HISTORY

OF

SAN MATEO COUNTY

CALIFORNIA

By

ROY W. CLOUD

VOLUME I

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CHAPTER XIV

SPRING VALLEY WATER COMPANY

THE WATER SUPPLY OF SAN FRANCISCO

By George A. Elliott, Vice President and Chief Engineer

The city of San Francisco is supplied with water by the Spring Valley Water Company, a public service corporation subject to regulation by the California State Railroad Commission. The developed capacity of the system in 1925 is 66 million gallons daily, and the consumption about 42½ million gallons daily. About 1¾ million gallons daily of this amount is used along the route of the transmission lines outside of San Francisco. The company owns 81,681 acres of land, consisting of watershed property and land overlying the subterranean sources as well as reservoir sites and that used in connection with the structures necessary for water-supply purposes. In the transmission of water from the sources to the distributing system use is made of 7 miles of tunnels, 13.8 miles of flumes and concrete aqueducts, and 90 miles of riveted pipe ranging in diameter from 30 inches to 54 inches. There are 713 miles of pipe in the city distributing system, supplying 91,000 service connections and 4,683 fire hydrants.

The Peninsula supply, as those sources situated in San Mateo County are known, consists of four reservoirs. Pilarcitos Reservoir is situated about midway between the Pacific Ocean and the Bay of San Francisco, about eleven miles south of the city. An earth dam seventy feet high, built across Pilarcitos Creek in the year 1867, impounds the run-off from 5.2 square miles of watershed, creating a lake which holds 1,000,000,000 gallons of water. The dam, with slopes of 2½ and 2 to 1, was constructed as a dry fill, with a

puddled-clay core, the earth being spread in thin layers and rolled.

The reservoir is at an elevation of approximately 700 feet above sea-level. The surrounding hills are at a much higher elevation, reaching 1,875 feet, and their slopes are covered with a heavy tree and brush growth. The average annual rainfall of 49 inches, the largest precipitation at any point of the water system, usually provides a greater annual run-off than can be stored in the lake, and the surplus is allowed to pass on through tunnels and flumes to either San Andres or Crystal Springs reservoir.

San Andres Reservoir is located in the next valley to the east of Pilarcitos and about two miles to the north. The dam was constructed in 1868 in the same manner as Pilarcitos, its height being 95 feet. The capacity of the reservoir is 6,000,000,000 gallons, and the average annual rainfall is about 40 inches. The drainage area directly tributary to the reservoir is 8.4 square miles. The run-off from about one square mile of the upper area drained by San Mateo Creek, which is naturally tributary to Crystal Springs Reservoir, is diverted by means of the Davis Tunnel through the ridge to the west of San Andres and finds its way into San Andres Reservoir.

Crystal Springs Reservoir occupies the lower portion of the same valley that contains San Andres, and is about thirteen miles south of San Francisco. It was formed by the construction of a concrete dam 154 feet high, containing 157,200 cubic yards of concrete, built in 1887-90. Crystal Springs Reservoir has a total length of about seven miles, a storage capacity of 22,500,000,000 gallons, and an average annual rainfall of 29 inches. The lake is divided into two parts by an earth dam built three miles from its southern end in 1877, creating the original Crystal Springs Reservoir. The concrete dam was built of interlocking blocks. The blocks are 40 feet long, 8 feet high, and 30 feet wide. Alternate blocks were built in place, and the spaces between them afterwards filled in with concrete in order to minimize the effect of the shrinkage due to the setting of the concrete. The dam was built with sufficient dimensions so that it can be raised in the future without adding to its thickness. This is a very valu-

SITE OF CRYSTAL SPRINGS RESERVOIR AS IT APPEARED IN 1887,
WHEN WORK STARTED ON THE HUGE CONCRETE DAM

able feature, as large storage in the vicinity of San Francisco is very desirable, due to the distance water must be brought to meet the future needs of the city.

The combined average daily production of Pilarcitos, San Andres, and Crystal Springs reservoirs is 18 million gallons.

Lake Merced, in the northwest corner of the county, is a natural lake whose capacity was increased to 2,500,000,000 gallons by the construction of an earth dike about 15 feet high across its outlet. It is situated about half a mile east of the Pacific Ocean, practically at sea-level. Water reaches it through the medium of an average annual rainfall of 23 inches, which falls on the sandy drainage area through which it percolates, finally entering the lake in the form of springs. All surface drainage which might enter Lake Merced is diverted around the reservoir and carried off so as to decrease the danger of contamination. The normal daily productivity is 3½ million gallons.

When the Upper Alameda Tunnel, which is now under construction, is completed, the run-off of an additional 40 square miles of drainage area will be transported a distance of 9,700 feet into Calaveras Reservoir.

The San Antonio and Arroyo Valle reservoirs, projected for the future, are situated on the streams of their respective names.

In addition to the surface storage described, the Spring Valley Water Company makes use of two underground sources of supply, known as Sunol and Livermore valleys. The Sunol Valley is a gravel-filled depression with a surface area of 1,300 acres, located at the upper entrance to Niles Canyon, through which the entire drainage of the Alameda system of over 600 square miles must pass on its way to the Bay. A low dam at the canyon entrance backs up the water in the gravels from which it is abstracted through an infiltration gallery. Water is taken from the Livermore Valley through the medium of wells ranging in depth from 50 to 600 feet. At the present time 75 wells are equipped with pumping units, which are operated when necessary. The Livermore Valley floor has an area of 35 square miles. Rainfall on an area of 412 square miles supplies the streams which pass through the valley.

In transporting the water from the sources of supply to the city distributing reservoirs the principal medium is riveted pipe. The character of the water as well as the soil in which these pipes are laid is such that deterioration has been slow. A part of the first pipe laid to bring Pilarcitos water to San Francisco was removed only a few years ago after a continuous use of over 50 years. Such flumes as are used are constructed of California redwood, which has a long life, and the tunnels, the longest of which is 7,500 feet, are lined with brick or concrete.

