Prepared in cooperation with the
CALIFORNIA DEPARTMENT OF WATER RESOURCES and the
NEVADA DIVISION OF WATER RESOURCES

STREAMFLOW

The characteristics of streamflow differ from one geohydrologic zone to another, from one stream to another, and from place to place along each stream channel. Streamflow also varies annually and seasonally. To determine average rates and distribution of streamflow in the basin, measurements or estimates were made for 31 streams and 4 groups of tributaries draining intervening areas (table 1).

Streamflow measurements made at two or more sites on five streams in mid-December 1987 (table 2) indicate variations in flow along channels. The results support the fact discovered by early pioneers: streamflow in an arid environment generally decreases in a downstream direction from the source. Therefore, even the streams listed in table 2 as gaining water (having positive specific seepage values) would be losing water (having negative values) if they were measured farther downstream.

A hydrograph of Willow Creek for the 1983 water year (October 1, 1982, to September 30, 1983; fig. 4) gives a quantitative picture of the seasonal fluctuation of runoff in the basin. The 20-year hydrograph of the total flow in Willow Creek (fig. 5) shows the large variation in runoff from year to year.

Mean Annual Flow

Mean annual streamflow (table 1) was computed by one of three methods, depending on the type of site, availability of data, and rate of flow during the study period: (1) Recorded streamflow data were used at three gaged streams for which at least 10 years of daily streamflow records were available. (2) Monthly measurements at 18 streams during the 1988 water year were correlated with long-term streamflow at gaged streams. (3) Runoff was estimated from drainage-area relations for intervening areas and for 10 ephemeral streams that did not sustain measurable flow throughout the 1988 water year.

All gages and sites at which mean annual streamflow was measured or estimated are above or near the mountain front and generally upstream from any significant diversions. Most streamflow is diverted or infiltrates into the alluvial fans long before it reaches the valley floor.

Data for estimates of mean annual streamflow were collected during the 1988 water year, when runoff was much lower than normal due to below-normal precipitation. All streams remained at or near base flow for the entire year and many streams did not flow during part or all of the year. (Base flow is sustained streamflow derived largely or entirely from ground-water discharge.) The accuracy of the streamflow estimates presumably would be greater if it had been possible to collect the data during a several year period of near-normal or above-normal flow.

TABLE 1.--*Streamflow data and related information*

Station number.--U.S. Geological Survey station identification. Symbol: --, no number assigned.
Drainage area.--Parenthetical drainage-area data for sites 14 and 16 on Long Valley Creek, site 25 on Baxter Creek, and site 32 on Gold Run Creek are not included in total listed at end of table; nearby sites 15, 24, and 30 on the same three streams, respectively, are used instead. Symbol: --, not determined.
Mean annual streamflow.--Symbols: C, estimated on basis of monthly measurements and correlation with gaged streams; G, based on long-term gaging-station record; R, estimated on basis of relation between drainage area and runoff; --, data not included in total flow listed at end of table. Historical records are from U.S. Geological Survey (1960, 1963, 1962-89) and California Department of Water Resources (1981).
Period of record.--Symbol: +, station remained active after water year 1988.

[Abbreviation: NA, not applicable.]

