COMPILATION AND INTERPRETATION OF WATER-QUALITY AND DISCHARGE DATA FOR ACIDIC MINE WATERS AT IRON MOUNTAIN, SHASTA COUNTY, CALIFORNIA, 1940-91

By Charles N. Alpers, D. Kirk Nordstrom, *and* J.M. Burchard

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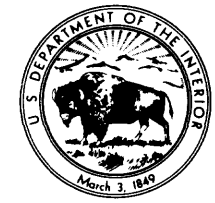

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Multiply	By	To obtain
degree Celsius (°C)	1.8 °C + 32	degree Fahrenheit (°F)
	°C + 273.15	kelvin (K)
cubic foot (ft^3)	28.32	liter (L)
cubic foot per second (ft^3/s)	448.4	gallon per minute (gal/min)
foot (ft)	0.3048	meter (m)
gallon (gal)	3.785	liter (L)
gallon per minute (gal/min)	0.06309	liter per second (L/s)
inch (in.)	2.54	centimeter (cm)
mile (mi)	1.609	kilometer (km)
ounce (oz)	28.35	gram (g)
	28,350	milligram (mg)

Abbreviations used:

moles/kg H_2O (moles per kilogram of water)
mL (milliliter)
mmho/cm (millimhos per centimeter)
mg/L (milligram per liter)

Vertical Datum

Sea Level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

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ABSTRACT

This report contains a compilation and interpretation of the historical records of water quality and discharge for the period 1940-91 from the two most significant discharge points for acid mine drainage at Iron Mountain, Shasta County, California--the Richmond and Lawson portals. The primary objectives are (1) to clarify whether or not there is a hydrologic connection between the Richmond and Lawson Tunnels, and (2) to formulate a conceptual model of subsurface processes that accounts for water-quality and discharge trends with time.

On the basis of five hydrogeochemical factors, it is concluded that mine drainage in the Lawson Tunnel contains metals and acidity derived primarily from oxidation of sulfides in the Hornet massive sulfide deposit. The factors are as follows: (1) a significant mass (about 1 million tons) of sulfides remain in the Hornet deposit, largely in the unsaturated zone; (2) the results of three-dimensional ground-water modeling indicate that ground water must enter the Hornet deposit; (3) there is a substantial difference in hydrograph response to winter storms between the Lawson and Richmond portal effluents, especially early in each wet season; (4) zinc/copper (Zn/Cu) ratios in Lawson Tunnel effluent are distinctly lower than those in Richmond Tunnel effluent during dry season low-flow conditions; and (5) results of mass-balance computations indicate that only a small part (about 2 percent by volume and 6 percent by metal content) of the Lawson Tunnel drainage could be derived from mixing of water from the Richmond deposit during low-flow conditions.

It is proposed that Zn/Cu ratios in the mine waters are controlled by alternating periods of precipitation and dissolution of sulfate minerals in the subsurface. Copper is concentrated relative to zinc in sulfate solid solutions such as melanterite, causing increased Zn/Cu ratios in mine waters during dry periods while sulfate minerals are forming. Flushing of the efflorescent salts during periods of rapid infiltration causes a rapid decrease in the Zn/Cu ratio of the mine waters. Weekly data from 1983-91 indicate a lag time as much as several weeks in each wet season between the time when the Richmond portal effluent is affected by these processes and the onset of higher flows and reduced Zn/Cu values in the Lawson portal effluent. This behavior and the distinct Zn/Cu ratio in the Lawson portal effluent during low-flow conditions reinforce the conclusion that the Lawson Tunnel drainage derives its metals from the Hornet Mine and not the Richmond Mine. Therefore, any viable remediation alternative at Iron Mountain needs to account for the generation of acidic mine drainage from the Hornet mine workings, a process which will probably continue after any plugging is attempted in the Richmond mine workings.

INTRODUCTION

BACKGROUND

Iron Mountain, located in Shasta County, California (fig. 1), refers to both an abandoned mining town and a mountain peak at the same site. At Iron Mountain, there is a group of mines that produced ore from massive sulfide mineral deposits. The gossan, or oxidized surface expression of the massive sulfide, was originally mined in the 1880's for its high gold and silver content. After the initial mining of gossan, high concentrations of copper and zinc were found in sulfides at depth. Iron Mountain became the largest producer of copper in California and the sixth largest producer in the country during the first quarter of the 20th century (Kinkel and others, 1956).

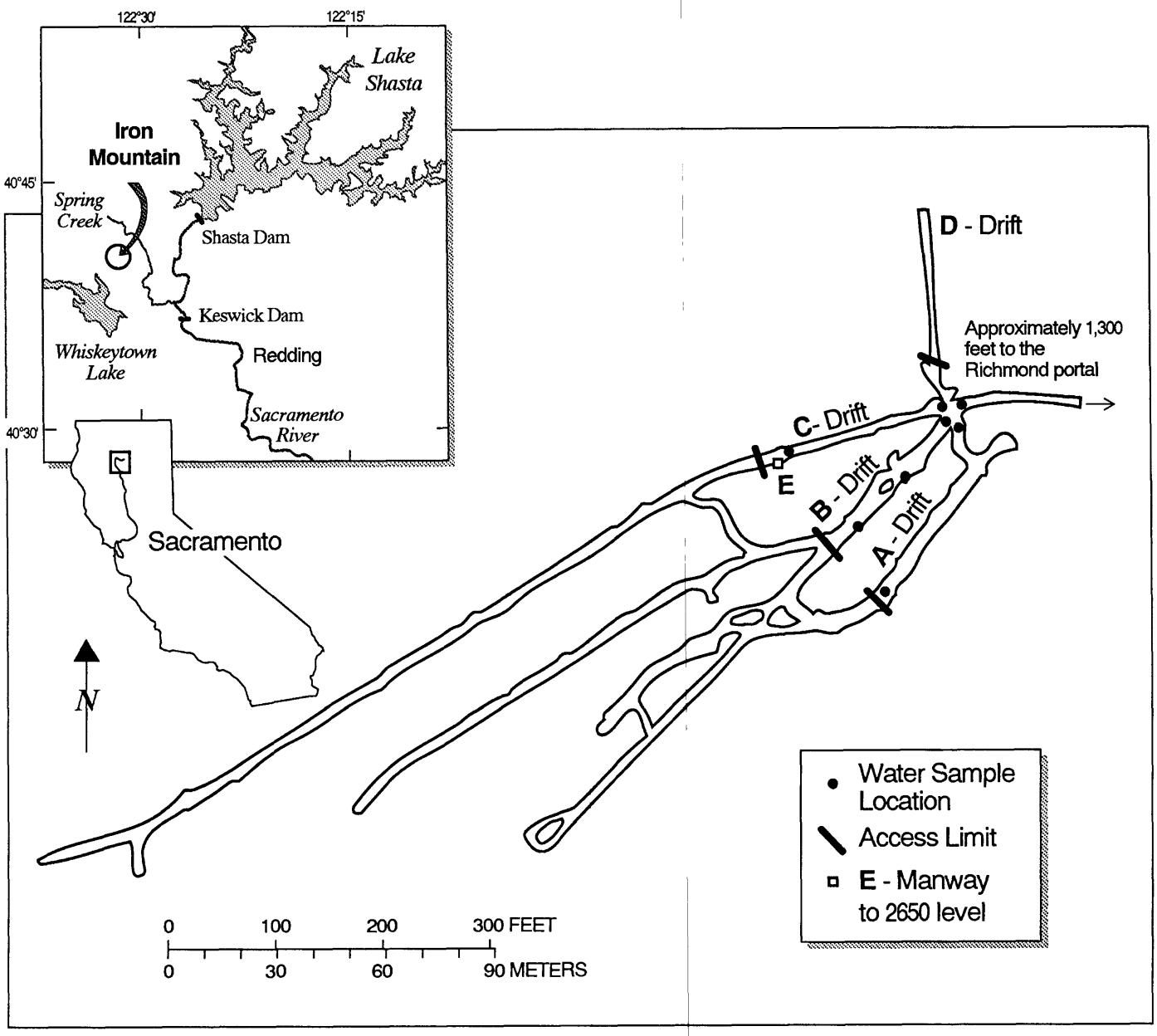

Figure 1. Location of Iron Mountain and plan view of mine workings on 2600 level of Richmond Mine.

Mining ceased in 1962 except for copper removal from effluent solutions by traditional cementation, utilizing gravity flow of portal effluent through cleaned scrap iron. The mine portal effluents were extremely acidic and contained high concentrations of metals. These effluents caused major fish kills in the Sacramento River during heavy rainstorms. The high concentration of copper in the runoff water may have been responsible for the fish mortality (Nordstrom and others, 1977, appendix). However, major fish kills may have been caused by the suffocating action of hydrolyzed iron and aluminum coating gill surfaces (Muniz and Leivestad, 1980). Fish kills from acid mine drainage produced at Iron Mountain have been reported since at least 1940, following the completion of Shasta Dam. Reports of fish kills were compiled by Nordstrom and others (1977). More recent fish kill data are being prepared for the U.S. Environmental Protection Agency by CH2M Hill.

In 1982, the U.S. Environmental Protection Agency (EPA) ranked Iron Mountain as one of the highest priority sites on the National Priority List for CERCLA or "Superfund" cleanup activity (Biggs, 1991). The EPA began a Remedial Investigation/ Feasibility Study (RI/FS) in 1983 to define the extent of the problem and to consider alternative remediation techniques. Although one RI/FS has been completed (CH2M Hill, 1985), inadequate hydrogeologic information was available to assess remediation alternatives. The country rock is primarily rhyolitic material that has been subjected to hydrothermal alteration and sea-floor metamorphism (Reed, 1984) and is highly fractured, resulting in fracture-controlled permeability that is difficult to model quantitatively. Proposals from private industry that promote mine plugging as a long-term remediation alternative have led to further consideration of both historical and recent data on water quality and discharge rates for clues to subsurface geochemical processes and hydrogeologic conditions. A better understanding of these processes and conditions will provide insight into the possible consequences of mine plugging and the necessity for any contingency measures. The EPA will complete a second RI/FS during 1992 for the Boulder Creek operable unit at Iron Mountain, which includes the two most significant discharge points for acid mine drainage in the area--the Richmond and Lawson portals.

The Richmond and Lawson Tunnels are connected by two sets of inclined passageways (fig. 2), which are now partly blocked by "muck" (heterogeneous sulfide, waste rock, and decayed timbers). The source of water and dissolved constituents from the Lawson Tunnel remains unknown because it is presently inaccessible. One possibility is that waters and dissolved constituents in the Lawson Tunnel come exclusively from the overlying Hornet Mine workings. A second possibility is that the Lawson Tunnel receives most of its flow and all its dissolved metals through the inclined passageways and(or) other pathways, including fracture flow from the Richmond Mine workings. In addition, a third possibility is that Lawson Tunnel effluent represents a mixture of drainage from both the Richmond and Hornet Mines.

Plugging of the Richmond Tunnel and the four passageways to the Lawson Tunnel has been proposed by industry as a remediation alternative. If a large proportion of the dissolved metals in the Lawson Tunnel effluent is indeed derived from the Richmond Mine and if this flow can be greatly reduced and perhaps neutralized by treatment in a plugging program, then this alternative could potentially succeed in drastically reducing water treatment costs by reducing metal fluxes from the Lawson portal as well as eliminating all drainage from the Richmond portal. However, if most metals in the Lawson

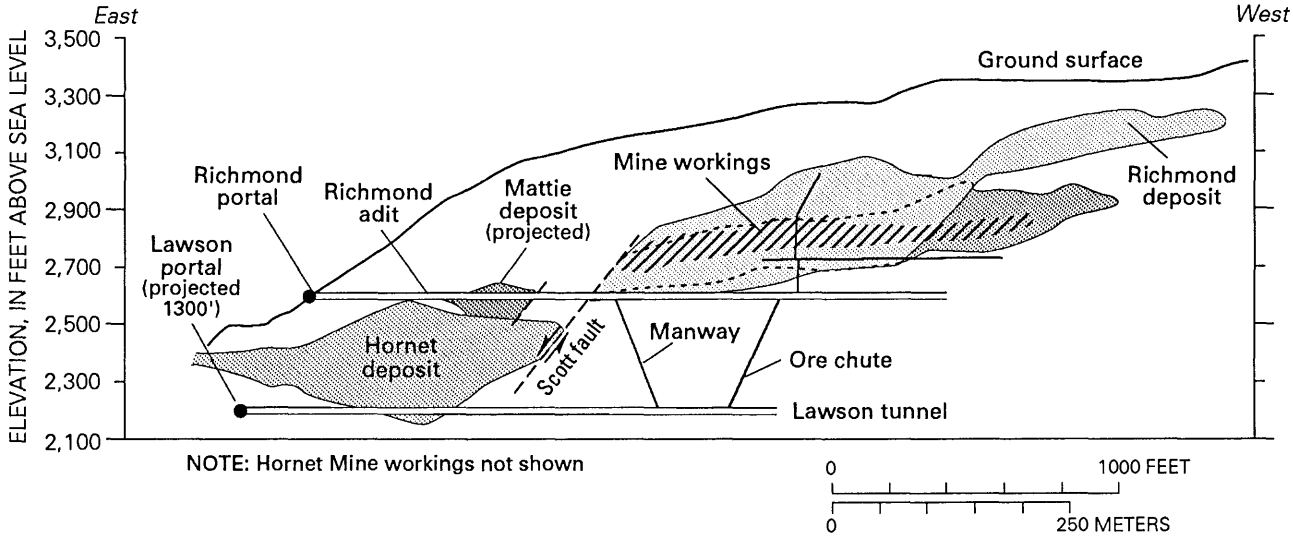

Figure 2. Cross section through Iron Mountain, showing location of Richmond and Hornet deposits, Richmond adit, and Lawson Tunnel.

Tunnel effluent are derived from oxidation of sulfides within the Hornet sulfide deposit, then the proposed plugging measures would have no positive effect on water quality in the Lawson Tunnel effluent and would probably increase its quantity by increasing the hydraulic head in the area. Therefore, the source of metals and acidity in the Lawson Tunnel effluent needs to be identified so that a viable remediation alternative can be selected.

The U.S. Geological Survey has provided technical support to EPA regarding the geochemistry of acid mine drainage at Iron Mountain on a fairly continuous basis since the initial thesis research of Nordstrom (1977). The present report represents a culmination of effort by the USGS over the period 1986-91, during which time several Interagency Agreements between EPA and USGS were made to fund this work.

PURPOSE AND SCOPE

The purpose of this report is to present a compilation and interpretation of historical records of water quality and discharge for the period 1940-91 from the two most significant discharge points for acid mine drainage at Iron Mountain--the Richmond and Lawson portals. The primary objectives are (1) to clarify whether or not there is a hydrologic connection between the Richmond and Lawson Tunnels, and (2) to formulate a conceptual model of subsurface processes that accounts for water-quality and discharge trends with time. Particular attention is focused on explaining the seemingly enigmatic seasonal variations in zinc and copper concentrations with changing discharge from the tunnels, previously described by Nordstrom and others (1990). In the present report, it is proposed that zinc/copper (Zn/Cu) ratios in the mine waters are controlled by alternating periods of precipitation and dissolution of sulfate minerals in the subsurface.

Precipitation data from Shasta Dam were compiled (Appendix A) along with data for metal concentrations, pH, and discharge from the Lawson and Richmond portals (Appendix B). Graphical examination of the data as time-series and correlation plots showed certain similarities and differences between the Lawson and Richmond portal effluents (Appendix C). Geochemical modeling and mass-balance calculations were then used to assess the possibility that some of the metals in the Lawson portal effluent could be derived from the oxidation of sulfides in the Richmond Mine rather than from the more proximal Hornet Mine, and to quantify the amount of possible ground-water mixing between these parts of the hydrogeologic system. The implications of these results are discussed with respect to remedial alternatives at Iron Mountain.

SUMMARY OF SITE CHARACTERISTICS

REMAINING SULFIDES IN THE RICHMOND AND HORNET MINES

Conditions at Iron Mountain seem to be nearly optimal for pyrite oxidation and maximum production of acidic mine waters. The most acidic mine waters that drain from Iron Mountain are carried by the Richmond adit and Lawson Tunnel, and discharge, respectively, at the Richmond and Lawson portals (fig. 2). The Richmond deposit is a well-defined massive sulfide body about 200 ft wide, 150 ft high and one-half mile long. The Richmond and Richmond Extension Mines produced about 3.5 million tons of sulfide ore from a total reserve estimated at about 11.5 million tons, averaging about 1 percent copper and 3 percent zinc, although the assays show a large range of values (Shaffer, 1953).

The Hornet deposit is a part of the Richmond massive sulfide lens, which was down-dropped to the east by movement along the Scott Fault. Another relatively small sulfide body in the area, known as the Mattie deposit, was intersected by the Richmond adit at an elevation of 2,600 ft above sea level (fig. 2). The original combined tonnage of the Hornet and Mattie deposits is estimated to be 3.5 million tons, of which 2.2 million tons were mined prior to 1952, leaving 1.3 million tons of sulfides in these areas (Shaffer, 1953).

CHARACTERISTICS OF RICHMOND MINE AND LAWSON TUNNEL DRAINAGES

Oxidation of sulfides in the Richmond and Richmond Extension Mines produces a drainage effluent whose sulfuric acid concentration seems to be greater than any observed in previously studied effluents anywhere in the world (Nordstrom, 1977; Alpers and Nordstrom, 1991). The Richmond adit

(elevation 2,600 ft above sea level) drains the workings of the Richmond and Richmond Extension Mines (fig. 2). During the period 1983-91, pH values in Richmond adit drainage have ranged from 0.02 to 1.5 (table 1), with typical values between 0.4 and 1.1.

The other main portal producing acidic drainage is at the mouth of the Lawson Tunnel, which underlies both the Richmond and Hornet deposits at an elevation of about 2,200 ft above sea level (fig. 2). Values of pH in Lawson Tunnel effluent have ranged from 0.6 to 2.8 in the period 1983-91, but most commonly were between 1.5 and 2.5. Concentrations of copper, zinc, and cadmium in the Lawson portal effluent are approximately 30 percent of those in the Richmond portal effluent (table 1). Chemical differences between the Richmond and Lawson effluents in terms of Zn/Cu ratio, especially during low flow conditions, are outlined in table 1 and are discussed in the section on "Interpretation of Hydrochemical Data."

Intermittently between 1940 and the present, a "cement copper" plant has been operated along Boulder Creek. Waters from both the Richmond and Lawson portals have been collected in a stainless-steel flume and directed to this plant, where copper has been exchanged chemically with scrap iron.

Appendix B includes a compilation of water-quality data for the combined Richmond and Lawson portal effluents.

FLOW OF GROUND WATER THROUGH THE RICHMOND AND HORNET MINES

Hydrogeologic modeling of ground-water conditions at Iron Mountain was done by CH2M Hill, using the CFEST program (Gupta and others, 1987), and by Roy F. Weston, Inc., using the MODFLOW program (McDonald and Harbaugh, 1988). The results from both modeling efforts are generally similar. They indicate that underground workings of both the Richmond Mine and the Hornet Mine are major sinks for ground water and that substantial quantities of ground water flow into both mines from the sides.

The important point here is that clean ground water is forecast to flow toward the Hornet sulfide deposit without first passing through the Richmond deposit. Hence, some of the water issuing from the Lawson portal must have passed through the bedrock surrounding the Hornet Mine and not through the Richmond Mine by way of partly open manways or ore chutes.

Table 1. Characteristics of Lawson and Richmond portal effluents, 1983-91

[Source of data: See appendix B. gal/min, gallon per minute; mg/L, milligram per liter; --, no data]

	Lawson portal effluent		Richmond portal effluent	
	Mean	Range	Mean	Range
Overall				
Discharge (gal/min)	40	13 - 236	70	8 - 800
pH (units)	1.6	0.6 - 2.8	.8	0.02 - 1.5
Zinc (mg/L)	540	280 - 840	1,600	700 - 2,600
Copper (mg/L)	90	50 - 150	250	120 - 650
Zinc/copper (weight ratio)	6.2	2 - 10	7.5	2 - 13
Wet season				
Discharge (gal/min)	--	40 - 80	--	100 - 200+
Zinc/copper (weight ratio)	--	3 - 6	--	3 - 6
Dry season				
Discharge (gal/min)	--	~ 20	--	~ 10
Zinc/copper (weight ratio)	--	4 - 9	--	8 - 13

INTERPRETATION OF HYDROGEOCHEMICAL DATA

All available historical and recent data on water quality and discharge rates were compiled for the Boulder Creek area to aid in the interpretation of subsurface hydrogeology and hydrogeochemistry at Iron Mountain. The tables of data and corresponding time-series plots are included as appendixes to this report and include (1) daily precipitation data at Kennett and Shasta Dam, 1940-91 (Appendix A, table A1, fig. A1) and a monthly summary (table A2), (2) data for discharge, pH, and copper, zinc, and cadmium concentrations for the Richmond and Lawson portal effluents (Appendix B, tables B1 and B2), (3) data for discharge, and copper, zinc and cadmium concentrations for influent and effluent from the Boulder Creek copper cement plant (Appendix B, table B3), and (4) data for discharge, and copper, zinc, and cadmium concentrations for influent and effluent from an emergency plant that treated the Richmond portal discharge by lime neutralization during the wet seasons of 1989-90 and 1990-91 (Appendix B, table B4). Time-series plots of these data were prepared both for decades and individual years and are given in Appendix C (figs. C1-C94).

HYDROGRAPH CORRELATIONS BETWEEN RICHMOND AND LAWSON PORTAL EFFLUENTS

Graphical comparison of discharge rates from the Richmond portal and those from the Lawson portal based on weekly monitoring data from 1983-91 (fig. 3) indicates a generally positive correlation; however, significant differences between the two portals are apparent. The Richmond portal shows a much larger range in discharge, from 8 to 800 gal/min, whereas the Lawson portal discharge fluctuated only between 15 and 230 gal/min in the same period. Minimum flow rates during dry-season conditions are about twice as high at the Lawson portal as at the Richmond portal, which indicates that the Lawson Tunnel receives a greater component of steady ground-water inflow than the Richmond Mine and is less influenced by rapidly infiltrating surface waters.

In a typical wet season, the Richmond adit responds earlier than the Lawson Tunnel by several weeks with increased discharge after storms. An example of this behavior is the 1986-87 wet season

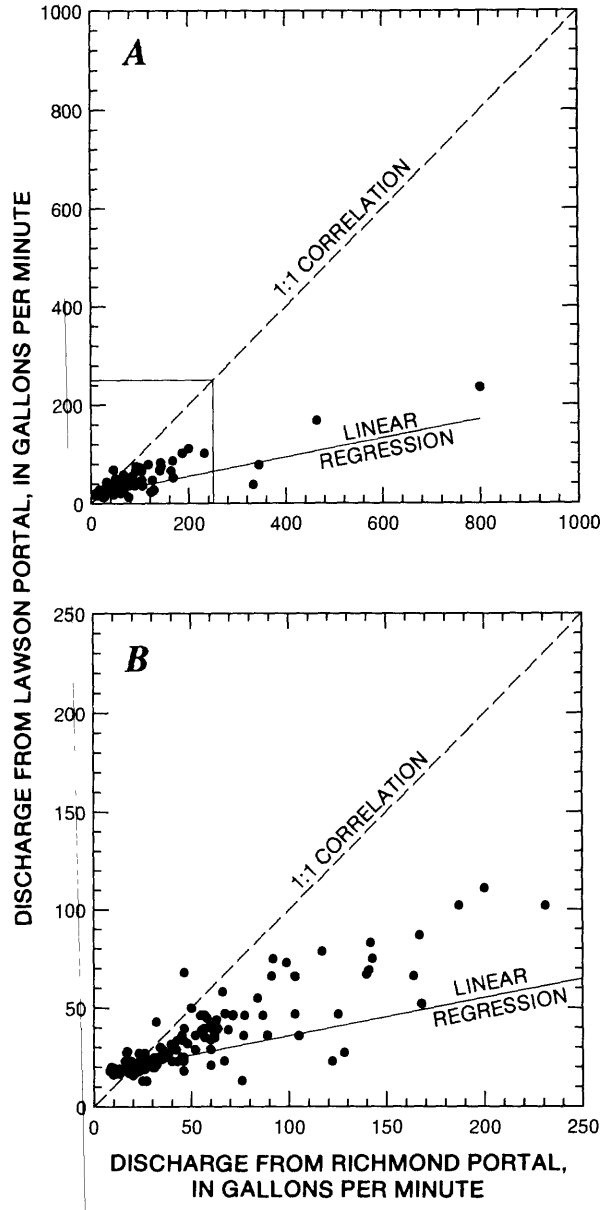

Figure 3. Correlation of discharge from Lawson and Richmond portals, 1983-91. Solid line indicates linear regression: $y=0.19x+16.5$. *A*, All data. *B*, Discharge less than 250 gallons per minute.

(fig. 4). In early- to mid-December 1986, Richmond portal discharge was less than Lawson discharge; however this relation reversed in late December, after storms caused an increase in Richmond portal discharge but had virtually no effect on Lawson portal discharge. Similarly, rainfall during the latter half of

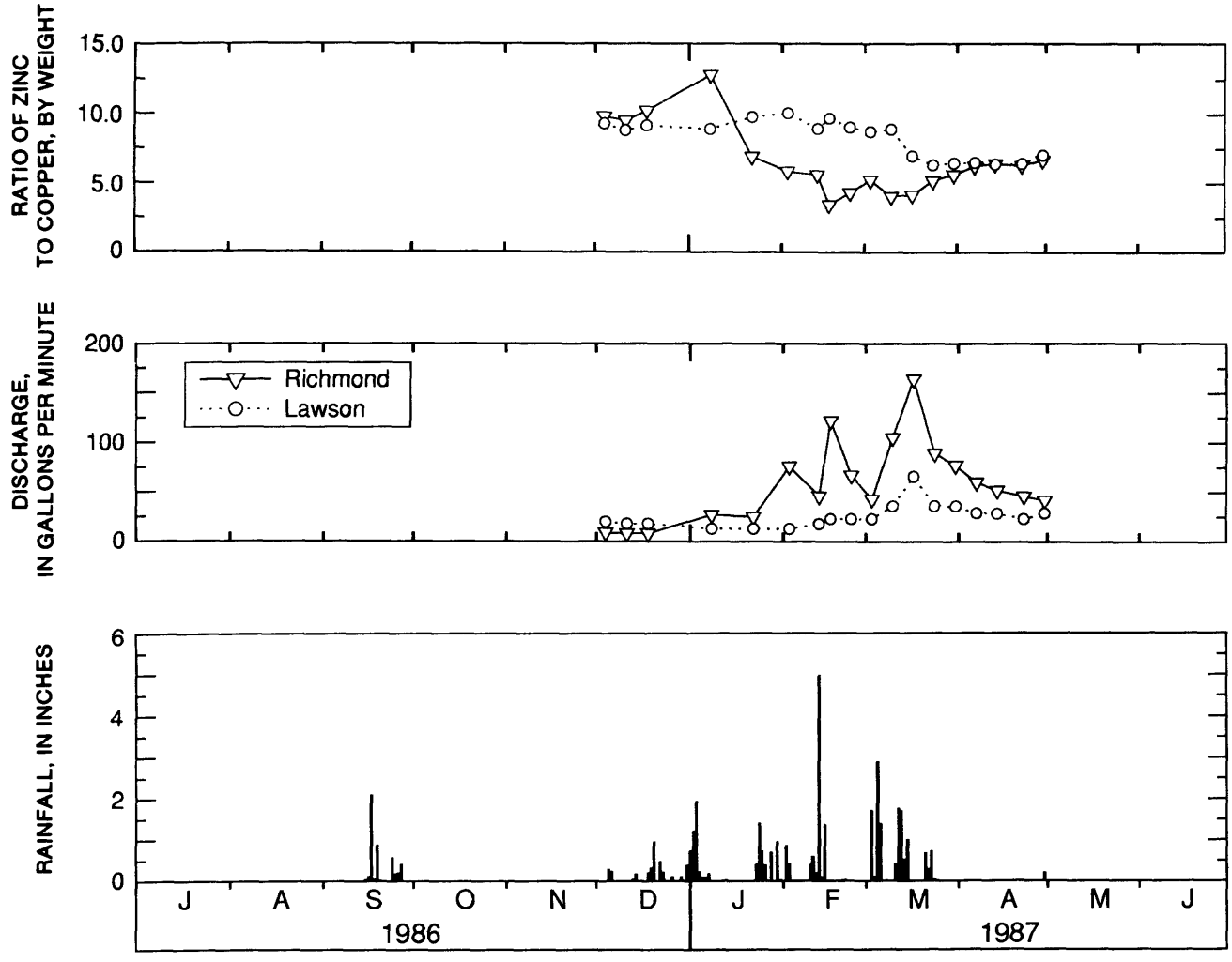

Figure 4. Time-series plot of the ratio of zinc to copper and the discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, July 1986-June 1987.

January and early February caused increased discharge from the Richmond portal and virtually no change in the Lawson portal discharge. In mid-February, immediately after the season's most intense storm, the Lawson discharge finally began to increase, after which the two discharges responded in a parallel manner to the storms in early March.

Although the Richmond adit is located at an elevation about 400 ft above the Lawson Tunnel, the uppermost workings in both the Richmond and Hornet Mines are located within 200 to 300 ft of the present surface (fig. 2), so the differences between the hydrograph response at the two portals cannot be explained simply by the difference in elevation. The differences in response to storms may be due in part to the different mining methods used in the Richmond Mine (underhand stoping and room-and-pillar) as compared with those used in the Hornet Mine (block caving), which resulted in different degrees of fracture, rubblization, and collapse (D. Smith, CH2M Hill, oral commun., 1991). Apparently, the Richmond Mine area has better hydrologic connectivity through open fractures to the surface.

In summary, the steady-state base flow of ground water during dry-season conditions is about twice as high into the Lawson Tunnel as into the Richmond Mine. During the early part of each wet season, only the Richmond adit discharge rate increases in response to storms. Apparently, some degree of saturation must be attained each wet season before rapidly infiltrating surface water can reach the Lawson Tunnel within a few days of a storm.

GEOCHEMICAL CORRELATIONS BETWEEN RICHMOND AND LAWSON PORTAL EFFLUENTS

If there is a direct hydrologic connection between the Richmond mine workings and the Lawson Tunnel, such as an open passageway, and if most of the dissolved metals in the Lawson effluent are derived from the Richmond deposit, then one would expect to see a strong positive correlation between metal concentrations in water samples taken simultaneously from the Richmond and Lawson portals. Concentrations of copper and zinc from the two portals for 1983-91 are plotted in figure 5. These plots show very poor correlations, which indicate that such a direct hydrologic connection is unlikely. Even considering the possibility of a time lag of up to several days or weeks to account for a tortuous flow path between the two sets of mine workings, one would expect better correlations on the plots if a significant proportion of the metals in the Lawson portal effluent were derived from the Richmond mine via a direct hydrologic connection.

Copper concentrations tend to increase sharply with the onset of high-flow conditions in both the Richmond and Lawson portal effluents, whereas zinc and cadmium concentrations tend to decrease (Nordstrom and others, 1990; Crowe, 1990). Zinc and cadmium concentrations correlate very well together throughout all variations in discharge. This correlation is to be expected on the basis of chemical properties and could be used to predict cadmium concentrations for waters with data for zinc only. The generally positive correlation between discharge and concentrations of copper suggests that copper-bearing sulfate salts are dissolved in flushing-out events after prolonged dry periods, whereas zinc concentrations tend to be diluted during the high-flow conditions.

As indicated in table 1, there is a striking difference in the Zn/Cu ratios of Richmond and Lawson portal effluents under low-flow conditions; however, during high flow less distinction between the ratios is apparent. This relation is illustrated graphically in figure 6, a plot of Zn/Cu ratio and discharge for both Richmond and Lawson effluents during 1983-91. At low-flow conditions (for example, less than 50 gal/min) the Lawson portal effluent had Zn/Cu values from 3 to 10 with most values from 5 to 8, whereas the Richmond portal

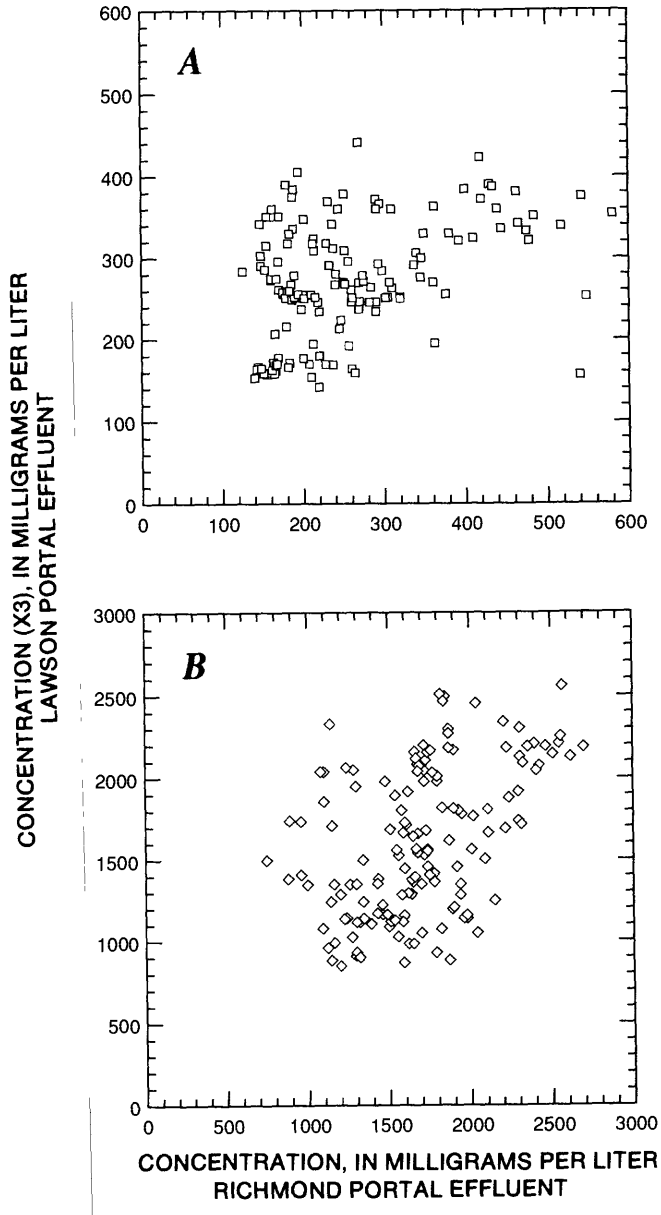

Figure 5. Copper and zinc concentrations of Richmond and Lawson portal effluents, 1983-91. *A*, Copper. *B*, Zinc.

effluent had Zn/Cu ranging from 4 to 13 with most values from 7 to 12. In contrast, at high-flow conditions, both effluents had Zn/Cu in the range of 2 to 6, with most values between 3 and 5; nevertheless, the Lawson Zn/Cu ratios remain somewhat lower than those for the Richmond effluent even at the highest discharge rates (fig. 6).

The differences in Zn/Cu ratio between the Richmond and Lawson effluents provide a strong indication that the two tunnels drain different parts of the mine workings. A straightforward explanation for the difference is a variation in the bulk Zn/Cu ratio of the original sulfide ore. This explanation is consistent with the limited amount of available data on metal zoning within the Richmond and Hornet deposits. The Richmond Extension is known as a zinc-rich part of the mining district, and the Hornet and adjacent Mattie ore bodies are relatively copper-rich (Shaffer, 1953). More quantitative information on ore reserves and production figures from individual stopes within these mines is not available. Nevertheless, from what is known about sulfide zoning in other massive sulfide deposits (for example, Ohmoto and others, 1983) primary sulfide zoning is a likely explanation for the difference in Zn/Cu ratio between Richmond and Lawson effluents during low-flow conditions.

Additional insight is gained into the systematic covariation of zinc and copper by examining a plot of the weight ratio of Zn/Cu in the Lawson effluent as compared with that of Zn/Cu in the Richmond effluent (fig. 7). As with the absolute values of zinc and copper concentration (fig. 5), a nearly perfect positive correlation on this type of plot would be expected if all the metals in the Lawson effluent were derived by dilution of Richmond Mine water that had leaked down to the Lawson Tunnel. Rather than a simple linear correlation, figure 7 shows a more complex, arcuate cluster of data, with numerous outlying points. Examination of the data on an annual basis for the years 1983-91 (fig. 8) reveals a systematic counterclockwise movement with time during several of the most recent wet-season cycles. For example, in 1984-85, the Richmond Zn/Cu ratio dropped dramatically during November while the Lawson value was unchanged, causing movement to the left (fig. 8*B*). This behavior is consistent with hydrographs (fig. 9), which show a delayed response by the Lawson Tunnel effluent to the precipitation in early November 1984. By mid-November, the Lawson effluent had begun to respond and the Lawson Zn/Cu ratio dropped, though not as dramatically as the previous drop in the Richmond Zn/Cu ratio. By mid-December, Zn/Cu in the two effluents was approximately equal. A similar counterclockwise pattern is evident for each of the years from 1985-86 through 1988-89. The data for 1983-84 were collected too late in the water year to

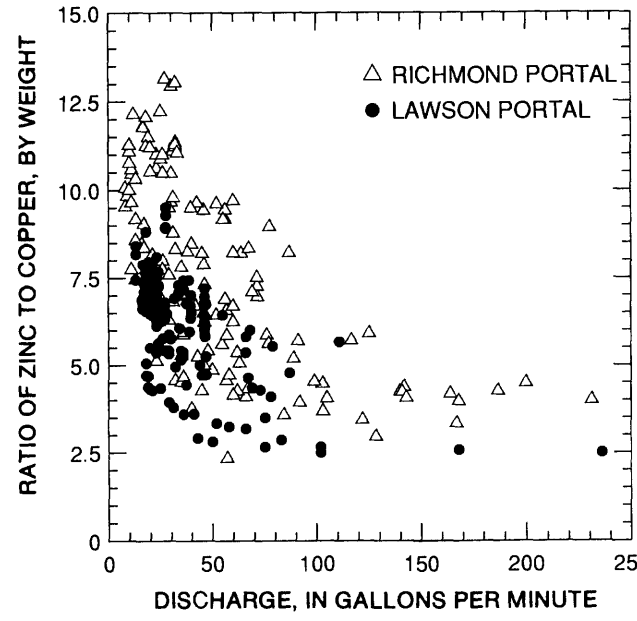

Figure 6. Concentration ratios of zinc to copper as a function of discharge, Richmond and Lawson portal effluents, 1983-91.

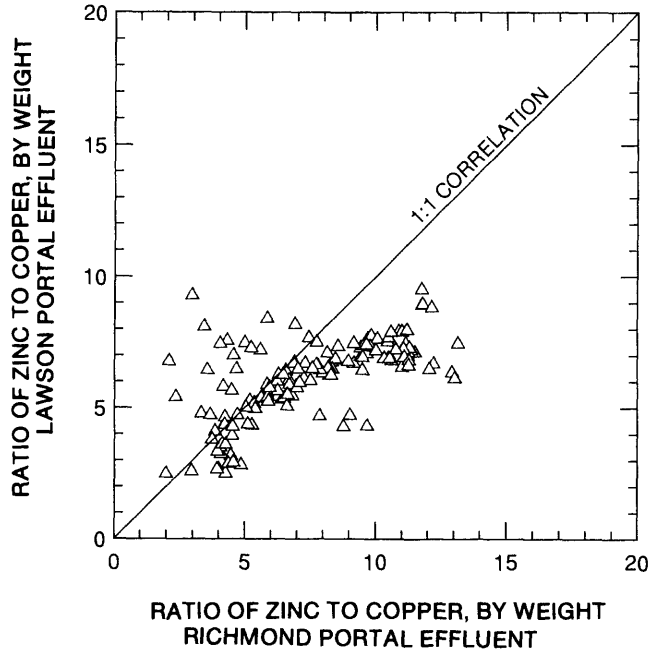

Figure 7. Concentration ratios of zinc to copper in effluent from the Richmond portal compared to that of the Lawson portal, 1983-91.

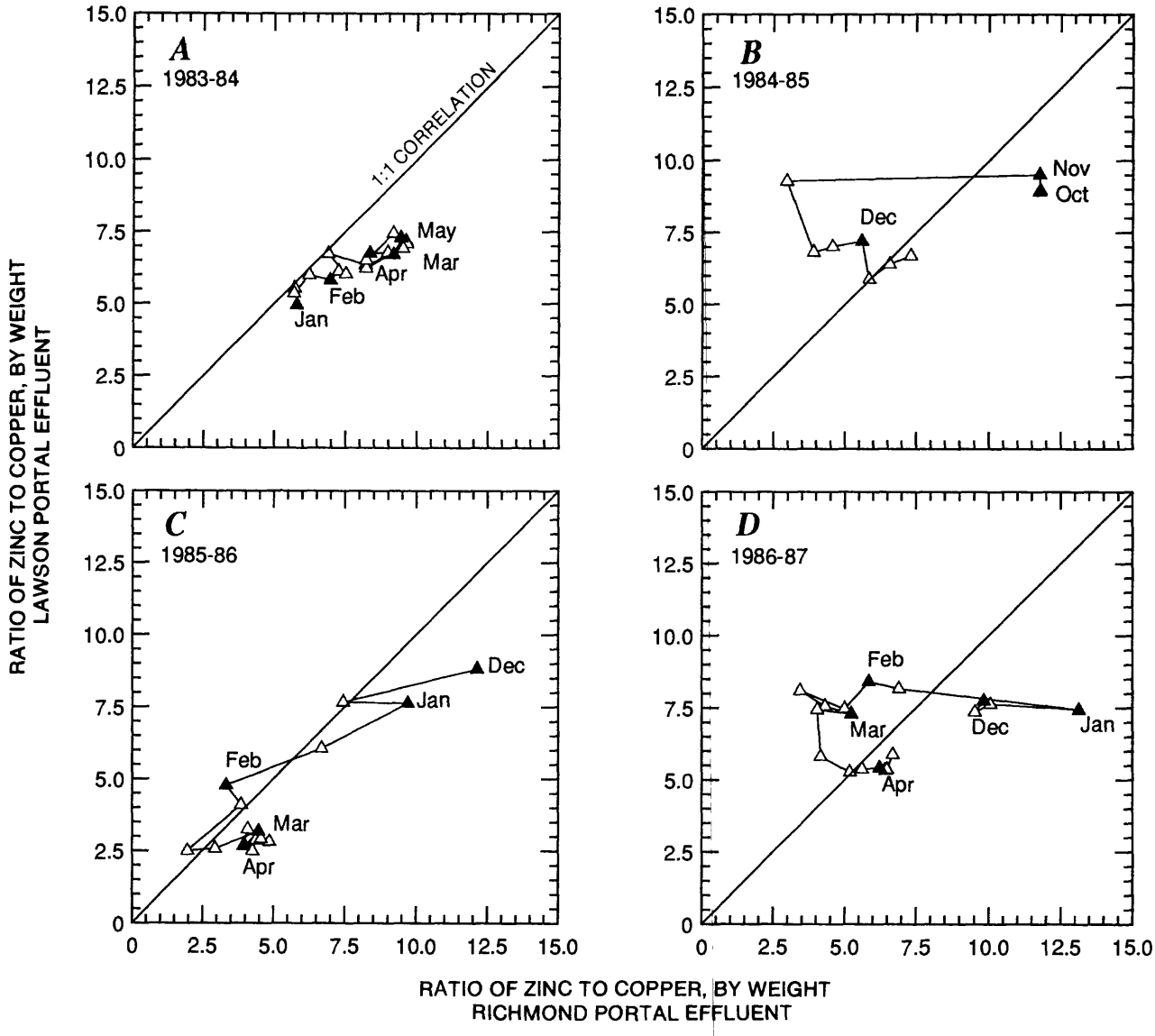

Figure 8. Concentration ratios of zinc to copper in effluent from the Richmond portal compared to that of the Lawson portal, by year, 1983-91. *A*, 1983-84. *B*, 1984-85. *C*, 1985-86. *D*, 1986-87. *E*, 1987-88. *F*, 1988-89. *G*, 1989-90. *H*, 1990-91. Solid symbol indicates first data point of each month. Solid line connects data points in chronological order.

record the full cyclic pattern. Zn/Cu data for 1989-90 and 1990-91 seem to be more complicated; however, it must be kept in mind that these years had total precipitation much below the annual average for the area and may not be typical. Possible influence of the partial capping work completed in 1988 and the underground renovations in the Richmond Mine completed in 1990 may also be a factor. Data from a more typical wet season would be required to clarify whether or not this work has caused a fundamental change in the mine hydrology and hydrogeochemistry.

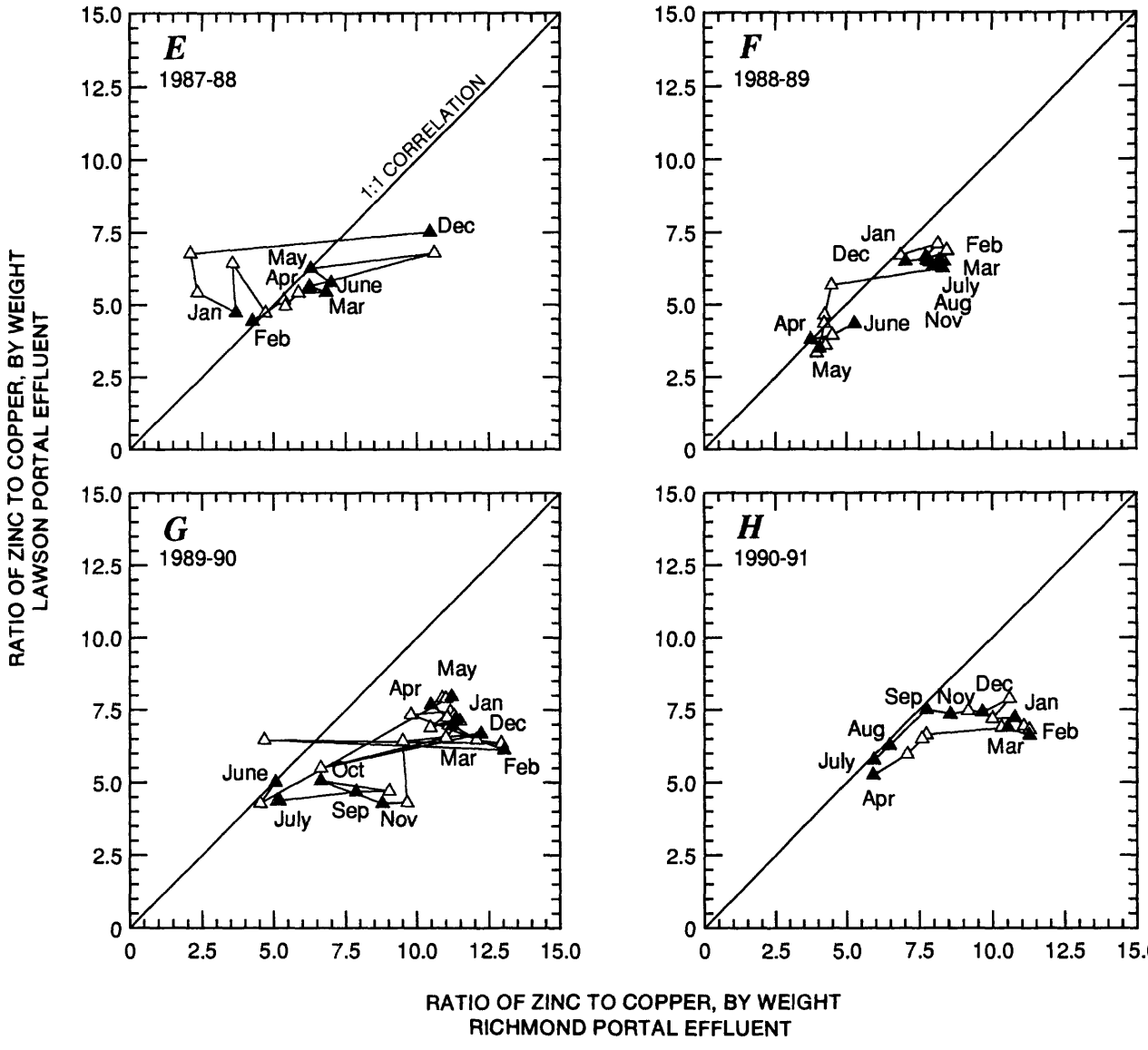

Figure 8. Continued.

A possible mechanism to explain these variations in Zn/Cu ratios involves the precipitation and dissolution of Fe-Zn-Cu-bearing sulfate salts. The salts tend to form during drying-out periods or low-flow conditions, and then dissolve rapidly during flushing-out episodes after large storms. For this mechanism to explain the observed variations in effluent Zn/Cu ratios, the precipitated salts must have a lower Zn/Cu ratio than the mine waters from which they form. Thus, copper must be preferentially removed from the water compared to zinc during salt formation, causing the Zn/Cu ratio of the water to rise during the drying-out periods. Flushing during high-flow conditions dissolves the sulfate salts, which then have a large influence on the chemistry of the mine water. In several cases, copper concentrations

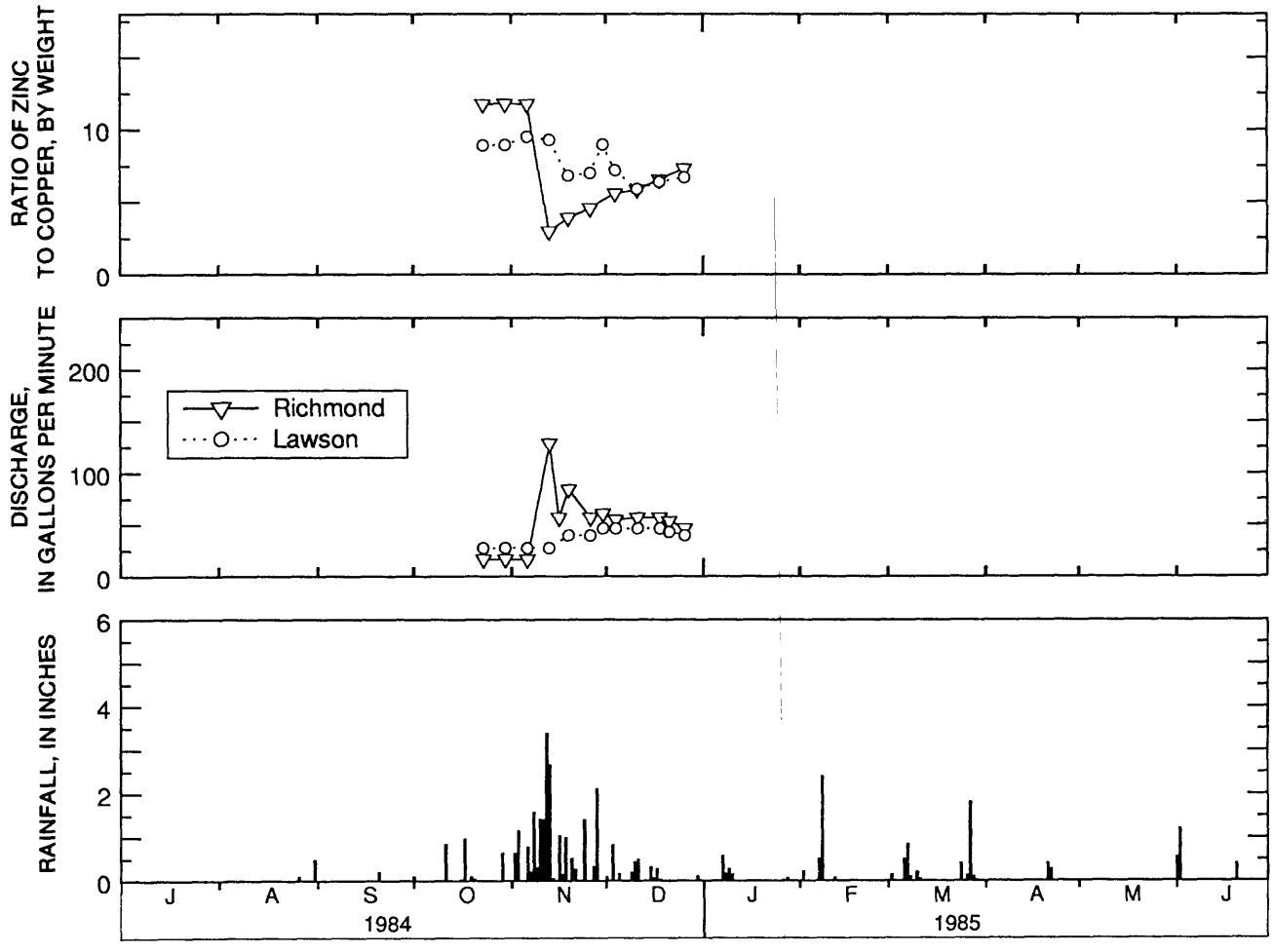

Figure 9. Time-series plot of the ratio of zinc to copper and the discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, July 1984-June 1985.

have actually increased during flushing while zinc concentrations decreased, causing a dramatic decrease in the Zn/Cu ratio (figs. 4, 9; see Appendix C, figs. C55-C58 and C63-C66).

A mineral commonly found in the accessible part of the Richmond Mine, which meets the requirement of having a lower Zn/Cu ratio than the mine water from which it forms, is melanterite. Pure melanterite ($Fe^{II}SO_4 \cdot 7H_2O$) incorporates Cu^{II} and Zn^{II} as solid-solution components in substitution for Fe^{II}. One sample of melanterite taken from a large, actively forming stalactite in B-drift, 2,600-foot level, Richmond Mine, had the molar composition $Fe_{0.945}Zn_{0.036}Cu_{0.019}SO_4 \cdot 7H_2O$, corresponding to a Zn/Cu weight ratio of 2.0. This zinc-copper-melanterite was forming from a mine water with a Zn/Cu weight ratio of 3.3, so it can be seen that copper was incorporated preferentially to zinc into the solid phase. Work is in progress to determine the Zn/Cu ratio in other Fe^{II}-bearing sulfates that were found in samples from the Richmond Mine, such as römerite [$Fe^{II}Fe^{III}_2(SO_4)_4 \cdot 14H_2O$], voltaite [$K_2Fe^{II}_5Fe^{III}_4(SO_4)_{12} \cdot 18H_2O$], and halotrichite [$Fe^{II}Al_2(SO_4) \cdot 22H_2O$]. Melanterite is probably the

most abundant sulfate formed in the Richmond Mine in the inaccessible workings above the 2,650-foot level, because this mineral is the first to form when the Fe^{II}-rich Richmond effluent is evaporated (Alpers and others, 1991).

Therefore, it is an entirely plausible hypothesis that formation and dissolution of zinc-copper-melanterite can account for the observed cyclic variations in Zn/Cu ratios in the Richmond adit and Lawson Tunnel effluents. Although relatively pure sulfates of copper (chalcanthite) and zinc (goslarite) have been found in samples from the 2,600-foot level of the Richmond Mine (C. N. Alpers and R.C. Erd, U.S. Geological Survey, unpub. data) they are volumetrically minor. It is likely that melanterite and other iron-rich sulfate solid solutions represent the predominant forms of copper and zinc available for dissolution. Therefore, it is probably the formation and dissolution of the iron-rich sulfate minerals that control the concentrations of copper and zinc in the effluents.

MASS-BALANCE CALCULATIONS

Three possibilities for explaining the origin of dissolved constituents in the Lawson portal effluent are (1) all dissolved constituents including metals and acidity are derived from oxidation of sulfides and dissolution of silicates within the Hornet mine workings and adjacent country rocks; (2) all dissolved metals and acidity are derived from oxidation of sulfides in the workings of the Richmond and Richmond Extension Mines and these waters then mix with extremely dilute waters to produce the Lawson portal effluent; (3) a combination of 1 and 2 in which Richmond Mine water mixes in some proportion with water that has previously interacted with sulfides and silicates in the Hornet Mine.

In this section, the three possible origins of Lawson portal effluent are evaluated by mass-balance calculations. Samples of Lawson and Richmond portal effluent collected September 20, 1990, were used for the mass-balance analysis. Compositional data for these water samples are given in table 2. Charge balance was achieved within 4 percent using program PHREEQE (Parkhurst and others, 1980) by adjusting sulfate concentrations. Molalities were computed using program WATEQ4F (Ball and others, 1987).

Straightforward mass-balance calculations were made using program BALANCE (Parkhurst and others, 1982) to determine the proportion of minerals required to be dissolved and(or) precipitated to account for the composition of Richmond portal effluent and Lawson portal effluent. The BALANCE program is designed to help deduce mineral-water reactions that occur between two water samples along a flow path. For this study, the starting water composition was assumed to be that of rainwater. Because the dissolved concentrations in the mine waters are extremely high, concentrations in rainwater values are virtually insignificant. Thus, the effluent compositions were taken as equal to the delta, or "final-initial," value for the purpose of the BALANCE calculation. The minerals considered as possible reactants and products are given in table 3. Additionally, CO_2 and O_2 gas were included as potential reactants or products. Other examples of this modeling approach were described by Alpers and Nordstrom (1990, 1991).

Results of the separate mass-balance calculations are given in table 4. For the Richmond effluent, two possible solutions (R1 and R2) were found. The two Richmond solutions differ from each other primarily in the source of calcium as either epidote or calcite. In both models, similar proportions of pyrite, sphalerite, and chalcopyrite are oxidized to produce the observed iron, zinc, and copper in solution, less a significant amount of iron (0.70 of 1.07 moles) which is retained as a melanterite precipitate. Albite, chlorite, and sericite also dissolve to produce the observed concentrations of sodium, aluminum, magnesium, and potassium. Some of the released silica is reprecipitated, probably in the form of amorphous silica in the country rock.

Table 2. Composition of Lawson and Richmond portal effluents

[Molality values computed using program WATEQ4F (Ball and others, 1987) and used as input to program BALANCE (Parkhurst and others, 1982). °C, degree Celsius; --, no data]

	Lawson portal effluent		Richmond portal effluent	
	Milligrams per liter[1]	Molality	Milligrams per liter[1]	Molality
Iron (total)	6,940	0.1287	18,600	0.3904
Copper	92.5	.00151	290	.00535
Zinc	653	.0103	2,060	.0369
Sodium	80.4	.00362	255	.0130
Potassium	88.3	.00234	281	.00842
Calcium	233	.00602	183	.00535
Magnesuim	681	.0290	850	.0410
Aiumunim	1,180	.0453	2,320	.1008
Silica	110	.00190	165	.00322
Sulfate	29,600		108,000	
Sulfate (adjusted)[2]	24,200	.2608	121,790	1.486
Redox State[3]	--	1.842	--	10.183
pH (units)	2.5		0.4	
Temperature (°C)	[4]28		28	

[1]Analytical data from U.S. Environmental Protection Agency for samples taken September 20, 1990 (unpublished data).

[2]Sulfate value adjusted to achieve charge balance using program PHREEQE (Parkhurst and others, 1980).

[3]Redox State (RS) parameter required by program BALANCE.

$RS = 6\ m_{SO4} + 2\ m_{Fe(II)} + 3\ m_{Fe(III)}$. Speciation of iron computed by program WATEQ4F assuming Eh based on measured values of Fe(II) and Fe(Total) from a Richmond portal sample taken September 11, 1990, and from an average of 22 samples from the Lawson portal effluent taken from December 1983 through May 1984.

[4]Temperature value assumed for Lawson portal effluent.

Results for the Lawson effluent are similar (table 4). Three possible solutions were found (L1, L2, and L3), which differ from each other primarily in the sources and sinks of calcium and aluminum. Solution L1 is probably not viable because the pH of Lawson effluent is too low to produce kaolinite as the BALANCE model predicts. It is important to stress that these solutions are based solely on mineral stoichiometry and water compositions and not on any thermodynamic or solubility constraints. Comparison of the mineral saturation indices from aqueous speciation calculations, using a program such as WATEQ4F (Ball and others, 1987, Ball and Nordstrom, 1991) can provide a thermodynamic check on the viability of a given BALANCE model. All phases indicated in table 4 as dissolving are indeed undersaturated in both the Lawson and Richmond portal effluents considered, and silica and melanterite are near to saturation, so both solutions L2 and L3 represent reasonable possibilities for explaining the overall reactions that produced the Lawson portal effluent.

Table 3. Composition of minerals considered in mass-balance computations

[References: **1**, Kinkel and others (1956); **2**, Reed (1984)]

Mineral	Formula	References
albite	$Na_{0.96}Ca_{0.04}Al_{1.04}Si_{2.96}O_8$	**1**
sericite	$K_{0.70}Na_{0.12}(H_3O)_{0.16}Al_{1.91}Mg_{0.06}Fe^{II}_{0.02}(Al_{0.9}Si_{3.1})O_{10}(OH)_2$	**2**
kaolinite	$Al_2Si_2O_5(OH)_4$	
epidote	$Ca_{1.96}Fe^{II}_{0.88}Mg_{0.05}Al_{2.05}Si_{3.04}O_{12}(OH)$	**2**
chlorite	$Mg_{2.95}Fe^{II}_{0.88}Al_{Oct1.82}Al_{tet0.81}Si_{2.82}O_{10}(OH)_8$	**2**
quartz	SiO_2	
calcite	$CaCO_3$	
pyrite	FeS_2	
chalcopyrite	$CuFeS_2$	
sphalerite	$Zn_{0.933}Fe_{0.062}Cu_{0.005}S$	**2**
melanterite	$Fe^{II}SO_4 \cdot 7H_2O$	

Hypothesis 2, that all metals in the Lawson effluent are derived from the Richmond Mine, is unreasonable because there are no possible solutions to this version of the mass-balance problem. That is, there is no way to start with Richmond portal effluent and to come up with Lawson portal effluent simply by dilution and non-sulfide mineral dissolution and precipitation reactions.

Hypothesis 3, that some mixing of Richmond mine water and Hornet mine water occurs in the Lawson Tunnel, was evaluated using the mixing feature of the BALANCE program. Results of the mixing computations are given in table 5. Six possible solutions were found; however, only the first three (M1, M2, and M3) are reasonable. Solutions M4, M5, and M6 have two flaws: (1) sphalerite and chalcopyrite were oxidized but pyrite was not, and (2) melanterite is dissolved, not precipitated, despite the fact that the sampling was done in September 1990 during an extreme low-flow condition.

