because by the end of the dry season most feed supplies are gone. Most stockmen must use range forage almost as soon as seasonal growth begins.

Nonagricultural soils.—These soils are not suitable for productive use. They consist mainly of rough broken and stony lands and other miscellaneous land types such as Coastal beach, Riverwash, Tidal marsh, and Excavated land.

The rough broken and stony lands are very steep, and many slopes are precipitous. The soils are very shallow, and covered mostly by brush. They provide very little forage for livestock, although some places could support very light grazing. About one-third of the survey area is made up of these land types.

These areas make up the major watersheds above the farmland of this Area. Protection of these watersheds is very important to maintain water supplies. Most of this land is within Los Padres National Forest, where it is protected against fire and overgrazing.

DRAINAGE

The few localities in this Area where the water table is within the root zone of common crops are along the lower edges of the Carpinteria and Goleta Valleys. All of these areas are at low elevations, in some places only 1 to 3 feet above sea level. Water stands on nearly all of these soils a few days to a few weeks after major storms. These soils are wet until later in the spring than well-drained areas.

Most of the soils are of the Sorrento, Yolo, and Mocho series on recent alluvium. A few basin areas have the finer textured dark-colored Clear Lake soils. Drainage through Clear Lake soils is slow, but in most places the material beneath is sandy and permeable.

Because of the high and fluctuating water table, the soils are not suited to orchards or to permanent crops. Drainage would allow a wider variety of crops and better yields on these soils. They are now used mostly for lima beans, tomatoes, and other vegetables. Yields are fair, but they would be better in some areas if the soils were well drained.

Except for those of the Clear Lake series, the soils are moderately permeable. They would drain easily if a drainage outlet were made available. In most places, however, they are so near sea level that deep drains would not be effective. It seems possible, however, to install drains, either open or tile, in which water could be directed to a sump and then pumped to areas of Tidal marsh just below. The fine-textured Clear Lake soils could be drained, but they might need closer spacing of the drain ditches than most other soils of the Area.

A few areas of recent alluvial soils along some of the minor drainageways are overflowed during the rainy season. A little sediment may be deposited at such times. These areas are small, and the overflow damage usually is not great. Water seldom stands for more than a few hours. Walnut and lemon orchards are seldom injured

by overflow. The danger of overflow, however, does make these areas unsuitable for such winter crops as peas or grain. Also, overflow spreads many weed seeds, which increase the cost of growing crops in the years following.

In some places, these soils are affected by spots of slight or moderate salt concentration. The amount of salts is not strong except in the Alviso soils. Improvement in drainage would allow the salts to wash out. Within a few seasons after adequate drainage has been established, the salt problem will probably disappear.

IRRIGATION

In the Santa Barbara Area, rainfall must be supplemented by irrigation water for such crops as lemons and avocados. The rainfall of about 18 inches a year is enough for lima beans and tomatoes without irrigation in most seasons. However, when these crops are irrigated, yields are greatly increased. Walnuts have been successfully grown without irrigation, but in most years the yields are much better if the orchards are irrigated.

About two-thirds of the farms in the Area have some irrigation. The production of nonirrigated crops is possible because of the high humidity and frequent fog during the summer and fall. This extra moisture in the air keeps evaporation and transpiration down and conserves the moisture in the soil and in the plants during the rainless part of the year. Although supplemental water is necessary for good production of lemons and avocados and increases yields of other crops, the quantity of irrigation water required for crops is not high. It average about 1 to 1½ acre-feet per acre per year for tree crops, and somewhat more for vegetables and flowers.

Water supply.—According to the 1950 census, there were 976 irrigated farms in Santa Barbara County, of which this Area is a part. These farms had about 58,471 acres actually irrigated. About 60 percent of these farms operate their own irrigation systems. The others get water from 19 cooperatives, 4 irrigation districts, and the Bureau of Indian Affairs.

More than 90 percent of the water used for irrigation in 1950 was pumped from 1,238 wells and 84 small reservoirs on some of the smaller streams. Irrigation water in the Santa Barbara Area is mostly pumped from underground. The diversion of streamflow along the coast is small, although several larger ranches divert or pump water from streams during the winter to fill their own reservoirs. Current pumpage from the underground for agricultural use averages around 14,000 acre-feet per year and serves about 14,000 acres (1950–55 average).

Ground-water levels have been receding over a long period of time, though wet years have temporarily reversed the trend. The average net fall in level in all wells in the Goleta Valley was about 20 feet from 1945 to 1953, and 30 feet in the Carpinteria Valley under the same conditions for the same period.

Supplemental water is delivered from the Cachuma Project on the Santa Ynez River to the Goleta County Water District, Montecito Irrigation District, Summerland County Water District, and Carpinteria County Water District. The Montecito Irrigation District

also receives water from its Juncal Dam (Jameson Lake) on the Santa Ynez River. Tunnels carry the water from the several dams on the Santa Ynez River. Additional water to meet increasing needs will be supplied from the Cachuma Project for a number of years to come.

Types of irrigation.—Two types of irrigation are used in the Area. The more nearly level tracts, particularly the soils on recent alluvial fans in the Carpinteria and Goleta Valleys, are irrigated primarily by the furrow method. Light applications of water are made two to four times per season for lemons or avocados. Beans are usually irrigated twice, or in some seasons only once.

The more sloping soils of the terraces and uplands are usually irrigated by overhead sprinkler systems. For this area of rather low water requirements, the use of sprinklers on terraces and upland areas has been very satisfactory. Sprinkler irrigation permits farming on slopes without so much terracing, leveling, or erosion. In 1949, in Santa Barbara County, 6,271 acres was irrigated by sprinklers.

ALKALI

The term "alkali" is used in this report in its popular or nontechnical sense. It refers to soluble salts which are concentrated enough in the soil to harm crops.

These salts usually accumulate in soils, in a generally dry climate, that have a high or fluctuating water table. During the dry season, water from the water table rises to the surface and evaporates. The water always contains some salts, and its evaporation leaves the salts behind. After this has gone on for many years, enough salts are left at or near the surface of the soil to harm plants.

There are two kinds of alkali, commonly known as "white alkali" and "black alkali." White alkali is composed of neutral salts, mainly sodium sulfate (Glauber's salts) and sodium chloride (common table salt). Only the white alkali is found in the Santa Barbara Area.

Black alkali is composed mainly of sodium carbonate (caustic soda), which has a strongly basic reaction. The reaction of this salt with organic matter usually forms a dark-colored crust on the soil surface. Black alkali has a corrosive action on plants, and injures them more than the white alkali does. Black alkali also disperses or puddles the soil, and makes it hard to work.

Only one soil series in this Area, the Alviso, is affected by strong concentrations of alkali. These soils lie next to Tidal marsh on the lower fringes of the Carpinteria and Goleta Valleys and at the mouth of Jalama Creek. They are only 1 to 2 feet above sea level. Alviso soils have no agricultural use except for the scant forage they provide.

On the lower edges of the recent alluvial fans are areas of Clear Lake, and imperfectly drained Yolo, Sorrento, and Mocho soils, which have fluctuating water tables. They have slight and moderate concentrations of salts in some places. These areas do not produce so well as the salt-free areas.

