WATER QUALITY AND FLOW OF STREAMS IN SANTA CLARA VALLEY, SANTA CLARA COUNTY, CALIFORNIA, 1979-81

by Marc A. Sylvester

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CONVERSION FACTORS

For readers who prefer to use International System of Units (SI) rather than inch-pound units, the conversion factors for the terms used in this report are listed below:

Multiply	By	To obtain
ft (feet)	0.3048	m (meters)
ft^3/s (cubic feet per second)	0.02832	m^3/s (cubic meters per second)
inches	25.4	mm (millimeters)
mi (miles)	1.609	km (kilometers)
μmho/cm (micromhos per centimeter)	1	μS/cm (microsiemens per centimeter)

Degrees Celsius are used in this report. To convert degrees Celsius (°C) to degrees Fahrenheit (°F) use the formula:

$$\text{Temp. °F} = 1.8 \text{ temp °C} + 32$$

Explanation of abbreviations

mg/L	Milligrams per liter
μg/L	Micrograms per liter
μg/g	Micrograms per gram
mL	Milliliters
NTU	Nephelometric turbidity unit
EWI	Equal width increment
col/100 mL	Colonies per 100 milliliters

Use of trade names in this report is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.

WATER QUALITY AND FLOW OF STREAMS IN SANTA CLARA VALLEY, SANTA CLARA COUNTY, CALIFORNIA, 1979-81

By Marc A. Sylvester

ABSTRACT

Water-quality and streamflow data were collected during 1979-81 water years at 11 sampling stations in Santa Clara Valley to document water-quality and streamflow conditions. Streamflow and precipitation were greater than normal during the 1980 water year and at, or less than, normal during the 1979 and 1981 water years. The largest streamflow sampled was 7,900 cubic feet per second at Guadalupe River at San Jose. Streamflows less than 1.0 cubic foot per second were sampled at a number of stations.

Factors causing areal and temporal variations in water quality were rainstorms, urban runoff, basin geology and geomorphology, reservoir storage and release of water, runoff from land surrounding ranchhouses where livestock is kept, algae and aquatic vascular plants, riparian vegetation, and the dry season from May to November. Bicarbonate was the principal anion at all sampling stations and magnesium and calcium were usually the principal cations. Water temperature, pH, and dissolved oxygen were greatest at Llagas Creek at San Martin and Guadalupe River at Alamitos Recharge Facility because these stations had less riparian vegetation (more sunlight reached the stream water) and more aquatic plants than did other stations. Turbidity was generally greater at Los Gatos Creek at Los Gatos and Coyote Creek below Leroy Anderson Dam than at other stations because of the prevalence of landslide deposits and generally unstable terrain upstream of these stations. Concentrations of total nitrite plus nitrate, total phosphorus, and dissolved orthophosphorus generally were greater at stations in urban areas. Boron concentrations were generally greatest at Llagas Creek near Morgan Hill. Serpentine and peridotite are more prevalent upstream of this station than at other stations. Concentrations of fecal-coliform and fecal-streptococcal bacteria generally were greater at Los Gatos Creek at Lincoln Avenue and Guadalupe River at San Jose because these stations receive more urban drainage. Concentrations of fecal-coliform and fecal-streptococcal bacteria generally were less at stations near reservoir releases than at other stations.

Specific conductance and concentrations of dissolved boron generally were less during storms than at other times. Turbidity and concentrations of total nitrite plus nitrate, total phosphorus, suspended organic carbon, and fecal-coliform and fecal-streptococcal bacteria generally were greater during storms than at other times. Specific conductance was inversely related to streamflow except in the Coyote Creek basin. Turbidity was directly related to streamflow.

Concentrations of dissolved trace elements were generally less than 50 micrograms per liter and rarely exceeded 100 micrograms per liter. Organic biocide concentrations were usually less than detection limits. Malathion concentrations sometimes exceeded 0.1 micrograms per liter (U.S. Environmental Protection Agency criterion for freshwater aquatic life) during 1981, the year Malathion was sprayed to control the Mediterranean fruit fly. Streams in Santa Clara Valley generally met water-quality objectives. Fecal-coliform and total-coliform bacteria objectives for municipal-water supply were the only objectives frequently exceeded.

INTRODUCTION

Background

The Santa Clara Valley Water District (SCVWD) is responsible for management of water resources in Santa Clara County. During the last 40 years, the SCVWD has constructed a network of reservoirs, percolation ponds for ground-water recharge, and water treatment facilities to provide water for municipal, agricultural, industrial, and recreational uses. The SCVWD uses imported water from the South Bay Aqueduct and the Hetch Hetchy Aqueduct to supplement water supplies in Santa Clara County. Ground water is the principal source of water for municipal, agricultural, and industrial uses in the county. Reservoirs in the county are regulated primarily to store rainfall runoff and to release water to streams for ground-water recharge and for direct irrigation of agricultural land.

Continuing population growth and commercial and industrial development in Santa Clara County have increased the demand for water and resulted in changing land uses. The SCVWD needs streamflow and water-quality data from streams in the county to help manage its water collection and distribution system, to identify short- and long-term changes in water quality, and to evaluate the effects of population growth and changing land uses on the water quality of the streams. For these reasons, the SCVWD, in cooperation with the U.S. Geological Survey, began a water-quality sampling program in October 1978 to supplement streamflow information obtained from the existing network of surface-water gaging stations.

Purpose and Scope

The purposes of this report are to describe the water quality of streams in Santa Clara Valley and to evaluate the adequacy of the existing water-quality sampling program for streams in the valley. The report is based on streamflow and water-quality data collected during the 1979-81 water years at 11 sampling stations in the valley.

Acknowledgments

The author thanks David Gruget and Russell F. Schroeder of the Santa Clara Valley Water District for their assistance in the collection of water-quality samples at sites having automatic samplers. The author also thanks John H. Sutcliffe and Bob Peterson of the Santa Clara Valley Water District for providing streamflow data from SCVWD gaging stations and Isabel S. Gloege for providing information on SCVWD's water collection and distribution system.

DESCRIPTION OF STUDY AREA

Topography

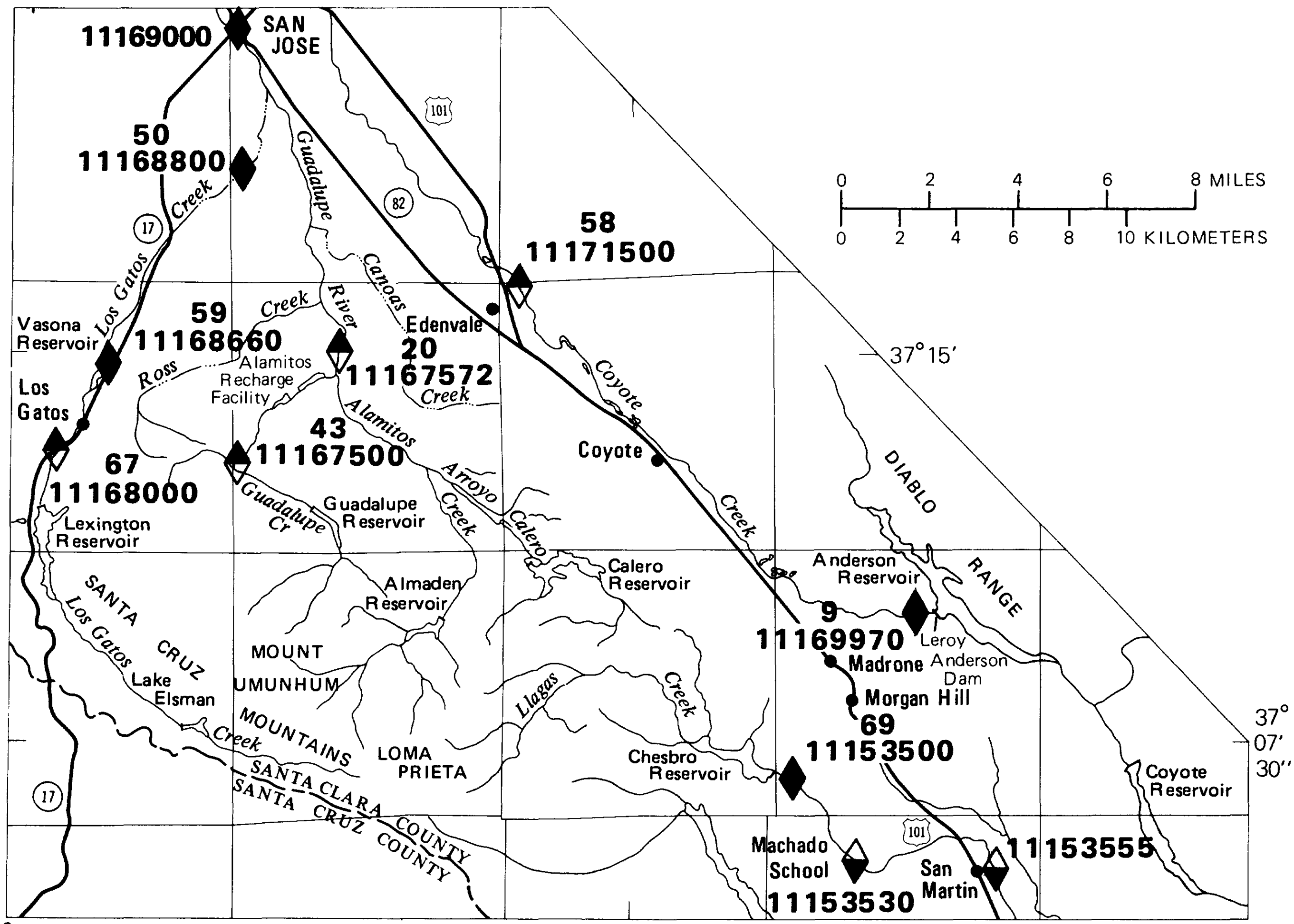
The study area is in Santa Clara County and includes the Santa Clara Valley from San Jose to San Martin (fig. 1). Santa Clara Valley is from 11 to 17 miles wide in the vicinity of San Jose north of Los Gatos and Edenvale. From Edenvale to San Martin, Santa Clara Valley ranges in width from one-half to about 5 miles. Santa Clara Valley is bordered by the Santa Cruz Mountains on the west and south and the Diablo Range on the east. Peaks in the Santa Cruz Mountains and Diablo Range are generally between 2,000 and 3,000 ft in elevation.

The major streams in the study area are Guadalupe River, Coyote Creek, Los Gatos Creek, and Llagas Creek. The study area includes the Guadalupe River basin upstream from downtown San Jose, including Los Gatos Creek, that part of Coyote Creek from Anderson Reservoir to downtown San Jose, and the Llagas Creek basin upstream of the southern limits of San Martin. About 10 miles northwest of downtown San Jose, Guadalupe River and Coyote Creek flow into the southern part of San Francisco Bay. About 10 miles southeast of San Martin, Llagas Creek flows into the Pajaro River, which flows southwest and west for about 20 miles before it enters Monterey Bay.

The major reservoirs in the study area are: Anderson and Coyote Reservoirs in the Coyote Creek basin; Lake Elsman, Lexington, Calero, Guadalupe, and Almaden Reservoirs in the Guadalupe River basin; and Chesbro Reservoir in the Llagas Creek basin. Vasona Reservoir on Los Gatos Creek, just downstream of the town of Los Gatos, is a ground-water recharge basin that is also used for recreation.

The main population centers in the study area are San Jose and nearby unincorporated communities, Los Gatos, Morgan Hill, and San Martin. Most of Santa Clara Valley is urban between Coyote Creek and Los Gatos Creek and to within about 3 miles of Guadalupe and Calero Reservoirs. Most of Santa Clara Valley is rural in the vicinity of Morgan Hill and San Martin and agriculture is the dominant land use. State Highway 17 and U.S. Highway 101 are the principal roads.

The Santa Cruz Mountains and Diablo Range are steep; greater than 30 percent slope is common. Areas of greater than 15 percent slope that are underlain by landslide deposits or bedrock susceptible to landsliding are considered to be moderately unstable to unstable. Such areas cover much of the Guadalupe River basin, particularly in the Los Gatos Creek drainage upstream of Los Gatos; most of the Coyote Creek basin upstream of Anderson Reservoir; and much of the Llagas Creek basin, especially in the vicinity of Chesbro Reservoir (Nilsen and others, 1979, pl. 3).



Base from U.S. Geological Survey 1:250,000 Topographic series, San Francisco, San Jose, 1968

EXPLANATION

▲ CONTINUOUS–RECORD GAGING STATION

△ MEASUREMENT STATION WITHOUT A GAGE

▼ WATER–QUALITY SAMPLING STATION WHERE SAMPLES WERE COLLECTED MANUALLY USING EQUAL WIDTH INCREMENT METHOD

▽ WATER–QUALITY SAMPLING STATION WHERE SAMPLES WERE COLLECTED WITH AN AUTOMATIC SAMPLER DURING 1980 AND 1981 WATER YEARS

69 TOP NUMBER IS SANTA CLARA VALLEY WATER DISTRICT STATION NUMBER

11153500 BOTTOM NUMBER IS U.S. GEOLOGICAL SURVEY STATION NUMBER

FIGURE 1.--Location of study area and sampling stations.

Geology

The geology of the Guadalupe River basin and the Llagas Creek basin are similar (fig. 2). Sandstone, mudstone, and conglomerate formations predominate in the headwaters. The Mesozoic Franciscan assemblage and localized areas of serpentine and peridotite predominate in the mountainous areas downstream of the headwaters. Unconsolidated sediments of gravel, sand, silt, clay and peat comprise the valley alluvium.

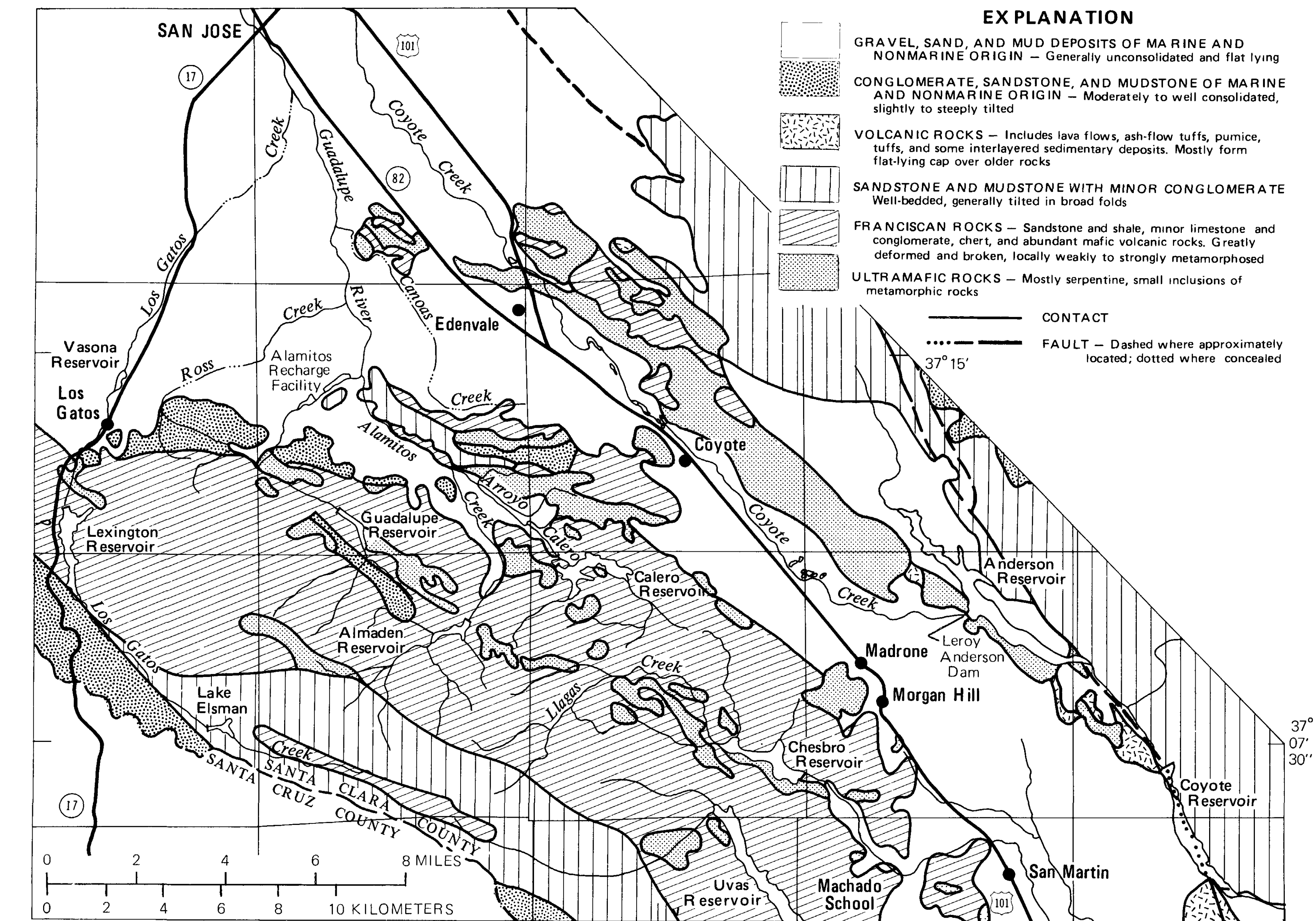
Isolated areas of limestone are scattered among the Franciscan assemblage, which also includes serpentine and peridotite. Mercury deposits occur in the vicinity of Guadalupe and Almaden Reservoirs and in the hills to the east of Arroyo Calero. The latter area and an area near Almaden Reservoir also have chromite deposits. There is a copper deposit to the east of Los Gatos Creek in the area between Lexington Reservoir and Lake Elsman. A major sand and gravel deposit occurs in the vicinity of the ground-water recharge basins along Los Gatos Creek.

A strip of sandstone, shale, and conglomerate borders the Santa Clara Valley to the east, except from Morgan Hill to Edenvale where serpentine and peridotite predominate. Unconsolidated sediments of gravel, sand, silt, clay, and peat comprise the valley portions of the Coyote Creek basin. The Franciscan assemblage predominates in the mountainous areas east of Anderson and Coyote Creek Reservoirs in the Coyote Creek basin.

Manganese deposits occur near the headwaters of Coyote Creek. Mercury, chromite, and magnesite deposits are scattered among the serpentine and peridotite that border the Santa Clara Valley on the east from Morgan Hill to Edenvale. A major sand and gravel deposit extends along Coyote Creek from about a mile downstream of Leroy Anderson Dam to about Edenvale (Schlocker, 1971; Bailey and Harden, 1975).

Climate

Most of the precipitation in Santa Clara County is received from November to May (the rainy season). Very little precipitation occurs from May to November (the dry season). Air temperatures are mild throughout the year, ranging from a mean daily minimum temperature in December of about 4°C to a mean daily maximum temperature in July of about 27°C.



Base from U.S. Geological Survey 1.250,000 Topographic series, San Francisco, San Jose, 1968

Geology modified from Bailey and Harden, 1975

FIGURE 2.--Generalized geology of study area.

WATER COLLECTION AND DISTRIBUTION SYSTEM OF

SANTA CLARA VALLEY WATER DISTRICT

Reservoirs and ground-water recharge facilities are major components of the SCVWD's water collection and distribution system (fig. 3). In the study area, the SCVWD owns and manages seven reservoirs: Anderson, Coyote, Lexington, Calero, Guadalupe, Almaden, and Vasona. Lake Elsman is owned and managed by the San Jose Water Works. Chesbro Reservoir is owned and managed by the Gavilan Water District. Reservoirs store rainfall runoff and release water to streams for ground-water recharge and for direct irrigation of agricultural land.

In the study area, the SCVWD owns and manages 11 ground-water recharge facilities: Page Pond System, Kirk Pond System, Los Gatos Creek Stream Bed System in the Los Gatos Creek basin; Kooser Pond System, Los Capitan Cillos Pond System, Alamitos Recharge Facility, Guadalupe Pond System, and Guadalupe River Bed System in the Guadalupe River basin; and Ford Road Pond System, Coyote Recharge Pond System, and Coyote Creek Stream Bed System in the Coyote Creek basin. Ground-water recharge facilities usually consist of a series of percolation ponds into which stream water is diverted. Some ground-water recharge also occurs as the result of water percolating through the bottom material of streams. Ground-water recharge from percolation ponds and streams supplements that from rainfall and helps to maintain ground water at levels adequate to meet water demands and to prevent subsidence in Santa Clara Valley.

Other important components of the SCVWD's water collection and distribution system are pipelines and canals, water treatment plants, and pump stations (fig. 3). Canals and some pipelines carry imported and local water to water treatment plants and ground-water recharge facilities. Other pipelines distribute treated water to users in Santa Clara County. This system of canals and pipelines allows for intrabasin transfer of local and imported water. Thus, the water delivered to recharge basins can be a mixture of local and imported surface water, and the water delivered to water treatment plants can be a mixture of ground water and local and imported surface water.

The South Bay Aqueduct is the principal source of imported water for Santa Clara County. Most of this water is delivered to the Rinconada and Penitencia Water Treatment Plants, but some is delivered to the SCVWD's ground-water recharge facilities. San Francisco Water Department's Hetch Hetchy Aqueduct is also a source of imported water. This water is delivered directly to city water-supply systems. None of it is delivered to the SCVWD's ground-water recharge facilities (Gloege and Bober, 1979-80). The San Felipe Project will bring water to Santa Clara County from San Luis Reservoir after the project's scheduled completion in January 1988.

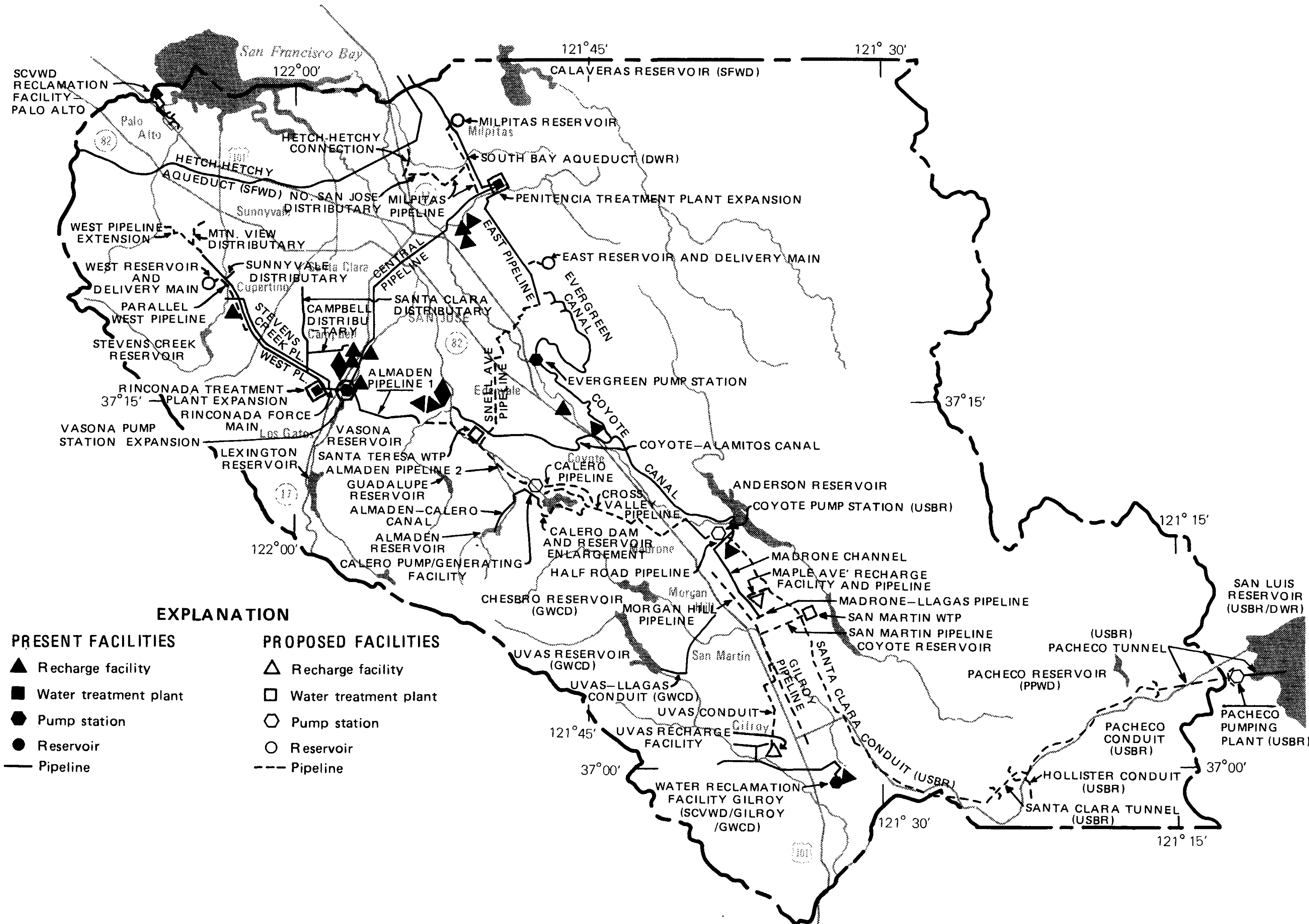


FIGURE 3.--Water collection and distribution system, Santa Clara Valley Water District. (Modified from Gloege, 1980, fig. 6.)

DATA COLLECTION AND METHODS

During the 1979 water year, the SCVWD and the U.S. Geological Survey began a cooperative, water-quality sampling program for streams in the Santa Clara Valley. The planned sampling program for the 1979-81 water years is shown in table 1. Six stations were sampled during the 1979 water year and 11 stations were sampled during the 1980 and 1981 water years (fig. 1). Of the planned nine samplings per year, four were to be prescheduled (one during November, May, July, and September) and five were to be done when storms occurred during the period December through April. Only three prescheduled samplings were done during the 1979 water year because the sampling program was not finalized until December 1978. Only three storm samplings were done during the 1980 and 1981 water years. Many storms during the 1980 water year occurred on weekends when sampling was not feasible. Few storms during the 1981 water year were of sufficient magnitude to result in appreciable rainfall runoff. During some sampling trips, Los Gatos Creek at Lincoln Avenue, Coyote Creek near Edenvale, and Llagas Creek at San Martin were dry; thus, samples could not be collected. Otherwise, the planned sampling program was followed.

Some stations were sampled manually using the Equal Width Increment (EWI) method (fig. 1). A depth-integrating, suspended-sediment sampler (DH-48 for wadable streamflows and a DH-59 or a D-49 for nonwadable streamflows) was lowered and raised at an equal transit rate through each of a number of equally spaced verticals in a cross section of streamflow. Water from each vertical was composited into a churn-type sample splitter. Beginning in the 1980 water year, automatic samplers were used at some stations to collect composite samples (fig. 1). Automatic samplers were time activated and collected a series of constant-time interval, constant-volume discrete samples for a specified length of time (usually 24 hours). To keep the samples cold, ice was packed into the bottle retaining ring, which is in the center of the sampler. Discrete samples were composited in a churn-type sample splitter. When an automatic sampler failed to collect enough sample for all analyses, the EWI method was used to collect samples.

At all stations, total organic carbon and biocide samples were collected by the EWI method except that only three verticals were sampled. These samples were collected in glass bottles that had been baked at 350°C. They were not composited into a churn-type sample splitter.

Bottom material samples were collected with acid-rinsed plastic scoops and were placed in whirl pack bags for shipment.

Bacterial samples were collected by SCVWD personnel using the grab sampling method (Bordner and others, 1978, p. 8). Five samples within a 30-day period were collected twice each year, once during the rainy season and once during the dry season.

Instantaneous-streamflow measurements using the current-meter method (Carter and Davidian, 1968, p. 6 and 7) were made at stations without continuous recorders. At continuous-record stations, water stages were measured using bubble-gage or float sensors with digital recorders. Streamflows were derived from the water-stage record and the stage-streamflow relation developed from current-meter measurements.

Table 1. - Water-quality sampling program for streams in Santa Clara Valley, 1979-81 water years

[Sampling or measurement frequency: number of times per year; C, continuous recorder]

	Station selection criteria									Sampling frequency										
Station name (numbers in parentheses are USGS and SCVWD station numbers)	Existing streamflow measuring station	Historical water-quality data	Reservoir release point	Upstream limits of ground-water recharge area	Downstream limits of ground-water recharge area	In ground-water recharge area and(or) at point of diversion to percolation ponds	In or downstream of urban area	Inflow to San Francisco Bay	Sampling period (water year)	Streamflow	Field measurements[1]	Major ions[2]	Nutrients[3]	Turbidity	Total organic carbon[4]	Chemical oxygen demand	Trace elements (water)[5]	Trace elements (bottom material)[6]	Biocides (water)[7]	Total coliform, fecal-coliform, and fecal-streptococcal bacteria
Llagas Creek near Morgan Hill (11153500, 69)	X	-	X	-	-	-	-	-	79	C	9	9	9	-	2	-	2	-	-	-
									80-81	C	9	9	9	9	9	-	2	2	2	10
Llagas Creek at Machado School near Morgan Hill (11153530)	-	-	-	-	-	-	-	-	80-81	9	9	9	9	9	9	-	2	2	2	10
Llagas Creek at San Martin (11153555)	-	-	-	-	-	X	-	-	79	9	9	3	-	-	-	-	-	-	-	-
									80-81	9	9	9	9	9	9	-	2	2	2	10
Guadalupe Creek at Guadalupe (11167500, 43)	X	-	-	X	-	-	-	-	80-81	C	9	9	9	9	9	9	2	2	2	10
Guadalupe River at Alamitos Recharge Facility at San Jose (11167572, 20)	X	-	-	-	-	X	X	-	79	C	9	9	9	-	2	-	2	1	-	-
									80-81	C	9	9	9	9	9	9	2	2	2	10
Los Gatos Creek at Los Gatos (11168000, 67)	X	X	X	-	-	-	-	-	80-81	C	9	9	9	9	9	9	2	2	2	10
Los Gatos Creek at Lark Avenue at Los Gatos (11168660, 59)	X	X	X	-	-	X	X	-	79	C	9	9	9	-	2	-	2	-	-	-
									80-81	C	9	9	9	9	9	9	2	2	2	10
Los Gatos Creek at Lincoln Avenue at San Jose (11168800, 50)	X	-	-	-	X	-	X	-	80-81	C	9	9	9	9	9	9	2	2	2	10
Guadalupe River at San Jose (11169000)	X	X	-	-	-	-	X	X	79	C	9	9	9	-	4	-	2	-	2	-
									80-81	C	9	9	9	9	9	9	2	2	2	10
Coyote Creek below Leroy Anderson Dam near Madrone (11169970, 9)	X	-	X	-	-	-	-	-	80-81	C	9	9	9	9	9	-	2	2	2	10
Coyote Creek near Edenvale (11171500, 58)	X	-	-	-	X	-	X	-	79	C	9	9	9	-	2	-	2	1	-	-
									80-81	C	9	9	9	9	9	-	2	2	2	10

[1]Field measurements = water temperature, specific conductance, pH, dissolved oxygen, and alkalinity.