Therefore, the results from solutions M1, M2, and M3 (table 5) are left. These results indicate that only about 2 percent of the Lawson effluent can be made up of Richmond mine water, and the other 98 percent must come from water affected by additional sulfide oxidation and silicate dissolution reactions, most likely to be taking place in the Hornet Mine area. Because the Richmond mine waters are about three times more concentrated than the Lawson effluent, the 2 percent contribution by volume may represent as much as 6 percent of the dissolved metals. Therefore, during low-flow conditions, the production of acidic mine drainage from the Hornet ore body far outweighs any leakage contribution from the Richmond Mine.

Table 4. Results of separate mass-balance computations for Lawson and Richmond portal effluents

[Computations made using program BALANCE (Parkhurst and others, 1982); input data for water compositions in table 2. **Phase**: Phase compositions in table 3. **Forcing**: "+" denotes dissolution/in-gassing only; "-" denotes precipitation/out-gassing only; no symbol allows either. **Mass transfer**: Positive coefficient denotes dissolution/in-gassing; negative coefficient denotes precipitation/out-gassing. moles/kg, moles per kilogram; --, no data]

Lawson portal effluent				
		Mass transfer (moles/kg H_2O of Lawson effluent)		
Phase	Forcing	Solution L1	Solution L2	Solution L3
albite	+	0.0034	0.0034	0.0034
epidote	+	.0030	.0016	--
kaolinite		-.0014	--	.0016
chlorite	+	.0097	.0097	.0098
sericite	+	.0033	.0033	.0033
pyrite	+	.1315	.1303	.1289
chalcopyrite	+	.0015	.0015	.0015
sphalerite	+	.0111	.0111	.0111
melanterite	+	-.0162	-.0137	-.0110
O_2 gas		.4918	.4878	.4834
silica		-.0520	-.0506	-.0490
calcite	+	--	.0028	.0059
CO_2 gas		--	-.0028	-.0059
13 models were tested				
3 models were found which satisfied the constraints				

Richmond portal effluent			
		Mass transfer (moles/kg H_2O of Richmond effluent)	
Phase	Forcing	Solution R1	Solution R2
albite	+	0.0120	0.0120
epidote	+	.0024	--
kaolinite		.0043	.0068
chlorite	+	.0136	.0137
sericite	+	.0120	.0120
pyrite	+	1.0677	1.0656
chalcopyrite	+	.0052	.0052
sphalerite	+	.0395	.0395
melanterite	+	-.6992	-.6950
O_2 gas		3.8337	3.8269
silica		-.1241	-.1217
calcite	+	--	.0047
CO_2 gas		--	-.0047
13 models were tested			
2 models were found which satisfied the constraints			

Table 5. Results of mass-balance mixing computations

[Computations made using program BALANCE (Parkhurst and others, 1982); Lawson portal effluent composition was derived from mixing of Richmond portal effluent with dilute water, accompanied by mineral-water reactions. **Phase**: Solid and gas phase compositions in table 3. Aqueous phase compositions in table 2. RICHMOND = Richmond portal effluent, September 20, 1991; DILUTION = Hypothetical diluting solution with arbitrarily low aqueous concentrations of 10^{-6} molal for each element considered. **Forcing**: "+" denotes dissolution/in-gassing only; "-" denotes precipitation/out-gassing only; no symbol allows either. "F" indicates that phase was forced to be in each model tested. **Mass transfer**: Positive coefficient denotes dissolution/in-gassing; negative coefficient denotes precipitation/out-gassing. moles/kg, moles per kilogram; --, no data]

		Solutions					
Phase	Forcing	M1	M2	M3	M4	M5	M6
		Mixing proportions					
RICHMOND	+ F	0.0158	0.0194	0.0231	0.1210	0.1216	0.1232
DILUTION	+ F	.9842	.9806	.9769	.8790	.8784	.8768
		Mass transfer (moles/kg H_2O of Lawson effluent)					
albite	+	0.0032	0.0031	0.0031	0.0019	0.0019	0.0019
epidote	+	--	.0014	.0029	--	.0007	.0027
kaolinite		.0015	--	-.0015	.0007	--	-.0020
chlorite	+	.0095	.0095	.0094	.0081	.0081	.0080
sericite	+	.0031	.0031	.0031	.0019	.0019	
pyrite	+	.1120	.1095	.1068	--	--	--
chalcopyrite	+	.0014	.0014	.0013	.0008	.0008	.0008
sphalerite	+	.0105	.0103	.0102	.0063	.0063	.0062
melanterite	+	--	--	--	.0731	.0722	.0699
O_2 gas		.4228	.4132	.4031	.0205	.0202	.0197
silica		-.0471	-.0481	-.0491	-.0343	-.0350	-.0367
calcite	+	.0058	.0030	--	.0053	.0038	--
CO_2 gas		-.0058	-.0030	--	-.0053	-.0038	--
		78 models were tested					
		6 models were found which satisfied the constraints					

CONCLUSIONS

Five factors lead to the conclusion that there is major production of acidic mine drainage from the Hornet Mine appearing in the Lawson Tunnel effluents:

1. Approximately one million tons of pyritic sulfide still remains in the Hornet Mine area on the basis of production and reserve estimates.

2. Three-dimensional computer models of groundwater flow indicate significant inflows of ground water along the sides of the Hornet Mine.

3. Hydrograph records of Richmond adit and Lawson Tunnel discharges show inadequate correlation to indicate any significant hydrologic connection.

4. Geochemical correlations between Lawson and Richmond portal effluents are poor for individual metals such as copper and zinc. The Zn/Cu ratio is correlated somewhat, but has a lag time of as much as several weeks at the beginning of each wet season. During the early part of the wet season, the Richmond adit responds to rapid infiltration of surface water with increased discharge and a sharp decrease in

Zn/Cu ratio. The Lawson portal effluent tends to respond several weeks later in a similar manner, but with less amplitude (that is, a damped signal), because of the higher proportion of base-level flow into the Lawson Tunnel.

5. Mass-balance considerations preclude the possibility that simple flow from the Richmond Mine is diluted with clean ground water to produce the Lawson portal effluent composition during low-flow conditions. Even allowing for additional geochemical reactions, the contribution of flow from the Richmond Mine directly to the Lawson Tunnel cannot be more than 2 percent by volume during low-flow conditions.

Any remediation alternatives in the Boulder Creek Operable Unit at Iron Mountain have to consider the Hornet Mine area to be producing its own acid mine drainage, which drains out the Lawson portal, independent of the acidic drainage from the Richmond Mine hydrogeologic system, which drains out the Richmond portal.

REFERENCES CITED

Alpers, C.N., Maenz, C., Nordstrom, D.K., Erd, R.C., and Thompson, J.M., 1991, Storage of metals and acidity by iron-sulfate minerals associated with extremely acidic mine waters, Iron Mountain, California: Geological Society of America, Abstracts with Programs, v. 23, no. 5, p. A382.

Alpers, C.N., and Nordstrom, D.K., 1990, Stoichiometry of mineral reactions from mass-balance computations of acid mine waters, Iron Mountain, California, *in* Gadsby, J.W. and others, eds., Acid Mine Drainage--Designing for Closure: Vancouver, Bi-Tech Publishers Ltd., p. 23-33.

_____1991, The geochemical evolution of extremely acid mine waters at Iron Mountain, California: Are there any lower limits to pH?: International Symposium on the Abatement of Acidic Drainage, 2d, Montréal, September 16-18, 1991, Proceedings, v. 2, p. 321-342.

Ball, J.W., and Nordstrom, D.K., 1991, User's manual for WATEQ4F, with revised thermodynamic data base and test cases for calculating speciation of major, trace, and redox elements in natural waters: U.S. Geological Survey Open-File Report 91-183, 189 p.

Ball, J.W., Nordstrom, D.K., and Zachmann, D.W., 1987, WATEQ4F--A personal computer translation of the geochemical model WATEQ2 with revised data base: U.S. Geological Survey Open-File Report 87-50, 108 p.

Biggs, F.R., 1991, Remediation progress at the Iron Mountain Superfund site, California: U.S. Bureau of Mines Information Circular IC-9289, 15 p.

CH2M Hill, 1985, Final remedial investigation report, Iron Mountain Mine, near Redding, California: U.S. Environmental Protection Agency, EPA 48.9L17.0, 319 p.

Crowe, C.N., 1990, Hydrologic and hydrogeologic factors controlling acid mine drainage at Iron Mountain Mine, Shasta County, California: Chico, California State University, unpub. M.S. thesis, 133 p.

Gupta, S.K., Cole, C.R., Kincaid, C.T., and Monti, A.M., 1987, Coupled fluid, energy, and solute transport (CFEST) model: Formulation and user's manual: Columbus, Ohio, Office of Nuclear Waste Isolation, Batelle Memorial Institute, Report BMI/ONW 1-660.

Kinkel, A.R., Jr., Hall, W.E., and Albers, J.P., 1956, Geology and base-metal deposits of the West Shasta copper-zinc district: U.S. Geological Survey Professional Paper 285, 156 p.

McDonald, M.G., and Harbaugh, A.W., 1988, A modular, three-dimensional finite-difference ground-water flow model: U.S. Geological Survey Techniques of Water-Resources Investigations, book 6, chap. A1, 586 p.

Muniz, I.P., and Leivestad, H., 1980, Acidification--Effects on freshwater fish, *in* Drabløs, D., and Tollan, A., eds., Ecological Impact of Acid Precipitation, Oslo, Norway, S.N.S.F. Proceedings, p. 84-92.

Nordstrom, D.K., 1977, Hydrogeochemical and microbiological factors affecting the heavy metal chemistry of an acid mine drainage system: Stanford, California, Stanford University, unpub. Ph.D. dissertation, 210 p.

Nordstrom, D.K., Burchard, J.M., and Alpers, C.N., 1990, Production and seasonal variability of acid mine drainage from Iron Mountain, California: A Superfund site undergoing rehabilitation, *in* Gadsby, J.W. and others, eds., Acid Mine Drainage--Designing for Closure: Vancouver, Bi-Tech Publishers Ltd., p. 13-21.

Nordstrom, D.K., Jenne, E.A., and Averett, R.C., 1977, Heavy metal discharges into Shasta Lake and Keswick Reservoirs on the upper Sacramento River, California: A reconnaissance during low flow: U.S. Geological Survey Open-File Report 76-49, 25 p.

Ohmoto, H., Mizukami, M., Drummond, S.E., Eldridge, C.S., Pisutha-Arnold, V., and Lenagh, T.C., 1983, Chemical processes of Kuroko formation, *in* Ohmoto, H. and Skinner, B.J., eds., The Kuroko and Related Volcanogenic Massive Sulfide Deposits: Economic Geology Monograph 5, p. 570-604.

Parkhurst, D.L., Plummer, L.N., and Thorstenson, D.C., 1982, BALANCE--A computer program for calculating mass transfer for geochemical reactions in ground water: U.S. Geological Survey Water-Resources Investigations Report 82-14, 29 p.

Parkhurst, D.L., Thorstenson, D.C., and Plummer, L.N., 1980, PHREEQE--A computer program for geochemical calculations: U.S. Geological Survey Water-Resources Investigations Report 80-96, 193 p. (Revised January 1985.)

Reed, M.H., 1984, Geology, wall-rock alteration, and massive sulfide mineralization in a portion of the West Shasta district, California: Economic Geology v. 79, p. 1299-1318.

Shaffer, L.E., 1953, Underground and surface reserves of the Mountain Copper Company, Ltd., at Matheson and Martinez, California: Unpublished memorandum from Southwestern Engineering Co. to Mountain Copper Co., January 1953, 11 p.

APPENDIX A

PRECIPITATION DATA AT SHASTA DAM AND NEARBY LOCALITIES

Sources of Precipitation Data

Shasta Dam

The precipitation data compiled in this report (table A1) are primarily from measurements recorded at Shasta Dam, Shasta County, California, at an elevation of 1,075 ft. above sea level. The gage at Shasta Dam is located at latitude 40°42'53" N, longitude 122°24'54" W.

Data have been collected at the Shasta Dam site since 1939, but are considered to be "consistent" only after Lake Shasta had filled in 1945 and weather patterns had stabilized. Published data for Shasta Dam begins in January 1944.

The U.S. Bureau of Reclamation (USBR), which operates Shasta Dam, has maintained daily operations sheets for the Central Valley Project since September 1957, and has tabulated monthly totals since 1945. The USBR sends the daily operations sheets to the U.S. National Weather Bureau for inclusion in monthly publications of Climatological Data, organized by State. The manually kept daily operations sheets are accompanied by tapes from the automatic rain gages.

The library of the U.S. Geological Survey has in its collection the monthly reports of Climatological Data for California since 1900. These reports were originally published by the U.S. Department of Agriculture; since July 1940, they have been published by the U.S. Department of Commerce.

Kennett

The town of Kennett is located north of Redding and east of the present Shasta Dam. Precipitation was measured each morning, for the preceding 24 hours at an elevation of 778 feet above sea level.

Data from Kennett was listed as "supplemental precipitation" in monthly reports of Climatological Data since 1907. The final report from Kennett was in January, 1943.

Description of tables and figures in appendix A

Table A1 includes daily precipitation data, in inches, from the Kennett station for 1940-42 and from the Shasta Dam station for the period from January 1, 1944, through April 11, 1991. No data are available for 1943 from either station. Data missing in the monthly publications are marked "M" on table A1. This designation indicates that the report failed to arrive by publication time, so these data should be found in the corresponding annual report. Other symbols in table A1 include: "R" to designate a recording gage as opposed to a manual measurement, as both were reported for the first few years of operation; and "*" which indicates that the precipitation for a given day is included in the following measurement. TR or T indicates trace.

Table A2 is a compilation of the monthly totals for the precipitation data from Shasta Dam, 1944-91. Figure A1 is a time-series plot of the data in table A2, plus monthly totals from the Kennett station for 1940-42.

Table A1. Daily precipitation data, in inches, from Kennett and Shasta Dam, 1940-91

DAILY PRECIPITATION AT KENNETT

1940	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	1.73	0.08	--	0.03	--	0.03	--	--	--	--	0.20	--
2	2.95	0.06	0.23	--	--	0.13	--	--	--	--	2.11	--
3	1.30	2.99	--	0.85	0.36	--	--	--	0.17	0.20	0.19	--
4	2.86	1.34	--	1.35	0.41	--	--	--	0.09	--	--	--
5	--	0.59	--	0.03	0.03	--	--	--	--	--	0.18	--
6	0.39	0.85	--	--	--	--	--	--	--	--	0.05	--
7	0.68	--	--	0.65	--	--	--	--	0.01	--	0.83	--
8	1.07	--	--	0.27	--	--	--	--	--	--	0.09	--
9	2.00	--	--	0.04	--	--	--	--	--	--	--	--
10	1.65	0.08	--	--	--	--	--	--	--	--	--	--
11	0.54	--	--	--	--	--	--	--	--	--	--	--
12	--	--	--	--	--	--	--	--	--	--	--	--
13	--	0.57	--	--	--	--	--	--	0.06	--	--	--
14	--	1.70	--	--	--	--	--	--	--	--	--	--
15	--	--	--	--	--	--	--	--	--	--	--	--
16	--	0.04	0.33	--	--	--	--	--	--	--	--	0.05
17	--	3.44	--	--	--	--	--	--	--	--	--	2.00
18	--	0.01	--	--	--	--	--	--	0.14	--	--	5.70
19	--	--	--	--	--	--	--	--	TR	--	--	0.55
20	--	--	--	--	--	TR	--	--	--	--	--	2.48
21	--	--	--	--	--	--	--	--	--	0.02	--	5.82
22	--	0.10	--	--	--	--	--	--	--	--	--	3.50
23	0.21	0.01	--	--	--	--	--	--	--	--	--	2.00
24	0.35	0.05	0.02	TR	--	--	--	--	--	2.54	--	2.16
25	2.67	1.12	1.16	1.06	--	--	--	--	--	1.04	--	1.44
26	3.40	0.70	2.12	0.22	--	--	--	--	--	--	--	2.52
27	0.14	5.41	2.62	0.20	--	--	--	--	0.14	0.04	--	3.36
28	--	7.10	0.42	--	--	--	--	--	--	--	--	--
29	--	0.23	3.06	--	--	--	--	--	--	0.72	--	0.19
30	--		7.92	--	0.28	--	--	--	--	0.23	--	--
31	TR		2.91		0.61		--	--		0.01		--
Total	21.94	26.47	20.78	4.79	1.69	0.16	0.0	0.0	0.61	4.80	3.65	31.77

1941	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	0.34	1.43	0.61	--	0.05	--	--	0.25	--	--	0.14
2	--	0.04	1.06	2.13	--	--	--	--	--	--	0.53	1.61
3	--	--	1.14	1.96	1.50	--	--	--	--	--	0.14	3.43
4	0.43	--	0.79	3.96	0.94	--	--	--	--	--	0.21	--
5	0.61	--	--	2.04	0.39	--	--	--	--	--	--	--
6	0.97	0.70	--	--	--	--	--	--	--	--	--	--
7	2.32	0.44	--	0.07	--	--	--	--	--	--	--	--
8	1.33	0.94	--	--	0.01	--	--	--	--	--	--	--
9	--	2.57	--	0.28	0.06	--	--	--	--	--	--	--
10	--	0.93	--	1.13	--	--	--	--	--	--	--	--
11	--	1.49	--	0.26	--	--	--	--	--	--	--	--
12	--	0.37	--	--	0.15	--	--	--	--	0.24	--	0.06
13	0.51	--	--	--	1.50	--	--	--	--	0.04	--	0.62
14	3.47	0.02	--	--	0.23	--	--	--	--	--	0.64	2.90
15	1.18	0.02	--	--	--	--	--	--	--	--	0.11	3.41
16	0.18	0.35	--	0.09	--	--	--	--	--	--	0.37	3.65
17	--	0.04	--	--	--	0.02	--	--	--	--	0.04	0.08
18	--	0.59	--	--	TR	0.16	--	0.01	--	--	--	3.03
19	1.28	--	--	--	--	0.01	--	--	0.07	--	--	1.15
20	0.98	--	--	--	--	--	--	--	--	0.20	--	0.84
21	1.12	0.12	--	--	--	--	--	--	--	--	--	--
22	2.51	0.15	--	--	--	--	--	--	--	--	--	0.16
23	1.94	0.28	--	--	--	0.14	--	--	--	--	--	0.53
24	2.19	1.88	--	--	--	0.10	--	--	--	--	--	--
25	2.02	--	--	--	--	0.73	--	--	--	--	--	0.14
26	3.05	--	--	0.07	0.48	0.34	--	--	--	--	--	0.12
27	--	1.00	--	--	0.05	--	--	--	--	1.60	--	0.47
28	--	2.69	0.05	--	--	--	--	--	--	0.62	0.03	1.12
29	--		0.61	0.19	0.99	--	--	--	--	0.02	0.21	0.70
30	--		1.24	0.83	0.17	--	--	--	--	--	2.02	0.16
31	--		2.59		0.33		--	--		TR		0.01
Total	26.09	14.96	8.91	13.62	6.80	1.55	0.0	0.01	0.32	2.72	4.30	24.33

Table A1.--Continued.

DAILY PRECIPITATION AT KENNETT

1942	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	0.88	--	1.12	1.21	--	--	--	--	--	--	--
2	--	3.66	--	--	--	0.42	--	--	--	--	--	--
3	--	1.07	--	0.11	--	--	--	--	--	--	0.34	--
4	--	3.42	--	1.57	--	--	--	--	--	--	--	--
5	--	0.98	--	1.87	--	--	--	--	--	--	--	--
6	--	2.78	--	0.04	--	--	--	--	--	--	--	--
7	0.73	0.67	--	--	--	--	--	--	--	--	--	--
8	9.72	0.03	--	--	--	--	--	--	--	--	0.12	--
9	--	--	--	0.02	--	--	--	--	0.07	--	--	--
10	--	--	TR	0.53	0.03	--	--	--	--	--	--	--
11	--	--	0.57	--	0.92	--	--	--	--	1.41	--	--
12	--	--	--	--	0.29	--	--	--	--	--	--	--
13	--	--	0.22	--	0.01	--	--	--	--	--	--	--
14	--	--	0.61	1.66	--	--	--	--	--	--	0.32	--
15	--	--	0.80	0.96	0.65	--	--	--	--	0.04	1.63	--
16	0.08	--	--	--	0.15	--	--	--	--	--	0.14	--
17	--	--	--	1.47	--	--	--	--	--	--	3.63	--
18	--	--	--	1.68	--	--	--	--	--	--	2.39	--
19	--	--	--	--	--	--	--	--	--	--	0.01	--
20	--	--	--	--	--	--	--	--	--	--	--	--
21	--	--	--	--	--	--	--	--	--	--	--	--
22	0.73	TR	--	--	TR	--	--	--	--	--	--	--
23	2.30	--	--	--	0.16	--	--	--	--	--	0.04	--
24	3.34	0.11	--	--	--	--	--	--	--	--	--	--
25	2.45	--	--	--	3.36	--	--	--	--	--	--	--
26	0.76	--	--	--	0.25	--	--	--	--	--	--	--
27	2.13	--	--	0.13	0.01	--	--	--	--	--	1.65	--
28	0.18	--	--	0.67	0.45	--	--	--	--	0.15	0.10	--
29	--		--	0.02	0.25	--	--	--	--	--	0.03	--
30	0.08		--	0.22	--	--	--	--	--	--	0.26	--
31	0.11		--		--		--	--		--		--
Total	13.61	13.60	2.20	12.07	7.74	0.42	0.0	0.0	0.07	1.60	10.66	M

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1944	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.55	0.69	0.80	--	--	1.10	--	--	--	--	0.24	2.79
2	1.00	2.70	0.10	--	--	1.40	--	0.44	--	--	0.23	0.43
3	0.06	4.85	0.06	--	--	0.45	--	--	--	--	1.32	--
4	--	0.31	1.80	TR	--	--	--	--	--	--	2.64	--
5	1.20	--	0.02	0.31	--	--	--	--	--	--	0.15	--
6	0.75	--	--	--	--	--	--	--	--	--	--	--
7	--	--	TR	0.01	--	--	--	--	--	--	0.82	--
8	--	0.99	0.04	0.34	--	--	--	--	--	TR	--	--
9	--	0.52	--	0.03	--	--	--	--	--	--	1.18	--
10	0.27	--	TR	--	--	--	--	--	--	--	1.09	--
11	--	--	--	1.30	0.03	--	--	--	--	--	0.11	--
12	--	--	--	0.23	--	--	--	--	--	--	0.46	--
13	--	--	--	TR	--	--	--	--	--	0.20	0.15	--
14	0.51	--	--	0.12	--	0.60	--	--	--	--	0.02	--
15	--	--	--	TR	0.69	0.57	--	--	--	--	--	--
16	--	--	--	--	0.02	0.06	--	--	--	--	--	--
17	TR	--	--	--	0.29	0.15	--	--	--	--	--	--
18	--	--	--	--	0.21	0.06	--	--	--	--	--	--
19	--	0.04	--	TR	--	0.03	--	--	--	--	--	0.70
20	--	--	--	0.25	--	--	--	--	--	--	--	--
21	--	0.15	--	0.15	--	TR	--	--	--	0.05	--	1.45
22	--	0.85	--	--	--	0.13	--	--	--	--	--	TR
23	0.56	0.42	--	--	--	--	--	--	--	--	--	0.87
24	0.21	--	--	0.45	--	0.03	--	--	--	--	--	0.24
25	--	--	--	TR	--	0.22	--	--	--	--	--	0.02
26	--	--	--	TR	--	--	--	--	--	--	0.32	--
27	--	--	--	0.52	--	--	--	--	--	--	0.10	0.12
28	--	0.84	--	TR	--	--	--	--	--	--	--	1.44
29	TR	2.38	--	--	--	--	--	--	--	--	0.63	0.56
30	0.30		--	--	--	--	--	--	--	TR	0.51	0.26
31	0.70		--		0.28		--	--		4.33		--
Total	6.11	14.74	2.82	3.71	1.52	4.84	0.00	0.44	0.00	4.58	9.97	8.89

1945	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	3.27	--	--	--	--	--	--	--	--	0.10	--
2	--	2.17	--	--	--	--	--	--	--	--	--	--
3	--	1.64	--	--	--	--	--	--	--	--	--	--
4	0.01	--	0.03	--	--	TR	--	--	--	--	--	3.03
5	--	1.48	--	--	--	--	--	--	--	--	--	2.32
6	--	--	0.74	--	--	0.56	--	0.10	--	--	--	0.30
7	--	--	0.24	--	--	0.03	--	--	--	--	0.04	0.40
8	--	0.43	0.02	0.72	--	0.08	--	--	--	--	--	--
9	--	0.16	--	0.02	--	--	--	--	--	--	0.03	--
10	0.11	--	TR	--	0.35	--	--	--	--	0.03	0.60	--
11	TR	--	--	--	--	--	--	--	--	0.36	0.10	--
12	TR	--	TR	--	0.13	--	--	--	--	0.15	0.80	--
13	--	0.07	0.08	--	2.40	--	--	--	--	--	0.01	--
14	--	1.43	--	--	0.87	--	--	--	--	--	--	--
15	0.11	--	0.31	--	0.30	--	--	--	--	--	0.70	0.02
16	0.02	--	0.04	--	0.29	--	--	--	--	--	0.35	0.20
17	--	0.07	2.48	--	0.04	--	--	--	--	0.08	0.80	--
18	0.47	0.01	0.05	--	0.40	--	--	--	--	--	0.05	--
19	--	--	--	--	--	--	--	--	--	--	0.98	--
20	--	--	0.04	--	TR	--	--	--	--	--	--	--
21	--	--	0.50	--	0.48	--	--	--	--	TR	--	1.45
22	--	--	0.60	--	0.24	--	--	--	--	--	--	1.37
23	--	--	1.72	--	0.47	--	--	--	--	--	0.12	1.24
24	--	--	--	--	0.05	--	--	--	--	--	0.02	0.43
25	--	--	0.63	--	0.08	0.01	--	--	--	--	1.70	1.17
26	--	--	0.97	0.01	0.06	0.01	--	--	--	--	0.70	0.76
27	--	--	0.05	--	TR	--	--	--	--	--	--	5.10
28	--	TR	--	--	--	--	--	--	--	--	0.46	2.35
29	--		--	--	TR	--	--	--	--	0.53	1.06	1.00
30	0.03		--	--	0.40	--	--	--	--	2.35	--	--
31	3.18		--		TR		--	--		4.04		--
Total	3.93	10.73	8.50	0.75	6.56	0.69	0.0	0.10	0.0	11.45	8.62	21.14

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1946	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	--	--	0.39	--	--	--	--	--	TR	--	TR
2	0.31	--	--	--	--	--	--	--	--	0.18	--	0.05
3	1.18	0.33	--	0.04	--	--	--	--	TR	0.12	--	0.06
4	1.68	0.01	--	--	--	--	--	--	--	--	--	1.30
5	0.98	TR	--	--	--	--	--	--	--	--	--	0.38
6	--	0.05	--	--	--	--	--	--	--	--	--	2.47
7	0.38	0.95	--	--	--	--	--	--	--	--	--	0.07
8	0.21	--	--	0.38	--	--	--	--	--	--	--	0.43
9	--	--	--	0.14	--	--	--	--	--	--	--	0.05
10	--	--	--	0.01	--	--	--	--	--	--	--	--
11	--	0.03	0.07	--	--	--	--	--	--	--	--	--
12	--	--	--	--	--	--	--	--	--	--	--	--
13	--	--	1.04	--	--	--	--	--	--	--	--	--
14	--	--	--	--	--	--	--	--	--	--	--	TR
15	--	--	--	--	--	--	--	--	--	--	--	0.02
16	--	0.07	0.05	--	--	--	--	--	0.06	--	--	--
17	--	--	0.02	--	--	--	--	--	--	0.03	TR	--
18	--	--	0.03	--	--	--	--	--	--	--	0.54	--
19	--	--	0.02	--	--	--	--	--	--	--	3.91	--
20	0.15	0.57	0.11	--	--	--	--	--	--	--	0.02	--
21	--	0.92	0.08	--	--	--	--	--	--	0.06	0.02	--
22	0.01	0.12	0.13	--	0.06	--	--	--	--	0.41	0.81	--
23	--	--	0.11	--	0.19	--	--	--	--	0.14	3.23	--
24	0.05	--	--	--	--	--	--	--	--	--	--	--
25	--	0.20	--	--	--	--	--	--	--	--	--	0.10
26	--	--	--	--	1.18	--	0.98	--	--	--	--	0.07
27	--	0.43	--	--	0.16	--	0.09	--	--	--	--	TR
28	--	0.03	--	--	--	--	--	--	--	--	--	--
29	--		0.30	--	--	--	--	--	--	--	--	0.12
30	--		1.00	--	--	--	--	--	--	--	--	--
31	--		0.33		--		--	--		--		--
Total	4.98	3.71	3.29	0.96	1.59	0.0	1.07	0.0	0.06	0.94	8.53	5.12

1947	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	TR	TR	--	--	1.92	--	--	--	--	0.57	0.11
2	--	--	1.41	0.05	--	0.37	--	--	--	--	0.14	--
3	--	--	2.91	0.76	--	TR	--	--	--	--	--	0.01
4	--	--	2.25	--	--	--	--	--	--	--	0.09	0.06
5	--	--	--	TR	--	0.79	--	--	--	--	TR	--
6	--	--	--	0.16	--	0.45	--	--	--	--	--	--
7	--	--	--	--	--	0.76	--	--	TR	--	--	--
8	--	TR	0.19	--	0.01	0.64	--	--	--	1.09	--	--
9	--	0.13	0.47	0.08	TR	0.03	--	--	--	TR	--	--
10	--	0.69	2.53	--	--	--	--	--	--	2.91	--	--
11	--	0.06	0.06	--	--	--	--	--	--	1.53	--	--
12	TR	4.46	--	--	--	--	--	--	--	--	--	--
13	0.11	0.86	--	--	--	--	--	--	--	--	--	--
14	0.03	--	--	--	--	--	--	--	--	--	--	--
15	--	--	--	--	--	--	--	--	--	0.29	0.23	--
16	--	0.52	--	--	--	--	--	--	--	2.39	0.10	--
17	--	--	--	--	--	0.12	--	--	--	0.19	--	0.59
18	--	--	--	--	--	--	--	--	--	--	--	0.01
19	--	--	TR	--	--	--	--	--	0.11	--	--	0.03
20	--	--	--	--	--	--	--	--	--	--	--	0.62
21	--	--	--	--	--	--	--	--	--	0.49	--	0.52
22	--	--	--	--	--	--	--	0.06	--	--	--	0.41
23	--	--	0.14	--	--	--	--	--	--	--	--	--
24	--	--	0.03	--	--	--	--	--	--	--	--	--
25	--	--	0.01	--	--	--	--	--	--	--	--	--
26	0.29	--	--	--	--	--	--	--	--	--	--	--
27	--	0.22	--	--	0.18	--	--	--	--	--	--	--
28	0.50	--	0.47	--	0.15	--	0.22	--	--	0.03	--	0.07
29	0.47		0.59	TR	--	--	0.03	TR	--	2.62	--	--
30	0.33		2.09	--	0.07	--	--	0.29	--	0.24	--	--
31	0.09		0.56		0.52		--	--		--		--
Total	1.82	6.94	13.71	1.05	0.93	5.08	0.25	0.35	0.11	11.78	1.13	2.43

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1948	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.11	--	--	--	0.06	--	--	--	--	--	0.58	--
2	1.58	--	--	--	--	--	--	--	--	--	2.33	TR
3	0.25	TR	--	2.52	--	TR	0.14	--	--	0.50	0.28	0.29
4	0.37	TR	--	0.91	0.12	TR	--	--	--	0.65	--	--
5	1.71	0.25	--	0.09	--	0.25	--	--	--	0.22	--	0.90
6	1.39	--	0.01	0.17	--	0.42	0.23	--	--	TR	--	0.55
7	4.41	--	--	0.41	--	--	TR	--	--	--	--	0.45
8	0.42	0.15	--	0.02	--	--	--	--	--	--	--	0.88
9	--	1.01	0.37	0.83	--	--	--	--	--	--	--	--
10	--	0.11	--	1.10	--	0.27	--	--	--	--	--	0.08
11	--	--	--	0.21	--	1.61	--	--	--	0.01	--	--
12	--	--	--	--	--	--	--	--	--	TR	--	0.05
13	--	--	1.32	--	--	--	--	--	--	--	--	0.28
14	--	--	0.34	1.08	--	--	--	--	--	0.06	--	0.32
15	--	0.15	TR	0.81	--	--	--	--	--	--	0.45	TR
16	--	0.11	0.52	0.29	--	--	--	--	--	--	0.01	--
17	--	--	0.73	0.08	0.09	--	--	--	0.27	--	0.30	TR
18	--	--	--	0.02	0.22	--	--	--	1.50	--	--	--
19	--	0.07	0.23	--	0.10	--	--	0.25	--	--	0.07	--
20	--	--	--	--	0.38	--	--	--	--	--	0.04	--
21	--	--	--	--	0.11	--	--	--	--	--	--	--
22	--	0.19	--	1.27	--	--	--	--	--	--	--	--
23	--	--	3.06	0.11	--	--	--	0.09	0.07	--	--	--
24	--	--	0.75	--	--	--	--	--	--	TR	--	--
25	--	--	0.38	--	--	--	--	--	0.02	--	--	0.28
26	--	--	--	--	--	--	--	--	--	--	--	0.34
27	--	--	--	0.46	--	--	--	--	--	--	--	0.30
28	--	0.62	--	0.61	1.00	--	--	--	--	--	--	0.01
29	--		0.40	1.13	0.30	--	--	--	--	--	TR	0.12
30	--		0.03	2.10	0.78	--	--	--	--	--	--	0.31
31	--		--		0.03		--	--		--		TR
Total	10.24	2.66	8.14	14.22	3.19	2.55	0.37	0.34	1.86	1.44	4.06	5.14

1949	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.46	--	0.15	--	--	0.09	--	--	--	--	--	--
2	0.11	--	2.30	--	0.18	--	--	--	--	--	--	--
3	--	0.30	2.39	--	0.06	--	--	--	--	--	--	--
4	--	0.16	0.39	--	--	--	--	--	--	--	--	--
5	--	0.48	--	--	--	--	--	--	--	--	--	0.15
6	--	TR	0.36	--	--	--	--	--	--	--	--	--
7	--	0.78	--	0.04	--	--	--	--	--	--	TR	0.03
8	--	TR	TR	--	--	--	--	--	TR	--	0.21	0.02
9	--	--	0.29	--	0.01	--	--	--	TR	--	1.30	--
10	--	0.43	2.47	--	0.10	--	--	--	--	0.02	0.87	--
11	--	1.75	1.30	--	--	--	--	--	--	--	0.22	--
12	--	--	0.76	--	--	--	--	--	--	--	0.03	--
13	--	--	0.02	--	0.06	--	--	--	--	--	--	--
14	--	--	0.01	--	0.21	--	--	--	--	--	--	--
15	--	--	0.61	--	0.08	--	--	--	--	--	--	0.18
16	--	0.09	1.26	--	--	--	--	--	--	--	--	0.28
17	--	--	1.40	--	--	--	--	--	--	--	--	1.12
18	--	--	2.11	--	0.06	--	--	--	--	--	--	0.02
19	--	--	1.05	--	--	--	--	--	--	--	--	0.22
20	--	TR	1.30	--	0.08	--	--	--	--	--	--	--
21	0.03	1.18	0.03	--	0.14	--	--	--	--	--	--	--
22	0.37	1.19	0.17	--	--	--	--	--	--	--	--	--
23	0.29	0.69	0.95	--	--	--	--	--	--	--	--	--
24	--	--	0.04	--	--	--	--	--	TR	--	--	0.04
25	--	--	--	--	--	--	--	--	--	--	--	--
26	--	0.52	--	--	--	--	--	--	--	--	--	--
27	--	0.12	--	--	--	--	--	--	--	--	--	--
28	--	TR	--	--	--	--	--	--	0.15	--	0.03	--
29	--		--	0.10	0.55	--	--	--	--	--	--	--
30	--		--	--	1.61	--	--	--	--	--	--	TR
31	--		--		0.07		TR	--		--		--
Total	1.26	7.69	19.36	0.14	3.21	0.09	0.00	0.00	0.15	0.02	2.66	2.06

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1950	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	--	--	--	0.13	--	--	--	--	--	--	0.28
2	0.06	--	--	--	0.48	--	--	--	--	--	--	--
3	--	--	--	--	0.56	--	--	--	--	--	--	2.56
4	--	2.17	--	--	TR	--	--	--	--	0.15	--	0.95
5	--	1.34	0.03	--	--	--	--	--	--	0.29	--	--
6	--	0.39	0.22	0.37	--	--	--	--	--	0.13	--	0.25
7	--	--	--	0.28	--	--	--	--	--	--	--	0.40
8	1.00	--	--	0.68	--	--	--	--	--	--	--	0.89
9	0.13	--	0.09	0.21	--	--	--	--	0.01	--	--	0.85
10	2.27	0.37	0.10	--	--	0.02	--	--	0.12	--	--	--
11	1.30	0.04	--	--	--	0.18	--	--	0.04	--	--	0.66
12	0.11	--	--	--	--	0.78	--	--	--	--	0.03	0.05
13	--	--	--	0.02	--	--	--	--	--	--	0.17	--
14	1.10	--	--	--	--	--	--	--	--	--	--	1.54
15	--	--	--	--	0.45	--	--	--	--	--	1.12	0.81
16	0.68	0.27	TR	--	--	--	--	--	--	--	1.46	0.11
17	1.22	0.03	0.66	--	--	TR	--	--	TR	2.26	0.15	--
18	3.07	--	0.02	--	--	--	--	--	0.35	2.40	0.34	--
19	0.29	--	1.41	--	--	--	--	--	0.01	--	0.11	0.03
20	0.11	--	--	--	--	--	--	--	--	--	0.23	0.04
21	0.58	--	--	--	--	--	--	--	--	--	--	--
22	0.32	--	0.75	--	--	--	--	--	--	--	--	--
23	0.56	--	TR	--	--	--	--	--	--	--	--	--
24	0.02	--	1.44	--	--	--	--	--	--	TR	--	--
25	--	--	0.13	--	--	--	--	--	--	0.33	--	--
26	--	--	0.06	--	--	--	--	--	--	0.67	--	--
27	0.06	--	0.24	--	--	--	--	--	--	1.10	0.43	TR
28	1.12	--	TR	--	--	--	--	--	--	3.95	--	--
29	--		--	--	--	--	--	--	--	3.83	--	--
30	--		--	--	--	--	--	--	--	2.26	--	0.15
31	0.01		--		--		--	--		0.01		--
Total	14.01	4.61	5.15	1.56	1.62	0.98	0.0	0.0	0.53	17.38	4.98	9.57

1951	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	--	TR	--	0.01	--	--	--	--	0.64	--	5.20
2	--	0.13	--	--	TR	--	--	--	--	2.36	--	0.62
3	0.42	0.51	--	--	0.89	--	--	--	--	0.07	--	2.22
4	0.47	2.36	0.31	--	0.90	--	--	--	--	--	--	1.05
5	0.14	2.05	0.48	--	0.71	--	--	--	--	--	--	1.16
6	--	0.01	0.65	--	0.15	--	--	--	--	--	--	--
7	--	0.01	0.36	--	TR	--	--	--	--	--	--	--
8	--	0.05	0.02	--	TR	--	--	--	--	--	--	--
9	0.21	0.06	0.64	--	--	--	--	--	--	--	--	--
10	1.64	--	--	--	--	--	--	--	--	--	0.37	--
11	1.69	2.99	--	--	0.99	--	--	--	--	0.10	0.82	--
12	TR	0.52	--	--	0.03	--	--	--	--	0.05	1.90	--
13	--	--	--	--	TR	--	--	--	--	--	--	--
14	--	--	--	--	--	--	--	--	--	--	0.10	--
15	0.18	--	--	--	--	--	--	--	--	--	--	--
16	0.12	--	--	--	--	--	--	--	--	--	--	--
17	1.85	--	--	0.20	--	--	--	--	--	--	--	--
18	0.74	0.11	--	0.04	--	--	--	--	--	--	--	0.58
19	0.14	--	--	--	--	--	--	--	--	--	0.95	0.69
20	--	0.26	--	--	--	--	--	--	--	--	2.28	--
21	1.01	0.16	--	--	--	--	--	--	--	--	0.68	--
22	1.50	0.07	--	--	--	--	--	--	--	--	--	--
23	0.02	--	--	--	--	--	--	--	--	--	--	--
24	--	--	--	--	--	--	--	0.03	--	0.98	--	0.36
25	--	--	--	--	--	--	--	--	--	0.31	TR	--
26	--	--	--	--	--	--	--	--	--	--	1.43	1.24
27	--	0.19	--	--	--	--	--	--	--	--	0.24	5.50
28	--	TR	--	1.93	--	--	--	--	--	--	0.86	0.96
29	--		0.01	0.04	--	--	--	--	--	--	0.43	0.04
30	--		--	0.15	--	--	--	--	0.03	--	2.13	0.12
31	--		--		--		--	--		--		--
Total	10.13	9.48	2.47	2.36	3.68	0.00	0.00	0.03	0.03	4.51	12.19	19.74

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1952	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	1.90	--	--	0.66	--	--	TR	--	--	--	2.75
2	--	1.09	--	--	--	--	--	--	--	--	--	2.15
3	--	0.49	0.01	--	--	--	--	--	--	--	--	0.27
4	--	--	0.50	--	--	--	--	--	--	--	--	TR
5	0.01	--	0.07	--	--	--	--	--	0.20	--	--	1.19
6	1.25	--	0.44	--	--	0.04	--	--	--	--	--	2.35
7	0.21	--	0.93	0.11	0.51	0.03	--	--	--	--	--	3.96
8	1.01	--	0.01	0.02	1.14	--	--	--	--	--	--	0.22
9	TR	--	--	--	--	--	--	--	--	--	--	0.03
10	1.02	--	--	--	--	0.08	--	--	--	--	--	1.24
11	0.78	0.66	TR	--	--	0.04	--	--	TR	--	--	1.45
12	0.99	0.06	0.42	--	--	--	--	--	--	--	0.13	--
13	0.40	--	0.01	TR	--	--	--	--	--	--	0.29	TR
14	1.59	--	0.37	0.34	--	0.12	--	--	--	--	3.23	--
15	0.10	TR	1.76	TR	--	--	--	--	--	--	0.89	--
16	0.03	0.69	0.05	--	--	--	--	--	--	--	TR	--
17	0.50	--	--	--	--	--	--	--	--	--	--	--
18	--	0.01	1.68	--	--	--	--	--	--	0.25	--	TR
19	--	0.12	0.26	--	--	--	--	--	--	0.17	--	0.49
20	2.24	0.23	--	--	0.03	--	--	--	--	--	--	0.93
21	0.09	0.01	--	--	--	--	--	--	--	--	--	--
22	0.03	0.21	--	--	--	--	--	--	--	--	--	--
23	--	1.05	--	--	--	0.03	--	--	--	--	--	--
24	1.39	--	--	--	--	0.02	--	--	--	--	--	--
25	0.50	--	--	TR	--	TR	--	--	--	--	--	0.27
26	0.63	--	--	0.02	--	--	--	--	--	--	--	1.05
27	0.01	--	--	--	--	--	--	--	--	--	--	3.22
28	--	--	--	--	--	1.06	--	--	--	--	--	0.16
29	0.02		--	--	--	1.75	--	--	--	--	--	0.40
30	0.04		--	1.13	--	0.12	--	--	--	--	--	2.38
31	0.62		--		--		0.10	--		--		0.01
Total	13.46	6.52	6.51	1.62	2.34	3.29	0.10	0.00	0.20	0.42	4.54	24.52

1953	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.41	--	0.04	--	TR	--	--	--	--	--	--	TR
2	0.44	--	--	--	--	0.09	--	--	--	--	0.05	--
3	--	--	--	--	--	--	--	--	--	--	--	--
4	--	TR	--	--	--	--	--	--	--	--	--	0.86
5	--	0.41	--	--	--	--	--	--	--	--	0.23	TR
6	0.33	0.18	--	--	--	0.63	--	--	--	--	0.26	0.10
7	1.94	--	--	--	0.11	0.29	--	--	--	--	TR	0.89
8	0.24	0.25	--	--	--	--	--	--	--	--	--	--
9	3.80	--	--	0.31	0.02	0.21	--	--	--	--	--	--
10	0.19	--	0.03	0.81	--	--	--	--	--	0.15	0.11	--
11	0.04	--	0.62	--	--	--	--	--	--	0.02	1.31	--
12	0.81	--	1.35	--	--	--	--	--	--	--	0.83	--
13	2.78	--	0.03	--	--	--	--	--	--	--	0.03	--
14	0.68	--	--	TR	0.04	--	--	--	--	TR	2.00	--
15	--	--	--	--	0.25	--	--	--	--	0.05	0.57	--
16	--	--	--	--	0.04	0.63	--	--	--	--	0.07	--
17	1.07	--	0.15	0.25	--	--	--	--	--	--	0.30	--
18	2.13	--	--	--	--	--	--	--	--	2.00	--	0.35
19	1.40	--	3.55	--	0.50	--	--	--	--	--	--	0.80
20	1.70	--	1.32	0.05	0.18	--	--	--	--	--	0.23	0.18
21	0.14	--	0.80	--	0.23	--	--	--	0.27	--	TR	TR
22	--	--	TR	--	0.01	--	--	--	--	--	0.63	--
23	--	0.88	--	--	1.06	--	--	--	--	--	0.90	--
24	--	TR	--	--	--	--	--	--	--	--	1.83	--
25	TR	--	0.03	--	1.03	--	--	--	--	--	0.02	--
26	--	--	--	0.12	0.02	--	--	0.03	--	--	TR	--
27	--	--	--	2.33	0.10	--	--	0.02	--	--	TR	--
28	--	--	--	0.18	--	--	--	--	--	--	--	--
29	0.01		0.02	0.45	TR	--	--	0.50	--	--	--	--
30	--		--	0.05	0.03	--	--	0.10	--	--	0.05	--
31	--		--		0.28		--	--		--		--
Total	18.11	0.84	7.94	4.55	3.94	1.85	0.00	0.65	0.27	2.22	9.42	3.18

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1954	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	TR	--	--	--	--	--	--	--	--	--	--	0.35
2	--	--	--	--	--	--	--	--	--	--	--	1.32
3	1.16	--	--	0.77	--	--	--	--	--	--	--	0.20
4	--	--	--	1.01	--	--	--	--	--	--	--	0.26
5	TR	--	--	3.84	--	0.08	--	--	--	--	--	0.82
6	--	--	--	0.35	--	--	--	--	--	--	--	3.22
7	0.80	--	--	--	--	--	--	--	--	1.40	--	0.03
8	TR	--	0.56	--	--	0.28	--	--	--	0.09	0.71	0.01
9	--	--	2.38	0.05	--	1.38	--	--	--	--	4.49	1.58
10	--	--	3.40	--	TR	--	--	--	--	--	0.13	0.23
11	--	--	--	--	--	--	--	--	0.07	--	0.03	--
12	TR	2.83	--	--	--	0.39	--	--	--	--	1.16	--
13	--	2.00	--	--	--	0.08	--	--	--	--	--	0.94
14	--	2.25	--	--	--	--	--	--	--	--	0.32	TR
15	0.15	0.24	--	--	--	--	--	0.46	0.21	--	2.90	--
16	4.85	0.40	0.14	--	--	--	--	--	--	--	0.27	--
17	4.37	2.25	0.27	--	--	--	--	--	TR	--	--	--
18	--	0.16	--	--	--	--	--	--	--	--	--	--
19	0.60	--	0.30	--	--	--	--	--	--	0.26	--	--
20	--	--	0.65	--	--	--	--	--	--	TR	--	--
21	--	--	0.78	--	--	--	--	--	--	--	--	--
22	1.86	--	0.05	--	--	--	--	--	--	--	--	--
23	1.83	--	--	--	--	--	--	--	--	--	--	--
24	--	--	--	--	--	--	--	--	--	--	--	TR
25	--	--	TR	0.06	--	--	TR	--	--	--	--	--
26	0.42	--	--	--	--	--	0.01	1.52	--	--	--	--
27	1.83	--	--	0.64	--	--	--	0.03	--	--	--	--
28	2.81	--	--	1.37	--	--	--	2.02	--	--	--	--
29	0.22		0.58	0.01	--	--	--	0.11	--	--	--	0.12
30	0.44		0.25	--	--	--	--	--	--	--	--	0.05
31	--		0.01		--		--	--		--		1.10
Total	21.34	10.13	9.37	8.10	0.00	2.21	0.01	4.14	0.28	1.75	10.01	9.63

1955	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.16	0.22	--	--	--	--	--	--	--	--	--	0.21
2	--	--	--	--	--	--	--	--	--	--	--	--
3	--	--	--	--	0.02	--	--	--	--	--	--	--
4	--	--	--	--	--	--	0.06	--	--	--	TR	--
5	0.03	--	--	--	--	--	--	--	--	--	0.02	0.27
6	--	--	--	--	--	--	--	--	--	--	--	2.72
7	--	--	--	--	--	--	--	--	--	--	--	--
8	--	--	--	--	0.07	--	--	--	--	--	--	--
9	0.32	--	0.17	--	--	--	--	--	--	--	--	0.94
10	0.66	--	0.01	TR	--	TR	--	--	--	0.38	--	--
11	--	--	--	--	--	0.02	--	--	--	0.20	--	--
12	--	--	--	--	--	--	--	--	--	--	--	--
13	--	--	--	TR	--	--	--	--	--	--	0.57	--
14	--	--	--	0.02	--	--	--	--	0.16	--	0.68	--
15	0.10	--	--	--	--	--	--	--	0.20	--	--	TR
16	0.78	0.06	--	--	--	--	--	--	--	--	0.85	0.45
17	--	0.22	--	0.42	--	--	--	--	--	--	0.47	0.40
18	2.00	--	--	0.20	--	--	--	--	--	--	1.00	2.64
19	1.38	--	--	0.31	--	--	--	--	--	--	1.12	5.92
20	0.64	--	--	1.59	--	--	--	--	--	--	3.58	6.36
21	--	--	--	2.19	--	--	--	--	--	--	1.83	1.63
22	--	--	--	0.99	--	--	--	--	--	--	--	8.24
23	--	--	--	--	--	--	--	--	--	--	0.46	2.47
24	--	--	--	--	--	--	--	--	--	--	0.80	0.01
25	--	--	--	0.13	--	--	--	--	--	--	--	0.55
26	--	0.07	--	0.98	--	TR	--	--	--	0.15	--	1.02
27	--	1.93	--	--	--	--	--	--	--	--	--	0.13
28	--	0.09	0.32	TR	--	--	--	--	--	--	--	0.02
29	--		0.45	0.16	--	--	--	--	--	--	--	--
30	0.22		--	0.05	--	--	--	--	--	--	--	--
31	0.03		--		--		--	--		--		--
Total	6.32	2.59	0.95	7.04	0.09	0.02	0.06	0.00	0.36	0.73	11.38	33.98

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1956	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	2.00	--	--	0.01	--	--	--	--	--	--	0.20	--
2	0.30	--	--	--	--	--	0.17	--	--	--	0.27	--
3	--	--	TR	--	--	--	--	--	--	--	--	--
4	0.26	--	--	--	0.55	0.54	--	--	--	--	--	0.07
5	0.66	--	0.06	--	1.29	--	--	--	--	--	--	0.13
6	0.10	--	--	--	0.33	--	--	--	--	--	--	TR
7	1.42	--	--	--	0.10	--	--	--	--	--	--	--
8	0.38	--	--	--	0.08	--	--	--	--	TR	--	--
9	--	--	--	--	--	--	--	--	--	--	--	--
10	0.81	--	--	0.20	0.21	--	--	--	--	0.30	--	--
11	0.68	--	--	0.25	0.99	--	--	--	--	0.24	--	--
12	--	--	--	0.46	0.01	--	--	--	--	--	--	TR
13	0.64	--	--	0.24	--	--	--	--	--	--	--	--
14	1.66	--	--	0.10	--	TR	--	--	--	--	--	--
15	3.32	--	--	0.07	--	--	--	--	--	--	--	--
16	0.70	--	--	--	--	--	--	--	--	--	--	--
17	--	--	--	--	--	--	--	--	--	--	--	--
18	0.16	--	--	--	--	--	--	--	--	0.02	--	--
19	0.25	0.42	--	--	--	0.60	--	--	0.05	0.04	--	--
20	0.74	6.14	--	--	--	--	--	--	0.14	--	--	--
21	0.22	3.88	--	--	--	--	--	--	--	--	--	--
22	0.50	2.88	--	--	--	--	--	--	--	--	--	--
23	0.81	0.76	--	--	--	--	--	--	--	0.02	--	--
24	--	0.06	--	--	--	--	--	--	--	TR	--	--
25	0.69	1.29	--	--	--	--	--	--	--	TR	--	--
26	0.59	0.30	0.10	0.22	--	--	--	--	--	0.50	--	--
27	1.15	0.05	--	0.05	--	--	--	--	--	TR	--	--
28	0.36	--	--	TR	--	--	--	--	--	--	--	--
29	--	0.34	--	--	--	--	--	--	--	--	--	--
30	--		--	--	0.21	--	--	--	--	3.73	--	--
31	--		--		--		--	--		0.02		--
Total	18.40	16.12	0.16	1.60	3.77	1.14	0.17	0.00	0.19	4.87	0.47	0.20

1957	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	TR	0.01	--	--	--	--	--	--	--	--	--
2	--	0.28	TR	--	0.96	--	--	--	--	--	--	--
3	--	--	0.02	--	0.30	--	--	--	--	--	--	--
4	--	--	0.95	--	--	--	--	--	--	--	--	--
5	--	--	0.87	--	--	--	--	--	--	0.10	--	0.21
6	--	--	0.76	--	--	--	--	--	--	0.10	--	--
7	--	--	0.18	--	--	--	--	--	--	0.15	--	--
8	0.10	0.75	--	--	0.02	--	--	--	--	--	0.16	--
9	--	--	0.36	--	0.60	--	--	--	--	0.97	--	--
10	--	--	--	--	0.09	0.07	--	--	--	1.67	0.40	--
11	TR	--	0.15	--	0.02	--	--	--	--	0.21	0.20	--
12	2.46	--	1.10	0.09	--	--	--	--	--	--	0.13	TR
13	2.30	TR	0.01	0.02	0.16	--	--	--	--	2.32	1.67	--
14	0.36	0.05	--	1.45	0.49	--	--	--	--	0.13	2.91	--
15	1.87	--	0.47	--	TR	--	--	--	--	--	--	0.60
16	0.02	--	1.05	--	--	--	--	--	--	--	--	1.87
17	--	--	0.92	1.49	--	--	--	--	--	--	--	0.69
18	--	--	--	0.58	1.48	--	--	--	--	--	0.19	1.12
19	--	--	--	TR	0.35	--	--	--	--	--	0.09	0.14
20	1.40	0.03	--	0.71	0.53	--	--	--	--	--	--	0.60
21	0.03	1.75	--	--	0.26	--	--	--	--	--	--	3.26
22	--	0.72	--	--	--	--	--	--	--	--	--	0.42
23	--	1.30	--	--	--	--	--	--	--	0.59	--	--
24	TR	3.54	--	--	--	--	--	--	--	2.16	--	0.13
25	TR	3.51	--	--	--	--	--	--	--	0.04	--	0.12
26	0.03	1.94	--	--	--	--	--	--	0.01	0.01	--	0.12
27	--	1.31	--	--	--	--	--	--	4.43	--	--	--
28	--	--	0.02	--	--	--	--	--	1.09	--	--	0.56
29	--		0.02	--	0.03	--	--	--	0.30	--	--	0.34
30	--		0.32	--	--	--	--	--	0.31	--	--	--
31	--		0.10		--		--	--		--		--
Total	8.57	15.18	7.31	4.34	5.29	0.07	0.00	0.00	6.14	8.45	5.75	10.18

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1958	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	--	--	2.00	--	0.06	--	--	--	--	0.04	--
2	1.06	0.52	--	1.69	--	4.04	0.31	0.17	--	--	--	--
3	--	1.32	--	1.35	--	0.47	--	--	--	--	--	--
4	--	1.32	--	0.93	--	--	--	--	--	--	--	--
5	--	0.85	--	1.24	--	--	--	--	--	--	--	--
6	--	0.80	--	1.44	--	0.02	--	--	--	--	--	--
7	--	3.39	--	0.06	--	0.31	--	--	--	--	--	--
8	0.01	0.82	0.05	--	--	0.04	--	--	0.14	--	--	--
9	--	0.81	TR	--	--	0.78	--	--	--	--	--	0.03
10	1.14	1.10	--	--	--	--	--	--	--	--	0.68	--
11	0.14	0.02	--	--	0.51	--	--	--	--	--	--	--
12	1.01	2.78	--	--	0.90	0.14	--	--	--	--	--	--
13	1.67	--	0.91	--	--	--	--	--	--	--	--	--
14	--	1.04	0.29	--	--	--	--	--	--	--	0.35	--
15	0.16	1.61	0.21	--	--	--	--	--	--	--	--	--
16	--	3.26	--	--	--	--	--	--	--	--	--	--
17	--	0.06	--	0.02	--	--	--	--	--	--	--	--
18	--	0.42	--	0.09	--	--	--	--	--	0.23	0.01	--
19	--	4.34	--	--	--	--	--	--	--	0.12	0.17	--
20	0.02	0.69	0.45	--	--	0.16	--	--	--	--	--	--
21	--	0.10	2.31	--	--	--	--	--	--	--	--	0.50
22	--	--	1.39	--	--	--	--	--	--	--	--	--
23	--	0.74	0.71	--	0.51	--	0.60	--	0.28	--	--	--
24	1.18	2.20	0.53	--	--	--	--	--	--	--	--	0.05
25	0.90	2.60	0.68	--	--	--	TR	--	--	--	--	1.17
26	1.16	--	--	--	--	--	--	--	--	--	--	TR
27	0.01	--	--	--	--	--	--	--	--	--	--	2.04
28	1.14	--	0.01	--	--	--	--	--	--	--	--	0.23
29	2.04		1.76	0.07	--	--	--	--	--	--	--	--
30	1.32		1.81	--	--	0.08	--	--	--	--	--	--
31	TR		0.02		0.38		--	--		--		--
Total	12.96	30.79	11.15	8.89	2.30	6.10	0.91	0.17	0.42	0.35	1.25	4.02

1959	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	--	--	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	--	--	--	--	--	--
3	--	--	--	--	--	--	--	--	--	--	--	--
4	--	--	--	--	--	--	--	--	--	--	0.05	--
5	1.67	--	--	--	--	--	--	--	--	--	--	--
6	3.63	--	--	--	--	0.05	--	--	--	--	--	--
7	0.38	--	--	--	--	--	--	--	--	--	--	--
8	3.76	--	--	--	--	--	--	--	--	0.03	--	--
9	6.79	--	--	--	--	--	--	--	--	--	--	--
10	1.92	1.26	--	--	--	--	--	--	--	--	--	--
11	0.79	0.56	--	--	--	--	--	--	--	--	--	--
12	4.33	0.04	--	--	--	--	--	--	--	--	--	--
13	--	--	--	--	--	--	--	--	--	--	--	0.48
14	--	1.13	--	--	--	--	--	--	--	--	--	--
15	--	3.42	--	--	--	--	--	--	0.36	--	--	--
16	--	3.18	--	--	0.03	--	--	--	--	--	--	--
17	--	0.81	--	--	--	--	--	--	--	--	--	--
18	--	0.66	--	--	0.02	--	--	--	3.10	--	--	--
19	--	0.66	--	--	0.09	--	--	--	4.34	--	--	--
20	--	0.11	--	--	--	--	--	--	0.07	--	--	--
21	--	0.92	--	--	--	--	--	0.23	--	--	--	--
22	--	0.42	0.25	--	--	--	--	--	--	TR	--	--
23	--	0.02	2.25	--	0.14	--	--	--	--	--	--	0.51
24	0.42	--	0.06	--	--	--	--	--	--	--	--	1.57
25	0.77	--	--	TR	--	--	--	--	--	--	--	0.22
26	0.15	--	0.37	4.96	--	--	--	--	--	--	--	--
27	0.12	--	--	0.03	--	--	--	--	--	--	--	--
28	1.04	--	0.03	--	--	--	--	--	--	--	--	--
29	--		0.02	--	--	--	--	--	--	--	--	--
30	0.09		1.69	--	--	--	--	--	--	--	--	--
31	--		0.05		--		--	--		--		--
Total	25.86	13.19	4.72	4.99	0.28	0.05	0.0	0.23	7.87	0.03	0.05	2.78

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1960	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	1.92	--	--	--	--	--	--	--	--	--	4.87
2	--	1.58	--	--	0.15	--	--	--	--	--	--	1.33
3	--	0.10	0.21	--	0.01	--	--	--	--	--	--	0.33
4	--	1.46	2.02	--	0.07	--	--	--	--	--	--	--
5	--	1.17	1.34	--	--	--	--	--	--	--	--	--
6	--	0.05	2.65	--	--	--	--	--	--	0.43	0.08	--
7	0.02	1.08	1.77	0.41	0.11	--	--	--	--	--	0.10	--
8	0.78	3.18	0.25	0.19	--	--	--	--	--	0.10	--	--
9	0.27	0.78	--	--	--	--	--	--	--	--	--	--
10	0.40	0.62	--	--	--	--	--	--	--	--	--	--
11	0.62	--	--	0.02	--	--	--	--	--	--	0.43	0.15
12	0.61	--	0.38	--	--	--	--	--	--	--	0.20	--
13	--	0.04	0.27	--	--	--	--	--	--	--	2.07	--
14	0.22	--	--	--	--	--	--	--	--	--	0.26	--
15	0.09	--	--	--	--	--	--	--	--	--	0.11	0.11
16	--	--	--	--	--	--	--	--	--	--	--	2.11
17	--	--	--	--	--	--	--	--	--	--	--	2.80
18	--	0.01	--	--	--	--	--	--	--	--	0.70	1.06
19	--	--	--	0.01	--	--	--	--	--	--	--	0.28
20	TR	--	--	--	--	--	--	--	--	--	--	--
21	0.23	--	--	--	--	--	--	--	--	--	0.07	--
22	2.55	--	--	--	--	--	--	--	--	--	--	--
23	0.27	--	--	0.30	0.16	--	--	--	--	--	--	--
24	--	--	--	--	2.88	--	--	--	--	--	1.17	--
25	2.35	--	--	0.05	1.34	--	--	--	--	--	1.52	--
26	0.71	--	--	0.07	0.31	--	--	--	--	--	0.63	--
27	0.71	--	0.10	1.78	0.17	--	--	--	--	--	0.20	--
28	1.94	--	0.74	0.09	--	--	--	--	--	--	--	--
29	TR		--	--	--	--	--	--	--	--	--	--
30	0.64		1.00	--	--	--	--	--	--	--	0.75	--
31	--		--		--		--	--		--		--
Total	12.41	11.99	10.73	2.92	5.20	0.0	0.0	0.0	0.0	0.53	8.29	13.04