Site number (fig. 2)	Station number	Station name or description of intervening areas	Drainage area (square miles)	Mean annual streamflow (cubic feet per second)	Period of record (water year)	Topo-graphic quad-rangle (fig. 3)	Remarks
[a]2	10353950	Spencer Creek near Herlong, Calif.	4.72	0.53R	1988	23	
3	10353860	Skedaddle Creek near Herlong, Calif.	83.4	6.9R	1988	23	
NA	NA	Intervening areas, Shaffer Mountain to Never Sweat Hills	74.5	8.2R	NA	NA	
4	10353970	Cottonwood Creek near Flanigan, Nev.	14.6	2.2C	1988	36	
5	10353965	Gasperoni Creek near Flanigan, Nev.	1.24	.08C	1988	36	
6	10353971	Rock Springs Creek near Flanigan, Nev.	2.46	.29R	1988	35	
7	10353972	Milne Creek near Flanigan, Nev.	2.28	.27R	1988	35	
8	10353975	Willow Springs Creek near Flanigan, Nev.	.79	.22C	1988	35	
9	10353976	Fish Springs Creek near Flanigan, Nev.	3.73	.43R	1988	35	
10	10353977	Antoinette Creek near Flanigan, Nev.	.77	.04C	1988	35	
11	10353977	Butler Creek near Flanigan, Nev.	.50	.04C	1988	35	
12	10353978	Mullen Creek near Flanigan, Nev.	.46	.15C	1988	35	
13	10353980	Fort Sage Creek near Flanigan, Nev.	1.56	.61C	1988	35	
NA	NA	Intervening areas, Virginia and Fort Sage Mountains	25.9	3.3R	NA	NA	
[b]14	--	Long Valley Creek at Hallelujah Junction, Calif.	(100)	--	1971-74	41	
[b]15	10354000	Long Valley Creek near Scotts, Calif.	125	11C	1917-19, 1988+	41	
16	--	Long Valley Creek near Doyle, Calif.	(266)	--	1958-69	34	
17	10354500	Long Valley Creek near the mouth, near Doyle, Calif.	--	--	1918	34	
18	10354450	Willow Ranch Creek near Doyle, Calif.	7.11	2.9C	1988	34	
NA	NA	Intervening areas, Long Valley Creek drainage	281	24R	NA	NA	
19	10354670	McDermott Creek near Milford, Calif.	3.63	1.5C	1988	27	
20	10354700	Mill Creek at Milford, Calif.	2.26	2.8C	1963-69, 1988	27	
21	10354800	Hallett Creek near Buntingville, Calif.	2.18	.55C	1988	20	Water from Thompson Creek diverted into basin until 1988.
22	10354900	Parker Creek at Highway 395 at Buntingville, Calif.	2.89	0.86C	1988	20	
23	--	Elysian Creek near Janesville, Calif.	10.8	4.9R	1988	19	
24	10354950	Baxter Creek near Johnstonville, Calif.	4.38	2.3C	1988	19	
25	10355500	Baxter Creek near Janesville, Calif.	(19.6)	--	1913-19	19	Includes Elysian Creek; published as "near Lassen," 1918-19.
26	10355550	Sloss Creek near Janesville, Calif.	1.05	.59R	1915, 1918-19	19	Published as "at Lassen," 1918-19.
27	10356000	Bankhead Creek near Janesville, Calif.	1.83	.98R	1915, 1918-19, 1988	19	Published as "Janesville Creek at Lassen," 1918-19.
28	10356500	Susan River at Susanville, Calif.	184	94.7G	1900-06, 1917-21, 1951-88+	11	Gaged at several sites and datums.
29	10356700	Piute Creek at Susanville, Calif.	26.3	4.7C	1988	11	Originally named Smith Creek.
30	10356900	Gold Run Creek near Susanville, Calif.	6.99	6.1C	1957-88+	11	Recorder operated during irrigation season only.
31	10356950	Hills Creek near Susanville, Calif.	2.54	2.2C	1988	18	
32	10357000	Gold Run Creek above Richmond School near Susanville, Calif.	(15.1)	--	1915-16	18	
33	10357400	Lassen Creek above County Road 205 near Susanville, Calif.	2.45	1.4C	1988	18	
[c]34	10357500	Lassen Creek near Susanville, Calif.	(7.53)	--	1913-16	18	
[c]35	10358000	Willow Creek at Merrillville, Calif.	--	--	1904-06	5	
36	10358500	Willow Creek near Susanville, Calif.	90.4	34.7G	1951-88+	12	
37	10358600	Petes Creek near Litchfield, Calif.	140	11R	1988	7	
38	10358650	Balls Canyon Creek near Litchfield, Calif.	370	26R	1988	13	
39	10358700	Willow Creek near Litchfield, Calif.	--	--	1958-68	13	
40	10359000	Willow Creek near Standish, Calif.	--	--	1900, 1905-06	13	
NA	NA	Intervening areas, Diamond Mountains and Cascade Range	106	57R	--	--	
41	10355910	Shaffer Creek near Litchfield, Calif.	5.63	.22G	1963-73, 1988	14	
Total for areas tributary to valley floor (rounded)			1,600	314	NA	NA	

[a] Site 1 is Honey Lake (see figures 2 and 7).
[b] Site is south of area shown in figure 2.
[c] Site is north of area shown in figure 2.

TABLE 2.--*Seepage data for selected stream reaches, December 15-16, 1987*

[All flow values in cubic feet per second, except as indicated.
Abbreviations: AF, alluvial fan; UD, upland draw; VF, valley floor]

Stream	Geological Survey station number	Site number[1]	Topo-graphic setting	Bed material	Discharge	Reach length[2] (miles)	Tributary Inflow	Diversion	Seepage[3]	Specific seepage for reach[3] (cubic feet per second, per mile)
Fort Sage Creek	10353980	13A	UD	Cobbles, sand	0.16					
		13B	AF	Sand, cobbles	.11	0.2	0.00	0.00	-0.05	-0.25
		13C	VF	Sand	.00	.6	.00	.00	-.11	-.18
Long Valley Creek	10354000	15A	VF	Sand	3.10					
		15B	VF	Sand	3.59	6.8	.00	.00	+.49	+.07
Mill Creek	10354700	20A	UD	Gravel, sand	.77					
		20B	AF	Sand, gravel	.94	.7	.00	.00	+.17	+.25
Piute Creek	10356700	29A	UD	Sand, cobbles	1.58					
		29B	UD	Sand, cobbles	1.28	.55	.00	.00	-.30	-.55
Gold Run Creek	10356900	30A	UD	Cobbles	.96					
		30B	UD	Cobbles	1.32	.35	.00	.00	+.36	+1.03
		30C	UD	Cobbles	1.36	.15	.00	.26	+.30	+2.00
		30D	VF	Cobbles, gravel	1.45	1.15	.19	.00	-.10	-.09

[1] From figure 2 and table 1.
[2] Distance below nearest upstream site, measured on 7.5-minute topographic map to nearest 0.05 mile.
[3] Negative value indicates seepage loss relative to nearest upstream site; positive value, seepage gain.

