SOIL SURVEY

Santa Clara Area California

Series 1941, No. 17

Issued June 1958

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with the
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 of farm enterprises. Farmers of the Santa Clara 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 Clara 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, 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 symbol Cv. Look among the colored rectangles in the margin of the soil map and find the one with C printed on it; this symbol means Cropley clay loam, 1 to 3 percent slopes. All areas of this soil, wherever they occur on the map, are identified by the color and symbol shown in this rectangle.

What is Cropley clay loam, 1 to 3 percent slopes, like and to what uses is it suited? This information will be found in the section, Descriptions of the Soils.

How much does Cropley clay loam, 1 to 3 percent slopes, produce under the management it now receives, and how much will it produce if management is improved? Table 11 lists the soils alphabetically and gives estimates of the suitability of each soil for various crops usually grown in the Area under the common systems of management. The range of yields that may be expected from soils of various degrees of suitability for crops is given in table 12. To find out what management practices may be necessary for each soil, find what capability unit it falls into by referring to the table Principal Characteristics of Soils of the Santa Clara Area that accompanies the soil map in the jacket that holds this report. These capability units are listed and described in the section on Capability Classification. Additional information on management can be found in the sections on Irrigation and Drainage, Erosion and Deposition, and Saline and Alkali Soils.

SOILS OF THE AREA AS A WHOLE

A general idea of the soils of the Area is given in the introductory part of the section, Soils, and in the subsection, Soil Series and Their Relationships. These parts of the report tell about the principal kinds of soils, where they are found, and how they are related to one another. After reading these parts of the report, study the 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; the kinds and conditions of farm tenure, including tenancy; 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 Character of the Area.

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 publication of the soil survey of the Santa Clara Area, Calif., is a cooperative contribution from the—

SOIL CONSERVATION SERVICE

and the

UNIVERSITY OF CALIFORNIA AGRICULTURAL EXPERIMENT STATION

Series 1941, No. 17 Issued June 1958

SOIL SURVEY OF THE SANTA CLARA AREA, CALIFORNIA[1][2]

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

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[1] This report is included in preliminary abstract form in the report on Soils of Santa Clara County, California, (27) issued for limited distribution by the University of California.

[2] Field work for this survey was done by the Division of Soil Survey while it was part of the Bureau of Plant Industry, Soils, and Agricultural Engineering. Soil Survey was transferred to the Soil Conservation Service on November 15, 1952.

DECIDUOUS tree fruits were first grown in the Santa Clara Area shortly after the founding of Mission Santa Clara de Asis in 1777. Today the area is one of the important deciduous tree fruit sections of the State. Prunes, apricots, pears, cherries, and wine grapes are the principal fruits produced; in addition there are important acreages of walnuts, vegetables, sugar beets, and forage crops. Fruit canning and packing and wine making are important industries directly connected with agriculture. Some of the fruit is sold in foreign markets, but much of the agricultural produce goes to the more than 2½ million people living within a radius of 50 miles of San Jose, the principal city of the Area. Because of the mild climate and proximity to San Francisco, many summer homes and residences have been established in the Area. To provide a basis for the best agricultural uses of the land this cooperative soil survey was begun in 1940 by the United States Department of Agriculture and the University of California Agricultural Experiment Station. This report contains the findings of that survey, and unless otherwise stated, information in this report refers to conditions at the time of survey.

GENERAL CHARACTER OF THE AREA

The Santa Clara Area lies in the west central part of California in the northwestern part of Santa Clara County (fig. 1). It is mainly within the southern part of the San Francisco Bay drainage basin. It includes the northern part of the Santa Clara Valley, which extends with variable width for some 60 miles in a southeasterly direction

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

from the southern end of San Francisco Bay. This gently sloping valley is one of the largest of the many valleys in the Coast Range Region, most of which follow the general northwest-southeast direction of the enclosing mountain ranges. The Santa Cruz Mountains lie between the Santa Clara Valley and the Pacific Ocean and form part of its western boundary. The Diablo Range, one of the most extensive of the Coast Ranges, forms its eastern boundary. The valley gradually narrows from a point south of the area surveyed to where the Gabilan Range, the extension of the Santa Cruz Mountains south of the Pajaro River, converges with the Diablo Range.

The area surveyed covers approximately 490 square miles, or 314,000 acres. It is roughly triangular; the longest side is to the southwest

and the shortest to the north. The southwestern boundary is formed by the Santa Clara-Santa Cruz and Santa Clara-San Mateo County lines, and it follows the crest of the Santa Cruz Mountains. The northwestern and northern boundaries are the Santa Clara-San Mateo and the Santa Clara-Alameda county lines. The northeastern boundary lies along the crest of the first ridge of hills east of the valley floor (Los Buellis Hills), except for a break where Penitencia Creek enters the survey area. The southeastern boundary coincides with the northwestern boundary of the Gilroy soil survey area (*5*),[3] which was arbitrarily drawn in many places and does not follow definite geographic or physiographic features. In general this boundary is along or near the southern lines of the Yerba Buena and Santa Teresa land grants and the southern line of the Pueblo Lands of San Jose. Latitude 37°20′ intersects longitude 121°55′ in the western part of the city of San Jose.

San Jose, the county seat of Santa Clara County and the largest city in the county, lies near the center of the Area and on the gently sloping valley floor. It is 40 miles southeast of San Francisco, 85 miles southwest of Sacramento, 305 miles northwest of Los Angeles, and 125 miles northwest of Fresno.

The early soil survey of the San Jose Area (1903) (*14*), long out of print, and the reconnaissance soil survey of the San Francisco Bay region (1914) (*7*) included parts of the Santa Clara Area. However, about 25 percent of the Santa Clara Area, in the southern part, had not been previously surveyed. On the southwest the Area joins the detailed soil survey of the Santa Cruz Area (1935) (*20*), which covers Santa Cruz County, and on the southeast it joins the detailed survey of the Gilroy Area (1923) (*5*) in Santa Clara County. The Santa Clara Area includes about 38 percent of Santa Clara County. Including the Gilroy Area, approximately 800 square miles, or 61 percent, of the county has been surveyed in detail. The rest of the county consists principally of rough mountainous land on the western slopes of the Diablo Range.

PHYSIOGRAPHY, RELIEF, AND DRAINAGE

The western upland of the Area, on the Santa Cruz Mountains, consists of a number of complex ridges or small ranges with rugged slopes that vary in gradient from 40 to 60 percent or more. The crest of these mountains lies at elevations of 2,000 to 3,000 feet. Black Mountain, west of San Jose (fig. 2), has an elevation of 2,787 feet;[4] and Loma Prieta, the highest point in the Area and located south of New Almaden, has an elevation of 3,806 feet.

The eastern upland of the Area is part of the complex of hills and mountains that make up the Diablo Range. Since only the lower foothills of this range are included, this upland has smoother and less steep slopes than the western upland. Slopes generally range from 20 to 40 percent but in some places range from 50 to 60. The crests of these foothills vary from 1,000 to a little more than 2,000 feet in elevation. Monument Peak at the northeastern corner of the survey area has an elevation of 2,591 feet, and Masters Hill east of San Jose has an

[3] Italic numbers in parentheses refer to Literature Cited, p. 201.

[4] Elevations taken from U. S. Geological Survey topographic quadrangles.

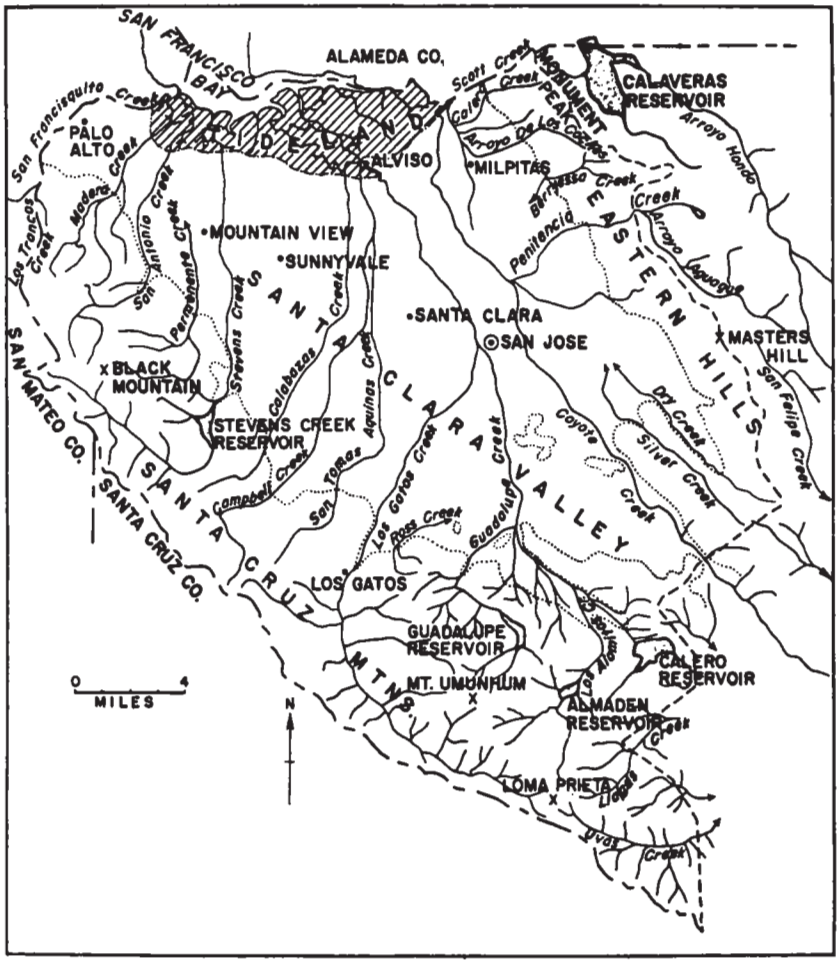


FIGURE 2.—Principal drainage channels in the Santa Clara Area. The dotted line shows the edge of the valley floor.

elevation of 2,427 feet. Further east and outside the Area, the mountains of the Diablo Range rise to elevations above 4,000 feet. Mount Hamilton has an elevation of 4,209 feet, and Copernicus Peak, the highest point in the county and located near Mount Hamilton, has an elevation of 4,372 feet.

Upland areas of undulating to rolling relief, representing eroded terraces, occur in many places at the bases of the mountains and hills on both sides of the valley. The slopes of these areas vary from 5 to 35 percent, and elevations from 250 to nearly 1,000 feet.

The lowland, or valley floor, consists chiefly of a number of confluent alluvial fans and flood plains formed by the deposits from numerous streams that enter the valley from both mountain systems. Slopes are toward San Francisco Bay and are fairly uniform and gradual; gradients range from less than 1 percent near tideland to 5 or more percent

near the hills. Elevations range from sea level to about 300 feet. The width of the valley floor, on a line running east and west through San Jose, is about 14 miles. South of this line, however, the valley narrows gradually and irregularly to a width of only one quarter mile at the gap between Tulare Hill and the Edenvale Hills where Coyote Creek enters the Area. Farther south and outside the Area the valley floor widens again to 3 or 4 miles. About 60 percent of the Santa Clara Area is valley floor, 36 percent upland, and 4 percent tidal marsh and part of San Francisco Bay.

The Santa Clara Valley is drained by two distinct stream systems and is therefore actually two valleys. From Morgan Hill southward the valley is drained by Uvas and Llagas Creeks, tributaries of the Pajaro River. This river leaves the valley between the Santa Cruz Mountains and the Gabilan Range and enters the ocean in Monterey Bay. Only about 25 square miles in the southern corner of the Santa Clara Area is included in this drainage basin. The very low divide of the valley floor near Morgan Hill is nearly imperceptible but it definitely separates the drainage into southern and northern parts. Most of the Santa Clara Area lies in the northern part and is drained by streams that flow toward San Francisco Bay.

The following principal streams entering the Area from the eastern mountains are listed in order of their position from north to south (fig. 2): Scott, Calero, Arroyo de los Coches, Berryessa, Penitencia, Dry, Silver, and Coyote. About half the drainage area of Scott Creek lies within the Area, but most of that of Penitencia Creek lies just east of it. Coyote Creek, the largest stream, drains a large section of the southeastern part of the county that is outside of the Area. The entire drainage system of the other creeks lies within the Area.

From north to south, the principal streams from the western mountains are: San Francisquito, Los Trancos (a tributary of San Francisquito), Madera (Matadero), San Antonio (Adobe), Permanente, Stevens, Calabazas, Campbell, San Tomas Aquinas (Aguinas), Los Gatos, Ross, and Guadalupe, with Los Alamitos (New Almaden) and Arroyo Calero as tributaries. The areas drained by these streams, except for San Francisquito, Los Trancos, and Arroyo Calero, lie within the Santa Clara Area. Only a small part of the area drained by San Francisquito Creek, about half that drained by Los Trancos Creek, and about 1 square mile at the headwaters of Arroyo Calero Creek lie outside of the Area.

The creeks on the eastern side, including that part of Coyote Creek within the Area, are intermittent. Minor west-side streams are also intermittent, but Los Gatos, Guadalupe, Stevens, Los Alamitos, Llagas, and Uvas Creeks are usually perennial in the mountains.

Characteristics of the streamflow in the Area are shown in table 1. Differences in the average acre-feet of flow for each square mile of drainage area are caused principally by differences in the annual rainfall on the drainage basins. Usually about 80 percent of the runoff comes during the months of January, February, and March.

Entrenchment of streams in upland regions is common. All of those in the mountainous regions and Guadalupe, Los Gatos, and Stevens Creeks in upland areas of terraces and old alluvial fans are deeply entrenched. Entrenchment in soils on recent alluvial fans or

TABLE 1.—*Stream flow in the Santa Clara Area, California* [1]

Creek	Drainage area	Average annual flow [2]	Maximum annual flow [2]	Minimum annual flow [2]	Average annual flow per square mile of drainage area [2]
	Square miles	*Acre-feet*	*Acre-feet*	*Acre-feet*	*Acre-feet*
Minor east-side creeks [3]	78	15,600	69,000	0	200
Coyote Creek	193	63,200	204,000	900	328
Minor west-side creeks [4]	101	31,400	103,000	0	311
Stevens Creek	18	6,800	20,000	500	380
Los Gatos Creek	40	28,000	59,800	2,100	700
Guadalupe Creek	13	7,900	17,800	300	610
Alamitos Creek [5]	29	15,400	42,000	0	530
Total	472	168,300	515,600	3,800	356

[1] Data based on publications of the California Department of Public Works (*2*, *3*).
[2] Estimates for the period 1902–32.
[3] Includes all of the drainage of Scott and Penitencia Creeks.
[4] Includes all of the drainage of San Francisquito and Los Trancos Creeks.
[5] Includes all of the drainage of Arroyo Calero.

flood plains is not usual, but Coyote, Guadalupe, and Los Gatos Creeks in these areas are also well entrenched.

Just east of Edenvale, where Coyote Creek flows through a narrow pass between the Edenvale Hills and the isolated Lick Hills, the creek bottom lies on bedrock. Upstream to the south of this pass the creek channel is not much entrenched in the recent alluvium of the valley floor. Below the pass, however, and to a point near the junction with Penitencia Creek, Coyote Creek is well entrenched and apparently actively cutting in the recent alluvium. Part of the channel of Guadalupe Creek south of San Jose is also well entrenched in recent alluvium, and the stream appears to be actively cutting in places. Likewise, part of Los Gatos Creek between Campbell and San Jose is actively cutting in recent alluvium.

No overflow of Coyote and Guadalupe Creeks takes place at present south of San Jose; however, both creeks, and particularly Guadalupe Creek, overflow between San Jose and the bay at some seasons. Additional discussion of overflow of creeks is given in the section, Erosion and Deposition.

GEOLOGY

San Francisco Bay is an example of an old valley that has been ocean-flooded by a local sag of the Coast Range Mountains. The northern part of the Santa Clara Valley is part of this structural valley that is above sea level.

Structural and historical geology of the mountains and hills of the bay region are very complex. Sedimentary rocks predominate. Many of these are highly twisted, folded, and faulted, and they range in age

from the Jurassic to the Quaternary and Recent periods (*9*). In many places igneous material has been intruded.

The principal rock formation of the Santa Cruz Mountains within the Area is sedimentary and belongs to the Franciscan group. This formation is of somewhat questionable age but is generally accepted as Jurassic. Branner, Newsom, and Arnold (*1*) stated that:

> The formation is characteristically metamorphic, although large areas of unaltered rocks are found within it. It consists of sandstone, shale, limestone, chert, schist, and gneiss. It is associated at many places with serpentine, which intrudes it in the form of dykes and large masses.

The ridge southwest of Saratoga along the Castle Rock County line consists of Oligocene (San Lorenzo formation) and lower Miocene (Vaqueros sandstone and Monterey shale) marine sediments.

Next to the valley floor and extending as a narrow strip from Palo Alto to Los Gatos are unconsolidated or slightly consolidated Quaternary and upper Pliocene fresh-water sediments largely of the Santa Clara formation (*1*). Other geologic formations of minor extent in the western part of the Area are: Middle Miocene and Upper Cretaceous marine sediments and Miocene volcanics southwest of Palo Alto; middle and lower Pliocene sediments southwest of Los Altos; Upper Cretaceous and Upper Eocene sediments and Jurassic ultrabasic intrusives (serpentinaceous rocks) largely forming the Santa Teresa Hills; Jurassic ultrabasic intrusives near New Almaden; middle Miocene sediments east of Los Gatos; and a narrow area of Jurassic ultrabasic intrusives following the San Andreas fault line from near Alma College to the headwaters of Stevens Creek.

On the eastern side of the valley, the hills within the Area are composed principally of upper Miocene marine sediments, although southeast of Evergreen, Lower Cretaceous sediments predominate. Near East San Jose a few small areas of Jurassic ultrabasic intrusives and middle Miocene and Lower Cretaceous sediments occur. Next to the valley floor from near Evergreen to East San Jose are Quaternary and upper Pliocene sediments. The Edenvale and Lick Hills are composed almost entirely of Jurassic ultrabasic intrusives. Farther east (outside the Area) the Diablo Range consists principally of the Franciscan formation.

Major fault lines occur on both sides of the valley. The San Andreas Fault, the most important one, lies just east of the crest of the Santa Cruz Mountains near Wrights (Wright) and Alma College and along the upper part of Stevens Creek. The San Andreas Fault leaves the Area southeast of Wrights and lies just west of the crest of the Santa Cruz Mountains. The earthquake that caused so much destruction in San Francisco in 1906 originated from slippage along this fault line. On the east side of the valley the Hayward Fault lies near the eastern edge of the valley floor and extends into the hills to the south along Dry Creek. The Calaveras Fault branches eastward from the Hayward Fault east of Morgan Hill and runs generally northward along the eastern base of the hills that form the eastern boundary of the Area.

Minerals or rocks of economic importance in the Area are chiefly cinnebar, from which quicksilver is obtained (Guadalupe and New Almaden mines), and limestone that is used in making cement. Between 1878 and 1886 about 80,000 barrels of paraffin-base oil were taken from wells in Moody Gulch off Los Gatos Creek (*17*).

In recent years leveling data have shown that the surface of a large section of the valley within the Area has subsided to some degree. The first precise level passing through San Jose, and through the area which later developed into the zone of recession, was made in 1912. In 1920 a second precise level was made that showed a discrepancy at San Jose of 0.4 foot. This discrepancy was considered a survey error. Releveling in 1932–33, however, showed a lowering of 0.5 foot at Palo Alto and 4.1 feet at San Jose. This difference, of course, could not be attributed to error, and work was begun on a system of levels, now being taken annually by the Coast and Geodetic Survey, that would show the extent and degree of recession.

Tolman and Poland (*22*) have summed up the data so far obtained in a report dealing largely with recession of the ground-surface and the ground-water depression in the valley. In this report they show the recession area as roughly oval—one end of it enclosing San Jose and the other lying about 3 miles northeast of Palo Alto. This area covers the zone of former artesian flow (*4*) (fig. 4). The regions of greatest subsidence occur near or within this zone at San Jose and Moffett Field. Maximum sinking has occurred at San Jose, where the difference in elevation between 1912 and 1937 amounted to 5.57 feet. Between 1934 and 1937 a drop of 0.8 foot occurred at San Jose and a drop of 0.9 foot occurred near Moffett Field. Tolman and Poland make the following summary of data available to date:

(1) Ground-water depression in the Santa Clara Valley has affected an area of about 200 square miles.

(2) The depression represents a volume of 44,480 acre-feet for the period 1934–37, and for the period 1919–37, of 232,000 acre-feet, which is approximately 15 percent of the quantity of water pumped during these periods.

(3) The sinking is limited to areas underlain by dense blue clay.

(4) No sinking has occurred within areas where water-table conditions exist, or in areas underlain by more than 40 percent of sand and gravel.

(5) The areas of maximum sinking contain deep wells (two at Moffett Field 1,000 feet deep, and one in San Jose 1,500 feet deep, and others 1,000+ feet deep.

(6) The areas of maximum sinking are areas of maximum well-production.

(7) The "rising" of casings is common in the sinking area. Many of these casings have risen two to three feet above ground-surface. This rising registers the compaction of materials between bottom of well-casing and ground-surface.

(8) Sinking of ground-surface virtually ceased in 1937, three years after spreading operations were initiated by the Santa Clara Water Conservation District, and after a rise in average ground water level of approximately 50 feet.

(9) In 1938–39 there has been a drop of well water levels. This rise and drop of ground water level is reflected by a rise and drop of land surface, as indicated by the uncorrected survey levels. However, this change in level is not to be accepted until the surveys are checked and adjusted.

(10) No significant ground movements have been detected along the San Andreas and Hayward faults. The survey lines show small but irregular ground-elevations to the east of Hayward's fault, but these are too small and too irregular to be considered indicative of earth movements along that fault.

CLIMATE

The climate of the Santa Clara Area is characterized by wet and dry seasons that coincide with winter and summer. However, because of its latitude, surrounding mountains, and proximity to the Pacific Ocean, the Area has mild and equable weather most of the year. The climate is oceanic, and winds are generally of the land-breeze and sea-breeze system.

Precipitation varies considerably within the Area and nearby territory, principally because of relief. Isohyetal lines showing differences in annual rainfall are given in figure 3 (*4*). These lines show clearly the variability in average annual rainfall. There is a general increase of precipitation from the ocean toward the crest of the Santa Cruz Mountains, a decrease from these mountains toward the valley, and then an increase again, but not so great, toward Mount Hamilton and the Diablo Range.

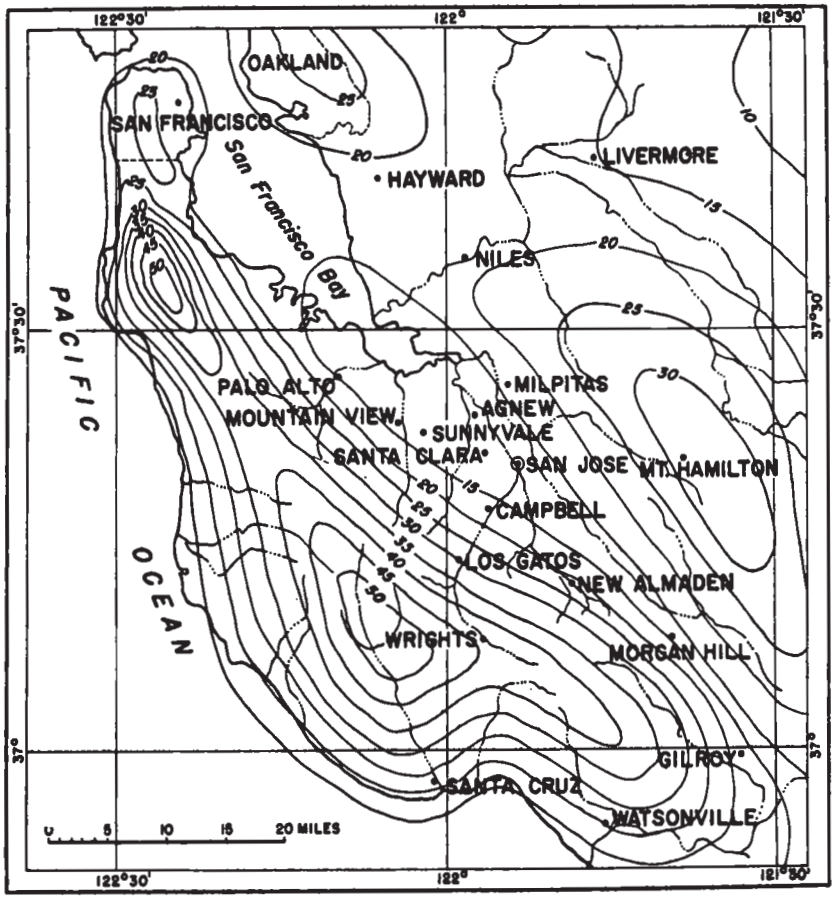


FIGURE 3.—Location and extent of belts of different rainfall in the Santa Clara Area and in counties to the north and west. Isohyetal lines indicate lines of equal rainfall.

Precipitation and temperature data for 5 stations in Santa Clara County (*23*) are given in table 2.[5] Data for San Jose, Santa Clara, and Palo Alto represent the valley floor; data for Los Gatos represent the Western foothill section in the Area; and data for Mount Hamilton (Lick Observatory) represent the higher eastern mountains. Usually, about 74 percent of the average annual precipitation of the Area falls during the months of December, January, February, and March. January is usually the month of greatest rainfall, and July the month of least rainfall. July and August are frequently rainless.

TABLE 2.—*Normal monthly, seasonal, and annual temperature and precipitation at five stations in Santa Clara County, California*

SAN JOSE, ELEVATION 95 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	50. 5	75	22	2. 39	0. 78	10. 55
January	49. 3	76	22	2. 37	. 86	. 50
February	52. 8	81	25	2. 53	. 61	. 70
Winter	50. 9	81	22	7. 29	2. 25	11. 75
March	55. 2	88	30	1. 89	1. 31	5. 80
April	57. 6	92	32	1. 05	. 92	. 79
May	61. 4	102	35	.43	. 11	. 96
Spring	58. 1	102	30	3. 37	2. 34	7. 55
June	65. 3	104	38	. 10	1. 45	. 04
July	67. 7	103	43	0	0	0
August	67. 2	102	42	. 02	0	0
Summer	66. 7	104	38	. 12	1. 45	. 04
September	66. 6	103	39	. 07	0	0
October	62. 3	97	31	. 67	(3)	4. 48
November	56. 0	85	27	1. 17	0	1. 73
Fall	61. 6	103	27	1. 91	(3)	6. 21
Year	59. 3	104	22	12. 69	[4] 6. 04	[5] 25. 55

See footnotes to table on page 18.

[5] This table also includes data given in annual reports for the California section of the U. S. Weather Bureau to 1953.

TABLE 2.—*Normal monthly, seasonal, and annual temperature and precipitation of five stations in Santa Clara County, California*—Con.

PALO ALTO, ELEVATION 57 FEET

Month	Temperature [1]			Precipitation [2]		
	Average	Absolute maximum	Absolute [lute] minimum	Average	Total for the driest year	Total for the wettest year
	° *F.*	° *F.*	° *F.*	*Inches*	*Inches*	*Inches*
December	48. 0	75	22	2. 94	1. 66	1. 84
January	46. 9	67	23	3. 52	. 71	15. 24
February	50. 4	79	25	3. 23	1. 02	3. 13
Winter	48. 4	79	22	9. 69	3. 39	20. 21
March	53. 5	84	30	2. 08	. 76	5. 67
April	56. 1	91	31	. 99	. 88	1. 16
May	60. 0	94	36	. 46	. 04	. 44
Spring	56. 5	94	30	3. 53	1. 68	7. 27
June	63. 9	102	40	. 17	1. 17	. 02
July	65. 6	100	44	0	0	0
August	65. 0	96	46	. 02	0	0
Summer	64. 8	102	40	. 19	1. 17	. 02
September	63. 9	99	39	. 28	0	0
October	59. 9	95	34	. 72	. 15	. 70
November	53. 3	83	31	1. 36	[3]	. 30
Fall	59. 0	99	31	2. 36	. 15	1. 00
Year	57. 2	102	22	15. 77	[4] 6. 39	[5] 28. 50
LOS GATOS, ELEVATION 500 FEET						
December	48. 5	74	26	5. 60	1. 44	2. 66
January	47. 4	74	24	6. 61	4. 41	27. 66
February	50. 3	82	28	5. 78	2. 12	4. 79
Winter	48. 7	82	24	17. 99	7. 97	35. 11
March	53. 1	89	32	4. 75	. 07	14. 16
April	56. 5	94	32	1. 88	3. 49	2. 46
May	60. 1	103	31	. 82	. 02	. 59
Spring	56. 6	103	31	7. 45	3. 58	17. 21
June	65. 1	106	39	. 10	. 10	. 05
July	68. 2	109	43	0	0	[3]
August	67. 6	104	43	. 03	[3]	0
Summer	67. 0	109	39	. 13	. 10	. 05
September	66. 1	106	40	. 40	. 82	[3]
October	61. 1	98	37	1. 38	. 16	. 55
November	54. 5	86	32	2. 76	. 34	. 70
Fall	60. 6	106	32	4. 54	1. 32	1. 25
Year	58. 2	109	24	30. 11	[7] 12. 97	[5] 53. 62

See footnotes to table on page 18.

TABLE 2.—*Normal monthly, seasonal, and annual temperature and precipitation of five stations in Santa Clara County, California*—Con.

MOUNT HAMILTON (LICK OBSERVATORY), ELEVATION 4,209 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	42.4	74	14	5.35	1.51	33.84
January	40.3	72	10	5.49	4.75	5.60
February	40.5	74	12	5.01	1.97	12.76
Winter	41.1	74	10	15.85	8.23	52.20
March	42.5	78	18	4.70	.17	16.35
April	46.7	79	20	2.42	4.61	11.96
May	52.6	88	22	1.23	.08	1.24
Spring	47.3	88	18	8.35	4.86	29.55
June	61.3	95	29	.30	.45	3.85
July	70.2	99	30	.01	0	0
August	70.1	97	38	.02	0	.15
Summer	67.2	99	29	.33	.45	4.00
September	62.9	96	30	.33	.73	.65
October	55.7	90	28	1.38	.49	3.71
November	48.8	88	15	2.67	.56	.01
Fall	55.8	96	15	4.38	1.78	4.37
Year	52.8	99	10	28.91	[7] 15.32	[8] 90.12
SANTA CLARA, ELEVATION 88 FEET						
December	48.8	80	20	2.80	0.83	10.78
January	47.1	78	19	3.02	.85	.58
February	50.5	82	23	2.71	.69	.48
Winter	48.8	82	19	8.53	2.37	11.84
March	52.7	89	28	2.54	1.27	5.82
April	55.5	94	29	1.00	.95	.74
May	59.6	104	32	.53	.07	.91
Spring	55.9	104	28	4.07	2.29	7.47
June	63.6	108	31	.12	.95	.01
July	65.9	111	38	0	0	0
August	65.7	103	39	.03	0	0
Summer	65.2	111	31	.15	.95	.01
September	64.5	108	36	.29	0	0
October	60.4	100	30	.75	.01	4.88
November	54.1	87	24	1.40	0	2.01
Fall	59.7	108	24	2.44	.01	6.89
Year	57.4	111	19	15.19	[4] 5.62	[5] 26.21

See footnotes to table on page 18.

875177—58——2

Footnotes for table 2.

[1] Average temperature at San Jose based on a 47-year record, 1906 to 1953; Palo Alto on a 30-year record, 1922 to 1952; at Los Gatos, on a 67-year record, 1886 to 1953; at Mount Hamilton, on a 58-year record, 1888 to 1946; at Santa Clara, on a 67-year record, 1886 to 1953. Highest and lowest temperatures at San Jose based on a 24-year record, 1907 through 1930; at Palo Alto on an 8-year record, 1923 through 1930; at Los Gatos on a 34-year record, 1897 through 1930; at Mount Hamilton on a 42-year record, 1889 through 1930; at Santa Clara on a 34-year record, 1897 through 1930.

[2] Average precipitation at San Jose based on an 80-year record, 1874 through 1953; at Palo Alto on a 42-year record, 1911 through 1952; at Los Gatos on a 60-year record, 1885 through 1953; at Mount Hamilton on a 72-year record, in the period 1881 to 1953; at Santa Clara on a 72-year record, in the period 1881 to 1953. Wettest and driest years at San Jose based on an 80-year record, 1874 through 1953; at Palo Alto on a 42-year record, 1911 through 1952; at Los Gatos on a 69-year record, 1885 through 1953; at Mount Hamilton on a 69-year record, in the period 1881 to 1953; at Santa Clara on a 72-year record, in the period 1881 to 1953.

[3] Trace.

[4] In 1929.

[5] In 1889.

[6] In 1911.

[7] In 1923.

[8] In 1884.

Average temperatures are fairly uniform throughout the Area, as can be seen in table 2. The most significant differences are between the data for Mount Hamilton (Lick Observatory) at an elevation of 4,209 feet and the data for San Jose on the valley floor. San Jose has the highest average temperature in winter of any of the stations.

Frost data for the same 5 stations (*23*) are given in table 3.[6] The average growing season in the valley ranges from 261 to 311 days. Along the western edge of the valley the average growing season is a little longer than on the valley floor or in the mountains.

Frost ordinarily does little damage to crops in the valley. Susceptible crops usually are not grown. Vegetables of the cabbage family are commonly grown during the winter months or frost period, and these crops are harmed only by very heavy and exceptional frost. The eastern hills, on which early peas are grown, are mostly in a frost-free zone. The danger period for apricots, grapes, and prunes is generally from the middle of February to the middle of April, and during this time smudge pots are used in many orchards and vineyards. The rare frost occurring "out of season" in April or May seriously damages most crops in the valley.

Prevailing wind directions at 5 stations are also given in table 3 (*23*). The valley is shielded on the east from the hot summer winds of the San Joaquin Valley by the Diablo Range and on the west from winds and fog from the Pacific Ocean by the Santa Cruz Mountains. At San Jose the average annual wind velocity is 6.8 miles an hour, and only once during an average year does the wind attain gale velocity (32 miles an hour).

WATER SUPPLY

Wells are the chief source of water for irrigation in the Area. Since most of the highly developed agriculture of the valley depends on irrigation, the importance of an adequate and constant groundwater reserve cannot be overestimated.

[6] See footnote 5 on page 15.

TABLE 3.—*Frost and wind data at stations in Santa Clara County, California*

Station	Elevation	Killing frost						Prevailing wind direction [1]					
		Length of record	Average date of last in spring	Average date of first in fall	Average growing season	Latest date in spring	Earliest date in fall	Length of record	Season				
									Spring [2]	Summer [3]	Fall [4]	Winter [5]	Annual
	Feet	*Years*			*Days*			*Years*					
San Jose	95	53	Feb. 4	Dec. 12	311	Apr. 7	Nov. 4	23	NW	NW	NW	SE	NW
Santa Clara	88	54	Mar. 7	Nov. 23	261	June 1	Oct. 17	16	NW	NW	NW	S	NW
Palo Alto	57	30	Feb. 15	Dec. 3	291	Apr. 10	Oct. 29	9	NW	NW	NW	NW	NW
Los Gatos	500	46	Feb. 11	Dec. 14	306	Apr. 30	Oct. 28	24	N	N	N	N	N
Mount Hamilton (Lick Observatory).[6]	4,209	49	May 15	Nov. 7	196	June 24	Oct. 2	24	N	NW	N	N	N

[1] Taken from summary records of 1930.
[2] Spring—March, April, May.
[3] Summer—June, July, August.
[4] Fall—September, October, November.
[5] Winter—December, January, February.
[6] Outside Area but within Santa Clara County.

According to Clark (*4*), and also Tibbets and Kieffer,[7] the ground water of the valley is supplied almost entirely by rainfall on the valley and surrounding mountains. The chief percolation takes place from those parts of stream beds near the rim of the valley. Clark estimates that the normal annual recharge of the ground water in the part of the valley covered by the Santa Clara Area is about 1 acre-foot per acre, and Tibbetts and Kieffer give estimates of annual percolation as 125,800 acre-feet maximum; 18,200 acre-feet minimum; and 76,500 acre-feet average.

With the development of agriculture on the valley floor and the greater dependence on irrigation for normal and continuous crop production, the draft on the ground-water reservoir increased and fluctuations in the water level were viewed with apprehension. Hunt makes the following statements in a report of the Santa Clara Valley Water Conservation District.[8]

> By 1912 the pumping draft was heavy enough to cause a decline in water levels whenever the yearly rainfall was less than normal. Although the levels rose during the wet years of 1915 and 1916, from then on they fell steadily until 1934. In 1920 the water was 30 feet lower than in 1913, causing the formation of the 'Santa Clara Valley Water Conservation Committee' who engaged Fred H. Tibbets and Stephen E. Kieffer, civil engineers of San Francisco, to investigate the water resources of the valley.
>
> The investigators concluded that, although draft had not at that time exceeded normal natural replenishment and, although the observed water table declines were in the nature of fluctuations rather than a permanent trend, a yearly average deficiency of about 82,000 acre-feet would occur by the time the valley was fully developed and the water level decline would then be permanent unless means were taken to replenish the supply.

In 1929 the Santa Clara Valley Water Conservation District, essentially covering the valley floor included in the Santa Clara Area, was formed. At the request of the district, the State Division of Water Resources between 1930 and 1933 investigated ground-water conditions and means of developing a sufficient and constant replenishment of the ground-water reservoir (*3*). This investigation showed that the average ground-water level had dropped 95 feet between 1915 and 1933. It also determined that ground-water levels could be restored by conserving waste water and using it to replenish the underground supply.

Hunt further states that by 1932, ". . . ground-water levels had receded alarmingly, orchards depended on irrigation for proper bearing, pumping costs were staggeringly high and conservation measures were plainly indicated." Water conservation plans of the district were carried out in 1935 and 1936. Five storage dams, controlling about 35 percent of the total normal runoff, were built on the major streams of the valley. These reservoirs and their capacities are given below.

Reservoirs:	*Acre-feet*
Stevens Creek	4,000
Guadalupe	3,500
New Almaden	2,000
Calero	9,500
Coyote	30,000
Total	49,000

[7] TIBBETTS, F. H. and KIEFFER, S. E. REPORT TO THE SANTA CLARA VALLEY WATER CONSERVATION COMMITTEE. 1921. [Unpublished.]

[8] HUNT, G. W. DESCRIPTION AND RESULTS OF OPERATIONS OF THE SANTA CLARA WATER CONSERVATION DISTRICT'S PROJECT. 1940. [Unpublished.]

Only floodwaters are stored in these reservoirs, and no storage is made until streams begin to waste into the bay. Calero Reservoir (pl. 1) stores water mainly from Alamitos Creek (New Almaden Creek), the water being diverted to the dam by a canal. All of these reservoirs lie within the Santa Clara Area (see fig. 2) except Coyote Reservoir, which is located in the mountains northeast of Gilroy.

After these dams were constructed, considerable regulation of the flow of water onto the valley floor was found possible. The next step was supplying the ground-water reservoir with some of the stored water, which normally would have drained into the bay mainly as waste water. To accomplish this the district constructed percolation dams along the creeks in strategic places where it was estimated the greatest percolation would result. All of the creeks with storage reservoirs, except Stevens Creek and Los Gatos Creek, have percolation dams or areas. Stevens Creek has a stream bed of naturally high absorption rate and capacity.

From 1935 to 1939, Hunt estimated that through the district's water conservation measures 174,000 acre-feet of water were added to the ground water above the normal natural absorption, and that the consequent rise of the ground-water level saved $715,000 in pumping costs for the farmers of the district.

Lines of equal elevation of ground-water level in the valley in the fall of 1938 are shown in figure 4, which was taken from data supplied by the district. At this time the average depth to ground water as measured in wells was 94 feet. The depths varied, however, from zero or only a few feet near tideland to as much as 250 feet near the hills. The lines of equal elevation of ground-water level are not constant; the principal variations are due to changes in seasonal rainfall. However, the operation of the storage and percolation dams should reduce the amount of annual fluctuation considerably. Besides the annual fluctuation, there is also a seasonal fluctuation of ground-water level caused chiefly by pumping. Generally from the middle of May to the middle of June the ground-water level drops rapidly, normally about 10 or 15 feet, since the greatest draft is made during this period. The water conservation district estimated that in 1939 there was a total draft of 89,800 acre-feet on the ground-water reservoir.

The area that formerly had artesian wells (*4*) is shown in figure 4. At one time in this Area many wells flowed at least intermittently during the year. As the ground-water level in other parts of the valley dropped, most of these wells ceased flowing completely. In the last few years, however, some wells that were being pumped are now flowing again.

Except for Palo Alto, the principal cities of the Area are supplied with gravity water from smaller reservoirs in the Santa Cruz Mountains. The chief watershed is that of Los Gatos Creek, where the San Jose Water Works bought the entire village of Wrights in 1936 to safeguard the quality of the water. Wells also have been developed to supplement the mountain water in emergency or during a prolonged dry period. Palo Alto obtains part of its water from the same sources as San Francisco; namely, Hetch-Hetchy Reservoir in the Sierra Nevada and Calaveras Reservoir in Alameda and Santa Clara Counties. Well water supplements reservoir water in Palo Alto.

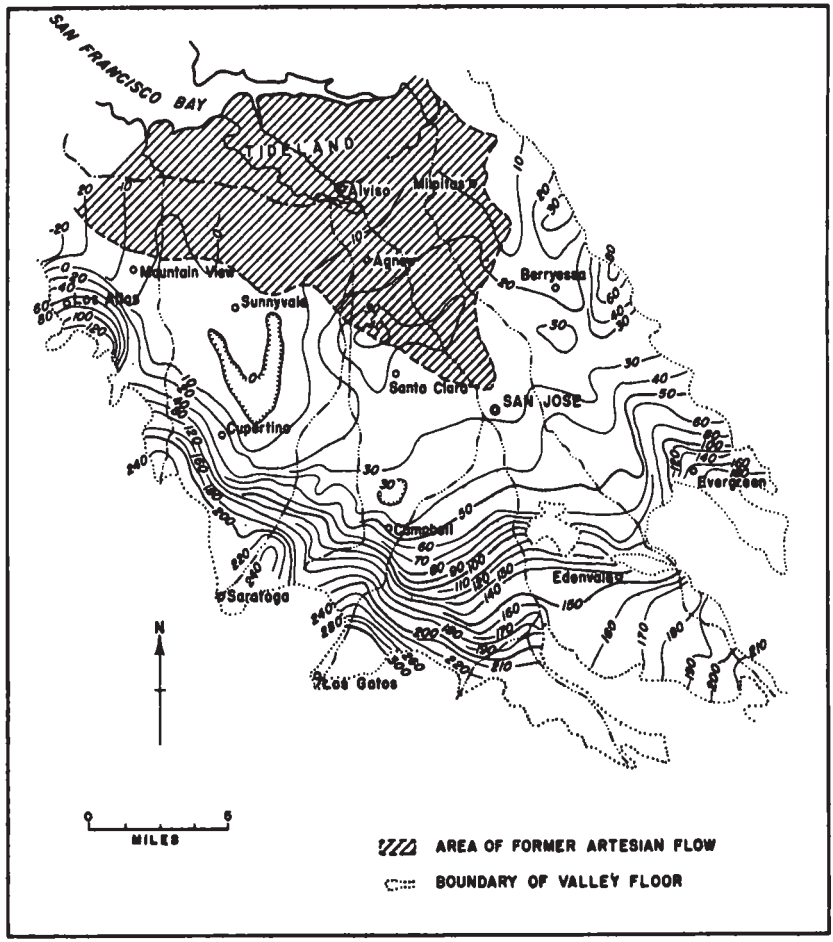


FIGURE 4.—Lines of equal depth to ground water in the Santa Clara Valley, as measured in the autumn of 1938; this area formerly had artesian flow in wells.

VEGETATION

If definite correlations between soil type and vegetation type in this Area are found, they are mentioned in this report in the descriptions of the soil types. The valley floor and adjacent low foothills are mostly in cultivation, but the mountains and hills within the Area are covered by a varied natural vegetative growth. In general, because of more rainfall, the Santa Cruz Mountains have a more luxuriant natural vegetation than the hills in the eastern part of the Area (pl. 2, *A* and *B*). The vegetation of both of these upland sections creates a definite fire hazard during the dry season of summer and early fall. Fire lookout stations are on Copernicus Peak, Loma Prieta, and Bielawski Mountain (west of Los Gatos just in Santa Cruz County). The county forest ranger station is located near Alma College along Los Gatos Creek.

VEGETATION ON THE SANTA CRUZ MOUNTAINS

The vegetation types mapped in the western part of the Santa Clara Area are shown in figure 5, which is based on Jensen's report on the vegetation of the Santa Cruz Mountains (*10*). The vegetation types and the predominant plants in each are as follows:

Grassland.—This type consists predominantly of annual grasses such as slender oat or wild oat (*Avena barbata*), soft chess or soft cheat (*Bromus mollis*), ripgut grass (*B. rigidus*), and foxtail fescue (*Festuca megalura*). In a few places the perennial purple needlegrass (*Stipa pulchra*) occurs in considerable abundance. Commonly

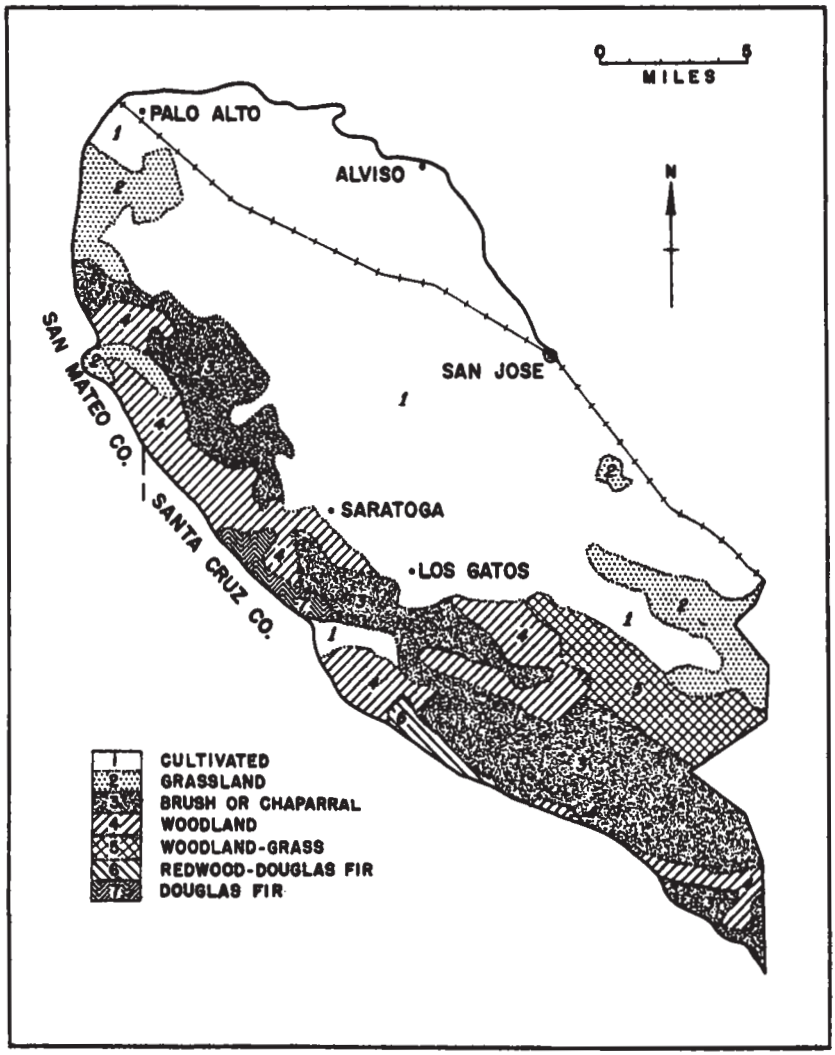


FIGURE 5.—Vegetation types in the western part of the Santa Clara Area, California.

associated with the grasses are herbs such as alfileria or redstem filaree (*Erodium cicutarium*), long heronbill (*E. botrys*), and California burclover (*Medicago hispida*).

In winter and spring the grasses predominate, but the herbs generally are more conspicuous during late summer and autumn. Much of the grassland of the mountains is on areas that have been cleared and cultivated and then abandoned. A few of these abandoned areas are slowly reverting to brush, woodland, and even timber.

Brush and chaparral.—This vegetation type consists of shrubs that are more or less hard and woody. Various associations include Eastwood manzanita or manzanita (*Arctostaphylos glandulosa*), California scrub oak (*Quercus dumosa*), scrub canyon live oak. (*Q. chrysolepis*), Jimbrush (*Ceanothus sorediatus*), birchleaf mountain mahogany or hardtack (*Cercocarpus betuloides*), Christmasberry or toyon (*Photinia arbutifolia*), poison-oak (*Toxicodendron diversilobum*), California buckthorn or California coffeeberry (*Rhamnus californica*), oceanspray or creambush (*Holodiscus discolor*), chamise (*Adenostoma fasciculatum*), and chaparral-pea (*Pickeringia montana*).

In general the growth is very dense, varies from 4 to 10 feet in height, and occupies soils and sites not favorable for the production of commercial timber. This type provides an effective watershed cover, but it also creates a fire hazard.

Woodland.—These forests of various broadleaved or hardwood trees form fairly dense closed-canopy stands. Predominant species are coast live oak (*Quercus agrifolia*), California black oak (*Q. kelloggii*), canyon live oak or maul oak (*Q. chrysolepis*), highland live oak or interior live oak (*Q. wislizenii*), Pacific madrone or madrone (*Arbutus menziesii*), tanoak (*Lithocarpus densiflora*), and California-laurel (*Umbellularia californica*).

Heights of trees vary from 15 to 50 feet and diameters from 6 to 35 inches. Generally an understory of shrubby or herbaceous vegetation is present. Some of the area now in woodland is potential redwood and Douglas-fir land, but the woodland has taken over areas where the conifers were removed either by logging and fire, or fire alone. Besides being an excellent watershed cover, the trees of this type produce a hard wood that is very good for fuel. Madrone has been used for making charcoal, and tanoak bark for making tannin.

Woodland-grass.—This type has open stands of woodland trees, and the intervening spaces are occupied by grasses and other herbaceous plants. The trees are principally coast live oak, California black oak, California blue oak (*Quercus douglasii*), and valley white oak (*Q. lobata*). The herbaceous vegetation is similar to that in the grassland vegetation type. These areas are used principally for grazing.

Redwood-Douglas Fir.—These stands contain both redwood (*Sequoia sempervirens*) and Douglas-fir (*Pseudotsuga menziesii*). Either of these species may make up 20 percent or more of the total stand. Tanoak, madrone, coast live oak and highland live oak are generally associated with this type, as is also an undergrowth of such shrubs as California hazel (*Corylus californica*), blue myrtle or blueblossom (*Ceanothus thyrsiflorus*), poison oak, California dewberry or California blackberry (*Rubus vitifolius*), and box blueberry or California huckleberry (*Vaccinium ovatum*). Several fern species are also commonly present.

The trees of this type are young, mainly between the ages of 40 and 80 years. They normally vary in height from 60 to 130 feet and in diameter from 8 to 36 inches. There are 2,590 acres of this type within the Santa Clara Area.

Douglas-fir.—This type consists of stands of Douglas-fir in which redwood, if at all present, makes up less than 20 percent. Tanoak, madrone, highland live oak, and canyon live oak are common associates either in the understory or as an important part of the canopy. A dense undergrowth is also usually present; it includes ferns and such shrubs as California hazel, poison oak, box blueberry, California dewberry, and thimbleberry (*Rubus parviflorus*).

This vegetation type consists of young timber, mainly 40 to 80 years old. Heights vary from 60 to 130 feet and diameters from 10 to 25 inches. The total area of this type within the Santa Clara Area is 3,390 acres.

Large acreages of conifers grow outside the Area on the western slopes of the Santa Cruz Mountains. However, of the original total of 254,280 acres of timber in the Santa Cruz Mountains, only 27,440 acres, or 10.8 percent, at present consists of virgin timber. The remaining area consists of 136,960 acres of young-growth timber and 89,880 acres of deforested land. Virgin stands of redwood occur on a few scattered stream-bottom flats, mainly in Santa Clara County. These trees generally vary from 175 to 225 feet in height and from 3 to 10 feet in diameter, although some reach heights of 300 feet and diameters of 15 or more feet. Virgin stands of Douglas-fir occur mainly in San Mateo County; the trees generally vary from 150 to 180 feet in height and from 2 to 4 feet in diameter.

The original woodland and forest area covered 17,020 acres, of which 5,980 acres, or 35 percent, now consists of timber that is mostly too young to have commercial value. In general, the young timber represents natural regrowth on areas where the original stands were removed by logging or fire.

Jensen (*10*) states that water-powered and early steam sawmills operated within the Santa Clara Area between 1842 and 1874. These were located along upper Los Gatos Creek and near the headwaters of Campbell, Los Trancos, and Uvas Creeks. Steam-powered sawmills, which operated between 1876 and 1905 and with which ox-logging methods were used, were located near the headwaters of Los Gatos and Uvas Creeks. One modern mill, in which steam-powered logging methods were used, operated from 1906 to 1935 near the headwaters of Los Gatos Creek. At the time of the survey there were no major sawmills operating within the Area, although a few were operating in Santa Cruz and San Mateo Counties.

VEGETATION ON THE EASTERN HILLS[9]

Vegetation on the eastern hills within the Area consists principally of annual grasses and herbs. The predominant species are generally the same as those of the grassland type on the Santa Cruz Mountains.

A few areas of brush, chiefly California sagebrush (*Artemisia californica*), chamise, and coyote brush or kidneywort (*Baccharis pilularis*), occur principally on Monument Peak, along the sides of Alum

[9] Names of predominant species on the eastern hills and valley floor supplied by the Biology Department of San Jose State College.

Rock Canyon, and on the Edenvale Hills. The brush generally occupies steep slopes and very shallow and poor soils.

A few small areas of woodland occur on slopes of northern exposure and along streams. The chief species are coast live oak, canyon live oak, Pacific madrone, and California-laurel. The areas of woodland-grass that also occur consist of representative species of woodland and grass already listed.

VEGETATION ON THE VALLEY FLOOR

Before cultivation began in the valley, the original parklike vegetation consisted of large scattered valley white oaks and coast live oaks and grass in the intervening spaces. Such a type of vegetation was especially common on the well-drained soils on alluvial fans in the southern and western parts of the Area. Herbaceous plants and grasses predominated on the poorly drained black clay soils closer to the bay and also in the eastern part of the Area. At present the natural vegetation remains chiefly on tideland and on alkali soils next to tideland. Tidal marsh supports herbaceous plants; cordgrass (*Spartina foliosa*), pickleweed or samphire (*Salicornia ambigua*), and alkali heath (*Frankenia grandifolia*) predominate. In alkali areas next to tideland, pickleweed, saltgrass (*Distichlis spicata*), and brass-buttons (*Cotula coronopifolia*) are common.

A few plantings of eucalyptus are scattered over the valley floor and in the hills. These plantings are mostly associated with residences and real estate developments. Fields that have not been cultivated for some time develop a cover of grasses and weeds, which are discussed in the section on agriculture.

HISTORY OF SETTLEMENT AND DEVELOPMENT[10]

Spanish explorers under Gaspar de Portolo discovered the Santa Clara Valley in 1769. In 1777, a year after the founding of Mission San Francisco de Asis Dolores, the Franciscan Padres established Mission Santa Clara de Asis on the Guadalupe River just north of the present city of Santa Clara. That same year Pueblo de San Jose de Guadalupe (later the city of San Jose) was established as one of the first civil settlements in California. The nearest source of food supplies for the soldiers protecting the missions of San Francisco and Santa Clara was Mexico, and the Pueblo was established primarily to assist the missions in growing crops to take the place of this distant food source.

The mission at Santa Clara, and also the Pueblo, prospered. Mission San Jose de Guadalupe (in Alameda County) was founded 12 miles north of Mission Santa Clara in 1797, and it also became firmly established.

Although California was part of Mexico until 1848, at least two men from the United States, John Gilroy (Cameron) and Robert Livermore, had settled in the valley as early as 1814 and 1816. In March 1846, an American exploration party, headed by John C. Fremont and Kit Carson, entered the valley. However, American

[10] Much of the information in this section is derived from histories of San Jose and Santa Clara County (*8, 17*).

settlers did not begin to arrive in increasing numbers until the discovery of gold and the acquisition of California by the United States.

The first state convention of California met at Monterey in 1849 and chose San Jose for the State capital, but Sacramento was later chosen. Santa Clara County is one of the original counties established when California became a State in 1850, and San Jose has been the county seat from the establishment of the county.

The population of the county grew as the agriculture of the valley developed. Agricultural development was advanced by the completion in 1864 of the San Francisco and San Jose Railroad (later taken over by the Southern Pacific Company), the early rapid growth of San Francisco and California, the completion of the transcontinental railroad, and the development of refrigerated railroad cars.

Population figures from the United States Census for 1930, 1940, and 1950 for Santa Clara County and the incorporated cities within the Area, are given in table 4. No exact figures for the population of the Santa Clara Area are available, but an estimate was obtained that is based on census figures for judicial townships of the county. According to this method, the population of the Area in 1950 was about 270,000, or more than 90 percent of the total population of the county. The population is not uniformly distributed; it is greatly concentrated on the valley floor. The 1950 census figures for Santa Clara County, which covers 1,305 square miles, give an average density of 222.6 persons a square mile.

TABLE 4.—*Population in stated years of Santa Clara County and incorporated cities within the Santa Clara Area, California*

Area	1930	1940	1950
Santa Clara County	145, 118	174, 949	290, 547
San Jose	57, 651	68, 457	95, 280
Palo Alto	13, 652	16, 774	25, 475
Santa Clara	6, 302	6, 650	11, 702
Mountain View	3, 308	3, 946	6, 563
Los Gatos	3, 168	3, 597	4, 907
Sunnyvale	3, 094	4, 373	9, 829
Alviso	381	677	652

San Jose is the center of the industrial and agricultural activities of the Area. It is one of the important fruit-packing and canning points in California. San Jose State College also marks it as an important educational center for the Area. Palo Alto, incorporated in 1894, originated with the founding of Stanford University in 1887. Today it is a well-known residential area and one of the important educational centers of California.

Santa Clara, incorporated in 1862, is an important fruit-packing point in the Area, and like San Jose and Palo Alto, it is a well-known educational center. Santa Clara University, founded by the Jesuits in 1851 as Santa Clara College, was one of the first institutions of higher learning established in the State.

Mountain View, incorporated in 1902, is an important shipping point for the Area. A large printing and publishing plant is located here. Sunnyvale, incorporated in 1912, is another important indus-

trial and shipping point for the Area. Both Sunnyvale and Mountain View are located near Moffett Field, a military flying base.

Los Gatos, incorporated in 1887, is well known for its equable climate and is principally a residential and recreational center. Alviso, incorporated in 1852, was an important water transportation terminal until the coming of the railroads, which greatly reduced freighting by water to San Francisco and other bay points.

Other towns in the Area are Milpitas, located in a vegetable and grain-hay producing section; Saratoga, noted for its annual blossom festival and like Los Gatos a residential and resort center; Campbell, located in the fruit-growing section; and Los Altos, chiefly a residential center.

TRANSPORTATION FACILITIES AND MARKETS

The Area is served by two transcontinental railroads, the Southern Pacific and the Western Pacific Companies. Deep-water ports at San Francisco and Oakland are connected by rail with San Jose. All of the incorporated cities of the Area are connected by railroad. Bus service is available at all cities and towns.

U. S. Highway 101, which connects San Diego, Los Angeles, San Francisco, Portland, and Seattle, passes through the Area and the cities of San Jose, Sunnyvale, Mountain View, and Palo Alto. From San Diego to San Francisco this part of the highway has long been known as El Camino Real. A four-lane highway, U. S. Highway 101 Bypass or Bayshore Highway, from San Francisco to San Jose, follows the edge of San Francisco Bay for much of its distance, and most of the "through traffic" travels by this route. State Highway 17 connects San Jose with Oakland and Santa Cruz and passes through Milpitas and Los Gatos. State Highway 9 terminates at Milpitas and Santa Cruz; it passes through Alviso, Sunnyvale, and Saratoga. State Highway 5, or Skyline Boulevard, from San Francisco follows along the crest of the Santa Cruz Mountains to Highway 9. Numerous paved county roads crisscross the Area and allow easy and direct transportation by truck and automobile between points in the Area or to points outside the Area.

Commercial airports are located near San Jose and Palo Alto. The San Francisco municipal airport is 38 miles from San Jose on U. S. Highway 101 Bypass. Moffett Field, one of the important military flying fields and the site of the Ames Aeronautical Research Laboratory, lies about 8 miles northwest of San Jose. The hangar that originally housed the Navy dirigible, U. S. S. Macon, is part of the equipment of this field. A few private airports are also located in the Area. Yacht harbors are located at Alviso and near Palo Alto on San Francisco Bay. Little commercial use is made of these ports at present.

Much of the agricultural produce of the Area is marketed within a radius of 50 miles from San Jose. This is particularly true of fresh vegetables, fresh fruit, and dairy and poultry products. Fresh fruit has, besides bay-area and Pacific Coast markets, important eastern markets. Dried and canned fruit, canned vegetables, and wines normally have national and international markets. About 25 percent of the garden seed grown in the Area is normally exported to Europe, India, and Argentina. More detailed information concerning markets is discussed under individual crops in the section on agriculture.

HOME AND COMMUNITY IMPROVEMENTS AND RECREATIONAL FACILITIES

Two universities and a State college lie within the Area: Stanford University near Palo Alto, Santa Clara University in Santa Clara, and San Jose State College in San Jose. St. Joseph's College near Los Altos, and Sacred Heart Novitiate and Alma College in the hills above Los Gatos are theological schools. The Lick Observatory of the University of California is located outside the Area, 26 miles by road from San Jose, on the summit of Mount Hamilton in the northeastern part of Santa Clara County.

Public schools in San Jose and the county include kindergartens, elementary schools, junior high schools, senior high schools, and a junior college. In rural areas an extensive school-bus system provides easy access to schools for children living in nearly every part of the Area. In addition to public schools, there are a number of private schools within the Area. Many denominations have churches in the county.

Electric power is supplied to the Area from hydroelectric plants in the Sierra Nevada. Electric power is available to all homes in incorporated cities, and according to the Pacific Gas and Electric Company, about 99 percent of the rural homes in the Area are continually supplied with electricity. In 1950, 4,764 farms reported having electricity in Santa Clara County. Natural gas for fuel is supplied to the cities and adjacent areas through pipes from the Kettleman Hills oilfields in the San Joaquin Valley. In 1950, 3,476 farms in Santa Clara County reported having telephones, 4,436 farms reported having 7,518 automobiles, and 2,965 farms reported having 4,379 tractors.

Most rural homes in the Area have nearly as many conveniences as urban homes, and many rural sections on the valley floor and along the edge of the hills and mountains have gradually assumed a more suburban character. The mild climate and the convenient transportation throughout the Area and to San Francisco have made this an important residential area. In 1950 there were 4,436 farms reported on a hard-surface road; 142 on a gravel, shell or shale road; and 177 on a dirt or unimproved road.

The county maintains two recreational parks in the Area, Alum Rock Park and Stevens Creek Park. The district storage reservoirs in the Area are used for swimming and boating. Golf courses are located near Palo Alto, Los Altos, Los Gatos, Evergreen, and East San Jose. Other recreational opportunities in the Area are yachting on San Francisco Bay; trout fishing in Stevens, Guadalupe, Uvas, and Llagas Creeks; horseback riding, particularly near Alum Rock Park and Los Gatos; and deer hunting in the mountains just east of the Area. The Santa Cruz Mountains, particularly the timbered parts, have long been summer recreational areas. Many summer homes are located in the Los Gatos Creek drainage area and elsewhere in the mountains.

INDUSTRIES

The most important argicultural industries are the canning and packing of fruits and vegetables. The canning and packing plants employ thousands of men and women at the peak of the season in July and August.

There are a number of creameries and cheese factories in the Area. Wineries annually produce millions of gallons of wine; zinfandel, burgundy, port, sauterne, and champagne are the principal wines made. Thousands of head of beef cattle are slaughtered each year in the Area. An important industry connected with agriculture is the manufacturing of equipment for canneries and orchards.

The manufacturing of cement is one of the most important of the nonagricultural industries. Portland cement was at first produced at the Permanente plant near Monte Vista, largely for the Shasta Dam project in the northern part of the Sacramento Valley. Other important nonagricultural industries are pottery making, the manufacturing of massive machinery and castings, planing mills, salt works, and printing and publishing.

Of more historical than present importance is the New Almaden quicksilver mine near the town of New Almaden. This mine is said to have been first seen by a white man, Jose Berryessa, in 1824 (*17*). It was thought at first that the mine contained silver, and little attention was paid to the cinnabar. When silver was not found the mine was soon abandoned. It was not until 1845 that the red rock was found to contain quicksilver, and mining was started. The mine passed through various ownerships and developed, between 1860 and 1880, into one of the important quicksilver mines of the world. In more recent years, however, the mine has been either inactive or only slightly worked.

AGRICULTURE

As far as is known, the Indians that occupied the Santa Clara Valley before the white men came practiced very little or no agriculture. The mild climate and abundant game, fish, herbs, and berries made agriculture unnecessary.

The earliest agriculture in the Area was planned to make the newly established missions at San Francisco and Santa Clara and the Spanish soldiers in the region independent of supplies from Mexico (see section, History of Settlement and Development). In 1777, through a land grant made by the Spanish king, 66 persons settled on the equivalent of about 60 acres and founded Pueblo de San Jose de Guadalupe, later known as the city of San Jose, for the purpose of growing crops and breeding livestock. Pear, olive, and other fruit trees, grapevines, vegetable seeds, flowering plants, grain seeds, oxen, horses, cows, sheep, and goats were brought from Mexico. By 1800, besides grain and livestock, enough fruit was grown to supply the needs of the community, and by 1805 more fruit than could be disposed of was being grown.

Following the secularization of church property in 1934, the intensive and self-sufficient type of agriculture that had developed around Mission Santa Clara and the Pueblo was allowed to deteriorate. Large ranchos were established from land grants, and soon cattle and horse raising became the dominant agricultural pursuit of the Spanish and Mexican landowners.

After the annexation of California by the United States in 1848 many of the large land grants were gradually subdivided and sold to American settlers. The growing of hay and grain became the prin-

cipal agriculture on the valley floor, although small orchards and vineyards, many of which originated from the old Mission stock, were scattered among the fields.

Fruit growing on a commercial scale began in 1856 when Louis Pellier introduced from France the Petit Prune d'Agen, more commonly known as the French prune. Fruit-tree nurseries were established near San Jose, and orchards began to expand, although hay and grain were still the dominant crops for years.

The first dried prunes were shipped from the Area in 1867, when 500 pounds for eastern markets were sent around Cape Horn in a clipper ship. The completion of the transcontinental railroad gave the first great impetus to fruit growing and shipping. Other encouragements to fruit growing were the development of the canning industry, begun in the Area in 1871, and the development of refrigerated railroad cars for fresh fruit shipments. Shipment of fresh fruit began in 1875.

CROPS

At present the dominant agriculture of the Area and of Santa Clara County is the raising of fruit (pl. 3, *A*). Prunes, the chief crop, occupy more acreage than all other fruits combined and more acreage than any other group of crops, including hay and forage crops. Vegetables are also important; the county ranked fifth among the 51 counties in the State growing vegetables commercially in 1949 (pl. 3, *B*). The acreages of the principal crops in the county are given in table 5, and the number of fruit and nut trees and grapevines of bearing age in table 6. With increased use of land for industries and for dwelling houses, the number of fruit trees decreased sharply between 1940 and 1950.

TABLE 5.—*Acreages of the principal crops in Santa Clara County, Calif., in stated years*

Crop	1929	1939	1949
Small grains threshed or combined:			
Wheat	794	710	1,000
Oats	36	750	189
Barley	2,266	4,561	10,447
Hay, total [1]	31,523	27,863	22,491
Alfalfa	8,798	5,211	2,576
Clover or timothy	31	218	37
Grains cut green	17,518	16,626	18,563
Wild hay	1,068	3,230	717
Other hay [1]	4,108	2,578	598
Irish potatoes harvested for sale or home use	386	88	[2] 45
Corn	369	506	210
Sugar beets harvested for sugar	110	6,169	4,078
Vegetables harvested for sale	12,577	15,606	25,537
Strawberries and other small fruits harvested for sale	865	802	1,600

[1] Does not include sorghum hay.
[2] Does not include acres for farms with less than 10 bags harvested.

TABLE 6.—*Number of fruit and nut trees and grapevines of bearing age in Santa Clara County, Calif., in stated years*

Crop	1930	1940	1950
	Number	*Number*	*Number*
Apple trees	59, 237	35, 262	16, 099
Apricot trees	1, 368, 296	1, 344, 636	1, 231, 216
Cherry trees	127, 880	161, 448	183, 531
Fig trees	3, 641	19, 038	2, 377
Olive trees	3, 633	3, 636	4, 056
Peach trees	122, 719	50, 112	22, 751
Pear trees	610, 383	677, 524	638, 917
Plum and prune trees	5, 326, 074	4, 403, 626	3, 534, 733
Citrus trees	1, 935	3, 735	3, 756
Walnut trees	103, 139	194, 683	321, 167
Almond and other nut trees	14, 188	6, 228	9, 062
Grapevines	4, 044, 362	2, 976, 897	3, 019, 284

TREE FRUITS, NUTS, AND GRAPES

Tree fruits, nuts, and grapes are the most important crop group of the county and Area. The University of California maintains a fruit-tree field station about a mile south of Santa Clara, where research work, chiefly on disease and insect pests, is done.

Apples.—As shown in table 6, the number of apple trees in the county has been steadily decreasing for years. Apple production now is of relatively minor importance. The chief reasons for the decline have been market conditions and competition from other apple-producing sections.

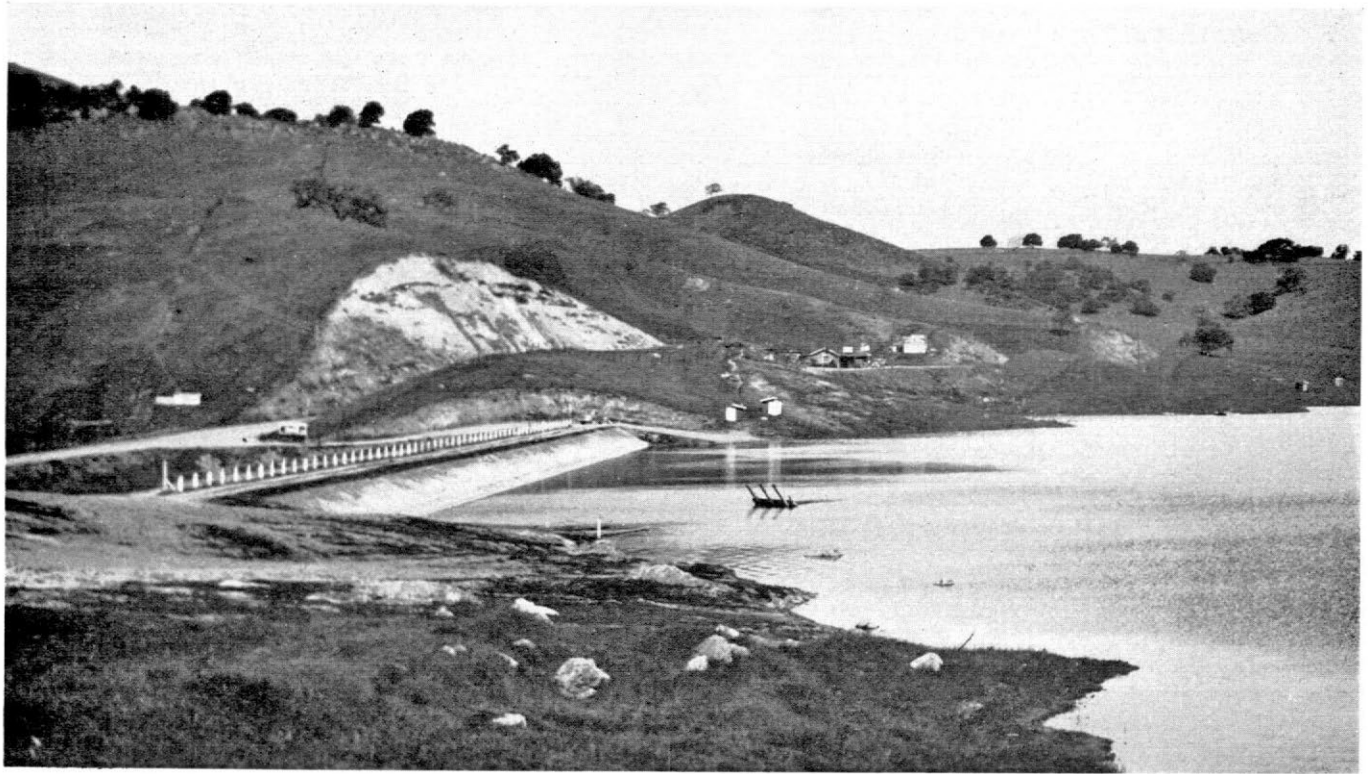
Most of the acreage of apples in the county is within the area surveyed. The orchards north of San Jose along Coyote Creek are irrigated. Those south of Los Gatos on the crest of the Santa Cruz mountains are not irrigated.

