A CONCEPTUAL GROUND-WATER-QUALITY MONITORING NETWORK FOR SAN FERNANDO VALLEY, CALIFORNIA

By James G. Setmire

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CONVERSION FACTORS

For readers who prefer to use metric units rather than inch-pound units the conversion factors for terms used in this report are listed below:

Multiply	By	To obtain
acres	0.4047	hectares
acre-feet (acre-ft)	0.001233	cubic hectometers
acre-feet per year (acre-ft/yr)	0.001233	cubic hectometers per year
feet (ft)	0.3048	meters
feet per year (ft/yr)	0.3048	meters per year
gallons (gal)	0.003785	cubic meters
inches (in.)	25.4	millimeters
miles (mi)	1.609	kilometers
square miles (mi^2)	2.590	square kilometers
pounds (lb)	453.6	kilograms

Air temperature is given in degrees Fahrenheit (°F), which can be converted to degrees Celsius (°C) by the following equation: °C=(°F-32)/1.8.

Abbreviations used:

mg/L - milligrams per liter
µS/cm at 25°C - microsiemens per centimeter at 25° Celsius

Water Year: The water year starts October 1 and ends September 30; it is designated by the calendar year in which it ends.

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ABSTRACT

A conceptual (ideal) ground-water-quality monitoring network was developed for San Fernando Valley to provide the California State Water Resources Control Board with an integrated, basinwide control system to monitor the quality of ground water. The geology, occurrence and movement of ground water, land use, background water quality, and potential sources of pollution were described and then considered in designing the conceptual monitoring network. The network was designed to monitor major known and potential point and nonpoint sources of ground-water contamination over time. The network is composed of 291 sites where wells are needed to define the ground-water quality.

The ideal network includes four specific-purpose networks to monitor (1) ambient water quality, (2) nonpoint sources of pollution, (3) line sources of pollution, and (4) point sources of pollution.

INTRODUCTION

Under the Porter-Cologne Water Quality Control Act and Federal regulations, the California State Water Resources Control Board and the Regional Water Quality Control Boards are responsible for protecting the ground-water quality in California. San Fernando Valley is one of 21 "priority 1" ground-water basins in which water-quality-monitoring networks are required. Various governmental and private agencies have their own specific and regional monitoring needs and programs; however, an integrated, basinwide monitoring network would best fulfill the State's requirements and serve each of the agencies' needs.

San Fernando Valley is located in Los Angeles County about 15 miles northwest of the city of Los Angeles. The valley represents a prime example of the transformation of agricultural land into a modern suburban area. In the late 1920's, irrigated agriculture occupied about 50 percent of the San Fernando Valley, but by 1960 decreased to about 10 percent. Present land use in the valley is predominantly residential with industrial complexes, industrial and commercial complexes, and commercial with service-oriented businesses interspersed.

Water quality in the valley is diverse, ranging in dissolved-solids concentration from 210 mg/L for imported Owens River-Mono Basin water, to 740 mg/L for imported Colorado River water, and 1,200 to 1,500 mg/L for low flows in the Los Angeles River. The specific conductance of ground water in the western part of San Fernando Valley ranges from 940 to 2,240 µS/cm, and in the eastern part it ranges from 420 to 1,210 µS/cm. Specific conductance in the Sylmar subbasin ranges from 540 to 680 µS/cm.

Purpose and Scope

The purpose of this study was to design an ideal or conceptual basinwide network to monitor ambient ground-water quality, trends in ground-water quality, and the degree of threat from point and nonpoint pollution sources in San Fernando Valley. Specific objectives were to (1) define the ground-water system, including the direction and velocity of flow; (2) define regional baseline ground-water quality; (3) describe land use as it may affect ground-water quality; (4) define sources and potential sources of pollution, whether natural or manmade; and (5) in consideration of items 1-4 above, present a water-quality monitoring scheme for San Fernando Valley.

This report is one of seven reports, each dealing with a specific basin, completed by the U.S. Geological Survey under a cooperative program with the California State Water Resources Control Board. The presence of existing wells was not considered in the network design. Because of past litigation among various local agencies, the necessary well data are tightly controlled and were not made available for use in the design of this network.

Approach

This report is the third phase of a four-phase study. Phase 1 determined the level of ongoing surveillance in the San Fernando Valley ground-water basin. Work in the second phase resulted in a comprehensive catalog of operational ground-water-quality monitoring networks, containing a description of individual monitoring sites and data being collected; however, because of litigation concerning water rights, few data were made available for cataloging. Phase 3, developing a ground-water-quality monitoring network, involved two steps. First, an ideal or conceptual network was designed without regard to cost, logistical constraints, or presence of existing wells. Sites for monitoring in this ideal network were selected based only on land use, geohydrology, ground-water-quality conditions in the valley, and potential for contamination. Second, an operable network, corresponding as closely as possible to the ideal, was to be designed using wells currently being monitored by an agency; however, because the necessary well data were unavailable due to litigation, the operable network could not be designed. Hence, this report presents only the ideal network. Virtually all data used in this study are from previously published sources, and no fieldwork was performed.

Developing this network to meet the monitoring objectives involved a number of tasks. First it was necessary to describe the geohydrology, including occurrence and movement of ground water, aquifer characteristics, and sources of recharge and discharge. This information provided many of the criteria necessary to determine the number and location of sites and to assess their usefulness. Following geohydrology, the land use and water-quality characteristics of the basin were evaluated. Land use and water quality were the major sources of information that helped determine the type and location of existing or potential problems in the basin. The final selection of the monitoring sites was based on the geohydrology at the problem areas, which provided the information necessary to determine sampling frequency, constituents to be sampled, and depth of the well. Each of these characteristics--geohydrology, water resources, land use, and water quality--are discussed in the sections that follow. The information from these sections was evaluated to determine how an ideal network might be developed to meet not only the general monitoring needs, but also more specific monitoring objectives identified during the basin-evaluation process and by the Regional Board.

Description of the Study Area

San Fernando Valley is an alluvial basin located about 15 miles northwest of the city of Los Angeles and alined in a westerly direction (fig. 1). It is bounded on the northeast by the San Gabriel Mountains, on the northwest by the Santa Susana Mountains, on the west by the Simi Hills, on the south by the Santa Monica Mountains, and on the east by the San Rafael Hills, the Repetto Hills, and the Verdugo Mountains (pl. 1). The alluviated part of the valley is about 23 miles long and about 12 miles wide at its broadest point, and occupies 185 mi^2. The main cities include San Fernando, Burbank, and Glendale (pl. 1). The main access is by U.S. Highway 101 and Interstate Routes 5, 210, and 405. The Southern Pacific Railroad serves the area.

Comprising about 514 mi^2, the valley and its drainage area ranges in altitude from 7,124 feet above sea level at the mountain peaks to 320 feet on the valley floor. The alluvial basin itself ranges from an altitude of about 1,600 feet in the Sylmar area to 320 feet at the Los Angeles River's outlet from the basin.

The Los Angeles River system drains the entire study area (pl. 1). The main tributaries of the Los Angeles River are Arroyo Calabasas, Browns Canyon, Aliso Canyon, Bull Creek, Pacoima Wash, and Big and Little Tujunga Creeks. Records of the Los Angeles County Flood Control District indicate that for the 29-year period 1929-57, the average annual discharge of the Los Angeles River above Arroyo Seco (at outlet of San Fernando Valley) was about 40,000 acre-ft (Upper Los Angeles River Area Watermaster, 1981, p. 15). Since 1940, the flow above the outlet has been regulated by the Hansen flood-control reservoir, and by the Sepulveda flood-control reservoir since 1941. These two reservoirs have a combined capacity of 49,400 acre-ft. Many diversions from the Los Angeles River are made above this point for domestic use and irrigation.

Average annual precipitation for 85 years of record is 19.86 inches for the drainage area, 16.3 inches for the valley-fill area, and 22 inches for the hill and mountain areas (California State Water Rights Board, 1962, p. 69). Generally, precipitation in the drainage area ranges from 14 inches at the western end of the valley to 35 inches in the San Gabriel Mountains (California State Water Rights Board, 1962, p. 65); average annual temperature is 63°F.

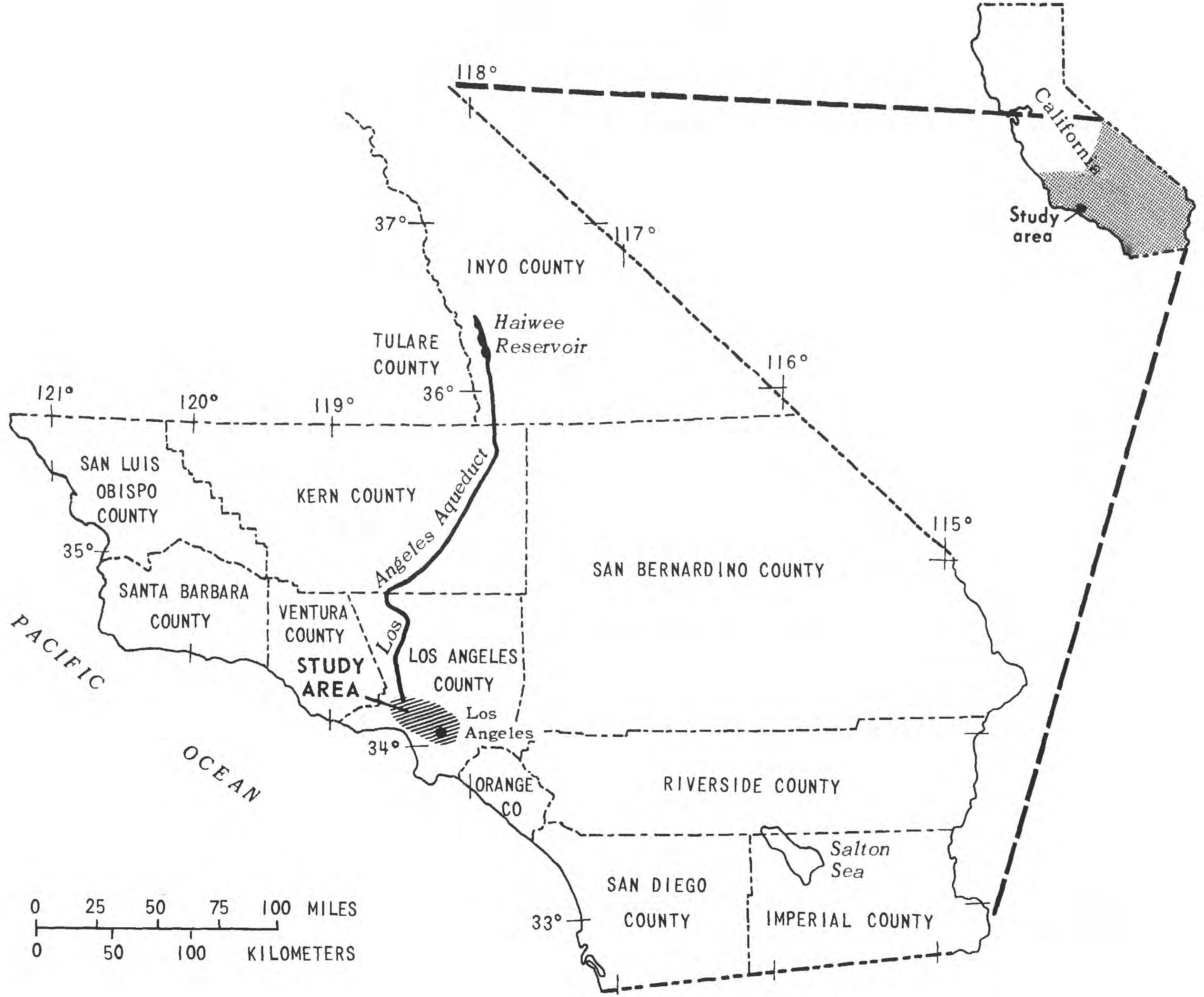
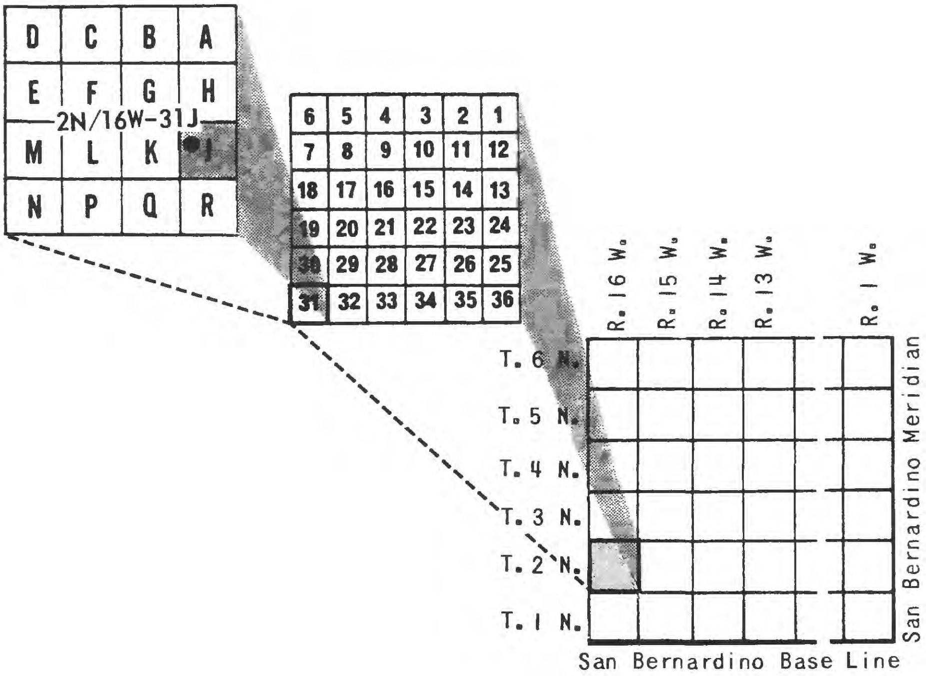


FIGURE 1.--Location of study area.