[2]Major ions = dissolved Ca, Mg, Na, K, Fe, alkalinity (lab), Cl, SO_4, SiO_2, F, and B.

[3]Nutrients - dissolved NO_2 and NO_3 as N, NH_4 as N, organic nitrogen as N, orthophosphorus as P, total NO_2 + NO_3 as N, NH_4 as N, organic nitrogen as N, and phosphorus as P.

[4]Dissolved and suspended phases separated in field and analyzed separately during 1980-81 water years.

[5]Trace elements (water) = dissolved Al, As, Cd, Cr, Cu, Pb, Mn, Hg, Ni, and Zn.

[6]Trace elements (bottom material) = Al, As, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Se, and Zn.

[7]Biocides (water) = total recoverable organochlorine compounds, organophosphorus insecticides, and chlorophenoxy acid herbicides with gross PCB and gross PCN.

Water-temperature measurements were made with hand-held, mercury-filled thermometers that had been checked to be accurate to ±0.5°C. Portable meters were used to make field measurements of specific conductance and pH. Dissolved-oxygen concentrations in water were determined titrimetrically by the Alsterberg-azide modification of the Winkler Method (Skougstad and others, 1979, p. 611-613). Alkalinity measurements were made by the electrometric titration method (Skougstad and others, 1979, p. 517 and 518).

Water samples for dissolved inorganic constituents were filtered in the field through 0.45-micrometer membrane filters. Samples for suspended plus dissolved nutrients were dispensed from churn-type sample splitters. During the 1980 and 1981 water years, dissolved and suspended phases of the total organic carbon sample were separated by filtering the sample through 0.45-micrometer silver membrane filter. A stainless steel filtering assembly was used for these filtrations. Nutrient samples were put in brown plastic bottles and a mercuric chloride tablet added to aid in preservation. Water samples for cations and trace elements were acidified with nitric acid to a pH of less than 2. Chemical oxygen demand samples were acidified with sulfuric acid to a pH less than 2. All samples were chilled to less than 4°C immediately after collection or filtration.

Except for bacterial samples, all samples were analyzed at the U.S. Geological Survey Water Quality Laboratory in Denver, Colorado. Bacterial samples were analyzed at the SCVWD's laboratory in Los Gatos. Analyses for inorganic constituents, chemical oxygen demand, and turbidity were done according to methods given by Skougstad and others (1979). Analyses for total organic carbon and biocides were done according to methods given by Goerlitz and Brown (1972). Bacterial concentrations were determined by the membrane filter method using LES M-Endo agar for total-coliform bacteria, MFC broth for fecal-coliform bacteria, and M-enterococcus agar for fecal-streptococcal bacteria (Bordner and others, 1978, p. 108-112 and 124-128; Slack and others, 1973, p. 50-54).

PRECIPITATION AND STREAMFLOW

The SCVWD operates an extensive network of precipitation stations. Some of these stations were selected to represent precipitation conditions in the study area (table 2). Selection criteria were basin or area coverage and period of record. Some stations were selected to represent precipitation conditions in more than one basin because precipitation in the vicinity of these stations drains into more than one basin.

The streamflow stations Guadalupe Creek at Guadalupe, Los Gatos Creek at Los Gatos, Coyote Creek below Leroy Anderson Dam, and Llagas Creek near Morgan Hill were selected to represent the regulated runoff from upland areas in the study area. The station Guadalupe River at San Jose was selected to represent streamflows traveling out of the study area after passing major ground-water recharge areas and receiving urban-rainfall runoff from the San Jose area (fig. 1).

Data from these precipitation and streamflow stations were used to compare annual precipitation and annual mean streamflow during the study period (water years 1979-81) with mean annual precipitation and streamflow (fig. 4). This comparison shows that precipitation and streamflow were greater than normal during the 1980 water year except in the Coyote Creek basin downstream of Anderson Reservoir where streamflow was less than normal despite greater than normal precipitation in this basin. Precipitation and streamflow were at or less than normal during the 1979 and 1981 water years except in the Coyote Creek basin downstream of Anderson Reservoir where streamflow was slightly greater than normal during the 1979 water year. Thus, except in the Coyote Creek basin downstream of Anderson Reservoir, annual mean streamflows followed the pattern of annual precipitation, even though streamflows were regulated by reservoirs.

At stations immediately downstream of reservoirs (Llagas Creek near Morgan Hill and Coyote Creek below Leroy Anderson Dam), sampled streamflows were generally similar to monthly mean streamflows (fig. 5). At other stations, sampled streamflows were similar to monthly mean streamflows generally only from May to December, the dry season and early part of the rainy season, when pre-scheduled samplings were done (fig. 5). From December through April, sampled streamflows were expected to be greater than monthly mean streamflows because these samplings were to be done during storms. At stations immediately downstream of reservoirs, storage and regulated release of rainfall runoff moderated streamflows during storms. Sampled streamflows during storms were generally much greater than monthly mean streamflows at stations farther downstream of reservoirs (particularly Guadalupe River at San Jose and Guadalupe River at Alamitos Recharge Facility) because these stations receive tributary inflow and rainfall runoff from urban areas, which are not regulated by reservoirs (fig. 5). Occasionally, streamflows less than monthly mean streamflows were sampled (for example, during May 1979 and 1981 at Los Gatos Creek at Lark Avenue). These samplings were generally during the dry season when streamflows at all stations were regulated by releases of water from reservoirs.

Table 2. - Precipitation stations selected

[See Santa Clara Valley Water District (1981) for location of stations]

Basin or area	Station name and Water District number	Period of record (water years)
Guadalupe River	Mt. Umunhum (69)	1969-81
	Guadalupe Watershed (123)	1976-81
Los Gatos Creek	Lexington Reservoir (42)	1952-81
	Loma Prieta (44)	1962-81
	Mt. Umunhum (69)	1969-81
Coyote Creek	Coe Park (17)	1961-81
	UTC (102)	1962-67,1972-81
	Cow Ridge (127)	1978-81
Llagas Creek	Loma Prieta (44)	1962-81
	Uvas Reservoir (104)	1962-81
	Calero Watershed (128)	1979-81
Santa Clara Valley	Alamitos (1)	1960-81
	Laguna Seca (37)	1966-69,1973-81
	San Jose (86)	1874-1981
	Vasona pump station (125)	1976-81

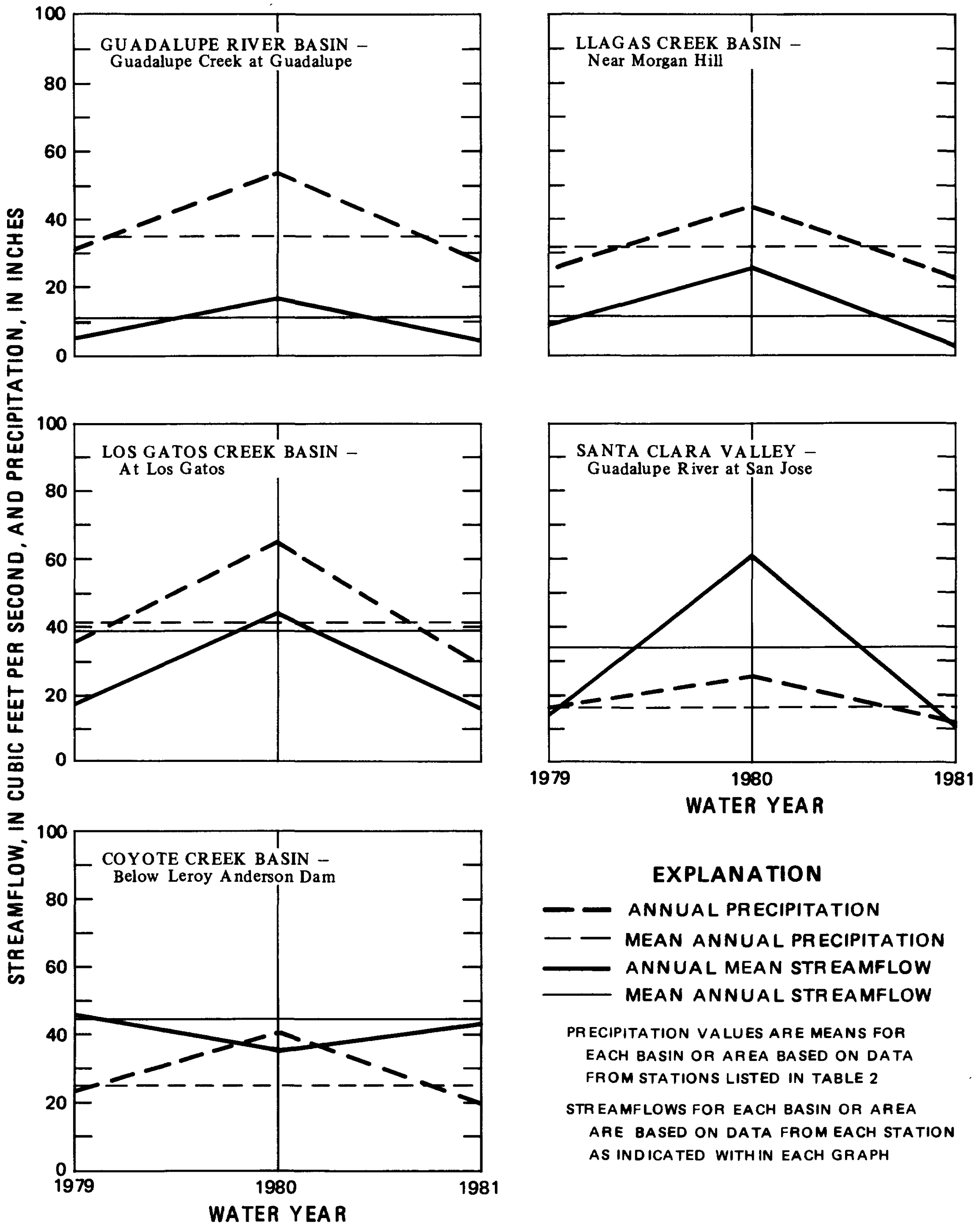


FIGURE 4.--Comparison of annual precipitation and annual mean streamflow during the study period with mean annual precipitation and streamflow.

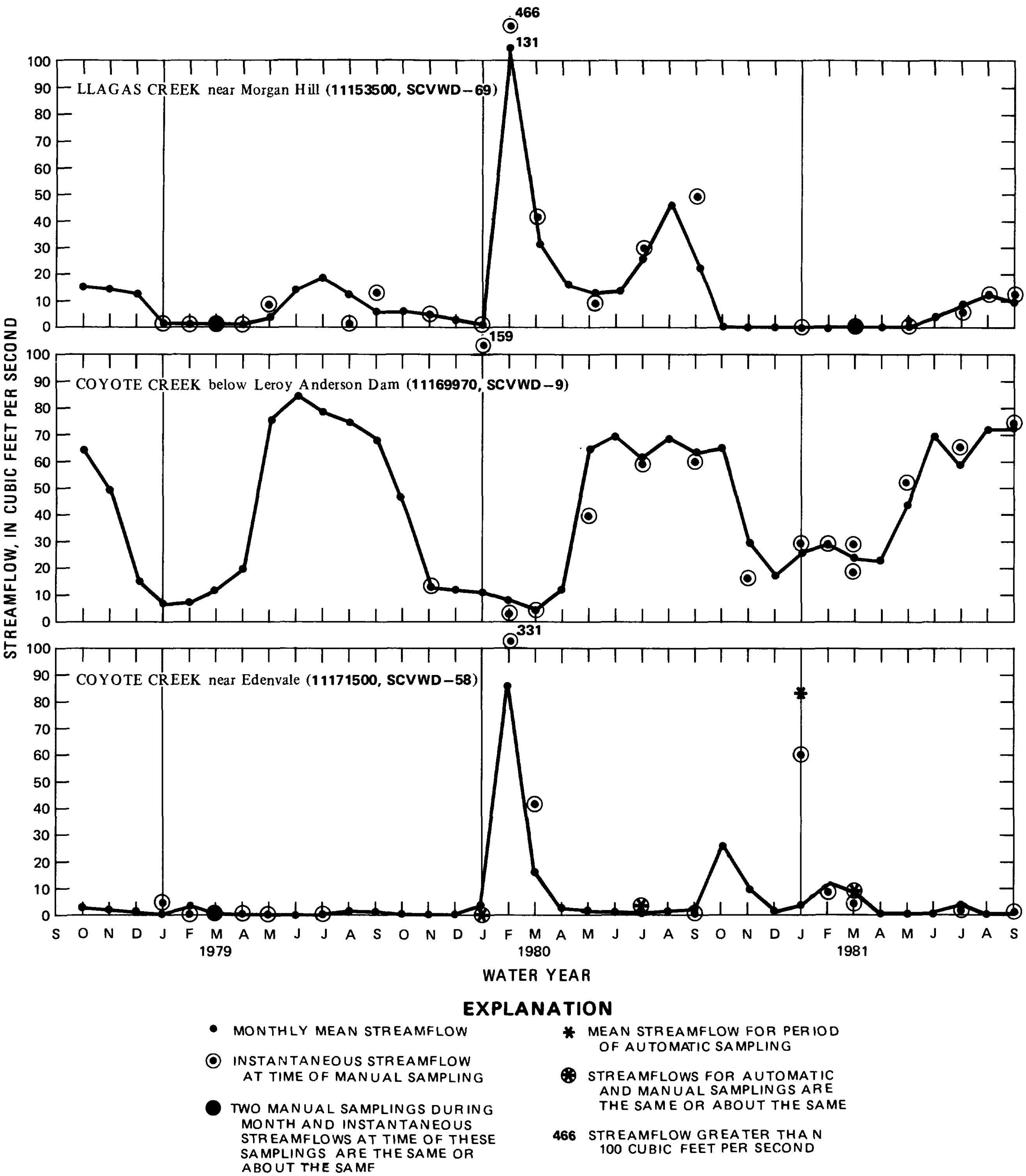


FIGURE 5.--Comparison of streamflow during sampling to monthly mean streamflows during the study period.

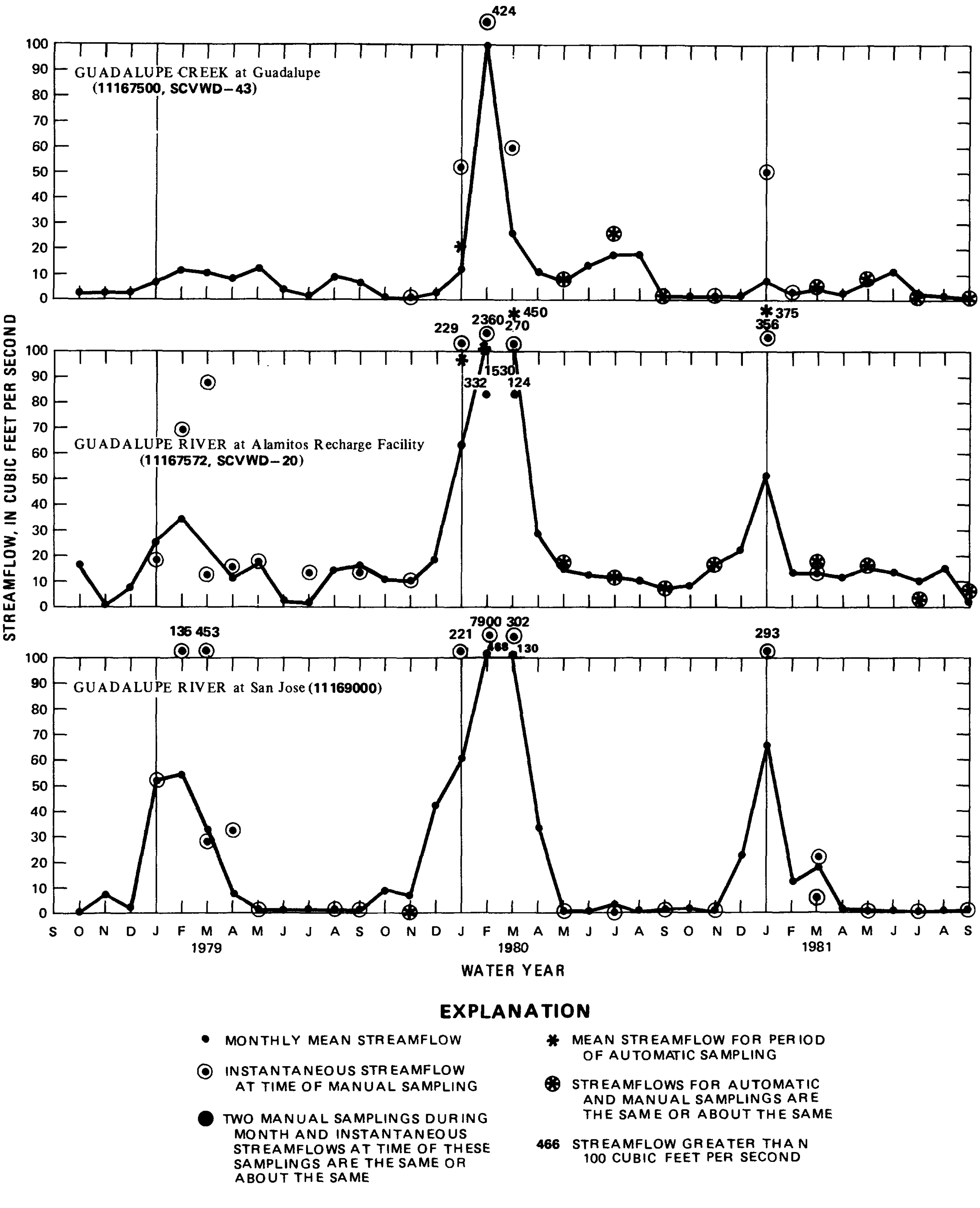


FIGURE 5.--Continued.

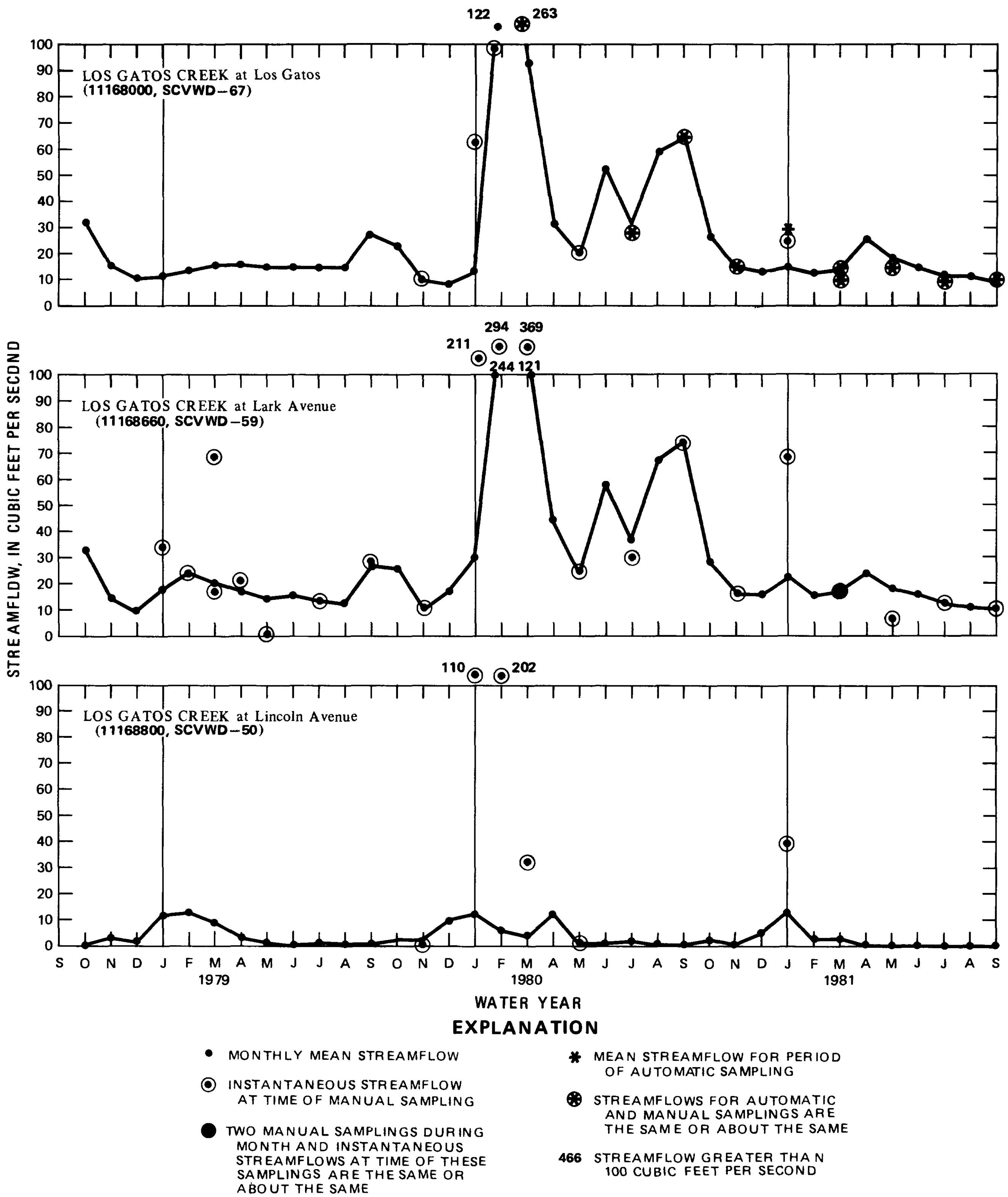


FIGURE 5.--Continued.

The largest streamflow sampled was 7,900 ft^3/s at Guadalupe River at San Jose during a February 1980 storm (fig. 5). Streamflows less than 1.0 ft^3/s were sampled at Llagas Creek near Morgan Hill, Coyote Creek near Edenvale, Guadalupe Creek at Guadalupe, Guadalupe River at San Jose, and Los Gatos Creek at Lincoln Avenue (fig. 5). As mentioned previously, Los Gatos Creek at Lincoln Avenue, Coyote Creek near Edenvale, and Llagas Creek at San Martin were dry at times and could not be sampled. Comparison of sampled streamflows to monthly mean streamflows is not possible for Llagas Creek at Machado School and Llagas Creek at San Martin because these stations do not have a continuous-record streamflow gage.

WATER QUALITY

Major-Ion Composition

Bicarbonate was the principal anion at all sampling stations in the study area (fig. 6). The principal cations were as follows:

1. Magnesium and calcium in the Llagas Creek basin and at Guadalupe Creek at Guadalupe;
2. Magnesium at Guadalupe River at Alamitos Recharge Facility;
3. Magnesium, calcium, and sodium at Guadalupe River at San Jose;
4. Calcium at Los Gatos Creek at Los Gatos and Los Gatos Creek at Lark Avenue; and
5. Calcium, magnesium, and sodium at Los Gatos Creek at Lincoln Avenue and in the Coyote Creek basin.

Major-ion concentrations were greatest at Guadalupe River at San Jose except for magnesium, which was greatest at Guadalupe River at Alamitos Recharge Facility. Concentrations of calcium, magnesium, and bicarbonate were least at Los Gatos Creek at Lincoln Avenue. Concentrations of sodium, sulfate, and chloride were least in the Llagas Creek basin.

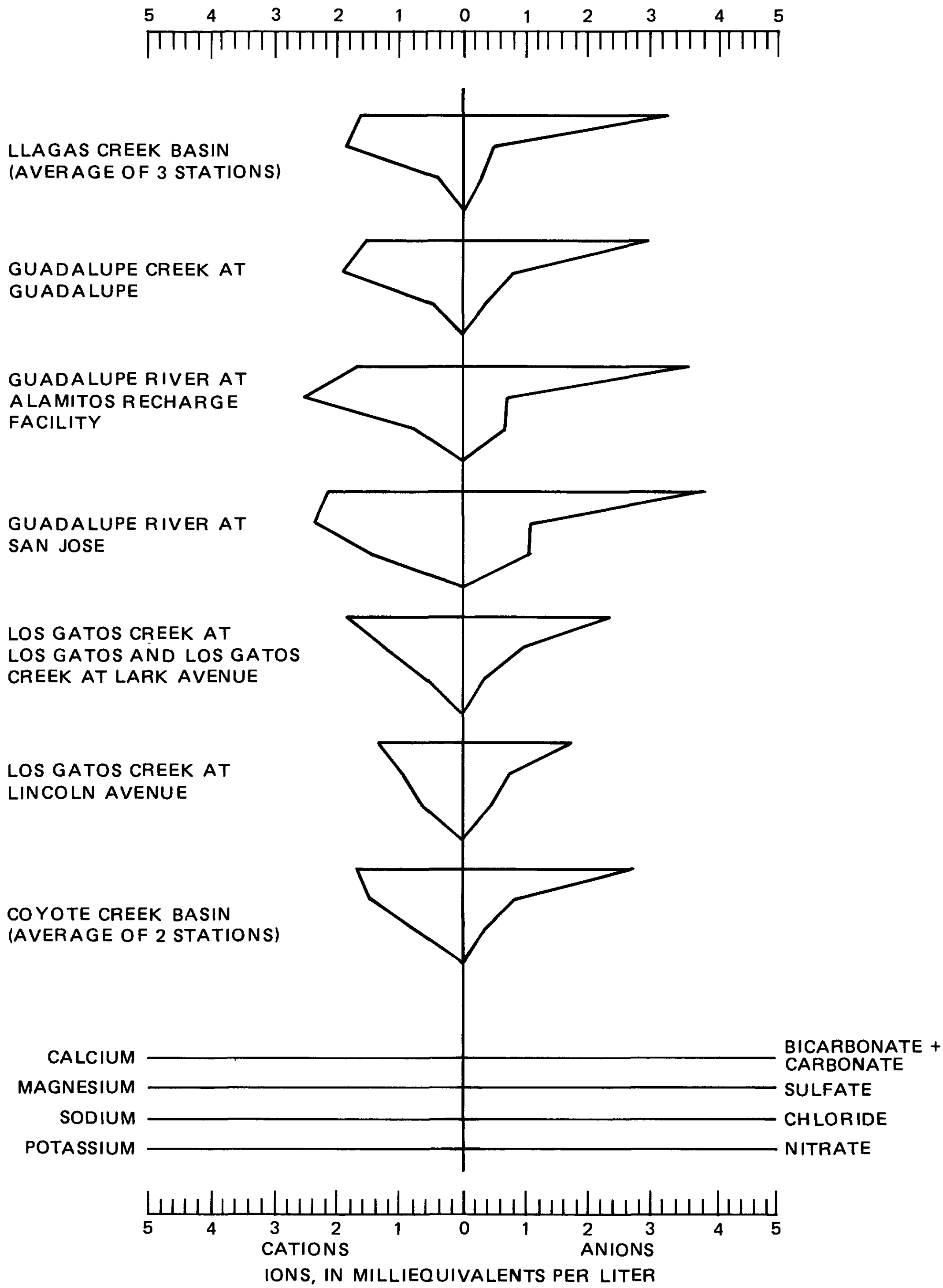


FIGURE 6. — Stiff diagrams showing major-ion composition of streams in the study area.

Physical Properties, Nutrients, Boron, and Organic Carbon

Areal Variation

Schematic plots (figs. 7-18) show the similarities and differences in water quality between and within stream basins. These plots were obtained using the SPLOT procedure in the Statistical Analysis System (SAS) (Helwig and Council, 1979).

Specific conductance

Specific conductance (fig. 7) was generally greatest at Guadalupe River at Alamitos Recharge Facility (median of 453 μmho/cm) and was generally least at Los Gatos Creek at Lincoln Avenue (median of 294 μmho/cm). However, only six measurements of specific conductance were made at Los Gatos Creek at Lincoln Avenue and most of these were taken from stormflows, which characteristically have lower specific conductances than dry-weather flows. If Los Gatos Creek at Lincoln Avenue had not been dry during many of the dry-season sampling trips, the median specific conductance at this station probably would have been similar to those at Los Gatos Creek at Los Gatos and at Lark Avenue.

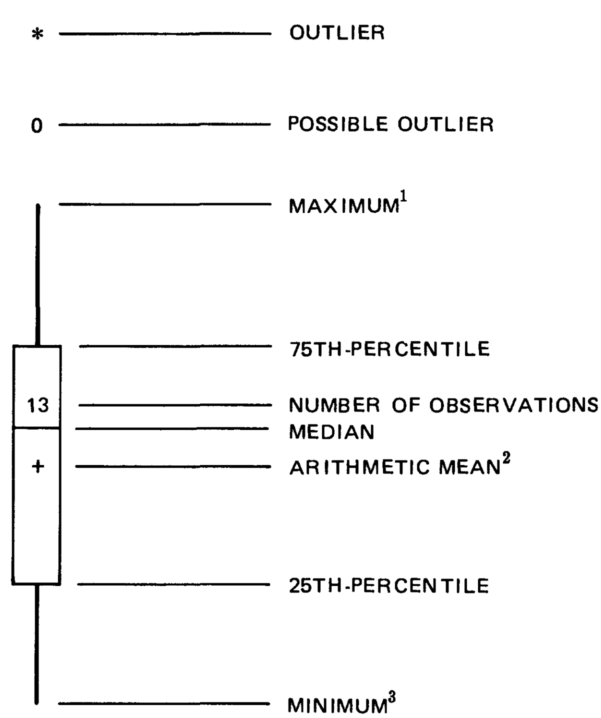
Specific conductance was similar at the three Llagas Creek stations (medians 340-365 μmho/cm). This is not surprising because there are no significant tributaries between these stations, and release water from Chesbro Reservoir constitutes nearly all the flow in Llagas Creek at these stations.

Specific conductance increased from Guadalupe Creek at Guadalupe (median of 409 μmho/cm) to Guadalupe River at Alamitos Recharge Facility (median of 453 μmho/cm) and from Coyote Creek below Leroy Anderson Dam (median of 314 μmho/cm) to Coyote Creek near Edenvale (median of 403 μmho/cm). These increases might be the result of dry-season runoff from urban areas between these stations. Drainage from a large strip of serpentine and peridotite that borders Coyote Creek on the east (fig. 2) might also be responsible for the observed increase in specific conductance between the Coyote Creek stations. Alamitos Creek enters Guadalupe River 0.2 mile upstream of Guadalupe River at Alamitos Recharge Facility. This creek drains a large area of serpentine and peridotite on the eastern part of its drainage and, hence, might be causing the increase in specific conductance between Guadalupe Creek at Guadalupe and Guadalupe River at Alamitos Recharge Facility. However, Calero Reservoir, which releases water to Arroyo Calero (the largest tributary of Alamitos Creek), has specific conductances less than 400 μmho (U.S. Geological Survey, 1981, p. 120-138). Water-quality data have not been collected from Alamitos Creek.

The decrease in median specific conductance from 453 μmho/cm at Guadalupe River at Alamitos Recharge Facility to 400 μmho/cm at Guadalupe River at San Jose was probably due to the inflow of Los Gatos Creek (median specific conductance 294-388 μmho/cm) and storm runoff from urban areas between these stations.