Chief varieties grown are White Pearmain, Newtown, and Astrachan, although a few acres each of Bellflower, Jonathan, Delicious, Gravenstein, Rome Beauty, and Winesap varieties also are grown. Most of the apples are marketed locally, although a few of the Astrachan variety are shipped to Los Angeles. Some of the crop is processed for juice. Normally trees are planted 80 to an acre.

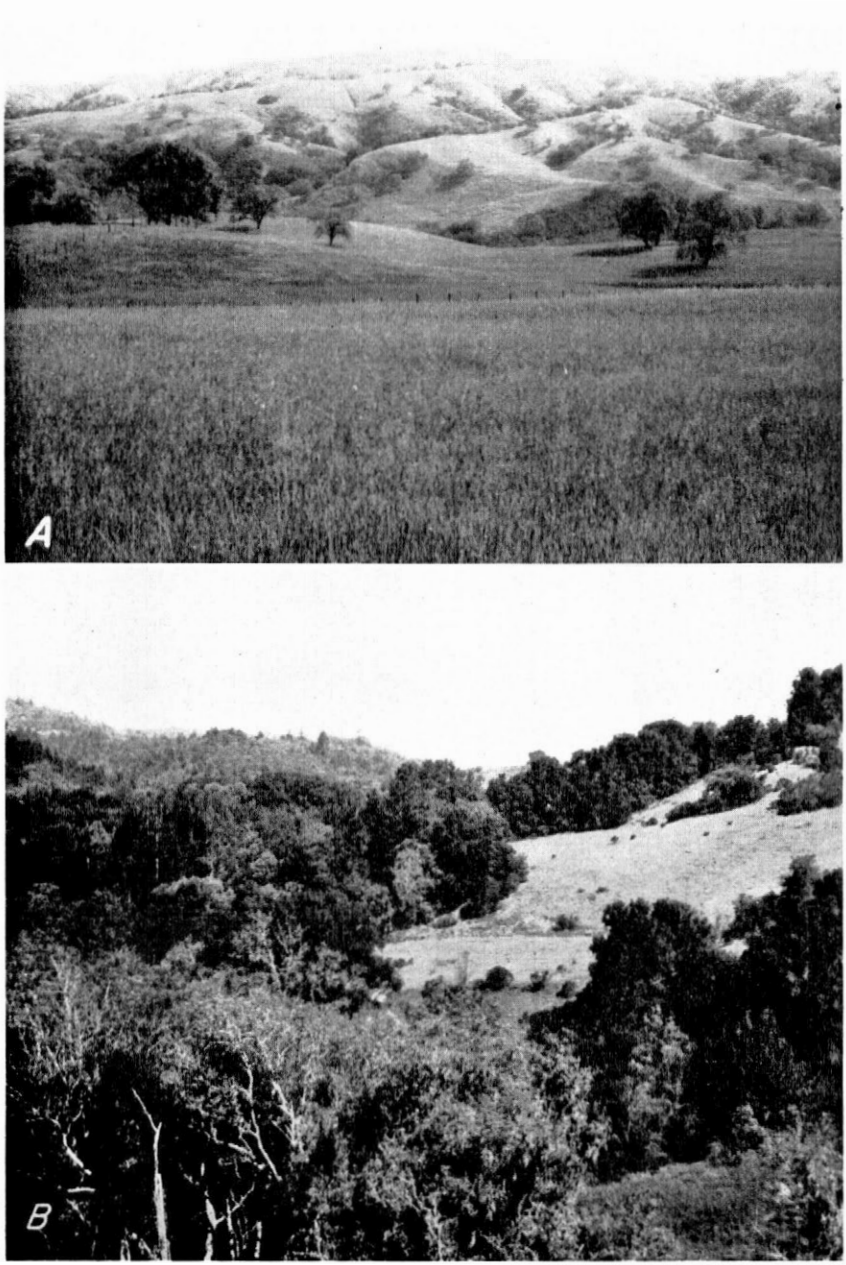
Codling moth is the principal pest, and some trees are carriers for blight. Arsenate of lead spray is generally used for control of codling moth. The tree is sprayed three to six times a season, beginning shortly before blossoming time and continuing until about a month before picking. An oil spray is sometimes applied in winter, and lime-sulfur spray is sometimes used in the spring.

A cover crop of grasses and weeds is allowed to grow in the orchard during late fall and in winter, and is turned under in the spring as soon as the soil is dry enough to cultivate. Where the orchard is irrigated, the contour-check system is generally used. Generally three irrigations are given (spring, summer, and fall), and from 8 to 10 acre-inches of water a season are used.

Apricots.—Santa Clara County ranks first in the United States in acreage of apricots. About three-fourths of the county acreage lies within the surveyed area. Because the climate and many of the soils



Part of Calero Reservoir; Vallecitos soils on hills. Water storage is necessary to maintain a water supply for irrigation.



A, Typical landscape south of Evergreen in the eastern part of the Area. Grain hay on Milpitas loam in foreground; upland of Vallecitos and Gaviota soils in background used for grazing.

B, Wooded Hugo soils; the natural cover of these soils was mainly redwood and Douglas-fir.

A, Orchard on Yolo loam. The deep Sorrento and Yolo soils are among the most productive in the Area.

B, Sorrento soils prepared for truck crops.

C, Vineyard on Pleasanton gravelly loam; Lone Hill in background. This soil is better suited for vines and orchard trees than for truck and field crops.

A, Typical use of the complex of Berryessa-Altamont clays; early spring peas in foreground, grain hay in middleground, and apricot trees in background.

B, Very steep and stony Gaviota soils suited only for range pasture. Dark areas are cloud shadows.

C, Typical landscape of dense brush-covered very steep and stony Maymen soils. These areas have no agricultural use and serve only as watershed.

of the Area are favorable for apricot production and markets are fairly good, the acreage increased rapidly until 1930 and has since maintained a high level.

The chief variety is Blenheim, but appreciable acreages of Royal, Moorpark, Hemskirke, and Tilton varieties also occur. Irrigated apricots are grown on the well-drained soils developed on alluvial fans; nonirrigated apricots are grown on soils of the uplands. Between 80 and 90 trees are planted to an acre. Harvest season is generally about the first of July, and average county yields vary from 3 to 5 tons (125 to 210 bushels) an acre. Most of the apricots produced are dried and nearly 25 percent are canned. Some apricots are sold fresh locally, and some fresh fruit is shipped to eastern markets. The United States is the largest consumer, although England buys a considerable part of the dried apricots.

Brown-apricot scale and black scale, twig borer, brown rot, bacterial canker, and oak-root fungus are the chief pests and diseases attacking apricot trees and fruit. Generally a dormant oil spray is applied in winter for control of scale insects. Some diseases are controlled by sprays containing a copper compound, generally bordeaux mixture. Copper sprays are generally applied in the spring at late red-bud stage. The use of resistant rootstocks (myrobolan) has proved somewhat effective in controlling oak-root fungus.

Many of the orchards are not systematically fertilized. Some, however, are fertilized with nitrates and superphosphates regularly every year or every other year. In irrigated sections a legume cover crop (horse beans, purple vetch, fenugreek, burclover, or melilotus) is generally allowed to grow in the fall and is turned under in spring. In some of the foothill sections, a natural cover of grasses and weeds is allowed to develop until spring and is then turned under. Where irrigation is practiced, normally one application of water is made in the spring and one in the fall, although after seasons of heavy rainfall the spring irrigation may be omitted. The check system of irrigation is usual, but in a few places the furrow system is employed. About 6 to 8 acre-inches of water are applied at each irrigation.

In irrigated districts the medium-textured soils of the Yolo, Sorrento, Cropley, and Zamora series, and Pleasanton loam, are very suitable for the growth of apricots. In the foothills or nonirrigated sections, clay or adobe clay types of the Berryessa, Azule, Los Gatos, Altamont, and Diablo series are the most suitable of the upland soils in the Area for this crop. Yields are considerably lower and more irregular on foothill soils than on irrigated areas. The climate of the foothill section, however, because of differences in air drainage, is warmer and more favorable to apricot production than many places on the valley floor.

Cherries.—Santa Clara County ranks second to San Joaquin County in the State and ninth in the United States in number of cherry trees. Most of these trees are within the area surveyed. The greatest cherry acreage in the county was reached at about the turn of the century, after which the bearing acreage declined until about 1930. Since then there has been a gradual increase almost to the earlier high level.

Royal Ann (Napoleon) is the chief variety, although appreciable acreages of Bing and Tartarian cherries also are grown in the Area. Most of the Royal Ann variety is canned; other varieties are sold

locally or shipped to Los Angeles or eastern markets. The cherry acreage within the Area occurs mostly on the recent alluvial fans of Penitencia, Los Gatos, and Stevens Creeks. Normally there are 70 trees to an acre. Cherries are harvested from the middle of May to the middle of July. Yield and quality vary chiefly according to climatic factors, particularly rain, while the crop is maturing.

In general there are no serious cherry diseases in the Area. A spray of Bordeaux mixture is used to some extent to control brown rot. Sulfur dusting at a late stage of cherry development is sometimes needed to control red-spider infestations. Occasionally bacterial gummosis, crown rot, or crinkle leaf becomes serious. The growing of legume cover crops during winter and early spring is general, but commercial fertilizers are applied regularly by few farmers. All of the important cherry orchards are irrigated, and practices are similar to those for apricots and prunes. Generally irrigations of 6 to 8 acre-inches are applied in spring, summer, and fall. Yolo loam, gravelly loam, and fine sandy loam, and Sorrento loam and gravelly loam are best suited for cherry production.

Peaches.—Peaches, at one time of considerable importance in the county, have rapidly decreased in acreage, mainly because of competition from other areas. Those that are now produced are mostly for local markets.

The principal type grown is freestone; Muir, J. H. Hale, and Crawford are the main varieties. Peak, Paloro, and Tuscan (Tuskena) are the main clingstone or canning varieties. General irrigation and cultural practices are very nearly the same as for other fruits, and many of the trees are mixed in orchards with apricots, cherries, or prunes. Bordeaux or lime-sulfur spray is frequently used to control curlyleaf.

In this area peaches need irrigation. The medium- and coarse-textured soil types of the Yolo, Mocho, and Sorrento series are best suited to peach production, although many other well-drained alluvial soils produce fair to good yields.

Pears.—In 1950 the county ranked second to Yakima County, Wash., in number of bearing and nonbearing pear trees. Most of these are within the survey area. The acreage of pears, especially of shipping varieties, in the county has been gradually increasing because of good markets.

About 60 percent of the pears grown are of the Bartlett variety, which is used chiefly for canning. The Hardy (Beurre Hardy) is the main shipping variety. Winter Nelis, Bosc (Beurre Bosc), and Comice (Doyenne du Comice) varieties are also grown. Fresh pears are shipped to the eastern United States, and also to England, France, and the Scandinavian countries. Some pear orchards are scattered throughout the fruit-growing sections, but by far the greatest concentration is on basin clays, on shallow phases of Mocho soils over basin clays, and on Campbell silty clay. Between 110 and 120 pear trees are planted to an acre. August is the harvest season for Bartletts, and September for the shipping varieties.

At first, pear blight did very little damage in the Area, but it is now the worst disease pear growers have to control. Control measures are severe, and at times an entire orchard must be cut down and burned to prevent the disease from spreading. If only parts of the trees are infected, the diseased places are painted with zinc chloride or the in-

fected parts are cut off with sterile instruments. Arsenate of lead spray is used for codling moth, lime-sulfur for blister mite, and foliage oil or sulfur dust for red spider.

Two methods of pear cultivation are usually practiced in the Area. One is similar to the general cultivation practices for other orchards. A cover crop is turned under in the spring, and the orchard is kept clean of weeds by disking until after harvesttime. Generally two irrigations by the check system are given before the crop is mature, and one after the fruit is picked in the fall. The other method consists of turning the cover crop under in the spring, forming irrigation checks, and then continuing irrigations without cultivation to stop weed growth. With this method four or five irrigations are made a year. Expense of irrigation water determines which method is used. About 6 acre-inches of water are applied at each irrigation.

Prunes.—For many years prunes have been the principal crop of the county and Area. Nearly nine-tenths of these prunes are of the French variety. Climate and many of the soils are well suited to production of prunes, but mainly because of unfavorable markets, the acreage has been decreasing since 1930. The French Sugar, and Imperial varieties are most commonly grown, but Burton, Sergeant, and others are also grown in the Area.

Prunes are grown throughout the cropland of the Area with or without irrigation, but mostly under irrigation on alluvial fans in the western and southwestern parts. Prune trees are often grown in mixed orchards. Between 80 and 90 trees are planted to an acre. Harvest season is in the early part of August. Nearly all the prune crop is dried, either by the sun or dehydrators, and some of the crop is canned. The United States is the largest market, but as much as 40 percent of the crop is shipped to Europe.

Oak-root fungus is the worst disease prune growers have to control. The fungus, *Armillaria mellea*, supposedly originates from infected roots of old oak trees that originally grew on the valley floor. The disease generally localizes itself to less than an acre, and infected areas are usually circular in form. In many prune orchards English walnuts on black walnut rootstock have been planted in these diseased spots. The black walnut rootstock is more resistant than the prune to the fungus. Control of the disease is difficult, but the use of a resistant rootstock (myrobalan) for prunes—a result of studies at the Deciduous Fruit Station—is having some success. The fungus not only attacks all common rootstocks of prunes, but also is a serious disease of other fruit trees.

Brown-apricot scale, black scale, and Italian pear scale are generally controlled by oil sprays applied in winter. Some spraying to kill eggs of the mealy plum-aphis is also generally done at this time. Sulfur dust is generally used for red spider and mites, and nicotine dust for thrips. Crown gall and diamond canker develop into important diseases in some places.

In a few orchards legume or mustard cover crops are planted, but most prune orchards are not fertilized or planted to cover crops. Weeds are allowed to grow during winter and spring, and this cover is turned under shortly before blossoming time. The orchards are kept clean of weeds until after the prunes are harvested. Prunes, unlike other orchard fruits, are harvested after they have fallen to

the ground. Shortly before they begin to drop, the soil is smoothed or "planked" to facilitate picking.

For best production in this Area prunes should be irrigated. Many areas are not irrigated, especially those on the foothills on both sides of the valley. On areas not irrigated, yields are generally light or the prunes are small if a heavy set develops. Where irrigation is practiced, two applications of water are normally made, one in the spring and one in the fall. After seasons of heavy rainfall, however, the spring irrigation is frequently omitted. The contour-check system is generally used, and 6 to 8 acre-inches of water are applied at each irrigation.

In irrigated localities the best yields of prunes are obtained from medium- or heavy-textured soil types of the Yolo, Sorrento, Mocho, Campbell, and Zamora series. Fair to good yields are obtained from the very extensive plantings on soils of the Pleasanton series. In upland sections the heavy-textured soils of the Berryessa, Altamont, Diablo, and Azule series are best suited to this crop.

Other tree fruits.—A few plums, olives, lemons, figs, and oranges are grown, but are of little commercial significance. There are also very small acreages of quinces, loquats, persimmons, avocados, nectarines, pomegranates, guavas, and limes.

Nuts.—English walnuts are the principal nuts grown in the county. Most of the acreage in this crop lies within the area surveyed. Because of favorable yields and good markets the acreage has been increasing.

Franquette and Payne are the main varieties, and Mayette, Eureka and Concord walnuts are also important. These are all late varieties and are harvested in October. About 27 mature trees grow on an acre. Practically all of the walnuts are on California black-walnut rootstock, although small acreages are seedlings. The crop is marketed in the United States, and some canned walnut kernels are exported.

Walnut blight, for which a spray of bordeaux mixture is generally used, is the principal disease. In some places crown-rot becomes serious, particularly during exceptionally wet seasons. Nicotine dust is frequently used for the walnut aphis. Cover crops, some of which are legumes, are turned under in the spring, and general cultivation practices are similar to those used for other orchard crops. Two or three irrigations a year are given, and about 6 acre-inches of water are applied at each irrigation. Medium-textured soils of the Yolo, Sorrento, Campbell, and Zamora series are best suited to walnut production, although other well-drained deep alluvial soils produce fair to good yields.

About 1900 there was an appreciable almond acreage in the county. As a result of competition from other sections, however, the acreage decreased until at present almonds are of little commercial significance. The acreages of chestnuts and filberts grown in the Area are very small.

Grapes.—About half of the vineyards of the county are within the area surveyed. More than 95 percent of the grapes grown in the county are used for making wine. The county ranks eighth in the State in acreage of wine grapes, but it is one of the foremost in the State in acreage of varieties used in the making of table wines (dry and natural sweet wines). Nearly all varieties of wine grapes are

grown in the county and Area. About 85 percent of the acreage consists of varieties used in making red or dark wines; Zinfandel, Carignane, and Mataro are the chief varieties, but there are also smaller acreages of Grenache, Mission, Alicante Bouschet, Petite Syrah, Pinot noir, and other varieties. Sauvignon Vert (Colombard), Palomino, Golden Chasselas, Franken Reisling (Sylvaner), Burger, Chardonnay, and other varieties are grown for making white wines. One of the important champagne-producing sections of the United States is within the Santa Clara Area.

Most of the acreage is in or near the hills in the southeastern, southern, and southwestern parts of the Area. Most cultivation practices are similar to those used in orchards. About a quarter of the acreage is irrigated, and generally only one irrigation is made in fall. A cover crop of weeds is turned under in spring. Harvest season is in September and October. Average yields from irrigated vineyards on alluvial fan soils differ considerably from those from unirrigated vineyards on upland soils. In general, yields may be 3 to 4 tons or more on the valley floor and 1 ton or less to 2 tons in upland sections. Between 650 and 800, usually about 680, vines are planted to an acre. No important diseases or insect pests affect vineyards in the Area. Rootstocks resistant to phylloxera have been used. In places nicotine dust is used to control grape leafhopper, and sulfur dust to control mildew.

In grape production for table wines, quality is more important than yield. Quality is determined largely by climate, exposure, and seasonal weather variations. Many of the finer varieties of wine grapes are grown on upland soils that produce only fair to poor yields, as compared to grape yields on many alluvial soils on the valley floor. In upland sections grapes are grown extensively on Los Gatos clay loam, Maymen loam, and Saratoga and Positas loams. On the valley floor most of the grapes are grown on Pleasanton loam and gravelly loam (pl. 3, *C*).

SPECIAL CROPS

Sugar beets.—At one time a considerable acreage in the county was used for growing sugar beets, but diseases, particularly curlytop, resulted in a large decrease in acreage. Since 1930, however, largely because of the development of varieties resistant to the curlytop disease, the acreage has increased. About one-third of this acreage is in the Santa Clara Area.

In 1949, sugar beets were grown on 4,078 acres. The crop is grown in many places but mostly on heavy-textured basin soils. Average county yields generally vary from 10 to 15 tons an acre, although yields within the Santa Clara Area are generally somewhat higher. All the acreage is irrigated. The crop is harvested in August, and most of it is shipped to Alvarado (Alameda County) for extraction and refining of the sugar.

Vegetables.—Vegetables rank second to fruits and nuts in importance and value in Santa Clara County. The acreage of vegetables is increasing. About three-fourths of the vegetables from the county are from the survey area. These crops are grown throughout the cropland of the Area, but the greatest acreage is north and northwest of San Jose. Three main groups of vegetables are produced in the

Area: Those grown for processing, those grown for eastern shipment, and those grown for local markets.

Tomatoes, spinach, and snap (string) beans are the chief vegetables grown for canning. About half of the total county acreage of tomatoes grows within the Area, and most of the crop is canned. The bulk of the tomato crop is harvested in September. All the acreage is irrigated, but only about a quarter is fertilized. Most of the spinach grown in the county is canned. Two crops are grown—an irrigated crop harvested in fall and a nonirrigated crop harvested in spring. A relatively small acreage is fertilized. Nearly all the snap beans grown in the county are grown in this Area, and the county leads the State in acreage of snap beans for canning. Two crops are grown—a nonirrigated one in spring and an irrigated one in fall. Other vegetables grown for processing are lima beans, which are fresh-frozen, cucumbers for pickles, and chili peppers.

Peas, broccoli, and cauliflower are the chief vegetables grown for eastern shipment. Two crops of peas are grown. The spring crop is not irrigated and is grown almost entirely on the hills in the eastern part of the Area (pl. 4, *A*). The fall pea crop is irrigated. Broccoli and cauliflower are winter crops. Broccoli is increasing in acreage. Some celery, sweet anise, and garlic are grown.

Nearly all kinds of vegetables, except artichokes and asparagus, are grown in the Area for home consumption or for local markets in San Jose and San Francisco. Many of the market or garden vegetables are grown on small acreages of the better alluvial soils. The soils are very intensively cultivated and highly fertilized. Two or three crops are frequently harvested from the same soil in a year, one crop being planted shortly after a previous crop has been harvested. Celery, snap beans, peas, broccoli, cauliflower, bell-peppers, lettuce, and cabbage are the chief market vegetables grown.

Small fruits.—Strawberries and raspberries are the principal small fruits grown in the county; others are blackberries and loganberries. Small fruits are intensively cultivated and are frequently grown on farms that produce market vegetables.

Other special crops.—Relatively small but important acreages of pricklypears (cactus pears or cactus fruits), a subtropical fruit, are grown in the eastern part of the Area. The crop grows mostly on medium-textured soils of the Sorrento and Campbell series, although some is on Clear Lake clay (adobe). Nearly all production is shipped fresh to eastern markets.

Many nurseries for the propagation of fruit trees, ornamental shrubs, and flowers are located in the Area. At one time the Area was one of the most important vegetable- and flower-seed producing sections in the State. Seed production on a commercial scale began in the Area about 1875, but since then other sections of the State principally Sacramento, Santa Barbara, and San Benito Counties, have taken the lead in this field. Prevalence of diseases in some seed crops and development of better locations for certain kinds of seeds caused this shift from the Santa Clara Area. At present vegetable seed, principally onion and lettuce, is almost the only commercial seed grown in the county, and most of the acreage lies outside the Area in the Gilroy section. Some salsify, mustard, sunflower, parsely, parsnips, carrots, and table beets are grown for seed. One seed firm has a breeding station for the improvement of vegetable seed.

CEREALS

Cereals or small grains grown for threshing were the most important crops of the Area before 1900. At present cereals are of minor importance in the county and are outranked by both fruits and vegetables. The principal cereal grown in 1879 was wheat, but since 1890 it has been barley. The grain is dry-farmed, chiefly on fine-textured or adobe soils north and northwest of San Jose.

HAY AND FORAGE CROPS

Hay and forage crops, supporting the dairy industry and supplementing range feed for beef cattle, have been important in the county for many years. According to the 1950 census, the hay crop acreage in Santa Clara County was 22,491, and about one-third of this lay within the Santa Clara Area. In spite of the acreage in forage and hay crops, not enough is produced to support the livestock in the Area. Considerable alfalfa hay is imported, mainly from the San Joaquin Valley.

Alfalfa.—Alfalfa is produced chiefly in the dairy section north and northwest of San Jose. It is grown mainly on irrigated soils of medium to fine texture that have developed in basin positions that have moderately restricted drainage. Only a little of the alfalfa is grown for hay; most of it is cut and fed green to dairy herds. Three or four cuttings a year are usually made, and annual yields range from 4 to 6 tons of hay an acre.

Grains cut green.—Grains cut green for hay (principally barley and red oats) are the chief forage crops of the county. These crops are grown mostly on heavy-textured or adobe soils in the northern and northwestern parts of the Area, and on clay types of the Berryessa, Altamont, and Diablo series on the hills in the eastern part. Grain hay is dry-farmed, and annual yields, particularly in the upland sections, vary somewhat with seasonal rainfall. Normal yields vary from 1 to 2 tons of hay an acre. Other hay and forage crops are chiefly wild oats (not cultivated), timothy, and clover.

WEEDS

Yellow star thistle (*Centaurea solstitialis*) and morning-glory (*Convolvulus arvensis*) are the chief weeds of economic importance in the Area. There are some areas of Klamath weed (*Hypericum claudestinum*) and puncturevine (*Tribulus terrestris*), and the county is sponsoring work to prevent their spread.

Some weeds are allowed to grow in orchards during the winter and early spring to act as a cover crop. These are mostly wild oats and other grasses, alfileria, burclover, Indianlettuce (undesirable), and wild mustard (sometimes planted). In some places mallow weed is included.

LIVESTOCK AND LIVESTOCK PRODUCTS

The numbers of livestock in Santa Clara County from 1930 to 1950 are listed in table 7. More than 80 percent of the dairy cattle in the county are in the area surveyed. Dairying is the chief livestock enterprise. Most of the dairy cattle are Holstein-Friesians, although there are some Jerseys and an increasing number of Guernseys. Most dairy

TABLE 7.—*Number of livestock on farms in Santa Clara County, Calif., in stated years*

Livestock	1930	1940	1950
	Number	*Number*	*Number*
Horses and colts	5, 204	[1] 3, 841	2, 710
Mules and mule colts	196	[1] 116	52
Cattle and calves	39, 587	[1] 39, 772	56, 802
Milk cows	[2] 15, 203	[2] 14, 865	16, 664
Sheep and lambs	2, 344	[3] 1, 340	1, 768
Goats and kids	725	[4] 366	754
Hogs and pigs	4, 592	[4] 11, 816	8, 418
Chickens	[1] 377, 417	[4] 308, 087	513, 185
Turkeys	8, 198	[4] 2, 887	3, 379
Beehives	1, 338	530	794

[1] Over 3 months old on April 1.
[2] Over 2 years old on January 1.
[3] Over 6 months old on April 1.
[4] Over 4 months old on April 1.

farms in the Area are north and northwest of San Jose, although there are a few near the hills in the southern and southeastern parts of the Area. Half of the forage for dairy herds is imported into the Area from the San Joaquin Valley; some dairy farms do not produce any of the forage consumed. In 1949 there were 150,349,743 pounds of whole milk sold. More than half of the milk produced is sold in San Francisco and Oakland as whole milk; the rest is sold locally as whole milk or as butterfat.

Production of beef cattle is important in the county. Most of the cattle ranches and grazing lands lie outside the Santa Clara Area in the mountains in the eastern part of the county, but a few cattle ranches are located in the eastern part. Grazing lands are mainly on soils of the Gaviota and Vallecitos series (pls. 2, *A*, and 4, *B*). Carrying capacity of the grazing land within the Area varies considerably but averages about 10 acres per animal unit per year. The need for supplemental feeding in July, August, or September depends on condition of the range grass and the livestock. The chief beef-cattle breed is Hereford, and many of the herds are maintained and improved by use of registered Hereford bulls.

The Santa Clara Area has long been well known for horse breeding. Trotting champions were bred in the early days on the Palo Alto stock farm, now the site of Stanford University. Other racing champions have been produced since then on various breeding and training farms in the Area. One farm specializes in thoroughbred stock and saddle horses. About one-third of the horses in the county are in the Area; many of them are saddle horses. There are numerous riding trails in the Santa Cruz Mountains and on the slopes of Alum Rock Canyon in the eastern part of the Area. Some of the horses and most of the mules in the Area are draft animals. They are used in the cultivation of peas, grapes, and other crops on steep slopes.

Poultry products rank second to dairy products in importance in the county. In 1949, 4,657,681 dozens of chicken eggs were sold in the county. Chickens, chiefly White Leghorns, are raised in many places in the Area, but mostly near San Jose. Turkeys, ducks, geese, and squabs are also raised in the Area.

Hogs and pigs are raised on a few specialized farms. Most of them are fed unused or partially spoiled fruit and other edible refuse from farms and cities.

LAND IN FARMS AND TYPES OF FARMS

Census statistics for farms and farmland in the county for stated years are given in table 8. The average size of farms in the county was about 111.5 acres in 1950. Only a very small part of the grazing land of the large cattle ranches in the county is included in the Area.

TABLE 8.—*Data on number, size, acreage, and tenure of farms in Santa Clara County, Calif., for stated years*

Item	1930	1940	1950
Number of farms in county	6, 237	5, 608	5, 282
Under 10 acres	1, 486	1, 357	1, 562
10 to 49 acres	3, 517	3, 060	2, 600
50 to 99 acres	613	597	527
100 to 259 acres	396	352	329
260 to 499 acres	103	120	125
500 to 999 acres	72	66	61
1,000 or more acres	50	56	78
Acreage in county	849, 920	835, 200	835, 200
Acreage in farms	516, 974	606, 800	588, 996
Percentage of county acreage in farms	60. 8	72. 7	70. 5
Average acreage per farm	82. 9	108. 2	111. 5
Farm tenure:			
Owner operated:			
Number	5, 196	4, 525	4, 591
Percent	83. 3	80. 7	86. 9
Tenant operated:			
Number	763	892	594
Percent	12. 2	15. 9	11. 3
Manager operated:			
Number	278	191	97
Percent	4. 5	3. 4	1. 8

The number of the principal types of farms in the county in 1950, as shown by the Federal Census, are given below.

Type of farm:	*Number*
Field-crop farms other than vegetable and fruit-and-nut	69
Vegetable farms	304
Fruit-and-nut farms	2,575
Dairy farms	158
Poultry farms	394
Livestock farms other than dairy and poultry	172
General farms	125
Miscellaneous and unclassified farms	1,485

Most of the fruit-and-nut farms are from 10 to 49 acres in size, but a considerable number are larger than 100 acres and a few are larger than 1,000 acres. Most of the livestock farms or ranches are more than 1,000 acres in size; several contain more than 10,000 acres.

There is very little diversity of agriculture within individual farms. Most fruit farms raise only fruit, and many specialize in a single kind of fruit. Likewise, other types of farms specialize almost completely in certain kinds of crops or livestock.

Wheel and caterpillar tractors are used almost exclusively in cultivation, and generally each farm has one or more trucks. About three-fourths of the farms employ hired labor at some time during the year.

SOIL SURVEY METHODS AND DEFINITIONS

Soil surveying (*24*) 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 underlying formations are examined systematically 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 distinct soil layers, or horizons, called collectively the soil profile. Each horizon of the soil, as well as the parent material beneath the soil, is studied in detail; and the color,[11] structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The reaction of the soil, and its content of lime and salts (alkali) are determined by simple tests. The drainage, both internal and external, and other features, such as the relief or lay of the land, are taken into consideration, and the interrelation of soils and vegetation is studied.

The soils are grouped into classification units on the basis of their characteristics. Special emphasis is given to those factors influencing the suitability of the land for crop plants, grasses, and trees. The principal grouping units are the *series*, the *type*, and the *phase*. In some places two or more of these principal units may be in such intimate or mixed pattern that they cannot be shown separately on a small-scale map but must be mapped as a *complex*. Areas of land, such as tidal marsh or riverwash, that have no true soil are called *miscellaneous land types*.

The *soil series* is a group of soils having the same genetic horizons, similar in their important characteristics and arrangement in the soil profile, and developed from similar parent material. Thus, the series is comprised of soils having about the same color, structure, and other important internal characteristics, and about the same natural drainage and general range in relief. The texture of the upper part of the soil, including that commonly plowed, may vary within a series. The soil series are given names of places or geographic features near which they were first found. Thus, Hugo, Altamont, Sorrento, and Yolo are names of important soil series in the Santa Clara Area.

Within a soil series are one or more *soil types* separated according to the texture of the upper part of the soil. Thus, 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, Altamont clay loam and Altamont clay are soil types within the Altamont series. Except for the texture of the surface soil, these soil types have approximately the same internal and external characteristics.

Phases of a soil type are variations within the type. They differ in

[11] Soil color terms used in this report conform to standards adopted by the Division of Soil Survey in 1946.

some characteristics (other than soil profile), that may be of practical signficance. Differences in relief, stoniness, degree of accelerated erosion, and depth to loose gravel 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, Ohmer clay loam, 10 to 20 percent slopes. Similarly, soils differing in degree of accelerated erosion may be separated into phases, for example, Ohmer clay loam, slightly eroded, 10 to 20 percent slopes.

The soil surveyor makes a map of the county or area, showing the location of each of the soil types, phases, complexes, and miscellaneous land types in relation to roads, houses, streams, lakes, and other local cultural and natural features of the landscape. In the Santa Clara Area, aerial photographs were used exclusively as a base for mapping. By far the larger part of the Area is covered by photographs at a scale of approximately 1:20,000 (nearly 3 inches to a mile), which were made under the direction of the Agricultural Adjustment Administration. A very small part of the Santa Cruz Mountains within the area surveyed is not covered by these photographs, but here United States Army photographs of scale approximately 1:40,000 (nearly 1½ inches to a mile) were used. Extensive use was also made of topographic quadrangles of the United States Geological Survey for names of places, streams, and mountains, and as an aid in studying relief and land forms.

See the glossary (p. 199) for definition of some of the terms that have a special meaning in soil surveying.

SOILS

Within the Santa Clara Area the relatively wide differences in climate, parent rock, relief, drainage, vegetation, and stage of soil development are reflected in the large number of soil units that are mapped in the Area. The Area covers one of the most productive deciduous fruit sections in the State. However, only about two-thirds of the Area is cultivated, as large areas of mountainous land were included in the survey. Most of the uncultivated sections occur in the Santa Cruz Mountains, where the soils support a dense cover of brush, trees and grass, or timber.

The soils of the Area fall naturally into four main groups based on physiographic position and parent soil materials: (1) Soils of the alluvial fans and flood plains, (2) soils of the basins, (3) soils of the terraces, and (4) soils of the uplands. A fifth group (5) consists of miscellaneous land types that have no natural soil. The relative positions of the soil groups and the relationship of principal crops of the Area to the soil groups are shown in figure 6.

The soils of groups 1 and 2 are the soils of the gently sloping valley floor. The most intensive agriculture is practiced on these soils, which comprise the irrigable land of the Santa Clara Area. The soils of group 3 have a typically undulating or rolling relief. Most of these soils are cultivated but not irrigated. The soils of group 4, which have a hilly or rough mountainous relief, are the most extensive in the Area.

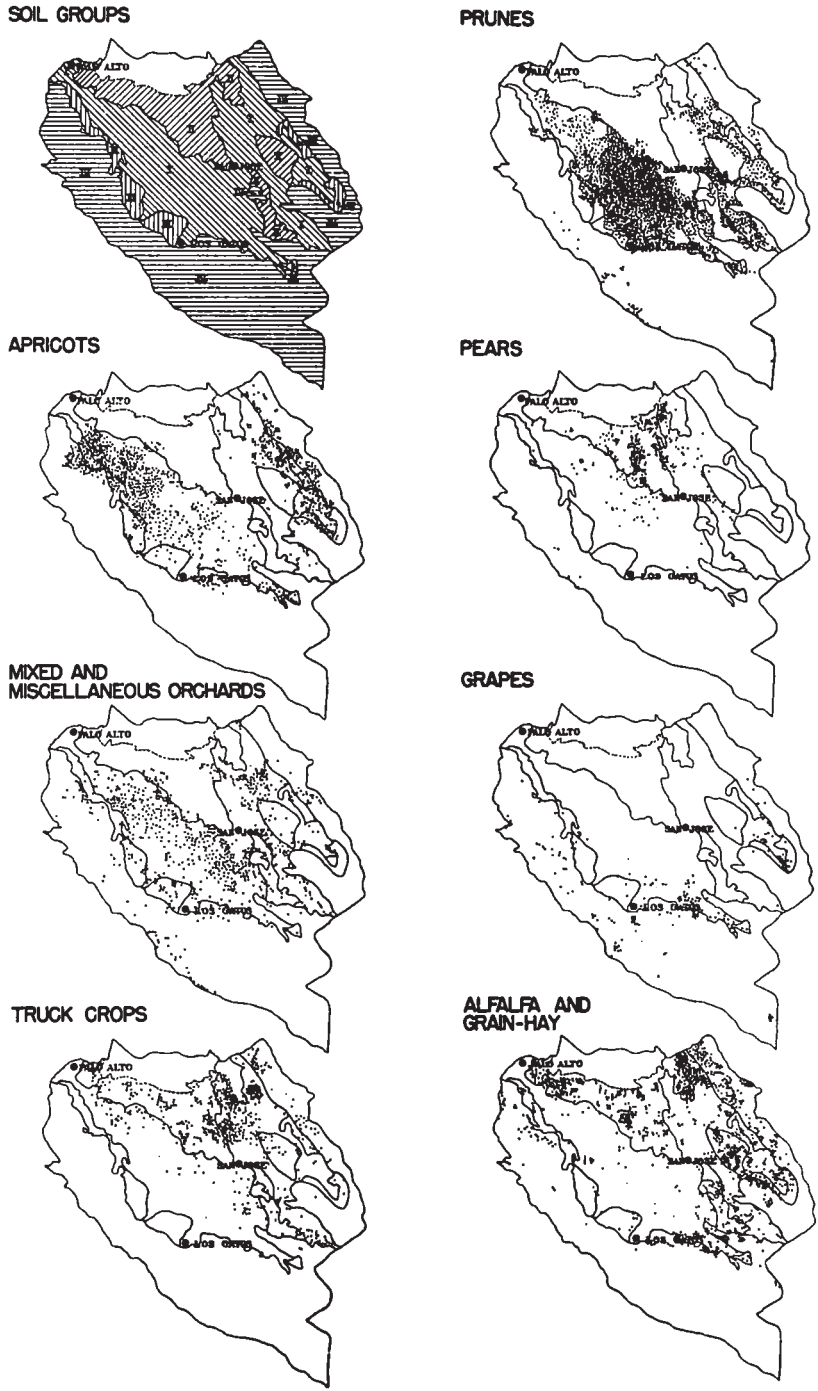


FIGURE 6.—Location of soil groups in the Santa Clara Area, and the location of principal crops at the time of the survey. Each dot represents 20 acres planted to a specified crop.

In many places they are cultivated, but the largest areas are uncultivated and have a natural cover of grass, brush, woodland, or timber (see section on vegetation). The soils of group 5 are able to support very little agriculture; most of them are entirely useless for cultivation. A cross section of the valley and the relationships of the soil groups and principal soil series to physiography are shown in figure 7.

SOIL SERIES AND THEIR RELATIONSHIPS

GROUP 1—SOILS OF THE ALLUVIAL FANS AND FLOOD PLAINS

Most of the deciduous fruits and a large part of the truck crops of the Area are grown on the soils of group 1. Most of these soils have developed on very gentle slopes (less than 3 percent) where subdrainage is good and the average annual rainfall is 15 to 30 inches.

In most of these soils that are intensively cultivated, plowpans or dense layers have formed at the depth of most frequent cultivation, generally 6 to 10 inches below the surface. Plowpans tend to hinder the penetration of roots and water. Usually a plowpan is the result of cultivating or disturbing the soil when too moist. This practice also tends to produce a hard cloddy tilth in fine-textured soils. Plowpans form very slowly, if at all, and good tilth can be produced if the soil is worked at the optimum moisture content.[12] Most plowpans may be broken up to some extent by subsoiling.

For convenience of discussion and because of important inherent differences in the soils, the soils of group 1 are divided into two subgroups: Soils of the recent alluvial fans and flood plains, and soils of the older alluvial fans. The soils of these two subgroups occupy about 156 square miles, or 32 percent of the survey Area.

SOILS OF THE RECENT ALLUVIAL FANS AND FLOOD PLAINS

This subgroup, soils of the recent alluvial fans and flood plains, has the most highly productive and intensively cultivated soils in the Area. The typical relief of these soils is smooth and very gently sloping (less than 3 percent slopes). A few places have slightly stronger slopes. Because of low rainfall, favorable slopes, and available water supply, most of the crops grown on these soils are regularly irrigated.

The soils have developed on deep, permeable, unconsolidated alluvium that originated mainly in areas of sandstone and shale rocks. The average annual rainfall varies from 15 to 20 inches. Differences in characteristics of the soil series of this group are caused by minor differences in parent material, in stage of development, and in drainage. Most of the soils had good drainage during development. At present, because of large-scale pumping in the valley, all of the soils are well drained.

The following soil series are in this subgroup: Yolo, Sorrento, Mocho, Zamora, Campbell, Dublin, Cropley, and Edenvale.

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[12] This optimum moisture content is very near the lower plastic limit of the soil, which is defined as the lowest moisture content at which threads of soil about one-half inch in length and one-tenth inch in diameter can be formed without crumbling by lightly rolling beneath the fingers. In other words, if a sample of soil when rolled to a long slender mass, breaks into pieces about one-half inch in length, the soil is near the best moisture content for cultivation.

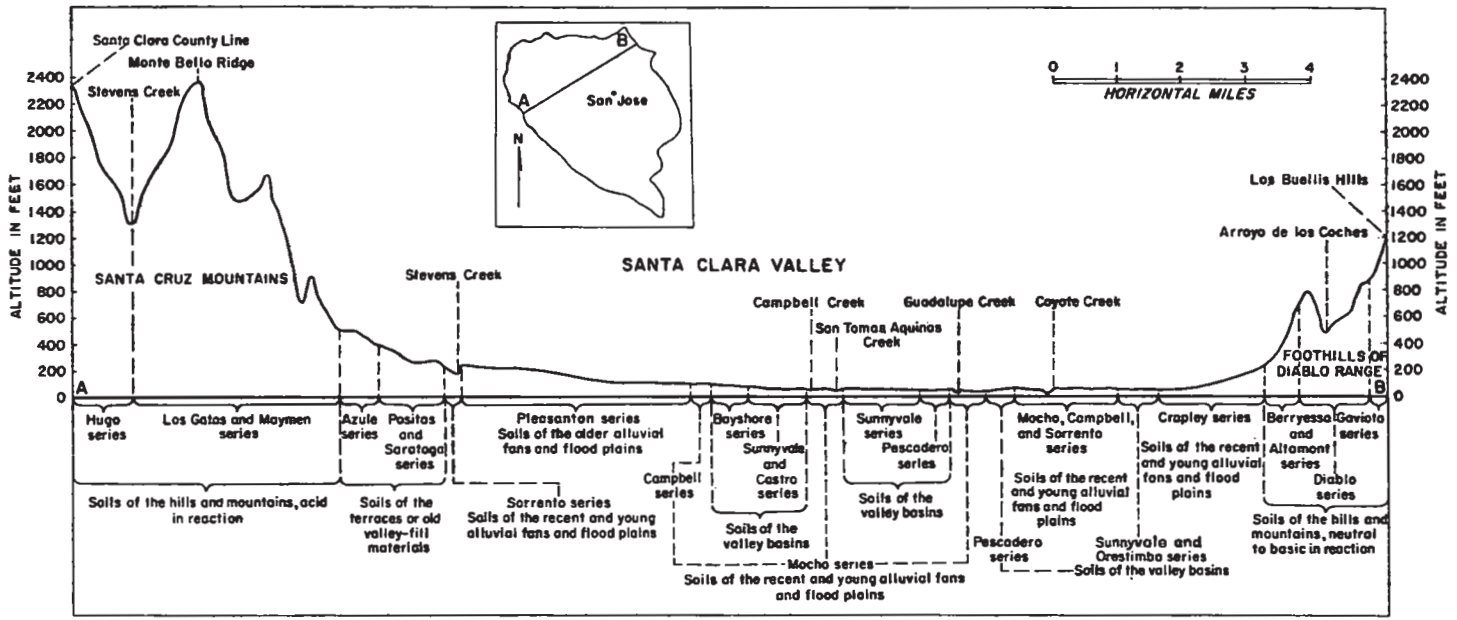


FIGURE 7.—Cross section of the Santa Clara Valley showing the relationship of soil groups and principal soil series to physiography. This hypothetical line passes from the junction of Santa Clara, Santa Cruz, and San Mateo Counties on the crest of the Santa Cruz Mountains to the crest of the Los Buellis Hills near the Laguna School.

Soils of Yolo, Sorrento, and Mocho series are brown and have practically no differentiation of profile layers. Those of the Zamora and Campbell series are also brown and have only slight differentiation of profile layers. Soils of the Campbell series are well drained at present but were developed under a somewhat restricted subdrainage. The Dublin and Cropley series consist of dark-gray or dark grayish-brown soils with only slight differentiation of profile layers. Soils of the Edenvale series are dark gray and have only slight differentiation of profile layers; they were derived from alluvium originating in areas of basic igneous rocks.

The soils of this subgroup occupy 112 square miles, or about 24 percent of the area surveyed.

In the reconnaissance soil survey of the San Francisco Bay region (*7*), soil series were given broader definitions than those now used. Soils of the Yolo, Sorrento, Mocho, Zamora, and Campbell series were classified as members of the Yolo series in the reconnaissance survey. Soils of the Dublin, Cropley, and Edenvale series were previously classified as Dublin.

SOILS OF THE OLDER ALLUVIAL FANS

This subgroup, soils of the older alluvial fans, includes a large part of the soils of the Area on which prunes, apricots, pears, and other fruits are grown. Typical slopes are moderately smooth (less than 3 percent), but near areas of entrenched stream channels the slopes are steeper and more eroded. Most of the gentle slopes are irrigated, but the more sloping areas are generally not irrigated.

These soils are on well-drained unconsolidated older alluvium that originated mainly in areas of sandstone and shale rocks. The average annual rainfall varies from 15 to nearly 30 inches. The characteristics of the soils vary because of small differences in parent material and in relief or position.

Only two soil series, the Pleasanton and San Ysidro, comprise this subgroup. The subsoil horizon of the San Ysidro series is more compact than that of the Pleasanton. Many soils originally classified as gravelly types of the Yolo series in the reconnaissance soil survey of the San Francisco Bay region have been reclassified as Pleasanton soils in this survey. Areas of the Corning soils near Los Altos have also been reclassified as Pleasanton soils. Some areas of the San Ysidro soils were originally classified with the Tehama series in the reconnaissance survey.

The soils of this subgroup occupy about 44 square miles, approximately 9 percent of the Area surveyed.

GROUP 2—SOILS OF THE BASINS

Soils of group 2, developed in basin positions or positions marginal to basin areas, occur most extensively in the low part of the valley extending from San Jose northward and northwestward to the tidal marsh of San Francisco Bay. They also occur in small isolated basins on the valley floor northwest of Evergreen and west of Edenvale. The soils of this group typically have smooth and nearly level relief (less than 0.5 percent in slope); and most of them are heavy textured. In the Santa Clara Area, field crops are grown principally on these soils.

Because of the relatively low rainfall, favorable slopes, and available water supply, most of the crops (except grain hay) are irrigated.

The soils are on deep, unconsolidated, finely divided alluvium that originated mainly in areas of sandstone and shale rocks. The average annual rainfall is about 15 inches. All of the soils have developed under various degrees of slow or very slow runoff and high groundwater levels. Such variability in drainage has produced the principal differentiating characteristics of the soils. Because of large-scale pumping for irrigation in the valley, most of these soils are now considerably better drained than they were under natural conditions. The alkali soils of the Area are part of this group of soils.

The Sunnyvale, Castro, Bayshore, Alamitos, Clear Lake, Pescadero, Orestimba, and Alviso series are in this group.

The Sunnyvale and Castro series consist of black soils that are calcareous throughout and have marly or lime hardpan subsoils. The Bayshore series consists of gray soils that are calcareous throughout. The soil of the Alamitos series is black; it is noncalcareous throughout or has very slightly calcareous subsoil. Soils of the Clear Lake and Pescadero series are dark gray or dark grayish brown and have calcareous subsoils; in places they contain alkali. Those of the Orestimba series are grayish brown, have calcareous subsoils, and contain alkali in places. The soil of the Alviso series is dark gray and borders areas of tidal marsh; it is calcareous throughout and normally contains large amounts of alkali.

The soils of group 2 occupy 55 square miles, or about 11 percent of the survey Area. These soils were originally greater in extent; but recent alluvial deposition has changed large areas of basin soils to shallow Mocho soils over basin clays.

In the reconnaissance soil survey of the San Francisco Bay region, all of the dark-gray and black soils of this group were classified in the Dublin series. The browner Orestimba and some areas of the Pescadero soils were included in the Yolo series.

GROUP 3—SOILS OF THE TERRACES

Soils of group 3 occur on terraces or old valley-fill materials on either side of the gently sloping valley floor. Usually the terrace soils lie between the more recent alluvial soils of the valley floor and the soils derived from bedrock of the hills and mountains.

The prevailing relief of these soils is rolling, although in many areas the relief is undulating, hilly, or even steep. Most of the soils have dense claypan subsoils, contain some gravel, and, except for the Hovey soils, are slightly or medium acid. Nearly all areas are cultivated, and because of slope, soil type, and cultural practices, all are eroded in various degrees. The parent material of these soils is old alluvial deposits that originated from sedimentary or metamorphosed sedimentary rocks. The characteristics of the soils of group 3, however, vary because of small differences in parent material and because of differences in stage of development of the soil profiles.

The following soil series comprise this group: Milpitas, Positas, Saratoga, Ohmer, Azule, and Hovey.

Soils of the Milpitas series are brown or pale brown and have dense clay subsoils. Those of the Positas series are brown to reddish brown and also have dense clay subsoils. The Saratoga series consists of

brown to reddish-brown gravelly soils that have moderately dense subsoils. The Ohmer series consists of dark grayish-brown soils that have dense subsoils. Soil of the Azule series is brown or pale brown and has moderately dense subsoil. The Hovey series consists of dark-gray or dark grayish-brown calcareous soils.

The soils of group 3 occupy about 35 square miles, or 7 percent of the survey Area.

In the reconnaissance soil survey of the San Francisco Bay region all soils of the terraces in this Area were classified in the Pleasanton and Corning series. These series have been redefined since the reconnaissance survey was made, and soils of the terraces now are classified in other series. The Pleasanton soils, as redefined, occur extensively in this Area, but there are no members of the Corning series as now defined.

GROUP 4—SOILS OF THE UPLANDS

Soils of the uplands occur extensively in the Santa Clara Area. Because of the wide variety of rocks and of marked differences in climate in upland sections of the Area, a relatively large number of different series are represented in group 4. Many places on the hills bordering the valley are cultivated, but most of these soils support a cover of grass, brush, woodland, or timber. The principal grazing areas are in these uplands. The predominant relief is hilly (slopes from 20 to 35 percent), but some areas of lesser slopes and large areas of steep or very steep slopes are included. The average annual rainfall on these soils varies from 15 to 45 inches.

The soils of this group are divided into two subgroups for convenience in discussion and classification. These subgroups are soils of the uplands, neutral to basic in reaction; and soils of the uplands, acid in reaction.

The soils of group 4 occupy about 219 square miles, or about 44 percent of the survey area.

SOILS OF THE UPLANDS, NEUTRAL TO BASIC IN REACTION

This subgroup contains all the soils derived from bedrock on the eastern hills and many of the soils on hills near the southern and western edges of the valley. These soils normally vary in reaction from pH 6.6 to 8.3. In most places the average annual rainfall is 15 to 25 inches. The original vegetation was mostly grass, woodland-grass, and brush. Hilly relief with smooth rounded slopes, is typical. In many places, however, the relief is rolling or steep. In many places these soils are cultivated, and various degrees of erosion have resulted.

The soil series in this subgroup are of the Altamont, Berryessa, Diablo, Ayar, Permanente, Gaviota, Vallecitos, Montara, Los Trancos, and Climax series.

The soils of this subgroup differ from one another mainly because of differences in parent bedrock material. The Altamont series, brown or grayish-brown soils with calcareous subsoils, is derived from well-consolidated sandstone and shale. The Berryessa series, brown or grayish-brown soils with calcareous subsoils, is derived from moderately or weakly consolidated sandstone and shale. The Diablo series, dark-gray soils with calcareous subsoils, is derived from sandstone and shale. The Ayar series, brown soils with calcareous surface

soils and subsoils, is derived from highly calcareous sandstone and shale. The Permanente series, brown stony shallow soils, is derived from limestone. The Gaviota series, grayish-brown or brown noncalcareous soils, is derived from well-consolidated sandstone and shale. The Vallecitos series, brown noncalcareous soils, is derived from metamorphosed sedimentary rock. The Montara series, dark grayish-brown noncalcareous stony shallow soils, is derived from basic igneous (serpentine) bedrock. The Los Trancos series, also grayish-brown or dark grayish-brown noncalcareous stony shallow soils, is derived from basic igneous rock (mainly diabase). The Climax series, dark-gray or dark grayish-brown soils with calcareous subsoils, is derived from basic igneous rock containing considerable serpentine.

In some places the soils of two series are so complexly associated that they cannot be separated on the map. In such places the soils are mapped as complexes.

The soils of this subgroup occupy nearly 75 square miles, or about 15 percent of the survey Area.

In the reconnaissance soil survey of the San Francisco Bay region the soils of the Altamont, Berryessa, Gaviota, and Vallecitos series on the eastern hills were all included in the Altamont series. Soils mapped as Climax in the earlier survey have been subdivided into the Climax and Los Trancos series. Areas of Diablo soils of the eastern part of the Area remain essentially unchanged. Soils of the Montara series were classed as undifferentiated stony soils in the reconnaissance survey. Areas of Permanente soils in the Santa Cruz Mountains were also included with the Altamont soils in the reconnaissance survey, but most of the soils of the Ayar series were not covered in the older reconnaissance survey.

SOILS OF THE UPLANDS, ACID IN REACTION

Most of the soils in the Santa Cruz Mountains within the Area are in this subgroup (soils of the uplands, acid in reaction). These are primary soils with a pH of less than 6.6. The average annual rainfall varies from 20 to 45 inches, but the most extensive soils of this subgroup occur under rainfall of 30 to 45 inches. The natural vegetation classifies as dense brush, woodland, or timber (see section on vegetation). Much of the area has very steep and stony slopes that permit little or no agriculture. Orchard fruits and wine grapes are grown in a few isolated places. The wine grapes, many of which are of choice stock, are probably of greatest importance. Where cultivated, these soils have eroded significantly, and some severely eroded areas on steeper slopes have been abandoned.

The soil series in this subgroup are the Cayucos, Soper, Los Gatos, Sobrante, Hugo, and Maymen.

These soils differ from one another mainly because of differences in bedrock, parent material, and climate. The Cayucos series consists of dark-gray soils derived from well-consolidated sandstone and shale. The Soper series consists of brown or light-brown soils derived from moderately or weakly consolidated conglomerate. The Los Gatos series, brown soils with brown to reddish-brown subsoils, is derived from metamorphosed sedimentary rock. The soil of the Sobrante series is brown, has a reddish-brown subsoil, and is derived mainly from highly metamorphosed basic rock. Soils of the Hugo series are pale brown or grayish brown and are derived from sandstone and shale. Those of

the Maymen series are light brown or pale brown and are derived from well-consolidated sandstone, shale, and conglomerate.

The soils of this subgroup occupy about 144 square miles, or 29 percent of the survey area.

In the reconnaissance soil survey of the San Francisco Bay region, nearly all the soils of the Santa Cruz Mountains within the Santa Clara Area were classified in the Altamont series. In the present survey these soils have been divided into the Hugo and Los Gatos series. In the reconnaissance survey, the Cayucos soils were included with the Diablo soils, and the Soper with the Pleasanton. Areas of Maymen soils were not covered by the older survey.

GROUP 5—MISCELLANEOUS LAND TYPES

Miscellaneous land types (group 5) consist of land that has been artificially made or radically changed by man, land where the natural soil has been completely removed, or land without a definite soil. Some of the land types are suitable for agriculture, but in all cases a natural soil is lacking. The following land types are mapped in this area: Riverwash, Made land (over Alviso soil material), Tidal marsh, Pits, and Kitchen middens. These land types, mostly tidal marsh, occupy about 15 square miles. The small part of San Francisco Bay within the Santa Clara Area, the salt concentration ponds associated with Tidal marsh and reservoirs cover about eleven additional square miles.

DESCRIPTIONS OF THE SOILS

In the following pages the soils of the Santa Clara Area are described in detail and their agricultural relationships and uses are discussed. The location and distribution of each soil are shown on the accompanying soil map. Important characteristics of the soils are listed briefly in the summary of soil characteristics that accompanies the soil map. The approximate acreage of each soil and its proportion to the total land of the county are given in table 9.

TABLE 9.—*Approximate acreage and proportionate extent of the soils mapped in the Santa Clara Area, Calif.*

Map symbol	Soil	Acres	Percent
Aa	Alamitos clay, 0 to 1 percent slopes	1,096	0.3
	Altamont clay (adobe):		
Ab	Slightly eroded 20 to 35 percent slopes	765	.2
Ac	Moderately eroded, 35 to 50 percent slopes	262	.1
Ad	Severely eroded, 35 to 50 percent slopes	93	(1)
	Altamont clay:		
Ae	20 to 35 percent slopes	670	.2
Af	Moderately eroded, 20 to 35 percent slopes	274	.1
Ag	Slightly eroded, 20 to 35 percent slopes	955	.3
Ah	Slightly eroded, 10 to 20 percent slopes	12	(1)
Ak	35 to 50 percent slopes	617	.2
Al	Moderately eroded, 35 to 50 percent slopes	83	(1)
Am	Altamont clay loam, 10 to 20 percent slopes	24	(1)
An	Alviso clay, 0 to 1 percent slopes	3,485	1.1

See footnote at end of table.

TABLE 9.—*Approximate acreage and proportionate extent of the soils mapped in the Santa Clara Area, Calif.*—Continued

Map symbol	Soil	Acres	Percent
	Ayar clay:		
Ao	Moderately eroded, 20 to 35 percent slopes	66	(1)
Ap	Slightly eroded, 20 to 35 percent slopes	92	(1)
Ar	10 to 35 percent slopes	457	0. 1
As	35 to 50 percent slopes	177	. 1
	Azule silty clay:		
At	20 to 35 percent slopes	369	. 1
Au	Moderately eroded, 20 to 35 percent slopes	890	. 3
Av	Slightly eroded, 20 to 35 percent slopes	1, 818	. 6
Aw	10 to 20 percent slopes	1, 165	. 4
Ax	Slightly eroded, 10 to 20 percent slopes	371	. 1
Ay	35 to 50 percent slopes	412	. 1
Az	Moderately eroded, 35 to 50 percent slopes	98	(1)
	Bayshore clay loam:		
Ba	3 to 5 percent slopes	42	(1)
Bb	1 to 3 percent slopes	1, 013	. 3
	Berryessa-Altamont clays:		
Bc	20 to 35 percent slopes	625	. 2
Bd	Moderately eroded, 20 to 35 percent slopes	4, 661	1. 5
Be	Slightly eroded, 20 to 35 percent slopes	1, 722	. 5
Bf	Slightly eroded, 10 to 20 percent slopes	115	(1)
Bg	Severely eroded, 35 to 50 percent slopes	41	(1)
Bh	Berryessa-Altamont gravelly clays, slightly eroded, 20 to 35 percent slopes	169	. 1
Ca	Campbell clay loam, 0 to 1 percent slopes	5, 032	1. 6
	Campbell silty clay:		
Cb	0 to 1 percent slopes	5, 514	1. 7
Cc	Over basin clays, 0 to 1 percent slopes	1, 172	. 4
Cd	Castro clay, 0 to 1 percent slopes	1, 367	. 4
Ce	Castro silty clay, 1 to 3 percent slopes	741	. 2
	Cayucos clay:		
Cf	20 to 35 percent slopes	800	. 3
Cg	Slightly eroded, 20 to 35 percent slopes	315	. 1
Ch	Slightly eroded, 10 to 20 percent slopes	392	. 1
	Cayucos clay loam:		
Ck	20 to 35 percent slopes	209	. 1
Cl	Slightly eroded, 10 to 20 percent slopes	58	(1)
Cm	Clear Lake clay (adobe), 0 to 1 percent slopes	3, 130	1. 0
	Climax clay (adobe):		
Cn	Moderately eroded, 20 to 35 percent slopes	537	. 2
Co	Slightly eroded, 10 to 20 percent slopes	259	. 1
	Cropley clay (adobe):		
Cp	3 to 6 percent slopes	723	. 2
Cr	Over Milpitas clay loam, 1 to 3 percent slopes	324	. 1
Cs	1 to 3 percent slopes	2, 989	. 9
	Cropley clay loam:		
Ct	3 to 6 percent slopes	328	. 1
Cu	Over Milpitas clay loam, 3 to 6 percent slopes	83	(1)
Cv	1 to 3 percent slopes	725	. 2
	Cropley gravelly clay loam:		
Cw	3 to 6 percent slopes	72	(1)
Cx	1 to 3 percent slopes	147	(1)
	Diablo clay:		
Da	Moderately eroded, 20 to 35 percent slopes	1, 406	. 4
Db	Slightly eroded, 20 to 35 percent slopes	1, 145	. 4
Dc	Severely eroded, 35 to 50 percent slopes	28	(1)

See footnote at end of table.

TABLE 9.—*Approximate acreage and proportionate extent of the soils mapped in the Santa Clara Area, Calif.*—Continued

Map symbol	Soil	Acres	Percent
	Diablo clay loam:		
Dd	Moderately eroded, 20 to 35 percent slopes	204	0.1
De	Slightly eroded, 20 to 35 percent slopes	132	(1)
Df	35 to 50 percent slopes	56	(1)
	Dublin clay (adobe):		
Dg	3 to 6 percent slopes	204	.1
Dh	1 to 3 percent slopes	1,017	.3
	Dublin clay loam:		
Dk	3 to 6 percent slopes	103	(1)
Dl	1 to 3 percent slopes	411	.1
	Edenvale clay (adobe):		
Ea	3 to 6 percent slopes	144	(1)
Eb	1 to 3 percent slopes	572	.2
Ec	Pits	545	.2
	Gaviota gravelly loam:		
Ga	20 to 35 percent slopes	262	.1
Gb	Moderately eroded, 20 to 35 percent slopes	81	(1)
Gc	35 to 50 percent slopes	763	.2
	Gaviota loam-Altamont clay loam:		
Gd	20 to 35 percent slopes	557	.2
Ge	Moderately eroded, 20 to 35 percent slopes	321	.1
Gf	35 to 50 percent slopes	389	.1
Gg	Moderately eroded, 35 to 50 percent slopes	74	(1)
Gh	Severely eroded, 35 to 50 percent slopes	279	.1
	Gaviota loam:		
Gk	20 to 35 percent slopes	1,054	.3
Gl	Moderately eroded, 20 to 35 percent slopes	175	.1
Gm	Slightly eroded, 20 to 35 percent slopes	2,496	.8
Gn	35 to 50 percent slopes	1,397	.4
Go	Moderately eroded, 35 to 50 percent slopes	152	(1)
Gp	Gaviota stony soils, undifferentiated, 50+percent slopes	2,523	.8
Gr	Gaviota stony loam-Ayar stony clay, 20 to 35 percent slopes	71	(1)
Gs	Gaviota stony loam, 20 to 35 percent slopes	35	(1)
	Hovey clay:		
Ha	10 to 20 percent slopes	151	(1)
Hb	Slightly eroded, 10 to 20 percent slopes	152	(1)
	Hugo clay loam:		
Hc	Slightly eroded, 20 to 35 percent slopes	483	.2
Hd	Moderately eroded, 10 to 20 percent slopes	174	.1
He	Slightly eroded, 3 to 20 percent slopes	198	.1
	Hugo loam:		
Hf	Moderately eroded, 20 to 35 percent slopes	649	.2
Hg	Slightly eroded, 20 to 35 percent slopes	738	.2
Hh	Moderately eroded, 10 to 20 percent slopes	238	.1
Hk	Severely eroded, 35 to 50 percent slopes	193	.1
Hl	Slightly eroded, 3 to 20 percent slopes	535	.2
	Hugo sandy loam:		
Hm	Moderately eroded, 20 to 35 percent slopes	159	.1
Hn	Severely eroded, 10 to 20 percent slopes	99	(1)
Ho	Slightly eroded, 10 to 20 percent slopes	49	(1)
Hp	Hugo soils, undifferentiated, 35+percent slopes	11,788	3.7
Hr	Hugo stony soils, undifferentiated, 50+percent slopes	4,379	1.4
Ka	Kitchen middens	71	(1)

See footnote at end of table.

TABLE 9.—*Approximate acreage and proportionate extent of the soils mapped in the Santa Clara Area, Calif.*—Continued

Map symbol	Soil	Acres	Percent
	Los Gatos clay loam:		
La	20 to 35 percent slopes	1,968	0.6
Lb	Moderately eroded, 20 to 35 percent soples	469	.1
Lc	Slightly eroded, 20 to 35 percent slopes	1,593	.5
Ld	Slightly eroded, 10 to 20 percent slopes	552	.2
Le	Severely eroded, 35 to 50 percent slopes	312	.1
Lf	Los Gatos-Maymen stony soils, undifferentiated, 50+ percent slopes	46,123	14.6
Lg	Los Trancos stony clay, 10 to 35 percent slopes	529	.2
Ma	Made land (over Alviso soil material)	166	.1
	Maymen loam:		
Mb	Severely eroded, 20 to 50 percent slopes	771	.2
Mc	Moderately eroded, 20 to 35 percent slopes	458	.1
Md	Slightly eroded, 10 to 35 percent slopes	731	.2
Me	Maymen stony soils, undifferentiated, 50+ percent slopes	13,476	4.3
Mf	Milpitas clay loam, 3 to 10 percent slopes	616	.2
	Milpitas loam:		
Mg	3 to 10 percent slopes	823	.3
Mh	Slightly eroded, 10 to 20 percent slopes	983	.3
	Mocho clay loam:		
Mi	Over basin clays, 0 to 1 percent slopes	3,895	1.2
Mj	Over Cropley and Campbell soils, 1 to 3 percent slopes	1,223	.4
Mk	1 to 3 percent slopes	465	.1
Ml	Mocho fine sandy loam, over basin clays, 0 to 1 percent slopes	193	.1
Mm	Mocho gravelly loam, 1 to 3 percent slopes	106	(1)
	Mocho loam:		
Mn	Over basin clays, 0 to 1 percent slopes	805	.3
Mo	Over Campbell and Cropley soils, 1 to 3 percent slopes	726	.2
Mp	Over Cropley and Zamora clay loams, 3 to 6 percent slopes	134	(1)
Mq	1 to 3 percent slopes	2,009	.6
Mr	Mocho sandy loam, over basin clays, 0 to 1 percent slopes	233	.1
Ms	Mocho soils, undifferentiated, 1 to 3 percent slopes	924	.3
Mt	Montara clay, slightly eroded, 20 to 35 percent slopes	160	.1
Mu	Montara clay loam, slightly eroded, 20 to 35 percent slopes	162	.1
Mv	Montara stony soils, undifferentiated, 35+ percent slopes	4,691	1.5
Mw	Montara stony clay-Climax clay (adobe), 20 to 35 percent slopes	2,314	.7
Mx	Montara stony clay, 10 to 35 percent slopes	4,959	1.6
	Montara stony clay loam:		
My	20 to 35 percent slopes	1,410	.4
Mz	10 to 20 percent slopes	328	.1
	Ohmer clay loam:		
Oa	3 to 10 percent slopes	125	(1)
Ob	Slightly eroded, 20 to 35 percent slopes	74	(1)
Oc	10 to 20 percent slopes	260	.1
Od	Slightly eroded, 10 to 20 percent slopes	581	.2
Oe	Ohmer gravelly clay loam, 3 to 10 percent slopes	110	(1)

See footnote at end of table.

TABLE 9.—*Approximate acreage and proportionate extent of the soils mapped in the Santa Clara Area, Calif.*—Continued

Map symbol	Soil	Acres	Percent
Of	Orestimba clay loam, 0 to 1 percent slopes	2,563	0.8
Og	Orestimba silty clay loam, 0 to 1 percent slopes	3,898	1.2
Pa	Permanente stony soils, undifferentiated, 50+ percent slopes	635	.2
Pb	Permanente stony loam, slightly eroded, 20 to 35 percent slopes	64	(1)
Pc	Pescadero clay (adobe), 0 to 1 percent slopes	931	.3
Pd	Pescadero clay, 0 to 1 percent slopes	1,132	.4
	Pleasanton clay loam:		
Pe	3 to 6 percent slopes	499	.2
Pf	1 to 3 percent slopes	2,379	.8
Pg	Pleasanton gravelly clay loam, 1 to 3 percent slopes	919	.3
	Pleasanton gravelly loam:		
Ph	Gently sloping, 3 to 8 percent slopes	740	.2
Pk	Moderately eroded, 20 to 35 percent slopes	88	(1)
Pl	20 to 30 percent slopes	91	(1)
Pm	Undulating, 3 to 10 percent slopes	1,399	.4
Pn	Slightly eroded, 8 to 20 percent slopes	164	.1
Po	1 to 3 percent slopes	13,794	4.4
	Pleasanton loam:		
Pp	Cobbly subsoil, 1 to 3 percent slopes	399	.1
Pr	3 to 10 percent slopes	1,049	.3
Ps	1 to 3 percent slopes	5,622	1.8
	Positas-Saratoga gravelly loams:		
Pt	10 to 20 percent slopes	62	(1)
Pu	Moderately eroded, 10 to 20 percent slopes	88	(1)
	Positas-Saratoga loams:		
Pv	3 to 10 percent slopes	659	.2
Pw	Slightly eroded, 10 to 20 percent slopes	2,479	.8
Px	Slightly eroded, 3 to 10 percent slopes	432	.1
Ra	Riverwash	235	.1
Sa	San Ysidro clay loam, 1 to 2 percent slopes	74	(1)
Sb	San Ysidro loam, 1 to 2 percent slopes	2,859	.9
	Saratoga-Positas loams:		
Sc	Deep, slightly eroded, 3 to 10 percent slopes	271	.1
Sd	Deep, slightly eroded, 10 to 20 percent slopes	558	.2
Se	3 to 10 percent slopes	247	.1
Sf	Moderately eroded, 20 to 35 percent slopes	779	.2
Sg	Slightly eroded, 20 to 35 percent slopes	421	.1
Sh	10 to 20 percent slopes	252	.1
Sk	Slightly eroded, 10 to 20 percent slopes	717	.2
Sl	Sobrante clay, slightly eroded, 10 to 35 percent slopes	823	.3
	Soper gravelly loam:		
Sm	20 to 35 percent slopes	242	.1
Sn	Moderately eroded, 20 to 35 percent slopes	326	.1
So	35 to 50 percent slopes	825	.3
	Sorrento clay loam:		
Sp	Over Sunnyvale clay, 0 to 1 percent slopes	250	.1
Sr	1 to 3 percent slopes	10,287	3.3
Ss	Sorrento fine sandy loam, 1 to 3 percent slopes	121	(1)
St	Sorrento gravelly loam, 1 to 3 percent slopes	1,302	.4
Su	Sorrento loam, 1 to 3 percent slopes	4,247	1.3
Sv	Sorrento silt loam, 1 to 3 percent slopes	697	.2
Sw	Sorrento silty clay loam, 0 to 2 percent slopes	2,980	.9
Sx	Sunnyvale clay, 0 to 1 percent slopes	16,950	5.4
Sy	Sunnyvale clay loam, 0 to 1 percent slopes	354	.1
Ta	Tidal marsh	6,205	2.0

See footnote at end of table.