Numbering System for Suggested Monitoring Sites

The system used herein to designate location of selected monitoring sites is based on the State's well-numbering system. Wells are numbered according to their location in the rectangular system for the subdivision of public land. That part of the number preceding the slash, as in 2N/16W-31J, indicates the township (T. 2 N.); the part following the slash indicates the range (R. 16 W.); the number following the hyphen indicates the section (sec. 31); the letter following the section number indicates the 40-acre subdivision according to the lettered diagram below. All wells are north and west of the San Bernardino base line and meridian.



GEOHYDROLOGY

Overview of Basin Geohydrology

San Fernando Valley is composed of unconsolidated deposits and consolidated rocks (pl. 1). The consolidated rocks, exposed in the surrounding mountains, form the basement complex of the valley and in most areas define the boundary of the alluvial basin. The consolidated rocks range from Precambrian age for the basement complex to Pliocene age for some of the sedimentary formations (California State Water Rights Board, 1962, p. 29). Unconsolidated deposits of Pleistocene and Holocene age compose the valley fill and constitute the main water-bearing units of San Fernando Valley.

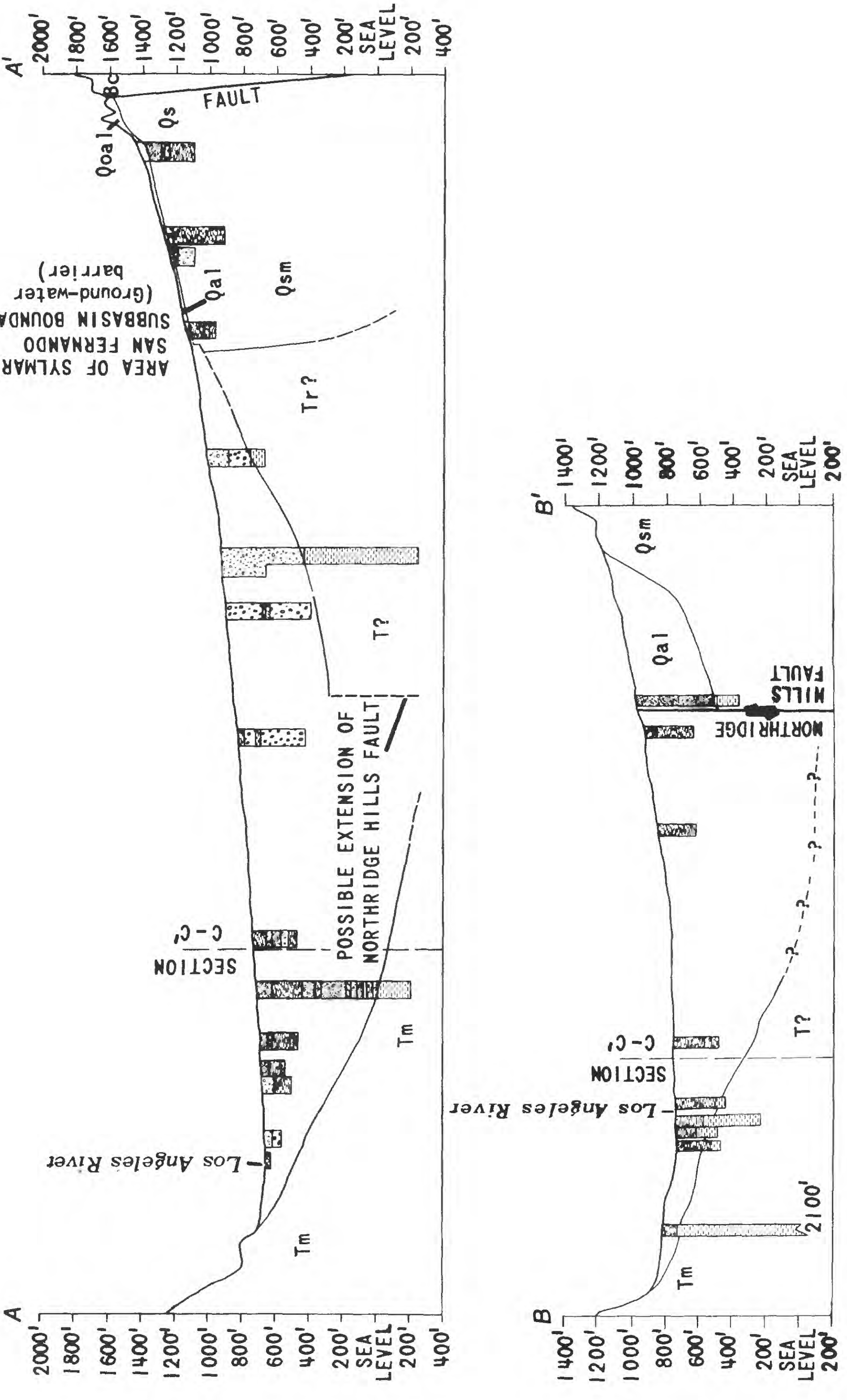
Other water-bearing deposits include the Saugus Formation, the older alluvium, and the younger alluvium. The Saugus Formation, composed of uncemented continental and marine deposits of conglomerate, sand, silt, and clay, is found only in the northern part of the valley where it crops out on the southerly slopes of the mountains (California State Water Rights Board, 1962, p. 32). It probably underlies the younger water-bearing formations in the extreme northern part of the basin. The California State Water Rights Board (1962) recognizes the part of the Saugus Formation overlain by the older and younger alluvium and below the water table as part of the ground-water reservoir. In the areas where it is exposed, such as in Sylmar and the northern part of San Fernando Valley (pl. 1), the Saugus Formation forms the boundary of the basin and is treated as non-water bearing.

Geohydrology of Individual Subbasins

Underlying the valley fill and other water-bearing areas, the San Fernando basin includes the San Fernando and Sylmar subbasins (pl. 1). Sections through the Sylmar and San Fernando subbasins are shown in figure 2.

San Fernando Subbasin

With the exception of its division from the Sylmar subbasin, the boundary of the San Fernando subbasin is the same as that for San Fernando Valley as described in the section, "Description of the Study Area." The Sylmar subbasin is separated from the San Fernando subbasin to the south by the eroded south limb of the Little Tujunga syncline (pl. 1) which causes a break (or offset) in the water table. Water levels on the northwestern side of the syncline have been about 40 to 50 feet higher than the levels on the southeastern side (California State Water Rights Board, 1962, p. 46).



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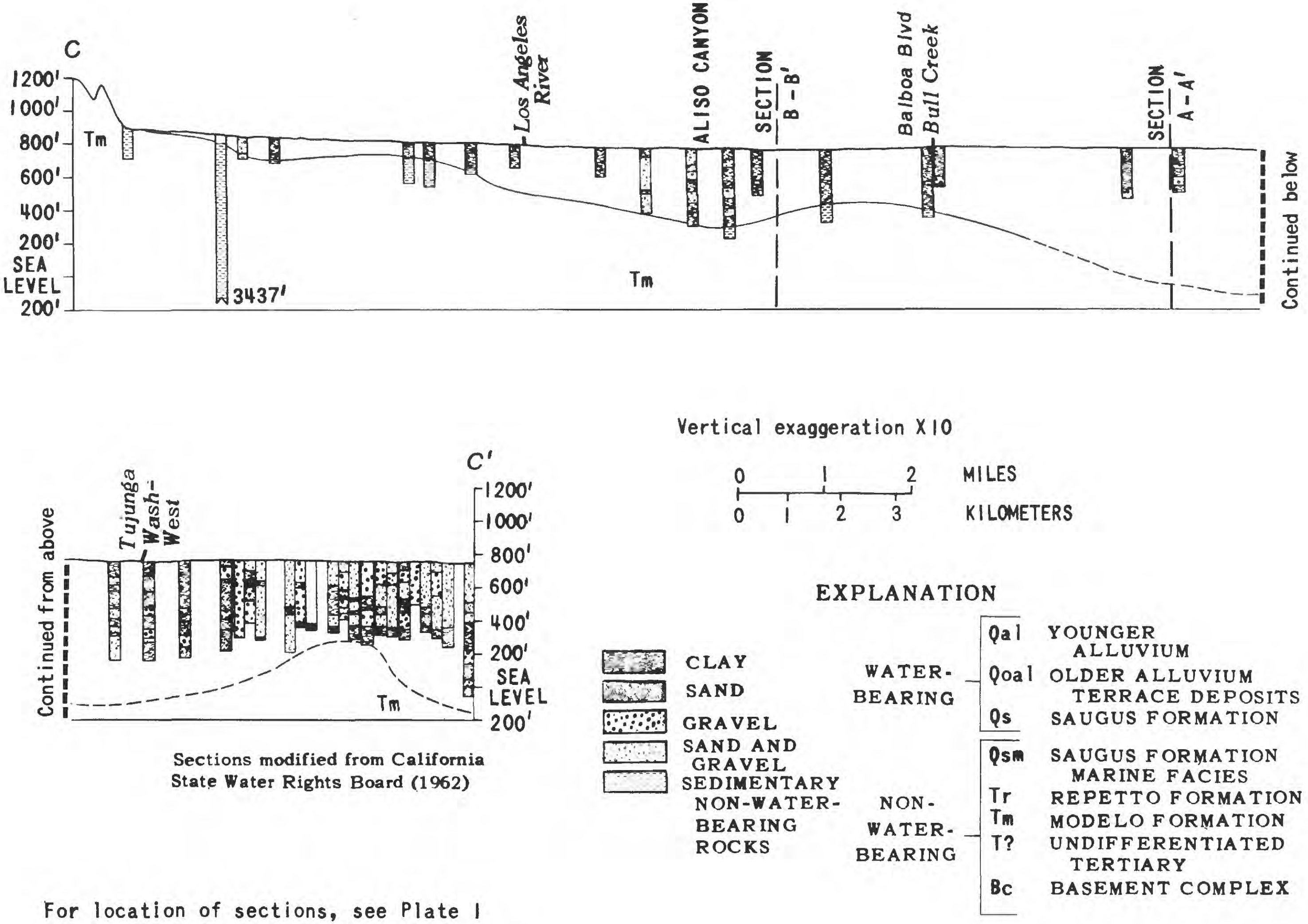

Sections modified from California State Water Rights Board (1962)

For location of sections, see Plate I

FIGURE 2.--Generalized sections showing wells located approximately along A-A', B-B', and C-C'.

West of Pacoima Wash (pl. 1), the valley fill of the San Fernando subbasin is composed of materials that have a high clay content. Movement of water in this area is relatively slow--probably about 5 to 10 feet per year--because of the clay and resulting decreased porosity. East of Pacoima Wash, most of the material forming the aquifer is sand and gravel. In these materials, water levels fluctuate with precipitation and irrigation withdrawal, which might indicate water-table conditions. Ground-water mounds are developed around certain wells, suggesting that water from deeper confined zones is leaking into the shallow zone in the alluvium (California State Water Rights Board, 1962, p. 44-48).

In the western part of the subbasin, local thin sedimentary beds contain water under pressure. Some confined zones are also located in the western part of the subbasin. These appear to be in aquifers formed by shallow, older material that is overlain by younger alluvium (California State Water Rights Board, 1962, p. 46 and 48). However, areas where ground water occurs under water-table versus confined conditions are not well defined.

The older alluvium in the subbasin is composed of coarse-grained unconsolidated deposits (California State Water Rights Board, 1962, p. 33). Deposition of this material was from modern streams during earlier periods of erosion and deposition. These deposits have greater permeabilities than those of the Saugus Formation, though the permeabilities vary according to the source. Ground water moves readily through these deposits, probably on the order of several tens to 100 to 200 ft/yr.