Pilarcitos water flows through 4,921 feet of tunnels, 5,280 feet of wood flume, and 730 feet of 44-inch and 4,488 feet of 22-inch riveted pipe into San Andres Reservoir. In the event of an overflow through the Pilarcitos wasteway, a dam about two miles downstream diverts this flow into a conduit consisting of 5.3 miles of flume, 1.3 miles of tunnel, and .4 mile of 44-inch pipe which carries it to San Andres. The outlet from San Andres Reservoir is a tunnel roughly 4 feet wide, 6 feet high, and 2,800 feet long. A 44-inch pipe receives the water from this tunnel at elevation 367 feet and carries it to Baden, a distance of about 27,000 feet. At Baden this pipe divides into two 30-inch lines, one 43,000 feet long leading to College Hill Reservoir, with a capacity of 13,500,000 gallons at elevation 255 feet, and the other 36,000 feet long, known as the Merced branch, going to Central pump at elevation of 190 feet, located at Sloat Boulevard and Twenty-third Avenue in San Francisco. The Merced branch passes through the Rancho de la Merced, an old Spanish grant, and a spur-line 16 inches in diameter enables water to be taken from the pipe and pumped to Lake Honda distributing reservoir at elevation 370 feet by Ocean View pumps situated near the San Francisco county line. Ocean View pumps consist of two units with total daily capacity of 6,000,000 gallons. This station can also take water from the College Hill branch, which passes just to the east of the pumps. A second spur from the Merced branch 22 inches in diameter carries water to City pumps on the shore of Lake Merced in San Francisco. City pumping station contains two units with a total daily capacity of 7,500,000 gallons, which pump either San Andres or Lake Merced water into Lake Honda. Central pump is a

SAN FELIX STATION M. CAREY, PROP. SAN MATEO CO. CAL.

"CAREY'S IS AT THE BOTTOM OF THE LAKE"

single unit with a capacity of 8,000,000 gallons daily, which receives its supply from the end of the Merced branch and forces it to Lake Honda.

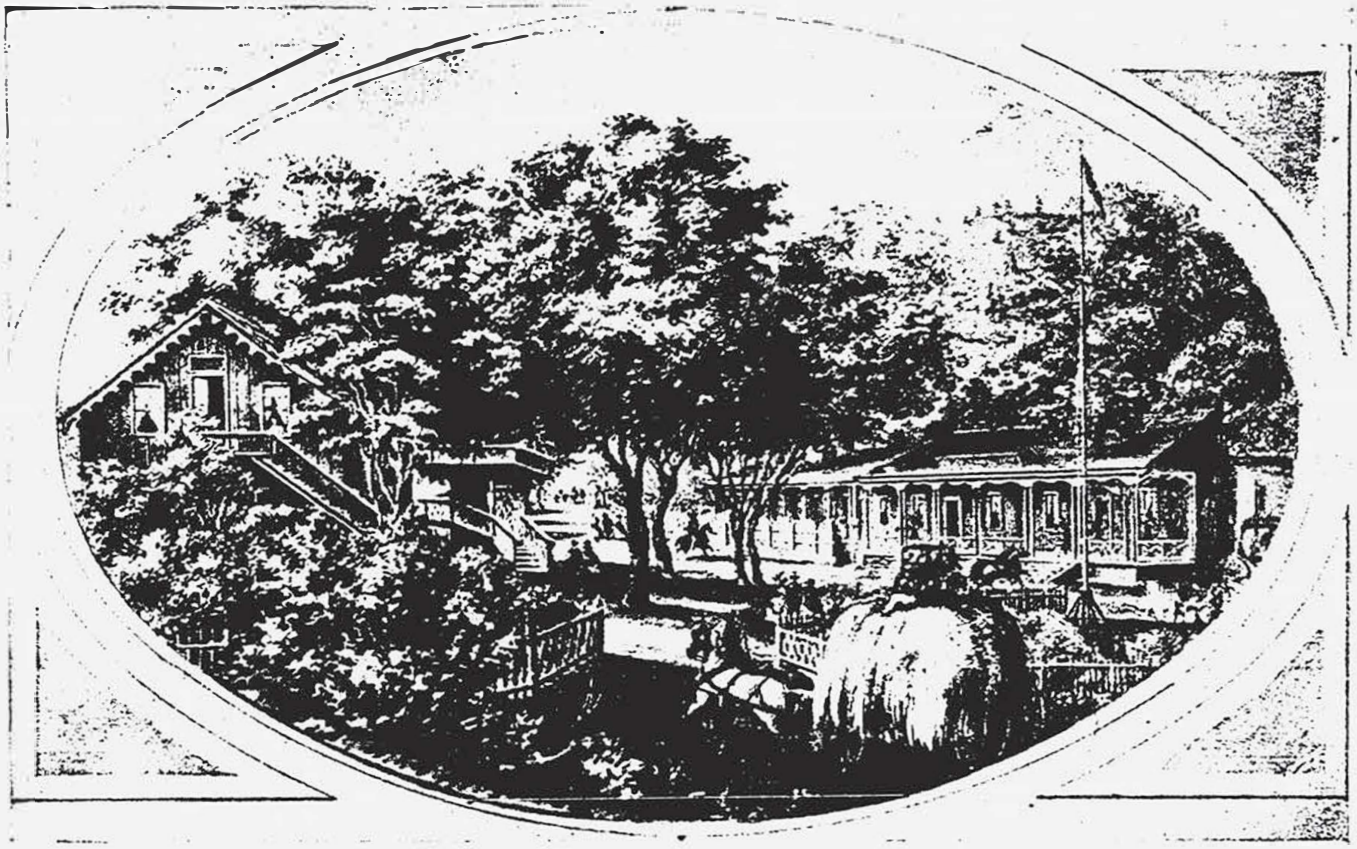
Crystal Springs Reservoir at elevation 288 feet delivers its supply through a 44-inch pipe 89,500 feet long to University Mound Reservoir in the southeast quarter of San Francisco. An electrically operated pumping station at Crystal Springs Dam can be used to pump the water through the pipe-line when the demand is greater than can be met by the ordinary gravity flow. This station also contains a second unit which may be used to pump Crystal Springs water to San Andres whenever necessary, through a wood flume 29,300 feet long built along the east slope of the valley occupied by these reservoirs. At Millbrae a 10,000,000 gallon pump is so arranged as to take water from the Crystal Springs line and force it into the pipe carrying the San Andres water to San Francisco.

Water from the three sources of supply in the Alameda system, namely, Livermore and Sunol valleys and Calaveras Reservoir, is united at Sunol and carried through the same transmission system. The infiltration system consisting of 8,985 feet of rectangular tunnels with concrete tops and concrete-lined sides pierced with numerous 2-inch pipes, fed by 2,725 feet of auxiliary perforated concrete pipe 36 inches in diameter, with open joints, collects the supply from the water-filled gravels. The collecting system is below the surface of the ground water which is maintained by Sunol Dam, a concrete structure about 28 feet high at the valley outlet.