TABLE 9.—*Approximate acreage and proportionate extent of the soils mapped in the Santa Clara Area, Calif.*—Continued

Map symbol	Soil	Acres	Percent
	Vallecitos clay loam:		
Va	20 to 35 percent slopes	3,308	1.0
Vb	Moderately eroded, 20 to 35 percent slopes	453	.1
Vc	Slightly eroded, 20 to 35 percent slopes	95	(1)
Vd	Slightly eroded, 10 to 20 percent slopes	29	(1)
Ve	35 to 50 percent slopes	2,450	.8
Vf	Severely eroded, 35 to 50 percent slopes	87	(1)
	Vallecitos loam:		
Vg	Slightly eroded, 20 to 35 percent slopes	269	.1
Vh	35 to 50 percent slopes	126	(1)
Ya	Yolo clay loam, 1 to 3 percent slopes	5,927	1.9
Yb	Yolo fine sandy loam, 1 to 3 percent slopes	953	.3
Yc	Yolo gravelly fine sandy loam, 1 to 3 percent slopes	758	.2
Yd	Yolo gravelly loam, 1 to 3 percent slopes	2,117	.7
	Yolo loam:		
Ye	3 to 6 percent slopes	329	.1
Yf	Over Clear Lake clay, 0 to 1 percent slopes	138	(1)
Yg	1 to 3 percent slopes	3,462	1.1
	Zamora clay loam:		
Za	3 to 6 percent slopes	705	.2
Zb	1 to 3 percent slopes	4,565	1.4
	Zamora gravelly clay loam:		
Zc	3 to 6 percent slopes	291	.1
Zd	Over San Ysidro clay loam, 1 to 3 percent slopes		(1)
Ze	1 to 3 percent slopes	4,681	1.5
Zf	Zamora silty clay loam, 1 to 3 percent slopes	3,922	1.2
	Levee	2,059	.7
	Salt concentration pond	2,779	.9
	Tidal flats	1,477	.5
	Water	3,225	1.0
	Total	315,878	100.0

[1] Less than 0.05 percent.

ALAMITOS SERIES

The soils of the Alamitos series developed in very poorly drained basin positions under an average annual rainfall of about 15 inches. The soils occur most typically in basin areas south of the Lick Hills. These areas originally were fresh-water tule marshes. They were drained by a ditch that empties into Cincas Creek, but since the general lowering of the ground-water level in this area through pumping for irrigation, the drainage ditch is necessary only in years of exceptionally high rainfall. The parent material of the Alamitos soils consists of finely divided alluvial material originating mainly in areas of sandstone and shale rocks.

The surface soils are black, high in organic matter, fine textured, firm, noncalcareous, and neutral to slightly basic in reaction (pH 7.0 to 7.8). They grade quickly into gray or light-gray massive noncalcareous or very slightly calcareous subsoils of clay texture. The reaction is neutral or slightly basic, and the pH ranges from 7.0 to 8.0. The subsoils are slowly permeable to water and fairly uniform to

depths of 6 or more feet. Rust-brown and bluish or greenish mottlings, characteristic of poorly drained soils, occur in the lower subsoils. During the winter months, ground-water level or saturation of the soil is in most places within 6 feet of the surface.

The Alamitos soils normally lie at slightly lower elevations than the associated Sunnyvale soils. They differ from the Sunnyvale soils mainly in having developed under poorer drainage and in having noncalcareous surface soils and noncalcareous or only slightly calcareous subsoils. The Alamitos soils are also similar in some respects to soils of the Sacramento series, mapped mainly in the Sacramento Valley. The Alamitos soils occupy about 1½ square miles.

Alamitos clay, 0 to 1 percent slopes (AA).—The surface soil is a black, noncalcareous, neutral or slightly basic firm clay that varies in depth from 11 to 17 inches. Although the soil is of clay texture, it is fairly easily worked. If cultivation is done carefully at the proper moisture content, a good seedbed can be produced. On drying in an undisturbed state, the soil breaks to large, more or less angular blocks. Near or at the surface a fine blocky structure generally develops from secondary cracking. The surface soil grades rapidly into a gray or light-gray noncalcareous or very slightly calcareous massive subsoil of clay texture. The subsoil is highly mottled with rust-brown stains, and normally some bluish or greenish mottlings are also present. The subsoil is fairly uniform to a depth of 6 feet, and various characteristics indicate it was formerly water-saturated throughout the year.

Although most areas of this soil have been drained either by ditches or a lowering of the ground-water level through pumping, even at the present time the soil is saturated in some places within 6 feet of the surface.

Alamitos clay, 0 to 1 percent slopes, is the only soil of the Alamitos series recognized in the survey Area. The largest body of it occurs south of the Lick Hills. South of Santa Clara and east of the County Hospital are small areas of a different but closely similar soil. The soil in these areas is coarser textured and slightly gravelly.

Except for residential or industrial areas, all of the Alamitos soil is cultivated. Grain hay, sugar beets, and truck crops are the principal crops grown, although there are small acreages of prunes, pears, and walnuts. The soil is best suited to shallow-rooted crops, and good or excellent yields of grain hay, sugar beets, and some truck crops are obtained. The soil is not well suited to deep-rooted crops, and yields and tree growth of prunes, pears, and walnuts are generally poor.

ALTAMONT SERIES

Soils of the Altamont series occur mostly on hills where the average annual rainfall is about 20 inches. The original vegetation was mainly grasses, oaks near drainageways and extending upward on north slopes for short distances, and brush on some of the steeper slopes. Except for a few steep slopes, most of the soils have been or are now under cultivation. The soils have a hilly relief (20 to 35 percent slopes), but some areas are rolling or steep. Erosion has occurred in a number of places where the soils are cultivated.

The surface soils are brown or grayish brown, generally fine textured, and normally neutral or slightly acid in reaction (pH 6.1 to 7.3).

The soils crack to a coarse blocky structure, which in the very fine-textured soils is typical of adobe structure. The surface soils overlie brown or grayish-brown fine-textured upper subsoils that are also normally neutral or slightly acid in reaction. The upper subsoils crack to a weak prismatic structure, and generally the structural units are coated with some colloidal material. The upper subsoils grade into brown or lighter grayish-brown, calcareous, fine-textured lower subsoils of basic reaction (pH 7.4 to 8.3). Lime is usually segregated in small soft masses and along small tubular pores. Fragments of bedrock are common in the lower subsoils; the fragments increase in number and size with depth. The bedrock is well-consolidated shale or fine-grained sandstone that contains some lime in cracks and seams.

The Altamont soils are associated with soils of the Diablo, Gaviota, and Berryessa series. The Diablo soils are dark gray; the Gaviota soils are typically shallower and noncalcareous; and the Berryessa soils differ primarily in the softer consolidation of the bedrock parent material. In many places the Altamont soils occur in such close association with the Berryessa or Gaviota soils that they are mapped as complexes. Soils of the Altamont series occupy about 5½ square miles in this Area.

Altamont clay loam, 10 to 20 percent slopes (Am).—This phase is on a few small isolated hills near the edge of the valley floor. The surface soil is a grayish-brown slightly acid medium blocky clay loam that varies in depth from 6 to 14 inches. It grades into a similar-colored or slightly browner clay loam or light clay subsoil of basic reaction. The subsoil rests on partially decomposed fine-grained sandstone at depths of 18 to 30 inches. Normally some lime occurs in the lower subsoil and in seams or along cracks in the bedrock.

All of the soil is cultivated. Grain hay is the principal crop, and there are some orchards. Yields are fair.

Altamont clay, 20 to 35 percent slopes (Ae).—The surface soil is a grayish-brown slightly acid clay that varies in depth from 8 to 13 inches. On drying in an undisturbed state, this soil cracks to a coarse blocky structure of hard consistence. The surface soil grades into a brown or grayish-brown noncalcareous upper subsoil of clay texture and weak prismatic structure. Some colloidal coating is present along small tubular pores and cracks. At depths of 13 to 23 inches the upper subsoil grades into a brown or yellowish-brown calcareous clay lower subsoil that generally contains some fragments of bedrock. Lime is segregated in small soft masses and along tubular pores. Partially decomposed shale or fine-grained sandstone bedrock normally occurs at depths of 20 to 35 inches. Lime is in the bedrock, in seams or along cracks. Profile characteristics of Altamont clay, 20 to 35 percent slopes, are somewhat variable because of localized differences in parent material and slope.

Noneroded areas of this soil occur on the Santa Teresa Hills and other hills in the southern part of the Area. East of the Calero Reservoir this soil joins an area classified as Rough mountainous land in the Gilroy Area (*5*). None of the soil is cultivated. The vegetation is largely grasses, trees, and brush. The soil is used for grazing, and the carrying capacity is fair to good, depending on the season.

Altamont clay, slightly eroded, 20 to 35 percent slopes (AG).—These areas of Altamont clay are similar to the Altamont clay previously described except that sheet erosion has caused the surface soil to be shallower and in a few places calcareous.

This soil is mapped on the hills in the eastern and southern parts of the Area. Southeast of Evergreen the soil is more nearly of clay loam texture. All of the soil has been or is now under cultivation. Apricots, prunes, and grain hay are the principal crops. Yields of fruits are poor, but the quality is frequently good. Yields of grain hay are fairly good. Erosion control measures are required for proper cultivation. Some areas are used for grazing.

Altamont clay, moderately eroded, 20 to 35 percent slopes (AF).—Small areas of this soil are mapped in association with other phases of Altamont clay. Except for differences caused by moderate erosion, the soil is similar to the slightly eroded Altamont clay previously described. North of the Calera Reservoir, the soil is of clay or clay loam texture.

All of this soil is or has been cultivated. Grain hay, apricots, and prunes are the principal crops grown. Yields are poor, and in most places the soil should not be clean-cultivated.

Altamont clay, slightly eroded, 10 to 20 percent slopes (AH).—This soil is associated with other Altamont clays. In most places some erosion has occurred. Most of the soil is cultivated. Tree fruits and grain hay are the main crops grown. Yields of tree fruits are fair, but some erosion control is needed for sustained production. Yields of grain hay are normally good.

Altamont clay, 35 to 50 percent slopes (AK).—This soil is considerably shallower than less steep Altamont clays, and in most places it has some rock outcrops. Some of the soil is of clay or clay loam texture. East of Calero Reservoir, areas of this soil join Rough mountainous land as mapped in the Gilroy Area.

The few cultivated areas of the steep soil are generally eroded. Most of this soil is covered by grass or trees and grass, with occasional brushy areas.

Altamont clay, moderately eroded, 35 to 50 percent slopes (AL).—A little of this soil occurs on the hills bordering the valley in the southern part of the Area. These areas have been or are under cultivation. Orchard fruits, principally apricots, are the main crop. The soil is not suited to clean-cultivated crops; a permanent cover should be maintained.

Altamont clay (adobe), slightly eroded, 20 to 35 percent slopes (AB).—A noneroded Altamont clay (adobe) is not mapped in this Area, but the following profile description would be applicable to the noneroded soil. The surface soil is a brown, neutral or slightly acid, clay that varies in depth from 10 to 15 inches. The soil cracks to large blocks typical of adobe structure. The surface soil grades into slightly or moderately compact brown clay that is usually structureless and massive. At depths of 24 to 30 inches the upper subsoil grades into a brown calcareous lower subsoil, also of clay texture. Some lime is segregated along small tubular pores. Well-consolidated shale or fine-textured sandstone bedrock normally lies at depths of 40 to 50

inches. Altamont clay (adobe) differs from Altamont clay in being finer textured, deeper, and of more pronounced blocky structure.

Soil profile characteristics in the slightly eroded areas are similar to those given above except for minor changes due to erosion. Some rolling areas of this soil and one very small area of steep relief are included in this soil.

Grain hay and such truck crops as early spring peas are the principal crops grown on the soil. Yields are fair to good.

Altamont clay (adobe), moderately eroded, 35 to 50 percent slopes (Ac).—This soil, mapped on the hills in the northeastern part of the Area, is generally similar to the Altamont clay (adobe) just described except that it is steeper and more eroded.

Grain hay and early spring peas are the principal crops. Yields are poor, and a few fields have been abandoned. Steep areas of Altamont clay (adobe) should be kept under a permanent cover of vegetation.

Altamont clay (adobe), severely eroded, 35 to 50 percent slopes (Ad).—Small areas of these soils are closely associated with moderately eroded steep soils in the upper part of the Calero Creek drainage. Grain hay and early spring peas are the principal crops. Yields are poor, and some fields have been abandoned because of severe erosion. These areas should not be cultivated.

ALVISO SERIES

The soil of the Alviso series is a saline or "alkali" soil that occurs near and on the margin of Tidal marsh. The average annual rainfall is about 15 inches. Drainage was very poor during development, and is at present. Very little of this soil is cultivated. The natural vegetation consists largely of grasses, saltgrass predominating, and pickleweed and brassbuttons. The parent material is very finely divided alluvium, mainly from areas of sandstone and shale rocks. However, the drainage conditions have determined the characteristics of this soil. The water, which in many places saturates the lower subsoil and keeps the upper subsoil and part of the surface soil constantly moist, is mostly seepage from San Francisco Bay. The soil is typically basic in reaction (pH 7.8 to 8.4) in both surface and subsoil horizons.

Where the Alviso soil is associated with soils of the Sunnyvale series, it resembles to some degree the Sunnyvale soils, and likewise, where associated with soils of the Pescadero series, it somewhat resembles the Prescadero soils. The Alviso soil covers about 5 square miles.

Alviso clay, 0 to 1 percent slopes (An).—The surface soil is a dark-gray calcareous clay to depths of 6 to 10 inches. The soil cracks to a hard coarse blocky structure, but secondary cracking results in a fine blocky structure in the first inch or two. The surface soil grades into a dark-gray or dark grayish-brown, calcareous, medium blocky upper subsoil of fine clay texture. Lime occurs throughout the surface soil and upper subsoil, but in the upper subsoil it is segregated as small white specks or masses. This lime segregation in the upper subsoil increases somewhat with depth. There is normally an abrupt transition to a light-gray, highly calcareous, fine-textured lower subsoil that has rust-brown and bluish and greenish mottles. The lower subsoil generally contains a few calcareous nodules, and in some places

a few small nodules occur in the upper subsoil. The lower subsoil of strong alkali soils, especially near Tidal marsh, is generally water saturated, and the upper subsoil and part of the surface soil are constantly moist.

Alviso clay, 0 to 1 percent slopes, occurs near Tidal marsh. Nearly all of the soil is moderately or strongly affected with salts. In some places the immediate surface of the soil that has strong salt concentrations is very friable and is of granular structure and puffy appearance. Neutral (white alkali) salts by far predominate, but some of the soil contains a relatively large amount of basic salts (black alkali) in addition to neutral salts. The areas with black alkali have a strongly basic reaction (pH greater than 8.5).

Very little of Alviso clay is cultivated. Most of it is either used for pasture or allowed to remain idle.

AYAR SERIES

Soils of the Ayar series occur mainly on the lower hills in the southern part of the Area. The average annual rainfall is about 20 inches. The natural vegetation is mainly grasses, scattered oaks, and brush on some of the steeper slopes. Typical slopes range from 20 to 35 percent, although in a few places slopes may be 10 to 50 percent. In some places the soils are cultivated, and some erosion generally has resulted.

The surface soils are brown and become nearly reddish brown when moist. They are usually fine textured but friable, calcareous, and mildly or moderately basic in reaction (pH 7.4 to 8.0). Normally they crack to a fine to medium blocky structure. The surface soils grade into brown or nearly reddish-brown, friable, highly calcareous subsoils of fine texture. Lime is segregated in the subsoils along numerous small tubular pores so as to have the appearance of a threadlike network. The subsoils grade irregularly into light-brown or very pale brown, highly calcareous, fine-grained sandstone or limestone bedrock. In some places the bedrock has been mined for limestone.

Soils of the Ayar series are similar in general appearance to the Altamont or Berryessa soils but differ from them chiefly in having calcareous surface soils. In some places the Ayar soils are closely associated with the noncalcareous Gaviota soils. The soils of the Ayar series occupy about 1½ square miles.

Ayar clay, 10 to 35 percent slopes (Ar).—The surface soil is a brown calcareous clay that normally varies in depth from 8 to 17 inches. In spite of the clay texture the soil is friable and easily worked to a good seedbed. The surface soil grades into a brown, subangular blocky, highly calcareous subsoil of clay or clay loam texture. Lime in the subsoil is highly segregated in a threadlike form. At depths of 20 to 38 inches the subsoil grades irregularly into a light-brown or very pale brown, highly calcareous, fine-grained sandstone or limestone.

The soil occurs in small bodies near the northwestern end of the Santa Teresa Hills, north of the Calero Reservoir dam, and southwest of Palo Alto. None of it is cultivated. The vegetation is mostly grass or trees and grass. These areas are used mainly for grazing, and the carrying capacity is normally good.

Ayar clay, slightly eroded, 20 to 35 percent slopes (Ap).—This soil is similar to the Ayar clay on slopes of 10 to 35 percent, except that it is more eroded. It occurs mainly on low hills in the southern part of the Area. South of Alamitos it has a less sloping relief. All of the soil is cultivated. Grapes, apricots, and prunes are the principal crops.

Ayar clay, moderately eroded, 20 to 35 percent slopes (Ao).—This soil is like the slightly eroded Ayar clay, except that in a number of places the lighter colored material of the lower subsoil is exposed by erosion, and in some places the bedrock is exposed. The soil occurs south of Alamitos and southwest of the junction of Arroyo Calero and Los Alamitos Creek. Grapes, apricots, and grain hay are the principal crops grown, and yields are normally poor.

Ayar clay, 35 to 50 percent slopes (As).—All of this soil is on the northwestern end of the Santa Teresa Hills. Normally it is shallower than others in this series. None of the soil is cultivated. The vegetative cover, mainly grass or trees and grass, is used for grazing. The two small areas shown with stone symbols (rock outcrops) are brush covered.

AZULE SERIES

Soils of the Azule series occur on terrace material near the western edge of the valley. The average annual rainfall is 20 to 30 inches. Original vegetation was mostly brush and grass, with wooded areas near streams. Many areas of these soils are now cultivated; they produce mainly nonirrigated orchard fruits (pl. 5, *A*). Typical slopes range from 20 to 35 percent, but some are as slight as 10 percent, and others as steep as 50 percent. Erosion has generally resulted where the soils are cultivated. The elevation of the Azule soils varies from about 500 feet to about 1,000 feet. The climate and elevation are favorable for apricots.

The surface soils are brown or pale brown, fine textured, and normally medium acid in reaction (pH 5.6 to 6.0). In spite of the fine texture, the soils are not difficult to work, and a good tilth can be produced if the soils are cultivated when at the proper moisture content. Under natural conditions the surface soils have a weak medium blocky structure and a firm consistence. The surface soils overlie brown or pale-brown slightly compact subsoils of fine texture and of medium or strongly acid reaction (pH 5.0 to 6.0). Root and water penetration are considerably better than for other terrace soils of the Area, because the subsoils are less compact and impermeable than the subsoils of most other soils of this group. In most places the roots of orchard trees extend well below the subsoils into the underlying material. The subsoils grade into light-brown or light yellowish-brown unconsolidated or very slightly consolidated terrace material of variable texture. The reaction of the underlying material varies from acid to slightly calcareous and basic. The terrace material from which the Azule soils have developed is older geologically than that from which other terrace soils of the area have developed.

The Azule soils occur only on the Santa Clara geologic formation. The Azule series occupies nearly 8 square miles. Only one soil type, Azule silty clay, is mapped, but it has significant variations in slope and erosion.

Azule silty clay, 20 to 35 percent slopes (At).—The surface soil is a brown or pale-brown medium acid silty clay that normally varies from 8 to 15 inches in depth. The surface soil overlies a brown or pale-brown slightly compact subsoil of silty clay texture. The underlying material at depths of 20 to 45 inches is light-brown or light yellowish-brown unconsolidated material of clay loam or silty clay loam texture. In a few places a small amount of gravel occurs in the profile.

Most of Azule silty clay on hilly relief is in one of the eroded mapping units. None of this uneroded soil is cultivated. The largest area is east of Permanente. The vegetation is mostly brush, but there is some in grass and woodland.

Azule silty clay, slightly eroded, 20 to 35 percent slopes (Av).—Most of this soil is slightly eroded. Profile characteristics are similar to those of the noneroded Azule silty clay, but because of erosion the surface soil is generally shallower, and in a few places the soil is lighter in color or gullies have developed.

Areas of this soil are northwest of Saratoga. All of this soil is or has been cultivated. Apricots and prunes are the principal crops, and some grapes and grain hay are grown. Yields of fruits are fair. The quality of such fruits as apricots is good, largely because of favorable climate. Small uneroded areas of woodland or woodland-brush near drainage channels are included.

Azule silty clay, moderately eroded, 20 to 35 percent slopes (Au).—This soil is similar in profile to other soils of the Azule series, except for being more eroded. The surface soil in some places has been entirely removed, and the subsoil is exposed. The texture is silty clay, which is more difficult to work to a good tilth than the surface of less eroded areas. Surface color is generally lighter or in some places redder. In nearly all areas occasional gullies occur.

The largest area of this soil is west of Saratoga. Most of it is cultivated, but a few small uncultivated areas along drainageways are included. Prunes, apricots, and grapes are the chief crops. Yields are poor, and some fields have been abandoned.

Azule silty clay, 10 to 20 percent slopes (Aw).—This soil is similar to the Azule silty clay, 20 to 35 percent slopes, except that its slopes are more gradual. The largest area of this soil is west of Los Altos and south of Alta Mesa. A few areas of undulating relief are included.

Most of the soil is cultivated and very slightly eroded. Dry-farm apricots and prunes are the principal crops, although some walnuts, pears, and grain hay are raised. Yields of fruits are fair, but the quality is ordinarily good. Yields of grain hay are good.

Azule silty clay, slightly eroded, 10 to 20 percent slopes (Ax).—These areas of Azule silty clay are like others of the Azule series except for slight sheet erosion. The largest area is located south of Los Altos. A little moderately eroded soil south of Monta Vista is included.

Most of the soil is cultivated. Prunes, apricots, and grapes are the principal crops. Yields of fruits are fair, and quality is generally better than average, particularly for apricots. Some of the soil is in grass and used for grazing.

Azule silty clay, 35 to 50 percent slopes (Ay).—These areas of Azule silty clay are not cultivated. They support a brush cover that is of little value except as watershed protection. The surface soil is thinner and generally somewhat coarser textured than that of most Azule soils. The largest area is east of Stevens Creek Reservoir.

Azule silty clay, moderately eroded, 35 to 50 percent slopes (Az).—Where steep areas of Azule silty clay have been cultivated, the result has been moderate erosion in most places and severe erosion in others. Very little of the original surface soil remains, and in many places part of the subsoil is gone. Small areas occur east of Stevens Creek Reservoir.

Prunes are the principal crop, and apricots are grown. Yields are poor, and some orchards have been abandoned.

BAYSHORE SERIES

Soils of the Bayshore series are marginal to basin areas. They developed while drainage was poor and the ground-water level was prevailingly high. At the present time, however, the ground-water level has been lowered so that crops and soils are not affected. The original vegetation was mainly grasses, but all areas have been cultivated for a number of years. The parent material is medium-textured alluvial material from areas of sandstone and shale rocks. However, the formerly poor drainage has had the greatest effect in producing the principal characteristics of the series.

The soils are gray or dark grayish brown, calcareous, and basic in reaction (pH 7.5 to 8.0) in both surface and subsoils. The surface soils are highly calcareous, very friable, and granular in structure. They grade into slightly compact calcareous gray or dark grayish-brown clay loam upper subsoils of blocky structure. These upper subsoils grade into gray, dark-gray, or grayish-brown weak blocky clay loam or clay lower subsoils that usually contain segregated lime. The underlying material is somewhat stratified gray or grayish-brown calcareous alluvium of medium or moderately fine texture and is moderately permeable to roots and moisture. In most places the lower subsoils and underlying material are slightly mottled with rust-brown stains, and in a few places some calcareous nodules are in the lower parts of the soil profiles.

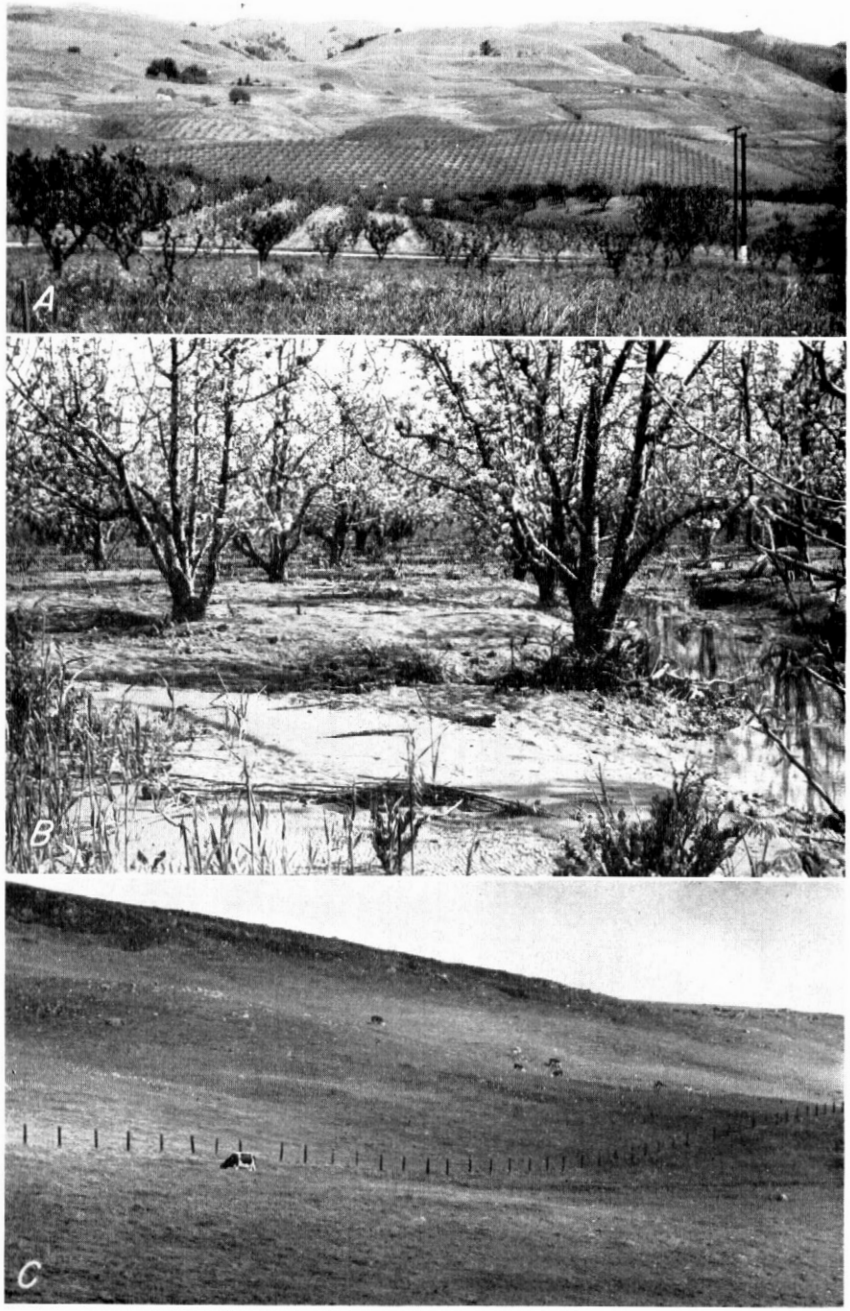
In most places the Bayshore soils lie between soils of the Campbell and Sunnyvale series. They are more like the Sunnyvale series near the Sunnyvale soils and more like the Campbell series near the Campbell soils. In some places the Bayshore soils are between the Campbell and Castro soils. The Bayshore soils occupy about 1½ square miles.

Bayshore clay loam, 1 to 3 percent slopes (Bb).—The surface soil is a gray or dark grayish-brown highly calcareous clay loam to depths of 10 to 15 inches. The soil is very friable and easily worked into an excellent tilth for seedbeds. The surface soil grades into a gray or dark grayish-brown, calcareous, slightly compact upper subsoil of clay loam texture. At depths of 25 to 31 inches the upper subsoil grades into a gray, dark-gray, or grayish-brown calcareous lower subsoil of clay loam or clay texture. Lime is disseminated throughout the surface soil and the upper and lower subsoil and is also segregated

A, Prune trees on Azule silty clay; orchards on the same soil in the distance. This hilly and steep soil has eroded in most places where cultivated.

B, Grain hay on Cropley clay (adobe). This heavy-textured soil is best suited for field crops.

C, Orchards and grain hay on Diablo soils.



A, Apricot orchard on Milpitas loam; this soil with claypan subsoil is not well suited for orchard trees. Berryessa and Altamont soils on hills in background.

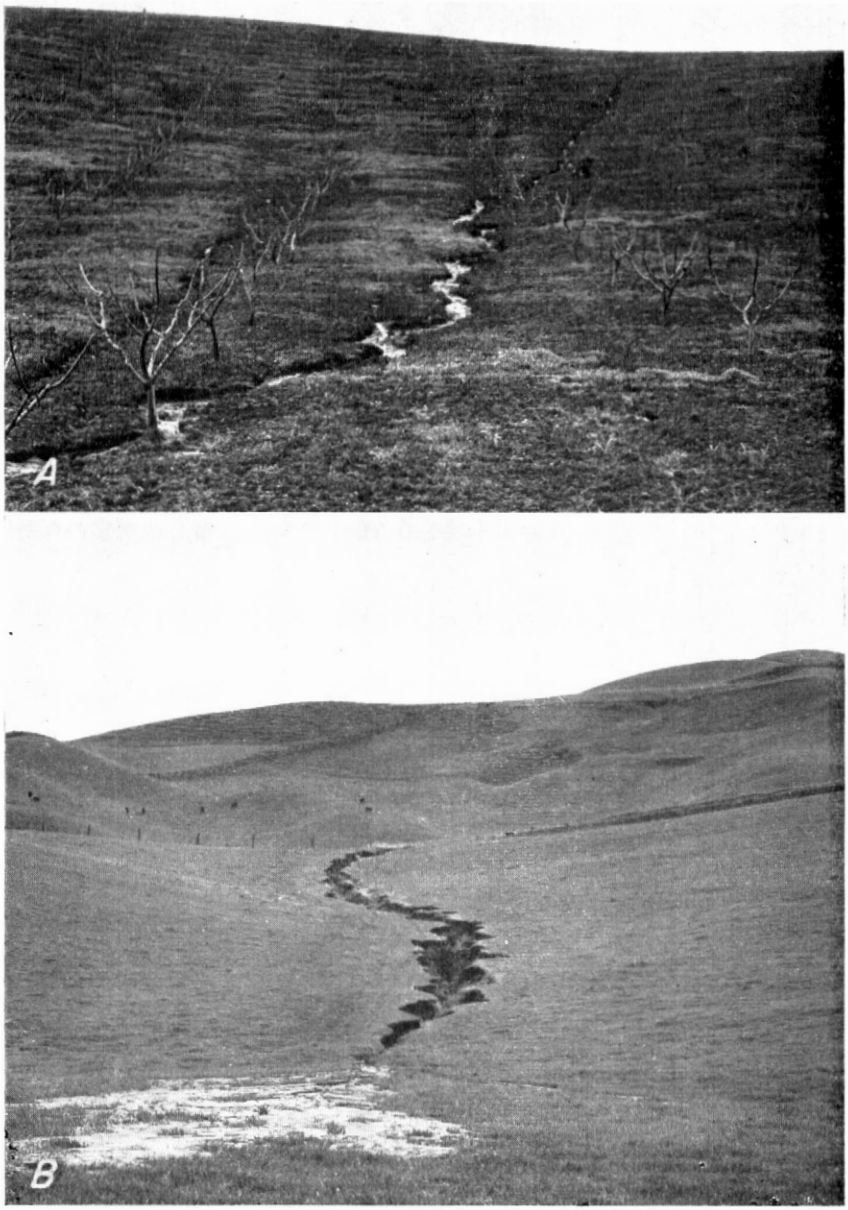
B, Pear orchard shortly after overflow and deposition of Mocho soil material; underlain by black Sunnyvale clay at depths of 18 to 30 inches. Such deposition generally benefits pear trees, but damages truck crops.

C, Montara stony clay of hilly relief. This very shallow and stony soil is suited only for range pasture.

A, Mocho soils, undifferentiated, along Coyote Creek, showing typical break from Mocho soils to higher lying Sorrento soils.

B, Typical relief and use of the complex of Positas-Saratoga loams; grain hay in foreground, prune and apricot trees in background.

C, French prune trees on Positas loam. The dense claypan subsoil makes this soil less suitable for orchards than the closely associated but more permeable Saratoga loam. Erosion control is a problem on these soils.



A. Moderate sheet erosion and small gullies in a young apricot orchard on Altamont clay (adobe).

B, Gully in Berryessa clay, which is underlain by softly consolidated sedimentary rock. The Altamont and Berryessa soils are not extremely erodible, but have eroded in most places where cultivated.

in the lower subsoil. The lower subsoil, at depths of 39 to 45 inches, grades into underlying moderately permeable gray or grayish-brown, rust-brown mottled, calcareous alluvium. Some small calcareous nodules may occur in the lower subsoil and underlying material. In a few places a small amount of gravel occurs throughout the soil profile. Near Lawrence some areas of this soil are browner than typical. Other areas are near Moffett Field and 1 mile northwest of Mountain View.

All of this soil is cultivated. Various crops are grown with only fair success. Poor to fair yields of prunes, apricots, and walnuts, and fair to good yields of grain hay, truck crops, and sugar beets are obtained.

Bayshore clay loam, 3 to 5 percent slopes (BA).—Profile characteristics of this soil are very similar to those of Bayshore clay loam on slopes of 1 to 3 percent, but this soil is on slightly steeper slopes formed by old drainageways and seep areas. Generally there is a little gravel throughout the soil profile.

A little of this soil is near Lawrence. Most of it is in fruit orchards, principally prunes and apricots. Yields are rather poor.

BERRYESSA SERIES

Soils of the Berryessa series occur mainly on the lower hills in the eastern part of the Area. They are closely associated with soils of the Altamont series. Berryessa soils are derived from slightly consolidated calcareous sedimentary rocks and have formed under an average annual rainfall of about 20 inches. The original vegetation was mainly grasses, with some woodland along drainageways and scattered brush on some of the steeper slopes. Most of the soils are now cultivated. Orchard fruits and grain hay are the principal crops. The soils have typical hilly relief. Slopes are mostly between 20 and 35 percent but range from 10 to 50 percent. Most of the cultivated soils are eroded.

The surface soils are brown or grayish brown to nearly dark grayish brown, fine textured, and normally neutral in reaction (pH 6.6 to 7.3). They crack to a coarse blocky structure of hard consistence but produce a moderately good tilth if worked carefully at the proper moisture content. The surface soils grade into slightly or moderately compact brown or grayish-brown fine-textured upper subsoils of neutral to slightly basic reaction (pH 7.0 to 7.8). The upper subsoils are weakly blocky but are otherwise similar to the surface soils. The upper subsoils grade into somewhat lighter brown or grayish-brown calcareous, fine-textured lower subsoils of basic reaction (pH 7.8 to 8.3). Generally some lime is segregated in small soft masses and along tubular pores in the lower subsoils. The lower subsoils overlie light brownish-gray or light yellowish-brown, calcareous, softly consolidated shale or fine-textured sandstone.

The Berryessa soils are very similar to the Altamont soils. The chief difference between the soils is the degree of consolidation of the parent rock. The softer rock under the Berryessa soils favors the development of the deep gullies (pl. 8, *B*) and landslips, which are characteristic of the soils where erosion has occurred. In some places the material underlying these soils seems to be terrace or old valley-fill material rather than bedrock.

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The Berryessa soils in the Santa Clara Area are mapped only in complexes with soils of the Altamont series. The Berryessa-Altamont soils occupy about 11 square miles.

Berryessa-Altamont clays, 20 to 35 percent slopes (Bc).—This complex consists of a close association of Berryessa clay and Altamont clay, with Berryessa clay predominating. The profile characteristics of Altamont clay in the complex are similar to those previously described under Altamont clay, 20 to 35 percent slopes.

The following profile description is of Berryessa clay, 20 to 35 percent slopes. The surface soil is a brown or grayish-brown, blocky, noncalcareous, neutral clay to depths of 8 to 13 inches. The surface soil grades into a brown or grayish-brown noncalcareous clay-textured upper subsoil that is slightly or moderately compact and weakly blocky. At depths of 20 to 35 inches the upper subsoil grades into a lighter brown or grayish-brown calcareous clay lower subsoil. Lime is disseminated throughout the lower subsoil and is also segregated in small soft masses or along tubular pores. Slightly consolidated calcareous shale or fine-grained sandstone is at depths of 30 to 45 inches.

This complex is not common in the Area, since most of the Berryessa-Altamont clays on hilly relief have been cultivated and consequently eroded. Most of this complex occurs on the eastern foothills. Some small areas south of Alma, not too typical of the Berryessa or Altamont series but generally similar to the Berryessa series, are included. A few small areas of uneroded soil with steep relief are also included.

None of this complex is cultivated. The soils support a cover of grass, trees, trees and grass, or brush.

Berryessa-Altamont clays, slightly eroded, 20 to 35 percent slopes (Be).—The complex is extensive on the eastern hills of the Area. The soils are similar in profile to the Berryessa clay and Altamont clay soils previously described but are more eroded. Occasional deep gullies are characteristic. In a few places where the soil was originally very shallow, the exposed soil is calcareous. Some included soils northwest of Alma are similar to but not typical of the Berryessa or Altamont series.

All of this complex is cultivated. Apricots, prunes, grain hay, and truck crops (early spring peas) are the principal crops grown (pl. 4, *A*). Yields are fair for fruits, and quality, particularly of apricots, is generally good. Yields of grain hay are good, and yields of peas are fair to good, depending on the weather.

Berryessa-Altamont clays, moderately eroded, 20 to 35 percent slopes (Bd).—This hilly and moderately eroded complex is extensive. It occupies a nearly continuous strip along the lower hills in the eastern part of the area.

The soils generally conform to the descriptions of Berryessa clay and Altamont clay previously given. In many places the surface is lighter colored than typical, and in some places the exposed soil is calcareous. Occasional deep gullies and landslips are also characteristic.

All of this complex is cultivated. Prunes, apricots, grain hay, and truck crops (early spring peas) are the principal crops grown. Yields are only fair or poor. Erosion control is needed in most places.

Berryessa-Altamont clays, slightly eroded, 10 to 20 percent slopes (BF).—This rolling slightly eroded complex occurs mainly on the eastern foothills. Near Alma College the soils are not too typical of the Berryessa or Altamont series. Most of the complex is cultivated. Grain hay, truck crops, and orchard fruits are the principal crops.

Berryessa-Altamont clays, severely eroded, 35 to 50 percent slopes (BG).—The small areas of this complex are on steep slopes and are severely eroded. The calcareous subsoils or even the parent materials may be exposed. Gullies are fairly common. This complex is associated with other complexes of Berryessa and Altamont clays in the northeastern part of the Area. Some tree fruits and early spring peas are grown, but yields are poor. These areas should be taken out of cultivation.

Berryessa-Altamont gravelly clays, slightly eroded, 20 to 35 percent slopes (BH).—This complex is a close association of Berryessa gravelly clay and Altamont gravelly clay, with Berryessa gravelly clay predominating.

The surface soil of Berryessa gravelly clay, 20 to 35 percent slopes, is a brown or grayish-brown, neutral, gravelly clay to depths of 7 to 13 inches. It grades into a moderately compact noncalcareous upper subsoil, also of gravelly clay texture. At 20 to 32 inches the upper subsoil grades into a lighter brown calcareous or slightly calcareous lower subsoil of gravelly clay or gravelly clay loam texture. Slightly consolidated calcareous conglomerate normally occurs at depths of 35 to 45 inches. In general the soil is less calcareous in the lower subsoil than Berryessa clay, and it may even be noncalcareous. Altamont gravelly clay has a similar profile but has developed from more firmly consolidated conglomerate.

This complex occurs southwest of Evergreen. Prunes, apricots, and grain hay are the principal crops grown. Yields are only fair for fruits but fairly good for grain hay, depending upon the rainfall.

CAMPBELL SERIES

Soils of the Campbell series are among the most productive and intensively cultivated in the Area. The soils occur on the very gently sloping fringes of alluvial fans, under an average annual rainfall of about 15 inches. Before the development of intensive agriculture in the valley, these soils were probably influenced by at least intermittently high ground-water levels. Pumping for irrigation has so lowered the ground-water level in most places in the valley that at present crops or soil profiles are rarely affected. The original vegetation was mainly grasses and a few scattered oaks, but for a number of years all of the soils have been cultivated. The alluvial parent material from which the soils have developed originated mainly in the sandstone and shale formations of the mountains on both sides of the valley.

The surface soils are grayish brown or dark grayish brown and of moderately fine or fine texture. They are considerably darker when moist. In orchard areas the soils are generally a shade darker than in areas used for field crops. The surface soils are typically noncalcareous and neutral to slightly basic in reaction (pH 7.0 to 7.8). They grade into grayish-brown, slightly or moderately compact, mas-

sive upper subsoils that are noncalcareous or very slightly calcareous. The reaction of the upper subsoil is slightly to moderately basic (pH 7.5 to 8.0). The upper subsoils grade into grayish-brown, rust-brown mottled, moderately fine or fine textured calcareous lower subsoils that are distinctly basic in reaction (pH 7.8 to 8.3). The lower subsoils are normally less compact than the upper subsoils and are uniform and moderately permeable to depths of 6 or more feet. Lime usually occurs at depths of 25 to 42 inches. Most of it is disseminated throughout the lower subsoils, but in some places it is segregated along small tubular pores or in the form of small soft masses. The upper subsoils retard root and moisture penetration very slightly, and in orchard areas roots extend throughout the depths of the soils. In many places a slightly or moderately compact plowpan has developed at the depth of most frequent cultivation.

The Campbell soils are similar to and associated in some places with soils of the Zamora series, and the color of surface soils in many places is nearly the same. The chief differences between the soils are the presence of lime and considerable rust-brown mottling in the subsoils of the Campbell series. The Campbell soils normally lie at slightly lower elevations than the Zamora soils. The Campbell soils are also somewhat similar to and in places associated with soils of the Sorrento series. The Campbell soils are generally darker or grayer in color and have developed under more restricted drainage. Soils of this series are mapped on about 17 square miles.

Campbell clay loam, 0 to 1 percent slopes (CA).—The surface soil is a grayish-brown, coarse granular, friable clay loam to depths of 10 to 22 inches. The soil breaks to firm, medium-sized lumps or clods that are fairly easily crushed to a coarse granular mass. In many places, particularly in orchards, there is a slightly compact plowpan at the depth of most frequent cultivation. Reaction is about neutral. The surface soil grades into a grayish-brown slightly compact, massive, noncalcareous or very slightly calcareous upper subsoil that is generally of clay loam texture. At depths of 30 to 42 inches the upper subsoil grades into a grayish-brown or pale-brown, calcareous, less compact, moderately permeable rust-brown mottled clay loam lower subsoil. Lime is disseminated throughout the lower subsoil.

Roots and moisture penetrate the soil easily in orchard areas to depths of 6 or more feet. In some places a little gravel occurs in the soil, and in other places the upper subsoil is slightly mottled with rust-brown stains. The soil is typically free of alkali, but a very small area is slightly affected with alkali.

Most of this soil is near the center of the area, near San Jose, but small areas are scattered on the valley floor. All of the soil is cultivated, except in residential areas. Truck crops, prunes, alfalfa, sugar beets, grain hay, pears, and walnuts are the principal crops grown. Yields are normally good or very good.

Campbell silty clay, 0 to 1 percent slopes (CB).—This soil has a grayish-brown or dark grayish-brown silty clay surface soil, 14 to 20 inches thick. It is neutral or slightly basic in reaction. The soil is considerably darker when moist. In orchard areas where cover crops have been turned under regularly for a number of years, the surface soil is generally much darker than in areas used for field crops. When cultivated the soil breaks to medium- or large-sized clods that are

hard when dry. If the soil has been cultivated at the proper moisture content, the clods break fairly easily to a coarse granular mass, and a good seedbed can be prepared. The soil "puddles" easily, however, if worked when too moist, and in a number of places a moderately compact plowpan has developed in the surface soil from cultivation.

The surface soil grades into a grayish-brown moderately compact, massive, noncalcareous or very slightly calcareous upper subsoil of silty clay texture. At depths usually of 25 to 40 inches the upper subsoil grades into a grayish-brown or pale-brown, less compact, slowly permeable, calcareous, rust-brown mottled lower subsoil of silty clay or silty clay loam texture. Lime is disseminated throughout the lower subsoil, and in some places it is segregated along small tubular pores or in small soft masses. The silty clay texture and the compaction in the upper subsoil retard water penetration somewhat, but roots penetrate the soil to depths of 6 or more feet in orchard areas. In a few places the upper subsoil is slightly mottled with rust-brown stains.

North of San Jose, where some of this soil has been flooded by the Guadalupe River and Coyote Creek, the surface soils are slightly calcareous, although very little material has been deposited recently. Other areas of the soil are southwest of Santa Clara.

All of the soil is either cultivated or in residential areas. Prunes, for which the soil is well suited, and other orchard fruits are the chief crops. Considerable acreages of truck crops, pears, and walnuts are also grown. Yields are good to very good for prunes and pears and fair to good for most other crops grown.

Campbell silty clay, over basin clays, 0 to 1 percent slopes (Cc).—This soil adjoins soils of the Clear Lake or Sunnyvale series. It consists of 12 to 50 inches of Campbell silty clay over dark-gray or black clays of the Clear Lake or Sunnyvale series. In general the Campbell soil material is deeper over the Clear Lake soil material than over the Sunnyvale soil material. The Campbell soil material in several places is somewhat darker than typical, and it may be slightly calcareous at the surface. A few small areas of clay loam texture are included. Drainage through the underlying clay is very slow.

This soil is in the central part of the Area near the basin soils. All of the soil not in residential areas is cultivated. Pears, alfalfa, prunes, and some truck crops are the principal crops. The soil is not well suited for most fruit trees, and yields are generally only fair. However, good yields of pears are obtained.

CASTRO SERIES

Soils of the Castro series have formed in a similar way to the soils of the Sunnyvale series. Castro soils are mostly southwest of Alviso in the northern or lower part of the valley. The soils are dark gray or black, calcareous, and basic in reaction (pH 7.5 to 8.0) in both surface and subsoils. As in soils of the Sunnyvale series, the black or dark-gray color of Castro soils is caused by a relatively high content of organic material. The surface soils are fine textured, but their structure and consistence vary according to the texture and lime content. However, a good seedbed can be prepared even on the clay if the soil is worked carefully and at the proper moisture content. The surface soils grade into slightly compact clay-textured dark-gray or black calcareous upper subsoils that normally have a medium blocky

structure when dry. Lime is disseminated throughout the surface soils and upper subsoils, but in the upper subsoils it generally is segregated as small white specks. The upper subsoils are underlain by lower subsoils, which are white partially cemented lime hardpans. The hardpans are very highly calcareous soil material in which numerous irregularly rounded calcareous nodules occur. The nodules are about ¼ to ½ inch in diameter but may be cemented together to form larger masses. The lower subsoils grade into light-gray or light brownish-gray, slightly rust-brown mottled, calcareous clay loam alluvial soil material that contains a few nodules in most places.

The Castro soils are similar to and associated with soils of the Sunnyvale series. The chief differences between the soils of these series are a higher content of lime and more cementation in the lower subsoils of the Castro series. Soils of the Castro series occupy about 6 square miles.

Castro silty clay, 1 to 3 percent slopes (CE).—The surface soil is dark-gray, friable, highly calcareous, coarse granular silty clay to depths of 10 to 15 inches. It is easily cultivated and can be worked into an excellent tilth for seedbeds. The surface soil grades into a dark-gray very slightly compact calcareous upper subsoil of silty clay texture and medium blocky structure. Lime is disseminated throughout the surface soil and upper subsoil, and it also is segregated in the upper subsoil. At depths of 20 to 28 inches is a light-gray or white partially cemented nodular lime hardpan. This lower subsoil hardpan is usually 18 to 22 inches thick. It overlies pale-brown or light brownish-gray, rust-brown mottled, calcareous alluvial clay loam material.

Some areas of clay loam texture and containing a small amount of gravel are included with this soil. The typical relief is very gently sloping, but a few small areas along old drainageways are slightly undulating. In such areas where the soil has been leveled, the light-colored lower subsoil may be exposed.

Like soils of the Sunnyvale series, this Castro soil is typically free of alkali; however, one small area is slightly affected and another is moderately affected by alkali. All of the soil lies between Santa Clara and Sunnyvale, near Lawrence.

Nearly all of the soil is cultivated. Good yields of grain hay and fair yields of truck crops, sugar beets, and alfalfa are obtained. Because of the highly calcareous surface soil and partially cemented very highly calcareous lower subsoil, shallow-rooted crops are best adapted. The areas slightly affected by alkali are used for grain hay. The moderately affected areas are used for grazing.

Castro clay, 0 to 1 percent slopes (CD).—This soil has a surface layer of black calcareous clay. This layer, on drying in an undisturbed state, cracks to coarse- or medium-sized blocks that generally break into smaller blocks near the surface. Although of clay texture, the surface soil is fairly easily worked, and if cultivation is done carefully and at the proper moisture content a good seedbed can be prepared. At depths of 8 to 13 inches the surface soil grades into a black slightly compact calcareous medium-blocky upper subsoil of clay texture. Lime is disseminated throughout the surface soil and upper subsoil, and it is also generally segregated into white specks or spots in the black material of the upper subsoil. At depths of 22 to 27

inches, the upper subsoil grades rapidly into a white, slightly rust-brown mottled, partially cemented, nodular lime hardpan. This hardpan is 18 to 25 inches thick and overlies light brownish-gray, rust-brown mottled, calcareous clay or clay loam alluvial material that contains a few lime nodules in most places. The highest lime concentration in the soil profile is in the lower subsoil horizon. Most of the soil is northeast of Sunnyvale and is free of alkali. One small area 2½ miles north of Lawrence is slightly affected by alkali.

Nearly all of the soil is cultivated. Grain hay, sugar beets, truck crops, alfalfa, and pears are the principal crops. Good or very good yields of grain hay, sugar beets, and certain truck crops and fair yields of alfalfa are obtained. Yields of pears are usually poor. Because of the very highly calcareous lower subsoil the soil is not well suited for fruit trees, and those trees grown on the soil show strong symptoms of chlorosis. Where slightly affected with salts, the soil is used for grain hay or grazing.

CAYUCOS SERIES

Soils of the Cayucos series are mapped mostly on hills in the northwestern part of the Area. The average annual rainfall is about 20 inches. The natural vegetation is grass and a few oaks. At present the soils are cultivated in many places. Tree fruits and grain hay are the principal crops grown. The typical relief of Cayucos soils is hilly, but a few areas of less sloping soils are mapped in this series. In most places where the soils are cultivated they are eroded.

The surface soils are dark gray, relatively high in organic matter, and slightly or medium acid in reaction (pH 5.5 to 6.6). On drying in an undisturbed state they crack to moderate-sized more or less cubical blocks. When wet they are plastic or sticky. The surface soils grade into gray or dark-gray blocky subsoils that are normally acid but slightly less so than the surface soil. Some rock fragments occur in the subsoils; the fragments increase in number with depth. The bedrock is light brownish-gray or light-gray, noncalcareous, well-consolidated shale or very fine grained sandstone.

The Cayucos soils resemble soils of the Diablo series, except that the Diablo soils are neutral to slightly basic in reaction in the surface soils and calcareous in the subsoils. The Cayucos series occupies about 2½ square miles.

Cayucos clay, 20 to 35 percent slopes (CF).—The surface soil is a dark-gray slightly or moderately acid clay to depths of 8 to 17 inches. It breaks to coarse clods that are difficult to reduce to small clods or a granular mass. However, if the surface soil is worked carefully at the proper moisture content, a good seedbed can be prepared. The surface soil grades into a gray or dark-gray blocky clay subsoil. In most places some rock fragments occur in the subsoil; their number increases with depth. At depths of 22 to 30 inches, the subsoil rests on bedrock of light-gray or light brownish-gray noncalcareous shale or very fine grained sandstone. In the very few places where the parent material is calcareous, small areas of Diablo clay are included in this mapping unit.

The largest areas of this soil occur near Felt Lake. A few other areas are on the western foothills. The natural vegetation is mostly grass or trees and grass. None of this soil is cultivated; it is used mainly for grazing. The carrying capacity is fairly good.

Cayucos clay, slightly eroded, 20 to 35 percent slopes (CG).—This soil is similar to Cayucos clay, 20 to 35 percent slopes, except that it is slightly eroded. Some areas are lighter gray in color, and the soil is generally a little shallower than is typical of the uneroded Cayucos clay.

Some areas are located near Felt Lake. All of the soil is cultivated. Apricots, walnuts, grain hay, and prunes are the principal crops grown. Yields of grain hay are normally good, but yields of orchard crops are poor to fair.

Cayucos clay, slightly eroded, 10 to 20 percent slopes (CH).—This soil is similar to the slightly eroded Cayucos clay just described, except that slopes are less steep.

It occurs west of Loyola, and most of it is cultivated. Apricots, grain hay, and prunes are the principal crops grown.

Cayucos clay loam, 20 to 35 percent slopes (CK).—The surface soil is a dark-gray slightly or moderately acid clay loam to depths of 6 to 15 inches. It breaks to clods that are reduced to smaller clods or a granular mass more easily than the surface layer of the Cayucos clay soils. The surface soil grades into a gray or dark grayish-brown weakly blocky subsoil of clay loam texture. At depths of 18 to 26 inches lies the bedrock of light-gray or light brownish-gray noncalcareous sandstone or shale.

None of Cayucos clay loam, 20 to 35 percent slopes, is cultivated. It occurs north of the Guadalupe Reservoir Dam and southeast of Felt Lake. The natural vegetation is mainly grass or trees and grass.

Cayucos clay loam, slightly eroded, 10 to 20 percent slopes (CL).—This soil differs from the uneroded Cayucos clay loam just described in having more gradual slopes and, due to cultivation, more erosion. In a number of places the darker surface soil has been removed and the lighter soil beneath is exposed. The soil is used mainly for orchard crops. Small areas are south of Alamitos and southwest of the Union School.

CLEAR LAKE SERIES

The soil of the Clear Lake series occurs in basin positions on the valley floor. The average annual rainfall is about 15 inches. This soil originally had very slow runoff and a prevailing high groundwater level. The original vegetation was mainly grasses, but all of this soil has been under cultivation for years. The parent material is very finely divided alluvium from areas of sandstone and shale rocks; however, the profile characteristics are primarily the result of poor drainage. Because of the general lowering of the groundwater level in the valley through pumping for irrigation, drainage is considerably better in Clear Lake soil than it was under natural conditions. The dark-gray color of both surface soil and upper subsoil is caused by the moderately high content of well-decomposed organic material. The highest concentration of lime is normally in the lower subsoil.

Clear Lake soil occurs in small basins or marginal to soils of the Sunnyvale series. The Sunnyvale soils differ in being darker colored (black) and in having a much higher lime content in the lower subsoil. The Clear Lake soil is somewhat similar to soils of the Pesca-

dero series, but the Pescadero soils differ in being somewhat browner in color and in having considerably denser and more compact lower subsoil. The Clear Lake series occupies nearly 5 square miles.

Clear Lake clay (adobe), 0 to 1 percent slopes (CM).—The surface soil is a dark-gray, noncalcareous, neutral or slightly basic (pH 7.0 to 7.8) clay that, on drying in an undisturbed state, cracks to large more or less cubical hard blocks of typical adobe structure. The blocks measure from 4 to 10 inches or more across the upper surface, and the cracks are frequently 1 or 2 inches wide and 8 to 12 inches deep. The surface soil is difficult to work and breaks to coarse clods that are rather difficult to reduce to smaller aggregates. At depths of 9 to 13 inches the surface soil grades into a slightly compact, dark-gray, clay-textured upper subsoil. This is noncalcareous or only very slightly calcareous and basic in reaction (pH 7.5 to 8.0). The upper subsoil when dry generally contains a few vertical cracks, and its structure is weakly blocky. At depths of 20 to 25 inches, the upper subsoil grades into a dark grayish-brown, rust-brown mottled, massive lower subsoil. Although this layer is normally slightly compact clay, it is less dense and somewhat more permeable than the upper subsoil. The lower subsoil is calcareous and basic in reaction (pH 7.8 to 8.3). Lime is disseminated throughout the lower subsoil, and it is also segregated to some degree along small tubular pores and in the form of small soft masses. In some places there are a few lime nodules in the lower subsoil. At depths of 32 to 40 inches, the lower subsoil grades into underlying grayish-brown, rust-brown mottled, calcareous, moderately permeable alluvium of clay loam texture.

Clear Lake clay (adobe), 0 to 1 percent slopes, occurs in small or medium-sized bodies widely scattered over the valley floor. In some places the soil is slightly affected by salts. All of the soil is cultivated, except for residential areas. Grain hay, sugar beets, alfalfa, and truck crops are the principal crops. Prunes, walnuts, pears, and apricots are also grown. The soil is best suited to field crops, and yields for such crops are fairly good. Yields of orchard fruits and nuts are normally poor or fair. The soil is used chiefly for grain hay where it is slightly affected by salts.

CLIMAX SERIES

Soils of the Climax series are mapped mainly in the eastern part of the Area. The average annual rainfall is about 20 inches. The original vegetation was mainly grass with occasional oaks. At present most of the soils are cultivated. The typical relief of the soils is hilly, with slopes of 20 to 35 percent; however, in a few places the soils occur on rolling relief. In most places a significant amount of erosion has occurred.

The surface soils are dark gray or dark grayish brown, fine textured, normally noncalcareous, and neutral or slightly basic in reaction (pH 6.6 to 7.5). On drying the surface soils crack to a very coarse blocky (adobe) structure. When wet they are plastic or very sticky. The surface soils grade into dark-gray or dark grayish-brown, fine-textured, medium blocky subsoils that are calcareous and basic in reaction (pH 7.5 to 8.0). The underlying material is calcareous bedrock, chiefly metamorphosed basic igneous intrusives.

The Climax soils are related to and in places very closely associated with soils of the Montara series. The Montara soils differ in being noncalcareous, normally stony, and very shallow. Soils of the Climax series occupy about 1½ square miles.

Climax clay (adobe), moderately eroded, 20 to 35 percent slopes (CN).—The surface soil of uneroded Climax clay (adobe) is a dark-gray or dark grayish-brown, noncalcareous, neutral or slightly basic clay to depths of 10 to 16 inches. Its fine texture and tendency to crack to a very coarse blocky (adobe) structure make the soil difficult to work. However, if the soil is worked carefully at the proper moisture content, a moderately good seedbed can be prepared. The surface soil grades into a dark-gray or dark grayish-brown, slightly compact, medium blocky, calcareous clay subsoil. Lime is disseminated throughout the subsoil, and in some places it is also segregated in the form of small soft white specks or masses. At depths of 28 to 40 inches the subsoil grades rather rapidly into gray, calcareous, metamorphosed basic igneous bedrock.

Profile characteristics of Climax clay (adobe), moderately eroded, 20 to 35 percent slopes, are similar to those given above except for differences brought about by erosion. In a number of places the soil at the surface is calcareous and generally lighter in color than the uneroded soil. Gullies also have developed in a few places. Some of the soil on the Lick Hills is only very slightly eroded. A few small moderately gravelly or stony areas northeast of Berryessa are included.

All of this soil is cultivated. Grain hay, prunes, truck crops, and apricots are the principal crops grown. Yields of grain hay are fair, but yields of other crops are normally poor.

Climax clay (adobe), slightly eroded, 10 to 20 percent slopes (Co).—The general profile characteristics of this soil are similar to those of the moderately eroded Climax clay (adobe) but it is less steep and less eroded. In a few places the soil is calcareous at the surface, and in some places occasional gullies have developed. Some small areas of gravelly or stony soil are included.

Areas of this soil are located on the Lick Hills, east of Berryessa, and near Evergreen. All of it is cultivated. Grain hay, apricots, and truck crops are the principal crops. Yields of grain hay are normally good, but yields of other crops are mostly poor.

CROPLEY SERIES

Soils of the Cropley series occur mainly in the eastern and southern parts of the valley on very gently sloping or gently sloping small alluvial fans. The average annual rainfall is about 15 inches. The original vegetation was mainly grasses, with a few scattered oaks near stream channels. All of the soils have been cultivated for years. The parent material from which the soils are derived is alluvium deposited by small intermittent creeks heading in sandstone and shale formations.

The surface soils are dark gray or dark grayish brown, noncalcareous, moderately fine to fine-textured, and generally neutral in reaction (pH 6.6 to 7.3). The dark color of the soils is caused by the moderate content of organic matter. The surface soils grade into slightly compact dark-gray or dark grayish-brown weakly blocky

upper subsoils that are noncalcareous and neutral in recaction. The upper subsoils grade into dark grayish-brown or grayish-brown, less compact, massive, more permeable lower subsoils that are calcareous and slightly basic in reaction (pH 7.4 to 8.3). Lime occurs normally at depths of 36 to 50 inches. It is generally disseminated throughout the lower subsoils, but in some places it is segregated along small tubular pores or in small soft masses. Internal drainage is hindered somewhat by the upper subsoils, but in most orchard areas roots extend to depths of 6 or more feet.

The Cropley soils are very similar to the Dublin soils, except that the Dublin soils are noncalcareous in both surface soil and subsoil. The Cropley soils are similar to the Edenvale soils in color and reaction; however, the Edenvale soils have developed from parent material that originated in basic igneous rock areas. Soils of the Cropley series occupy about 7 square miles.

Cropley gravelly clay loam, 1 to 3 percent slopes (Cx).—The surface soil is a dark grayish-brown, noncalcareous, friable, neutral gravelly clay loam. It contains gravel that somewhat interferes with tillage. When cultivated, the soil breaks to medium-sized clods that generally can be crushed fairly easily to a coarse granular and gravelly mass. In some places a slightly compact plowpan has developed at the depth of most frequent cultivation. The surface soil grades into a slightly compact dark grayish-brown or grayish-brown, noncalcareous, neutral upper subsoil, usually at depths of 15 to 20 inches. The upper subsoil is a gravelly clay loam, and at depths of 38 to 50 inches it grades into a grayish-brown, calcareous, less compact and more permeable lower subsoil of gravelly clay loam or gravelly loam texture. Lime is generally disseminated throughout the lower subsoil. Moisture and roots penetrate the soil easily, in orchard areas to depths of 6 or more feet.

The two areas of this soil surveyed are located in the eastern part of the Area. Most of the soil is used for truck crops and grain hay, and a small area is in prunes and apricots. Yields are fairly good.

Cropley gravelly clay loam, 3 to 6 percent slopes (Cw).—These areas of Cropley gravelly clay loam are similar to Cropley gravelly clay loam, 1 to 3 percent slopes, except for relief. The soil occurs on the upper parts of small alluvial fans 2 miles northeast of Milpitas and in east San Jose. Most of this soil is in residential areas. A little is used for growing prunes and apricots.

Cropley clay loam, 1 to 3 percent slopes (Cv).—This soil has a dark grayish-brown moderately friable, noncalcareous, neutral clay loam surface soil to depths of 14 to 23 inches. The soil breaks to firm clods on cultivation, but when worked at the proper moisture content a good seedbed can be prepared. In some places, however, a slightly compact plowpan has developed at the most frequent depth of cultivation. The surface soil grades into a slightly compact, massive, noncalcareous, dark grayish-brown or grayish-brown upper subsoil of clay loam texture and of neutral reaction. Normally, at depths of 36 to 47 inches the upper subsoil grades into a grayish-brown less compact, moderately friable, permeable, calcareous lower subsoil of clay loam or loam texture.

Lime is disseminated throughout the lower subsoil, and in a few places it is segregated along small tubular pores. There may be a small amount of gravel throughout the soil profile. This gravel is partially decomposed and causes a variegation of color in the subsoil horizons. Moisture is only slightly retarded by the compaction of the upper subsoil, and tree roots penetrate to a depth of 6 or more feet. This soil is mapped entirely on alluvial fans in the eastern part of the valley.

All of the soil outside of residential areas is cultivated. Most of it is used for orchard fruits. Prunes, apricots, cherries, walnuts, truck crops, and grain hay are grown, and yields are normally good or very good.

Cropley clay loam, 3 to 6 percent slopes (Cт).—This soil occurs mainly in the eastern part of the Area on the upper parts of small alluvial fans. It is very similar to the Cropley clay loam on lesser slopes. In many places a small amount of gravel is scattered throughout the soil profile. Nearly all of the soil is cultivated, mostly to orchard fruits. Prunes, apricots, walnuts, and truck crops are the principal crops. Yields are normally good. Not all of the crops are irrigated. Where irrigation is practiced, more careful water control is necessary than for the less sloping Cropley clay loam.

Cropley clay loam, over Milpitas clay loam, 3 to 6 percent slopes (Cu).—In a few places, edges of the alluvial fans occupied by Cropley clay loam are next to or extend over the older terrace on which occur the Milpitas soils. Along these edges may occur 15 to 35 inches of Cropley clay loam soil material abruptly overlying a dense brown claypan. The claypan, which is similar to the claypan that occurs as a subsoil of Milpitas clay loam, definitely retards moisture and root penetration. The underlying material of brown or yellowish-brown rather compact clay loam is also similar to that which underlies Milpitas clay loam.

This Cropley soil occurs in small bodies in the eastern part of the Area. One small area north of Evergreen that slopes less than 3 percent is included. Prunes and apricots are grown on the soil, but yields are only fair. The favorable rooting zone is limited, and the nearly impermeable claypan allows saturation of the overlying soil at times during the winter months. The soil is best suited to shallow-rooted crops.

Cropley clay (adobe), 1 to 3 percent slopes (Cs).—The surface soil is dark-gray or grayish-brown noncalcareous clay that, on drying where undisturbed, cracks into the large more or less cubical blocks typical of adobe structure. The blocks are 6 to 15 inches across the upper surface, and the cracks are 1 or 2 inches wide and 12 to 18 inches deep. The reaction is generally neutral, although in a few places it may be slightly acid. The surface soil is difficult to work, but makes a fairly good seedbed if cultivated carefully at the proper moisture content. At depths of 12 to 20 inches, the surface soil grades into a dark-gray or dark grayish-brown, moderately compact, weakly blocky, noncalcareous upper subsoil of clay texture and neutral reaction. When dry the upper subsoil contains a few vertical cracks, and generally there is some colloidal staining along cracks and tubular pores. The upper subsoil, normally at depths from 36 to 50 inches,

grades into a grayish-brown, somewhat less compact, slowly permeable calcareous lower subsoil of clay texture. Lime is disseminated throughout the lower subsoil and is more concentrated with depth. In some places the lime is segregated along small tubular pores or in small soft masses. Water penetration is slow; it is hindered by the texture and the compaction of the upper subsoil. Tree roots penetrate the soil to depths of 6 or more feet. In a few places a small amount of gravel occurs throughout the soil profile.

Cropley clay (adobe), 1 to 3 percent slopes, is the most extensive soil of the Cropley series in this Area and is most representative of the Cropley series. Most of it occurs in the eastern part of the Area. The largest bodies are east, northeast, and southeast of Milpitas. The soil occurs on very gently sloping relief. Some areas that have clay texture and lack the adobe structure are included with this unit.

All of the soil is cultivated. Truck crops and grain hay (pl. 5, *B*) are the principal crops grown, and yields are good. Prunes and apricots are also grown, but yields are generally only fair.

Cropley clay (adobe), over Milpitas clay loam, 1 to 3 percent slopes (CR).—This soil is in an area in east San Jose where the alluvial fan material for Cropley clay (adobe) has been deposited over the older terrace materials from which soils of the Milpitas series have formed. Here the Cropley clay (adobe) soil material is 17 to 30 inches deep. It rests abruptly on a dense brown claypan similar to the claypan occurring in Milpitas clay loams. The claypan definitely retards root and moisture penetration. The underlying brown or yellowish-brown rather compact clay loam is also like that of the Milpitas soils.

Where this Cropley soil is not occupied by residences, grain hay, prunes, and apricots are grown. This soil is best suited to shallow-rooted crops.

Cropley clay (adobe), 3 to 6 percent slopes (CP).—This soil is very similar to Cropley clay (adobe), 1 to 3 percent slopes, except that the slopes are slightly steeper. The soil occupies the more sloping parts of small alluvial fans, mainly in the eastern part of the Area.

Most of the soil is cultivated. Grain hay is the principal crop grown, but there are some acreages of truck crops, prunes, and apricots.

DIABLO SERIES

Soils of the Diablo series occur mainly on the eastern hills of the Area. The average annual rainfall is about 20 inches. The original vegetation was mainly grasses, with occasional oaks near drainageways. Most of the soils are cultivated at present. Grain hay, orchard fruits, and truck crops are the principal crops grown (pl. 5, *C*). The typical relief on these soils is hilly, but some places are steep. Some erosion has occurred on most of the soils of this series.

The surface soils are dark gray, moderately fine to fine textured, and normally neutral to slightly basic in reaction (pH 7.0 to 7.6). The dark color of the soils is caused by the relatively high content of organic material. The soils crack to a coarse blocky structure of hard consistence. The soils are moderately difficult to work, but if tilled carefully at optimum moisture content, will produce a good seedbed. The surface soils grade into dark-gray or dark grayish-brown, cal-

careous, moderately fine to fine textured subsoils that are moderately basic in reaction (pH 7.6 to 8.3). Lime generally is segregated as white specks or masses against the darker colored soil material. The subsoils grade into pale-brown or light yellowish-brown, moderately consolidated, highly calcareous shale or sandstone bedrock.

The Diablo soils are associated with soils of the Altamont and Berryessa series; however, the dark-gray color of the Diablo soils differs conspicuously from the brown of those soils. The Diablo series occupies about 4½ square miles.

Diablo clay, slightly eroded, 20 to 35 percent slopes (DB).—The uneroded surface layer of the Diablo clay soils is a dark-gray neutral clay to depths of 8 to 14 inches. On drying, the soil cracks to a coarse blocky structure of hard consistence. When wet, it is plastic and sticky. The surface soil grades into a dark-gray or dark grayish-brown calcareous subsoil of clay texture and indistinct blocky structure. Lime is segregated as white specks or masses against the darker color of the subsoil. At depths of 28 to 40 inches the subsoil grades into pale-brown or light yellowish-brown, highly calcareous, moderately consolidated shale or fine-grained sandstone bedrock.

Profile characteristics of the slightly eroded Diablo clay, 20 to 35 percent slopes, are similar to those given above except for the effects of erosion. In a number of places the surface layer is calcareous because some of the original surface soil has been removed by erosion and the rest of it has been mixed with the calcareous subsoil during tillage. This soil occurs on the eastern foothills, but a few areas of rolling relief are included.

All of the soil is cultivated. Grain hay and truck crops (mainly early spring peas) are the principal crops grown. Yields of grain hay are normally good, but depend on seasonal rainfall. Yields of early spring peas are fairly good.