The range of specific conductance was greatest at Guadalupe River at San Jose, perhaps because this station receives water from a number of sources (for example, from Los Gatos Creek, Alamitos Creek, and storm and dry-season runoff from urban areas).

EXPLANATION (FIGURES 7 - 18)



* Outlier: Value is greater than 75th percentile or less than 25th percentile by more than 1.5 times the interquartile range (75th percentile minus 25th percentile)

0 Possible outlier: Value is greater than 75th percentile or less than 25th percentile by 1.0 to 1.5 times the interquartile range

[1]Maximum except for outliers and possible outliers

[2]Geometric mean for pH

[3]Minimum except for outliers and possible outliers

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11169000 – GUADALUPE RIVER AT SAN JOSE
11169970 – COYOTE CREEK BELOW LEROY ANDERSON DAM
11171500 – COYOTE CREEK NEAR EDENVALE

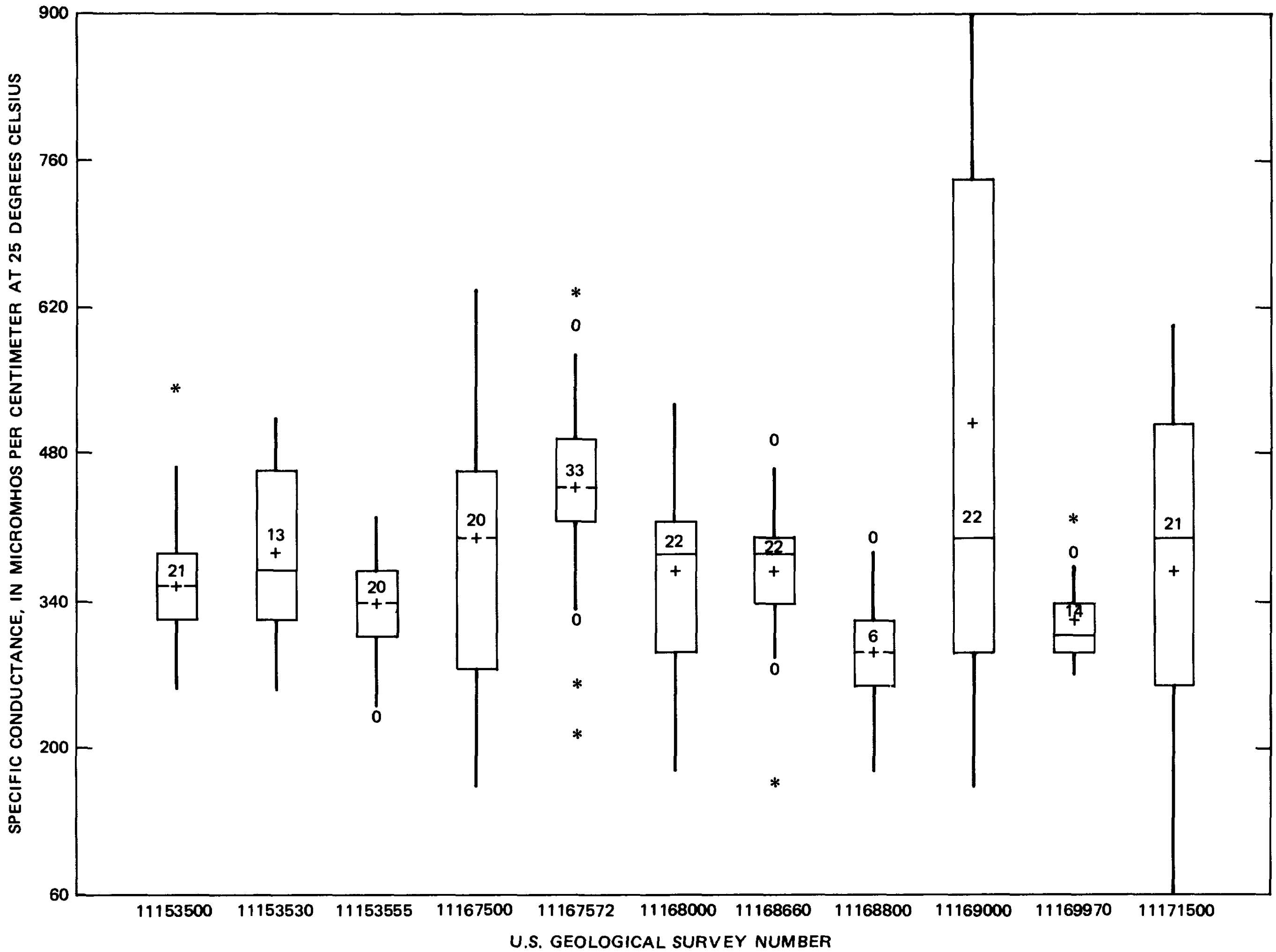

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FIGURE 7. - Schematic plots of specific conductance.

pH

Generally, the greatest pH (median of 8.2, fig. 8) was measured at Llagas Creek at San Martin and Guadalupe River at Alamitos Recharge Facility. Coyote Creek near Edenvale generally had the least pH (median of 7.5). In the Guadalupe River and Coyote Creek basins, pH generally decreased from reservoir release to the farthest station downstream. This was probably due to urban-storm runoff, which has been shown to have a pH range of 5.9 to 7.8 in the area surrounding San Francisco Bay (Sylvester and Brown, 1978; U.S. Geological Survey, 1973). In the Llagas Creek basin, pH was similar at Llagas Creek near Morgan Hill (median of 7.8) and Llagas Creek at Machado School (median of 7.7). However, the pH at Llagas Creek at San Martin was much greater (median of 8.2). This appears to be the result of more algal growth at Llagas Creek at San Martin than at the upstream stations. Algal growth reduces the amount of carbon dioxide in the water, thus increasing pH. Extensive algal mats were noticeable at Llagas Creek at San Martin during nonstorm flows. Algal growths were much less noticeable at the upstream stations. Conditions for algal growth are more favorable at Llagas Creek at San Martin than at the upstream stations because few trees are near Llagas Creek at San Martin whereas a riparian woodland borders the upstream stations. Hence, Llagas Creek at San Martin receives more sunlight and has higher water temperatures (fig. 9) than the upstream stations. Similar reasoning explains the increase in pH from Guadalupe Creek at Guadalupe (median of 8.0) to Guadalupe River at Alamitos Recharge Facility (median of 8.2). Cattails and other aquatic vascular plants are abundant at Guadalupe River at Alamitos Recharge Facility, as well as algae. Aquatic plants were much less noticeable at Guadalupe Creek at Guadalupe.

The range of pH was greatest at Llagas Creek at San Martin and Guadalupe Creek at Guadalupe. The large range in pH (7.1 to 9.0) at Llagas Creek at San Martin reflects the contrast between stormflows with low pH and dry-season flows with high pH because of algal growth. The reason for the large range in pH (6.6 to 8.5) at Guadalupe Creek at Guadalupe is not known. Although some algal growth was observed at this station, it was not nearly as extensive as at Llagas Creek at San Martin and Guadalupe River at Alamitos Recharge Facility. Except for the 6.6 pH measured during a January 1980 storm, all pH values were greater than 7.0 at Guadalupe Creek at Guadalupe. The 6.6 pH is a possible outlier and might represent an inaccurate pH measurement. If so, the range of pH at Guadalupe Creek at Guadalupe would not be as large as at Llagas Creek at San Martin.

Water temperature

Water temperatures (fig. 9) were generally highest (median of 15.5°C) at Llagas Creek at San Martin and Guadalupe River at Alamitos Recharge Facility because these stations are not at reservoir releases and receive more sunlight than other stations. Grass and a few shrubs border Llagas Creek at San Martin, and bare ground and a few shrubs border Guadalupe River at Alamitos Recharge Facility. Other stations are near reservoir release points, and (or) trees border the stream. Except for Los Gatos Creek at Lincoln Avenue, water temperatures were generally lowest (median of 12.0 to 13.0°C) at stations near reservoir releases (fig. 1) because water is released from near the bottom where it is colder than surface waters. Downstream of stations near reservoir releases, water temperatures generally increased (fig. 9).

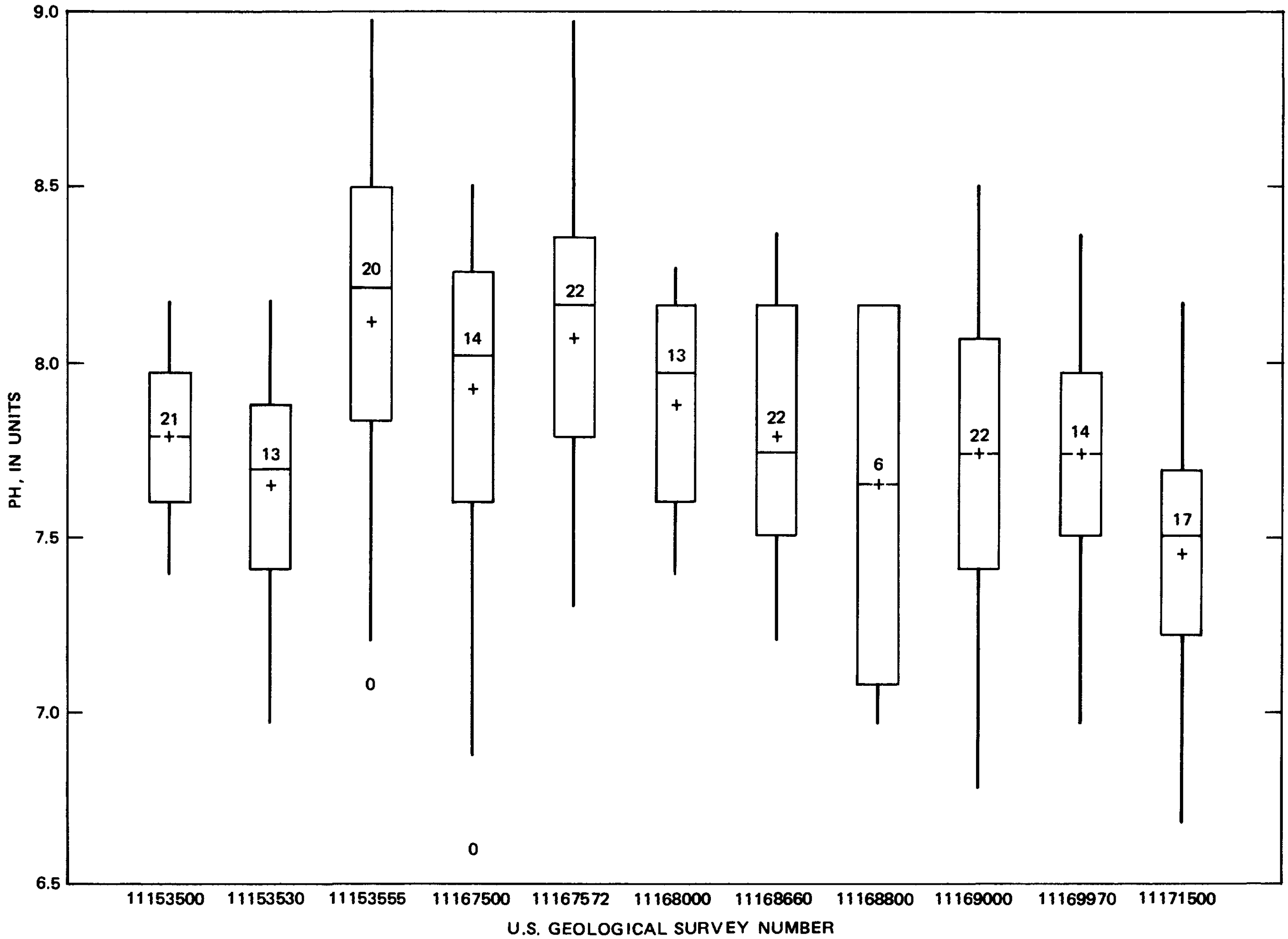

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FIGURE 8. - Schematic plots of pH.

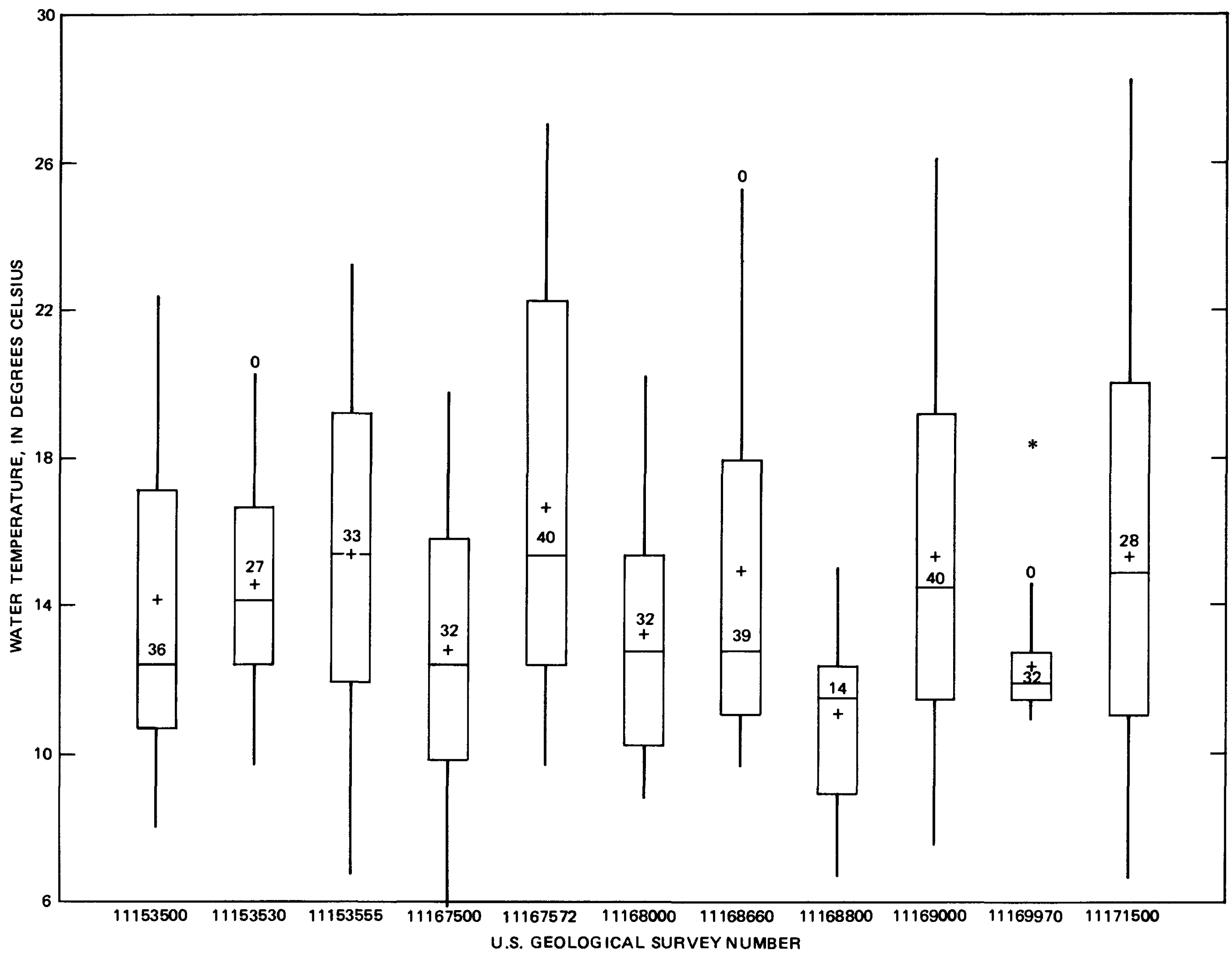

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FIGURE 9. - Schematic plots of water temperature.

Water temperatures were lower at Los Gatos Creek at Lincoln Avenue than at other stations, but this is because only one water-temperature measurement was made during the dry season (May 6, 1980). During other dry season samplings, Los Gatos Creek at Lincoln Avenue was dry. If other dry season measurements had been made, median water temperatures at this station would have been greater. The range in water temperature was greatest at Coyote Creek near Edenvale because of a July 31, 1979, measurement of 28°C when the streamflow was only 0.30 ft^3/s.

Turbidity

Except for Los Gatos Creek at Lincoln Avenue, turbidity (fig. 10) was generally greater at Los Gatos Creek at Los Gatos (median of 28 NTU) and Coyote Creek below Leroy Anderson Dam (median of 25 NTU) than at other stations (medians less than 20 NTU). This is because most of the Los Gatos Creek basin upstream of Lexington Reservoir and most of the Coyote Creek basin upstream of Anderson Reservoir are underlain by landslide deposits or bedrock susceptible to landsliding (Nilsen and others, 1979, plate 3). Such areas are very susceptible to erosion by rainfall, thus yield much sediment to streams. These conditions are not as prevalent in the other stream basins studied. Turbidity data from Los Gatos Creek at Lincoln Avenue are not comparable to turbidity data from other stations because only one dry-season sample was collected at this station. Turbidity was generally least at Llagas Creek at Machado School (median of 4.4 NTU). The reason for this is not known. The range in turbidity was greatest at Guadalupe River at San Jose (2.1 to 800 NTU).

Dissolved oxygen

Dissolved-oxygen concentrations (fig. 11) were generally greatest at Llagas Creek at San Martin (median of 11.0 mg/L), whereas the percent saturation of dissolved oxygen (fig. 12) was generally greatest at Guadalupe River at Alamitos Recharge Facility (median of 121 percent). Abundant algal growth at Llagas Creek at San Martin and abundant growth of algae and aquatic-vascular plants at Guadalupe River at Alamitos Recharge Facility were responsible for the high dissolved-oxygen levels at these stations. Other stations had more shade from trees and much less aquatic plant growth.

Dissolved oxygen was generally least at Coyote Creek near Edenvale (median concentration of 7.8 mg/L and median percent saturation of 74 percent). At this station, dissolved-oxygen concentrations were generally less than 7.0 mg/L during the dry season when streamflows were less than or equal to 2.0 ft^3/s. The lowest dissolved-oxygen concentrations at this station were 3.9 mg/L during an April 26, 1979, storm and 3.8 mg/L during a January 11, 1980, storm when the streamflow was less than 0.50 ft^3/s. In both cases, the source of the streamflow was a storm sewer 300 feet upstream of the sampling station.

Stations near reservoir releases had dissolved-oxygen concentrations near saturation (fig. 12). The range in dissolved oxygen was greatest (1.0 to 15.6 mg/L, 9 to 173 percent saturation) at Guadalupe River at San Jose. The 15.6 mg/L (173 percent saturation) measurement was made July 16, 1980, when there was an abundance of attached algae and the streamflow was 0.24 ft^3/s. The 1.0 mg/L (9 percent saturation) measurement was made November 18, 1980, when the stream had a milky color, contained much decaying organic matter, and had a flow of 0.24 ft^3/s.

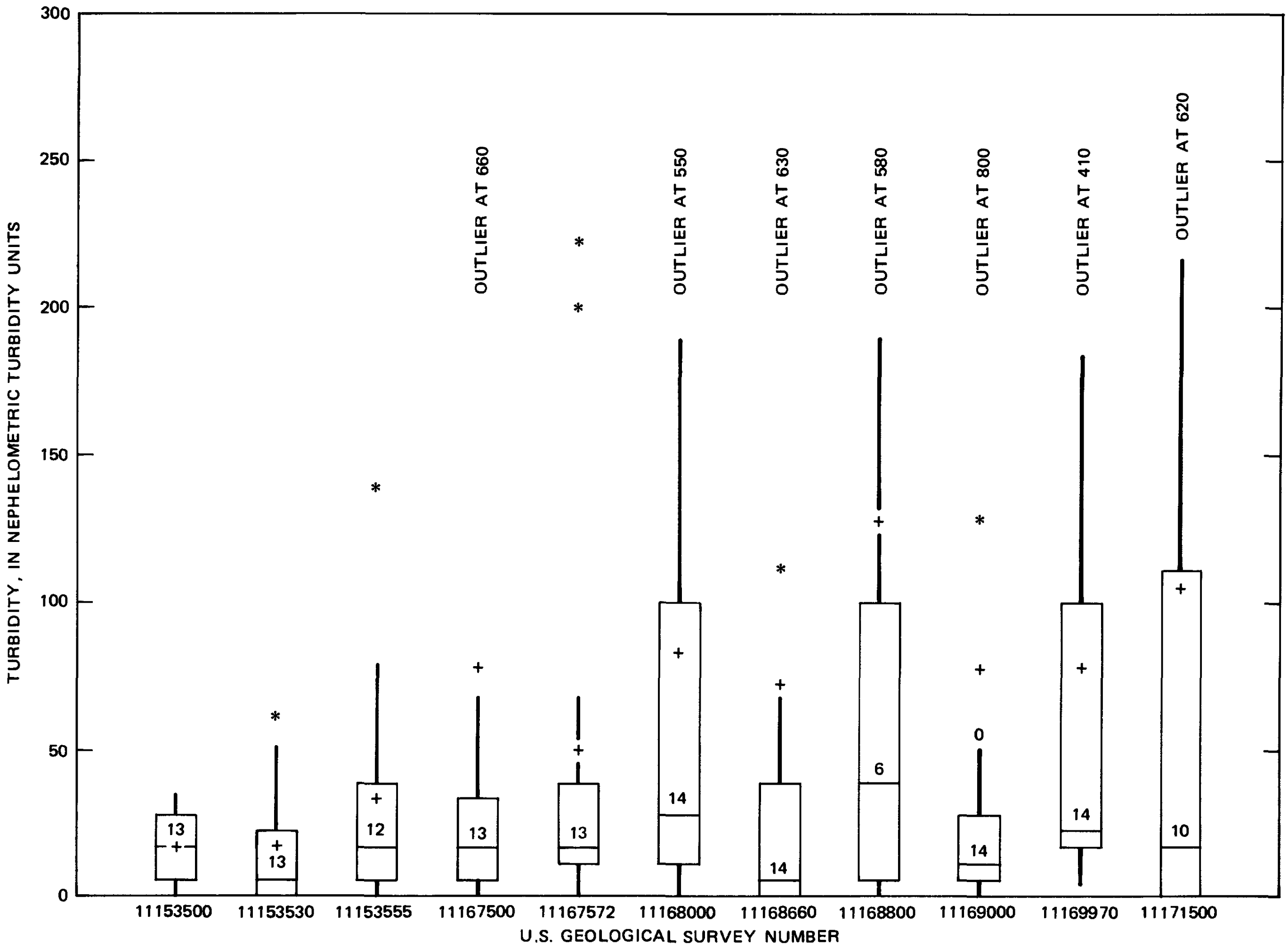

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FIGURE 10. - Schematic plots of turbidity.

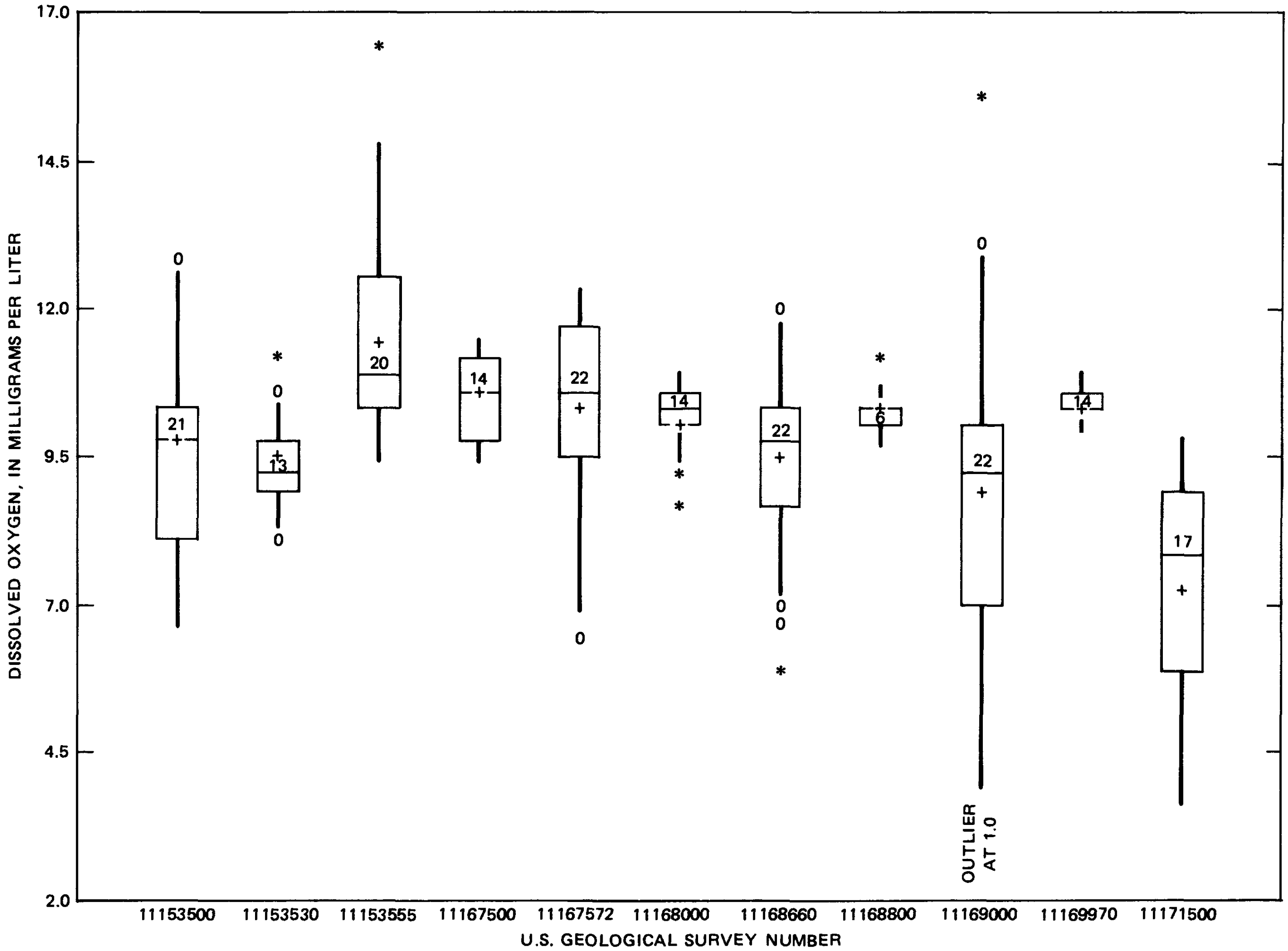

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FIGURE 11. - Schematic plots of dissolved-oxygen concentration.

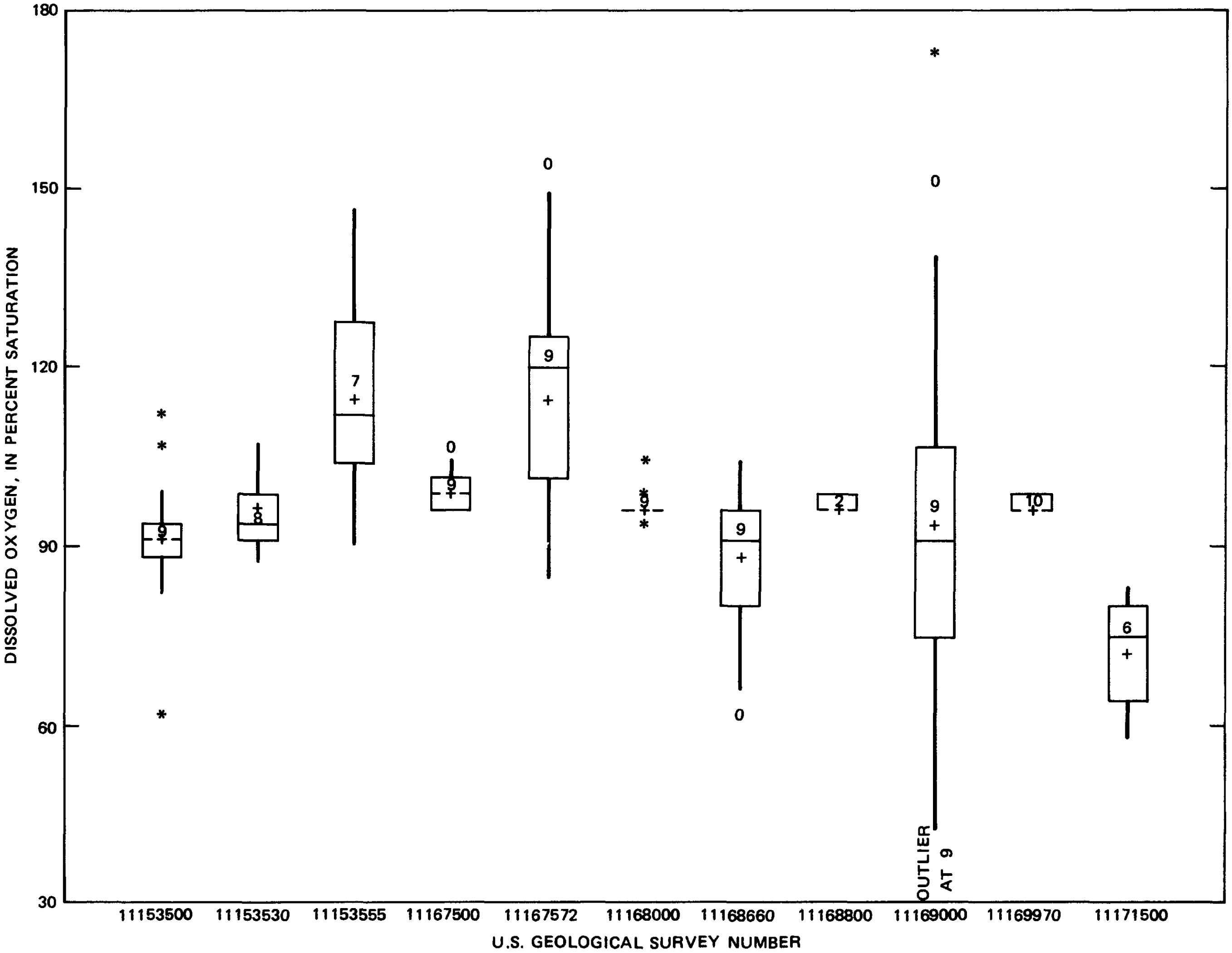

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FIGURE 12. - Schematic plots of dissolved-oxygen percent saturation.

Nitrogen

Concentrations of total nitrite plus nitrate (inorganic nitrogen) were generally greatest (median of 1.3 mg/L) at Guadalupe River at Alamitos Recharge Facility and were generally least (median of 0.14 mg/L) at Guadalupe Creek at Guadalupe (fig. 13). Except for Llagas Creek at Machado School, concentrations of total nitrite plus nitrate generally were greater (medians 0.68-1.3 mg/L) at stations in urban areas (Guadalupe River at Alamitos Recharge Facility, Los Gatos Creek at Lincoln Avenue, Guadalupe River at San Jose, and Coyote Creek near Edenvale) than at other stations (medians less than or equal to 0.50 mg/L). Stations near reservoir releases generally had lesser concentrations of total nitrite plus nitrate (medians less than or equal to 0.44 mg/L) than other stations (medians greater than or equal to 0.50 mg/L). Most of the nitrogen in release water was in the ammonia and organic forms (fig. 14).