The salts in these soils could be washed out if good drainage and irrigation practices were established. Enough water would have to be applied to dissolve the salts and carry them down into the drainage water. Good drainage must be maintained to reclaim alkali soils.

LABORATORY STUDIES [5]

All soil samples for laboratory analyses were screened through a 2-millimeter sieve. The soil aggregates were crushed with a rubber-tipped pestle, and the pebbles and stones larger than 2 millimeters were rubbed relatively clean. The sieved material was thoroughly mixed, and aliquot parts were used for the laboratory analyses.

A mechanical analysis was made of each surface soil sample by a proximate method. Each weighed sample of sieved soil was shaken overnight in distilled water to which sodium oxalate had been added as a dispersing agent. The sand was separated from the silt and clay by washing the soil through a 300-mesh sieve. The sand was dried, weighed, and reported as total sand separate. The suspension of silt and clay was made up to one liter, allowed to stand, and sampled with a pipette at time intervals to give effective maximum diameters of coarse silt at 50 microns, fine silt at 5 microns, clay at 2 microns, and colloidal clay at 1 micron. The results of these analyses were used mainly to check field textural classification and are not published.

Several representative soils were chosen for a more complete study. Mechanical analyses of profile samples from these soils were made by the Modified International method. Weighed samples of sieved soil were pretreated with hydrogen peroxide and hydrochloric acid to remove organic matter and carbonates. After the soil had been washed free of electrolytes, it was dispersed by overnight shaking in distilled water to which sodium oxalate had been added.
Determinations of very coarse sand, coarse sand, medium sand, fine sand, and very fine sand were not made on these samples. The results of these analyses are given in table 6.

Moisture equivalents were determined by the standard method on all soil samples collected. In this method 30 grams of saturated soil is subjected to a force of 1,000 times gravity in a centrifuge. The results are reported in table 7 as the percentage of moisture retained. The percentage is calculated on the basis of oven-dry soil. A few soils were so impermeable that water was not thrown out by the centrifugal force, but remained on the surface of the soil. The moisture equivalent determination for these soils was repeated with paraffined paper linings at the sides of the cups to allow drainage. Where drainage of the soil in the cups is satisfactory, the moisture equivalent is about equal to the normal field moisture capacity, or the amount of water that is held in a soil after a heavy rain or an irrigation where drainage downward is free and uninterrupted.

Determinations of pH value also were made on all soil samples collected. The pH was found by using a Beckman pH meter on a sample of soil, at saturation, about 2 centimeters deep in a tall 4-ounce bottle. The pH values are given in table 7. In general, these pH values are somewhat lower than expected from field determinations.

Carbonates were determined by the McMiller method on all soil samples that had pH of more than 7.0. The soil was treated with standard hydrochloric acid until effervescence ceased. The mixture was then back titrated with a standard base to determine the amount of

[5] Contributed by E. P. Perry, Division of Soils, University of California Agricultural Experiment Station.

TABLE 6.—*Mechanical analyses of selected soils of the Santa Barbara Area, Calif.*

Soil and depths in inches	Material and diameter of particles (in millimeters)					
	Total sands (2.00–0.05)	Silt		Total clay (< 0.002)	Colloidal clay (< 0.001)	Total
		Coarse (0.05–0.005)	Fine (0.005–0.002)			
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Baywood loamy fine sand:						
0–10	65. 7	21. 4	4. 2	7. 9	6. 2	99. 2
10–35	65. 1	21. 7	4. 5	7. 9	6. 4	99. 2
35–54	79. 3	13. 3	3. 3	4. 1	2. 2	100. 0
54–72	81. 9	12. 6	1. 8	4. 3	3. 1	100. 6
Sorrento fine sandy loam:						
0–37	69. 5	18. 4	2. 8	8. 8	7. 3	99. 5
37–54	83. 6	9. 2	2. 3	5. 5	5. 1	100. 6
54–72	53. 8	29. 2	6. 1	10. 6	9. 0	99. 7
Olivenhain fine sandy loam:						
0–7	61. 1	23. 2	4. 7	11. 0	9. 1	100. 0
7–16	59. 3	26. 8	3. 1	10. 8	7. 8	100. 0
16–26	53. 0	20. 3	3. 7	21. 0	19. 0	98. 0
26–38	60. 7	21. 7	2. 9	13. 8	11. 0	99. 1
38–50	58. 9	18. 8	4. 4	16. 6	17. 1	98. 7
Sespe clay loam:						
0–13	19. 1	38. 6	9. 4	30. 9	26. 1	98. 0
13–29	7. 3	53. 2	12. 0	26. 0	19. 7	98. 5
29–40	20. 5	40. 5	12. 9	24. 3	15. 7	98. 2
Milpitas fine sandy loam:						
0–12	45. 0	40. 7	4. 1	9. 0	5. 9	98. 8
12–23	34. 3	46. 8	7. 1	14. 9	10. 3	103. 1
23–38	22. 0	32. 4	6. 7	38. 1	35. 4	99. 2
38–53	35. 3	28. 3	6. 4	28. 7	25. 2	98. 7
53–72	60. 2	16. 6	4. 4	17. 8	14. 9	99. 0
Montezuma clay:						
0–10	36. 1	20. 5	8. 3	33. 5	29. 4	98. 4
10–21	29. 6	21. 8	7. 6	39. 8	35. 4	98. 8
21–22	32. 5	19. 5	7. 4	38. 6	35. 1	98. 0
32–44	38. 4	19. 5	6. 4	34. 4	31. 3	98. 7
44–72	43. 3	19. 6	5. 9	30. 5	28. 3	99. 3
Arguello shaly loam:						
0–14	38. 7	24. 1	8. 2	28. 5	23. 2	99. 5
14–24	35. 6	25. 2	8. 5	30. 5	24. 1	99. 8
24–37	33. 1	26. 9	9. 7	30. 1	24. 4	99. 8
37–72	36. 9	21. 9	8. 4	32. 1	26. 7	99. 3
Santa Lucia shaly loam:						
0–6	25. 1	20. 0	13. 6	41. 1	29. 5	99. 8
6–14	21. 1	21. 0	12. 2	47. 3	36. 6	101. 6
14–24	19. 3	19. 8	8. 8	53. 7	46. 5	101. 6

TABLE 7.—*Carbonates, pH, and moisture equivalents of soils of the Santa Barbara Area, Calif.*