Diablo clay, moderately eroded, 20 to 35 percent slopes (DA).—The profile of this soil is similar to the hilly and uneroded Diablo clay profile previously described, except for differences caused by erosion. In many places the surface soil is calcareous, and in a few more severely eroded places the surface layer is gray or light brownish gray. In some places a number of gullies have formed.

This soil is extensive in the eastern hills. Some also occurs north of the Stevens Creek Reservoir dam. All of the soil is cultivated. Grain hay, prunes, apricots, truck crops, and grapes are the principal crops grown. Yields of fruits and truck crops are generally low, although quality is usually good. Yields of grain hay are fair.

Diablo clay, severely eroded, 35 to 50 percent slopes (DC).—This steep and severely eroded soil was cultivated at one time, but little use is now made of it.

Diablo clay loam, slightly eroded, 20 to 35 percent slopes (DE).—The uneroded surface soil of the Diablo clay loams is a dark-gray, friable, neutral clay loam that is usually from 6 to 13 inches in depth. On drying, where undisturbed, the soil cracks into a medium blocky structure of hard consistence. The surface soil grades into a dark grayish-brown calcareous subsoil of clay loam texture. At depths of 25 to 37 inches, the subsoil grades into light brownish-gray, calcareous, moderately consolidated, fine-textured sandstone bedrock. Lime gen-

erally is segregated in the subsoil. A few rock outcrops normally occur.

Profile characteristics of this slightly eroded phase of Diablo clay loam on 20 to 35 percent slopes are similar to those given above except that, due to erosion, the surface soil is calcareous in some places. Grain hay is the principal crop.

Diablo clay loam, moderately eroded, 20 to 35 percent slopes (DD).—This soil occurs northeast of Milpitas. It is generally calcareous at the surface, due to erosion. Grain hay and truck crops (mainly early spring peas) are the principal crops grown. This soil is not well suited to cultivated crops. Erosion must be controlled or yields will drop.

Diablo clay loam, 35 to 50 percent slopes (DF).—This soil occupies the steep slopes of a canyon formed by Arroyo de los Coches. It is not cultivated and supports a cover of grass and oaks.

DUBLIN SERIES

Soils of the Dublin series occur on very gently sloping or gently sloping small alluvial fans in the southern and western parts of the valley. The average annual rainfall varies from 15 to 20 inches. The original vegetation was mainly grasses, with occasional oaks. Most of the soils, however, have been cleared and cultivated for years. The parent material from which the soils were derived is alluvium deposited by intermittent streams heading in sandstone and shale formations.

The soils are typically moderately fine and fine textured, dark gray or dark grayish brown, deep, and slowly to moderately permeable. The dark color of the soils is caused by moderate content of organic matter. The soils are noncalcareous and neutral or slightly acid (pH 6.1 to 7.3) in the surface soils and about neutral in the subsoils. The surface soils grade into slightly or moderately compact, weakly blocky, dark-gray or dark grayish-brown upper subsoils of fine texture. There is a gradual change from the upper subsoils into grayish-brown, less compact, massive, moderately permeable lower subsoils of medium to fine texture. Drainage through the soil is fairly slow because it is retarded by the fine-textured surface soils and upper subsoils, but tree roots can penetrate the entire profile.

The Dublin soils are similar to the Cropley soils but are not calcareous in the lower subsoils. Dublin soils are mapped on about 2½ square miles.

Dublin clay loam, 1 to 3 percent slopes (DL).—The surface soil is a dark-gray or dark grayish-brown clay loam to depths of 9 to 20 inches. It crushes fairly easily to coarse granules. The surface soil grades into a dark grayish-brown or grayish-brown, slightly compact, weakly blocky upper subsoil of clay loam texture. At depths of 28 to 40 inches the upper subsoil grades into a grayish-brown less compact moderately permeable lower subsoil of loam or clay loam. The clay loam lower subsoil is not so typical of the Dublin soils as the clay (adobe), but it is more permeable. In orchard areas roots penetrate the soil to depths of 6 or more feet. Reaction is about neutral in the surface soil and subsoil.

This soil occurs near Madera Creek in the western part of the valley. A few very small areas of gravelly clay loam texture are included with this unit. Much of the soil is taken up by residences. Where it is cultivated, very good yields of prunes, truck crops, and grain hay are obtained.

Dublin clay loam, 3 to 6 percent slopes (DK).—This soil is similar to Dublin clay loams on lesser slopes. It occurs mainly on or near the campus of Stanford University. Because of its location, very little of the soil is cultivated. Some grain hay is grown.

Dublin clay (adobe), 1 to 3 percent slopes (DH).—The dark-gray clay surface soil, on drying where undisturbed, cracks into a very coarse blocky or adobe structure. The soil is difficult to work but if it is carefully cultivated at the proper moisture content, a fairly good seedbed can be prepared. Reaction is slightly acid or neutral. The surface soil grades into a dark-gray, weakly blocky, slightly acid or neutral upper subsoil at depths of 14 to 20 inches. At depths of 26 to 41 inches, the upper subsoil grades into a grayish-brown or dark grayish-brown, massive, less compact, moderately permeable lower subsoil of clay loam or clay texture and of neutral reaction.

Water penetrates the soil slowly, although tree roots reach to depths of 6 or more feet. In most places the soil is deep, but in a few small areas the Dublin soil material overlies, at depths of 4 or 5 feet, a very compact, nearly impervious claypan similar to the claypan occurring in soils of the San Ysidro series.

Dublin clay (adobe), 1 to 3 percent slopes, is mapped on small alluvial fans in the western and southern parts of the Area. Most of the soil is cultivated. It gives fair yields of prunes and apricots and good yields of grain hay and truck crops. The soil is best suited for truck and field crops.

Dublin clay (adobe), 3 to 6 percent slopes (DG).—This soil is very similar to the more nearly level Dublin clay (adobe) soils except for the stronger slopes. The soil occurs on the upper parts of small alluvial fans or along intermittent creeks in the hills near the western and southern edges of the valley.

Because of location, some areas are not cultivated. Where crops are grown, fair yields of prunes and apricots and good yields of grain hay and truck crops are obtained.

EDENVALE SERIES

Soils of the Edenvale series occur on very gently sloping or gently sloping small alluvial fans, mainly in the southwestern part of the Area. The soil material originated in areas of basic igneous and serpentinaceous rocks, in which soils of the Montara and Climax series occur. The soils have developed under an average annual rainfall of about 15 inches. The natural vegetation was mainly grasses, but most of the soils have been cultivated for years.

The surface soils are dark gray or dark grayish brown, fine textured, noncalcareous, and neutral in reaction (pH 6.6 to 7.3). They grade into slightly or moderately compact, dark-gray or dark grayish-brown, fine-textured upper subsoils that are noncalcareous and neutral to slightly basic in reaction (pH. 7.0 to 7.8). The upper subsoils grade into grayish-brown, massive but less compact, lower subsoils that are

calcareous and basic in reaction (pH 7.8 to 8.3). Lime is found in the soils at depths of 28 to 45 inches, and it is disseminated throughout the lower subsoils. The lime content generally increases somewhat with depth, and it may be segregated in light-colored, soft masses.

The soils are similar to soils of the Conejo series mapped in other soil survey areas and have developed from the same kind of parent material. The principal difference between the soils is the presence of lime in the lower subsoils of the Edenvale series. The Conejo soils are typically noncalcareous in both surface and subsoil. The Edenvale soils occupy slightly more than 1 square mile.

Edenvale clay (adobe), 1 to 3 percent slopes (EB).—The surface soil of Edenvale clay (adobe), 1 to 3 percent slopes, is a dark-gray or dark grayish-brown, noncalcareous, neutral clay that, on drying in an undisturbed state, cracks into the large more or less cubical blocks typical of adobe structure. The blocks are 8 to 15 inches or more across the upper surface, and the cracks are frequently 1 to 2 inches wide and 12 to 18 inches deep. Cultivation, however, destroys most of this natural structure. The surface soil is difficult to work, but if it is cultivated at the proper moisture content, a fairly good tilth can be produced. At depths of 15 to 20 inches, the surface soil grades into a dark-gray or dark grayish-brown, noncalcareous, moderately compact, clay-textured upper subsoil. This layer is of weak blocky structure and has some vertical cracks when dry. The upper subsoil grades into a grayish-brown, calcareous, less compact, slowly permeable, clay-textured lower subsoil at depths of 28 to 45 inches. Lime is disseminated throughout the lower subsoil and becomes more concentrated with depth. In some places lime is segregated in small soft masses. In some places a little gravel occurs throughout the soil profile. The clay texture and the moderately compact upper subsoil slow water penetration and retard root growth, although tree roots may reach to depths of at least 6 feet.

Most of this soil is in the southeastern part of the Area and near Coyote Creek. On one small area which is flooded annually, some alluvium has recently been deposited. Most of the soil is cultivated. Fair yields of prunes, apricots, and truck crops and good yields of grain hay are generally obtained.

Edenvale clay (adobe), 3 to 6 percent slopes (EA).—In profile characteristics this soil is similar to Edenvale clay (adobe) on 1 to 3 percent slopes. The soil occurs on small alluvial fans in the southeastern part of the Area. Most of it is cultivated. Fair yields of prunes and apricots and good yields of grain hay are obtained.

GAVIOTA SERIES

Soils of the Gaviota series occur mainly on the higher hills in the eastern part of the Area and to some extent on the hills near the southern edge of the valley. The average annual rainfall is 20 to 25 inches. Natural vegetation is predominantly grasses and scattered oaks, with brush on some of the steeper slopes (pl. 2, *A*). In some places the soils are cultivated, but most areas are used for grazing. These soils occupy the largest area of grazing land in the survey. The typical relief of the soils is hilly, but many slopes are steeper than

this. Nearly all areas that have been cultivated or grazed intensively have been eroded.

The surface soils are grayish brown or brown, medium textured, and normally neutral in reaction (pH 6.6 to 7.3). They overlie brown, medium-textured, noncalcareous subsoils that are generally neutral or slightly basic in reaction (pH 6.6 to 7.5). The subsoils usually have an indefinite structure, although in some places they crack to a weak prismatic structure. The subsoils grade irregularly into well-consolidated sandstone, shale, or conglomerate bedrock. Although the bedrock may be calcareous, the soils are typically noncalcareous. In most places there are some rock outcrops.

The soils generally lie above soils of the Altamont, Diablo, and Berryessa series, and normally the Gaviota soils are coarser textured and shallower than those lower lying soils. In some places, the Gaviota soils are mapped as a complex with the Altamont soils or with the Ayar soils. The Gaviota soils of this series occupy about 17 square miles, including the areas of complex association with other soils.

Gaviota loam, 20 to 35 percent slopes (GK).—The surface soil is a grayish-brown friable neutral loam to depths of 6 to 10 inches. It grades into a grayish-brown or pale-brown very slightly compact loam subsoil. In most places the subsoil contains some fragments of bedrock, the number increasing with depth. Well-consolidated sandstone bedrock normally occurs at depths of 15 to 25 inches. In many places the bedrock contains numerous shell fossils and is moderately calcareous.

Gaviota loam, 20 to 35 percent slopes, is associated mainly with other soils of the Gaviota series. South of Alamitos the soil has rolling instead of hilly relief. None is cultivated. The natural cover is trees and grass or grass. This soil is used mainly for grazing, and its carrying capacity is normally fairly good.

Gaviota loam, slightly eroded, 20 to 35 percent slopes (GM).—This soil is extensive in the northeastern part of the Area on the Los Buellis Hills. It is used mainly for range. The slight erosion in these noncultivated areas has resulted largely from overgrazing. The soil is similar to Gaviota loam, 20 to 35 percent slopes, except for small differences due to erosion. A few gullies have developed. Some of the soil has been cultivated for grain hay, but most of it is grazed.

Gaviota loam, moderately eroded, 20 to 35 percent slopes (GL).—This soil is like the slightly eroded Gaviota loam but is more eroded. In many places the lighter colored subsoil shows, and in a few places bedrock crops out. The soil occurs on the Santa Teresa Hills, and all of it is cultivated. Prunes, apricots, and grapes are the principal crops. Yields are poor and depend entirely on seasonal rainfall. This soil is poorly suited for cultivated crops. Erosion cannot be checked while this soil is in cultivation.

Gaviota loam, 35 to 50 percent slopes (GN).—The largest area of this soil is southeast of Evergreen. Other areas are in the eastern hills. None of this soil is cultivated. The natural cover is grass, brush, or trees and grass. These areas are used mostly for grazing, along with other soils of the Gaviota series.

Gaviota loam, moderately eroded, 35 to 50 percent slopes (Go).—This soil in the eastern hills is like the other soils of the Gaviota series except for differences of slope and erosion. Grazing is the main use, but small areas have been cultivated for grain hay and truck crops. This soil should not be cultivated. Less intense grazing is needed to control erosion.

Gaviota stony loam, 20 to 35 percent slopes (Gs).—The soil occurs in small isolated bodies among cultivated fields. Areas are on Lone Hill, southwest of Alamitos, and south of Alamitos. Little use, even for grazing, is made of the soil. It is considerably shallower than the Gaviota loams, and enough stones and rock outcrops are present to make the soil practically untillable. The natural cover is trees, trees and grass, or brush. In some places the slope is much less steep than the typical 20 to 35 percent.

Gaviota gravelly loam, 20 to 35 percent slopes (GA).—The surface soil is a brown or grayish-brown friable neutral gravelly loam, 5 to 11 inches thick. It grades into a brown, slightly compact, noncalcareous gravelly loam subsoil. Normally the subsoil contains more gravel than the surface soil. The gravel increases with depth. The subsoil grades into a well-consolidated conglomerate bedrock at depths of 14 to 23 inches.

This soil occurs southeast of Evergreen. It is not cultivated, and it supports a cover of grass or trees and grass. It is used chiefly for grazing, along with other soils of the Gaviota series.

Gaviota gravelly loam, moderately eroded, 20 to 35 percent slopes (GB).—This soil is like that just described except for the effects of erosion. Some areas east of Los Gatos are more severely eroded and contain some reddish terrace material. Near Lone Hill the slopes are less steep than is usual for the series. This soil also occurs southeast of Evergreen.

The soil has been and is now used mainly for orchard fruits. It is not suited to cultivated crops. In most places you would have to take the soil out of cultivation to control erosion.

Gaviota gravelly loam, 35 to 50 percent slopes (Gc).—This steep soil is shallower than moderately eroded Gaviota gravelly loam and has more rock outcrops. It occurs southeast of Evergreen. The soil is not cultivated. The natural cover is mainly grass or trees and grass. The soil is used for grazing with other Gaviota soils.

Gaviota stony soils, undifferentiated, 50+ percent slopes (GP).—These soils occur in the northeastern part of the Area, on the eastern hills, and on the hills near the southern edge of the valley. These are Gaviota soils on broken and very steep slopes. They cannot be cultivated because of many rock outcrops and very steep slopes. The soils are much shallower and stonier than other members of the Gaviota series but are like them in other profile characteristics. Near Alamitos the bedrock has been quarried for building stone.

The plant cover is mostly scattered brush, grass, and some trees. Grazing is the principal use of these areas, but the carrying capacity is rather low (pl. 4, *B*).

Gaviota loam-Altamont clay loam, 20 to 35 percent slopes (GD).—This complex is an intricate association of hilly phases of Gaviota

loam and Altamont clay loam, both previously described. It occurs north of Felt Lake in the northwestern part of the Area. The soils have developed from nearly the same kind of shale or fine-grained sandstone parent rock, the surface soils are similar in color, and depths to bedrock have about the same range. The subsoil of Altamont clay loam is normally calcareous, but the Gaviota loam is noncalcareous throughout its profile.

These soils are not cultivated. They support a natural cover of grass or trees and grass. The areas are used principally for grazing, and the carrying capacity is normally good.

Gaviota loam-Altamont clay loam, moderately eroded, 20 to 35 percent slopes (GE).—This complex is like Gaviota loam-Altamont clay loam, 20 to 35 percent slopes, except for the effects of moderate erosion. It occurs on the hills east of Los Gatos and south of the Union School. A few small severely eroded areas are included. All of the acreage is cultivated. Apricots, prunes, and grain hay are the main crops, and yields are normally poor. In most places this complex should be taken out of cultivation to prevent further erosion.

Gaviota loam-Altamont clay loam, 35 to 50 percent slopes (GF).—This complex is located on the hills east of Los Gatos and south of the Union School. None of it is cultivated. The natural plant cover is mostly trees and grass. Most of the acreage is used for grazing, and the carrying capacity is fairly good.

Gaviota loam-Altamont clay loam, moderately eroded, 35 to 50 percent slopes (GG).—This unit is mapped south of the Union School, where cultivation of steep areas of the Gaviota loam-Altamont clay loam complex has caused erosion. The principal crop is apricots, and yields are poor. This complex is not suited to cultivation.

Gaviota loam-Altamont clay loam, severely eroded, 35 to 50 percent slopes (GH).—All areas of this complex have been or are being cultivated, but yields are poor. The main crops are apricots, grain hay, prunes, and grapes. This complex should be taken out of cultivation to prevent further erosion.

Gaviota stony loam-Ayar stony clay, 20 to 35 percent slopes (GR).—This is an intricate association of Gaviota stony loam and Ayar stony clay on two hills southwest of Alamitos. A few very small areas of soil similar to Altamont clay loam also occur in this complex.

Gaviota stony loam is typically noncalcareous throughout its profile, but Ayar stony clay is typically calcareous in both surface soil and subsoil. Both soils are derived from sandstone and shales, and the differences in the soils mostly reflect differences in the parent rock. A description of Gaviota stony loam, 20 to 35 percent slopes, has been given previously. Ayar stony clay, 20 to 35 percent slopes, is similar to Ayar clay, 10 to 35 percent slopes, except it has steeper slopes, shallower depth, and many stone and rock outcrops.. None of this complex is cultivated. The stones prevent any use except grazing. The natural cover is grass and a few trees.

HOVEY SERIES

Soils of the Hovey series occur on terrace or old valley-fill materials near Coyote Creek in the southeastern part of the Area. The average

rainfall is about 15 inches. The original vegetation was mostly grasses. Most of the soils have been or are under cultivation. The typical relief is rolling, with slopes of 10 to 20 percent. The Hovey soils differ noticeably from other soils on the terraces or old valley-fill materials, mostly because the parent material of the Hovey series came from basic igneous rocks.

The surface soils are dark gray or dark grayish brown, fine textured, slightly or moderately calcareous, and basic in reaction (pH 7.4 to 8.0). Although of fine texture, the soils are relatively easy to work, and an excellent seedbed can be produced if the soils are tilled at the proper moisture content. The surface soils overlie moderately compact upper subsoils that are fine textured, moderately blocky, and of dark grayish-brown or dark-gray color. The upper subsoils are basic in reaction and moderately or highly calcareous, but the lime is mostly scattered throughout the soil mass. The lower subsoils are grayish-brown or gray fine-textured material that is basic in reaction and highly calcareous. Lime is separated out as white masses in the darker soil material. The lower subsoils grade into pale-brown or light brownish-gray calcareous underlying terrace material of fine texture. In some places a little gravel occurs throughout the soil profiles. The Hovey soils occupy less than one-half square mile.

Hovey clay, 10 to 20 percent slopes (HA).—The surface soil is a dark-gray or dark grayish-brown, friable, calcareous clay to depths of 7 to 16 inches. The soil produces a good seedbed when tilled at the proper moisture content. The surface soil grades into a moderately compact, moderately blocky, calcareous upper subsoil of clay texture and dark-gray or dark grayish-brown color. At depths of 20 to 28 inches the upper subsoil grades into a highly calcareous, gray or grayish-brown, clay-textured lower subsoil. Lime in this horizon is separated out, mostly as soft white masses, but in some places as a few hard calcareous nodules. The lower subsoil grades into pale-brown or light brownish-gray calcareous underlying material at depths of 30 to 43 inches. The underlying material is unconsolidated old valley-fill material of variable but generally fine texture. As mapped in this area the soil profile of Hovey clay varies. A few small areas of gravelly clay and gravelly clay loam are included, and in these areas the soil has much less lime and browner color than is usual for this series.

One body of this soil occurs near the Coyote Creek percolation dam. Most of it has been cultivated at some time, and very slight erosion has taken place. At present, grain hay is the main crop. Some areas are used for grazing.

Hovey clay, slightly eroded, 10 to 20 percent slopes (HB).—The slightly eroded areas of Hovey clay differ from the soil just described mainly in degree of erosion. The surface soil is somewhat more shallow. In a few small areas where the erosion has been more severe, the lighter colored and highly calcareous lower subsoil is exposed. The soil varies in profile characteristics, and some small areas of gravelly clay loam and gravelly clay are included.

A little of this soil occurs near the Coyote Creek percolation dam. Grain hay, apricots, and prunes are grown. Yields are fair for tree fruits and fairly good for grain hay.

HUGO SERIES

Soils of the Hugo series are the principal timbered soils of the Area. They occur only on the Santa Cruz Mountains at the southwestern boundary of the Area. Elevations vary from about 800 feet to a little more than 2,200 feet. The average annual rainfall is 35 to 45 inches. The natural vegetation is mainly redwood, Douglas-fir, and associated plants (pl. 2, *B*) (see section on vegetation). The typical relief on these soils is hilly, but large areas of steep relief occur. In some places the soils have been cleared and cultivated for grapes and orchard fruits. In nearly all places where cultivated, the soils have eroded significantly.

The surface soils are pale brown or grayish brown, moderately coarse to moderately fine textured, and slightly or medium acid in reaction (pH 5.6 to 6.5). Under natural conditions a 2- or 3-inch layer of litter and humus lies over the surface soil. The uncultivated surface soil is distinctly darker in color and less acid in reaction than the cultivated surface soil. The surface soils grade into pale-brown or grayish-brown moderately coarse to moderately fine textured subsoils that are usually strongly to very strongly acid in reaction (pH 4.5 to 5.5). In most places some rock fragments occur in the subsoils; the number and size of the fragments increase with depth. The subsoil grades irregularly into moderately or well consolidated acid sedimentary bedrock, mainly lower Miocene marine sediments.

In this Area the Hugo soils are associated with the brush-covered soils of the Los Gatos series, which have developed from the metamorphosed sedimentary rocks of the Franciscan formation. In many places the boundary between the soils of these two series and their distinctly different types of vegetation is very sharp and coincides with the San Andreas fault line. Hugo soils in this Area cover about 31 square miles.

Hugo clay loam, slightly eroded, 20 to 35 percent slopes (Hc).—The uneroded surface soil is a grayish-brown, friable, slightly or medium acid coarse clay loam to depths of 8 to 13 inches. The soil is fairly easily crushed to a coarse granular mass. The surface soil grades into a grayish-brown or pale-brown slightly compact subsoil of clay loam texture. The subsoil generally contains rock fragments, which increase in number and size with depth. At depths of 18 to 30 inches the subsoil grades irregularly into partly decomposed shale bedrock. The slightly eroded soil differs mainly in being lighter or paler colored, more acid in reaction, and somewhat more shallow in depth.

This soil is associated with other soils of the Hugo series on the Santa Cruz Mountains. A few small moderately eroded areas and a few areas that are only very slightly eroded are included.

Nearly all of this soil is cultivated. Grapes, prunes, and other fruits are the main crops grown. The soils do not have enough plant nutrients. Balanced fertilization would improve yields, but little fertilizer is used. Crop yields are poor to fair. Erosion control is necessary for proper cultivation.

Hugo clay loam, slightly eroded, 3 to 20 percent slopes (He).—This soil is like the slightly eroded soil just described, except that the slopes are less steep. It occurs in small bodies near Holy City, near

Alma, and near the Montezuma School. A few areas that are only very slightly eroded are included. Prunes, apples, and other orchard fruits are grown on the soil. Yields are usually fair.

Hugo clay loam, moderately eroded, 10 to 20 percent slopes (HDQ).—This soil is like the slightly eroded soil just described, except for more severe erosion. In many places the subsoil is exposed, and in some places the bedrock beneath is exposed. A few small areas of undulating relief and a small severely eroded area are included. All of the soil is or has been cultivated. The chief crops are prunes and apples. Yields are poor.

Hugo loam, slightly eroded, 20 to 35 percent slopes (HG).—In the Santa Clara Area, all areas of Hugo loam are more or less eroded. An uneroded surface soil of this type is a pale-brown or grayish-brown, friable, slightly or medium acid loam to depths of 6 to 11 inches. The soil is easily worked; it breaks to a cloddy tilth that can be reduced easily to a granular mass. The surface soil grades into a pale-brown friable subsoil of loam or fine sandy loam texture. Ordinarily some rock fragments occur in the subsoil and increase in number with depth. At depths of 16 to 34 inches the subsoil grades irregularly into partly decomposed sandstone bedrock.

Hugo loam, slightly eroded, 20 to 35 percent slopes, differs from the above description in being lighter or paler colored, more acid in reaction, and somewhat more shallow. Most of it is located near the crest of the Santa Cruz Mountains. Some stony areas are northwest of Black Mountain and are shown on the map by stone symbols.

Prunes, other orchard fruits, and grapes are the principal crops grown. Yields are usually poor to fair, but the quality is often good.

Hugo loam, moderately eroded, 20 to 35 percent slopes (HF).—These moderately eroded areas differ from the slightly eroded areas on the same slopes chiefly in degree of erosion. The soil is somewhat more shallow, a few gullies have developed, and in some places bedrock is exposed. The soil is associated with other Hugo soils in the Santa Cruz Mountains. A few small severely eroded areas are included.

The soil is used mainly for fruits, chiefly prunes and apples. Yields are generally poor. Some areas have been abandoned and have gone back to grass and brush.

Hugo loam, slightly eroded, 3 to 20 percent slopes (HL).—This soil profile is very much like that of other areas of Hugo loam. The soil is associated with other Hugo soils in the Santa Cruz Mountains. A few areas where erosion is very slight are included.

The soil is used mainly for prunes, apples, and other fruits. Yields are only fair, but in most places the quality of the fruit is good.

Hugo loam, moderately eroded, 10 to 20 percent slopes (HH).—This soil is like the soil just described except that it is steeper and more eroded. In most places the original surface soil is gone, and in a few small areas bedrock is exposed. The soil is associated with other Hugo soils. Orchard fruits are grown on the soil, but yields are generally poor.

Hugo loam, severely eroded, 35 to 50 percent slopes (HK).—This soil occurs on the Santa Cruz mountains. Severe erosion has removed

most of the soil and exposed many areas of bedrock. Many areas formerly cultivated have been abandoned and have gone back to grass, brush, and in some places coniferous trees. A few small moderately eroded areas are included.

Hugo sandy loam, moderately eroded, 20 to 35 percent slopes (HM).—The uneroded surface soil of Hugo sandy loam is a pale-brown or grayish-brown, very friable, slightly or medium acid sandy loam to depths of 6 to 13 inches. The soil is easily worked to an excellent tilth. Beneath the surface soil is a pale-brown or grayish-brown very friable more acid sandy loam subsoil that usually contains some rock fragments. At depths of 18 to 32 inches the subsoil grades irregularly into moderately consolidated sandstone that is partly decomposed and disintegrated.

Hugo sandy loam, moderately eroded, has a profile like the one described above, except that the surface soil is paler and generally more acid, and the soil profile is much more shallow. The soil occurs on the Santa Cruz Mountains. A few small slightly eroded areas are included. Some small areas of Hugo fine sandy loam are combined with this sandy loam.

All of this soil is or has been cultivated. Prunes and other fruits are the main crops. Yields are generally poor. Erosion is hard to control where the soil is cultivated.

Hugo sandy loam, slightly eroded, 10 to 20 percent slopes (Ho).—This soil is much like the moderately eroded Hugo sandy loam except that it is less sloping and less eroded. It is associated with other Hugo soils, and the crops are similar.

Hugo sandy loam, severely eroded, 10 to 20 percent slopes (HN).—A few small moderately eroded areas are included in this severely eroded soil. All of the soil is or has been cultivated. It is associated with other soils of the Hugo series, and similar crops are grown. Yields are very poor, and some areas have been abandoned.

Hugo soils, undifferentiated, 35+ percent slopes (HP).—These undifferentiated Hugo soils are the largest unit of Hugo soils mapped in the Santa Clara Area. They occur on steep slopes, some of more than 50 percent. Nearly all of the original timber of the Santa Clara Area was on soils of the Hugo series, and all of the present timber of the Area is located on the steep soils of this unit (see section on vegetation). They are naturally well suited to timber production and to recreation. Many summer homes and recreational areas are located on these soils; the most thickly settled area is on the Los Gatos Creek drainage. The soils are cultivated only for home gardens. A few small areas could be cultivated successfully if erosion were controlled carefully enough. The most common type in this mixed unit is Hugo loam, but some fair-sized areas of Hugo clay loam and Hugo sandy loam are included.

Hugo stony soils, undifferentiated, 50+ percent slopes (HR).—This unit is mapped near the crest of Castle Rock and near Croy Ridge in the southern part of the Area. These soils are very shallow and have many rock outcrops. The natural growth is brush, madrone, and associated woody plants. A few coniferous trees also grow, but in general these areas are much less valuable for timber production than the less steep areas. These areas are almost worthless.

KITCHEN MIDDENS

A few small areas that were once used as campsites by Indians are separated and classified as Kitchen middens (Ka). The soil material is dark gray, friable, and calcareous. It was formed from a mixture of soil materials, ashes, charcoal, shell fragments, stones, and a few bones. These areas are usually slightly higher than adjacent land. In most places unaltered soil material, normal to the soil on which the campsite was made, occurs within a few feet of the surface.

Areas recognized and mapped as Kitchen middens are located as follows: ½ mile west and 1½ miles northwest of Berryessa, ¼ mile east of Edenvale, 1½ miles north of Sunnyvale, and ⅔ mile northeast of the Whisman School (north of Mountain View). Most areas of Kitchen middens have been cultivated.

LOS GATOS SERIES

Soils of the Los Gatos series cover much of the Area. Large areas occur near New Almaden and on the eastern parts of the Santa Cruz Mountains, especially on Monte Bello Ridge and Sierra Azul. Elevations range from about 600 feet to nearly 3,500 feet. The soils have developed under an average annual rainfall of 25 to 40 inches. The natural vegetation is almost entirely a dense growth of brush. The soils are cultivated in a few places where not too steep or stony. The main crops grown are wine grapes and orchard fruits. The typical slopes of the soil range from 20 to 35 percent, but some slopes are as gentle as 10 percent and some are more than 50 percent. Cultivation has generally resulted in erosion.

The surface soils are brown (becoming nearly reddish brown when moist), moderately fine textured, friable, weakly granular, and slightly or medium acid in reaction (pH 5.5 to 6.6). They grade into brown or reddish-brown slightly compact subsoils of finer texture than the surface soils. Reaction is slightly or medium acid (pH 5.5 to 6.6). In most places some rock fragments occur in the subsoils. The number and size of the fragments increase with depth. The soils are underlain by hard but generally broken or shattered shale or sandstone that has undergone varying degrees of metamorphism.

The Los Gatos soils, and in places the associated Maymen soils, follow closely the Franciscan geologic formation as it occurs in the Santa Cruz Mountains. The western boundary of this formation and also the western boundary of the Los Gatos soils coincide with the San Andreas fault line for a considerable distance. West of this line occur the timber-covered soils of the Hugo series. In many places the change from Hugo soils to Los Gatos soils, and also the change in the typical vegetation that occurs on these soils, is very sharp and distinct. In general the Hugo soils occur under somewhat higher rainfall than the brush-covered Los Gatos soils, but in many places it appears that the change in vegetation is due more to a difference in soils than to a difference in climate. Soils of the Los Gatos series, as separated on the map, occupy nearly 8 square miles; however, large areas of Los Gatos soils undifferentiated from the Maymen soils occur on very steep and stony slopes.

Los Gatos clay loam, 20 to 35 percent slopes (La).—The surface soil is a brown, weakly granular, friable, slightly or medium acid clay

loam to depths of 6 to 14 inches. The soil breaks to a medium cloddy tilth that is readily reduced to a coarse granular mass under cultivation. The surface soil grades into a slightly or moderately compact brown or reddish-brown subsoil of clay loam texture. Rock fragments are present in the subsoil and in a few places in the surface soil. The subsoil grades irregularly into hard, broken metamorphosed sedimentary rock at depths of 26 to 38 inches. A few small areas of Permanente soil on crystalline limestone and Montara soil on serpentine rock are included in areas of this soil.

Areas are located on the hills south of Felt Lake, near Black Mountain and along the crest of the southern part of Monte Bello Ridge, northwest and south of Permanente, and on hills and mountains in the southern part of the Area. In most places the soil occurs along the crest of ridges in close association with very steep and stony areas of Los Gatos and Maymen soils. The areas are not cultivated. The soil supports a natural cover of grass, trees and grass, or brush. In some places where grass predominates the soil is used for grazing.

Los Gatos clay loam, slightly eroded, 20 to 35 percent slopes (Lc).—These areas differ from the noneroded areas just described mainly in degree of erosion. In a number of places the exposed soil is somewhat redder and somewhat finer textured than typical because of partial or complete removal of the surface soil and mixture with part of the subsoil by cultivation.

Areas of this soil are located along the crest of Monte Bello Ridge, just west of the Stevens Creek Reservoir, near Los Gatos, and south of Lone Hill. All areas are cultivated. The principal crops are grapes and apricots. Yields are fair for grapes but generally poor for apricots. The quality of grapes for making wine is reported to be excellent, and the quality of apricots is also generally good.

Los Gatos clay loam, moderately eroded, 20 to 35 percent slopes (Lb).—This soil is like the noneroded Los Gatos clay loam except that the exposed soil is redder in color, somewhat shallower, and contains a few gullies. Small areas occur on Monte Bello Ridge near Saratoga and Los Gatos, south of Lone Hill, and west of Guadalupe. It is usually associated with the slightly eroded soil, but a few small severely eroded areas are included. All of this soil has been or is being cultivated, and the principal crop is grapes. Yields are normally poor, but quality for wine is very good.

Los Gatos clay loam, slightly eroded, 10 to 20 percent slopes (Ld).—Except for gentler slopes and more erosion, this soil is similar in profile characteristics to the uneroded Los Gatos clay loam on slopes of 20 to 35 percent. It is associated mainly with other Los Gatos clay loams.

Areas of this soil occur in the extreme southern part of the Area, northeast of Mount Chvai, west of the Guadalupe Reservoir dam, near Los Gatos, and near the Stevens Creek Reservoir. In a few places the soil is moderately eroded, and one small area has undulating relief. Wine grapes and orchard fruits are the principal crops grown. Yields are normally fair for grapes and poor for orchard fruits. However, the quality of grapes for wine is reported to be excellent.

Los Gatos clay loam, severely eroded, 35 to 50 percent slopes (LE).—Erosion has removed the surface soil and part of the subsoil from this soil, and in most places the exposed soil is distinctly redder than the typical Los Gatos surface soil. The depth to bedrock is usually much less than that of the less eroded soils. A few moderately eroded areas are included.

Small areas of this soil occur near Wrights and Los Gatos, near the Stevens Creek Reservoir, and near Black Mountain. Grapes and orchard fruits are grown on the soil. Yields are generally very poor. Some areas of this soil are abandoned and have reverted to grass or brush.

Los Gatos-Maymen stony soils, undifferentiated, 50+ percent slopes (LF).—One of the most extensive units in the Santa Clara Area consists of very steep and stony areas of Los Gatos and Maymen soils. Slopes are steep, and in most places rock outcrops are numerous. No areas are cultivated. The vegetation is a dense growth of brush, the chief value of which is for watershed protection. Most of the very steep areas on Monte Bello Ridge, on the Sierra Azul, and near New Almaden are mapped in this unit.

The soils have very little agricultural value. The Los Gatos soils predominate, but in some places fairly large areas of Maymen soils occur. Because of the very steep and stony surface and the dense brush cover, no attempt was made to map the soils separately.

LOS TRANCOS SERIES

The soil of the Los Trancos series occurs inextensively on hills in the western and southern parts of the Area. The average annual rainfall is about 20 inches. The natural vegetation is mainly grass or grass and a few trees. The soil has developed from basic igneous rock (mainly diabase) of the Miocene period.

The surface soil is grayish brown or dark grayish brown, fine textured, and slightly or medium acid in reaction (pH 5.6 to 6.5). At a very shallow depth it grades rapidly but very irregularly into hard but generally broken volcanic bedrock. Numerous small rock outcrops and the very shallow depth of the soil make it untillable.

The soil is associated with but unrelated to soils of the Gaviota series. Only Los Trancos stony clay, 10 to 35 percent slopes, is mapped in this Area. It occupies less than 1 square mile.

Los Trancos stony clay, 10 to 35 percent slopes (LG).—The surface soil is a grayish-brown or dark grayish-brown, slightly or medium acid stony clay that normally is only a few inches to about 10 inches deep. When dry, the soil cracks to a fine blocky structure of hard consistence. When wet, it is plastic and sticky. The soil grades quickly but very irregularly into vesicular volcanic bedrock that in most places is fairly well broken or shattered. Because of unequal weathering of the bedrock, the soil varies greatly in depth within short distances.

Small areas of this soil are on the southern and western foothills, and larger areas are northeast of Felt Lake. None of this soil is cultivated. It is used entirely for grazing, although the carrying capacity is normally low.

MADE LAND (OVER ALVISO SOIL MATERIAL)

Made land (over Alviso soil material) (Ma) is a fill of earth and refuse over Alviso soil material or over Tidal marsh. It occurs northwest of Milpitas, at Alviso, north of Mountain View, and at the Palo Alto Yacht Harbor. Because sea water has seeped into these areas, most of this land is strongly affected by alkali. This land type is of little agricultural value.

MAYMEN SERIES

Soils of the Maymen series occur on the Santa Cruz Mountains, mainly in the southern part of the Area. The soils have developed under an average annual rainfall of 25 to a little more than 40 inches. The natural vegetation consists almost entirely of a dense cover of brush. Elevations range from about 1,000 feet to 3,800 feet (the summit of Loma Prieta lies within the area of these soils). Some attempts have been made at cultivation, but the shallow soils and resultant erosion forced abandonment of most of these areas.

The surface soils are light brown or pale brown, medium textured. friable, and slightly to medium acid in reaction (pH 5.5 to 6.6). They overlie light-brown or light reddish-brown medium-textured subsoils that are normally somewhat more acid than the surface soils. In most places rock fragments occur in the subsoils and in the surface soils. The subsoils grade irregularly at shallow depths into hard sandstone or conglomerate bedrock. In some places the parent material has undergone some metamorphism.

In profile characteristics and in parent rock, the Maymen soils are somewhat like the soils of the associated Hugo and Los Gatos series. Soils of the Maymen series occupy about 24 square miles in the Santa Clara Area.

Maymen loam, moderately eroded, 20 to 35 percent slopes (Mc).—The surface soil is a light-brown or pale-brown, friable, slightly or medium acid loam to depths of 6 to 10 inches. In most places some rock fragments are present. The surface soil grades into a light-brown or light reddish-brown friable loam subsoil that contains numerous rock fragments. At depths of 11 to 16 inches, the subsoil grades into hard sandstone or conglomerate bedrock. The soil is typically shallow and very poor for agricultural use.

The soil occurs in small scattered areas on Sierra Azul and Monte Bello Ridge. Many areas of this soil were once cultivated and then abandoned and allowed to go back to brush and grass. In some places wine grapes and a few orchard crops are grown. Yields are normally very poor.

Maymen loam, severely eroded, 20 to 50 percent slopes (Mb).—This unit consists of hilly and steep areas of Maymen loam that once were cultivated and where severe erosion took place. Most of the soil is located on Sierra Azul, and a few areas are on Monte Bello Ridge. The areas are abandoned and in most places have gone back to brushy vegetation. This soil is very poorly suited to cultivation and should be left under its natural cover of brush.

Maymen loam, slightly eroded, 10 to 35 percent slopes (Md).—This soil is associated with other Maymen soils and with soils of the Los Gatos series, mostly on Monte Bello Ridge. Very little is cultivated; most areas are used for grazing.

Maymen stony soils, undifferentiated, 50+ percent slopes (ME).—By far the major part of the Maymen soils are mapped in this unit. Rock outcrops are numerous. The natural vegetation consists of a very dense growth of brush (pl. 4, *C*). Large areas of these soils occur near Loma Prieta, and some are east of Los Gatos. The soils have practically no agricultural value, and the principal use is as a watershed.

MILPITAS SERIES

Soils of the Milpitas series occur in the southeastern part of the Area on undulating and rolling terraces. The soils have had good surface drainage and an average annual rainfall of about 20 inches during development. The original vegetation was mainly grasses and occasional oaks. At present most of the soils are cultivated. Orchard fruits are the principal crop. The typical slopes of the soils range from 4 to 10 percent, but some slopes range up to 20 percent. Erosion has occurred in a number of places. An outstanding characteristic of the Milpitas series is a dense and compact claypan subsoil.

The surface soils are brown or pale brown, friable, and slightly or medium acid in reaction (pH 5.6 to 6.5). They overlie slightly more reddish-brown, dense, compact claypan subsoils that are normally of clay texture and of medium or slightly acid reaction (pH 5.6 to 6.5). The subsoils, when moist, are massive and plastic in consistence. On drying they tend to crack to a weak prismatic structure. In most places the soil material immediately above the subsoils is somewhat mottled with rust-brown and light-gray streaks or spots. The subsoils grade into moderately compact, pale-brown, yellowish-brown, or brownish-yellow gravelly or slightly gravelly underlying terrace material, generally of neutral reaction (pH 6.6 to 7.3). In a few places the underlying material is slightly calcareous and moderately basic in reaction (pH 7.8 to 8.3), and in other places it is moderately acid (pH 5.6 to 6.0).

In most places the terrace material is unconsolidated. In a few places where less gravel is present, the material appears to be partially consolidated. Generally dark-colored manganese stains are present in the underlying material. The claypan subsoils very definitely retard water and root penetration, and during the winter months the surface soils are frequently water saturated. In claypan development, the Milpitas soils are similar to soils of the Positas series, but the latter are reddish brown in color. The soils of the Milpitas series occupy about 14 square miles.

Milpitas loam, 3 to 10 percent slopes (MG).—The surface soil is a pale-brown, friable, slightly or medium acid loam that normally reaches to depths of 9 to 21 inches. The soil is easily worked and breaks to medium-sized clods that are readily crushed to a coarse granular mass. The surface soil grades rapidly into a compact, slightly more reddish, claypan subsoil. This claypan retards drainage and causes the surface soil to be waterlogged frequently during the winter. In most places the soil material just above the claypan is somewhat mottled with rust-brown and light-gray streaks or spots. At depths of 28 to 43 inches, the subsoil grades into pale-brown, yellowish-brown, or brownish-yellow moderately compact terrace material of sandy clay, sandy clay loam, or gravelly clay loam texture. Gen-

erally dark-colored manganese stains are present in this material, and in a few places the material is partially consolidated.

Milpitas loam of 3 to 10 percent slopes is not mapped extensively. Most of it is south of East San Jose and near Evergreen. Southwest of Evergreen and along Silver Creek the soil is somewhat darker colored than typical of the series. To the northeast and east of Evergreen a few very small areas with slopes less than 3 percent are included. Some small areas of this soil south of Palo Alto are more rust-brown mottled and more acid in the subsoil and underlying material than typical.

Most of this soil is cultivated. Nonirrigated prunes, apricots, and grain hay are the principal crops. Some areas are used mainly for pasture. In most places the soil is very slightly eroded, but erosion is not a serious problem in the use of this soil. Yields of prunes and apricots are poor, and the life of trees is relatively short (pl. 6, *A*). The water-saturated surface soil during the winter months favors the development of the "sour-sap" disease affecting orchard trees, particularly apricots. Yields of grain hay are generally fairly good.

Milpitas loam, slightly eroded, 10 to 20 percent slopes (MH).—This soil has eroded slightly in many places and moderately in a few places. Occasional gullies have formed. A few areas are only very slightly eroded, and a small area with hilly relief is moderately eroded. The soil is similar to Milpitas loam on lesser slopes, although erosion has left the surface soil shallower, and somewhat more reddish-brown than typical, because of mixture with the subsoil. Erosion control practices are essential in the proper cultivation of this soil.

The soil occurs along the eastern and southeastern edges of the valley. Most of it is cultivated. Nonirrigated apricots, prunes, grapes, and grain hay are the principal crops grown (pl. 2, *A*). Yields of fruits are mostly poor, but yields of grain hay are fairly good.

Milpitas clay loam, 3 to 10 percent slopes (MR).—The surface soil is a brown or pale-brown, friable, slightly acid clay loam to depths of 11 to 19 inches. The soil breaks to a medium cloddy tilth that is readily reduced, if the soil has been worked at the proper moisture content, to a coarse granular mass. The surface soil grades rapidly into a compact slightly more reddish-brown claypan subsoil of clay texture. The claypan definitely retards drainage and causes the soil immediately above the claypan to be generally mottled with rust-brown and light-gray streaks and spots. At depths of 31 to 47 inches the subsoil grades into brown, pale-brown, or yellowish-brown moderately compact terrace material of gravelly clay loam or sandy clay loam texture. In most places the underlying material is unconsolidated, although in a few places it appears to be partially consolidated. In some places many dark-colored manganese stains occur in this material.

This soil occurs in some areas near the edge of the hills in the eastern and southern parts of the valley. Part of this soil in east San Jose has less than 4 percent slopes, and small areas northeast of Evergreen and southeast of Los Gatos have 11 to 20 percent slopes. In some places material eroded from higher areas of Milpitas loam has been deposited. These departures from the typical gently sloping Milpitas clay loam are included mainly because of their small extent.

Except for areas in east San Jose and southeast of Los Gatos, most of this soil is cultivated. Prunes, grain hay, grapes, and apricots, mostly nonirrigated, are grown. Fairly good yields of grain hay are obtained. Fruit yields are normally poor, and the saturation of the surface soil during the winter months favors the development of the "sour-sap" disease in orchard trees. In a number of places the soil is very slightly eroded, although erosion control in general is not an outstanding problem in the use of this soil.

MOCHO SERIES

Soils of the Mocho series are among the most productive and intensively cultivated in the Santa Clara Area. They are the principal soils on which pears and truck crops are grown. The average annual rainfall is about 15 inches.

Mocho soils are fairly extensive in the Area. They are found mainly along the lower courses of Coyote Creek, the Guadalupe River, and other creeks on both sides of the valley. They occur most commonly as shallow soils over clay soils that have developed in basin positions. These areas are, or have been until very recently, subject to flooding, and the soils occur in areas of active deposition from the creeks (pl. 6, *B*). Additional discussion of the method of formation of Mocho soil material is given in the section of the report on erosion and deposition.

The soils are brown, pale brown, or grayish brown. When moist, they are considerably darker in color, particularly in orchard areas. They are deep (except where otherwise designated), friable to very friable, and have less tendency toward forming plowpans than the Yolo and Sorrento soils. Both the surface soils and subsoils are slightly or moderately calcareous and are basic in reaction (pH 7.8 to 8.3). Lime is mostly disseminated throughout the soil mass, but in a few places lime is segregated along small tubular pores or, where silty strata occur in the subsoils, between thin layers of the silty strata. The surface soils and subsoils are very similar, and roots and moisture penetrate the soils easily to depths of 6 or more feet. Where the Mocho soils are now subject to annual flooding from streams, their texture and extent may change during exceptionally heavy rainfall or stream overflow.

Soils of the Mocho series are similar in color and profile characteristics to soils of the Sorrento and Yolo series. The Sorrento soils are calcareous only in the subsoils, and the Yolo are noncalcareous; whereas the Mocho soils are calcareous in both surface soils and subsoils. Soils of the Mocho series are mapped on about 17 square miles in this Area.

Mocho sandy loam, over basin clays, 0 to 1 percent slopes (MR).—In this Area, Mocho sandy loam is represented only by this shallow soil over basin clays. The sandy loam surface soil is pale brown, slightly calcareous, and very friable. At depths of 9 to 22 inches the surface soil grades into material that is similar to the surface soil except for considerable rust-brown mottling and somewhat higher lime content. This lower material rests abruptly, at depths of 12 to 26 inches, on very dark gray or black calcareous clay typical of the Sunnyvale or Alviso series. The underlying clay material definitely retards drainage and root penetration.

This Mocho soil over clay occurs along the lower courses of Stevens and Permanente Creeks northwest of Moffett Field. Along Stevens Creek one small area of Mocho gravelly sandy loam (over basin clays) is included with this soil.

Nearly one-third of the soil is affected by moderate or strong concentrations of salts. The Mocho soils are typically well drained and not affected by alkali; however, where they have been deposited over the highly saline soils of the Alviso series, some concentrations of salts are present in the Mocho soil material. Where affected by salts, the soil is not cultivated and is generally used for grazing, but where free from salts, fair to good yields of hay and truck crops are obtained. This soil is not well suited to orchard crops, except possibly pears.

Mocho fine sandy loam, over basin clays, 0 to 1 percent slopes (ML).—Mocho fine sandy loam, like Mocho sandy loam, is represented only by a shallow soil over basin clays. The surface soil is a pale-brown, slightly or moderately calcareous, very friable fine sandy loam. At depths of 18 to 30 inches the Mocho fine sandy loam rests directly on dark grayish-brown, dark-gray, or black clay typical of the Pescadero or Sunnyvale series. Generally a zone 4 to 6 inches thick just above the clay is mottled with rust-brown stains. The stains indicate that drainage is retarded by the underlying clay soils.

Areas of this soil lie next to Campbell and San Tomas Aquinas Creeks northwest of Santa Clara and west of Agnew. All of this soil is cultivated. Truck crops and pears are the principal crops. The soil is easily worked to a good seedbed and is very suitable for truck crops. It is not well suited to most orchard crops, although pear trees do well because they are more tolerant of poor subdrainage and occasional flooding than other orchard trees.

Mocho gravelly loam, 1 to 3 percent slopes (MM).—The surface of this soil is a brown or pale-brown, friable, slightly calcareous loam containing enough gravel to interfere somewhat with tillage. At depths of 14 to 30 inches the surface soil grades into a pale-brown, calcareous, somewhat stratified gravelly subsoil that is similar to the surface soil. The soil is moderately permeable to depths of 6 or more feet.

This soil is mapped north of San Jose and along Berryessa Creek. Prunes, cherries, apricots, and walnuts are the principal crops grown. Yields are normally good or very good.

Mocho loam, 1 to 3 percent slopes (MQ).—This soil has a brown or pale-brown, slightly calcareous, friable loam surface layer 12 to 20 inches thick. When cultivated the soil breaks to small or medium-sized clods that are easily crushed to a fine granular mass. The surface soil grades into a pale-brown, moderately permeable, calcareous, somewhat stratified loam or fine sandy loam subsoil. This is similar in many respects to the surface soil. Generally some rust-brown mottling occurs in the subsoil. Roots and moisture penetrate the soil readily to depths of 6 or more feet.

Most of this soil occurs along Coyote Creek north of San Jose. A few very small areas that have a fine sandy loam surface soil were included with this soil. In some places the surface texture approaches a silt loam. One small area west of Milpitas is slightly affected by alkali and not quite so well drained as typical.

The soil is excellent for general agriculture. Yields of pears, truck crops, apricots, prunes, and cherries are good to very good. The chief fruit grown is pears, but the soil is well suited to other orchard crops, except where prolonged flooding occurs.

Mocho loam, over basin clays, 0 to 1 percent slopes (Mn).—This shallow Mocho loam overlies dark grayish-brown, dark-gray, or black clay soil materials resembling those of the Pescadero, Sunnyvale, or Alviso series. Normally the pale-brown, friable, slightly calcareous Mocho loam extends to depths of 24 to 40 inches, but bordering areas of typical Mocho loam the depth is nearly 5 feet, and bordering areas of soils of the Pescadero, Sunnyvale, or Alviso series the depth is only about 1 foot. In most places the Mocho loam is mottled with rust-brown stains just above the clay. The mottling indicates poor subdrainage.

Most of this soil occurs along or near Coyote Creek northwest of Milpitas and along the Guadalupe River north of San Jose. Small areas of this soil along or near Coyote Creek northwest of Milpitas contain slight, moderate, or strong concentrations of alkali. One small area moderately affected by alkali is near the lower part of Stevens Creek, northwest of Moffett Field.

Where free of alkali, the soil is used intensively for pears and truck crops. The soil is not well suited to most orchard crops, but pear trees do well and yields are very good. For truck crops and field crops, the soil is excellent.

Pears and truck crops are also grown where the soil is only slightly affected by alkali. Yields are somewhat lower than in alkali-free areas, and it is considerably more difficult to maintain uniform healthy growth of pear trees. In areas of this soil with slight alkali concentration, the salts are mostly in the underlying clay soil material, although in a few places the Mocho soil material is also affected.

Areas of this soil affected by moderate or strong concentrations of alkali are underlain by material resembling Alviso clay. These areas are not cultivated and are used chiefly for grazing.

Mocho loam, over Campbell and Cropley soils, 1 to 3 percent slopes (Mo).—This soil consists of 12 to 30 inches of pale-brown, friable, slightly calcareous loam, typical of the Mocho series, overlying grayish-brown or dark-gray clay loam or clay soil materials resembling those of the Campbell or Cropley soils. The underlying soil material interferes somewhat with moisture penetration, but in general the soil has better subdrainage than Mocho loam over basin clays.

This soil occurs along or near the Guadalupe River and Coyote Creek or in small areas that have received recent deposits from intermittent creeks heading in the eastern hills. The surface soil may be darker than is typical of the Mocho series. Truck crops, pears, prunes, and apricots are grown. Yields are normally good.

Mocho loam, over Cropley and Zamora clay loams, 3 to 6 percent slopes (Mp).—This soil is a pale-brown or grayish-brown, friable, slightly calcareous loam overlying, at depths of 12 to 24 inches, clay loam soil materials resembling those of the Cropley and Zamora series. The soil is similar to and associated with Mocho loam over Campbell and Cropley soils, 1 to 3 percent slopes. It differs primarily in the underlying soil materials and in occurring on more sloping relief.

The soil is in the eastern part of the Area on the upper parts of alluvial fans where recent deposits have been left by intermittent streams. In a few places the surface soil is somewhat darker than is typical of the Mocho series. Prunes and apricots are the principal crops. Yields are good.

Mocho clay loam, 1 to 3 percent slopes (MK).—The brown or pale-brown, slightly calcareous, moderately friable clay loam surface soil normally ranges from 8 to 20 inches in depth. When cultivated at the proper moisture content, it is worked readily to an excellent seedbed. The subsoil is normally pale brown, calcareous, somewhat stratified, and moderately permeable to roots and moisture to depths of 6 or more feet. Lime is mostly disseminated throughout the soil mass, although in some places in the subsoil it is concentrated along small tubular pores or between thin silty layers.

Many small areas of this soil occur in the northeastern and eastern parts of the Area. Mocho clay loam is typically free of alkali, but west of Milpitas near Coyote Creek some of this soil is slightly affected by alkali, is less well drained than the typical Mocho soils, and has rust-brown mottling in the subsoil.

All areas of Mocho clay loam, 1 to 3 percent slopes, are under cultivation. Prunes, truck crops, pears, apricots, cherries, and walnuts are the principal crops grown. Good to excellent yields are normally obtained. Good yields of truck and field crops are obtained in spite of slight alkali accumulation in some places. Orchard crops are not so successful on this alkali soil.

Mocho clay loam, over basin clays, 0 to 1 percent slopes (MI).—To depths of 12 to 40 inches the soil consists of a brown or pale-brown calcareous, friable, and moderately permeable clay loam typical of the Mocho series. This Mocho material directly overlies grayish-brown, dark-gray, or black clay or clay loam soil material similar to that of the Orestimba, Pescadero, Clear Lake, Sunnyvale, or Alviso series. The surface soil, when cultivated at the proper moisture content, is readily worked to an excellent seedbed for truck crops or cover crops. Although the Mocho clay loam is permeable, the underlying finer textured basin soil materials seriously interfere with drainage. In many places the soil just above the clay is highly mottled with rust-brown stains.

Most of this soil is north of San Jose along the Guadalupe River and Coyote Creek. In some places, especially along the Guadalupe River near areas of Mocho loam, the surface soil is of light clay loam or loam texture. Where Mocho clay loam has been deposited over alkali soil materials resembling those of the Orestimba, Pescadero, or Alviso series, areas with slight, moderate, and strong accumulations of salt occur. In general, the soil is more poorly drained where affected with alkali and the surface soil color is somewhat darker than is typical of the Mocho series. Some areas of this soil along the Guadalupe River southeast of Alviso are apparently increasing in salt content because of the encroachment of tidewater.

This soil, where not affected by alkali, is the principal "pear soil" of the Area. The most important single crop is pears. Truck crops, sugar beets, and other field crops are also grown. Because of the underlying dense clay soils and consequent retarded drainage, the soil is not well suited to most tree fruits other than pears. It is

nearly as well suited to truck crops and field crops as typical Mocho clay loam, and yields of most crops now grown are good or very good.

Where the soil is affected with slight amounts of salts, truck crops, pears, and sugar beets are grown. Healthy growth of pear trees is difficult to maintain, and yields are only fair. Shallow-rooted crops are the most suitable for this soil, and yields are fair to good. Where moderate alkali has accumulated, the soil is used for pasture, field crops, truck crops, and pears. Pear trees do very poorly. Because in most places the salts are concentrated in the lower part of the soil, fair yields can be obtained from field crops and poor to fair yields from truck crops. Where strong alkali has accumulated, the soil is not suited to crops and is used entirely for pasture.

Mocho clay loam, over Cropley and Campbell soils, 1 to 3 percent slopes (Mɔ).—This soil consists of a brown or pale-brown, slightly calcareous, friable clay loam fairly typical of the Mocho series, that overlies dark-gray or grayish-brown clay or clay loam soil material resembling that of the Cropley or Campbell soils. Depths of the Mocho soil material normally range from 8 to 30 inches. The underlying soil material is generally fairly permeable and does not impede drainage so greatly as where finer textured basin soils underlie Mocho clay loam.

Nearly all of this soil is in the eastern part of the Area. One small included area near Evergreen consists of Mocho clay loam over Pleasanton soil material. Good yields of truck crops, prunes, pears, sugar beets, walnuts, and cherries are obtained.

Mocho soils, undifferentiated, 1 to 3 percent slopes (Ms).—This mapping unit contains small narrow areas of Mocho soils of variable texture and so intricately associated that separation was not practical. The soils occupy small, recently formed "benches" that are generally 5 to 10 feet higher than the channel of Coyote Creek and 5 to 15 feet lower than adjacent soils of the Sorrento series (pl. 7, *A*). The "benches" are the result of cutting and filling by the creek and are subject to overflow during exceptional floods.

Because of the manner of their formation, these soils are extremely variable in texture. They range from coarse sandy loam or gravelly sandy loam to silt loam or clay loam within short distances. The subsoils are generally highly stratified and in many places contain alternate layers of gravelly sandy loam and loam or silt loam. The soils are brown or pale brown and are slightly or moderately calcareous in both surface soils and subsoils.

Because of the highly stratified subsoil and the extreme variability in surface texture, these undifferentiated areas of Mocho soils have a considerably lower use capability than the more uniform Mocho soils. In some places truck crops, prunes, and walnuts are grown, and fair to poor yields are obtained. Where not cultivated, the soils support a growth of grass and brush. They are utilized for grazing, for dumping dirt or building refuse, and as a source of sand and gravel.

MONTARA SERIES

Soils of the Montara series occur mainly on hills in the southern part of the Area. The average annual rainfall is 15 to 25 inches. The natural vegetation is mainly grass, with trees and grass or brush

on some of the steeper slopes. The typical slopes range from 20 to 35 percent, but they may be as little as 10 percent or more than 35 percent. Most of the areas are not cultivated. In the few small cultivated areas some erosion has occurred. The soils are typically very stony and very shallow. They have developed from highly serpentinized, ultrabasic, intrusive bedrock of Jurassic age.

The surface soils are dark grayish brown, moderately fine to fine in texture, generally stony, and normally neutral in reaction (pH 6.6 to 7.3). On drying they crack to a fine blocky structure of hard consistence. The subsoils are mostly thin irregular transition zones from the surface soils to the underlying bedrock. The subsoils are noncalcareous and similar to the surface soils except that they are slightly more basic. Bedrock is encountered abruptly and consists of dull greenish serpentine rock that in a number of places contains some magnesite.

The Montara soils are related to and in some places very closely associated with soils of the Climax series. They were derived from similar parent material, but the Climax soils are normally deeper and less stony than the Montara soils and are characteristically calcareous in the subsoils. The soils of the Montara series occupy about 22 square miles, including the complex of Montara and Climax soils.

Montara stony clay, 10 to 35 percent slopes (Mx).—The surface soil is a dark grayish-brown, blocky, neutral clay that varies in depth from only a few inches to about 10 inches. Nearly everywhere the stony surface and very shallow depth of soil make clearing for cultivation impractical. The subsoil is absent, or may consist of a thin weathering transition zone from the surface soil to the underlying serpentine bedrock. The soil profile is very irregular as a result of uneven weathering of the parent rock, and the depth of soil varies markedly within short distances.

The soil occurs extensively in this Area on the Edenvale Hills and in the southern hills. None of it is cultivated. The natural vegetation is mainly grass. Soil areas are used chiefly for grazing, but the carrying capacity is relatively low (pl. 6, *C*). The soil cannot be tilled, because of its very shallow depth and stoniness.

Montara clay, slightly eroded, 20 to 35 percent slopes (Mt).—The surface soil is a dark grayish-brown neutral clay to depths of 6 to 14 inches. The soil breaks to medium-sized hard blocks that can be broken to smaller aggregates only with considerable difficulty. When moist or wet, the soil is plastic or very sticky. The surface soil grades into a dark grayish-brown, moderately compact, blocky subsoil of clay texture. At depths of 18 to 30 inches the subsoil grades irregularly into serpentinaceous bedrock. In most places some stones are present in the soil, but in general the soil is considerably less stony than Montara stony clay.

A little of this soil occurs north of Edenvale and near the Calero Reservoir. Nearly all of it is cultivated. Apricots, prunes, and grain hay are the chief crops. Yields are normally poor.

Montara stony clay loam, 20 to 35 percent slopes (My).—The surface soil is a dark grayish-brown or grayish-brown, blocky, neutral clay loam that varies in depth from only a few inches to about 10 inches. The subsoil is only a thin weathering transition zone from

the surface soil to the underlying serpentine bedrock. The surface is stony, and nearly everywhere the number of stones and very shallow depth of the soil make impractical the clearing of the soil for cultivation.

Soil areas are located on the Lick Hills and on other hills in the southern part of the Area. None of this soil is cultivated. The natural vegetation is mainly grass. The areas are used chiefly for grazing, but the carrying capacity is relatively low.

Montara stony clay loam, 10 to 20 percent slopes (Mz).—Except for less steep slopes, this soil is very similar to Montara stony clay loam on 20 to 35 percent slopes. The soil is mapped north of Edenvale. None of it is cultivated, and grass is the principal cover. The areas are used for grazing, but as for other soils of the Montara series, the carrying capacity is relatively low.

Montara clay loam, slightly eroded, 20 to 35 percent slopes (Mu).—The surface soil is a dark grayish-brown, blocky, neutral clay loam to depths of 6 to 15 inches. It grades into a grayish-brown or dark-brown, moderately compact subsoil of heavy clay loam or clay texture. At depths of 17 to 30 inches the subsoil grades irregularly but rapidly into serpentine bedrock. The soil is similar to but somewhat deeper and considerably less stony than the associated Montara stony clay loam on 20 to 35 percent slopes. Near Svedal, where the soil occurs under higher rainfall than is typical for the series, it is browner than in other parts of the Area.

Most of this soil has been or is being cultivated, and some erosion has occurred in nearly all areas. Grain hay and grapes are the principal crops. Yields are poor for most crops.

Montara stony soils, undifferentiated, 35+ percent slopes (Mv).—These extensive soils occur on broken, very stony and steep or very steep slopes under natural vegetation that consists mainly of brush. They are untillable and have very little or no value for grazing.

These undifferentiated Montara soils are most common near Fern Hill, south of the Calero Reservoir, and between the New Almaden and Guadalupe Reservoirs. Some small areas of steep soils of the Vallecitos and Los Trancos series are included. In the Santa Cruz Mountains, where the rainfall is somewhat higher than is usual on the Montara soils, the soils are browner and lighter colored than is typical of the series.

Montara stony clay-Climax clay (adobe), 20 to 35 percent slopes (Mw).—This complex consists of close associations of Montara stony clay, 20 to 35 percent slopes, and Climax clay (adobe), 20 to 35 percent slopes. Both soils have developed from basic igneous rock; however, there are differences in the parent materials that explain the differences in the soils. The Climax soils are calcareous in the subsoils and deeper and considerably less stony than the Montara soils. Montara stony clay, 10 to 35 percent slopes, and Climax clay (adobe) moderately eroded, 20 to 35 percent slopes, have already been described.

The largest areas of these soils are on the Edenvale and Lick Hills. In a few places small areas of Los Trancos stony clay are included. Most areas have slope gradients of 20 to 35 percent, but a few small areas of 10 to 20 percent slopes are included.

Grain hay is grown on some small areas of Climax soils within this complex, and yields are fair if seasonal rainfall is normal. The most extensive use of this complex is for grazing. The natural vegetation is mainly brush and grass.

OHMER SERIES

Soils of the Ohmer series occur on terrace or old valley-fill materials in the northwestern part of the Area. The average annual rainfall is about 20 inches. The original vegetation was mainly grass and a few scattered oaks. Most areas of these soils have been or are now under cultivation. The typical slopes of these soils range from 10 to 20 percent, but they may be as much as 35 percent or as little as 3 percent. In some areas significant erosion has occurred.

The surface soils are dark grayish brown, moderately fine textured, and slightly or medium acid in reaction (pH 5.6 to 6.5). When wet the soils are slightly sticky, but on drying they crack to a coarse blocky structure. The surface soils overlie brown compact subsoils that are normally of clay loam or gravelly clay texture and slightly acid reaction (pH 6.1 to 6.5). The compact subsoils definitely hinder root and water penetration. In a few places the surface soils are waterlogged for considerable periods during the winter. The subsoils grade into yellowish-brown moderately compact terrace material of gravelly loam or gravelly clay loam texture. The color varies slightly, due to partial decomposition of some of the gravels in the subsoils and underlying material. The underlying material is normally neutral in reaction (pH 6.6 to 7.3), although in a few places it is slightly basic in reaction and very slightly calcareous.

The Ohmer soils are associated with soils of the Milpitas series but differ from them mainly in being darker colored and somewhat less compact in the subsoils. Soils of the Ohmer series occupy about 2 square miles.

Ohmer clay loam, 10 to 20 percent slopes (Oc).—The surface soil is a dark grayish-brown slightly or medium acid clay loam to depths of 8 to 14 inches. The soil is rather difficult to work. When tilled it breaks to large clods that are not easily reduced to a good seedbed. The surface soil overlies a brown, compact, weakly prismatic subsoil of clay loam or gravelly clay texture. The subsoil seriously retards root and water penetration. At depths of 17 to 25 inches, the subsoil grades into yellowish-brown moderately compact terrace material of gravelly loam or gravelly clay loam texture. The underlying material is generally less compact, more permeable, and more gravelly than the subsoil.

This soil occurs southeast of Stanford University and west of Alta Mesa. Most of it has been cultivated at one time or another. The principal crop has been grain or grain hay. The soil is best suited for grain hay and other shallow-rooted crops. At present most of the soil is in grass and is used chiefly for grazing.

Ohmer clay loam, slightly eroded, 10 to 20 percent slopes (Od).—The profile of this slightly eroded soil is similar to that of the uneroded soil, except that the surface soil is generally thinner, and in some places the eroded soil is browner or lighter colored. The slightly eroded areas occur near Los Altos and Felt Lake, where agricultural

practices have been more intensive and the soil has been left unprotected more frequently. This soil is used for grazing or for grain hay, and yields are fairly good. Apricots are also grown, but yields are normally poor. The soil is best suited for shallow-rooted crops.

Ohmer clay loam, slightly eroded, 20 to 35 percent slopes (OB).—This soil is similar to the Ohmer clay loam just described, but the slopes are steeper. Slight sheet erosion has resulted in a thinner and lighter colored surface soil than typical. This soil occurs southwest of Alta Mesa. Grain hay and walnuts are grown, and some areas are used for grazing.

Ohmer clay loam, 3 to 10 percent slopes (OA).—This soil has profile characteristics similar to those of the other Ohmer clay loams, but it occurs on less steep relief. Very slight erosion has occurred in a few places. Most of the areas are south of Los Altos and southwest of Palo Alto. Some of this soil is used for apricots; yields are generally only fair. Most of this soil is used for grazing.

Ohmer gravelly clay loam, 3 to 10 percent slopes (OE).—The surface soil is a dark grayish-brown slightly or medium acid gravelly clay loam to depths of 8 to 15 inches. It contains gravel that interferes with cultivation. The surface soil overlies a brown compact subsoil of gravelly or cobbly clay loam texture. The underlying material is moderately compact yellowish-brown terrace material of gravelly or cobbly clay loam or loam texture. As in other soils of the Ohmer series, the subsoil restricts drainage and root penetration.

This soil occurs south of Palo Alto. Most of it is cultivated, and grain hay is the principal crop. In a few places, a very slight amount of erosion has made the soil lighter colored and generally more gravelly on the surface.

ORESTIMBA SERIES

Soils of the Orestimba series occur in the eastern and southern parts of the valley in small basin and semibasin areas or on the margins of the larger basin areas. They are affected by alkali in a number of places. The average annual rainfall is about 15 inches. The soils were imperfectly drained during development, but they are much better drained now because of pumping for irrigation. The original vegetation was mainly grasses, but most areas have been cultivated for a number of years. The parent material is alluvium, mostly from areas of sandstone and shale rocks. Drainage has had the greatest influence on the profile of this soil.

The surface soils are grayish brown, typically noncalcareous, moderately fine textured, and neutral in reaction (pH 6.6 to 7.3). If undisturbed while drying, they crack to a medium or coarse blocky structure of hard consistence. The surface soils grade into slightly darker grayish-brown, moderately compact, noncalcareous, fine-textured upper subsoils that normally have a moderately well developed medium blocky structure. The reaction normally is slightly basic (pH 7.4 to 7.8). The upper subsoils grade into slightly compact, calcareous, moderately permeable, massive lower subsoils that are moderately or strongly basic in reaction (pH 7.8 to 9.0) and of moderately fine texture. The lower subsoils are brown and become paler brown with depth. In most places this layer has considerable rust-brown mottling.

Lime is disseminated throughout the lower soil. It is also segregated along small tubular pores, in small soft masses, or in small, hard, calcareous nodules.

The soils are similar to soils of the Campbell series, but they are generally somewhat darker in color, more compact in subsoil horizons, and have developed under poorer drainage. The two types of the Orestimba series occupy about 9 square miles.

Orestimba clay loam, 0 to 1 percent slopes (Of).—The surface soil is a grayish-brown, noncalcareous, neutral clay loam to depths of 9 to 15 inches. Where cultivated, the soil breaks to medium-sized clods that can be crushed to a granular mass with some difficulty. The surface soil grades into a slightly darker grayish-brown, moderately compact, noncalcareous upper subsoil that is generally a finer clay loam of medium blocky structure. At depths of 20 to 23 inches the upper subsoil grades into a brown or pale-brown, slightly compact, massive, calcareous lower subsoil of clay loam texture, which is normally mottled with rust-brown stains. Lime occurs in both disseminated and segregated forms throughout the lower soil mass.

Much of this soil is slightly affected with alkali. Several small areas are strongly affected and contain both saline salts (white alkali) and alkaline salts (black alkali). The surface soil in such areas is normally harder and more difficult to work, and the subsoil horizons, in which the alkali is most frequently concentrated, are strongly basic in reaction (pH greater than 8.5).