1961	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	0.09	--	--	0.04	0.08	--	--	--	--	--	--
2	--	0.81	--	--	0.31	0.30	--	--	--	--	--	--
3	--	0.38	--	--	--	0.03	--	--	--	--	--	--
4	--	--	--	--	--	0.50	--	--	--	--	--	--
5	--	--	0.22	--	--	--	--	--	--	--	--	--
6	--	0.07	0.75	--	0.05	--	--	--	--	--	--	--
7	--	--	--	--	0.64	--	--	--	--	--	--	--
8	0.06	0.37	--	--	--	--	--	--	--	--	--	--
9	0.10	1.50	0.82	--	--	--	--	--	--	--	--	--
10	0.05	0.92	0.47	--	0.53	--	--	--	--	--	--	--
11	--	0.75	0.13	--	0.68	0.07	--	--	--	0.65	0.02	--
12	--	0.11	--	--	0.04	0.02	--	--	--	0.02	--	--
13	--	0.03	--	--	--	--	0.21	--	--	--	--	--
14	--	0.87	--	--	--	--	--	--	--	--	--	TR
15	--	0.52	1.76	--	--	--	--	--	--	--	--	0.01
16	--	0.09	0.12	--	--	--	--	--	0.05	--	--	--
17	--	--	1.37	--	--	--	--	--	0.33	--	--	0.59
18	--	--	--	--	--	--	--	--	TR	--	--	0.24
19	--	--	--	--	--	--	--	--	--	--	--	1.11
20	--	--	0.36	--	--	--	--	0.05	--	0.03	0.55	1.36
21	--	--	--	0.05	--	--	--	--	--	0.03	--	0.54
22	--	--	TR	0.19	--	--	--	--	--	--	0.17	--
23	0.55	--	0.06	0.48	--	--	--	--	--	--	0.88	--
24	--	--	0.22	--	--	--	--	--	--	--	1.23	--
25	--	--	0.82	0.04	--	--	--	--	--	--	4.41	--
26	0.18	--	0.65	--	0.23	--	--	--	--	0.06	2.05	--
27	0.66	--	0.76	--	0.03	--	--	--	--	0.10	0.47	--
28	0.07	--	--	--	--	--	--	--	--	0.36	--	--
29	0.57		--	--	--	--	--	--	--	--	0.83	--
30	3.22		--	0.22	0.04	--	--	--	--	--	0.88	--
31	3.24		--		0.73		--	--		--		--
Total	8.70	6.51	8.51	0.98	3.32	1.00	0.21	0.05	0.38	1.25	11.49	9.48

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1962	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	--	1.58	--	TR	--	--	--	--	--	--	0.08
2	--	--	0.15	--	--	--	--	--	--	--	--	0.95
3	--	--	0.07	--	--	--	--	--	--	0.11	--	1.40
4	--	--	0.18	--	--	--	--	0.06	--	--	--	--
5	--	--	1.18	--	--	--	--	--	--	--	0.01	--
6	--	0.18	2.44	--	--	--	--	--	--	--	--	--
7	--	1.81	0.65	--	--	--	--	--	--	--	--	--
8	--	3.02	--	--	--	--	--	0.48	--	0.15	--	--
9	--	1.97	--	--	0.06	--	--	0.65	--	0.09	0.3	--
10	--	1.55	--	--	0.04	--	--	--	--	3.48	0.15	--
11	--	0.44	--	--	0.03	--	--	--	--	0.57	0.02	--
12	0.18	0.73	--	--	--	--	--	--	--	3.54	0.17	--
13	--	4.84	--	--	0.07	--	--	--	--	2.68	0.06	0.35
14	--	1.81	--	--	--	--	--	--	--	0.30	--	0.30
15	--	2.06	--	--	--	--	--	--	--	--	--	1.84
16	--	1.09	0.57	--	--	--	--	--	--	--	--	1.27
17	--	0.16	0.01	--	--	--	--	--	--	--	--	0.59
18	0.07	0.43	--	--	0.03	--	--	--	--	--	--	0.04
19	1.36	0.37	--	--	--	--	--	--	--	--	--	--
20	2.66	--	1.04	0.09	--	--	--	--	--	--	--	--
21	0.08	--	0.01	--	--	--	--	--	--	--	--	--
22	--	--	1.23	--	--	--	--	--	--	--	--	--
23	--	--	TR	--	--	--	--	--	--	--	--	--
24	--	0.06	--	--	--	--	--	--	--	--	0.02	--
25	--	--	--	--	--	--	--	--	--	--	--	--
26	--	--	--	--	0.06	--	--	--	--	--	2.32	--
27	--	--	--	--	0.05	--	--	--	--	--	0.84	--
28	--	0.25	--	0.73	--	--	--	--	0.39	--	--	--
29	--		--	--	0.07	--	--	--	1.13	--	--	--
30	--		--	--	--	--	--	--	--	--	--	--
31	--		--		--		--	--		--		--
Total	4.35	20.77	9.11	0.82	0.41	0.07	0.0	1.19	1.52	10.92	3.62	6.82

1963	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	2.37	--	0.17	--	--	--	--	--	--	--	--
2	--	0.29	--	--	--	--	--	--	--	--	0.03	--
3	--	0.94	--	0.31	--	--	--	--	--	--	0.27	--
4	--	0.01	--	--	--	--	--	--	--	--	2.17	--
5	--	0.21	--	0.41	0.03	--	--	--	--	0.05	0.63	--
6	--	TR	--	2.95	--	--	--	--	--	0.08	2.08	--
7	--	0.08	--	0.88	0.31	--	--	--	--	--	0.30	--
8	--	0.12	--	0.03	0.58	--	--	--	--	--	0.92	--
9	--	0.06	0.13	1.48	0.24	--	--	0.01	--	0.38	1.58	0.39
10	--	0.60	--	1.16	0.05	--	--	--	--	--	--	--
11	--	0.08	--	0.23	0.43	--	--	--	--	2.27	--	--
12	--	0.01	--	0.39	0.08	--	--	--	--	0.10	--	--
13	--	1.62	--	0.90	--	--	--	--	0.18	--	--	--
14	--	--	0.07	1.76	--	--	--	--	--	--	2.52	--
15	--	--	0.12	1.16	--	--	--	--	--	--	1.48	--
16	--	0.01	1.60	--	--	--	--	--	--	0.26	--	--
17	--	0.51	0.18	--	--	0.07	--	--	--	--	--	--
18	--	--	--	--	--	--	--	--	--	--	--	--
19	--	--	--	1.40	--	--	--	--	--	--	1.00	--
20	--	0.06	--	0.01	--	--	--	--	--	--	1.85	0.62
21	--	--	--	--	--	--	--	--	--	0.01	--	--
22	--	--	--	0.34	--	--	--	--	--	--	--	--
23	--	--	1.45	--	--	0.13	--	--	--	0.57	0.95	--
24	--	--	0.36	--	--	--	--	--	--	--	0.65	--
25	--	--	--	0.04	--	--	--	--	--	0.07	--	0.01
26	--	--	--	0.36	--	--	--	--	--	--	--	--
27	--	--	1.27	0.01	--	--	--	--	--	--	--	0.16
28	--	--	2.46	--	--	0.03	--	--	--	--	--	0.18
29	0.10		0.59	--	0.02	--	--	--	--	0.03	--	0.27
30	1.26		0.92	--	0.23	--	--	--	--	--	--	--
31	2.64		0.05		--		--	--		--		--
Total	4.00	6.97	9.20	13.99	1.97	0.23	0.0	0.01	0.18	3.82	16.4	1.63

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1964	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	0.07	0.02	0.34	--	--	--	--	0.27	--	0.56	1.24
2	--	--	0.40	--	--	--	--	--	--	--	2.07	0.04
3	--	--	--	--	0.30	--	--	--	--	--	0.05	0.04
4	--	--	--	--	0.28	0.02	--	--	--	--	--	--
5	--	--	--	--	--	--	--	--	--	--	--	--
6	--	--	--	--	--	0.14	--	--	--	--	--	--
7	--	--	--	--	--	0.14	--	--	--	--	--	--
8	--	--	--	--	--	0.24	--	--	--	--	0.51	0.02
9	--	--	0.03	--	--	0.34	--	--	--	--	2.68	0.05
10	0.13	--	--	--	--	0.53	--	--	--	--	2.81	0.19
11	--	--	--	--	--	--	--	--	--	--	0.06	0.85
12	--	--	1.46	--	--	--	--	--	--	--	1.88	--
13	--	--	0.09	--	--	--	--	--	--	--	--	--
14	0.15	--	--	--	--	--	--	--	--	--	--	--
15	--	0.06	--	--	--	--	--	--	--	--	--	0.07
16	--	--	--	--	--	--	--	--	--	--	--	--
17	0.25	--	--	--	0.16	--	--	--	--	--	--	--
18	0.83	--	--	--	--	--	--	--	--	--	--	--
19	0.84	--	--	--	--	--	--	--	--	--	--	2.80
20	3.92	--	--	--	--	--	--	--	--	--	--	2.58
21	1.51	--	--	--	--	--	--	--	--	--	--	3.58
22	0.42	--	0.26	--	--	--	--	--	--	--	0.41	11.64
23	0.08	--	0.47	--	--	--	--	--	--	--	--	3.58
24	0.27	--	0.26	--	--	--	--	--	--	--	0.11	1.01
25	0.16	--	--	--	--	--	--	--	--	--	0.89	0.34
26	0.03	--	--	--	--	--	--	--	--	--	0.01	0.65
27	--	--	--	--	--	--	--	--	--	0.15	--	0.80
28	--	--	--	--	0.26	--	--	--	--	1.26	2.05	0.11
29	0.07	0.04	--	--	--	--	--	--	--	2.45	0.58	0.32
30	0.12		--	--	--	--	0.10	--	--	0.55	--	0.37
31	--		--		--		--	--		--		0.21
Total	8.78	0.17	2.99	0.34	1.00	1.41	0.10	0.0	0.27	4.41	14.67	30.49

1965	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	--	--	0.12	--	--	--	--	--	--	--	--
2	0.28	--	--	0.65	--	--	--	--	--	--	--	--
3	2.32	--	--	0.05	--	--	--	--	--	--	--	--
4	0.04	--	--	--	--	--	--	--	--	--	0.13	--
5	1.50	0.60	--	0.11	--	--	--	--	--	--	0.01	--
6	1.55	--	0.04	0.62	--	--	--	--	--	--	--	--
7	0.03	--	--	0.02	--	--	--	--	--	--	0.02	--
8	--	--	--	0.80	--	--	--	--	--	--	1.15	--
9	0.06	--	--	1.91	--	--	--	--	--	--	--	--
10	--	--	--	1.07	--	--	--	--	--	--	--	--
11	0.63	--	--	0.04	--	--	--	0.03	--	--	0.01	0.01
12	--	--	0.08	--	--	--	--	0.50	--	--	1.21	0.27
13	--	--	0.01	0.02	--	--	--	--	--	--	2.00	--
14	--	--	--	0.52	--	--	--	--	--	--	6.50	--
15	--	--	--	0.63	--	0.13	--	--	--	0.10	3.66	--
16	--	--	--	1.78	--	--	--	--	--	--	0.15	--
17	--	--	--	--	--	0.01	--	--	--	--	0.72	--
18	--	--	--	0.82	--	--	--	0.07	--	--	2.93	--
19	--	--	--	1.67	--	--	--	0.40	--	--	0.62	--
20	0.01	--	--	1.05	--	--	--	0.05	--	--	0.05	--
21	0.01	--	--	1.32	0.11	--	--	0.34	--	--	--	--
22	--	--	--	--	0.20	--	--	0.02	--	--	--	--
23	0.34	--	--	--	--	--	--	--	--	--	0.51	--
24	2.79	--	--	--	--	--	--	--	--	--	0.68	0.20
25	--	--	--	--	--	--	--	0.01	--	--	0.85	0.33
26	--	--	0.42	--	--	--	--	--	--	--	0.18	--
27	--	0.69	0.37	--	--	--	--	--	--	--	0.70	0.05
28	--	--	0.06	--	--	--	--	--	--	--	--	0.37
29	--		--	--	--	--	--	--	--	--	--	0.83
30	--		0.08	--	--	--	--	--	--	--	--	0.09
31	--		--		--		--	--		--		0.23
Total	9.56	1.29	1.06	13.20	0.31	0.14	0.0	1.42	0.0	0.10	22.08	2.38

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1966	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	0.56	--	--	--	--	--	--	--	--	--	1.07
2	--	0.03	--	--	--	--	--	--	--	--	--	1.40
3	1.00	--	0.04	--	--	--	--	--	--	--	--	1.72
4	4.16	2.40	--	--	--	--	--	--	--	--	--	0.72
5	2.64	2.15	0.86	--	--	--	--	--	--	--	--	5.27
6	1.03	0.19	0.15	--	--	--	--	--	--	--	0.88	0.02
7	--	--	0.06	--	--	0.07	--	--	--	--	0.15	--
8	0.27	--	0.43	--	--	--	--	--	--	--	--	--
9	--	--	0.41	--	--	--	--	--	--	--	--	0.20
10	--	--	1.10	1.06	--	--	--	--	--	--	--	0.71
11	--	--	--	0.23	--	--	--	--	--	--	0.10	0.01
12	--	--	--	0.58	--	--	--	--	--	--	1.17	0.06
13	--	--	0.47	--	--	--	--	--	0.25	--	0.79	0.17
14	--	--	--	--	--	--	--	--	--	--	1.50	0.60
15	--	--	--	--	--	--	--	--	--	--	2.95	--
16	--	--	0.21	--	--	--	--	--	--	--	1.96	--
17	--	--	--	--	--	--	--	--	--	--	--	--
18	--	--	--	--	--	--	--	--	0.10	--	--	--
19	--	0.41	0.08	--	--	--	--	--	0.02	--	0.37	--
20	--	0.66	--	--	--	--	--	--	--	--	2.85	--
21	--	--	--	--	--	--	--	--	--	--	1.33	--
22	0.13	--	--	--	--	--	--	--	--	--	1.41	--
23	0.09	0.31	--	--	--	--	--	--	--	--	--	0.05
24	--	0.32	--	--	--	--	--	--	--	--	--	0.05
25	--	0.08	--	--	--	--	--	--	--	--	--	--
26	--	0.90	--	--	--	--	--	--	--	--	--	0.02
27	--	--	--	--	--	--	--	--	--	--	--	--
28	--	--	--	--	--	--	--	--	--	--	0.34	--
29	--		--	--	--	--	--	0.06	--	--	0.64	--
30	--		--	--	--	--	--	0.12	--	--	--	--
31	--		--		--		--	0.02		--		--
Total	13.69	9.01	3.81	1.87	0.0	0.7	0.0	0.20	0.37	0.0	16.44	12.07

1967	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	0.03	--	0.62	--	0.50	--	--	--	--	--	0.29
2	--	0.11	--	--	--	1.37	--	--	--	--	--	0.10
3	--	--	--	--	--	--	--	--	TR	1.06	--	2.51
4	--	--	--	--	--	--	--	--	--	--	--	0.57
5	--	--	--	0.32	--	--	--	--	--	0.09	--	1.21
6	--	--	--	2.24	--	0.24	--	--	--	--	--	--
7	--	--	--	0.68	--	--	--	--	--	--	--	1.24
8	--	--	--	--	--	--	--	--	--	--	0.09	--
9	--	--	--	0.39	--	--	--	--	--	--	0.20	--
10	--	--	0.50	0.26	1.00	--	--	--	--	--	--	--
11	--	--	1.60	0.56	0.06	--	--	--	--	--	--	--
12	--	--	1.09	0.02	0.24	--	--	--	--	--	--	--
13	--	--	0.17	--	--	0.11	--	--	--	--	--	--
14	--	--	0.30	--	--	--	--	--	--	--	1.25	--
15	--	--	0.02	0.15	--	--	--	--	--	--	0.03	--
16	--	0.02	1.72	0.03	--	--	--	--	--	--	--	--
17	--	--	1.65	0.85	--	--	--	--	--	--	--	--
18	--	--	0.03	1.51	--	--	--	--	0.05	--	--	0.63
19	--	--	--	0.47	--	--	--	--	--	--	0.15	--
20	1.62	--	0.60	0.19	--	--	--	--	--	--	--	--
21	3.32	--	0.23	0.03	--	--	--	--	--	--	--	--
22	0.15	--	--	0.23	--	--	--	--	--	0.08	--	--
23	--	--	0.11	0.70	--	--	--	--	--	--	--	--
24	1.42	--	--	0.31	--	--	--	--	--	--	--	--
25	0.28	0.90	--	0.02	--	--	--	--	--	--	--	--
26	1.19	--	--	--	--	--	--	--	--	--	--	--
27	0.44	--	--	0.61	--	--	--	--	--	--	--	--
28	1.45	--	--	0.03	--	--	--	--	--	--	0.20	--
29	2.16		0.16	--	--	--	0.02	--	--	--	0.91	--
30	0.20		0.31	--	--	--	--	--	--	--	1.23	--
31	2.71		2.76		--		--	--		--		--
Total	14.94	1.06	11.25	10.22	1.30	2.22	0.02	0.0	0.05	1.23	4.06	6.55

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1968	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	0.10	--	0.10	--	--	--	0.06	--	--	--	0.56
2	--	0.66	--	0.33	--	--	--	--	--	--	1.02	--
3	--	0.62	--	--	--	--	--	--	--	--	0.41	--
4	--	--	--	--	--	--	--	--	--	--	0.51	--
5	--	--	--	--	--	0.26	--	--	--	--	0.01	--
6	--	--	0.03	--	--	0.24	--	--	--	--	0.01	--
7	--	--	0.88	--	--	--	--	--	--	--	--	--
8	--	--	0.14	--	--	--	--	0.19	--	--	--	0.30
9	0.41	0.15	0.16	--	--	--	--	--	--	--	--	0.15
10	2.51	--	--	--	--	--	--	--	--	--	--	2.44
11	--	--	--	--	--	--	--	--	--	0.02	--	1.35
12	--	--	--	--	--	--	--	--	--	2.93	0.61	0.05
13	0.27	--	1.37	--	0.80	--	--	--	--	0.18	--	--
14	0.78	0.31	1.21	--	0.78	--	--	0.02	0.11	--	--	1.78
15	1.16	0.25	0.24	--	--	--	--	--	--	0.24	1.24	1.20
16	0.17	0.12	1.32	--	--	--	--	--	--	--	--	0.36
17	0.05	2.73	0.12	--	--	--	--	0.60	--	--	--	--
18	--	0.10	0.06	--	--	--	--	--	--	--	0.37	--
19	--	0.57	--	--	--	--	--	0.85	--	--	0.09	--
20	--	1.45	--	--	0.80	--	--	0.28	--	--	--	--
21	--	1.14	--	--	0.03	--	--	0.58	--	--	--	--
22	--	1.37	--	--	0.38	--	--	--	--	--	--	--
23	--	1.44	0.12	--	--	--	--	--	--	--	--	2.19
24	--	0.44	0.08	--	--	--	--	--	--	--	0.39	2.63
25	--	--	0.20	--	0.03	--	--	--	--	--	0.10	1.39
26	--	--	--	--	--	--	--	0.06	--	--	--	0.11
27	--	--	--	--	--	--	--	--	--	--	--	--
28	0.06	--	--	--	--	--	--	--	--	--	--	1.61
29	3.05	--	--	--	--	--	--	--	--	0.37	--	0.28
30	1.75		--	--	--	--	--	--	--	0.44	0.60	--
31	0.15		--		--		--	--		--		--
Total	10.36	11.48	5.93	0.43	2.82	0.50	0.0	2.64	0.11	4.18	5.36	16.40

1969	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	0.34	1.93	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	--	--	--	--	--	--
3	--	--	0.43	0.96	--	--	--	--	--	--	--	--
4	--	--	--	--	--	--	--	--	--	--	--	--
5	--	0.80	--	1.06	--	--	--	--	--	--	0.43	--
6	--	1.60	--	0.84	--	--	--	--	--	--	0.70	--
7	--	0.03	--	--	--	--	--	--	--	--	0.16	--
8	--	0.10	--	--	--	--	--	--	--	0.07	0.81	0.69
9	--	3.43	--	--	--	--	--	--	--	--	--	0.03
10	--	0.64	--	--	--	0.16	--	--	--	--	--	1.00
11	0.78	1.26	--	--	--	0.25	--	--	--	--	--	2.28
12	3.28	2.13	0.71	--	--	0.09	--	--	--	--	--	3.90
13	7.42	--	--	0.04	--	--	--	--	--	--	--	1.95
14	0.17	0.49	--	--	--	--	--	--	--	0.10	--	0.75
15	--	2.11	--	--	--	--	--	--	--	0.08	--	0.44
16	--	0.18	--	--	--	--	--	--	--	1.11	--	0.02
17	--	--	0.37	--	--	--	--	--	--	0.32	--	0.29
18	--	0.35	0.44	0.17	--	--	--	--	--	--	--	0.46
19	1.13	0.02	--	--	--	0.17	--	--	0.06	--	--	2.00
20	3.20	--	--	--	--	--	--	--	--	--	--	2.12
21	5.05	--	0.04	--	--	--	--	--	--	--	--	3.85
22	0.25	0.06	--	--	--	--	--	--	--	--	--	0.01
23	--	0.80	--	1.21	--	--	--	--	--	--	--	1.38
24	--	1.21	--	0.37	--	--	--	--	--	--	--	0.59
25	0.22	0.19	--	0.05	--	--	--	--	--	--	--	0.55
26	1.47	0.31	--	--	--	--	--	--	--	--	--	--
27	0.05	0.10	--	--	0.04	--	--	--	--	--	--	--
28	0.01	2.41	--	--	--	--	--	--	--	--	--	--
29	--		--	--	--	--	--	--	--	--	--	--
30	1.15		--	--	--	--	--	--	--	--	--	--
31	--		--		--		--	--		--		--
Total	24.18	18.56	3.92	4.70	0.04	0.67	0.0	0.0	0.06	1.68	2.10	22.31

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1970	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	--	1.80	--	--	--	--	--	--	--	--	0.98
2	--	--	--	--	--	--	--	--	--	--	--	0.59
3	--	--	--	--	--	--	--	--	--	--	--	1.10
4	--	--	0.30	--	--	--	--	--	--	--	1.36	3.43
5	--	--	0.81	--	--	--	--	--	0.02	--	2.88	0.18
6	--	--	--	--	--	--	--	--	--	--	0.30	0.21
7	--	--	0.11	--	0.02	--	--	--	--	--	0.91	0.60
8	0.36	--	0.46	--	0.08	--	--	--	--	--	0.69	1.28
9	2.07	--	0.05	--	0.11	1.49	--	--	--	--	3.15	0.50
10	3.58	--	0.16	--	--	0.06	--	--	--	--	0.21	--
11	0.49	--	0.09	--	--	--	--	--	--	--	0.60	--
12	0.38	0.17	0.06	--	0.05	--	--	--	--	--	0.28	--
13	1.33	0.92	--	0.04	--	--	--	--	--	--	--	--
14	5.56	0.46	0.20	0.16	--	0.46	--	--	--	--	--	0.12
15	0.36	--	--	--	--	--	--	--	--	--	--	0.13
16	2.15	--	--	--	--	--	--	--	--	--	--	1.55
17	0.74	2.05	--	--	--	--	--	--	--	--	--	0.03
18	0.18	--	--	--	--	--	--	--	--	0.20	--	0.65
19	0.40	--	--	--	--	--	--	--	--	--	--	0.01
20	0.81	--	--	--	--	--	--	--	--	0.93	--	--
21	2.04	--	--	--	--	--	--	--	--	0.04	--	2.27
22	2.94	--	--	--	--	--	--	--	--	1.52	0.54	--
23	2.95	--	--	--	--	--	--	--	--	0.44	0.35	--
24	4.80	--	--	--	--	--	--	--	--	0.67	0.78	--
25	0.03	--	--	--	--	--	--	--	--	--	1.96	--
26	0.34	--	--	--	--	--	--	--	--	--	0.18	--
27	2.62	--	--	--	--	--	--	--	--	--	1.32	0.03
28	--	0.19	--	--	--	--	--	--	--	--	6.53	0.25
29	--		--	--	--	--	--	--	--	--	1.76	2.41
30	--		--	--	--	--	--	--	--	--	1.92	0.02
31	--		--		--		--	--		--		0.06
Total	34.13	3.79	4.04	0.20	0.26	2.01	0.0	0.0	0.02	3.80	25.72	16.40

1971	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.08	--	--	--	--	0.11	--	--	--	--	--	--
2	0.10	--	--	--	--	--	--	--	--	--	--	0.41
3	--	--	--	--	0.41	--	--	--	--	--	--	0.71
4	--	--	0.02	--	0.19	0.35	--	--	--	--	--	0.24
5	--	--	--	--	0.04	--	--	--	--	--	--	--
6	--	--	--	--	--	--	--	--	--	--	--	0.22
7	--	--	--	0.01	--	--	--	--	--	--	--	--
8	--	--	--	--	0.45	--	--	--	--	--	--	--
9	--	--	--	0.02	0.19	--	--	--	--	--	0.02	0.10
10	0.54	--	--	1.28	--	0.03	0.03	--	--	--	0.31	0.13
11	0.33	--	0.78	--	--	--	--	--	--	--	0.35	--
12	0.09	--	2.98	--	--	--	--	--	--	--	0.77	1.70
13	0.43	--	0.79	--	0.23	--	--	--	--	--	2.71	--
14	0.20	--	0.11	--	--	--	--	--	--	--	--	0.01
15	0.89	0.02	0.33	--	--	--	--	--	--	--	--	0.03
16	3.35	--	--	--	--	--	--	--	--	--	--	--
17	1.91	--	0.07	--	--	--	--	--	--	--	--	--
18	0.25	--	--	--	--	0.02	--	--	--	--	--	--
19	--	0.20	--	--	--	--	--	--	--	--	--	--
20	--	--	--	0.14	--	--	--	--	--	0.27	--	--
21	--	--	--	0.04	--	--	--	--	--	0.04	--	--
22	--	--	--	--	--	--	--	--	--	--	--	1.89
23	--	--	1.10	0.02	--	--	--	--	--	0.35	--	0.04
24	--	--	0.44	--	--	--	--	--	--	0.13	0.11	0.27
25	--	--	1.14	--	--	--	--	--	--	--	0.06	0.54
26	--	--	2.87	--	0.25	0.24	--	--	--	--	0.18	0.40
27	--	--	0.03	--	0.14	0.05	--	--	0.03	--	1.00	0.31
28	--	--	--	--	0.90	--	--	--	--	--	1.68	--
29	--		--	--	0.04	--	--	--	0.03	--	0.44	0.02
30	--		--	--	--	--	--	--	0.68	--	--	--
31	--		--		--		--	0.15		--		--
Total	8.17	0.22	10.66	1.51	2.84	0.80	0.03	0.15	0.74	0.79	7.63	7.02

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1972	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	--	--	--	--	--	--	--	--	--	--	--
2	--	--	0.75	0.33	--	--	--	--	--	--	--	--
3	--	--	0.99	--	--	--	--	--	--	--	0.40	0.26
4	--	--	--	--	--	--	--	--	--	--	1.36	0.59
5	--	0.04	--	0.52	--	--	--	--	--	--	--	--
6	--	0.23	--	1.55	--	--	--	--	--	--	--	0.66
7	--	--	--	0.11	--	--	--	--	--	--	0.07	0.04
8	--	--	--	--	0.10	--	--	--	--	--	0.45	0.08
9	--	--	--	--	--	--	--	--	--	0.59	0.04	--
10	--	--	0.47	0.01	--	1.51	--	--	--	0.69	0.70	--
11	--	--	0.39	0.83	--	0.05	--	--	--	1.02	2.21	--
12	--	--	0.01	1.31	--	--	--	--	0.05	0.30	--	0.05
13	--	--	--	0.26	--	--	--	--	--	0.05	1.05	0.03
14	--	--	--	--	--	--	--	--	--	0.27	3.68	--
15	--	--	--	--	--	--	--	--	--	0.80	0.43	--
16	--	--	--	--	--	--	--	--	--	0.50	2.15	0.17
17	--	--	--	--	0.05	--	--	--	--	0.30	0.05	1.04
18	--	--	--	--	--	--	--	0.08	--	--	0.35	0.28
19	0.19	--	--	--	0.15	--	--	--	--	--	0.33	1.15
20	0.67	0.17	--	--	0.51	--	--	--	--	--	--	0.17
21	1.30	--	--	--	1.75	--	--	--	--	--	--	0.14
22	1.04	0.20	0.66	--	0.02	--	--	--	--	--	0.05	1.00
23	1.60	0.38	1.52	--	--	--	--	--	--	--	--	0.15
24	--	0.26	0.18	0.35	--	--	--	--	--	--	--	0.31
25	0.68	--	0.39	0.05	--	--	--	--	--	--	--	--
26	0.10	0.74	--	--	--	--	--	--	0.34	--	--	--
27	1.28	0.13	--	--	--	--	--	--	1.03	--	--	--
28	--	0.81	--	--	--	--	--	--	--	--	--	0.46
29	--	0.69	--	--	--	--	--	--	--	--	--	--
30	--		--	--	--	--	--	--	--	--	--	--
31	--		--		--		--	--		--		--
Total	6.86	3.65	5.36	5.32	2.58	1.56	0.0	0.08	1.42	4.52	13.36	6.58

1973	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	--	1.60	--	--	0.21	--	--	--	--	--	2.89
2	--	--	--	--	--	--	--	--	--	--	--	0.05
3	--	--	0.03	--	--	--	--	--	--	--	--	--
4	--	0.76	0.48	--	--	--	--	--	--	--	--	--
5	--	2.40	--	--	--	--	--	--	--	--	1.32	0.03
6	--	0.23	1.39	--	--	--	--	--	--	--	1.75	--
7	--	0.91	0.39	--	--	--	--	--	--	--	0.73	0.03
8	--	0.24	0.32	--	--	--	--	--	--	2.50	1.84	0.13
9	1.30	0.15	--	--	--	--	--	--	--	--	1.22	--
10	0.78	1.41	0.03	--	--	--	--	--	--	0.10	3.40	--
11	1.69	2.12	0.28	--	--	--	--	--	--	--	3.07	0.66
12	1.16	0.23	--	--	--	--	--	--	--	--	1.42	0.14
13	1.04	0.11	--	--	--	--	--	--	--	--	0.55	0.32
14	--	0.79	--	--	--	--	--	--	--	--	1.07	0.04
15	0.10	1.03	--	--	--	--	--	--	--	--	1.17	--
16	7.74	--	--	--	--	--	--	--	--	--	1.88	--
17	0.15	--	0.06	0.02	--	--	--	--	--	--	0.38	0.41
18	2.60	--	--	--	--	--	--	--	--	--	3.71	0.02
19	0.09	--	--	--	--	--	--	--	0.56	--	--	--
20	--	--	1.77	--	--	--	--	--	0.01	0.15	0.12	0.07
21	0.36	--	0.73	--	--	--	--	--	--	0.08	0.19	2.08
22	--	--	0.57	--	--	--	0.16	--	0.80	1.25	0.36	0.84
23	--	--	--	--	--	--	--	--	--	0.81	0.11	--
24	--	0.70	--	--	0.34	--	--	--	--	0.16	0.24	0.17
25	0.39	1.00	--	--	0.52	--	--	--	--	--	--	0.08
26	0.09	0.18	--	--	--	--	--	--	--	--	--	0.03
27	--	0.96	--	--	--	--	--	--	--	--	0.05	0.98
28	--	0.66	--	--	--	--	--	--	--	--	0.07	1.00
29	0.24		--	--	--	--	--	--	--	--	0.05	1.73
30	0.90		0.12	--	--	--	--	--	--	--	2.92	--
31	0.33		0.64		--		--	--		--		--
Total	18.98	13.88	8.41	0.02	0.86	0.21	0.16	0.0	1.37	5.05	27.62	11.70

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1974	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	1.30	1.93	2.84	--	--	--	--	--	--	0.04	--
2	--	--	0.44	0.61	--	--	--	--	--	--	--	0.48
3	0.10	--	0.58	--	--	--	--	--	--	--	--	3.08
4	0.01	--	--	--	--	--	--	--	--	--	--	2.36
5	0.03	--	--	--	--	--	--	--	--	--	--	--
6	0.06	--	--	0.06	--	--	--	0.25	--	--	--	--
7	--	--	1.30	--	--	--	--	--	--	--	--	--
8	--	--	0.12	--	--	--	0.88	--	--	--	1.11	--
9	--	--	--	0.44	--	--	2.63	--	--	--	--	--
10	--	--	--	0.15	--	--	0.52	--	--	--	--	--
11	--	--	1.98	--	--	--	--	--	--	--	--	--
12	0.68	--	0.90	--	--	--	--	--	--	--	--	--
13	1.00	0.35	0.08	--	--	--	--	--	--	--	--	0.36
14	0.47	--	--	--	--	--	--	--	--	--	--	0.06
15	2.83	--	--	--	--	--	--	--	--	--	--	0.08
16	4.77	0.30	--	--	--	--	--	--	--	--	--	--
17	3.60	--	--	--	--	0.10	--	--	--	--	--	0.02
18	0.73	0.16	--	--	0.46	--	--	--	--	--	0.36	--
19	0.93	1.51	--	--	--	0.15	--	--	--	--	--	--
20	--	--	--	--	--	0.32	--	--	--	--	--	--
21	--	--	--	--	--	--	--	--	--	--	0.32	0.02
22	--	0.10	--	--	--	--	--	--	--	--	0.75	0.05
23	--	--	--	--	--	--	--	--	--	--	--	--
24	--	--	--	0.96	--	--	--	--	--	--	--	--
25	--	--	0.17	0.44	--	--	--	--	--	--	0.24	--
26	--	--	0.70	0.33	--	--	--	--	--	--	--	--
27	--	--	0.61	--	--	--	--	--	--	--	--	1.15
28	--	0.84	2.11	--	--	--	--	--	--	2.51	--	1.58
29	--		3.08	--	--	--	--	--	--	0.18	--	--
30	--		4.97	--	--	--	--	--	--	--	--	--
31	0.75		0.05		--		--	--		0.47		--
Total	15.96	4.56	19.02	5.83	0.46	0.57	4.03	0.25	0.0	3.16	2.82	9.24

1975	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	2.16	0.06	--	--	--	--	--	--	--	--	0.08
2	--	1.23	0.84	--	--	--	--	--	--	--	--	--
3	--	0.08	0.05	--	--	--	--	--	--	--	--	--
4	0.11	0.64	--	0.19	--	--	--	--	--	--	--	--
5	--	0.42	0.10	0.80	--	--	--	--	--	--	--	2.41
6	1.45	0.33	1.05	0.06	--	--	--	--	--	--	0.02	0.81
7	0.02	1.22	1.09	--	--	--	--	0.01	--	0.12	0.32	--
8	1.55	0.59	1.30	0.34	--	--	--	--	--	--	0.02	--
9	--	1.85	0.91	--	--	--	--	--	--	--	--	--
10	--	0.86	0.90	--	--	--	--	--	--	3.41	0.41	--
11	--	0.13	0.03	--	--	--	--	--	--	0.53	--	--
12	--	1.72	--	--	--	--	--	--	--	0.01	--	0.43
13	--	4.17	0.60	--	--	--	--	--	--	--	--	--
14	--	0.04	0.60	--	--	--	--	--	--	--	--	--
15	--	--	0.29	0.70	--	--	0.39	--	--	--	0.45	--
16	--	--	1.27	--	--	--	0.18	--	--	--	0.74	--
17	--	--	0.21	--	--	--	--	--	--	--	--	--
18	--	--	3.90	--	--	--	--	0.36	--	--	--	--
19	--	0.38	4.47	0.16	--	--	--	0.02	--	--	--	--
20	--	0.74	0.02	--	--	--	--	--	--	--	0.19	--
21	--	--	0.21	--	--	--	--	--	--	--	--	--
22	--	--	2.27	--	--	--	--	--	--	--	--	0.45
23	--	--	0.17	0.45	--	--	--	--	--	--	--	--
24	--	--	0.60	0.61	--	0.31	--	--	--	--	--	--
25	--	--	2.22	0.70	--	--	--	--	--	0.12	--	--
26	--	--	--	0.14	--	--	--	--	--	2.27	--	--
27	--	0.06	--	--	--	--	--	--	--	--	--	--
28	--	--	--	--	--	--	--	0.08	--	--	--	--
29	--		--	--	--	--	--	--	--	--	--	--
30	--		--	--	--	--	--	--	--	1.34	--	--
31	0.21		--		--		--	--		0.03		--
Total	3.34	16.61	23.16	3.95	0.0	0.31	0.57	0.47	0.0	7.83	2.15	4.18

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1976	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	--	1.37	0.04	--	--	--	--	--	--	--	--
2	--	--	0.63	--	--	--	--	0.36	--	0.05	--	--
3	--	--	0.96	--	--	--	--	--	--	0.02	--	--
4	--	--	--	--	--	--	--	0.02	--	--	--	--
5	0.06	--	--	0.01	--	--	--	TR	--	--	--	--
6	--	--	--	0.45	--	--	--	--	--	--	--	--
7	--	--	--	0.25	--	--	--	0.05	--	--	--	--
8	--	--	--	2.85	--	--	--	--	--	--	--	--
9	0.65	--	--	1.01	--	--	--	--	--	--	--	--
10	--	--	--	0.02	--	TR	--	--	--	--	--	--
11	--	--	--	0.83	--	--	--	--	--	--	0.02	--
12	0.03	--	--	0.16	--	--	--	--	0.12	--	0.06	--
13	--	0.01	--	0.02	--	--	--	--	--	--	--	--
14	--	0.32	--	--	--	--	--	0.70	--	--	1.25	--
15	--	1.14	--	--	--	--	--	3.40	--	--	0.22	--
16	--	1.31	--	--	--	--	--	0.02	9.64	--	--	--
17	--	0.54	--	--	--	--	--	0.01	--	--	--	--
18	--	0.09	--	0.08	--	--	--	0.75	--	--	--	--
19	--	0.27	0.05	--	--	--	--	0.10	--	--	--	--
20	--	--	--	--	--	--	--	--	--	--	--	--
21	--	--	--	--	--	--	--	--	--	--	--	--
22	--	--	--	--	--	--	--	0.04	--	--	--	--
23	--	--	--	--	--	--	--	0.02	--	--	--	--
24	--	--	--	--	--	--	--	--	--	--	--	--
25	--	0.44	0.13	--	--	--	--	--	--	--	--	--
26	--	3.48	--	--	--	--	--	--	--	--	--	--
27	--	0.70	--	--	--	--	--	--	--	--	--	--
28	--	0.27	--	--	--	--	--	--	0.95	--	--	--
29	--	0.58	--	--	--	--	--	--	--	--	--	--
30	--		--	--	--	--	--	--	--	--	--	0.38
31	--		--		0.03		--	--		--		0.02
Total	0.74	9.15	3.14	5.72	0.03	TR	0.0	5.47	1.71	0.07	1.56	0.40

1977	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	--	--	--	0.48	--	0.01	--	--	--	--	--
2	1.43	--	--	--	0.30	--	--	--	--	--	--	--
3	1.44	--	--	--	0.01	--	--	--	--	--	--	--
4	0.21	--	--	--	0.10	--	--	--	--	--	--	--
5	--	--	--	--	--	--	--	--	--	--	1.05	--
6	--	--	--	--	0.22	--	--	--	--	--	--	--
7	--	--	--	--	--	--	--	--	--	--	--	0.08
8	--	0.07	0.02	0.18	--	--	--	--	--	--	--	--
9	--	0.81	0.31	0.10	0.20	--	--	--	--	--	--	--
10	--	--	--	--	1.13	--	--	--	--	--	--	--
11	--	--	--	--	0.75	--	--	--	--	--	--	0.25
12	0.23	--	0.02	--	0.14	--	--	--	--	--	0.15	0.71
13	--	--	--	--	--	--	--	--	--	--	0.01	0.42
14	--	--	0.01	--	--	--	--	--	--	--	--	3.74
15	--	--	0.54	--	--	--	--	--	--	--	--	1.77
16	--	--	0.93	--	--	--	--	--	0.61	--	--	0.12
17	--	--	0.13	--	--	--	--	--	1.39	--	--	2.05
18	--	--	--	--	--	--	--	--	0.78	--	--	--
19	--	--	--	--	0.12	--	--	--	0.66	--	--	--
20	--	--	--	--	--	0.03	--	--	3.24	--	--	--
21	--	--	--	--	--	--	--	--	--	--	1.67	0.02
22	--	0.84	--	--	--	--	--	--	--	--	1.11	0.89
23	--	0.71	0.09	--	0.87	--	--	--	--	--	0.38	2.04
24	--	0.03	0.41	--	0.08	--	--	--	--	0.04	0.25	0.06
25	--	--	0.50	0.04	--	--	--	0.07	--	--	--	--
26	--	--	--	0.84	0.92	--	--	0.20	--	0.02	0.14	0.33
27	--	--	--	--	0.22	--	--	--	--	0.12	0.01	0.55
28	--	--	--	--	--	--	--	--	0.66	0.32	--	0.13
29	--		--	--	--	--	--	--	1.54	1.02	--	0.19
30	--		--	0.12	--	--	--	--	0.01	0.37	--	0.05
31	--		--		--		--	--		--		--
Total	3.31	2.48	2.95	1.26	5.34	0.03	0.01	0.27	8.89	1.89	4.77	13.38

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1978	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	0.04	--	3.79	0.12	--	0.04	--	--	--	--	0.18
2	0.57	0.86	0.46	0.19	--	--	--	--	--	--	--	--
3	0.55	0.13	3.23	0.34	--	--	--	--	--	--	--	--
4	0.26	--	1.44	0.69	--	--	--	--	--	--	--	--
5	2.90	0.98	2.92	0.01	--	--	--	--	0.05	--	--	0.03
6	0.88	1.48	0.95	1.46	--	--	--	--	1.53	--	--	--
7	--	2.76	--	0.11	--	--	--	--	0.10	--	--	--
8	0.62	1.02	3.09	--	--	--	--	--	--	--	--	--
9	5.14	1.16	-1.83	--	--	--	--	--	0.13	--	--	--
10	0.34	--	--	--	0.05	--	--	--	3.14	--	--	--
11	0.13	--	0.03	--	--	--	--	--	--	--	--	--
12	2.81	0.42	0.11	--	--	--	--	--	--	--	--	0.05
13	1.23	0.92	--	--	--	--	--	--	0.03	--	0.17	--
14	2.00	0.03	--	--	--	--	--	--	0.02	--	--	--
15	4.43	0.12	--	0.81	--	--	--	--	--	--	--	--
16	4.58	0.02	--	1.23	--	--	--	--	--	--	--	--
17	2.00	0.05	--	0.01	--	--	--	--	--	--	--	0.12
18	0.32	--	--	--	--	--	--	--	--	--	--	--
19	3.31	--	--	--	--	--	--	--	--	--	0.18	--
20	0.18	--	--	0.28	--	--	--	--	--	--	1.07	--
21	--	--	0.02	0.08	--	--	--	--	--	--	0.96	--
22	0.40	--	1.07	--	--	--	--	--	--	--	0.57	--
23	--	--	0.40	--	--	--	--	--	--	--	--	--
24	--	--	0.02	--	--	--	--	--	--	--	--	--
25	--	-0.04	--	1.24	0.03	--	--	0.01	--	--	--	--
26	--	--	--	0.57	--	--	--	--	--	--	--	--
27	--	0.01	--	--	--	--	--	--	--	--	--	--
28	--	--	--	--	--	0.25	--	--	--	--	--	--
29	--		--	0.02	--	--	--	--	--	--	--	--
30	--		--	--	--	--	--	--	--	--	--	--
31	0.02		--		--		--	--		--		--
Total	32.67	10.04	15.59	10.63	0.20	0.25	0.04	0.01	5.00	0.0	2.95	0.38

1979	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	--	0.35	--	0.63	--	--	--	--	--	--	--
2	--	--	--	--	0.03	--	--	--	0.05	--	--	--
3	--	--	0.15	--	--	--	--	--	--	--	1.17	0.19
4	0.05	--	0.11	--	--	--	--	--	--	--	0.75	--
5	--	--	--	--	0.50	--	--	--	--	--	0.84	--
6	--	--	--	0.15	0.65	--	--	--	--	--	0.35	--
7	--	--	--	--	0.40	--	--	--	--	--	0.02	--
8	1.03	--	--	--	0.03	--	--	--	--	--	--	--
9	1.70	0.10	--	--	--	--	--	--	--	0.02	--	--
10	0.58	--	--	--	--	--	0.2	--	--	--	--	--
11	6.73	0.35	--	--	--	--	--	--	--	--	--	--
12	0.15	0.01	--	--	--	--	--	--	--	--	--	--
13	--	3.39	--	--	--	--	--	--	--	--	--	--
14	1.50	2.04	--	--	--	--	--	--	--	0.30	--	--
15	2.96	--	0.89	--	--	--	--	--	--	2.53	--	--
16	0.08	1.36	0.88	--	--	--	--	--	--	0.11	0.70	--
17	--	--	0.80	0.66	--	--	--	--	--	--	1.03	--
18	--	1.12	0.22	0.28	--	--	--	--	--	--	--	--
19	--	0.36	0.11	--	--	--	--	--	--	1.46	--	0.15
20	--	0.57	--	--	--	--	--	0.17	--	0.05	--	0.29
21	--	2.30	--	--	--	--	--	--	--	0.30	--	0.97
22	--	0.70	0.90	0.04	--	--	--	--	--	--	--	--
23	--	0.40	--	0.70	--	--	--	--	--	0.60	0.89	0.40
24	--	0.02	--	1.28	--	--	--	--	--	TR	1.20	2.50
25	--	--	--	--	--	--	--	--	0.21	2.62	0.25	1.02
26	--	0.70	--	0.29	--	--	--	--	0.15	--	0.56	0.44
27	--	--	2.08	0.75	--	--	--	--	--	--	--	--
28	--	0.40	0.76	--	--	--	--	0.07	--	--	--	--
29	--		0.04	--	--	--	--	0.53	--	--	--	0.04
30	--		--	--	--	--	--	0.02	--	--	--	0.95
31	--		--		--		--	--		--		0.76
Total	14.78	13.84	7.29	4.15	2.24	0.0	0.2	0.79	0.42	7.99	7.76	7.71

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1980	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.05	0.02	--	--	--	--	--	--	--	--	--	--
2	--	--	0.03	--	--	--	--	--	--	--	--	1.74
3	--	0.03	0.10	--	--	--	--	--	--	--	--	8.48
4	--	0.06	0.44	0.23	--	0.16	--	--	--	--	--	3.96
5	0.08	--	0.52	3.76	--	0.66	--	--	--	--	--	--
6	0.02	0.08	2.58	0.06	--	--	--	--	--	--	--	--
7	--	--	0.36	--	--	--	--	--	--	--	--	--
8	--	--	--	--	--	--	--	--	--	--	0.25	--
9	0.06	--	--	0.03	0.06	--	--	--	--	--	--	--
10	0.03	--	--	--	1.16	--	--	--	--	--	--	--
11	0.16	--	--	--	--	0.03	--	--	--	--	--	--
12	2.64	--	--	--	0.01	0.55	--	--	--	0.33	--	--
13	0.80	--	--	--	--	0.13	--	--	--	0.33	--	--
14	0.63	--	0.70	--	0.28	0.16	--	--	0.24	0.13	--	--
15	0.63	0.30	1.10	TR	--	--	--	--	--	--	--	--
16	0.47	2.48	--	--	--	--	--	--	--	--	--	--
17	0.76	6.98	--	--	--	--	--	--	--	TR	--	--
18	--	3.81	0.07	--	--	--	--	--	0.30	--	--	--
19	--	4.18	--	--	--	--	--	--	0.81	--	--	--
20	--	0.38	--	0.03	--	--	--	--	0.09	--	--	--
21	--	0.97	--	0.61	--	--	--	--	--	--	--	0.15
22	--	1.50	--	0.06	--	--	--	--	--	--	0.32	0.72
23	--	0.21	--	--	--	--	--	--	--	--	TR	--
24	--	--	--	0.04	0.02	--	--	--	--	--	0.04	--
25	--	0.03	0.08	--	--	--	--	--	--	0.04	--	0.23
26	--	0.04	0.05	--	--	--	--	--	--	--	--	--
27	0.02	0.21	--	--	--	--	--	--	--	--	--	--
28	--	1.19	--	--	--	--	--	--	--	--	--	0.18
29	--	0.04	--	--	0.03	--	--	--	--	--	--	--
30	--		--	--	--	--	--	--	--	--	0.35	--
31	--		--		0.28		--	--		--		0.01
Total	6.35	22.51	6.03	4.82	1.84	1.69	0.0	0.0	1.44	0.83	0.96	15.47

1981	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	--	--	0.06	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	--	--	--	--	--	--
3	TR	--	--	--	--	--	--	--	--	0.02	--	--
4	0.23	--	1.60	--	--	--	--	--	--	--	--	--
5	--	TR	0.36	--	--	--	0.02	--	--	--	--	--
6	--	--	--	--	--	--	--	--	--	--	--	0.16
7	TR	--	0.04	--	--	--	0.09	--	--	0.66	--	1.01
8	--	--	0.01	--	--	--	--	--	--	0.02	--	--
9	--	--	--	--	--	--	--	--	--	--	--	--
10	--	--	--	--	--	--	--	--	--	0.72	0.06	0.75
11	--	0.61	--	--	--	--	--	--	--	0.03	0.41	--
12	TR	0.20	--	--	--	--	--	--	--	--	2.36	0.25
13	--	0.38	0.66	--	--	--	--	--	--	--	0.69	0.80
14	--	3.35	--	--	0.04	--	--	--	--	--	2.40	1.67
15	--	--	0.13	--	--	--	--	--	--	--	2.36	0.70
16	0.74	--	1.30	--	--	--	--	--	--	--	4.64	--
17	1.47	0.39	--	--	--	--	--	--	--	--	2.32	--
18	0.51	--	--	--	1.21	--	--	--	--	--	0.01	0.47
19	0.01	--	0.60	1.09	2.59	--	--	--	--	--	--	3.40
20	0.60	0.09	0.58	0.68	0.09	--	--	--	--	--	--	2.86
21	0.47	--	1.66	0.14	--	--	--	--	--	--	0.57	0.56
22	0.71	--	1.35	--	--	--	--	--	--	--	0.48	--
23	3.00	--	0.02	--	--	--	--	--	--	--	2.07	--
24	0.78	0.63	0.02	--	TR	--	--	--	0.38	--	0.99	--
25	--	1.35	1.07	0.03	0.04	--	--	--	--	--	--	--
26	0.43	0.28	0.89	1.09	0.10	--	--	--	0.20	--	0.41	0.05
27	1.29	0.57	0.05	0.03	--	--	--	--	0.62	0.95	1.47	0.45
28	3.95	--	--	--	--	--	--	--	--	3.64	0.15	--
29	0.64		--	--	--	--	--	--	--	0.51	--	1.20
30	0.22		--	--	--	--	--	--	--	--	--	0.58
31	--		--		--		--	--		--		0.17
Total	15.05	7.85	10.34	3.12	4.07	0.0	0.11	0.0	1.20	6.55	21.39	15.08

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1982	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	2.00	--	1.88	1.15	--	--	--	--	--	--	--	--
2	0.56	--	1.33	1.85	--	--	--	--	--	--	--	0.16
3	1.76	--	0.02	2.85	--	--	--	--	--	--	--	0.32
4	0.26	--	0.09	--	--	0.04	--	--	0.03	--	--	0.05
5	--	--	--	--	--	0.07	--	--	--	--	--	--
6	--	--	--	0.10	--	--	--	--	--	--	--	--
7	--	--	--	0.15	--	--	--	--	--	0.24	--	--
8	--	--	0.42	0.02	--	--	--	--	--	--	--	--
9	--	--	0.35	--	--	--	--	--	--	--	--	--
10	--	0.04	0.28	0.05	--	--	--	--	--	--	--	--
11	--	--	0.20	0.95	--	--	--	--	--	--	--	--
12	--	--	--	0.30	--	--	--	--	--	--	--	--
13	--	0.64	--	0.03	--	--	--	--	--	--	--	0.20
14	--	2.18	0.40	4.07	--	--	--	--	--	--	--	--
15	--	1.32	0.09	--	--	--	--	--	--	--	--	1.91
16	--	2.90	0.47	--	--	--	--	--	--	--	--	2.20
17	--	0.71	0.30	--	--	--	--	--	0.08	--	0.74	3.70
18	0.06	--	0.02	--	--	--	--	--	0.03	--	2.05	--
19	0.28	0.52	0.08	--	--	--	--	--	0.48	--	0.28	--
20	1.23	--	--	--	--	--	--	--	0.14	0.02	0.15	0.18
21	0.58	--	--	--	--	--	--	--	--	0.07	0.02	3.15
22	--	--	--	--	--	--	--	--	--	1.13	0.03	1.82
23	0.10	--	--	--	--	--	--	--	--	0.62	0.27	0.83
24	0.02	--	--	--	--	--	--	--	--	0.10	--	--
25	--	--	--	--	--	--	--	--	0.16	0.08	--	--
26	0.58	TR	--	--	--	--	--	--	--	1.78	--	--
27	0.05	1.34	0.67	--	--	0.18	--	--	--	--	0.33	--
28	1.32	--	0.38	--	--	TR	--	--	--	--	0.65	--
29	--		0.25	--	--	2.02	--	0.33	--	0.06	2.61	--
30	--		1.20	--	--	--	--	--	--	1.86	1.01	--
31	--		2.17		--		(m)	--		--		--
Total	8.80	9.65	10.60	11.52	0.0	2.31	0.59	0.33	0.92	5.96	8.67	14.52

1983	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	--	4.59	--	0.20	--	--	--	0.34	0.03	1.12	0.08
2	--	--	1.64	0.21	0.01	--	0.03	--	--	--	0.48	0.05
3	--	--	2.95	--	--	--	--	--	--	--	0.03	1.85
4	--	--	0.06	--	--	--	--	--	--	--	0.36	0.30
5	--	0.47	0.84	--	0.79	--	--	--	--	--	--	--
6	--	2.00	1.12	--	1.41	--	--	--	--	--	0.15	0.98
7	--	1.90	1.71	--	--	--	--	--	--	--	0.70	2.48
8	0.01	1.73	0.10	--	--	--	0.08	--	--	--	--	0.20
9	--	1.55	0.23	--	0.01	--	--	--	--	0.03	0.52	2.19
10	--	0.93	0.45	--	--	--	--	--	--	--	2.70	2.27
11	--	0.21	0.73	--	--	0.24	--	--	--	--	2.88	3.59
12	--	1.85	1.02	0.07	--	--	--	--	--	--	0.84	1.20
13	--	1.46	5.16	--	--	--	--	--	--	--	0.82	0.80
14	--	--	0.50	--	--	--	--	--	--	--	0.21	0.18
15	--	0.09	--	--	--	--	--	--	--	--	0.01	0.02
16	0.27	0.45	--	--	--	--	--	--	--	--	0.91	0.02
17	0.12	--	1.05	--	--	--	0.12	--	--	--	1.90	0.33
18	1.28	0.97	0.58	--	--	--	--	--	--	--	0.02	--
19	1.59	0.34	--	0.67	--	--	--	--	--	--	0.48	--
20	0.01	--	--	0.58	--	--	0.02	0.06	--	--	0.82	--
21	0.01	--	1.18	--	--	--	--	--	--	--	--	--
22	0.49	0.09	1.20	0.03	--	--	--	1.06	--	--	--	--
23	0.35	--	0.78	0.64	--	--	--	0.46	2.00	0.08	0.74	0.28
24	2.69	0.27	2.01	1.20	--	--	--	--	--	0.60	1.40	1.80
25	0.58	1.04	0.71	1.12	--	--	--	--	--	--	--	1.47
26	3.63	1.27	--	0.11	--	--	--	--	--	--	--	1.39
27	4.61	1.69	2.33	0.15	--	--	--	--	--	--	--	1.08
28	0.55	2.39	0.07	1.00	--	--	--	--	--	--	--	--
29	0.53		0.82	0.90	--	--	--	--	--	--	--	0.04
30	0.57		1.84	0.21	--	--	--	--	0.13	1.04	--	1.04
31	0.06		0.88		--		--	--		1.48		0.02
Total	17.35	20.70	34.55	6.89	2.44	0.24	0.25	1.58	2.47	3.26	17.09	23.66

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1984	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	--	--	0.07	0.18	--	--	--	--	0.09	--	0.09
2	--	--	0.02	--	0.81	--	--	--	--	--	0.64	--
3	--	--	--	--	0.20	--	--	--	--	--	1.15	0.83
4	--	--	--	0.01	0.01	0.01	--	--	--	--	--	--
5	--	--	--	--	--	--	--	--	--	--	--	0.16
6	--	--	--	0.02	--	0.68	0.03	--	--	--	0.78	--
7	--	--	--	--	--	0.33	--	--	--	--	0.20	--
8	--	--	--	0.37	--	--	--	--	--	--	1.58	--
9	--	0.50	--	0.02	--	--	--	--	--	--	0.30	0.19
10	0.05	0.40	--	0.65	--	--	--	--	--	--	1.42	0.44
11	0.05	--	--	0.05	TR	--	--	--	--	0.84	1.40	0.49
12	--	0.65	--	--	0.02	--	--	--	--	0.01	3.38	--
13	--	0.94	1.61	--	--	--	--	--	--	0.01	2.66	--
14	--	0.43	2.17	--	--	--	--	--	--	--	0.05	--
15	0.04	0.74	1.30	--	--	--	--	--	--	--	--	0.32
16	0.35	0.55	0.02	--	--	--	--	--	--	0.03	1.04	0.06
17	--	--	0.82	--	--	--	--	--	--	0.97	0.15	0.27
18	--	--	--	0.55	--	--	--	--	--	--	0.99	0.03
19	--	--	--	0.82	--	--	--	--	TR	0.09	--	--
20	--	0.02	--	--	--	--	--	--	0.19	0.04	0.52	--
21	0.09	0.30	--	--	--	--	--	--	TR	--	0.26	--
22	--	--	--	--	--	--	--	--	--	--	--	--
23	--	--	--	--	--	--	--	--	--	--	--	--
24	--	0.15	--	--	--	--	--	--	--	--	1.40	--
25	--	--	--	--	--	--	--	--	--	--	--	--
26	--	--	--	--	--	--	--	0.09	--	0.01	--	0.01
27	--	--	--	--	--	--	--	--	--	--	0.33	--
28	--	--	--	--	--	--	--	--	--	--	2.12	--
29	--		--	--	--	--	--	--	--	0.65	--	--
30	--		--	0.03	--	--	--	0.01	--	--	TR	0.11
31	--		0.05		--		--	0.48		--		0.02
Total	0.58	4.68	5.99	2.59	1.22	1.02	0.03	0.58	0.19	2.74	20.37	3.02

1985	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	--	--	--	--	0.55	--	--	--	--	--	--
2	--	0.22	0.14	--	--	1.20	--	--	--	--	--	3.24
3	--	--	--	--	--	--	--	--	--	--	--	1.97
4	--	--	0.01	--	--	--	--	--	--	--	--	--
5	--	--	--	--	--	--	--	--	--	--	--	0.60
6	--	--	0.50	--	--	--	--	--	--	--	--	0.19
7	0.57	0.50	0.85	--	--	--	--	--	0.02	--	--	0.40
8	0.16	2.39	0.11	--	--	--	--	--	4.18	--	--	--
9	0.27	--	--	--	--	--	--	--	1.88	--	--	--
10	0.15	--	--	0.20	--	--	--	--	--	0.27	--	--
11	--	--	0.05	--	--	--	--	--	--	--	--	--
12	--	0.07	--	--	--	--	--	--	0.01	--	--	--
13	--	--	--	--	--	--	--	--	--	--	--	--
14	--	--	--	--	--	--	--	--	0.01	--	--	--
15	--	--	--	--	--	--	--	--	--	--	--	--
16	--	--	--	--	--	--	--	--	--	--	--	--
17	--	--	--	--	--	--	--	--	--	--	--	--
18	--	--	--	--	--	--	--	0.20	0.01	--	--	--
19	--	--	--	--	--	--	--	0.05	--	--	--	--
20	--	--	--	--	--	0.39	--	--	--	--	--	--
21	--	--	--	0.40	--	--	--	--	--	1.19	--	--
22	--	--	--	0.27	--	--	--	--	--	0.70	--	--
23	--	--	--	--	--	--	--	--	--	2.14	--	--
24	--	--	0.41	--	--	--	--	--	--	0.02	--	--
25	--	--	--	--	--	--	--	--	--	--	--	--
26	--	--	0.13	--	--	--	--	--	--	--	--	--
27	--	--	1.82	--	--	--	--	--	--	--	--	--
28	0.06	--	0.10	--	--	--	--	--	--	--	--	--
29	--		0.02	--	--	--	--	--	--	--	--	T
30	--		--	--	--	--	0.09	--	--	--	--	0.15
31	--		--		--		1.00	--		--		0.02
Tot	1.21	3.18	4.34	0.67	0.25	2.14	1.09	0.25	6.38	4.05	M	6.57

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1986	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.16	1.36	--	--	--	--	--	--	--	--	--	--
2	0.14	1.22	--	--	0.04	--	--	--	--	--	--	--
3	0.09	0.63	--	--	1.85	--	--	--	--	--	--	--
4	0.43	0.52	--	--	0.10	--	--	--	--	--	--	--
5	0.82	--	--	--	0.05	--	--	--	--	--	--	0.29
6	0.05	--	--	--	0.20	--	--	--	--	--	--	0.24
7	--	--	2.03	0.32	T	--	--	--	--	--	--	--
8	--	--	3.43	0.33	--	--	--	--	--	--	--	--
9	--	--	0.09	--	--	--	--	--	--	--	--	--
10	--	--	2.85	--	--	--	--	--	--	--	--	--
11	--	--	0.24	--	--	--	--	--	--	--	--	--
12	--	1.01	0.61	--	--	--	--	--	--	--	--	--
13	--	1.35	0.71	--	--	--	--	--	--	--	--	0.04
14	--	2.64	0.24	--	--	--	--	--	--	--	--	0.17
15	0.95	2.20	1.26	--	--	--	--	--	0.04	--	--	--
16	3.94	1.57	1.41	0.39	--	--	--	--	0.12	--	--	0.02
17	2.23	3.71	--	0.72	--	--	--	--	2.10	--	--	--
18	0.32	4.77	--	--	--	--	--	--	0.05	--	--	0.21
19	0.03	1.88	--	--	--	--	--	--	0.88	--	0.02	0.33
20	0.31	0.15	--	--	--	--	--	--	0.02	--	--	0.96
21	--	0.17	--	--	2.71	--	--	--	--	--	0.17	--
22	--	0.91	--	--	--	--	--	--	--	--	--	0.48
23	0.60	--	--	--	--	--	--	--	--	--	--	0.22
24	--	--	0.02	--	--	--	--	--	0.58	--	--	--
25	--	--	--	--	--	--	--	--	0.18	--	0.02	--
26	--	--	--	--	--	--	--	--	0.21	--	--	0.10
27	--	--	--	--	--	--	--	--	0.42	--	--	--
28	--	--	--	--	--	--	--	--	--	--	--	--
29	0.47	--	--	--	--	--	--	--	--	--	0.14	0.10
30	3.34	--	--	--	--	--	--	--	--	--	--	--
31	1.05	--	--	--	--	--	--	--	--	--	--	0.39
Total	14.93	24.09	12.89	1.76	4.95	0.0	0.0	M	4.60	1.43	0.35	3.55

1987	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.74	--	--	--	--	--	--	--	--	--	--	1.52
2	1.22	0.86	--	--	--	--	--	--	--	--	0.29	2.88
3	1.95	0.43	1.72	0.01	--	--	--	--	--	--	TR	2.20
4	0.23	--	0.11	--	--	--	--	--	--	--	--	0.10
5	0.09	--	2.89	--	--	--	--	--	--	--	--	2.15
6	0.09	--	1.39	--	--	--	--	--	--	--	TR	2.28
7	0.18	--	--	--	--	--	--	--	--	--	0.06	0.60
8	--	--	0.02	--	--	--	--	--	--	--	--	1.03
9	--	--	--	--	--	--	--	--	--	--	0.50	1.68
10	--	0.39	--	--	--	--	--	--	--	--	--	1.37
11	--	0.60	0.42	--	--	--	--	--	--	--	--	--
12	--	0.21	1.77	--	--	--	--	--	--	--	--	--
13	0.03	4.98	1.72	--	--	--	--	--	--	--	0.60	--
14	--	0.10	0.53	--	--	--	--	--	--	--	0.10	--
15	--	1.37	1.00	--	--	--	--	--	--	--	--	0.14
16	--	--	--	--	--	--	--	--	--	--	--	0.52
17	--	--	--	--	--	--	--	--	--	--	0.15	0.15
18	--	--	--	--	--	--	0.08	--	--	--	0.12	--
19	--	--	--	--	--	--	0.13	--	--	--	--	--
20	--	--	--	--	--	--	--	--	--	--	--	--
21	--	0.02	0.68	--	--	--	--	--	--	--	1.20	0.02
22	--	0.03	0.29	--	--	--	--	--	--	--	--	0.05
23	0.41	--	0.73	--	--	--	--	--	--	0.25	--	--
24	1.41	--	0.05	--	--	--	--	--	--	0.03	--	--
25	0.73	--	--	--	--	--	--	--	--	--	--	--
26	0.38	--	--	--	--	--	--	--	--	--	--	--
27	--	--	--	--	--	0.08	--	--	--	--	--	0.17
28	0.71	--	--	--	--	--	--	--	--	--	--	0.59
29	0.01		--	--	--	--	--	--	--	0.16	--	0.48
30	0.96		--	0.21	--	--	--	--	--	0.03	--	0.14
31	0.03		--		--		--	--		--		--
Total	9.17	8.99	13.32	0.22	1.90	0.08	0.21	0.0	0.0	0.47	3.83	18.07

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1988	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	--	0.29	--	--	0.07	--	--	--	--	--	--
2	--	--	--	--	--	0.33	--	--	--	--	0.20	--
3	0.88	--	--	--	--	0.02	--	--	--	--	5.01	--
4	1.92	--	--	--	--	--	--	--	--	--	0.02	--
5	0.50	--	0.05	--	0.26	0.03	--	--	--	--	--	--
6	--	--	--	--	0.26	0.16	--	--	--	--	0.04	--
7	--	--	--	--	1.45	0.55	--	--	--	--	--	--
8	0.70	--	--	--	0.95	0.42	--	--	--	--	0.13	--
9	1.10	--	--	--	0.73	0.01	--	--	--	--	--	--
10	0.40	--	--	--	--	0.02	--	--	--	--	1.93	--
11	1.58	--	--	--	--	--	--	--	--	0.08	0.04	--
12	--	--	--	--	--	--	--	--	--	0.17	0.46	--
13	0.09	--	--	--	0.08	--	--	--	--	--	0.78	--
14	0.17	--	--	0.20	--	--	--	--	--	0.45	0.58	--
15	0.41	--	--	0.11	--	--	--	--	--	--	0.08	--
16	1.90	--	--	--	0.15	--	--	--	--	--	0.78	--
17	0.10	--	--	0.03	0.63	--	--	--	--	--	1.35	--
18	--	--	--	--	--	--	--	--	--	--	--	--
19	--	--	--	1.65	--	--	--	--	--	--	--	--
20	--	--	--	1.51	--	--	--	--	--	--	--	--
21	--	--	--	0.05	--	--	--	--	--	--	--	--
22	--	--	--	0.02	--	--	--	--	--	--	2.60	--
23	--	--	--	0.73	--	--	--	--	--	--	2.12	--
24	--	--	--	--	--	--	--	--	--	--	--	--
25	--	--	--	--	--	--	--	--	--	--	0.95	--
26	--	--	--	--	--	--	--	--	--	--	0.01	--
27	--	--	--	--	--	--	0.25	--	--	--	--	--
28	--	0.10	--	--	--	--	--	--	--	--	0.08	--
29	0.58		--	0.17	1.40	--	--	--	--	--	--	--
30	0.70		--	0.05	--	--	--	--	--	--	--	--
31	--		--		--		--	--		--		--
Total	11.12	0.10	0.34	4.52	5.96	1.61	0.25	0.0	--	0.70	17.16	--

1989	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	--	--	--	0.13	--	0.03	--	--	--	--	--
2	--	--	2.27	0.33	--	--	--	--	--	--	--	--
3	--	--	0.17	0.10	--	--	--	--	--	--	--	--
4	--	--	--	--	--	0.08	--	--	--	--	--	--
5	0.53	--	0.78	--	--	0.01	--	--	--	--	--	--
6	0.02	--	1.48	--	--	--	--	--	--	--	--	--
7	0.03	--	0.08	--	--	--	--	--	--	--	--	--
8	0.06	--	1.57	--	--	--	--	--	--	--	--	--
9	0.24	--	1.26	--	--	--	--	--	--	--	--	--
10	0.76	0.76	0.57	--	1.06	--	--	--	--	--	--	--
11	--	0.06	1.10	--	0.04	--	--	--	--	--	--	--
12	--	0.01	--	--	--	--	--	--	--	--	--	--
13	--	--	0.10	--	--	--	--	--	--	--	--	--
14	0.10	--	--	--	--	--	--	--	--	--	--	--
15	--	--	--	--	--	--	--	--	--	--	--	--
16	--	--	0.35	--	--	--	--	--	--	--	--	--
17	--	--	0.12	--	--	--	--	--	2.10	--	--	--
18	--	0.10	1.24	--	--	--	--	--	2.16	--	--	--
19	--	0.70	0.37	--	--	--	--	--	--	--	--	--
20	--	0.02	--	--	--	--	--	--	--	--	--	--
21	--	0.06	--	0.07	--	--	--	--	--	0.37	--	--
22	0.34	0.13	--	0.33	--	--	--	--	--	1.63	--	--
23	0.26	0.07	--	0.39	0.08	--	--	0.15	--	2.47	--	--
24	--	--	1.09	0.28	--	--	--	--	--	0.81	0.26	--
25	--	--	1.37	0.22	--	--	--	--	--	0.13	0.12	--
26	--	--	0.11	0.10	--	--	--	--	0.05	--	0.97	--
27	--	--	0.13	0.04	--	--	--	--	0.05	0.65	--	--
28	--	--	0.58	--	--	--	--	--	--	--	--	--
29	--		--	--	--	--	--	--	0.28	--	--	--
30	--		--	0.27	--	0.04	--	--	0.53	--	--	--
31	--		0.18		--		--	--		--		--
Total	2.34	1.30	14.92	2.13	1.31	0.13	0.03	0.15	5.17	6.06	1.35	0.0

Table A1.--Continued.