Soil type and depth in inches	$CaCO_3$ carbonates equivalent	pH [1]	Moisture equivalent
	Percent		*Percent*
Ballard fine sandy loam:			
0–13		6.3	20.6
13–25		6.3	17.2
25–42		6.4	16.0
42–55		6.2	13.6
55–70		6.2	13.3
Zaca clay:			
0–14	10.5	7.6	35.9
14–38	13.2	7.8	35.3
38–50 [2]	27.5	8.3	34.9
Baywood loamy fine sand:			
0–10		6.2	11.8
10–35		6.4	10.7
34–54		6.9	6.7
54–72		6.2	6.6
Sorrento fine sandy loam:			
0–37	.8	7.6	11.1
37–54	.9	7.1	5.3
54–72	2.6	8.0	18.4
Carpinteria clay loam:			
0–16		6.5	18.6
16–33	1.0	7.0	19.4
33–50	.4	7.4	21.5
50–72	.7	7.9	21.6
Mocho fine sandy loam:			
0–14	.9	7.4	7.9
14–52	.8	7.8	8.2
52–72	1.2	7.9	4.5
Olivenhain fine sandy loam:			
0–7		5.7	13.9
7–16		5.7	13.6
16–26		5.2	20.8
26–38		6.0	17.4
38–50		6.5	20.4
Clear Lake clay:			
0–11	1.8	7.5	33.5
11–22	1.2	7.8	21.7
22–38	3.0	7.9	16.3
38–64	4.7	8.2	10.8
Aliso fine sandy loam:			
0–18		5.7	15.3
18–39		6.5	23.8
39–51	1.0	8.0	19.5
51–72	2.1	7.4	23.0
Maymen fine sandy loam:			
0–14		5.6	14.6
14–34		5.2	12.1
34–48 [2]		5.1	8.0
Sespe clay loam:			
0–13		6.7	24.3
13–29		6.6	22.4
29–40	3.8	7.6	20.3
40–60			
Yolo fine sandy loam:			
0–20		6.9	13.6
20–53		6.5	20.0
53–72		6.7	16.2

See footnotes at end of table.

TABLE 7.—*Carbonates, pH, and moisture equivalents of soils of the Santa Barbara Area, Calif.*—Continued

Soil type and depth in inches	$CaCO_3$ carbonates equivalent	pH [1]	Moisture equivalent
San Andreas loamy sand:	*Percent*		*Percent*
0–22		5.0	7.0
22–45		6.1	5.7
45–72		6.1	6.2
Milpitas fine sandy loam:			
0–12		6.1	16.2
12–23		5.9	18.7
23–38		6.9	[3] 30.7
38–53	.8	7.6	[3] 25.6
53–72		6.9	[3] 18.0
Montezuma clay loam:			
0–10		6.3	27.7
10–21		6.9	[3] 37.6
21–32	2.0	7.7	[3] 34.4
32–44	.9	7.6	[3] 34.3
44–72		5.1	
Gaviota fine sandy loam:			
0–7		5.7	16.1
7–17		5.1	16.4
17–30 [2]		4.6	16.2
Nacimiento clay:			
0–11		6.8	32.0
11–26	4.7	7.6	30.9
26–43	6.3	7.9	31.6
43–60			
Zaca clay loam:			
0–7	3.1	7.5	44.0
7–21	5.8	7.6	44.3
21–36 [2]	73.0	8.4	
Agueda gravelly clay loam:			
0–28	12.6	7.8	42.3
28–49	13.8	7.7	39.6
49–70	17.6	7.8	38.2
Alviso clay loam: [4]			
0–11	2.8	7.6	28.8
11–19	1.8	7.2	35.4
19–36			
Watsonville loam:			
0–8		5.8	21.6
8–18		5.7	18.3
18–24		5.8	14.7
24–37		6.4	[3] 46.2
37–50		5.5	[3] 43.5
50–60			
Jalama shaly sandy loam:			
0–18		4.9	25.5
18–33		4.6	24.1
33–50		4.1	27.5
50–72		4.3	29.7
Tangair loamy sand:			
0–15		5.9	5.8
15–35		5.9	5.4
35–52		5.8	4.1
52–72		5.6	3.2

See footnotes at end of table.

TABLE 7.—*Carbonates, pH, and moisture equivalents of soils of the Santa Barbara Area, Calif.*—Continued

Soil type and depth in inches	$CaCO_3$ carbonates equivalent	pH [1]	Moisture equivalent
Arguello shaly loam:	*Percent*		*Percent*
0–14	----------	6. 5	38. 0
14–24	----------	6. 2	36. 6
24–37	----------	6. 0	36. 0
37–72	----------	6. 3	[3] 38. 5
Climax clay (adobe):			
0–11	2. 3	7. 6	56. 2
11–21	4. 4	7. 9	56. 0
21–33	6. 7	8. 3	58. 8
33–50 [2]	----------	----------	----------
Baywood loamy sand:			
0–25	----------	6. 6	5. 6
25–44	----------	6. 1	4. 0
44–67	----------	5. 7	3. 0
67–80	----------	6. 0	1. 1
Tierra fine sandy loam:			
0–15	----------	6. 0	19. 8
15–19	----------	6. 2	19. 6
19–34	----------	6. 0	34. 1
34–52	----------	6. 9	[3] 33. 8
52–70	. 8	7. 5	[3] 37. 9
Elder shaly clay loam:			
0–14	2. 6	7. 4	37. 6
14–38	1. 6	7. 6	26. 9
38–72	2. 1	7. 7	27. 4
Los Osos clay:			
0–11	----------	5. 6	29. 2
11–28	----------	6. 2	29. 8
28–41	. 4	7. 0	[3] 31. 5
41–53 [2]	----------	----------	----------
Crow Hill loam:			
0–6	----------	5. 3	88. 3
6–24	----------	5. 1	90. 8
24–36 [2]	----------	----------	----------
Santa Lucia shaly loam:			
0–6	----------	5. 4	60. 0
6–14	----------	5. 3	53. 3
14–24 [2]	----------	----------	----------
Montara stony clay: [5]			
0–8	[6] 4. 7	6. 9	41. 2
8–17	[6] 2. 9	7. 2	41. 2
17–25	----------	----------	----------
Los Trancos stony loam:			
0–7	----------	5. 8	28. 5
7–15	----------	5. 5	29. 9
15–30 [2]	----------	----------	----------
Botella clay loam:			
0–13	----------	5. 6	28. 0
13–28	----------	5. 8	29. 2
28–49	----------	6. 5	27. 2
49–66	1. 0	7. 7	[3] 32. 0

[1] Determinations of pH made by glass electrode on saturated soils.
[2] Parent material or parent rock.
[3] Moisture equivalent determined with wax-paper lined cups.
[4] From area mapped as Alviso soils, undifferentiated,
[5] From area mapped as Montara stony soils, undifferentiated.
[6] Soil contains magnesium carbonate.

acid used in the reaction. The results, calculated as equivalent amounts of calcium carbonate on a percentage basis, are given in table 7. Where other carbonates are present, the calculation of the total carbonate as calcium carbonate or lime will show a misleading result.

The soils of this Area vary. According to the proximate mechanical analyses of surface soils, the sand content varies from 5.7 percent in Nacimiento clay to 88.2 percent in Baywood loamy sand. The highest silt content occurs in Alviso clay loam (mapped as Alviso soils, undifferentiated), which contains 53.2 percent silt, and lowest silt content is in Tangair loamy sand, which contains 6.4 percent. Clay content varies from a low of 4.2 percent in San Andreas and Baywood loamy sands to a high of 54.6 percent in Climax clay (adobe).

Moisture-equivalent values (see table 7) vary from 3.2 percent in the underlying material of Tangair loamy sand, through 58.8 percent in the lower subsoil of Climax clay (adobe), to 90.8 in the subsoil of Crow Hill loam. The Crow Hill series is formed from soft diatomaceous earth and has both apparent and true density values lower than do the more common mineral soils. The high moisture-equivalent values for Crow Hill loam are therefore not exactly comparable to values for other soils of the Area.