Most of the soil is located east and southeast of San Jose. All of it is cultivated except that affected by strong alkali or used for residences. Where the soil is free of salts, the principal crops are prunes, pears, walnuts, truck crops, and alfalfa. Yields are normally fair to good. Where slight concentrations of salts are present, grain hay and alfalfa are grown, and yields are normally fair or good. Where strongly affected with alkali, the natural vegetation of saltgrass and alkali weeds furnishes low-value grazing.

Orestimba silty clay loam, 0 to 1 percent slopes (Og).—The surface soil is a grayish-brown, noncalcareous, neutral silty clay loam to depths of 6 to 10 inches. If not disturbed while drying, the soil cracks to a coarse blocky structure. On cultivation it breaks to a coarse cloddy tilth that can be reduced to a good seedbed only with considerable difficulty. The surface soil grades into a moderately compact, slightly darker grayish-brown, noncalcareous upper subsoil or silty clay texture. It has a moderate medium blocky structure and shows considerable colloidal staining on the surface of the aggregates. At depths of 20 to 26 inches the upper subsoil grades into a slightly compact, massive, brown or pale-brown, rust-brown mottled, calcareous lower subsoil that generally is of clay loam or light clay texture. Lime is disseminated throughout the lower subsoil and also generally is segregated along small tubular pores or in the form of small soft masses or small, hard nodules.

The soil occurs in the eastern and southern parts of the valley, and a considerable area is affected with slight, moderate, or strong accumulations of alkali. All areas strongly affected with salts contain both alkaline salts (black alkali) and saline salts (white alkali), except the area located northwest of Evergreen. The surface soil in these strongly alkaline areas normally is harder and more difficult to work,

and the subsoil horizons, in which the concentration of salts most frequently occurs, are strongly basic in reaction (pH greater than 8.5). None of the soil strongly affected by salts is cultivated, and the natural growth of alkali grasses and weeds is of low value for grazing.

Where free of salts, the soil is used chiefly for grain hay, alfalfa, prunes, and truck crops. Yields of most field crops are fair, and for certain field crops good, but yields of orchard fruits are generally poor. Areas slightly affected by salts are used mainly for grain hay and grazing, and soil areas moderately affected are used for grain hay, grazing, and alfalfa. Yields are rather poor.

PERMANENTE SERIES

Soils of this series occur under an average annual rainfall of 25 to 35 inches and at elevations of 1,000 to 2,700 feet on Monte Bello Ridge in the western part of the Area. The natural vegetation is almost entirely brush. Most of the soils occur on steep, broken, and stony slopes and are normally very shallow.

The surface soils are brown (becoming nearly reddish brown when moist), medium textured, stony, and generally noncalcareous. Soil reaction is normally slightly basic (pH 7.3 to 7.8). In most places fragments of bedrock are mixed with the surface soils, which grade irregularly at very shallow depths into light-gray or white hard limestone bedrock.

The soils are unimportant for agriculture, although in a few places they have been cultivated. They are associated with soils of the Los Gatos series. The Permanente soils cover less than 1 square mile.

Permanente stony loam, slightly eroded, 20 to 35 percent slopes (PB).—The surface soil is a brown, slightly basic, stony loam that becomes nearly reddish brown when moist. The surface soil grades irregularly at depths of 3 to 14 inches into light-gray or white hard limestone bedrock. The slightly eroded soil is similar but even shallower. In some places the cultivated surface soil is calcareous from the grinding and mixing of fragments of limestone with the soil.

This soil occurs west of the Stevens Creek Reservoir Dam and near the summit of Black Mountain. It was cultivated at one time, but most areas have since been abandoned. This shallow stony soil has little agricultural value.

Permanente stony soils, undifferentiated, 50+ percent slopes (PA).—These very steep areas of Permanente soils are very shallow and stony and of little agricultural value. They support a very dense growth of brush. They are located west of the Stevens Creek Reservoir Dam, near Permanente, and near the summit of Black Mountain.

PESCADERO SERIES

Soils of the Pescadero series have developed under poor drainage and contain saline salts (alkali) in some places. They are in the northern part of the Area near and between Coyote Creek and the Guadalupe River. The average annual rainfall is about 15 inches. The original vegetation was mainly grasses, but most areas have been cultivated for a number of years. The parent material is very finely divided alluvium, mainly from areas of sandstone and shale rocks.

The poor drainage has had more influence on the profile of these soils than the parent material.

The surface soils are dark gray or dark grayish brown, fine textured, noncalcareous, and neutral or slightly basic in reaction (pH 7.0 to 7.8). On drying in an undisturbed state, the soil cracks into large more or less cubical blocks, in places typical of adobe structure. The surface soils grade into dark-gray or dark grayish-brown, moderately compact, fine-textured, slightly calcareous upper subsoils that are mostly massive. The upper subsoils grade into grayish-brown, fine-textured, massive, calcareous, rust-brown mottled lower subsoils that become lighter and somewhat yellowish in color with depth. Lime is mostly disseminated in the lower subsoils, but some is segregated in soft irregular masses and small hard nodules. In some places crystals of gypsum occur in the lower subsoils. The subsoil horizons are normally slowly permeable to water.

The soils are somewhat similar to the soils of the Clear Lake series, but in general they are a little browner, more dense and compact in the subsoil horizons, and less permeable than the Clear Lake soil. The soils of the Pescadero series occupy about 2½ square miles.

Pescadero clay, 0 to 1 percent slopes (Pd).—The dark grayish-brown, noncalcareous, neutral or slightly basic, clay-textured surface soil normally varies in depth from 10 to 13 inches. On drying in an undisturbed state, the soil cracks to large hard blocks. When cultivated, it forms a hard cloddy tilth that is somewhat difficult to reduce to a good seedbed. The surface soil grades into a dark grayish-brown, slightly or moderately calcareous, massive, moderately compact upper subsoil of clay texture. At depths of 27 to 39 inches, the upper subsoil grades into a grayish-brown, rust-brown mottled, calcareous, clay-textured lower subsoil that generally becomes somewhat yellowish in color with depth. Lime is disseminated through the lower soil layers and also is segregated in small soft masses. In some places a few calcareous nodules and crystals of gypsum occur in the lower subsoil. Water is slow to penetrate the fine-textured compact subsoil.

Some of this soil is slightly affected by alkali. It occurs north of San Jose between Campbell and Coyote Creeks. Originally this soil was much more extensive, but Mocho soil material has been deposited over a large area. In some places near areas of Mocho soils, where floodwaters have covered parts of Pescadero clay with very little deposition, the surface soil is slightly calcareous and more friable than typical. Some fine clay loam is included.

All of the soil is cultivated. Pears, truck crops, grain hay, sugar beets, and alfalfa are the principal crops. Yields and tree growth of pears are generally poor, but yields for other crops (mainly field crops) are generally fair. The areas slightly affected by salts are used mainly for field crops.

Pescadero clay (adobe), 0 to 1 percent slopes (Pc).—The surface soil is a dark-gray or dark grayish-brown, noncalcareous, neutral or slightly basic, clay that, on drying in an undisturbed state, cracks into large more or less cubical blocks typical of adobe structure. The soil is hard to work. Cultivation produces coarse clods somewhat difficult to reduce to a proper seedbed. At depths of 15 to 20 inches, the surface soil grades into a dark-gray or dark grayish-brown, mod-

erately compact, massive, slightly calcareous upper subsoil of clay texture. The upper subsoil grades into a grayish-brown massive lower subsoil at depths of 27 to 35 inches. The lower subsoil normally becomes lighter colored and somewhat yellowish with depth. It is of clay texture and moderately calcareous, and in places, particularly near Alviso clay, it contains crystals of gypsum. Lime is disseminated throughout the lower subsoil and also is segregated in irregular-shaped soft masses or as hard calcareous nodules. Water penetrates the soil slowly because of the compact subsoil.

This soil is mapped in the northern part of the Area, near Alviso and Agnew. Most of the soil is slightly affected by alkali. It is used chiefly for grain hay, pears, and some irrigated field crops. Yields of grain hay are fairly good, but yields of most other crops are poor. One small area moderately affected by alkali is used chiefly for pasture.

PITS

Pits (Ec) consist of areas large enough to map where excavations have been made and where the original soil has been removed. Excavations in this area have been principally for gravel and for soil material used in the manufacture of bricks. Soil material for bricks is removed mainly from areas of Sorrento loam or Sorrento silt loam near Coyote Creek. Since these soils are rather uniform to considerable depths, the soil material at the bottom of the excavations, which are 10 or 15 feet deep, is sometimes used for fruit trees and truck crops. Most of these excavated areas have little agricultural value.

PLEASANTON SERIES

Soils of the Pleasanton series are the most extensive alluvial fan or flood plain soils in the Area. They occur on well-drained older alluvial fans that are mostly smooth and gently or very gently sloping. They are mapped on both sides of the valley, but more on the western side. The average annual rainfall is 15 to nearly 30 inches. The original vegetation was grasses and scattered oaks. Nearly all of the soils have been cleared and cultivated for a number of years, mainly to deciduous fruits. The parent material from which the soils were derived is somewhat mixed, but it consists mainly of alluvium deposited by streams heading in areas of sandstone and shale rocks. Because of earth movements, or possibly because of increases in velocity and volume of streamflow, these streams are now well entrenched through the older alluvial fans. Along the entrenched streams, the Pleasanton soils have steeper slopes than are typical for the series.

The soils are brown to pale brown, deep, moderately permeable, medium textured, generally gravelly, and normally neutral or slightly acid in reaction (pH 6.1 to 7.0). The surface soils are friable and easily worked, except for the gravel in some phases. The surface soils grade into brown, moderately compact, weak-structured, gravelly upper subsoils that normally are slightly finer textured than the surface soils and a shade more reddish. The upper subsoils grade into brown or light-brown gravelly underlying material that, except for gravel, is in most places similar to the surface soils in texture. The compact upper subsoils retard water penetration a little but cause very little difficulty in irrigation. In orchard areas roots extend to

depths of 6 or more feet. The gravel content normally increases with depth. Partially decomposed gravel in the subsoils and underlying material cause some variegation of color in most places.

The Pleasanton soils are at slightly higher elevations than the closely associated soils of the San Ysidro series, which differ in having dense claypan subsoils. Where associated with soils of the Yolo and Zamora series, the Pleasanton soils also occur at somewhat higher elevations. The soils of the Pleasanton series cover nearly 39 square miles.

Pleasanton gravelly loam, 1 to 3 percent slopes (Po).—The surface soil is a brown loam that contains enough gravel to interfere somewhat with such tillage operations as disking. On cultivation the soil breaks to medium-sized clods that can readily be crushed to a granular and gravelly mass. The reaction is normally about neutral. At depths of 16 to 22 inches, the surface soil grades into a brown or light-brown, moderately compact, slightly acid subsoil of gravelly clay loam or fine gravelly loam texture. The gravel content tends to "mask" the compactness of this horizon. Generally the subsoil is slightly more reddish than the surface soil. At depths of 38 to 45 inches the subsoil grades into permeable light-brown or brown underlying material, generally of gravelly loam texture. Gravel content normally increases with depth. Water penetrates the soil fairly easily, and in orchard areas roots extend to depths of 6 or more feet.

This soil is one of the most extensive in the Area. It is mapped mostly in the western part of the valley, near to and northwest of Lone Hill, northeast of Los Gatos, near to and northwest of Vasona Junction, and north of Cupertino. Except in residential areas, all of the soil is cultivated. Prunes, grapes, apricots, and walnuts are the principal crops, and some truck crops and grain hay are grown. This is the principal soil for grapes in this Area (pl. 3, *C*), and it also has much of the prune acreage. Yields of grapes are good, and yields of most other crops are fair to good.

Pleasanton gravelly loam, gently sloping, 3 to 8 percent slopes (Ph).—This soil is like the one just described except that the slopes are a little steeper. The soil occurs on the upper parts of smooth gently sloping older alluvial fans or along entrenched stream channels near the hills on both sides of the valley. The average rainfall is a little higher than that over most of the Pleasanton gravelly loams.

Except for areas within the town of Saratoga and within Stanford University, all of this soil is cultivated. Prunes, apricots, and grapes are the chief crops grown, most of these without irrigation. Yields are normally good for dry-farmed areas.

Pleasanton gravelly loam, undulating, 3 to 10 percent slopes (Pm).—This soil lying along or near entrenched stream channels near the hills differs from the two soils of Pleasanton gravelly loam just described principally in having undulating relief. This soil receives a little more rainfall than the other Pleasanton gravelly loams. A small area about 1 mile northwest of Alma that has a strongly undulating or rolling relief is included in this soil.

Most of this soil is cultivated. Prunes and grapes are the principal crops. Nearly all of the crops are dry-farmed, and yields are fairly good for dry-farmed soils.

Pleasanton gravelly loam, slightly eroded, 8 to 20 percent slopes (PN).—This soil occurs on small stream benches of undulating and rolling relief in the extreme southern part of the Area and in the western part of the Area near Stevens Creek. Most of this soil at one time was cultivated, but at present many areas have reverted to grass or grass and a few trees. Where cultivated, the main crop is grapes grown without irrigation. Most of the soil is slightly eroded, and cultivated areas are still eroding. In some places the soil is more gravelly than is typical of Pleasanton gravelly loams.

Pleasanton gravelly loam, 20 to 30 percent slopes (PL).—This soil occupies slopes facing toward streams that are entrenched in the old alluvial fan material on which soils of the Pleasanton series occur. The soil is more gravelly, especially in the subsoil, than is typical of the Pleasanton series. Most of the soil is covered with grass and is very slightly eroded. A few small areas in nonirrigated orchards are slightly eroded.

Pleasanton gravelly loam, moderately eroded, 20 to 35 percent slopes (PK).—This soil occurs near the edge of the western hills on old alluvial fans in which streams have become so entrenched as to form a hilly relief. The subsoil is somewhat more gravelly and varied than is typical of the Pleasanton series.

Most of this soil has been cultivated at some time. Moderate erosion has occurred in many places. At present most of the soil is either occupied by residences or is uncultivated and in grass. There are a few small acreages of nonirrigated prunes.

Pleasanton loam, 1 to 3 percent slopes (PS).—The surface soil is a brown neutral loam, 11 to 20 inches deep. It is easily worked and breaks to small- or medium-sized clods that can readily be crushed to a coarse granular mass. In most places the surface soil contains a little gravel. The surface soil grades into a moderately compact brown or reddish-brown slightly acid subsoil of gravelly clay loam texture. At depths of 32 to 43 inches, the subsoil grades into brown or light-brown moderately permeable alluvial material of gravelly loam texture. The gravel content of the soil profile generally increases with depth. The compact subsoil interferes only slightly with root and water penetration, and in orchard areas roots extend to depths of 6 or more feet.

This soil occurs mostly in the western part of the valley, near Los Altos, east of Loyola, and near Monta Vista. Near Los Altos the soil is somewhat redder than typical, and one area near Evergreen that contains a larger amount of material from igneous rock sources is slightly darker in color.

Except for residential areas, all of this soil is cultivated. Most crops are irrigated. Prunes and apricots are the principal crops, but grapes, walnuts, and some truck crops are also grown. Yields are normally good or very good.

Pleasanton loam, cobbly subsoil, 1 to 3 percent slopes (PP).—The pale-brown, friable, slightly gravelly surface soil of loam or heavy sandy loam texture is easily worked, and a good tilth for seedbeds is readily produced. At depths of 16 to 22 inches, the surface soil grades into a brown slightly compact cobbly loam subsoil. The underlying material is a brown or light-brown cobbly loam or cobbly

sandy loam. The soil is similar to typical Pleasanton loam except for its somewhat lighter colored surface soil and the cobbles in the subsoil and underlying material. The well-rounded sandstone cobbles are generally 2 to 5 inches in diameter. Roots and moisture penetrate the soil easily, and in orchard areas roots grow to depths of 6 or more feet.

One area of this soil is located 1 mile south of Azule. Prunes and apricots are the only crops grown, and yields are normally good. The soil is best suited to orchard fruits grown under irrigation.

Pleasanton loam, 3 to 10 percent slopes (PR).—This soil is very similar to the Pleasanton loams on lesser slopes except that it occurs on smooth slopes of 3 to 10 percent. It is mapped near Evergreen and a mile northwest of Los Altos. Some of the soil south of Evergreen is somewhat darker in color and is derived more from basic igneous rock sources than is typical of the series. One very small area about 1 mile southeast of Evergreen, and another area about 3 miles southeast, is slightly eroded and has slopes of 11 to 20 percent.

Prunes, apricots, and grapes are the principal crops grown. Yields, particularly where irrigated, are normally good. This soil is best suited to orchard fruits.

Pleasanton gravelly clay loam, 1 to 3 percent slopes (PG).—The surface soil is a brown, friable, neutral clay loam that contains enough gravel to interfere somewhat with such tillage operations as disking. If worked at the proper moisture content, the soil breaks to medium-sized clods that are readily crushed to a coarse granular and gravelly mass. At depths of 11 to 17 inches the surface soil grades into a brown, moderately compact, weakly blocky, neutral or slightly acid subsoil of gravelly clay loam texture. Generally the subsoil is a shade redder than the surface soil. The subsoil, at depths of 35 to 50 inches, grades into brown or light-brown moderately permeable alluvial material of gravelly clay loam or gravelly loam texture. The subsoil retards drainage somewhat, but tree roots penetrate the soil to depths of 6 or more feet. The gravel content normally increases with depth.

Most of this soil is mapped near Lone Hill. All of it is cultivated, mostly to tree fruits. Prunes, apricots, and grapes are the principal crops, but walnuts, pears, peaches, and truck crops are also grown. Yields of grapes are normally very good, and yields of orchard crops are normally fair or good.

Pleasanton clay loam, 1 to 3 percent slopes (PF).—This soil has a brown, friable, neutral surface soil of clay loam texture. If cultivated at the proper moisture content, the soil breaks to medium-sized clods that are fairly easily crushed to a coarse granular mass. In most places, particularly in orchards, a moderately compact plowpan has developed at the depth of most frequent cultivation. The surface soil grades into a brown, moderately compact, neutral or slightly acid subsoil at depths of 10 to 17 inches. The subsoil has a weak blocky structure and clay loam texture. At depths of 27 to 58 inches the subsoil grades into brown or light-brown moderately permeable alluvial material of clay loam or loam texture. Generally a little gravel occurs throughout the soil; the amount increases somewhat with depth. Because some of the gravel is partially decomposed, the subsoil and

underlying material are somewhat variegated in color. The compact subsoil tends to restrict drainage, but roots can penetrate to depths of 6 or more feet.

The soil occurs in many places on either side of the valley. North and west of Evergreen one area, derived more from basic igneous rock, is slightly darker in color than is typical of the Pleasanton series.

All of this soil is cultivated except a small area in east San Jose. Prunes and apricots are the principal crops; walnuts and grapes are also grown. Yields are normally fair to good.

Pleasanton clay loam, 3 to 6 percent slopes (PE).—This soil occurs on gently and slightly undulating slopes near the hills on both sides of the valley. It is similar to Pleasanton clay loam on lesser slopes. One area of the soil west of Monta Vista is darker in color and finer textured than typical, mainly because some of the parent material has originated in areas of Azule silty clay.

Most of the soil is cultivated. The principal crop is prunes; apricots, walnuts, and grain hay are also grown. The average rainfall is a little higher than for most areas of Pleasanton soils, and in many places crops are not regularly irrigated. Yields are normally fair or good.

POSITAS SERIES

Soils of the Positas series occur on terrace material along the southern and western edges of the valley in close association with soils of the Saratoga series. The average annual rainfall varies from 20 to nearly 30 inches. The original vegetation was mainly grass, a few oaks, and brush. Most of the soils have been cleared and cultivated for years. The typical slopes on these soils range from 3 to 10 percent, but they may be as steep as 20 percent. Some areas are moderately eroded.

The surface soils are brown or reddish brown, medium textured, friable, and moderately or slightly acid in reaction (pH 5.6 to 6.5). When wet or moist they are distinctly more reddish in color than when dry. In some places the soil material immediately above the subsoils is somewhat mottled with rust-brown and light-gray streaks or spots. The surface soils overlie brown or reddish-brown subsoils of clay texture that generally become somewhat more yellowish or lighter brown with depth. These subsoils are compact claypans, which for long periods of the year are massive and more or less plastic in consistence. On drying, these subsoils tend to crack to a weak prismatic structure. Some gravel is present in many places, and the reaction normally is medium or slightly acid (pH 5.6 to 6.5). The subsoils grade into moderately compact light-brown or yellowish-brown gravelly clay loam terrace material that is usually medium or slightly acid in reaction (pH 5.6 to 6.5). The variegation in color of the subsoils and underlying material is caused by partially decomposed gravel. In a few places some dark-colored manganese stains show in the underlying material. The claypan subsoils definitely retard water and root penetration and cause the surface soils to be frequently waterlogged during winter months.

Except in color, the Positas soils are similar to the brown or pale-brown soils of the Milpitas series, particularly in the clapyan development. In the Santa Clara Area the Positas soils are mapped only

in complexes with Saratoga soils. The Saratoga soils are similar to the Positas soils in color and have developed from the same type of terrace material, but they have less well-developed claypan subsoils. In the complexes of Positas-Saratoga soils, the Positas soils predominate, whereas in the complexes of Saratoga-Positas soils, the Saratoga soils predominate. The complexes of Positas-Saratoga soils occupy about 6 square miles.

Positas-Saratoga loams, 3 to 10 percent slopes (Pv).—This complex is a close association of Positas loam and Saratoga loam, with Positas loam predominating. A profile description of Saratoga loam is given in the description of Saratoga-Positas loams, 10 to 20 percent slopes. The following profile description is of Positas loam, 3 to 10 percent slopes.

The surface soil of Positas loam, 3 to 10 percent slopes, is a brown or reddish-brown, friable, medium or slightly acid loam to depths of 11 to 20 inches. The soil is easily worked and breaks to medium-sized clods that are easily crushed to a coarse granular mass. In most places the surface soil contains a little gravel. The surface soil grades rapidly into a compact brown or reddish-brown claypan subsoil, generally of gravelly clay texture. The subsoil is plastic for long periods of the year, but it cracks to a weak prismatic structure on drying. Drainage is definitely retarded by the claypan, and frequently during winter months the surface soil is waterlogged. A thin zone somewhat mottled with rust-brown and light-gray appears in some places just above the claypan. At depths of 33 to 43 inches, the subsoil grades into light-brown or yellowish-brown, moderately compact, unconsolidated underlying terrace material or gravelly clay loam texture. Some variegation of color in the subsoil and underlying material is caused by decomposition of the included gravel.

This complex occurs in scattered areas near the western, southern, and southeastern edges of the valley. Southeast of Evergreen the slopes are a little steeper than 10 percent. Grain hay is the principal crop, and yields are fairly good. Nonirrigated prunes, apricots, and grapes are also grown. Yields of grapes are fair, and yields of orchard fruits generally poor. Yields of grapes and orchard fruits are somewhat better on Saratoga loam than on Positas loam. In most places the soils are very slightly eroded, but erosion at present is not a major problem in the use of these soils.

Positas-Saratoga loams, slightly eroded, 3 to 10 percent slopes (Px).—This complex of Positas loam and Saratoga loam differs from the complex just described principally in the effects of erosion. In general the surface soils are slightly shallower, and in some places they are finer textured because of mixture with part of the subsoils.

This unit is mapped north of New Almaden and near Saratoga. All of the complex is cultivated. Nonirrigated prunes, apricots, pears, grapes, and grain hay are grown (pl. 7, *B*). Yields of orchard fruits are poor, yields of grapes are poor to fair, and yields of grain hay are fair. Erosion control is a serious problem in the use of these soils.

Positas-Saratoga loams, slightly eroded, 10 to 20 percent slopes (Pw).—The principal characteristics of this soil complex are the same as for the complex of uneroded Positas loam and Saratoga loam on lesser slopes, but erosion has in most places made the surface soils

somewhat shallower. Frequently the surface soils are of finer texture because they have mixed with parts of the subsoils. In some places a few gullies have formed.

This complex occurs near the edge of the valley in the southern and western parts. Nearly all of it is cultivated but not irrigated. The principal crop is prunes (pl. 7, *C*); other crops are grapes, grain hay, and apricots. Yields of orchard fruits are normally poor, yields of grapes are poor to fair, and yields of grain hay are fair. Erosion control is an important problem in cultivated areas.

Positas-Saratoga gravelly loams, 10 to 20 percent slopes (PT).—This complex is a close association of Positas gravelly loam and Saratoga gravelly loam. Positas gravelly loam predominates. Its surface soil is a brown or reddish-brown gravelly loam or light gravelly clay loam to depths of 11 to 17 inches. Gravel interferes somewhat with cultivation, particularly disking. The surface soil grades into a brown or reddish-brown compact claypan subsoil of gravelly clay texture. This claypan retards drainage considerably. At depths of 27 to 41 inches, the subsoil grades into moderately compact, light-brown, unconsolidated terrace material of gravelly or cobbly clay loam texture. The partial decomposition of some of the gravel causes some color variegation in the subsoil and underlying material. In general the entire soil profile is more gravelly than that of Positas loam.

The Saratoga gravelly loam in this complex is similar to Saratoga loam described under Saratoga-Positas loams, 10 to 20 percent slopes, except that it has more gravel in the surface soil.

A little of this unit is mapped in the southern part of the valley near the hills. Nonirrigated prunes and grain hay are grown. Yields of prunes are normally poor, and those of grain hay are fair. Some areas are used for pasture. In most places these soils are very slightly eroded, and erosion control is important in their conservation.

Positas-Saratoga gravelly loams, moderately eroded, 10 to 20 percent slopes (PU).—The principal characteristics of this complex are the same as those of the Positas-Saratoga gravelly loams complex just described, except for damage caused by erosion. Most areas are moderately eroded, and occasional gullies have formed. In general the surface soils are considerably shallower than those of the noneroded complex, and of finer texture because of mixing with part of the subsoil during cultivation. A few small areas are severely eroded.

These soils occur southeast of San Tomas. The principal crop is nonirrigated prunes, and yields are normally poor. Erosion control is essential in the proper use of these soils.

RIVERWASH

Riverwash (RA) is the loose stony, gravelly, and sandy material immediately adjacent to streams, which is generally flooded every year. Areas of Riverwash occur along Alamitos, Los Gatos, and Campbell Creeks. They are generally bare of vegetation and useless for agriculture. Some areas are used as a source of gravel.

SAN YSIDRO SERIES

These soils occur on very gently sloping older alluvial fans under an average annual rainfall of 15 to 20 inches. The original vegetation

was mainly grasses, but all areas have been cultivated for years. The soils have slow surface drainage. An outstanding characteristic of the series is the well-developed claypan subsoil.

The surface soils are normally brown or pale brown, medium to moderately fine textured, and neutral to slightly acid in reaction (pH 6.1 to 7.0). The surface soils of the coarser textured types are more easily worked, whereas the finer textured types generally crack to a medium or coarse blocky structure and are considerably harder to work. The surface soils grade rapidly into brown very compact claypan upper subsoils that are neutral to slightly acid in reaction (pH 6.1 to 7.0). When dry, the upper subsoils generally crack to a hard fine blocky structure, the units of which are well coated with dark-brown colloidal material. Normally the soil material just above the upper subsoils is pale brown and streaked with ashy and rust-brown mottlings, due to the very slow drainage through the claypan. The upper subsoils grade into brown, compact, massive, fine-textured lower subsoils that are generally neutral in reaction (pH 6.6 to 7.3). The underlying material is a slightly compact brown or yellowish-brown, medium-textured, moderately permeable alluvium of the same general reaction as the lower subsoils. Because of the very slow drainage through the dense upper subsoils, the surface soils frequently become waterlogged and nearly fluid in consistence during the wet winter months.

These soils are closely associated with soils of the Pleasanton series, mostly in the southern and western parts of the valley. The soils are derived from the same type of alluvial material, and differences in profile are caused mainly by differences in surface drainage. The San Ysidro soils occur in swales or at slightly lower elevations than the Pleasanton soils. The San Ysidro soils somewhat resemble the Milpitas soils. The San Ysidro series occupies nearly 5 square miles.

San Ysidro loam, 1 to 2 percent slopes (SB).—The surface soil is a brown or pale-brown, friable, neutral or slightly acid loam to depths of 15 to 25 inches. In some places the soil is a loam or nearly a clay loam. It is easily worked and breaks on cultivation to medium-sized clods that can readily be crushed to a granular mass. The surface soil grades rapidly into a brown, dense, very compact upper subsoil or claypan of clay or sandy clay texture. In most places the upper subsoil is massive and does not dry sufficiently to crack or to develop a distinct structure. Generally a zone 1 to 3 or more inches thick above the upper subsoil is mottled with light-gray and rust-brown streaks. The upper subsoil, at depths of 32 to 45 inches, grades into a moderately compact, massive, brown lower subsoil of clay loam or sandy clay loam texture. At depths of 43 to 55 inches the lower subsoil grades into brown or yellowish-brown moderately permeable alluvial material. The compact fine-textured upper subsoil very definitely retards moisture and root penetration, and irrigation must be done carefully or excessive water will accumulate in the surface soil.

Many small areas of this soil occur, mostly in the southern and western parts of the valley. The slopes south and southeast of Alamintos are slightly steeper than typical of the series. In some places the subsoil horizons and underlying material contain some gravel.

Prunes and apricots are the principal crops grown, but because of the dense subsoil or claypan, the soil is not well suited to orchard fruits. Yields are generally poor and the life of fruit trees relatively short. During very wet winters the surface soil is saturated for long periods of time. The wetness favors development of the "sour-sap" disease of fruit trees. Some grapes and grain hay are grown. This soil is best suited to shallow-rooted crops.

San Ysidro clay loam, 1 to 2 percent slopes (SA).—This soil lies in low positions and has been considerably modified by mixing with fine-textured alluvial material. The surface soil is darker than is typical of the series and consists of a grayish-brown neutral or slightly acid clay loam to depths of 11 to 16 inches. On drying in an undisturbed state, the soil cracks to medium- or large-sized blocks of hard consistence. When cultivated the soil breaks to large clods that can be crushed to smaller aggregates only with considerable difficulty. The surface soil grades quickly into a very compact and dense upper subsoil or claypan of brown or dark grayish-brown color and of weak or indistinct structure. This claypan definitely retards drainage, and in most places causes the soil immediately above it to be mottled with light-gray and rust-brown streaks. At depths of 28 to 35 inches, the upper subsoil grades into a moderately compact, brown, massive, lower subsoil of clay or sandy clay texture. The lower subsoil grades into slightly compact brown or yellowish-brown clay loam or sandy clay loam, the underlying alluvial material, at depths of 47 to 55 inches.

Because of the moderately fine texture of the surface soil and the highly compacted upper subsoil, the internal drainage of the soil is very poor. In a few places some gravel occurs in the subsoil horizons and underlying material. The soil is mainly associated with soils of the Pleasanton series. Some slopes southwest of Alamitos are slightly steeper than typical.

Prunes and grain hay are grown on this soil. Yields of prunes are normally poor. The soil is not well suited to orchard fruits because during very wet winters, the surface soil is waterlogged for long periods, and this favors the development of the "sour-sap" disease. The soil is best suited for grain hay and certain other shallow-rooted crops.

SARATOGA SERIES

Soils of the Saratoga series occur on terraces at the southern and western edges of the valley. The average annual rainfall is 20 to 30 inches. The original vegetation was mostly grasses, scattered oaks, and occasional brush. At present most areas are cultivated. The typical slopes of these soils range from 10 to 20 percent; but they may vary from 3 percent to 35 percent. Improper use of these soils has resulted in erosion in many places.

The surface soils are medium textured, slightly or medium acid in reaction (pH 5.6 to 6.5), and brown or reddish brown in color. They become more reddish when moist. In general the soils are easily worked and break to a cloddy tilth that can readily be reduced to a coarse granular mass. The surface soils overlie reddish-brown moderately compact subsoils of gravelly clay loam texture and of medium or slightly acid reaction (pH 5.6 to 6.5). The subsoils grade

into brown, fairly permeable, unconsolidated terrace material of gravelly loam texture and of medium or slighly acid reaction (pH 5.6 to 6.5). The compact subsoils tend to retard drainage, but in general the soils are considerably more permeable than soils of the Positas or Milpitas series.

The Saratoga soils are closely associated with the Positas soils and in the Santa Clara Area occur only in complexes of the two series. The soils of both series are similar in color, but the Saratoga subsoils are less compact than those of the Positas soils. In the complex of Saratoga-Positas soils the Saratoga soils predominate, whereas in the complex of Positas-Saratoga soils the Positas soils predominate. The Saratoga-Positas soils occupy about 4½ square miles.

Saratoga-Positas loams, 10 to 20 percent slopes (SH).—This is a close association of Saratoga loam and Positas loam, with Saratoga loam, 10 to 20 percent slopes, predominating. A profile description of Positas loam was given in the description of Positas-Saratoga loams, slightly eroded, 3 to 10 percent slopes. The following profile description is of Saratoga loam, 10 to 20 percent slopes. The surface soil is a brown or reddish-brown, friable, slightly or medium acid loam to depths of 8 to 13 inches. It is easily worked and breaks to medium-sized clods that are readily crushed to a coarse granular mass. In most places a little gravel is present in the soil. The surface soil overlies a reddish-brown moderately compact subsoil of gravelly clay loam texture. The subsoil tends to retard drainage but is more permeable than the subsoil of Positas loam. At depths of 42 to 50 inches the subsoil grades into moderately permeable, brown, massive terrace material of gravelly loam texture. The subsoil and underlying material are variegated in color because of the partially decomposed gravel in these lower horizons. Slopes normally range from 10 to 20 percent, but south of Masters Hill some are a little steeper.

Most of this inextensive complex is southeast of Evergreen, east of Lake Lagunita, and south of Masters Hill. Some of these areas east of Lake Lagunita are occupied by residences, and there the soils are more gravelly than typical. In most other places the soils are not cultivated and are in trees and grass or grass. Erosion control would be necessary if these soils were cultivated.

Saratoga-Positas loams, slightly eroded, 10 to 20 percent slopes (SK).—This complex occurs on terraces near the southern and western edges of the valley. The soils have the same characteristics as the Saratoga loam and Positas loam complex just described except for differences caused by erosion. In general the surface soils are shallower and in many places they are redder than typical because of mixture with part of the reddish-brown subsoils. Occasional gullies have developed in some places. One small severely eroded area about 1 mile west of Los Gatos is included.

Nearly all of this complex is cultivated, but not irrigated. The principal crops are prunes, apricots, and hay. Yields of crops are normally fair. Erosion control practices are required for the best use of these soils.

Saratoga-Positas loams, 3 to 10 percent slopes (SE).—This complex of Saratoga-Positas loams is similar to previously described complexes of these soils except for having less steep slopes. It is located

along the southern and western edges of the valley. Most of this complex is cultivated, and is very slightly eroded. A few small areas north of New Almaden are slightly eroded.

Erosion is not at present an important factor in determining the use of these soils. Prunes, apricots, grapes, and grain hay are grown on the soils, and a few areas are pastured. Yields of crops are fair to good.

Saratoga-Positas loams, slightly eroded, 20 to 35 percent slopes (SG).—This complex of Saratoga and Positas loams occurs on hilly relief near the southern edge of the valley. South of Masters Hill only one crop is grown, nonirrigated grapes. Northwest of Los Gatos miscellaneous crops are grown or the soils are occupied by residences. In most places the surface soils are considerably shallower and redder than typical because of mixture with part of the reddish-brown subsoils. In some places the soils are more gravelly than typical. Erosion control practices should be followed if this soil complex is cultivated.

Saratoga-Positas loams, moderately eroded, 20 to 35 percent slopes (SF).—This complex occurs between Saratoga and Los Gatos. Erosion has exposed the reddish-brown subsoils in many places, and in others the surface soils are generally redder than for the uneroded soils. Nonirrigated prunes and apricots are the principal crops on these soils. Yields are poor. Some areas once cultivated are now abandoned to brush and grass.

Saratoga-Positas loams, deep, slightly eroded, 10 to 20 percent slopes (SD).—This complex of Saratoga and Positas loams is similar to the others described, except for the depth of surface soils. Where these deep Saratoga loams are not eroded or only very slightly eroded, the surface soil is 11 to 22 inches in depth. It overlies a reddish-brown moderately compact subsoil similar to that of the other Saratoga loam soils. The surface soil of the deep Positas loams is also significantly deeper than that of the other Positas loam soils. In this complex however, most areas have been slightly eroded, and the surface soil is consequently not so deep as where uneroded.

The complex is located west of the Vasona Dam on Los Gatos Creek. Most areas are cultivated, and nonirrigated prunes, grapes, and apricots are the principal crops. Yields are fairly good on these soils. Erosion control measures are important in the proper use of these soils.

Saratoga-Positas loams, deep, slightly eroded, 3 to 10 percent slopes (SC).—This complex of deep Saratoga and Positas loams has less steep relief than the preceding complex. Areas are located near Saratoga and Monta Vista. Nonirrigated prunes, apricots, and grapes are the principal crops, and yields are normally fairly good. These soils have eroded slightly, and erosion control should be practiced.

SOBRANTE SERIES

The Sobrante soil occurs mostly in the southeastern part of the Area under an average annual rainfall of about 25 inches. The natural vegetation was brush, trees and grass, or grass. Most areas are now in orchards. The relief is rolling and hilly, and in nearly all cultivated places some erosion has occurred.

The surface soil is brown, becoming reddish brown when moist, fine textured, weakly blocky, and slightly acid in reaction (pH 6.1 to 6.5). The surface soil overlies a moderately compact reddish-brown slightly acid subsoil of fine texture and of weakly prismatic structure. Some colloidal staining generally coats the surfaces of aggregates in the subsoil. Some fragments of bedrock normally occur in the lower parts of the subsoil, which grades irregularly into highly metamorphosed basic rock that resembles igneous rock.

The Sobrante soil is associated with the Los Gatos soils, which are not as fine-textured and which are developed from rock that is less basic. Only one Sobrante soil is mapped in this Area, and it occupies about 1½ square miles.

Sobrante clay, slightly eroded, 10 to 35 percent slopes (SL).—The uneroded surface soil is a brown slightly acid light clay to depths of 7 to 13 inches. When moist it is reddish brown and in some places dark reddish brown. When dry it breaks to a brittle or crumbly weakly blocky structure, and when wet it is plastic or slightly sticky. It is relatively easy to work, and careful cultivation produces a very good tilth. The surface soil grades rather rapidly into a moderately compact reddish-brown subsoil of clay texture. When partially dry the subsoil cracks to a weak prismatic structure of hard consistence. In most places some fragments of rock occur in the subsoil; the number and size of the fragments increase with depth. At depths of 28 to 40 inches the subsoil grades irregularly into hard, broken, highly metamorphosed rock that resembles basic igneous rock.

The slightly eroded soil is similar to that described, except for the loss of some of the surface soil and the mixture, through cultivation, of the remainder with part of the redder subsoil. In a few places some gullies have developed. A few areas that are only very slightly eroded are included. A few very small areas of Permanente soils, which were developed from crystalline limestone, could not be separated at this scale of mapping.

Most of this soil is cultivated. Apricots and grain hay are the principal crops. Yields of grain hay are normally good. Yields of apricots are fair if the season is favorable, but the quality of fruit is generally good. Walnuts, prunes, and grapes are also grown.

SOPER SERIES

Soils of the Soper series occur in the western part of the Area, mainly near the Stevens Creek Reservoir, under an average annual rainfall of about 25 inches. The natural vegetation consists almost wholly of brush. The soils are cultivated only in a few small areas. The typical slopes of Soper soils usually range from 20 to 35 percent, but steep slopes are more common in this Area. Where the soils have been cultivated, moderate erosion has resulted in most places.

The surface soils are brown or light brown, medium textured, generally gravelly, and slightly or medium acid in reaction (pH 5.5 to 6.6). The gravel content interferes somewhat with cultivation. The surface soils grade into slightly more reddish-brown, moderately compact, weakly blocky subsoils of gravelly clay loam texture and of medium or strongly acid reaction (pH 5.1 to 6.0). The subsoils in most places are dense enough to retard drainage to a moderate degree.

The subsoils grade into brown or yellowish-brown, noncalcareous, moderately or weakly consolidated conglomerate bedrock. The rock from which the parent material of the Soper soils is derived is the Santa Clara geologic formation, from which also developed the Azule soils. In general, however, the well-consolidated parent material of the Soper soils appears to be primary or residual, whereas the unconsolidated or only slightly consolidated parent material of the Azule soils seems to be terrace or old valley-fill material. The total area of Soper soils is about 2 square miles.

Soper gravelly loam, 20 to 35 percent slopes (SM).—The surface soil is a brown or light-brown, friable, slightly or medium acid gravelly loam to depths of 8 to 13 inches. Cultivation breaks the soil to a cloddy tilth that is readily worked down to a granular and gravelly mass. The surface soil grades into a slightly more reddish-brown, moderately compact, weakly blocky subsoil of gravelly clay loam texture. The subsoil retards drainage somewhat and causes waterlogging of the surface soil during heavy rains. At depths of 23 to 32 inches the subsoil grades into a noncalcareous moderately or weakly consolidated conglomerate bedrock that is somewhat more permeable than the subsoil.

The soil is mapped near Permanente. None of it is cultivated. The natural vegetation is grass, brush, or trees and grass. The soil is used for grazing, for which it is moderately well suited.

Soper gravelly loam, moderately eroded, 20 to 35 percent slopes (SN).—The soil is similar to the noneroded soil except for the effects of erosion. Much of the surface soil has been eroded. The finer textured subsoil is exposed in a number of places. In most places some gullies have formed. A few small severely eroded areas near the Stevens Creek Reservoir have been included. All of this soil has been or is being cultivated. The principal crops are apricots, prunes, and grapes. Yields are normally poor.

Soper gravelly loam, 35 to 50 percent slopes (So).—This soil is normally somewhat shallower than that on less steep slopes. None of it is cultivated. The natural vegetation is a thick growth of brush. The soil has practically no agricultural value. It is all mapped near the Stevens Creek Reservoir.

SORRENTO SERIES

Soils of the Sorrento series, like soils of the Yolo and Mocho series, are some of the most productive and intensively cultivated soils in the Area. The average annual rainfall on the Sorrento soils is about 15 inches. The original vegetation was mainly grasses, with occasional scattered valley oaks, but all areas have been cleared and under cultivation for years (pl. 3, *B*). The soils occur on well-drained very gently sloping alluvial fans where recent deposits have been left by creeks heading mainly in sandstone and shale formations. Most of these areas are in the eastern part of the valley near creeks that run from the eastern mountains or the Diablo Range. A few areas of Sorrento soils lie in the western part of the valley on the recent alluvial fan of Stevens Creek, which heads in the Santa Cruz Mountains.

The soils are brown or pale brown, deep, friable, and moderately permeable. The surface soils and upper subsoils are noncalcareous and neutral to slightly basic in reaction (pH 7.0 to 7.8), but the lower subsoils are slightly or moderately calcareous and moderately basic in reaction (pH 7.8 to 8.3). Lime, beginning at depths of 30 to 52 inches, normally is disseminated throughout the lower subsoils, but in places it is segregated along small tubular pores or root holes. The upper subsoils are similar to the surface soils in many respects, but in some places, particularly in the finer textured types, they are slightly compact. The lower subsoils are pale brown, moderately permeable, and generally somewhat stratified in the coarser textured types. Roots can penetrate the subsoils easily, and tree roots extend to depths of 6 feet or more. The soils are easily cultivated, but the finer textured types tend to develop plowpans at the most frequent depth of cultivation.

The Sorrento soils resemble the Yolo soils except for being calcareous in the lower subsoils. They are also similar to the associated Campbell soils, except that the Campbell soils are grayer or darker, have developed under partially restricted drainage, and are rust-brown mottled in the lower subsoils. The Sorrento soils are also associated with soils of the Orestimba series. Soil types and phases of the Sorrento series are mapped on about 31 square miles in this Area.

Sorrento fine sandy loam, 1 to 3 percent slopes (Ss).—The surface soil is a brown or pale-brown, friable, noncalcareous fine sandy loam of neutral to slightly basic reaction. It overlies, at depths of 6 to 18 inches, a pale-brown, friable, moderately permeable, noncalcareous upper subsoil of sandy loam, fine sandy loam, or loam texture and of slightly basic reaction. The lower subsoil, which begins at depths of 36 to 52 inches and extends to depths of 72 or more inches, is very similar to the upper subsoil but normally is slightly calcareous. In a number of places the soil is stratified and contains layers of loamy sand, sandy loam, or gravelly sandy loam, which definitely lower the water-holding capacity of the soil.

This soil is easily worked. It breaks on cultivation to small clods that are easily crushed to a fine granular mass. Prunes, apricots, and alfalfa are grown on this soil, and good yields are obtained. The only area of this soil mapped in the survey lies along Stevens Creek near Monta Vista.

Sorrento gravelly loam, 1 to 3 percent slopes (Sr).—The surface soil is a brown or pale-brown, friable, noncalcareous, neutral loam containing enough gravel to interfere somewhat with disking and other cultivation. At depths of 8 to 20 inches it overlies an upper subsoil that is very similar to the surface soil. Disseminated lime occurs in the generally gravelly lower subsoil that begins at depths of 30 to 48 inches. In the few places where lime does not occur in the profile above depths of 5½ or 6 feet, the soil resembles Yolo gravelly loam. The soil is somewhat stratified and is moderately permeable to a depth of 6 or more feet.

Where associated with finer textured types of the Sorrento series, the soil usually occurs on small low ridges or next to streams. In the eastern part of the valley it lies along Penitencia Creek, near Berryessa Creek, and in narrow bodies northwest of Berryessa. In the eastern part of the valley it occurs along or near Stevens Creek.

Prunes and apricots are the main crops grown on the soil, but walnuts and cherries are also grown. Yields are normally good. This soil is suitable for a wide range of crops grown in this Area, but it is best for orchard and vineyard crops. The soil does not have so high a moisture-holding capacity as Sorrento loam, but it has no serious irrigation problems.

Sorrento loam, 1 to 3 percent slopes (Su).—The brown, light-brown, or pale-brown, friable, noncalcareous surface soil normally is 6 to 15 inches deep. Reaction is neutral to slightly basic. When cultivated at the proper moisture content the soil works to medium-sized clods that can readily be crushed to a soft granular mass. The surface soil overlies a pale-brown, friable, moderately permeable, noncalcareous upper subsoil, generally of loam or clay loam texture. The lower subsoil, except for the small amount of lime which normally begins at depths of 30 to 52 inches from the surface, is similar to the upper subsoil and extends to depths of 6 or more feet. Generally the lime is disseminated throughout the lower subsoil, but in a few places it is segregated on the surfaces of small tubular pores or root holes. This soil is usually rather uniform in profile, but it may be stratified with very coarse soil material. Near Berryessa the soil contains some gravel, but not enough for the soil to be classed as gravelly.

The soil is fairly extensive east and southeast of San Jose and along or near Stevens Creek. It is an excellent soil for general agriculture and is suitable for a wide range of crops grown in this Area. Prunes are the chief crop, but such orchard crops as apricots, cherries, and walnuts are also grown. Near the County Home this soil is used intensively for truck crops, and west of Milpitas a vegetable-seed breeding station is located on it. Yields of nearly all crops grown are very good.

Sorrento silt loam, 1 to 3 percent slopes (Sv).—This soil has a soft, friable, noncalcareous silt loam surface soil which in places is almost a loam or a clay loam in texture. The reaction is neutral or slightly basic. On cultivation the soil breaks to medium-sized clods that are readily crushed to a granular mass, but in some places a plowpan has developed at the depth of most frequent cultivation. At depths of 8 to 20 inches the brown or pale-brown surface soil grades into a brown, very slightly compact, noncalcerous upper subsoil of silt loam or clay loam texture. A pale-brown, friable, moderately permeable, slightly or moderately calcerous lower subsoil normally begins at depths of 30 to 48 inches. Lime is disseminated throughout the lower subsoil and also is segregated along small tubular pores. The soil is only slightly stratified and normally is very uniform to depths of 6 or more feet.

This soil is mapped along or near Coyote Creek. The largest areas are just north of San Jose and east and northeast of Lick. Like Sorrento loam, this is an excellent soil for general agricultural use. It is suitable for a wide range of crops. Prunes, apricots, cherries, and walnuts are the principal orchard crops; and truck crops, for which the soil is very well suited, are also grown to a considerable extent. Yields are normally very good.

Sorrento clay loam, 1 to 3 percent slopes (Sr).—The surface soil is a brown or pale-brown, friable, noncalcareous clay loam to depths

of 8 to 15 inches. The reaction is neutral or slightly basic. If cultivated at the proper moisture content, the soil breaks to medium-sized clods that are crushed fairly easily to a coarse granular mass. However, if the soil is worked too moist, it puddles and, on drying, develops firm, hard clods that are difficult to break into smaller aggregates. The surface soil is dark brown or grayish brown when moist. Generally in orchard areas, where the soil is somewhat shaded and where cover crops have been turned under regularly for years, the soil is a little darker in color than in areas of field crops. In many places a plowpan has formed at the most frequent depth of cultivation. The upper subsoil is brown, noncalcareous, and generally very slightly compact, but not enough so to restrict drainage or root penetration. The upper subsoil is a clay loam of slightly basic reaction. At depths of 36 to 50 inches it grades into a friable, moderately permeable, pale-brown lower subsoil that is slightly or moderately calcareous and generally of clay loam or silty clay loam texture. Lime is disseminated throughout the lower subsoil and also segregated along small tubular pores or root holes. In general the soil is only very slightly stratified and is relatively uniform to depths of 6 or more feet.

This soil is one of the most extensive of the Sorrento series. The largest areas occur along Coyote Creek above San Jose. Near Berryessa and north of it, the soil is a little darker than typical and contains some gravel. Some slopes are a little greater than 3 percent.

This soil is one of the most suitable in the Area for prune production, and prunes are grown to a large extent. Nearly every orchard crop in the valley is also grown on these soils, and truck crops and alfalfa. Yields are good or very good.

Sorrento clay loam, over Sunnyvale clay, 0 to 1 percent slopes (Sr).—This soil consists of 18 to 36 inches of brown moderately friable Sorrento clay loam, over a black calcareous clay resembling that of the Sunnyvale series. Lime occurs in the Sorrento soil material a few inches above the black clay. This zone is generally mottled with rust-brown stains because of retarded drainage through the clay. The underlying material resembles typical Sunnyvale clay, and gray or light-gray highly calcareous marly material occurs at depths of 48 to 72 inches from the surface.

Two bodies of this soil are mapped, one about 2 miles northwest of Evergreen and the other just east of Palo Alto. Hay, alfalfa, and truck crops are the chief crops on this soil, and a few fruit trees are grown northwest of Evergreen. The soil is not too well suited to orchard crops, but field crops do nearly as well as on Sorrento clay loam, 1 to 3 percent slopes.

Sorrento silty clay loam, 0 to 2 percent slopes (Sw).—The surface soil to depths of 8 to 18 inches is a brown, noncalcerous, silty clay loam of neutral or slightly basic reaction. If cultivated when too moist, the soil puddles easily and dries into hard clods. However, if the soil is worked carefully at the proper moisture content, a good tilth can be produced. In some places a moderately compact plowpan has formed at the depth of most frequent cultivation. The color of Sorrento silty clay loam in orchard areas is slightly darker than in areas of field crops. The upper subsoil is mostly massive and consists of brown, slightly compact, noncalcareous silty clay loam of slightly basic reaction. In general the upper subsoil is a little

more compact than is typical of other Sorrento soils, and in some places this compaction interferes slightly with root and moisture penetration. At depths of 36 to 52 inches, the upper subsoil grades into a pale-brown, slightly or moderately calcareous, friable, moderately permeable lower subsoil of silty clay loam texture. In general the soil is only very slightly stratified; it is relatively uniform to depths of 6 or more feet.

This soil is one of the most extensive of the Sorrento series, and all of it is mapped along or near Coyote Creek below San Jose. Large acreages of prunes are grown on the soil, which is well-suited for prune production. There are also some walnuts, apricots, pears, and cherries. Besides orchard crops, truck crops, sugar beets, and alfalfa are grown to a considerable extent. Yields are normally good or very good.

SUNNYVALE SERIES

Soils of the Sunnyvale series are the most extensive of the soils occurring in basin positions. They are mostly in the northern part of the Area, under an average annual rainfall of about 15 inches. The original vegetation was mainly grasses, but all of the soils have been cultivated for years. Surface drainage is very slow on these smooth, nearly level slopes. These soils originally had a prevailingly high ground-water level. These environmental conditions have been the chief factor in producing the principal characteristics of this series. At present, however, because of large-scale pumping for irrigation, the ground water in most places is below the level that might affect crops or soil characteristics. The parent material was very finely divided alluvium from areas of sandstone and shale rocks.

The soils are typically black and fine textured, and they are calcareous and basic in reaction (pH 7.7 to 8.3) in both surface soils and subsoils. The black color is caused by a high content of well-decomposed organic material. The surface soils, if undisturbed while drying, crack to large angular blocks that show numerous secondary cracks near the surface. On becoming drier the blocks near or at the surface generally break along the secondary cracks and produce a fine blocky or even a granular structure. The surface soils grade into black, fine-textured, slightly compact upper subsoils that normally contain some small light-colored nodules and soft masses of segregated lime. The upper subsoils grade rapidly into gray or light-gray, fine-textured, massive lower subsoils so highly calcareous that they are locally referred to as marl. Lime is segregated in soft masses and a few hard nodules. The underlying material is light-gray or light brownish-gray, rust-brown mottled, calcareous, moderately fine to fine-textured alluvium, which contains less lime than the lower subsoils.

The Sunnyvale soils are related to and in some places associated with soils of the Castro series, which differ in having lower subsoils consisting of weakly cemented lime hardpans. The Sunnyvale soils are also associated with soils of the strongly saline Alviso series. Soils of the Sunnyvale series occupy about 24 square miles.

Sunnyvale clay loam, 0 to 1 percent slopes (Sr).—The surface soil is a friable, slightly calcareous, dark-gray or dark grayish-brown clay loam to depths of 11 to 17 inches. The soil breaks to clods that

can be fairly easily crushed to a coarse granular mass. The surface soil grades into a dark-gray or dark grayish-brown, calcareous, slightly compact upper subsoil of heavy clay loam texture. Lime is disseminated throughout the surface soil and upper subsoil, and in most places some is segregated in the upper subsoil. At depths of 25 to 37 inches the upper subsoil grades into a highly calcareous, light-gray or light brownish-gray, rust-brown mottled, lower subsoil, which is of clay loam texture and 10 to 22 inches thick. The underlying material is a pale-brown, rust-brown mottled, permeable, clay loam alluvium that contains less lime than the lower subsoil horizon. A few areas have some gravel throughout the soil profile, and others have a noncalcareous or only very slightly surface soil.

Except in residential areas, all of this soil is cultivated. Most of it is near the central part of the Area. It is best suited to shallow-rooted truck and field crops, and yields are good. Some pears and prunes are grown, and yields are poor to fair. The rooting zone of deep-rooted crops is somewhat limited by the highly calcareous lower subsoil.

Sunnyvale clay, 0 to 1 percent slopes (Sx).—This soil has a black calcareous clay surface soil to depths of 10 to 15 inches. The soil is fairly easily worked in spite of the fine texture, because of its relatively high content of lime. If the soil is cultivated carefully at the proper moisture content, a good seedbed can be prepared. The surface soil grades into a black, slightly compact, weakly blocky, clay-textured upper subsoil that is calcareous and generally contains a few white specks or small masses of segregated lime. Lime segregation increases somewhat with depth, and at depths of 28 to 35 inches the upper subsoil grades rapidly into a gray or light-gray, highly calcareous, slightly rust-brown mottled, lower subsoil of clay texture. The lower subsoil, at depths of 40 to 60 inches, grades into a light brownish-gray, rust-brown mottled, calcareous, moderately permeable clay loam. The deep underlying material is less calcareous than the lower subsoil, although lime nodules occur in both.

In a few places a little gravel occurs in the lower subsoil and underlying material, and also the surface soil may be only very slightly calcareous or even noncalcareous. Sunnyvale clay is one of the most extensive soils of the Area, and it is the most typical of the Sunnyvale series. It occurs mainly in the northern and lower part of the valley west of the Guadalupe River, and between San Francisco Bay and the Southern Pacific Railroad. Small areas of this soil have formed in small basins in the eastern and southern parts of the valley.

In some places, especially south of the Lick Hills, where the soil originally had a slightly uneven surface and was leveled for irrigation, the black surface soil and upper subsoil have been removed in spots, and the gray or light-gray lower subsoil has been exposed. By far the largest part of the soil does not contain alkali, but a few areas lying next to alkali soils do contain some salts. The soil is well suited to shallow-rooted crops, and grain hay and truck crops are the principal crops on the alkali-free areas. Alfalfa, sugar beets, pears, prunes, and walnuts are also grown. Mainly because of the fine surface texture and the highly calcareous lower subsoil, Sunnyvale clay is not well-suited to orchard crops. In most places where they are grown, definite symptoms of chlorosis are present. Pears do better

than other fruits and yields are fair. For prunes and walnuts the yields are normally poor. Yields of alfalfa are good, and yields of grain hay, certain truck crops, and sugar beets are good or very good. Where slightly affected by alkali the soil is used mainly for grain hay. Small areas moderately and strongly affected with alkali are used chiefly for grazing.

TIDAL MARSH

Tidal marsh (Ta) consists of land that is periodically covered by the tide and on which a rank herbaceous growth normally occurs. Predominant plants are cordgrass, pickleweed or samphire, and alkali heath. Numerous sloughs originally meandered throughout this land type. At present, however, large areas that formerly were tidal marsh have been ponded and are used for evaporating sea water for the production of salt. Tidal marsh has no agricultural value.

VALLECITOS SERIES

Soils of the Vallecitos series occur on hills in the eastern and southern parts of the Area, under an average annual rainfall of about 25 inches. The natural vegetation is grass and scattered oaks, and brush on some of the steeper slopes (pl. 2, *A*). The typical slope range is from 20 to 35 percent, but some slopes are as slight as 10 percent or as steep as 50 percent. Some erosion has occurred.

The surface soils are brown (becoming nearly reddish brown when moist), medium to moderately fine textured, and normally slightly or medium acid in reaction (pH 5.6 to 6.5). On drying they crack to a medium blocky structure of hard consistence, and when moist they are plastic or sticky. The surface soils overlie brown or reddish-brown moderately compact subsoils of medium to moderately fine texture and of neutral to slightly or medium acid reaction. At relatively shallow depths the subsoils grade irregularly into hard but generally shattered partially metamorphosed sedimentary rock of the Franciscan or a similar geological formation. Occasional rock outcrops are characteristic of these soils, and normally some rock fragments occur throughout the soil profiles.

The Vallecitos soils occur rather extensively in this Area. They are related to and in places associated with the more reddish soils of the Los Gatos series, which have developed from the same kind of rocks but under higher rainfall. The soils of the Vallecitos series occupy about 9½ square miles.

Vallecitos clay loam, 20 to 35 percent slopes (Va).—The surface soil is a brown, friable, slightly or medium acid clay loam to depths of 8 to 16 inches. The soil cracks to a medium blocky structure and can be worked carefully to a good tilth. The surface soil grades irregularly into a brown or reddish-brown moderately compact blocky subsoil of clay loam texture. At depths of 18 to 32 inches, the subsoil grades into shattered metamorphosed sedimentary rock of somewhat variable composition. In some places the bedrock contains seams of calcite, and in a few places the lower subsoil is slightly calcareous.

Most of this soil is on the hills in the southeastern part of the Area. Some of it occurs also on hills in the southern part of the Area. A few areas of rolling relief and some of loam texture are included. None of this soil is cultivated. The vegetation is mainly

grass or trees and grass. Soil areas are used chiefly for grazing, and the carrying capacity is normally fairly good.

Vallecitos clay loam, slightly eroded, 20 to 35 percent slopes (Vc).—This soil is like the soil just described, except for the loss of some surface soil through erosion. It is mapped mostly on hills in the southern part of the Area. All of this soil is cultivated. Prunes, apricots, grapes, and grain hay are the principal crops. Yields are generally poor and are entirely dependent on seasonal rainfall.

Vallecitos clay loam, moderately eroded, 20 to 35 percent slopes (Vb).—This soil is like the uneroded soil except that in most places the surface layer is shallower; in some places the subsoil and parent material are exposed. Areas of this soil occur near Masters Hill and southwest of Alamitos. All of the soil is cultivated. Apricots, grapes, prunes, truck crops, and grain hay are grown. Yields are poor and depend to a large extent on seasonal rainfall. In most places it would be extremely difficult to control erosion and continue the cultivation of this soil.

Vallecitos clay loam, slightly eroded, 10 to 20 percent slopes (Vd).—Except for less steep slopes but more erosion, this soil is similar to the uneroded Vallecitos clay loam previously described. Small areas are mapped on hills near the southern edge of the valley. All of this soil is cultivated. Orchard fruits and grapes are the principal crops. Yields are only fair and entirely dependent on seasonal climatic conditions.

Vallecitos clay loam, 35 to 50 percent slopes (Ve).—The profile of this soil is similar to that of Vallecitos clay loam on lesser slopes but is somewhat shallower. This soil occurs in the southeastern part of the Area near Coyote Peak, along the headwaters of Dry Creek, and near Masters Hill. None of it is cultivated. The natural vegetation is mainly grass; some brush or trees and grass grow on northern slopes. This soil is used chiefly for grazing.

Vallecitos clay loam, severely eroded, 35 to 50 percent slopes (Vf).—This soil is similar to other steep Vallecitos clay loams except that it is severely eroded. In many places the subsoil is exposed, and in some places bedrock is exposed. This soil occurs west of Masters Hill. All of it is cultivated. Prunes, truck crops, and grain hay are the principal crops, and yields are normally very poor. This soil should not be cultivated.

Vallecitos loam, slightly eroded, 20 to 35 percent slopes (Vg).—The uneroded surface soil is a brown friable slightly acid loam to depths of 6 to 10 inches. It overlies a brown or reddish-brown slightly compact subsoil of loam or clay loam texture. At depths of 12 to 20 inches, the subsoil grades rapidly but irregularly into hard, more or less shattered and partially weathered, metamorphosed sedimentary rock of brown or reddish-brown color. In most areas there are some rock outcrops, and the rock fragments that occur throughout the soil profile increase in number with depth. In a few places where seams of calcite occur in the rock, the soil immediately above is slightly calcareous. This slightly eroded soil has a profile similar to the uneroded profile just described, except for slight differences brought about by erosion.

This soil is mapped just north of Alum Rock Canyon and north of the Calero Reservoir dam. Very little of it is cultivated. The erosion that has taken place is chiefly the result of overgrazing. Some soil that is only very slightly eroded is included. The natural vegetation is grass, and some areas are covered by trees and grass.

Vallecitos loam, 35 to 50 percent slopes (VH).—This soil is generally shallower than the Vallecitos loam on less steep slopes. It occurs north of the Calero Reservoir dam. The natural vegetation consists largely of brush and a few areas of grass. None of the soil is cultivated, nor is it suited to cultivation.

YOLO SERIES

Members of the Yolo series are some of the most productive and intensively cultivated soils in the Area. They occur mainly on the western side of the valley under an average annual rainfall of 15 to 20 inches. The original vegetation was mainly grasses and scattered oaks, but all areas have been cleared and cultivated for years. The soils occur on well-drained very gently sloping alluvial fans where material has recently been deposited by creeks heading in sandstone and shale formations.

The soils are brown or pale brown, and they are deep, friable, and permeable. They are noncalcareous and neutral in reaction (pH 6.6 to 7.3) in both surface soils and subsoils. The subsoils are in most respects similar to the surface soils, but normally they are slightly lighter in color. In places, particularly in the coarser textured types, the subsoils are somewhat stratified. Roots can penetrate the subsoils easily to depths greater than 6 feet. The soils are easily cultivated, but the finer textured types are likely to develop a plowpan at the depth of most frequent cultivation.

The Yolo soils are associated mostly with soils of the Zamora, Pleasanton, and Campbell series and in a few places with soils of the Sorrento series. The Zamora and Pleasanton soils are related to the Yolo soils but have somewhat more compact subsoils and different color. The Campbell soils, also related to the Yolo soils, have had partially restricted drainage during development and are rust-brown mottled and calcareous in the subsoils. The Sorrento soils are very similar to the Yolo soils but are calcareous in the subsoils. Soils of the Yolo series are mapped on about 13 square miles.

Yolo fine sandy loam, 1 to 3 percent slopes (YB).—The surface soil is a pale-brown or brown friable fine sandy loam or loam to depths of 8 to 16 inches. The subsoil consists of brown or pale-brown, friable stratified alluvial material to depths of 6 or more feet. The reaction is neutral in both the surface soil and subsoil. Close to stream channels, the subsoil may be highly stratified and contain alternate layers of very slightly compact loam or silt loam and sand, sandy loam, or gravelly loam. Slight rust-brown mottling generally occurs in the finer textured strata. In a few small areas some gravel occurs in the surface soil, but not enough for the soil to be classified as gravelly. This soil is mapped along Los Gatos Creek below the Vasona dam and also east of Campbell along the old channel of Los Gatos Creek.

Yolo fine sandy loam is an excellent soil and under irrigation is suitable for a wide range of crops. In this Area the soil is particularly suitable for the production of cherries. All of this soil is cultivated; nearly all of it is in irrigated orchards. Cherries are the principal crop, although prunes, apricots, and walnuts are also grown. Coarse-textured strata in the subsoil lower the water-holding capacity of the soil and make necessary light but frequent irrigations to provide enough moisture for satisfactory crop production.

Yolo gravelly fine sandy loam, 1 to 3 percent slopes (Yc).—This soil has a brown or pale-brown gravelly fine sandy loam surface soil to depths of 10 to 24 inches. It is very friable and of neutral reaction, but enough well-rounded gravel ½ to 1½ inches in diameter is present to interfere somewhat with disking and other cultivation. The subsoil is similar to the surface soil and consists of stratified gravelly material that sometimes includes strata of coarse sand and gravel and extends to depths of 6 or more feet. Because of the generally coarse texture of both surface and subsoil, the soil has a low water-holding capacity.

Most of this soil occurs along Campbell Creek west of the Moreland School, and also along Los Gatos Creek between Los Gatos and Campbell. This soil is not among the best for orchards, mainly because the low moisture-holding capacity of the soil makes it very hard to provide enough moisture for good tree growth and fruit production. However, most of the soil is in orchards, mainly prune trees. Yields are only fair, and the average life of orchard trees is relatively short. Grapes, for which the soil is generally better suited than for orchards, are grown south of Campbell and north of San Tomas.

Yolo gravelly loam, 1 to 3 percent slopes (Yd).—This soil is similar to and associated with both Yolo loam and Yolo gravelly fine sandy loam. The surface soil to depths of 8 to 18 inches is a brown or pale-brown friable gravelly loam of neutral reaction. The well-rounded gravel generally ranges from ½ to 2 inches in diameter and interferes somewhat with disking. The subsoil, which resembles the surface soil, is a pale-brown, friable, moderately permeable gravelly loam to depths of 6 or more feet. In some places the subsoil is stratified with coarse- and fine-textured material, but usually it is more uniform in texture.

Many small and narrow areas of this soil lie near the Moreland School and along Campbell Creek. All of the soil is very gently sloping except one small area along Los Gatos Creek that has an average slope slightly greater than 4 percent. Where the soil occurs as isolated and very narrow stringers adjacent to creeks, the subsoil is somewhat more compact than is typical of the Yolo series.

The difficulties in irrigation and maintenance of proper moisture content are less for this soil than for Yolo gravelly fine sandy loam. All of the soil is cultivated, and nearly all of it is in orchards. Prunes, apricots, and walnuts are grown, and yields are good or very good. Truck crops and dry-farmed grain hay are also grown in a few places.

Yolo loam, 1 to 3 percent slopes (Ye).—The surface soil is a brown or pale-brown friable loam that is 8 to 20 inches deep and neutral

in reaction. When moist or wet the soil is dark brown. Generally in orchards, where the soil is somewhat shaded and cover crops have been turned under regularly for years, the soil is slightly darker in color than it is at a comparable moisture content in areas used for field crops. When the soil is tilled under proper moisture conditions, it breaks to small clods that are easily crushed to a fine granular mass. In some areas of this soil a slightly compact plowpan has developed in the surface soil at the depth of most frequent cultivation. The subsoil is normally a little lighter colored than the surface soil and of loam or clay loam texture. In a few places the subsoil is stratified, but usually it is uniform to a depth of 6 or more feet. A few small bodies contain some gravel.

Yolo loam is the most typical soil of the Yolo series. It is most extensive east and northeast of Campbell. This is an excellent soil for orchard crops and for a wide range of other crops suited to the Area. All of it is cultivated and most of it is in orchards (pl. 3, *A*). Some of the best yields of prunes, apricots, cherries, walnuts, and other orchard crops are obtained from this soil.

Yolo loam, 3 to 6 percent slopes (YE).—This soil occurs in the southeastern part of the Area. In most respects it is similar to the Yolo loam just described, except that its slopes are slightly steeper. The slopes are smooth, but control of irrigation water is expensive and difficult. All of the soil is cultivated, and in some places it is dry-farmed. Prunes and apricots are the principal crops, and yields are normally good.

Yolo loam, over Clear Lake clay, 0 to 1 percent slopes (YF).—This soil consists of Yolo loam overlying, at depths of 18 to 42 inches, a dark-gray clay resembling Clear Lake clay. In most of these areas the Yolo loam is slightly mottled with rust-brown stains just above the clay, which indicates slow drainage through the Clear Lake soil material. In a few places the mottled zone of Yolo loam is slightly calcareous, but usually lime occurs only in the Clear Lake soil material at depths of 30 to 60 inches from the surface. This soil is entirely within the city of San Jose. Most of it is occupied by residences, but it is used for a few orchards and truck crops.

Yolo clay loam, 1 to 3 percent slopes (YA).—This soil has a brown or pale-brown surface layer that darkens considerably when moist. The surface soil is a shade darker in orchard areas than in areas of field crops. Normally the surface soil varies from 10 to 24 inches in depth and consists of friable clay loam of neutral reaction. If cultivated at the proper moisture content, the soil breaks to medium-sized clods that, on drying, are fairly easily crushed to a coarse granular mass. However, if cultivated when too moist, the soil generally puddles, forms hard clods on drying, and develops a moderate compact plowpan in the surface soil at the depth of most frequent cultivation. The subsoil, which extends to depths of 6 or more feet, is normally of uniform clay loam texture. In general, however, the subsoil of this soil is a little more compact than the subsoils of coarser textured members of the series, and in a few places, particularly in orchards, the lower subsoil is very slightly mottled with rust-brown

stains. A little gravel is found along Guadalupe River near Alamitos; however, this is not enough to classify the soil as a gravelly clay loam.

Large areas of this soil occur near the County Hospital, east of Campbell near Los Gatos Creek, and along the Guadalupe River near Alamitos. It is a good soil for production of the wide range of crops suited to the Area. It has a high water-holding capacity, readily gives up moisture to plant roots, and has no outstanding irrigation problems. It is particularly well suited to prunes and other orchard fruits. Prunes are the chief crop, but apricots, walnuts, cherries, pears, and truck crops are also grown. Yields are good or very good for most crops.

ZAMORA SERIES

Soils of the Zamora series are used intensively in this Area for the production of orchard fruits. The soils have developed on well-drained very gently or gently sloping young alluvial fans from soil material deposited by creeks heading mainly in the sandstone and shale formations of the Santa Cruz Mountains. However, the parent material of some of these soils originated in the eastern hills and the Diablo Range. The average annual rainfall is 15 to 25 inches. The original vegetation was grasses and scattered oaks, but all areas have been cleared and cultivated for years.