DAILY PRECIPITATION AT SHASTA DAM

1990	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	0.69	--	--	--	0.10	--	--	--	--	--	--
2	0.20	0.05	0.28	--	--	--	--	--	--	--	--	--
3	--	--	1.48	--	--	--	--	--	--	--	--	--
4	--	0.69	0.18	--	--	--	--	--	--	--	--	--
5	--	--	0.36	0.06	--	--	--	--	--	--	--	--
6	-T-	0.36	--	--	--	0.02	--	--	--	--	--	--
7	1.53	--	--	--	--	--	--	--	--	--	--	--
8	3.22	--	0.05	0.28	--	--	--	--	--	--	--	--
9	0.56	--	--	0.02	--	--	--	--	--	--	--	--
10	0.08	--	0.45	--	--	--	--	--	--	--	--	0.16
11	--	--	0.05	--	--	--	--	--	--	--	--	0.24
12	--	--	--	--	--	--	--	--	--	--	--	--
13	2.51	--	--	--	--	--	--	--	--	--	--	--
14	2.07	--	0.14	--	--	--	--	--	--	--	0.37	--
15	--	--	--	--	--	--	--	--	--	--	--	0.26
16	0.06	1.03	--	--	--	0.06	--	--	--	--	--	0.09
17	0.05	0.46	--	0.17	--	--	-T-	--	--	--	--	--
18	--	0.05	--	--	--	--	0.01	0.18	--	0.06	--	--
19	--	--	--	--	--	--	-T-	0.02	--	0.22	--	0.02
20	--	--	--	--	0.95	--	--	--	--	--	--	--
21	--	--	--	--	1.64	--	--	0.06	--	--	--	--
22	--	--	--	--	0.87	--	--	--	--	--	--	--
23	--	--	0.02	1.38	3.59	--	--	--	0.01	--	--	--
24	--	--	--	0.02	--	--	--	--	0.14	--	--	--
25	--	--	--	--	--	--	--	--	0.01	--	--	--
26	--	--	--	--	0.72	--	--	0.62	0.37	--	0.28	--
27	--	--	--	--	1.83	--	--	0.02	--	--	--	--
28	--	--	--	--	2.28	--	--	--	--	--	--	--
29	--		--	--	0.32	--	--	--	--	--	--	--
30	0.27		--	--	0.11	--	--	0.18	--	--	--	--
31	0.08		--		0.45		--	--		1.71		--
Total	10.63	3.33	3.01	1.93	12.76	0.18	0.01	1.08	0.53	1.99	0.65	0.77

1991	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	--	--	1.68	--	--	--	--	--	--	--	--	--
2	--	--	1.35	0.22	--	--	--	--	--	--	--	--
3	--	--	4.37	--	--	--	--	--	--	--	--	--
4	--	--	3.00	--	--	--	--	--	--	--	--	--
5	--	--	0.20	--	--	--	--	--	--	--	--	--
6	--	--	--	0.28	--	--	--	--	--	--	--	--
7	0.42	--	--	--	--	--	--	--	--	--	--	--
8	--	--	--	--	--	--	--	--	--	--	--	--
9	0.17	--	--	--	--	--	--	--	--	--	--	--
10	0.04	--	0.23	--	--	--	--	--	--	--	--	--
11	0.02	--	0.10	--	--	--	--	--	--	--	--	--
12	0.30	--	0.84	--	--	--	--	--	--	--	--	--
13	0.53	--	0.85	--	--	--	--	--	--	--	--	--
14	--	--	--	--	--	--	--	--	--	--	--	--
15	0.01	--	0.09	--	--	--	--	--	--	--	--	--
16	--	--	--	--	--	--	--	--	--	--	--	--
17	--	--	0.34	--	--	--	--	--	--	--	--	--
18	--	--	1.11	--	--	--	--	--	--	--	--	--
19	--	--	0.09	--	--	--	--	--	--	--	--	--
20	--	--	1.87	--	--	--	--	--	--	--	--	--
21	--	--	0.52	--	--	--	--	--	--	--	--	--
22	--	--	0.03	--	--	--	--	--	--	--	--	--
23	--	--	1.02	--	--	--	--	--	--	--	--	--
24	--	--	1.91	--	--	--	--	--	--	--	--	--
25	--	--	0.44	--	--	--	--	--	--	--	--	--
26	--	--	1.95	--	--	--	--	--	--	--	--	--
27	--	--	0.27	--	--	--	--	--	--	--	--	--
28	--	0.17	--	--	--	--	--	--	--	--	--	--
29	--		--	--	--	--	--	--	--	--	--	--
30	--		--	--	--	--	--	--	--	--	--	--
31	--		--		--		--	--		--		--
Total	1.49	0.17	22.26	0.50 (4/11)	--	--	--	--	--	--	--	--

Table A2. Monthly summary of precipitation data, in inches, Shasta Dam, 1944-91

(--, no data. n, number of years. s, standard deviation)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	Annual
1944	6.11	14.74	2.82	3.71	1.52	4.80	0.00	0.44	0.00	4.58	9.97	8.89	57.58
1945	3.93	10.73	8.50	0.75	6.56	0.69	0.00	0.10	0.00	11.45	8.62	21.14	72.47
1946	4.98	3.71	3.29	0.96	1.59	0.00	1.07	0.00	0.06	0.94	8.53	5.12	30.25
1947	1.82	6.94	13.71	1.05	0.93	5.08	0.25	0.35	0.11	11.78	1.13	2.43	45.58
1948	10.24	2.66	8.14	14.22	3.19	2.55	0.37	0.34	1.86	1.44	4.06	5.14	54.21
1949	1.26	7.69	19.36	0.14	3.21	0.09	0.00	0.00	0.15	0.02	2.66	2.06	36.64
1950	14.01	4.61	5.15	1.56	1.62	0.98	0.00	0.00	0.53	17.38	4.98	9.57	60.39
1951	10.13	9.48	2.47	2.36	3.68	0.00	0.00	0.03	0.03	4.51	12.19	19.74	64.62
1952	13.46	6.52	6.51	1.62	2.34	3.29	0.10	0.00	0.20	0.42	4.54	24.52	63.52
1953	18.11	0.84	7.94	4.55	3.94	1.85	0.00	0.65	0.27	2.22	9.42	3.18	52.97
1954	21.34	10.13	9.37	8.10	0.00	2.21	0.01	4.14	0.28	1.75	10.01	9.63	76.97
1955	6.32	2.59	0.95	7.04	0.09	0.02	0.06	0.00	0.36	0.73	11.38	33.98	63.52
1956	18.40	16.12	0.16	1.60	3.77	1.14	0.17	0.00	0.19	4.87	0.47	0.20	47.09
1957	8.57	15.18	7.31	4.34	5.29	0.07	0.00	0.00	6.14	8.45	5.75	10.18	71.28
1958	12.96	30.79	11.15	8.89	2.30	6.10	0.91	0.17	0.42	0.35	1.25	4.02	79.31
1959	25.86	13.19	4.72	4.99	0.28	0.05	0.00	0.23	7.87	0.03	0.05	2.78	60.05
1960	12.41	11.99	10.73	2.92	5.20	0.00	0.00	0.00	0.00	0.53	8.29	13.04	65.11
1961	8.70	6.51	8.51	0.98	3.32	1.00	0.21	0.05	0.38	1.25	11.49	9.48	51.88
1962	4.35	20.77	9.11	0.82	0.41	0.07	0.00	1.19	1.52	10.92	3.62	6.82	59.60
1963	4.00	6.97	9.20	13.99	1.97	0.23	0.00	0.01	0.18	3.82	16.43	1.63	58.43
1964	8.78	0.17	2.99	0.34	1.00	1.41	0.10	0.00	0.27	4.41	14.67	30.49	64.63
1965	9.56	1.29	1.06	13.20	0.31	0.14	0.00	1.42	0.00	0.10	22.08	2.38	51.54
1966	13.42	9.01	3.81	1.87	0.00	0.07	0.00	0.20	0.37	0.00	16.44	12.07	57.26
1967	14.94	1.06	11.25	10.22	1.30	2.22	0.02	0.00	0.05	1.23	4.06	6.55	52.90
1968	10.36	11.48	5.93	0.43	2.82	0.50	0.00	2.64	0.11	4.18	5.36	16.40	60.21
1969	24.18	18.56	3.92	4.70	0.04	0.67	0.00	0.00	0.06	1.68	2.10	22.31	78.22
1970	34.13	3.79	4.04	0.20	0.26	2.01	0.00	0.00	0.02	3.80	25.72	16.40	90.37
1971	8.17	0.22	10.66	1.51	2.84	0.80	0.03	0.15	0.74	0.79	7.63	7.02	40.56
1972	6.86	3.65	5.36	5.32	2.58	1.56	0.00	0.08	1.42	4.52	13.36	6.58	51.29
1973	18.96	13.88	8.41	0.02	0.86	0.21	0.16	0.00	1.37	5.05	27.62	11.70	88.24
1974	15.96	4.56	19.02	5.83	0.46	0.57	4.03	0.25	0.00	3.16	2.82	9.24	65.90
1975	3.34	16.62	23.16	3.95	0.00	0.31	0.57	0.47	0.00	7.83	2.15	4.18	62.58
1976	0.74	9.15	3.14	5.72	0.03	0.00	0.00	5.47	1.71	0.07	1.56	0.40	27.99
1977	3.31	2.48	2.96	1.26	5.34	0.03	0.01	0.27	8.89	1.89	4.77	13.38	44.59
1978	32.67	10.04	15.59	10.63	0.20	0.25	0.04	0.01	5.00	0.00	2.95	0.38	77.76
1979	14.78	13.84	7.29	4.15	2.24	0.00	0.02	0.79	0.42	7.99	7.76	7.71	66.99
1980	6.35	22.51	6.03	4.82	1.84	1.69	0.00	0.00	1.44	0.83	0.96	15.47	61.94
1981	15.05	7.58	10.34	3.12	4.07	0.00	0.11	0.00	1.20	6.55	21.39	15.08	84.49
1982	8.80	9.65	10.60	11.52	0.00	2.31	0.66	0.33	0.92	5.96	8.67	14.52	73.94
1983	17.35	20.70	34.55	6.89	2.44	0.24	0.25	1.58	2.47	3.26	17.09	23.66	130.48
1984	0.58	4.68	5.99	2.59	1.22	1.02	0.03	0.58	0.19	2.74	20.37	3.02	43.01
1985	1.21	3.18	4.34	0.67	0.25	2.14	1.09	0.25	6.38	4.05	4.79	6.57	34.92
1986	14.93	24.09	12.89	1.76	4.95	0.00	0.00	0.00	4.60	1.43	0.35	3.55	68.55
1987	9.17	8.99	13.32	0.22	1.90	0.08	0.21	0.00	0.00	0.47	3.83	18.07	56.26
1988	11.12	0.10	0.34	4.52	5.96	1.61	0.25	0.00	0.00	0.70	17.16	6.39	48.15
1989	2.34	1.30	14.92	2.13	1.31	0.13	0.03	0.15	5.17	6.06	1.35	0.00	34.89
1990	10.63	3.33	3.01	1.93	12.76	0.18	0.01	1.08	0.53	1.99	0.65	0.77	36.87
1991	1.49	0.17	22.26	0.50	---	---	---	---	---	---	---	---	
Total	526.14	428.24	416.28	194.61	108.19	50.37	10.77	23.42	63.88	168.18	392.50	467.84	
Mean	10.96	8.92	8.67	4.05	2.30	1.07	0.23	0.50	1.36	3.58	8.35	9.95	
n =	48	48	48	48	47	47	47	47	47	47	47	47	
	s=7.86	s=7.20	s=6.83	s=3.87	s=2.39	s=1.42	s=0.63	s=1.06	s=2.24	s=4.06	s=7.21	s=8.22	

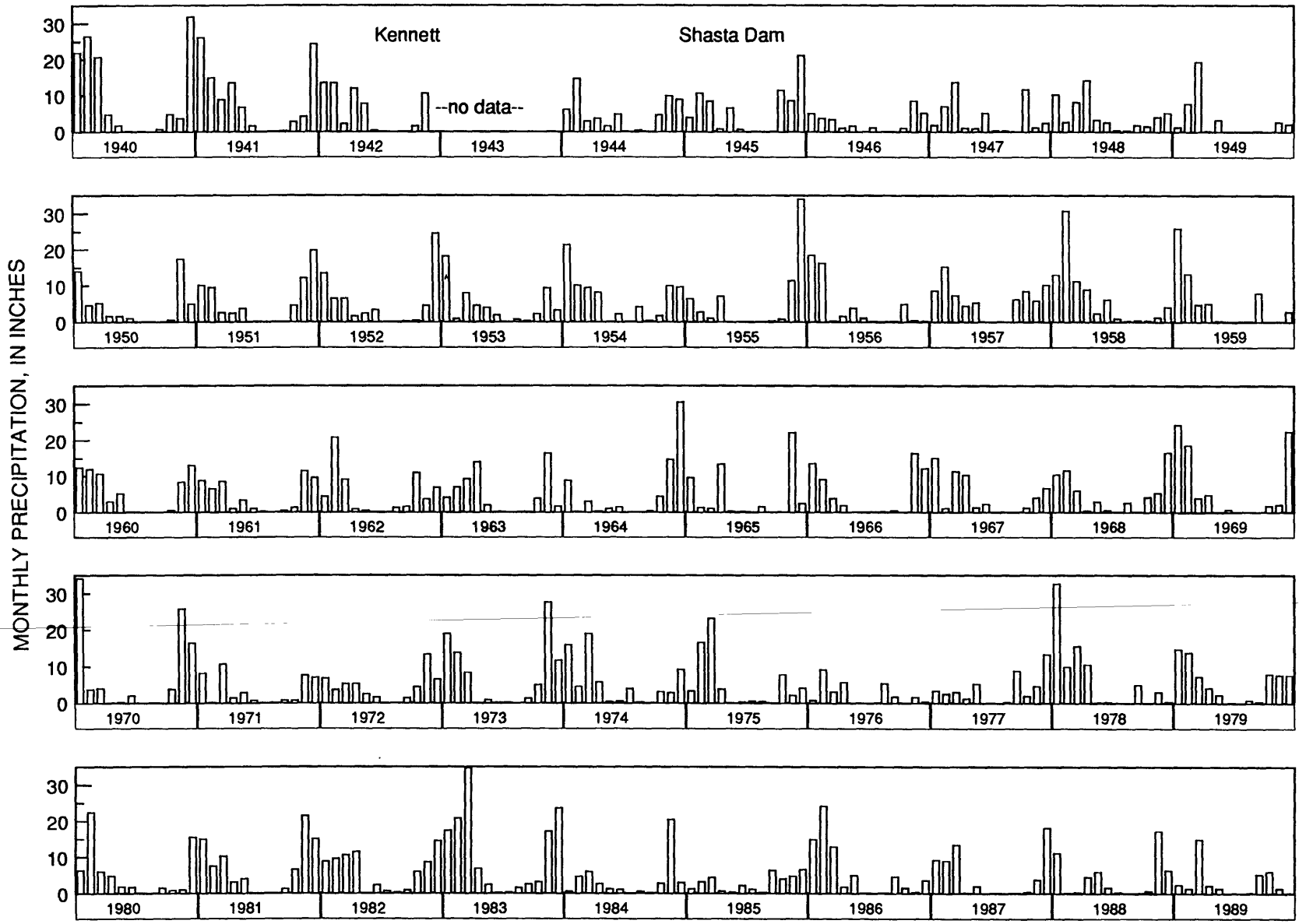

Figure A1. Time-series plot of monthly precipitation data at Kennett, 1940-42, and Shasta Dam, 1944-89.

APPENDIX B

TABLES OF WATER-QUALITY DATA

REFERENCES for tables B1, B2, B3, and B4.

1. Shaw, Paul A., 1941, Mine tunnel drainage in the Shasta Reservoir area: Unpublished memorandum, California Division of Fish and Game, 12 p.

2. Mountain Copper Co., Ltd., 1944-1948, Unpublished reports, Mattie Laboratory.

3. Anonymous, 1955, Water samples from Sacramento River and tributaries - 1955: Unpublished report, California Regional Water Quality Control Board, Central Valley Region.

4. Trumbull, L.E., 1959, Unpublished reports to Mountain Copper Company. Includes representative water assays (by the U.S. Geological Survey) for new copper precipitation plant operating at Iron Mountain from October 21, 1958.

5. George, L.A., 1972, Unpublished monitoring data reports from Stauffer Chemical Co. to California Regional Water Quality Control Board, Central Valley Region.

6. Nordstrom, D.K., 1977, Hydrogeochemical and microbiological factors affecting the heavy metal chemistry of an acid mine drainage system: Stanford University, unpublished Ph.D thesis.

7. California Regional Water Quality Control Board, Central Valley Region, 1979, Iron Mountain Mine compliance reports: Unpublished memorandums from K.L. Smarkel to J.C. Pedri.

8. California Regional Water Quality Control Board, Central Valley Region, 1980, Iron Mountain Mine compliance reports: Unpublished memorandums from D.R. Heiman to J.C. Pedri.

9. California Regional Water Quality Control Board, Central Valley Region, 1984, Treatment plant summary sheet: Unpublished notes.

10. CH2M Hill, 1985, Final remedial investigation report, Iron Mountain Mine: U.S. Environmental Protection Agency report 48.9L17.0.

11. California Regional Water Quality Control Board, Central Valley Region, 1986-88, Acid mine drainage control and permit compliance - Iron Mountain Mine: Unpublished memorandums from D.R. Heiman to J.C. Pedri.

12. California Regional Water Quality Control Board, Central Valley Region, 1986, Water quality monitoring report - Iron Mountain Mine, December 1985 through April 1986: Unpublished report.

13. California Regional Water Quality Control Board, Central Valley Region, 1987, Water quality monitoring report - Iron Mountain Mine, December 1986 through April 1987: Unpublished report.

14. California Regional Water Quality Control Board, Central Valley Region, 1988, Water quality monitoring report - Iron Mountain Mine, December 1987 through June 1988: Unpublished report.

15. California Regional Water Quality Control Board, Central Valley Region, 1989, Water quality monitoring report - Iron Mountain Mine, July 1988 through June 1989: Unpublished report, October 1989.

16. Crowe, C.N., 1990, Hydrologic and hydrogeologic factors controlling acid mine drainage at Iron Mountain Mine, Shasta County, California: Chico, California State University, unpublished, M.S. thesis, 133 p.

REFERENCES for tables B1, B2, B3, and B4--*Continued.*

17. Unpublished data, Stauffer Chemical Co., supplied by I.C.I. Americas on September 3, 1990, and used in compiling Tables 5, 7 and 8 in Roy F. Weston's 1989 report: Geohydrology and acid mine drainage of underground mine workings, Iron Mountain, California.

18. California Regional Water Quality Control Board, Central Valley Region, 1990, Water quality monitoring report - Iron Mountain Mine, July 1989 through June 1990: Unpublished report, August 1990.

19. California Regional Water Quality Control Board, Central Valley Region, 1991, Water quality monitoring report - Iron Mountain Mine, July 1990 through June 1991: Unpublished report, August 1991.

20. Unpublished data, D.K. Nordstrom and C.N. Alpers, U.S. Geological Survey.

Table B1. Water-quality and discharge data from the Richmond Mine, 1970-91

[gal/min, gallon per minute; mg/L, milligram per liter; --, no data]

Date	Discharge (gal/min)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Iron (mg/L)	Sulfate (mg/L)	(Reference) Remarks
2-05-70	80	2.14	237	--	1,740	11,600	--	(17)
3-09-70	250	1.45	163	--	48.2	7,580	--	(17)
4-07-70	50	1.30	213	--	2,330	35,800	--	(17) 20,000 mg/L, Fe(II)
5-18-70	3	1.27	177	--	1,920	4,770	--	(17)
6-10-70	--	1.58	70	--	375	3,170	--	(17)
9-08-70	10	2.33	27	--	126	14.3	--	(17)
1-22-71	225	1.05	160	--	960	7,070	--	(17) 5,450 mg/L, Fe(II)
3-02-71	20	.92	232	--	2,320	15,200	--	(17)
4-28-71	25	.85	217	--	9,070	14,800	--	(17)
4-28-71	3	.60	362	--	10,100	24,300	--	(17) Middle fork in adit, beyond Scott fault
4-28-71	15	.83	237	--	9,980	16,100	--	(17) North fork in adit, beyond Scott fault
6-22-71	2	2.13	139	--	1,730	9,500	--	(17) Inside Richmond Tunnel
7-20-71	1.5	2.35	26.9	--	107	1,330	--	(17) Inside Richmond Tunnel
9-28-71	1	2.39	18.1	--	76.7	1,030	--	(17) Inside Richmond Tunnel
3-11-71	.5	2.5	20	--	15	61	--	(17) Inside Richmond Tunnel
12-01-71	.5	2.0	25	--	92	897	--	(17) Inside Richmond Tunnel
1-20-72	0	1.0	337	--	1,500	8,040	--	(17) No flow (ponded water)
1-20-72	35	1.0	341	--	1,730	9,110	--	(17) Adit - East; North branch near substation
3-07-72	50	1.0	312	--	1,470	8,000	--	(17) Flow measured at bottom of Richmond pipeline
6-01-72	0	.90	242	--	2,090	9,900	--	(17) No flow (ponded water). Water 0.2 foot below invert elevation of Richmond pipeline
10-10-72	2	2.0	20	--	70	970	--	(17) Water just started to flow into pipeline 10-10 or 10-11
2-22-73	120	.73	400	--	1,910	23,000	--	(17) Scum on water surface requires daily cleaning of screen at mouth of pipeline
6-12-73	25	.83	280	--	2,310	15,600	--	(17) New dam built 200 feet farther into adit. Flow into pipeline 25 gal/min
9-18-73	2	1.8	19.1	--	72	--	--	(17) Flow started 5 to 7 days prior to sampling; water level coming up with onset of cooler weather. Water color is light orange
12-18-73	110	1.1	320	--	1,800	--		(17)
4-03-76	--	.80	218	10.8	1,290	9,200	35,000	(6) Complete analysis; sample 76WA39
2-16-79	--	--	494	20	2,420	--	--	(7)
3-31-79	2.3	--	345	12.2	1,570	--	--	(7)
8-05-80	--	--	243	17.5	2,470	19,300	--	(8) 2,340 mg/L, Al
8-25-80	--	--	233	17.6	2,470	18,300	--	(8)
12-01-83	361	.50	231	6	851	--	33,200	(20) Complete analysis
12-30-83	240	1.0	118	3.5	695	7,340	37,600	(10) Complete analysis
1-04-84	162	1.4	188	8	1,090	--	46,600	(10) Complete analysis

Table B1. Water-quality and discharge data from the Richmond Mine, 1970-91--*Continued*

Date	Discharge (gal/min)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Iron (mg/L)	Sulfate (mg/L)	(Reference) Remarks
1-10-84	117	0.55	210	7.8	1,200	--	62,400	(10) Complete analysis
1-17-84	91.1	.85	228	9.0	1,300	12,200	70,300	(10) Complete analysis
1-24-84	46.2	.80	260	11.0	1,620	15,100	72,000	(10) Complete analysis
2-01-84	71.5	.65	237	14.5	1,650	15,000	68,000	(10) Complete analysis
2-08-84	71.5	.70	219	9.7	1,590	14,700	70,000	(10) Complete analysis
2-15-84	71.4	.75	207	11.5	1,560	14,200	63,900	(10) Complete analysis
2-22-84	56.1	.90	264	13.0	1,820	15,700	56,000	(10) Complete analysis
2-29-84	63.7	.72	183	9.45	1,500	13,700	59,800	(10) Complete analysis
3-07-84	56.1	.60	144	9.0	1,320	12,300	58,800	(10) Complete analysis
3-14-84	56.1	.85	143	10.4	1,350	11,800	58,400	(10) Complete analysis
3-20-84	86.7	.75	169	11.0	1,390	12,700	60,400	(10) Complete analysis
3-27-84	77.5	.80	163	10.5	1,460	11,500	61,200	(10) Complete analysis
4-03-84	67.4	.75	181	9.7	1,510	12,600	64,200	(10) Complete analysis
4-11-84	60.0	.98	155	8.6	1,270	11,800	62,100	(10) Complete analysis
4-17-84	55.2	.80	156	11.0	1,430	12,300	64,400	(10) Complete analysis
4-24-84	52.1	.90	166	10.7	1,600	13,200	55,200	(10) Complete analysis
5-02-84	45.8	--	158	12.0	1,490	13,400	48,600	(10) Complete analysis
5-08-84	42.6	1.05	165	12.7	1,590	13,900	63,400	(10) Complete analysis
5-16-84	39.6	.86	162	12.0	1,540	14,200	59,800	(10) Complete analysis
10-23-84	16.6	.70	148	13.4	1,740	15,800	57,600	(10) Complete analysis
10-30-84	16.6	.60	151	14.4	1,780	16,200	54,800	(10) Complete analysis
11-06-84	16.6	.70	148	13.8	1,740	15,100	57,000	(10) Complete analysis
11-13-84	128	.80	540	13.0	1,600	14,800	60,900	(10) Complete analysis
11-16-84	56.9	--	--	--	--	--	--	(10)
11-19-84	84.2	--	551	--	2,150	16,700	54,000	(10) Complete analysis
11-26-84	56.9	.93	362	13.9	1,650	13,500	62,000	(10) Complete analysis
11-30-84	60.6	--	--	--	--	--	--	(10)
12-04-84	54.8	.70	257	11.5	1,440	11,800	45,300	(10) Complete analysis
12-11-84	56.9	1	212	10.2	1,240	11,300	52,400	(10) Complete analysis
12-18-84	56.9	.72	166	9.12	1,090	10,300	48,000	(10) Complete analysis
12-21-84	53.3	--	--	--	--	--	--	(10)
12-26-84	46.3	.80	168	9.7	1,230	11,300	--	(10) Complete analysis
1-02-85	42.9	.99	--	--	--	--	--	(10)
1-09-85	36.4	1	--	--	--	--	--	(10)
1-16-85	33.3	1.05	--	--	--	--	--	(10)
1-23-85	33.3	.92	--	--	--	--	--	(10)
1-25-85	33.3	--	--	--	--	--	--	(10)
2-01-85	33.3	.70	--	--	--	--	--	(10)
2-08-85	27.3	.60	--	--	--	--	--	(10)
2-15-85	21.7	.90	--	--	--	--	--	(10)
2-19-85	24.4	--	--	--	--	--	--	(10)
2-26-85	21.7	.95	--	--	--	--	--	(10)
3-05-85	21.7	.97	--	--	--	--	--	(10)
3-12-85	19.1	.90	--	--	--	--	--	(10)
3-18-85	21.7	.70	--	--	--	--	--	(10)
3-25-85	21.7	.96	--	--	--	--	--	(10)
4-01-85	21.7	.98	--	--	--	--	--	(10)
4-10-85	27.3	.85	--	--	--	--	--	(10)
12-02-85	12	.91	140	11.1	1,700	--	--	(12, 16)
12-16-85	14	--	--	--	--	--	--	(12)
12-31-85	13	--	220	--	1,640	--	--	(12)
1-09-86	13	--	--	--	--	--	--	(12)
1-18-86	60	.71	200	11.5	1,920	--	--	(12)

Table B1. Water-quality and discharge data from the Richmond Mine, 1970-91--*Continued*

Date	Discharge (gal/min)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Iron (mg/L)	Sulfate (mg/L)	(Reference) Remarks
1-31-86	60	--	245	12.5	1,640	--	--	(12, 16)
2-04-86	300	--	--	--	--	--	--	(12)
2-05-86	167	0.82	320	8.0	1,200	--	--	(12)
2-15-86	345	--	290	8.3	1,120	--	--	(12)
2-18-86	800	--	580	8.2	1,140	--	--	(12)
2-31-86	464	--	440	9.0	1,300	--	--	(12)
3-07-86	103	--	380	12.5	1,700	--	--	(12)
3-14-86	231	--	290	8.4	1,160	--	--	(12)
3-21-86	187	--	310	10.0	1,320	--	--	(12)
3-28-86	142	--	410	11.5	1,790	--	--	(12)
4-04-86	92	--	475	17.2	1,870	--	--	(12)
4-11-86	66	--	484	13.9	1,980	--	--	(12)
4-18-86	50	--	420	13.8	2,040	--	--	(12)
4-25-86	32	--	430	13.6	1,960	--	--	(12)
11-25-86	9	--	170	12.0	1,520	--	--	(13)
12-04-86	9	--	175	13.0	1,720	--	--	(13)
12-11-86	8.1	--	170	12.0	1,620	--	--	(13)
12-18-86	8.1	--	179	12.2	1,800	--	--	(13)
1-08-87	27	--	175	16.0	2,300	--	--	(13)
1-22-87	25	--	260	12.7	1,800	--	--	(13)
1-30-87	45	1.1	220	12.0	1,700	--	--	(16)
2-03-87	76	--	290	12.0	1,700	--	--	(13)
2-13-87	46	--	260	9.2	1,300	--	--	(13)
2-17-87	122	--	320	7.4	1,100	--	--	(13)
2-18-87	90	1.0	99	10.1	1,150	--	--	(11)
2-24-87	67	--	250	7.5	1,080	--	--	(13)
3-03-87	43	--	210	7.4	1,100	--	--	(13)
3-10-87	105	--	220	6.3	890	--	--	(13)
3-11-87	90	1.0	68	8.8	1,000	--	--	(11)
3-17-87	164	--	180	5.0	750	--	--	(13)
3-24-87	89	--	185	6.5	960	--	--	(13)
3-31-87	77	--	178	6.9	1,000	--	--	(13)
4-07-87	60	--	186	7.4	1,160	--	--	(13)
4-14-87	52	--	196	8.2	1,260	--	--	(13)
4-23-87	46	--	200	8.75	1,300	--	--	(13)
4-30-87	42	--	200	9.05	1,340	--	--	(13)
12-01-87	11	.85	179	13.4	1,870	--	--	(14)
12-09-87	333	1.47	648	8.0	1,150	--	--	(14)
12-22-87	57	--	376	8.6	881	--	--	(14)
12-24-87	49	--	--	--	--	--	--	(14)
12-31-87	46	.80	334	10.0	1,300	--	--	(16)
1-07-88	40	.90	298	9.4	964	--	--	(14)
1-14-88	103	.98	310	8.3	1,140	--	--	(14)
1-21-88	84	.89	269	7.4	960	--	--	(14)
1-28-88	58	.69	284	9.7	1,340	--	--	(14)
2-03-88	62	.64	305	10.4	1,300	--	--	(14)
2-11-88	62	.66	302	11.8	1,620	--	--	(14)
2-19-88	48	1.0	270	10.9	1,460	--	--	(14)
3-04-88	36	.46	269	12.5	1,580	--	--	(14)
3-11-88	34	.60	273	12.5	1,700	--	--	(16)
3-18-88	31	1.37	261	12.1	1,780	--	--	(14)
4-06-88	24	.44	275	13.5	1,720	--	--	(14)
4-21-88	23	.67	165	13.0	1,750	--	--	(14)

Table B1. Water-quality and discharge data from the Richmond Mine, 1970-91--*Continued*

Date	Discharge (gal/min)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Iron (mg/L)	Sulfate (mg/L)	(Reference) Remarks
5-05-88	29	0.99	320	14.1	2,010	--	--	(14)
6-15-88	34	.70	240	12.5	1,680	--	--	(14)
7-06-88	28	.70	231	12.9	1,710	--	--	(16)
7-15-88	26	.81	218	12.6	1,740	--	--	(15) Daily discharge data begins
8-24-88	19	.75	247	15.3	1,920	--	--	(15)
11-09-88	11	.62	252	14.2	1,950	--	--	(15)
11-18-88	21	.75	282	17.0	2,300	--	--	(15)
11-30-88	38	.82	307	15.7	2,110	--	--	(15)
12-13-88	37	--	274	14.7	1,930	--	--	(15)
1-04-89	35	.77	238	13.6	1,850	--	--	(15)
1-11-89	35	.98	215	12.4	1,680	--	--	(15)
1-19-89	40	.73	190	12.1	1,610	--	--	(15)
1-25-89	16	.94	189	11.4	1,600	--	--	(15)
1-30-89	17	.77	189	11.7	1,580	--	--	(15)
2-06-89	38	.56	183	11.6	1,510	--	--	(15)
2-14-89	45	.79	194	11.6	1,590	--	--	(15)
2-22-89	46	.86	198	11.7	1,560	--	--	(15)
3-06-89	32	.68	201	12.5	1,670	--	--	(15)
3-13-89	200	.36	345	11.6	1,550	--	--	(15)
3-20-89	140	.67	337	10.9	1,430	--	--	(15)
3-27-89	141	.61	392	12.4	1,660	--	--	(15)
4-03-89	143	.66	465	14.7	1,890	--	--	(15)
4-10-89	94	.38	543	16.7	2,150	--	--	(15)
4-17-89	60	.07	478	15.8	1,980	--	--	(15)
4-24-89	45	.51	445	15.2	1,900	--	--	(15)
5-01-89	40	1.2	518	13.4	1,940	--	--	(15)
5-15-89	35	.33	463	16.0	2,090	--	--	(15)
6-14-89	35	.89	400	15.5	2,110	--	--	(15)
7-14-89	23	.91	434	15.9	2,220	--	--	(18)
8-17-89	19	--	295	18.5	2,330	--	--	(18)
9-18-89	17	.39	269	19.2	2,430	--	--	(18)
10-24-89	23	.08	194	12.6	1,290	--	--	(18)
11-08-89	31	1.52	188	14.5	1,650	--	--	(18)
11-15-89	30	.50	179	14.1	1,730	--	--	(18)
11-21-89	29	.30	181	14.2	1,720	--	--	(18)
11-29-89	22	.31	169	13.9	1,770	--	--	(18)
12-06-89	25	.02	126	13.5	1,540	--	--	(18)
12-13-89	19	.67	187	11.6	1,240	--	--	(18)
12-20-89	23	.65	170	13.9	1,870	--	--	(18)
12-28-89	19	.73	161	13.7	1,850	--	--	(18)
1-03-90	18	.65	162	16.1	1,820	--	--	(18)
1-10-90	18	.58	155	14.4	1,870	--	--	(18)
1-16-90	30	.70	147	12.6	1,900	--	--	(18)
1-24-90	36	.21	244	16.3	1,140	--	--	(18)
2-01-90	32	.77	201	14.8	2,620	--	--	(18)
2-07-90	31	1.02	188	14.8	1,840	--	--	(18)
2-14-90	31	1.16	183	13.7	2,040	--	--	(18)
2-21-90	30	1.16	169	13.4	1,770	--	--	(18)
3-01-90	32	1.02	148	12.7	1,680	--	--	(18)
3-07-90	31	.92	155	13.0	1,720	--	--	(18)
3-14-90	32	1.03	148	12.4	1,660	--	--	(18)
3-21-90	32	.82	148	12.4	1,670	--	--	(18)
3-28-90	33	1.41	153	12.7	1,690	--	--	(18)

Table B1. Water-quality and discharge data from the Richmond Mine, 1970-91--*Continued*

Date	Discharge (gal/min)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Iron (mg/L)	Sulfate (mg/L)	(Reference) Remarks
4-04-90	26	1.24	165	13.4	1,730	--	--	(18)
4-11-90	25	.84	160	13.1	1,740	--	--	(18)
4-18-90	26	.78	160	13.2	1,760	--	--	(18)
5-09-90	20	1.0	167	14.2	1,870	--	--	(18)
5-29-90	134	--	384	13.1	1,770	--	--	(18)
5-31-90	99	1.16	419	14.4	1,900	--	--	(18)
6-14-90	63	1.14	362	13.9	1,830	--	--	(18)
7-19-90	36	--	340	15.6	2,020	--	--	(19)
8-16-90	25	--	346	17.6	2,240	--	--	(19) Discharge includes combined flow from Richmond adit and Richmond Tunnel; water-quality data for adit only
9-11-90	18.7	.52	290	15.9	2,010	20,300	118,000	(20) 18,100 mg/L, Fe(II); complete analysis
9-24-90	18	--	298	17.9	2,310	--	--	(19)
11-07-90	13	--	293	20.5	2,510	--	--	(19)
11-19-90	13	--	252	18.4	2,310	--	--	(19)
12-03-90	11	--	256	19.8	2,470	--	--	(19)
12-12-90	11	--	241	19.8	2,550	--	--	(19)
12-27-90	10	--	233	18.5	2,330	--	--	(19)
1-08-91	10	--	238	20.1	2,560	--	--	(19)
1-22-91	10	--	232	20.1	2,570	--	--	(19)
1-31-91	10	--	213	18.8	2,400	--	--	(19)
2-06-91	10	--	214	18.9	2,410	--	--	(19)
2-27-91	13	--	229	18.5	2,360	--	--	(19)
3-07-91	20	--	212	17.8	2,230	--	--	(19)
3-14-91	26	--	349	20.6	2,700	--	--	(19)
3-21-91	29	--	291	16.9	2,210	--	--	(19)
3-29-91	69	--	237	13.2	1,680	--	--	(19)
4-03-91	125	--	251	11.6	1,480	--	--	(19)
4-11-91	79	--	--	--	--	--	--	(19)
4-26-91	37	--	--	--	--	--	--	(19)

Table B2. Water-quality and discharge data from the Lawson portal and the Hornet Mine, 1974-91

[gal/min, gallon per minute; mg/L, milligram per liter; --, no data]

Date	Discharge (gal/min)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Sulfate (mg/L)	(Reference) Remarks
11-05-74	50	0.92	148	12.3	1,750	43,100	(6) Complete analysis; sample 74WA158
2-08-75	70	1.0	182	9.0	1,090	29,500	(6) Complete analysis; sample 75WA11
4-04-75	360	1.02	222	10.2	1,260	49,800	(6) Complete analysis; sample 75WA134
10-03-75	--	1.1	160	16.0	1,460	44,600	(6) Complete analysis; sample 75WA30
1-18-76	--	1.1	360	14.0	1,860	41,000	(6) Complete analysis; sample TD-7
4-03-76	--	1.1	230	9.3	1,140	33,600	(6) Complete analysis; sample 76WA38
1-11-79	5	--	149	--	670	--	(7)
1-21-79	1	--	179	--	--	--	(7)
2-16-79	--	--	99	4.9	750	--	(7)
8-05-80	--	--	106	6.98	952	--	(8) Fe 8,200 mg/L, Al 1,062 mg/L
8-25-80	--	--	100	7.06	932	--	(8) Fe 7,410 mg/L
9-26-83	32	1.8	62.8	3.88	522	--	(16)
12-01-83	222	1.4	87	2.0	345	--	(16)
12-30-83	91.1	1.9	56.3	2.0	299	11,300	(10) Complete analysis
1-04-84	76	2.25	62	2.0	307	10,300	(10) Complete analysis
1-10-84	79	1.85	51.3	1.9	284	11,800	(10) Complete analysis
1-17-84	66	1.8	56.5	2.0	303	13,000	(10) Complete analysis
1-24-84	68	1.8	54.7	2.6	328	12,000	(10) Complete analysis
2-01-84	46.5	1.95	56.4	2.6	328	6,000	(10) Complete analysis
2-08-84	46.5	1.8	47.3	1.9	290	15,800	(10) Complete analysis
2-15-84	46.2	1.65	56.7	1.8	342	9,580	(10) Complete analysis
2-22-84	46.2	1.9	53.1	3.3	358	10,300	(10) Complete analysis
2-29-84	39.6	1.75	57.2	2.0	363	13,200	(10) Complete analysis
3-07-84	46.2	1.75	55.5	2.4	372	15,100	(10) Complete analysis
3-14-84	46.2	1.6	54.6	2.0	380	15,100	(10) Complete analysis
3-20-84	46.2	1.81	59.2	--	369	14,200	(10) Complete analysis
3-27-84	46.2	1.88	57.3	2.7	388	15,800	(10) Complete analysis
4-03-84	47.1	2.8	55.4	2.4	374	15,900	(10) Complete analysis
4-11-84	40	1.8	52.5	2.4	342	14,200	(10) Complete analysis
4-17-84	38.7	1.62	52.4	2.6	390	14,200	(10) Complete analysis
4-24-84	36.2	2.05	53.8	2.4	386	13,100	(10) Complete analysis
5-02-84	33.5	--	53.2	2.9	388	13,100	(10) Complete analysis
5-08-84	33.6	1.95	52.7	2.4	373	15,200	(10) Complete analysis
5-16-84	31.6	1.65	54.3	2.9	376	14,400	(10) Complete analysis
10-23-84	27.4	1.55	54.5	3.5	486	--	(10) Complete analysis
10-30-84	27.4	1.45	52.8	3.16	473	17,500	(10) Complete analysis
11-06-84	27.4	1.5	54.8	3.76	521	15,300	(10) Complete analysis
11-13-84	27.4	1.65	52	3.45	483	15,800	(10) Complete analysis
11-19-84	39.6	--	65.3	3.3	446	20,600	(10) Complete analysis
11-26-84	39.6	1.6	64.9	3.23	455	21,300	(10) Complete analysis
11-30-84	46.3	--	52.8	3.16	473	--	(10) Complete analysis
12-04-84	46.3	1.6	64	3.21	461	--	(10) Complete analysis
12-11-84	46.3	1.7	64.8	2.87	381	14,700	(10) Complete analysis
12-18-84	46.3	1.5	56.2	2.75	360	14,300	(10) Complete analysis
12-21-84	42.9	--	--	--	--	--	(11)
12-26-84	39.6	1.6	56.6	2.73	379	16,200	(11)

Table B2. Water-quality and discharge data from the Lawson portal and the Hornet Mine, 1974-91--*Continued*

Date	Discharge (gal/min)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Sulfate (mg/L)	(Reference) Remarks
1-01-85	39.6	1.6	--	--	--	--	(11)
1-09-85	39.6	1.65	--	--	--	--	(11)
1-16-85	33.3	1.65	--	--	--	--	(11)
1-23-85	33.3	1.7	--	--	--	--	(11)
1-25-85	33.3	--	--	--	--	--	(11)
2-01-85	33.3	1.7	--	--	--	--	(11)
2-08-85	33.3	1.6	--	--	--	--	(11)
2-15-85	27.3	1.7	--	--	--	--	(11)
2-19-85	27.3	--	--	--	--	--	(11)
2-26-85	33.3	1.6	--	--	--	--	(11)
3-05-85	27.3	1.6	--	--	--	--	(11)
3-12-85	27.3	1.6	--	--	--	--	(11)
3-18-85	27.3	1.7	--	--	--	--	(11)
3-25-85	27.3	1.7	--	--	--	--	(11)
4-01-85	27.3	1.8	--	--	--	--	(11)
4-10-85	27.3	1.8	--	--	--	--	(11)
12-02-85	18	--	51	2.8	450	--	(12)
12-16-85	20	--	--	--	--	--	(12)
12-31-85	19	--	60	2.8	460	--	(12)
1-09-86	17	--	--	--	--	--	(12)
1-18-86	21	--	59	2.6	450	--	(12)
1-31-86	34	--	71	7.6	430	--	(12)
2-05-86	87	--	90	2.6	430	--	(12)
2-15-86	78	--	78	1.9	320	--	(12)
2-18-86	236	--	118	1.9	295	--	(12)
2-21-86	168	--	120	2.0	310	--	(12)
3-07-86	66	--	110	2.4	350	--	(12)
3-14-86	102	--	124	2.3	330	--	(12)
3-21-86	102	--	120	2.1	300	--	(12)
3-28-86	83	--	105	2.0	310	--	(12)
4-04-86	75	--	111	2.3	295	--	(12)
4-11-86	58	--	117	2.1	330	--	(12)
4-18-86	50	--	124	2.4	350	--	(12)
4-25-86	43	--	130	2.45	380	--	(12)
11-25-86	19	--	94	4.4	660	--	(16)
12-04-86	20	--	85.2	4.4	660	--	(13)
12-11-86	18	--	87.0	4.6	640	--	(13)
12-18-86	18	--	86.5	4.35	660	--	(13)
1-08-87	13	--	86.0	4.4	640	--	(13)
1-22-87	13	--	82.0	4.2	670	--	(13)
1-30-87	20	1.87	84.0	4.1	660	--	(16)
2-03-87	13	--	82.0	4.5	690	--	(13)
2-13-87	18	--	87.0	4.2	650	--	(13)
2-17-87	23	--	84.0	4.3	680	--	(13)
2-24-87	23	--	90.0	4.20	680	--	(13)
3-03-87	23	--	85	3.8	620	--	(13)
3-10-87	36	--	78	3.5	580	--	(13)
3-17-87	66	--	86.0	2.9	500	--	(13)
3-24-87	36	--	89.2	2.75	470	--	(13)
3-31-87	36	--	83.6	2.7	450	--	(13)
4-07-87	29	--	83	2.6	450	--	(13)

Table B2. Water-quality and discharge data from the Lawson portal and the Hornet Mine, 1974-91--*Continued*

Date	Discharge (gal/min)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Sulfate (mg/L)	(Reference) Remarks
12-20-89	18	--	117	--	766	--	(18)
12-28-89	18	--	117	--	832	--	(18)
1-03-90	17	--	120	--	836	--	(18)
1-10-90	20	--	117	--	757	--	(18)
1-16-90	23	--	114	--	724	--	(18)
1-24-90	27	--	120	--	776	--	(18)
2-01-90	23	--	116	--	710	--	(18)
2-07-90	21	--	112	--	822	--	(18)
2-14-90	20	--	110	--	818	--	(18)
2-21-90	20	--	98.4	--	678	--	(18)
3-01-90	21	--	96.7	--	695	--	(18)
3-07-90	23	--	105	--	733	--	(18)
3-14-90	23	--	101	--	720	--	(18)
3-21-90	24	--	96.8	--	706	--	(18)
3-28-90	24	--	95.3	--	691	--	(18)
4-04-90	24	--	91.5	--	703	--	(18)
4-11-90	21	--	90.9	--	719	--	(18)
4-18-90	19	--	91.5	--	723	--	(18)
5-09-90	19	--	91.5	--	728	--	(18)
5-31-90	73	--	141	--	605	--	(18)
6-14-90	44	--	121	--	606	--	(18)
7-19-90	26	--	102	3.96	589	--	(19)
8-16-90	24	--	100	4.39	627	--	(19)
9-24-90	23	--	94.7	4.86	710	--	(19)
11-07-90	17	--	97.6	5.07	716	--	(19)
11-19-90	17.7	--	103	5.37	768	--	(19)
12-03-90	17.5	--	98.6	5.12	731	--	(19)
12-12-90	16.6	--	93.5	4.97	737	--	(19)
12-27-90	17.6	--	97	4.76	697	--	(19)
1-08-91	17.6	--	104	5.18	751	--	(19)
1-22-91	16.9	--	123	5.86	853	--	(19)
1-31-91	16.3	--	108	5.02	736	--	(19)
2-06-91	16.3	--	103	4.68	682	--	(19)
2-27-91	16.7	--	106	4.96	730	--	(19)
3-07-91	16	--	106	4.9	729	--	(19)
3-14-91	20	--	110	4.8	730	--	(19)
3-21-91	23.5	--	120	5.3	780	--	(19)
3-29-91	39	--	114	4.6	680	--	(19)
4-03-91	47	--	126	4.5	661	--	(19)

Table B2. Water-quality and discharge data from the Lawson portal and the Hornet Mine, 1974-91--*Continued*

Date	Discharge (gal/min)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Sulfate (mg/L)	(Reference) Remarks
4-14-87	29	--	84.4	2.65	450	--	(13)
4-23-87	23	--	84	2.85	450	--	(13)
4-30-87	29	--	85	2.85	500	--	(13)
12-01-87	18	1.55	71.8	3.22	540	--	(14)
12-09-87	37.5	1.97	84.2	3.36	570	--	(14)
12-22-87	35	--	85.2	3.3	462	--	(14)
1-14-88	47	2.06	87.7	2.7	415	--	(14)
1-21-88	55	1.62	89.9	2.5	579	--	(14)
1-28-88	45	1.57	88	2.5	415	--	(14)
2-03-88	37.5	1.71	83.8	2.6	372	--	(14)
2-11-88	35	1.68	83.6	2.56	432	--	(14)
2-19-88	32	1.85	82.2	2.7	408	--	(14)
3-04-88	27	1.47	78.9	2.8	428	--	(14)
3-18-88	25	1.44	83.7	2.94	455	--	(14)
4-06-88	24	1.47	90.5	3.2	510	--	(14)
4-21-88	27	2.06	68.9	3.2	469	--	(14)
5-05-88	23	1.56	83.4	3.06	522	--	(14)
6-15-88	30	1.57	89.2	3.31	514	--	(14)
7-15-88	27	1.75	81.9	3.25	518	--	(15)
8-24-88	23	1.62	74.5	3.39	486	--	(15)
11-09-88	19	1.47	89.3	3.62	593	--	(15)
11-18-88	17	1.61	81.8	3.52	580	--	(15)
11-30-88	27	1.66	90.0	3.86	603	--	(15)
12-13-88	25	--	92.8	3.86	601	--	
1-11-89	24	1.75	84.0	3.53	553	--	(15)
1-19-89	23	1.51	83.7	3.6	572	--	(15)
1-25-89	23	1.66	84.0	3.5	576	--	(15)
1-30-89	28	1.45	92.9	3.8	602	--	(15)
2-06-89	27	1.35	86.6	3.54	563	--	(15)
2-14-89	25	1.59	85.2	3.49	555	--	(15)
2-22-89	25	1.33	78.8	3.29	509	--	(15)
3-06-89	25	1.46	83.5	3.37	522	--	(15)
3-13-89	111	1.36	91.9	3.29	520	--	(15)
3-20-89	67	1.55	97.1	2.81	451	--	(15)
3-27-89	69	1.52	107	2.91	465	--	(15)
4-03-89	75	1.68	114	2.57	399	--	(15)
4-10-89	52	1.54	125	2.68	417	--	(15)
4-17-89	41	1.33	107	2.58	386	--	(15)
4-24-89	36	1.65	112	2.7	403	--	(15)
5-01-89	31	1.55	113	2.71	428	--	(15)
5-15-89	29	1.45	127	3.39	501	--	(15)
6-14-89	25	1.56	128	3.67	556	--	(15)
7-14-89	19	1.53	129	3.66	564	--	(18)
8-17-89	19	1.04	122	3.91	572	--	(18)
9-18-89	18	1.38	147	4.88	692	--	(18)
10-24-89	18	--	135	--	683	--	(18)
11-08-89	21	--	128	--	548	--	(18)
11-15-89	20	--	130	--	560	--	(18)
11-21-89	21	--	106	--	682	--	(18)
12-06-89	20	--	94.6	--	632	--	(18)
12-13-89	20	--	125	--	688	--	(18)

Table B3. Water-quality and discharge data from Boulder Creek copper plant, 1940-89

[gal/min, gallon per minute; mg/L, milligram per liter; --, no data]

Date	Discharge (gal/min)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Sulfate (mg/L)	(Reference)	Remarks
3-21-40	490	2.0	160	--	--	--	(1)	Effluent
6-22-40	305	2.5	10	--	--	--	(1)	Effluent
7-18-40	130	2.6	2	--	--	--	(1)	Effluent
8-03-40	130	3.2	1	--	--	--	(1)	Effluent
8-14-40	70	2.2	60	--	--	--	(1)	Effluent
1-03-41	310	1.6	100	--	--	--	(1)	Effluent
2-15-41	450	2.0	120	--	--	--	(1)	Effluent
1-03-44	--	--	258	--	--	--	(2)	Influent
	--	--	26	--	--	--	(2)	Effluent
7-26-44	--	--	68	--	--	--	(2)	Influent
	--	--	45	--	--	--	(2)	Effluent
1-01-45	--	--	565	--	--	--	(2)	Influent
	--	--	31.5	--	--	--	(2)	Effluent
6-02-45	--	--	303	--	2,750	--	(2)	Influent
	--	--	35.5	--	2,460	--	(2)	Effluent
1-06-46	--	--	488	--	4,500	--	(2)	Influent
	--	--	298	--	--	--	(2)	Effluent
1-15-47	--	--	308	--	2,280	--	(2)	Influent
	--	--	302	--	2,360	--	(2)	Effluent
6-25-47	--	--	429	--	1,330	--	(2)	Influent
	--	--	180	--	1,340	--	(2)	Effluent
2-02-48	--	--	517	--	3,010	--	(2)	Influent
	--	--	49.4	--	2,790	--	(2)	Effluent
4-22-55	--	1.6	360	--	2,000	--	(3)	Influent
	--	1.7	100	--	1,800	--	(3)	Effluent
4-24-55	--	1.4	300	--	1,900	--	(3)	Influent
	--	1.6	135	--	320	--	(3)	Effluent
11-11-58	42	--	430	--	--	--	(4)	Influent
	42	--	80	--	--	--	(4)	Effluent
12-04-58	45	--	245	--	--	--	(4)	Influent
	45	--	73	--	--	--	(4)	Effluent
1-07-59	75	--	210	--	--	--	(4)	Influent
	75	--	97	--	--	--	(4)	Effluent
2-04-59	205	--	460	--	--	--	(4)	Influent
	205	--	30	--	--	--	(4)	Effluent
2-27-59	500	1.8	342	--	1,720	21,700	(4)	Complete analysis; Influent
	500	1.9	96	--	2,050	21,700	(4)	Complete analysis; Effluent
3-04-59	520	--	271	--	--	--	(4)	Influent
	520	--	26	--	--	--	(4)	Effluent
4-09-59	225	--	292	--	--	--	(4)	Influent
	225	--	47	--	--	--	(4)	Effluent

Table B3. Water-quality and discharge data from Boulder Creek copper plant, 1940-89--*Continued*