The Calaveras supply is discharged from the reservoir through a 48-inch pipe laid in an outlet tunnel which pierces the west abutment of the dam. The water is allowed to flow down Calaveras Creek to Sunol, where it percolates through the gravels into the infiltration system.

The well supply from the Livermore Valley is abstracted from the underground gravels by pumps and discharged into a 30-inch pipe 28,000 feet long, which carries it to Sunol and delivers it into the main gallery of the infiltration system at the Water Temple, a structure of classic design which surmounts the basin at the meeting-point of the various subsources of the Alameda system.

Beginning at the Water Temple, a concrete conduit below the ground surface carries the supply to Sunol Dam. Passing through the interior of the dam from end to end, the water enters the first of five tunnels having a total length of 14,500 feet, which together with 11,400 feet of concrete conduit form the Sunol Aqueduct. This aqueduct has a total length of 4.9 miles and a capacity of 70,000,000 gallons daily. It delivers the water to the Niles regulating reservoir, which has a capacity of 5,000,000 gallons at an elevation of 181 feet. From Niles Reservoir two pipe-lines transport the supply on its way to San Francisco. The first is a 36-inch pipe 56,000 feet long which carries part of the supply to Dumbarton Point on San Francisco Bay. The Bay is crossed by means of two 16-inch and two 22-inch submarine pipes, each 6,400 feet long. The submarines have flexible joints permitting a movement of 21 degrees from a straight line in order to accommodate the pipe to the uneven floor of the Bay. On the west shore of the Bay an electrically operated centrifugal pump forces the water through 51,500 feet of 36-inch pipe to the Belmont pumping station. Belmont pumps, consisting of seven steam-driven units with a capacity of 27,000,000 gallons, force the water through 35,000 feet of 36-inch pipe and 16,700 feet of 54-inch pipe to Millbrae, where the line is connected to the Crystal Springs-University Mound pipe. The second line from Niles Reservoir begins with a 44-inch pipe 15,600 feet long which carries the water to a point near Irvington. From there the supply is transported through the Bay Division of the Hetch Hetchy Aqueduct built by the city of San Francisco and used by the Spring Valley Water Company under an agreement with the municipality. The Bay Division Aqueduct begins near Irvington with a 60-inch pipe 48,500 feet long which runs to the east shore of San Francisco Bay at Dumbarton Point. The Bay crossing is made with a 42-inch cast-iron flexible joint pipe for the first half mile. The west end of the submarine pipe terminates in the bottom of a large concrete chamber, which also acts as the end pier for a steel span bridge about 3,000 feet long, supported by concrete piers, which carries a 60-inch pipe from the end of the submarine to the west edge of the Bay. From the end of the bridge to Crystal Springs Reser-



BEFORE CRYSTAL SPRINGS BECAME A SPRING VALLEY LAKE

Its gayeties attracted visitors from all parts of the peninsula

voir, into which the water is delivered, the line consists of 50,100 feet of 60-inch pipe and a 10-foot tunnel 8,700 feet long. An electrically operated pumping station with a daily capacity of 32,000,000 gallons, located near the Bay, pumps the water into Crystal Springs Reservoir.

The distributing system in San Francisco is necessarily complicated owing to the uneven topography of the city. San Francisco is essentially a city of hills. Covering an area of 46½ square miles, it ranges in elevation from sea-level to over 900 feet. The hills do not rise gradually in easy slopes, but are abrupt and occur irregularly. Consequently the distributing-pipe system is divided by closed gate valves into a large number of major and minor areas in order to avoid excessive pressure variations. A large amount of pumping is necessary after the water reaches the city. In 1924, 44 per cent of the consumption was pumped. The total installed pumpage capacity of the system is 187,000,000 gallons daily, 35,000,000 of it in San Francisco.

In all there are 18 separate service districts in San Francisco, of which six might be termed major districts, the remainder being comparatively small areas which receive their supplies for the most part through automatic electrically operated pumps, supplied directly from the principal districts.

The lowest pressure zone, the University Mound district, receives its supply by gravity from University Mound Reservoir, with a capacity of 59,400,000 gallons at elevation 172 feet. This district comprises in general the waterfront, industrial and principal business areas, together with some domestic consumers in the east and north sections of the city. College Hill Reservoir, with a capacity of 13,500,000 at elevation 255 feet, supplies the next higher zone. Lake Honda, with a capacity of 44,000,000 gallons, situated near the geographical center of the city at elevation 370 feet, supplies the greater part of the domestic use. In addition to the water pumped into this reservoir from the Merced branch of the San Andres line and Lake Merced, it receives the surplus pumpage from Clarendon pumps, as well as the entire pumpage from Precita Valley pumps, an electrically driven unit of 3,300,000 gallons capacity which takes its supply from the University Mound distributing system. The next higher dis-