The soils are brown or grayish brown, become considerably darker or grayer when moist, and are deep and moderately permeable. They are noncalcareous and neutral or slightly acid in reaction (pH 6.1 to 7.3) in both surface soils and subsoils. The surface soils are of moderately fine texture and, if cultivated at the proper moisture content, produce a good tilth. However, in some places a moderately compact plowpan has developed at the depth of most frequent cultivation. The surface soils grade into brown slightly or moderately compact upper subsoils that hinder root and moisture penetration only a little. Normally there is a gradual transition from the upper subsoils into brown or pale-brown, somewhat stratified, friable, moderately permeable, less compact lower subsoils. Tree roots extend to depths of 6 or more feet.

The Zamora soils are related to and closely associated with soils of the Yolo series but generally are at slightly lower elevations. The Zamora soils are slightly grayer in color and slightly older in stage of development; their upper subsoils are somewhat compact. The Zamora soils are also associated with the Campbell soils, which are similar to them in color and other profile characteristics, except that the Campbell soils are calcareous and mottled with rust-brown in the lower subsoils. The Campbell soils are generally at somewhat lower elevations than the Zamora soils. The Zamora soils occupy about 23 square miles.

Zamora gravelly clay loam, 1 to 3 percent slopes (ZE).—The surface soil is a brown or grayish-brown, friable, neutral or slightly acid clay loam that contains enough gravel to interfere somewhat with such cultivation practices as disking. The soil breaks to medium-sized clods, which can be fairly easily crushed to a coarse granular mass. In some places a slightly compact plowpan has developed at

the depth of most frequent cultivation. At depths of 15 to 30 inches the surface soil grades into a brown or grayish-brown slightly or moderately compact upper subsoil of gravelly clay loam texture. This upper subsoil grades into a pale-brown or brown, friable, moderately permeable, somewhat stratified gravelly clay loam lower subsoil at depths of 36 to 48 inches. Slightly decomposed gravel in both upper and lower subsoils generally results in some variegation of color in these soil horizons. The compaction of the upper subsoil retards water and root penetration only slightly, and tree roots extend to depths of 6 or more feet. The reaction is about neutral throughout.

The soil occurs in numerous small areas in the western part of the valley and also in the southern and eastern parts. In some places southeast of Evergreen, northwest of Simla, and northwest of Azule the texture of the surface soil is a coarse gravelly clay loam or gravelly loam.

All of this soil is cultivated. Nearly all of it is in fruit trees, its best suited crop. The principal crop is prunes, and there are also apricots, walnuts, and grapes. Yields are usually good.

Zamora gravelly clay loam, 3 to 6 percent slopes (Zc).—This soil is similar to the Zamora gravelly clay loam just described except that its slopes are a little stronger. The soil occurs near the hills on the upper parts of small alluvial fans or in small irregular strips along streams in the mountainous sections. In some places the texture of the surface soil is a gravelly clay loam or gravelly loam, and some slopes are slightly irregular and more undulating.

Most cultivated areas of this soil are not irrigated, because of their slopes. Where cultivated, grain hay, prunes, apricots, and grapes are grown and yields are normally fairly good. The soil is probably best suited to grapes. Because some areas are small and isolated, they are not cultivated and are in trees or trees and grass.

Zamora gravelly clay loam, over San Ysidro clay loam, 1 to 3 percent slopes (Zd).—This is a friable brown gravelly clay loam of the Zamora series, overlying, at depths of 20 to 40 inches, a compact claypan similar to the normal subsoil of San Ysidro clay loam. The claypan is brown in color but generally somewhat mottled with rust-brown or reddish stains; it is dense and very definitely retards root and moisture penetration. In this layer only a little gravel is normally present. At depths of 30 to 60 inches the claypan grades into brown or yellowish-brown somewhat less compact material very similar to the underlying material of the San Ysidro soils.

One small area of this soil occurs 1½ miles south of Cupertino. All of this soil is cultivated and in fruit trees. Prunes and apricots are the principal fruits grown, and yields are fair. Because the underlying claypan is very slowly permeable, the soil above the claypan may become saturated during winter. This saturation favors development of the "sour-sap" disease of fruit trees.

Zamora clay loam, 1 to 3 percent slopes (Zb).—The surface soil is a brown or grayish-brown moderately friable clay loam of neutral or slightly acid reaction. Under cultivation the soil breaks to medium-sized clods that are fairly easily crushed to a coarse granular mass if worked at the proper moisture content. A slightly compact plowpan

may occur at the depth of most frequent cultivation. The surface soil grades into a slightly or moderately compact brown or grayish-brown clay loam upper subsoil at depths of 12 to 26 inches. The upper subsoil grades into a brown or pale-brown, friable, moderately permeable, depths of 6 or more feet.
less compact lower subsoil at depths of 36 to 50 inches. The lower subsoil is generally of clay loam texture, sometimes stratified with coarser textured material. Some areas of this soil contain a little gravel, particularly in the subsoil horizons. Tree roots extend to

Most of this soil is in the western part of the valley, but there are some areas in the eastern and southern parts of the valley. All of the soil is cultivated, except in residential areas. Most of it is in orchards, especially prunes, for which the soil is very well suited. Apricots, walnuts, cherries, truck crops, and grain hay are also grown. Yields are good or excellent.

Zamora clay loam, 3 to 6 percent slopes (ZA).—This soil is similar to the Zamora clay loam just described except that the slopes are slightly steeper. In a few places the surface soil is of fine clay loam or coarse clay texture. Most of the soil is east and north of Evergreen.

Some of this soil is not cultivated and supports a grass cover. Where cultivated and irrigated, good yields of prunes, apricots, walnuts, and grapes are obtained. Irrigation practices are more difficult on these gently sloping areas than on the more nearly level areas of Zamora soils.

Zamora silty clay loam, 1 to 3 percent slopes (ZF).—The surface soil is a brown or grayish-brown "smooth-feeling" silty clay loam to depths of 15 to 23 inches. The soil is considerably darker in color when moist, and generally in orchards where cover crops have been turned under regularly for years, the soil is slightly darker than in areas of field crops. In most places a plowpan varying in compaction has developed at the most frequent depth of cultivation. The surface soil grades into a brown or grayish-brown, moderately compact, fine silty clay loam upper subsoil, which tends to retard roots and moisture penetration. In most places some colloidal staining shows on the surfaces of the weakly developed soil aggregates or along small tubular pores. At depths of 32 to 50 inches the upper subsoil grades into a brown, less compact, moderately permeable lower subsoil that becomes lighter in color and more friable with depth. Roots can penetrate the soil fairly easily, and in orchards they extend to depths of 6 or more feet. The reaction is neutral or slightly acid in the surface soil and about neutral in the lower subsoil.

Most of the soil is in the western part of the valley. The largest areas are located northwest of and near Campbell and north of the Moreland School. Some of the soil is lighter colored than the rest because its parent material came from the Diablo Range. One small body of this soil southeast of Alamitos has slopes of 3 to 6 percent.

All of this soil is cultivated, except in residential districts. Nearly all of it is in orchards. The main crop is prunes, for which the soil is well suited. There are also appreciable acreages of apricots, walnuts, pears, and truck crops. Yields of prunes and truck crops are good, and of most other crops, fair to good.

RELATIVE SUITABILITY OF SOILS FOR AGRICULTURE

The aim of efficient land use and good soil management is to produce a good income over a period of years without diminishing the productivity of the soil. This requires use of each soil for the crops or other purposes for which it is agriculturally and economically suited. It also requires soil management—including irrigation, crop rotation, tillage practices, and applications of manures and fertilizers—that will maintain or build up the fertility of the soil and minimize erosion. In order to manage soils properly, the farmer must take advantage of their good points and overcome their deficiencies.

The intensive agriculture of the Santa Clara Area is of a highly specialized type, and much of it is dependent on irrigation. Crop management, including both irrigation practices and soil management where directly related to a crop, is discussed by individual crops in the section, Agriculture. Management practices for alkali soils are given in the section, Saline and Alkali soils; and practices for soils apt to erode are given in the section, Erosion and Deposition. Characteristics of individual soils that have important effects on their use are described in relative terms in the supplement that accompanies the soil map.

The soils of the Santa Clara Area are arranged in table 10 in alphabetical order and rated according to the Storie index (*18*, *26*),[18] which is a numerical expression of the physical suitability of a soil, or its value for general intensive agriculture. Factors that govern both present and potential use and productive capacity of a soil are considered in the index. This is an index of soil conditions only; it is independent of other physical or economic factors that might determine the advisability of growing certain plants in a given locality. It cannot be regarded by itself as an index for land valuation.

Four general factors are considered in the index rating. These factors are (A) the characteristics of the soil profile and soil depth; (B) the texture of the surface soil; (C) slope; and (X) modifying factors such as drainage, alkali, nutrient level, and erosion. Each of these four factors is evaluated on the basis of 100 percent for the most favorable or ideal condition. The index rating is obtained by multiplying the four factors, A times B times C times X; thus any one factor may dominate or control the final rating. As an example, a soil may have a deep moderately permeable profile justifying a rating of 100 percent for factor A, excellent surface soil conditions justifying 100 percent for factor B, a smooth nearly level surface justifying 100 percent for factor C, but a high accumulation of salts that would give a rating of 10 percent for factor X. Multiplying these four ratings gives 10 percent as the index for this soil. The high accumulation of salts would dominate the quality of the soil, render it wholly unproductive for crops, and justify the index of 10.

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[18] This system of rating soils was further revised in 1944 by R. Earl Storie in a lithoprint of the California Agricultural Experiment Station titled Revision of the Soil-rating Chart.

TABLE 10.—*Storie index ratings for soils of the Santa Clara Area, Calif.*

Soils	Rating factors				Index rating	Grade and subgrade[1]
	A (profile)	B (texture)	C (slope)	X (other characteristics)		
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	
Alamitos clay, 0 to 1 percent slopes	95	70	100	[2] 75	50	3–A
Altamont clay loam, 10 to 20 percent slopes	50	85	90	100	38	4–C
Altamont clay, 20 to 35 percent slopes	50	70	85	100	30	4–C
Altamont clay, slightly eroded, 20 to 35 percent slopes	50	70	85	[3] 85	25	4–D
Altamont clay, moderately eroded, 20 to 35 percent slopes	50	70	85	[4] 70	21	4–E
Altamont clay, slightly eroded, 10 to 20 percent slopes	50	70	90	[3] 85	27	4–D
Altamont clay, 35 to 50 percent slopes	45	70	50	100	16	5–B
Altamont clay, moderately eroded, 35 to 50 percent slopes	45	70	50	[4] 70	11	5–C
Altamont clay (adobe), slightly eroded, 20 to 35 percent slopes	60	70	85	[3] 85	30	4–D
Altamont clay (adobe), moderately eroded, 35 to 50 percent slopes	50	70	50	[4] 70	12	5–C
Altamont clay (adobe), severely eroded, 35 to 50 percent slopes	45	70	50	[5] 50	8	6–B
Alviso clay, 0 to 1 percent slopes:						
(Slight alkali)	85	60	100	[6] 54	28	4–A
(Moderate alkali)	85	60	100	[7] 36	18	5–A
(Strong alkali)	85	60	100	[8] 9	5	6–A
Ayar clay, 10 to 35 percent slopes	45	70	85	100	27	4–C
Ayar clay, slightly eroded, 20 to 35 percent slopes	45	70	85	[3] 85	23	4–D
Ayar clay, moderately eroded, 20 to 35 percent slopes	45	70	85	[4] 70	19	5–C
Ayar clay, 35 to 50 percent slopes:						
(Without rock outcrops)	45	85	50	100	19	5–B
(With rock outcrops—shown by stone symbols on map)	45	50	50	100	11	5–E
Azule silty clay, 20 to 35 percent slopes	75	70	85	100	45	3–E
Azule silty clay, slightly eroded, 20 to 35 percent slopes	75	70	85	[3] 85	38	4–D
Azule silty clay, moderately eroded, 20 to 35 percent slopes	75	70	85	[4] 70	31	4–E
Azule silty clay, 10 to 20 percent slopes	75	70	95	100	50	3–E
Azule silty clay, slightly eroded, 10 to 20 percent slopes	75	70	95	[3] 90	45	3–E
Azule silty clay, 35 to 50 percent slopes	75	70	50	100	26	4–C
Azule silty clay, moderately eroded, 35 to 50 percent slopes	75	70	50	[4] 70	18	5–C

Bayshore clay loam, 1 to 3 percent slopes	90	85	100	[9] 72	55	3–B
Bayshore clay loam, 3 to 5 percent slopes	90	85	95	[9] 72	52	3–B
Berryessa-Altamont clays, 20 to 35 percent slopes	60	70	85	100	36	4–C
Berryessa-Altamont clays, slightly eroded, 20 to 35 percent slopes	60	70	85	[3] 85	30	4–D
Berryessa-Altamont clays, moderately eroded, 20 to 35 percent slopes	60	70	70	[4] 70	21	4–E
Berryessa-Altamont clays, slightly eroded, 10 to 20 percent slopes	60	70	90	[3] 85	32	4–D
Berryessa-Altamont clays, severely eroded, 35 to 50 percent slopes	60	70	50	[5] 50	11	5–D
Berryessa-Altamont gravelly clays, slightly eroded, 20 to 35 percent slopes	60	50	85	[3] 85	22	4–D
Campbell clay loam, 0 to 1 percent slopes:						
(Free of alkali)	95	90	100	100	86	1–A
(Slight alkali)	95	90	100	[10] 90	77	2–B
Campbell silty clay, 0 to 1 percent slopes	90	80	100	100	72	2–A
Campbell silty clay, over basin clays, 0 to 1 percent slopes	90	70	100	[2] 90	57	3–A
Castro silty clay, 1 to 3 percent slopes:						
(Free of alkali)	50	80	100	[2] 90	36	4–A
(Slight alkali)	50	80	100	[11] 77	31	4–A
(Moderate alkali)	50	70	100	[12] 48	17	5–A
Castro clay, 0 to 1 percent slopes:						
(Free of alkali)	50	70	100	[2] 85	30	4–A
(Slight alkali)	50	70	100	[11] 77	27	4–A
Cayucos clay, 20 to 35 percent slopes	50	70	85	100	30	4–C
Cayucos clay, slightly eroded, 20 to 35 percent slopes	50	70	85	[3] 85	25	4–D
Cayucos clay, slightly eroded, 10 to 20 percent slopes	50	70	90	[3] 85	27	4–D
Cayucos clay loam, 20 to 35 percent slopes	30	85	85	100	22	4–C
Cayucos clay loam, slightly eroded, 10 to 20 percent slopes	35	85	90	[3] 85	23	4–D
Clear Lake clay (adobe), 0 to 1 percent slopes:						
(Free of alkali)	85	55	100	[2] 90	42	3–A
(Slight alkali)	85	55	100	[11] 81	38	4–A
Climax clay (adobe), moderately eroded, 20 to 35 percent slopes	50	70	85	[11] 70	21	4–E
Climax clay (adobe), slightly eroded, 10 to 20 percent slopes	50	65	90	[3] 85	25	4–D
Cropley gravelly clay loam, 1 to 3 percent slopes	95	80	100	100	76	2–C
Cropley gravelly clay loam, 3 to 6 percent slopes	95	80	95	100	72	2–D
Cropley clay loam, 1 to 3 percent slopes	95	85	100	100	81	1–A
Cropley clay loam, 3 to 6 percent slopes	95	85	95	100	77	2–D
Cropley clay loam, over Milpitas clay loam, 3 to 6 percent slopes	70	85	100	100	59	3–C
Cropley clay (adobe), 1 to 3 percent slopes	95	60	100	100	57	3–A
Cropley clay (adobe), over Milpitas clay loam, 1 to 3 percent slopes	70	60	100	100	42	3–C
Cropley clay (adobe), 3 to 6 precent slopes	95	60	95	100	54	3–A

See footnotes at end of table.

TABLE 10.—*Storie index ratings for soils of the Santa Clara Area, Calif.*—Continued

Soils	Rating factors				Index rating	Grade and subgrade[1]
	A (profile)	B (texture)	C (slope)	X (other characteristics)		
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	
Diablo clay, slightly eroded, 20 to 35 percent slopes	50	70	85	[3] 85	25	4–D
Diablo clay, moderately eroded, 20 to 35 percent slopes	50	70	85	[4] 70	21	4–E
Diablo clay, severely eroded, 35 to 50 percent slopes	45	70	50	[5] 50	8	6–B
Diablo clay loam, slightly eroded, 20 to 35 percent slopes	50	85	85	[3] 85	31	4–D
Diablo clay loam, moderately eroded, 20 to 35 percent slopes	50	85	85	[4] 70	25	4–E
Diablo clay loam, 35 to 50 percent slopes	50	70	50	100	18	5–B
Dublin clay loam, 1 to 3 percent slopes	95	85	100	100	81	1–A
Dublin clay loam, 3 to 6 percent slopes	95	85	93	100	75	2–D
Dublin clay (adobe), 1 to 3 percent slopes	95	60	100	100	57	3–A
Dublin clay (adobe), 3 to 6 percent slopes	95	60	95	100	54	3–A
Edenvale clay (adobe), 1 to 3 percent slopes	85	65	100	100	55	3–A
Edenvale clay (adobe), 3 to 6 percent slopes	85	65	95	100	52	3–A
Gaviota loam, 20 to 35 percent slopes	40	100	85	100	34	4–C
Gaviota loam, slightly eroded, 20 to 35 percent slopes	40	100	85	[3] 85	29	4–D
Gaviota loam, moderately eroded, 20 to 35 percent slopes	40	100	85	[4] 70	24	4–E
Gaviota loam, 35 to 50 percent slopes	35	100	50	100	18	5–B
Gaviota loam, moderately eroded, 35 to 50 percent slopes	35	100	50	[4] 70	12	5–C
Gaviota stony loam, 20 to 35 percent slopes	25	70	85	100	15	5–E
Gaviota gravelly loam, 20 to 35 percent slopes	35	70	85	100	21	4–C
Gaviota gravelly loam, moderately eroded, 20 to 35 percent slopes	35	70	85	[4] 70	15	5–C
Gaviota gravelly loam, 35 to 50 percent slopes	35	80	50	100	14	5–B
Gaviota stony soils, undifferentiated, 50+ percent slopes						[13] 6–C
Gaviota loam-Altamont clay loam, 20 to 35 percent slopes	40	100	85	100	34	4–C
Gaviota loam-Altamont clay loam, moderately eroded, 20 to 35 percent slopes	40	100	85	[4] 70	24	4–E
Gaviota loam-Altamont clay loam, 35 to 50 percent slopes	35	100	50	100	18	5–B
Gaviota loam-Altamont clay loam, moderately eroded, 35 to 50 percent slopes	35	100	50	[4] 70	12	5–C

Gaviota loam-Altamont clay loam, severely eroded, 35 to 50 percent slopes	35	100	50	[5] 50	9	6–B
Gaviota stony loam-Ayar stony clay, 20 to 35 percent slopes	25	50	85	100	11	5–E
Hovey clay, 10 to 20 percent slopes	70	60	95	100	40	3–E
Hovey clay, slightly eroded, 10 to 20 percent slopes	70	60	95	[3] 90	36	4–D
Hugo clay loam, slightly eroded, 20 to 35 percent slopes	50	85	85	[3] 85	31	4–D
Hugo clay loam, slightly eroded, 3 to 20 percent slopes	50	85	90	[3] 85	33	4–D
Hugo clay loam, moderately eroded, 10 to 20 percent slopes	50	100	90	[4] 70	32	4–E
Hugo loam, slightly eroded, 20 to 35 percent slopes:						
(Stone-free areas)	50	100	85	[3] 85	36	4–D
(Stony areas—shown on map by stone symbols)	40	60	85	[3] 85	17	5–E
Hugo loam, moderately eroded, 20 to 35 percent slopes	50	100	85	[4] 70	30	4–E
Hugo loam, slightly eroded, 3 to 20 percent slopes	50	100	90	[3] 85	38	4–D
Hugo loam, moderately eroded, 10 to 20 percent slopes	50	100	90	[4] 70	32	4–E
Hugo loam, severely eroded, 35 to 50 percent slopes	40	100	50	[5] 50	10	5–D
Hugo sandy loam, moderately eroded, 20 to 35 percent slopes	40	95	85	[4] 70	23	4–E
Hugo sandy loam, slightly eroded, 10 to 20 percent slopes	40	95	85	[3] 85	27	4–D
Hugo sandy loam, severely eroded, 10 to 20 percent slopes	40	95	90	[5] 50	17	5–D
Hugo soils, undifferentiated, 35+ percent slopes						[13] 5–B
Hugo stony soils, undifferentiated, 50+ percent slopes						[13] 6–C
Kitchen middens						[13] 3–A
Los Gatos clay loam, 20 to 35 percent slopes	60	85	85	100	43	3–E
Los Gatos clay loam, slightly eroded, 20 to 35 percent slopes	60	85	85	[3] 85	37	4–D
Los Gatos clay loam, moderately eroded, 20 to 35 percent slopes	60	85	85	[4] 70	30	4–E
Los Gatos clay loam, slightly eroded, 10 to 20 percent slopes	60	85	90	[3] 85	39	4–D
Los Gatos clay loam, severely eroded, 35 to 50 percent slopes	50	85	50	[5] 50	11	5–D
Los Gatos-Maymen stony soils, undifferentiated, 50+ percent slopes						[13] 6–C
Los Trancos stony clay, 10 to 35 percent slopes	20	40	85	100	7	6–C
Made land (over Alviso soil material)						[13] 6–C
Maymen loam, moderately eroded, 20 to 35 percent slopes	25	100	85	[4] 70	15	5–C
Maymen loam, severely eroded, 20 to 50 percent slopes	25	100	60	[5] 50	8	6–B
Maymen loam, slightly eroded, 10 to 35 percent slopes	30	100	85	[3] 85	22	4–D
Maymen stony soils, undifferentiated, 50+ percent slopes						[13] 6–C
Milpitas loam, 3 to 10 percent slopes	50	100	93	100	47	3–C
Milpitas loam, slightly eroded, 10 to 20 percent slopes	50	100	85	[3] 90	38	4–B
Milpitas clay loam, 3 to 10 percent slopes	50	85	93	100	40	3–C
Mocho sandy loam, over basin clays, 0 to 1 percent slopes:						
(Free of alkali)	85	95	100	[2] 90	73	2–B
(Moderate alkali)	85	95	100	[7] 36	29	4–A
(Strong alkali)	85	95	100	[8] 9	7	6–A

See footnotes at end of table.

TABLE 10.—*Storie index ratings for soils of the Santa Clara Area, Calif.*—Continued

Soils	Rating factors				Index rating	Grade and subgrade[1]
	A (profile)	B (texture)	C (slope)	X (other characteristics)		
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	
Mocho fine sandy loam, over basin clays, 0 to 1 percent slopes	85	100	100	[2] 90	77	2–B
Mocho gravelly loam, 1 to 3 percent slopes	100	80	100	100	80	1–A
Mocho loam, 1 to 3 percent slopes:						
(Free of alkali)	100	100	100	100	100	1–A
(Slight alkali)	100	100	100	[10] 90	90	1–B
Mocho loam, over basin clays, 0 to 1 percent slopes:						
(Free of alkali)	85	100	100	[2] 90	77	2–B
(Slight alkali)	85	100	100	[11] 63	54	3–B
(Moderate alkali)	85	100	100	[7] 36	31	4–A
(Strong alkali)	85	100	100	[8] 9	8	6–A
Mocho loam, over Campbell and Cropley soils, 1 to 3 percent slopes	90	100	100	100	90	1–B
Mocho loam, over Cropley and Zamora clay loams, 3 to 6 percent slopes	90	100	95	100	86	1–B
Mocho clay loam, 1 to 3 percent slopes:						
(Free of alkali)	100	90	100	100	90	1–A
(Slight alkali)	100	90	100	[10] 90	81	1–B
Mocho clay loam, over basin clays, 0 to 1 percent slopes:						
(Free of alkali)	85	90	100	[2] 90	69	2–B
(Slight alkali)	85	90	100	[11] 63	48	3–B
(Moderate alkali)	85	90	100	[7] 36	28	4–A
(Strong alkali)	85	90	100	[8] 9	7	6–A
Mocho clay loam, over Cropley and Campbell soils, 1 to 3 percent slopes	90	85	100	100	77	2–A
Mocho soils, undifferentiated, 1 to 3 percent slopes						[13] 4–A
Montara stony clay, 10 to 35 percent slopes	20	40	85	100	7	6–C
Montara clay, slightly eroded, 20 to 35 percent slopes	35	70	85	[3] 85	18	5–C
Montara stony clay loam, 20 to 35 percent slopes	20	50	85	100	9	6–C
Montara stony clay loam, 10 to 20 percent slopes	20	50	90	100	9	6–C

Montara clay loam, slightly eroded, 20 to 35 percent slopes	35	85	85	[3] 85	21	4–D
Montara stony soils, undifferentiated, 35+ percent slopes						[13] 6–C
Montara stony clay-Climax clay (adobe), 20 to 35 percent slopes	25	50	85	100	11	5–E
Ohmer clay loam, 10 to 20 percent slopes	50	85	85	100	36	4–B
Ohmer clay loam, slightly eroded, 10 to 20 percent slopes	50	85	90	[3] 85	33	4–B
Ohmer clay loam, slightly eroded, 20 to 35 percent slopes	50	85	85	[3] 85	31	4–D
Ohmer clay loam, 3 to 10 percent slopes	50	85	93	100	40	3–C
Ohmer gravelly clay loam, 3 to 10 percent slopes	50	70	93	100	38	4–B
Orestimba clay loam, 0 to 1 percent slopes:						
(Free of alkali)	85	85	100	[2] 90	65	2–B
(Slight alkali)	85	85	100	[11] 81	59	3–B
(Strong alkali)	85	85	100	[14] 14	10	5–A
Orestimba silty clay loam, 0 to 1 percent slopes:						
(Free of alkali)	85	85	100	[2] 90	65	2–B
(Slight alkali)	85	85	100	[11] 81	59	3–B
(Moderate alkali)	85	85	100	[12] 54	39	4–A
(Strong alkali)	85	85	100	[14] 14	10	6–A
Permanente stony loam, slightly eroded, 20 to 35 percent slopes	20	70	85	[3] 85	10	5–E
Permanente stony soils, undifferentiated, 50 + percent slopes						[13] 6–C
Pescadero clay, 0 to 1 percent slopes:						
(Free of alkali)	85	70	100	[2] 85	51	3–A
(Slight alkali)	85	70	100	[11] 77	46	3–B
Pescadero clay (adobe), 0 to 1 percent slopes:						
(Free of alkali)	80	60	100	[2] 85	41	3–A
(Slight alkali)	80	60	100	[11] 77	37	4–A
(Moderate alkali)	80	60	100	[12] 51	24	4–A
Pits						[13] 6–C
Pleasanton gravelly loam, 1 to 3 percent slopes	90	70	100	100	63	2–C
Pleasanton gravelly loam, gently sloping, 3 to 8 percent slopes	90	70	95	100	60	2–D
Pleasanton gravelly loam, undulating, 3 to 10 percent slopes	90	70	90	100	57	3–D
Pleasanton gravelly loam, slightly eroded, 8 to 20 percent slopes	90	70	80	[3] 85	43	3–D
Pleasanton gravelly loam, 20 to 30 percent slopes	70	70	80	100	39	4–C
Pleasanton gravelly loam, moderately eroded, 20 to 35 percent slopes	70	70	80	[4] 70	27	4–E
Pleasanton loam, 1 to 3 percent slopes	85	100	100	100	85	1–A
Pleasanton loam, cobbly subsoil, 1 to 3 percent slopes	70	100	100	100	70	2–C
Pleasanton loam, 3 to 10 percent slopes	85	100	93	100	79	2–D
Pleasanton gravelly clay loam, 1 to 3 percent slopes	85	75	100	100	64	2–C
Pleasanton clay loam, 1 to 3 percent slopes	85	85	100	100	72	2–A
Pleasanton clay loam, 3 to 6 percent slopes	85	85	95	100	69	2–D

See footnotes at end of table.

TABLE 10.—*Storie index ratings for soils of the Santa Clara Area, Calif.*—Continued

Soils	Rating factors				Index rating	Grade and subgrade[1]
	A (profile)	B (texture)	C (slope)	X (other characteristics)		
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	
Positas-Saratoga loams, 3 to 10 percent slopes	55	100	93	100	51	3–C
Positas-Saratoga loams, slightly eroded, 3 to 10 percent slopes	55	100	93	[3] 90	46	3–C
Positas-Saratoga loams, slightly eroded, 10 to 20 percent slopes	55	100	85	[3] 90	42	3–C
Positas-Sarotoga gravelly loams, 10 to 20 percent slopes	55	70	90	100	35	4–B
Positas-Saratoga gravelly loams, moderately eroded, 10 to 20 percent slopes	55	70	80	[4] 70	22	4–B
Riverwash						[12] 6–C
San Ysidro loam, 1 to 2 percent slopes	55	100	100	[2] 90	50	3–C
San Ysidro clay loam, 1 to 2 percent slopes	55	85	100	[2] 90	42	3–C
Saratoga-Positas loams, 10 to 20 percent slopes	80	100	90	100	72	2–D
Saratoga-Positas loams, slightly eroded, 10 to 20 percent slopes	80	100	90	[3] 90	65	2–D
Saratoga-Positas loams, 3 to 10 percent slopes	80	100	93	100	74	2–D
Saratoga-Positas loams, slightly eroded, 20 to 35 percent slopes	75	100	85	[3] 85	54	3–E
Saratoga-Positas loams, moderately eroded, 20 to 35 percent slopes	75	100	85	[4] 70	45	3–E
Saratoga-Positas loams, deep, slightly eroded, 10 to 20 percent slopes	85	100	90	[3] 90	69	2–D
Saratoga-Positas loams, deep, slightly eroded, 3 to 10 percent slopes	85	100	93	[3] 90	71	2–D
Sobrante clay, slightly eroded, 10 to 35 percent slopes	65	70	85	[3] 85	33	4–D
Soper gravelly loam, 20 to 35 percent slopes	40	70	85	100	24	4–C
Soper gravelly loam, moderately eroded, 20 to 35 percent slopes	40	70	85	[4] 70	17	5–C
Soper gravelly loam, 35 to 50 percent slopes	30	70	50	100	11	5–B
Sorrento fine sandy loam, 1 to 3 percent slopes	80	100	100	100	80	1–B
Sorrento gravelly loam, 1 to 3 percent slopes	100	80	100	100	80	1–A
Sorrento loam, 1 to 3 percent slopes	100	100	100	100	100	1–A
Sorrento silt loam, 1 to 3 percent slopes	100	100	100	100	100	1–A
Sorrento clay loam, 1 to 3 percent slopes	100	90	100	100	90	1–A
Sorrento clay loam, over Sunnyvale clay, 0 to 1 percent slopes	90	85	100	[2] 90	69	2–B
Sorrento silty clay loam, 0 to 2 percent slopes	95	90	100	100	86	1–A
Sunnyvale clay loam, 0 to 1 percent slopes	85	85	100	[2] 90	65	2–B

Sunnyvale clay, 0 to 1 percent slopes:						
(Free of alkali)	85	70	100	[2] 90	54	3–A
(Slight alkali)	85	70	100	[11] 81	48	3–B
(Moderate alkali)	85	70	100	[12] 54	32	4–A
(Strong alkali)	85	70	100	[14] 14	8	6–A
Tidal marsh						[13] 6–C
Vallecitos clay loam, 20 to 35 percent slopes	40	85	85	100	29	4–C
Vallecitos clay loam, slightly eroded, 20 to 35 percent slopes	40	85	85	[3] 85	25	4–D
Vallecitos clay loam, moderately eroded, 20 to 35 percent slopes	40	85	85	[4] 70	20	4–E
Vallecitos clay loam, slightly eroded, 10 to 20 percent slopes	50	85	90	[3] 85	33	4–D
Vallecitos clay loam, 35 to 50 percent slopes	40	85	50	100	17	5–B
Vallecitos clay loam, severely eroded, 35 to 50 percent slopes	40	85	50	[5] 50	9	6–B
Vallecitos loam, slightly eroded, 20 to 35 percent slopes	40	100	85	[3] 85	29	4–D
Vallecitos loam, 35 to 50 percent slopes	30	100	50	100	15	5–B
Yolo fine sandy loam, 1 to 3 percent slopes	85	100	100	100	85	1–B
Yolo gravelly fine sandy loam, 1 to 3 percent slopes	70	80	100	100	56	3–D
Yolo gravelly loam, 1 to 3 percent slopes	100	80	100	100	80	1–A
Yolo loam, 1 to 3 percent slopes	100	100	100	100	100	1–A
Yolo loam, 3 to 6 percent slopes	100	100	95	100	95	1–B
Yolo loam, over Clear Lake clay, 0 to 1 percent slopes	85	100	100	[2] 90	77	2–B
Yolo clay loam, 1 to 3 percent slopes	100	90	100	100	90	1–A
Zamora gravelly clay loam, 1 to 3 percent slopes	95	80	100	100	76	2–C
Zamora gravelly clay loam, 3 to 6 percent slopes	95	80	95	100	72	2–D
Zamora gravelly clay loam, over San Ysidro clay loam, 1 to 3 percent slopes	70	80	100	100	56	3–C
Zamora clay loam, 1 to 3 percent slopes	95	85	100	100	81	1–A
Zamora clay loam, 3 to 6 percent slopes	95	85	95	100	77	2–D
Zamora silty clay loam, 1 to 3 percent slopes	90	85	100	100	77	2–A

[1] Number of grade indicates relative suitability of soils to principal crops of the Area. Grade 1 soils are best suited; Grade 6 soils are almost useless for agriculture. Letter of subgrade indicates groupings of those soils requiring similar management for best use.

[2] Imperfect drainage.

[3] Slight erosion.

[4] Moderate erosion.

[5] Severe erosion.

[6] Poor drainage and slight alkali.

[7] Poor drainage and moderate alkali.

[8] Poor drainage and strong alkali.

[9] Imperfect drainage and extremely calcareous surface soil.

[10] Slight alkali.

[11] Imperfect drainage and slight alkali.

[12] Imperfect drainage and moderate alkali.

[13] Miscellaneous land types and areas of undifferentiated soils are given a grade but no values for index rating or for rating factors.

[14] Imperfect drainage and strong alkali.

SOIL GRADES

According to their index rating, the soils are placed in six grades. These soil grades have been divided into broad subgrades on the general basis of (1) the limitations affecting soil use and (2) broad management requirements. Brief descriptions of these grades and subgrades follow. For more specific statements concerning use and management, refer to the individual soils in the section, Descriptions of the Soils.

GRADE 1 SOILS

These soils range in index rating from 80 to 100. They are excellent soils, well suited for general intensive agriculture. They are easily worked, and their productivity is relatively easy to maintain or improve. Irrigation can be carried on simply and efficiently, and no special practices of erosion control are required. Some of these soils have no significant limitations to crop production. Others are slightly handicapped by slope, alkali, or stratified profiles, but potentially they are nearly as productive and easily managed as the soils of grade 1 that do not have these handicaps.

Subgrade 1–A.—These are nearly level or very gently sloping soils well suited for orchard, field, and truck crops. They are very deep, of intermediate texture and permeability, and well drained or moderately well drained. They occur on recent or young alluvial fans and flood plains. They have no important limitations that prevent sustained production of a wide range of crops. They are easily irrigated, and erosion hazard is negligible. The following soils are in this subgrade:

Campbell clay loam, 0 to 1 percent slopes.
Cropley clay loam, 1 to 3 percent slopes.
Dublin clay loam, 1 to 3 percent slopes.
Mocho gravelly loam, 1 to 3 percent slopes.
Mocho loam, 1 to 3 percent slopes.
Mocho clay loam, 1 to 3 percent slopes.
Pleasanton loam, 1 to 3 percent slopes.
Sorrento gravelly loam, 1 to 3 percent slopes.
Sorrento loam, 1 to 3 percent slopes.
Sorrento silt loam, 1 to 3 percent slopes.
Sorrento clay loam, 1 to 3 percent slopes.
Sorrento silty clay loam, 0 to 2 percent slopes.
Yolo gravelly loam, 1 to 3 percent slopes.
Yolo loam, 1 to 3 percent slopes.
Yolo clay loam, 1 to 3 percent slopes.
Zamora clay loam, 1 to 3 percent slopes.

Subgrade 1–B.—These are very gently sloping soils slightly affected by alkali or abnormally stratified, or sloping soils having slightly stronger slopes than those in subgrade 1–A. The soils are very deep and of intermediate texture and permeability. They are well drained or moderately well drained. They occur on recent alluvial fans and floodplains. Potentially, they are nearly as productive and easily managed as soils of subgrade 1–A. Some of these soils could be improved by alkali reclamation. Others would require somewhat more careful irrigation because of slope or stratified subsoils. In this subgroup are:

Mocho loam, 1 to 3 percent slopes (slight alkali).
Mocho loam, over Campbell and Cropley soils, 1 to 3 percent slopes.
Mocho loam, over Cropley and Zamora clay loams, 3 to 6 percent slopes.
Mocho clay loam, 1 to 3 percent slopes (slight alkali).
Sorrento fine sandy loam, 1 to 3 percent slopes.
Yolo fine sandy loam, 1 to 3 percent slopes.
Yolo loam, 3 to 6 percent slopes.

GRADE 2 SOILS

These soils have index ratings of 60 to 80. They are good soils, moderately well suited to general intensive agriculture. Their crop range or their yields are somewhat less than for soils of grade 1, and productivity is somewhat more difficult to increase or to maintain. Irrigation can be carried on, but less efficiently for some soils. Erosion control is required for some of these soils.

Subgrade 2–A.—These are nearly level or very gently sloping well-drained soils that have a rather fine texture or a moderately compact subsoil. They are not suited to so wide a range of crops as soils of subgrade 1–A but are nearly as productive for field and truck crops. They occur on recent or young alluvial fans and flood plains. They are easily irrigated, and erosion hazard is negligible.

Campbell silty clay, 0 to 1 percent slopes.
Mocho clay loam, over Cropley and Campbell soils, 1 to 3 percent slopes.
Pleasanton clay loam, 1 to 3 percent slopes.
Zamora silty clay loam, 1 to 3 percent slopes.

Subgrade 2–B.—In this subgrade are nearly level imperfectly drained soils or soils that contain a slight amount of alkali. These soils are productive, but productivity could be raised by improving subdrainage. The soils are deep or moderately deep and have moderate to slow permeability in their subsoils. They are easily irrigated, and erosion hazard is negligible. Where they are not protected adequately from stream overflow, the hazard of flooding is higher than for other soils of grades 1 and 2.

Campbell clay loam, 0 to 1 percent slopes (slight alkali).
Mocho sandy loam, over basin clays, 0 to 1 percent slopes.
Mocho fine sandy loam, over basin clays, 0 to 1 percent slopes.
Mocho loam, over basin clays, 0 to 1 percent slopes.
Mocho clay loam, over basin clays, 0 to 1 percent slopes.
Orestimba clay loam, 0 to 1 percent slopes.
Orestimba silty clay loam, 0 to 1 percent slopes.
Sorrento clay loam, over Sunnyvale clay, 0 to 1 percent.
Sunnyvale clay loam, 0 to 1 percent slopes.
Yolo loam, over Clear Lake clay, 0 to 1 percent slopes.

Subgrade 2–C.—In this subgrade are very gently sloping gravelly soils that have slightly or moderately compact subsoils. These soils occur on young alluvial fans. They contain gravel or cobblestones that reduce water-holding capacity and reduce the volume of material in which plants can put down roots. They are less easily tilled than nongravelly soils but are of fair to good suitability for most of the crops commonly grown in the Area. There are no important problems in irrigation. Erosion hazard is low.

Cropley gravelly clay loam, 1 to 3 percent slopes.
Pleasanton gravelly loam, 1 to 3 percent.
Pleasanton loam, cobbly subsoil, 1 to 3 percent slopes.
Pleasanton gravelly clay loam, 1 to 3 percent slopes.
Zamora gravelly clay loam, 1 to 3 percent slopes.

Subgrade 2–D.—In this subgrade are gently sloping or rolling soils that have slightly or moderately compact subsoils. These soils are less easily irrigated than other soils of class 2. When they are clean cultivated, the more sloping soils have a moderate erosion hazard. Most of these soils are deep. They occur on young alluvial fans and terraces, mostly near the edges of the valley floor.

Cropley gravelly clay loam, 3 to 6 percent slopes.
Cropley clay loam, 3 to 6 percent slopes.
Dublin clay loam, 3 to 6 percent slopes.
Pleasanton gravelly loam, gently sloping, 3 to 8 percent slopes.
Pleasanton clay loam, 3 to 6 percent slopes.
Pleasanton loam, 3 to 10 percent slopes.
Saratoga-Positas loam, 10 to 20 percent slopes.
Saratoga-Positas loams, slightly eroded, 10 to 20 percent slopes.
Saratoga-Positas loams, 3 to 10 percent slopes.
Saratoga-Positas loams, deep, slightly eroded, 3 to 10 percent slopes.
Saratoga-Positas loams, deep, slightly eroded, 10 to 20 percent slopes.
Zamora gravelly clay loam, 3 to 6 percent slopes.
Zamora clay loam, 3 to 6 percent slopes.

GRADE 3 SOILS

These soils have an index rating of 40 to 60. They are only fairly well suited to general intensive agriculture. Their crop range or their yields are less than for soils of grade 2, and productivity is more difficult to improve or to maintain. Some have rolling or hilly slopes, compact claypan subsoils, areas affected by alkali, poor drainage, or susceptibility to erosion. Specialized management practices are required for cultivation. Some of these soils require drainage, alkali reclamation, or erosion control practices for good productivity. Irrigation may be difficult.

Subgrade 3–A.—Nearly level or gently sloping, fine-textured, deep soils and kitchen middens have been placed in this subgrade. For some soils, improvement in drainage would increase crop production, but, in general, productivity of these soils is difficult to improve. Because of their clayey texture, these soils are not easily worked, and suitable seedbeds or planting beds are more difficult to prepare than for medium-textured soils. These soils are well suited to grain crops and some truck crops but generally are poorly suited to orchard crops.

Alamitos clay, 0 to 1 percent slope.
Campbell silty clay, over basin clays, 0 to 1 percent slopes.
Clear Lake clay (adobe), 0 to 1 percent slopes.
Cropley clay (adobe), 1 to 3 percent slopes.
Cropley clay (adobe), 3 to 6 percent slopes.
Dublin clay (adobe), 1 to 3 percent slopes.
Dublin clay (adobe), 3 to 6 percent slopes.
Edenvale clay (adobe), 1 to 3 percent slopes.
Edenvale clay (adobe), 3 to 6 percent slopes.
Kitchen middens.
Pescadero clay, 0 to 1 percent slopes.
Pescadero clay (adobe), 0 to 1 percent slopes.
Sunnyvale clay, 0 to 1 percent slopes.

Subgrade 3–B.—In this subgrade are nearly level or undulating imperfectly drained soils that contain a slight amount of alkali or a large amount of lime. Alkali reclamation would increase productivity of most of these soils. Management problems in general are comparable to those for soils of subgrade 3–A.

Bayshore clay loam, 1 to 3 percent slopes.
Bayshore clay loam, 3 to 5 percent slopes.
Mocho loam, over basin clays, 0 to 1 percent slopes (slight alkali).
Mocho clay loam, over basin clays, 0 to 1 percent slopes (slight alkali).
Orestimba clay loam, 0 to 1 percent slopes (slight alkali).
Orestimba silty clay loam, 0 to 1 percent slopes (slight alkali).
Pescadero clay, 0 to 1 percent slopes (slight alkali).
Sunnyvale clay, 0 to 1 percent slopes (slight alkali).

Subgrade 3–C.—This subgrade consists of very gently sloping and rolling soils that have very compact claypan subsoils. The soils are shallow or moderately shallow. Most of them have very slowly permeable subsoils. They are not well suited for deep-rooted crops. Productivity is generally difficult to improve. Care is required in irrigation, and simple erosion control practices are needed on the more sloping soils.

Cropley clay loam, over Milpitas clay loam, 3 to 6 percent slopes.
Cropley clay (adobe), over Milpitas clay loam, 1 to 3 percent slopes.
Milpitas loam, 3 to 10 percent slopes.
Milpitas clay loam, 3 to 10 percent slopes.
Ohmer clay loam, 3 to 10 percent slopes.
Positas-Saratoga loams, 3 to 10 percent slopes.
Positas-Saratoga loams, slightly eroded, 3 to 10 percent slopes.
Positas-Saratoga loams, slightly eroded, 10 to 20 percent slopes.
San Ysidro loam, 1 to 2 percent slopes.
San Ysidro clay loam, 1 to 2 percent slopes.
Zamora gravelly clay loam, over San Ysidro clay loam, 1 to 3 percent slopes.

Subgrade 3–D.—In this subgrade are very gently sloping and rolling deep gravelly soils. Gravel content reduces water-holding capacity and makes the soils harder to till. Care is required in irrigation because of the slope and the porosity of the coarse-textured stratified subsoils. Erosion hazard for the very gently sloping soils is slight.

Pleasanton gravelly loam, undulating, 3 to 10 percent slopes.
Pleasanton gravelly loam, slightly eroded, 8 to 20 percent slopes.
Yolo gravelly fine sandy loam, 1 to 3 percent slopes.

Subgrade 3–E.—The soils of this subgrade are rolling to hilly and moderately deep. Erosion control practices, such as cross-slope tillage, are necessary for sustained production. In general these soils are not well suited to gravity irrigation.

Azule silty clay, 20 to 35 percent slopes.
Azule silty clay, 10 to 20 percent slopes.
Azule silty clay, slightly eroded, 10 to 20 percent slopes.
Hovey clay, 10 to 20 percent slopes.
Los Gatos clay loam, 20 to 35 percent slopes.
Saratoga-Positas loams, slightly eroded, 20 to 35 percent slopes.
Saratoga-Positas loams, moderately eroded, 20 to 35 percent slopes.

GRADE 4 SOILS

These soils range in index rating from 20 to 40 and are poorly suited to general intensive agriculture. Their crop range is narrow or their yields are low. Productivity is hindered by steep slopes, poor drainage, hardpan subsoils, slight or moderate concentrations of alkali, or susceptibility to accelerated erosion. Alkali reclamation may be difficult. Intensive erosion control practices may be needed if these soils are cultivated. Productivity is harder to increase or to maintain than on the soils in the grades previously described.

Subgrade 4–A.—In this subgrade are nearly level or very gently sloping imperfectly drained soils that have hardpan subsoils or contain a slight or moderate amount of alkali. Alkali reclamation would improve production on many of these soils, but reclamation is more difficult than for soils of subgrade 3–B. In general, the range of crops adapted to these soils is considerably narrower than for soils of higher

grades. Irrigation, however, can be performed simply, and erosion hazard is negligible. In places these soils are subject to stream overflow. Mocho soils, undifferentiated, are placed in this subgrade for this reason.

Alviso clay, 0 to 1 percent slopes (slight alkali).
Castro silty clay, 1 to 3 percent slopes.
Castro silty clay, 1 to 3 percent slopes (slight alkali).
Castro clay, 0 to 1 percent slopes.
Castro clay, 0 to 1 percent slopes (slight alkali).
Clear Lake clay (adobe), 0 to 1 percent slopes (slight alkali).
Mocho sandy loam, over basin clays, 0 to 1 percent slopes (moderate alkali).
Mocho loam, over basin clays, 0 to 1 percent slopes (moderate alkali).
Mocho clay loam, over basin clays, 0 to 1 percent slopes (moderate alkali).
Mocho soils, undifferentiated, 1 to 3 percent slopes.
Orestimba silty clay loam, 0 to 1 percent slopes (moderate alkali).
Pescadero clay (adobe), 0 to 1 percent slopes (slight alkali).
Pescadero clay (adobe), 0 to 1 percent slopes (moderate alkali).
Sunnyvale clay, 0 to 1 percent slopes (moderate alkali).

Subgrade 4–B.—This subgrade contains undulating and rolling shallow soils that have compact claypan subsoils. These soils are poorly suited to orchard crops. In general, erosion control practices such as cross-slope tillage are necessary to prevent erosion. The soils are not well suited to gravity irrigation.

Milpitas loam, slightly eroded, 10 to 20 percent slopes.
Ohmer clay loam, 10 to 20 percent slopes.
Ohmer clay loam, slightly eroded, 10 to 20 percent slopes.
Ohmer gravelly clay loam, 3 to 10 percent slopes.
Positas-Saratoga gravelly loams, 10 to 20 percent slopes.
Positas-Saratoga gravelly loams, moderately eroded, 10 to 20 percent slopes.

Subgrade 4–C.—In this subgrade are sloping, hilly, or steep soils that are moderately deep or moderately shallow and not eroded. These soils erode under cultivation unless they are carefully managed. They are fairly well suited to a rather wide range of crops. However, most of these crops are nonirrigated, so average yields are considerably less than for the deeper irrigated soils of the valley floor. In general these soils are not well suited to gravity irrigation.

Altamont clay loam, 10 to 20 percent slopes.
Altamont clay, 20 to 35 percent slopes.
Ayar clay, 10 to 35 percent slopes.
Azule silty clay, 35 to 50 percent slopes.
Berryessa-Altamont clays, 20 to 35 percent slopes.
Cayucos clay, 20 to 35 percent slopes.
Cayucos clay loam, 20 to 35 percent slopes.
Gaviota loam, 20 to 35 percent slopes.
Gaviota gravelly loam, 20 to 35 percent slopes.
Gaviota loam-Altamont clay loam, 20 to 35 percent slopes.
Pleasanton gravelly loam, 20 to 30 percent slopes.
Soper gravelly loam, 20 to 35 percent slopes.
Vallecitos clay loam, 20 to 35 percent slopes.

Subgrade 4–D.—In this subgrade are rolling and hilly soils that are moderately deep or moderately shallow and slightly eroded. Intensive erosion control practices are needed where these soils are cultivated. In general these soils are comparable to those of subgroup 4–C, but greater care is required because of slight erosion that has already occurred. The Hugo soils are suitable for production of redwood and Douglas-fir timber.

Altamont clay, slightly eroded, 20 to 35 percent slopes.
Altamont clay, slightly eroded, 10 to 20 percent slopes.

Altamont clay (adobe) slightly eroded, 20 to 35 percent slopes.
Ayar clay, slightly eroded, 20 to 35 percent slopes.
Azule silty clay, slightly eroded, 20 to 35 percent slopes.
Berryessa-Altamont clays, slightly eroded, 20 to 35 percent slopes.
Berryessa-Altamont clays, slightly eroded, 10 to 20 percent slopes.
Berryessa-Altamont gravelly clays, slightly eroded, 20 to 35 percent slopes.
Cayucos clay, slightly eroded, 20 to 35 percent slopes.
Cayucos clay, slightly eroded, 10 to 20 percent slopes.
Cayucos clay loam, slightly eroded, 10 to 20 percent slopes.
Climax clay (adobe), slightly eroded, 10 to 20 percent slopes.
Diablo clay, slightly eroded, 20 to 35 percent slopes.
Diablo clay loam, slightly eroded, 20 to 35 percent slopes.
Gaviota loam, slightly eroded, 20 to 35 percent slopes.
Hovey clay, slightly eroded, 10 to 20 percent slopes.
Hugo clay loam, slightly eroded, 20 to 35 percent slopes.
Hugo clay loam, slightly eroded, 3 to 20 percent slopes.
Hugo loam, slightly eroded, 20 to 35 percent slopes.
Hugo loam, slightly eroded, 3 to 20 percent slopes.
Hugo sandy loam, slightly eroded, 10 to 20 percent slopes.
Los Gatos clay loam, slightly eroded, 20 to 35 percent slopes.
Los Gatos clay loam, slightly eroded, 10 to 20 percent slopes.
Maymen loam, slightly eroded, 10 to 35 percent slopes.
Montara clay loam, slightly eroded, 20 to 35 percent slopes.
Ohmer clay loam, slightly eroded, 20 to 35 percent slopes.
Sobrante clay, slightly eroded, 10 to 35 percent slopes.
Vallecitos clay loam, slightly eroded, 20 to 35 percent slopes.
Vallecitos clay loam, slightly eroded, 10 to 20 percent slopes.
Vallecitos loam, slightly eroded, 20 to 35 percent slopes.

Subgrade 4–E.—In this subgrade are rolling and hilly soils that are moderately deep or moderately shallow and moderately eroded. These soils are poorly suited to almost all cultivated crops. Continued cultivation will make intensive erosion control necessary. These soils are comparable to those of subgrade 4–D, but because of high erosion hazard, they should be kept under grass or other permanent cover.

Altamont clay, moderately eroded, 20 to 35 percent slopes.
Azule silty clay, moderately eroded, 20 to 35 percent slopes.
Berryessa-Altamont clays, moderately eroded, 20 to 35 percent slopes.
Climax clay (adobe), moderately eroded, 20 to 35 percent slopes.
Diablo clay, moderately eroded, 20 to 35 percent slopes.
Diablo clay loam, moderately eroded, 20 to 35 percent slopes.
Gaviota loam, moderately eroded, 20 to 35 percent slopes.
Gaviota loam-Altamont clay loam, moderately eroded, 20 to 35 percent slopes.
Hugo clay loam, moderately eroded, 10 to 20 percent slopes.
Hugo loam, moderately eroded, 20 to 35 percent slopes.
Hugo loam, moderately eroded, 10 to 20 percent slopes.
Hugo sandy loam, moderately eroded, 20 to 35 percent slopes.
Los Gatos clay loam, moderately eroded, 20 to 35 percent slopes.
Pleasanton gravelly loam, moderately eroded, 20 to 35 percent slopes.
Vallecitos clay loam, moderately eroded, 20 to 35 percent slopes.

GRADE 5 SOILS

These soils have index ratings ranging from 10 to 20 and are very poorly suited to general intensive agriculture. Steep slopes, stony surfaces, shallow depth, strong alkali, and severe erosion make these soils almost useless for cultivated crops. Many of them can be used for pasture or forest.

Subgrade 5–A.—In this subgrade are nearly level or very gently sloping, imperfectly or poorly drained soils that have moderate or strong concentrations of alkali. These soils have very limited possibilities for crop production. The reclamation of these soils would be

very difficult. They are best suited to pastures of alkali-tolerant grasses and to other forage crops.

Alviso clay, 0 to 1 percent slopes (moderate alkali).
Castro silty clay, 1 to 3 percent slopes (moderate alkali).
Orestimba clay loam, 0 to 1 percent slopes (strong alkali).

Subgrade 5–B.—This subgrade consists of steep soils that are moderately shallow or shallow and not eroded. The soils are not cultivated and probably should not be brought under cultivation. Except for the Hugo soils, they are well suited as range for livestock. The Hugo soils are suitable for redwood and Douglas-fir timber.

Altamont clay, 35 to 50 percent slopes.
Ayar clay, 35 to 50 percent slopes.
Diablo clay loam, 35 to 50 percent slopes.
Gaviota loam, 35 to 50 percent slopes.
Gaviota gravelly loam, 35 to 50 percent slopes.
Gaviota loam-Altamont clay loam, 35 to 50 percent slopes.
Hugo soils, undifferentiated, 35+ percent slopes.
Soper gravelly loam, 35 to 50 percent slopes.
Vallecitos clay loam, 35 to 50 percent slopes.
Vallecitos loam, 35 to 50 percent slopes.

Subgrade 5–C.—In this subgrade are hilly and steep soils of moderately shallow or shallow depth that have been slightly or moderately eroded. The soils are comparable to those of subgrade 5–B, except for slight to moderate erosion. They should not be clean cultivated. They are fairly well suited for use as range.

Altamont clay, moderately eroded, 35 to 50 percent slopes.
Altamont clay (adobe), moderately eroded, 35 to 50 percent slopes.
Ayar clay, moderately eroded, 20 to 35 percent slopes.
Azule silty clay, moderately eroded, 35 to 50 percent slopes.
Gaviota loam, moderately eroded, 35 to 50 percent slopes.
Gaviota gravelly loam, moderately eroded, 20 to 35 percent slopes.
Gaviota loam-Altamont clay loam, moderately eroded, 35 to 50 percent slopes.
Maymen loam, moderately eroded, 20 to 35 percent slopes.
Montara clay, slightly eroded, 20 to 35 percent slopes.
Soper gravelly loam, moderately eroded, 20 to 35 percent slopes.

Subgrade 5–D.—This subgrade consists of rolling and steep soils that have moderately shallow or shallow depth and severe erosion. The soils should not be cultivated. If they are used for range, only light grazing is advisable.

Berryessa-Altamont clays, severely eroded, 35 to 50 percent slopes.
Hugo loam, severely eroded, 35 to 50 percent slopes.
Hugo sandy loam, severely eroded, 10 to 20 percent slopes.
Los Gatos clay loam, severely eroded, 35 to 50 percent slopes.

Subgrade 5–E.—In this subgrade are hilly and steep stony soils of shallow depth. Clearing of stones for crop production is not feasible. These soils are fairly well suited for use as range.

Ayar clay, 35 to 50 percent slopes (the stony areas shown on map by stone symbols).
Gaviota stony loam, 20 to 35 percent slopes.
Gaviota stony loam-Ayar stony clay, 20 to 35 percent slopes.
Hugo loam, slightly eroded, 20 to 35 percent slopes (the stony areas shown on map by stone symbols.
Montara stony clay-Climax clay (adobe), 20 to 35 percent slopes.
Permanente stony loam, slightly eroded, 20 to 35 percent slopes.

GRADE 6 SOILS

These soils and land types have index ratings of less than 10. They cannot be used successfully for agriculture because of extreme steep-

ness of slope, alkali concentration, poor drainage, shallow depth, stones, or rock outcrops.

Subgrade 6–A.—This subgrade is made up of nearly level imperfectly drained soils that have strong concentrations of alkali. Alkali reclamation in most places is not feasible. These soils are suitable only for pasture of low productivity.

Alviso clay, 0 to 1 percent slopes (strong alkali).
Mocho sandy loam, over basin clays, 0 to 1 percent slopes (strong alkali).
Mocho loam, over basin clays, 0 to 1 percent slopes (strong alkali).
Mocho clay loam, over basin clays, 0 to 1 percent slopes (strong alkali).
Orestimba silty clay loam, 0 to 1 percent slopes (strong alkali).
Sunnyvale clay, 0 to 1 percent slopes (strong alkali).

Subgrade 6–B.—In this subgrade are hilly and steep soils of shallow or moderately shallow depth that have been severely eroded. These soils are comparable to soils of subgrade 5–D but generally are shallower and more extremely limited in their use, even if used as range for livestock.

Altamont clay (adobe), severely eroded, 35 to 50 percent slopes.
Diablo clay, severely eroded, 35 to 50 percent slopes.
Gaviota loam-Altamont clay loam, severely eroded, 35 to 50 percent slopes.
Maymen loam, severely eroded, 20 to 50 percent slopes.
Vallecitos clay loam, severely eroded, 35 to 50 percent slopes.

Subgrade 6–C.—In this subgrade are steep and very steep stony soils, of shallow or very shallow depth, and miscellaneous land types. These soils and land types are of little or no use for agriculture, but they are important as watersheds, wildlife habitats, and recreation sites.

Gaviota stony soils, undifferentiated, 50+ percent slopes.
Hugo stony soils, undifferentiated, 50+ percent slopes.
Los Gatos-Maymen stony soils, undifferentiated, 50+ percent slopes.
Los Trancos stony clay, 10 to 35 percent slopes.
Made land (over Alviso soil material).
Maymen stony soils, undifferentiated, 50+ percent slopes.
Montara stony clay, 10 to 35 percent slopes.
Montara stony clay loam, 20 to 35 percent slopes.
Montara stony clay loam, 10 to 20 percent slopes.
Montara stony soils, undifferentiated, 35+ percent slopes.
Permanente stony soils, undifferentiated, 50+ percent slopes.
Pits.
Riverwash.
Tidal marsh.

ESTIMATED YIELDS

Table 11 (in the jacket) lists the soils of the Area and gives the suitability of each for the principal crops of the Area. In estimating the suitability of a soil for a particular crop, these things were considered: (1) the soil and climatic requirements of the crop; (2) the probable yield and quality of the crop under management commonly practiced in the Area; (3) the feasibility of irrigation; and (4) the probable productive life of the crop if it is a perennial.

Although yield is not the only factor considered in suitability estimates, it is a major factor. Table 12 gives estimated ranges in average yield of principal crops for soils of the various suitabilities (very poor, poor, fair, good, very good) given in table 11. A crop should not be attempted on soils that are very poorly suited to it, as a profitable yield is unlikely. However, a crop may succeed on poorly suited soils under very special management or as a noncommercial home garden crop. Yield of a crop under common manage-

ment practices on soil of fair suitability for that crop approximates the present average yield of the crop in the region. Profit or loss depends on price received for the crop and on management skill. Under common crop and farm management practices of the Area and with normal prices, a crop on soils of good or very good suitability should be successful.

TABLE 12.—*Estimated range in average yields per acre of principal crops under present common management on soils of various suitabilities for crop production in the Santa Clara Area, Calif.*

Crop	Estimated yields for soil rated in table 11 as—				
	Very poor	Poor	Fair	Good	Very good
		Less than—			*More than—*
Apricots, fresh:					
Irrigated, tons	(1)	3	3–6	6–10	10
Nonirrigated, tons	(1)	1½	1½–3	3–5	5
Cherries, irrigated, tons	(1)	1	1–2½	2½–5	5
Pears, irrigated, tons	(1)	6	6–10	10–15	15
Prunes, dried:					
Irrigated, tons	(1)	1	1–2½	2½–4	4
Nonirrigated, tons	(1)	½	½–1	1–2	2
Walnuts, irrigated, tons	(1)	¼	¼–½	½–1½	1½
Grapes, wine, fresh:					
Irrigated, tons	(1)	2½	2½–5	5–9	9
Nonirrigated, tons	(1)	1	1–2	2–4	4
Tomatoes, irrigated, tons	(1)	4	4–8	8–12	12
Spinach, irrigated, tons	(1)	3	3–5½	5½–8	8
Peas:					
Pole, irrigated, tons [2]	(1)	1½	1½–2½	2½–3½	3½
Bush, nonirrigated, tons [2]	(1)	½	½–1	1–1¾	1¾
Snap beans (string beans), irrigated, tons	(1)	1	1–3	3–5	5
Cauliflower, irrigated, tons [3]	(1)	4	4–6	6–8	8
Celery, irrigated, tons [4]	(1)	8	8–12	12–16	16
Alfalfa hay, irrigated, tons	(1)	3½	3½–5	5–6½	6½
Sugar beets, irrigated, tons	(1)	8	8–14	14–20	20
Barley, nonirrigated 100-lb. sacks an acre	(1)	7	7–12	12–16	16
Grain hay, nonirrigated tons an acre	(1)	½	½–1½	1½–2½	2½
Pasture:					
Ladino, irrigated [5] cow-acre-days [6]	----------	200	200–300	300–400	400
Range, nonirrigated [7] cow-acre-days	Less than 5	5–15	15–25	25–50	50

[1] Very low or no yields of commercial importance.
[2] Weight is for peas and pods.
[3] Cauliflower is generally packed in crates holding about 40 pounds.
[4] Celery is generally packed in crates holding about 65 pounds.
[5] Ladino pasture consists of areas seeded and irrigated for pasture that has Ladino clover as the main plant.
[6] The term "cow-acre-days" is used to express the carrying capacity or grazing value of pasture or range lands. It equals the number of animal units to the acre multiplied by the number of days of grazing. One animal unit is a mature cow, steer, or horse, or five mature sheep.
[7] Range pasture consists of hilly and mountainous, more or less open range land. In the Santa Clara Area this includes natural forage of the valley floor.

THE CAPABILITY CLASSIFICATION

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Soils of the Santa Clara Area vary widely in profile, depth, slope, degree of erosion, presence or absence of salts, wetness, nutrient deficiencies, and other factors. These differences are reflected in the 232 different soil types and phases shown on the soil map of the Area. These soils are grouped in the capability classification for ease in discussing adapted uses and management practices.

The capability classification is a grouping of different kinds of soil according to their susceptibility to deterioration, limitations in use, and hence their conservation requirements in terms of use and management. The classification levels, ranging from the most general to the most specific, are the class, subclass, and unit.

CLASS

All soils are placed in eight broad capability classes. The grouping is based on the degree of limitation and on general suitability for agricultural use. The classes are designated by numerals (I to VIII). They range from class I, the best, most easily farmed soils, to class VIII, soils that have no value for cultivation, grazing, or forestry but may be suitable for wildlife, recreation, or watershed protection.

Class I: Very good cultivable soils, from all points of view. They are nearly level and do not erode readily. The soils are deep and easy to work. They hold water well and are fairly well supplied with plant nutrients. These soils are suitable for continuous cultivation under normal good management practices.

Class II: Good cultivable soils that have minor limitations if used for continuous cultivation. Certain physical conditions make them not quite so good as class I soils. They may be on a slight slope, may be naturally wet and require drainage, or may have reduced water-holding capacity. Each of these deficiencies either limits the use of the soil in some way, or requires some special management year after year.

Class III: Moderately good cultivable soils that have major limitations if used for continuous cultivation. They are more limited in use than class II soils, and they have one or more natural features that require special treatment. They may be more steeply sloping than class II soils, shallower in depth, coarser in texture, wetter, or a combination of any of these factors.

Class IV: Fairly good soils, good enough for occasional cultivation under careful management, but not suitable for continuous production of cultivated crops. They are often too steep or too shallow for continuous cultivation because of the danger of erosion.

Class V: Soils that are well suited to grazing or forestry. (No class V soils occur in the Santa Clara Area.) They are not suited to cultivation because of stoniness or rock outcrop, wetness, overflow hazard, or climatic limitation.

Class VI: Soils that are well suited to grazing or forestry but have minor limitations in use because of shallow depth, moderately steep slopes, excessive wetness that cannot be corrected, excessive salts or alkali, and the like.

Class VII: Soils that are fairly well suited to grazing or forestry but have major limitations in use. Where these soils are very shallow or very steep, they require extreme care to prevent erosion.

Class VIII: Soils not suited to cultivation, grazing, or forestry. They may be used for wildlife, recreational, or watershed purposes. Usually these soils are extremely rough, steep, stony, sandy, wet, severely eroded, or severely affected by salts or alkali.

SUBCLASS

The kinds of problems or limitations for the soils in any one of the capability classes (except class I) may vary considerably. For example, one area may be in class II because of slope that creates an erosion problem, while another may be in class II because of a drainage problem. As the corrective practices for drainage problems are distinctly different from erosion control practices, it is useful to divide the land-capability classes into subclasses. The division into subclasses is based on dominant kinds of limitations or hazards in use and management. The four subclasses recognized are shown by a lowercase letter following the Roman numeral for the class. They are:

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, nutrient deficiencies, and the like.
c=adverse climatic conditions (none recognized in this Area).

UNIT

The subclasses are further subdivided into capability units, which are groups of soils that can be adapted to similar crops, need the same kind of management practices, and can produce similar kinds and amounts of vegetation. The capability unit shows the specific conditions or combination of conditions that limit the use of the soil. The kinds of soils within a capability unit may differ slightly in the details of management practices and in crop yields. In range or woodland areas the capability unit expresses the range or woodland site. The capability unit is designated by an arabic number, and it follows the lowercase letter that designates the subclass. In the Santa Clara Area, the following capability-unit numerals are used:

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 resulting from very coarse soil texture, excessive gravel, or rock outcrop.
5=problem or limitation resulting from very fine texture.
7=special nutrient problem or limitation. Includes the high-lime or alkali soils of the valleys and the upland soils derived from serpentine and related formations.

Plate 9 shows how the capability classification is used in the Santa Clara Area.

CAPABILITY CLASS I

Land suited to cultivation with few limitations in use

This capability class consists of well-drained soils more than 5 feet deep that occur on recent alluvial fans and flood plains. Textures of these soils range from fine sandy loam to silty clay loam. Permeability ranges from moderately rapid to moderately slow.

The best agricultural lands of this county are in this capability class. The soil profiles are relatively uniform except for that of Mocho loam over Campbell and Cropley soils. This soil varies in degree of stratification, but this does not seriously affect penetration of roots and moisture.

The following soils are in this class:

Mocho clay loam, 1 to 3 percent slopes (Mk).
Mocho loam, over Campbell and Cropley soils, 1 to 3 percent slopes (Mo).
Mocho loam, 1 to 3 percent slopes (Mq).
Sorrento clay loam, 1 to 3 percent slopes (Sr).
Sorrento fine sandy loam, 1 to 3 percent slopes (Ss).
Sorrento loam, 1 to 3 percent slopes (Su).
Sorrento silt loam, 1 to 3 percent slopes (Sv).
Sorrento silty clay loam, 0 to 2 percent slopes (Sw).
Yolo clay loam, 1 to 3 percent slopes (Ya).
Yolo fine sandy loam, 1 to 3 percent slopes (Yb).
Yolo loam, 1 to 3 percent slopes (Yg).
Zamora clay loam, 1 to 3 percent slopes (Zb).
Zamora gravelly clay loam, 1 to 3 percent slopes (Ze).
Zamora silty clay loam, 1 to 3 percent slopes (Zf).

Use and management.—The soils of capability class I are highly productive. Fertilization, mainly with nitrogen, is necessary for maximum returns. All crops suited to the climate of the county are adapted to these soils. Grapes, deciduous fruits, nuts, and pasture are grown under irrigation. Good management is necessary to maintain a high level of production.

Organic matter is maintained by including a green-manure crop in the rotation every 3 to 5 years. Irrigated pasture, hay, or a seed crop of legumes or grasses may be used in the rotation. All crop residue should be returned to the soil. Irrigated pastures should receive good management, such as rotation grazing, and should be fertilized for maximum forage production.

In orchards and vineyards, a green-manure cover crop should be fertilized and seeded in the fall. The residue should be retained on or near the surface in the spring. This will help maintain organic matter and protect against puddling during the rainy season.

These soils may be irrigated by furrow, border, contour-basin, or sprinkler irrigation systems. The length of runs for furrows, borders, or basins and the rate of application by sprinklers will vary with soil textures, the head of water, and the slope. The soil profiles are deep and cause no difficulty in land leveling. Frost may occasionally be a problem.

CAPABILITY CLASS II

Capability unit IIe–1: Land suited to cultivation with moderate risk of erosion damage because of slopes that range from 3 to 6 percent

The soils are well drained and more than 5 feet deep. They occur on recent alluvial fans and flood plains. Textures of these soils range from loam to clay loam. Permeability ranges from moderate to moderately slow.

The soils of this capability unit are similar to those of class I, except that they occur on gentle slopes that have more rapid runoff and greater erosion hazard. These soils have no unusual problems of droughtiness, moisture penetration, or drainage. A few of them have gravel throughout the profile. These soils occur in or next to the valley floor. The following soils are in this unit:

Cropley clay loam, 3 to 6 percent slopes (Ct).
Cropley clay loam, over Milpitas clay loam, 3 to 6 percent slopes (Cu).
Cropley gravelly clay loam, 3 to 6 percent slopes (Cw).
Dublin clay loam, 3 to 6 percent slopes (Dk).
Kitchen middens (Ka).
Mocho loam, over Cropley and Zamora clay loams, 3 to 6 percent slopes (Mp).
Yolo loam, 3 to 6 percent slopes (Ye).
Zamora clay loam, 3 to 6 percent slopes (Za).
Zamora gravelly clay loam, 3 to 6 percent slopes (Zc).

Use and management.—The soils of this capability unit are suitable for a wide range of row crops, deciduous orchards, including fruits and nuts, vineyards, hay, and irrigated pasture. They present minor management problems in the irrigation of slopes, and some hazard of erosion unless precautions are taken. Sheet erosion may be controlled by cross-slope tillage, stubble mulching, or similar easily applied measures. Concentrated drainage from canyons and higher lying areas may require water diversion and disposal to prevent gullying.