According to the California State Water Rights Board (1962, p. 34), "Recent deposits east of Pacoima Wash and north of the Los Angeles River consist of predominantly coarse accumulations of boulders, gravels, and sands in the form of coalescing alluvial fans derived primarily from basement complex sources. West of Pacoima Wash and south of the Los Angeles River, the sediments are derived primarily from sedimentary rocks and are finer grained and deposited in much the same manner as the underlying older alluvium." Because of these geological differences, the major well fields are east of Pacoima Wash.

Two major faults, the Verdugo and the Northridge Hills, influence ground-water movement and levels in the San Fernando subbasin (pl. 1). The Verdugo fault, which runs along the southwesterly base of the Verdugo Mountains from Eagle Rock northwesterly toward Pacoima, has a controlling influence on water levels. In the Glendale area, depth to bedrock and water-level differences of 300 feet across the fault indicate a bedrock displacement along the Verdugo fault. These water-level differences are less when the Hansen spreading grounds are in operation. The Northridge Hills fault probably affects the movement of ground water, but data are insufficient to assess its influence (California State Water Rights Board, 1962, p. 35-36). Other faults, synclines, and anticlines are shown on plate 1.

The direction of ground-water movement in this subbasin is perpendicular to the water-level contours (pl. 5)--roughly parallel to that of the surface water--from the periphery of the subbasin toward the lower areas and out the southeastern corner near Burbank.

Sylmar Subbasin

The Sylmar subbasin is bounded by the San Gabriel Mountains on the north, the Mission Hills on the southwest, the exposed Saugus Formation of upper Lopez Canyon on the east, and the eroded south limb of the Little Tujunga syncline on the south (pl. 1). Faulting and folding of non-water-bearing materials and the water-bearing Saugus Formation in the Sylmar subbasin have produced complicated geology. The most important geologic factor of the subbasin in relation to ground water is the Little Tujunga syncline, which affects at least 6,000 feet of the thickness of the Saugus Formation and a greater thickness of non-water-bearing sediments. "The syncline has been truncated by erosion and covered by a thin blanket of older and younger alluvium" (California State Water Rights Board, 1962, p. 51-52).

The following summary from the report by the California State Water Rights Board (1962) describes the effects of this syncline on water levels of the Sylmar subbasin geology:

"1. Water levels northwesterly of the break in water surface are about 50 feet higher than those to the southeast of the break.

2. Water levels northwesterly of the break are related to the eroded ends of confined aquifers in the Saugus Formation.

3. Water levels southeasterly of the break are free ground-water levels and are associated with coarse alluvial deposits which had the Pacoima drainages as a source area.

4. The discordance in water levels is related to the eroded south flank of the Little Tujunga syncline which has been covered with a thin veneer of alluvium.

5. Subsurface flow from the Sylmar subbasin into the San Fernando subbasin occurs only at two places; namely, the Sylmar and Pacoima notches [which are buried stream channels filled with alluvium that are cut into underlying, older material having a low permeability]. There is hydraulic continuity between the confined aquifers and the veneer of alluvium that overlies that eroded south flank of the Little Tujunga syncline.

6. Continuity exists between the Sylmar and San Fernando subbasins through the saturated alluvium in the two notches.

7. The configuration of the break in water surface through the Sylmar and Pacoima notches is not sharp as would be caused by a fault but is a steep gradient which is similar to that found in a ground-water cascade."

Ground water flows from the periphery of the Sylmar subbasin to the notches described above and thence to the San Fernando subbasin as mentioned above. In 1888, the Pacoima submerged dam at the Pacoima notch was constructed to retard the flow of ground water from the Sylmar subbasin. Confined aquifers in the Saugus Formation provide all the water for the subbasin, though there is an area of unused free ground water in the south-central part of the subbasin.

Ground-Water Inflow and Outflow

In order to select sites for monitoring wells, it was necessary to have a general idea of the inflow and outflow of water in the basin. The inflow, depending on its quantity and quality, can significantly improve or degrade the water quality of the aquifer. This section provides general indications of the amounts and sources of recharge and discharge. The information was compiled from an annual publication by the Upper Los Angeles River Area Watermaster (1981).

Recharge to San Fernando Valley is derived from precipitation onto the valley floor, runoff from precipitation on the surrounding hills and mountains, and from imported water via the Colorado River aqueduct, the California Water Project, and the Los Angeles aqueduct.

The 25-year runoff average from hill and mountain areas was 35,450 acre-ft to the San Fernando subbasin and 7,050 acre-ft to the Sylmar subbasin (California State Water Rights Board, 1962, p. 76). Average precipitation over San Fernando Valley for the 1980 water year was 30.25 inches (Upper Los Angeles River Area Watermaster, 1981, p. 11). For the same year, precipitation over San Fernando Valley and its drainage area amounted to 923,000 acre-ft (Upper Los Angeles River Area Watermaster, 1981, p. 7). Of this, the Los Angeles County Flood Control District and the city of Los Angeles were able to recharge 47,852 and 5,448 acre-ft in their respective spreading basins (Upper Los Angeles River Area Watermaster, 1981, p. 8). The largest amount recharged, 31,087 acre-ft at the Hansen spreading grounds below Hansen Dam, was composed primarily of runoff from the San Gabriel Mountains via Big Tujunga Creek (Upper Los Angeles River Area Watermaster, 1981, p. 16). The second-largest amount 15,583 acre-ft at the Pacoima spreading grounds, was runoff from the San Gabriel Mountains via Pacoima Creek.

The total amount of water infiltrated at spreading basins in San Fernando Valley in 1980 was about 73,500 acre-ft. Imported water, which is one of the major sources of water supply for southern California, comprised only 20,200 acre-ft of the amount spread. Although only 20,200 acre-ft of imported water was spread, a total of 540,231 acre-ft was imported to the basin. Of this, 62,477 acre-ft came from the Metropolitan Water District with the remainder coming from the Owens River via the Los Angeles Aqueduct (Upper Los Angeles River Area Watermaster, 1981, p. 8). From the 540,231 acre-ft of water imported, 255,543 acre-ft was subsequently exported from the basin to the city of Los Angeles.

The drainage system within the San Fernando subbasin consists of the Los Angeles River and its tributaries. Urbanization of the San Fernando subbasin has led to increased impervious areas, especially in the foothills. The effect of this increase is that more precipitation is falling on impervious surfaces and is collected by storm drains, routed in concrete-lined channels to the Los Angeles River, and then discharged from the subbasin resulting in a decrease in the "natural" recharge.

For the San Fernando subbasin, a total of 63,000 acre-ft was pumped from the ground-water system in the 1980 water year (Upper Los Angeles River Area Watermaster, 1981, p. 26). For the Sylmar subbasin, 6,100 acre-ft of ground water was extracted for the same water year. (Ground-water-level contours for the San Fernando and Sylmar subbasins for autumn 1980 are shown on plate 5.)

Historical Water-Level Fluctuations

Data from the California State Water Rights Board (1962) show that in a small part of the western area of the San Fernando subbasin during the period 1931-58, water levels rose from a few inches to as much as 30 feet, but in most of the area east of Balboa Boulevard water levels declined from 10 to 20 feet to as much as 110 feet. In the eastern part of the subbasin from 1942-44 to 1966-67, water levels generally declined from 80 to 190 feet (Upper Los Angeles River Area Watermaster, 1981). Between 1967 and 1977 a slight recovery occurred, followed by another decline to about the 1966-67 lows. Since 1977, water levels have generally risen about 10 to 100 feet because of above-normal rainfall and spreading operations. Water-level fluctuations in the Sylmar subbasin reflect a similar pattern, but of less total change.

WATER QUALITY

Ground-water quality in the eastern part of the San Fernando subbasin deteriorated between 1953 and 1973. According to the Los Angeles Department of Water and Power (1977, p. 1), concentrations of dissolved solids increased as much as 40 percent. This increase is shown when comparing plate 2, which has selected ranges of dissolved solids in 1950, to plate 3, which has 1970 data. Greater permeabilities in the eastern part of the subbasin have led to pumping in excess of the safe yield. Water-level decline in the western half (generally west of the Pacoima Wash) of the San Fernando subbasin probably caused the trapped water in hill and mountain areas to flow into the eastern well fields which raised the dissolved-solids concentration of the pumped water (Los Angeles Department of Water and Power, 1977, p. 3). However, other external sources may have contributed to this increase in dissolved solids.

The majority of the streams in the western part of the San Fernando subbasin are underlain by sedimentary rocks which contain gypsum, thereby producing runoff high in calcium sulfate. The streams in the eastern part of the subbasin, with runoff from areas that are granitic (from basement complex), produce a predominantly calcium carbonate water (California State Water Rights Board, 1962, p. 100-103).

The following sections on "Imported Water," "Surface Water," and "Ground Water" summarize the water quality in the San Fernando Valley and are extracted from a report by the Upper Los Angeles River Area Watermaster (1981, p. 24-25).

Imported Water

Owens River-Mono basin water is sodium bicarbonate in character and is the highest quality water available to the area. Before 1969 the dissolved-solids concentration averaged approximately 210 mg/L for 30 years with the highest record being 320 mg/L on April 1, 1946, and the lowest, 150 mg/L on September 17, 1941. The average dissolved-solids concentration for 1979-80 was 177 mg/L, which was higher than the 160 mg/L for 1978-79. This increase in dissolved solids was caused by a decreased export of streamflow (90 mg/L average) and a greater export of pumped ground water (195 mg/L average) from Owens Valley.

Colorado River water is predominantly sodium calcium sulfate in character, changing to sodium sulfate after treatment to reduce total hardness. Between 1941 and 1975, the dissolved-solids concentration was as high as 875 mg/L in August 1955, and as low as 625 mg/L in April 1959. The average dissolved-solids concentration over the 34-year period was approximately 740 mg/L. For 1979-80, the average dissolved-solids concentration was 698 mg/L.

Northern California water (State Water Project water) is sodium bicarbonate sulfate in character and generally contains less dissolved solids and is softer than local southern California and Colorado River water. Since April 1972 when the northern California water arrived, the dissolved-solids concentration of the water has ranged from a low of 247 mg/L to a high of 390 mg/L. The average dissolved-solids concentration during 1979-80 was 378 mg/L. Colorado River and northern California water were first blended in May 1975. In the 1979-80 period, the average dissolved-solids concentration was 502 mg/L.

Surface Water

Surface-water runoff contains salts dissolved from rocks in the tributary areas. Predominant cations are sodium and calcium, with sulfate and bicarbonate as anions. In 1979-80, low flows in the Los Angeles River at its outflow from the subbasin had an average dissolved-solids concentration of 670 mg/L and a total hardness of 230 mg/L.

Ground Water

Ground water in San Fernando Valley is moderately hard to very hard. The character of ground water from the major water-bearing formations is of two general types, each reflecting the composition of the surface-water runoff in the area. In the western part of the valley, it is calcium sulfate bicarbonate in character, whereas in the eastern part, including the Sylmar subbasin, it is calcium bicarbonate.

Ground water is generally within the recommended limits of the U.S. Environmental Protection Agency drinking water standards, except perhaps for wells in the western end of the San Fernando subbasin which have excess concentrations of sulfate. Chemical-quality data from wells and sites representative of the San Fernando basin are presented in table 1.

LAND USE

Land use is one of the major factors in determining the need for monitoring wells when selecting sites for an ideal network. In San Fernando Valley, past land use is often as important a criterion as in site selection as current land use. A network of monitoring wells must meet the need of describing the effects of the past widespread agricultural land use on the water table as well as take into account the current problems of urban runoff. In the western part of the valley where the soils are of low permeability, transit time for dissolved chemicals, such as nitrate, to reach the water table can be up to 50 years. Generalized land use in San Fernando Valley is shown on plate 4.

Many types of land use have the potential to cause a specific type of pollution. Sites with these types of land use were selected when designing the ideal network. Generally, networks are established to monitor land uses, such as parks, golf courses, airports, urban areas, and sewage-treatment plants that are associated with ground-water contamination. For example, not all airports contaminate the surrounding aquifer with toxic organics and jet fuels; however, because airports are a repository for those types of compounds, the potential for contamination exists, thereby establishing the need for monitoring.

Another way of looking at land use as an indicator of the potential for ground-water contamination is that prior to any development, a monitoring network would be needed to describe the ambient ground-water quality of an area. As the land use changes and the activity in that area increases, additional sites are needed to monitor the effects of that increased activity. Areas such as airports and industrial developments represent a substantial increase in activity and therefore require additional monitoring sites.