The 1.2 mg/L increase in the median concentration of total nitrite plus nitrate from Guadalupe Creek at Guadalupe to Guadalupe River at Alamitos Recharge Facility might be due to rainfall runoff from the urban area between these stations. Rainfall runoff from urban areas in the vicinity of San Francisco Bay typically has a total nitrite plus nitrate concentration of about 1.0 mg/L and can reach levels around 5.0 mg/L (Sylvester and Brown, 1978; U.S. Geological Survey, 1974).

Concentrations of total ammonia plus organic nitrogen (fig. 14) were similar at all stations. Median concentrations ranged from 0.67 mg/L at Los Gatos Creek at Lark Avenue to 1.1 mg/L at Guadalupe River at San Jose and Coyote Creek near Edenvale.

The median concentration of total nitrogen (nitrite plus nitrate and ammonia plus organic nitrogen) was greatest (2.1 mg/L) at Guadalupe River at San Jose. This station receives most of the urban runoff from the San Jose area. The median concentration of total nitrogen increased in Llagas Creek from 1.2 mg/L near Morgan Hill to 1.9 mg/L at Machado School and in Coyote Creek from 1.2 mg/L below Leroy Anderson Dam to 2.0 mg/L near Edenvale. Rainfall runoff from the urban and agricultural areas between the two Coyote Creek stations might be the source of the increase in total nitrogen between them. Rainfall runoff from land surrounding ranchhouses where livestock such as horses, turkeys, and chickens is kept might be the source of the increase in total nitrogen between Llagas Creek near Morgan Hill and Llagas Creek at Machado School. There are no urban or agricultural areas between these Llagas Creek stations. Even though concentrations of ammonia plus organic nitrogen increased, nitrification might also be occurring between the Coyote Creek stations and between Llagas Creek near Morgan Hill and Llagas Creek at Machado School because concentrations of total nitrite plus nitrate also increased (fig. 13). The range in concentrations of total nitrite plus nitrate was greatest (0.02 to 4.7 mg/L) at Coyote Creek near Edenvale. The range in concentrations of total ammonia plus organic nitrogen was greatest (0.68 to 4.7 mg/L) at Guadalupe River at San Jose.

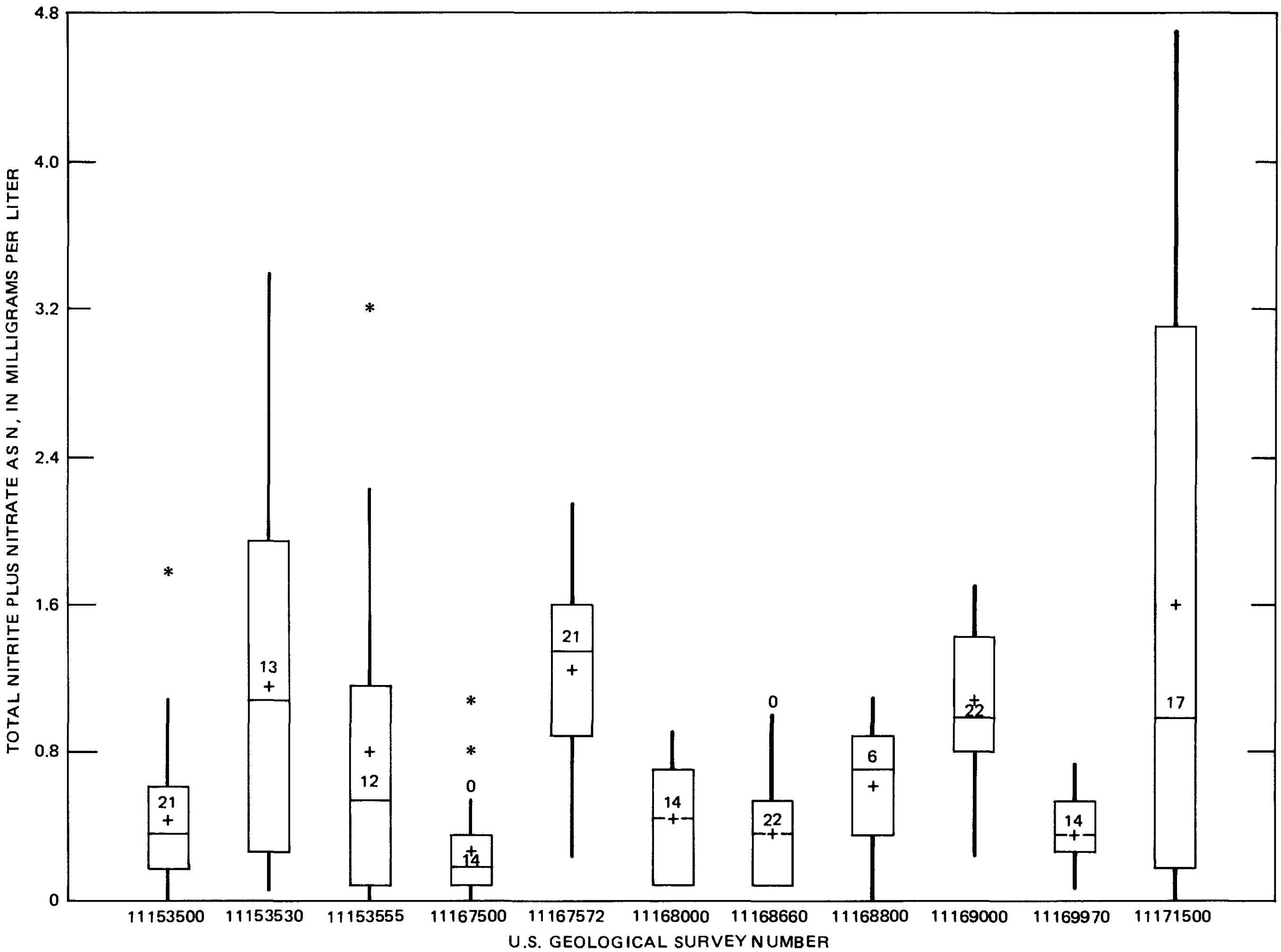

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FIGURE 13. - Schematic plots of total nitrite plus nitrate as N.

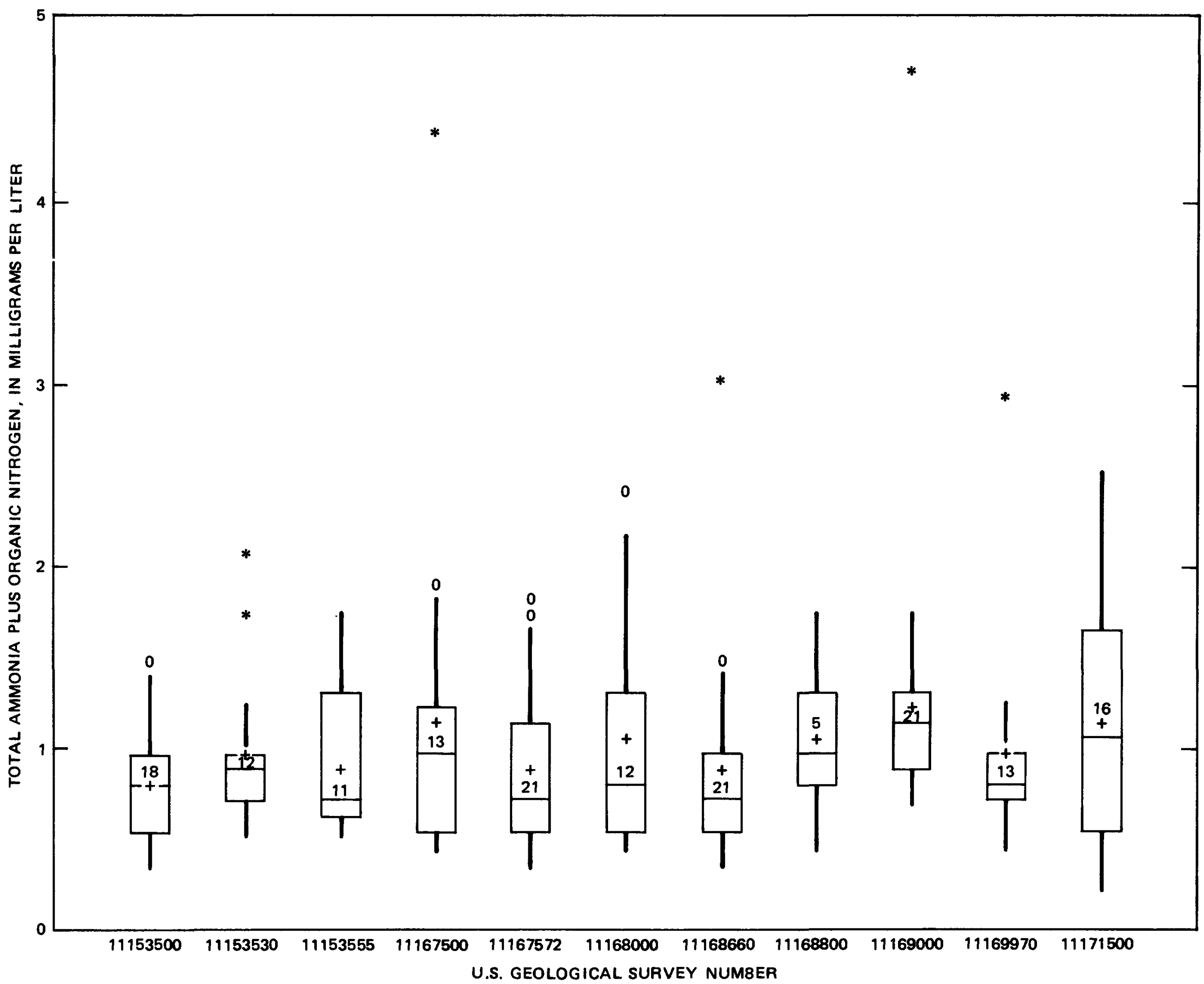

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FIGURE 14. - Schematic plots of total ammonia plus organic nitrogen.

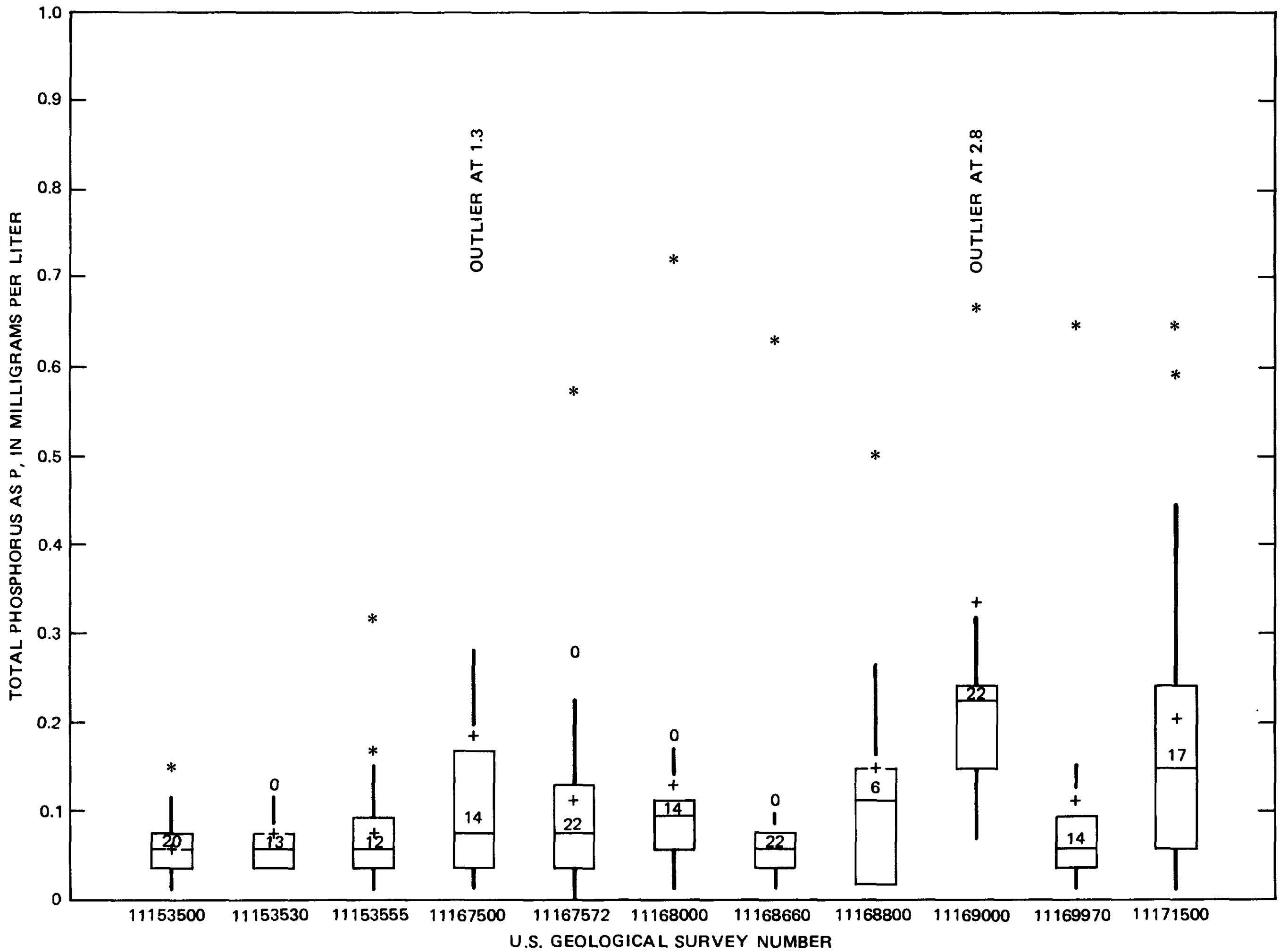
Phosphorus

Concentrations of total phosphorus (fig. 15) were generally greatest (median of 0.22 mg/L) at Guadalupe River at San Jose. Concentrations of dissolved orthophosphorus (fig. 16) were also generally greatest (0.10 mg/L) at Guadalupe River at San Jose. Except for Coyote Creek near Edenvale and Los Gatos Creek at Lincoln Avenue, concentrations of total phosphorus were generally less than 0.10 mg/L and concentrations of dissolved orthophosphorus were generally less than 0.03 mg/L at other stations. Data from Los Gatos Creek at Lincoln Avenue are not comparable to those from other stations because only six samples were collected at this station and only one of the six was taken in the dry season. The greater concentrations of total phosphorus and dissolved orthophosphorus at Guadalupe River at San Jose and Coyote Creek near Edenvale than at other stations might be due to urban runoff in the Guadalupe River basin and urban and agricultural runoff in the Coyote Creek basin. Urban and (or) agricultural runoff might also be responsible for the range in total phosphorus being greatest (0.07 to 2.8 mg/L) at Guadalupe River at San Jose and for the range in dissolved orthophosphorus being greatest (0.00 to 0.23 mg/L) at Coyote Creek near Edenvale.

Boron

Concentrations of boron (fig. 17) were generally greatest (median of 180 µg/L) at Llagas Creek near Morgan Hill and were generally least (medians less than or equal to 70 µg/L) in the Los Gatos Creek basin. Concentrations of boron generally correlate with the amount of serpentine and peridotite upstream of the sampling stations (fig. 2). Serpentine and peridotite are most prevalent upstream of Llagas Creek near Morgan Hill and least prevalent in the Los Gatos Creek basin. They are common in the Guadalupe River basin where the median concentration of boron ranged from 135 to 145 µg/L and rare in the Coyote Creek basin upstream of Anderson Reservoir. The median concentration of boron at Coyote Creek below Leroy Anderson Dam was 85 µg/L.

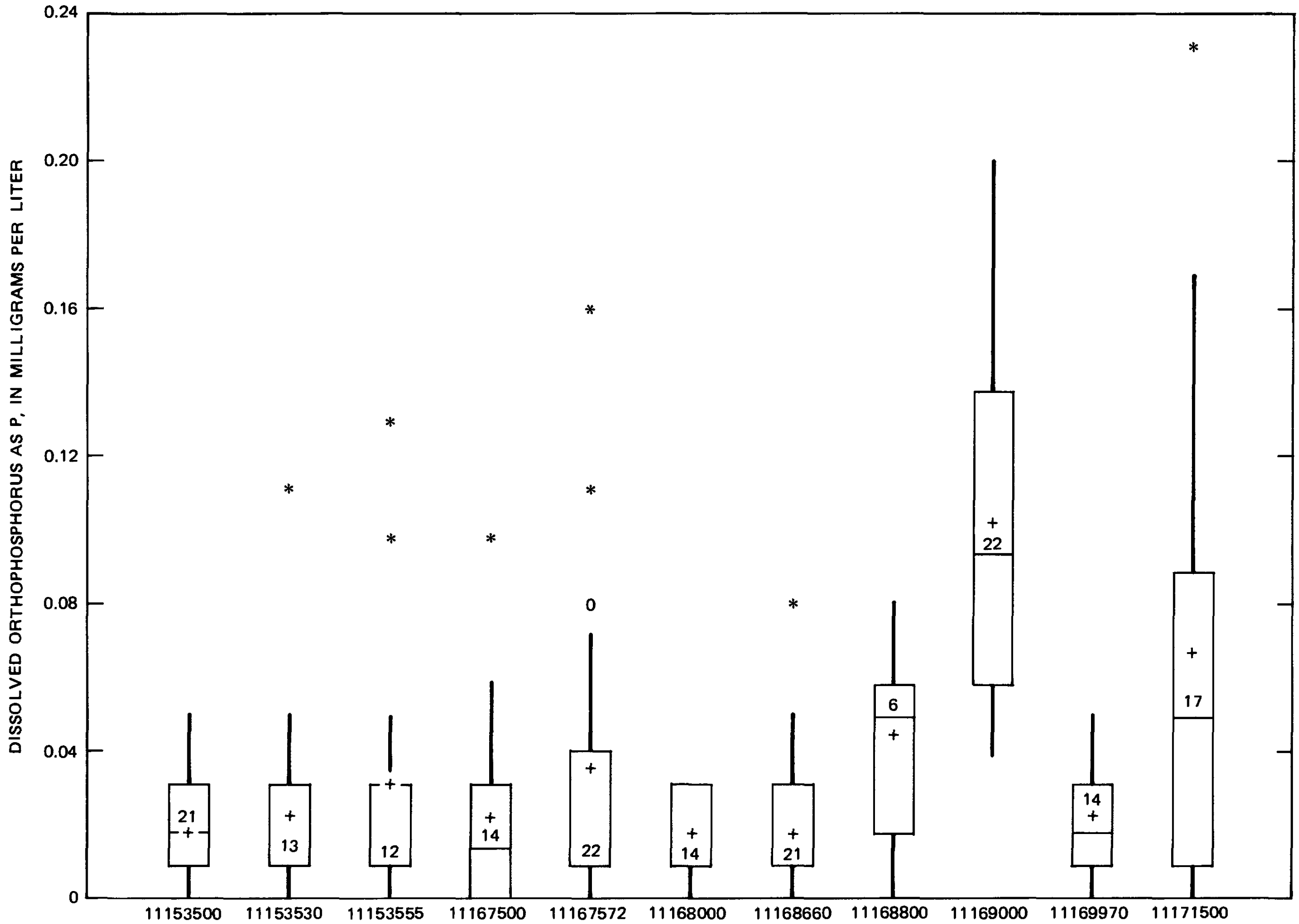
The range in concentrations of boron was greatest at Guadalupe Creek at Guadalupe. The concentration of boron at this station was least (40 µg/L) during a February 1980 storm when the streamflow was 424 ft^3/s and was greatest (520 µg/L) for a composite sample collected August 31 to September 1, 1981, when the mean streamflow for the sampling period was 1.8 ft^3/s.



U.S. GEOLOGICAL SURVEY NUMBER AND STATION NAME

11153500 – LLAGAS CREEK NEAR MORGAN HILL
11153530 – LLAGAS CREEK AT MACHADO SCHOOL
11153555 – LLAGAS CREEK AT SAN MARTIN
11167500 – GUADALUPE CREEK AT GUADALUPE
11167572 – GUADALUPE RIVER AT ALAMITOS RECHARGE FACILITY
11168000 – LOS GATOS CREEK AT LOS GATOS
11168660 – LOS GATOS CREEK AT LARK AVENUE
11168800 – LOS GATOS CREEK AT LINCOLN AVENUE
11169000 – GUADALUPE RIVER AT SAN JOSE
11169970 – COYOTE CREEK BELOW LEROY ANDERSON DAM
11171500 – COYOTE CREEK NEAR EDENVALE

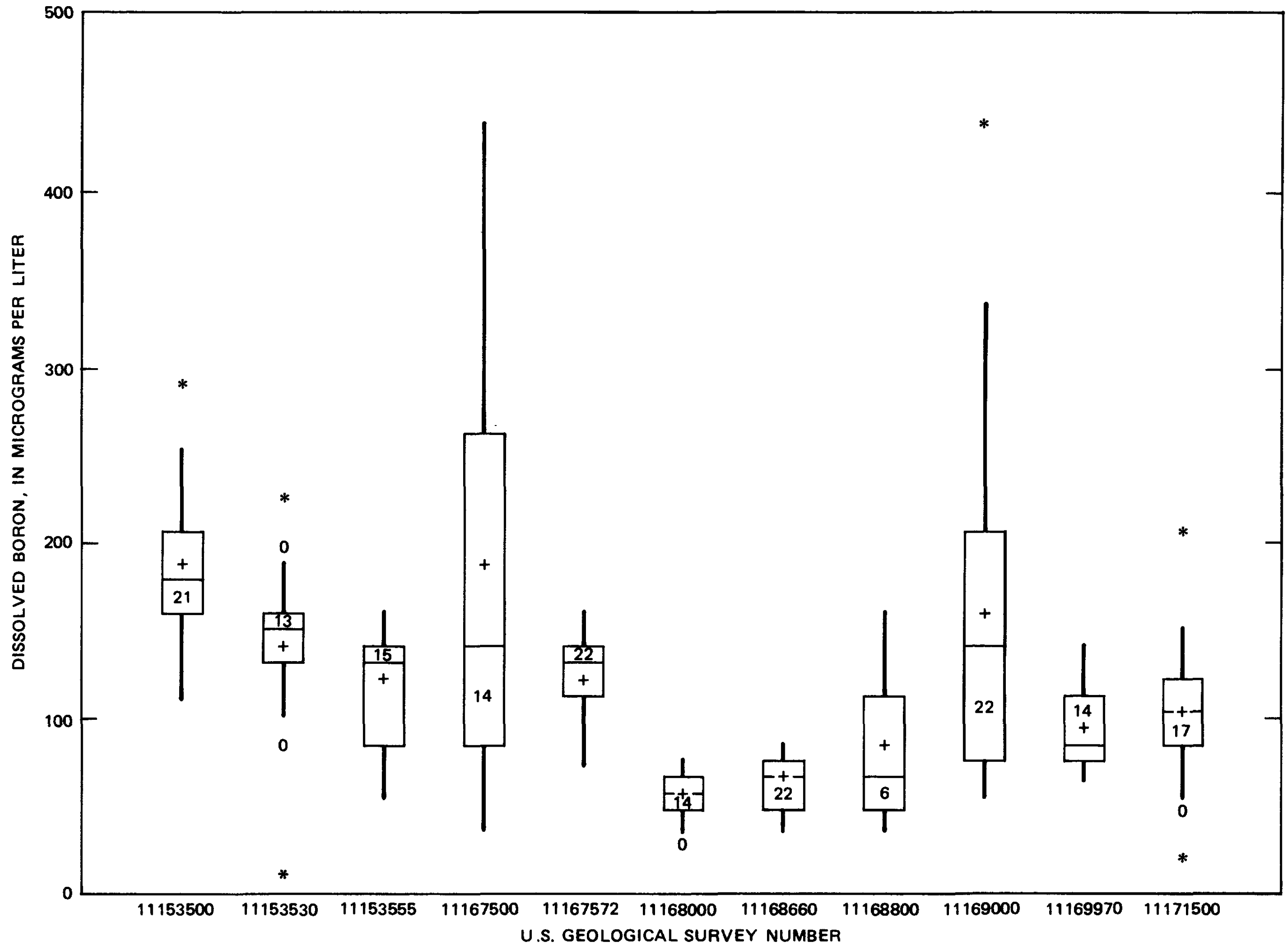
FIGURE 15. - Schematic plots of total phosphorus as P.



U.S. GEOLOGICAL SURVEY NUMBER AND STATION NAME

11153500 – LLAGAS CREEK NEAR MORGAN HILL
11153530 – LLAGAS CREEK AT MACHADO SCHOOL
11153555 – LLAGAS CREEK AT SAN MARTIN
11167500 – GUADALUPE CREEK AT GUADALUPE
11167572 – GUADALUPE RIVER AT ALAMITOS RECHARGE FACILITY
11168000 – LOS GATOS CREEK AT LOS GATOS
11168660 – LOS GATOS CREEK AT LARK AVENUE
11168800 – LOS GATOS CREEK AT LINCOLN AVENUE
11169000 – GUADALUPE RIVER AT SAN JOSE
11169970 – COYOTE CREEK BELOW LEROY ANDERSON DAM
11171500 – COYOTE CREEK NEAR EDENVALE

FIGURE 16. - Schematic plots of dissolved orthophosphorus as P.



U.S. GEOLOGICAL SURVEY NUMBER AND STATION NAME

11153500 – LLAGAS CREEK NEAR MORGAN HILL
11153530 – LLAGAS CREEK AT MACHADO SCHOOL
11153555 – LLAGAS CREEK AT SAN MARTIN
11167500 – GUADALUPE CREEK AT GUADALUPE
11167572 – GUADALUPE RIVER AT ALAMITOS RECHARGE FACILITY
11168000 – LOS GATOS CREEK AT LOS GATOS
11168660 – LOS GATOS CREEK AT LARK AVENUE
11168800 – LOS GATOS CREEK AT LINCOLN AVENUE
11169000 – GUADALUPE RIVER AT SAN JOSE
11169970 – COYOTE CREEK BELOW LEROY ANDERSON DAM
11171500 – COYOTE CREEK NEAR EDENVALE

FIGURE 17. - Schematic plots of dissolved boron.

Dissolved organic carbon

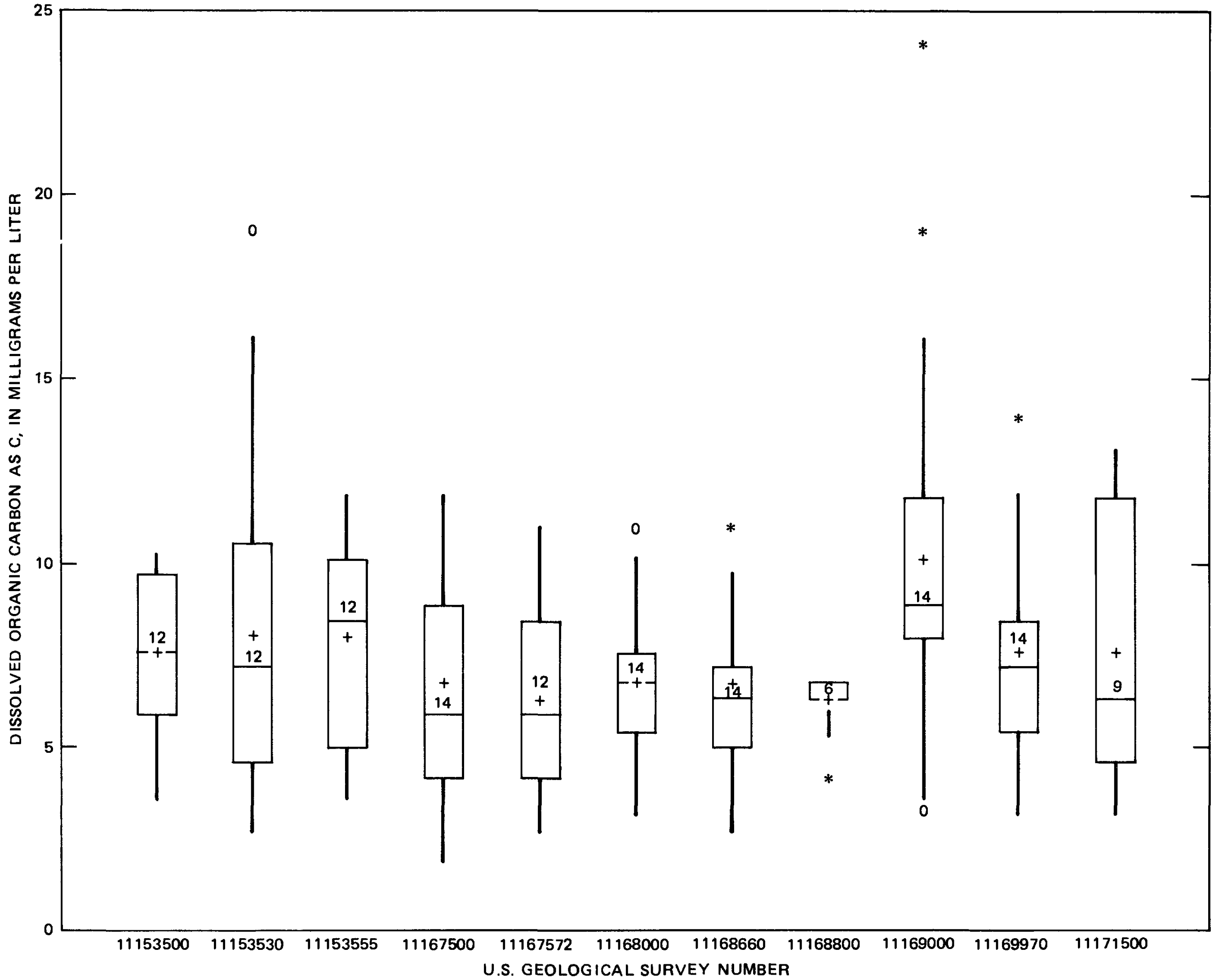
Concentrations of dissolved organic carbon (fig. 18) generally were greatest (median of 9.0 mg/L) at Guadalupe River at San Jose and generally were least (median of 5.8 mg/L) at Guadalupe River at Alamitos Recharge Facility. Median concentrations of dissolved organic carbon decreased from stations near reservoir releases to the next station downstream. These decreases ranged from 0.9 mg/L between the Coyote Creek stations to 0.2 mg/L from Guadalupe Creek at Guadalupe to Guadalupe River at Alamitos Recharge Facility and from Los Gatos Creek at Los Gatos to Los Gatos Creek at Lark Avenue. Such decreases might be due to the utilization by aquatic organisms of dissolved organic carbon in water released from reservoirs. Water is released from reservoirs through penstocks located near the bottom of dams. Bottom water released to streams is likely to have higher concentrations of dissolved organic carbon than surface water because of the decomposition of particulate organic compounds that have settled to the reservoir bottom. The increase in the median concentration of dissolved organic carbon in Llagas Creek from 7.2 mg/L at Machado School to 8.6 mg/L at San Martin might be due to rainfall runoff from agricultural land. The range in the concentration of dissolved organic carbon was greatest (3.3 to 24 mg/L) at Guadalupe River at San Jose, probably because this station receives water from a number of sources.