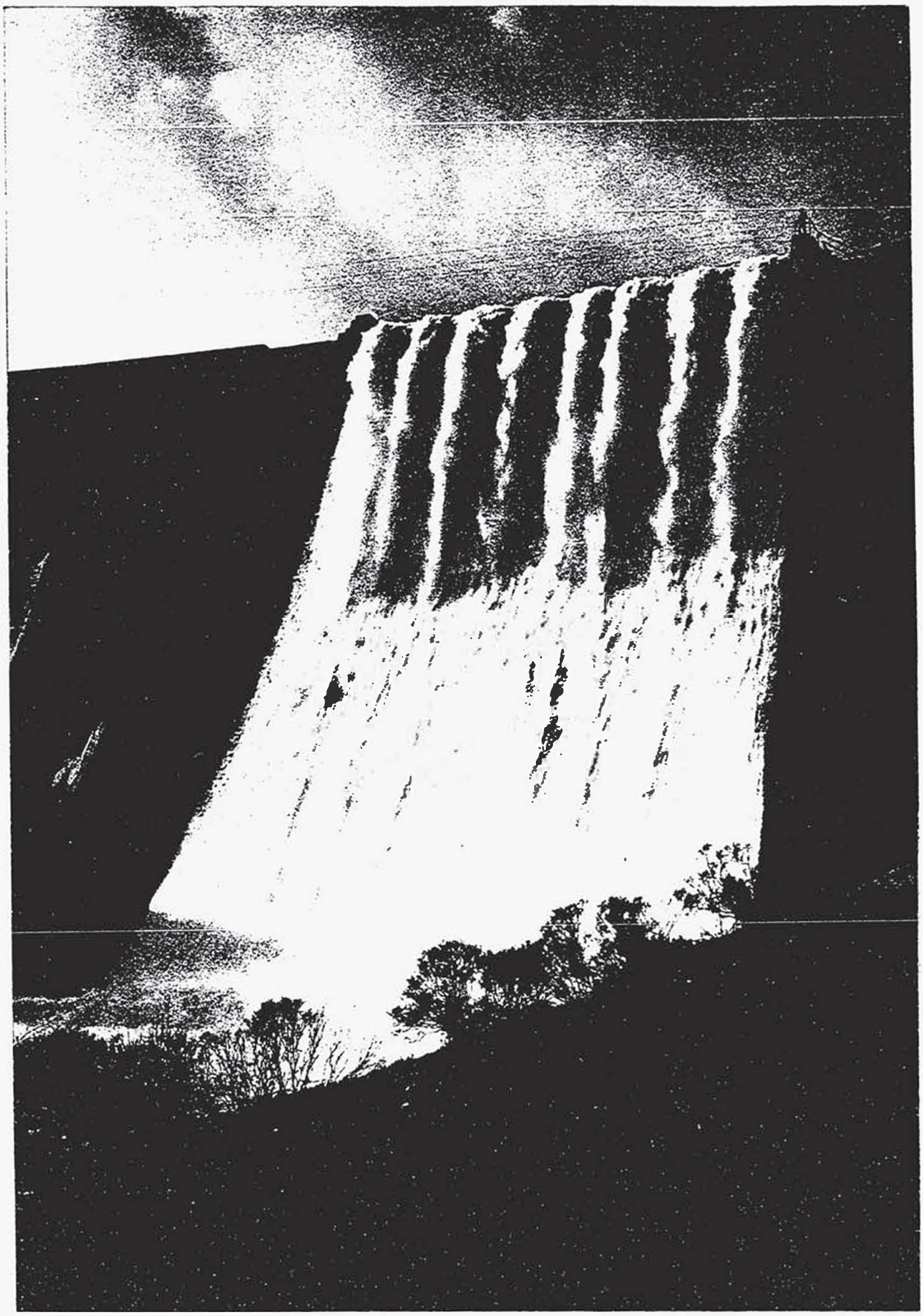
trict is Presidio Heights, comprising the top of the ridge running along the north edge of the city. Water is pumped to Presidio Heights tank with a capacity of 700,000 gallons at elevation 400 feet, from Black Point station, containing two steam-driven units with a total capacity of 6,500,000 gallons daily. This station pumps directly out of the University Mound pipe system. Lombard Street Reservoir supplies a district on the intermediate slopes of Russian and Telegraph hills. It is a subsidiary of Lake Honda, and receives its supply by gravity from the Lake Honda distributing system. Stanford Heights Reservoir at elevation 614 feet has a capacity of 5,000,000 gallons, and is so constructed that this may be doubled at any time. It is supplied by Clarendon pumps, consisting of two steam-operated units with a total daily capacity of 2,600,000 gallons, which draw water from the University Mound system. The district supplied by this reservoir lies on the upper slopes of the Twin Peaks hills. The highest service in the city is Forest Hill, with storage at elevation of 760 feet.

Although ownership of the drainage areas affords a practical protection to the water, as a further insurance the supply is sterilized.

SPRING VALLEY—AN HISTORICAL REVIEW

In the "Days of Forty-Nine" San Francisco obtained its water from wells. Later on, water was brought from the hills across the Golden Gate and sold in the streets from water-carts. In 1858 John Bensley organized the San Francisco City Water Company, and brought water from Lobos Creek, a little stream flowing through the Presidio (United States Military Reservation) into the Pacific Ocean. This first organized supply was two million gallons a day; it flowed through tunnel, flume, and pipe-line around Fort Point to the foot of Van Ness Avenue, and was pumped to two reservoirs on Russian Hill—the Lombard and Francisco street reservoirs.

The year 1860 saw the beginning of Spring Valley Water Works, organized by George Ensign. The name came from a spring in the hollow between Clay and Broadway, Powell and



CRYSTAL SPRINGS RESERVOIR

Built to accommodate the run-off of its big watershed during the recurring periods of heavy rainfall. When the great reservoir is full to overflowing, the excess water pours over the spillway into the channel of San Mateo Creek and finds its way to San Francisco Bay.

STORAGE RESERVOIRS

NAME	Type	Year Built	Dams: Height (feet)	Dams: Length (feet)	Dams: Crest Elevation (feet)	Dams: Slopes	Dams: Contents (cu. yds.)	Dams: Elev. High Water (feet)	Reservoirs: Area (acre)	Reservoirs: Capacity (m.g.)	Reservoirs: Daily Yield (m.g.)	Reservoirs: Watershed (sq.m.)
Pilarcitos	Earth	1867	70	520	700	2½:1-2:1	371,202	697	109	1,000	9	5.2
San Andres	Earth	1868	95	710	450	3½:1-3:1	529,700	446	550	6,000		8.4
Crystal Springs	Concrete	1887–90	154	600	288	———	157,200	288				
Upper Crystal Springs	Earth	1877	85	520	292	3½:1-1½:1	220,140	288	1492	22,500	9	22.5
Calaveras	Earth	1924	220	1200	775	3:1&2:1	3,461,000	755	1450	32,800	38.2	100
									3600	62,300	56.0	136.0

DISTRIBUTING RESERVOIRS

NAME	Year Built	Depth of Water (feet)	Elevation High Water (feet)	Area (acres)	Capacity (m.g.)
Lake Merced	1895	30	18	386	2,500
Lake Honda	1861 & 1915	35.5	370	6	44
University Mound	1885 & 1924	26	172	9.8	59.4
College Hill	1870	16.5	255	3.1	13.5
Stanford Heights	1923	20	614	1.2	5
Lombard Street	1860	17.5	303	0.8	2.7
Francisco Street	1859	8	135	1.7	2.5
Potrero Heights	1897	21.5	315	0.3	1
Niles Reservoir	1924	15.7	181	1.6	5

Mason streets, called the Valley Spring. But the company's first water supply was Islais Creek, tapped at a point west of the present Mission Street viaduct. The water was carried by flume and pipe-line to a reservoir at Sixteenth and Brannan streets. The yield was 200,000 gallons a day.