Irrigation may be by furrow, border, or sprinkler system. The irrigation system should be planned and water application controlled so as to avoid erosion. A system for collecting excess water and conducting it to a safe outlet is necessary. The management practices discussed under class I for maintaining soil productivity apply to this unit. Deep cuts can be made when leveling the land or smoothing slope irregularities, because the soil profiles are deep.

Capability unit IIe-3: Land suited to cultivation with moderate risk of damage or limitation in use because of slope, compact subsoil, and gravel

These are moderately well drained soils, 3 to 5 feet deep, on older terraces. Textures range from gravelly loam to clay loam. Permeability ranges from moderately rapid in those soils that contain much gravel to moderately slow in the finer textured types.

These soils occur on older terraces near Madrone. Areas of Milpitas soils, which have a dense claypan, lie next to these soils. Small areas of Milpitas soils may be included within the larger areas of Pleasanton soils. The normal fertility level of the Pleasanton soils is lower than that of the soils in class I. The following soils make up this unit:

Pleasanton clay loam, 3 to 6 percent slopes (Pe).
Pleasanton gravelly loam, gently sloping, 3 to 8 percent slopes (Ph).
Pleasanton gravelly loam, undulating, 3 to 10 percent slopes (Pm).
Pleasanton loam, 3 to 10 percent slopes (Pr).

Use and management.—These soils must be fertilized and carefully managed to get good yields. A fairly wide range of crops may be grown, although deep-rooted crops like the deciduous orchards common to the Area are sometimes affected by the excess gravel or compacted subsoil. Tree crops do not grow as well as those on class I soils.

Irrigation water is available in most areas where the Pleasanton soils are found. Sprinkler irrigation systems are best because of the slope and because the gravel spots in many fields cause considerable variation in permeability. Irrigation may also be done by cross-slope furrows on grades, although sprinkler irrigation gives better control of amount and distribution of water. A sprinkler system will also help to avoid the development of waterlogged spots or loss of water through deep percolation.

These soils are in slightly elevated positions and are somewhat more free of frost than the basin soils. They occur on slopes ranging from 3 to 10 percent. They are subject to sheet erosion during heavy rains, and a diversion system for collecting and safely disposing of rainwater is desirable. A green-manure crop will help to protect the soil from erosion and to maintain organic matter and soil structure. All crop residue should be returned to the soil except diseased tree prunings. If cereals are grown, the stubble should remain on the surface to help reduce soil and water losses.

Capability unit IIw–2: Land suited to cultivation with moderate limitations in use because of wetness

These are soils from 3 to 5 feet or more deep in the flood plains and basins. Textures range from sandy loam to silty clay. Permeability ranges from moderate to slow.

These soils have developed under conditions of slow or very slow surface runoff and high ground-water levels. Since the development of large-scale pumping for irrigation in the Area, most of the soils are now considerably better drained than they were naturally. The Campbell and Orestimba soils occasionally contain small areas of slight alkali that adversely affects soil structure and moisture penetration. The Sorrento clay loam over Sunnyvale clay contains small to moderate accumulations of lime in the subsoil. This produces a characteristic discoloration of leaves of plants and trees known as lime-induced chlorosis. The Mocho soils over clay were placed in this unit because the clay subsoil frequently causes poor drainage by restricting the downward movement of water.

The following soils are in this unit:

Campbell clay loam, 0 to 1 percent slopes (Ca).
Campbell silty clay, 0 to 1 percent slopes (Cb).
Campbell silty clay, over basin clays, 0 to 1 percent slopes (Cc).
Cropley clay loam, 1 to 3 percent slopes (Cv).
Cropley gravelly clay loam, 1 to 3 percent slopes (Cx).
Dublin clay loam, 1 to 3 percent slopes (Dl).
Mocho clay loam, over basin clays, 0 to 1 percent slopes (Mi).
Mocho clay loam, over Cropley and Campbell soils, 1 to 3 percent slopes (Mj).
Mocho fine sandy loam, over basin clays, 0 to 1 percent slopes (Ml).
Mocho loam, over basin clays, 0 to 1 percent slopes (Mn).
Mocho sandy loam, over basin clays, 0 to 1 percent slopes (Mr).
Orestimba clay loam, 0 to 1 percent slopes (Of).
Orestimba silty clay loam, 0 to 1 percent slopes (Og).
Sorrento clay loam, over Sunnyvale clay, 0 to 1 percent slopes (Sp).
Sunnyvale clay loam, 0 to 1 percent slopes (Sy).
Yolo loam, over Clear Lake clay, 0 to 1 percent slopes (Yf).

Use and management.—These are good soils, but in use they have minor problems of delayed tillage, water disposal, and irrigation. Best suited to these soils are irrigated pasture, hay, grain, and row

crops. Except for pears, orchard crops are not well suited unless drainage is improved. Prunes and apricots with adapted root stocks are sometimes grown. Because of their low position and imperfect drainage, these soils tend to collect excess water from higher lying lands. Such water should be diverted into suitable outlets. Mole drains, open drains, and tile drains may be used to remove excess water.

These soils are productive, and good yields may be expected. Irrigation must be controlled to prevent ponding and waterlogging. Sprinkler irrigation systems can best control the quantity of water applied. Furrow irrigation should be carefully managed because too much water may bring on lime-induced chlorosis. The problem of lime-induced chlorosis may be partially or completely overcome by improvement of the drainage and by the application of various iron compounds to the crop.

To maintain soil fertility and good soil structure, a crop rotation that includes a grass-legume crop every 3 or 4 years should be used. A green-manure crop will add needed organic matter. If a tillage pan exists, subsoiling will improve soil permeability.

Where the Orestimba and Campbell soils contain slight alkali, they may be improved by the use of soil amendments, by leaching, and by providing adequate drainage.

Capability unit IIw–5: Land suited to cultivation with moderate limitations in use owing to wetness and texture

These nearly level soils in or near the basins are more than 5 feet deep. Their clay textures make them slowly permeable.

Except for finer texture, these soils are like those in capability unit IIw–2, and except for more gentle slopes they are like the soils in capability unit IIe–5. The very fine texture of these soils makes their internal drainage slow. The Clear Lake, Cropley, and Edenvale soils have slight to moderate amounts of lime in the subsoil. In combination with the restricted drainage, this may cause chlorosis in plants. The following soils are in this unit:

Clear Lake clay (adobe), 0 to 1 percent slopes (Cm).
Cropley clay (adobe), over Milpitas clay loam, 1 to 3 percent slopes (Cr).
Cropley clay (adobe), 1 to 3 percent slopes (Cs).
Dublin clay (adobe), 1 to 3 percent slopes (Dh).
Edenvale clay (adobe), 1 to 3 percent slopes (Eb).

Use and management.—These are good soils, but they have problems in management because of the very fine texture and drainage. These soils are generally very hard to work when dry, and they puddle if cultivated while wet. It is important to cultivate these soils at the proper moisture content.

Crops best suited to these soils are grain, grain hay, and truck crops. Yields are generally good. Of the deciduous fruit trees in the Area, pears are best adapted to these soils. Apricots and prunes are sometimes grown. Where lime-induced chlorosis is a problem, improved drainage and application of iron compounds directly to the crop will bring improvements.

The management practices discussed for soils of capability unit IIw–2 also apply to these soils.

Capability unit IIe–5: Land suited to cultivation with moderate risk of erosion because of slope and some limitations in use because of very fine texture

These soils near basin areas or along the lower edge of alluvial fans and flood plains are more than 5 feet deep. They are clay textured and slowly permeable.

Root growth in these soils is moderately limited because of the retarded penetration of water. Surface drainage is good, but internal drainage is slow. The soils of this capability unit are similar to those of the IIw–5 unit, except that they have more slope and better surface drainage. Soils in this unit are:

Cropley clay (adobe), 3 to 6 percent slopes (Cp).
Dublin clay (adobe), 3 to 6 percent slopes (Dg).
Edenvale clay (adobe), 3 to 6 percent slopes (Ea).

Use and management.—These soils are best suited to grain, grain hay, and irrigated pasture. With care in management, prunes, apricots, and truck crops also can be grown. Because of the very fine texture of these soils, maintenance of good soil structure is important. This may be done by growing green-manure crops. Those practices discussed for capability unit IIw–2 also apply to this unit.

Water erosion may be a problem, owing to the slope. This can be prevented by careful management of irrigation water, diversion of excess water from higher lying lands, cross-slope cultivation, and utilization of crop residue on the land. In orchards, annual diversion ditches with protected outlets will retard erosion.

Capability unit IIs–3: Land suited to cultivation with moderate limitations in use because of compact subsoil and gravel

These soils on the nearly level terraces are from 3 to 5 feet in depth. Textures range from loam to clay loam. Permeability ranges from moderate in the gravelly soils to moderately slow in the finer textured soils.

A compact subsoil that frequently contains imbedded gravel is the main difference between these soils and those of class I. The soils are also similar to those of capability unit IIe–3, except that these IIs–3 soils are nearly level. Gravelly spots that have a very low water-holding capacity are common. These very gravelly areas often occur in long stringers paralleling the main valley. Most of the Pleasanton soils are near Morgan Hill and Madrone. To the north, the Pleasanton soils grade into more recent soils of the Yolo and related series. To the south and east, the Pleasanton soils merge with older Milpitas soils that have a denser and better developed subsoil. The following soils are in this unit:

Pleasanton clay loam, 1 to 3 percent slopes (Pf).
Pleasanton gravelly clay loam, 1 to 3 percent slopes (Pg).
Pleasanton gravelly loam, 1 to 3 percent slopes (Po).
Pleasanton loam, cobbly subsoil, 1 to 3 percent slopes (Pp).
Pleasanton loam, 1 to 3 percent slopes (Ps).

Use and management.—Like the soils of capability unit IIe–3, these soils are suited to a fairly wide range of crops. Some varieties of orchard trees cannot be grown because of the depth limitation. Sprinklers are the best irrigation systems because the soils are limited in depth and may contain gravel. Where fields are more uniform in

texture and depth, a furrow or contour-check irrigation system may be adequate. If a furrow or contour-check irrigation system is used, a disposal system for tailwaters should be provided.

Other good soil management practices are needed to maintain soil structure and soil fertility. Rotations that contain row crops should include a green-manure crop every 2 to 4 years. Other methods for soil improvement include the use of a grass-legume seeding or a hay crop in the rotation, and the return of crop residues to the soil. Manure should be applied when available. A cover crop, planted and fertilized in the fall and retained on or near the soil surface in the spring, is beneficial to orchards and vineyards.

Capability unit IIs–4: Land suited to cultivation with moderate limitations in use because of gravel content

These soils on recent alluvial fans and flood plains are more than 5 feet deep. Textures range from moderately coarse to medium gravelly. Permeability ranges from rapid to moderate. The water-holding capacity and fertility of these soils are reduced as the gravel content increases. Gravel may be present only in the surface soil or it may occur throughout the soil profile. These soils may also be stratified throughout with layers of sand and gravel. Roots and water may penetrate to great depth in these soils. The following soils are in this unit:

Mocho gravelly loam, 1 to 3 percent slopes (Mn).
Sorrento gravelly loam, 1 to 3 percent slopes (St).
Yolo gravelly fine sandy loam, 1 to 3 percent slopes (Yc).
Yolo gravelly loam, 1 to 3 percent slopes (Yd).
Mocho soil, undifferentiated, 1 to 3 percent slopes (Ms).

Use and management.—These soils are suited to a wide range of crops, although dry-farmed crops may not produce well on the more gravelly soils. Under irrigation and moderate fertilization, good yields may be obtained. Applications of irrigation water must be light and frequent to prevent loss of water by deep percolation. Water can best be applied by using a sprinkler irrigation system. If furrow or border irrigation is used, short runs should be used to prevent excessive percolation and leaching of the soil.

All crops respond well to nitrogen fertilizers, and they may also respond to phosphorus fertilizers. Winter cover crops are good and are commonly used in orchards. Cover crops and green-manure crops help maintain good soil structure and fertility, and they bring better response of these soils to fertilizers. All crop residue should be returned to the soil. Frost protection may be necessary for almonds, apricots, and cherries.

Capability unit IIs–7: Land suited to cultivation with moderate limitations in use because of wetness and slight amounts of alkali

These soils on the level basin or near-basin areas on the valley floor are 3 to 5 feet or more deep. Textures range from loam to silty clay loam. Permeability ranges from moderate to moderately slow.

The salts present in these soils are both free (saline) and combined (alkali). These salts often affect the soil structure. When wet the soil surface frequently seals and impedes further water penetration. When the soil is drying, a crust may form on the surface and hamper emergence of seedlings. The following soils are in this unit:

Campbell clay loam, 0 to 1 percent slopes (slight alkali) (Ca).
Mocho clay loam, over basin clays, 0 to 1 percent slopes (slight alkali) (Mi).
Mocho clay loam, 1 to 3 percent slopes (slight alkali) (Mk).
Mocho loam, over basin clays, 0 to 1 percent slopes (slight alkali) (Mn).
Mocho loam, 1 to 3 percent slopes (slight alkali) (Mq).
Orestimba clay loam, 0 to 1 percent slopes (slight alkali) (Of).
Orestimba silty clay loam, 0 to 1 percent slopes (slight alkali) (Og).

Use and management.—These soils are suited to irrigated pasture, row crops, hay, and grain. Yields may be improved by removal of excess salt and by improving drainage. Orchard fruits, except possibly pears, are not well suited to these soils.

To prevent the soil surface from sealing and to allow better control of placement and quantity of water, sprinkler irrigation systems are used. When drainage is improved, the alkali may be removed by leaching. To help remove the alkali, it may be necessary to apply gypsum or some other soil amendment as determined by soil tests.

Good soil management practices, such as those discussed for class I land, apply to these soils. Tillage pans, which form easily in these soils, can be broken up by subsoiling.

CAPABILITY CLASS III

Capability unit IIIe-1: Land suited to cultivation with severe risk of erosion damage because of slopes that range from 3 to 20 percent

These soils are from 20 to 36 inches deep. They occur on the lower lying uplands or on mountain ridges. Textures range from sandy loam to clay loam, and permeability ranges from moderate to moderately slow.

These soils have formed in the uplands over sedimentary rock. They have moderate water-holding capacity and are well drained. Their slopes range from 3 to 20 percent. When these soils are left bare during the rainy season, severe erosion may result. This is especially true of the Hugo soils, which are often used for orchards. These Hugo soils are found on the west side of the valley under an annual rainfall averaging about 50 inches. The Los Gatos soils also occur on the west side of the valley, but they have a native cover of coniferous trees and brush. The Vallecitos soils on the eastern slope of the valley are grass covered. Because of the relatively high elevation at which some of these soils occur, the winter climate is more severe than that of the valley bottom, and there are occasional snows and heavy frosts.

The following soils are in this unit:

Hugo clay loam, moderately eroded, 10 to 20 percent slopes (Hd).
Hugo clay loam, slightly eroded, 3 to 20 percent slopes (He).
Hugo loam, moderately eroded, 10 to 20 percent slopes (Hh).
Hugo loam, slightly eroded, 3 to 20 percent slopes (Hl).
Hugo sandy loam, slightly eroded, 10 to 20 percent slopes (Ho).
Los Gatos clay loam, slightly eroded, 10 to 20 percent slopes (Ld).
Vallecitos clay loam, slightly eroded, 10 to 20 percent slopes (Vd).

Use and management.—These are fairly good soils. They are best suited to range and forest but are also suited to hay, grain, and some orchard trees and vineyards. Fertilizers that contain nitrogen and phosphorus are beneficial.

Major soil conservation practices will be needed to prevent sheet and gully erosion caused by slope. All tillage and planting should be on the contour or across the slope. On land used for grain or hay,

a green-manure crop should be planted every 3 or 4 years. All crop residue should be returned to the soil. Grain and hay stubble, if allowed to remain on the surface, will greatly aid in the reduction of sheet erosion. In orchards, an annual cover crop should be planted and fertilized. Cover crops help to prevent erosion during the rainy season and add needed organic matter to the soil. If water is available, cover crops should be irrigated to start early growth.

If irrigation is practiced, sprinkler systems are best because of the slopes. Waterways and protected outlets should be provided. Subsoiling on the contour when the soil is dry will help increase water intake.

Brush control may be needed, especially on the Los Gatos and Hugo soils, if more intensive land use is planned.

Capability unit IIIe–3: Land suited to cultivation, with severe risk of erosion damage because of slope, and with limitations in use because of depth

These soils are from 10 to 36 inches deep. They occur on old terraces. Textures range from loam to clay loam, and permeability ranges from moderate to moderately slow.

These soils have slopes of 3 to 10 percent and a tight claypan at depths of 10 to 36 inches. The surface soils are readily penetrated by roots and water, but the claypan is a barrier to both roots and moisture. Irrigation water or rainfall that exceeds the water-holding capacity of the surface soil will cause rapid surface runoff and tempo rary waterlogging. If the soils are bare during the rainy season, severe erosion will result.

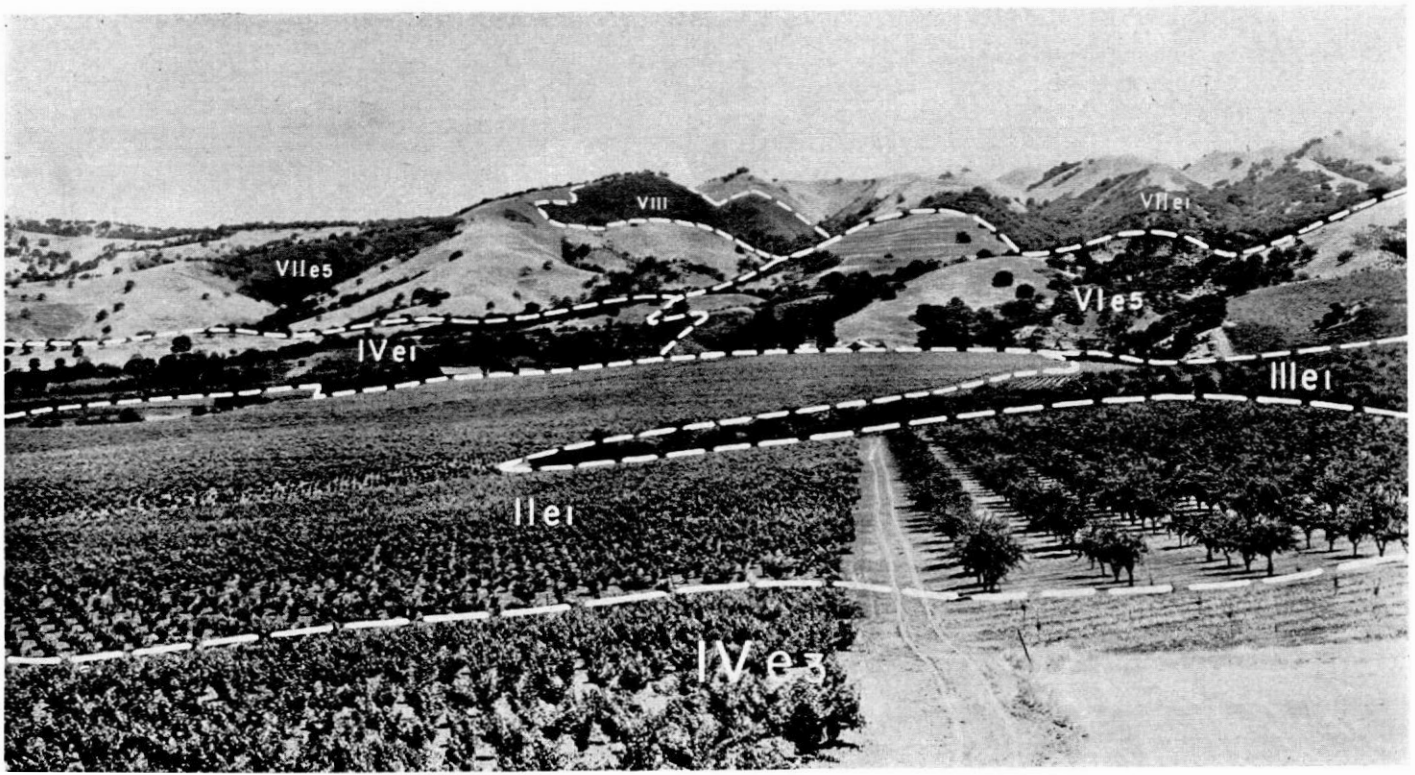
The Saratoga-Positas loams, deep, are somewhat deeper above the claypan. They have been placed in this unit because of their similarity to others of the unit in soil profile and management needs. The normal fertility level of these soils is often low. The following soils are in this unit:

Milpitas clay loam, 3 to 10 percent slopes (Mf).
Milpitas loam, 3 to 10 percent slopes (Mg).
Ohmer clay loam, 3 to 10 percent slopes (Oa).
Ohmer gravelly clay loam, 3 to 10 percent slopes (Oe).
Positas-Saratoga loams, 3 to 10 percent slopes (Pv).
Positas-Saratoga loams, slightly eroded, 3 to 10 percent slopes (Px).
Saratoga-Positas loams, deep, slightly eroded, 3 to 10 percent slopes (Sc).
Saratoga-Positas loams, 3 to 10 percent slopes (Se).

Use and management.—These soils have major problems in use because of their slope and the limited depth of usable soil material. Crops best suited are irrigated pasture, grain, and hay. Deep-rooted tree crops are not well suited. Winter-growing crops such as grain and hay make good use of the available moisture.

Irrigation must be carefully controlled to avoid saturation of the soil above the claypan. Saturation may cause root rot and leaching of plant nutrients. These soils are best suited to sprinkler irrigation systems, although furrow irrigation will be satisfactory when alined on about 0.5 percent grade.

Good soil management practices discussed for capability unit IIIe–1 also apply to these soils. These include rotation of cultivated crops with grasses and legumes, returning of crop residue to the soil, use of green manure, and cross-slope cultivation.



Representative land capability units in the Santa Clara Area; symbols indicate class, subclass, and unit as explained in the section, The Capability classification.

These soils, in spite of gentle slopes, erode easily if allowed to remain bare during winter. When good soil structure deteriorates, these soils erode more easily. Soil structure may be destroyed by overworking the dry soil, or by working when too moist. Because of soft subsoil and substratum materials, these soils tend to gully readily in swale areas and water outlets. To prevent gullying, all water outlets and channels should be protected. On longer slopes, diversion ditches are needed to intercept surface water and lead it to suitable ditches or outlets.

Capability unit IIIe–5: Land suited to cultivation with severe risks of erosion damage because of slopes that range from 10 to 35 percent

The soils are from 20 to 60 inches deep. Textures range from clay loam to clay. When wet the soils are slowly permeable. They tend to form large cracks when they dry. The soils are relatively stable against sheet erosion. They occur on moderate slopes of the uplands and are underlain by softly consolidated rock.

The soils of this unit are similar to those of capability unit IIIe–1 but are finer textured. The following soils are in this unit:

Altamont clay, slightly eroded, 10 to 20 percent slopes (Ah).
Altamont clay loam, 10 to 20 percent slopes (Am).
Ayar clay, 10 to 35 percent slopes (Ar).
Berryessa-Altamont clays, slightly eroded, 10 to 20 percent slopes (Bf).
Cayucos clay, slightly eroded, 10 to 20 percent slopes (Ch).
Climax clay (adobe), slightly eroded, 10 to 20 percent slopes (Co).
Hovey clay, 10 to 20 percent slopes (Ha).
Hovey clay, slightly eroded, 10 to 20 percent slopes (Hb).
Sobrante clay, slightly eroded, 10 to 35 percent slopes (Sl).

Use and management.—The soils of this capability unit have high water-holding capacity. Grain and grain hay are well suited. Orchards, irrigated pasture, and row crops are not so well suited. Many nonirrigated orchards, however, are growing near Alum Rock and Mount Pleasant. Some of the soils occur in extensive grassland areas and are used for grazing.

Because of the strong slopes, sprinklers are the best means of irrigation. The good soil management practices given for capability unit IIIe–1 also apply to this unit.

Capability unit IIIw–5: Land suited to cultivation with severe limitations in use because of poor drainage

The soils are from 20 to 60 inches deep, fine textured, and slowly permeable. They occur in nearly level basin areas, mostly near Alviso. The textures range from silty clay to clay. They are free of alkali. The subsoil, and in some cases the surface soil as well, has a high content of lime. The high lime content, combined with the poor drainage, often causes lime-induced chlorosis, particularly in orchards. The general lowering of the water table in the valley has improved the drainage and resulted in a wider crop suitability than formerly existed. The soils of capability unit IIIw–5 are more poorly drained than soils of unit IIw–5, but they are otherwise similar. The following soils are in this unit:

Alamitos clay, 0 to 1 percent slopes (Aa).
Castro clay, 0 to 1 percent slopes (Cd).
Castro silty clay, 1 to 3 percent slopes (Ce).
Pescadero clay (adobe), 0 to 1 percent slopes (Pc).

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Pescadero clay, 0 to 1 percent slopes (Pd).
Sunnyvale clay, 0 to 1 percent slopes (Sx).

Use and management.—The soils are best suited to irrigated pasture, hay, and grain. Some row crops and truck crops are also suited. Orchards are not suited. Drainage can be improved by the diversion of runoff from higher lands and by avoiding overirrigation. The low-lying position makes drainage difficult. The good soil management practices described for capability unit IIIe–1 also apply to these soils.

Capability unit IIIw–7: Land suited to cultivation with severe limitations in use because of poor drainage and alkali problems

The soils are fine textured, slowly permeable, and 3 to 5 feet or more in depth. They occur in basin areas that are subject to frost. Textures range from clay loam to clay. The soils of this unit are similar to those of unit IIIw–5, but they contain slight to moderate amounts of alkali. They are also similar to those of capability unit IIIs–7, except that they have finer texture and contain less alkali. Bayshore clay loam is included in unit IIIw–7 because of its high lime content. The following soils are in this unit:

Bayshore clay loam, 1 to 3 percent slopes (Bb).
Castro clay, 0 to 1 percent slopes (slight alkali) (Cd).
Castro silty clay, 1 to 3 percent slopes (slight alkali) (Ce).
Clear Lake clay (adobe), 0 to 1 percent slopes (slight alkali) (Cm).
Orestimba silty clay loam, 0 to 1 percent slopes (moderate alkali) (Og).
Pescadero clay (adobe), 0 to 1 percent slopes (slight alkali) (Pc).
Pescadero clay, 0 to 1 percent slopes (slight alkali) (Pd).
Sunnyvale clay, 0 to 1 percent slopes (slight alkali) (Sx).

Use and management.—The soils are best suited to irrigated pasture, hay, and grain. Some row crops and truck crops are also suited. Orchards are not suited.

The soils should be drained and leached. Gypsum or sulfur should be added to assist in alkali removal. The good soil management practices described for capability unit IIIe–1 also apply to these soils.

Capability unit IIIs–8: Land suited to cultivation with severe limitations in use because of claypan subsoils

The surface soils are from 10 to 36 inches deep, of loam to clay loam texture, and lie over subsoils of very slow permeability. They occur on nearly level old terraces. The surface soils are readily penetrated by roots and water, but the subsoils are almost impervious to roots and water. Soils of this unit are similar to the soils of unit IIIe–3, but they differ in being on more gentle slopes. The following soils are in this unit:

San Ysidro clay loam, 1 to 2 percent slopes (Sa).
San Ysidro loam, 1 to 2 percent slopes (Sb).
Zamora gravelly clay loam, over San Ysidro clay loam, 1 to 3 percent slopes (Zd).

Use and management.—These soils are best suited to shallow-rooted crops such as irrigated pasture, hay, grain, and some row crops. Orchard crops are poorly suited. Irrigation should be carefully controlled to prevent saturation of the soil above the claypan. Periodic subsoiling is sometimes needed to shatter tillage pans. Care must be taken in subsoiling orchards so as not to prune the tree roots too much. The soils are easily trampled, so they should not be grazed when wet.

Cover crops and green-manure crops are needed to maintain organic matter. All crop residues should be returned to the soil. The soils respond well to nitrogen and phosphorus fertilizers.

Capability unit IIIs–7: Land suited to cultivation with severe limitations in use because of moderate alkali and poor drainage

The soils are from 3 to 5 feet or more in depth. The textures range from sandy loam to clay loam. The soils occur in nearly level basin areas near the outlets of Coyote and Guadelupe Creeks. The Mocho soils are recent alluvial material over old basin clay. The Bayshore soil was included in this unit because of its very high lime content and low-lying position. There is no economical way to remove the excess lime. Soils of this unit are similar to those of unit IIIw–7 but have coarser textures and contain more alkali. The following soils are in this unit:

Bayshore clay loam, 3 to 5 percent slopes (Ba).
Mocho clay loam, over basin clays, 0 to 1 percent slopes (moderate alkali) (Mi).
Mocho loam, over basin clays, 0 to 1 percent slopes (moderate alkali) (Mn).
Mocho sandy loam, over basin clays, 0 to 1 percent slopes (moderate alkali) (Mr).

Use and management.—The high lime content and the moderate amounts of alkali salts narrow the choice of suitable crops. The soils are suited to irrigated pasture, hay, grain crops, and to some row crops after drainage has lowered the alkali content. Reclamation seldom is advanced enough to permit growing of orchards. When not drained, the soils support native salt-tolerant plants suited to limited grazing.

Irrigation should be carefully controlled to avoid movement of alkali into the root zone. The land should be well leveled to avoid wet spots. After suitable drainage is established, the soils can be leached to a lower alkali content, if gypsum and sulfur are added. Water should be tested to determine its suitability for leaching. The high content of lime in the soils may cause lime-induced chlorosis. The application of soluble iron compounds will help to control this problem.

All crop residues should be returned to the soil. Grasses and legumes in the rotation will help to maintain organic matter.

CAPABILITY CLASS IV

Capability unit IVe–1: Land suited to occasional or limited cultivation, with severe risk of erosion damage because of slopes that range from 20 to 35 percent.

The soils are from 10 to 36 inches deep over sandstone or shale. Textures of the soils range from sandy loam to clay loam. The sandy loam soils are somewhat droughty. They are well drained, strongly sloping, and moderately permeable. The Vallecitos and Gaviota soils occur on the east side of the Santa Clara Valley, and the Hugo and Los Gatos soils occur on the west side. The Vallecitos and Gaviota soils have a cover of grass, oaks, and scattered brush. The Hugo soils are timber covered or have been cleared. The Los Gatos soils are often heavily brush covered and are of little value for grazing. The soils of capability unit IVe–1 are similar to, but steeper than, the soils of capability unit IIIe–1. The following soils are in this unit:

Gaviota gravelly loam, 20 to 35 percent slopes (Ga).
Gaviota gravelly loam, moderately eroded, 20 to 35 percent slopes (Gb).
Gaviota loam, 20 to 35 percent slopes (Gk).
Gaviota loam, moderately eroded, 20 to 35 percent slopes (Gl).
Gaviota loam, slightly eroded, 20 to 35 percent slopes (Gm).
Hugo clay loam, slightly eroded, 20 to 35 percent slopes (Hc).
Hugo loam, moderately eroded, 20 to 35 percent slopes (Hf).
Hugo loam, slightly eroded, 20 to 35 percent slopes (Hg).
Hugo sandy loam, moderately eroded, 20 to 35 percent slopes (Hm).
Hugo sandy loam, severely eroded, 10 to 20 percent slopes (Hn).
Los Gatos clay loam, 20 to 35 percent slopes (La).
Los Gatos clay loam, moderately eroded, 20 to 35 percent slopes (Lb).
Los Gatos clay loam, slightly eroded, 20 to 35 percent slopes (Lc).
Vallecitos clay loam, 20 to 35 percent slopes (Va).
Vallecitos clay loam, moderately eroded, 20 to 35 percent slopes (Vb).
Vallecitos clay loam, slightly eroded, 20 to 35 percent slopes (Vc).
Vallecitos loam, slightly eroded, 20 to 35 percent slopes (Vg).

Use and management.—The soils are well suited to a rotation consisting of hay, grain, and grass. Grass should be on the soils 3 years out of 5. The soils are frequently used for orchards. Vineyards are also grown on the west side of the valley. Orchards and vineyards require intensive soil conservation practices, such as use of fertilized and seeded fall cover crops or of a fertilized continuous cover crop. Long slopes need stripcropping and diversion terraces. All tillage should be as nearly on the contour as possible. If water is available, the soils can be used for irrigated pasture. Irrigation by sprinklers is necessary to avoid soil erosion.

In large part, the soils of this capability unit are used for grazing. The use and management of grazing land is similar to that discussed under capability unit VIe–1. The Hugo soils are well suited to forestry. Forest management is also discussed under capability unit VIe–1.

Capability unit IVe–3: Land suited to occasional or limited cultivation, with severe risk of erosion damage in use because of slopes that range from 10 to 20 percent and shallow soil depth over claypan

These soils are from 10 to 36 inches deep. They occur over claypan or partially cemented subsoils on terraces in the foothills around the edge of the Santa Clara Valley. Slopes are strong. Textures range from loam to silty clay, and permeability ranges from moderate to moderately slow. The Pleasanton and Saratoga-Positas soils often have gravel throughout their profile and may be somewhat droughty and lower in fertility than the rest.

Soils in this unit will gully more severely than those of unit IVe–1, because of their soft partly cemented subsoils. The following soils are in this unit:

Azule silty clay, 10 to 20 percent slopes (Aw).
Azule silty clay, slightly eroded, 10 to 20 percent slopes (Ax).
Milpitas loam, slightly eroded, 10 to 20 percent slopes (Mh).
Ohmer clay loam, 10 to 20 percent slopes (Oc).
Ohmer clay loam, slightly eroded, 10 to 20 percent slopes (Od).
Pleasanton gravelly loam, slightly eroded, 8 to 20 percent slopes (Pn).
Positas-Saratoga gravelly loams, 10 to 20 percent slopes (Pt).
Positas-Saratoga gravelly loams, moderately eroded, 10 to 20 percent slopes (Pu).
Positas-Saratoga loams, slightly eroded, 10 to 20 percent slopes (Pw).
Saratoga-Positas loams, deep, slightly eroded, 10 to 20 percent slopes (Sd).
Saratoga-Positas loams, 10 to 20 percent slopes (Sh).
Saratoga-Positas loams, slightly eroded, 10 to 20 percent slopes (Sk).

Use and management.—These soils are best suited to grazing. They can be cultivated for grain and grain hay if handled with care. If used for hay and grain, they should be planted to a grass-and-legume cover 4 out of 5 years. All crop residue should be returned to the soil. A few orchards are grown on these soils, but they generally produce little.

Long slopes that may collect large quantities of water should be interrupted by stripcropping and by diversion terraces. Cross-slope cultivation should be practiced.

When these soils are used for grazing, a perennial protective plant cover should be maintained. By using good range management, more and better quality feed will be available, and at the same time, the plants will protect the range for continuous use. Adapted rangeland management practices are discussed under capability unit VIe–1.

Capability unit IVe–5: Land suited to occasional or limited cultivation with severe risk of erosion damage in use, because of fine textures and slopes that range from 20 to 35 percent

Most of these soils are from 3 to 5 feet deep over soft calcareous sandstone and shale. The Climax soils occur over basic volcanic rock. Soil textures range from clay loam to clay, and the soils have slow permeability, high water-holding capacity, and rapid surface drainage. The soils are relatively stable, but their moderately steep slopes are a potential erosion hazard.

This unit occurs mainly on the east side of the valley and has an annual grass cover. The following soils are in this unit:

Altamont clay (adobe), slightly eroded, 20 to 35 percent slopes Ab).
Altamont clay, 20 to 35 percent slopes (Ae).
Altamont clay, moderately eroded, 20 to 35 percent slopes (Af).
Altamont clay, slightly eroded, 20 to 35 percent slopes (Ag).
Ayar clay, moderately eroded, 20 to 35 percent slopes (Ao).
Ayar clay, slightly eroded, 20 to 35 percent slopes (Ap).
Berryessa-Altamont clays, 20 to 35 percent slopes (Bc).
Berryessa-Altamont clays, moderately eroded, 20 to 35 percent slopes (Bd).
Berryessa-Altamont clays, slightly eroded, 20 to 35 percent slopes (Be).
Berryessa-Altamont gravelly clays, slightly eroded, 20 to 35 percent slopes (Bh).
Cayucos clay, 20 to 35 percent slopes (Cf).
Cayucos clay, slightly eroded, 20 to 35 percent slopes (Cg).
Cayucos clay loam, 20 to 35 percent slopes (Ck).
Cayucos clay loam, slightly eroded, 10 to 20 percent slopes (Cl).
Climax clay (adobe), moderately eroded, 20 to 35 percent slopes (Cn).
Diablo clay, moderately eroded, 20 to 35 percent slopes (Da).
Diablo clay, slightly eroded, 20 to 35 percent slopes (Db).
Diablo clay loam, moderately eroded, 20 to 35 percent slopes (Dd).
Diablo clay loam, slightly eroded, 20 to 35 percent slopes (De).
Gaviota loam-Altamont clay loam, 20 to 35 percent slopes (Gd).
Gaviota loam-Altamont clay loam, moderately eroded, 20 to 35 percent slopes (Ge).

Use and management.—When cultivated, the soils of this capability unit are used for grain, grain hay, orchards, and vineyards. They are best suited to hay and grain, and good yields can be expected. When so used, they should be under permanent plant cover for 4 out of 6 years. All crop residue should be returned to the soil.

A fairly large amount of dry-farmed prunes and apricots is grown on these soils near Alum Rock and Mount Pleasant. Soil loss by

erosion from these moderately steep slopes has reduced the water-holding capacity. Many orchards have been abandoned or converted to hay, grain, and pasture.

Long slopes should be interrupted by stripcropping and diversion terraces. Farming operations should be across the slope. Some irrigated pastures are grown, when water is available. A sprinkler irrigation system is best.

These soils produce the most forage and will probably give the largest net returns over long periods when used for grazing. Many of these soils are associated with steeper rangeland soils and are used along with them for grazing. Rangeland management practices discussed under unit VIe–1 apply to this unit. For range condition, the standards discussed under unit VIe–5 apply to this unit. These soils are not suited to timber production.

Capability unit IVw–7: Land suited to cultivation with severe limitations in use because of poor drainage, alkali, and lime accumulations

These clay-textured soils with poor drainage are 3 to 5 feet or more in depth. They have high water-holding capacity and are fertile. These soils are similar to those in capability unit IIIw–7 but have poor drainage and more alkali. They occur near Alviso, near the southern tip of San Francisco Bay. The following soils are in this unit:

Alviso clay, 0 to 1 percent slopes (slight alkali) (An).
Castro silty clay, 1 to 3 percent slopes (moderate alkali) (Ce).
Pescadero clay, 0 to 1 percent slopes (moderate alkali) (Pd).
Sunnyvale clay, 0 to 1 percent slopes (moderate alkali) (Sx).

Use and management.—When unimproved, these soils are used for pasture. They produce only fair yields of forage. Where reclamation work has been intensified, irrigated pasture and a few vegetable crops are grown.

These soils are mostly marginal and are not usually recommended for costly improvements. They may be reclaimed by constructing dikes and tide gates and by using sump pumps for removing excess water.

Grain and hay crops will assist in the reclamation process if the soils are not overly wet or too severely affected by alkali. A sprinkler system is recommended for irrigated pasture on these soils. If other types of irrigation are used, a tailwater disposal system should be provided. Alkali- and water-tolerant plants should be used in the seeding mixture.

When these soils are used for grazing, the general practices discussed under capability unit VIe–1 apply. These soils are not suited to timber, nor to orchards or vineyards.

CAPABILITY CLASS VI

Capability unit VIe–1: Land not suited to cultivation, but suited to grazing or forestry with moderate risk of erosion damage

The soils are less than 20 inches deep. They occur on the steep slopes of the uplands, over sedimentary and metamorphosed sedimentary rocks. The textures range primarily from loams to clay loams, and there are a few pebbles and stones. Fertility is moderate.

Soils on the east side of the Santa Clara Valley have a grass, oak, or brush cover, but brush and trees predominate on the west side of the valley. Forage is earlier on the sunny slopes, which face generally south and west. On the protected slopes, generally those facing north and east, rainfall is more effective and forage growth is ranker. Precipitation increases as elevation increases. Colder temperatures at the higher elevations delay forage growth.

These soils are similar to those of capability unit IVe–1 but they differ in being steeper and shallower. The following soils are in this unit:

Gaviota gravelly loam, 35 to 50 percent slopes (Gc).
Gaviota loam-Altamont clay loam, severely eroded, 35 to 50 percent slopes (Gn).
Gaviota loam, moderately eroded, 35 to 50 percent slopes (Go).
Gaviota stony loam-Ayar stony clay, 20 to 35 percent slopes (Gr).
Gaviota stony loam, 20 to 35 percent slopes (Gs).
Hugo loam, slightly eroded, 20 to 35 percent slopes (stony) (Hg).
Hugo soils, undifferentiated, 35+ percent slopes (Hp).
Los Trancos stony clay, 10 to 35 percent slopes (Lg).
Permanente stony loam, slightly eroded, 20 to 35 percent slopes (Pb).
Vallecitos clay loam, 35 to 50 percent slopes (Ve).
Vallecitos loam, 35 to 50 percent slopes (Vh).

Use and management.—These soils are best suited to grazing or forestry. When used for hay and grain, the practices suggested for capability unit IVe–1 should be applied.

Proper grazing is important for maximum forage production and erosion control on grazing lands. Rotation grazing and proper stocking are the most important practices. If pasture has been properly grazed, the vegetation has a patchy appearance toward the end of the grazing season. It is well to allow plants to get a good early growth of at least 4 inches before grazing. Watering places should be readily available to livestock. This often requires development of springs and wells and the construction of dams.

Range reseeding is often desirable where forage has been depleted by overgrazing or cultivation. Harding grass, subterranean clover, annual ryegrass, alfalfa, and birdsfoot trefoil have proved satisfactory for reseeding programs in the Area. Reseeding will often lengthen the green-feed period.

Fertilizer, when enough is applied before the first rains, affords increased early forage. It also stimulates denser growth, which provides protection against heavy rains. Tests indicate that nitrogen and phosphorus are the most important elements needed.

Fences should be located according to range conditions. Properly located cross fences are essential for proper distribution of livestock and use of forage. At the end of the grazing season, enough vegetation should be left to protect the soils from the early rains.

Proper stocking is essential to good range management. The following is a guide for determining range condition:

EXCELLENT CONDITION: 65 percent or more of the vegetation is made up of soft chess, wild oats, or perennial grasses, and 20 to 35 percent of burclover and red- and white-stemmed filaree. There is a dense stand of vegetation. Mulch and litter are abundant and there is no active erosion. The range is producing at about its best under natural conditions.

GOOD CONDITION: 40 to 65 percent of the vegetation is made up of the better range plants. Under good range management practices this range can be improved to produce about 50 to 100 percent more usable forage.

FAIR CONDITION: 25 to 40 percent of the vegetation is made up of the better range plants. Poor forage plants, such as annual fescues, red brome, weeds, and some brush have invaded or are increasing. Range in fair condition can be improved to produce 2 to 4 times as much forage.

POOR CONDITION: Most of the vegetation consists of poor grasses, such as annual fescues and red brome, and weeds, such as broad-leaved filaree, turkey mullein, tarweed, and brush. About 15 percent or less of the good forage plants are left. The stand of vegetation may be light. There is very little mulch; erosion is active and may be severe. This range can be improved to produce four or more times as much forage.

Capability unit VIe–3: Land not suited to cultivation but suited to grazing with moderate risk of erosion damage

These soils are from 10 to 36 inches deep. They occur on old terraces. Soil textures range from loams to silty clays. The fertility is moderate. The underlying material of these soils is only slightly consolidated, and if not protected it will gully readily. Most of these soils have a dense claypan or are underlain by impervious terrace materials. Internal drainage and root penetration are restricted. Surface drainage, however, is rapid because of slope.

These soils have varying percentages of brush and grass cover. Those on the western side of the Santa Clara Valley tend to have more brush cover.

These soils are somewhat similar to those in capability unit IVe–3, except that they occur on steeper slopes, have less effective soil depth, and have greater limitations in use. The following soils are in this unit:

Azule silty clay, 20 to 35 percent slopes (At).
Azule silty clay, moderately eroded, 20 to 35 percent slopes (Au).
Azule silty clay, slightly eroded, 20 to 35 percent slopes (Av).
Olmer clay loam, slightly eroded, 20 to 35 percent slopes (Ob).
Pleasanton gravelly loam, moderately eroded, 20 to 35 percent slopes (Pk).
Pleasanton gravelly loam, 20 to 35 percent slopes (Pl).
Saratoga-Positas loams, moderately eroded, 20 to 35 percent slopes (Sf).
Saratoga-Positas loams, slightly eroded, 20 to 35 percent slopes (Sg).
Soper gravelly loam, 20 to 35 percent slopes (Sm).
Soper gravelly loam, moderately eroded, 20 to 35 percent slopes (Sn).

Use and management.—These soils are occasionally cultivated for orchard fruits, grain, or hay. They are poorly suited to these uses because of serious erosion hazard. They should be used for grazing. The rangeland management practices discussed under capability unit VIe–1 apply to these soils.

For evaluating range conditions, the following standards may be used as a guide:

EXCELLENT CONDITION: 60 percent or more of the vegetation is made up of soft chess, wild oats, perennial grasses, red- and white-stemmed filaree, and burclover; 20 percent or more may be made up of fair forage plants. Plant litter and mulch are adequate, and there is no active soil erosion. This range is producing at about its best under natural conditions.

GOOD CONDITION: Not more than 25 to 50 percent of this range is made up of chamise, sage, red brome, and other poor forage plants. This range can be improved to produce 50 to 100 percent more forage.

FAIR CONDITION: Not more than 50 to 75 percent of this range is made up or chamise, sage, red brome, and other poor forage plants. This range can be improved to produce two to four times as much forage.

POOR CONDITION: Most of the vegetation on this range is made up of poor forage grasses, weeds, and brush. Very few of the good forage plants are left. There is very little mulch; erosion is severe and active. This range can be improved to produce four or more times as much forage.

Capability unit VIe-5: Land not suited to cultivation but suited to grazing with moderate risk of erosion damage

These soils are from 10 to 36 inches deep. They occur over soft rock in the uplands on the east side of the Santa Clara Valley. Textures range from clay loam to clay. These soils have moderate fertility. They have a stable structure and do not erode so readily as the soils of units VIe–1 and VIe–3. The native cover is grass and a few scattered oaks.

These soils are similar to those of capability unit IVe–5, except that they are steeper and have less effective soil depth. The following soils are in this unit:

Altamont clay (adobe), moderately eroded, 35 to 50 percent slopes (Ac).
Altamont clay, 35 to 50 percent slopes (Ak).
Altamont clay, moderately eroded, 35 to 50 percent slopes (Al).
Ayar clay, 35 to 50 percent slopes (As).
Diablo clay loam, 35 to 50 percent slopes (Df).
Gaviota loam-Altamont clay loam, 35 to 50 percent slopes (Gf).
Gaviota loam-Altamont clay loam, moderately eroded, 35 to 50 percent slopes (Gg).

Use and management.—The range management practices described under capability unit VIe–1 also apply to these soils. These soils are sometimes cultivated for orchard fruits, grain, and hay. They are poorly suited to cultivated crops because of steep slopes. They are not suited to forestry.

Following is a guide for evaluating grazing land condition:

EXCELLENT CONDITION: 65 percent or more of the vegetation is made up of soft chess, wild oats, and perennial grasses, and 15 to 35 percent of burclover and red- and white-stemmed filaree. There is a dense stand of desirable vegetation. Mulch is abundant; there is no erosion. The range is producing at about its best under natural conditions.

GOOD CONDITION: 40 to 65 percent of the vegetation is made up of the good forage plants. Under good range management this cover can be improved to produce from 50 to 100 percent more usable forage.

FAIR CONDITION: 25 to 40 percent of the vegetation is made up of good forage plants. Poor forage plants, such as annual fescues, red brome, and weeds, have invaded or are increasing. Range in fair condition can be improved to produce two to four times as much forage.

POOR CONDITION: Most of the vegetation consists of poor grasses, such as annual fescues, red brome, and weeds such as broad-leaved filaree, turkey mullein, and tarweed. Fifteen percent or less of the good forage plants are left. There may be a light stand of desirable vegetation. There is very little mulch; erosion is active and may be severe. This range can be improved to produce four times or more as much forage.

CAPABILITY CLASS VII

Capability unit VIIe–1: Land suited to range or forestry with severe risk of erosion damage because of very steep slopes

These soils are moderately and severely eroded and are less than 20 inches deep. Texture ranges from loam to clay loam, and there are occasional stones. Fertility level and moisture-holding capacity are low. These soils have formed over sedimentary and metamorphic rocks.

The Hugo and Los Gatos soils occur on the west side of the Santa Clara Valley and have a native cover of trees and brush. The native cover of the Vallecitos soils, on the east side of the valley, is brush and grass. North-facing slopes and sheltered canyons are generally brush covered or wooded. The following soils are in this unit:

Hugo loam, severely eroded, 35 to 50 percent slopes (Hk).
Hugo stony soils, undifferentiated, 50+ percent slopes (Hr).
Los Gatos clay loam, severely eroded, 35 to 50 percent slopes (Le).
Vallecitos clay loam, severely eroded, 35 to 50 percent slopes (Vf).

Use and management.—Forage yields are generally low because of the dense brush cover, low fertility, and low moisture-holding capacity. Even after the soil has been cleared, brush reappears rapidly. Local areas of deeper soils, protected slopes, and swales have clearings which produce good forage. The grazing management practices discussed under capability unit VIe–1, except those for reseeding and fertilizing, apply to these soils.

The following standard is suggested as a guide for evaluating range condition:

EXCELLENT CONDITION: 60 percent or more of the vegetation is made up of soft chess, wild oats, and perennial grasses, and about 20 to 40 percent of burclover and white- and red-stemmed filaree. There is a good stand of vegetation. Mulch and litter are fairly abundant, and there is no active erosion. This range is producing at about its best under natural conditions.

GOOD CONDITION: 40 to 60 percent of the vegetation is made up of the better range plants. Under good range management practices this range can be improved to produce about 50 to 100 percent more usable forage.

FAIR CONDITION: 20 to 40 percent of the vegetation is made up of the better range plants. Poor forage plants, such as annual fescues, red brome, weeds, and brush, are increasing. Range in fair condition can be improved to produce two to four times as much forage.

POOR CONDITION: Most of the vegetation consists of poor grasses, such as annual fescues, red brome, weeds, and brush. About 15 percent or less of the good forage plants are left. There is very little mulch; erosion is active and may be severe. This range can be improved to produce four or more times as much forage.

Desirable forest management practices that apply to the Hugo soils are discussed under capability unit VIs–1.

Capability unit VIIe–3: Land suited to grazing, with severe risk of erosion damage because of steep slopes

These soils are from 10 to 36 inches deep. They occur on old terraces near Stevens Creek Reservoir on the west side of the Santa Clara Valley. Textures range from gravelly loam to silty clay. The soils are low in water-holding capacity and of moderate fertility. Surface runoff is excessive, and erosion is severe when the soils are unprotected. The native vegetation is mostly brush. In a few places, brush has been cleared and vineyards established, but most of these have since been abandoned. These soils differ from those in capability unit VIe–3 only in that they are shallower and steeper and generally more eroded. The following soils are in this unit:

Azule silty clay, 35 to 50 percent slopes (Ay).
Azule silty clay, moderately eroded, 35 to 50 percent slopes (Az).
Soper gravelly loam, 35 to 50 percent slopes (So).

Use and management.—Forage production on these soils is low because of the brush cover, low water-holding capacity, and low fertility. These soils are not suited to forestry. Production is generally lower than on the soils of capability unit VIe–3.

The management practices discussed under capability unit VIe–1 apply, except that reseeding and fertilization are not considered feasible on these soils.

The following is a guide to evaluating range condition:

EXCELLENT CONDITION: 35 percent or more of this range is made up of soft chess, wild oats, perennial grasses, burclover, and red- and white-stemmed filaree; 50 percent or more may be made up of fair forage plants. Brush does not cover more than 20 percent of the land. Plant litter and mulch are adequate, and there is no active soil erosion. This range is producing at about its best.

GOOD CONDITION: Not more than 25 to 50 percent of the range is made up of brush, red brome, and other poor forage plants. This range can be improved to produce 50 to 100 percent more forage.

FAIR CONDITION: Not more than 50 to 75 percent of this range is made up of brush, red brome, and other poor forage plants. This range can be improved to produce two to four times as much forage.

POOR CONDITION: Most of the vegetation is made up of poor forage grasses, weeds, and brush. Very few of the good forage plants are left. There is very little mulch; erosion is severe and active. This range can be improved to produce four or more times as much forage.

Capability unit VIIe-5: Land not suited to cultivation, but suited to grazing with severe limitations in use because of very high erosion hazard

These are upland soils occurring on the east side of the Santa Clara Valley. They were derived from soft calcareous sedimentary rock. The texture ranges from clay loam to clay. Heavy use has resulted in a loss of most of the topsoil. This erosion has lowered the fertility level and water-holding capacity of the soils.

The vegetation consists mostly of annual grass and weeds. The sheltered canyons and north-facing slopes occasionally have oaks and some brush. The following soils are in this unit:

Altamont clay (adobe), severely eroded, 35 to 50 percent slopes (Ad).
Berryessa-Altamont clays, severely eroded, 35 to 50 percent slopes (Bg).
Diablo clay, severely eroded, 35 to 50 percent slopes (Dc).
Gaviota loam-Altamont clay loam, severely eroded, 35 to 50 percent slopes (Gh).

Use and management.—These soils are too steep for cultivated crop production. Some of them have been used for orchards and as a result have been severely eroded. They should be maintained in a permanent grass cover. The soils are not suited to forestry. When soils of this unit are used for grazing, the grazing practices discussed under capability unit VIe–1 apply. The following is a guide for determining range condition.

EXCELLENT CONDITION: 60 percent or more of the vegetation is made up of soft chess, wild oats, and perennial grasses, and about 15 to 35 percent of burclover and red- and white-stemmed filaree. There is a good stand of desirable vegetation. Mulch is abundant, and there is no active erosion. This range is producing at about its best under natural conditions.

GOOD CONDITION: 40 to 60 percent of the vegetation is made up of the above good forage plants. Under good range management this cover can be improved to produce from 50 to 100 percent more usable forage.

FAIR CONDITION: 20 to 40 percent of the vegetation is made up of good forage plants. Poor plants, such as annual fescues, red brome, and brush are increasing. Range in fair condition can be improved to produce two to four times as much forage.

POOR CONDITION: Most of the vegetation consists of poor grasses, such as annual fescues, red brome, and weeds such as broad-leaved filaree, turkey mullein, tarweed, and brush. Fifteen percent or less of the good forage plants are left. There may be a light stand of desirable vegetation. There is very little mulch; erosion is active and is severe. This range can be improved to produce four or more times as much forage.

Capability unit VIIe–7: Land not suited to cultivation, but suited for grazing with severe risk of erosion damage because of slope, and having poor forage yields because of low fertility

The texture of these soils ranges from loam to clay loam. Rocks and stones are often present. Water-holding capacity is low. These soils occur in the foothills next to the Santa Clara Valley and in hills extending into the valley. The Montara soils were formed from serpentine rock and are less than 36 inches deep. The Maymen soils were formed from various sedimentary and metamorphic rocks and are shallow and rocky. Vegetation consists of weeds, sparse annual grasses, and occasional tufts of perennial grasses on the Montara soils and brush on the Maymen soils. The following soils are in this unit:

Maymen loam, severely eroded, 20 to 50 percent slopes (Mb).
Maymen loam, moderately eroded, 20 to 35 percent slopes (Mc).
Maymen loam, slightly eroded, 10 to 35 percent slopes (Md).
Montara clay, slightly eroded, 20 to 35 percent slopes (Mt).
Montara clay loam, slightly eroded, 20 to 35 percent slopes (Mu).
Montara stony soils, undifferentiated, 35+ percent slopes (Mv).
Montara stony clay-Climax clay (adobe), 20 to 35 percent slopes (Mw).
Montara stony clay, 10 to 35 percent slopes (Mx).
Montara stony clay loam, 20 to 35 percent slopes (My).
Montara stony clay loam, 10 to 20 percent slopes (Mz).

Use and management.—These soils are used for grazing. Forage production is low, especially on the Maymen soils. Fertilizing to increase forage production usually is not economical. The soils are not suited to forestry. Except for seeding and fertilizing, the range management practices discussed under capability unit VIe–1 apply to this unit.

The following is a guide to range condition:

EXCELLENT CONDITION: Perennial grasses, such as needlegrass and squirreltail cover half of the ground. Between the perennial grasses are soft chess, red- and white-stemmed filaree, and burclover. There is a good stand of vegetation. Mulch is abundant, and there is no active erosion. This range is producing at about its best.

GOOD CONDITION: Perennial grasses are scattered. Annual grasses and weeds such as soft chess, red- and white-stemmed filaree, and burclover are equal in amount to the poorer forage plants, such as foxtail, weeds, and brush. Under good range management practices this range can be improved to produce 50 to 100 percent more usable forage.

FAIR CONDITION: Poor forage plants such as foxtail grass, goldfields, other weeds, or brush make up 50 percent or more of the cover. Good forage plants such as needlegrass, soft chess, and burclover are scarce. Range in this condition can be improved to produce two to four times as much forage.

POOR CONDITION: Foxtail grass, goldfields, or brush and other poor forage plants cover the land. Few good forage plants are left. There is little mulch on the ground; erosion is active. This range can be managed to produce four or more times as much forage.

Capability Unit VIIw–7: Land not suited to cultivation, but suited for grazing with severe limitations in use because of alkali and excess water

In texture, these soils are mostly clay loams and clays. They occur in basin areas or tidal flats along the edge of San Francisco Bay near Alviso. They are periodically inundated by high tides and floodwaters. Vegetation consists of salt- and water-tolerant plants. The following soils are in this unit:

Alviso clay, 0 to 1 percent slopes (moderate alkali) (An).
Alviso clay, 0 to 1 percent slopes (strong alkali) (An).
Mocho clay loam, over basin clays, 0 to 1 percent slopes (strong alkali) (Mi).
Mocho loam, over basin clays, 0 to 1 percent slopes (strong alkali) (Mn).
Mocho sandy loam, over basin clays, 0 to 1 percent slopes (strong alkali) (Mr).
Orestimba clay loam, 0 to 1 percent slopes (strong alkali) (Of).
Orestimba silty clay loam, 0 to 1 percent slopes (strong alkali) (Og).
Sunnyvale clay, 0 to 1 percent slopes (strong alkali) (Sx).

Use and management.—The soils are used principally for grazing. The vegetation normally consists of pickleweed, saltgrass, foxtail, and other annual plants. Forage production is very low. Reclamation is not advisable because of the high expense involved. Fencing, water development, and proper use of forage are the primary grazing management practices suited to these soils. The soils are not suited to forestry.

CAPABILITY CLASS VIII

Land not suited to cultivation, grazing, or forestry, but suited to wildlife, watersheds, or recreation

In this class are miscellaneous land types such as Made land, land with little or no soil, tidal marsh, and very steep rough mountainous land.

These land types are scattered throughout the Santa Clara Area. Extensive areas, classified as rough and mountainous land, include some areas of land suitable for grazing. These are generally too small to use separately. They occur mainly near Permanente and in other areas along the west side of the valley. The following soils and land types are in this class:

Pits (Ec).
Gaviota stony soils, undifferentiated, 50+ percent slopes (Gp).
Los Gatos-Maymen stony soils, undifferentiated, 50+ percent slopes (Lf).
Made land (over Alviso soil material) (Ma).
Maymen stony soils, undifferentiated, 50+ percent slopes (Me).
Permanente stony soils, undifferentiated, 50+ percent slopes (Pa).
Riverwash (Ra).
Tidal marsh (Ta).

Use and management.—Land in this class is mostly brush covered. The slopes are too steep and the soils are too shallow to permit any extensive improvement in cover. The present cover does provide valuable protection to the watersheds and supplies forage for wildlife. Fire protection is needed to maintain these values. Burns should be seeded, because fire-denuded slopes are a serious flood threat to highly developed valley lands. Stream-channel protection and fencing of critically eroded areas may also be desirable.

IRRIGATION AND DRAINAGE

Before 1898, little of the land was irrigated because the commercial orchardists in the Area thought irrigation was not necessary.[14] However, the dry years of 1898 and 1899 caused a considerable drop in yields and changed the opinion of farmers to favor irrigation of orchards on the valley floor.

Most of the early irrigation was done on land next to streams from which water was diverted when needed and available. Even this

[14] HUNT, G. W. DESCRIPTION AND RESULTS OF OPERATIONS OF THE SANTA CLARA WATER CONSERVATION DISTRICT'S PROJECT. 1940. [Unpublished report.]

source of water was not reliable enough. Another dry year, 1908, resulted in a conversion to wells and the more dependable underground water supply. Irrigation from wells rapidly became common.

By 1912 an estimated 20 percent of the valley land in the Area was under irrigation, and by 1920 more than 60 percent of the land and nearly 90 percent of the orchards on the valley floor were irrigated. During the period from 1920–34 only 2 years were above normal in rainfall. More wells were drilled, and the irrigated area increased until by 1934 it included most of the irrigable land in the Area. The draft on the underground water supply during these years was greater than natural replenishment. Water levels dropped considerably, and the cost of pumping water increased. Water conservation measures became necessary, and in 1935 construction of storage and percolation reservoirs was begun (see section on water supply).

Census figures for irrigation in Santa Clara County are considered representative for the area surveyed, since the survey includes the irrigated parts of the county.

The following data from United States census reports give the area irrigated in Santa Clara County during stated years.

Year:	*Acres irrigated*
1889	6,686
1899	40,097
1909	37,637
1919	70,312
1929	96,130
1939	95,959
1949	101,172

Two-thirds of the farms in the county have irrigation. These 3,449 farms include 105,721 acres actually irrigated. More than half of these farms supply their own water, which irrigates 72 percent of the land irrigated in Santa Clara County. The other farms get water from the 9 cooperatives and 6 commercial irrigation enterprises.

The investment in irrigation enterprises [15] and their subsequent operation and maintenance is considerable.

About 95 percent of the irrigated acreage is supplied with water pumped from wells. There are 3,077 wells for irrigation in the Area. Practically all of the well pumps are powered by electricity. The cost of the pump power needed to lift 1 acre-foot of water 1 foot varies. It depends upon the efficiency of the pump, the horsepower of the motor, and length of time that power is used. Power costs usually range from 1 to 10 cents and most frequently from 4 to 6 cents an acre-foot per foot of lift. Since the depth to ground water ranges from only a few feet to more than 200 feet in the valley, the cost of pumping the well water varies considerably.

The wells in the county numbered 3,080 as of January 1, 1950, and the average pumping lift was 142 feet. Gravity water, which is available in only a few areas and at certain times, is sold at prices ranging

[15] An *irrigation enterprise* is an independent irrigation establishment owning or operating works for supplying water to agricultural land. An enterprise may represent a short canal or a pumping plant watering a single small farm, or a system of canals and reservoirs, operated under one management, that supplies many farms. In 1950 there were 2,228 irrigation enterprises in Santa Clara County.

from 4 to 6 dollars an acre-foot. In general, throughout the valley floor the lower the cost of water the more frequent and regular are the applications of water.

The contour-check system of irrigation is generally used for orchards, particularly for prunes and apricots on the very gently sloping alluvial fans. The checks are irregular basins formed by small levees or ridges 12 to 14 inches above ground level located on level contours, and by cross levees or enclosing levees at the ends of the orchard tract. The usual interval in elevation between contours is 0.2 foot. The position of a contour ridge is determined originally with an engineer's level and target rod. Because the ridges are broken down by cultivation, their location is established by marking the trees between which a contour lies. Four or five colors are generally used in uniform rotation to designate contours so that a single contour can be easily followed from a tractor during ridge construction. Each check is filled individually with water, and not filled, as in rice culture, by overflow from the next higher basin.

Rectangular checks or basins are also used, particularly on nearly level land and in the irrigation of pears and alfalfa. Ridges are constructed by the same types of ridgers used in constructing contour checks. The size of checks, whether of the contour or rectangular type, depends upon the head of water available and the type of soil. In general the proper ratio of irrigation head measured in cubic feet per second, to the area of check expressed in acres, is 20 to 1 for sandy soils, 2 to 1 for clay soils, and intermediate ratios for intermediate types of soils. Coarse-textured soils require light applications of water at frequent intervals, and fine-textured soils require larger applications at longer intervals.

Furrow irrigation is practiced in only a few orchards, but it is uniformly used in irrigation of truck crops and for irrigated field crops.

Annual amounts of irrigation water generally applied to the principal fruit crops in the Area are given below.

Crop:	*Acre-feet per acre*
Apricots	1 to 1½
Cherries	1½ to 2
Pears	1 to 2½
Prunes	½ to 1½
Grapes	½ to 1

In recent years drainage has not been a problem in the Area, except in places near tidal marsh, mainly because of the general drop in ground-water level. At one time the basins northwest of Evergreen and southwest of Edenvale were marshy, and drainage ditches were dug to reclaim these areas. However, the lowering of ground-water level through pumping for irrigation was the chief factor in bringing about complete reclamation. Census figures show only 3,726 acres in the county in the 2 drainage districts in 1950. This acreage is drained by open ditches and levees. Another 1,788 acres is drained by the 17 irrigation enterprises having drainage as a part of their program.

EROSION AND DEPOSITION[16]

Erosion is a geologic process that removes or wears away soils and geologic materials from the land surface through the action of natural agencies, primarily wind, water, and gravitational creep. *Normal erosion* is the term generally applied to erosion that is characteristic of the land surface in its natural environment, undisturbed by human activity. This type of erosion is sometimes referred to as geologic erosion. *Accelerated erosion* is erosion of soil or soil material, over and above normal erosion, brought about by changes in the natural cover or ground conditions caused by human activity. This is the type of erosion that decreases and tends to destroy the productivity of agricultural land.

In the Santa Clara Area, accelerated erosion has taken place mainly because of water. *Water erosion* is the moving of soil by water running rapidly over exposed land surfaces. It is affected by slope, soil type, land use, and intensity of rainfall. It takes place on sloping areas where the soil is of a type susceptible to washing and where land use has removed the protective vegetation from the surface. Both *sheet erosion*, which is the more or less even removal of soil in thin layers over an entire surface of sloping land, and *gully erosion* occur in the Area. The most important type, however, is the less obvious sheet erosion. Only accelerated erosion was recognized and mapped in this survey.

None of the upland soils of the Area are considered highly erosive because of inherent soil characteristics. However, in most cultivated places these soils have eroded because of slope and the method of land use. Orchard fruits are the principal crops grown in the upland sections.

Nearly all of the orchards are planted in the usual rectangular system with little or no regard for contours. General cultivation practices are as follows. A natural cover crop is turned under by disking in the spring as soon as the soil is dry enough to be worked. During the summer and early fall the soil may be disked again to keep down weeds. With the first fall rains, the cover crop is allowed to start. By January, the month of greatest rainfall, the cover crop is usually well established and serving as some protection against erosion. The soil is exposed or bare during the dry summer months but is at least partly protected during the wet winter months. Such a system favors erosion control to some extent. However, a late spring or summer rain or a heavy fall rain coming when the soil is unprotected usually causes serious erosion. Accelerated erosion has had an important effect on the soils of about 60 square miles in the Area.

On the eastern and southern hills, the upland soils of the Altamont, Berryessa, Diablo, Climax, and Ayar series are usually considered to be resistant to erosion or to erode at relatively slow rates. However, many years of cultivation with little regard to erosion control have allowed slight or moderate erosion of nearly all of the soils affected (pl. 8, *A* and *B*). Sheet erosion is by far the most usual type except in the Berryessa soils, in which fairly numerous deep gullies and landslips have developed because of the softly consolidated underlying material. Most soils of the Montara, Gaviota, Ayar, and

[16] Definitions in this section are taken mainly from the Soil Conservation Survey Handbook (*15*) and Soils and Men (*25*).

Vallecitos series are uncultivated and used mainly for grazing. The slight erosion on some of these soils, especially Gaviota loam, is caused mainly by overgrazing. In the few places where these soils are cultivated slight or moderate erosion has occurred.

Of the upland soils on the western hills and mountains only the fine-textured Cayucos soils are considered resistant to erosion. Nevertheless, significant erosion has occurred in most places where these soils are cultivated. Various degrees of erosion, including severe erosion, have occurred on cultivated areas of the Los Gatos, Hugo, Maymen, Soper, and Permanente soils. No important erosion has occurred on the Los Trancos soils because their area is small and they are not cultivated. During every winter in the Santa Cruz Mountains one or more roads are blocked by landslips or are washed out where they cross drainage channels. This is especially true in the intensively built-up recreational sections in the Los Gatos Creek drainage area.

Most of the terrace soils of the Area are cultivated, and in nearly all places slight or moderate erosion has occurred. In this group, soils of the Milpitas, Saratoga, and Positas are the most susceptible to erosion. Soils of the Azule, Hovey, and Ohmer series are considered relatively resistant to erosion.

This report will not go into detailed and specific recommendations for erosion control. Such recommendations vary according to soil type, slope, land use, and climate, and also generally vary from one farm to another. The following are a few erosion control measures that have been useful: Cover crops for seasonal protection; contour planting and cultivation; crop rotation; retirement of severely eroded areas to natural vegetation; control of gullies by check dams and vegetation; and regulation of stocking in grazing areas. In most places a combination of measures is necessary to control erosion properly.

Water-eroded soil material is carried by streams and either deposited on lower lying and more nearly level areas or is carried to San Francisco Bay. In the Santa Clara Area suspended material from eroded areas has been deposited over rather large areas of the valley floor. This recently deposited material makes up the soils of the Mocho series. In many places along the larger creeks the deposits are more than 6 feet deep, but the largest areas have an overwash of less than 6 feet over basin clays.

Differences in depth of Mocho soil material on either side of old levees or road embankments and statements made by people who have directly inherited land taken up at the beginning of the intensive settlement of the valley indicate that nearly all of the material that has become the Mocho soils has been deposited since about 1850. Deposition still occurs along most of the streams of the valley at some time during each winter. The total area of this recent deposition or accumulation at the time of the survey was about 17 square miles.

In many counties deposits of material from areas of accelerated erosion are destructive and ruin better farmland. In the Santa Clara Area, however, most of the deposits are beneficial, and the flooding that accompanies the deposition does little damage to the pear trees and most other crops. Along the eastern edge of the valley a few drainage ditches, roads, orchards, and winter vegetable crops have been damaged.

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SALINE AND ALKALI[17] SOILS

The term "alkali," as commonly understood in this Area and as used in this report, refers to soluble salts, either neutral or alkaline in reaction, that occur in soils in sufficient quantities to have a toxic or retarding effect on the growth of cultivated plants.

There are two principal kinds of alkali. One consists of salts, commonly called "white alkali," which are neutral in reaction and generally composed of sodium chloride (common salt) and sodium sulfate (Glauber's salt). The other consists of true alkali salts, commonly called "black alkali," which are alkaline in reaction and generally composed of sodium bicarbonate (baking soda) and sodium carbonate (sal soda). Normally all alkali soils contain neutral salts, but the black alkali soils also contain the alkaline salts.

The neutral salts, or white alkali, have originated from the disintegration and decomposition of rocks. These salts accumulate in soils principally through the agency of water and the process of evaporation. Most soils affected by alkali have developed under conditions of poor drainage and a prevailing high ground-water level. In such soils capillary rise brings moisture near or to the surface of the soil, where the moisture evaporates. The very small amounts of soluble salts that are in the soil originally, and also those carried by the ground water, are gradually deposited near the surface until finally the concentration is enough to damage or even kill most crop plants. Irrigated areas where the ground-water level is usually less than 10 feet from the surface are generally likely to develop alkali.