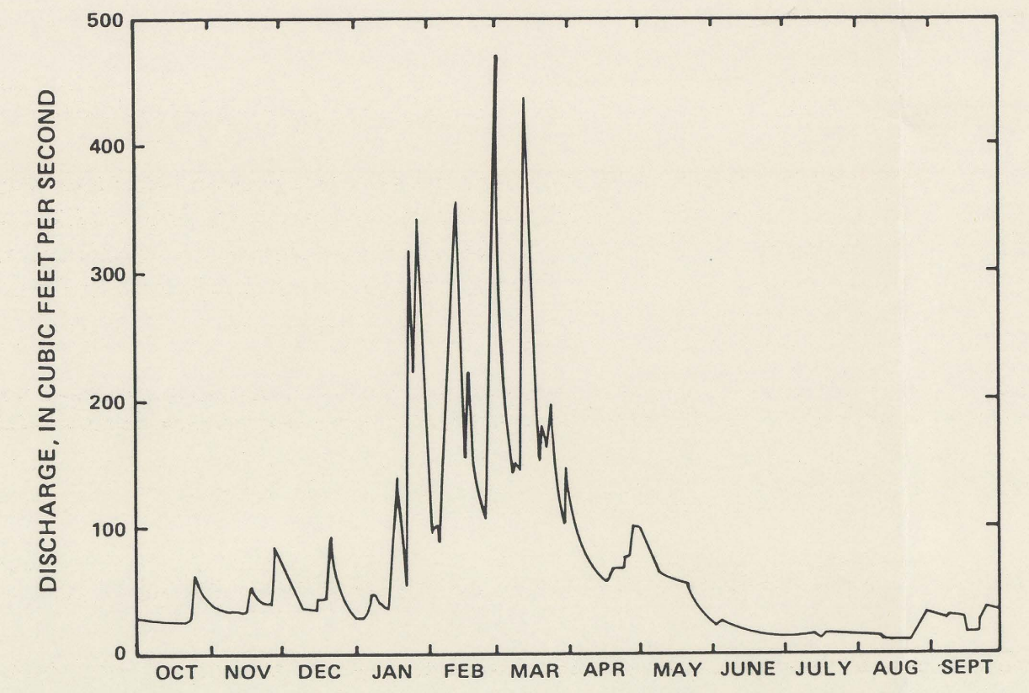

FIGURE 4.--Daily mean discharges of Willow Creek near Susanville, water year 1983.

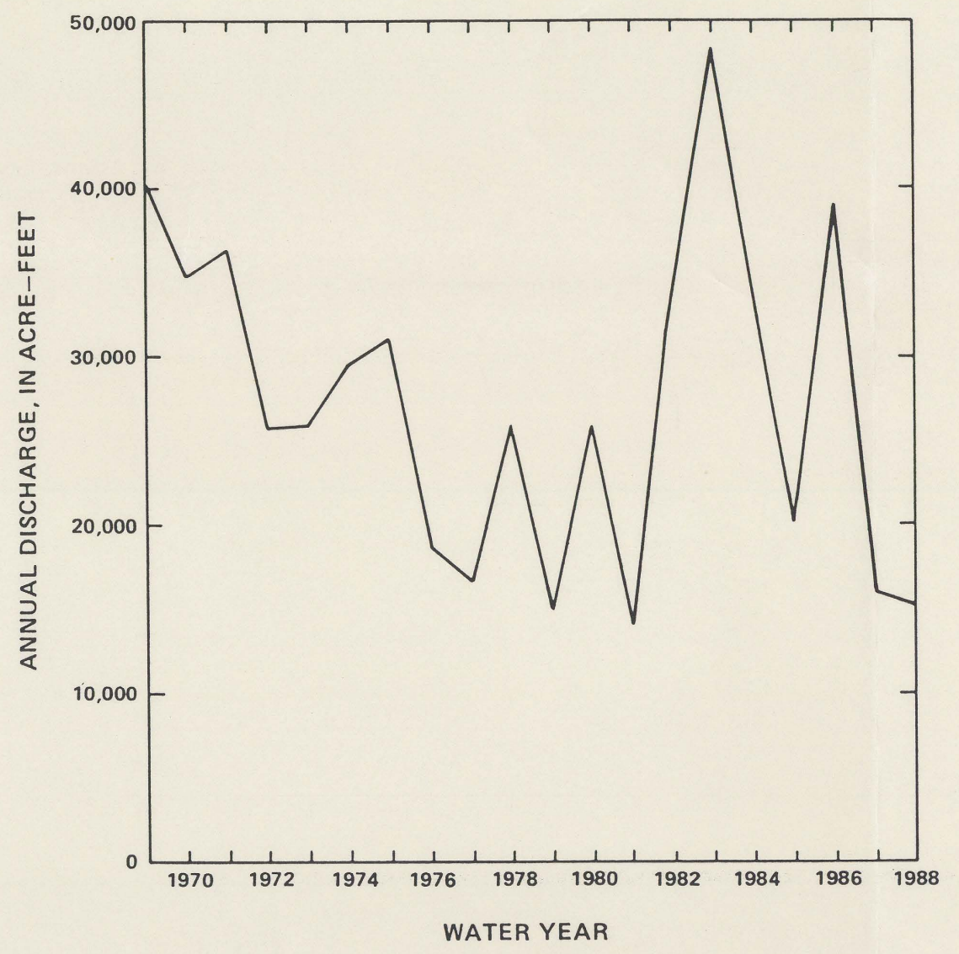

FIGURE 5.--Annual discharges of Willow Creek near Susanville, water years 1969-88.

The three streams that have long-term streamflow records are Susan River, Willow Creek, and Shaffer Creek (fig. 2; sites 28, 36, and 41). The Susan River and Willow Creek gages are currently (1989) in operation, but the Shaffer Creek site was discontinued in 1973 after about 10 years of operation. The mean annual discharges for these three sites were calculated from historical records. Mean flows for the Susan River and Willow Creek were not adjusted for upstream storage or diversions. Shaffer Creek has no diversions or storage facilities. The mean annual discharge of the three gaged streams totals about 130 ft^3/s, which accounts for 41 percent of the estimated average flow (314 ft^3/s) toward the valley floor. Data for the gaged streams are considered accurate to within about 15 percent.