The western half of San Fernando Valley was dominated by irrigated agriculture until 1950. During the same period, the eastern part of the valley was residential but there was an increasing amount of industry. The size of the residential area in the eastern part of the valley increased during the years 1920 to 1950. From 1950 to 1955, the amount of irrigated agriculture in the western half of the valley diminished considerably as residential communities, along with business and industry, spread westward. "In 1928-29, irrigated agriculture occupied 47 percent of the valley floor and by 1957-58, constituted only 13 percent of the valley floor. On the other hand, residential, commercial, and industrial acreage had tripled during the period 1928 through 1957-58" (California State Water Rights Board, 1962, p. 126). By the 1960's, irrigated agriculture had virtually been eliminated except for some isolated patches throughout the valley.

Urban areas commonly contribute runoff that has a high chemical and biochemical oxygen demand, and contains lead, cadmium, detergents, and other pollutants. Agricultural areas contribute runoff that is high in dissolved solids, sodium, chloride, and nitrate. Older residential areas that previously used septic tanks for waste disposal produce an effluent that is high in dissolved solids, inorganic and organic nitrogen, fecal coliform bacteria, fecal streptococcal bacteria, and has a high chemical oxygen demand.

TABLE 1.--Representative chemical analyses of water

[Modified from Upper Los Angeles River Area Watermaster (1981)]

Well field or source	Date sampled	Specific conductance (µS/cm at 25°C)	pH	Constituents in Milligrams per liter / Milliequivalents per liter											Dissolved solids (mg/L)	Hardness as $CaCO_3$ (mg/L)
				Ca	Mg	Na	K	CO_3	HCO_3	SO_4	Cl	NO_3	F	B		
Imported Water																
Blended State Project and Colorado River water at Eagle Rock Reservoir	79-80	850	8.01	55 2.74	22 1.81	86 3.74	3.7 0.09	0 0	102 1.67	193 4.02	81 2.29	2.4 0.04	0.28 0.01	0.21 0.06	515	227
Owens River water at Upper Van Norman Reservoir Inlet	79-80	283	7.89	22 1.10	4.0 0.33	29 1.26	3.2 0.08	0 0	97 1.59	23 0.48	13 0.37	1.3 0.02	0.52 0.03	0.40 0.11	177	72
State Project Water at Joseph Jensen Filtration Plant (influent)	79-80	611	7.70	50 2.50	18 1.50	48 2.09	3.1 0.08	0 0	108 1.77	124 2.58	44 1.24	0.58 0.01	0.39 0.02	0.38 0.11	378	197
Surface Water																
Los Angeles River at Sepulveda Blvd.	11-21-79	1,400	8.36	132 6.59	46 3.78	104 4.52	6.0 0.15	0 0	238 3.90	340 7.08	102 2.88	3.0 0.05			868	520
	4- 9-80	1,740	8.21	192 9.58	73 6.00	125 5.44	7.3 0.19	0 0	210 3.44	655 13.85	102 2.88	3.5 0.06				
Los Angeles River at Burbank-Western Wash	11-21-79	1,350	7.35	60 3.00	26 2.14	148 6.43	12 0.31	0 0	114 1.87	240 5.00	151 4.26	5.5 0.10			837	256
	4- 9-80	1,080	7.53	51 2.54	25 2.06	128 5.57	14 0.36	0 0	135 2.21	208 4.33	112 3.16	6.0 0.10			670	232
Los Angeles River at Colorado Blvd.	11-21-79	900	7.88	88 4.39	30 2.47	58 2.52	6.0 0.15	0 0	200 3.28	175 3.65	54 1.52	2.0 0.03			558	344
	4- 9-80	950	8.28	95 4.74	31 2.55	86 3.74	6.4 0.16	0 0	192 3.15	244 5.08	74 2.09	5.1 0.08			589	362

Burbank Reclamation Plant discharge to Burbank-Western Wash	8- 6-80	950	7.08	- -	- -	112 4.87	- -	0 0	- -	- -	94 2.65	1.03 0.02	0.80 0.04	- -	573	-
Los Angeles-Glendale Reclamation Plant discharge to Los Angeles River	9-80	642	6.80	49 2.45	17 1.42	133 5.78	13 0.33	0 0	181 2.97	163 3.40	122 3.44	4.9 0.08	1.1 0.06	0.9 0.25	642	-
Ground Water																
(San Fernando Subbasin - Western Part)																
Reseda	11-27-79	953	7.20	120 6.00	29 2.39	45 1.96	2.0 0.05	- -	250 4.10	208 4.33	29 0.82	7.4 0.12	0.36 0.02	0.32 0.09	591	420
(San Fernando Subbasin - Eastern Part)																
North Hollywood	7-25-80	618	7.41	74 3.69	20 1.65	28 1.22	3.2 0.08	- -	188 3.08	89 1.85	18 0.51	3.9 0.06	0.50 0.03	0.19 0.05	383	264
Burbank	11-29-79	-	8.00	52 2.61	8.8 0.72	33 1.44	3.5 0.09	0 0	207 3.39	45 0.94	18 0.50	- -	0.50 0.03	- -	292	173
Grandview	4-27-78	580	8.10	52 2.61	10.8 0.89	55 2.39	3.6 0.09	0 0	188 3.08	43 0.90	66 1.86	- -	0.50 0.03	- -	376	175
(San Fernando Subbasin - Los Angeles Narrows)																
Pollock	10-17-79	1,180	7.00	114 5.69	39 3.21	88 3.83	2.8 0.07	- -	265 4.34	205 4.27	94 2.65	3.9 0.06	0.26 0.01	0.38 0.11	713	445
(Sylmar Subbasin)																
Mission	7-10-79	768	7.60	90 4.49	18 1.48	41 1.78	5.1 0.13	- -	205 3.36	118 2.46	43 0.70	4.2 0.07	0.27 0.01	0.28 0.08	476	296
San Fernando	1-10-79	550	7.50	65 3.25	20 1.64	28 1.22	2.3 0.06	0 0	232 3.80	68 1.42	25 0.70	- -	0.5 0.03	0.19 0.05	364	245

Airports, heavy industry, and landfills are also major potential sources of pollution and must be included in any monitoring network. The Hollywood-Burbank Airport, with its surrounding industrial area, is a major feature of San Fernando Valley. The area encompassing this land has been associated with hazardous organic chemicals and is a key area to the development of an ideal monitoring network.

Any ground-water-quality monitoring network for San Fernando Valley must take into account the potential for contamination. Within San Fernando Valley, 6.0 million gallons of liquid chemicals and 1.1 million pounds of solid chemicals are used per year (SCS Engineers and Calscience Research, Inc., 1982, p. S-2). Over half of the liquid chemicals are made up of gasoline (SCS Engineers and Calscience Research, Inc, 1982, p. S-2). The production, handling, storing, use, and disposal of this volume of chemicals represents a significant potential for contaminating the ground water of San Fernando Valley.

Because trichloroethylene, tetrachloroethylene, and carbon tetrachloride have been found in the wells in the North Hollywood area, a major concern is industrial use of the 24,000 gallons of halogenated compounds used annually (SCS Engineers and Calscience Research, Inc., 1982, p. S-2). The toxic wastes generated by industrial use of liquid chemicals in San Fernando Valley amount to almost 7.3 million gallons annually (SCS Engineers and Calscience Research, Inc., 1982, p. S-5). Most of the industries using these toxic chemicals have onsite treatment facilities. Nevertheless, a significant amount of wastewater containing chromium, copper, cyanide, nickel, and zinc is generated in San Fernando Valley.

DISTRIBUTION AND USE OF TOXIC MATERIALS

Many businesses and industries in San Fernando Valley have onsite wastewater treatment and disposal. Even though discharge permits established limits for the quality of the water discharged, the discharge sites within the valley represent a potential for ground-water contamination. For instance, within the North Hollywood area alone over 75 businesses have private disposal systems. Considering the very large number of discharges, identification and location of all the private disposal systems in the basin is a task greater in scope than can be covered in this report. For the purpose of this network design, an effort was made to identify only those areas where there is a high density of these disposal sites. The potential sources of pollution in San Fernando Valley are shown on plate 5. A breakdown of the various types of industries, the number of companies, and the annual quantity of toxic chemicals used is given in table 2. The various chemical wastes, the number of companies, and the annual quantity of generated wastes are presented in table 3. The number of pounds of solid toxic chemicals used annually in San Fernando Valley is given in table 4.

Within San Fernando Valley there are 39 dischargers that release effluent into various tributaries of the Los Angeles River and operate under permits issued by NPDES (National Pollutant Discharge Elimination Systems) (Los Angeles Department of Water and Power, 1982a, p. 8). Some of the tributaries receiving effluent are Bell Creek, Bull Creek, Tujunga Wash, Burbank Western Wash, and

Verdugo Wash. According to a Los Angeles Department of Water and Power report (1982a), "Of these 39 NPDES permittees, 21 discharge cooling tower waters; 7 discharge swimming pool wastewater, fountain water, or artificial lake overflow; 4 permittees discharge film rinse water; and 7 discharge miscellaneous waste streams." These surface-water releases are regulated and monitored; nevertheless they present the potential for ground-water contamination in the area of the unlined reaches of the Los Angeles River, and therefore are considered in the network design.

TABLE 2.--Industries in San Fernando Valley using toxic chemicals

[Data from SCS Engineers and Calscience Research, Inc., 1982]

Industry	Number of companies	Annual quantity (gallons)
Construction	6	6,205
Furniture manufacturing	3	11,300
Printing and publishing	26	5,627
Chemical manufacturing	27	165,556
Miscellaneous plastic products	2	300
Fabricated structural metal products	28	11,149
Screw machine products	6	505
Metal stamping	7	750
Metal coating	26	14,367
Miscellaneous fabricated metal products	7	763
Metal working machinery	11	1,735
Special industrial machinery	5	703
Miscellaneous machinery	127	18,919
Electronic components	2	27
Motor vehicle equipment manufacturing	3	725
Aircraft and parts manufacturing	41	1,973,815
Instruments, photographic equipment, and optical goods	7	391
Miscellaneous manufacturing	9	3,410
Public warehousing	1	90,000
Water transportation services	1	360
Machinery (wholesale)	3	250
Chemicals (wholesale)	7	1,850
Alcoholic beverages	2	732,000
Service stations	13	2,954,594
Reproduction, commercial art	6	1,415
Building services	6	287
Automotive services	123	10,830
Miscellaneous repair services	7	590
Motion picture production services	2	400
Total		6,008,823

TABLE 3.--Toxic wastes generated in San Fernando Valley

[Data from SCS Engineers and Calscience Research, Inc., 1982]

Type of chemical waste	Companies producing waste	Annual quantity (gallons)
Aliphatic solvents	1	12
Chlordane	1	60
Chromium solutions	3	4,225,000
Copper solutions	1	130,000
Cyanide solutions	1	150,000
Halomethanes	1	52,000
Heavy metals, mixed or unspecified	2	1,750,055
Insecticides, unspecified	1	120
Ketones	1	10
Nickel solutions	1	130,000
Oils, waste	107	107,987
Paints/lacquers	1	250
Petroleum distillates	1	200
Photographic chemicals	11	251,236
Sludges, toxic	6	16,750
Solvents, halogenated, mixed or unspecified	2	3,720
Solvents, nonhalogenated, mixed or unspecified	7	7,455
Tetrachloroethylene	1	110
Toluene	4	982
1, 1, 1-Trichloroethane	3	360
Zinc solutions	1	500,000
Total		7,326,307

Effluent from the Burbank and Los Angeles-Glendale Water Reclamation Plants is discharged to the Los Angeles River. During the 1980-81 water year, these two plants discharged approximately 13,600 acre-ft/yr of wastewater, which accounted for 56 percent of the annual baseflow in the Los Angeles River (Los Angeles Department of Water and Power, 1982a, p. 9). The major reason these discharges and those of the NPDES permittees are considered potential pollution sources is that the Los Angeles River below Sepulvada Dam has two unlined reaches in which infiltration to the ground-water table can occur. Because of the potential for ground-water contamination in these unlined reaches, the design of the ideal network must take these areas into account.