Date	Discharge (gal/min)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Sulfate (mg/L)	(Reference)	Remarks
5-05-59	150	--	217	--	--	--	(4)	Influent
	150	--	55	--	--	--	(4)	Effluent
6-04-59	125	--	214	--	--	--	(4)	Influent
	125	--	21	--	--	--	(4)	Effluent
8-05-59	92	--	190	--	--	--	(4)	Influent
	92	--	43	--	--	--	(4)	Effluent
9-18-59	110	--	212	--	--	--	(4)	Influent
	110	--	54	--	--	--	(4)	Effluent
10-30-59	100	1.9	234	--	1,270	20,500	(4)	Conductance, Fe; Influent
	100	2.0	193	--	1,460	20,600	(4)	Effluent
1----65	295	--	320	--	--	--	(5)	Influent
	295	--	75	--	--	--	(5)	Effluent
2----65	190	--	328	--	--	--	(5)	Influent
	190	--	95	--	--	--	(5)	Effluent
3----65	150	--	300	--	--	--	(5)	Influent
	150	--	45	--	--	--	(5)	Effluent
4----65	575	--	260	--	--	--	(5)	Influent
	575	--	15	--	--	--	(5)	Effluent
5----65	225	--	240	--	--	--	(5)	Influent
	225	--	25	--	--	--	(5)	Effluent
6----65	150	--	285	--	--	--	(5)	Influent
	150	--	20	--	--	--	(5)	Effluent
7----65	70	--	235	--	--	--	(5)	Influent
	70	--	20	--	--	--	(5)	Effluent
8----65	60	--	112	--	--	--	(5)	Influent
	60	--	5	--	--	--	(5)	Effluent
9----65	43	--	130	--	--	--	(5)	Influent
	43	--	105	--	--	--	(5)	Effluent
10----65	46	--	115	--	--	--	(5)	Influent
	46	--	25	--	--	--	(5)	Effluent
11----65	400	--	295	--	--	--	(5)	Influent
	400	--	30	--	--	--	(5)	Effluent
12----65	90	--	205	--	--	--	(5)	Influent
	90	--	35	--	--	--	(5)	Effluent
1----66	175	--	155	--	--	--	(5)	Influent
	175	--	38	--	--	--	(5)	Effluent
2----66	485	--	230	--	--	--	(5)	Influent
	485	--	55	--	--	--	(5)	Effluent
3----66	355	--	208	--	--	--	(5)	Influent
	355	--	40	--	--	--	(5)	Effluent
4----66	90	--	209	--	--	--	(5)	Influent
	90	--	38	--	--	--	(5)	Effluent
5----66	60	--	155	--	--	--	(5)	Influent
	60	--	37	--	--	--	(5)	Effluent
6----66	60	--	150	--	--	--	(5)	Influent
	60	--	38	--	--	--	(5)	Effluent
7----66	60	--	124	--	--	--	(5)	Influent
	60	--	40	--	--	--	(5)	Effluent
8----66	25	--	130	--	--	--	(5)	Influent
	25	--	40	--	--	--	(5)	Effluent

Table B3. Water-quality and discharge data from Boulder Creek copper plant, 1940-89--*Continued*

Date	Discharge (gal/min)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Sulfate (mg/L)	(Reference)	Remarks
9----66	25	--	125	--	--	--	(5)	Influent
	25	--	41	--	--	--	(5)	Effluent
10----66	30	--	130	--	--	--	(5)	Influent
	30	--	42	--	--	--	(5)	Effluent
11----66	245	--	295	--	--	--	(5)	Influent
	245	--	55	--	--	--	(5)	Effluent
12----66	360	--	258	--	--	--	(5)	Influent
	360	--	53	--	--	--	(5)	Effluent
1----67	240	--	28	--	--	--	(5)	Influent
	240	--	62	--	--	--	(5)	Effluent
2----67	185	--	235	--	--	--	(5)	Influent
	185	--	45	--	--	--	(5)	Effluent
3----67	435	--	165	--	--	--	(5)	Influent
	435	--	57	--	--	--	(5)	Effluent
4----67	350	--	120	--	--	--	(5)	Influent
	350	--	39	--	-	--	(5)	Effluent
5----67	360	--	130	--	--	--	(5)	Influent
	360	--	35	--	--	--	(5)	Effluent
6----67	235	--	165	--	--	--	(5)	Influent
	235	--	38	--	--	--	(5)	Effluent
7----67	150	--	160	--	--	--	(5)	Influent
	150	--	35	--	--	--	(5)	Effluent
8----67	140	--	168	--	--	--	(5)	Influent
	140	--	35	--	--	--	(5)	Effluent
9----67	135	--	165	--	--	--	(5)	Influent
	135	--	39	--	--	--	(5)	Effluent
10----67	135	--	110	--	--	--	(5)	Influent
	135	--	20	--	--	--	(5)	Effluent
11----67	150	--	170	--	--	--	(5)	Influent
	150	--	25	--	--	--	(5)	Effluent
12----67	215	--	250	--	--	--	(5)	Influent
	215	--	35	--	--	--	(5)	Effluent
1----68	215	--	310	--	--	--	(5)	Influent
	215	--	37	--	--	--	(5)	Effluent
2----68	270	--	225	--	--	--	(5)	Influent
	270	--	50	--	--	--	(5)	Effluent
3----68	305	--	255	--	--	--	(5)	Influent
	305	--	35	--	--	--	(5)	Effluent
4----68	235	--	225	--	--	--	(5)	Influent
	235	--	35	--	--	--	(5)	Effluent
5----68	185	--	185	--	--	--	(5)	Influent
	185	--	40	--	--	--	(5)	Effluent
6----68	185	--	185	--	--	--	(5)	Influent
	185	--	35	--	--	--	(5)	Effluent
7----68	165	--	180	--	--	--	(5)	Influent
	165	--	39	--	--	--	(5)	Effluent
8----68	110	--	185	--	--	--	(5)	Influent
	110	--	40	--	--	--	(5)	Effluent
9----68	70	--	180	--	--	--	(5)	Influent
	70	--	30	--	--	--	(5)	Effluent
10----68	45	--	170	--	--	--	(5)	Influent
	45	--	35	--	--	--	(5)	Effluent

Table B3. Water-quality and discharge data from Boulder Creek copper plant, 1940-89--*Continued*

Date	Discharge (gal/min)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Sulfate (mg/L)	(Reference)	Remarks
11----68	45	--	175	--	--	--	(5)	Influent
	45	--	45	--	--	--	(5)	Effluent
12----68	90	--	200	--	--	--	(5)	Influent
	90	--	55	--	--	--	(5)	Effluent
1----69	150	--	270	--	--	--	(5)	Influent
	150	--	65	--	--	--	(5)	Effluent
2----69	260	--	260	--	--	--	(5)	Influent
	260	--	60	--	--	--	(5)	Effluent
3----69	175	--	195	--	--	--	(5)	Influent
	175	--	60	--	--	--	(5)	Effluent
4----69	150	--	197	--	--	--	(5)	Influent
	150	--	45	--	--	--	(5)	Effluent
5----69	150	--	195	--	--	--	(5)	Influent
	150	--	55	--	--	--	(5)	Effluent
6----69	145	--	197	--	--	--	(5)	Influent
	145	--	45	--	--	--	(5)	Effluent
7----69	90	--	192	--	--	--	(5)	Influent
	90	--	45	--	--	--	(5)	Effluent
8----69	90	--	195	--	--	--	(5)	Influent
	90	--	40	--	--	--	(5)	Effluent
4----70	75	--	175	--	--	--	(5)	Influent
	75	--	18	--	--	--	(5)	Effluent
5----70	60	--	173	--	--	--	(5)	Influent
	60	--	15	--	--	--	(5)	Effluent
	75	1.39	175	--	1,630	4,890	(17)	Influent
6----70	70	1.52	146	--	--	--	(17)	Influent
	70	--	160	--	--	--	(5)	Influent
	70	--	10	--	--	--	(5)	Effluent
9----70	40	1.73	175	--	1,500	10,300	(17)	Influent
1-22-71	100	1.58	133	--	865	5,300	(17)	Influent
3-02-71	40	1.36	183	--	1,110	10,400	(17)	Influent
4-28-71	45	1.18	153	--	1,100	10,100	(17)	Influent
9-29-71	40	1.31	174	--	1,640	10,800	(17)	Influent
9----71	25	--	185	--	--	--	(5)	Influent
	25	--	12	--	--	--	(5)	Effluent
10----71	40	--	210	--	--	--	(5)	Influent
	40	--	15	--	--	--	(5)	Effluent
11----71	40	--	205	--	--	--	(5)	Influent
	40	--	20	--	--	--	(5)	Effluent
11-03-71	35	1.4	275	--	1,550	8,700	(17)	Influent
12-21-71	40	1.45	455	--	1,750	8,680	(17)	Influent
12-28-71	40	1.45	435	--	1,750	9,700	(17)	Influent
12----71	40	--	200	--	--	--	(5)	Influent
	40	--	10	--	--	--	(5)	Effluent
1-20-72	60	1.0	341	--	1,070	6,730	(17)	Influent
1-25-72	45	1.5	336	--	1,190	6,270	(17)	Influent
1----72	40	--	421	--	--	--	(5)	Influent
	40	--	7	--	--	--	(5)	Effluent
2-01-72	60	1.5	329	--	1,350	6,750	(17)	Influent

Table B3. Water-quality and discharge data from Boulder Creek copper plant, 1940-89--*Continued*

Date	Discharge (gal/min)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Sulfate (mg/L)	(Reference)	Remarks
2-08-72	80	1.5	350	--	1,320	6,680	(17)	Influent
	85	1.6	279	--	1,250	6,830	(17)	Influent
2-22-72	85	1.6	254	--	1,200	6,830	(17)	Influent
2-29-72	85	1.6	238	--	1,270	6,750	(17)	Influent
2----72	80	--	350	--	--	--	(5)	Influent
	80	--	5	--	--	--	(5)	Effluent
3-07-72	90	1.44	259	--	1,390	7,180	(17)	Influent
3-21-72	90	1.48	238	--	1,320	7,430	(17)	Influent
3----72	90	--	259	--	--	--	(5)	Influent
	90	--	1	--	--	--	(5)	Effluent
4-04-72	90	1.5	216	--	1,290	7,180	(17)	Influent
4-11-72	120	1.41	234	--	1,170	6,680	(17)	Influent
4-18-72	120	1.3	246	--	1,370	9,180	(17)	Influent
4-25-72	120	1.3	200	--	1,200	7,500	(17)	Influent
4----72	120	--	246	--	--	--	(5)	Influent
	120	--	2.1	--	--	--	(5)	Effluent
5-02-72	110	1.37	196	--	1,308	8,160	(17)	Influent
5-09-72	80	1.4	191	--	1,118	7,760	(17)	Influent
5----72	110	--	196	--	--	--	(5)	Influent
	110	--	0.8	--	--	--	(5)	Effluent
6-01-72	60	1.31	194	--	1,300	8,130	(17)	Influent
6-26-72	50	1.26	194	--	1,400	9,250	(17)	Influent
6----72	80	--	191	--	--	--	(5)	Influent
	80	--	0.6	--	--	--	(5)	Effluent
7-17-72	60	1.24	190	--	1,450	9,750	(17)	Influent
7----72	60	--	192	--	--	--	(5)	Influent
	60	--	2	--	--	--	(5)	Effluent
8-01-72	60	1.25	184	--	1,450	9,800	(17)	Influent
8-15-72	60	1.25	198	--	1,530	10,300	(17)	Influent
8----72	60	--	198	--	--	--	(5)	Influent
	60	--	2.4	--	--	--	(5)	Effluent
9-12-72	50	1.18	192	--	1,600	10,400	(17)	Influent
9-29-72	50	1.2	182	--	1,540	10,000	(17)	Influent
9----72	50	--	192	--	--	--	(5)	Influent
	50	--	1.5	--	--	--	(5)	Effluent
10-11-72	60	1.15	183	--	1,540	10,200	(17)	Influent
10----72	60	--	184	--	--	--	(5)	Influent
	60	--	24	--	--	--	(5)	Effluent
11-01-72	60	1.26	180	--	1,310	8,000	(17)	Influent
11-16-72	250	1.3	690	--	1,580	7,600	(17)	Influent
11-29-72	100	1.18	330	--	1,520	9,400	(17)	Influent
11----72	60	--	180	--	--	--	(5)	Influent
	60	--	3	--	--	--	(5)	Effluent
12-21-72	70	1.26	350	--	1,410	8,500	(17)	Influent
12----72	60	--	190	--	--	--	(5)	Influent
	60	--	5	--	--	--	(5)	Effluent
1-15-73	120	1.1	340	--	1,190	8,400	(17)	Influent
1-26-73	150	1.11	220	--	1,000	7,800	(17)	Influent
2-13-73	320	.96	320	--	1,100	14,400	(17)	Influent
2-23-73	240	1.06	247	--	1,070	12,900	(17)	Influent
3-27-73	150	1.19	242	--	1,280	9,900	(17)	Influent
4-19-73	150	.98	310	--	1,990	14,600	(17)	Influent

Table B3. Water-quality and discharge data from Boulder Creek copper plant, 1940-89--*Continued*

Date	Discharge (gal/min)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Sulfate (mg/L)	(Reference)	Remarks
5-15-73	70	0.97	250	--	1,760	13,300	(17)	Influent
6-06-73	75	1.07	237	--	1,790	12,800	(17)	Influent
6-12-73	75	1.07	230	--	1,770	12,500	(17)	Influent
7-05-73	60	1.18	234	--	1,800	12,000	(17)	Influent
8-01-73	60	1.26	210	--	1,810	11,800	(17)	Influent
9-06-73	45	1.2	204	--	1,820	11,400	(17)	Influent
10-15-73	50	1.27	202	--	1,700	11,200	(17)	Influent
11-15-73	400	1.31	360	--	930	6,650	(17)	Influent
12-12-73	180	1.16	240	--	1,300	11,000	(17)	Influent
12-20-73	150	1.25	240	--	1,300	11,000	(17)	Influent
12-07-75	--	1.1	340	13.0	1,880	10,170	(6)	Complete analysis, sample RH; Influent
4-03-76	--	1.1	4.23	9.5	1,210	33,400	(6)	Complete analysis, sample 76WA37; Effluent
3-02-77	--	--	243	10.0	1,350	--	(7)	Fe; Influent
8-08-77	--	--	323	--	1,320	--	(7)	Fe; Influent
9-19-77	--	--	520	14.2	1,280	--	(7)	Influent
9-19-77	--	--	324	10.0	1,370	--	(7)	Influent
12-09-77	--	--	445	11.2	1,740	--	(7)	Fe, Al; Influent
	--	--	324	10.2	1,370	--	(7)	Influent
12-13-78	--	--	333	--	--	--	(7)	Influent
	40	--	333	--	--	--	(7)	Influent
12-20-78	40	--	275	--	--	--	(7)	Influent
	50	--	304	14.7	2,250	--	(9)	Influent
1----79	91	--	350	10.6	1,850	--	(9)	Influent
1-11-79	91	--	350	10.6	1,850	--	(9)	Influent
1-21-79	59	--	421	--	--	--	(7)	Influent
2----79	130	--	345	17.5	2,450	--	(9)	Influent
2-16-79	130	--	456	17.5	2,450	--	(7)	Influent
	130	--	345	17.5	2,450	--	(9)	Influent
2-26-79	130	--	456	17.5	2,450	--	(7)	Influent
3-21-79	158	--	262	10.4	1,307	--	(9)	Influent
	120	--	282	10.5	1,350	--	(7)	Influent
3-31-79	195	--	288	10.2	1,270	--	(7)	Influent
4----79	--	--	276	--	--	--	(7)	Influent
6-08-79	71	--	237	12.6	1,740	--	(9)	Influent
6----79	71	--	237	12.6	1,740	--	(9)	Influent
8-05-80	50	--	162	10.9	1,570	--	(7)	Influent
	44.2	--	132	11.5	1,580	--	(9)	Influent
8-28-80	44.2	--	152	11.6	1,510	--	(7)	Influent
	--	--	93.4	10.8	1,570	--	(9)	Influent
10-30-80	47.5	--	134	11.1	1,470	--	(9)	Influent
	47.5	--	188	11.2	1,460	--	(9)	Influent
	47.5	--	130	11.0	1,440	--	(8)	Influent
	47.5	--	190	11.0	1,420	--	(8)	Influent
	48	--	134	11.1	1,470	--	(16)	Influent
12-05-80	100	--	183	12.3	1,840	--	(16)	Influent

Table B3. Water-quality and discharge data from Boulder Creek copper plant, 1940-89--*Continued*

Date	Discharge (gal/min)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Sulfate (mg/L)	(Reference) Remarks
1-23-81	104	1.5	126	7.05	1,000	--	(9) Influent
2-27-81	104	1.3	153	7.76	1,130	--	(9) Fe; Influent
3-13-81	345	1.4	190	9.84	1,280	--	(9) Influent
3-20-81	150	.90	241	10.1	1,400	--	(9) Influent
3-31-81	230	.99	260	9.1	1,270	--	(9) Influent
4-06-81	159	.85	337	10.9	1,540	--	(9) Influent
4-24-81	97	.78	305	12.3	1,880	--	(9) Influent
4-29-81	90	.79	280	12.3	1,740	--	(9) Influent
5-20-81	99	.90	310	14.7	1,960	--	(9) Influent
6-05-81	93	.91	227	10.7	1,520	--	(9) Influent
6-10-81	93	.85	221	11.2	1,550	--	(9) Influent
6-15-81	81	--	202	11.2	1,460	--	(16) Influent
7-17-81	77	--	168	10.0	1,480	--	(9) Influent
8-06-81	55	1.01	163	10.9	1,510	--	(9) Influent
11-01-81	70	1.5	466	11.2	1,718	--	(16) Influent
11-08-81	--	1.5	466	11.2	1,718	--	(9) Influent
11-12-81	207	--	235	9.3	1,150	--	(9) Influent
11-15-81	207	--	235	9.3	1,150	--	(16) Influent
11-30-81	203	--	235	9.3	1,150	--	(16) Influent
12-04-81	182	--	221	--	1,130	--	(16) Influent
12-09-81	164	--	195	9.5	1,300	--	(16) Influent
12-15-81	147	1.4	243	11.1	1,470	--	(16) Influent
12-16-81	147	1.4	243	11.1	1,470	--	(9) Influent
12-20-81	164	--	194	9.5	1,300	--	(9) Influent
12-23-81	340	1.3	249	8.7	1,260	--	(16) Influent
12-30-81	242	--	307	10.8	1,460	--	(16) Influent
1-08-82	231	1.2	278	9.1	1,390	--	(9, 16) Influent
1-15-82	256	1.2	274	10.2	1,510	--	(9, 16) Influent
1-22-82	281	.9	211	10.7	1,540	--	(9, 16) Influent
1-28-82	306	.9	216	10.9	1,510	--	(9, 16) Influent
2-05-82	332	1.1	343	10.2	1,410	--	(9, 16) Influent
2-19-82	298	1.2	269	9.4	1,330	--	(9, 16) Influent
2-27-82	237	.8	296	11.5	1,530	--	(9, 16) Influent
3-05-82	415	1.4	269	9.3	1,550	--	(9, 16) Influent
3-11-82	209	1.3	283	10.8	1,510	--	(9, 16) Influent
3-22-82	209	1.8	259	10.6	1,580	--	(9, 16) Influent
3-26-82	237	2.0	169	8.3	1,410	--	(9, 16) Influent
4-07-82	266	2.0	169	8.3	1,190	--	(9, 16) Influent
4-14-82	510	1.4	285	9.7	1,640	--	(9, 16) Influent
4-26-82	272	1.2	297	12.7	1,620	--	(9, 16) Influent
5-01-82	129	1.8	209	11.3	1,440	--	(9, 16) Influent
6-28-82	66.5	1.8	148	10.6	1,680	--	(9, 16) Influent
7-19-82	64	1.8	131	10.3	1,320	--	(9, 16) Influent
8-06-82	57	1.6	113	8.5	1,220	--	(9, 16) Influent
9-10-82	43	1.8	113	9.8	1,520	--	(9, 16) Influent
10-18-82	30	1.6	102	8.6	1,240	--	(9, 16) Influent
11-08-82	49	1.4	186	10.8	1,510	--	(9, 16) Influent
11-22-82	64	1.2	125	9.1	1,490	--	(9, 16) Influent
12-03-82	87	1.2	130	7.9	1,300	--	(9, 16) Influent
12-27-82	90	1.2	285	8.5	1,130	--	(9, 16) Influent
1-13-83	104	1.0	138	8.0	994	--	(9, 16) Influent
1-19-83	94	1.5	137	7.2	1,040	--	(9, 16) Influent

Table B3. Water-quality and discharge data from Boulder Creek copper plant, 1940-89--*Continued*

Date	Discharge (gal/min)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Sulfate (mg/L)	(Reference) Remarks
1-24-83	103	1.7	127	7.0	917	--	(9, 16) Influent
1-26-83	369	1.9	104	5.7	700	--	(9, 16) Influent
1-28-83	474	1.1	664	9.1	1,160	--	(9, 16) Influent
2-04-83	384	.9	290	8.1	1,040	--	(9, 16) Influent
2-15-83	415	1.0	202	5.6	764	--	(9, 16) Influent
2-24-83	339	1.0	239	7.6	1,120	--	(9, 16) Influent
3-02-83	423	1.2	196	6.4	759	--	(9, 16) Influent
4-04-83	292	1.4	152	6.0	815	--	(9, 16) Influent
4-06-83	350	1.46	154	5.7	797	--	(16) Influent
4-29-83	300	1.3	154	6.1	1,040	--	(9, 16) Influent
6-06-83	150	1.3	151	8.9	1,440	--	(9, 16) Influent
6-14-83	150	1.3	157	9.4	1,490	--	(9, 16) Influent
7-11-83	47	.94	176	13.2	1,910	--	(9, 16) Influent
8-26-83	35	1.1	108	8.2	1,220	--	(9, 16) Influent
9-21-83	50	1.3	97	8.1	1,170	--	(9, 16) Influent
9-26-83	64	2.8	119	9.2	966	--	(16) Influent
11-04-83	35	1.45	81	8.0	1,180	--	(9, 16) Influent
12-01-83	242	1.0	170	6.0	832	--	(16) Influent
12-14-83	266	--	175	4.5	730	--	(9, 16) Influent
12-29-83	134	--	151	6.0	849	--	(9, 16) Influent
1-10-84	659	--	208	7.8	1,150	--	(16) Influent
2-15-84	131	--	158	7.4	1,220	--	(9, 16) Influent
2-22-84	100	--	200	8.1	1,360	--	(9, 16) Influent
2-29-84	93	--	153	7.1	1,250	--	(9, 16) Influent
3-07-84	86	--	134	7.5	1,210	--	(9, 16) Influent
3-14-84	92	--	129	7.5	1,020	--	(9, 16) Influent
3-20-84	123	--	149	7.5	1,130	--	(9, 16) Influent
3-27-84	165	--	149	7.3	1,180	--	(9, 16) Influent
4-03-84	115	--	137	7.7	1,220	--	(9, 16) Influent
4-11-84	108	--	154	8.4	1,330	--	(9, 16) Influent
4-17-84	88	--	130	7.9	1,130	--	(9, 16) Influent
4-26-84	85	--	128	8.1	1,180	--	(9, 16) Influent
5-02-84	78	--	118	7.7	1,300	--	(9, 16) Influent
5-08-84	74	--	119	7.5	1,350	--	(9, 16) Influent
5-16-84	69	--	125	7.3	1,170	--	(9, 16) Influent
5-23-84	64	--	--	--	--	--	(9, 16) Influent
7-13-84	56	1.3	105	7.7	1,060	--	(9, 16) Influent
9-04-84	43	1.2	96	7.4	1,120	--	(9, 16) Influent
10-11-84	25	--	83	7.7	794	--	(9, 16) Influent
10-26-84	39	1.2	87	6.8	919	--	(9, 16) Influent
11-07-84	30	--	182	6.3	811	--	(9, 16) Influent
11-13-84	164	.88	400	9.5	1,460	--	(9, 16) Influent
11-21-84	50	--	169	6.1	809	--	(9, 16) Influent
12-01-84	75	1.9	125	--	--	--	(9, 16) Influent
12-07-84	90	--	125	--	--	--	(9, 16) Influent
12-21-84	125	1.7	109	5.7	643	--	(16) Influent (12-31-84?)
12-28-84	100	1.08	126	6.8	904	--	(9, 16) Influent
12-31-84	125	1.7	109	5.7	643	--	(9) Influent (12-21-84?)
1-04-85	100	1.9	118	6.1	728	--	(9, 16) Influent
1-11-85	90	2.0	111	6.0	730	--	(9, 16) Influent
1-18-85	85	1.9	110	6.0	726	--	(9, 16) Influent
1-25-85	70	1.9	108	6.0	734	--	(9, 16) Influent
2-11-85	67	1.06	100	6.0	894	--	(16) Influent

Table B3. Water-quality and discharge data from Boulder Creek copper plant, 1940-89--*Continued*

Date	Discharge (gal/min)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Sulfate (mg/L)	(Reference)	Remarks
2-15-85	60	2.0	104	6.9	855	--	(9, 16)	Influent
2-22-85	60	1.7	101	6.5	803	--	(9, 16)	Influent
2-27-85	55	1.7	95	6.0	720	--	(9, 16)	Influent
3-08-85	40	1.9	97	6.4	711	--	(9, 16)	Influent
3-15-85	40	1.7	97	6.9	774	--	(9, 16)	Influent
3-20-85	28	1.7	96	6.6	730	--	(9, 16)	Influent
3-22-85	40	--	95	6.6	730	--	(16)	Influent
3-28-85	35	1.6	92	6.4	700	--	(9, 16)	Influent
4-08-85	40	1.9	94	7.0	730	--	(9, 16)	Influent
5-21-85	30	1.5	94	6.4	619	--	(9, 16)	Influent
6-03-85	45	--	91	6.1	912	--	(9, 16)	Influent
6-05-85	30	1.5	91	6.9	567	--	(9, 16)	Influent
7-14-85	25	1.5	63	3.5	302	--	(9, 16)	Influent
9-17-85	30	1.0	90	6.3	583	--	(9, 16)	Influent
9-10-85	27	1.22	86	5.6	900	--	(9, 16)	Influent
9-20-85	25	1.3	101	6.9	717	--	(9, 16)	Influent
11-04-85	25	1.5	102	6.6	677	--	(9, 16)	Influent
12-02-85	33	1.28	65	4.6	710	--	(16)	Influent
12-07-85	52	1.5	183	7.7	833	--	(16)	Influent
12-13-85	45	1.7	187	7.7	842	--	(16)	Influent
12-16-85	46	1.0	180	9.0	1,400	--	(16)	Influent
12-20-85	40	1.9	183	7.8	842	--	(16)	Influent
12-27-85	40	1.2	162	7.0	784	--	(16)	Influent
	40	--	162	--	--	--	(11)	Influent
	40	--	5.3	7.0	784	--	(11)	Effluent
12-31-85	40	--	140	--	--	--	(16)	Influent
1-04-86	37	1.3	133	---	--	--	(11, 16)	Influent
	37	--	1.9	5.8	597	--	(11, 16)	Effluent
1-10-86	30	1.1	147	--	--	--	(11, 16)	Influent
	30	--	1.0	6.4	686	--	(11, 16)	Effluent
1-17-86	60	1.2	208	--	--	--	(11, 16)	Influent
	60	--	1.7	8.2	860	--	(11, 16)	Effluent
1-18-86	85	.84	160	9.5	1,460	--	(16)	Influent
1-24-86	50	1.1	209	--	--	--	(11, 16)	Influent
	50	--	1.7	8.2	860	--		Effluent
1-25-86	28	--	134	--	--	--	(11)	Influent
	28	--	.63	7.7	1,120	--		Effluent
1-31-86	113	--	164	8.5	1,130	--	(16)	Influent
2-03-86	200	1.1	238	--	--	--	(11, 16)	Influent
	200	--	1.9	6.2	632	--	(11, 16)	Effluent
2-04-86	--	.97	260	6.2	1,000	--	(16)	Influent
2-10-86	155	1.0	235	--	--	--	(11, 16)	Influent
	155	--	1.9	6.2	628	--	(11, 16)	Effluent
2-14-86	125	1.2	227	--	--	--	(11, 16)	Influent
	125	--	3.4	5.7	539	--	(11, 16)	Effluent
2-20-86	--	--	490	--	--	--	(11, 16)	Influent
	--	--	12.4	6.9	762	--	(11, 16)	Effluent
2-21-86	--	--	430	8.7	1,240	--	(16)	Influent
2-28-86	45	1.2	347	--	--	--	(11, 16)	Influent
	45	--	23	6.6	686	--		Effluent
3-07-86	196	--	260	8.0	1,100	--	(16)	Influent
	150	--	316	--	--	--	(11)	Influent
	150	--	12.1	7.6	592	--		Effluent

Table B3. Water-quality and discharge data from Boulder Creek copper plant, 1940-89--*Continued*

Date	Discharge (gal/min)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Sulfate (mg/L)	(Reference)	Remarks
3-14-86	220	--	265	7.9	1,060	--	(16)	Influent
	375	--	294	--	--	--	(11)	Influent
	375	--	7.3	6.7	650	--		Effluent
3-21-86	266	--	260	7.8	1,040	--	(16)	Influent
	230	--	276	--	--	--	(11)	Influent
	230	--	6.0	6.4	557	--		Effluent
3-28-86	220	--	312	8.8	1,310	--	(16)	Influent
	260	--	343	--	--	--	(11)	Influent
	260	--	3.0	7.3	659	--		Effluent
4-04-86	142	--	346	11.3	1,340	--	(16)	Influent
	150	--	374	--	--	--	(11)	Influent
	150	--	11.4	7.8	713	--	(11)	Effluent
4-11-86	125	--	348	9.5	1,320	--	(16)	Influent
	125	--	601	--	--	--	(11)	Influent
	125	--	3.5	11.0	890	--	(11)	Effluent
4-18-86	125	--	508	--	--	--	(11)	Influent
	125	--	3.7	11.0	850	--	(11)	Effluent
	110	--	305	9.4	1,360	--	(16)	Influent
4-25-86	97	--	310	9.4	1,380	--	(16)	Influent
4-28-86	95	1.3	477	--	--	--	(12, 16)	Influent
	95	--	1.2	11.0	880	--	(12, 16)	Effluent
5-02-86	60	1.5	454	--	--	--	(12, 16)	Influent
	60	--	24	13.0	740	--	(12, 16)	Effluent
5-09-86	50	1.5	290	--	--	--	(12, 16)	Influent
	50	--	2.33	12.0	1,420	--	(12, 16)	Effluent
5-16-86	50	1.4	290	--	--	--	(12, 16)	Influent
	50	--	2.04	12.0	1,390	--	(12, 16)	Effluent
6-12-86	55	1.3	263	--	--	--	(12, 16)	Influent
	55	--	1.9	9.3	1,790	--	(12, 16)	Effluent
9-21-86	25	1.5	158	--	--	--	(12, 16)	Influent
	25	--	.70	10.0	1,180	--	(12, 16)	Effluent
10-08-86	30	1.5	149	10.0	1,210	--	(16)	Influent
11-15-86	25	1.5	134	9.8	1,210	--	(16)	Influent
11-25-86	28	--	134	7.7	1,140	--	(16)	Influent
12-04-86	--	--	122	8.0	1,080	--	(16)	Influent
12-11-86	--	--	112	8.5	1,160	--	(16)	Influent
12-18-86	--	--	114	6.9	1,030	--	(16)	Influent
12-20-86	30	1.0	126	12.0	1,390	--	(16)	Influent
12-31-86	35	1.0	124	12.0	1,350	--	(16)	Influent
1-06-87	30	1.0	156	14.0	1,950	--	(16)	Influent
1-08-87	--	--	148	12.0	1,700	--	(16)	Influent
1-14-87	45	1.0	169	14.0	2,020	--	(16)	Influent
1-21-87	40	1.0	214	8.3	1,380	--	(16)	Influent
1-22-87	--	--	190	9.3	1,340	--	(16)	Influent
1-30-87	70	--	180	--	--	--	(16)	Influent
	50	1.0	209	8.3	1,140	--	(16)	Influent
2-03-87	--	--	250	11.0	1,520	--	(16)	Influent
2-10-87	75	1.0	209	8.3	1,290	--	(16)	Influent
2-13-87	--	--	210	7.4	1,080	--	(16)	Influent
2-17-87	--	--	280	7.0	1,020	--	(16)	Influent
	100	1.0	178	--	--	--	(13)	Influent
	100	--	3.1	6.2	980	--	(13)	Effluent

Table B3. Water-quality and discharge data from Boulder Creek copper plant, 1940-89--*Continued*

Date	Discharge (gal/min)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Sulfate (mg/L)	(Reference)	Remarks
2-24-87	--	--	200	6.4	980	--	(16)	Influent
	80	1.0	111	--	--	--	(13)	Influent
	80	--	3.1	5.9	980	--	(13)	Effluent
3-03-87	--	--	150	5.6	840	--	(16)	Influent
3-06-87	80	1.0	187	--	--	--	(13)	Influent
	80	--	1.2	6.4	900	--	(13)	Effluent
3-10-87	--	--	170	5.3	790	--	(16)	Influent
3-13-87	110	1.0	151	--	--	--	(13)	Influent
	110	--	4.2	4.9	30	--	(13)	Effluent
3-17-87	--	--	150	4.2	650	--	(16)	Influent
3-24-87	--	--	141	4.8	720	--	(16)	Influent
3-27-87	86	1.0	138	--	--	--	(13)	Influent
	86	--	.7	8.9	870	--	(16)	Effluent
3-31-87	--	--	144	5.15	800	--	(16)	Influent
4-03-87	80	1.0	143	--	--	--	(13)	Influent
	80	--	.5	7.6	950	--	(13)	Effluent
4-07-87	--	--	148	5.6	880	--	(16)	Influent
4-10-87	80	1.0	147	--	--	--	(13)	Influent
	80	--	.5	7.6	960	--	(13)	Effluent
4-14-87	--	--	158	6.25	960	--	(16)	Influent
4-17-87	70	1.0	138	--	--	--	(13)	Influent
	70	--	.7	8.1	980	--	(13)	Effluent
4-23-87	--	--	150	6.2	900	--	(16)	Influent
4-24-87	60	1.0	143	--	--	--	(13)	Influent
	60	--	.7	8.5	1,000	--	(13)	Effluent
4-30-87	--	--	130	5.7	830	--	(16)	Influent
5-17-87	60	1.0	138	--	--	--	(14)	Influent
	60	--	1.5	8.9	1,020	--	(14)	Effluent
6-15-87	50	1.5	127	--	--	--	(14)	Influent
	50	--	1.4	8.0	1,100	--	(14)	Effluent
7-15-87	45	1.5	98	--	--	--	(14)	Influent
	45	--	.74	8.3	1,100	--	(14)	Effluent
8-19-87	25	1.5	114	--	--	--	(14)	Influent
	25	--	9.1	7.2	910	--	(14)	Effluent
9-20-87	25	1.5	114	--	--	--	(14)	Influent
	25	--	2.5	7.8	1,100	--	(14)	Effluent
12-01-87	--	1.21	95.9	6.0	890	--	(14, 16)	Influent
	--	--	6.4	5.45	800	--	(14, 16)	Effluent
12-09-87	--	1.53	565	7.4	1,090	--	(14, 16)	Influent
	--	--	182	7.05	110	--	(14, 16)	Effluent
12-22-87	--	--	274	6.7	696	--	(14, 16)	Influent
	--	--	.42	6.6	705	--	(14, 16)	Effluent
12-31-87	--	1.03	214	6.5	940	--	(16)	Influent
1-07-88	--	1.18	194	--	--	--	(14)	Influent
	--	--	1.1	6.2	676	--	(14)	Effluent
1-14-88	--	1.07	243	--	--	--	(14)	Influent
	--	--	3.08	--	--	--	(14)	Effluent
1-21-88	--	1.0	182	5.32	798	--	(14)	Influent
	--	--	1.15	5.4	828	--	(14)	Effluent
1-28-88	--	--	--	6.8	--	--	(14, 16)	Influent
	--	--	--	6.6	--	--	(14, 16)	Effluent
2-03-88	--	.88	20.7	7.0	962	--	(14, 16)	Influent
	--	--	.53	--	--	--	(14, 16)	Effluent

Table B3. Water-quality and discharge data from Boulder Creek copper plant, 1940-89--*Continued*

Date	Discharge (gal/min)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Sulfate (mg/L)	(Reference) Remarks
2-11-88	--	0.82	226	8.15	1,150	--	(14, 16) Influent
	--	--	.34	8.15	1,180	--	(14, 16) Effluent
2-19-88	--	1.17	201	7.85	1,050	--	(14, 16) Influent
	--	--	48.8	7.6	991	--	(14, 16) Effluent
3-18-88	--	--	204	--	--	--	(14, 16) Influent
	--	--	.87	--	--	--	(14, 16) Effluent
4-06-88	--	.68	178.2	8.0	1,070	--	(14, 16) Influent
	--	--	16.6	--	--	--	(14, 16) Effluent
4-21-88	--	--	165	--	--	--	(14, 16) Influent
	--	--	195	--	--	--	(14, 16) Effluent
5-05-88	--	--	208	--	--	--	(14, 16) Influent
	--	--	203	--	--	--	(14, 16) Effluent
6-15-88	--	.90	171	8.3	1,140	--	(14, 16) Influent
	--	--	13.4	8.18	1,140	--	(14, 16) Effluent
7-06-88	--	--	157	--	--	--	(15, 16) Influent
7-15-88	--	1.09	154	8.11	1,160	--	(15, 16) Influent
8-17-88	30	1.0	90	6.3	583	--	(15, 16) Influent
8-24-88	--	1.05	164	8.43	1,220	--	(15, 16) Influent
9-20-88	25	1.3	101	6.9	717	--	(15, 16) Influent
10-20-88	--	--	144	--	--	--	(15, 16) Influent
11-09-88	--	.92	148	7.42	1,100	--	(15, 16) Influent
11-17-88	--	1.6	169	--	--	--	(15, 16) Influent
11-18-88	--	.91	170	9.71	1,360	--	(15, 16) Influent
11-30-88	--	.97	218	10.7	1,480	--	(15, 16) Influent
12-07-88	--	2.1	176	--	1,170	--	(15, 16) Influent
12-13-88	--	--	203	10.6	1,420	--	(15, 16) Influent
1-04-89	--	1.29	119	5.76	868	--	(15, 16) Influent
1-11-89	19	1.54	97	4.21	670	--	(15, 16) Influent
1-19-89	62	.84	176	10.4	1,430	--	(15, 16) Influent
1-25-89	39	1.19	120	6.4	948	--	(15, 16) Influent
1-30-89	43	1.04	128	6.48	944	--	(15, 16) Influent
2-06-89	60	.74	153	8.54	1,210	--	(15, 16) Influent
2-14-89	60	.99	149	8.24	1,140	--	(15, 16) Influent
2-22-89	25	1.34	78	3.26	509	--	(15, 16) Influent
3-06-89	52	.87	148	8.16	1,080	--	(15, 16) Influent
3-11-89	--	1.3	276	--	--	--	(15, 16) Influent
3-13-89	250	.67	264	9.03	1,240	--	(15, 16) Influent
3-20-89	160	.83	274	8.8	1,220	--	(15, 16) Influent
3-25-89	--	--	317	--	1,700	--	(15, 16) Influent
3-27-89	171	.76	244	7.67	1,040	--	(15, 16) Influent
4-03-89	177	.82	338	10.3	1,360	--	(15, 16) Influent
4-10-89	107	.49	384	11.3	1,460	--	(15, 16) Influent
4-17-89	98	.23	334	10.8	1,380	--	(15, 16) Influent
4-24-89	74	.72	320	10.5	1,340	--	(15, 16) Influent
5-01-89	70	1.55	156	3.77	569	--	(15, 16) Influent
5-15-89	55	.60	328	11.0	1,470	--	(15, 16) Influent
6-14-89							Flume out
7-14-89	94	--	--	--	--	--	(15, 16) Influent

Table B4. Water-quality and discharge data from Richmond Mine emergency treatment plant, 1989-91

[All concentrations refer to influent to plant; gal/d, gallon per day; mg/L, milligram per liter; --, no data]

Date	Volume (gal/d)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Zinc/Copper (Wt. ratio)	(Reference) Remarks
12-01-89	28,800	--	204	10.7	1,700	8.3	(18)
12-02-89	28,800	--	204	10.7	1,700	8.3	(18)
12-03-89	28,800	--	204	10.7	1,700	8.3	(18)
12-04-89	28,000	--	196	10.7	1,700	8.7	(18)
12-05-89	28,000	--	196	10.7	1,700	8.7	(18)
12-06-89	28,000	--	196	10	1,800	9.2	(18)
12-07-89	28,000	--	166	10	1,800	10.8	(18)
12-08-89	28,000	--	166	10	1,800	10.8	(18)
12-09-89	28,000	--	166	10	1,800	10.8	(18)
12-10-89	28,000	--	166	10	1,800	10.8	(18)
12-11-89	28,000	--	166	10	1,800	10.8	(18)
12-12-89	28,800	--	166	10	1,800	10.8	(18)
12-13-89	28,000	--	173	14	1,600	9.3	(18)
12-14-89	28,800	--	173	14	1,600	9.3	(18)
12-15-89	28,800	--	173	14	1,600	9.3	(18)
12-16-89	28,800	--	173	11.5	1,700	9.8	(18)
12-17-89	28,800	--	157	14	1,700	10.8	(18)
12-18-89	28,800	--	154	14	1,600	10.4	(18)
12-19-89	28,598	--	179	13.2	1,500	8.4	(18)
12-20-89	37,440	--	178	13.3	1,700	9.6	(18)
12-21-89	31,536	--	175	13.1	1,500	8.6	(18)
12-22-89	31,536	--	177	13	1,700	9.6	(18)
12-23-89	31,622	--	184	11.9	1,700	9.2	(18)
12-24-89	34,560	--	186	12	1,800	9.8	(18)
12-25-89	32,400	--	187	11.6	1,800	9.6	(18)
12-26-89	29,923	--	185	11.8	1,800	9.7	(18)
12-27-89	29,952	--	181	12.2	1,700	9.4	(18)
12-28-89	28,944	--	174	12.4	1,700	9.8	(18)
12-29-89	28,658	--	176	12.9	1,800	10.2	(18)
12-30-89	28,658	--	172	12.4	1,800	10.5	(18)
12-31-89	28,658	--	177	12.5	1,800	10.2	(18)
1-01-90	28,368	--	166	12.5	1,900	11.5	(18)
1-02-90	26,352	--	168	12.1	1,800	10.7	(18)
1-03-90	26,496	--	167	12.2	1,800	10.8	(18)
1-04-90	25,920	--	176	11.7	1,700	9.7	(18)
1-05-90	27,072	--	177	12.8	2,000	11.3	(18)
1-06-90	26,640	--	178	12.5	1,700	9.6	(18)
1-07-90	25,344	--	171	12.6	1,800	10.5	(18)
1-08-90	25,632	--	172	12.3	1,800	10.5	(18)
1-09-90	25,920	--	175	12.7	1,800	10.3	(18)
1-10-90	24,624	--	176	12.8	1,600	9.1	(18)
1-11-90	25,776	--	172	12.9	1,800	10.5	(18)
1-12-90	26,784	--	168	12.7	2,100	12.5	(18)
1-13-90	45,216	--	154	11.4	1,700	11.0	(18)
1-14-90	37,008	--	164	12.4	1,900	11.6	(18)
1-15-90	31,680	--	167	12.4	1,800	10.8	(18)
1-16-90	43,344	--	147	12.6	1,900	12.9	(18)

Table B4. Water-quality and discharge data from Richmond Mine emergency treatment plant, 1989-91--*Continued*

Date	Volume (gal/d)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Zinc/Copper (Wt. ratio)	(Reference) Remarks
1-17-90	43,776	--	140	13.1	2,400	17.1	(18)
1-18-90	17,784	--	173	14.1	2,100	12.1	(18)
1-19-90	31,962	--	146	11.8	2,300	15.8	(18)
1-20-90	41,904	--	146	15.4	2,300	15.8	(18)
1-21-90	48,096	--	168	15.9	2,500	14.9	(18)
1-22-90	49,248	--	173	15.6	2,100	12.1	(18)
1-23-90	48,960	--	161	15.5	2,300	14.3	(18)
1-24-90	51,264	--	134	15.5	2,400	17.9	(18)
1-25-90	50,832	--	150	15.8	2,200	14.7	(18)
1-26-90	49,824	--	168	14.5	2,400	14.3	(18)
1-27-90	45,216	--	168	14.6	2,400	14.3	(18)
1-28-90	40,896	--	168	14.6	2,400	14.3	(18)
1-29-90	49,824	--	130	13.8	2,300	17.7	(18)
1-30-90	48,960	--	187	13.8	1,900	10.21	(18)
1-31-90	46,224	--	177	13.7	2,100	11.9	(18)
2-01-90	46,090	--	200	13	1,900	9.5	(18)
2-02-90	36,623	--	210	14	1,900	9.0	(18)
2-03-90	42,503	--	92	6.3	900	9.8	(18)
2-04-90	37,928	--	85	6	900	10.6	(18)
2-05-90	41,332	--	190	13	1,900	10.0	(18)
2-06-90	29,715	--	200	14	1,800	9.0	(18)
2-07-90	38,126	--	200	13	1,900	9.5	(18)
2-08-90	41,472	--	200	13	1,900	9.5	(18)
2-09-90	33,891	--	180	13	1,900	10.6	(18)
2-10-90	39,419	--	180	13	1,800	10.0	(18)
2-11-90	40,950	--	200	14	1,800	9.0	(18)
2-12-90	39,081	--	180	13	1,800	10.0	(18)
2-13-90	42,161	--	180	14	1,900	10.6	(18)
2-14-90	47,133	--	180	13	1,900	10.6	(18)
2-15-90	40,776	--	170	12	1,800	10.6	(18)
2-16-90	33,464	--	180	14	1,900	10.6	(18)
2-17-90	44,087	--	180	13	1,800	10.0	(18)
2-18-90	41,143	--	170	13	1,800	10.6	(18)
2-19-90	39,479	--	170	13	1,800	10.6	(18)
2-20-90	40,040	--	170	13	1,800	10.6	(18)
2-21-90	43,566	--	160	12	1,700	10.6	(18)
2-22-90	39,758	--	170	13	1,900	11.2	(18)
2-23-90	36,208	--	170	14	1,700	10.0	(18)
2-24-90	35,045	--	170	12	1,800	10.6	(18)
2-25-90	33,009	--	160	12	1,800	11.31	(18)
2-26-90	34,040	--	150	13	1,600	10.7	(18)
2-27-90	29,764	--	140	7	1,000	7.1	(18)
2-28-90	38,691	--	88	5.8	900	10.2	(18)
3-01-90	43,200	--	152	12.5	1,900	12.5	(18)
3-02-90	42,624	--	152	12.4	1,700	11.2	(18)
3-03-90	42,624	--	145	12.2	1,700	11.7	(18)
3-04-90	39,744	--	146	12.1	1,700	11.6	(18)
3-05-90	32,937	--	146	11.7	1,800	12.3	(18)
3-06-90	41,904	--	179	11.6	1,800	10.1	(18)

Table B4. Water-quality and discharge data from Richmond Mine emergency treatment plant, 1989-91--*Continued*

Date	Volume (gal/d)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Zinc/Copper (Wt. ratio)	(Reference) Remarks
3-07-90	43,200	--	165	11.9	1,800	10.9	(18)
3-08-90	44,064	--	160	11.7	1,700	10.6	(18)
3-09-90	43,632	--	156	11.4	1,700	10.9	(18)
3-10-90	43,632	--	138	10.9	1,500	10.9	(18)
3-11-90	45,648	--	139	11.3	1,300	9.4	(18)
3-12-90	45,648	--	144	11.7	1,600	11.1	(18)
3-13-90	44,784	--	143	11.6	2,300	16.1	(18)
3-14-90	45,936	--	139	11.5	1,300	9.4	(18)
3-15-90	45,216	--	141	11.6	2,300	16.3	(18)
3-16-90	47,808	--	146	11.9	1,400	9.6	(18)
3-17-90	47,808	--	151	12	1,600	10.6	(18)
3-18-90	47,952	--	149	12	1,600	10.7	(18)
3-19-90	47,952	--	149	11.8	1,600	10.7	(18)
3-20-90	45,792	--	148	12.1	1,500	10.1	(18)
3-21-90	46,080	--	147	11.9	1,600	10.9	(18)
3-22-90	46,944	--	147	11.4	1,600	10.9	(18)
3-23-90	46,080	--	149	12	1,600	10.7	(18)
3-24-90	46,080	--	134	11.9	1,500	11.2	(18)
3-25-90	45,648	--	131	11.5	1,500	11.5	(18)
3-26-90	45,648	--	136	11.7	1,500	11.0	(18)
3-27-90	45,936	--	135	11.8	1,500	11.1	(18)
3-28-90	44,640	--	139	11.9	1,500	10.8	(18)
3-29-90	45,072	--	139	11.6	1,500	10.8	(18)
3-30-90	44,784	--	138	11.9	1,500	10.9	(18)
3-31-90	44,784	--	137	11.2	1,500	11.0	(18)
11-30-90	18,000	--	156	10.7	1,350	9.0	(19)
12-01-90	17,424	--	256	17.4	2,190	8.6	(19)
12-02-90	17,424	--	247	17.1	2,150	8.7	(19)
12-03-90	18,432	--	247	17.4	2,160	8.7	(19)
12-04-90	17,280	--	258	17.3	2,150	8.3	(19)
12-05-90	18,000	--	245	16.9	2,120	8.7	(19)
12-06-90	17,856	--	248	17.3	2,160	8.7	(19)
12-07-90	17,856	--	244	16.8	2,140	8.8	(19)
12-08-90	17,568	--	245	17.3	2,150	8.8	(19)
12-09-90	17,569	--	246	17.3	2,160	8.8	(19)
12-10-90	17,568	--	243	17.1	2,150	8.9	(19)
12-11-90	18,000	--	235	17.7	2,310	9.8	(19)
12-12-90	18,576	--	233	18.0	2,350	10.1	(19)
12-13-90	18,000	--	226	17.3	2,300	10.2	(19)
12-14-90	17,712	--	224	17.5	2,320	10.4	(19)
12-15-90	17,712	--	218	17.4	2,300	10.6	(19)
12-16-90	17,712	--	217	17.6	2,320	10.7	(19)
12-17-90	17,712	--	242	18.7	2,310	9.6	(19)
12-18-90	17,712	--	269	19.1	2,470	9.2	(19)
12-19-90	17,712	--	261	18.5	2,400	9.2	(19)
12-20-90	16,560	--	259	19.3	2,490	9.6	(19)
12-24-90	14,976	--	253	19.5	2,530	10.0	(19)
12-25-90	15,264	--	243	10.3	1,390	5.7	(19)
12-26-90	15,408	--	249	15.1	1,950	7.8	(19)

Table B4. Water-quality and discharge data from Richmond Mine emergency treatment plant, 1989-91--*Continued*

Date	Volume (gal/d)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Zinc/Copper (Wt. ratio)	(Reference) Remarks
12-27-90	16,560	--	256	19.0	2,430	9.5	(19)
12-28-90	16,704	--	256	18.7	2,420	9.4	(19)
12-29-90	16,704	--	249	19.2	2,450	9.8	(19)
12-30-90	16,704	--	256	18.8	2,440	9.5	(19)
12-31-90	16,704	--	256	19.1	2,450	9.6	(19)
1-01-91	16,704	--	233	19.1	2,390	10.3	(19)
1-02-91	16,416	--	238	19.3	2,400	10.1	(19)
1-03-91	14,400	--	235	19.1	2,400	10.2	(19)
1-04-91	14,976	--	235	18.9	2,380	10.1	(19)
1-05-91	14,976	--	232	18.1	2,270	9.8	(19)
1-06-91	16,128	--	226	18.7	2,350	10.4	(19)
1-07-91	16,128	--	236	19.1	2,400	10.2	(19)
1-08-91	15,840	--	231	18.4	2,330	10.1	(19)
1-09-91	15,552	--	237	18.6	2,360	10.0	(19)
1-10-91	15,696	--	238	18.6	2,370	10.0	(19)
1-11-91	16,560	--	238	18.6	2,360	9.9	(19)
1-12-91	16,560	--	235	18.6	2,350	10.0	(19)
1-13-91	16,984	--	230	18.3	2,320	10.1	(19)
1-14-91	15,984	--	226	18.3	2,310	10.2	(19)
1-15-91	15,840	--	222	18.1	2,290	10.3	(19)
1-16-91	15,120	--	222	18.0	2,300	10.4	(19)
1-17-91	14,832	--	224	18.2	2,310	10.3	(19)
1-18-91	15,696	--	223	18.0	2,310	10.4	(19)
1-19-91	15,696	--	223	17.9	2,330	10.4	(19)
1-20-91	15,120	--	222	18.0	2,310	10.4	(19)
1-21-91	15,120	--	220	17.8	2,290	10.4	(19)
1-22-91	12,960	--	165	15.3	1,900	11.5	(19)
1-23-91	15,624	--	164	15.2	1,890	11.5	(19)
1-24-91	14,832	--	232	18.3	2,320	10.0	(19)
1-25-91	15,120	--	238	18.6	2,400	10.1	(19)
1-26-91	15,120	--	232	18.5	2,360	10.2	(19)
1-27-91	15,552	--	223	17.7	2,290	10.3	(19)
1-28-91	15,552	--	238	19.1	2,420	10.2	(19)
1-29-91	15,264	--	238	18.8	2,410	10.1	(19)
1-30-91	15,120	--	233	18.4	2,360	10.1	(19)
1-31-91	15,408	--	230	18.6	2,360	10.8	(19)
2-01-91	15,120	--	229	18.1	2,340	10.2	(19)
2-02-91	15,120	--	218	17.5	2,240	10.3	(19)
2-03-91	15,696	--	225	17.9	2,320	10.3	(19)
2-04-91	15,696	--	227	17.9	2,320	10.2	(19)
2-05-91	15,552	--	226	18.3	2,350	10.4	(19)
2-06-91	15,552	--	228	18.5	2,370	10.4	(19)
2-07-91	15,408	--	228	18.2	2,350	10.3	(19)
2-08-91	15,552	--	223	18.1	2,340	10.5	(19)
2-09-91	15,552	--	216	17.6	2,220	10.3	(19)
2-10-91	16,272	--	211	17.5	2,170	10.3	(19)
2-11-91	16,272	--	217	17.7	2,230	10.3	(19)

Table B4. Water-quality and discharge data from Richmond Mine emergency treatment plant, 1989-91--*Continued*

Date	Volume (gal/d)	pH	Copper (mg/L)	Cadmium (mg/L)	Zinc (mg/L)	Zinc/Copper (Wt. ratio)	(Reference) Remarks
2-12-91	16,416	--	217	17.8	2,250	10.4	(19)
2-13-91	18,000	--	213	17.7	2,200	10.3	(19)
2-14-91	19,296	--	214	18.2	2,250	10.5	(19)
2-15-91	19,584	--	207	17.5	2,170	10.5	(19)
2-16-91	19,584	--	212	18.0	2,340	11.0	(19)
2-17-91	20,592	--	216	18.3	2,380	11.0	(19)
2-18-91	20,592	--	217	18.2	2,380	11.0	(19)
2-19-91	21,024	--	213	18.1	2,330	11.0	(19)
2-20-91	20,448	--	219	18.5	2,380	10.9	(19)
2-21-91	21,168	--	218	18.2	2,360	10.8	(19)
2-22-91	21,168	--	220	18.3	2,340	10.6	(19)
2-23-91	21,168	--	221	17.9	2,300	10.4	(19)
2-24-91	21,024	--	222	17.8	2,280	10.3	(19)
2-25-91	21,024	--	226	17.8	2,290	10.1	(19)
2-26-91	21,024	--	224	17.6	2,250	10.0	(19)
2-27-91	21,168	--	231	17.9	2,290	9.9	(19)
2-28-91	20,448	--	218	17.0	2,170	10.0	(19)
3-01-91	20,880	--	221	16.1	2,080	9.4	(19)
3-02-91	20,880	--	215	16.0	2,060	9.6	(19)
3-03-91	20,304	--	211	15.8	2,030	9.6	(19)
3-04-91	21,456	--	193	14.2	1,800	9.3	(19)
3-05-91	19,008	--	208	15.7	2,000	9.6	(19)
3-06-91	21,744	--	187	13.4	1,720	9.2	(19)
3-07-91	25,056	--	201	15.4	1,940	9.7	(19)
3-08-91	30,240	--	216	16.9	2,150	10.0	(19)
3-09-91	30,240	--	206	16.8	2,150	10.4	(19)
3-10-91	33,840	--	235	17.7	2,300	9.8	(19)
3-11-91	33,840	--	264	19.6	2,480	9.4	(19)
3-12-91	35,568	--	283	19.5	2,470	8.7	(19)
3-13-91	36,720	--	304	19.4	2,460	8.1	(19)
3-14-91	38,304	--	328	19.8	2,500	7.6	(19)
3-15-91	38,592	--	358	21.0	2,670	7.5	(19)
3-16-91	38,304	--	342	19.7	2,550	7.5	(19)
3-17-91	43,200	--	334	19.6	2,500	7.5	(19)
3-18-91	43,200	--	322	18.9	2,380	7.4	(19)
3-19-91	44,784	--	311	17.9	2,310	7.4	(19)
3-20-91	44,928	--	291	16.8	2,190	7.5	(19)
3-21-91	45,360	--	278	16.3	2,120	7.6	(19)
3-22-91	48,240	--	272	16.4	2,100	7.7	(19)
3-23-91	48,240	--	245	14.9	1,950	8.0	(19)
3-24-91	63,360	--	244	15.2	1,950	8.0	(19)
3-25-91	63,360	--	235	15.0	1,920	8.2	(19)
3-26-91	78,768	--	220	14.8	1,920	8.7	(19)
3-27-91	93,024	--	267	16.8	2,170	8.1	(19)
3-28-91	93,312	--	267	15.4	2,020	7.6	(19)
3-29-91	91,728	--	253	14.6	1,870	7.4	(19)
3-30-91	88,416	--	254	14.1	1,820	7.2	(19)
3-31-91	84,816	--	252	13.7	1,750	6.9	(19)

APPENDIX C

TIME-SERIES PLOTS OF WATER-QUALITY DATA

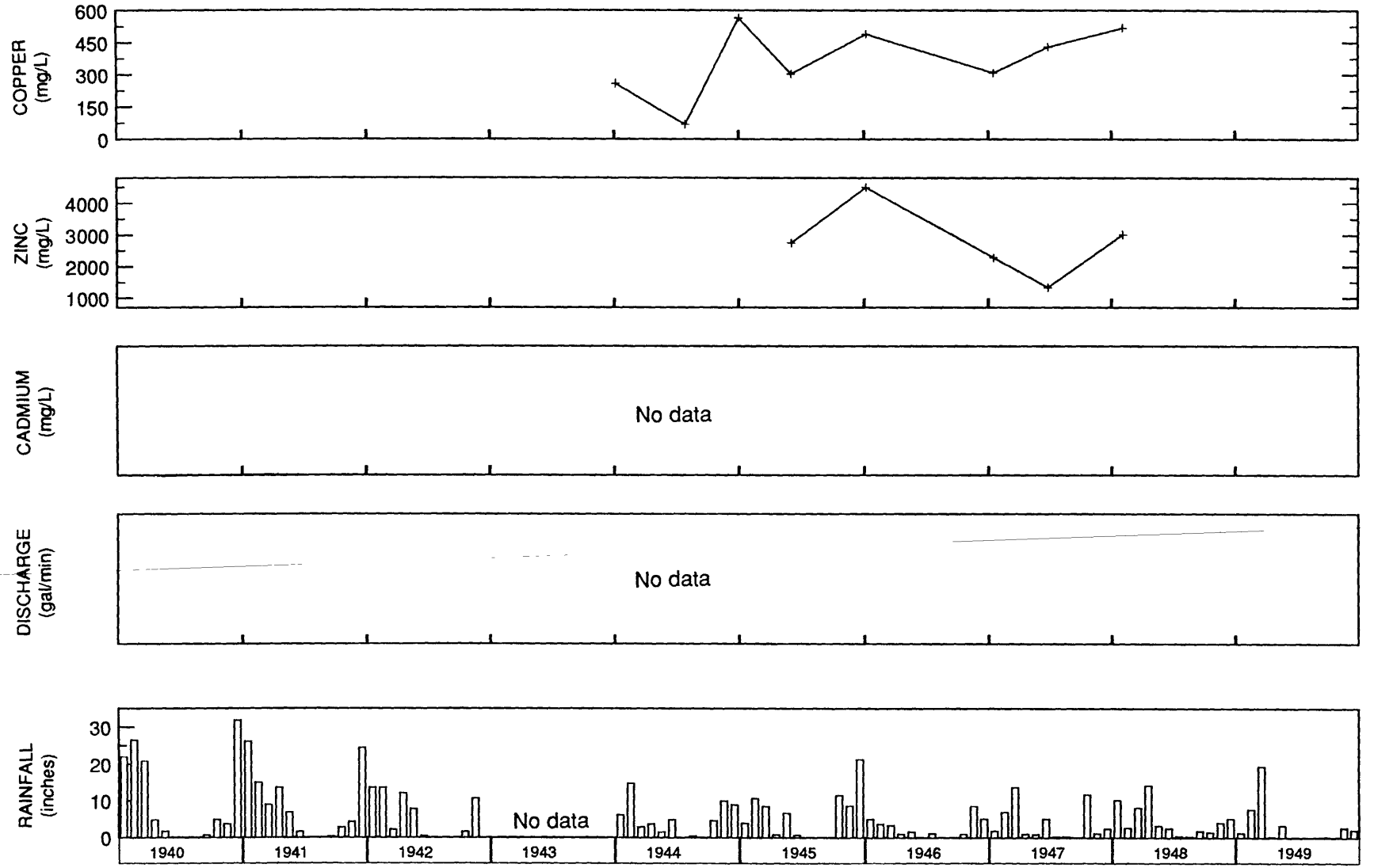

Figure C1. Copper and zinc concentrations of Boulder Creek copper plant influent, and rainfall at Kennett and Shasta Dam, 1940-49.