The mean annual discharges at 18 sites were estimated using the method developed by Riggs (1969). The method involved two separate steps. In the first step, the mean discharge for the 1988 water year (October 1, 1987, to September 30, 1988) was estimated at each site using measurements of instantaneous discharge that were made near the middle of each month during the 1988 water year. The measured discharge was correlated with monthly discharge at a continuous-record streamflow gage, Willow Creek near Susanville (site 36, fig. 2). The resulting monthly mean discharges were averaged to estimate the 1988 annual mean discharge.

In the second step, a relation between the mean discharge for water year 1988 and the long-term mean was developed by comparison with long-term data from 21 continuous-record gaging stations (3 within and 18 outside the basin). The long-term mean annual discharge for each of the 18 study-area sites was estimated from this relation. (See streamflow measurements labeled "C" in table 1.) Mean annual streamflow from the 18 study-area streams is estimated to total about 40 ft^3/s, which is only 13 percent of the estimated total flow (314 ft^3/s) toward the valley floor. Streamflow estimates for these 18 sites are considered accurate to within minus 30 to plus 40 percent, on the basis of a statistical "standard error of estimate."

Many streams in the basin were not measured during 1988, mainly because of insufficient streamflow. The mean annual discharge for these streams and for intervening areas was estimated by correlation with drainage area-runoff characteristics of the 3 gaged streams and 18 streams that were measured monthly. The 21 sites were divided into two groups--a Sierra-Cascade group and an eastern group. A statistical relation was developed for each group using drainage areas and mean annual discharges at the included sites.

The Sierra-Cascade group used data from 2 gaged streams and 10 streams that were measured monthly. The eastern group used data from one gaged stream and eight streams that were measured monthly. Mean annual streamflow for the Sierra-Cascade group is an estimated 100 ft^3/s (32 percent of the estimated flow toward the valley floor) and is considered accurate to within minus 40 to plus 80 percent. Total annual streamflow for the eastern group is an estimated 44 ft^3/s (only 14 percent of the estimated flow [table 1] toward the valley floor) and is considered accurate to within minus 60 to plus 140 percent.

The estimated mean annual discharges for areas listed in table 1 as "intervening areas" were calculated using the Sierra-Cascade or the eastern group relation, depending on location.

Chemical Character of the Streamflow

As part of this study, four streams in the Fort Sage and Virginia Mountains (southeast part of the basin) were sampled once, in February 1988. The quality of water from the four southern streams and from the Susan River (northwestern part of the basin) is illustrated by diagrams (fig. 6). The diagrams show concentrations (in milliequivalents per liter) of chemical constituents in water. Cations are on the left and anions on the right in each diagram. (Ions are electrically charged atoms or molecules derived from the solution of minerals; cations are positively charged and anions are negatively charged.) The shape of the patterns can be compared to show similarities and differences in composition of different water samples.

Patterns for the four southern streams are similar. No cation is predominant; concentrations of calcium, magnesium and sodium plus potassium are about equal. The predominant anion is bicarbonate. Similar quality (sodium calcium bicarbonate) was reported in a sample from Long Valley Creek (Hilton, 1963, p. 28).

Discharge in all the southern streams was at base flow when the samples were collected. In these streams, low flows are maintained solely by hot and cool springs along the banks. The chemical characteristics of the water probably are significantly different during snowmelt or storm events.

The Susan River has been sampled by the U.S. Geological Survey since 1978, and some samples were collected as early as 1952. The diagram of a January 1988 sample (fig. 6) indicates a water type similar to that of the southern drainages. The river contains predominantly calcium, magnesium, and bicarbonate ions, typical of water in the Sierra Nevada.