Temporal Variation

Time-series plots (figs. 19-23) show changes in water quality and streamflow at selected sampling stations. Except for Llagas Creek at San Martin, those stations with the longest period of record (1979-81 water years) were selected. Llagas Creek at San Martin was not selected because most of the water in Llagas Creek downstream of Chesbro Reservoir is water released from this reservoir, and the quality of this water is best measured at Llagas Creek near Morgan Hill, which is only 0.3 mile downstream of Chesbro Reservoir. Relations between water quality and streamflow and between water-quality variables are also shown in the time-series plots. Correlation coefficients are given when these relations are significant at the 0.01 or 0.05 level and the correlation coefficient is greater than 0.70.

Llagas Creek near Morgan Hill

Changes in water quality and streamflow at Llagas Creek near Morgan Hill are shown in figure 19. Dissolved oxygen was least (6.8 mg/L, 61 percent saturation) and specific conductance and turbidity were greatest (541 µmho/cm and 33 NTU, respectively) January 30, 1981, when the streamflow was least (0.10 ft^3/s). When streamflows are this low, samples cannot be collected at the weir where they are usually collected because only a trickle of water flows over the weir. Instead, samples were collected from the stagnant pool behind the weir. Under these conditions, the dissolved oxygen and specific conductance values observed were expected because utilization rather than production of dissolved oxygen would be favored and dissolved solids would be concentrated. The reason the turbidity was greatest during the least streamflow sampled is not known.



U.S. GEOLOGICAL SURVEY NUMBER AND STATION NAME

11153500 – LLAGAS CREEK NEAR MORGAN HILL
11153530 – LLAGAS CREEK AT MACHADO SCHOOL
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11169970 – COYOTE CREEK BELOW LEROY ANDERSON DAM
11171500 – COYOTE CREEK NEAR EDENVALE

FIGURE 18. - Schematic plots of dissolved organic carbon as C.

As expected, specific conductance was least (263 μmho/cm) during the greatest streamflow sampled (466 ft^3/s) during a February 1980 storm. Except for the turbidity of 33 NTU on January 30, 1981, turbidity was greater than 25 NTU only when streamflows were greater than 40 ft^3/s.

The concentration and percent saturation of dissolved oxygen were greatest during March of each year. Attached algae were observed during the March samplings, but they were also observed during other samplings when the dissolved oxygen was less than 10 mg/L and 94 percent saturation.

Total ammonia plus organic nitrogen and total phosphorus generally appear to be increasing with time. The reason for this is not known. The concentration of total nitrite plus nitrate was greatest (1.8 mg/L) January 30, 1981, when the streamflow was least (0.10 ft^3/s) and the turbidity was greatest (33 NTU). Apparently, the suspended material causing the high turbidity was high in nitrite plus nitrate. Concentrations of total nitrite plus nitrate were generally greater than 0.50 mg/L during the rainy season and were generally less than 0.20 mg/L during the dry season. This indicates that rainfall runoff was the primary determinant of total nitrite plus nitrate concentrations.

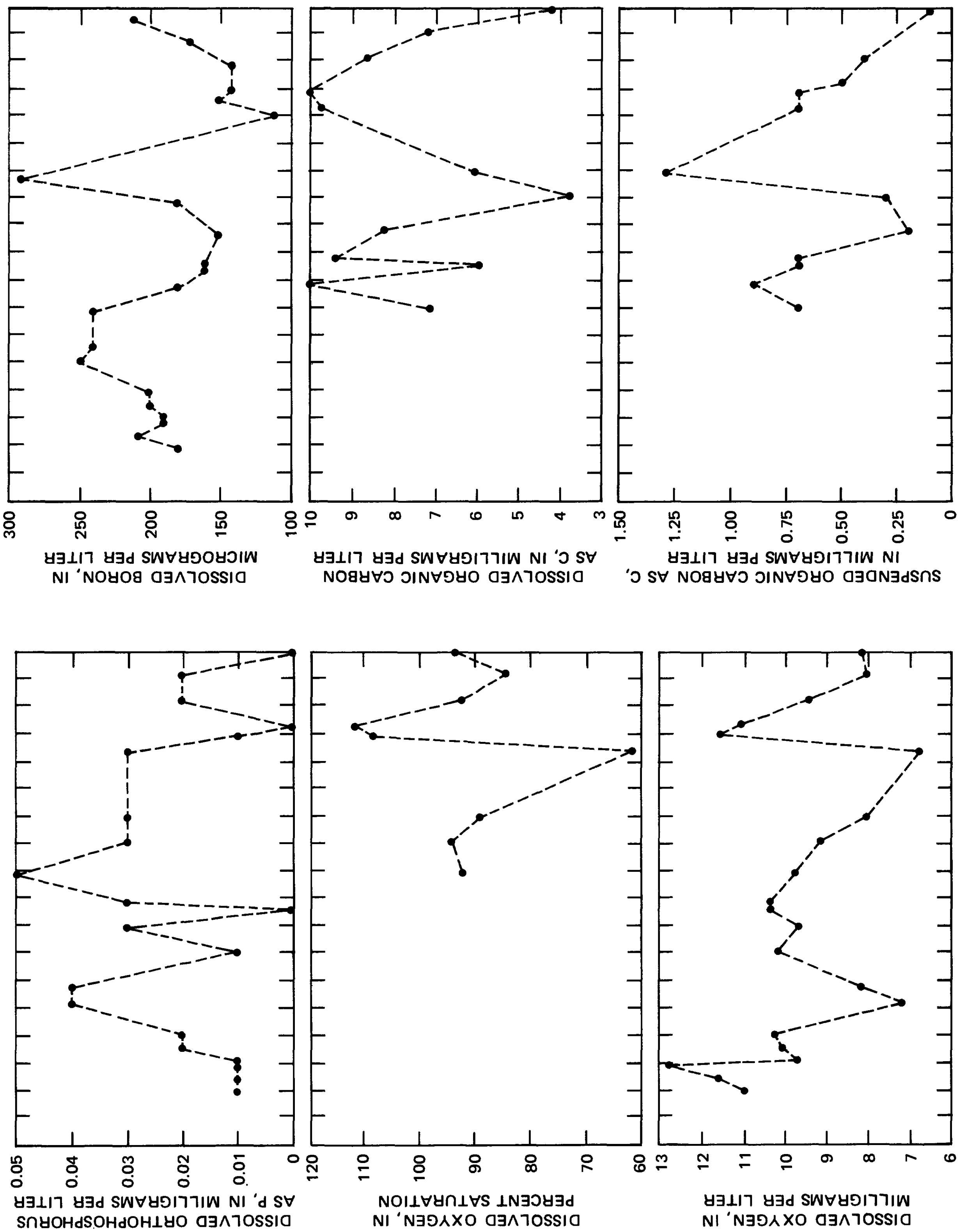
Concentrations of dissolved boron were greatest (210-290 μg/L) from August through November of each year. This is when the effect of the ground-water contribution to streamflow would be greatest. Concentrations at other times ranged from 110 to 210 μg/L. This is when the rainfall-runoff contribution to streamflow would be greatest. Concentrations of dissolved boron were generally greater (median of 200 μg/L) during the 1979 water year than during the 1980 and 1981 water years (median of 160 μg/L). The reason for this is not known.

Concentrations of dissolved and suspended organic carbon were generally greater (medians of 9.6 and 0.7 mg/L, respectively) during the rainy season than during the dry season (medians of 6.6 and 0.3 mg/L, respectively). Concentrations of suspended organic carbon were related to turbidity (correlation coefficient of 0.72, number of observations = 12, significant at 0.01 level).

Los Gatos Creek at Lark Avenue

Changes in water quality and streamflow at Los Gatos Creek at Lark Avenue are shown in figure 20. Specific conductance generally was inversely related to streamflow (correlation coefficient of -0.73, number of observations = 22, significant at 0.01 level). Specific conductance was least (170 μmho/cm) during a February 1980 storm when the streamflow was 294 ft^3/s (second largest sampled). During the largest streamflow sampled (369 ft^3/s during a March 1980 storm), specific conductance was 271 μmho/cm (the second smallest measured). Specific conductance was greatest (392-488 μmho/cm) during November of each year because little or no rainfall had occurred since April.

Turbidity was greater (37-730 NTU) in samples taken during storms when the streamflow was greater than 60 ft^3/s than in samples taken at other times (turbidity less than 14 NTU and streamflows generally less than 20 ft^3/s). Thus, rainfall runoff substantially affected water clarity.


DISSOLVED BORON, IN MICROGRAMS PER LITER
300
250
200
150
100
DISSOLVED ORGANIC CARBON AS C, IN MILLIGRAMS PER LITER
10
9
8
7
6
5
4
3
SUSPENDED ORGANIC CARBON AS C, IN MILLIGRAMS PER LITER
1.50
1.25
1.00
0.75
0.50
0.25
0
DISSOLVED ORTHOPHOSPHORUS AS P, IN MILLIGRAMS PER LITER
0.05
0.04
0.03
0.02
0.01
0
DISSOLVED OXYGEN, IN PERCENT SATURATION
120
110
100
90
80
70
60
DISSOLVED OXYGEN, IN MILLIGRAMS PER LITER
13
12
11
10
9
8
7
6

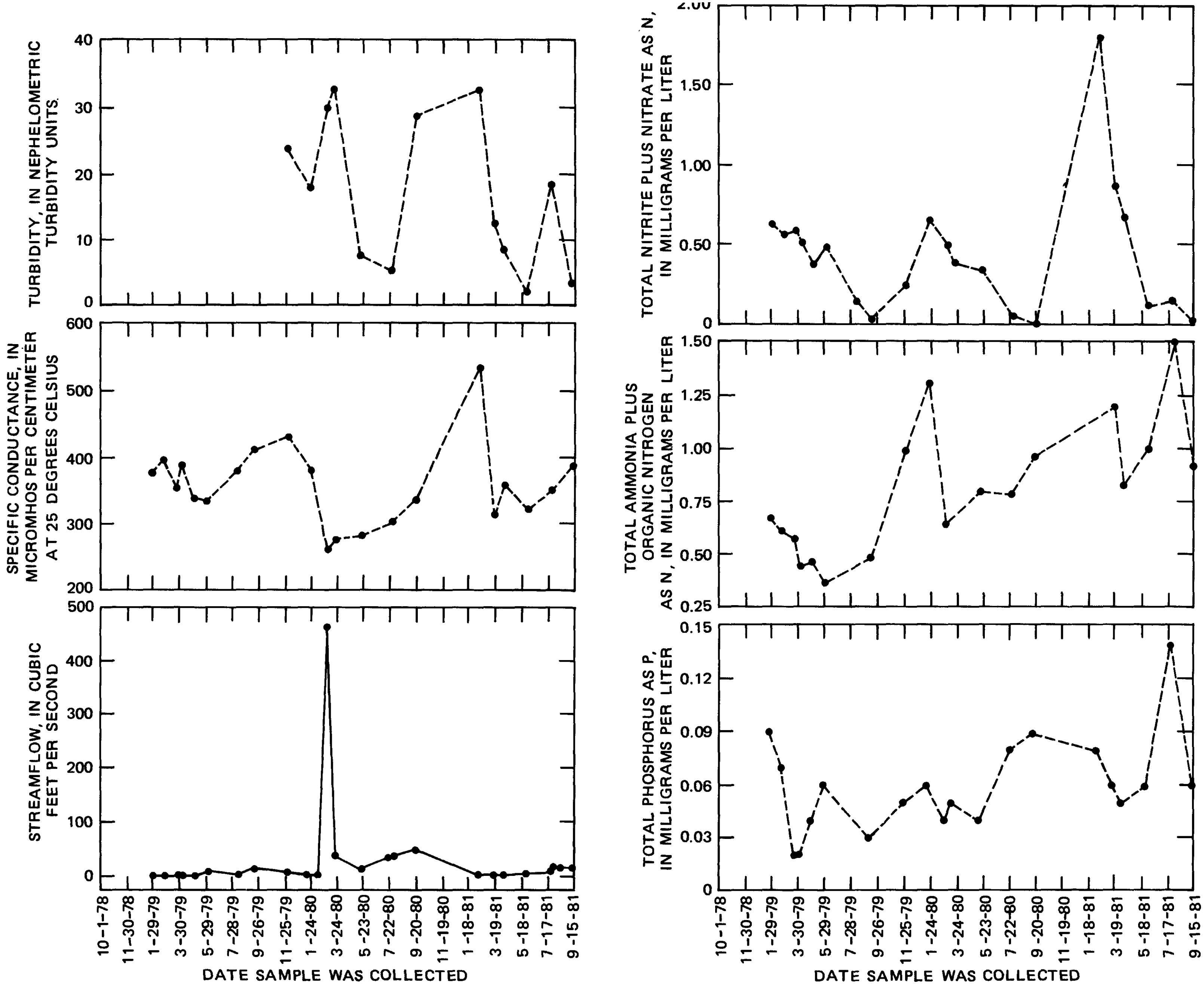
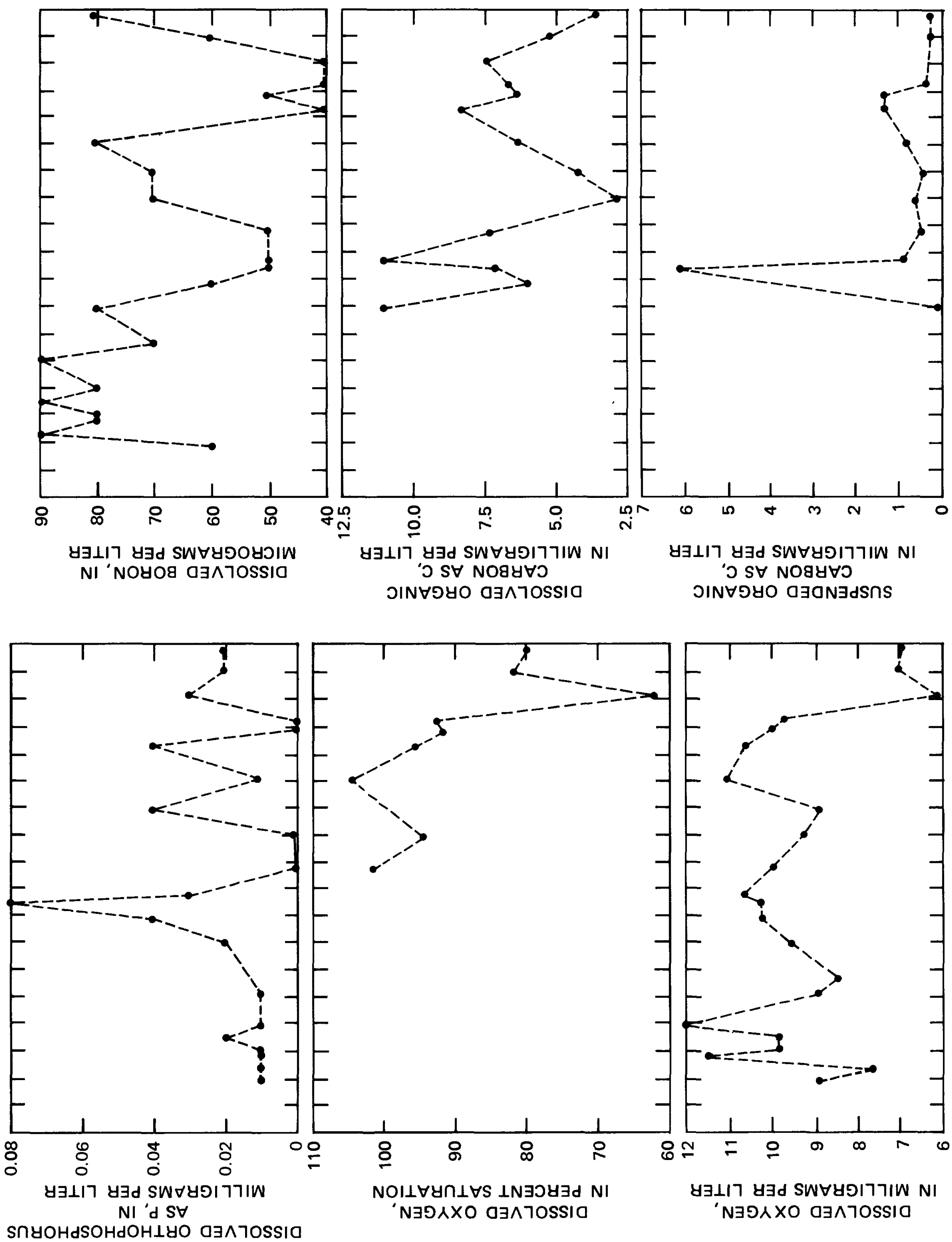


FIGURE 19.– Changes in water quality and streamflow at Llagas Creek near Morgan Hill (11153500, 69).



DISSOLVED BORON, IN MICROGRAMS PER LITER
DISSOLVED ORGANIC CARBON AS C, IN MILLIGRAMS PER LITER
SUSPENDED ORGANIC CARBON AS C, IN MILLIGRAMS PER LITER
DISSOLVED ORTHOPHOSPHORUS AS P, IN MILLIGRAMS PER LITER
DISSOLVED OXYGEN, IN PERCENT SATURATION
DISSOLVED OXYGEN, IN MILLIGRAMS PER LITER

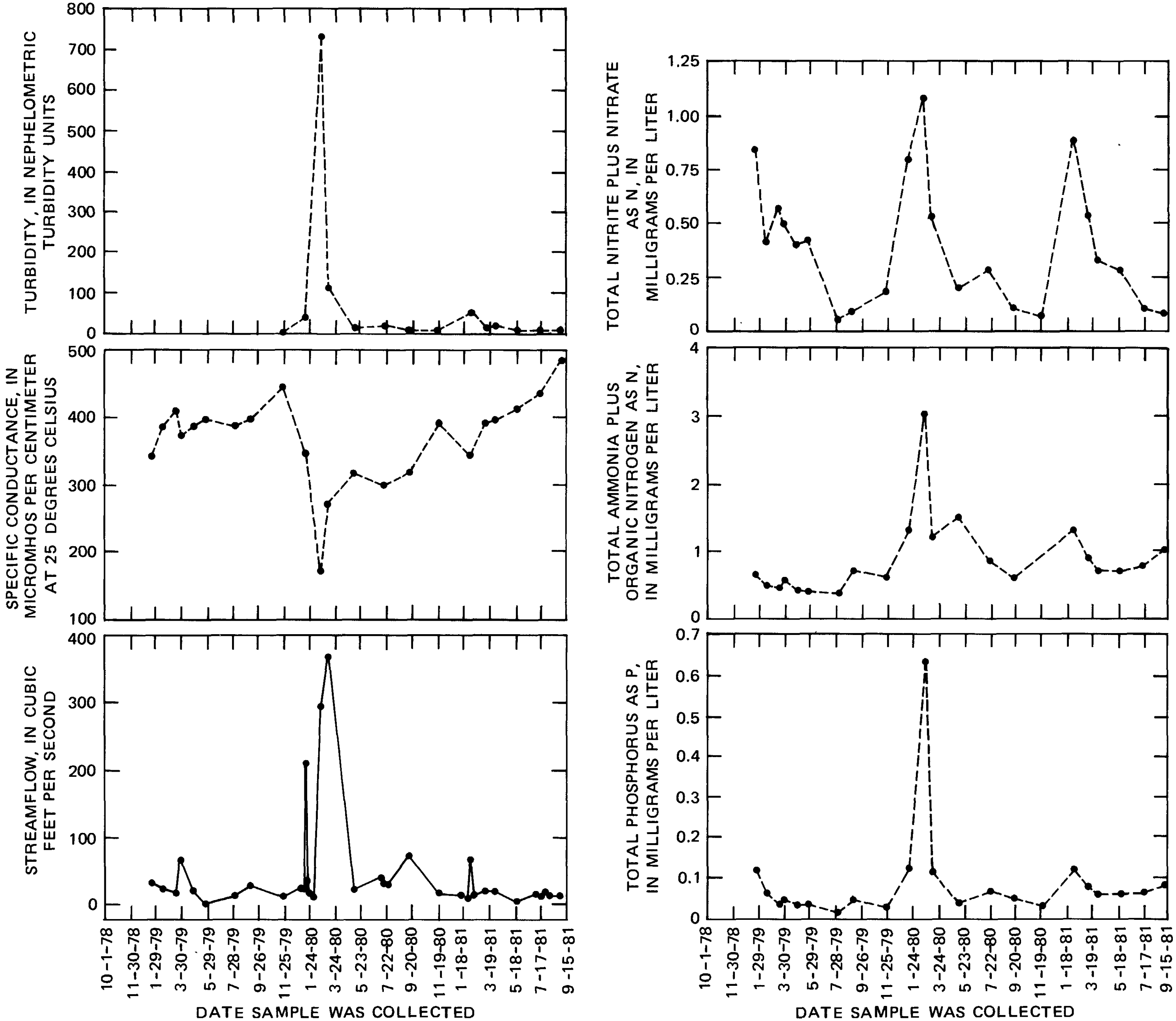


FIGURE 20.— Changes in water quality and streamflow at Los Gatos Creek at Lark Avenue at Los Gatos (11168660, 59).

Dissolved oxygen was less than 7.0 mg/L and 82 percent saturation during the May, July, and September 1981 samplings. At other times, dissolved oxygen was greater than 8.3 mg/L, except during a February 1979 storm when it was 7.6 mg/L. The low dissolved-oxygen values during May, July, and September 1981 samplings might be the result of an abundance of aquatic vascular plants in the stream. These plants covered almost all of the water surface and thus retarded light penetration into the water. Under such conditions, limited light penetration into the water would make conditions unfavorable for photosynthesis (and thus oxygen production) by algae attached to the stream bottom. At other times, aquatic-vascular plants were generally restricted to the edges of the stream and did little to retard light penetration into the water. The concentration of dissolved oxygen was greatest (12.1 mg/L) during May 1979 when the water was clear and algae attached to rocks on the bottom of the stream were abundant.

Concentrations of total nitrite plus nitrate and total phosphorus were generally greater (medians of 0.53 and 0.07, respectively) in samples taken during storms than at other times (medians of 0.10 and 0.04, respectively). Concentrations of total nitrite plus nitrate, total ammonia plus organic nitrogen, total phosphorus, and dissolved orthophosphorus were greatest (1.1, 3.0, 0.63, and 0.08 mg/L, respectively) during a February 1980 storm when the streamflow was 294 ft^3/s (second largest streamflow sampled). Turbidity was also greatest (730 NTU) during this storm, suggesting a relation between turbidity and nutrient concentrations. Correlation coefficients between turbidity and total ammonia plus organic nitrogen, total phosphorus, and dissolved orthophosphorus were 0.91 (number of observations = 13), 0.99 (number of observations = 14), and 0.76 (number of observations = 14), respectively. These correlation coefficients are significant at the 0.01 level.

Concentrations of dissolved boron were low (less than 100 µg/L) during all samplings. Concentrations of this constituent were least (40-60 µg/L) in samples taken during storms in the 1980 and 1981 water years and were greatest during the 1979 water year (60-90 µg/L). As with Llagas Creek near Morgan Hill, the reason concentrations of dissolved boron were greatest during the 1979 water year is not known.

Concentrations of dissolved organic carbon were similar in storm and nonstorm streamflows (medians of 6.8 and 5.6 mg/L, respectively). Concentrations of suspended organic carbon were greater (median of 1.2 mg/L) during storms than at other times (median of 0.3 mg/L) and were related to turbidity (correlation coefficient of 0.98, number of observations = 12, significant at 0.01 level). Thus, rainfall runoff affected concentrations of suspended organic carbon, but did not affect concentrations of dissolved organic carbon.

Guadalupe River at Alamitos Recharge Facility

Changes in water quality and streamflow at Guadalupe River at Alamitos Recharge Facility are shown in figure 21. Specific conductance generally was inversely related to streamflow (correlation coefficient of -0.72, number of observations = 21, significant at 0.01 level). Specific conductance was least (223 μmho/cm) during the largest streamflow sampled (2,360 ft^3/s during a February 1980 storm) and was greatest (638 μmho/cm) in a composite sample collected July 13-14, 1981, when the mean streamflow for the sampling period was 3.2 ft^3/s (second smallest streamflow sampled).

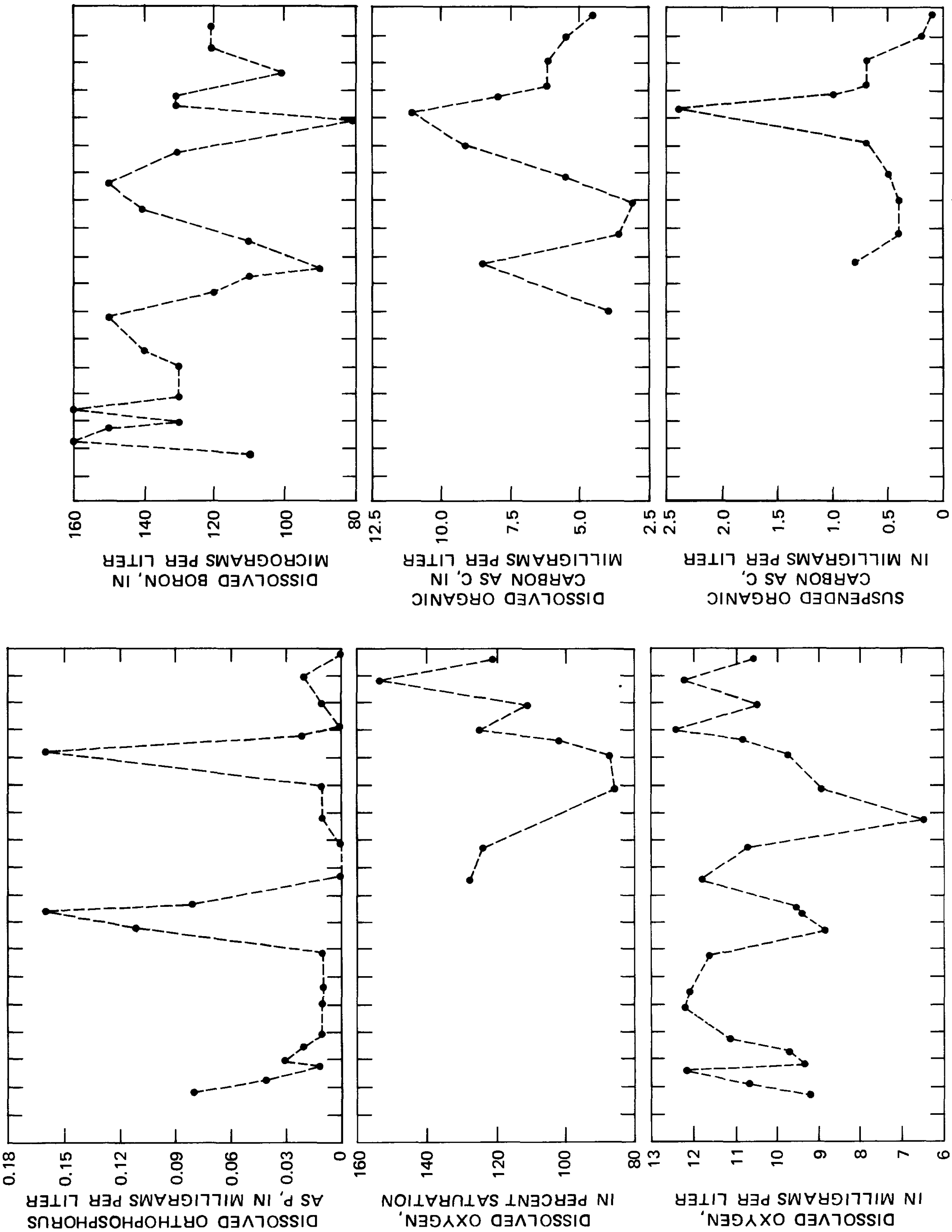
Turbidity was greater during storms (median of 46 NTU) than at other times (median of 11 NTU). Turbidity was greatest (220 NTU) in a composite sample collected February 18-19, 1980, during a storm (mean streamflow for the sampling period was 1,530 ft^3/s).

Dissolved-oxygen values were generally less during storms (median concentration of 9.7 mg/L, median percent saturation of 102) than at other times (median concentration of 11.4 mg/L, median percent saturation of 122). This might be due to the greater abundance of aquatic vascular plants and algae during the dry season. The reason the dissolved oxygen was only 6.4 mg/L during the September 10, 1980, sampling is not known. The percent saturation of dissolved oxygen was greatest (154 percent) during the July 14, 1981, sampling when the stream channel was clogged with aquatic plants.

Concentrations of total nitrite plus nitrate, total ammonia plus organic nitrogen, total phosphorus, and dissolved orthophosphorus were greater during storms (medians of 1.6, 0.83, 0.13, and 0.04 mg/L, respectively) than at other times (medians of 0.82, 0.64, 0.03, and 0.01 mg/L, respectively). The concentration of total nitrite plus nitrate was greatest (2.1 mg/L) in a composite sample collected March 4-5, 1981, during a storm (mean streamflow for the sampling period was 17 ft^3/s). The concentration of total nitrite plus nitrate was least (0.29 mg/L) during a September 4, 1979, sampling when the streamflow was 13 ft^3/s. The concentration of total ammonia plus organic nitrogen was greatest (1.8 mg/L) in a composite sample collected March 26-27, 1981, during a storm (mean streamflow for the sampling period was 15 ft^3/s). The concentration of total ammonia plus organic nitrogen was least (0.38 mg/L) during a July 31, 1979, sampling when the streamflow was 13 ft^3/s.

Concentrations of total phosphorus and dissolved orthophosphorus were related to turbidity (correlation coefficients of 0.91 and 0.86, respectively; number of observations = 13, significant at 0.01 level). The concentration of total phosphorus was greater than 0.20 mg/L and the concentration of dissolved orthophosphorus was greatest (0.16 mg/L) only when turbidity was greater than or equal to 200 NTU.

Concentrations of dissolved boron did not follow any explainable pattern. Concentrations of this constituent were not related to streamflow or turbidity and did not vary seasonally (median during storms was 130 μg/L, median at other times was 130 μg/L).