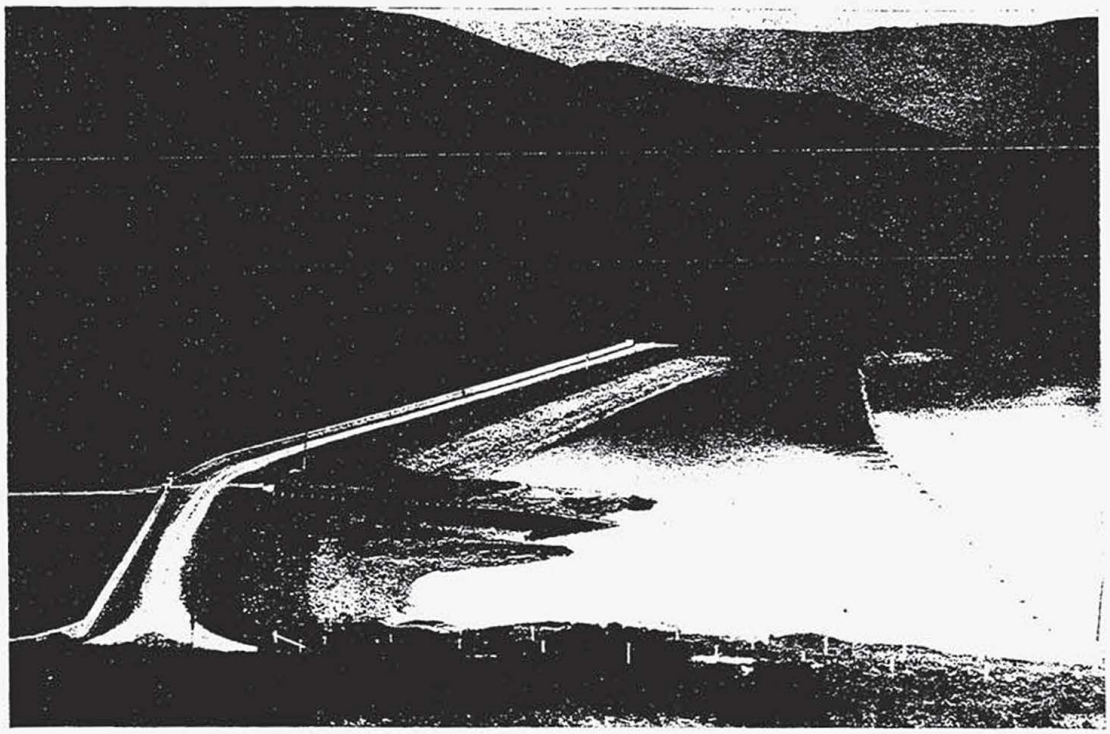
More enterprising than its elder competitor, Spring Valley proceeded far afield to develop water on a large scale, and chose strategic positions for its big distributing reservoirs within the city.

San Francisco's neighboring county to the south is San Mateo, a region of beautiful valleys, mountains thickly wooded, and, nowadays, of dense suburban population. Spring Valley, immediately realizing that San Francisco was destined to become a great metropolis which could not be supplied from streams like Lobos and Islais, went prospecting for water down the peninsula. Within two years the Company was building its first catchment reservoir, at Pilarcitos high in the San Mateo hills, and its first big distributing reservoir, Laguna Honda, in San Francisco. By '62 Pilarcitos water was flowing by gravity thirty-two miles to Laguna Honda. Two years later Pilarcitos was being enlarged.

Laguna Honda (deep lake) was far from all city dwellings in those days. Rollin M. Daggett, a popular poet and journalist, wrote of the new reservoir: "There is much to feed the eye of fancy along the road that leads to Honda, and something, withal, to touch the sense of grosser speculation. After leaving Hayes Valley, the road to the lake passes through narrow valleys studded with chaparral, and we presume peppered with fleas!"

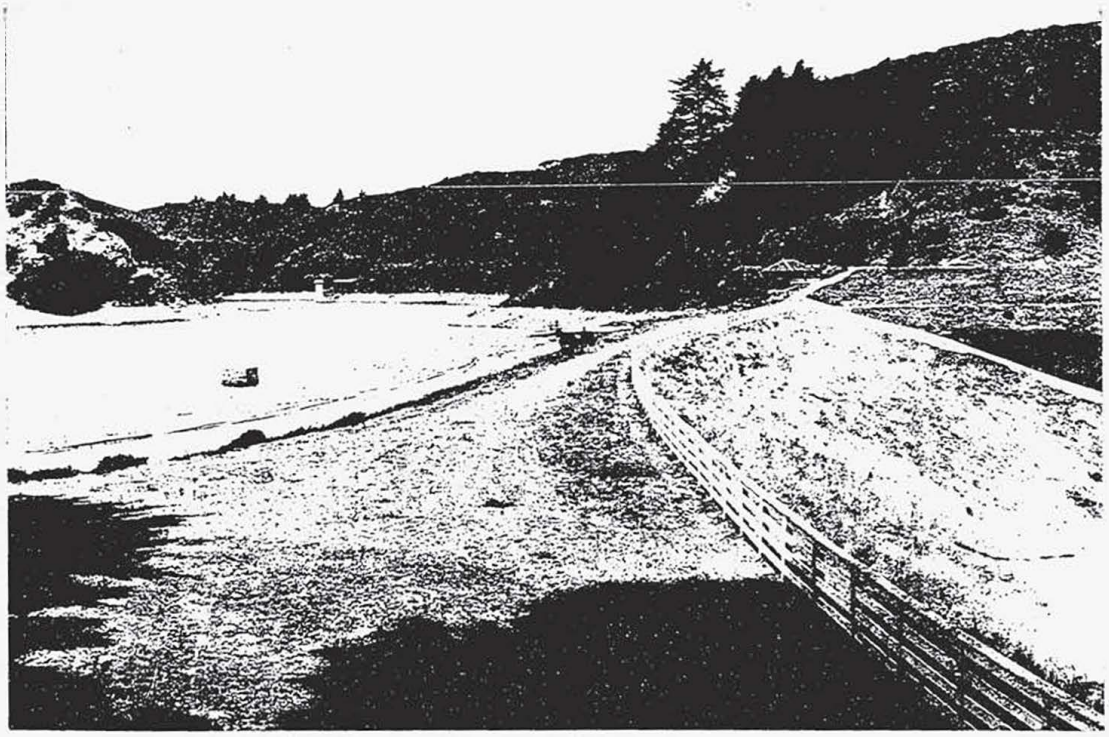
By '65 Spring Valley had absorbed the San Francisco City Water Company, taking over the Lobos Creek supply and structures, the pumping station at Black Point, the two reservoirs on Russian Hill, and the pipes in the streets. Ever since then Spring Valley alone has borne the responsibility of supplying this city with water. The corporate name was changed to Spring Valley Water Company in 1903.