In reaction, the rocks in this Area vary from acid shales to highly calcareous shales, and this is reflected in the pH values of the soils. Jalama shaly sandy loam has a pH of 4.1 in the subsoil, whereas Climax clay (adobe) has a pH of 8.3 in the lower subsoil. The highest lime content of a surface soil sample is 12.6 percent, for Agueda gravelly clay loam. This soil contained 17.6 percent lime in the lower subsoil. The highest lime content of all samples analyzed was that for the C horizon of Zaca clay loam, a highly calcareous shale that contained 73.0 percent lime.

The recent Alluvial soils of this Area are nearly neutral in reaction. The greatest range from surface to subsoil occurs in Botella clay loam, a weakly developed Prairie soil, which has a surface soil pH of 5.6 and lower subsoil pH of 7.7. The Botella soils have formed mainly on mixed alluvial parent materials; they are acid or basic, depending mainly on the nature of these materials. Agueda gravelly clay loam, an Alluvial soil, has formed on materials washed entirely from calcareous Zaca and Nacimiento soils and therefore contains lime throughout the profile. The lime varies from 12.6 to 17.6 percent in the profile studied.

The moisture-equivalent values are influenced by the texture of the soil. In the recent Alluvial soils the values show that there was stratification at time of depositing. There is no consistent tendency of the soils to increase or decrease in water-holding capacity with depth. The Arguella, Prairie soils, and Carpinteria, Alluvial soils, are on young alluvium and show slight increase in moisture-equivalent values in the subsoils; this indicates the beginning of a B horizon. In this slightly older group of soils, the presence of a B horizon is detected in the field by a slightly more compact layer that is harder to dig than the subsoils of recent Alluvial soils. Commonly there is not enough increase of fine materials to increase the moisture-equivalent values.

The recent and young soils from wind-deposited materials are slightly to medium acid in the surface soils and more nearly neutral

in the subsoils. They are of sand, loamy sand, or loamy fine sand texture and have low water-holding capacities. The water-holding capacity is even lower in the subsoils. The low water-holding capacity restricts the agricultural use of these soils. Determinations were made on samples of Baywood loamy sand and loamy fine sand. Samples of Marina sand were not collected.

The low-lying basin soils are somewhat calcareous and therefore basic in reaction. They have clay loams or clays at the surface. The underlying materials are stratified, and their texture depends on the texture of sediments laid down.

The terrace soils of alluvial or marine origin, without hardpan and underlain by unconsolidated material, have slightly to medium acid A horizons and become more neutral or basic in the B horizons. Most of them show some lime in the lower B horizons. All increase markedly in water-holding capacity in the B horizons, a characteristic of claypan soils. The Watsonville, Montezuma, and Milpitas soils are too tight in the subsoils to allow proper drainage of water when moisture-equivalent determinations are made. This is frequently true of claypan layers. Aliso fine sandy loam, which did not show this impermeability in the centrifuge, had a moisture-equivalent of only 23.8 percent in the B horizon.

The Montezuma soils have been classified as Chernozems, intergrading to Grumusols. They have dark surface color and lime accumulations in the substratum. The lime content is low, only 2.0 percent, and the substratum showed a marked impermeability in the centrifuge. Moisture-equivalent determinations on Montezuma soils have to be run with wax-paper liners in the cups to facilitate drainage. This impermeability of the lower horizons restricts the agricultural use of Montezuma soils.

The terrace soils of alluvial or marine origin that have a hardpan or are underlain by partially consolidated material are generally acidic. Jalama shaly sandy loam has a pH of 4.9 in the surface soil, and a pH of 4.1 in the lower B horizon. The parent material of Tierra fine sandy loam, on the other hand, has a pH of 7.5 and contains a trace of lime.

The increase in moisture-equivalent values in the B horizons indicates a higher clay content. Complete mechanical analyses were run on samples of a profile of Olivenhain fine sandy loam. There was 11.0 percent clay in the A horizon sample, of which 9.1 percent was less than 1 micron in effective diameter. In the B horizon, the total clay increased to 21.0 percent and the colloidal clay increased to 19.0 percent. A high ratio of colloidal clay to total clay is characteristic of claypan soils; it contributes to the greater bulk density of these soils and to the impeded internal drainage. The Jalama and Olivenhain samples contained enough sand to allow water to drain from the cups in the moisture-equivalent determinations, but the Tierra lower B horizon did not. In the field, all these soils have reduced permeability in the B horizons.

The Tangair soils have formed on wind-deposited material on terraces. They are loamy sands, medium acid in reaction, and low in water-holding capacity in the solum. This low water-holding capacity restricts the agricultural use of Tangair soils.

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The soils of the uplands in general reflect the reaction of their parent materials. In the foothill region, most of the soils have a higher pH in the lower horizon than in the surface soil. The San Andreas and Crow Hill series have formed on softly consolidated material and are medium acid in the surface soil. The Crow Hill remains medium acid throughout the profile, whereas the San Andreas subsoil is only slightly acid. The San Andreas soils are loamy sands or fine sandy loams and show little change in water-holding capacity with increase in depth.

The Crow Hill series is represented by a loam type, although the moisture equivalent is 88.3 percent. This very fluffy diatomaceous material has a lower true density than that of the usual mineral soils and a much lower bulk density. This gives a high moisture-equivalent value when it is calculated on the weight of oven-dry soil. When the water-holding capacity is calculated on a volume-percent basis, the water content per foot of soil depth is more nearly comparable to that of other loam soils. The mechanical analysis calculations are based on the settling velocities of normal mineral soils. As the true density of the particles of diatomaceous earth is lower than for normal mineral soil, the data, as determined, show an erroneously high clay content.

In part, such differences in densities may also explain the unusually high clay contents and moisture-equivalent values, relative to texture, that have been determined in the field for Santa Lucia shaly loam. All the soils formed on calcareous material show lower lime content in the surface soils than in the lower horizons. This difference indicates that enough rainfall leaches some lime out of the surface layers. Moisture-equivalent values for all the soils of the uplands show only slight changes from surface to subsoil. These slight changes indicate very little if any development of usual B-horizon characteristics. On these steeper slopes, erosion apparently keeps pace with rock weathering and soil-forming processes, so the soil stays at an early stage of development.

The Montara soils have formed from serpentine parent material that is very high in magnesium. The carbonate content, as given in table 7 for Montara stony clay (mapped as Montara stony soils, undifferentiated), undoubtedly represents a magnesium compound and not calcium carbonate. In fact, soils from serpentine usually lack the calcium and other nutrients needed for good plant growth. They are improved by the addition of lime or gypsum. Soils developing from serpentine are usually poor for agriculture.

MORPHOLOGY AND GENESIS OF SOILS

Soil results when climate and biological forces act on the parent soil material deposited or accumulated by geologic agencies. The characteristics of the soil at any given point depend on: (1) The physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and has existed since accumulation; (3) the relief or lay of the land; (4) the plant and animal life in and on the soil; and (5) the length of time the forces of development have acted on the material. The effect of each of these factors of soil formation in the Santa Barbara Area is discussed in the following pages.