TABLE 4.--Solid toxic chemicals used in San Fernando Valley

[Data from SCS Engineers and Calscience Research, Inc., 1982]

Chemical	Annual quantity used (pounds)
Amines	400
Antimony compounds	4,000
Beryllium	55
Chromium compounds	2,048
Copper compounds	250
Cyanides	3,639
Lead compounds	9,900
Nickel compounds	1,200
Petroleum products	1,000,000
Thiram	225
Zinc compounds	33,400
Total	1,055,117

Landfills are another important potential source of ground-water contamination within San Fernando Valley. There are over 65 active, inactive, or proposed landfill sites in San Fernando Valley (Los Angeles Department of Water and Power, 1982b). Although Group 1 wastes (toxic substances that could impair ground-water quality) are not permitted to be disposed of in San Fernando Valley, current monitoring wells located downgradient of some sites have shown increases in carbon dioxide and methane (indicators of gas production in landfills); trichloroethene, tetrachloroethene, and nitrate, and have dissolved-solids concentrations above background levels (Los Angeles Department of Water and Power, 1982b, p. 28-30). According to the Upper Los Angeles River Area Watermaster (1980):

> Following the discovery of trichloroethene (TCE) in four San Gabriel Valley wells in January 1980, and at the request of the State Department of Health Services (SDHS), a survey of Los Angeles City wells for TCE was initiated on January 17, 1980, by DWP. The survey was again expanded to include tetrachloroethene (PCE) on July 21, 1980. The survey was again expanded to include carbon tetrachloride (CTC) on September 26, 1980. By September 30, 1980, there had been 80 wells tested for TCE; 67 wells tested for PCE; and 25 wells tested for CTC. During this test period, 16 wells exceeded the SDHS action level (5 ppb) for TCE. As testing proceeded over the approximate eight-month period, some wells increased from below to above action level for TCE and some decreased from above to below the action level for TCE. The highest values measured during the DWP survey were 31 ppb for TCE and 31 ppb for PCE through September 30, 1980. Testing for these constituents is continuing. The blend of water served to consumers has not exceeded the SDHS action levels of 5 ppb for TCE, 4 ppb for PCE, and 5 ppb for CTC since testing began for these constituents by DWP.

Although current regulations control the location, design, and operation of landfills, prior to 1949 they were virtually unregulated as to both location and operation. It was not until 1978 that an impervious liner was required on the bottom of landfills in San Fernando Valley to prevent ground-water contamination by landfill leachate (Los Angeles Department of Water and Power, 1982b, p. 7).

NETWORK DESIGN

The geohydrology, land use, water quality, and potential sources of pollution of San Fernando Valley described heretofore provide the basis for selecting sites for the ideal monitoring network. The geohydrology, land use, and water quality are used to indicate either the presence of or the potential for a water-quality problem that would result in contamination of the ground water.

The first step in the design of the monitoring network was to determine the monitoring objectives for the basin. The second step was to prioritize these objectives according to their potential impact upon the utilization of ground water within the basin. The third step was to develop a specific monitoring network for each of the objectives. The final step was to combine the individual networks into one cohesive basinwide monitoring network. The following are the proposed ground-water-quality monitoring objectives for San Fernando Valley:

1. Determine ambient water quality
2. Monitor nonpoint sources of pollution
    a. Agricultural areas
    b. Industrial areas (including airports)
    c. Private disposal areas
3. Monitor line sources (unlined reaches of Los Angeles River)
4. Monitor point sources of pollution
    a. Landfills
    b. Sites where toxic organic pollutants have been detected.

An ideal monitoring network was developed for each of the objectives listed above.

Present or potential sources of pollution (pl. 5) as determined by land use, geohydrology, or water-quality data were major site-selection factors. A monitoring site was selected within the immediate influence of each of the pollution sources to determine the quality of the water. From the ground-water contours (pl. 5), probable flow lines were projected and monitoring sites were selected downgradient of the pollution source to monitor the movement of the plume of pollution. The distance between the site and the source of pollution was determined by a combination of the velocity of ground-water movement, the frequency of sampling, and the presence of any ground-water recharge or discharge. Where major areas of ground-water use are located downgradient of a pollution source, monitoring sites were usually spaced closer to the source in order to maintain surveillance of the movement of the plume of pollution.

Sampling frequency can be increased or decreased in order to detect the presence of the pollutant prior to its arrival at the area of water use in sufficient time that management plans can be initiated to prevent contamination of the water supply.

Sampling frequency was determined according to the source of pollution, the importance of the water, and the rate of ground-water movement (the higher the rate of movement, the more frequent the sampling interval). In areas that have been designated as well fields (intensive concentrations of public supply wells and heavy pumping in areas of high permeability), the sampling frequency is usually annual. Monitoring sites located at greater distances from pollution sources are usually monitored every 2 years. Areas that have slower ground-water velocities generally have sampling frequencies of 3 to 5 years. However, in a few cases, ambient water-quality areas of slow ground-water movement and no major present or potential sources of pollution have sampling frequencies of 5 to 10 years. Even though ground water will move only 50 to 100 feet in 10 years in the southwestern part of San Fernando Valley, sampling frequencies of 5 to 10 years are still recommended because drastic changes in land use can occur in that period.

In addition to monitoring potential or present sources of pollution in areas of major land use, monitoring sites for ambient water quality were also selected in areas where no major land-use features associated with pollution existed. These monitoring sites were often set up along ground-water contour lines to detect any pollutants in the flow perpendicular to the contours along a broad advancing front. By setting the sites on equal contour lines, an early-warning network of sites oriented toward ground-water movement is achieved. The lateral spacing of the sites is based primarily on the number of upgradient potential sources of pollution and the density most likely to detect the movement of a dispersing and migrating pollutant.

The idea of early-warning lines is carried over to the area in the southeastern part of San Fernando Valley where the soil is most permeable and the greatest densities of water-supply wells are located. These lines of monitoring sites are located upgradient of the major well fields to intercept and detect the advance of any pollutants.

In industrial areas where no toxic constituents have been detected, the area is treated as a potential nonpoint source. The Los Angeles Department of Water and Power has identified an area west of the Hollywood-Burbank Airport as having the greatest density of private disposal systems (Los Angeles Department of Water and Power, 1982a, p. 1). This area is also treated as a nonpoint source of pollution even though it is made up of many point sources.

The sites for the different monitoring objectives, which are included in the ideal water-quality network, are given in the following tables: the ambient monitoring network (table 5), the nonpoint-sources monitoring network (table 6), the line-sources monitoring network (table 7), and the point-sources monitoring network (table 8). The ideal network (comprised of the sites in tables 5, 6, 7, and 8) is presented in table 9 (at end of report). In addition to site locations for each network, this table includes the constituents to be sampled, sampling frequency, and the reason for site selection. Locations of the sites for the ideal network are shown on plate 6.

TABLE 5.--Ambient monitoring network

[Site location: Gives location of sites using State well-numbering system but does not refer to any existing wells]

Index No. (pl. 6)	Site location	Index No. (pl. 6)	Site location	Index No. (pl. 6)	Site location	Index No. (pl. 6)	Site location
13	1N/13W-21E	117	1N/16W-13K	166	2N/16W-18J	243	2N/14W-31Q
14	20R	118	14F	167	18M	253	19K
15	21A	119	10H	173B	2N/15W-34H	254	19M
21	17P	120	03J	180	28R	258	06E
22	18H	121	02C	181	27L	259	1N/16W-05C
23	18D	122	09H	182	26C	260	2N/16W-32R
24	1N/14W-24C	123	04A	185	24D	261	33G
30	22B	124	04Q	190	29P	262	34C
35	20H	128	06F	191	29H	263	28P
39	16J	129	1N/17W-12F	192	28B	264	33G
41	30A	130	01N	193	22P	265	3N/15W-31D
42	19F	131	01D	194	23E	266	30K
43	18L	132	2N/17W-36M	195	20N	267	30H
44	07L	133	36F	196	20H	268	20P
45	08M	134	25R	197	15P	269	21N
46	08M	135	2N/16W-36G	198	14K	270	22P
47	08F	136	25K	204	11A	271	23N
48	08G	137	24K	205	02R	272	25C
49	08Q	138	34J	206	18H	273	2N/14W-09G
77	09J	139	35C	207	17G	274	09H
83	03A	140	26K	208	16E	275	10L
84	02K	141	26B	209	16A	276	11M
85	12F	142	23G	210	10L	277	11Q
86	06M	143	13M	211	03R	278	14A
88	1N/15W-24L	144	13F	215	36N	279	12P
89	24C	145	12R	218	09F	280	13B
90	13F	147	31J	219	07E	281	2N/13W-18Q
91	12F	148	29P	220	08D	282	20D
92	01F	149	22J	221	03D	283	21N
94	02P	150	28F	222	03E	284	21Q
95	11M	151	28A	223	03F	285	28L
96	14M	152	22E	224	3N/15W-33R	286	34D
97	16P	153	15A	225	34E	287	34M
98	10M	154	15J	226	34A	288	1N/13W-03F
99	03M	155	11P	227	35B	289	10C
100	03B	156	11K	228	36M	290	10P
101	04E	157	12D	239	28J	291	15L
102	08H	163	17R	240	2N/14W-32H		
113	18Q	164	17J	241	32K		
116	1N/16W-01L	165	17G	242	32M		

TABLE 6.--Nonpoint-sources monitoring network

[Site location: Gives location of sites using State well-numbering system but does not refer to any existing wells]

Index No. (pl. 6)	Site location	Index No. (pl. 6)	Site location	Index No. (pl. 6)	Site location	Index No. (pl. 6)	Site location
4	1N/13W-32M	54	1N/14W-05M	108	1N/15W-06G	183	2N/15W-24N
5	32M	55	05L	109	06K	184	25D
6	32L	56	05P	110	07B	188	13J
7	32K	59	07D	111	07F	189	13R
8	32E	60	06N	112	07Q	199	15M
9	32F	61	06M	114	1N/16W-12E	202	11D
10	32G	62	06E	115	12C	203	11M
11	30R	63	06E	125	07H	209	16A
12	30A	64	06D	126	08D	210	10L
17	19L	65	06C	127	05P	211	03R
18	19G	66	06B	146	2N/16W-31K	212	02N
19	16Q	67	06G	147	31J	213	02K
20	16N	68	08H	148	29P	214	02A
26	1N/14W-23C	69	08A	149	22J	215	36N
27	14P	70	04M	150	28F	216	02A
28	14F	71	04M	151	28A	217	09D
29	14H	72	04L	152	22E	218	09F
30	22B	73	04K	153	15P	221	03D
31	22K	74	04P	154	15J	222	03E
32	22P	75	04A	155	11P	223	03F
33	28D	78	10D	156	11K	229	3N/15W-26R
34	06M	79	10B	157	12D	230	35A
35	20H	80	10H	160	30B	231	26M
36	16N	81	03P	161	20L	232	27R
37	16L	82	11L	162	21P	233	33F
38	16G	86	06M	168	2N/15W-36K	234	33L
39	16J	87	06K	171	25N	235	29R
45	08M	92	1N/15W-01F	172	36D	236	29R
46	08M	93	02A	173A	34M	237	29H
47	08F	98	10M	174	33K	238	28H
48	08G	100	03B	175	32J	240	2N/14W-32H
49	08Q	103	09L	176	31L	244	31C
50	07H	104	17K	177A	31N	256	19B
51	07A	105	08L	177B	31F	257	19E
52	07A	106	05M	178	31P	258	06E
53	06R	107	05D	179	32Q		

TABLE 7.--Line-sources monitoring network

[Site location: Gives location of sites using State well-numbering system but does not refer to any existing wells]

Index No. (pl. 6)	Site location
1	1S/13W-04M
2	04P
3	09B
4	1N/13W-32M
5	32M
6	32L
7	32K
8	32E
9	32F
10	32G
11	30R
12	30A
16	19E

TABLE 8.--Point-sources monitoring network

[Site location: Gives location of sites using State well-numbering system but does not refer to any existing wells]

Index No. (pl. 6)	Site location	Index No. (pl. 6)	Site location
1	1S/13W-04M	73	1N/14W-04K
2	04P	76	09H
3	09B	77	09J
16	1N/13W-19E	87	06K
25	1N/14W-24D	158	2N/16W-27F
33	28D	159	27G
40	29H	169	2N/15W-36B
50	07H	170	36B
51	07A	186	25D
52	07A	187	24P
53	06R	200	10P
54	05M	201	15R
55	05L	245	2N/14W-31G
56	05P	246	31A
57	08D	247	19P
58	08C	248	19R
68	08H	249	20P
69	08A	250	20L
70	04M	251	20L
71	04M	252	20F
72	04L	255	19G

SUMMARY

The purpose of this study was to develop an ideal or conceptual groundwater-quality monitoring network for San Fernando Valley. This report presents the network design with the recommended constituents to be sampled, the frequency of sample collection, and the rationale for site selection. Background information on the geohydrology and land use; nonpoint, line, and point sources of pollution; and water quality of San Fernando Valley was compiled and is included to show the reasoning behind the selection of the sites.

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Upper Los Angeles River Area Watermaster, 1980, Watermaster service in the upper Los Angeles River area, Los Angeles County, October 1, 1978 - September 30, 1979: 46 p.

-----1981, Watermaster service in the upper Los Angeles River area, Los Angeles County, October 1, 1979 - September 30, 1980: 51 p.