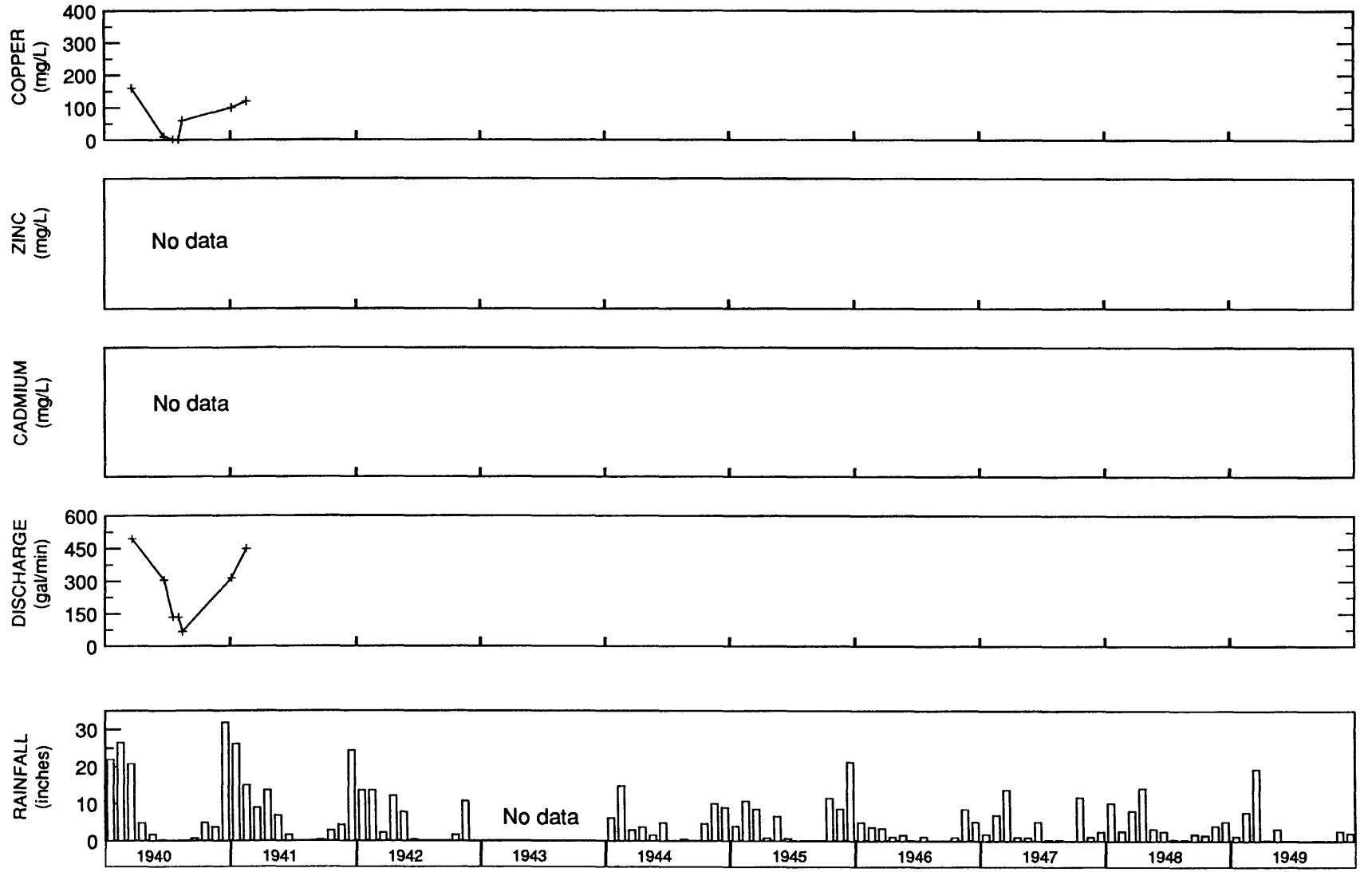

Figure C2. Copper concentrations and discharge of Boulder Creek copper plant effluent, 1940-41, and rainfall at Kennett and Shasta Dam, 1940-49.

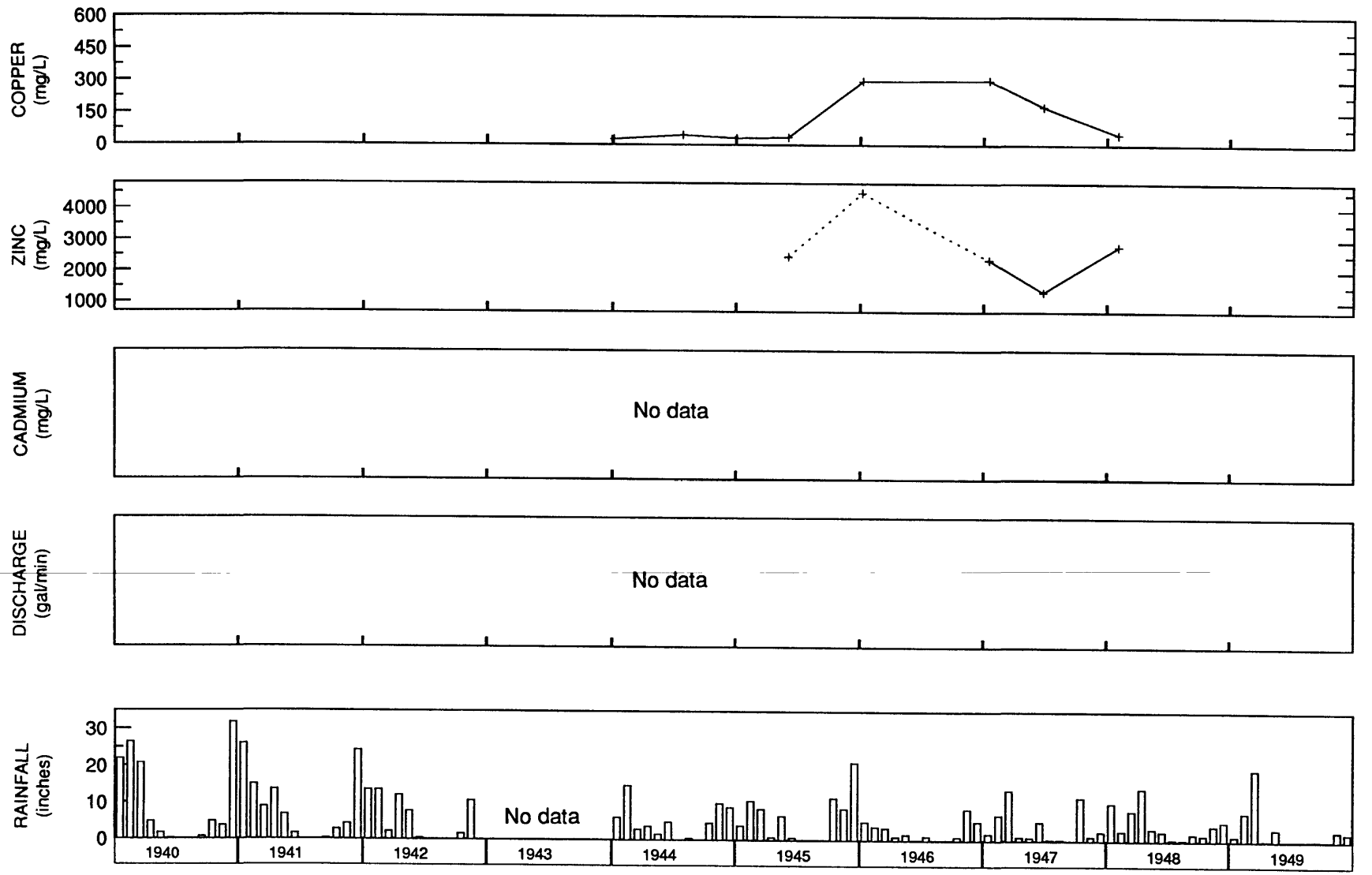

Figure C3. Copper and zinc concentrations of Boulder Creek copper plant effluent, 1944-48, and rainfall at Kennett and Shasta Dam, 1940-49.

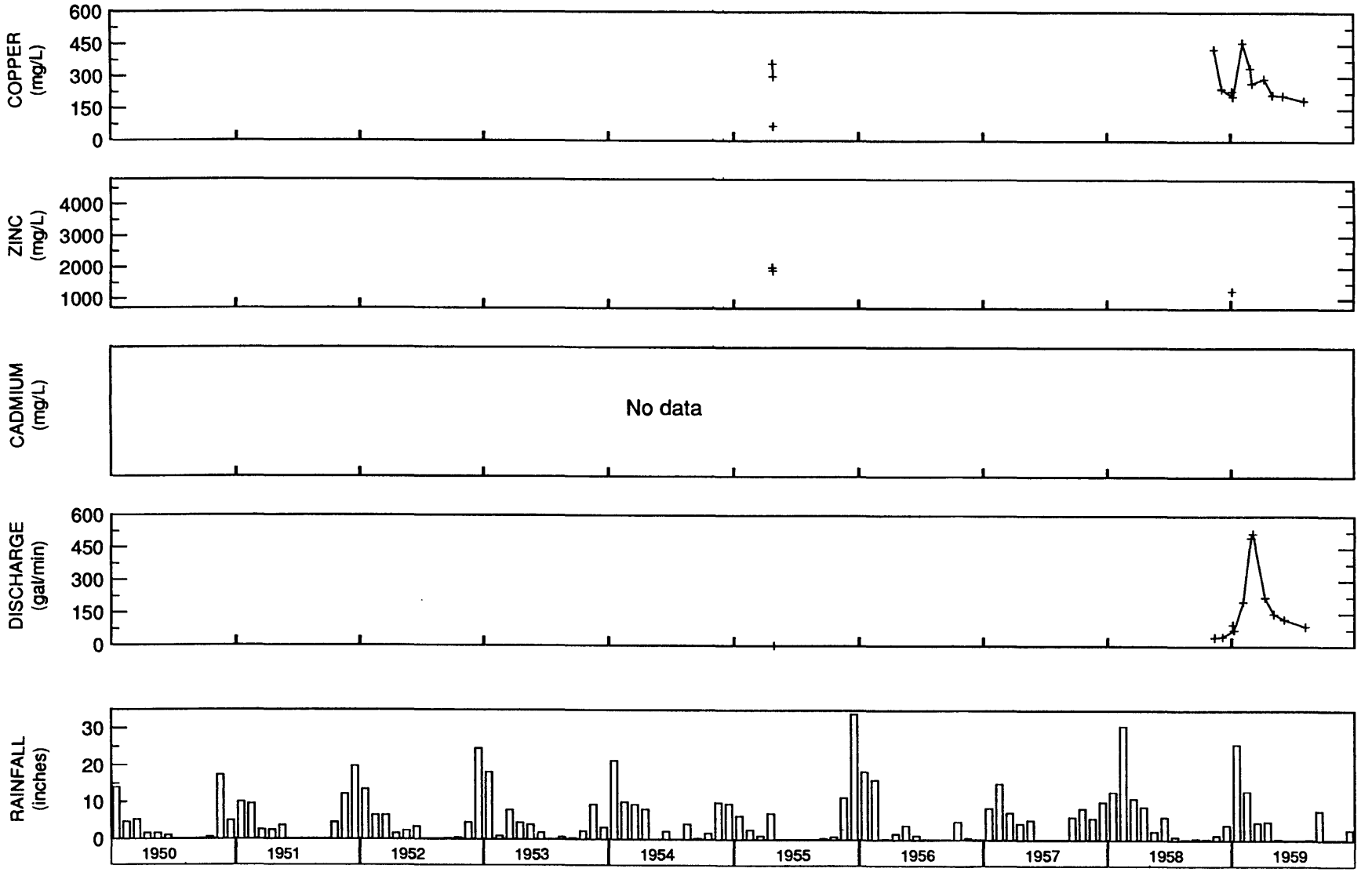

Figure C4. Copper and zinc concentrations and discharge of Boulder Creek copper plant influent, and rainfall at Shasta Dam, 1950-59.

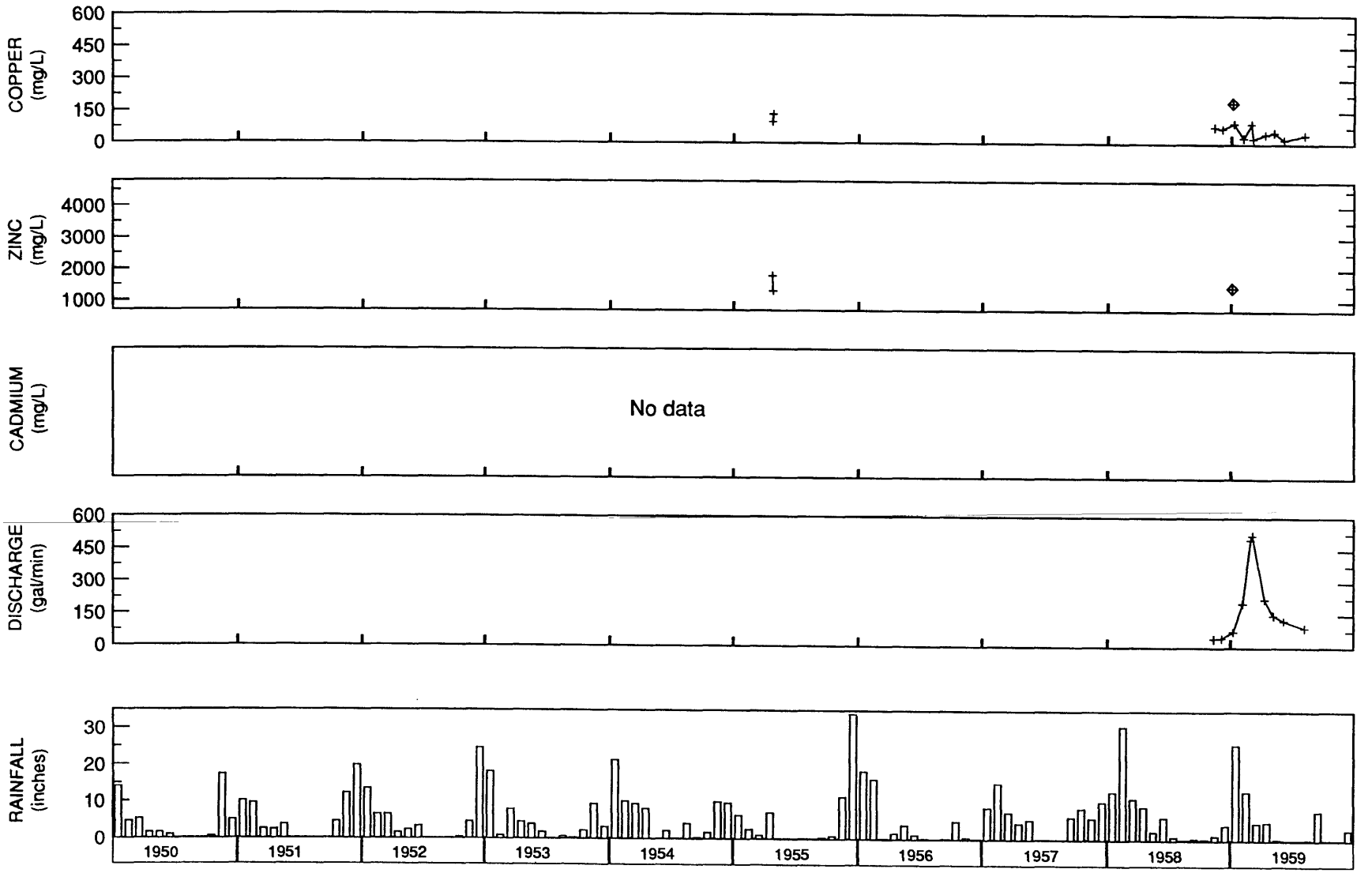

Figure C5. Copper and zinc concentrations and discharge of Boulder Creek copper plant effluent, and rainfall at Shasta Dam, 1950-59.

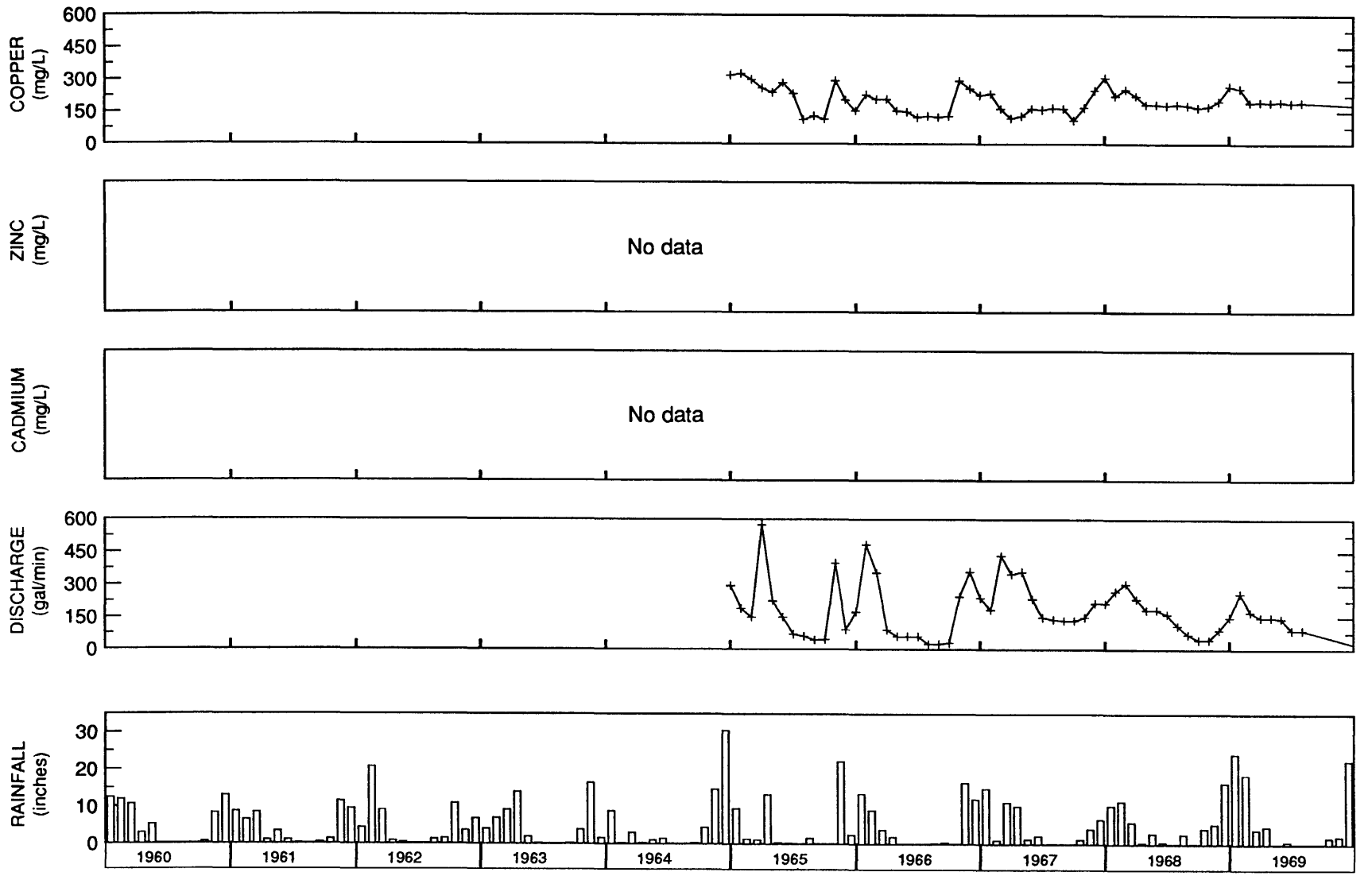

Figure C6. Copper concentrations and discharge of Boulder Creek copper plant influent, and rainfall at Shasta Dam, 1960-69.

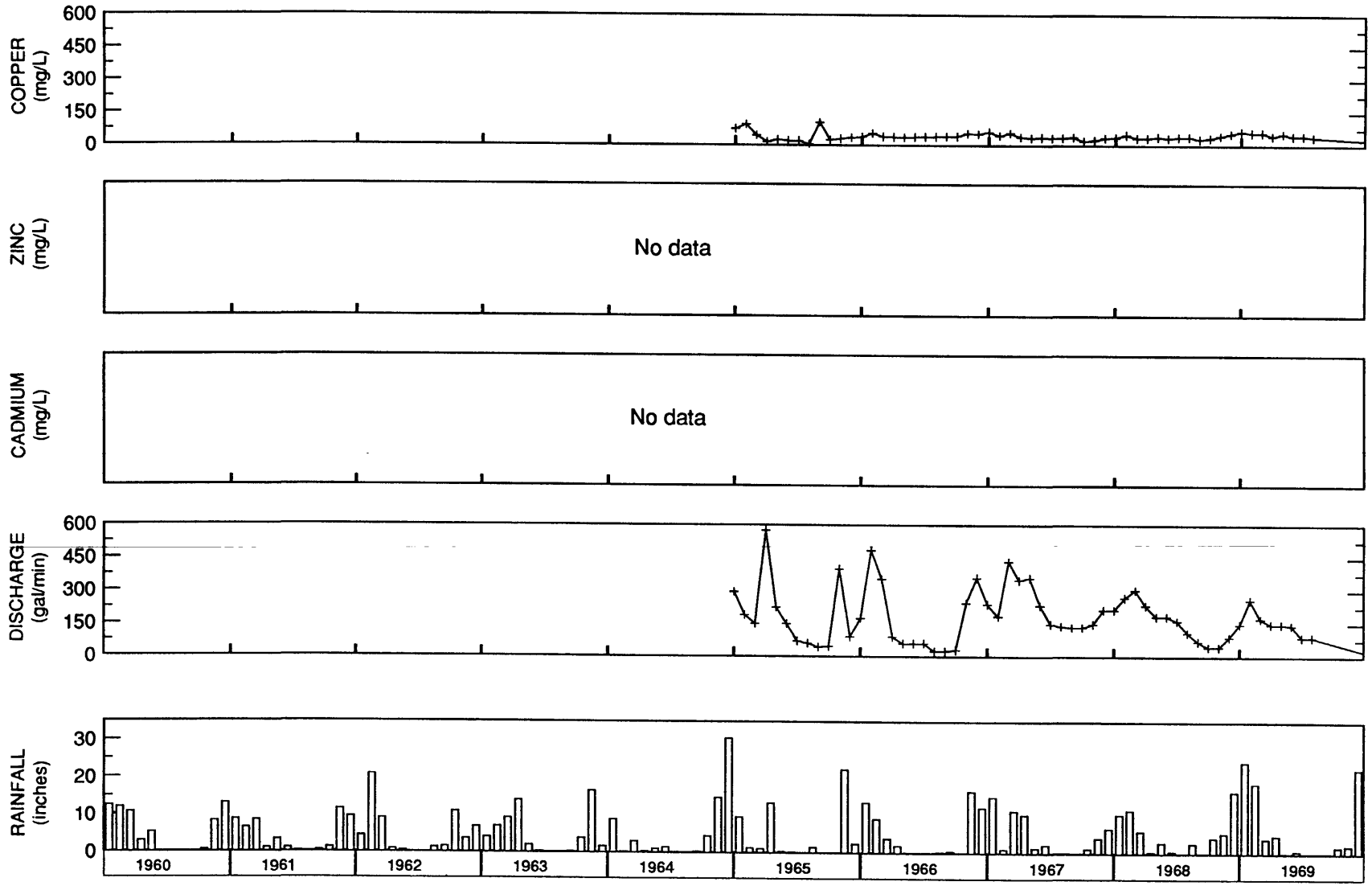

Figure C7. Copper concentrations and discharge of Boulder Creek copper plant effluent, and rainfall at Shasta Dam, 1960-69.

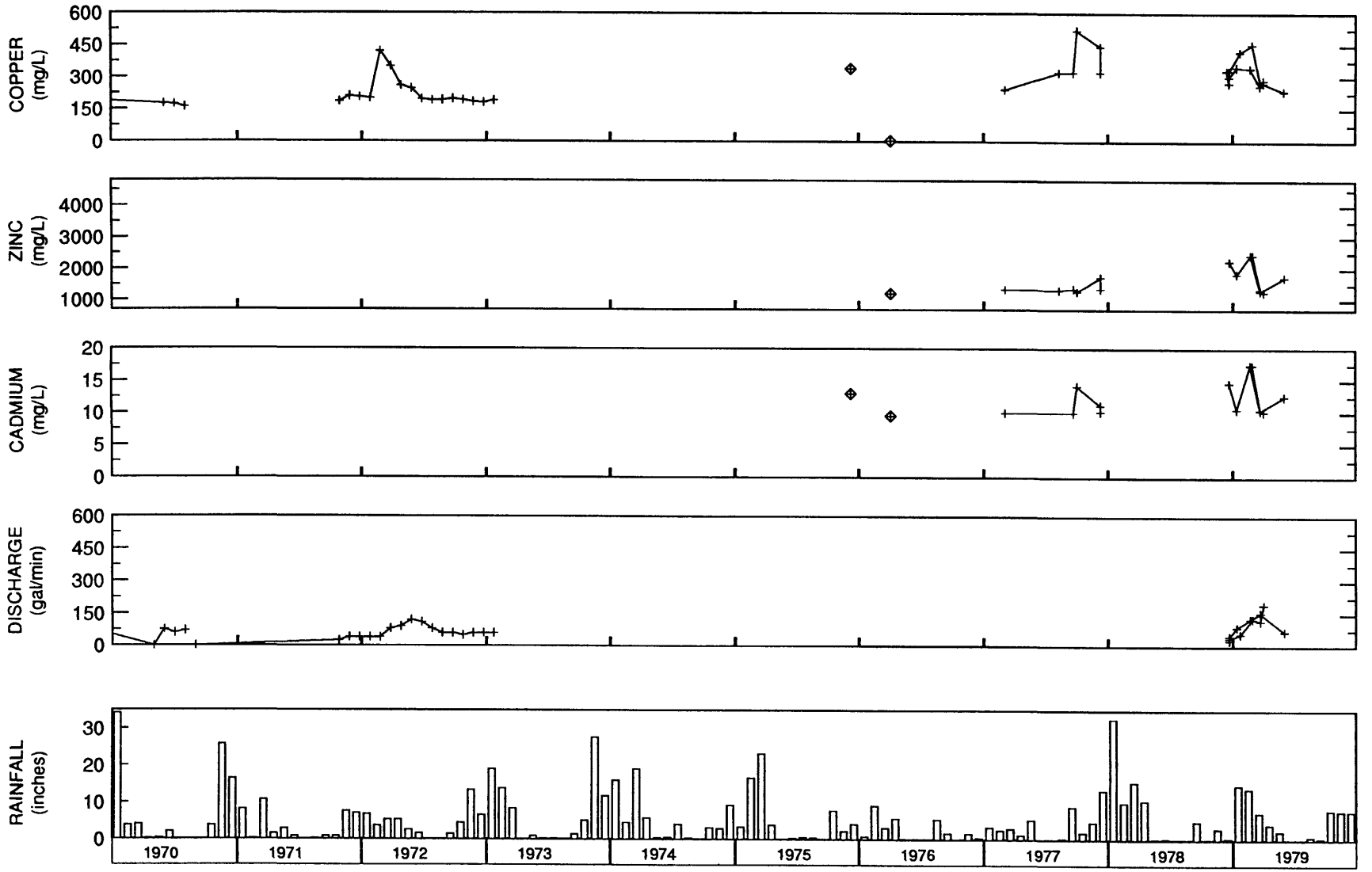

Figure C8. Copper, zinc, and cadmium concentrations and discharge of Boulder Creek copper plant influent, and rainfall at Shasta Dam, 1970-79.

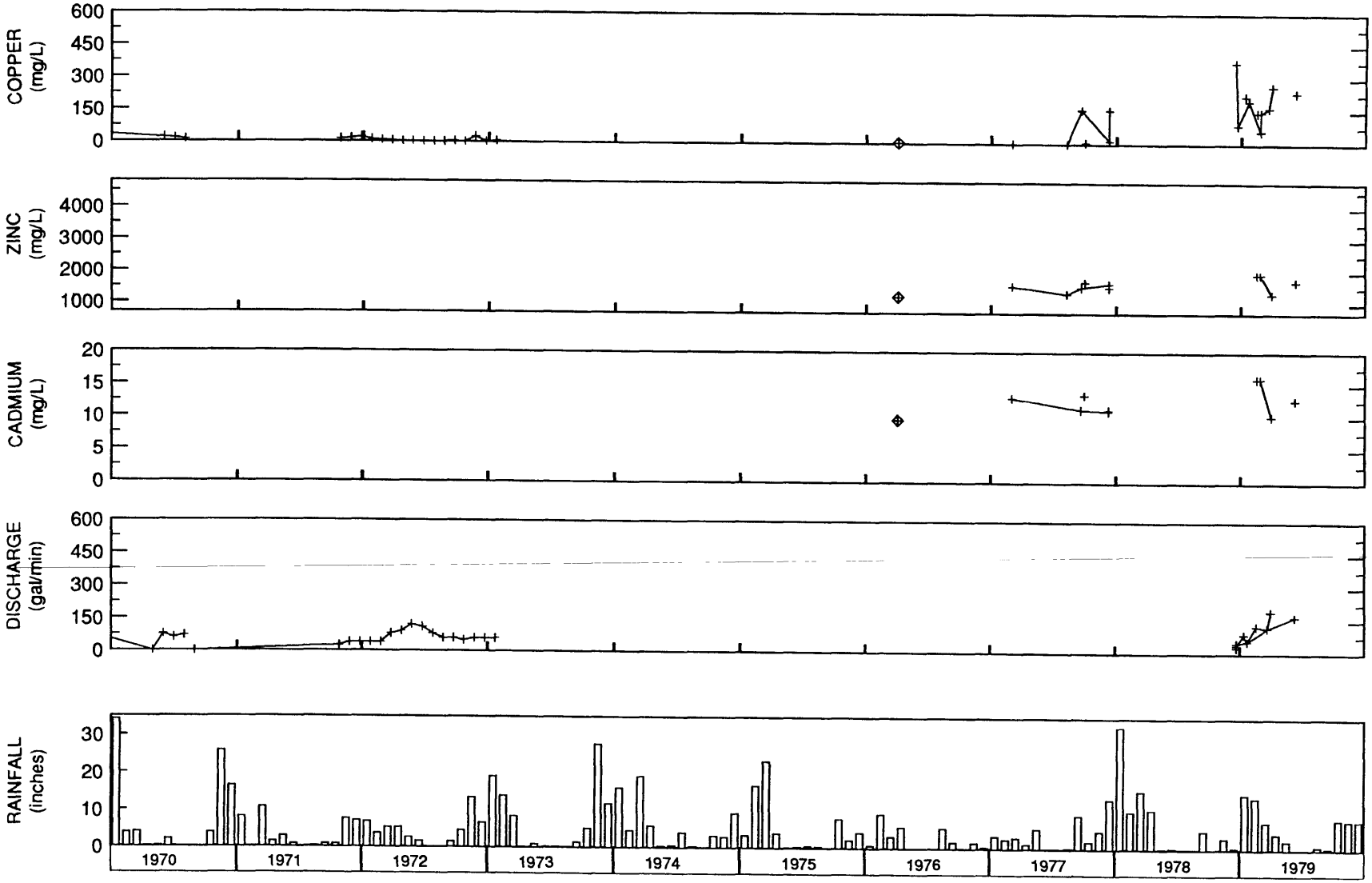

Figure C9. Copper, zinc, and cadmium concentrations and discharge of Boulder Creek copper plant effluent, and rainfall at Shasta Dam, 1970-79.

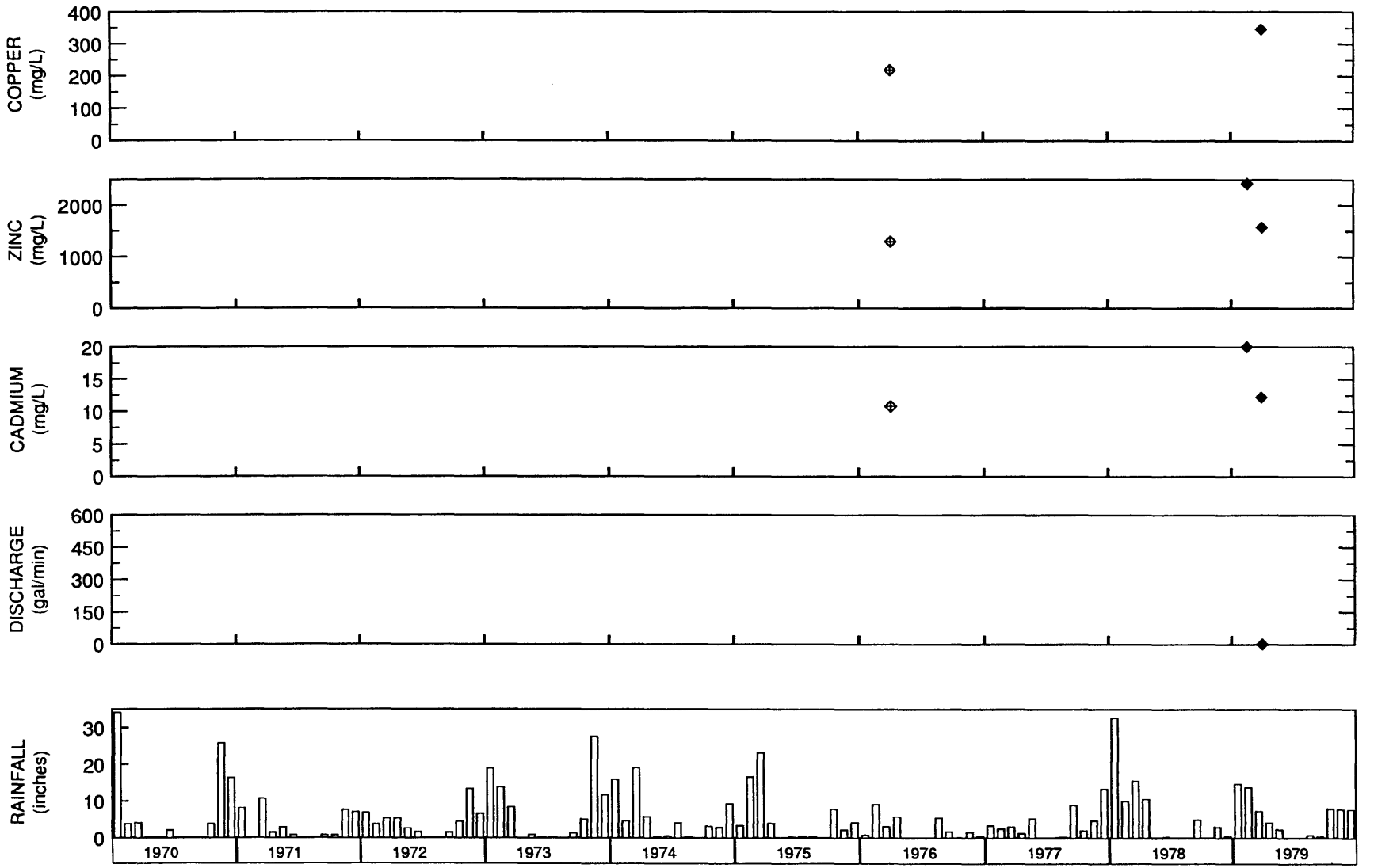

Figure C10. Copper, zinc, and cadmium concentrations and discharge of Richmond portal effluent, and rainfall at Shasta Dam, 1970-79.

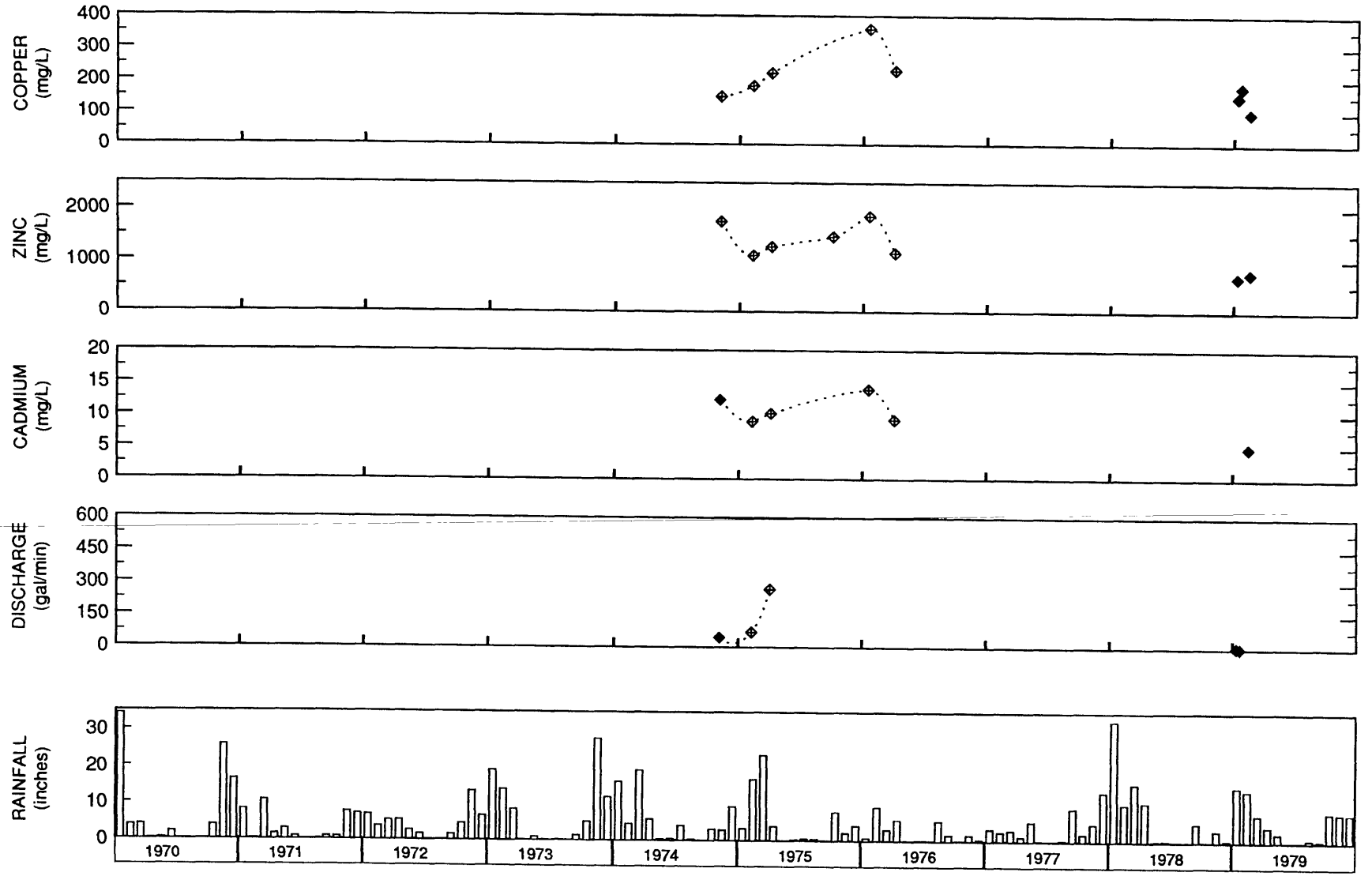

Figure C11. Copper, zinc, and cadmium concentrations and discharge of Lawson portal effluent, and rainfall at Shasta Dam, 1970-79.

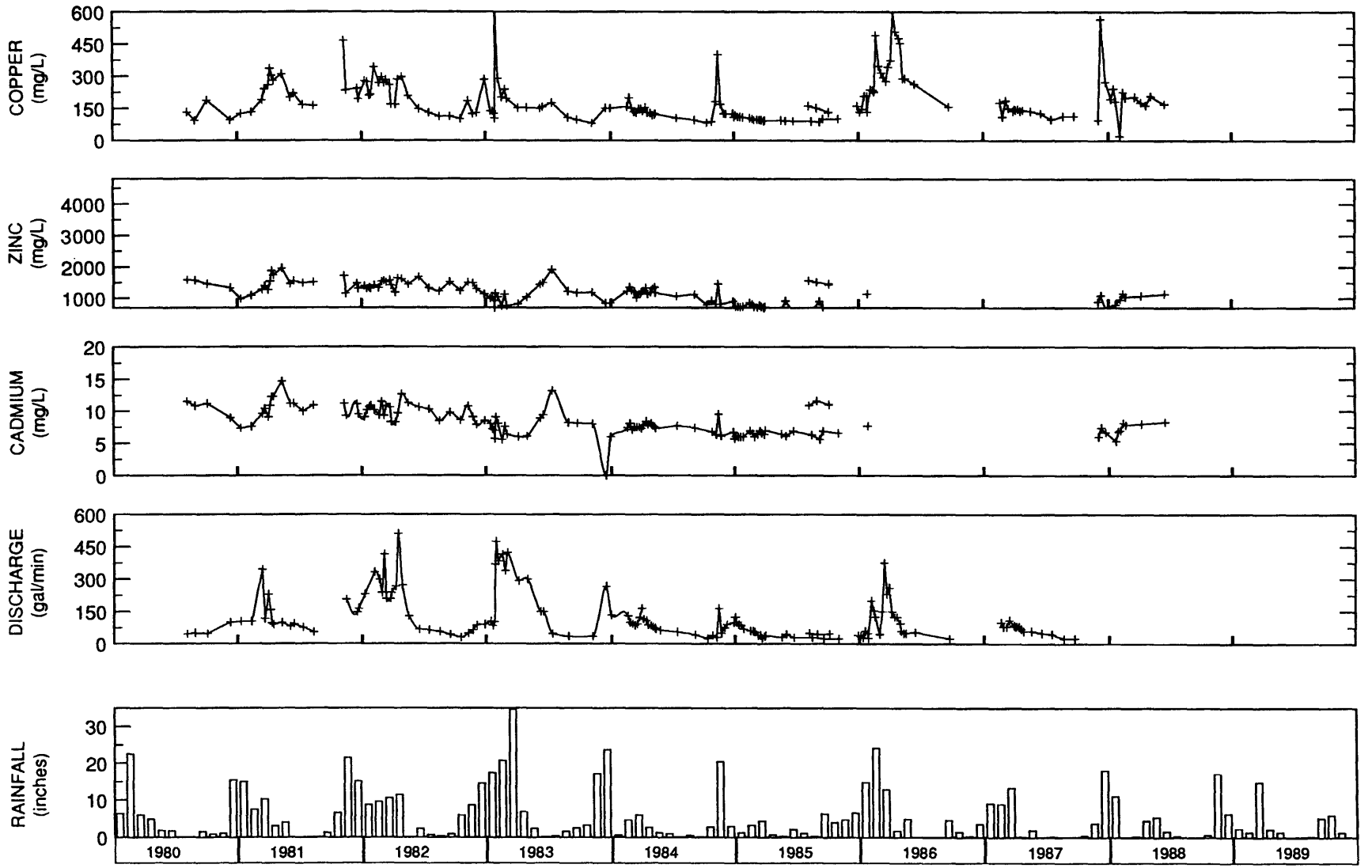

Figure C12. Copper, zinc, and cadmium concentrations and discharge of Boulder Creek copper plant influent, and rainfall at Shasta Dam, 1980-89.

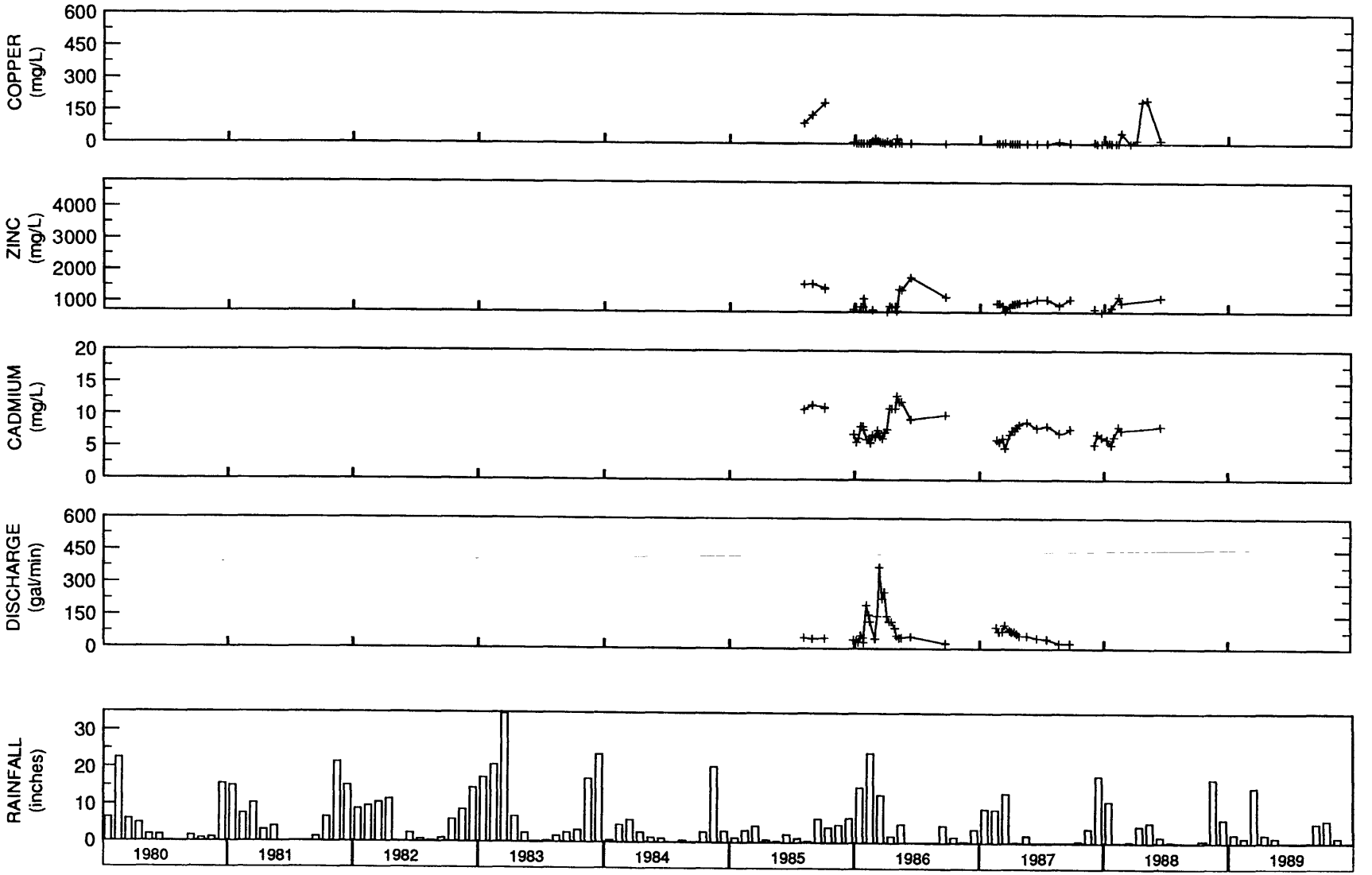

Figure C13. Copper, zinc, and cadmium concentrations and discharge of Boulder Creek copper plant effluent, and rainfall at Shasta Dam, 1980-89.

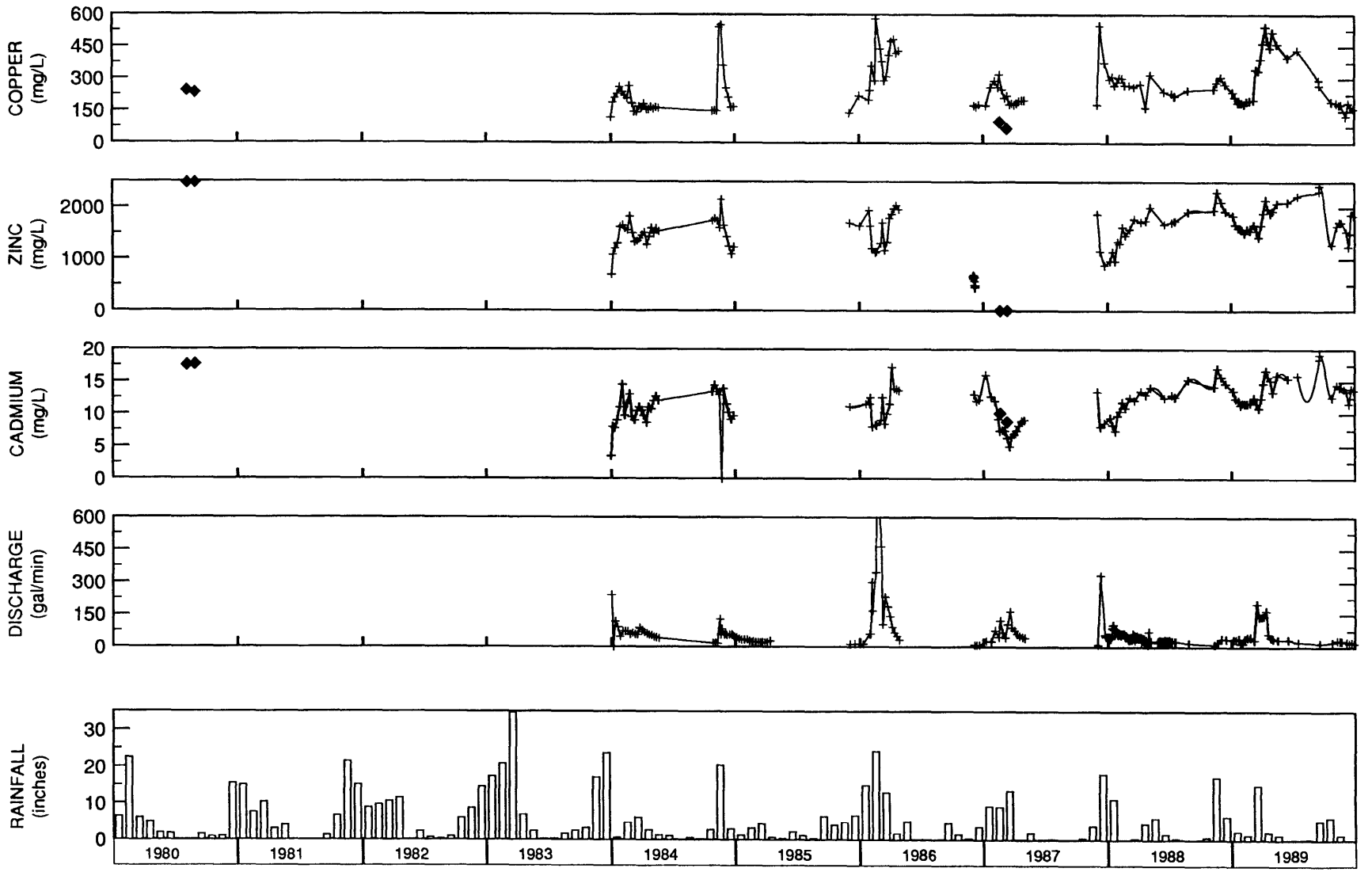

Figure C14. Copper, zinc, and cadmium concentrations and discharge of Richmond portal effluent, and rainfall at Shasta Dam, 1980-89.

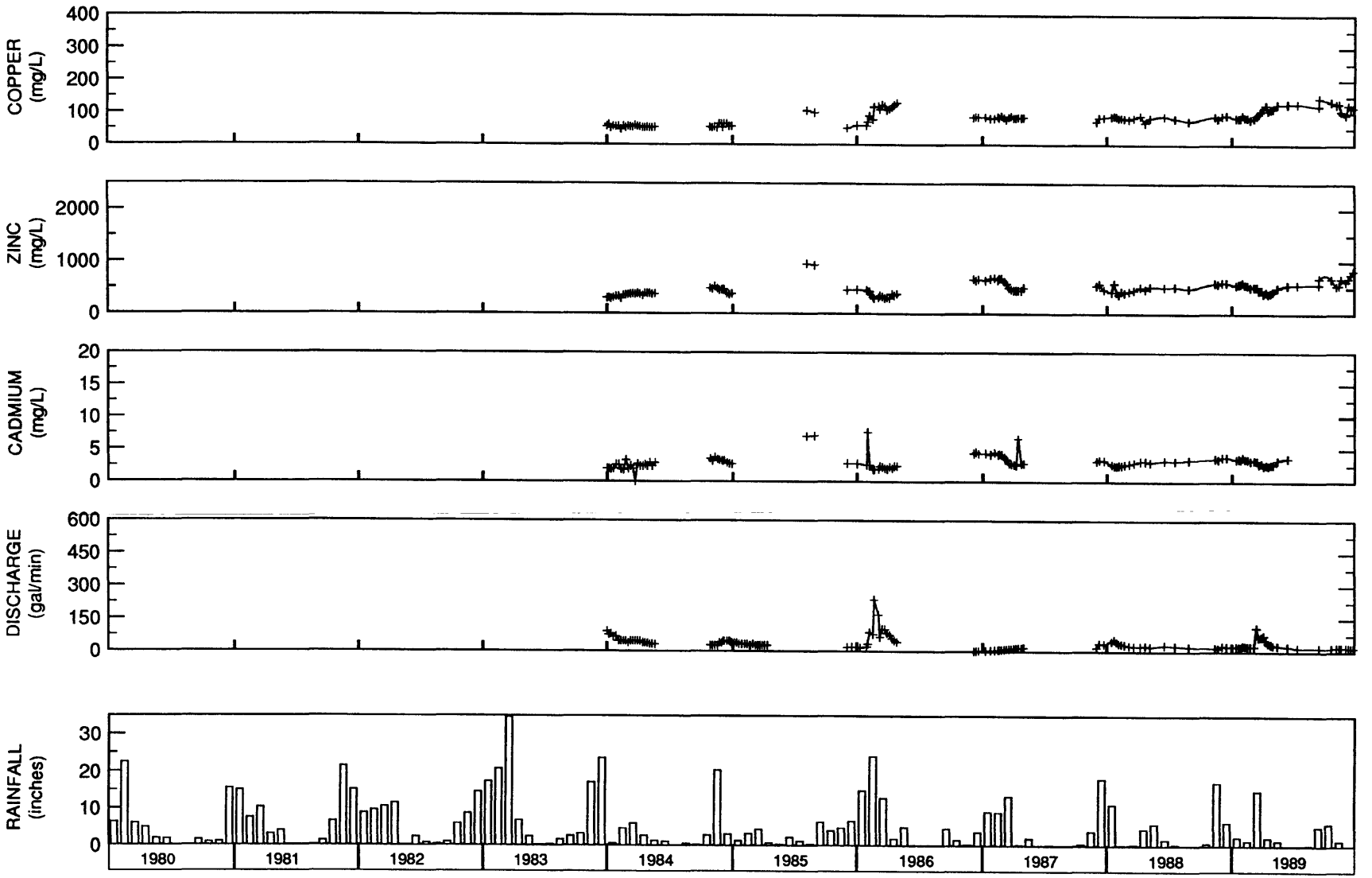

Figure C15. Copper, zinc, and cadmium concentrations and discharge of Lawson portal effluent, and rainfall at Shasta Dam, 1980-89.

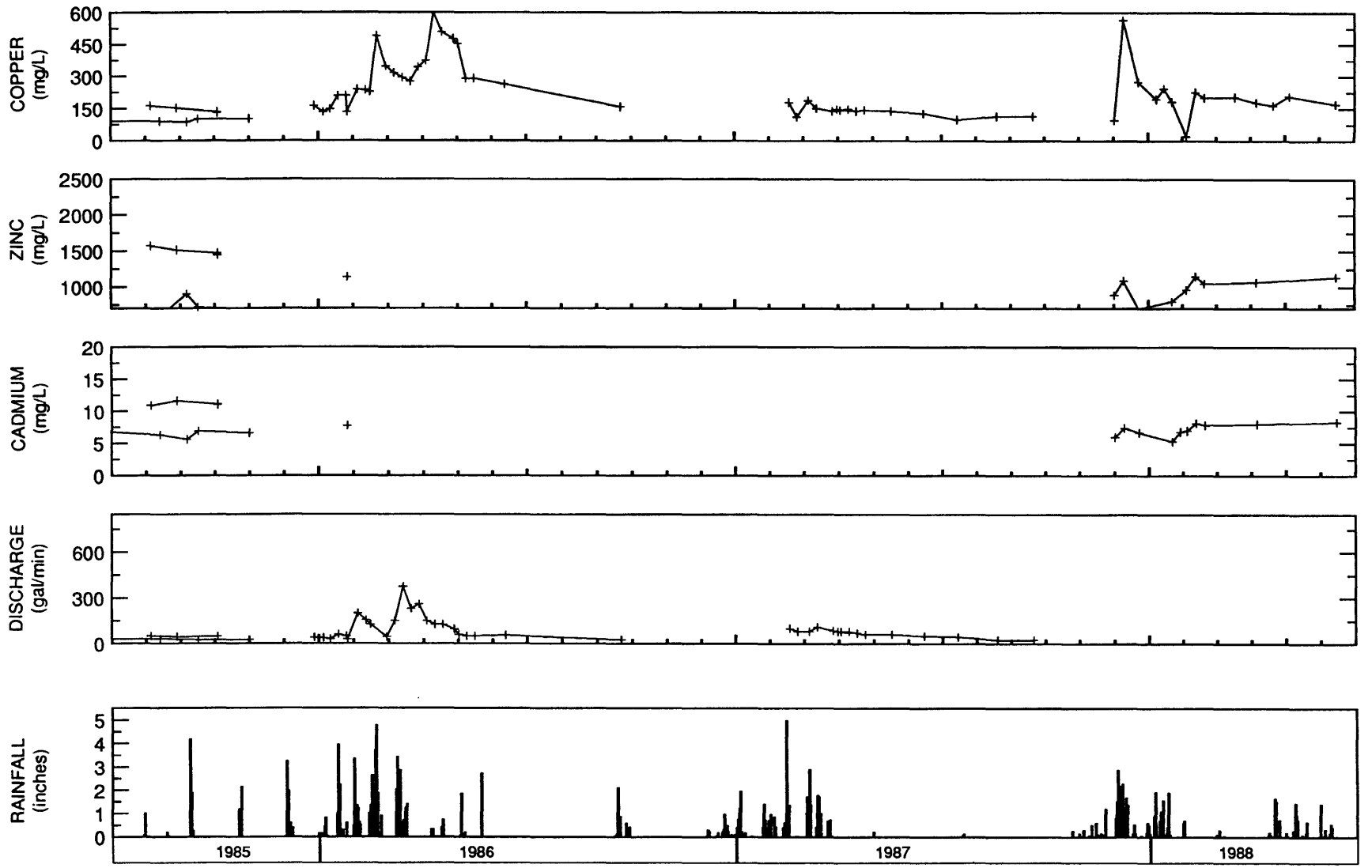

Figure C16. Copper, zinc, and cadmium concentrations and discharge of Boulder Creek copper plant influent, and rainfall at Shasta Dam, 1985-88.

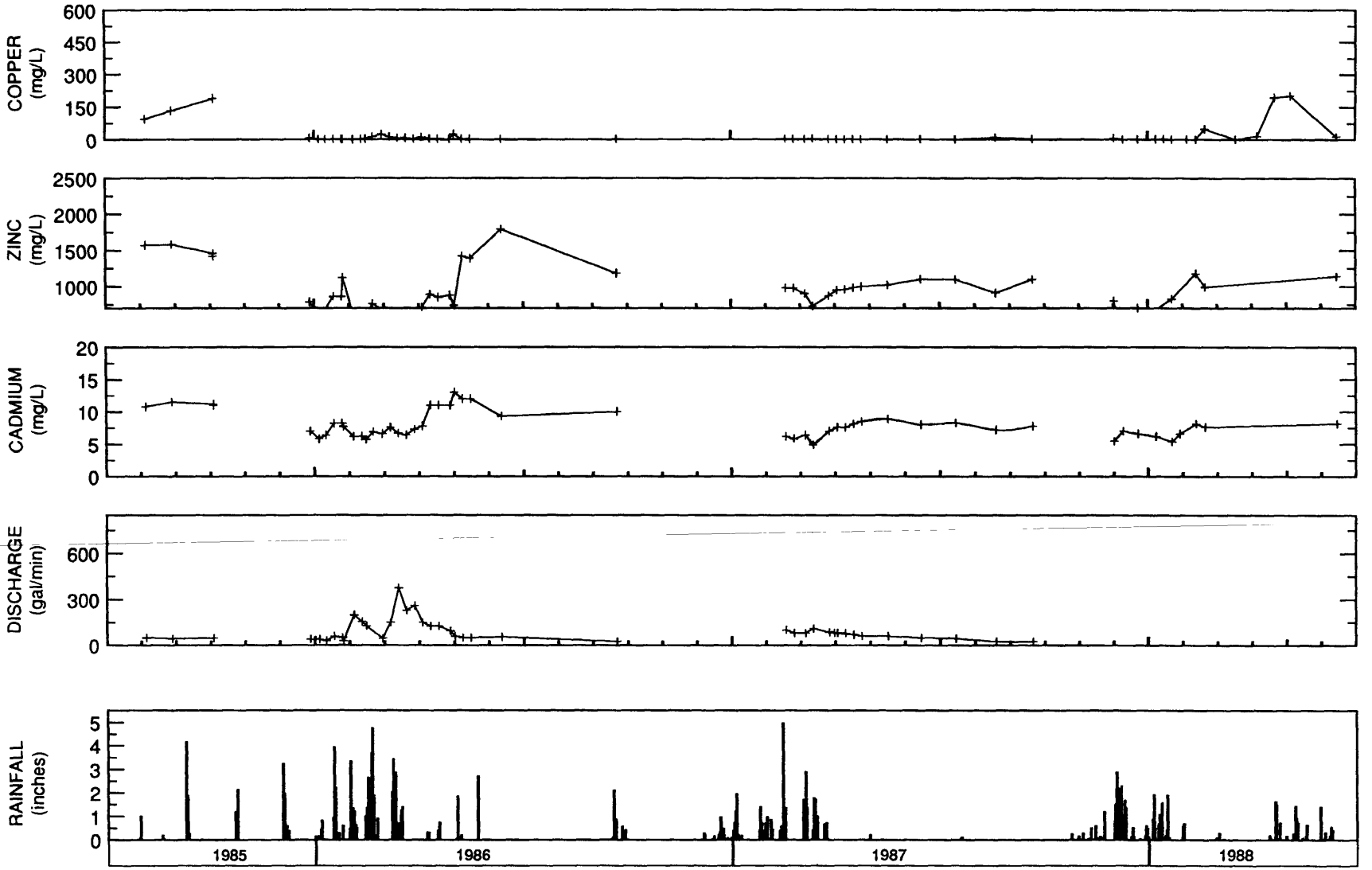

Figure C17. Copper, zinc, and cadmium concentrations and discharge of Boulder Creek copper plant effluent, and rainfall at Shasta Dam, 1985-88.