Land forms and geologic formations.—This Area is made up of a coastal strip of narrow alluvial fans and alluvial and marine terraces, a fringe of sand dunes and wind-modified material on the ocean side of this strip, and hilly and stony mountainous land of the island side. The southern slopes of the Santa Ynez Mountains in Santa Barbara County are part of this Area. One of the most important influences on the soils of the Area is parent rock material. The rock formations vary considerably, and strongly influence the soil developed from them.

From Gaviota Creek eastward, the rock formations lie in bands generally parallel to the sea coast. Along the crest of the Santa Ynez Mountains, and extending for some distance down the southern slopes, is the Tejon formation—rather hard, mostly light-colored, sandstones. On this formation of Eocene marine sediments the soils are mainly of the Maymen series.

Next to the Tejon formation, but at lower elevation, is the Sespe formation of Oligocene age, a continental shale that has interbeds of sandstone. Soils of the Sespe series develop on this formation.

In narrow bands, usually near the Sespe formation but at lower elevations, are Vaqueros sandstones of lower Miocene age and of marine origin. These hard, light-colored sandstones underlie Gaviota soils.

Next in general order toward the coast is the Temblor or Rincon formation, which is of marine origin and also of lower Miocene age. These rather soft calcareous shales form parent material of the soils of the Zaca and Nacimiento series.

The Monterey formation consists of hard, highly siliceous shales made up of marine diatomaceous material. This formation is Miocene in age and gives rise to the soils of the Santa Lucia series.

The Santa Barbara formation is mostly softly consolidated or unconsolidated sandy and gravelly material. This formation is transitional in age from upper Pliocene to lower Pleistocene. It is the parent rock material of soils of the San Andreas series.

West of Gaviota, the sedimentary rock formations are not so distinctly banded. Most of the formations mentioned above are found, but there are also some older formations such as upper Cretaceous marine sediments, mostly shales, and the Knoxville formation, which is transitional between the Jurassic and Cretaceous periods and is also mostly shales. These older formations give rise to the Los Osos, Diablo, and Cayucos soils. In the western part of the Area are several smaller formations. Among these is the Sisquoc formation of middle Pliocene age. Its white beds of diatomaceous earth develop into the Crow Hill soils.

Several igneous formations of Miocene age and older give rise to three soil series. The Climax soils are formed from volcanic ashlike material, the Montara soils from serpentinaceous material, and the Los Trancos soils from rhyolitic material.

Materials washed from soils and rocks of the above formations are the parent materials for the Alluvial soils in the Area. Some of the soil material has been resorted and modified by wind.

Climate.—The climate of the Area is similar to the general coastal climate that prevails along the California coast from San Diego northward to beyond the Golden Gate. It is characterized by mild wet winters, during which most of the annual rainfall occurs. The aver-

age annual rainfall is somewhat less than 15 inches along the coast from Point Arguello northward; it increases along the coast eastward from Point Conception, where the rainfall is 16.46 inches, to Santa Barbara, where the rainfall is 17.95 inches. Rainfall also increases with elevation going inland. At the south portal of Mission Tunnel (elev. 1,200 feet) it is 23.44 inches, and at San Marcos Pass (elev. 2,200 feet) it is 30.90 inches. Along the crest of the Santa Ynez Mountains, the average annual rainfall is between 32 and 36 inches.

Temperatures of the Area are mild because the climate is tempered by the ocean. The average growing season is 331 days, and periods of as long as 2 years are without killing frost.

Heavy fogs are common near the coast line. The extra moisture thus provided encourages greater plant growth, which provides more organic matter and produces a darker soil color than is found farther inland.

Relief.—Most of the Area is hilly to mountainous. Steeply sloping rough mountains rise above a series of lower foothills. Below these foothills are rolling terraces that extend to the coast in most places. The hills and mountains are cut by many small streams, most of which are dry during summer.

Narrow stringers of alluvium occur along many of the streams and finger back into the hills for some distance. Alluvium is still accumulating in places where the soils are flooded during periods of heavy rainfall. Two valleys of moderate size, the Carpinteria and Goleta, are made up of recent alluvial deposits. They have a gradual slope of from 6 percent near the foothills to less than 1 percent near the coast. Tidal marsh borders the coast in both valleys. The areas just above Tidal marsh have a high water table and some accumulation of salts.

Biological forces.—Vegetation on the higher mountainous areas is mostly brush, though some trees (oak associations) grow in the draws. The lower valleys are normally oak-covered. Some of the lower hills and terraces are covered with annual bromegrasses, burclover, and alfilaria. Some ryegrass grows along the lower slopes where moisture is more plentiful. Most of the soils near the coastline were naturally dark in color. Even under cultivation, the finer textured soils are still dark. The sandy soils of series such as the San Andreas, Marina, Mocho, and Sorrento tend to become somewhat lighter colored as a result of tillage.

Time and its relation to other factors of soil formation.—The upland soils that have developed on bedrock usually have indistinct profiles. They show little or no compaction or clay accumulation in their B horizons. The slopes are usually steep enough that normal geologic erosion removes soil from the surface as fast as it is formed. Thus, the soil cannot develop fully. Where the parent rock material is hard, as it is under the Maymen, Gaviota, Santa Lucia, Montara, and Los Trancos series, the soil is usually 2 feet or less in depth. Where the parent material is softer, as it is under the Zaca, Diablo, and San Andreas series, the soils are usually 2 to 5 feet in depth.

The coastal plain, which is mostly terraces, has some soils with strongly developed profiles that are classified as Planosols. Here, the forces of profile development have had time enough to allow large

amounts of clay to form and accumulate in the B horizons. Although the profiles are very well developed, the influence of parent materials is still strong. For example, both Milpitas and Aliso soils are found near Santa Barbara. The Aliso soils are brown to reddish-brown in color and have clay B horizons, which are calcareous in the lower parts. Although claypans have been developed in the Aliso soils, calcium carbonate is still concentrated in the lower B horizon. Milpitas soils are brown, have strong claypans, and are medium acid. As the Milpitas and Aliso soils occur on terraces of the same elevation and in the same general location, the only reason for difference appears to be the parent materials.

Along the lower edge of the Goleta and Carpinteria Valleys are soils having high water tables and accumulations of salt. These factors overshadow all others in their influence on the soil profiles.

CLASSIFICATION OF SOILS IN HIGHER CATEGORIES

The soils of this Area vary so widely in parent material, relief, and stage of soil development that they are difficult to classify into great soil groups. There are no large areas of zonal soils. Most of the upland soils are so shallow and their slopes are so steep that they cannot develop into zonal soils. Most of them are Lithosols. Many of the soils of the terraces have such strongly developed claypan or hardpan subsoils that they are considered Planosols. The soils on alluvial fans have not had time to develop well-defined profiles.

Table 8 classifies the soils of the Area into higher categories and lists certain important characteristics for each. Although the rainfall and temperature in this Area do not vary much, 11 great soil groups are represented. These great soil groups are discussed following table 8.

Some of the series are placed only tentatively in established great soil groups, because their characteristics are not well enough known or because some of their characteristics depart from those of the given groups. Also, some of the series appear to represent integrades between great soil groups rather than clear-cut members of single groups. For example, six series are called Prairie soils, two intergrading to Grumusols; and four Chernozems, intergrading to Grumusols. The reader will have noted the clay textures of these soils; there are many indications that the clay in soils like the Climax, Diablo, Los Osos, and the others is predominantly montmorillonitic. Thus, these Chernozems and Prairie soils have some of the distinctive characteristics of the group called Grumusols.