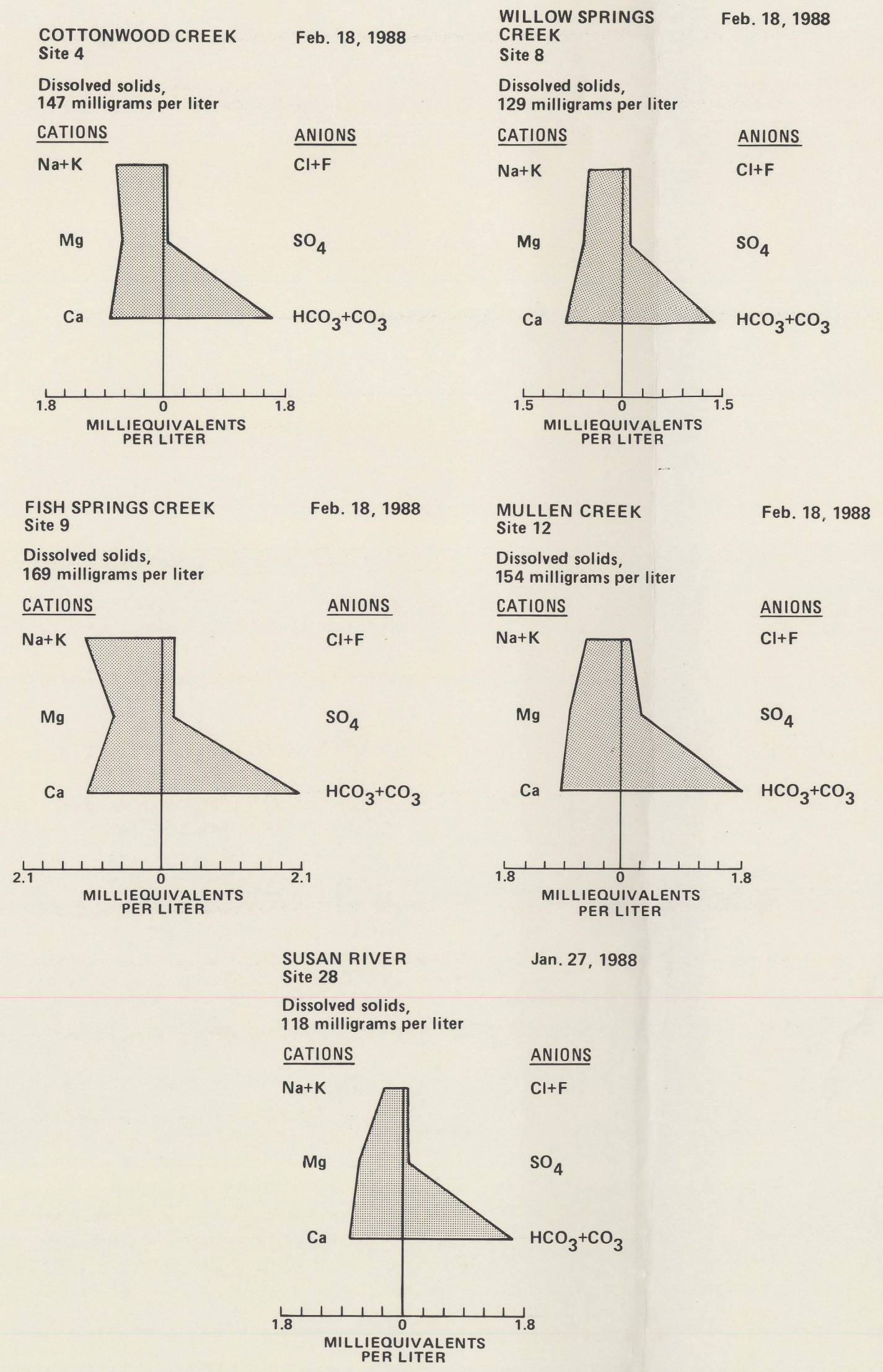

FIGURE 6.--Chemical character of water in five streams, January-February 1988. Chemical symbols: Ca, calcium; Cl, chloride; CO_3, carbonate; F, fluoride; HCO_3, bicarbonate; K, potassium; Mg, magnesium; Na, sodium; SO_4, sulfate. See table 1 for stream-site information and figure 2 for site locations.

HONEY LAKE

Honey Lake is an important stop for migrating water fowl. Estimates indicate that 15,000-25,000 water fowl use the Honey Lake State Wildlife Area during the fall, and 30,000-50,000 water fowl use the area in the spring. This does not include the many shore birds that use the area during their migration and birds that nest on the refuge. A 1977 bird count found 217 different species on the refuge, and many more species inhabit other parts of the lake (Paul Chappell, California Department of Fish and Game, oral commun., 1988).

Many native species of fish in the lake, such as Tahoe suckers and tui chub, have sustained man and beast through the ages. The Paiutes were known to harvest Tahoe suckers from Long Valley Creek near Doyle during spring spawning runs. Attempts were made in the late 1800's to stock the lake with black bass. The lake went dry a short time later, killing all the fish and causing quite a stench (Purdy, 1983, p. 43). The California Department of Fish and Game occasionally stock channel catfish. A recent count by the California Department of Fish and Game revealed other fish species not native to the lake, including Sacramento perch, brown bullheads, and crappie (Bruce Duel, California Department of Fish and Game, oral commun., 1988). Honey Lake water affects the environment in the valley in many ways, mainly by increasing the humidity and moderating the temperature (Guernsey and others, 1917, p. 6).