The year 1864 is notable in Spring Valley annals. It was then that a young man left the draughting-room of the Vulcan Iron Works to become assistant engineer for the water company. This was Hermann Schussler, who had



SAN ANDRES, SECOND IN SIZE OF THE THREE SAN MATEO COUNTY STORAGE RESERVOIRS

It takes its name from a valley famous in the annals of the Spanish explorers. In 1868 an earthen dam was thrown across San Andres Creek, forming this artificial lake. Though San Andres earthquake fault runs through the dam, it suffered no damage in 1906.



PILARCITOS, HIGH IN THE SAN MATEO COUNTY HILLS

Constructed in 1862 and afterwards enlarged to its present size. Pilarcitos water formerly flowed direct to San Francisco, but now goes to San Andres. The Pilarcitos region has the heaviest precipitation of all the peninsular watersheds.

been graduated in engineering in Zurich, Switzerland. He was destined to exert a profound influence upon the development of San Francisco's water supply. A. W. von Schmidt had been Spring Valley's first chief engineer. Calvin Brown succeeded him, and to Brown, who was constructing a new dam at Pilarcitos, young Schussler reported.

Hermann Schussler's first distinctive achievement was the discovery of the reservoir possibilities of San Andres Valley, northeast of Pilarcitos, and at a lower elevation, in San Mateo County.

"While making the survey for the Pilarcitos pipe-line," Mr. Schussler said many years later, "I noticed, in running one trial line up the San Andres Valley, some level ground, and I changed the route of the pipe-line and laid it on the hill, toward town, and we built the pipe-line on this second line. But I kept my old notes of the valley line, and found for a distance of nearly three miles that this valley raised but very little, perhaps ten or fifteen feet. So I kept this in mind, and when, gradually, the daily demand for water increased, I asked the executive committee of our board to go out with me and take a look at this valley, privately, in such a way that we would not be recognized by those eagle-eyed farmers. I showed it to William F. Babcock, Lloyd Tevis and John Parrott. They made up their minds that there was something in it. So they set an agent to work, and bought up this valley, with most of the watershed—another four or five square miles." The damming of San Andres Valley began in 1868.

As soon as San Andres water was available, a new distributing reservoir was built on College Hill to the west of Holly Park. This hill is a spur of Bernal Heights, and its name is reminiscent of St. Mary's College (now in Oakland), which was established early in the sixties on a tract of sixty acres originally intended for a Catholic cemetery. A description of the site in 1861 locates it "on the old San Jose Road and within six blocks of the line of the San Jose Railroad."

Two very important expansions of the system began in 1875. Development of the Crystal Springs watershed was begun with the construction of an earthen dam known as

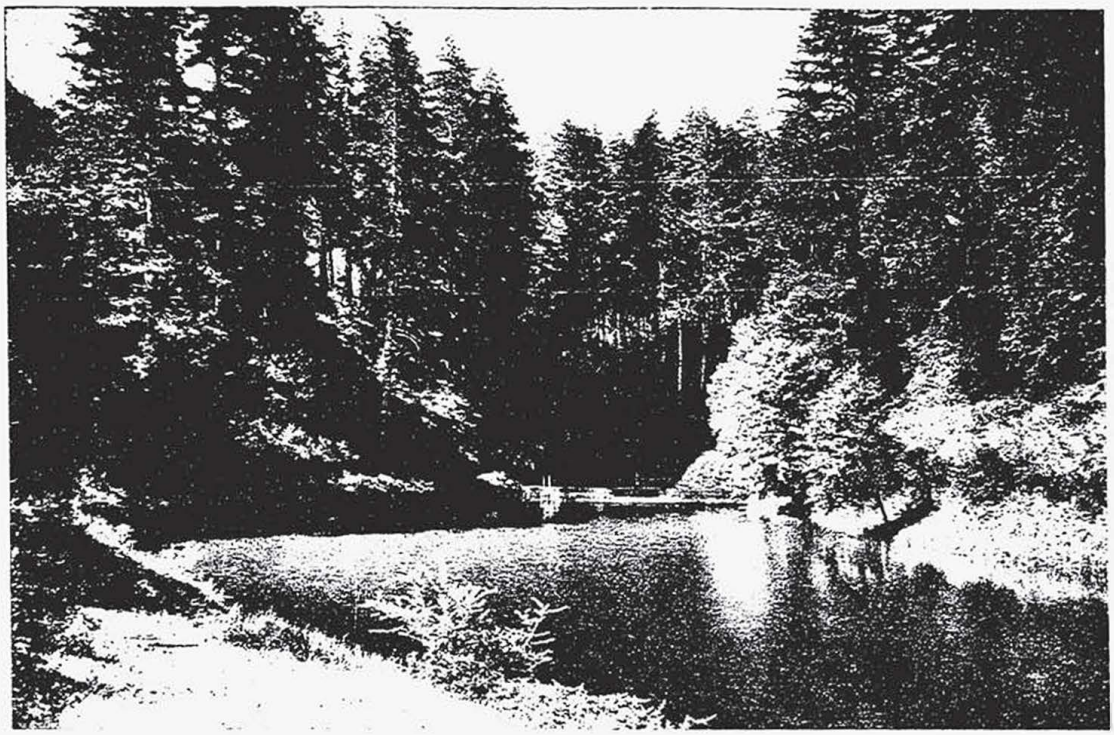
Upper Crystal Springs. In that year, too, Spring Valley turned its attention to water sources across the Bay. Land was bought in Calaveras Valley, fed by streams from Mt. Hamilton. The company also acquired the Vallejo Mills properties near Niles, where a primitive water supply had been constructed years before by Don José de J. Vallejo, a brother of General Mariano Guadalupe Vallejo. This was the beginning of the important Alameda Division of Spring Valley.

The enlargement of the Crystal Springs Reservoir went steadily forward. Watershed and reservoir properties and water-rights were acquired as opportunity offered. In 1887 the construction of the big Crystal Springs concrete dam was commenced.