PRAIRIE SOILS

Four of the series of this Area have been identified as Prairie soils. They are the Arguello, Botella, Jalama, and Santa Lucia. This great soil group has been described as follows (*9*): "The zonal group of soils having a very dark brown or grayish-brown surface horizon, grading through brown soil to the lighter colored parent material at 2 to 5 feet, developed under tall grasses, in a temperate, relatively humid climate." Chernozems, described below, are very similar, except that they have horizons of free carbonates, are slightly more basic in reaction, and are higher in exchangeable bases.

TABLE 8.—*The soils of the Santa Barbara Area, Calif., classified by great soil groups and series, and some of the soil characteristics on which the classification is based*

Soil classification	Parent material and physiographic position	Surface soil		Natural vegetation
		Color	Reaction	
Prairie soils:				
Arguello	Old alluvium washed from Santa Lucia soils onto older alluvial fans.	Dark gray	Medium acid	Grass, herbs.
Botella	Alluvium from Santa Lucia and Cayucos soils on slightly older alluvial fans and flood plains.	Dark gray	Neutral	Grass, herbs.
Jalama	Old alluvium washed from Santa Lucia soils onto terraces.	Dark gray	Medium acid	Grass, herbs.
Santa Lucia	Siliceous shale on uplands	Dark gray	Medium acid	Grass, herbs, scattered oaks, some brush.
Prairie soils, intergrading to Grumusols:				
Cayucos	Shale on uplands	Dark gray	Slightly acid	Grass, herbs.
Los Osos	Shales or clayey sandstones on uplands.	Gray	Slightly acid	Grass, herbs, scattered oaks.
Chernozems, intergrading to Grumusols:				
Climax	Volcanic ash on uplands	Dark gray	Slightly basic	Grass, herbs.
Diablo	Shale on uplands	Dark gray to very dark gray.	Neutral	Grass, herbs, some brush.
Montezuma	Old alluvium on terraces	Very dark gray	Neutral	Grass, herbs.
Sespe	Shale and clayey sandstone on uplands.	Very dark grayish brown.	Neutral	Brush, grass.

Noncalcic Brown soils:				
Ballard	Alluvium washed from Sespe soils onto slightly older alluvial fans.	Grayish brown	Slightly acid	Grass, herbs, scattered oaks.
Planosols:				
Aliso	Old alluvium on older low terraces.	Brown	Slightly acid to neutral	Grass, herbs.
Milpitas	Old alluvium on terraces	Brown	Slightly to medium acid.	Grass, herbs.
Olivenhain	Old alluvium on terraces	Brown	Slightly to medium acid.	Grass, herbs, some oaks, brush.
Tangair	Old wind-modified sandy material on terraces.	Dark grayish brown	Medium to strongly acid.	Grass, brush.
Tierra	Old marine sediments on terraces.	Dark gray	Medium acid	Grass, herbs, brush.
Watsonville	Old marine sediments on terraces.	Dark gray	Medium acid	Grass, herbs, brush.
Wiesenboden:				
Clear Lake	Fine-textured sediments in basins.	Black	Neutral	Sedges, reeds, grass.
Rendzinas:				
Nacimiento	Marly shale on uplands	Dark grayish brown	Slightly basic	Grass, herbs.
Zaca	Marly shale on uplands	Very dark gray	Slightly basic	Grass, herbs.
Solonchaks:				
Alviso	Medium to fine textured tidal sediments in basins.	Gray	Slightly basic	Saltgrass, weeds, herbs.
Alluvial soils:				
Agueda	Alluvium washed from Zaca and Nacimiento soils onto recent alluvial fans and flood plains.	Dark gray	Slightly basic (moderately calcareous).	Grass, herbs, oaks along streams.
Carpinteria	Alluvium washed from Sespe soils onto slightly older alluvial fans.	Dark grayish brown	Neutral	Grass, herbs, scattered oaks.
Elder	Alluvium washed from Santa Lucia soils onto recent alluvial fans and flood plains.	Dark gray	Neutral to slightly acid	Grass, herbs, oaks along streams.

TABLE 8.—*The soils of the Santa Barbara Area, Calif., classified by great soil groups and series, and some of the soil characteristics on which the classification is based*—Continued

Soil classification	Parent material and physiographic position	Surface soil		Natural vegetation
		Color	Reaction	
Alluvial soils—Con.				
Mocho	Alluvium washed from Sespe, Maymen, and Gaviota soils onto recent alluvial fans and flood plains.	Brown	Slightly basic	Grass, oaks.
Sorrento	Alluvium washed from Maymen soils onto recent alluvial fans and flood plains.	Dark grayish brown	Neutral to slightly basic.	Grass, oaks, herbs.
Yolo	Alluvium washed mostly from Maymen and Gaviota soils onto recent alluvial fans and flood plains.	Dark gray	Neutral	Grass, oaks, herbs.
Regosols:				
Baywood	Wind-modified sandy material on younger alluvial fans.	Grayish brown	Medium acid	Grass, brush.
Crow Hill	Diatomaceous material on uplands.	Gray	Slightly acid to neutral	Brush, grass.
Marina	Wind-modified sand on low terraces.	Pale brown	Medium acid	Brush, grass.
San Andreas	Sandstone on uplands	Grayish brown	Medium acid	Grass, herbs, scattered oaks.
Lithosols:				
Gaviota	Hard sandstone on uplands	Brown	Slightly to medium acid.	Grass, herbs, brush.
Los Trancos	Hard rhyolite on uplands	Dark gray	Slightly to medium acid.	Grass, brush.
Maymen	Hard sandstone on uplands	Brown	Medium acid	Brush.
Montara	Serpentinaceous rock on uplands	Very dark gray	Neutral	Grass, herbs.

Arguello soils serve to illustrate this group. Following is a typical profile of the Arguello series:

A_1 0 to 14 inches, dark-gray (10YR 4/1, dry) shaly sandy clay loam; strong fine granular structure; hard when dry, friable when moist; noncalcareous; slightly acid.

B_{21} 14 to 27 inches, dark-gray (10YR 4/1, dry) shaly sandy clay loam that has slightly more clay than the A_1; hard when dry, friable when moist; strong granular structure; noncalcareous; slightly acid.

B_{22} 27 to 37 inches, similar to the subhorizon above except that structure is moderate fine subangular blocky.

C_1 37 to 72 inches, gray (10YR 5/1, dry) shaly sandy clay loam; massive; hard when dry, friable when moist; noncalcareous; slightly acid.

PRAIRIE SOILS, INTERGRADING TO GRUMUSOLS

Two soil series, the Cayucos and Los Osos, fall into this class of intergrades. These are dark-colored clay soils that developed under good drainage on uplands.