TABLE 9.--San Fernando basin ground-water-quality monitoring network

Index No.: A convenient numbering system for the sites of the ideal network. Numbers are shown on plate 6.

Site location: Gives location of sites using State well-numbering system but does not refer to any existing wells.

Monitoring objective: Determine the quality of ground water in the San Fernando Valley; ambient, surrounding on all sides; nonpoint, agricultural, industrial, and private disposal areas; line, unlined reaches of the Los Angeles River; point, landfills, and sites where toxic organic pollutants have been detected.

Well depth and (perforated interval): The first number in the parenthesis minus 10 feet shows depth to water in autumn 1980. For example, for index number 1, the depth to water is 30 feet (40 feet minus 10); the perforated interval is 40 to 100 feet.

Constituents to be sampled:
DOC: Dissolved organic carbon.
Specific conductance: Specific conductance at 25°C (for all sites where specific conductance is used, pH and temperature also should be measured).
Toxic organic substances: Includes analysis for trichloroethylene, perchloroethylene, carbon tetrachloride, and other industrial organic substances.
Trace elements: Silver, aluminum, arsenic, barium, beryllium, cadmium, chromium, copper, mercury, nickel, lead, scandium, and zinc.
Inorganic constituents and properties: Alkalinity, boron, calcium, chlorine, iron, hardness, potassium, nitrate, silica, and sulfate.
Nutrients: Dissolved nitrite plus nitrate as nitrogen, dissolved ammonium as nitrogen, dissolved organic nitrogen as nitrogen, and dissolved orthophosphate as phosphorus.
Dissolved solids: Residue on evaporation at 180°C.

Sampling frequency: Where infiltration of industrial pollution is possible or TCE has been detected, samples are taken annually; if contamination is not detected, every 2, 3, 5, or 10 years.

Reason for selection: Site selection and frequency of sampling is based on ground-water-quality conditions in the valley. A basinwide network to monitor ambient ground-water quality would determine potential sources of pollution.

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
1	1S/13W-04M	Point, line	100 (40-100)	DOC, specific conductance, toxic organics	Annually	This site is located in a well field where TCE has been detected. Site is downgradient and in the flow lines of an unlined reach of the Los Angeles River (5,000 feet or about 15 years) where infiltration of industrial pollutants is possible.
2	1S/13W-04P	Point, line	100 (10-50)	DOC, specific conductance, toxic organics	Annually if TCE is present; every 5 years if not	Located 1,500 feet downgradient and in the flow lines of site 1.

TABLE 9.--San Fernando basin ground-water-quality monitoring network--Continued

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
3	1S/13W-09B	Point, line	75 (10-50)	DOC, specific conductance, toxic organics	Annually if TCE is present; every 5 years if not	Located 4,500 feet downgradient and in the probable flow lines of site 2.
4 5 6 7	1N/13W-32M 1N/13W-32M 1N/13W-32L 1N/13W-32K	Line, nonpoint	100 (26-60) 100 (25-60) 100 (30-70) 110 (50-100)	DOC, specific conductance, toxic organics, trace elements	Annually	Located upgradient of Pollock well field to intercept flow lines from unlined reach of Los Angeles River, industrial area, and sewage-treatment plant. These sites are to serve as an early warning perimeter around the Pollock well field.
8 9 10	1N/13W-32E 1N/13W-32F 1N/13W-32G	Line, nonpoint	100 (25-60) 100 (25-60) 125 (60-100)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 3 years	Located about 1,750 feet upgradient of sites 4 through 7 and in flow lines downgradient of unlined reach of Los Angeles River, industrial area, and sewage-treatment plant. Site 10 located on the downgradient end of the industrial area. These sites should show any effects of the industrial area on ground-water quality and act as an early warning indicator for the Pollock well field.
11	1N/13W-30R	Line, nonpoint	100 (10-50)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 2 years	Located within industrial area to determine any local effects on ground-water quality. Should pick up infiltration by the unlined reach of the Los Angeles River. Site is also downgradient of a sewage-treatment plant.
12	1N/13W-30A	Line, nonpoint	110 (45-80)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 2 years	Located within industrial area to determine any local effects on ground-water quality. In flow lines, picking up any infiltration by the unlined reach of the Los Angeles River.
13	1N/13W-21E	Ambient	280 (190-250)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 5 years	Ambient water quality.

TABLE 9.--San Fernando basin ground-water-quality monitoring network--Continued

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
14	1N/13W-20R	Ambient	250 (150-200)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 5 years	Ambient water quality.
15	1N/13W-21A	Ambient	400 (290-350)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 5 years	Ambient water quality.
16	1N/13W-19E	Point, line	200 (110-160)	DOC, specific conductance, toxic organics, trace elements	Annually	Located in well field where TCE has been detected. Site is in flow path downgradient of an unlined reach of the Los Angeles River where infiltration of industrial pollutants is possible.
17	1N/13W-19L	Nonpoint	120 (45-90)	DOC, specific conductance, toxic organics, trace elements	Annually	Located upgradient of well field. Serves as monitoring site for southern end of well field.
18 19 20	1N/13W-19G 1N/13W-16Q 1N/13W-16N	Nonpoint	190 (90-140) 520 (430-480) 330 (230-280)	DOC, specific conductance, toxic organics, trace elements	Annually	Sites are located upgradient of well field to monitor ground-water flow to the well field and to serve as indicators of potential pollution problems. Site 20 is located in an industrial area upgradient of the well field.
21 22 23	1N/13W-17P 1N/13W-18H 1N/13W-18D	Ambient	270 (170-220) 310 (210-260) 280 (180-230)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 5 years	Ambient water quality.
24	1N/14W-24C	Ambient	290 (190-240)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 5 years	Ambient water quality.

TABLE 9.--San Fernando basin ground-water-quality monitoring network--Continued

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
25	1N/14W-24D	Point	190 (90-140)	DOC, specific conductance, toxic organics	Annually	Located in well field where TCE has been detected. Site is 5,000 feet or about 15 years of ground-water flow downgradient of two industrial areas.
26	1N/14W-23C	Nonpoint	210 (110-160)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 3 years	Sites are located between 1,500 and 2,500 feet upgradient of well field to intercept ground-water flow to the well field and act as early warning indicators for contaminants moving downgradient. Sites 26 and 29 are downgradient of industrial areas.
27	1N/14W-14P		210 (110-160)			
28	1N/14W-14F		210 (110-160)			
29	1N/14W-14H		190 (90-140)			
30	1N/14W-22B	Nonpoint, ambient	220 (120-170)	DOC, specific conductance, toxic organics, trace elements	Every 3 years	Site located upgradient of industrial area. Site to determine ambient water quality.
31	1N/14W-22K	Nonpoint	190 (90-140)	DOC, specific conductance, toxic organics, trace elements	Every 3 years if contamination detected at site 32	Site located downgradient of industrial area. If contamination detected at site 32, this site will determine movement of plume of contamination.
32	1N/14W-22P	Nonpoint	200 (100-150)	DOC, specific conductance, toxic organics, trace elements	Every 3 years	Site located within industrial area to determine any local effects on ground water.
33	1N/14W-28D	Point, nonpoint	200 (100-150)	DOC, specific conductance, toxic organics, trace elements, nutrients	Every 3 years if contamination detected at site 40	Site located in the flow path downgradient of a landfill.
34	1N/14W-06M	Nonpoint, ambient (35, 39)	370 (270-320)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Initially, every 3 years; thereafter, every 5 years	Sites located about 2,000 feet upgradient of well field to intercept ground-water flow to the well field and act as early warning indicators for contamination moving downgradient. Sites 36 through 38 are located in the area of dissolved-solids change. Sites 35 and 39 are also for ambient quality.
35	1N/14W-20H		230 (130-180)			
36	1N/14W-16N		240 (140-190)			
37	1N/14W-16L		230 (130-180)			
38	1N/14W-16G		240 (140-190)			
39	1N/14W-16J		220 (120-170)			

TABLE 9.--San Fernando basin ground-water-quality monitoring network--Continued

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
40	1N/14W-29H	Point	190 (90-140)	DOC, specific conductance, toxic organics, trace elements, nutrients	Annually	Site located immediately downgradient in the flow path from landfill.
41	1N/14W-30A	Ambient	180 (80-130)	DOC, specific conductance, toxic organics, trace elements, nutrients, dissolved solids	Every 5 years	Ambient water quality.
42	1N/14W-19F		210 (110-160)			
43	1N/14W-18L		230 (130-180)			
44	1N/14W-07L		270 (170-220)			
45	1N/14W-08M	Nonpoint, ambient	280 (180-230)	DOC, specific conductance, toxic organics, trace elements	Every 2 years	Sites located about 500 feet upgradient of well field to intercept flow to the well field and act as early indicators for contaminants moving downgradient.
46	1N/14W-08M		280 (180-230)			
47	1N/14W-08F		290 (190-240)			
48	1N/14W-08G		270 (170-220)			
49	1N/14W-08Q	Nonpoint, ambient	260 (160-210)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Site located within well field to show local water quality. Also for ambient water quality.
50	1N/14W-07H	Point, nonpoint	280 (180-230)	DOC, specific conductance, toxic organics, trace elements, nutrients, dissolved solids	Annually	Sites are located upgradient of well field to intercept flow to the well field and to act as early warning indicators for contaminants moving downgradient. Site 52 is located immediately downgradient of a landfill. Sites 52 and 53 are located in the flow lines down gradient of an area where TCE has been detected. Sites 53 through 55 are located within an industrial area to determine any local effects on ground water. Site 56 is located downgradient of an industrial area.
51	1N/14W-07A		300 (200-250)			
52	1N/14W-07A		300 (200-250)			
53	1N/14W-06R		300 (200-250)			
54	1N/14W-05M		300 (200-250)			
55	1N/14W-05L		300 (200-250)			
56	1N/14W-05P		300 (200-250)			
57	1N/14W-08D	Point	300 (200-250)	DOC, specific conductance, toxic organics, trace elements, nutrients, dissolved solids	Annually	Located in well field where TCE has been detected and downgradient and in flow lines of landfill.

TABLE 9.--San Fernando basin ground-water-quality monitoring network--Continued

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
58	1N/14W-08C	Point	290 (190-240)	DOC, specific conductance, toxic organics, trace elements, nutrients, dissolved solids	Annually	Located downgradient and in flow lines of landfill.
59 60 61 62 63 64 65 66 67	1N/14W-07D 1N/14W-06N 1N/14W-06M 1N/14W-06E 1N/14W-06E 1N/14W-06D 1N/14W-06C 1N/14W-06B 1N/14W-06G	Nonpoint	290 (190-240) 300 (200-250) 310 (210-260) 330 (230-280) 330 (230-280) 330 (230-280) 330 (230-280) 330 (230-280) 330 (230-280)	DOC, specific conductance, toxic organics, trace elements, nutrients, dissolved solids	Annually	Sites located upgradient of well field to intercept flow to well field and act as early warning indicators for contaminants moving downgradient. Sites 62, 63, 65, 66, and 67 are located within industrial area to determine any local effects on ground water. Sites 63 and 65 located downgradient and in flow lines from area of private disposal systems.
68 69 70 71 72 73	1N/14W-08H 1N/14W-08A 1N/14W-04M 1N/14W-04M 1N/14W-04L 1N/14W-04K	Point, nonpoint	300 (200-250) 300 (200-250) 310 (210-260) 310 (210-260) 300 (200-250) 300 (200-250)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Sites 68 through 73 located upgradient of well field to intercept flow to the well field and to act as early warning indicators for contaminants moving downgradient. Site 69 located in area where TCE has been detected. Sites 70 through 73 located within industrial area to determine any local effects on ground water.
74	1N/14W-04P	Nonpoint	280 (180-230)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Site located in well field and downgradient and in flow line of major industrial area which includes an airport.
75	1N/14W-04A	Nonpoint	270 (170-122)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 2 years	Site located within major industrial area to determine any local ground-water effects.
76	1N/14W-09H	Point	260 (160-210)	DOC, specific conductance, toxic organics, trace elements, nutrients, dissolved solids	Annually	Site located immediately downgradient and in flow lines of a landfill.