The city had been growing, and by August, '85, the company had brought into service the third of its big city distributing reservoirs—University Mound. It stands on a plateau south of Silver Avenue, directly in front of the Lick Old Ladies' Home, which occupies a building long ago erected for University College. This was a little-known section in 1885. "The spot," said a newspaper, "is one of the dreariest and windiest on the Peninsula, the sparse population declaring that on no day in the year are its rough slopes unswept by roystering breezes. No car comes within a mile of it, and the only signs of life in the neighborhood are the distant view of the city, the flap of the blinds in the few occupied windows of the Old Ladies' Home, and the whizzing sails of the garden windmills on the flats beneath."

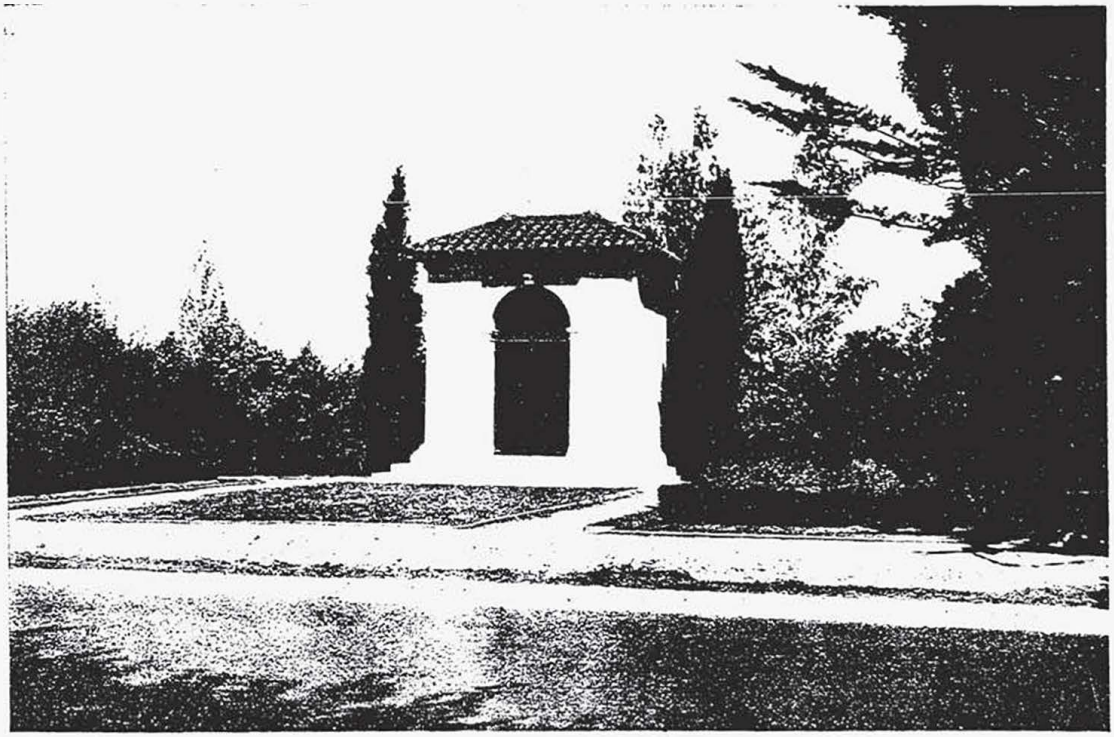
Meanwhile Lake Merced had been added to the peninsular catchment system. The company had acquired its first water-rights on the Lake Merced Rancho as early as 1868: purchase of lake and watershed lands began in 1877.

This beautiful body of water has a recorded history going back one hundred and fifty years. On September 24, 1775, Don Bruno de Heceta, who had but recently returned from a northern exploration and the discovery of the Columbia River, encamped here with his followers. He was searching for Don Juan Manuel de Ayala, who, he had reason to believe, was engaged in a survey of the port of San Francisco. It was the feast day of Our Lady of Mercy; so, in accordance with



THE STONE DAM, TWO MILES BELOW PILARCITOS, NEAR THE DIVIDING LINE BETWEEN THE OCEANSIDE AND THE INTERIOR WATERSHED OF THE SAN MATEO HILLS

Built to intercept the productive flow of streams that would otherwise waste to the Pacific. This is perhaps the most charming spot to be found on all the Spring Valley properties.



The Venturi meters at this station on the Highway twelve miles south of San Francisco are master-meters, measuring all the water that enters the city from Spring Valley sources. This station stands at the entrance to the Millbrae pumping station, the headquarters for the Peninsula Division, as Sunol is for the Alameda Division, of the company.

the pious Spanish custom, Fathers Palou and Campa, who were in the party, named the lake La Laguna de Nuestra Señora de la Merced (the Lake of Our Lady of Mercy). The Merced Rancho was granted, September 27, 1835, by José Jesús Castro, Governor of California, to José Antonio Galindo. This was the first grant of land in San Francisco. Within two years Galindo sold the two thousand odd acres to Francisco de Haro and Francisco Guerrero, the consideration being one hundred cows and goods valued at twenty-five dollars. September figures importantly in the annals of Lake Merced. Here, on September 13, 1859, United States Senator David C. Broderick and Judge David S. Terry, two giants of California's turbulent politics, faced each other in a duel that ranks among the classic encounters of the field of honor. Senator Broderick fell mortally wounded. The bullet of Judge Terry destroyed forever the hold of the code duelló on the Pacific Coast.

Spring Valley systematically enlarged its holdings and water-rights in the Alameda Division. In 1887, at the same time that the big concrete dam at Crystal Springs was started, Spring Valley began the construction of a pipe-line to divert Alameda Creek water from the Vallejo Mills (or Niles) Dam. This line, of course, had to cross San Francisco Bay, and the construction of the first submarine pipes was one of Hermann Schussler's great achievements.

Hermann Schussler had satisfied himself by his explorations that there was a large underground stretch of water-bearing gravels in the Sunol Valley. This fact determined the next great step in the development of the Alameda Division. A dam was built across Alameda Creek at Sunol, and water was diverted there instead of lower down at Niles. The famous filter galleries were run through the underground gravels, and at the spot where the Water Temple afterwards rose the water entered a conduit which carried it to Sunol Dam and the Niles Canyon line. This work was completed in 1900. In 1898 the first wells were put down at the Pleasanton outlet of the Livermore Valley; others were added from time to time.