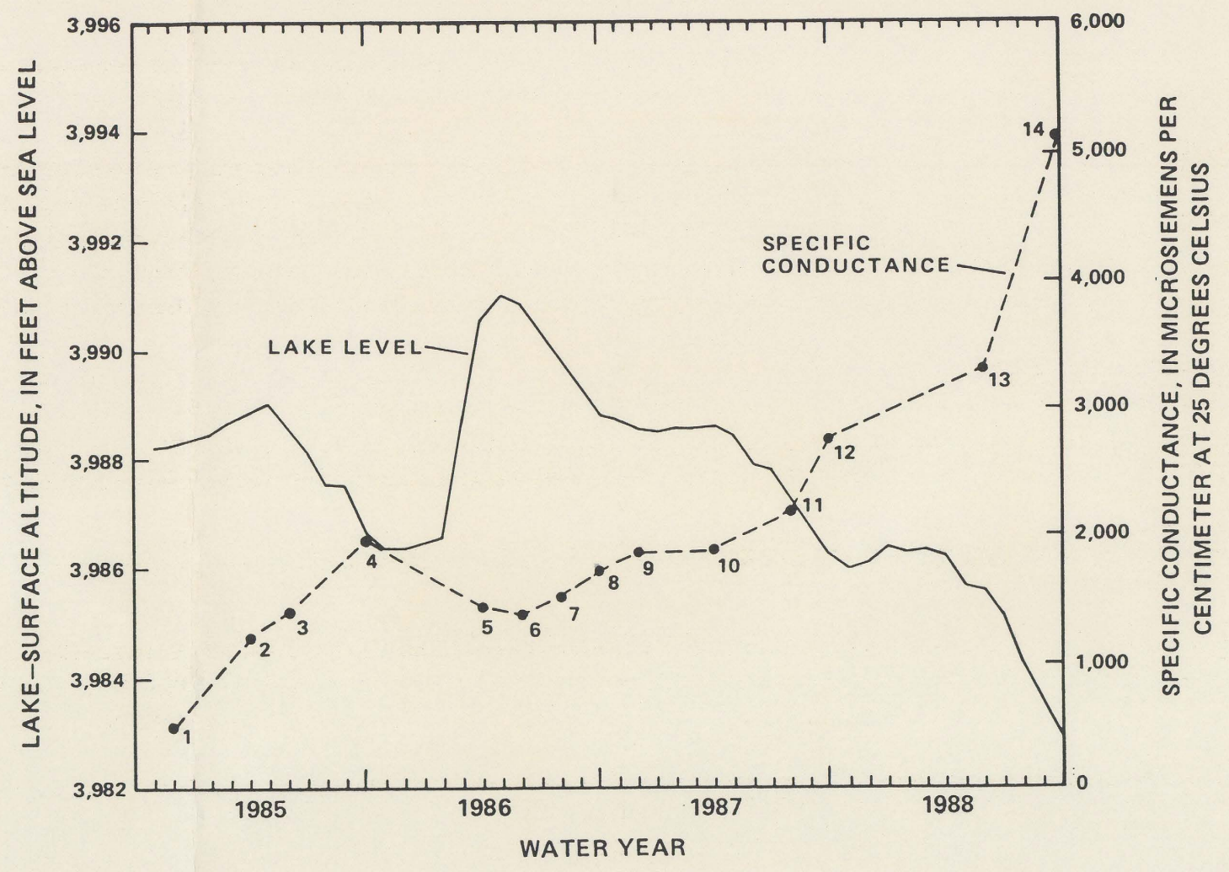

FIGURE 7.--Lake-surface altitude and specific conductance of water in Honey Lake, water years 1985-88. Lake gage is near Litchfield (station 10353907); water-quality site is near Buntingville (station 10353900). Specific-conductance determinations are numbered in chronological order. Numbers correspond with those in figure 9.

Water Level, Area, and Volume

The water level in Honey Lake fluctuates over a wide range (fig. 7). The maximum historical level may have been about 4,000 feet above sea level. [This conjecture is based on a brief discussion of the very high lake level of 1868 by Amesbury (1967, p. 25) and topographic contours adjacent to the lake near Milford (map 27, fig. 3).] In contrast, prehistoric Lake Lahontan (fig. 2) inundated Honey Lake Valley to a maximum altitude of about 4,365 feet--almost 400 feet above the present-day lake level--during the late Pleistocene Epoch from 14,000 to 12,500 years ago (Benson and Mifflin, 1986, p. 1). Honey Lake occasionally dries completely (table 3), at an altitude of about 3,977-1/2 feet. Many attempts have been made to use the lake water for irrigation, but the variability of the water level makes large-scale pumping inefficient. Most water withdrawal plants were abandoned in the early 1900's, but at least one ranch still uses lake water (mixed with ground water in lakeside ponds) for irrigation.

The lake-bottom shape, area, and volume of Honey Lake were determined on the basis of photographs and several sonar transects across the lake. Shorelines traced from the photographs taken at various lake stages during 1976 were used to help define the general lake-bottom topography. The resulting contours were then used to calculate the lake volume at selected altitudes. The bathymetric contours are shown in figure 2, and the area and volume data are listed in table 4 and shown in figure 8.

TABLE 3.--*Calendar years during which Honey Lake was reported dry*

(From Purdy, 1983, p. 43)