Oakes and Thorp (*4*) have given Houston Black as the type example of the Grumusol group and in addition have proposed that all or most of some fifteen characteristics should be possessed by a soil in order to classify it as a Grumusol. Some of the more important of those characteristics are: Clay texture; no eluvial or illuvial horizons; moderate to strong granular structure in upper 6 to 20 inches, becoming blocky or massive below; calcareous reaction; gilgai microrelief; extremely plastic consistence; exchange complex nearly saturated with calcium, or calcium and magnesium; clay minerals dominantly of the montmorillonite group; dark color of low chroma; medium to low content of organic matter; tall grass or savanna vegetation.

It will be seen that the two series listed have characteristics of both Prairie soils and Grumusols. They have the dark colors of both groups and the clay texture and plasticity of the Grumusols. Most of them appear to have weak eluvial and illuvial horizons that are more characteristic of Prairie soils than of Grumusols; the clay minerals appear to be dominantly montmorillonitic, but the upper horizons are not as strongly granular as those of typical Grumusols. A further complication in classification is that the clay loam types seem to be more nearly true Prairie soils than intergrades to Grumusols. The name of this group is based mainly upon consideration of the clay types.

Los Osos soils are representative of this class of intergrades. A typical profile of Los Osos clay follows:

A_{11} 0 to 11 inches, gray (10YR 5/1, dry) clay; weak coarse blocky structure; very hard when dry, very firm when moist, very plastic when wet; medium acid.

A_{12} 11 to 28 inches, dark grayish-brown (10YR 4/2, dry) clay with a few yellowish-brown mottles on surfaces of peds; weak coarse blocky structure; very hard when dry, very firm when moist, very plastic when wet; slightly acid.

C_1 28 to 41 inches, light grayish-brown (2.5Y 6/2, dry) clay with few mottles of strong brown on surfaces of peds, and a few soft iron-oxide concretions; weak coarse subangular blocky structure; very hard when dry, very firm when moist, and very plastic when wet; neutral in reaction.

D_r 41 to 50 inches +, olive-gray (5Y 5/2, dry) massive, noncalcareous, shale bedrock.

CHERNOZEMS, INTERGRADING TO GRUMUSOLS

Four series have been tentatively named Chernozems, intergrading to Grumusols. They are the Climax, Diablo, Montezuma, and Sespe.

They are mainly dark-colored clay soils that are well drained or moderately well drained. Chernozem soils have been defined as follows (*9*): "A zonal group of soils having a deep, dark-colored to nearly black surface horizon, rich in organic matter, which grades below into lighter colored soil and finally into a layer of lime accumulation; developed under tall and mixed grasses in a temperate to cool subhumid climate." Grumusols are described as a group in the preceding section.

The four series in this class have characteristics of both Chernozems and Grumusols. In many respects they are similar to the Los Osos and Cayucos; they differ in their reaction and in having free calcium carbonate. As in the Prairie soils intergrading to Grumusols, clay loam types of some series were recognized, and these are more nearly true Chernozems than intergrades to Grumusols.

Montezuma soils are representative of this class of intergrades. A typical profile of Montezuma clay follows:

A_{11} 0 to 10 inches, very dark gray (N 3/, dry) clay; strong very coarse blocky, breaking to fine blocky structure; extremely hard when dry, very firm when moist, very plastic when wet; noncalcareous; slightly acid to neutral.

A_{12} 10 to 21 inches, very dark gray (N 3/, dry) clay; moderate medium blocky structure; extremely hard when dry, very firm when moist, very plastic when wet; noncalcareous; neutral.

C_{ca1} 21 to 32 inches, dark-gray (N 4/, dry) clay; weak coarse blocky structure; extremely hard when dry, very firm when moist, very plastic when wet; slightly calcareous, the lime being disseminated and in whitish seams and nodules; slightly basic.

C_{ca2} 32 to 44 inches, grayish-brown (10YR 5/2, dry) heavy clay loam; massive; hard when dry, firm when moist, and very plastic when wet; slightly calcareous, the lime being mostly concentrated in fine seams and nodules; slightly basic.

C 44 to 72 inches +, grayish-brown (10YR 5/2, dry) clay loam; massive; hard when dry, firm which moist, and very plastic when wet; noncalcareous to slightly calcareous; neutral to slightly basic.

NONCALCIC BROWN SOILS

Only one soil series, the Ballard, was identified as a Noncalcic Brown soil in this Area. This great soil group has been described as follows (*9*): "The zonal group of soils with slightly acid light-pinkish or light reddish-brown A horizons over light reddish-brown or dull-red B horizons developed under mixed grass and forest vegetation in a subhumid wet-dry climate." The Ballard is considered to be a weakly developed Noncalcic Brown soil. Following is a description of a representative profile of Ballard fine sandy loam:

A_1 0 to 13 inches, grayish-brown (10YR 5/2, dry) fine sandy loam; moderate fine granular structure; slightly hard when dry and very friable when moist; slightly acid in reaction.

B_{21} 13 to 25 inches, brown (10YR 5/3, dry) gravelly loam; weak very fine subangular blocky structure; hard when dry and friable when moist; slightly acid.

B_{22} 25 to 42 inches, brown (10YR 5/3, dry) gravelly loam; weak very fine subangular blocky structure; hard when dry and friable when moist; slightly acid.

C_1 42 to 56 inches, yellowish-brown (10YR 5/4, dry) gravelly heavy sandy loam; massive; slightly hard when dry and very friable when moist; slightly acid.

C_2 56 to 70 inches+, similar to above, but more gravelly.

PLANOSOLS

Six series in this Area, on terraces, are advanced in stage of development and have panlike B horizons. Those series are Aliso, Milpitas, Olivenhain, Tangair, Tierra, and Watsonville. They do not all have the same sort of horizons, though they are grouped together as Planosols. Aliso, Milpitas, and Olivenhain have relatively light-colored A horizons, as if they were related to Noncalcic Brown soils. Tangair, Tierra, and Watsonville have relatively dark-colored A horizons, which indicates they are tending toward a Prairie or Chernozem type of profile. Tangair soils have what has been described as a "silica pan," whereas the other series in this group have claypans. In the 1938 Yearbook of Agriculture (*9*) Planosols were defined as follows: "An intrazonal group of soils with eluviated surface horizons underlain by B Horizons more strongly illuviated, cemented, or compacted than associated normal soils, developed upon nearly flat upland surface under grass or forest vegetation in a humid or subhumid climate."

The Milpitas series was selected to represent this group. A typical profile of Milpitas fine sandy loam is described below:

A_{11} 0 to 12 inches, brown (10YR 5/3, dry) fine sandy loam; weak very fine granular structure; hard when dry, very friable when moist; slightly acid.

A_{12} & A_2 12 to 23 inches, about the same color as A_{11} in the upper part, becoming gray or light gray at the lower edge; fine sandy loam; upper part is weak very fine granular, lower part is nearly massive and distinctly vesicular; medium acid: rests abruptly on layer below.

B_{21} 23 to 38 inches, yellowish-brown (10YR 5/4, dry) sandy clay; strong coarse prismatic structure; very hard when dry and firm when moist; noncalcareous; neutral; few faint brownish mottles on interiors of peds.

B_{22} 38 to 53 inches, yellowish-brown (10YR 5/4, dry) sandy clay loam with faint brownish mottles in interiors of peds: moderate coarse blocky structure; hard when dry and firm when moist; noncalcareous; slightly basic.