The Water Temple is considered the greatest architec-

tural achievement of the illustrious Willis Polk. Since his death a granite slab has been placed at the Temple bearing this inscription:

TO REMEMBER WILLIS POLK

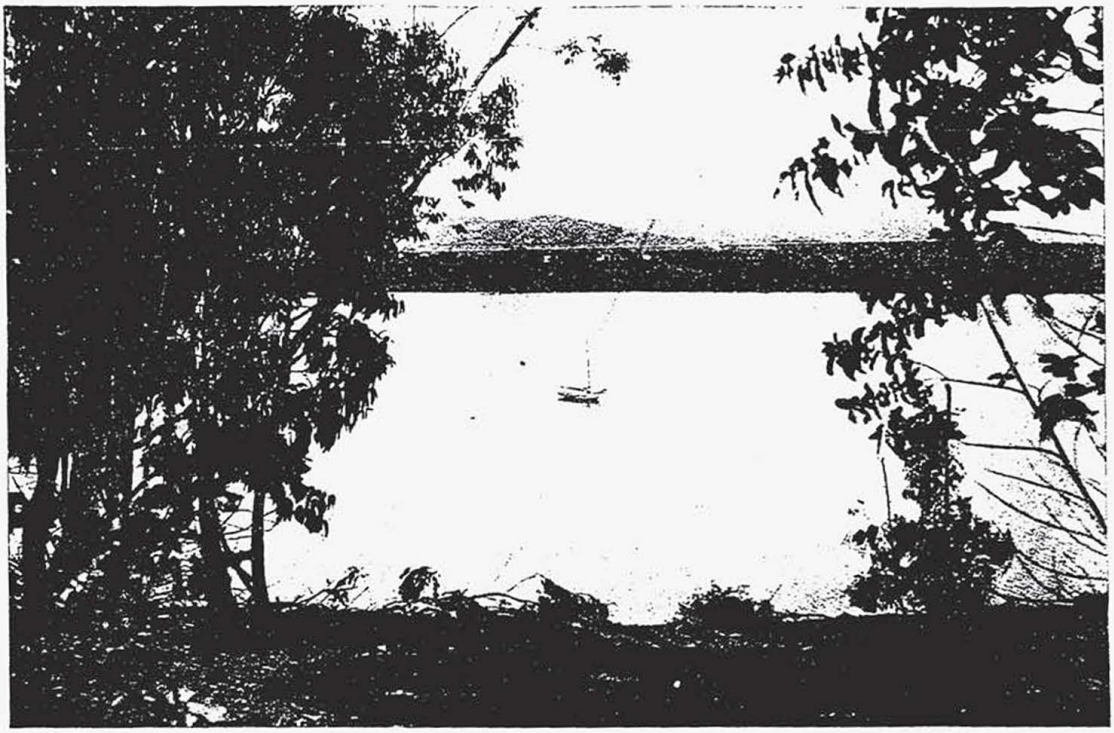
A thing of beauty is a joy forever;
Its loveliness increases; it will never
Pass into nothingness.—Keats.

The disaster of 1906 caused serious damage to the Spring Valley system. The Pilarcitos pipe-line to San Francisco was destroyed and never restored, Pilarcitos thereafter becoming a feeder to San Andres. In the city distributing system there were numerous breaks where the pipes crossed filled ground, and service connections were lost throughout the burnt district. But the distributing reservoirs in San Francisco, the great catchment reservoirs of the peninsula, the submarine pipes, the miles of tunnels on both sides of the Bay, and the costly pumping stations escaped—a striking proof of the excellence of their construction.

As far back as 1875 Spring Valley had visualized the construction of a great dam at the outlet of Calaveras Valley. The first explorations were made in 1886. Definite plans had been matured by 1906, at a time when the necessity of increasing the water supply was very much to the fore with company officials. The disaster of that year caused a postponement, but in 1913 the work of constructing the dam was commenced. Calaveras Dam was practically completed at the end of 1924. This expansion called for a bigger aqueduct down Niles Canyon, so the old conduit was replaced by the present Sunol Aqueduct, completed in the year 1923.

The city distributing system grew steadily with city growth. Reservoirs at strategic elevations were added through the years, and new pumping stations were installed, the most important being Central Pumps on Sloat Boulevard. To meet the remarkable growth of population west of Twin Peaks, the Stanford Heights Reservoir was constructed in 1923, and to care for the growing industrial needs down-town University Mound was the same year enlarged.

The growth of the city system is summarized in the following figures:



LAGUNA DE LA MERCED (LAKE MERCED)

A broad expanse of water in the midst of a great rancho that extends from the southwestern corner of San Francisco into San Mateo County. It supplies a minor part of San Francisco's daily water needs, and is therefore carefully safeguarded by Spring Valley, but access to the rancho is permitted.

Spring Valley has placed ten miles of Lake Merced trails at the disposal of the riding public. Signs explain the historic interest of the rancho, and direct equestrians to scenes of beauty and significance, notably to the site of the tragic Broderick-Terry duel in 1859, the last resort to the "code" in California.

Year	Population	Revenue Producing Services	Miles of City Pipe	Average Daily Consumption
1875	190,000	17,074	177	11,680,000 gals.
1890	300,000	33,248	327	20,430,000 "
1900	343,000	43,771	390	25,470,000 "
1906	------	37,894	444	29,200,000 "
1910	417,000	56,870	454	35,600,000 "
1920	507,000	71,931	638	36,168,000 "
1925	No census	91,394	713	41,000,000 "

Metering of the entire system was completed in 1918, and explains why daily consumption has not mounted in the same ratio as population. The drop in revenue-producing services in 1906 was the result of the great fire.

San Francisco is the largest American city with a privately operated water supply. The city of San Francisco has an option on the system which covers all properties, water-rights, and structures, save a few that the city feels it does not need. This option runs until 1933.

From 1858 until the adoption of the new State Constitution in 1879, California water rates were made under the authority of the state by a commission of three—appointees of the city and water company respectively, and a third selected by these two. After 1879 rates were made in San Francisco by the Board of Supervisors. This method was superseded in 1915, when the Railroad Commission was empowered to fix rates.

As early as 1875 acquisition of Spring Valley by the city of San Francisco was agitated, but the proposition by voting bonds was not submitted to the electorate until 1910. It failed to carry then, as likewise at bond elections held in 1915 and 1921.

The city program is to acquire Spring Valley and make it an integral part of the Hetch Hetchy municipal water supply heading in the Sierra Nevada Mountains.