1859	1919-37
1865	1943-47
1887	1961
1889	1976-79
1903	1981

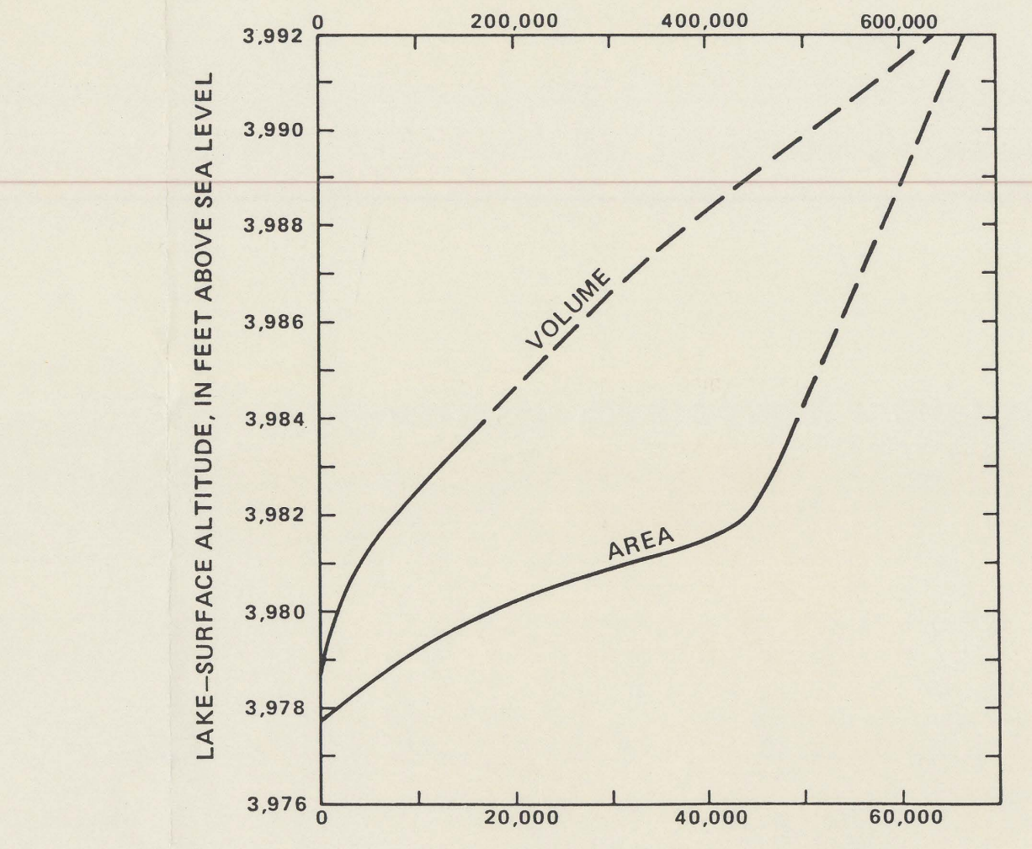

FIGURE 8.--Area and volume of Honey Lake.

TABLE 4.--*Area and volume of Honey Lake*

[Based on Landsat satellite imagery for 1976 and bathymetric data collected in June 1987]

Lake-surface altitude (feet above sea level)	Lake-surface area (acres)	Volume (acre-feet)	Lake-surface altitude (feet above sea level)	Lake-surface area (acres)	Volume (acre-feet)
3,977	0	0	3,982	44,000	76,000
3,978	1,900	180	3,984	49,000	170,000
3,979	8,200	3,500	3,988	58,000	380,000
3,980	18,000	16,000	3,992	[a]67,000	640,000
3,981	32,000	39,000	4,000	[b]85,000	1,200,000

[a] Extrapolated from data for 3,984, 3,988, and 4,000 feet altitude.

[b] Planimetered from 15-minute topographic quadrangle maps.

Chemical Character of the Lake

The concentration of dissolved solids in the lake water varies inversely with lake-surface altitude (figs. 7 and 9) because evaporation decreases the volume of lake water but not the quantity of dissolved salts. (Figures 7 and 9 show measurements of specific conductance, which are approximate indices of dissolved-solids concentrations; for Honey Lake, the dissolved-solids content, in milligrams per liter, is about 65 percent of the specific-conductance value.) The chemical character of the lake has been relatively constant during the last 74 years (fig. 10) despite wide fluctuations in concentration. Sodium is by far the predominant cation and carbonate plus bicarbonate are the predominant anions. This chemical composition is considerably different from that of water in the surrounding creeks (fig. 6).

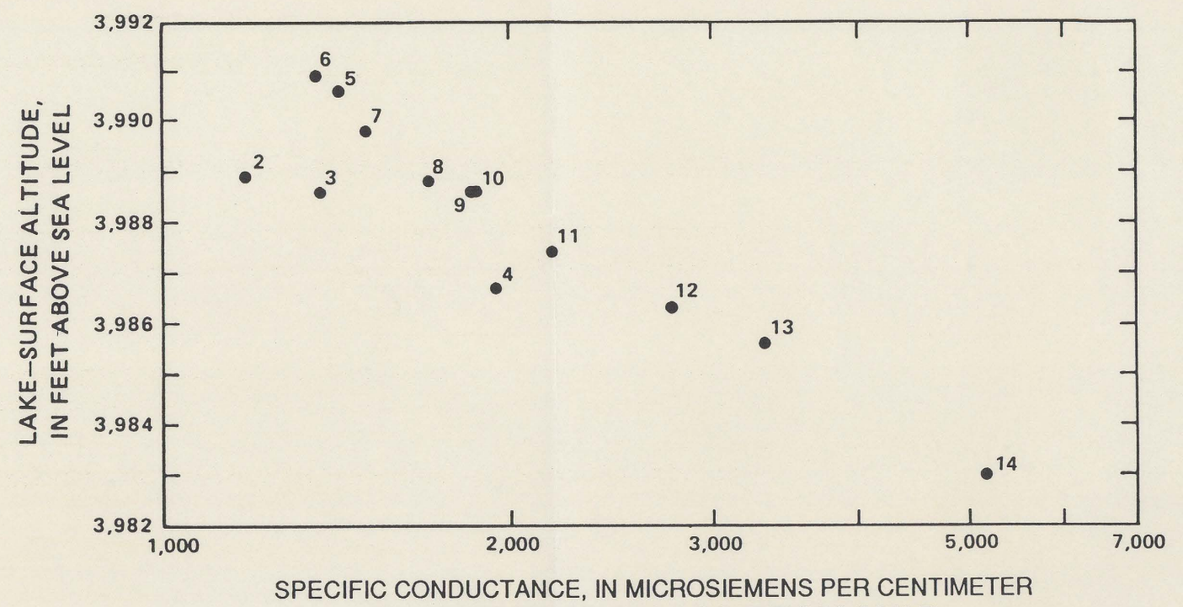

FIGURE 9.--Relation between lake-surface altitude and specific conductance of water in Honey Lake, water years 1985-88. Data points are numbered in chronological order and correspond with those in figure 7. Data point No. 1 (specific conductance, 487 microsiemens per centimeter at 25° Celsius; lake-surface altitude, 3,988.24 feet) is off graph.