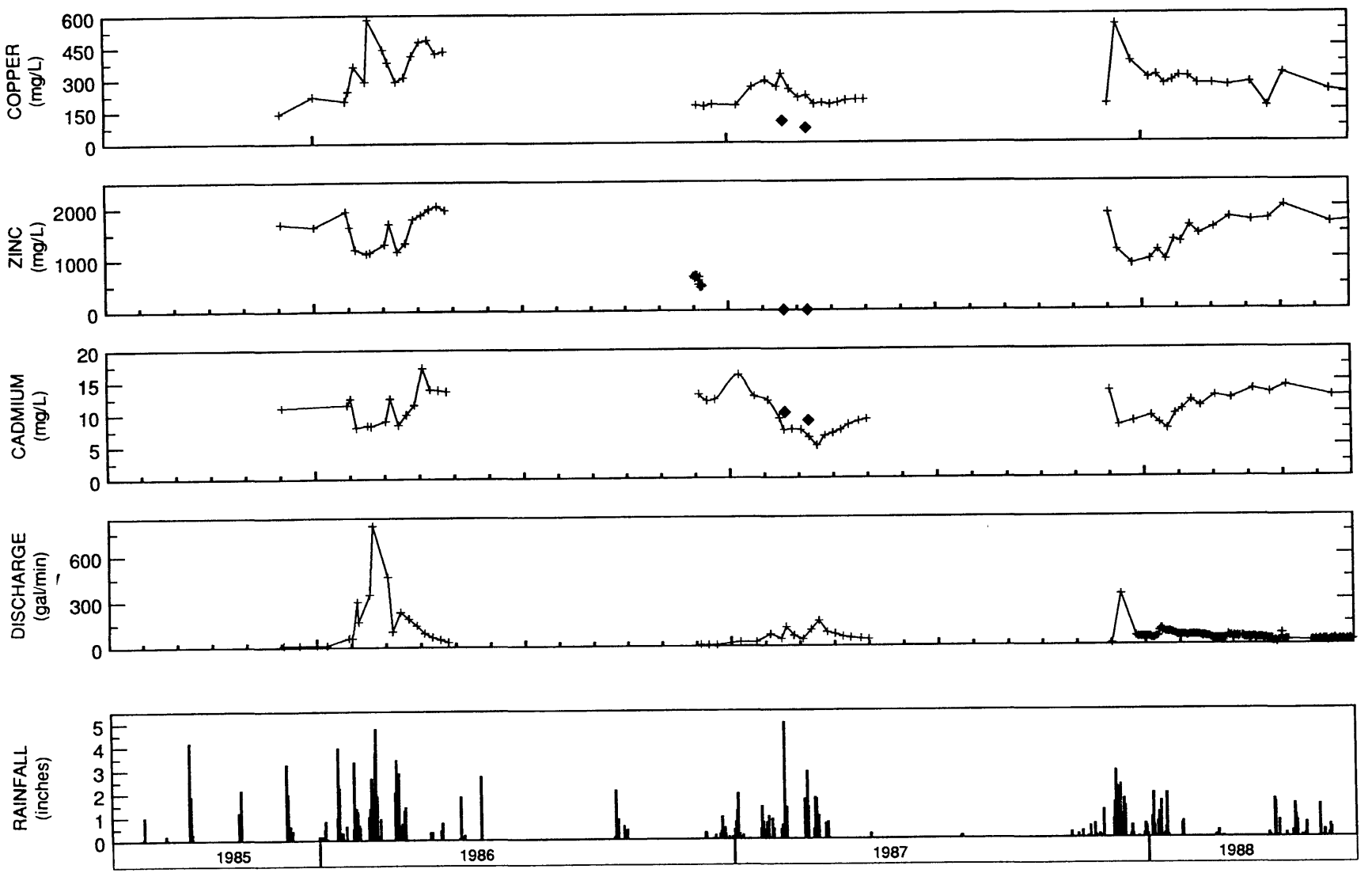

Figure C18. Copper, zinc, and cadmium concentrations and discharge of Richmond portal effluent, and rainfall at Shasta Dam, 1985-88.

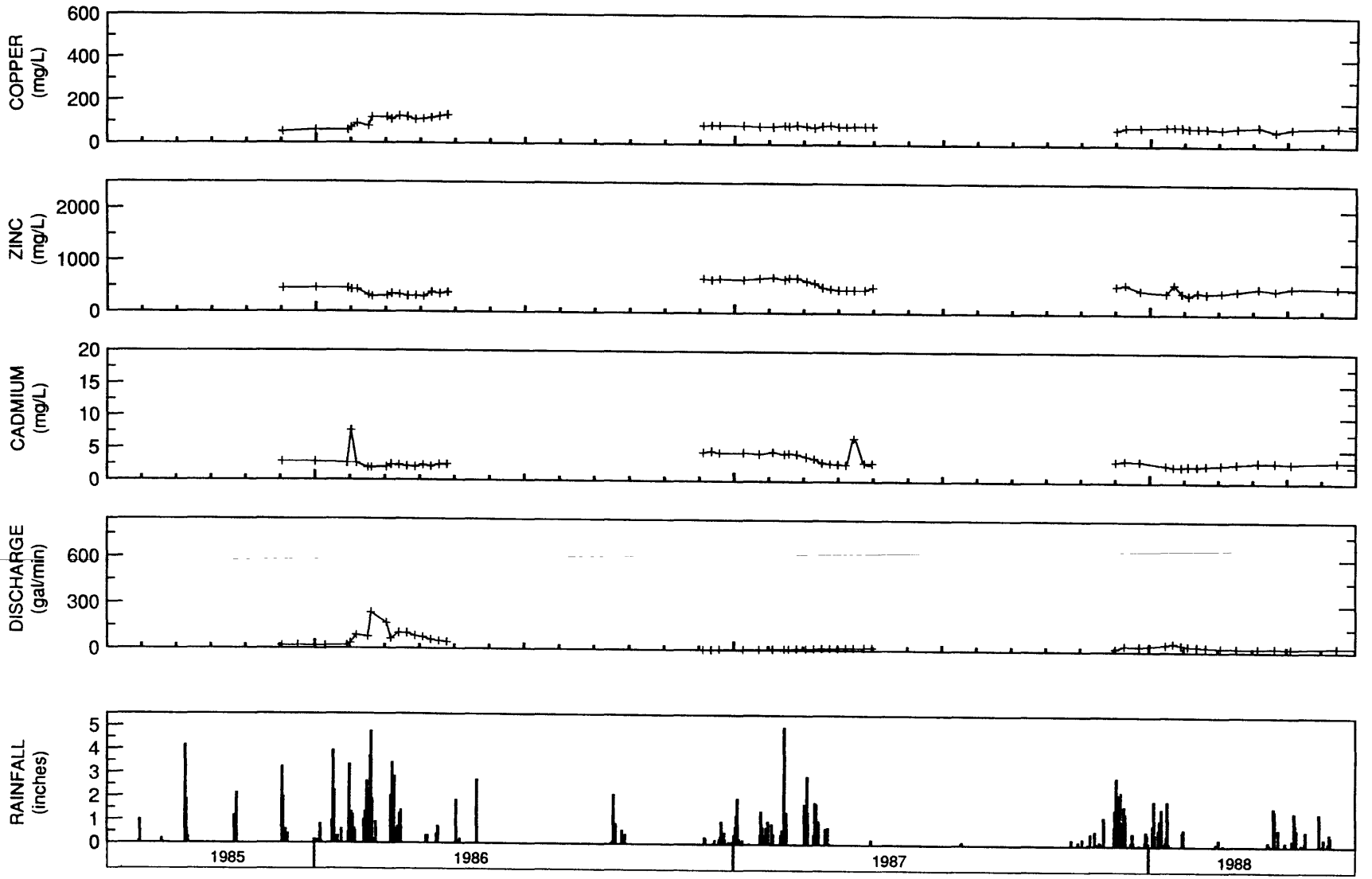

Figure C19. Copper, zinc, and cadmium concentrations and discharge of Lawson portal effluent, and rainfall at Shasta Dam, 1985-88.

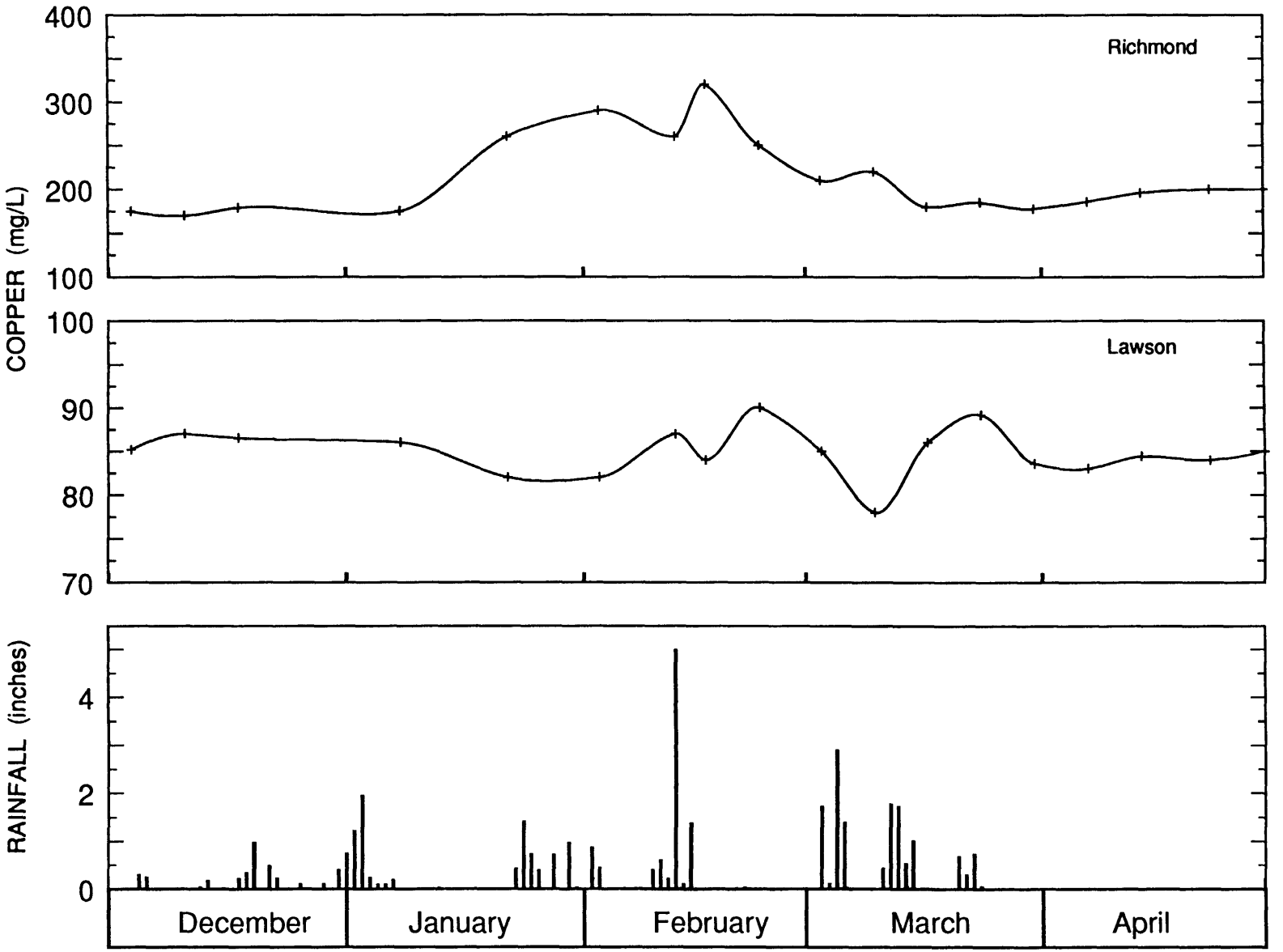

Figure C20. Copper concentrations of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, December 1986-April 1987.

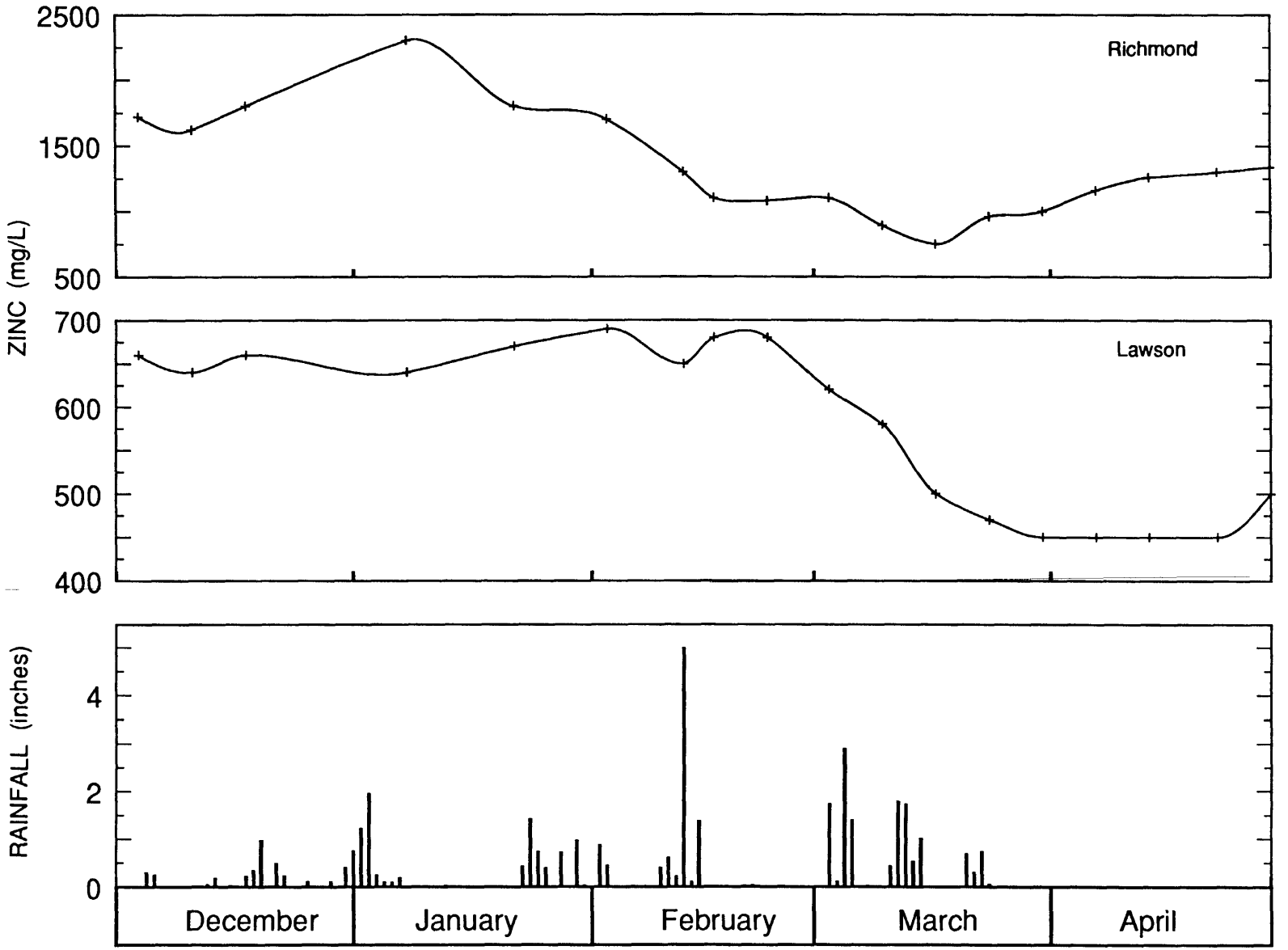

Figure C21. Zinc concentrations of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, December 1986-April 1987.

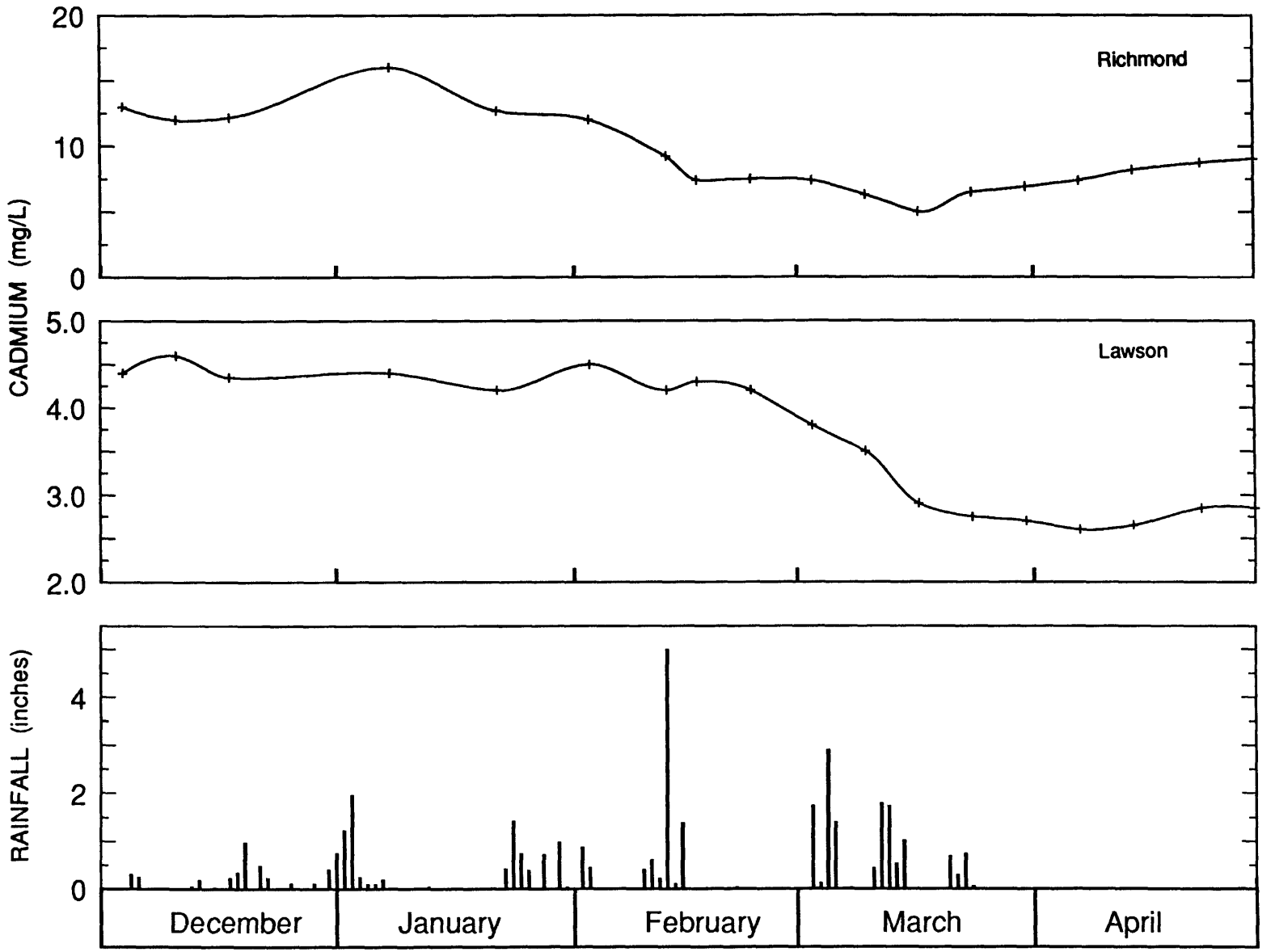

Figure C22. Cadmium concentrations of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, December 1986-April 1987.

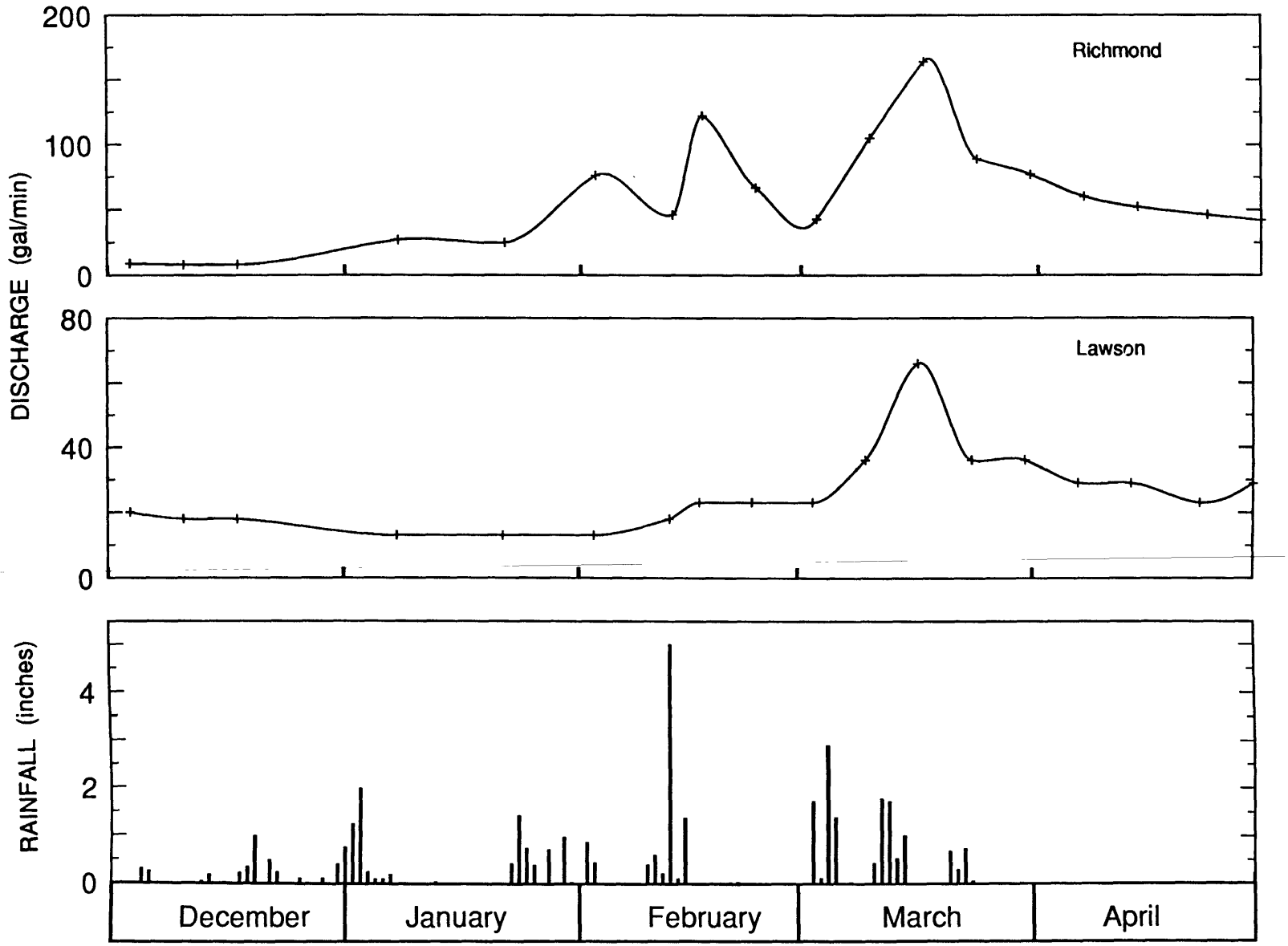

Figure C23. Discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, December 1986-April 1987.

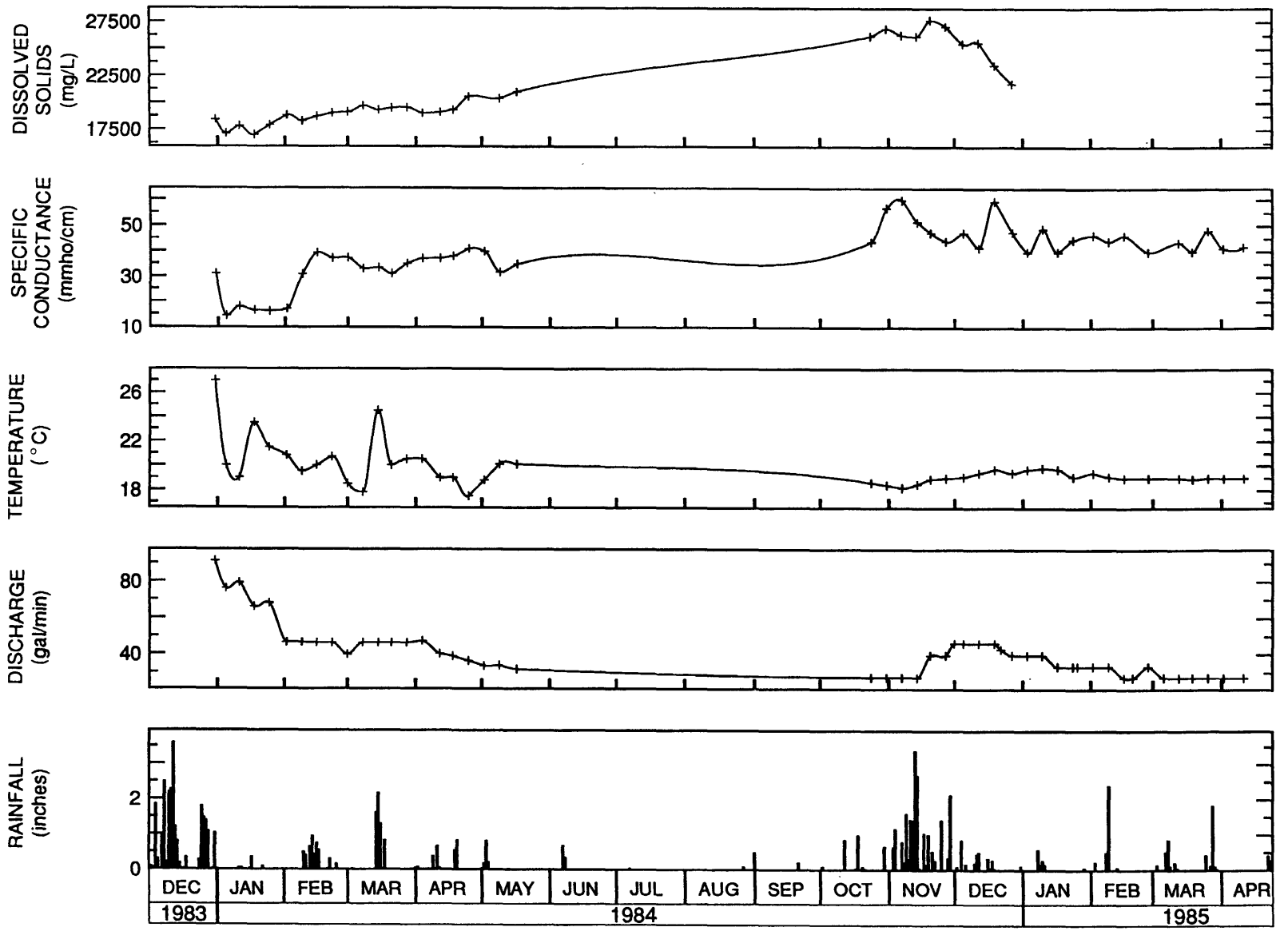

Figure C24. Dissolved solids, specific conductance, temperature, and discharge of Lawson portal effluent, and rainfall at Shasta Dam, December 1983-April 1985.

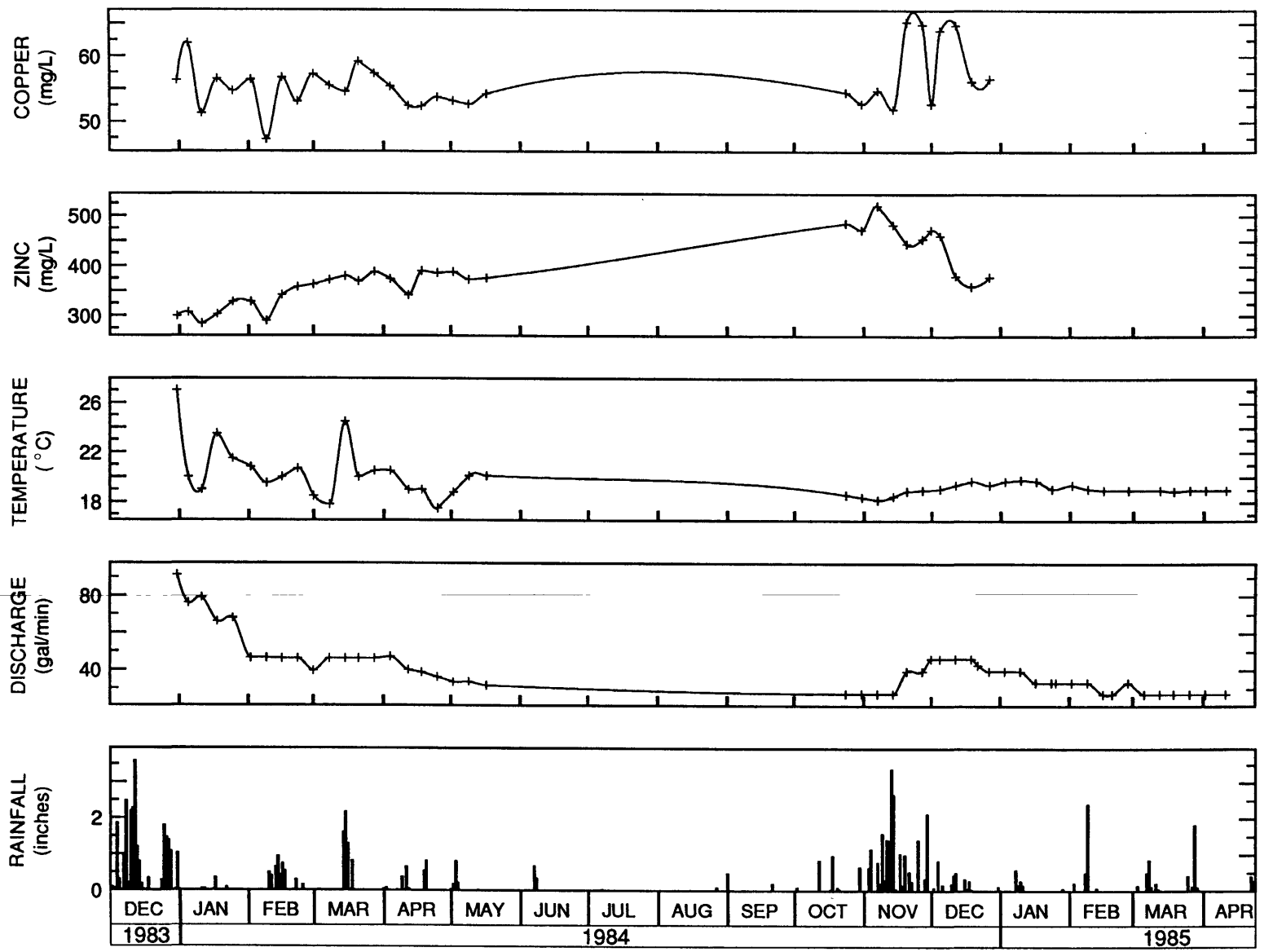

Figure C25. Copper and zinc concentrations, temperature, and discharge of Lawson portal effluent, and rainfall at Shasta Dam, December 1983-April 1985.

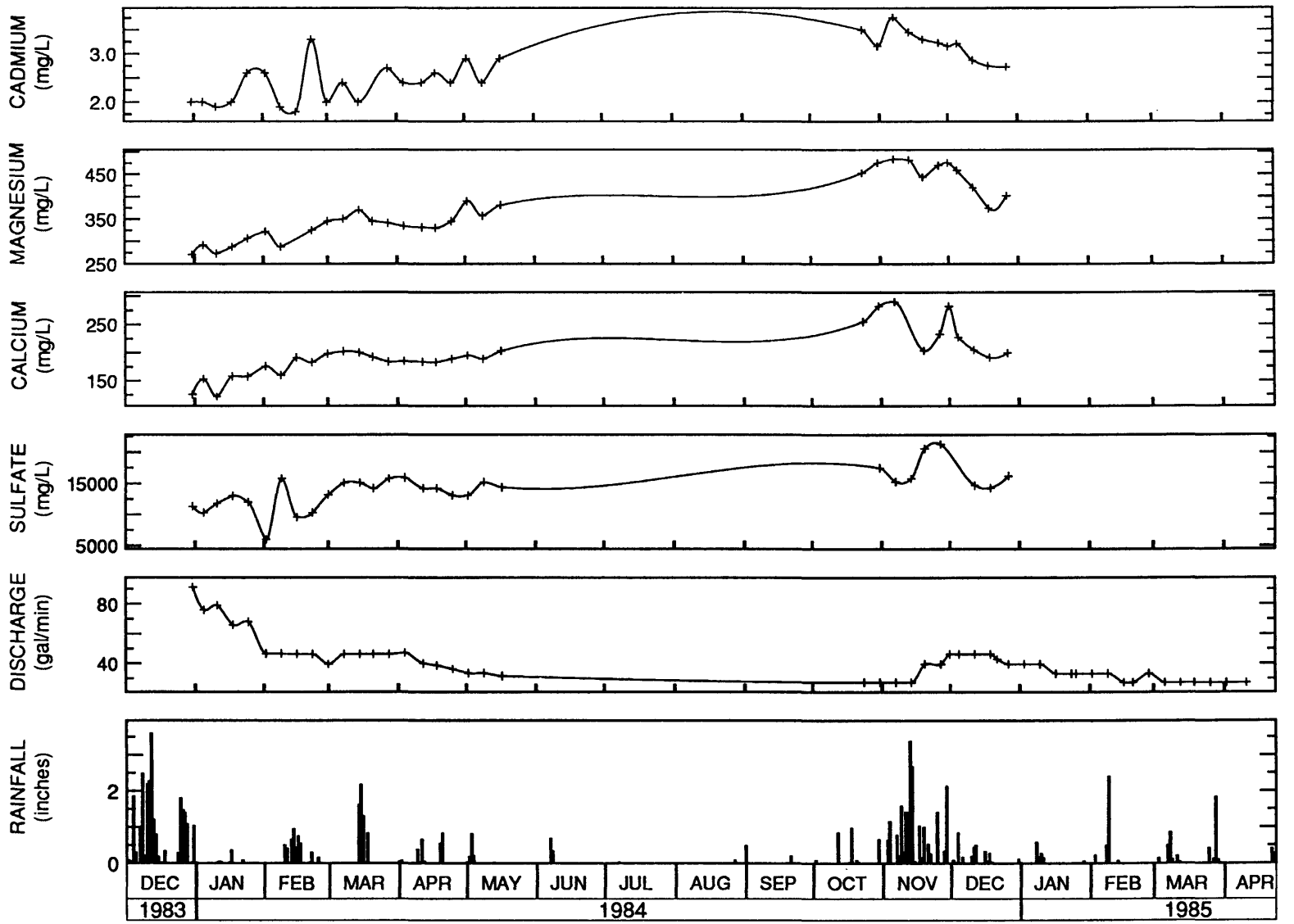

Figure C26. Cadmium, magnesium, calcium, and sulfate concentrations and discharge of Lawson portal effluent, and rainfall at Shasta Dam, December 1983-April 1985.

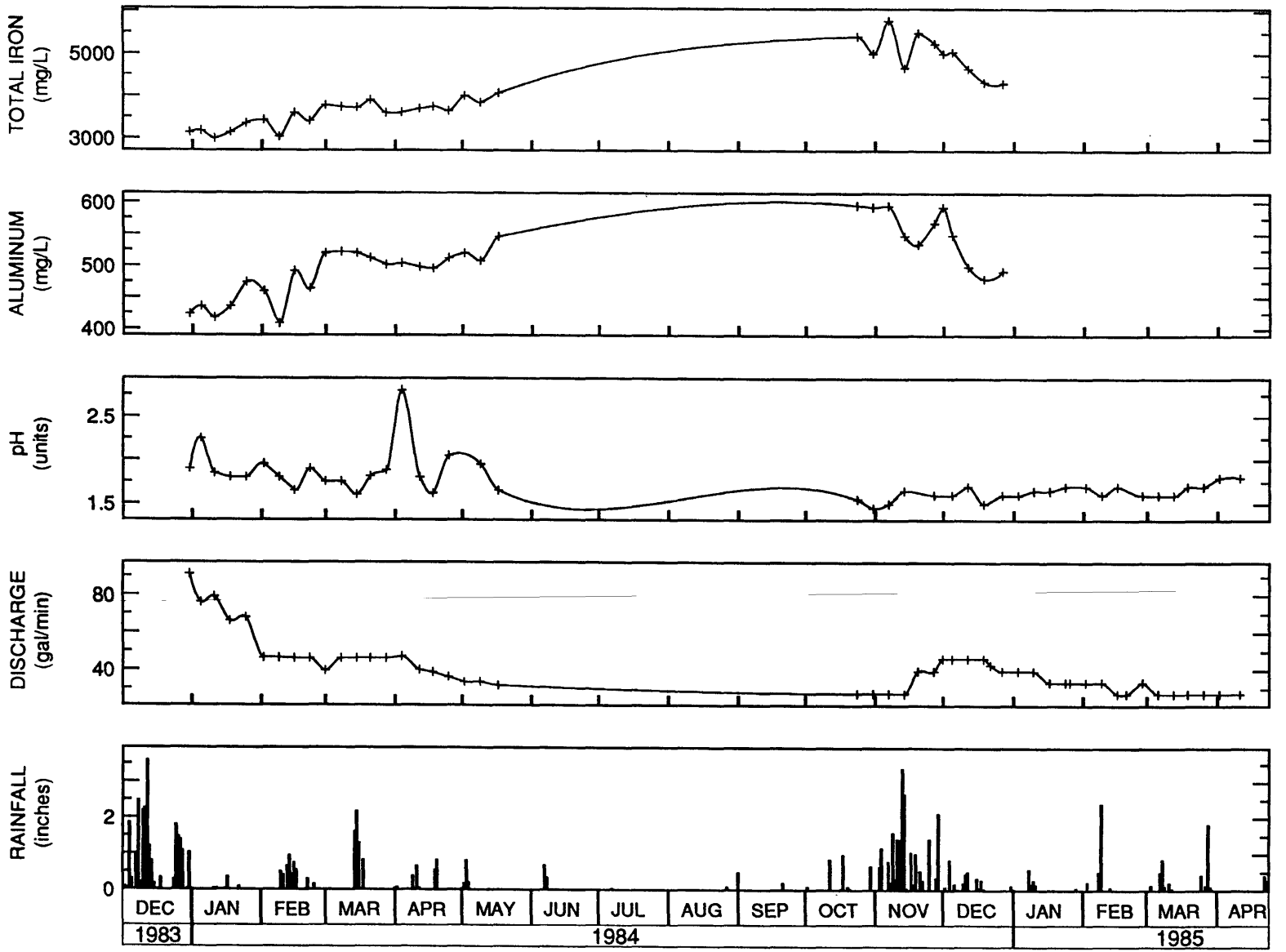

Figure C27. Total iron and aluminum concentrations, pH, and discharge of Lawson portal effluent, and rainfall at Shasta Dam, December 1983-April 1985.

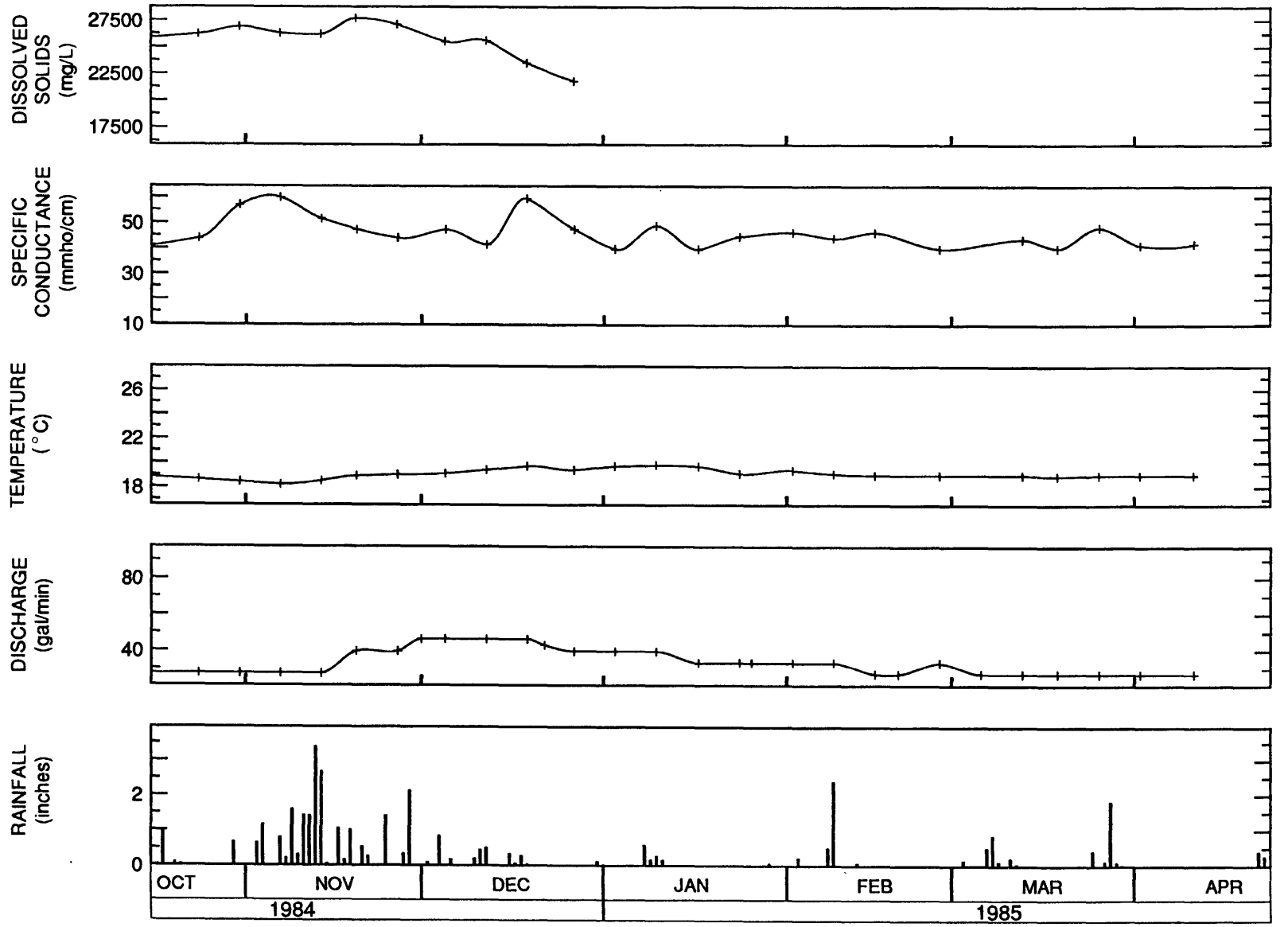

Figure C28. Dissolved solids, specific conductance, temperature, and discharge of Lawson portal effluent, and rainfall at Shasta Dam, October 1984-April 1985.

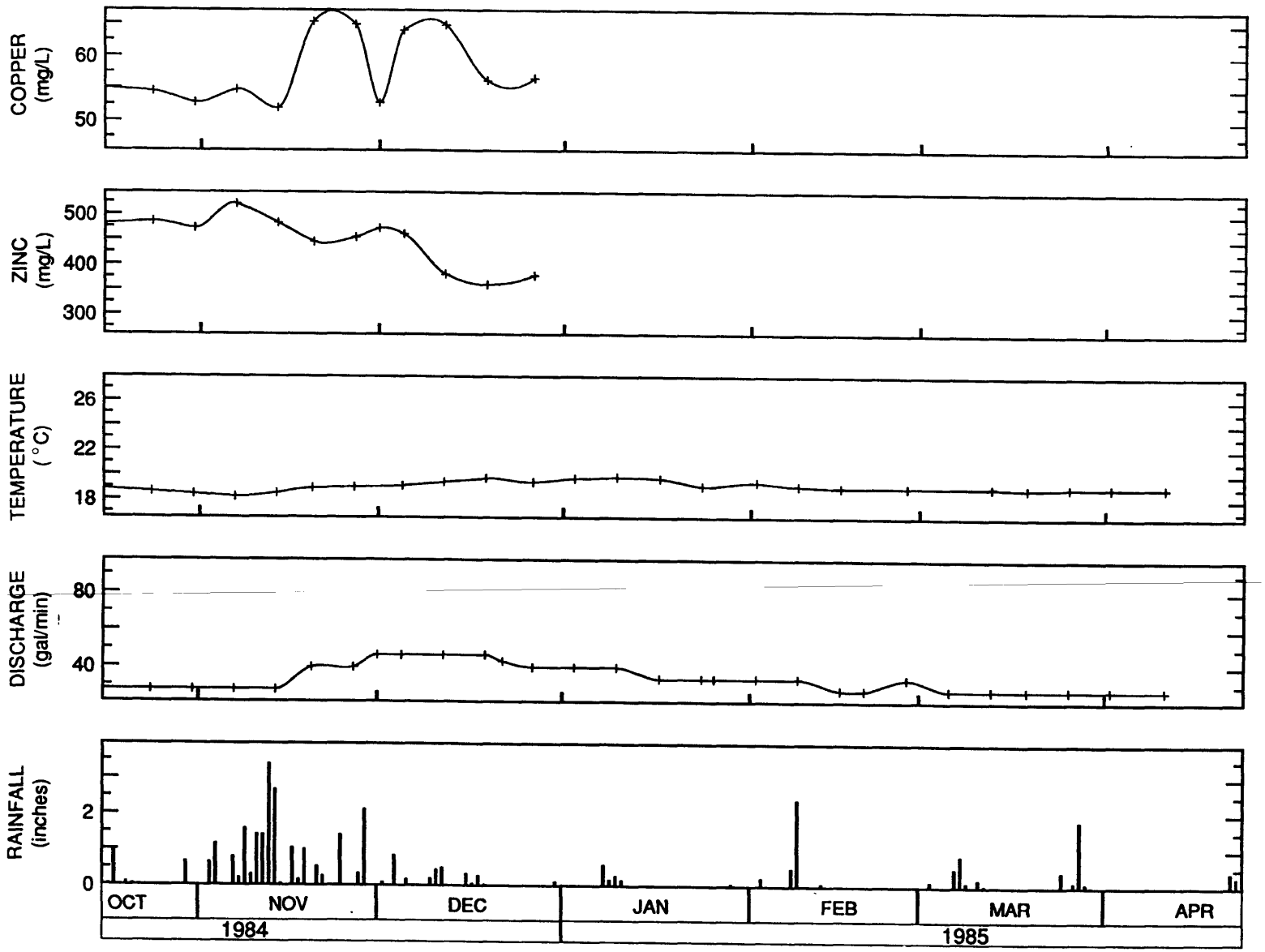

Figure C29. Copper and zinc concentrations, temperature, and discharge of Lawson portal effluent, and rainfall at Shasta Dam, October 1984-April 1985.

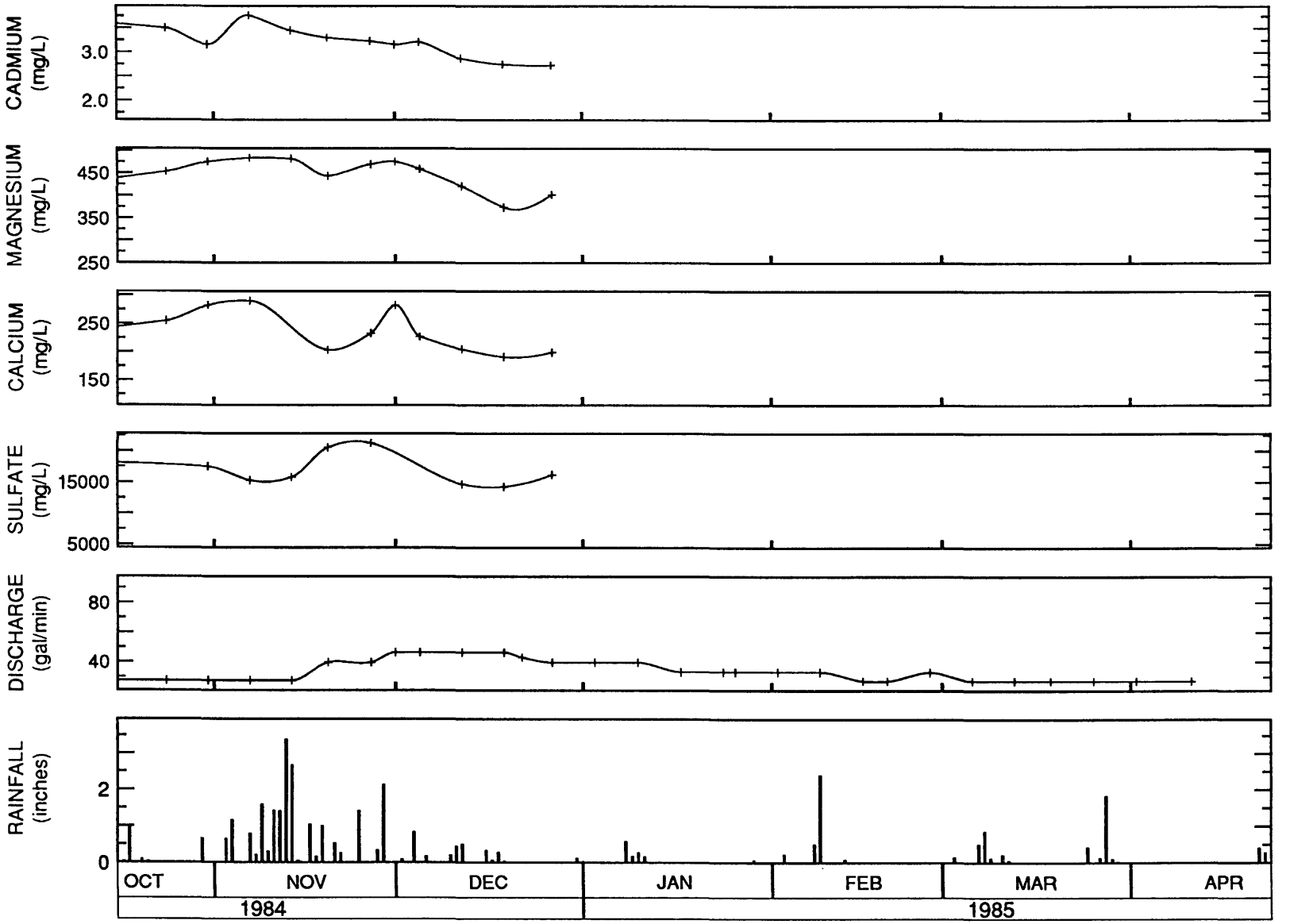

Figure C30. Cadmium, magnesium, calcium, and sulfate concentrations and discharge of Lawson portal effluent, and rainfall at Shasta Dam, October 1984-April 1985.

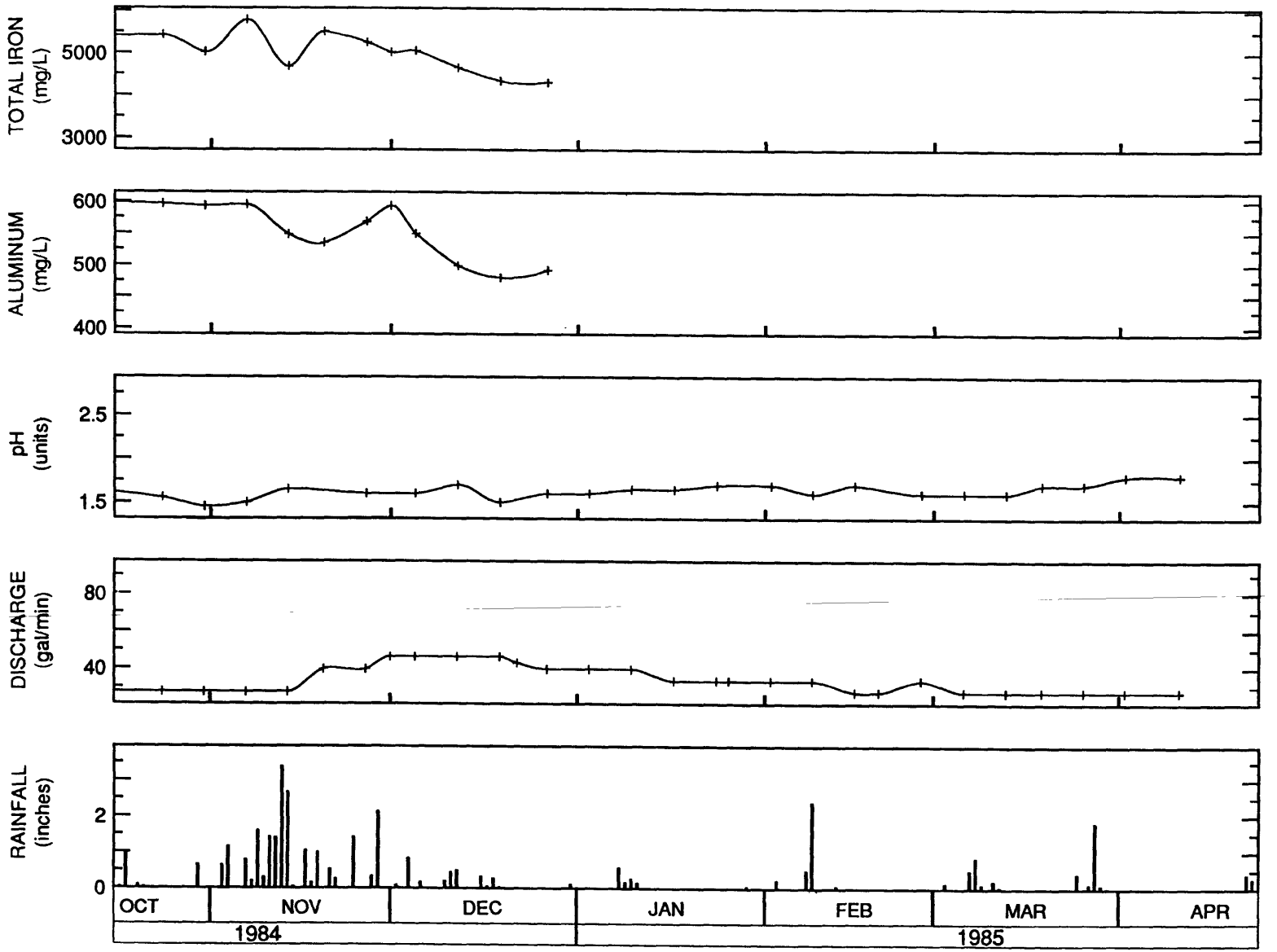

Figure C31. Total iron and aluminum concentrations, pH, and discharge of Lawson portal effluent, and rainfall at Shasta Dam, October 1984-April 1985.

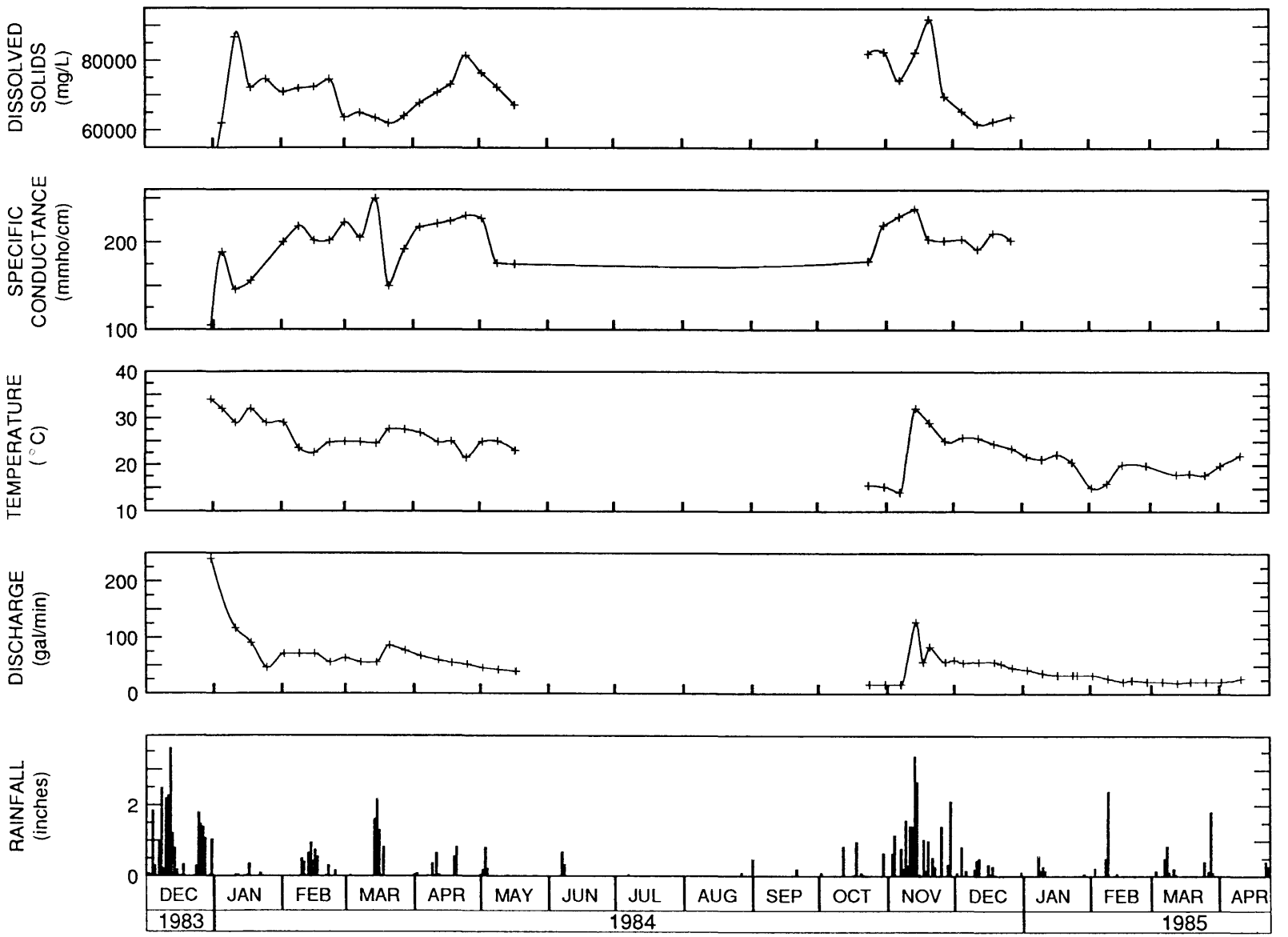

Figure C32. Dissolved solids, specific conductance, temperature, and discharge of Richmond portal effluent, and rainfall at Shasta Dam, December 1983-April 1985.

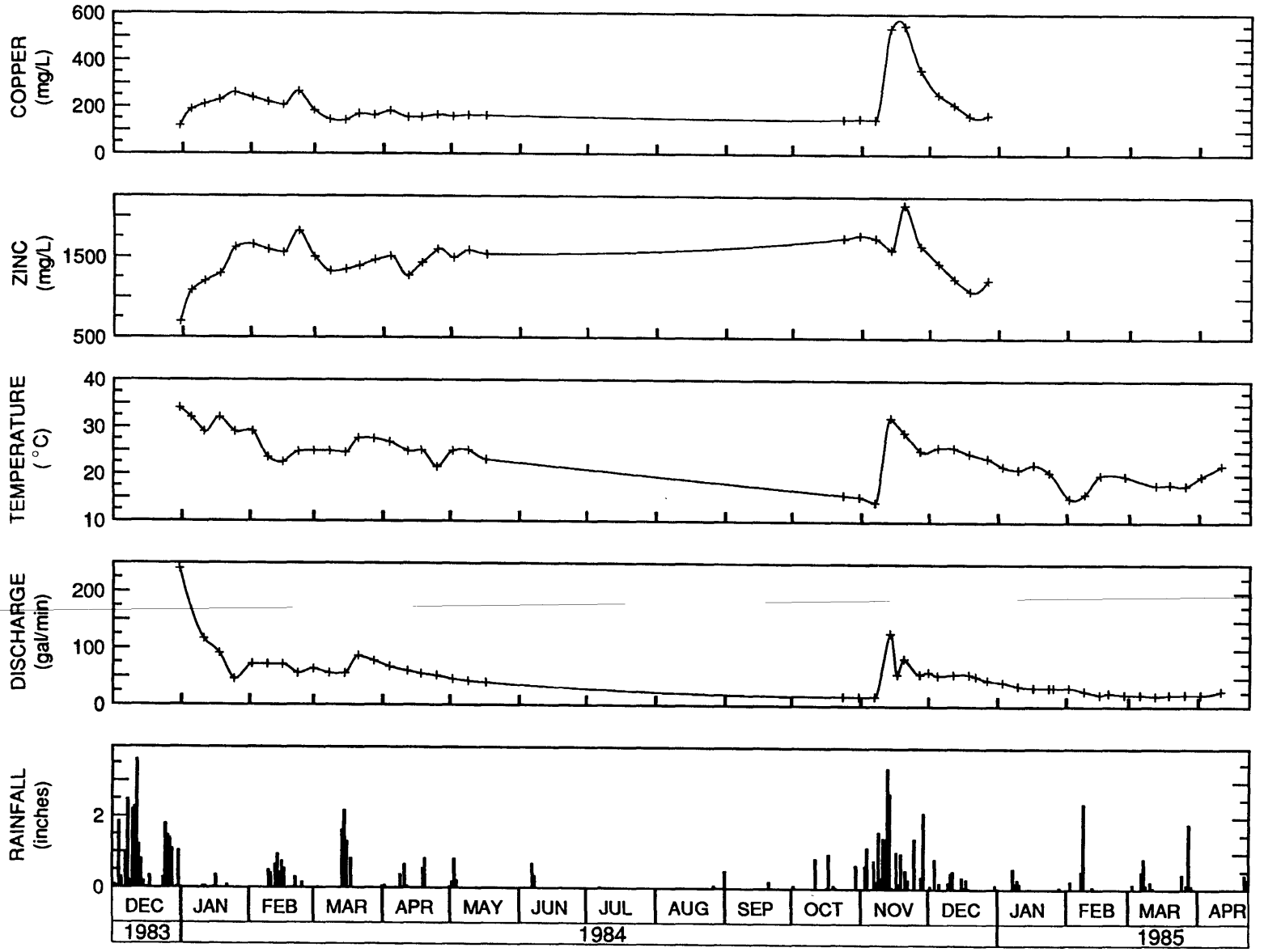

Figure C33. Copper and zinc concentrations, temperature, and discharge of Richmond portal effluent, and rainfall at Shasta Dam, December 1983-April 1985.