C 53 to 72 inches+, light yellowish-brown (10YR 6/4, dry) fine sandy loam or light sandy clay loam, with mottles of strong brown; massive; hard when dry and friable when moist; noncalcareous; neutral.

WIESENBODEN

Wiesenboden, called Humic Gley soils by some pedologists, are represented in the Santa Barbara Area by one series, the Clear Lake. These soils, formed in alluvium in basins, have poor drainage. Ordinarily, because of poor aeration resulting from waterlogging, the lower horizons of these soils are more or less mottled with rusty colors. Wiesenboden have been defined as follows (*9*): "An intrazonal group of soils with dark-brown or black soil high in organic matter, grading at 6 to 30 inches into gray soil; developed under grasses and sedges, mostly in a humid or subhumid climate."

A description of a typical profile of Clear Lake clay is as follows:

A_{11} 0 to 11 inches, black, (10YR 2/1, dry) clay; strong very coarse blocky, breaking to smaller blocks and finally to coarse granules; very hard when dry, firm when moist; noncalcareous; slightly basic.

A_{12} 11 to 22 inches, dark-gray (10YR 4/1, dry) clay with many white spots; moderate coarse blocky, breaking to smaller blocks and coarse granules; very hard when dry, firm when moist; slightly calcareous; numerous soft, white lime nodules; slightly basic.

AC_g 22 to 38 inches, dark grayish-brown (10YR 4/2, dry) clay loam with many fine mottles of yellowish brown and strong brown; massive; hard when dry and friable when moist; moderately calcareous; lime is disseminated or in soft white nodules and threads; moderately basic.

C_g 38 to 64 inches+, light brownish-gray (10 YR 6/2, dry) clay loam, with common fine mottles of yellowish brown and strong brown; massive; hard when dry and friable when moist; moderately calcareous; lime mainly disseminated but also in form of soft white nodules.

RENDZINAS

Another group of intrazonal soils, the Rendzinas, is represented by two series, Nacimiento and Zaca. Both series have formed in weathered marly shale under grass vegetation. Both are dark colored, but the Zaca soils are duller in color (less brown). Rendzinas have been defined as follows (*9*): "An intrazonal group of soils, usually with brown or black friable surface horizons underlain by light-gray or yellowish calcareous material; developed under grass vegetation or mixed grasses and forest, in humid and semiarid regions from relatively soft, highly calcareous parent material. From a Polish peasant term for productive calcareous soils."

Zaca soils are representative of the group. A typical profile of Zaca clay is described below:

A_{11} 0 to 14 inches, very dark gray (10YR 3/1, dry) clay; weak coarse granular structure; hard when dry and firm when moist; moderately calcareous; slightly basic.

A_{12} 14 to 38 inches, dark-gray (10YR 4/1, dry) clay; weak very fine subangular blocky structure; hard when dry and firm when moist; moderately calcareous; lime is both disseminated and in the form of soft, white nodules and thin seams; slightly basic.

D_r 38 to 50 inches+, pale-yellow (2.5Y 7/4, dry) massive shale; strongly calcareous.

SOLONCHAKS

In some of the basins near the coast a group of very poorly drained, saline, mottled soils has developed. These soils, members of the Alviso series, have been classified as Solonchaks. Solonchak soils have been defined as follows (*9*): "An intrazonal group of soils having a high concentration of soluble salts; usually light colored; without characteristic structural form; developed under salt-loving grass or shrub vegetation mostly in an arid, semiarid, or subhumid climate. From the Russian for salt."

A description of a typical profile of Alviso clay loam is given below:

A_{1g} 0 to 11 inches, gray (10YR 5/1, dry) clay loam distinctly mottled with strong brown and yellowish red; nearly massive, but the surface cracks into blocklike aggregates upon drying; hard when dry, friable when moist; very slightly calcareous; moderately saline; slightly basic.

C_g 11 to 60 inches+, light brownish-gray (2.5Y 6/2, dry) clay loam mottled with strong brown and yellowish red; massive, stratified; very slightly calcareous; moderately to strongly saline; neutral to slightly basic.

ALLUVIAL SOILS

Alluvial soils are an "azonal group of soils developed from transported and relatively recently deposited material (alluvium) characterized by a weak modification (or none) of the original material by soil-forming processes." (*9*) In other words their characteristics are almost entirely those of the original parent material. In the Santa

Barbara Area, six series have been assigned to this great soil group: Agueda, Carpinteria, Elder, Mocho, Sorrento, and Yolo. They are distinguished from one another by color, reaction, texture, and nature of parent alluvium.

The Sorrento series was chosen to represent the Alluvial soils. Following is the description of a typical profile of Sorrento loam:

A_1 0 to 37 inches, dark grayish-brown (10YR 4/2, dry) fine sandy loam; weak very fine granular structure; slightly hard when dry and very friable when moist; noncalcareous; slightly basic.

C_1 37 to 54 inches, pale-brown (10YR 6/3, dry) fine sandy loam; massive; soft when dry and very friable when moist; slightly calcareous.

C_2 54 to 72 inches +, very slightly lighter colored fine sandy loam; massive; soft when dry and very friable when moist; slightly calcareous; moderately basic.

REGOSOLS

Like Alluvial soils, the Regosols have developed in soft, unconsolidated or weakly consolidated materials and show little evidence of horizon differentiation except for darkening of the surface by organic matter. They differ from Alluvial soils principally in mode of origin of the parent material, which in Regosols is, in the broad sense, residual. That is, it has not been transported by water. Four series were assigned to this great soil group, as follows: Baywood, Crow Hill, Mariana, and San Andreas. Baywood soils serve to illustrate the group concept. A representative profile of Baywood loamy sand is described as follows:

A_1 0 to 25 inches, grayish-brown (10YR 5/2, dry) loamy sand; single grain; loose; neutral to slightly acid in reaction.

AC 25 to 44 inches, loamy sand that is very slightly lighter colored than the horizon above; slightly acid.

C_1 44 to 67 inches, pale-brown (10YR 6/3, dry) loamy sand; single grain; loose; medium acid.

C_2 67 to 80 inches +, light yellowish-brown (10YR 6/4, dry) sand; single grain; loose; medium acid.

LITHOSOLS

Lithosols, too, are weakly developed soils, that is, they have indistinct horizons. Unlike Alluvial soils and Regosols, they are forming in weathered residuum from hard rock and are commonly shallow. In addition, many of them are stony. In this Area, four series belong to this great soil group: Gaviota, Los Trancos, Maymen, and Montara. Distinctions among these series are caused mainly by differences in the parent rock.

The Gaviota series, developed on hard sandstones, is typical of the group. Following is a description of a representative profile of Gaviota fine sandy loam:

A_1 0 to 7 inches, brown (10YR 5/3, dry) fine sandy loam; weak very fine granular structure; slightly hard when dry and very friable when moist; medium acid in reaction.

C 7 to 17 inches, light yellowish-brown (10YR 6/4, dry) fine sandy loam containing numerous angular sandstone fragments; massive; slightly hard when dry and very friable when moist; strongly acid.

D_r 17 inches +, yellowish-brown (10YR 5/4, dry) hard, massive, sandstone bedrock; very strongly acid.

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