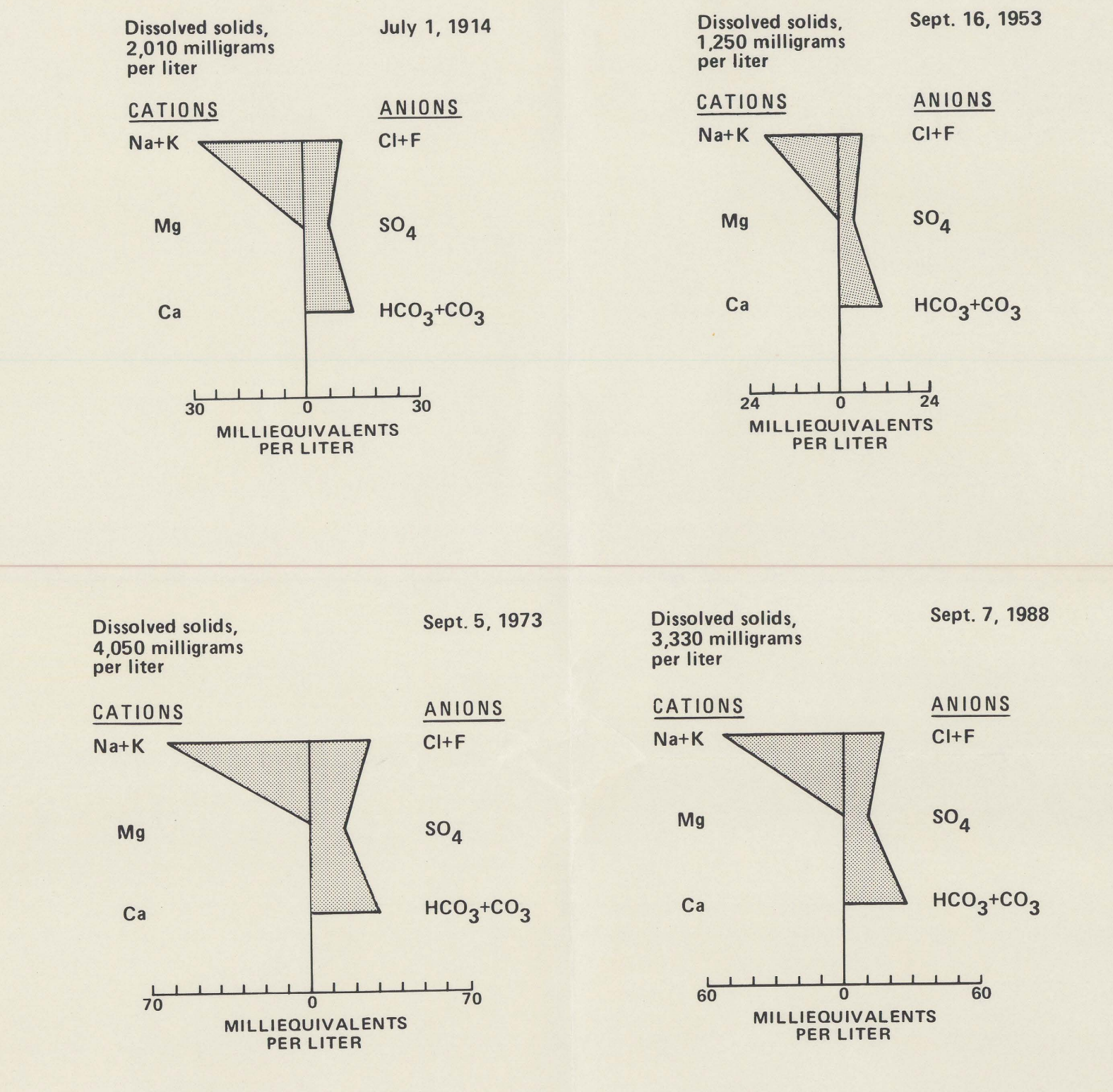

FIGURE 10.--Chemical character of water in Honey Lake in 1914, 1953, 1973, and 1988. Samples in 1953, 1973, and 1988 were collected near Buntingville (station 10353900). Collection site for 1914 sample is unknown. [Chemical symbols: Ca, calcium; Cl, chloride; CO_3, carbonate; F, fluoride; HCO_3, bicarbonate; K, potassium; Mg, magnesium; Na, sodium; SO_4, sulfate.]

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CONVERSION FACTORS AND ABBREVIATIONS

"Inch-pound" units of measure used in this report may be converted to International System (metric) units by using the following factors:

Multiply	*By*	*To obtain*
Acre	4,047	Square meter (m^2)
Acre	0.4047	Hectometer (hm)
Acre-foot (acre-ft)	1,233	Cubic meter (m^3)
Acre-foot (acre-ft)	0.001233	Cubic hectometer (hm^3)
Cubic foot per second (ft^3/s)	0.02832	Cubic meter per second (m^3/s)
Cubic foot per second, per mile [$(ft^3/s)/mi$]	0.0176	Cubic meter per second, per kilometer [$(m^3/s)/km$]
Foot (ft)	0.3048	Meter (m)
Inch (in.)	25.40	Millimeter (mm)
Mile (mi)	1.609	Kilometer (km)
Square mile (mi^2)	2.590	Square kilometer (km^2)

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SURFACE-WATER HYDROLOGY OF HONEY LAKE VALLEY, LASSEN COUNTY, CALIFORNIA, AND WASHOE COUNTY, NEVADA

By

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1990