DISSOLVED OXYGEN, IN MILLIGRAMS PER LITER
6 7 8 9 10 11 12 13
DISSOLVED OXYGEN, IN PERCENT SATURATION
80 100 120 140 160
DISSOLVED ORTHOPHOSPHORUS AS P, IN MILLIGRAMS PER LITER
0 0.03 0.06 0.09 0.12 0.15 0.18
SUSPENDED ORGANIC CARBON AS C, IN MILLIGRAMS PER LITER
0 0.5 1.0 1.5 2.0 2.5
DISSOLVED ORGANIC CARBON AS C, IN MILLIGRAMS PER LITER
2.5 5.0 7.5 10.0 12.5
DISSOLVED BORON, IN MICROGRAMS PER LITER
80 100 120 140 160

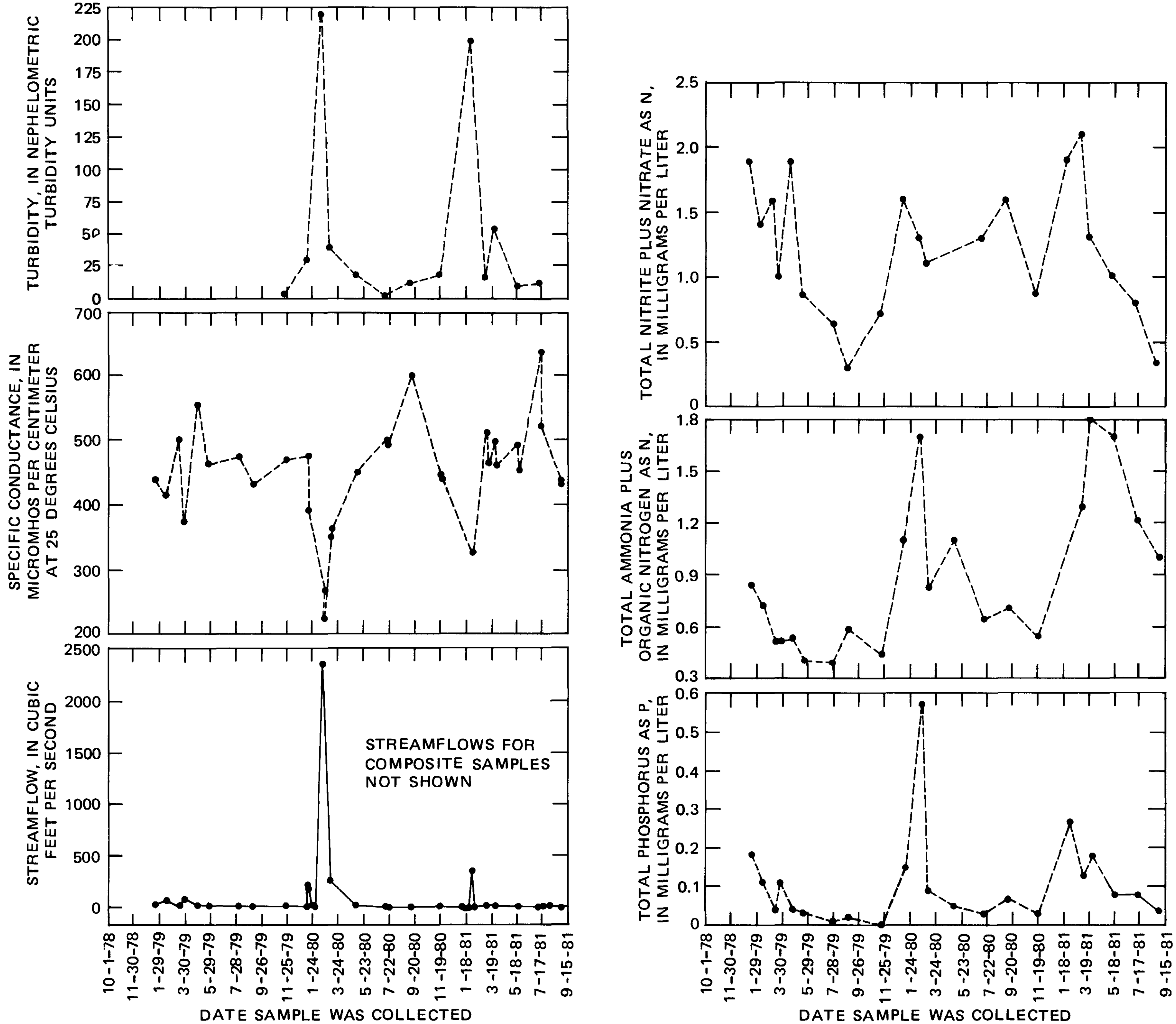


FIGURE 21. – Changes in water quality and streamflow at Guadalupe River at Alamitos Recharge Facility at San Jose (11167572, 20).

Concentrations of dissolved and suspended organic carbon were related to streamflow (correlation coefficients of 0.71 and 0.80, respectively; number of observations = 12 and 11, respectively; significant at 0.01 level) and were greater during storms (medians of 8.2 and 0.9 mg/L, respectively) than at other times (medians of 4.9 and 0.4 mg/L, respectively). Concentrations of dissolved and suspended organic carbon also appear to be related to turbidity (fig. 21), but correlation coefficients could not be calculated because organic-carbon samples were collected manually and composite samples from an automatic sampler were used for turbidity measurements. Results from composite and manual samples were stored as separate observations on the computer file.

Guadalupe River at San Jose

Changes in water quality and streamflow at Guadalupe River at San Jose are shown in figure 22. Specific conductance was much less during storms (median of 288 µmho/cm) than at other times (median of 750 µmho/cm). Specific conductance was least (172 µmho/cm) during a February 1980 storm when the streamflow was 7,900 ft^3/s (largest streamflow sampled) and was greatest (895 µmho/cm) during a May 23, 1979, sampling when the streamflow was 0.69 ft^3/s.

Turbidity was highly correlated with streamflow (correlation coefficient of 0.99, number of observations = 13, significant at 0.01 level). Turbidity was much greater during storms (median of 42 NTU) than at other times (median of 5.0 NTU). Turbidity was greatest (800 NTU) during the largest streamflow sampled (7,900 ft^3/s during a February 1980 storm) and was least (2.1 NTU) during a May 19, 1981, sampling when the streamflow was 0.46 ft^3/s.

Dissolved-oxygen concentrations were generally greater during storms (median of 9.7 mg/L) than at other times (median of 7.4 mg/L). Dissolved-oxygen values were variable during May through November when streamflows were less than 1.0 ft^3/s. During this period, dissolved-oxygen values ranged from 1.0 mg/L (9 percent saturation) to 15.6 mg/L (173 percent saturation), with both the low and high values occurring when the streamflow was 0.24 ft^3/s. The low value occurred November 18, 1980, when the water appeared milky with much decaying organic matter (a dead bullfrog and tadpole were also noticed). The high value occurred July 16, 1980, when algal mats covered the water surface. These observations suggest that algal growth during the late spring and summer and algal death and a reduction in algal growth in the fall caused the variability in dissolved oxygen observed at this station from May through November of each year. Dissolved-oxygen concentrations were much less variable (6.8 to 11.0 mg/L) in the stormflows sampled during December through April because dissolved-oxygen concentrations are primarily a function of physical aeration during storms when streamflows are considerably greater than 1.0 ft^3/s.

Concentrations of total nitrite plus nitrate did not follow a seasonal pattern and were not related to streamflow or turbidity. The concentration of this constituent was least (0.29 mg/L) during a July 16, 1980, sampling when the streamflow was 0.24 ft^3/s. This is the same sampling that had the greatest dissolved-oxygen values. Algal growth that produced the high dissolved-oxygen values might also be the cause of the low concentrations of total nitrite plus nitrate. A reduction in the concentration of total nitrite plus nitrate in the water would occur as algae take this nutrient from the water during growth. The concentration of total nitrite plus nitrate was greatest (1.7 mg/L) during a May 19, 1981, sampling when the streamflow was 0.46 ft^3/s.

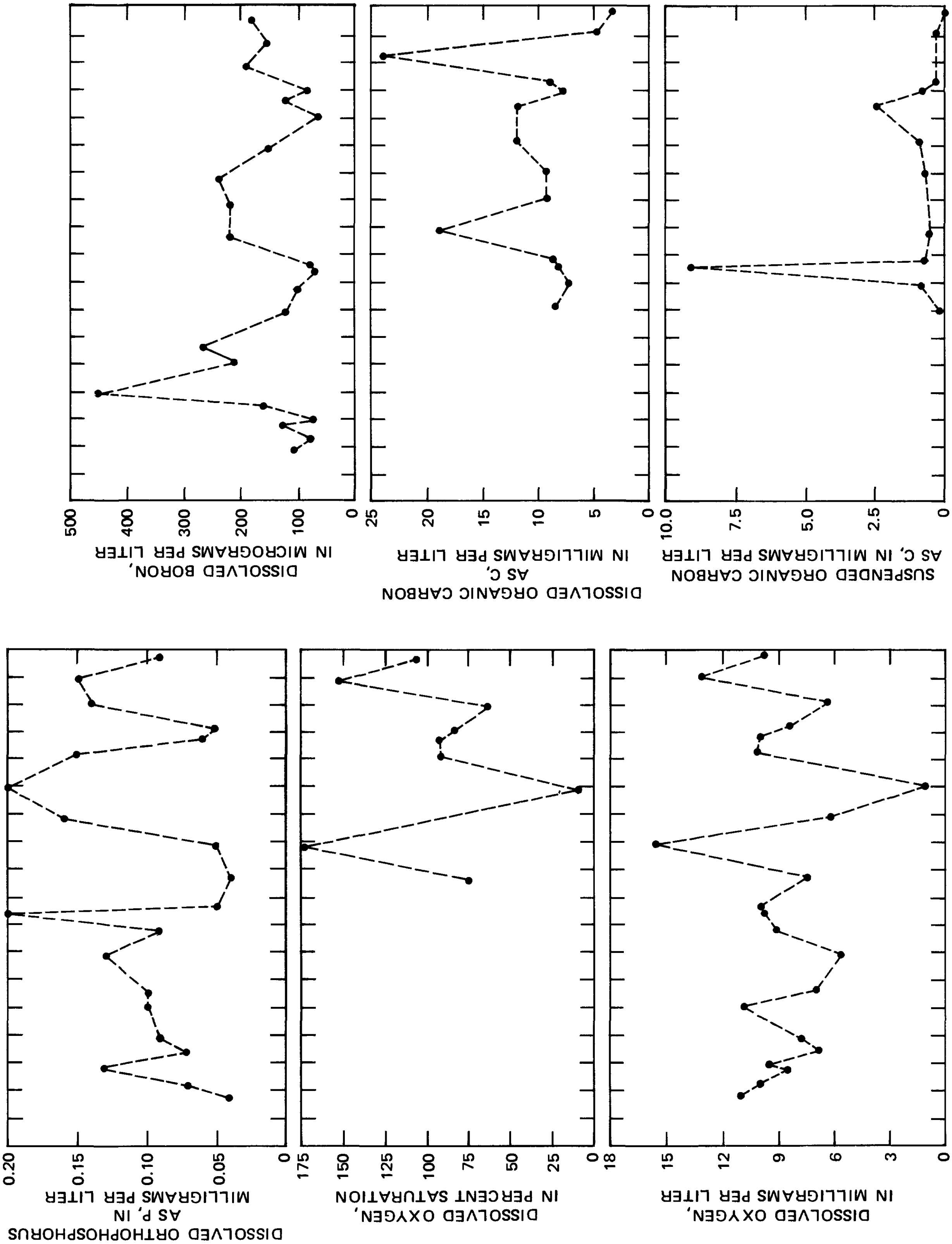
Concentrations of total ammonia plus organic nitrogen and total phosphorus were related to streamflow and turbidity. Correlation coefficients were as follows: total ammonia plus organic nitrogen with streamflow, 0.96, number of observations = 20; total ammonia plus organic nitrogen with turbidity, 0.98, number of observations = 13; total phosphorus with streamflow, 0.98, number of observations = 21; total phosphorus with turbidity, 0.98, number of observations = 14. All correlation coefficients were significant at 0.01 level. Concentrations of total ammonia plus organic nitrogen and total phosphorus were greatest (4.7 and 2.8 mg/L, respectively) during the largest streamflow sampled (7,900 ft^3/s during a February 1980 storm). The concentration of total ammonia plus organic nitrogen was least (0.68 mg/L) during a January 1979 storm when the streamflow was 52 ft^3/s. The concentration of total phosphorus was least (0.07 mg/L) during an August 1, 1979, sampling when the streamflow was 0.33 ft^3/s.

Concentrations of dissolved orthophosphorus did not follow a seasonal pattern and were not related to streamflow or turbidity. Concentrations of this constituent were essentially the same during storms (minimum of 0.04 mg/L, median of 0.07 mg/L, and maximum of 0.20 mg/L) as they were in May through November (minimum of 0.04, median of 0.10 mg/L, and maximum of 0.20 mg/L). The greatest concentrations (0.20 mg/L) occurred during extreme conditions: February 19, 1980, during a storm when the streamflow was the largest sampled (7,900 ft^3/s) and November 18, 1980, when the streamflow was only 0.24 ft^3/s and the water appeared milky with decaying organic matter. Rainfall runoff from the city of San Jose was probably the source of the phosphorus in the first case and release of cellular phosphorus by decay was probably the source of the phosphorus in the second case.

Concentrations of dissolved boron were related to specific conductance (correlation coefficient 0.81, number of observations = 22, significant at 0.01 level); they were generally greater in May through November (median of 210 μg/L) when streamflows were less than 1.0 ft^3/s than they were during storm samplings (median of 80 μg/L) when streamflows were considerably greater (median of 29 ft^3/s). The concentration of dissolved boron was greatest (450 μg/L) during a May 23, 1979, sampling when the streamflow was 0.69 ft^3/s and was least (60 μg/L) during a January 1981 storm when the streamflow was 293 ft^3/s.

Concentrations of dissolved organic carbon did not follow a seasonal pattern and were not related to streamflow or turbidity. Concentrations of this constituent were generally the same during storms (median of 8.5 mg/L) as they were during May through November (median of 9.3 mg/L). The concentration of this constituent was greatest (24 mg/L) during a May 19, 1981, sampling when the streamflow was 0.46 ft^3/s and the water had a humic appearance and was least (3.3 mg/L) during a September 1, 1981, sampling when the streamflow was 0.33 ft^3/s.

Concentrations of suspended organic carbon were related to streamflow (correlation coefficient of 0.97, number of observations = 12, significant at 0.01 level) and turbidity (correlation coefficient of 0.99, number of observations = 11, significant at 0.01 level). The concentration of this constituent was greatest (9.2 mg/L) when turbidity was greatest (800 NTU) during the largest streamflow sampled (7,900 ft^3/s during a February 1980 storm) and was least (0.1 mg/L) during a September 1, 1981, sampling when the streamflow was only 0.33 ft^3/s and the turbidity was only 2.6 NTU. This is the same sampling that had the least concentration of dissolved organic carbon.


DISSOLVED OXYGEN, IN MILLIGRAMS PER LITER
DISSOLVED OXYGEN, IN PERCENT SATURATION
DISSOLVED ORTHOPHOSPHORUS AS P, IN MILLIGRAMS PER LITER
SUSPENDED ORGANIC CARBON AS C, IN MILLIGRAMS PER LITER
DISSOLVED ORGANIC CARBON AS C, IN MILLIGRAMS PER LITER
DISSOLVED BORON, IN MICROGRAMS PER LITER

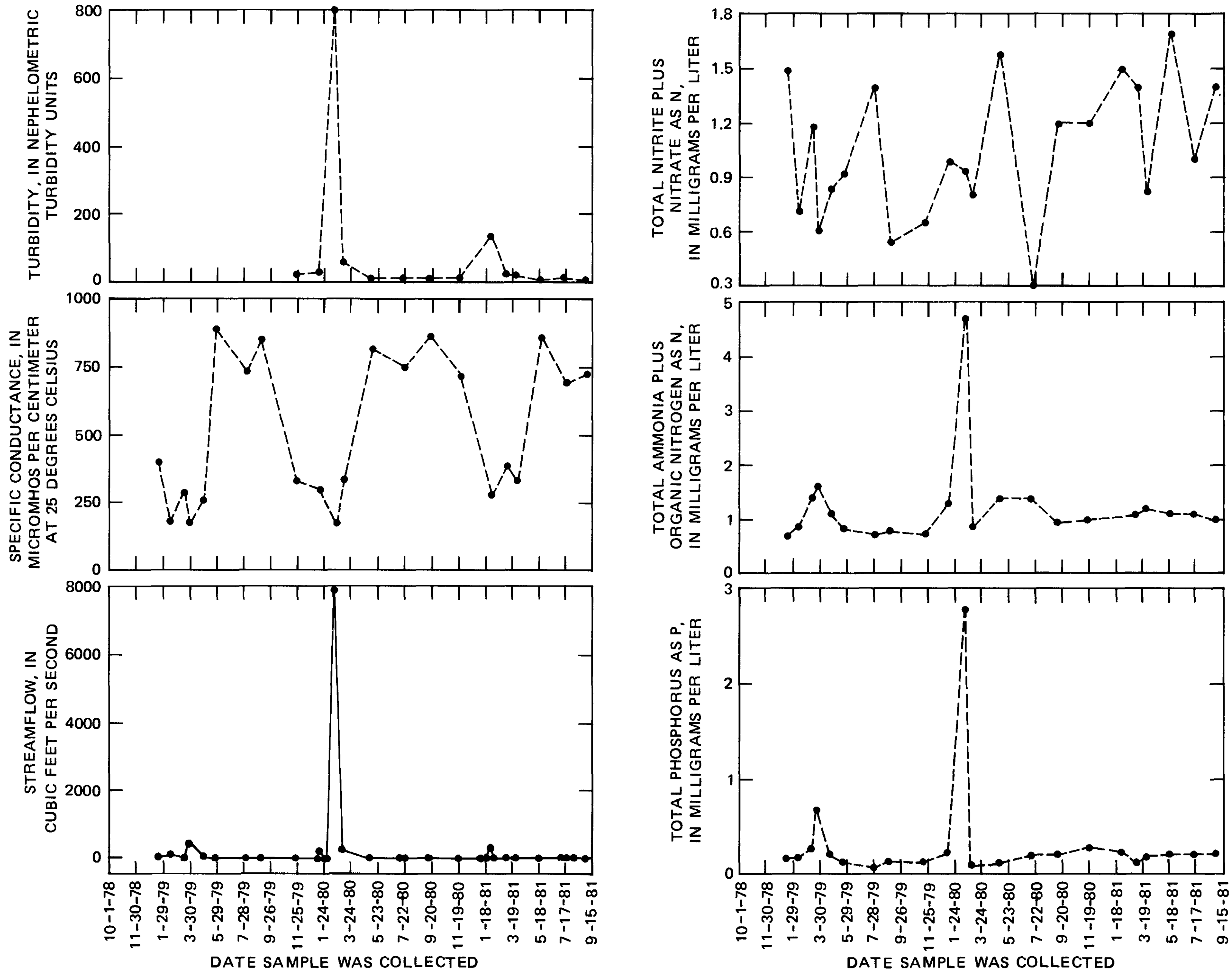


FIGURE 22.— Changes in water quality and streamflow at Guadalupe River at San Jose (11169000).

Coyote Creek near Edenvale

Changes in water quality and streamflow at Coyote Creek near Edenvale are shown in figure 23. Specific conductance was inversely related to turbidity (correlation coefficient of -0.73, number of observations = 10, significant at 0.05 level). Specific conductance did not follow a consistent seasonal pattern, was not related to streamflow, and was generally the same during storms (median of 430 μmho/cm) as other times (403 μmho/cm). The greatest specific conductance (605 μmho/cm) was measured in a manual sample collected March 28, 1981, during a storm when the streamflow was 3.8 ft^3/s. The least specific conductance (66 μmho/cm) was measured in a manual sample collected March 27, 1979, during a storm when all of the streamflow (1.4 ft^3/s) was coming from a storm sewer about 400 feet upstream of the sampling location and the water was visibly turbid (no analyses for turbidity were done during 1979).

Turbidity was highly correlated with streamflow (correlation coefficient of 1.00, number of observations = 6, significant at 0.01 level). Turbidity was much greater during storms (median of 96 NTU) than at other times (median of 0.80 NTU) and was greatest (620 NTU) in a composite sample collected January 11, 1980, during a storm (mean streamflow for the sampling period was 0.35 ft^3/s). Turbidity was least (0.50 NTU) in a manual sample collected September 10, 1980, when the streamflow was 0.50 ft^3/s.

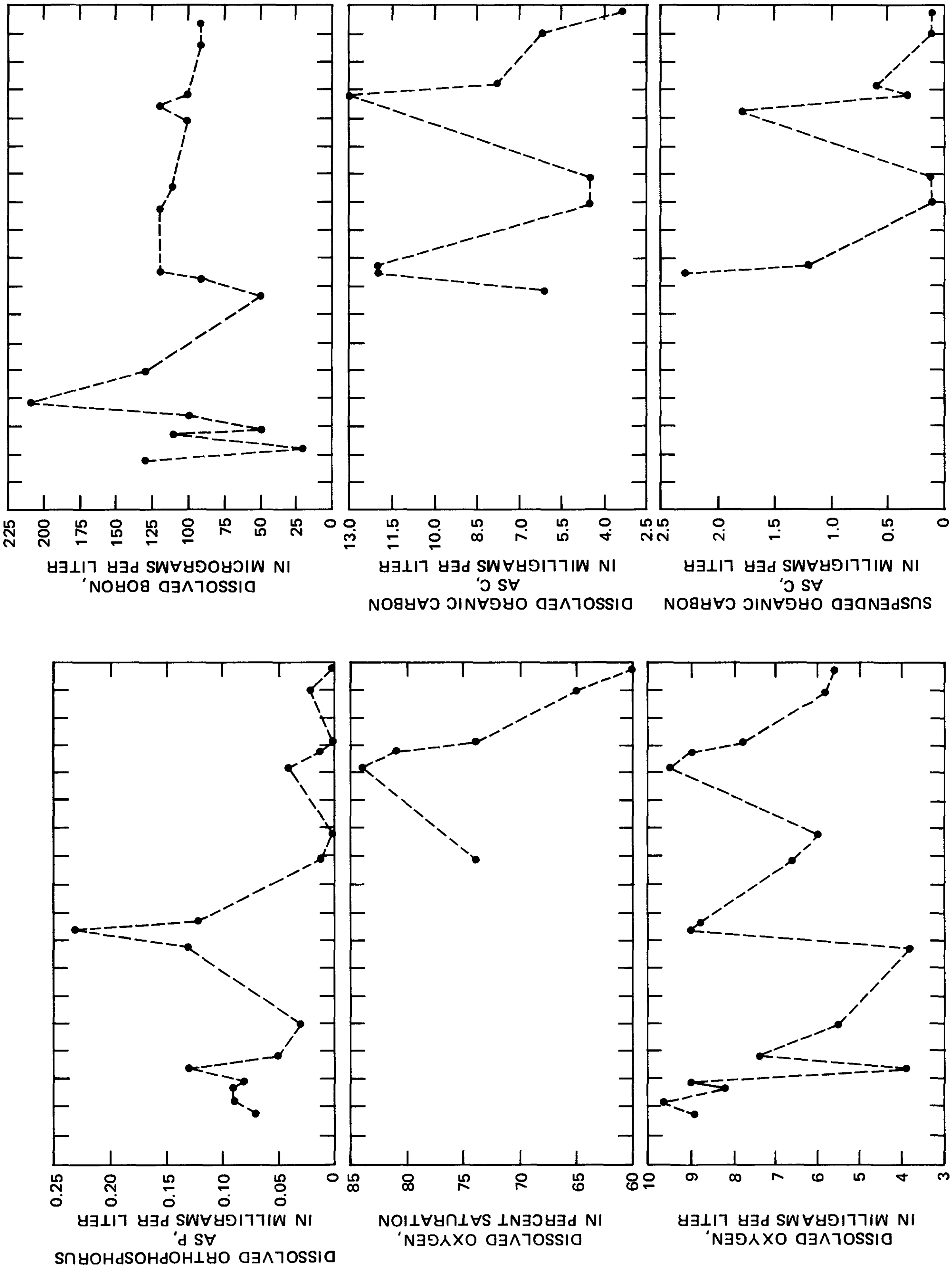
Concentrations of dissolved oxygen generally were greater during storms (median of 8.9 mg/L) than at other times (median of 5.9 mg/L). This was probably due to lower water temperatures (median of 12.8°C) and physical aeration associated with greater streamflows (median of 3.8 ft^3/s) during storms than at other times (median water temperature of 20.5°C and median streamflow of 1.9 ft^3/s). Dissolved oxygen in percent saturation generally was also greater during storms (74-84 percent) than at other times (60-74 percent).

Concentrations of nitrogen and phosphorus compounds were greater during storms (median of 2.6 mg/L for total nitrite plus nitrate, 1.2 mg/L for total ammonia plus organic nitrogen, 0.22 mg/L for total phosphorus, and 0.09 mg/L for dissolved orthophosphorus) than at other times (median of 0.16 mg/L for total nitrite plus nitrate, 0.58 mg/L for total ammonia plus organic nitrogen, 0.04 mg/L for total phosphorus, and 0.02 mg/L for dissolved orthophosphorus). Total phosphorus was related to streamflow (correlation coefficient of 0.79, number of observations = 13, significant at 0.01 level) and turbidity (correlation coefficient of 0.88, number of observations = 10, significant at 0.01 level). Dissolved orthophosphorus was related to streamflow (correlation coefficient of 0.76, number of observations = 13, significant at 0.01 level).

The concentration of total nitrite plus nitrate was greatest (4.7 mg/L) in a manual sample collected January 17, 1979, during a storm when the streamflow was 5.1 ft^3/s, and was least (0.02 mg/L) in a manual sample collected September 2, 1981, when the streamflow was 0.90 ft^3/s. The concentration of total ammonia plus organic nitrogen and total phosphorus was greatest (2.5 and 0.65 mg/L, respectively) when turbidity was greatest (620 NTU), in a composite sample collected January 11, 1980, during a storm (mean streamflow for the sampling period was 0.35 ft^3/s). The concentrations of total ammonia plus organic nitrogen and total phosphorus were least (0.24 and 0.02 mg/L, respectively) in a manual sample collected July 31, 1979, when the streamflow was 0.30 ft^3/s. The concentration of dissolved orthophosphorus was greatest (0.23 mg/L) during the greatest streamflow sampled (331 ft^3/s, February 20, 1980, during a storm). The concentration of dissolved orthophosphorus was less than 0.01 mg/L in manual samples collected September 10, 1980, March 28, 1981, and September 2, 1981, when the streamflow was 0.50, 3.8, and 0.90 ft^3/s, respectively. The apparent decreasing trend in concentrations of dissolved orthophosphorus is possibly the result of a relatively wet year, 1980 water year, followed by a relatively dry year, 1981 water year (fig. 4). This trend, therefore, might not continue.

Concentrations of dissolved boron did not follow a consistent seasonal pattern and were not related to streamflow. Concentrations of dissolved boron were inversely related to turbidity (correlation coefficient of -0.80, number of observations = 10, significant at 0.01 level). Concentrations of dissolved boron were generally the same during storms (median of 100 μg/L) and at other times (median of 120 μg/L). The concentration of this constituent was greatest (210 μg/L) in a manual sample collected May 23, 1979, when the streamflow was 0.40 ft^3/s and was least (less than 20 μg/L) in a manual sample collected February 14, 1979, when the streamflow was estimated at less than 0.01 ft^3/s.

Concentrations of suspended organic carbon were related to streamflow (correlation coefficient of 0.82, number of observations = 9, significant at 0.01 level) and turbidity (correlation coefficient of 0.92, number of observations = 6, significant at 0.01 level). Concentrations of dissolved organic carbon did not show a significant correlation with streamflow or turbidity, but did follow a seasonal pattern. Concentrations of dissolved and suspended organic carbon were greater during storms (median of 12 and 1.2 mg/L, respectively) than at other times (median of 4.5 and 0.1 mg/L, respectively). The concentration of dissolved organic carbon was greatest (13 mg/L) in a sample collected March 6, 1981, during a storm when the streamflow was 8.9 ft^3/s. The concentration of suspended organic carbon was greatest (2.3 mg/L) in a sample collected February 20, 1980, during a storm when the streamflow was 331 ft^3/s (greatest streamflow sampled). The concentration of dissolved and suspended organic carbon was least (3.3 and less than 0.1 mg/L, respectively) September 2, 1981, when the streamflow was 0.90 ft^3/s.



DISSOLVED BORON, IN MICROGRAMS PER LITER
225
200
175
150
125
100
75
50
25
0
DISSOLVED ORGANIC CARBON AS C, IN MILLIGRAMS PER LITER
13.0
11.5
10.0
8.5
7.0
5.5
4.0
2.5
SUSPENDED ORGANIC CARBON AS C, IN MILLIGRAMS PER LITER
2.5
2.0
1.5
1.0
0.5
0
DISSOLVED ORTHOPHOSPHORUS AS P, IN MILLIGRAMS PER LITER
0.25
0.20
0.15
0.10
0.05
0
DISSOLVED OXYGEN, IN PERCENT SATURATION
85
80
75
70
65
60
DISSOLVED OXYGEN, IN MILLIGRAMS PER LITER
10
9
8
7
6
5
4
3

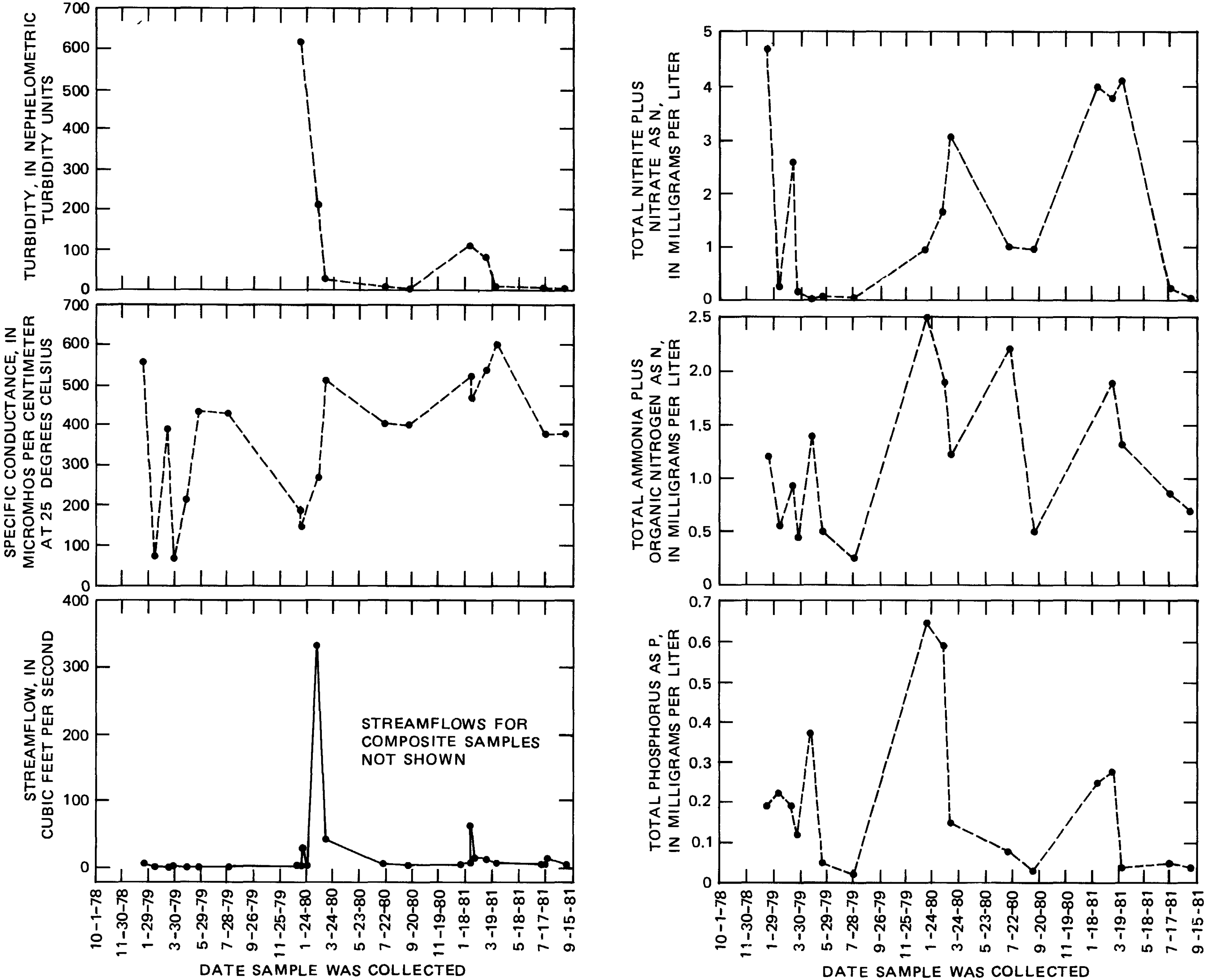


FIGURE 23. – Changes in water quality and streamflow at Coyote Creek near Edenvale (11171500, 58).