TABLE 9.--San Fernando basin ground-water-quality monitoring network--Continued

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
77	1N/14W-09J	Point, ambient	250 (150-200)	DOC, specific conductance, toxic organics, trace elements, nutrients, dissolved solids	Every 5 years	Site located about 1,500 feet downgradient and in flow lines of landfill. Ambient water quality.
78	1N/14W-10D	Nonpoint	260 (160-210)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 3 years	Sites located downgradient and in flow lines of major industrial area to determine any local effects on ground water.
79	1N/14W-10B		240 (140-190)			
80	1N/14W-10H		220 (120-170)			
81	1N/14W-03P	Nonpoint	260 (160-210)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 2 years	Sites located within industrial area to determine any local effects on ground water.
82	1N/14W-11L		210 (110-160)			
83	1N/14W-03A	Ambient	210 (110-160)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 5 years	Ambient water quality.
84	1N/14W-02K		370 (270-320)			
85	1N/14W-12F		330 (230-280)			
86	1N/14W-06M	Nonpoint, ambient	230 (130-180)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Site located in industrial area and in well field to determine any local effects on ground water. Located downgradient of area high in dissolved solids.
87	1N/14W-06K	Point, nonpoint	320 (220-270)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Site located in well field and in area where TCE has been detected. Site also downgradient and in flow line of industrial area.
88	1N/15W-24L	Ambient	170 (70-120)	DOC, specific conductance, nutrients, dissolved solids	Every 5 years	Ambient water quality.
89	1N/15W-24C		210 (110-160)			
90	1N/15W-13F		230 (130-180)			
91	1N/15W-12F		270 (170-220)			

TABLE 9.--San Fernando basin ground-water-quality monitoring network--Continued

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
92	1N/15W-01F	Nonpoint, ambient	310 (210-260)	DOC, specific conductance, toxic organics, trace elements, dissolved solids, nitrates	Every 3 years	Site located downgradient and in flow lines of area where private disposal systems are used. Also for ambient water quality and to monitor area high in dissolved solids.
93	1N/15W-02A	Nonpoint	310 (210-260)	DOC, specific conductance, toxic organics, trace elements, dissolved solids, nitrates	Annually	Site located within area of private disposal systems usage to determine any local effects on ground water.
94 95 96	1N/15W-02P 1N/15W-11M 1N/15W-14M	Ambient	270 (170-220) 250 (150-200) 210 (110-160)	Specific conductance, nutrients, dissolved solids	Every 5 years	Ambient water quality.
97 98 99 100 101 102	1N/15W-16P 1N/15W-10M 1N/15W-03M 1N/15W-03B 1N/15W-04E 1N/15W-08H	Ambient (97-102), nonpoint (98, 100)	140 (40-90) 230 (130-180) 270 (170-220) 280 (180-230) 280 (180-230) 230 (130-180)	Sites 97-102: specific conductance, nutrients, dissolved solids. Sites 98, 100 add DOC, toxic organics, trace elements.	Every 5 years	Ambient water quality. Sites 98 and 100 are located downgradient and in the flow lines of industrial areas to determine any local effects on ground water.
103	1N/15W-09L	Nonpoint	230 (130-180)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Located within industrial area to determine any local effects on ground water.
104 105	1N/15W-17K 1N/15W-08L	Nonpoint	140 (40-90) 200 (100-150)	Specific conductance, nutrients, dissolved solids	Every 2 years	Sites located in agricultural area near Sepulveda Dam to determine any local effects on ground water.
106 107	1N/15W-05M 1N/15W-05D	Nonpoint	250 (150-200) 260 (160-210)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 3 years	Sites located downgradient and in flow lines of industrial area to determine any local effects on ground water.

TABLE 9.--San Fernando basin ground-water-quality monitoring network--Continued

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
108 109	1N/15W-06G 1N/15W-06K	Nonpoint	250 (150-200) 240 (140-190)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Sites located within industrial area to determine any local effects on ground water.
110	1N/15W-07B	Nonpoint	250 (150-200)	Specific conductance, nutrients, dissolved solids	Every 5 years	Site located downgradient and in flow lines of agricultural area.
111	1N/15W-07F	Nonpoint	230 (130-180)	Specific conductance, nutrients, dissolved solids	Every 2 years	Site located within agricultural area behind Sepulveda Dam.
112	1N/15W-07Q	Nonpoint	180 (80-130)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 2 years	Site located in flood control area behind Sepulveda Dam to determine any local effects on ground water from storm runoff held by the dam.
113	1N/15W-18Q	Ambient	130 (30-80)	Specific conductance, nutrients, dissolved solids	Every 5 years	Ambient water quality.
114	1N/16W-12E	Nonpoint	140 (40-90)	Specific conductance, nutrients, dissolved solids	Every 2 years	Site located in agricultural area in basin behind Sepulveda Dam to determine any local effects on ground water.
115	1N/16W-12C	Nonpoint	150 (50-100)	Specific conductance, nutrients, dissolved solids	Every 5 years	Site located downgradient and in flow lines of agricultural area.
116	1N/16W-01L	Ambient	180 (80-130)	Specific conductance, nutrients, dissolved solids	Every 5 years	Ambient water quality.

TABLE 9.--San Fernando basin ground-water-quality monitoring network--Continued

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
117	1N/16W-13K	Ambient	170 (70-120)	Specific conductance, nutrients, dissolved solids; first sample add DOC, toxic organics, trace elements (continue these only if contamination found).	Every 5 years	Ambient water quality.
118	1N/16W-14F		190 (90-140)			
119	1N/16W-10H		120 (20-70)			
120	1N/16W-03J		120 (20-70)			
121	1N/16W-02C		130 (30-80)			
122	1N/16W-09H	Ambient	110 (10-60)	Specific conductance, nutrients, dissolved solids	Every 5 years	Ambient water quality.
123	1N/16W-04A		120 (20-70)			
124	1N/16W-04Q		110 (10-60)			
125	1N/16W-07H	Nonpoint	140 (40-90)	DOC, specific conductance, toxic organics, trace elements, dissolved solids, nutrients	Every 5 years	This is an area of low permeability and slow horizontal velocities (5 ft/yr). Site located within industrial area to determine any local effects on ground water.
126	1N/16W-08D	Nonpoint	120 (20-70)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Sample site 126 every 10 years only if contamination detected at site 125. Sample site 127 every 10 years only if contamination detected at site 126	Sites located downgradient and in flow lines of industrial area to determine any local effects.
127	1N/16W-05P		110 (10-60)			
128	1N/16W-06F	Ambient	120 (20-70)	Specific conductance, nutrients, dissolved solids	Every 10 years	Ambient water quality.
129	1N/17W-12F		125 (25-75)			
130	1N/17W-01N		110 (10-60)			
131	1N/17W-01D		110 (10-60)			
132	2N/17W-36M	Ambient	120 (20-70)	Specific conductance, nutrients, dissolved solids	Every 10 years	Ambient water quality.
133	2N/17W-36F		120 (20-70)			
134	2N/17W-25R		140 (40-90)			

TABLE 9.--San Fernando basin ground-water-quality monitoring network--Continued

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
135	2N/16W-36G	Ambient	200 (100-150)	Specific conductance, nutrients, dissolved solids	Every 5 years	Ambient water quality. Sites 135 and 136 located upgradient of large industrial area.
136	2N/16W-25K		220 (120-170)			
137	2N/16W-24Q		260 (160-210)			
138	2N/16W-34J	Ambient	120 (20-70)	Specific conductance, nutrients, dissolved solids	Every 5 years	Ambient water quality.
139	2N/16W-35C		130 (30-80)			
140	2N/16W-26K		170 (70-120)			
141	2N/16W-26B		210 (110-160)			
142	2N/16W-23G		270 (170-220)			
143	2N/16W-13M		330 (230-280)			
144	2N/16W-13F		340 (240-290)			
145	2N/16W-12R		340 (240-290)			
146	2N/16W-31K	Nonpoint	130 (30-80)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 3 years	Site located within industrial area to determine any local effects on ground water.
147	2N/16W-31J	Nonpoint, ambient	130 (30-80)	DOC, specific conductance, toxic organics, trace elements, dissolved solids, nutrients	Every 5 years for specific conductance, dissolved-solids, and nutrients. DOC, toxic organics, trace elements only if contamination detected at site 146	Site located downgradient of industrial area to determine any local effects on ground water. Ambient water quality.

TABLE 9.--San Fernando basin ground-water-quality monitoring network--Continued

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
148 149 150 151 152 153 154 155 156 157	2N/16W-29P 2N/16W-22J 2N/16W-28F 2N/16W-28A 2N/16W-22E 2N/16W-15P 2N/16W-15J 2N/16W-11P 2N/16W-11K 2N/16W-12D	Nonpoint, ambient	150 (50-100) 170 (70-120) 140 (40-90) 140 (40-90) 190 (90-140) 220 (120-170) 250 (150-200) 370 (270-320) 370 (270-320) 420 (320-370)	DOC, specific conductance, toxic organics, trace elements, dissolved solids, nutrients	Initially sample for all constituents. If any contamination detected, continue sampling for all constituents every 3 years. Otherwise, sample for specific conductance, nutrients, and dissolved solids every 5 years	Sites 148 through 154 located at varying distances downgradient of industrial and agricultural areas to serve as early warning indicators for contaminants moving southwestward in the basin. Ambient water quality.
158	2N/16W-27F	Point	130 (30-80)	DOC, specific conductance, toxic organics, trace elements, nutrients, dissolved solids	Annually	Site located immediately downgradient and in flow lines of landfill.
159	2N/16W-27G	Point	130 (30-80)	DOC, specific conductance, toxic organics, trace elements, nutrients, dissolved solids	Every 5 years only if contamination detected at site 158	Site located about 900 feet below landfill to determine movement of contaminents downgradient.
160	2N/16W-30B	Nonpoint	170 (70-120)	Specific conductance, nutrients, dissolved solids	Every 5 years only if contamination detected at site 158	Site located on downgradient side of agricultural area to determine any local effects on ground water.

TABLE 9.--San Fernando basin ground-water-quality monitoring network--Continued

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
161	2N/16W-20L	Nonpoint	190 (90-40)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Site located within industrial area to determine any local effects on ground water.
162	2N/16W-21P	Nonpoint	160 (60-110)	Specific conductance, nutrients, dissolved solids	Every 3 years	Site located within agricultural area to determine any local effects on ground water.
163 164 165	2N/16W-17R 2N/16W-17J 2N/16W-17G	Ambient	200 (100-150) 200 (100-150) 180 (80-130)	Specific conductance, nutrients, dissolved solids	Every 5 years	Sites located across dissolved solids gradient to determine any changes. Ambient water quality.
166 167	2N/16W-18J 2N/16W-18M	Ambient	170 (60-110) 120 (20-70)	Specific conductance, nutrients, dissolved solids	Every 5 years	Ambient water quality.
168	2N/15W-36K	Nonpoint	330 (230-280)	DOC, specific conductance, toxic organics, trace elements, nutrients, dissolved solids	Every 2 years	Site located upgradient of landfill for comparison of water quality with downgradient sites.
169	2N/15W-36B	Point	340 (240-290)	DOC, specific conductance, toxic organics, trace elements, nutrients, dissolved solids	Annually	Site located immediately downgradient and in flow lines of landfill.
170	2N/15W-36B	Point	340 (240-290)	DOC, specific conductance, toxic organics, trace elements, nutrients, dissolved solids	Every 3 years if contamiation is detected at site 169	Site located downgradient and in flow lines of landfill to determine spread of any concontaminants detected at site 169.

TABLE 9.--San Fernando basin ground-water-quality monitoring network--Continued

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
171	2N/15W-25N	Nonpoint	350 (250-300)	Specific conductance, toxic organics, trace elements, dissolved solids	Site 171 annually, site 172 every 3 years	Sites located downgradient of major recharge area.
172	2N/15W-36D		340 (240-290)			
173A	2N/15W-34M	Nonpoint	310 (210-260)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Site located within industrial area to determine any effects on ground water.
173B	2N/15W-34H	Ambient	310 (190-260)	Specific conductance, nutrients, dissolved solids	Every 3 years	Ambient water quality.
174	2N/15W-33K	Nonpoint	290 (190-240)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Site located within industrial area to determine any effects on ground water.
175	2N/15W-32J	Nonpoint	290 (190-240)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Sites located within industrial area and airport to determine any local effects on ground water.
176	2N/15W-31L		280 (180-230)			
177A	2N/15W-31N		290 (190-240)			
177B	2N/15W-31F					
178	2N/15W-31P	Nonpoint	280 (180-230)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Site 178 every 3 years if contamination is detected at site 178	Sites located about 500 and 1,500 feet, respectively, downgradient and in flow lines of industrial area and airport to determine the spread of any contaminants.
179	2N/15W-32Q		280 (180-230)			
180	2N/15W-28R	Ambient	330 (230-280)	Specific conductance, nutrients, dissolved solids	Every 5 years	Ambient water quality.
181	2N/15W-27L		340 (240-290)			
182	2N/15W-26C		370 (270-320)			

TABLE 9.--San Fernando basin ground-water-quality monitoring network--Continued

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
183	2N/15W-24N	Nonpoint	410 (310-360)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Site located within industrial area to determine local effects on ground water.
184	2N/15W-25D	Nonpoint	430 (330-380)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 3 years if contamination detected at site 183	Site located about 1,000 feet downgradient and in flow lines of industrial area to determine spread of any contaminants detected at site 183.
185	2N/15W-24D	Ambient	445 (345-395)	Specific conductance, nutrients, dissolved solids	Every 5 years	Ambient water quality.
186	2N/15W-24L	Point	410 (310-360)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Site located downgradient side of landfill to determine any local effects on ground water.
187	2N/15W-24P	Point	410 (310-360)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 3 years if contamination detected at site 186	Site located downgradient and in flow lines of landfill to determine spread of any contaminants detected at site 186.
188	2N/15W-13J	Nonpoint	450 (350-400)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Site located within industrial area to determine any local effects on ground water.
189	2N/15W-13R	Nonpoint	440 (340-390)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 3 years if contamination detected at site 188	Site located downgradient and in flow lines of industrial area to determine the spread of any contaminants detected at site 188. Site also located upgradient of recharge area.