Alkaline salts, or black alkali, form in soils already containing white alkali or develop along with the white alkali. Under certain conditions of moisture, salt concentration, and mineralogical composition of the soil, a complex reaction takes place involving the white alkali salt, the colloidal part of the soil, and the carbon dioxide of the soil water. As a result of this reaction the alkaline salts of black alkali are formed. Although these alkaline salts are white crystalline compounds, the reaction of the salts with what little organic matter there may be in the soil produces a dark-brown discoloration. Hence, the common name "black alkali" is used.

Soils in the Santa Clara Area affected with alkali occur mainly in the eastern part and next to tideland along San Francisco Bay. White alkali is by far the most common, but some areas also contain black alkali. The chief soils affected by alkali are those of the Alviso, Orestimba, Pescadero, and Clear Lake series. A few small areas of soils of the Campbell, Mocho, Sunnyvale, and Castro series are also affected. A discussion of alkali areas is included with the descriptions of the affected soils.

In general the alkali soils of the Area have formed under natural conditions as described above, except those influenced by tidewater. Sea water contains more than enough salts to poison crop plants, and where it seeps into soils an alkali condition soon develops. Because of the recent sinking of the land (see section on geology), seepage of bay water has extended increasingly further inland and is gradually lowering the productivity of some of the soils through salt accumulation.

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[17] The term "alkali" is used in this report in its popular rather than its technical sense.

The three grades of alkali mapped in the Area, are slight or spotty, moderate, and strong. Soils slightly affected with alkali have a somewhat lowered general productivity level; but if other factors are favorable, they give good yields of crops fairly tolerant of alkali. Soils moderately affected with alkali are definitely marginal, producing poor to fair yields of even tolerant crops. Soils strongly affected by alkali generally cannot be used. Alkali areas are shown on the soil map by a blue dashed line, with a blue letter symbol to denote the grade. Alkali grades were established principally on the kind and percentage of salts in the soil as shown below.

Alkali grade:	*Containing white alkali only, percent*	*Containing black alkali, percent*
Slight	0.20 to 0.49	0.10 to 0.29
Moderate	.50 to .99	.30 to .59
Strong	Over 1.00	Over .60

From 3 to 5 soil samples, from the surface of the soil to a depth of 5 feet, were collected at each point selected for salt determinations. The percentage of salt in each sample was obtained by the electrical conductivity method (modified Wheatstone bridge), using the procedure outlined in the Soil Survey Manual (*24*). The presence of black alkali was determined by phenolphthalein reaction.

The results of these determinations are shown on the soil map in blue figures in the form of a fraction (such as $\frac{0.25}{0.63}$), with a blue dot to show the location of sampling. The numerator of this fraction is the percentage of salts in the surface soil, and the denominator is the average salt percentage for the entire soil profile to a depth of 5 feet. Whichever is higher, the numerator or denominator of the alkali fraction, determines the alkali grade. Fractions followed by the letter "B" in blue denote that black alkali is present. Fractions in which −0.10 appears express a salt content of less than 0.10 percent. and those in which +3.00 appears express a salt content greater than 3 percent.

The effect of alkali on plant growth varies with the kind and amount of alkali, the type of soil, and the species or even variety of plant. The grasses in general are more resistant to alkali than most crops, although some, including bluegrass, are very sensitive. Wheat, barley, and milo maize endure alkali better than corn, and bermudagrass and Rhodes grass are exceptionally tolerant to black alkali. The legumes are generally rather sensitive, although alfalfa, sweetclover, and hairy vetch are fairly tolerant. Beans, peas, and melons are easily injured, but root crops such as sugar beets and onions are rather tolerant. Most fruit trees are easily injured. The following orchard crops are arranged in order of increasing relative resistance (*6*): Walnuts, citrus fruits, apples, apricots, plums, prunes, peaches, pears, grapes, and olives.

Before trying to reclaim an alkali area, consider the practical aspects of the operation. Kelley (*12*) states that:

> "The following points should be carefully considered before proceeding to reclaim an area of alkali soil: (1) The drainage conditions; (2) the composition of the soluble salts; (3) the content of replaceable (absorbed) sodium in the soil; (4) the nature and content of the calcium minerals of the soil; (5) the composition of the available irrigation water."

Most important in alkali reclamation is the establishment of good drainage, for without this no reclamation will be permanent.

Soils affected only with white alkali generally can be reclaimed in time by thorough leaching with irrigation water of good quality. Soils affected with black alkali are considerably more difficult to reclaim. Applications of gypsum, sulfur, iron sulfate, and alum, followed by leaching, have proved successful. Kelley (*11*) has shown through experiments that growing of bermudagrass is also an effective treatment. In general, the ease of reclamation, other conditions being equal, is inversely proportional to the clay content of the soil. The alkali soils in the Santa Clara Area are chiefly of clay, silty clay loam, or clay loam texture, and could be reclaimed only with difficulty and at considerable expense.

MORPHOLOGY AND GENESIS OF SOILS

By W. M. Johnson, Principal Soil Correlator, Western States

The discussion on morphology and genesis of soils presented in the following pages is technical and is intended primarily for soil scientists and other specialists who want a more detailed discussion of the nature and origin of the soils of the Santa Clara Area.[18]

Soil has many forms. The characteristics of the soil at any given place result from the action of climate and living organisms (including man himself) on rock materials, conditioned by relief, over a given period of time. Soil taxonomists say that the characteristics of a soil depend on five main factors: (1) The physical and mineralogical composition of the parent soil material; (2) the climate under which the soil material has accumulated and has existed since accumulation; (3) the plant and animal life in and on the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of development have acted on the material.

Because there are thousands of significant combinations of the genetic factors listed above, thousands of different kinds of soil exist in the world. Hundreds of different kinds exist in California. In studying the characteristics of soil and in predicting its behavior, it is not practicable to work with the entire known range, that is, with all of the different kinds of soils that are known to exist. Individual kinds of soil must be recognized, described, and studied separately. Thus we use classification as a tool for organizing and remembering information about soils, for seeing relationships among and between them, and for developing principles of prediction value.

Although the Santa Clara Area is relatively small, it encompasses a fairly wide range in the factors of soil formation, and therefore there are a large number of different soils. Also, because of the way in which the soil genetic factors vary within short distances, the soil pattern is rather complex. Differences in rainfall, caused largely by differences in relief, are pronounced over short distances. For example, annual rainfall varies from 15 to 45 inches within 10 miles. In the low-rainfall districts many of the soils are saline and basic in reaction, whereas in the high-rainfall districts they are typically medium or strongly

[18] For general technical discussions on soil formation and classification see: Soils and Men (*25*) and Development and Significance of the Great Soil Groups of the United States (*13*).

acid. Sharp differences in nature of the parent rock tend to produce distinctive soil differences, especially in upland areas. In the valley bottoms, differences in soil drainage have given rise to different soils and to a complex pattern of distribution. Finally, differences in soil age may be noted. Many of the soils in low physiographic positions, as along stream channels and in valley floors, are very youthful and exhibit little differentiation of horizons. As one goes up the terraces and alluvial fans to the uplands, soils tend to show evidence of greater and greater age.

The discussion that follows is based on classification of the soils into great soil groups. The scheme of terminology and classification used is basically that of Soils and Men (*25*), but it takes into account some minor modifications published more recently by Thorp and Smith (*21*) and Oakes and Thorp (*16*) that have been generally adopted by soil scientists in the United States.

The soil series of the Santa Clara Area have been classified by great soil groups as follows:

Noncalcic Brown soils:
- Azule
- Gaviota
- Los Gatos
- Pleasanton
- Saratoga
- Sobrante
- Soper
- Vallecitos

"Chernozemic" soils, intergrading to Grumusols:
- Altamont
- Ayar
- Berryessa
- Climax
- Cropley
- Diablo
- Edenvale
- Hovey

Noncalcic Brown soils, intergrading to Planosols:
- Milpitas
- Ohmer
- Positas
- San Ysidro

"Prairie-like" soils, intergrading to Grumusols:
- Cayucos
- Dublin

"Podzolic" soils:
- Hugo

"Hydro-Calcimorphic" soils:[20]
- Alviso
- Bayshore
- Castro
- Sunnyvale

Lithosols:
- Los Trancos
- Maymen
- Montara
- Permanente

"Solonetzic" soils:
- Orestimba
- Pescadero

Wiesenboden:
- Alamitos
- Clear Lake

Alluvial soils:
- Campbell
- Mocho
- Sorrento
- Yolo
- Zamora

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, many of the series appear to represent intergrades between great soil groups rather than clear-cut members of single groups. For example, 10 of the 40 series are called "Chernozemic," intergrading to Grumusols, or "Prairie-like," intergrading to Grumusols. The reader will have noted that clay soils are prominent in this Area, and there are many indications that much of the clay in soils like the Diablo, Dublin, and Climax is predominantly montmorillonitic. Thus, these "Chernozemic" and "Prairie-like" soils of fine tex-

[20] Poorly drained soils high in $CaCO_3$.

ture have some of the distinctive characteristics of the group called Grumusols.

NONCALCIC BROWN SOILS

Eight of the soil series of this Area have been identified as Noncalcic Brown soils. They are the Azule, Gaviota, Los Gatos, Pleasanton, Saratoga, Sobrante, Soper, and Vallecitos. This great soil group has been described as follows (*25*): "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."

It will be seen that the Noncalcic Brown soils of the Santa Clara Area do not all correspond precisely to this description; nevertheless, they are within the range allowed in this group.

Los Gatos soils are representative Noncalcic Brown soils. Los Gatos clay loam, one of the most extensive soils in this group, has a typical profile described as follows:

- A_1 0 to 9 inches, brown[20] (7.5YR 4.5/4) clay loam; weak medium blocky structure; soft when dry, friable when moist; numerous roots; medium acid.
- B_1 9 to 20 inches, brown (7.5YR 4.5/4) clay loam containing slightly more clay than the A_1; weak medium blocky structure; slightly hard when dry, firm when moist; slightly compact in place; contains some rock fragments; slightly acid.
- B_2 20 to 36 inches, brown (7.5YR 5/4) clay loam; weak medium blocky structure; slightly hard when dry, firm when moist; slightly compact in place; contains many rock fragments; slightly acid.
- D_r 36 to 48 inches+, brown (7.5YR 5/5) weathered metamorphosed sandstone or sandy shale; many distinct, medium and large mottles of dark brown and very dark gray; rock is well shattered and belongs to the Franciscan formation of the Santa Cruz Mountains.

Azule soils are finer textured throughout and are grayish brown, brown or yellowish brown; they have developed in weathered, unconsolidated or slightly consolidated old alluvium that is generally of moderately fine texture.

Gaviota soils are grayish brown or brown, medium textured, and usually neutral in reaction; they are rather thin soils that have developed in weathered, consolidated sandstone, shale, or conglomerate, which in places is calcareous.

Pleasanton soils have brown A horizons and reddish-brown B horizons and have developed in old alluvium derived from sedimentary and metamorphosed sedimentary rocks. These soils have stronger development than those of the Los Gatos series.

Sobrante soil has formed in weathered, highly metamorphosed, basic igneous rocks; it is usually redder, deeper, and finer textured than members of the Los Gatos series.

Soper soils are moderately deep and have formed in weathered, moderately or weakly consolidated conglomerate; their A horizons are brown or light brown, generally gravelly, and slightly acid to medium acid. Their B horizons are moderately compact gravelly clay loam of medium or strongly acid reaction.

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[20] Unless otherwise specified, colors refer to those of the dry soil.

Vallecitos soils are similar to Gaviota soils in many respects but differ in color and in parent material. Vallecitos soils are relatively thin but moderately developed Noncalcic Brown soils that have formed in weathered, hard, shattered, metamorphosed sandstones and shales of the Franciscan and similar formations. They have brown, medium or moderately fine textured A horizons and brown or reddish-brown, moderately compact, medium or moderately fine textured B horizons.

NONCALCIC BROWN SOILS, INTERGRADING TO PLANOSOLS

Four series in this area have been dominated by the same sort of soil-forming process that gave rise to the Noncalcic Brown soils, but they are more advanced in stage of development; that is, the horizons are more strongly differentiated. This group has been designated as Noncalcic Brown soils, intergrading to Planosols. The series included are the Milpitas, Ohmer, Positas, and San Ysidro. In general they resemble soils such as the Los Gatos and Pleasanton but have greater textural contrasts and more abrupt boundaries between A and B horizons.

Positas soils are good examples of this group of intergrades. A typical profile of a Positas soil is described as follows:

A_1 0 to 16 inches, brown (7.5YR 5/4) loam; weak medium blocky structure; slightly hard when dry, friable when moist; has well-developed tubular pores; medium acid; abrupt transition to B_2.

B_2 16 to 31 inches, brown (9YR 5/4) clay; weak medium prismatic structure; extremely hard when dry, firm when moist, and plastic when wet; contains a few pebbles; medium acid; gradual transition to B_3.

B_3 31 to 40 inches, yellowish-brown (10YR 5/4) clay loam; weak medium blocky structure; very hard when dry; firm when moist, and plastic when wet; contains numerous pebbles that are highly weathered; medium to slightly acid; gradual transition to C.

C 40 to 54 inches+, mottled light-brown and strong-brown (7.5YR 6/4 and 7.5YR 5/6) gravelly loam; moderately compact and massive, but unconsolidated; slightly acid to neutral; this layer is old alluvium derived from sedimentary and metamorphosed sedimentary rocks, mainly of the Franciscan formation.

Milpitas soils are similar to Positas soils except for color and the presence of an incipient A_2 horizon between the A_1 and B_2 horizons. Milpitas soils are more nearly true Planosols than are the Positas. Milpitas soils have brown or pale-brown, friable, medium-textured A_1 horizons; usually a thin, lighter colored, mottled A_2; and very compact brown or yellowish-brown claypan B_2 horizons overlying gravelly alluvium.

Ohmer soils closely resemble the Positas but have darker colored A_1 horizons.

San Ysidro soils have a claypan and have formed in old gravelly alluvium derived from unaltered and metamorphosed sedimentary rocks. In respect to color and texture, they resemble the Positas, but they are more nearly true Planosols in that they usually have a light-colored, weak A_2 horizon between the A_1 and B_2 horizons. San Ysidro soils have formed on the same kind of parent alluvium as the Pleasanton soils (Noncalcic Brown) but are more strongly developed.

"CHERNOZEMIC" SOILS, INTERGRADING TO GRUMUSOLS

Eight soil series have been tentatively named "Chernozemic" soils, intergrading to Grumusols. They are the Altamont, Ayar, Berryessa, Climax, Cropley, Diablo, Edenvale, and Hovey. They are mainly dark-colored clay soils that are well drained or moderately well drained. Chernozem soils have been defined as follows (*25*): "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."

Oakes and Thorp (*16*) have given Houston Black clay 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 Grumusol. Some of the more important of those characteristics are: clay texture; no eluvial and 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 eight series listed have characteristics of both Chernozems and Grumusols. They have the dark colors of both groups, but the carbonate horizon typical of the Chernozems, and the clay texture and plasticity of the Grumusols. Most of them appear to have weak eluvial and illuvial horizons, which are more characteristic of Chernozems 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 of some of the series (Altamont, Cropley and Diablo) seem to be more nearly true Chernozems than intergrades to Grumusols. The name of the group is based mainly upon consideration of the clay types.

Berryessa soils are representative of this group. A typical profile of Berryessa clay is described as follows:

- A_{11} 0 to 11 inches, dark grayish-brown (2.5Y 4/2) clay; moderate coarse blocky structure with weak tendency to form medium granules; very hard when dry, firm when moist, and very plastic when wet; neutral reaction; gradual transition to A_{12}
- A_{12} 11 to 24 inches, dark grayish-brown (2.5Y 4/2) clay; weak medium blocky structure; extremely hard when dry, very firm when moist, very plastic when wet; slightly compact; neutral to slightly calcareous; gradual transition to B_3 (?).
- B_3 (?) 24 to 40 inches brown (10YR 5/2.5) clay with a few faint medium mottles of dark grayish brown (10YR 4/2), massive; extremely hard when dry, very firm when moist, and very plastic when wet; slightly compact; calcareous, with a few small spots of segregated lime; gradual transition to C.
- C 40 to 72 inches+, light-gray (2.5Y 7/2), weakly consolidated, calcareous shale with a few faint fine specks of light yellowish brown.

Altamont soils have formed on harder shale or fine-grained sandstone, but otherwise are very similar to the Berryessa.

Ayar soils are inextensive in the Santa Clara Area, but distinctive and interesting. They are the only soils developed in residuum from bedrock that is calcareous throughout. Because of this, and because they are not so dark, they are less typical of either the Chernozems or Grumusols than the other seven series in the group. In fact, they are considered to be Rendzinas by some soil taxonomists. The Ayar soils have brown, clayey, friable, calcareous A horizons underlain by slightly warmer hued, calcareous, friable, weak B horizons; the C horizons consist of weathered, highly calcareous, fine-grained sandstone or limestone.

Climax soils consist of clay and are dark gray and blocky; they developed in weathered basic igneous rocks, some of which are serpentinized.

Cropley soils resemble members of the Dublin series ("Prairie-like" group). They have dark-colored, blocky and granular A horizons; weak, blocky, dark-colored (but browner) weak B horizons; and a weak horizon of carbonate accumulation that overlies alluvium derived from sedimentary rocks.

Diablo soils have formed on weathered sandstone and shale. They have very dark gray (nearly black) A horizons and very dark gray weak B horizons that are calcareous; the carbonate horizon is not conspicuous.

Edenvale soils, like those of the Cropley series, have developed in alluvium, but it is alluvium from upland areas of rocks high in serpentine. Aside from parent material, the profiles of Edenvale and Cropley are quite similar. Edenvale soils ordinarily have dark-gray or dark grayish-brown weakly granular and blocky A horizons; dark-colored, blocky or massive clay B horizons; and a slight accumulation of free lime in the upper part of the dark-brown or brown parent alluvium.

Hovey soils have parent material consisting of old alluvium in valley fills, like that in which Milpitas, Positas, and Saratoga soils have formed. The profiles above the parent material do not much resemble those of the Noncalcic Brown soils, but are more nearly typical of the "Chernozem-like" soils. The A horizons are dark gray or dark grayish brown, clayey, friable and calcareous; the weak B horizons are of similar color, calcareous, massive or weak blocky, and apparently somewhat higher in clay; below is a distinctly lighter colored horizon of carbonate accumulation that overlies pale-brown or light brownish-gray clayey alluvium.

"PRAIRIE-LIKE" SOILS, INTERGRADING TO GRUMUSOLS

There are two soil series, Cayucos and Dublin, in the group of "Prairie-like" soils, intergrading to Grumusols. The Prairie great soil group is defined as follows (*25*) : "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."

In other words, the Prairie soils are very much like Chernozems, except that they lack the horizon of free carbonates characteristic of Chernozems. Also, the Prairie soils are generally slightly less basic,

and lower in exchangeable bases, than the Chernozems. The Cayucos and Dublin soils, then, are very similar to the "Chernozemic" group of Altamont, Climax, Diablo, and so on, except that they are more acid and lack free calcium carbonate.

Dublin soils serve to illustrate this group. Following is a profile description of Dublin clay (adobe):

A_1 0 to 16 inches, very dark gray (2.5Y 3/1) clay; weak medium blocky structure with tendency toward medium granular; extremely hard when dry, very firm when moist, and very plastic when wet; slightly acid; gradual transition to B_1.

B_1 16 to 37 inches, very dark gray (2.5Y 3/1) clay containing some coarse and very coarse sand and a few pebbles; weak medium blocky structure; thin clay films on surfaces of blocks; extremely hard when dry, very firm when moist, and very plastic when wet; slightly acid; gradual transition to C.

C 37 to 48 inches +, grayish-brown (10YR 5/2) heavy sandy clay loam containing a few pebbles; massive; very hard when dry, firm when moist, and plastic when wet; neutral in reaction; consists of alluvium derived from weathered sedimentary or metamorphosed sedimentary rocks.

Cayucos soils have formed in weathered noncalcareous shales that are well consolidated; they are not quite so dark as Dublin soils, but otherwise their sola are quite similar.

"PODZOLIC" SOILS

In this report, Hugo soils have been called "Podzolic." Some pedologists assign them to the great group of Gray-Brown Podzolic soils. The thick A_1 and lack of A_2 constitute arguments against that correlation.

Hugo soil may belong in a new great soil group not yet defined and described. Following is a description of a representative profile of Hugo loam:

A_1 0 to 10 inches, grayish-brown (10YR 5.5/2) (very dark grayish-brown, 10YR 3.5/2 when moist) loam containing a few rock fragments; weak coarse and medium granular structure; soft when dry, friable when moist; in the virgin state has a thin layer of fresh and decomposing plant litter on the surface (A_{00} and A_0); slightly acid; gradual transition to B_2.

B_2 10 to 26 inches, pale-brown (10YR 6/3) (brown, 10YR 4/3, moist) loam with frequent fine and medium mottles of light yellow; weak medium blocky structure; soft when dry, friable when moist; fragments of parent rock are common; medium acid reaction; gradual transition to C.

C 24 to 48 inches +, very pale brown (10YR 7/4) (yellowish-brown, 10YR 5/6 when moist) partially decomposed sandstone; fractured; noncalcareous.

"SOLONETZIC" SOILS

There are two series of "Solonetzic" soils in the Santa Clara Area, the Orestimba and the Pescadero. Both series somewhat resemble the "Chernozemic" soils in having A-B-C profiles with dark-colored A_1 horizons and more or less distinct horizons of lime accumulation. In addition, however, they contain considerable quantities of soluble salts and variable, but usually significant, quantities of sodium. They do not have distinct A_2 horizons nor distinctly columnar structure in their B horizons, and so are not like typical solodized-Solonetz soils of some other areas.

Orestimba soils are more extensive of the two series and have been selected to illustrate the group. Following is a profile description representative of Orestimba clay loam:

A_1 0 to 10 inches, grayish-brown (10YR 4.5/1.5) clay loam; weak medium blocky structure; hard when dry, friable when moist; moderate quantity of roots; well-developed tubular pores; noncalcareous; neutral in reaction.

B_{21ca} 10 to 22 inches, dark grayish-brown (10YR 4/2) heavy clay loam; moderate medium blocky structure; very hard when dry; moderately compact in place; well-developed tubular pores are common; slightly calcareous; moderately basic in reaction; this is the horizon of highest salt concentration.

B_{22} 22 to 41 inches, grayish-brown (10YR 5/2) heavy clay loam; massive; very hard when dry; slightly compact in place; moderate amount of segregated lime; strongly basic in reaction.

C 41 to 60 inches +, grayish-brown (10 YR 5/2) silty clay with frequent fine mottles of pale brown and yellowish brown; massive; hard when dry, friable when moist; calcareous; strongly basic in reaction; this is the horizon of lowest salt concentration.

Pescadero soils have formed in the fine-textured alluvium laid down by Coyote and Guadalupe Creeks. They are dark-colored (typically darker than the Orestimba) clayey soils with massive, slightly calcareous, clay upper B horizons and grayish-brown or yellowish-brown dense clay lower B horizons. Like the Orestimba, Pescadero soils are basic in reaction and contain excess soluble salts.

"HYDRO-CALCIMORPHIC" SOILS

In some of the basins in this area a distinctive group of highly calcareous, dark-colored soils has developed. These are called "Hydro-Calcimorphic" soils;[21] the group consists of the Alviso, Bayshore, Castro, and Sunnyvale series. Most of the series in this group are not high in chlorides, sulfates and bicarbonates, and so cannot be considered typical Solonchak soils. All are poorly drained.

Sunnyvale soils are typical of the "Hydro-Calcimorphic" group. Following is a profile description of Sunnyvale clay, one of the most extensive soils in the Area:

A_{11} 0 to 13 inches, very dark gray (N3/) (black when moist) clay; weak coarse blocky structure that breaks to weak very fine blocky; extremely hard when dry, friable when moist; numerous roots; moderately high in organic matter; calcareous.

A_{12} 13 to 32 inches, very dark gray (N3/) clay with a few fine and medium-sized white spots of segregated calcium carbonate; moderate medium and fine blocky structure; extremely hard when dry, firm when moist; numerous roots; calcareous.

AC_{ca} 32 to 58 inches, dark-gray (2.5Y 4/1) clay with a few fine yellowish-brown mottles; massive; extremely hard when dry, firm when moist; very few roots; highly calcareous.

C_{ca} 58 to 72 inches+, light-gray (2.5Y 7/2) clay loam with a few fine and medium mottles of brown and yellowish brown; massive; very hard when dry, firm when moist; contains a few hard, nodular, lime concretions; very strongly calcareous; lime concentration decreases with increasing depth.

Alviso soil has formed in fine-textured sediments at the edge of tidal marsh or in areas that were formerly tidal marsh. It is dark-

[21] These soils have been called Calcium Carbonate Solonchaks by some taxonomists. Storie and Weir (*19*) consider the Alviso a Solonchak and the Bayshore, Castro, and Sunnyvale series, Wiesenbodens.

colored like the Sunnyvale, and clayey, wet, and highly calcareous. In addition, it has varying but significant amounts of salts more soluble than calcium carbonate; that is, it is a Solonchak in the general sense.

Bayshore soils are often found in close geographic association with members of the Sunnyvale and Castro series; ordinarily they occur around the margins of basin areas. They differ from other members of the group in being lighter colored (generally gray). They are very high in free carbonates and have strongly mottled lower horizons; the alluvium in which they have formed is moderately fine textured.

Castro soils, in their upper horizons, closely resemble those of the Sunnyvale. The Castro soils are believed to be somewhat older, because their lime horizon consists of nodular concretions or a lime-cemented hardpan.

WIESENBODEN

Another great soil group represented in Santa Clara Area is the Wiesenboden, which is genetically closely related to the "Hydro-Calcimorphic" soils. These soils, called Humic Gley soils by some pedologists, have formed on alluvium in basins, under poor or very poor drainage. Wiesenboden have been defined as follows (*25*): "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."

Ordinarily, because of poor aeration resulting from waterlogging, the lower horizons of Wiesenboden soils are more or less mottled with rusty colors. Two series, the Alamitos and Clear Lake, have been assigned to this group.

Alamitos soil is representative of the Wiesenboden group in the Santa Clara Area. Following is a profile description of Alamitos clay:

A_1 0 to 14 inches, dark-gray (2.5Y 4.5/1) clay; strong fine granular structure; hard when dry, firm when moist, and plastic when wet; slightly calcareous or noncalcareous; about neutral in reaction; gradual transition to B_g.

B_g 14 to 33 inches, gray (5Y 5/0.7) clay with frequent distinct, fine mottles of light gray, dark gray, and yellowish brown; weak medium blocky structure; extremely hard when dry, very firm when moist, and very plastic when wet; slightly calcareous or noncalcareous; about neutral in reaction; gradual transition to C_g.

C_g 33 to 48 inches +, light-gray (5Y 6/0.7) clay with many distinct fine medium mottles of gray, brownish yellow, and yellowish brown; massive; very hard when dry, very firm when moist, and very plastic when wet; slightly acid to neutral in reaction.

Clear Lake soil is apparently related to both the Sunnyvale and Castro soils. The Clear Lake is youngest of the three in stage of development. Its profile closely resembles that of the Alamitos soils but differs in having a very weak B_g horizon, or none at all, and in having somewhat greater amounts of free calcium carbonate.

LITHOSOLS

Lithosols have very little profile development and are commonly shallow over bedrock. In addition, many of them are stony. In the Santa Clara Area, four series belong to this great soil group, the Los Trancos, Maymen, Montara and Permanente.

Los Trancos soil has been selected as an example of the Lithosols in the Santa Clara Area. Following is a description of a representative profile of Los Trancos stony clay:

A_1 0 to 6 inches, dark-brown (7.5YR 3.5/2) stony clay; weak medium blocky structure, breaking to weak course and medium granular; very hard when dry, very firm when moist, and very plastic when wet; medium acid.

D_r 6 to 12 inches + gray (5Y 6/1) hard diabasic bedrock; rock is fractured, especially near the surface, and rock surfaces along cracks are coated with dark-brown clay washed down from the A_1 horizon.

Maymen soils, for the most part, have formed on brush-covered very steep and stony slopes. The soils are light brown or pale brown, medium textured, friable, and slightly or medium acid in reaction; they overlie hard sandstone or conglomerate, which in places seems to be metamorphosed. Their parent rock is similar to that giving rise to the Hugo soils.

Montara soils, like the Los Trancos, have formed in weathered, basic igneous rock, but it is serpentine rather than diabase. The material above bedrock in Montara soils looks very much like that in the Los Trancos.

Permanente soils have developed in weathering products of hard crystalline limestone, but, because of leaching, the A_1 horizon is normally noncalcareous. The horizon or horizons above bedrock are brown, medium textured, stony, and slightly basic in reaction.

ALLUVIAL SOILS

Alluvial soils, like the Lithosols, are young soils. Their characteristics are almost entirely inherited from the parent material. They differ from Lithosols in having formed in alluvium rather than weathered bedrock. In the Santa Clara Area, five series have been assigned to this group: Campbell, Mocho, Sorrento, Yolo, and Zamora. The parent materials of these soils were derived from areas of sandstone and shale or of metamorphosed sedimentary rocks, and from the soils forming on those rocks. The parent alluvium of most of the soils is moderately dark colored, so the soils themselves are moderately dark.

Yolo soils are representative of the Alluvial great soil group. The following describes a representative profile of Yolo clay loam:

A_1 0 to 19 inches, brown (10YR 5.5/2.5) light clay loam; weak medium blocky structure; hard when dry, firm when moist; contains numerous roots and tubular pores; in cultivated fields, particularly orchards, a moderately compact plowpan generally occurs at depths of from 6 to 10 inches; neutral reaction; gradual transition to C_1.

C_1 19 to 51 inches, brown (10YR 5/2.5) light clay loam; weak medium blocky structure; soft when dry, friable when moist; very slightly compact in place; roots and tubular pores are numerous; neutral in reaction; gradual transition to C_2.

C_2 51 to 72 inches, brown (10YR 4.5/2.5) light clay loam that is weakly stratified with silty layers; very weak medium blocky structure; soft when dry, friable when moist; numerous roots and tubular pores; noncalcareous; neutral in reaction.

Campbell soils are less well drained than the Yolo; apparently they developed under the influence of a fluctuating but moderately high ground-water level. Campbell soils lie toward the outer edges of alluvial fans at a lower elevation than the associated Sorrento, Yolo,

and Zamora soils. The Campbell series includes fine and moderately fine textured soils, slightly grayer in color than Yolo, that have mottled substrata.

Mocho soils are among the most feebly developed soils in the Area. The material in their profiles is added to nearly every year by floodwaters entering the valley. The soils are ordinarily well drained and have brown, calcareous, stratified, medium and moderately fine textured profiles with little or no mottling.

Sorrento soils are closely related to and similar to the Mocho soils but are probably slightly older. Though very weakly developed, the Sorrento soils are rarely, if ever, flooded. These soils are brown, friable, deep, stratified, unmottled, and calcareous usually only in lower layers.

Zamora soils are associated with and related to the Yolo but are slightly more advanced in stage of development, that is, slightly older. Parent materials of the two series of soils are very similar, but the Zamora lie at a slightly lower elevation and are apparently not quite so well drained. The Zamora A horizons are noncalcareous and brown but slightly darker than those of the Yolo soils. In the Santa Clara Area the A horizons of the Zamora soils are somewhat more clayey than those of the Yolo. Below the A_1 horizon the Zamora soil material is slightly compact, and this horizon grades into friable, noncalcareous alluvium.

LABORATORY STUDIES [22]

All soil samples for laboratory analyses were screened through a 2-millimeter sieve. The aggregates were crushed with a rubber-tipped pestle, and the gravel 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 pipette method, in which a weighed sample of sieved soil is shaken overnight in distilled water to which sodium oxalate has been added as a dispersing agent. These results are used only to check the field textural classification and are not published.

Eight representative soils were chosen for a more complete study. Mechanical analyses of these profiles were made by the modified international method in which a weighed sample of sieved soil is pretreated with hydrogen peroxide and hydrochloric acid to remove, respectively, organic matter and carbonates. After the soil sample is washed free of electrolytes, dispersal is effected by shaking it overnight with distilled water to which sodium oxalate has been added. The sands are separated from the silt and clay by wet-sieving through a 300-mesh sieve; they are dried, weighed, and reported as total sand separate. The suspension of silt and clay is sampled by means of 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 mechanical analyses of these eight soils are given in table 13.

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[22] This section contributed by E. P. Perry, Department of Soils, University of California, and revised by W. M. Johnson, Soil Conservation Service, U. S. Department of Agriculture.

TABLE 13.—*Mechanical analyses of samples of eight soils from the Santa Clara Area, California*

Soil type and sample number	Depth	Total sand (2.00–0.005 mm)	Coarse silt (0.05–0.005 mm)	Fine silt (0.005–0.002 mm)	Clay (less than 0.002 mm)	Colloidal clay (less than 0.001 mm)	Total
Sunnyvale clay:	*Inches*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
579701	0–13	5. 7	20. 5	11. 1	62. 9	54. 4	100. 2
579702	13–32	4. 4	20. 9	10. 8	64. 7	56. 9	100. 8
579703	32–58	10. 7	26. 7	11. 6	51. 7	44. 1	100. 7
579704	58–72	24. 3	31. 6	9. 4	35. 2	28. 7	100. 5
Vallecitos loam:							
579735	0–14	40. 9	25. 7	9. 0	24. 5	18. 6	100. 1
579736	14–30	65. 9	14. 4	5. 6	14. 0	10. 8	99. 9
Milpitas loam:							
579743	0–13	41. 0	31. 6	7. 6	18. 9	14. 0	99. 1
579744	13–32	22. 8	16. 9	5. 4	55. 5	52. 2	100. 6
579745	32–45	49. 1	22. 3	7. 9	21. 1	15. 4	100. 4
Sorrento loam:							
579784	0–15	55. 2	24. 3	5. 0	16. 0	13. 2	100. 5
579785	15–36	53. 6	26. 9	5. 5	14. 7	11. 9	100. 7
579786	36–55	53. 1	26. 1	5. 5	16. 0	13. 3	100. 7
579787	55–72	38. 1	30. 4	9. 6	23. 0	18. 0	101. 1
Positas loam:							
5797101	0–16	44. 8	29. 9	7. 4	17. 6	14. 0	99. 7
5797102	16–31	33. 8	20. 6	5. 1	41. 4	37. 3	100. 9
5797103	31–40	35. 6	22. 6	7. 1	35. 7	31. 3	101. 0
5797104	40–54	48. 1	22. 7	6. 1	22. 5	19. 1	99. 4
Pleasanton loam:							
5797128	0–15	54. 8	23. 1	6. 5	16. 0	12. 3	100. 4
5797129	15–37	51. 4	21. 2	5. 9	21. 3	18. 4	99. 8
5797130	37–60	63. 8	10. 5	4. 3	21. 8	19. 4	100. 4
Saratoga loam:							
5797157	0–11	56. 8	24. 1	5. 7	13. 7	9. 8	100. 3
5797158	11–38	49. 1	24. 0	5. 3	21. 8	17. 7	100. 2
5797159	38–49	52. 6	26. 0	5. 4	16. 5	12. 5	100. 5
5797160	49–60	61. 3	20. 9	5. 6	12. 6	9. 5	100. 4
Hugo clay loam:							
5797192	0–11	23. 7	44. 2	9. 0	22. 7	16. 8	99. 6
5797193	11–20	17. 5	49. 1	8. 4	26. 1	19. 6	101. 1
5797194	20–30	28. 1	50. 8	8. 1	14. 7	10. 8	101. 7
Cropley clay (adobe):							
579717	0–13	36. 2	27. 3	3. 7	33. 4	30. 1	100. 6
579718	13–37	36. 2	25. 4	5. 5	34. 0	30. 1	101. 1
579719	37–53	34. 4	26. 7	6. 6	33. 5	28. 9	101. 2
579720	53–72	32. 7	27. 5	7. 5	33. 5	29. 1	101. 2

Moisture equivalents were determined on all samples by the standard method. Thirty grams of saturated soil is subjected to a force of one thousand times gravity in a centrifuge; the results are reported as the percent by weight of moisture retained on an oven-dry soil basis. A few soils are so impermeable that water is not thrown out by the centrifugal force but remains on the surface of the soil. On these soils the moisture-equivalent determination is repeated in the usual moisture-equivalent cups, but paraffined paper is added to the sides of the cups to allow the excess water to drain away. Where drainage is satisfactory, the moisture equivalent represents approxi-

mately the normal field 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. Moisture-equivalent results are given in table 14.

Determinations of the pH of these soils were made by use of the Beckman glass-electrode pH meter. Fifty grams of air-dry soil are put into a tall 4-ounce bottle, and enough distilled water is added to saturate the soil. The pH values are determined after allowing the wet soil to stand a few hours. The results of pH determinations are given in table 14. These results are somewhat lower, particularly for soils of pH 7.0 and above, than are obtained by the colorimetric method with a higher ratio of water to soil.

Carbonates were determined by the McMillar method. The soil is treated with standardized hydrochloric acid until effervescence ceases. It is then back titrated with standardized base to determine the amount of acid that is used in the reaction. The amount of acid used is calculated as equivalent to the amount of calcium carbonate present in the soil. It is recognized that this method involves certain errors, particularly when sodium carbonate is present, since the total carbonate is calculated as calcium carbonate, or lime carbonate. These results are also included in table 14.

TABLE 14.—*pH, carbonates, and moisture equivalents of soils of the Santa Clara Area, California*

Soil type and sample No.	Depth	pH	Carbonates	Moisture equivalent
Sunnyvale clay:	*Inches*		*Percent*	*Percent*
579701	0–13	7.7	6.1	38.1
579702	13–32	8.1	6.9	39.5
579703	32–58	8.2	14.4	35.6
579704	58–72	8.2	25.4	29.2
Pescadero clay (adobe):				
579705	0–18	7.6	.9	31.9
579706	18–29	8.2	.7	[1] 37.7
579707	29–43	8.4	4.8	[1] 27.9
579708	43–72	8.4	5.0	[1] 27.4
Castro silty clay:				
579709	0–12	7.5	24.6	33.5
579710	12–24	7.8	23.8	32.2
579711	24–54	8.1	44.0	28.4
579712	54–72	8.0	24.4	25.2
Alviso clay:				
579713	0–7	7.9	9.9	45.1
579714	7–28	7.9	15.3	[1] 41.4
579715	28–45	8.3	27.8	[1] 36.5
579716	45–72	8.2	28.0	[1] 27.9
Cropley clay (adobe):				
579717	0–13	6.4	----------	25.1
579718	13–37	6.8	----------	23.7
579719	37–53	7.6	1.6	23.5
579720	53–72	8.0	2.7	23.4
Diablo clay:				
579721	0–10	6.9	----------	31.7
579722	10–31	7.7	1.5	31.5
579723	31–45	7.8	8.0	17.5

See footnotes at end of table.

TABLE 14.—*pH, carbonates, and moisture equivalents of soils of the Santa Clara Area, California*—Continued

Soil type and sample No.	Depth	pH	Carbonates	Moisture equivalent
	Inches		*Percent*	*Percent*
Altamont clay (adobe):				
579724	0–12	6.7	----------	26.5
579725	12–26	6.9	----------	23.8
579726	26–43	7.8	2.0	24.9
579727	43–60	7.8	5.1	----------
Berryessa clay:				
579728	0–11	6.8	----------	27.6
579729	11–24	7.1	2.7	27.6
579730	24–40	7.9	3.4	29.1
579731	40–72	8.1	----------	24.8
Gaviota loam:				
579732	0–8	6.7	----------	14.2
579733	8–17	6.8	----------	14.0
579734	17–31 [1]	6.8	----------	----------
Vallecitos loam:				
579735	0–14	6.3	----------	21.6
Climax clay (adobe):				
579737	0–14	7.0	----------	29.0
579738	14–34	7.6	5.0	30.9
579739	34–48	7.8	6.0	----------
Orestimba silty clay loam:				
579740	0–7	6.8	----------	24.7
579741	7–21	7.6	1.1	[1] 30.3
579742	21–60	8.5	1.6	[1] 30.4
Milpitas loam:				
579743	0–13	6.2	----------	17.5
579744	13–32	5.9	----------	34.9
579745	32–48	7.0	1.4	----------
Montara stony clay:				
579746	0–7	6.9	[2] 2.1	42.8
579747	7–23	7.0	[2] 5.2	[1] 41.6
579748	23+	7.5	[2] 2.5	----------
Pleasanton clay loam:				
579749	0–12	7.1	----------	20.6
579750	12–32	6.8	----------	21.8
579751	32–54	6.9	----------	20.3
579752	54–72	7.0	1.0	21.3
Clear Lake clay (adboe):				
579753	0–11	7.1	1.1	35.8
579754	11–23	7.5	3.0	32.0
579755	23–34	8.0	5.3	26.1
579756	34–60	8.0	5.2	23.7
Alamitos clay:				
579757	0–14	7.0	1.4	41.5
579758	14–33	7.1	1.9	37.8
579759	33–48	6.6	----------	34.8
Castro clay:				
579760	0–9	7.7	10.2	31.5
579761	9–23	7.5	14.4	28.9
579762	23–53	7.4	45.9	19.9
579763	53–72	7.6	33.6	20.3
Bayshore clay loam:				
579768	0–11	7.8	83.0	41.8
579769	11–28	7.9	79.9	30.0
579770	28–43	7.7	14.2	36.4
579771	43–60	7.3	1.7	26.7

TABLE 14.—*pH, carbonates, and moisture equivalents of soils of the Santa Clara Area, California*—Continued

Soil type and sample No.	Depth	pH	Carbonates	Moisture equivalent
	Inches		*Percent*	*Percent*
Mocho loam:				
579775	0–17	7.8	2.6	19.4
579776	17–43	8.0	2.9	18.2
579777	43–72	7.9	2.6	19.9
Pescadero clay:				
579778	0–11	7.3	2.5	31.5
579779	11–37	7.6	2.3	30.6
579780	37–60	7.8	5.9	29.1
Campbell silty clay:				
579781	0–16	7.1	2.2	28.8
579782	16–30	7.3	2.1	28.5
579783	30–60	7.9	2.1	26.3
Sorrento loam:				
579784	0–15	7.4	1.9	17.3
579785	15–36	7.4	1.8	16.4
579786	36–55	7.4	1.9	16.9
579787	55–72	8.1	2.0	21.7
Ohmer clay loam:				
579793	0–11	6.0	----------	21.7
579794	11–20	6.4	----------	24.1
579795	20–36	6.9	----------	18.1
Cayucos clay:				
579796	0–13	5.7	----------	30.8
579797	13–25	6.0	----------	33.9
Los Trancos stony clay:				
579799	0–6	5.9	----------	30.6
5797100	6–12	6.7	----------	----------
Positas loam:				
5797101	0–16	5.8	----------	17.9
5797102	16–31	5.6	----------	30.7
5797103	31–40	5.8	----------	30.6
Cropley clay loam:				
5797105	0–17	6.9	----------	20.6
5797106	17–36	6.8	----------	20.8
5797107	36–49	7.2	2.8	18.5
5797108	49–60	7.5	3.1	18.0
Vallecitos clay loam:				
5797109	0–10	5.8	----------	19.6
5797110	10–20	5.6	----------	19.0
5797111	20–26	5.4	----------	28.9
5797112	26–36	5.1	----------	28.1
Sorrento silty clay loam:				
5797113	0–13	7.0	1.2	21.6
5797114	13–38	7.0	1.6	20.1
5797115	38–49	7.5	1.2	18.5
5797116	49–72	8.3	6.0	21.4
Edenvale clay (adobe):				
5797117	0–17	6.7	----------	32.6
5797118	17–31	7.3	3.2	32.4
5797119	31–40	7.9	4.0	30.8
5797120	40–60	8.1	5.2	28.9
Hovey clay:				
5797121	0–11	7.5	6.6	36.3
5797122	11–23	7.5	9.6	36.2
5797123	23–38	7.8	15.3	36.5
5797124	38–72	8.0	13.2	45.2

See footnotes at end of table.

TABLE 14.—*pH, carbonates, and moisture equivalents of soils of the Santa Clara Area, California*—Continued

Soil type and sample No.	Depth	pH	Carbonates	Moisture equivalent
	Inches		*Percent*	*Percent*
Ayar clay:				
5797125	0–11	7.3	25.7	29.6
5797126	11–23	7.3	28.6	29.2
5797127	23–36	7.3	45.7	19.7
Pleasanton loam:				
5797128	0–15	6.9	----	15.1
5797129	15–37	6.2	----	15.3
5797130	37–60	6.1	----	13.5
Dublin clay (adobe):				
5797131	0–16	6.2	----	28.0
5797132	16–37	6.3	----	27.2
5797133	37–48	7.1	1.7	17.7
Yolo clay loam:				
5797137	0–19	6.6	----	23.0
5797138	19–51	6.5	----	18.8
5797139	51–72	6.5	----	19.5
Yolo fine sandy loam:				
5797140	0–12	6.6	----	13.9
5797141	12–40	6.6	----	14.8
5797142	40–54	6.9	----	17.3
5797143	54–72	7.1	1.5	5.6
San Ysidro clay loam:				
5797144	0–14	6.8	----	15.3
5797145	14–21	6.3	----	15.9
5797146	21–39	6.5	----	24.0
5797147	39–50	6.9	----	22.3
5797148	50–60	6.7	----	20.5
Zamora silty clay loam:				
5797149	0–17	6.2	----	20.2
5797150	17–38	6.3	----	20.8
5797151	38–51	6.6	----	18.6
5797152	51–72	6.7	----	18.5
Saratoga loam:				
5797157	0–11	6.2	----	15.6
5797158	11–38	5.8	----	15.9
5797159	38–49	5.9	----	14.2
5797160	49–60	5.9	----	13.4
Sobrante clay:				
5797161	0–9	6.3	----	22.3
5797162	9–19	6.2	----	31.2
5797163	19–30	6.4	----	26.3
5797164	30–36	6.6	----	24.5
Soper gravelly loam:				
5797165	0–11	6.0	----	16.8
5797166	11–28	5.2	----	19.9
5797167	28–42	5.5	----	16.9
Azule silty clay:				
5797168	0–9	5.7	----	24.7
5797169	9–18	5.3	----	23.1
5797170	18–45	5.4	----	23.5
5797171	45–54	5.6	----	23.5
Los Gatos clay loam:				
5797175	0–9	6.1	----	25.1
5797176	9–20	5.9	----	22.9
5797177	20–36	5.7	----	25.2
5797178	36–48	6.0	----	26.5
Permanente stony loam:				
5797179	0–11	7.3	1.8	22.4
5797180	11+	7.8	24.6	18.2

See footnotes at end of table.

TABLE 14.—*pH, carbonates, and moisture equivalents of soils of the Santa Clara Area, California*—Continued

Soil type and sample No.	Depth	pH	Carbonates	Moisture equivalent
	Inches		*Percent*	*Percent*
Hugo loam:				
5797181	0–10	6.5		21.5
5797182	10–26	5.6		16.8
5797183	26–48	4.9		11.9
Maymen loam:				
5797184	0–14	5.9		19.6
5797185	14–24	5.4		16.8
Altamont clay:				
5797186	0–10	5.7		30.0
5797187	10–25	6.1		30.6
5797188	25–30	7.3	11.2	24.2
Montara stony clay loam:				
5797189	0–6	6.6		35.4
5797190	6–15	6.8		42.5
Hugo clay loam:				
5797192	0–11	5.6		26.8
5797193	11–20	5.3		26.1
5797194	20–30	5.1		21.9
Orestimba clay loam:				
5797195	0–10	6.0		21.5
5797196	10–22	7.8	1.5	[1] 30.5
5797197	22–41	8.8	4.6	[1] 30.2
5797198	41–60	8.6	9.3	[1] 30.5
Pleasanton gravelly loam:				
5797199	0–18	6.8		15.3
5797200	18–40	6.2		13.3
5797201	40–54	6.1		11.6

[1] After centrifuging this soil, following preparation by the standard method, water was found standing on the surface. These samples were rerun after the metal cup walls were lined with paraffined paper to permit drainage.
[2] Probably magnesium carbonate.

The "Chernozemic" soils all have a neutral reaction in the surface soils but have a higher pH value with increased depth because of calcareous subsoils. The leaching of lime from the surface to the subsoils is characteristic of these soils. The higher organic-matter content of the surface soils probably accounts for the higher moisture-equivalent values in the surface soils than in the subsoils. The soils have a somewhat lower moisture-holding capacity than might be expected from the amount of clay they contain. The surface soils also show a relatively high proportion of colloidal clay to total clay. From 82 to 88 percent of the material below 2 microns effective diameter is also below 1 micron.

The "Prairie-like" soils are medium to slightly acid in reaction. They increase slightly in pH value with increased depth. There is normally no lime in the profiles of these soils.

Eight series were assigned to the Noncalcic Brown soil group. They are the Azule, Gaviota, Los Gatos, Pleasanton, Saratoga, Sobrante, Soper, and Vallecitos. Data on pH, carbonates, and moisture equivalents are given in table 14 for at least one set of samples representing each series. Mechanical analyses were made on samples of the Pleasanton, Saratoga, and Vallecitos series and are reported in table 13.

Noncalcic Brown soils are ordinarily noncalcareous and range from neutral to strongly acid in reaction. The reaction is usually fairly uniform throughout the profile and shows no marked pH change from one horizon to another. Values for moisture equivalent do not vary markedly by horizons but are about typical of the different textural classes.

The Pleasanton profile studied in detail shows weak textural differentiation of horizons. The differences may be caused mainly by stratification of the parent material. The Saratoga samples show distinct enrichment with clay in the B horizon. The proportion of fine clay (less than 1 micron) is greater in the B than in either the A or C horizons. This suggests that the clay enrichment in the profile is probably mainly the result of migration of fine clay particles in suspension. Only two horizons of the Vallecitos profile were sampled, and those extend to a depth of 30 inches. Without analyses of deeper horizons, it is difficult to interpret the existing data, but it seems likely that the higher clay content of the upper (0 to 14 inch) layer is due to stratification.

Four series (Milpitas, Ohmer, Positas and San Ysidro) are called Noncalcic Brown soils, intergrading to Planosols. These series range in reaction from neutral to medium acid. Reactions vary only slightly from one horizon to another within a profile. Samples from two profiles (Milpitas loam and Positas loam) were subjected to mechanical analysis. The results show pronounced clay enrichment of the B horizons in both soils. In Milpitas loam, clay increased from 18 percent in the A to 55 percent in the B; in Positas loam, from 17 percent in the A to 41 percent in the B. These claypan B horizons also have an exceptionally high ratio of colloidal clay (less than 1 micron) to total clay (less than 2 microns). In the Milpitas B horizon, 95 percent of total clay is finer than 1 micron in diameter; in the Positas, 90 percent of the total clay of the B horizon is finer than 1 micron. Both total clay content and colloidal clay content suggest that these claypans restrict water movement. The Milpitas is slightly calcareous in the C horizon, but all other horizons of this and the other soils in this group are noncalcareous. Moisture equivalents vary at different depths according to the ranges in clay content of the different horizons.

Altamont, Climax, Diablo, and related series of the "Chernozemic" soils, intergrading to Grumusols, are generally neutral to mildly basic in reaction. Characteristically they are leached of lime in the A_1 horizons and are calcareous below. Mechanical analyses were run on samples of one profile of Cropley clay (adobe). The laboratory data on particle-size distribution and moisture equivalent, as well as field evidence, indicate little or no clay enrichment of the B horizon, that is little or no eluviation and illuviation of clay particles. If these soils are indeed grumusolic, as the group name is intended to suggest, then textural differentiation of horizons is not to be expected.

The Cayucos and Dublin series are closely related to the soils of the "Chernozemic" group; they differ principally in reaction. They are classed as Prairie-like, intergrading to Grumusols. Like Prairie soils, they are generally noncalcareous and medium to slightly acid. Like Grumusols, they are high in clay, seem to lack textural differentiation of horizons, crack widely upon drying, and have granular

surface horizons. Particle-size distribution was not determined on samples of any members of this group, but field observations and moisture equivalent data suggest that they are clays throughout, with little or no clay enrichment of the B horizon.

Mechanical analyses were run on samples of one of the Hugo profiles. This soil is tentatively classified simply as "Podzolic." The analyses suggest slight enrichment in clay of the B horizon, but more data should be obtained to confirm this characteristic. Data on pH and moisture equivalent are available for two profiles, one of a loam type, the other of a clay loam. The reaction in both profiles is slightly acid in the A horizon and increases to very strongly acid in the C.

As would be expected in "Solonetzic" soils, the Orestimba and Pescadero soils have basic reactions. In some Orestimba profiles, the A_1 horizon is neutral or even slightly acid, but the B and C horizons are moderately to strongly basic. No mechanical analyses are available for these soils in the Santa Clara Area, but field indications and moisture-equivalent data indicate at least moderate clay enrichment of the B horizon. These soils are calcareous at or near the surface, and free carbonates increase with increasing depth. It was difficult to determine the moisture equivalents because of the very slow permeability of the soil materials in the B and C horizons. By repeating the determinations with paraffined paper linings for the moisture-equivalent cups, much of the excess water was drained away, and a value more nearly approaching the actual moisture capacity of the soil material was obtained.

Four series, Alviso, Bayshore, Castro, and Sunnyvale, were placed in the group of "Hydro-Calcimorphic" soils. All of these are strongly calcareous throughout and range in reaction from mildly to moderately basic. In most instances they are least calcareous in the A_1 and most calcareous in one of the horizons of the substratum. An exception is the Bayshore, which is most strongly calcareous in the A_1. There is no evidence that clay has migrated to any appreciable extent, and the profiles appear to have no textural differentiation of horizons. The moisture equivalents are rather high in the A_1 horizons, because these horizons are high in organic matter. Moisture-equivalent values decrease with increasing depth.

The Wiesenboden soils are clearly related to the "Hydro-Calcimorphic" soils group. The two series in this group, Alamitos and Clear Lake, are calcareous throughout, but not nearly so strongly calcareous as Alviso and others of the "Hydro-Calcimorphic" soils group. Moisture equivalents in the A_1 horizons are higher than the texture would lead one to expect, because of high organic-matter content. Moisture-equivalent values decrease with increasing depth. Clear Lake clay (adobe) samples varied from neutral in the A_1 to moderately basic in the substratum. Alamitos clay samples showed neutral reaction in the A_1 and slightly acid reaction in the substratum. There is little or no textural differentiation of horizons in these soils.

The four series of the Lithosol group (Los Trancos, Maymen, Montera, Permanente) vary considerably in reaction, content of free carbonates, and moisture equivalent, depending on parent rock, vegetation, and climate. None of them shows indication of significant clay migration, although mechanical analyses are not available to confirm

this statement. The Los Trancos and Maymen are strongly acid to neutral in reaction; the Montara and Permanente are neutral to mildly basic in reaction; and the Permanente is usually calcareous, at least in lower horizons. In most of the profiles studied, moisture equivalent decreased with increasing depth, probably because of decreasing organic matter and decreasing clay from the surface downward.

Like the Lithosols, the Alluvial soils are a varied group. Their nature depends largely upon the soils and rocks from which their alluvium was derived. There is little or no B horizon development in these very youthful soils. Variations in clay content from one horizon to another are probably the result of stratification of the alluvium. The Campbell, Mocho and Sorrento soils are neutral to moderately basic in reaction and are calcareous throughout. The Yolo and Zamora are slightly acid to neutral and are noncalcareous. Moisture-equivalent values are directly associated with texture and organic-matter content and vary only slightly from horizon to horizon.

GLOSSARY OF SPECIAL TERMS [23]

Certain special terms used in the descriptions and discussions of soils may not be familiar to the reader. In addition to the definitions already given, the following abbreviated glossary may be of value to the reader.

Acid soil. Practically, a soil giving an acid reaction below pH 6.6 throughout most or all of the part occupied by roots. (*See* Reaction, soil.)

Adobe soil. Generally, a soil of clay texture that cracks into large more or less cubical blocks on drying. This is a soil structure term and should not be confused with the name for material used to make adobe building bricks.

Aggregate (of soil). A single mass or cluster of soil consisting of many soil particles held together, such as a clod, crumb, or granule.

Alkali soil. See section on Saline and Alkali Soils.

Alkaline soil. Practically, a soil giving an alkaline or basic reaction above pH 7.3 (*see* Reaction, soil). An alkaline reaction, if not too strongly alkaline, does not necessarily indicate presence of toxic or injurious amounts of salts characteristic of alkali soil. Certain field crops respond best to mildly alkaline soils.

Alluvium. Fine material such as sand, mud, or other sediments deposited on land by streams.

Arable land. Land that in its present condition is physically capable, without further substantial improvement, of producing crops requiring tillage.

Association, soil. A group of soils, with or without common characteristics, geographically associated in typical pattern. If the individual areas of the association are too small to be separated at the map scale used, the association is mapped as a complex.

Bedrock. The solid rock beneath the soils and other unconsolidated natural formations.

Calcareous soil. A soil containing enough calcium carbonate (lime) to effervesce (fizz like sodawater) visibly to the naked eye when treated with dilute hydrochloric acid. The presence of free calcium carbonate gives this soil an alkaline reaction.

Clay. The small mineral soil grains, less than 0.002 mm. (0.000079 inch) in diameter.

Claypan. A dense fine-textured soil horizon beneath the upper part of some soils; very hard when dry, and plastic or sticky when wet.

[23] Taken mostly from the Glossary of Special Terms in Soils and Men (*25*).

Concretions. Local concentrations of certain chemical compounds, such as calcium carbonate or compounds of iron, that form hard grains or nodules of mixed composition and of various sizes, shapes, and colors.

Consistence, soil. The relative mutual attraction of the particles in the whole soil mass or their resistance to separation or deformation (as evidenced in cohesion and plasticity). Consistence is described by such general terms as loose or open; slightly, moderately, or very compact; friable; crumbly; plastic; sticky; soft; firm; hard; and cemented.

Consolidated (soil materials). Made solid, by cementation or other processes, from a previously fluid or loosely aggregated condition.

Erosion. See section on Erosion and Deposition.

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

Friable. Easily crumbled in the fingers.

Genesis, soil. The way the soil originated, especially the processes that developed the solum from the parent material (*See* Parent material; Solum).

Hardpan. An indurated (hardened) or cemented soil horizon. The soil may be of any texture, but is compacted or cemented together by iron oxide, organic material, silica, calcium carbonate, or other substances.

Horizon, soil. A soil layer, approximately parallel to the land surface, that has more or less well-defined characteristics produced by soil-building processes.

Humus. The well-decomposed, more or less stable part of the organic matter in the soil.

Igneous rock. A rock produced by cooling of melted mineral material.

Leaching. Removal of materials in solution.

Lime. Strictly, calcium oxide; but in the commonly used agricultural sense, calcium carbonate and calcium hydroxide. Agricultural lime may be any of these compounds, with or without magnesia, and is used as an amendment for acid soils.

Limestone. A general name for rocks composed mostly of calcium carbonate. There are a great many varieties differing in physical and chemical composition.

Marl. An earthy crumbling deposit consisting chiefly of calcium carbonate (lime) mixed with clay or other impurities in varying proportions.

Mellow soil. A soil that is easily worked or penetrated.

Metamorphic (or metamorphosed) rock. A rock much altered by the combined action of pressure, heat, and water; frequently a more compact and more highly crystalline form of rock than before.

Microrelief. Minor surface irregularities such as low mounds or shallow pits.

Mottled (mottling). Irregularly marked with spots of different colors.

Neutral soil. Practically, a soil that is not significantly acid or alkaline; one having a pH between 6.6 and 7.3 (*see* Reaction, soil).

Noncalcareous. Free from lime or calcium carbonate.

Parent material. The unconsolidated mass of geologic material from which the soil profile develops.

Peat. Unconsolidated soil material consisting mostly of undecomposed or slightly decomposed organic matter accumulated under very wet conditions.

Plastic. Capable of being molded or modeled without breaking.

Porosity, soil. The degree to which the soil mass is permeated with pores or cavities.

Productivity, soil. The ability of a soil to produce a specified plant or sequence of plants under a specified system of management.

Reaction, soil. The degree of acidity or alkalinity of the soil mass, generally expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality; higher values, alkalinity; and lower values, acidity. In this report the term "basic" is used in the same sense as the term "alkaline."

Saline soil. See section on Saline and Alkali Soils.

Sand. Small rock or mineral fragments from 2 to 0.05 mm. (0.079 to 0.002 inch) in diameter.

Sedimentary rock. A rock consolidated from particles deposited from suspension in water. The chief groups of sedimentary rocks are (1) conglomerates (gravels), (2) sandstones (from sands), (3) shales (from clays), and (4) limestones (from calcium carbonate deposits).

Silt. Small mineral soil grains, the particles of which range in diameter from 0.05 to 0.002 mm. (0.002 to 0.000079 inch).

Soil. The natural medium for the growth of land plants on the surface of the earth. A natural body composed of organic and mineral materials on the surface of the earth in which plants grow.

Solum. The part of the soil profile in which the soil-forming processes are active, above the parent material.

Structure, soil. The morphological aggregates in which the individual soil particles are arranged. Structure is described by such terms as "prismatic, subangular blocky, columnar, platy, crumb, granular, blocky, and single grain."

Subsoil. Roughly, that part of the solum below the surface soil.

Surface soil. A general term applied to the upper layer of the soil. This may be either the average plow depth, or the A horizon if it extends below plow depth.

Texture, soil. The relative proportion of the various size groups of individual soil grains. Texture is described by such terms as "fine sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, and clay."

Tilth. The physical conditions of a soil that affect its fitness for the growth of specified plants.

Water table (ground-water level). The upper limit of the part of the soil or underlying material wholly saturated with water.

Weathering. The physical and chemical disintegration and decomposition of rocks and minerals.

LITERATURE CITED

(1) BRANNER, J. C., NEWSOM, J. F., and ARNOLD, RALPH.
1909. SANTA CRUZ FOLIO, CALIFORNIA. U. S. Geol. Survey, Geol. Atlas of the U. S., folio 163, 12 pp., illus.

(2) CALIFORNIA DEPARTMENT OF PUBLIC WORKS.
1923. FLOW IN CALIFORNIA STREAMS. Calif. Dept. Pub. Works, Div. Engin. and Irrig. Bul. 5, 557 pp.

(3) ———.
1933. SANTA CLARA INVESTIGATION. Calif. Dept. Pub. Works, Div. Water Resources Bul. 42, 271 pp.

(4) CLARK, WILLIAM O.
1924. GROUND WATER IN SANTA CLARA VALLEY, CALIFORNIA. U. S. Geol. Survey, Water-Supply Paper 519, 209 pp., illus.

(5) COSBY, STANLEY W., and WATSON, E. B.
1927. SOIL SURVEY OF THE GILROY AREA, CALIFORNIA. U. S. Bur. Soils Field Oper. 1923: 599–642, illus.

(6) HIBBARD, P. L.
1925. ALKALI SOILS—ORIGIN, EXAMINATION, AND MANAGEMENT. Calif. Agr. Expt. Sta. Cir. 292, 14 pp. (Reprinted, 1931).

(7) HOLMES, L. C., and NELSON, J. W.
1919. RECONNAISSANCE SOIL SURVEY OF THE SAN FRANCISCO BAY REGION, CALIFORNIA. U. S. Bur. Soils Field Oper. 1914: 2679–2784, illus.

(8) JAMES, WILLIAM F., and MCMURRY, GEORGE H.
1933. HISTORY OF SAN JOSE, CALIFORNIA, NARRATIVE AND BIOGRAPHICAL. Paul Gordon Teal, biographical editor. 243 pp.

(9) JENKINS, OLAF P.
1938. GEOLOGIC MAP OF CALIFORNIA. Calif. Dept. Nat. Resources, Div. Mines. 6 sheets.

(10) JENSEN, HERBERT A.
1939. VEGETATION TYPES AND FOREST CONDITIONS OF THE SANTA CRUZ MOUNTAINS UNIT OF CALIFORNIA. U. S. Dept. of Agr., Calif. Forest and Range Expt. Station, For. Sur. Release 1, 55 pp., illus.

(11) KELLEY, W. P.
1937. THE RECLAMATION OF ALKALI SOILS. Calif. Agr. Expt. Sta. Bul. 617, 40 pp., illus.
(12) ——— and BROWN, S. M.
1934. PRINCIPLES GOVERNING THE RECLAMATION OF ALKALI SOILS. Calif. Agr. Expt. Sta., Hilgardia 8: 149–177, illus.
(13) KELLOGG, CHARLES E.
1936. DEVELOPMENT AND SIGNIFICANCE OF THE GREAT SOIL GROUPS OF THE UNITED STATES. U. S. Dept. Agr. Misc. Pub. 229, 40 pp., illus.
(14) LAPHAM, MACY H.
1903. SOIL SURVEY OF THE SAN JOSE AREA, CALIFORNIA. U. S. Bur. Soils Field Oper. 1903: 1183–1217.
(15) NORTON, E. A.
1939. SOIL CONSERVATION SURVEY HANDBOOK. U. S. Dept. of Agr. Misc. Pub. 352, 40 pp.
(16) OAKES, H., and THORP, J.
1950. DARK-CLAY SOILS OF WARM REGIONS VARIOUSLY CALLED RENDZINA, BLACK COTTON SOILS, REGUR, AND TIRS. Soil Sci. Soc. Amer. Proc. 15: 347–354.
(17) SAWYER, EUGENE T.
1922. HISTORY OF SANTA CLARA COUNTY, CALIFORNIA. 1692 pp., illus.
(18) STORIE, R. E.
1933. AN INDEX FOR RATING THE AGRICULTURAL VALUE OF SOILS. Calif. Agr. Expt. Sta. Bul. 556, 48 pp., illus. (Revised, 1937).
(19) ——— and WEIR, W. W.
1951. GENERALIZED SOIL MAP OF CALIFORNIA. Calif. Agr. Expt. Sta. and Ext. Ser. Manual 6, 52 pp., illus.
(20) ———, COLE, RALPH C., OWEN, BRUCE C., KOEHLER, L. F., ANDERSON, A. C., LEIGHTY, W. J., and RETZER, JOHN L.
1944. SOIL SURVEY OF THE SANTA CRUZ AREA, CALIFORNIA. U. S. Bur. Plant Indus. Ser. 1935, No. 25, 90 pp., illus.
(21) THORP, J., and SMITH, G. D.
1949. HIGHER CATEGORIES OF SOIL CLASSIFICATION: ORDER, SUBORDER, AND GREAT SOIL GROUPS. Soil Sci. 67: 117–126.
(22) TOLMAN, C. F., and POLAND, J. F.
1940. GROUND-WATER, SALT WATER INFILTRATION, AND GROUND-SURFACE RECESSION IN SANTA CLARA VALLEY, SANTA CLARA COUNTY, CALIFORNIA, Trans. of the Am. Geophys. Union, 1940, pt. I, pp. 23–35, illus.
(23) UNITED STATES DEPARTMENT OF AGRICULTURE
1930. CLIMATIC SUMMARY OF THE UNITED STATES, SECTION 17, CENTRAL CALIFORNIA. U. S. Dept. Agr., Weather Bur., 64 pp., illus.
(24) ———
1951. SOIL SURVEY MANUAL. U. S. Dept. Agr. Handbook 18, 503 pp., illus.
(25) ———
1938. SOILS AND MEN. U. S. Dept. Agr. Yearbook 1938, 1232 pp., illus.
(26) WEIR, W. W., and STORIE, R. E.
1936. A RATING OF CALIFORNIA SOILS. Calif. Agr. Expt. Station Bul. 599, 157 pp., illus.
(27) ———, and STORIE, R. E.
1947. SOILS OF SANTA CLARA COUNTY, CALIFORNIA. Calif. Agr. Expt. Sta., 62 pp., illus.

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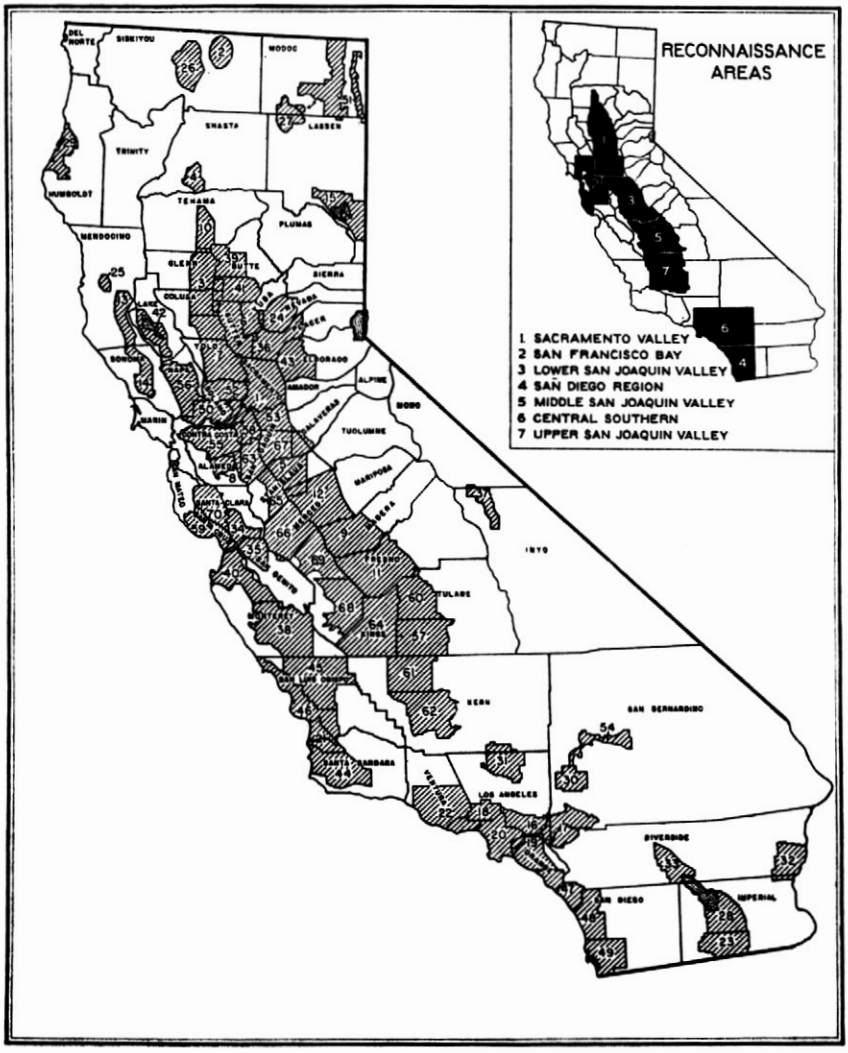

Areas covered by detailed surveys in California shown by hatching.

1. Sacramento
2. Butte Valley
3. Colusa
4. Redding
5. Modesto-Turlock
6. Marysville
7. Woodland
8. Livermore
9. Madera
10. Red Bluff
11. Fresno
12. Merced
13. Ukiah
14. Healdsburg
15. Honey Lake
16. Pasadena
17. Riverside
18. San Fernando Valley
19. Anaheim
20. Los Angeles
21. Santa Maria
22. Ventura
23. El Centro
24. Grass Valley
25. Willits
26. Shasta Valley
27. Big Valley
28. Brawley
29. Eureka
30. Victorville
31. Lancaster
32. Palo Verde
33. Coachella Valley
34. Gilroy
35. Hollister
36. Auburn
37. Bishop
38. King City
39. Chico
40. Salinas
41. Oroville
42. Clear Lake
43. Placerville
44. Santa Ynez
45. Paso Robles
46. San Luis Obispo
47. Capistrano
48. Oceanside
49. El Cajon
50. Suisun
51. Alturas
52. Dixon
53. Lodi
54. Barstow
55. Contra Costa County
56. Napa
57. Pixley
58. Sacramento-San Joaquin Delta
59. Santa Cruz
60. Visalia
61. Wasco
62. Bakersfield
63. Tracy
64. Kings County
65. Newman
66. Los Banos
67. Stockton
68. Coalinga
69. Mendota
70. Santa Clara

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