Fecal-Coliform and Fecal-Streptococcal Bacteria

In the Llagas Creek basin, concentrations of fecal-coliform and fecal-streptococcal bacteria were greater during the rainy season than during the dry season (table 3). Median concentrations of fecal-coliform bacteria ranged from 160 to 3,700 col/100 mL and averaged 1,100 col/100 mL during the rainy season whereas they ranged from 25 to 260 col/100 mL and averaged 150 col/100 mL during the dry season. Median concentrations of fecal-streptococcal bacteria ranged from 170 to 6,800 col/100 mL and averaged 1,700 col/100 mL during the rainy season whereas they ranged from 40 to 600 col/100 mL and averaged 270 col/100 mL during the dry season. Rainfall runoff from land surrounding ranchhouses where livestock (for example, horses, turkeys, chickens) is kept was probably the source of the greater concentrations of fecal-coliform and fecal-streptococcal bacteria in the Llagas Creek basin during the rainy season.

During the dry season, concentrations of fecal-coliform and fecal-streptococcal bacteria increased from Llagas Creek near Morgan Hill to Llagas Creek at Machado School. At Llagas Creek near Morgan Hill during the dry season the median concentration of fecal-coliform bacteria was 30 col/100 mL and the median concentration of fecal-streptococcal bacteria was 55 col/100 mL. At Llagas Creek at Machado School during the dry season, the median concentration of fecal-coliform bacteria was 240 col/100 mL and the median concentration of fecal-streptococcal bacteria was 380 col/100 mL.

Table 3. - Median fecal-coliform and fecal-streptococcal bacteria concentrations at water-quality sampling stations

[--, no streamflow measurement or bacteria sample]

Station name and number	Sampling period and number of samples	Median streamflow for samplings (ft^3/s)	Median concentration of bacteria (col/100 mL)	
			Fecal coliform	Fecal streptococcal
Llagas Creek near Morgan Hill (11153500, SCVWD-69)	1/3 - 1/30/80(5)	0.90	160	170
	7/9 - 7/22/80(3)	34	35	70
	1/29 - 2/5/81(2)	0.10	1,200	1,300
	7/7 - 8/4/81(5)	12	25	40
Llagas Creek at Machado School (11153530)	1/10 - 1/30/80(4)	--	300	340
	7/9 - 7/22/80(3)	--	260	600
	1/29 - 2/5/81(2)	--	970	920
	7/7 - 8/4/81(5)	--	230	170
Llagas Creek at San Martin (11153555)	1/10 - 1/30/80(4)	--	310	400
	7/9 - 7/22/80(3)	--	200	600
	1/29/81(1)	--	3,700	6,800
	7/7 - 8/4/81(5)	--	140	120

Table 3. - Median fecal-coliform and fecal-streptococcal bacteria concentrations at water-quality sampling stations--Continued

Station name and number	Sampling period and number of samples	Median streamflow for samplings (ft^3/s)	Median concentration of bacteria (col/100 mL)	
			Fecal coliform	Fecal streptococcal
Guadalupe Creek at Guadalupe (11167500, SCVWD-43)	1/3 - 1/29/80(5)	2.9	110	90
	7/8 - 7/22/80(3)	19	100	380
	1/8 - 2/5/81(5)	1.2	10	30
	7/7 - 8/4/81(5)	1.7	260	290
Guadalupe River at Alamitos Recharge Facility (11167572, SCVWD-20)	1/3 - 1/29/80(5)	14	750	140
	7/8 - 7/22/80(3)	8.3	70	180
	1/8 - 2/5/81(5)	7.4	130	20
	7/7 - 8/4/81(5)	15	120	80
Los Gatos Creek at Los Gatos (11168000, SCVWD-67)	1/3 - 1/29/80(5)	1.4	60	95
	7/8 - 7/22/80(3)	28	15	50
	1/8 - 2/5/81(5)	12	5	15
	7/7 - 8/4/81(5)	10	25	90
Los Gatos Creek at Lark Avenue (11168660, SCVWD-59)	1/3 - 1/29/80(5)	24	510	250
	7/8 - 7/22/80(3)	30	170	130
	1/8 - 2/5/81(5)	12	180	130
	7/7 - 8/4/81(5)	12	65	40
Los Gatos Creek at Lincoln Avenue (11168800, SCVWD-50)	1/3 - 1/29/80(4)	3.9	34,000	2,900
	7/8 - 7/22/80(0)	No flow	--	--
	1/8 - 2/5/81(4)	3.2	1,000	140
	7/7 - 8/4/81(0)	No flow	--	--
Guadalupe River at San Jose (11169000)	1/3 - 1/29/80(5)	12	7,700	8,000
	7/8 - 7/22/80(3)	0.33	1,100	320
	1/8 - 2/5/81(5)	2.4	950	240
	7/7 - 8/4/81(5)	0.33	160	160
Coyote Creek below Leroy Anderson Dam (11169970, SCVWD-9)	1/3 - 1/30/80(5)	12	32	60
	7/9 - 7/22/80(3)	60	10	20
	1/8 - 2/5/81(5)	29	5	5
	7/7 - 8/4/81(5)	66	5	5
Coyote Creek near Edenvale (11171500, SCVWD-58)	1/3 - 1/23/80(4)	0.40	1,800	1,000
	7/16/80(1)	3.4	110	560
	1/8 - 2/5/81(3)	4.0	120	170
	7/7 - 7/21/81(3)	2.2	160	200

In the Guadalupe River basin, concentrations of fecal-coliform and fecal-streptococcal bacteria generally were greater at stations in urban areas (Guadalupe River at Alamitos Recharge Facility, Los Gatos Creek at Lark Avenue, Los Gatos Creek at Lincoln Avenue, and Guadalupe River at San Jose) than in rural areas (Guadalupe Creek at Guadalupe and Los Gatos Creek at Los Gatos) (table 3). At urban stations, median concentrations of fecal-coliform bacteria ranged from 65 to 34,000 col/100 mL and averaged 3,400 col/100 mL whereas at rural stations they ranged from 5 to 260 col/100 mL and averaged 73 col/100 mL. At urban stations, median concentrations of fecal-streptococcal bacteria ranged from 20 to 8,000 col/100 mL and averaged 910 col/100 mL whereas at rural stations they ranged from 15 to 380 col/100 mL and averaged 130 col/100 mL. Nevertheless, Guadalupe Creek at Guadalupe generally had greater concentrations of fecal-streptococcal bacteria than Guadalupe River at Alamitos Recharge Facility and Los Gatos Creek at Lark Avenue. At Guadalupe Creek at Guadalupe, median concentrations of fecal-streptococcal bacteria ranged from 30 to 380 col/100 mL and averaged 200 col/100 mL whereas at Guadalupe River at Alamitos Recharge Facility they ranged from 20-180 col/100 mL and averaged 100 col/100 mL and at Los Gatos Creek at Lark Avenue they ranged from 40-250 col/100 mL and averaged 140 col/100 mL.

At urban stations, concentrations of fecal-coliform and fecal-streptococcal bacteria generally were greater during the rainy season than during the dry season. Median concentrations of fecal-coliform bacteria at urban stations ranged from 130 to 34,000 col/100 mL and averaged 5,700 col/100 mL during the rainy season whereas they ranged from 65 to 1,100 col/100 mL and averaged 280 col/100 mL during the dry season. Median concentrations of fecal-streptococcal bacteria at urban stations ranged from 20 to 8,000 col/100 mL and averaged 1,500 col/100 mL during the rainy season whereas they ranged from 40 to 320 col/100 mL and averaged 150 col/100 mL during the dry season. Not all urban stations followed this pattern. Median concentrations of fecal-streptococcal bacteria at Guadalupe River at Alamitos Recharge Facility were greater during the dry season than during the rainy season (table 3). The reason for this is not known. The source of fecal-coliform and fecal-streptococcal bacteria in rainfall runoff from urban areas having separate sanitary and stormwater systems is domestic animals (for example, dogs and cats) and rodents (Geldreich and others, 1968). Greater concentrations of these bacteria at urban stations during the rainy season than during the dry season reflects greater washoff of urban landscapes during storms than during the dry season when yard watering and car washing are the principal activities that result in urban washoff.

At Guadalupe Creek at Guadalupe, concentrations of fecal-streptococcal bacteria were from 260 to 290 col/100 mL greater during the dry season than during the rainy season. Otherwise, a consistent seasonal pattern in concentrations of fecal-coliform and fecal-streptococcal bacteria was not evident at rural stations.

In the Coyote Creek basin, concentrations of fecal-coliform and fecal-streptococcal bacteria were greater at Coyote Creek near Edenvale than at Coyote Creek below Leroy Anderson Dam (table 3). Median concentrations of fecal-coliform bacteria ranged from 110 to 1,800 col/100 mL and averaged 550 col/100 mL near Edenvale whereas they ranged from 5 to 32 col/100 mL and averaged 13 col/100 mL below the dam. Median concentrations of fecal-streptococcal bacteria ranged from 170 to 1,000 col/100 mL and averaged 480 col/100 mL near Edenvale whereas they ranged from 5 to 60 col/100 mL and averaged 45 col/100 mL below the dam. Drainage from agricultural and urban areas might be the source of the greater fecal-coliform and fecal-streptococcal bacteria concentrations at Coyote Creek near Edenvale. Coyote Creek near Edenvale is in a developing residential area whereas Coyote Creek below Leroy Anderson Dam is in a rural area. The streamflow at the latter station is comprised of release water from Anderson Reservoir as this station is only 500 feet downstream of the dam. The drainage into Anderson Reservoir is entirely from a rural area consisting of forest and rangeland where little, if any, agriculture occurs. Agricultural land uses predominate from Coyote Creek below Leroy Anderson Dam to Coyote Creek near Edenvale.

During the 1980 water year, median concentrations of fecal-coliform and fecal-streptococcal bacteria at both Coyote Creek stations were greater during the rainy season than during the dry season. During the 1981 water year, median concentrations of these bacteria at Coyote Creek below Leroy Anderson Dam were the same during the rainy and dry seasons. At Coyote Creek near Edenvale, median concentrations of these bacteria were less during the rainy season than during the dry season.

Concentrations of fecal-coliform and fecal-streptococcal bacteria generally were greater at Los Gatos Creek at Lincoln Avenue and Guadalupe River at San Jose than at the other nine stations sampled (table 3). Median concentrations of fecal-coliform bacteria ranged from 160 to 34,000 col/100 mL and averaged 7,500 col/100 mL at these two stations whereas they ranged from 5 to 3,700 col/100 mL and averaged 340 col/100 mL at the other nine stations sampled. Median concentrations of fecal-streptococcal bacteria ranged from 140 to 8,000 col/100 mL and averaged 2,000 col/100 mL at these two stations, whereas they ranged from 5 to 6,800 col/100 mL and averaged 430 col/100 mL at the other nine stations sampled. Los Gatos Creek at Lincoln Avenue and Guadalupe River at San Jose receive more urban drainage than the other nine stations sampled.

Concentrations of fecal-coliform bacteria generally were less at stations near reservoir releases (Guadalupe Creek at Guadalupe, Los Gatos Creek at Los Gatos, and Coyote Creek below Leroy Anderson Dam) than at other stations sampled (table 3). At stations near reservoir releases, median concentrations of fecal-coliform bacteria ranged from 5 to 260 col/100 mL and averaged 53 col/100 mL whereas at other stations sampled, they ranged from 25 to 34,000 col/100 mL and averaged 1,900 col/100 mL.

Except at Guadalupe Creek at Guadalupe, concentrations of fecal-streptococcal bacteria generally were less at stations near reservoir releases than at other stations sampled. At Los Gatos Creek at Los Gatos, median concentrations of fecal-streptococcal bacteria ranged from 15 to 95 and averaged 62 col/100 mL and at Coyote Creek below Leroy Anderson Dam they ranged from 5 to 60 col/100 mL and averaged 45 col/100 mL. At other stations sampled (excluding Guadalupe Creek at Guadalupe), median concentrations of fecal-streptococcal bacteria ranged from 20 to 8,000 col/100 mL and averaged 870 col/100 mL.

Trace Elements

Concentrations of dissolved trace elements in water were generally less than 50 μg/L and rarely exceeded 100 μg/L (table 4). Aluminum, manganese, and zinc were the only trace elements that exceeded 100 μg/L.

Tertiary mudstones might be the source of manganese. Concentrations of manganese are commonly greater than 100 μg/L in ground water in Tertiary mudstones that occur in the headwaters of the Los Gatos Creek and Guadalupe Creek drainages (Johnson, 1980, table 1, p. 20-23). Manganese deposits are associated with cherts of the Franciscan assemblage (Bailey, 1966) but, in the study area, these deposits only occur near the headwaters of Coyote Creek (Bailey and Harden, 1975). Nevertheless, concentrations of manganese were less than 50 μg/L at sampling stations in the Coyote Creek basin. Concentrations of manganese were greater than or equal to 100 μg/L only in samples collected during the dry season when the proportion of ground water to surface water contributing to streamflow is greatest.

The Franciscan assemblage might be the source of aluminum. Graywacke is the predominant rock in the Franciscan assemblage and feldspar (aluminum silicates) is the predominant mineral in Franciscan graywacke (Bailey and others, 1964, p. 5 and 27). The Franciscan assemblage is the predominant geologic rock unit in the mountainous areas of all the streams studied. Concentrations of aluminum were greater than or equal to 50 μg/L only in samples collected during a February 1980 storm. Except at Los Gatos Creek at Los Gatos, Los Gatos Creek at Lark Avenue, and Coyote Creek below Leroy Anderson Dam, streamflows during this storm were the greatest sampled during the study.

The source of zinc concentrations greater than 100 μg/L might be rainfall runoff from urban areas. The concentration of zinc was greater than 100 μg/L only at Guadalupe River at San Jose. This occurred February 19, 1980, in a sample taken during a storm when the streamflow was 7,900 ft^3/s. Guadalupe River at San Jose receives rainfall runoff from most of the urbanized area of San Jose. The source of zinc in rainfall runoff from urban areas is mostly from vehicular tire wear (Pitt and Shawley, 1981, p. 2-5). Apparently, rainfall runoff during other storms sampled and dry season washoff of streets as a result of such activities as lawn watering and car washing were not sufficient to mobilize accumulations of zinc on street surfaces because zinc concentrations were less than or equal to 40 μg/L in all but the February 19, 1980, sample. Except for the February 19, 1980, sample, samples for trace elements at Guadalupe River at San Jose were collected when streamflows were less than or equal to 52 ft^3/s.

Concentrations of dissolved mercury were less than or equal to 0.2 μg/L except at sampling stations in the Llagas Creek and Coyote Creek basins in September 1981 (table 4). Why concentrations of dissolved mercury were between 1.0 and 2.0 μg/L at sampling stations in the Llagas Creek and Coyote Creek basins in September 1981 is not known.

Table 4. - Trace elements in water

[Where time is given, sample was collected manually by equal-width-increment method; where time is not given, sample was collected with an automatic sampler; ND, not detected. Concentrations are micrograms per liter, dissolved]

Date	Time	Streamflow, instantaneous (ft^3/s)	Aluminum (AL)	Arsenic (AS)	Cadmium (CD)	Chromium (CR)	Copper (CU)	Lead (PB)	Manganese (MN)	Mercury (HG)	Nickel (NI)	Zinc (ZN)
11153500 -- Llagas Creek near Morgan Hill												
1-18-79	1245	0.90	10	1	<2	<20	2	6	60	<.1	ND	<3
8-01-79	1150	1.8	<100	1	<2	<20	ND	ND	2	<.1	ND	<3
2-20-80	1230	466	20	0	0	0	1	1	10	.1	0	10
9-09-80	0820	48	20	2	0	0	1	2	60	.0	0	0
3-28-81	1430	.40	20	1	0	10	2	2	50	.0	0	20
9-02-81	1345	12	10	1	3	0	1	8	70	1.2	0	10
11153530 -- Llagas Creek at Machado School near Morgan Hill												
2-20-80	1430	459	20	0	0	0	1	3	20	.1	0	10
9-09-80	1100	50	10	2	0	0	1	1	10	.0	0	10
3-28-81	1315	2.6	20	0	0	10	2	5	10	.0	0	30
9-02-81	1215	12	10	1	2	10	1	25	0	1.5	0	10
11153555 -- Llagas Creek at San Martin												
2-20-80	1700	582	10	1	0	0	1	5	0	.0	0	90
9-09-80	1245	42	10	2	0	0	0	2	30	.0	0	0
3-28-81	1115	3.0	30	0	0	10	2	5	10	.0	4	20
9-02-81	1030	20	10	1	0	0	1	4	0	1.7	0	0
11167500 -- Guadalupe Creek at Guadalupe												
2-19-80	1415	424	430	1	0	0	3	2	0	.0	0	20
9-10-80	--	--	0	3	0	0	0	4	130	.0	0	100
3-26,27-81	--	--	0	2	<1	10	2	5	20	.0	0	50
8-31-81/ 9-01-81	--	--	10	3	0	10	2	2	0	.0	0	90
11167572 -- Guadalupe River at Alamitos Recharge Facility at San Jose												
1-18-79	1015	18	10	2	<2	<20	3	4	8	<.1	<200	<3
7-31-79	1335	13	<100	1	<2	ND	ND	ND	3	<.1	ND	<3
2-18,19-80	--	--	50	1	0	0	3	3	20	.2	0	50
9-10-80	--	--	0	2	1	0	0	4	10	.0	0	50
3-26,27-81	--	--	20	2	2	10	4	3	5	.0	100	80
8-31-81/ 9-01-81	--	--	10	1	1	0	3	5	0	.0	0	80
11168000 -- Los Gatos Creek at Los Gatos												
2-19-80	1545	99	80	1	0	0	1	5	0	.0	0	10
9-10-80	--	--	10	2	0	0	1	3	230	.0	0	60
3-26,27-81	--	--	10	2	2	10	2	3	20	.0	100	50
8-31-81/ 9-01-81	--	--	10	2	0	10	4	2	40	.0	0	20

Table 4. - Trace elements in water--Continued

Date	Time	Stream-flow, instan-taneous (ft^3/s)	Alumi-num (AL)	Arse-nic (AS)	Cad-mium (CD)	Chro-mium (CR)	Cop-per (CU)	Lead (PB)	Man-ga-nese (MN)	Mer-cury (HG)	Nickel (NI)	Zinc (ZN)
		11168660 -- Los Gatos Creek at Lark Avenue at Los Gatos										
1-17-79	1420	34	10	1	<2	<20	3	7	<10	<.1	ND	<3
7-31-79	1110	13	<100	1	2	<20	ND	ND	100	<.1	ND	<3
2-19-80	1730	294	50	1	0	0	1	0	0	.0	0	10
9-10-80	1700	74	0	2	0	0	0	4	130	.0	0	10
3-27-81	0815	18	10	2	0	10	4	0	50	.0	0	10
9-01-81	0730	11	0	2	1	0	9	2	10	.0	0	10
		11168800 -- Los Gatos Creek at Lincoln Avenue at San Jose										
2-20-80	0830	202	170	1	0	0	2	6	0	.1	0	20
		11169000 -- Guadalupe River at San Jose										
1-17-79	0925	52	10	1	2	ND	3	26	4	<.1	ND	<20
8-01-79	1435	.33	<100	2	<2	ND	2	ND	30	<.1	ND	6
2-19-80	0900	7900	60	2	0	0	2	0	10	.0	0	190
9-10-80	0730	.53	10	4	0	0	2	2	0	.0	0	10
3-27-81	1415	3.7	20	3	1	10	6	3	20	.0	0	20
9-01-81	1300	.33	10	2	0	0	2	5	0	.0	0	40
		11169970 -- Coyote Creek below Leroy Anderson Dam near Madrone										
2-21-80	0800	3.3	170	1	0	0	2	0	10	.0	0	10
9-09-80	1440	60	20	2	0	0	2	2	30	.0	0	10
3-28-81	0945	19	10	1	0	10	3	4	20	.0	0	20
9-02-81	0915	73	0	1	0	0	1	2	0	1.9	0	10
		11171500 -- Coyote Creek near Edenvale										
1-17-79	1210	5.1	10	2	5	ND	4	3	6	<.1	ND	<3
7-31-79	1520	.30	<100	1	<2	ND	ND	ND	<10	<.1	ND	<3
2-20-80	1045	331	60	3	0	0	3	0	10	.1	0	10
9-10-80	1200	.50	10	1	1	0	1	2	10	.0	0	50
3-28-81	0815	3.8	10	1	0	10	2	6	10	.0	0	10
9-02-81	0745	.90	10	1	0	0	1	3	0	1.7	0	10

Concentrations of aluminum, iron, and manganese were greater than the concentrations of other trace elements in stream-bottom material (table 5). One process that contributes trace elements to stream-bottom material is the weathering of bedrock to produce soils that are subsequently eroded by rainfall and transported to streams where some of the soil settles to the stream bottom. The source of aluminum in stream-bottom material in the study area is probably the Franciscan assemblage. Iron is ubiquitous in geologic formations and soils in the study area. The source of manganese in stream-bottom material in the study area is probably from both the Tertiary mudstones and the Franciscan assemblage.

Concentrations of mercury in stream-bottom material were greater than 1.0 μg/g only at Guadalupe Creek and Guadalupe River stations. This drainage has numerous mercury deposits.

Table 5. - Trace elements in stream-bottom material

[Concentrations are micrograms per liter recoverable from bottom material, except for arsenic and selenium, which are totals in bottom material]

Date	Time	Streamflow, instantaneous (ft^3/s)	Aluminum (AL)	Arsenic (AS)	Cadmium (CD)	Chromium (CR)	Cobalt (CO)	Copper (CU)	Iron (FE)	Lead (PB)	Manganese (MN)	Mercury (HG)	Selenium (SE)	Zinc (ZN)
11153500 -- Llagas Creek near Morgan Hill														
2-20-80	1230	466	650	4	0	80	35	27	11000	10	480	0.22	0	36
9-09-80	0820	48	2900	3	2	20	20	19	7700	10	600	.05	0	27
3-28-81	1430	.40	5000	5	0	58	30	13	11000	5	500	.70	0	24
9-02-81	1345	12	4000	4	<1	120	30	20	19000	10	700	.05	0	43
11153530 -- Llagas Creek at Machado School near Morgan Hill														
2-20-80	1430	459	90	4	0	60	30	25	12000	10	550	.06	0	39
9-09-80	1100	50	6700	2	1	34	20	29	12000	0	360	.02	0	33
3-28-81	1315	2.6	6000	3	0	32	270	51	13000	20	550	.50	0	36
9-02-81	1215	12	7000	4	<1	60	30	38	23000	50	800	.02	0	55
11153555 -- Llagas Creek at San Martin														
2-20-80	1700	582	70	4	0	30	25	17	9700	85	340	.03	0	57
9-09-80	1245	42	1600	3	0	12	10	8	3700	10	270	.03	--	14
3-28-81	1115	3.0	6000	4	0	30	20	17	10000	10	450	.70	0	28
9-02-81	1030	20	6000	4	<1	70	20	28	21000	20	400	.03	0	46
11167500 -- Guadalupe Creek at Guadalupe														
2-19-80	1415	424	580	12	1	40	25	21	9000	0	670	.08	0	55
9-10-80	1345	1.5	5100	6	2	15	10	15	6000	50	210	.07	0	83
3-27-81	1100	4.9	6000	10	0	42	30	13	10000	20	430	.04	0	30
9-01-81	1015	1.7	6000	9	<1	70	20	20	18000	10	600	1.2	0	50
11167572 -- Guadalupe River at Alamitos Recharge Facility at San Jose														
5-23-79	1410	18	8900	8	0	130	--	25	--	10	570	7.2	--	52
2-19-80	1205	2360	90	14	0	60	30	20	11000	15	440	5.8	0	39
9-10-80	1000	6.4	3900	8	1	38	20	19	9800	10	260	3.5	0	31
3-27-81	1240	15	600	14	0	45	30	15	12000	10	310	.06	0	33
9-01-81	1115	4.9	5000	13	<1	90	30	25	20000	20	400	12	0	55

Table 5. - Trace elements in stream-bottom material--Continued

Date	Time	Stream-flow, instan-taneous (ft^3/s)	Alumi-num (AL)	Arse-nic (AS)	Cad-mium (CD)	Chro-mium (CR)	Co-balt (CO)	Cop-per (CU)	Iron (FE)	Lead (PB)	Manga-nese (MN)	Mer-cury (HG)	Sele-nium (SE)	Zinc (ZN)
11168000 -- Los Gatos Creek at Los Gatos														
9-10-80	1530	64	5700	5	2	29	20	25	7900	20	200	0.02	0	31
3-27-81	0930	11	4200	10	0	22	10	17	6000	20	440	.04	0	28
9-01-81	0845	9.8	7000	4	<1	50	10	32	15000	20	850	.02	0	46
11168660 -- Los Gatos Creek at Lark Avenue at Los Gatos														
2-19-80	1730	294	640	5	0	20	10	18	7300	85	190	.03	0	56
9-10-80	1700	74	3400	4	2	21	20	19	10000	40	350	.04	0	48
3-27-81	0815	18	4200	9	0	14	10	8	7000	35	480	.90	0	42
9-01-81	0730	11	4000	4	<1	30	10	20	16000	10	600	.06	0	55
11168800 -- Los Gatos Creek at Lincoln Avenue at San Jose														
2-20-80	0830	202	60	5	1	20	20	29	6200	150	240	.03	0	100
3-27-81	1345	.00	1300	4	0	5	2	5	1400	42	130	.06	0	43
9-01-81	1230	.00	4000	4	<1	20	10	19	11000	50	220	.03	0	85
11169000 -- Guadalupe River at San Jose														
2-19-80	0900	7900	700	8	2	50	25	44	13000	1000	400	1.7	0	810
9-10-80	0730	.53	3100	16	2	43	30	21	10000	40	540	10	0	43
3-27-81	1415	3.7	4200	10	0	21	15	17	7500	23	190	.40	0	70
9-01-81	1300	.33	5000	7	<1	50	20	100	16000	110	310	.36	0	120
11169970 -- Coyote Creek below Leroy Anderson Dam near Madrone														
2-21-80	0800	3.3	90	10	0	30	25	20	9500	35	610	.13	0	39
9-09-80	1440	60	3000	6	2	13	20	21	8000	10	700	.04	0	23
3-28-81	0945	19	4200	12	0	34	27	15	10000	10	1700	.60	0	25
9-02-81	0915	73	4000	14	<1	60	20	21	19000	10	1800	.04	0	43
11171500 -- Coyote Creek near Edenvale														
5-23-79	1130	.40	7400	3	0	140	--	55	--	410	380	.19	--	178
2-20-80	1045	331	0	8	0	10	5	4	150	5	190	.08	0	8
9-10-80	1200	.50	1600	6	1	58	40	23	6100	150	290	.14	--	104
3-28-81	0815	3.8	1800	7	0	58	27	8	6000	83	190	1.0	0	110
9-02-81	0745	.90	1000	10	<1	100	20	10	14000	50	230	.05	0	85

Concentrations of lead and zinc in stream-bottom material were greater than or equal to 100 μg/g at Los Gatos Creek at Lincoln Avenue, Guadalupe River at San Jose, and Coyote Creek near Edenvale. Except for Coyote Creek near Edenvale, the amount of urban area upstream of these stations is greater than at other stations and is the probable source of the lead and zinc. Los Gatos Creek at Lark Avenue has more urban area upstream than does Coyote Creek near Edenvale, but most of the lead and zinc probably settle to the bottom of Vasona Reservoir, and thus, are not found in high concentrations in the stream-bottom material at Los Gatos Creek at Lark Avenue. Exhaust particulates, fluid losses (gas and oil drips and spills), and mechanical wear products from motorized vehicles are the principal sources of lead on streets. Vehicular-tire wear is the principal source of zinc on streets (Pitt and Shawley, 1981, p. 2-5).

Concentrations of chromium in stream-bottom material were greater than or equal to 100 μg/g at Llagas Creek near Morgan Hill, Guadalupe River at Alamitos Recharge Facility, and Coyote Creek near Edenvale. Chromite deposits occur in the Coyote Creek basin in the mountains that border Santa Clara Valley on the east from Morgan Hill to Edenvale. In the Guadalupe River basin, chromite deposits occur in the hills to the east of Arroyo Calero and in the vicinity of Almaden Reservoir. Chromite deposits are not present in the Llagas Creek basin. Why the concentration of chromium was 120 μg/g in a bottom-material sample collected September 2, 1981, at Llagas Creek near Morgan Hill is not known.

Organic Biocides

Organic biocide concentrations were usually less than detection limits at all stations sampled. Malathion concentrations in an early September 1981 sampling were greater than 0.10 μg/L (U.S. Environmental Protection Agency criterion for freshwater aquatic life) at all stations except Guadalupe Creek at Guadalupe, Los Gatos Creek at Los Gatos, and Coyote Creek below Leroy Anderson Dam (table 6). The only other time the concentration of Malathion exceeded 0.10 μg/L was in a March 27, 1981, sampling of Guadalupe River at San Jose. Spraying of Malathion for control of the Mediterranean fruit fly was done during 1981 and was likely the source of Malathion concentrations greater than 0.10 μg/L. Concentrations of other organic biocides rarely exceeded 0.10 μg/L. Organic biocides were found more frequently and more kinds of organic biocides were detected at Guadalupe River at San Jose than at other stations. Guadalupe River at San Jose is downstream of most of the urban area of San Jose.