TABLE 9.--San Fernando basin ground-water-quality monitoring network--Continued

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
190	2N/15W-29P	Ambient	320 (220-270)	Specific conductance, nutrients, dissolved solids	Every 5 years	Ambient water quality.
191	2N/15W-29H		340 (240-290)			
192	2N/15W-28B		350 (250-300)			
193	2N/15W-22P		370 (270-320)			
194	2N/15W-23E		420 (320-370)			
195	2N/15W-20N		330 (230-280)			
196	2N/15W-20H		360 (260-310)			
197	2N/15W-15P		410 (310-360)			
198	2N/15W-14K		460 (360-410)			
199	2N/15W-15M	Nonpoint	440 (340-390)	Specific conductance, nutrients, dissolved solids	Every 2 years	Site located immediately downgradient and in flow lines of major recharge area to determine local effect on ground water.
200	2N/15W-10P	Point	430 (330-380)	DOC, specific conductance, toxic organics, trace elements, dissolved solids, nutrients	Annually	Site located immediately downgradient of landfill to determine any local effects on ground water.
201	2N/15W-15B	Point	470 (370-420)	DOC, specific conductance, toxic organics, trace elements, dissolved solids, nutrients	Every 3 years if contamination detected at site 200	Site located about 1,500 feet downgradient and in flow lines of landfill to determine spread of any contaminants detected at site 200.
202	2N/15W-11D	Nonpoint	500 (400-450)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Site located within industrial area to determine any local effects on ground water.
203	2N/15W-11M	Nonpoint	470 (370-420)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 3 years if contamination detected at site 202	Site located downgradient and in flow lines of industrial area to determine spread of any contaminants detected at site 202.
204	2N/15W-11A	Ambient	470 (70-420)	Specific conductance, nutrients, dissolved solids	Every 5 years	Ambient water quality.
205	2N/15W-02R		190 (90-140)			

TABLE 9.--San Fernando basin ground-water-quality monitoring network--Continued

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
206	2N/15W-18H	Ambient	360 (260-310)	Specific conductance, nutrients, dissolved solids	Every 5 years	Ambient water quality.
207	2N/15W-17G		350 (250-300)			
208	2N/15W-16E		350 (250-300)			
209	2N/15W-16A	Ambient, nonpoint	390 (290-340)	Specific conductance, nutrients, dissolved solids	Every 3 years	Ambient water quality. Site located upgradient of major recharge area.
210	2N/15W-10L	Ambient, nonpoint	440 (340-390)	DOC, specific conductance, toxic organics, trace elements, nutrients, dissolved solids	Every 3 years	Ambient water quality. Site located upgradient of landfill.
211	2N/15W-03R	Ambient, nonpoint	490 (70-440)	DOC, specific conductance, toxic organics, trace elements, nutrients, dissolved solids	Every 3 years	Ambient water quality. Site located upgradient of industrial area.
212	2N/15W-02N	Nonpoint	230 (80-180)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 3 years	Sites located downgradient and in flow lines of industrial areas to determine any local effects on ground water and to determine spread of any contaminants from the industries.
213	2N/15W-02K		220 (120-170)			
214	2N/15W-02A		270 (170-220)			
215	2N/15W-36N	Nonpoint, ambient	270 (170-220)	DOC, specific conductance, nutrients, toxic organics, trace elements, dissolved solids	Annually	Site located downgradient of recharge from Sylmar subbasin.
216	2N/15W-02A	Nonpoint	270 (170-220)	DOC, specific conductance, nutrients, dissolved solids	Every 3 years	Site located downgradient of area of recharge from Sylmar subbasin to determine the movement and water quality of the recharge.

TABLE 9.--San Fernando basin ground-water-quality monitoring network--Continued

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
217	2N/15W-09D	Nonpoint	370 (270-320)	Specific conductance, nutrients, dissolved solids	Every 2 years	Site located within agricultural area to determine any local effects on ground water.
218	2N/15W-09F	Nonpoint, ambient	390 (290-340)	Specific conductance, nutrients, dissolved solids	Every 5 years	Site located about 1,500 feet downgradient and in flow line of an agricultural area to determine spread of any contaminants from site 217. Ambient water quality.
219 220	2N/15W-07E 2N/15W-08D	Ambient	360 (260-310) 340 (240-290)	Specific conductance, nutrients, dissolved solids	Every 5 years	Ambient water quality.
221 222 223	2N/15W-03D 2N/15W-03E 2N/15W-03F	Nonpoint, ambient	250 (100-200) 250 (80-200) 250 (80-200)	DOC, specific conductance, toxic organics, trace elements, nutrients, dissolved solids	Site 221 annually, sites 222 and 223 every 3 years	Sites are located downgradient of the Sylmar notch where ground water flows from the Sylmar subbasin to the San Fernando subbasin.
224 225 226 227 228	3N/15W-33R 3N/15W-34E 3N/15W-34A 3N/15W-35B 3N/15W-36M	Ambient	200 (100-150) 260 (160-210) 250 (150-200) 330 (230-280) 210 (110-160)	Specific conductance, nutrients, dissolved solids	Every 5 years	Ambient water quality.
229	3N/15W-26R	Nonpoint	230 (130-180)	Specific conductance, nutrients, dissolved solids	Every 2 years	Site located within agricultural area to determine local effects on ground water.
230	3N/15W-35A	Nonpoint	280 (180-230)	Specific conductance, nutrients, dissolved solids	Every 5 years if contamination detected at site 229	Site located downgradient and in flow lines of agricultural area to determine the spread of any contaminants from site 229.

TABLE 9.--San Fernando basin ground-water-quality monitoring network--Continued

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
231	3N/15W-36M	Nonpoint	270 (170-220)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Site located within industrial area to determine any local effects on ground water.
232	3N/15W-27R	Nonpoint	210 (110-160)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 3 years if contamination detected at site 231	Site downgradient and in flow lines of industrial area to determine the spread of any contaminants detected at site 231.
233	3N/15W-33F	Nonpoint	210 (110-160)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Site located within industrial area to determine any local effects on ground water.
234	3N/15W-33L	Nonpoint	190 (90-140)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 3 years if contamination detected at site 233	Site located downgradient and in flow lines of industrial area to determine spread of any contaminants detected at site 233.
235	3N/15W-29R	Nonpoint	150 (50-100)	Specific conductance, nutrients, dissolved solids	Every 2 years	Site located within agricultural area to determine any local effects on ground water.
236	3N/15W-29R	Nonpoint	170 (70-120)	Specific conductance, nutrients, dissolved solids	Every 5 years if contamination detected at site 235	Site located downgradient and in flow lines of agricultural area to determine spread of any contaminants detected at site 235.
237	3N/15W-29H	Nonpoint	130 (30-80)	Specific conductance, nutrients, dissolved solids	Every 2 years	Site located within agricultural area to determine any local effects of ground water.

TABLE 9.--San Fernando basin ground-water-quality monitoring network--Continued

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
238	3N/15W-28H	Nonpoint	160 (60-110)	Specific conductance, nutrients, dissolved solids	Every 5 years if contamination detected at site 237	Site located downgradient and in flow lines of agricultural area to determine spread of any contaminants detected at site 237.
239	3N/15W-28J	Ambient	170 (70-120)	Specific conductance, nutrients, dissolved solids	Every 5 years	Ambient water quality.
240	2N/14W-32H	Nonpoint, ambient	350 (250-300)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Site located within industrial area to determine any local effects on ground water. Ambient water quality.
241	2N/14W-32K	Ambient	340 (240-290)	Specific conductance, nutrients, dissolved solids	Every 3 years	Ambient water quality.
242	2N/14W-32M		350 (250-300)			
243	2N/14W-31Q		340 (240-290)			
244	2N/14W-31C	Nonpoint	350 (250-300)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Site located within industrial area to determine any local effects on ground water.
245	2N/14W-31G	Point	350 (250-300)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Sites located immediately downgradient and in flow lines of landfills to determine any local effects on ground water.
246	2N/14W-31A		340 (240-290)			
247	2N/14W-19P	Point	310 (210-260)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Sites located immediately downgradient and in flow lines of landfills to determine any local effects on ground water.
248	2N/14W-19R		310 (210-260)			
249	2N/14W-20P		290 (190-240)			
250	2N/14W-20L		270 (170-220)			
251	2N/15W-20L		260 (160-210)			
252	2N/14W-20F		240 (140-190)			
253	2N/14W-19K	Ambient	280 (80-230)	Specific conductance, nutrients, dissolved solids	Every 3 years	Ambient water quality.
254	2N/14W-19M		280 (180-230)			

TABLE 9.--San Fernando basin ground-water-quality monitoring network--Continued

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
255	2N/14W-19G	Point	220 (70-170)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Site located immediately downgradient and in flow lines of landfill to determine any local effects on ground water.
256	2N/14W-19B	Nonpoint	350 (200-250)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Every 2 years	Site located upgradient of landfill to be used as a comparison in determining any effects of the landfill on ground water.
257	2N/14W-19E	Nonpoint	290 (190-240)	DOC, specific conductance, toxic organics, trace elements, dissolved solids	Annually	Site located within industrial area to determine any local effects on ground water.
258	2N/14W-06E	Nonpoint, ambient	510 (410-460)	DOC, specific conductance, toxic organics, trace elements, nutrients, dissolved solids	Every 2 years	Site located downgradient of agricultural area to determine any local effects on ground water. Ambient water quality.
259	1N/16W-05C	Ambient	100 (30-70)	Specific conductance, nutrients, dissolved solids, toxic organics, trace elements	Every 5 years	Ambient.
260	2N/16W-32R		100 (30-70)			
261	2N/16W-33G		100 (20-60)			
262	2N/16W-34C		100 (15_60)			
263	2N/16W-28P		120 (35-80)			
264	2N/16W-26P		140 (50-100)			
265	3N/15W-31D	Ambient	Not applicable. Some confined areas	Specific conductance, nutrients, dissolved solids, toxic organics, trace elements	Every 5 years	Ambient.
266	3N/15W-30K					
267	3N/15W-30H					
268	3N/15W-20P					
269	3N/15W-21N		[1]250 (150-225)			
270	3N/15W-22P		[1]250 (150-225)			
271	3N/15W-23N		[1]370 (270-320)			
272	3N/15W-25C		[1]250 (150-225)			

Footnote at end of table.

TABLE 9.--San Fernando basin ground-water-quality monitoring network--Continued

Index No. (pl. 6)	Site location	Monitoring objective	Well depth and (Perforated interval), in feet	Constituents to be sampled	Sampling frequency	Reason for selection
273	2N/14W-09G	Ambient	170 (70-120)	Specific conductance, nutrients, dissolved solids, toxic organics, trace elements	Every 5 years	Ambient.
274	2N/14W-09J		130 (30-80)			
275	2N/14W-10L		155 (55-105)			
276	2N/14W-11M		135 (35-85)			
277	2N/14W-11Q		130 (30-80)			
278	2N/14W-14A		135 (35-85)			
279	2N/14W-12P		160 (60-110)			
280	2N/14W-13B		285 (185-235)			
281	2N/13W-18Q	Ambient	Not applicable.	Specific conductance, nutrients, dissolved solids, toxic organics, trace elements	Every 5 years	Ambient.
282	2N/13W-20D		Not defined on current water-level maps			
283	2N/13W-21N					
284	2N/13W-21Q					
285	2N/13W-28L		[1]270 (170-220)			
286	2N/13W-34D		240 (140-190)			
287	2N/13W-34M		200 (100-150)			
288	1N/13W-03F	Ambient	240 (140-190)	Specific conductance, nutrients, dissolved solids, toxic organics, trace elements	Every 5 years	Ambient.
289	1N/13W-10C		175 (75-125)			
290	1N/13W-10P		195 (95-145)			
291	1N/13W-15L		160 (60-110)			

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[1] Approximate values.