Table 6. - Organic biocide concentrations greater than or equal to detection limits

[Detection limit for organic biocides listed was 0.01 μg/L except for chlordane, which was 0.1 μg/L. Concentrations are total recoverable]

Station name and number	Date	Streamflow (ft^3/s)	Organic biocide concentration (μg/L)
Llagas Creek near Morgan Hill (11153500, SCVWD-69)	Sept. 2, 1981	12	Malathion 0.35 2,4-D 0.01
Llagas Creek at Machado School near Morgan Hill (11153530)	Sept. 2, 1981	12	Malathion 0.24 2,4-D 0.01
Llagas Creek at San Martin (11153555)	Feb. 20, 1980	582	Diazinon 0.01
	Mar. 28, 1981	3.0	Diazinon 0.01
	Sept. 2, 1981	20	Malathion 1.5 2,4-D 0.01
Guadalupe Creek at Guadalupe (11167500, SCVWD-43)	Feb. 19, 1980	424	DDE 0.01 DDT 0.01 Endosulfan 0.01
	Sept. 1, 1981	1.7	Malathion 0.03 2,4-D 0.01
Guadalupe River at Alamitos Recharge Facility at San Jose (11167572, SCVWD-20)	Feb. 19, 1980	2,360	Chlordane 0.10 Diazinon 0.03
	Mar. 27, 1981	15	Diazinon 0.03 Lindane 0.01 2,4-D 0.06
	Sept. 1, 1981	4.9	Diazinon 0.01 Malathion 0.16 2,4-D 0.02
Los Gatos Creek at Los Gatos (11168000, SCVWD-67)	Sept. 1, 1981	9.8	Malathion 0.07 2,4-D 0.01
Los Gatos Creek at Lark Avenue at Los Gatos (11168660, SCVWD-59)	Feb. 19, 1980	294	DDE 0.01 DDT 0.02 Diazinon 0.01 Lindane 0.01 2,4-D 0.02 Silvex 0.01
	Mar. 27, 1981	18	Diazinon 0.01
	Sept. 1, 1981	11	Malathion 0.61 2,4-D 0.01
Los Gatos Creek at Lincoln Avenue at San Jose (11168800, SCVWD-50)	Feb. 20, 1980	202	DDT 0.01 Diazinon 0.02 Lindane 0.01

Table 6. - Organic biocide concentrations greater than or equal to detection limits--Continued

Station name and number	Date	Streamflow (ft^3/s)	Organic biocide concentration (μg/L)
Guadalupe River at San Jose (11169000)	Jan. 17, 1979	52	Diazinon 0.07 Lindane 0.02 2,4-D 0.07 Silvex 0.03
	Aug. 1, 1979	0.33	Diazinon 0.20 Lindane 0.01 2,4-D 0.11 2,4,5-T 0.01 Silvex 0.05
	Feb. 19, 1980	7,900	Chlordane 0.60 DDD 0.04 DDE 0.04 DDT 0.11 Diazinon 0.07 Dieldrin 0.02 Heptachlor 0.02 Lindane 0.02 Malathion 0.01 2,4-D 0.07 Silvex 0.03
	Sept. 10, 1980	0.53	Chlordane 0.10 DDD 0.01 Diazinon 0.03 Lindane 0.01 Silvex 0.01
	Mar. 27, 1981	3.7	Chlordane 0.10 Diazinon 0.34 Lindane 0.02 Malathion 0.22 2,4-D 0.17
	Sept. 1, 1981	0.33	Diazinon 0.02 Malathion 0.96 2,4-D 0.02
Coyote Creek below Leroy Anderson Dam near Madrone (11169970, SCVWD-9)	Sept. 2, 1981	73	Malathion 0.01
Coyote Creek near Edenvale (11171500, SCVWD-58)	Feb. 20, 1980	331	DDD 0.01 DDE 0.04 DDT 0.04 Diazinon 0.05 Endrin 0.02 Parathion 0.02 2,4-D 0.98
	Mar. 28, 1981	3.8	Diazinon 0.07 2,4-D 0.08
	Sept. 2, 1981	0.90	Malathion 0.24 2,4-D 0.01

COMPARISON OF WATER-QUALITY CONDITIONS WITH WATER-QUALITY OBJECTIVES

Existing and potential beneficial uses of water in streams in Santa Clara Valley are municipal and domestic supply, agricultural supply, ground-water recharge, water contact recreation, noncontact water recreation, cold and warm freshwater habitat, wildlife habitat, and fish spawning. Water-quality objectives have been established for Santa Clara Valley streams to maintain water suitable for these beneficial uses (table 7) (California Regional Water Quality Control Board, San Francisco Bay Region, 1982). Table 7 lists only the water-quality objectives for water-quality properties and constituents measured or analyzed in this study.

Streams in Santa Clara Valley sampled during this study generally met water-quality objectives (table 8). Fecal-coliform and total-coliform bacteria objectives for municipal supply were the only objectives frequently exceeded. Concentrations of fecal-coliform and total-coliform bacteria at Los Gatos Creek at Lincoln Avenue and Coyote Creek near Edenvale could not be compared to objectives because less than five samples within 30-day periods were collected at these stations. Based on the samples collected at these stations, concentrations of fecal-coliform and total-coliform bacteria would have exceeded objectives for municipal supply and water contact recreation if five samples within 30-day periods had been collected as planned. Thus, none of the streams sampled met the bacteria objectives for municipal supply.

In addition, the fecal-coliform bacteria objective for water contact recreation was exceeded at Llagas Creek at Machado School, Guadalupe Creek at Guadalupe, Guadalupe River at Alamitos Recharge Facility, Los Gatos Creek at Lark Avenue, and Guadalupe River at San Jose. Concentrations of fecal-coliform bacteria were consistently greater than 200/100 mL at Llagas Creek at Machado School even when less than five samples within 30 days were collected. At Guadalupe Creek at Guadalupe, the water contact objective was exceeded during July and early August 1981. At Guadalupe River at Alamitos Recharge Facility and Los Gatos Creek at Lark Avenue, this objective was exceeded only during storms. At Guadalupe River at San Jose, concentrations of fecal-coliform bacteria were usually greater than 500/100 mL with concentrations generally greater during storms than during non-storm periods. At this station, concentrations of fecal-coliform bacteria exceeded 2,000/100 mL (the objective for noncontact water recreation) during January 1980 storms. The source of the high concentrations of fecal-coliform bacteria at this station most likely was urban runoff from San Jose. Urban runoff might also be the source of the fecal-coliform bacteria at Guadalupe River at Alamitos Recharge Facility and Los Gatos Creek at Lark Avenue. Rainfall runoff from land surrounding ranch houses where livestock (for example, horses, turkeys, chickens) is kept was probably one of the sources of the fecal-coliform bacteria at Llagas Creek at Machado School. The source of the fecal-coliform bacteria at Guadalupe Creek at Guadalupe is not known.

Manganese concentrations were greater than 50 µg/L (the objective for municipal supply) at some stations. Tertiary mudstones might be the source of manganese (see section of this report on trace elements).

Table 7. - Water-quality objectives applicable to Santa Clara Valley streams

[Values in milligrams per liter except turbidity, in nephelometric turbidity units; pH, in units; bacteria, in numbers per 100 milliliters, and specfic conductance, in micromhos per centimeter at 25°C. Source: California State Water Resources Control Board, 1982]

Property or constituent	Objective				Comment
	Minimum	Mean[1]	Maximum[2]	Median	
Turbidity	--	--	[3]1/5	--	Municipal supply
pH	6.5	--	8.5	--	Controllable water-quality factors shall not cause changes greater than 0.5 units in normal ambient pH
Dissolved oxygen	7.0	--	--	80%[4]	Cold water habitat
	5.0	--	--	80%[4]	Warm water habitat
Fecal coliform bacteria	--	20/100mL	--	--	Municipal supply
	--	200/100mL[5]	--	--	Water contact recreation
	--	2000/100mL[6]	--	--	Noncontact water recreation
Total coliform bacteria	--	100/100mL	--	--	Municipal supply
Un-ionized ammonia[7]	--	--	0.4	0.025	
Aluminum	--	--	5/20	--	Agricultural supply
Arsenic	--	--	0.05	--	Municipal supply
	--	--	0.1/2.0	--	Agricultural supply
Boron	--	--	0.5/2.0	--	Agricultural supply
Chloride	--	--	250/500	--	Municipal supply
	--	--	142/355	--	Agricultural supply
Cadmium	--	--	0.01	--	Municipal supply
	--	--	0.01/0.5	--	Agricultural supply
Chromium	--	--	0.05	--	Municipal supply
	--	--	0.1/1.0	--	Agricultural supply
Copper	--	--	1.0	--	Municipal supply
	--	--	0.2/5.0	--	Agricultural supply
Fluoride	--	--	[8]0.8-1.7	--	Municipal supply
	--	--	1.0/15.0	--	Agricultural supply
Iron	--	--	0.3	--	Municipal supply
	--	--	5.0/20.0	--	Agricultural supply
Lead	--	--	0.05	--	Municipal supply
	--	--	5.0/10.0	--	Agricultural supply
Manganese	--	--	0.05	--	Municipal supply
	--	--	0.2/10.0	--	Agricultural supply
Mercury	--	--	0.002	--	Municipal supply
Nickel	--	--	0.2/2.0	--	Agricultural supply

Table 7. - Water-quality objectives applicable to Santa Clara Valley streams--Continued

Property or constituent	Objective: Minimum	Mean[1]	Maximum[2]	Median	Comment
Nitrite plus nitrate	--	--	10	--	Municipal supply
as N	--	--	5/30	--	Agricultural supply
Sulfate	--	--	250/500	--	Municipal supply
Dissolved solids	--	--	500/1000	--	Municipal supply
Specific conductance	--	--	900/1600	--	Municipal supply
	--	--	3000	--	Agricultural supply
Zinc	--	--	5.0	--	Municipal supply
	--	--	2.0/10.0	--	Agricultural supply
Endrin	--	--	0.0002	--	Municipal supply
Lindane	--	--	0.004	--	Municipal supply
Methoxychlor	--	--	0.1	--	Municipal supply
Toxaphene	--	--	0.005	--	Municipal supply
2,4-D	--	--	0.1	--	Municipal supply
2,4,5-TP (Silvex)	--	--	0.01	--	Municipal supply

[1]Mean based on a minimum of five consecutive samples collected within a 30-day period; arithmetic mean except objective for water contact recreation which is log mean.

[2]Maximum = limiting concentration where only one number; threshold concentration is first number and limiting concentration is second number where two values are given.

[3]Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases from normal background light penetration or turbidity relatable to waste discharge shall not be greater than 10 percent in areas of 10 Nephelometric Turbidity Units (NTU) or more. Waters of characteristically low natural turbidity (high clarity) shall be maintained so that discharges do not cause visible, aesthetically undesirable contrast with the natural appearance of the water.

[4]Median dissolved oxygen concentration for any three consecutive months shall not be less than 80 percent of the dissolved oxygen content at saturation.

[5]90th percentile less than 400/100 mL.

[6]90th percentile less than 4,000/100 mL.

[7]The method for calculating un-ionized ammonia concentrations is that given in Appendix B of the Revised San Francisco Bay Region Basin Plan (California Water Resources Control Board, 1982).

[8]Allowable concentration varies with annual average of maximum daily air temperature.

Table 8. - Sampling stations having water not in compliance with water-quality objectives

Station name	Property or constituent and objective	Number of times objective exceeded	Number of samples[1]
Llagas Creek near Morgan Hill	Dissolved oxygen: minimum, cold water habitat	1	21
	Fecal-coliform bacteria: municipal supply	2	2
	Total-coliform bacteria: municipal supply	2	2
	Manganese: municipal supply	3	6
Llagas Creek at Machado School near Morgan Hill	Fecal-coliform bacteria: municipal supply	1	1
	water contact recreation	1	1
	Total-coliform bacteria: municipal supply	1	1
Llagas Creek at San Martin	pH: maximum	3	20
	Fecal-coliform bacteria: municipal supply	1	1
	Total-coliform bacteria: municipal supply	1	1
Guadalupe Creek at Guadalupe	Fecal-coliform bacteria: municipal supply	3	3
	water contact recreation	1	3
	Total-coliform bacteria: municipal supply	3	3
	Manganese: municipal supply	1	4
	Boron: threshold, agricultural supply	1	14
Guadalupe River at Alamitos Recharge Facility at San Jose	pH: maximum	3	22
	Dissolved oxygen: minimum, cold water habitat	1	22
	Fecal-coliform bacteria: municipal supply	3	3
	water contact recreation	2	3
	Total-coliform bacteria: municipal supply	3	3

Table 8. - Sampling stations having water not in compliance with water-quality objectives--Continued

Station name	Property or constituent and objective	Number of times objective exceeded	Number of samples[1]
Los Gatos Creek at Los Gatos	Fecal-coliform bacteria:		
	municipal supply	3	3
	Total-coliform bacteria:		
	municipal supply	3	3
	Manganese: municipal supply	1	4
Los Gatos Creek at Lark Avenue at Los Gatos	Dissolved oxygen: minimum,		
	cold water habitat	3	22
	Fecal-coliform bacteria:		
	municipal supply	3	3
	water contact recreation	2	3
	Total-coliform bacteria:		
	municipal supply	3	3
	Manganese: municipal supply	2	6
Guadalupe River at San Jose	Dissolved oxygen: minimum,		
	cold water habitat	5	22
	warm water habitat	1	22
	Fecal-coliform bacteria:		
	municipal supply	3	3
	water contact recreation	3	3
	noncontact water recreation	1	3
	Total-coliform bacteria:		
	municipal supply	3	3
	Dissolved solids: threshold,		
	municipal supply	4	22
Coyote Creek below Leroy Anderson Dam near Madrone	Fecal-coliform bacteria:		
	municipal supply	2	3
	Total-coliform bacteria:		
	municipal supply	3	3
	Iron: municipal supply	1	14
Coyote Creek near Edenvale	Dissolved oxygen: minimum,		
	cold water habitat	7	17
	warm water habitat	2	17
	Iron: municipal supply	1	17

[1]Number of samples for fecal-coliform and total-coliform bacteria equals one for each five consecutive samples within a 30-day period.

The minimum dissolved-oxygen objective for cold water habitat (7.0 mg/L) was frequently not met at Coyote Creek near Edenvale. This occurred when streamflows were low (less than or equal to 2.0 ft^3/s). Low streamflows (less than 1.0 ft^3/s) at Guadalupe River at San Jose sometimes had concentrations of dissolved oxygen less than 7.0 mg/L.

The maximum pH objective was exceeded only at Llagas Creek at San Martin and Guadalupe River at Alamitos Recharge Facility. These stations had abundant algae and aquatic vascular plants, especially at times when the pH was greater than 8.5.

EVALUATION OF WATER-QUALITY SAMPLING PROGRAM

Water-quality data collected during this study were sufficient to document water quality of streams in Santa Clara Valley for the 1979-81 water years. The location of sampling stations, sampling frequency, and water-quality properties and constituents measured were appropriate for determining areal and temporal variations in water quality and for determining the suitability of stream water for ground-water recharge and other beneficial uses.

Continued water-quality data collection will be required to determine long-term changes in water quality and the effect of land use changes and population growth on water quality. Continued water-quality data collection will also refine the results of this study, which are based on only 2-3 years of data.

The 11 stations sampled during this study provide adequate areal coverage of Santa Clara Valley except that an additional water-quality station might be established near the mouth of Alamitos Creek (perhaps at SCVWD's streamflow-gaging station 70) to help determine the cause of the increase in specific conductance from Guadalupe Creek at Guadalupe to Guadalupe River at Alamitos Recharge Facility. Alamitos Creek drains an area where serpentine and peridotite are prevalent and mercury and chromite deposits occur. Also, Calero Reservoir near the headwaters of Arroyo Calero (the principal tributary to Alamitos Creek) will receive water from the San Felipe Project when it is completed.

The sampling frequency used during this study was appropriate for determining differences in water quality between the rainy season and dry season and for determining changes in water quality within each season. Thus, changes in sampling frequency do not appear to be needed.

Continued sampling of the water-quality properties and constituents sampled during this study appears advisable. If low concentrations of trace elements and biocides are confirmed during subsequent years of sampling, then sampling for these constituents could be discontinued at that time. Streamflow gaging stations might be installed at Llagas Creek at Machado School and Llagas Creek at San Martin to help determine how representative sampled streamflows are of monthly and annual mean streamflows.

Use of the same sampling methods at all stations would be advisable. A mixture of manual and automatic stations (as was the case during this study) can cause problems in data interpretation because of a difference in representativeness of the data collected by these methods. A composite of discrete samples collected for about a 24-hour period at a single point in the stream was obtained by automatic sampling. A cross-sectional and depth integrated sample representing instantaneous conditions was collected by manual sampling. Data from these different ways of sampling are difficult to compare.

SUMMARY

Water-quality and streamflow data were collected during the 1979-81 water years at 11 sampling stations in Santa Clara Valley to document water-quality and streamflow conditions. Precipitation data from some of the stations operated by the Santa Clara Valley Water District (SCVWD) were used to represent precipitation conditions in the study area.

Precipitation was greater than normal during the 1980 water year and at, or less than, normal during the 1979 and 1981 water years, depending on station locations. Even though streamflows are regulated by reservoirs, annual mean streamflows in the study area followed the pattern of annual precipitation except in the Coyote Creek basin downstream of Anderson Reservoir, where streamflow was less than normal during the 1980 water year and slightly greater than normal during the 1979 water year. From May to December, sampled streamflows were similar to monthly mean streamflows at all gaged stations. During the rest of the year, sampled streamflows were generally greater than monthly mean streamflows except at stations immediately downstream of reservoirs where storage and regulated release of rainfall runoff moderated streamflows. The largest streamflow sampled was 7,900 ft^3/s at Guadalupe River at San Jose during a February 1980 storm. Streamflows less than 1.0 ft^3/s were sampled at Llagas Creek near Morgan Hill, Coyote Creek near Edenvale, Guadalupe Creek at Guadalupe, Guadalupe River at San Jose, and Los Gatos Creek at Lincoln Avenue.

Bicarbonate was the principal anion at all sampling stations. Magnesium and calcium were the principal cations except at Guadalupe River at San Jose, Los Gatos Creek at Lincoln Avenue, and Coyote Creek stations where sodium was also a principal cation.

Specific conductance was generally greatest (median of 453 µmho/cm) at Guadalupe River at Alamitos Recharge Facility and was generally least (median of 294 µmho/cm) at Los Gatos Creek at Lincoln Avenue. At the three Llagas Creek stations, specific conductance was similar (medians of 340-365 µmho/cm). Specific conductance increased from Guadalupe Creek at Guadalupe (median of 409 µmho/cm) to Guadalupe River at Alamitos Recharge Facility (median of 453 µmho/cm) and from Coyote Creek below Leroy Anderson Dam (median of 314 µmho/cm) to Coyote Creek near Edenvale (median of 403 µmho/cm). These increases might be the result of dry-season runoff from urban areas between these stations and (or) drainage from serpentine and peridotite. The decrease in median specific conductance from 453 µmho/cm at Guadalupe River at Alamitos Recharge Facility to 400 µmho/cm at Guadalupe River at San Jose was probably due to the inflow of Los Gatos Creek (median specific conductance 294-388 μmho/cm) and storm runoff from urban areas between these stations. Specific conductance was inversely related to streamflow except in the Coyote Creek basin and generally was less during storms than at other times. Specific conductance was least (except in the Coyote Creek basin) during the largest storm of the study period, which occurred during February 1980.

Llagas Creek at San Martin and Guadalupe River at Alamitos Recharge Facility generally had the greatest pH (median of 8.2) because these stations had abundant algae and aquatic vascular plant growth. Coyote Creek near Edenvale generally had the least pH (median of 7.5).

Water temperatures were generally highest (median of 15.5°C) at Llagas Creek at San Martin and Guadalupe River at Alamitos Recharge Facility. Water temperatures generally were lowest (median of 12.0 to 13.0°C) at stations near reservoir releases. Water released from reservoirs is from near the bottom where temperatures are lower than in surface water.

Turbidity was generally greater at Los Gatos Creek at Los Gatos (median of 28 NTU) and Coyote Creek below Leroy Anderson Dam (median of 25 NTU) than at other stations (medians less than 20 NTU). This is because most of the Los Gatos Creek basin upstream of Lexington Reservoir and most of the Coyote Creek basin upstream of Anderson Reservoir are underlain by landslide deposits or bedrock susceptible to landsliding, which are very susceptible to erosion and yield much sediment to streams. These conditions are not as prevalent in the other stream basins studied. Turbidity was directly related to streamflow and was greater during storms than at other times. Turbidity was greatest (except in the Llagas Creek and Coyote Creek basins) during the largest storm of the study period, which occurred during February 1980.

The concentration of dissolved oxygen was generally greatest at Llagas Creek at San Martin (median of 11.0 mg/L). The percent saturation of dissolved oxygen was generally greatest at Guadalupe River at Alamitos Recharge Facility (median of 121 percent). Abundant algal and aquatic vascular plant growth were responsible for the high dissolved-oxygen levels at these stations. Dissolved oxygen was generally least at Coyote Creek near Edenvale (median concentration of 7.8 mg/L and median percent saturation of 74 percent). Reservoir releases had dissolved-oxygen concentrations near saturation. At Guadalupe River at Alamitos Recharge Facility, increased water clarity and sunlight during the dry season (May to November) resulted in abundant algal and aquatic vascular plant growth. At this station, dissolved oxygen was greater during the dry season than during the rainy season (November to May). In contrast, at Guadalupe River at San Jose and Coyote Creek near Edenvale, dissolved oxygen was less during the dry season than during the rainy season due to the prevalence of low streamflows (less than 2.0 ft^3/s) at these stations during the dry season. At Los Gatos Creek at Lark Avenue, a mat of aquatic vascular plants retarded light penetration into the water, thus limiting photosynthesis and reducing dissolved oxygen to less than 7.0 mg/L and 82 percent saturation.

Concentrations of total nitrite plus nitrate were generally greatest (median of 1.3 mg/L) at Guadalupe River at Alamitos Recharge Facility and were generally least (median of 0.14 mg/L) at Guadalupe Creek at Guadalupe. Except for Llagas Creek at Machado School, concentrations of total nitrite plus nitrate generally were greater (medians 0.68-1.3 mg/L) at stations in urban areas than at other stations (medians less than or equal to 0.50 mg/L). Stations near reservoir releases generally had lesser concentrations of total nitrite plus nitrate (medians less than or equal to 0.44 mg/L) than other stations (medians greater than or equal to 0.50 mg/L). Most of the nitrogen in release water was in the ammonia and organic forms. The median concentration of total nitrogen increased from 1.2 mg/L at Llagas Creek near Morgan Hill to 1.9 mg/L at Llagas Creek at Machado School and from 1.2 mg/L at Coyote Creek below Leroy Anderson Dam to 2.0 mg/L at Coyote Creek near Edenvale. Rainfall runoff from urban and agricultural areas in the Coyote Creek basin and from land surrounding ranchhouses where livestock is kept in the Llagas Creek basin might be the sources of the increased concentrations of total nitrite plus nitrate between these stations. Concentrations of total nitrite plus nitrate were greater during storms than at other times except at Guadalupe River at San Jose.

Concentrations of total ammonia plus organic nitrogen did not follow a consistent pattern throughout the study area. At Llagas Creek near Morgan Hill, concentrations of this constituent increased during the study period. At Guadalupe River at Alamitos Recharge Facility and Coyote Creek near Edenvale, concentrations of this constituent were greater during storms than at other times. This was not the case at other stations. Concentrations of this constituent were directly related to turbidity at Los Gatos Creek at Lark Avenue and Guadalupe River at San Jose. Concentrations of this constituent were directly related to streamflow only at Guadalupe River at San Jose.

Concentrations of total phosphorus and dissolved orthophosphorus were generally greatest (median of 0.22 and 0.10 mg/L, respectively) at Guadalupe River at San Jose. Except for Coyote Creek near Edenvale and Los Gatos Creek at Lincoln Avenue, concentrations of total phosphorus were generally less than 0.10 mg/L and concentrations of dissolved orthophosphorus were generally less than 0.03 mg/L at other stations. At Los Gatos Creek at Lark Avenue, Guadalupe River at Alamitos Recharge Facility, and Coyote Creek near Edenvale, concentrations of total phosphorus were greater during storms than at other times. This was also the case for dissolved orthophosphorus at the latter two stations. At Los Gatos Creek at Lark Avenue and Guadalupe River at Alamitos Recharge Facility, concentrations of total phosphorus and dissolved orthophosphorus were directly related to turbidity. At Guadalupe River at San Jose, concentrations of total phosphorus were directly related to streamflow and turbidity. At Coyote Creek near Edenvale, concentrations of total phosphorus and dissolved orthophosphorus were directly related to streamflow. Concentrations of total phosphorus were also directly related to turbidity at this station.

Boron concentrations generally correlate with the amount of serpentine and peridotite upstream of the sampling stations. Boron concentrations were generally greatest (median of 180 μg/L) at Llagas Creek near Morgan Hill and generally least (medians less than or equal to 70 μg/L) in the Los Gatos Creek basin. In the study area, serpentine and peridotite are most prevalent upstream of Llagas Creek near Morgan Hill and least prevalent in the Los Gatos Creek basin. Boron concentrations generally were less during the rainy season than during the dry season.

Concentrations of dissolved organic carbon were generally greatest (median of 9.0 mg/L) at Guadalupe River at San Jose and were generally least (median of 5.8 mg/L) at Guadalupe River at Alamitos Recharge Facility. Concentrations of suspended organic carbon generally were greater during storms than at other times and were directly related to turbidity. Concentrations of this constituent were also directly related to streamflow in the Guadalupe River (excluding Los Gatos Creek) and Coyote Creek basins. Concentrations of dissolved organic carbon were usually similar during storm and nonstorm periods and were usually not related to streamflow or turbidity.

Concentrations of fecal-coliform and fecal-streptococcal bacteria generally were greater at Los Gatos Creek at Lincoln Avenue and Guadalupe River at San Jose than at the other nine stations sampled. Median concentrations of fecal-coliform bacteria ranged from 160 to 34,000 col/100 mL and averaged 7,500 col/100 mL at these two stations whereas they ranged from 5 to 3,700 col/100 mL and averaged 340 col/100 mL at the other nine stations sampled. Median concentrations of fecal-streptococcal bacteria ranged from 140 to 8,000 col/100 mL and averaged 2,000 col/100 mL at these two stations whereas they ranged from 5 to 6,800 col/100 mL and averaged 430 col/100 mL at the other nine stations sampled. Los Gatos Creek at Lincoln Avenue and Guadalupe River at San Jose receive more urban drainage than the other nine stations sampled.

Concentrations of fecal-coliform bacteria generally were less at stations near reservoir releases (Guadalupe Creek at Guadalupe, Los Gatos Creek at Los Gatos, and Coyote Creek below Leroy Anderson Dam) than at other stations sampled. At stations near reservoir releases, median concentrations of fecal-coliform bacteria ranged from 5 to 260 col/100 mL and averaged 53 col/100 mL whereas at other stations sampled they ranged from 25 to 34,000 col/100 mL and averaged 1,900 col/100 mL. Except at Guadalupe Creek at Guadalupe, concentrations of fecal-streptococcal bacteria generally were less at stations near reservoir releases than at other stations sampled. At Los Gatos Creek at Los Gatos, median concentrations of fecal-streptococcal bacteria ranged from 15 to 95 and averaged 62 col/100 mL and at Coyote Creek below Leroy Anderson Dam they ranged from 5 to 60 col/100 mL and averaged 45 col/100 mL. At other stations sampled (excluding Guadalupe Creek at Guadalupe), median concentrations of fecal-streptococcal bacteria ranged from 20 to 8,000 col/100 mL and averaged 870 col/100 mL.

Concentrations of fecal-coliform and fecal-streptococcal bacteria at urban stations generally were greater during the rainy season than during the dry season. Median concentrations of fecal-coliform bacteria at urban stations ranged from 130 to 34,000 col/100 mL and averaged 5,700 col/100 mL during the rainy season whereas they ranged from 65 to 1,100 col/100 mL and averaged 280 col/100 mL during the dry season. Median concentrations of fecal-streptococcal bacteria at urban stations ranged from 20 to 8,000 col/100 mL and averaged 1,500 col/100 mL during the rainy season whereas they ranged from 40 to 320 col/100 mL and averaged 150 col/100 mL during the dry season. A consistent seasonal pattern in concentrations of fecal-coliform and fecal-streptococcal bacteria was not evident at rural stations.

Concentrations of dissolved trace elements were generally less than 50 μg/L and rarely exceeded 100 μg/L. Aluminum, manganese, and zinc were the only trace elements that exceeded 100 μg/L. Tertiary mudstones might be the source of manganese. The Franciscan assemblage might be the source of aluminum. Rainfall runoff from urban areas might be the source of zinc. Concentrations of aluminum, iron, and manganese were greater than the concentrations of other trace elements in stream-bottom material.

Organic biocide concentrations were usually less than detection limits at all stations sampled. Malathion concentrations sometimes exceeded 0.10 μg/L (U.S. Environmental Protection Agency criterion for freshwater aquatic life) during 1981, the year Malathion spraying was done to control the Mediterranean fruit fly. Organic biocides were detected most frequently at Guadalupe River at San Jose, which receives urban runoff from the city of San Jose.

Streams in Santa Clara Valley sampled during this study generally met water-quality objectives established to maintain water suitable for the following beneficial uses: Municipal and domestic supply, agricultural supply, ground-water recharge, water contact recreation, noncontact water recreation, cold and warm freshwater habitat, wildlife habitat, and fish spawning. Fecal-coliform and total-coliform bacteria objectives for municipal supply were the only objectives frequently exceeded. None of the streams sampled met these objectives. In addition, the fecal-coliform objective for water contact recreation was exceeded at Llagas Creek at Machado School, Guadalupe Creek at Guadalupe, Guadalupe River at Alamitos Recharge Facility, Los Gatos Creek at Lark Avenue, and Guadalupe River at San Jose. The fecal-coliform bacteria objective for non-contact water recreation was exceeded at Guadalupe River at San Jose during January 1980 storms. Urban runoff from San Jose probably was the source of fecal-coliform bacteria at Guadalupe River at Alamitos Recharge Facility, Los Gatos Creek at Lark Avenue, and Guadalupe River at San Jose. Rainfall and irrigation runoff from land surrounding ranchhouses where livestock is kept probably was the source of fecal-coliform bacteria at Llagas Creek at Machado School. The source of fecal-coliform bacteria at Guadalupe Creek at Guadalupe is not known.

The minimum dissolved-oxygen objective for cold water habitat (7.0 mg/L) was frequently not met at Coyote Creek near Edenvale. This occurred when streamflows were low (less than or equal to 2.0 ft^3/s). Low streamflows (less than 1.0 ft^3/s) at Guadalupe River at San Jose sometimes had concentrations of dissolved oxygen less than this objective.

The maximum pH objective was exceeded only at Llagas Creek at San Martin and Guadalupe River at Alamitos Recharge Facility. These stations had abundant algae and aquatic vascular plants, especially at times when pH exceeded the objective.

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