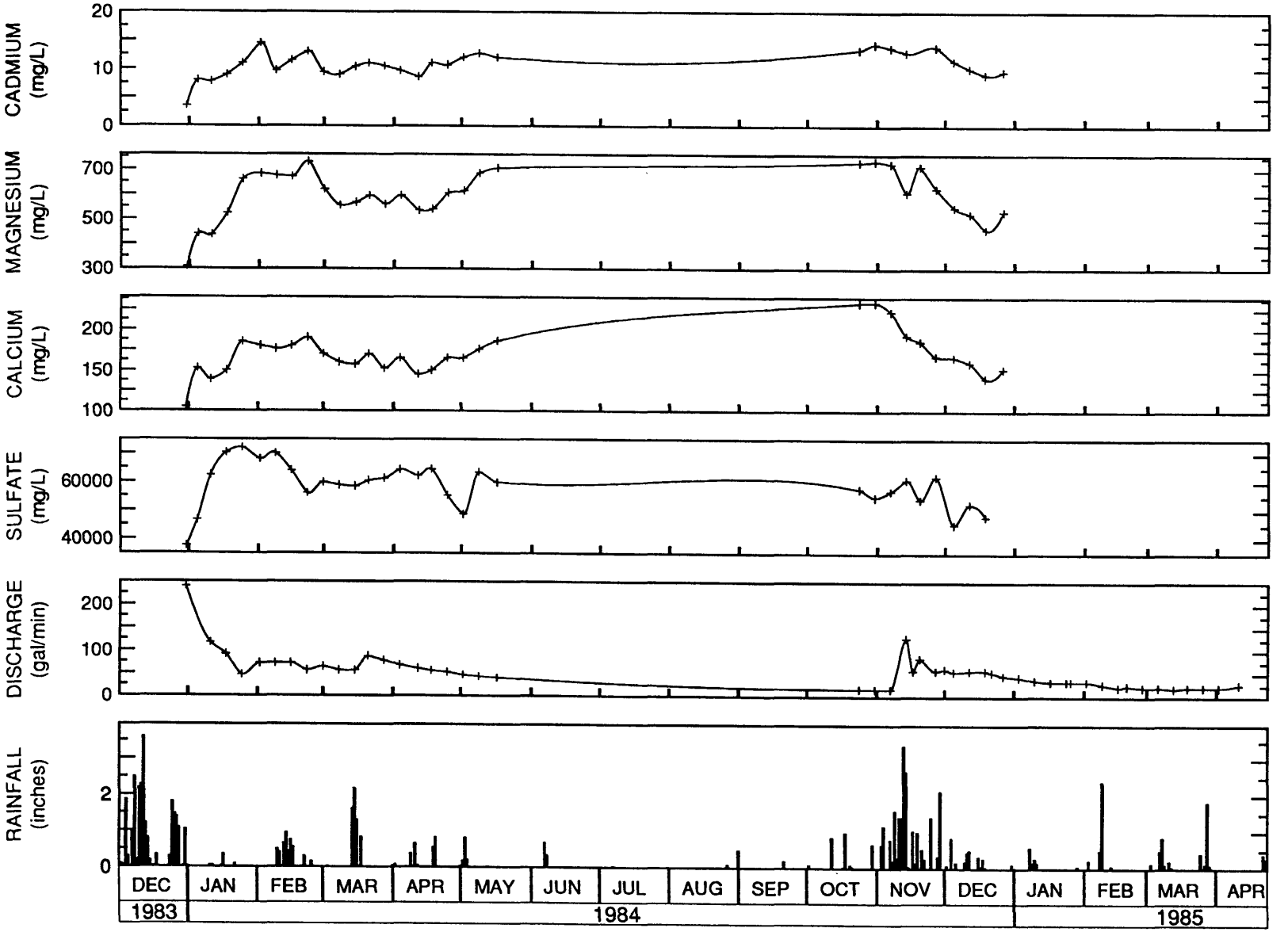

Figure C34. Cadmium, magnesium, calcium, and sulfate concentrations and discharge of Richmond portal effluent, and rainfall at Shasta Dam, December 1983-April 1985.

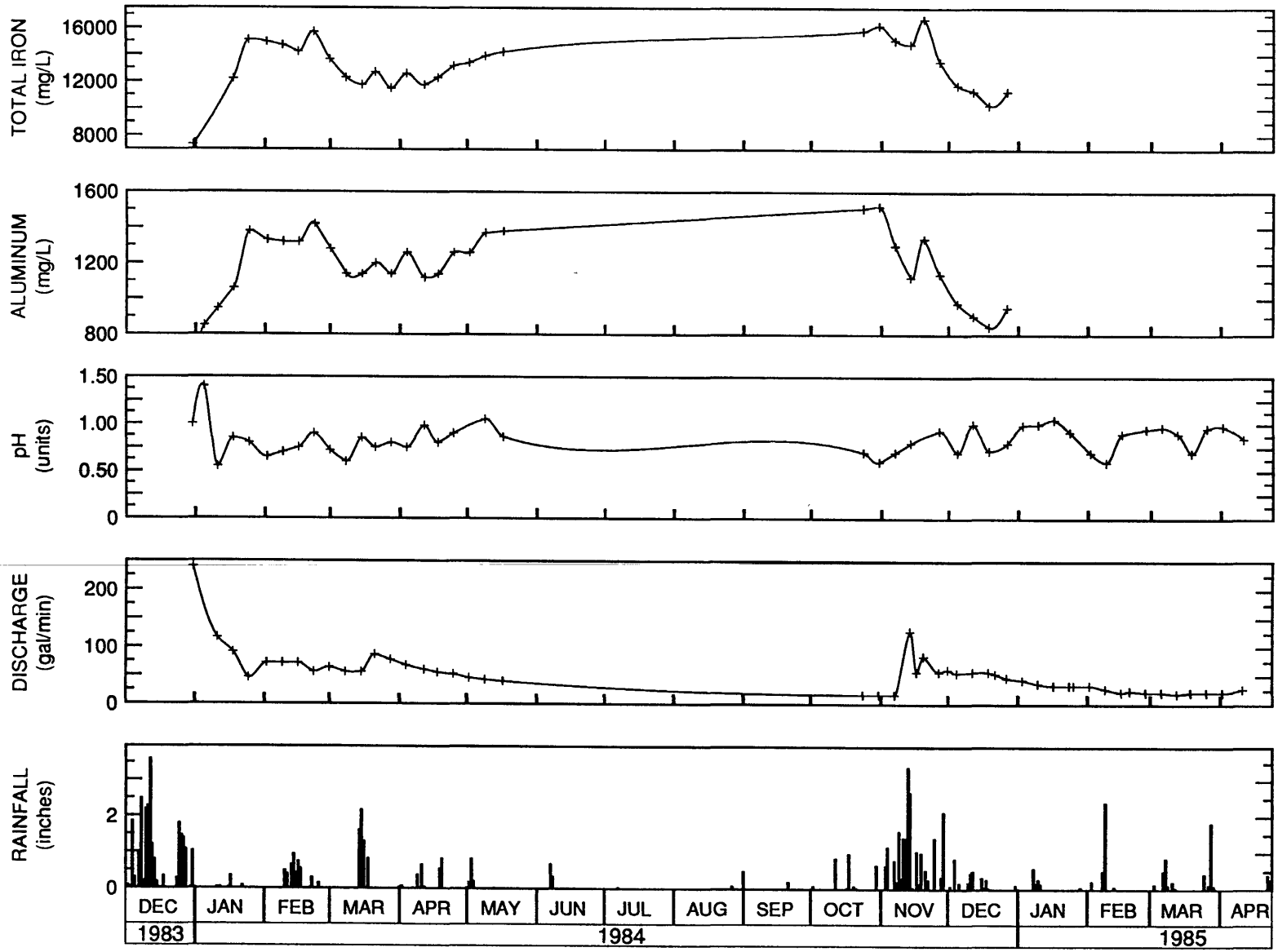

Figure C35. Total iron and aluminum concentrations, pH, and discharge of Richmond portal effluent, and rainfall at Shasta Dam, December 1983-April 1985.

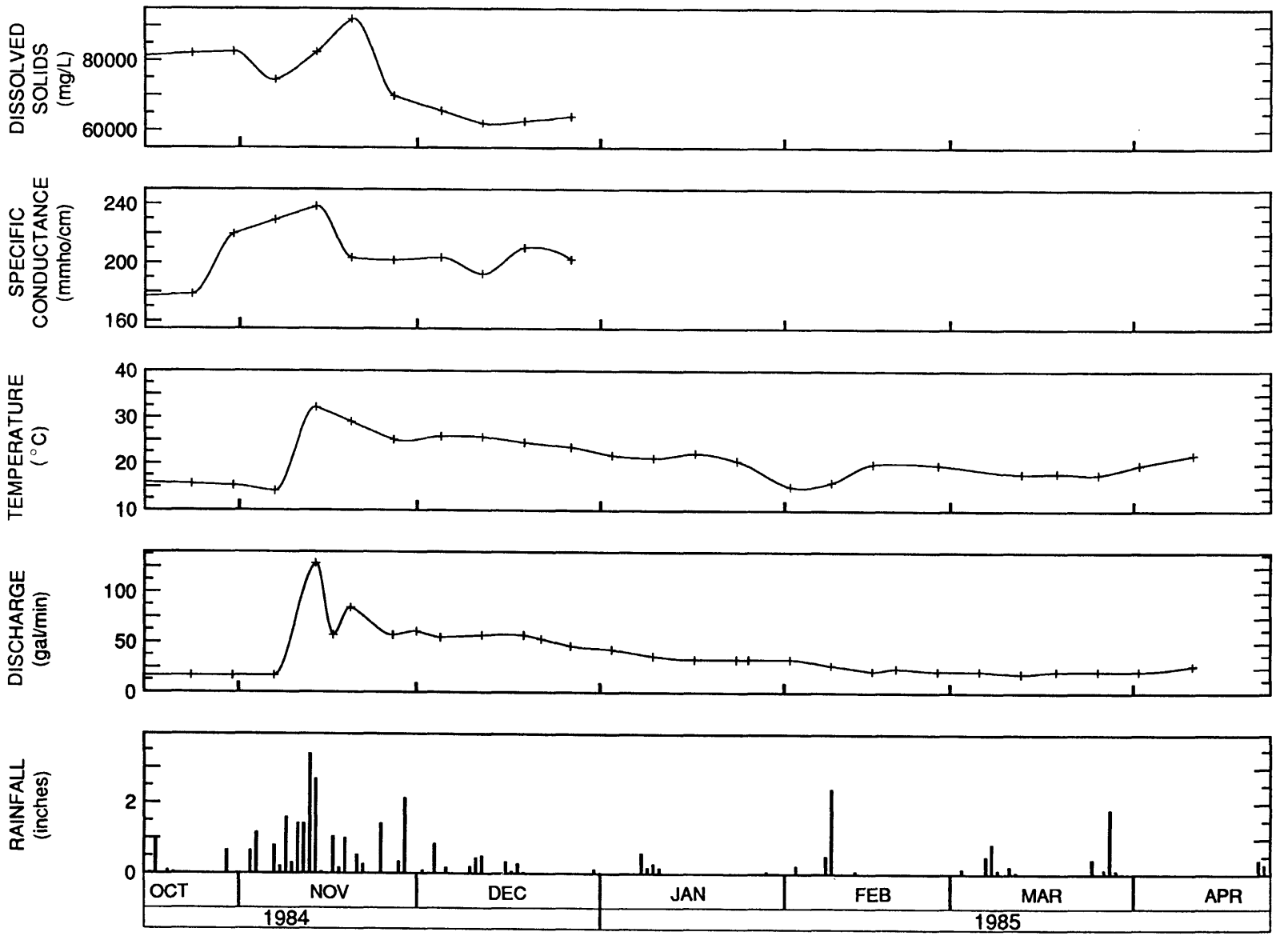

Figure C36. Dissolved solids, specific conductance, temperature, and discharge of Richmond portal effluent, and rainfall at Shasta Dam, October 1984-April 1985.

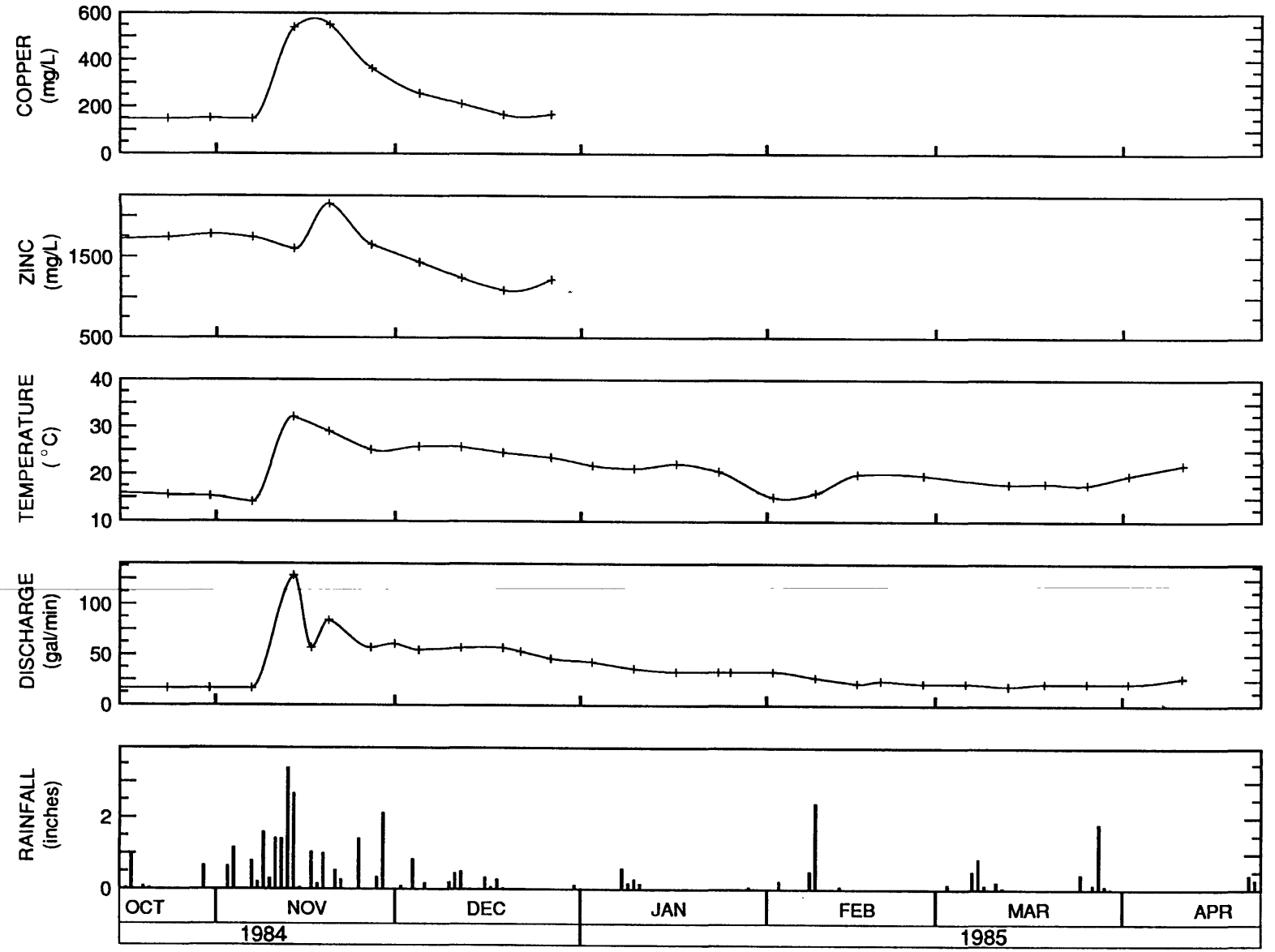

Figure C37. Copper and zinc concentrations, temperature, and discharge of Richmond portal effluent, and rainfall at Shasta Dam, October 1984-April 1985.

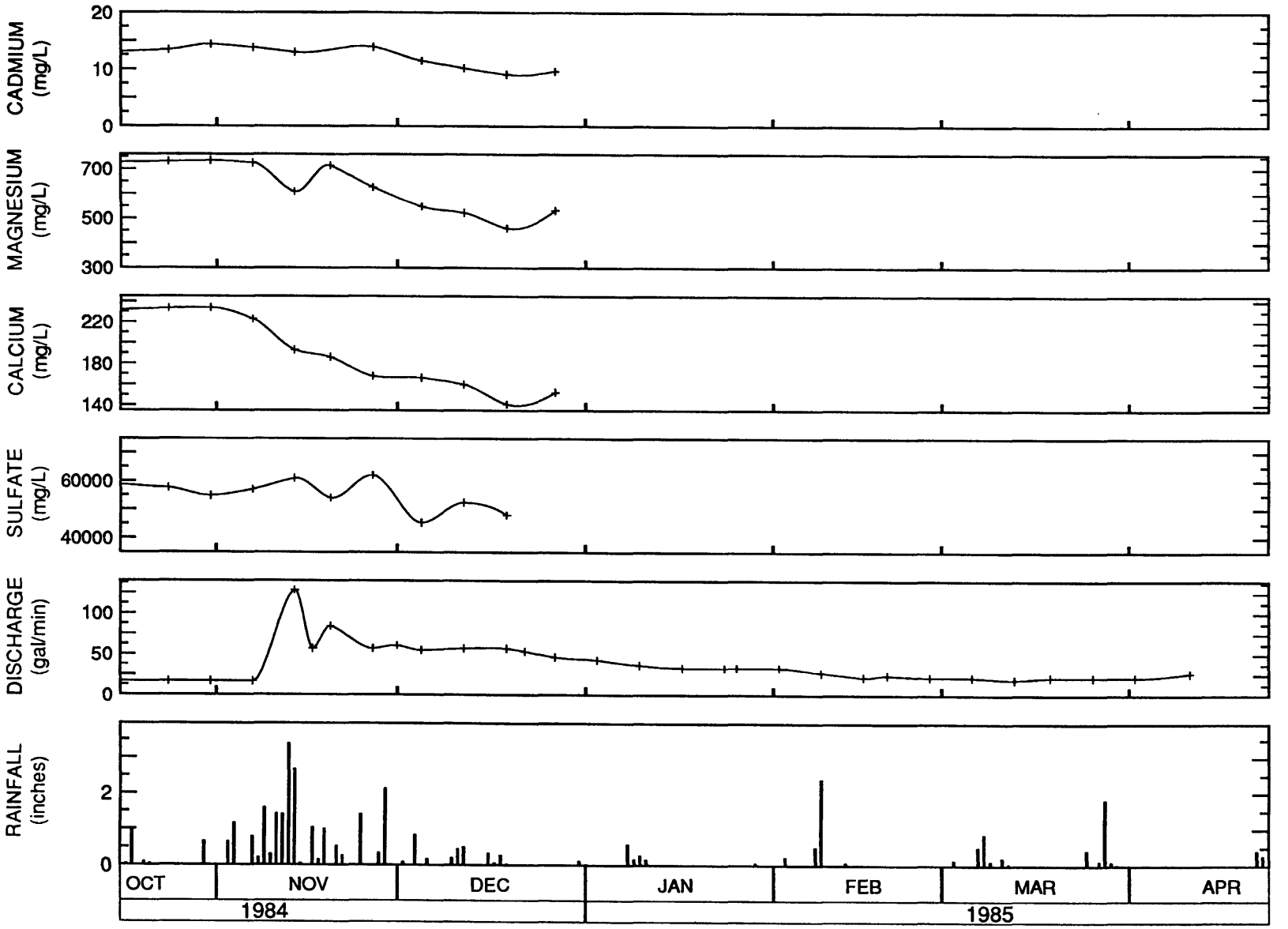

Figure C38. Cadmium, magnesium, calcium, and sulfate concentrations and discharge of Richmond portal effluent, and rainfall at Shasta Dam, October 1984-April 1985.

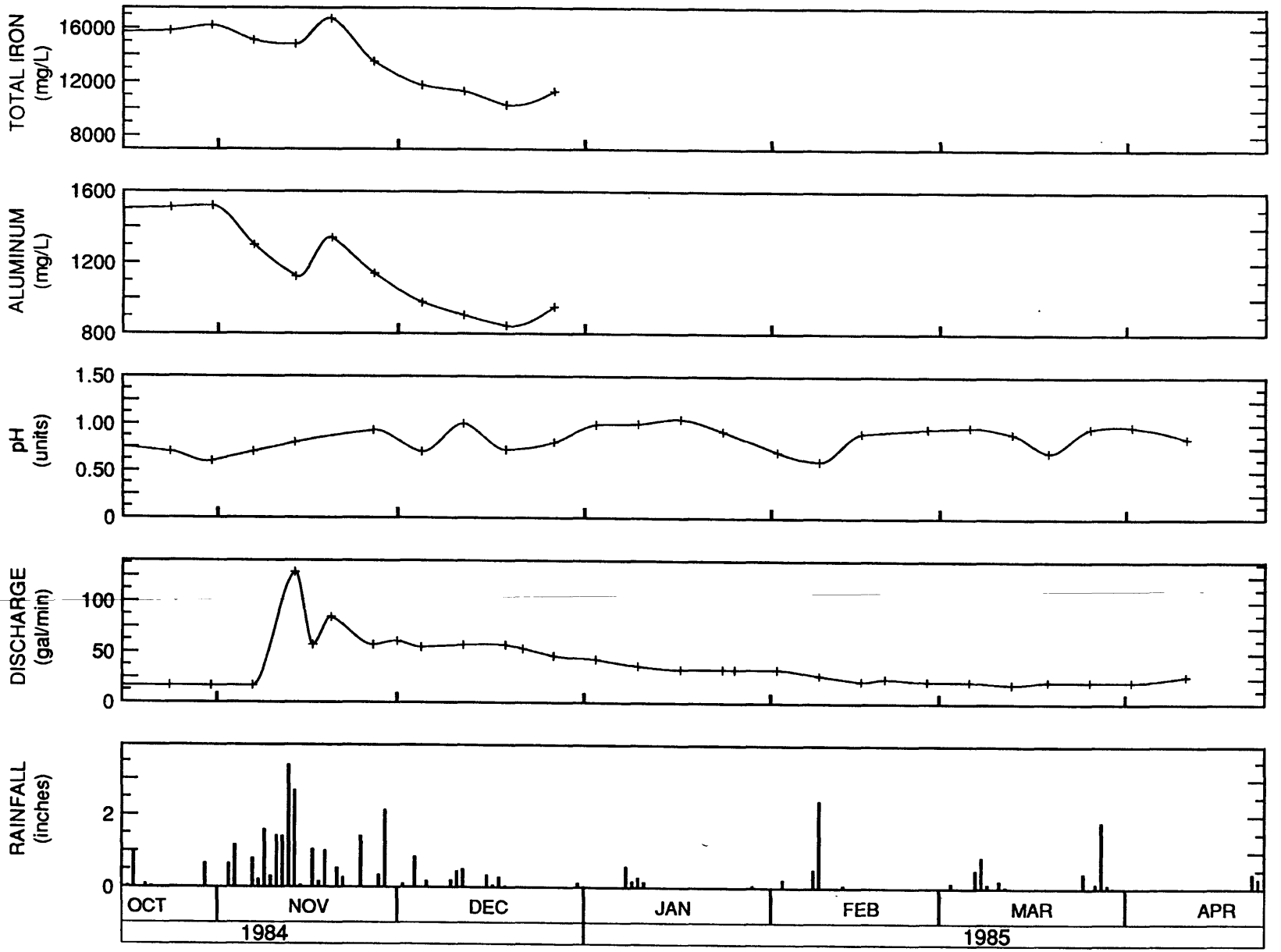

Figure C39. Total iron and aluminum concentrations, pH, and discharge of Richmond portal effluent, and rainfall at Shasta Dam, October 1984-April 1985.

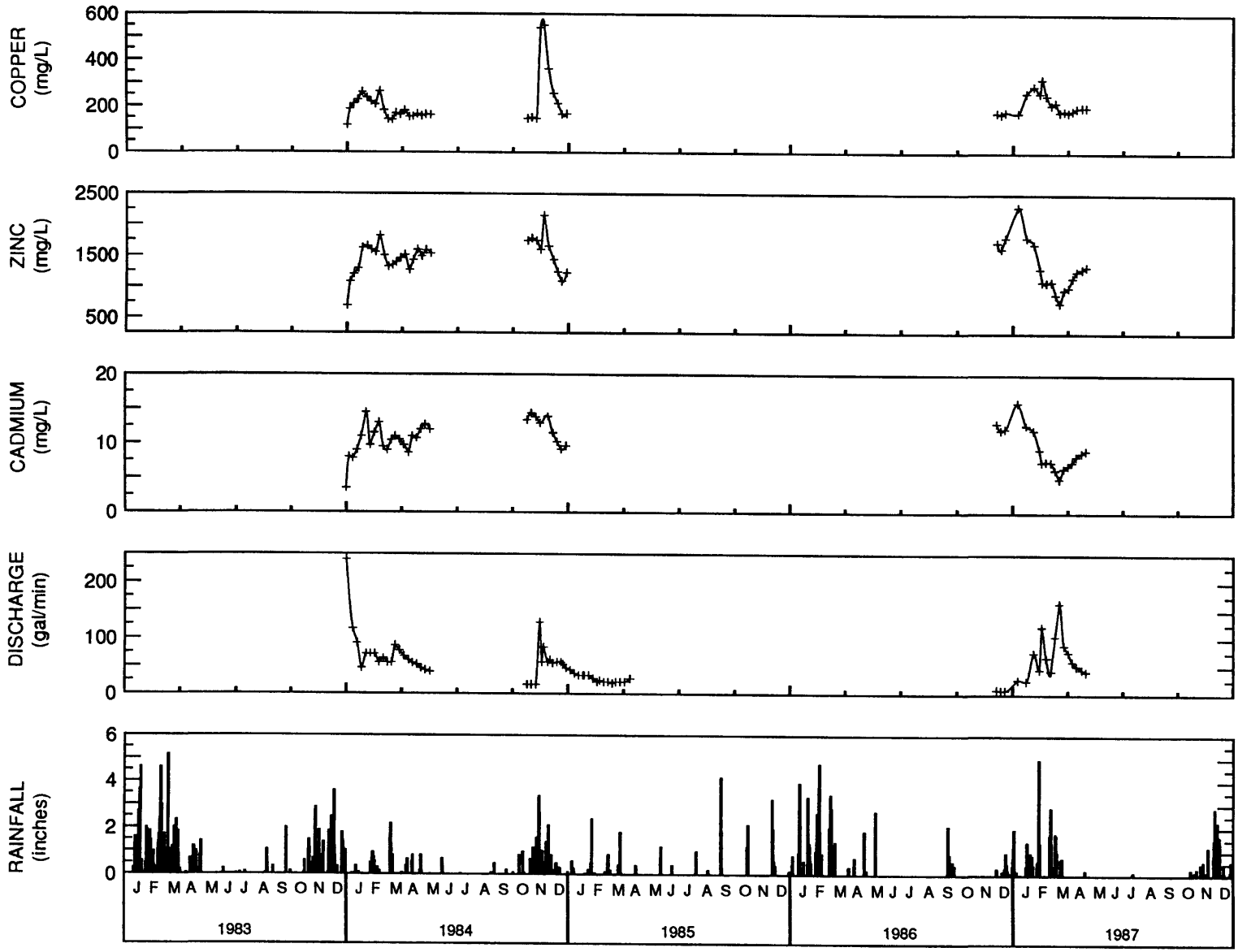

Figure C40. Copper, zinc, and cadmium concentrations and discharge of Richmond portal effluent, and rainfall at Shasta Dam, 1983-87.

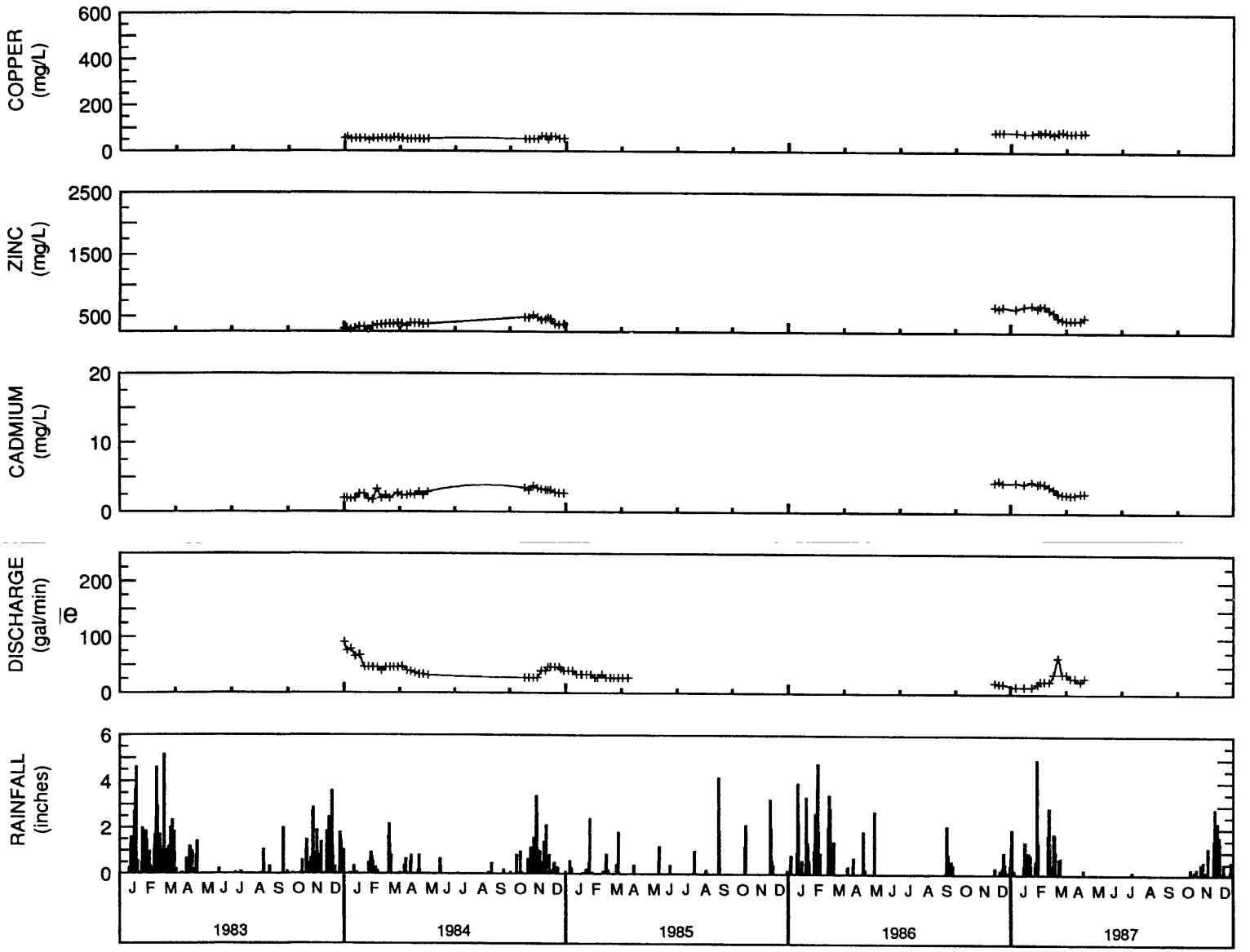

Figure C41. Copper, zinc, and cadmium concentrations and discharge of Lawson portal effluent, and rainfall at Shasta Dam, 1983-87.

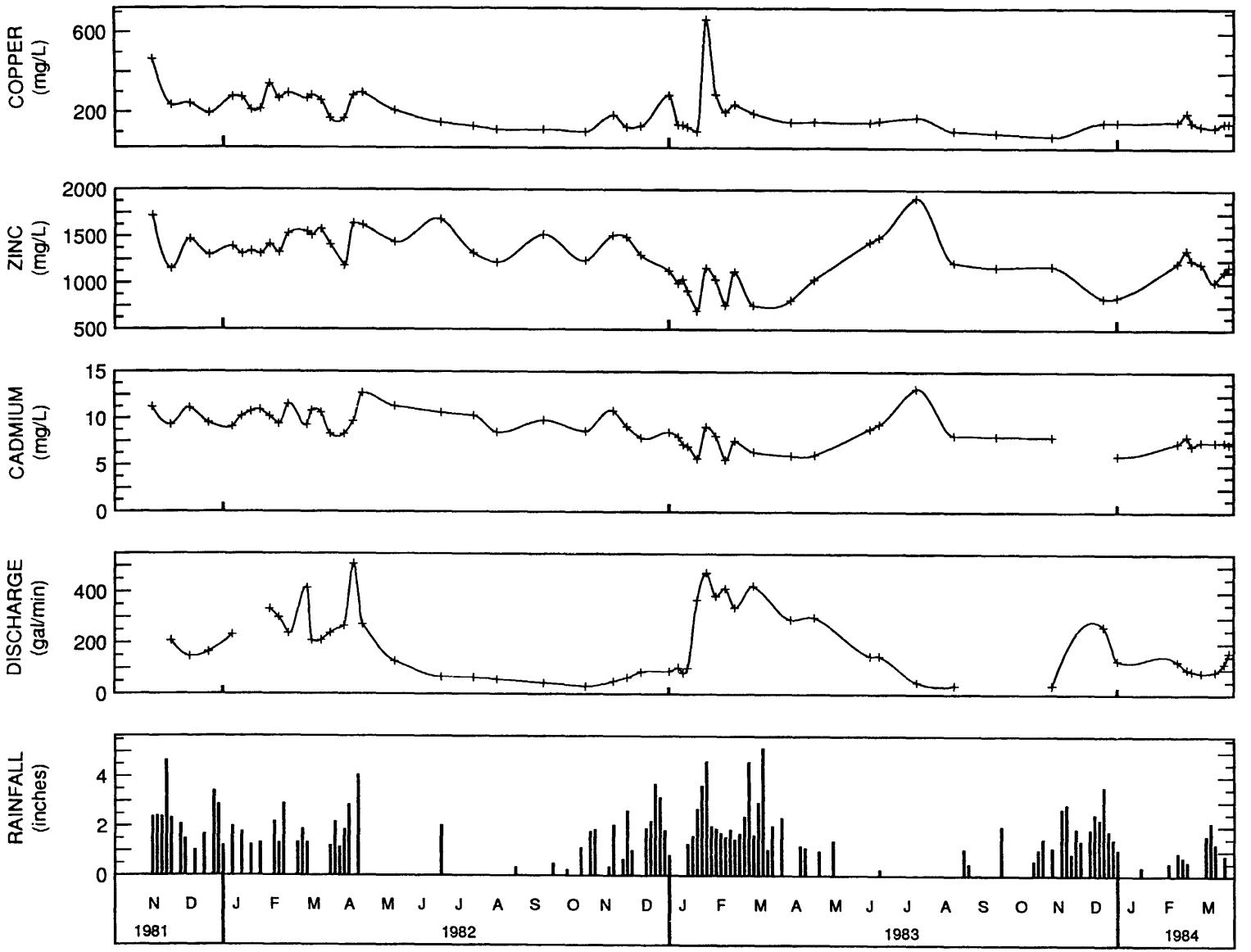

Figure C42. Copper, zinc, and cadmium concentrations and discharge of Boulder Creek copper plant influent, and rainfall at Shasta Dam, November 1981-March 1984.

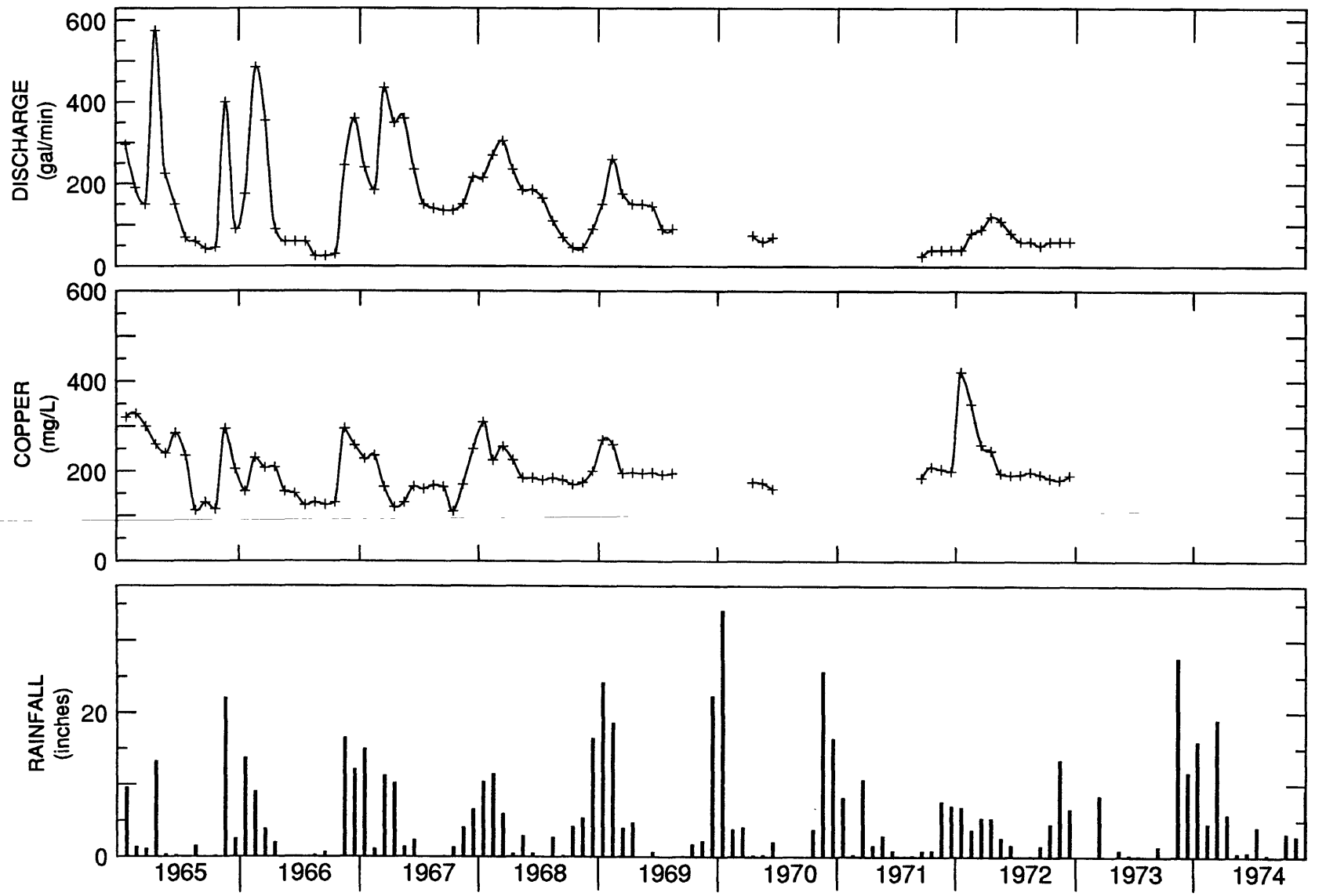

Figure C43. Discharge and copper concentrations of Boulder Creek copper plant influent, and rainfall at Shasta Dam, 1965-74.

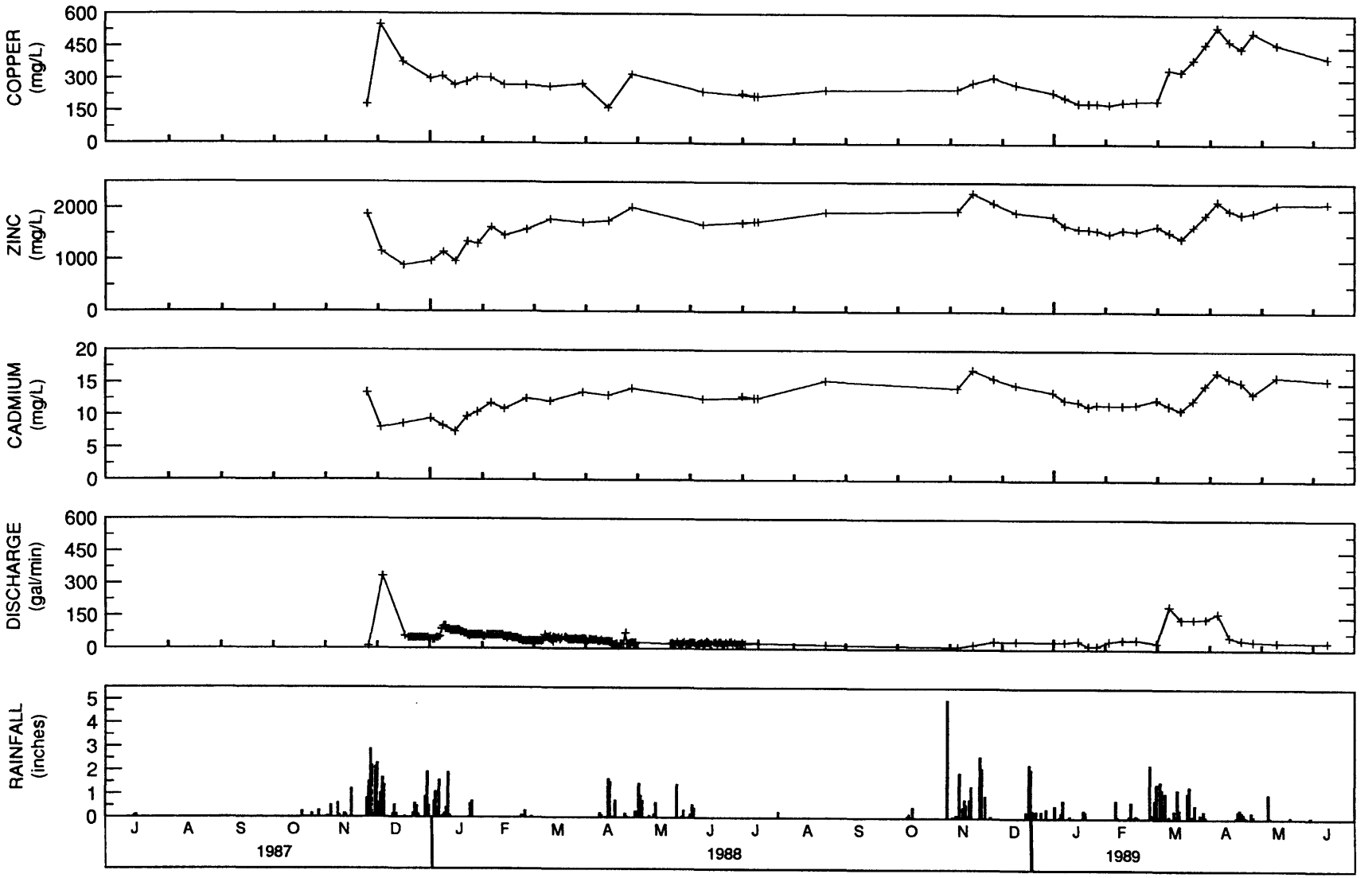

Figure C44. Copper, zinc, and cadmium concentrations and discharge of Richmond portal effluent, and rainfall at Shasta Dam, 1987-89.

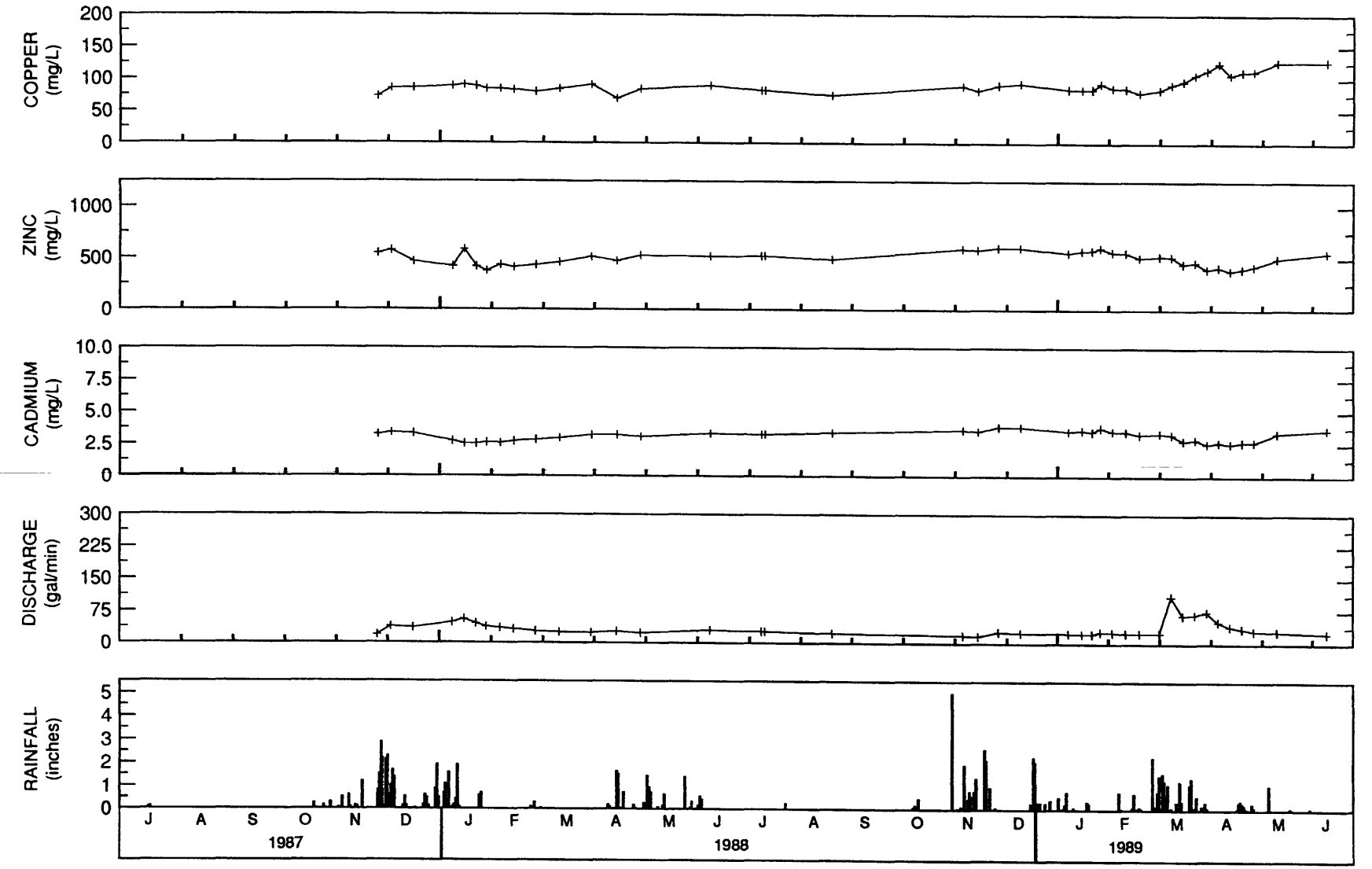

Figure C45. Copper, zinc, and cadmium concentrations and discharge of Lawson portal effluent, and rainfall at Shasta Dam, 1987-89.

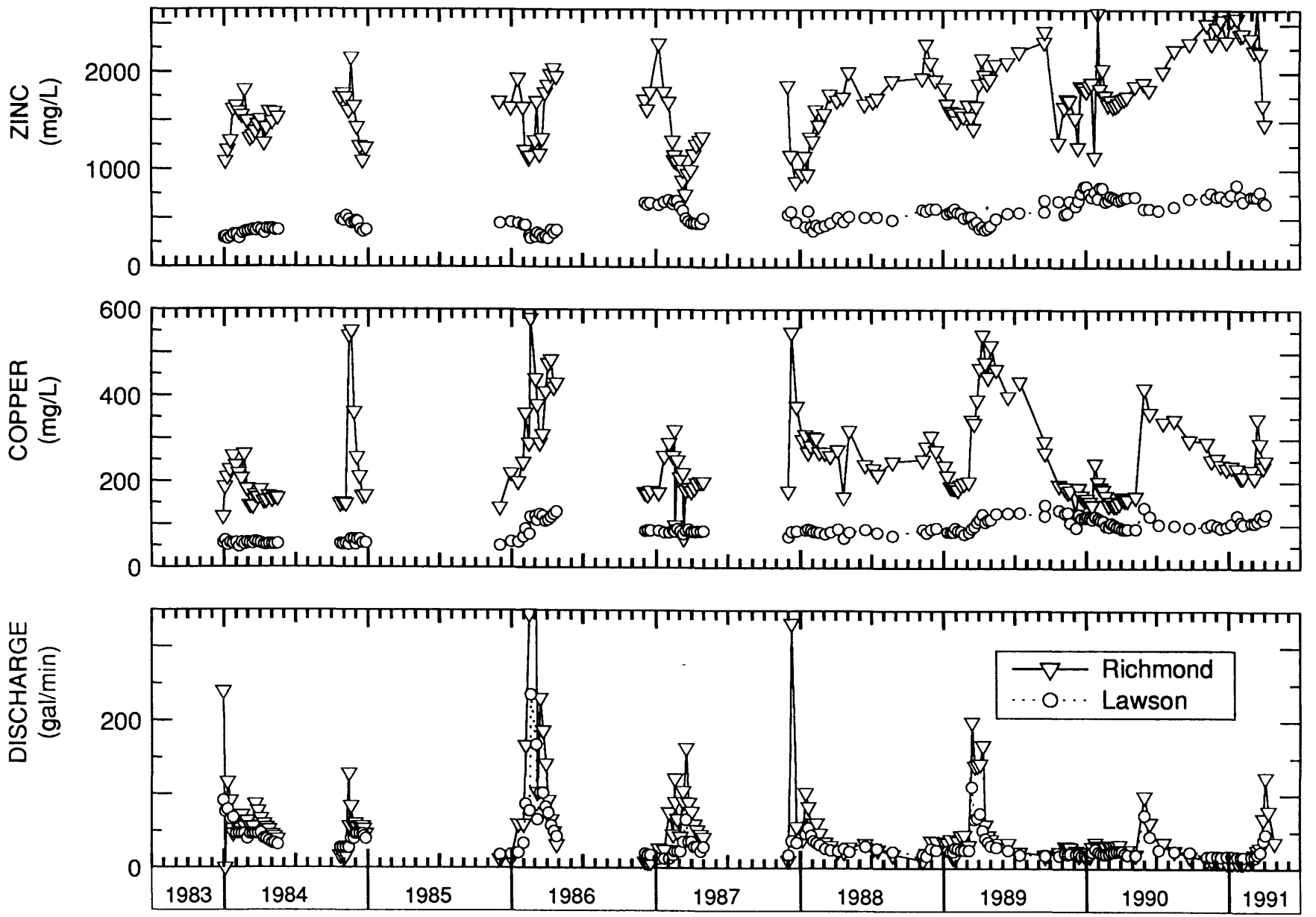

Figure C46. Zinc and copper concentrations and discharge of Richmond and Lawson portal effluents, 1983-91.

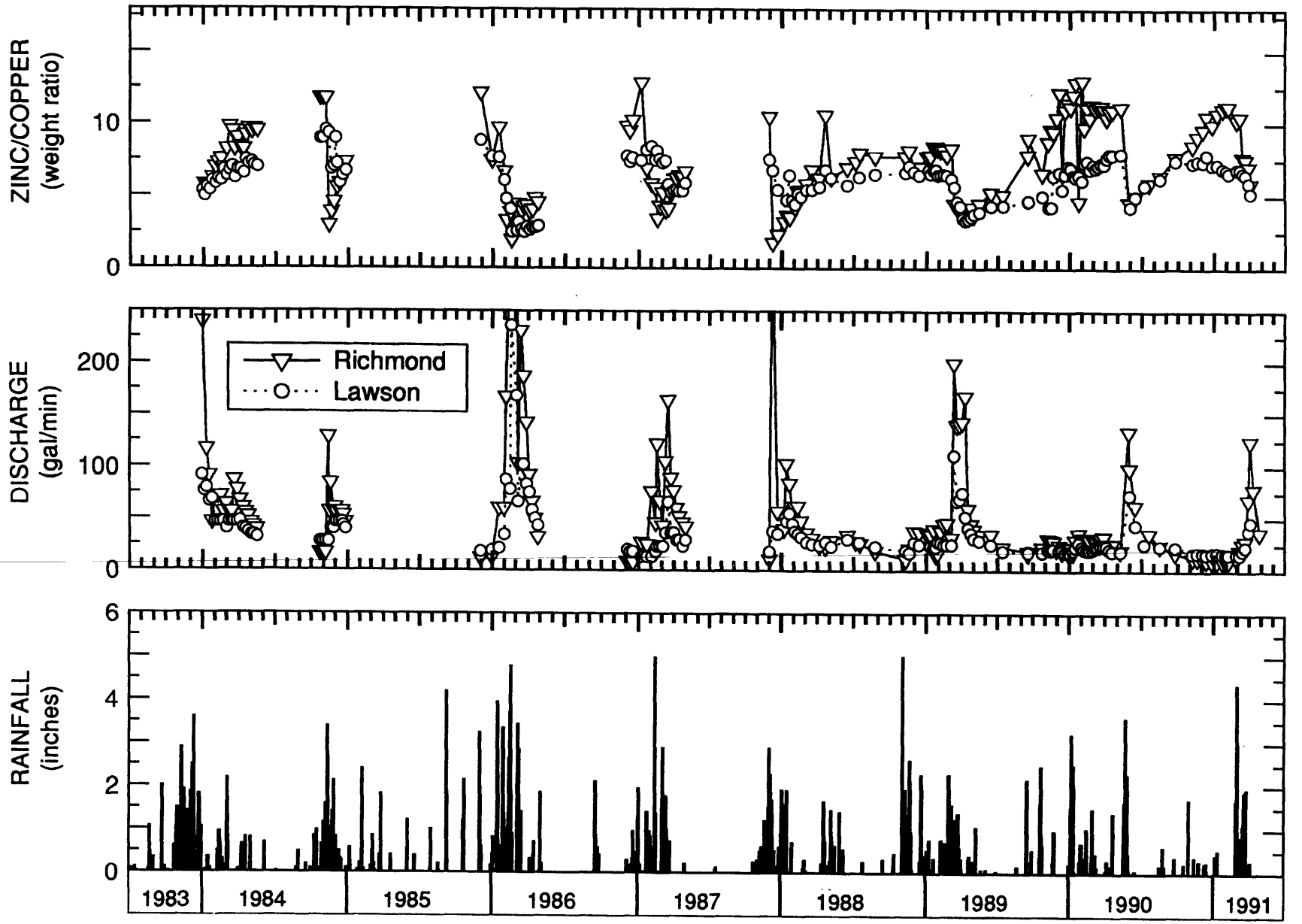

Figure C47. Zinc/copper ratios and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1983-91.

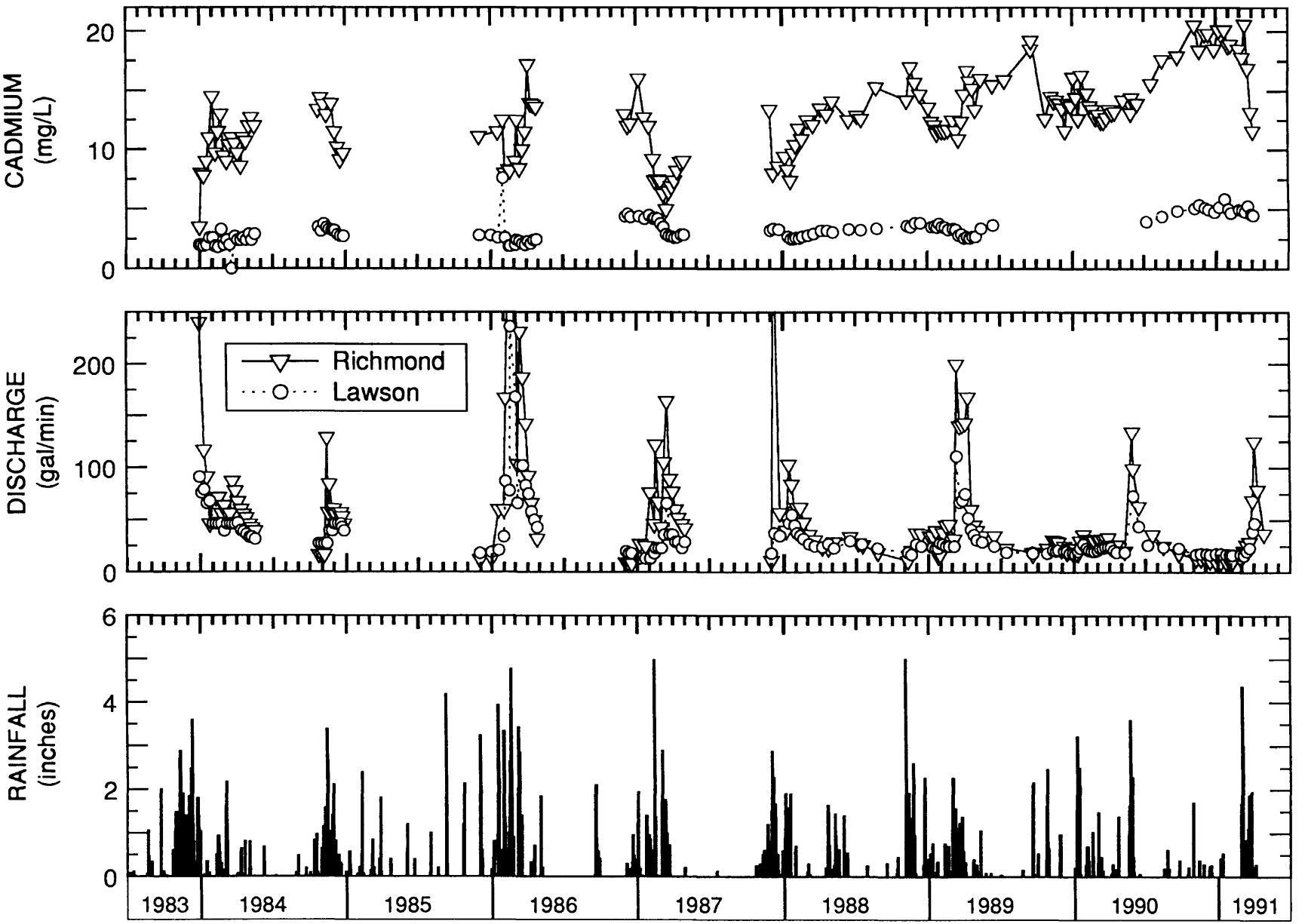

Figure C48. Cadmium concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1983-91.

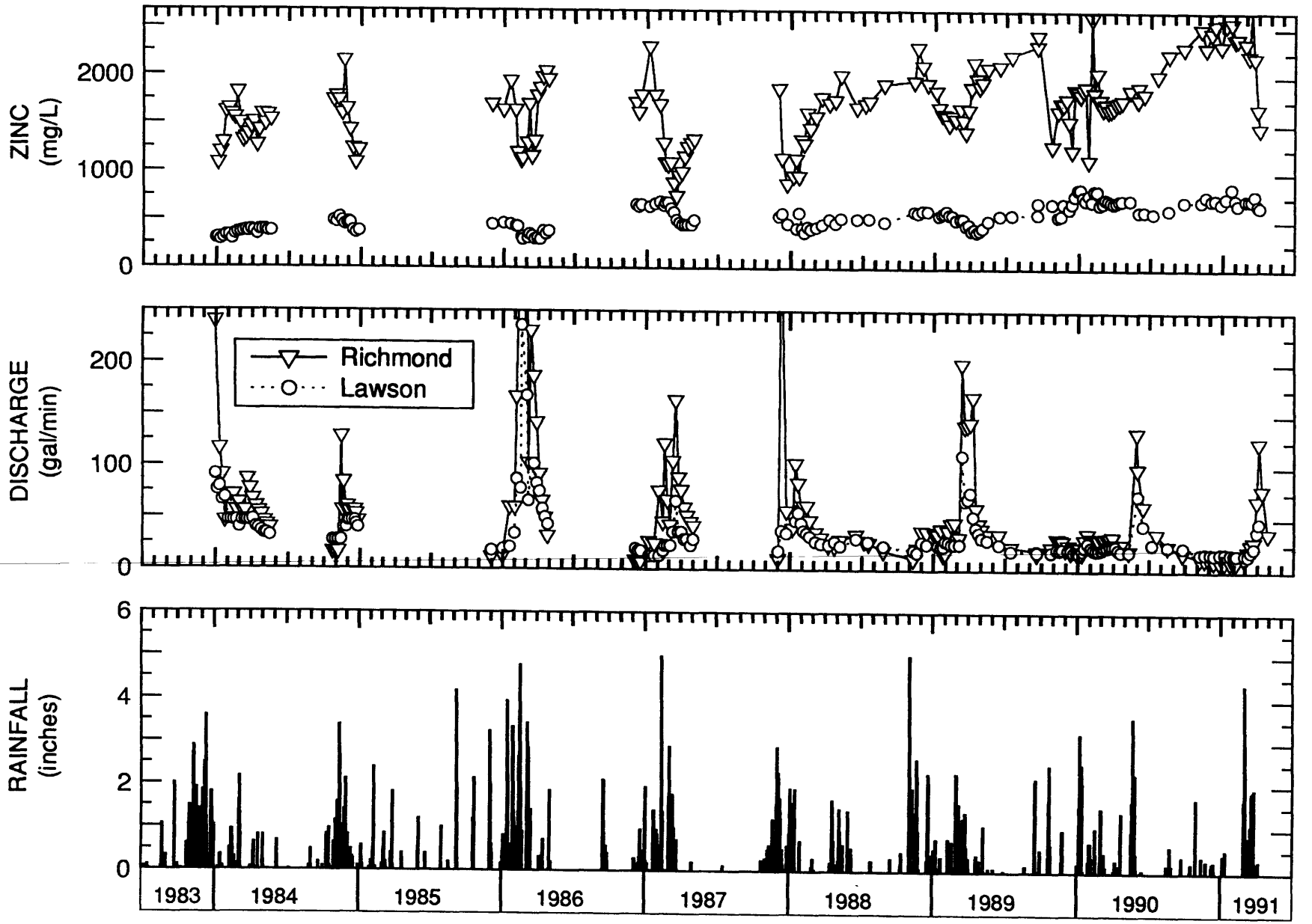

Figure C49. Zinc concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1983-91.

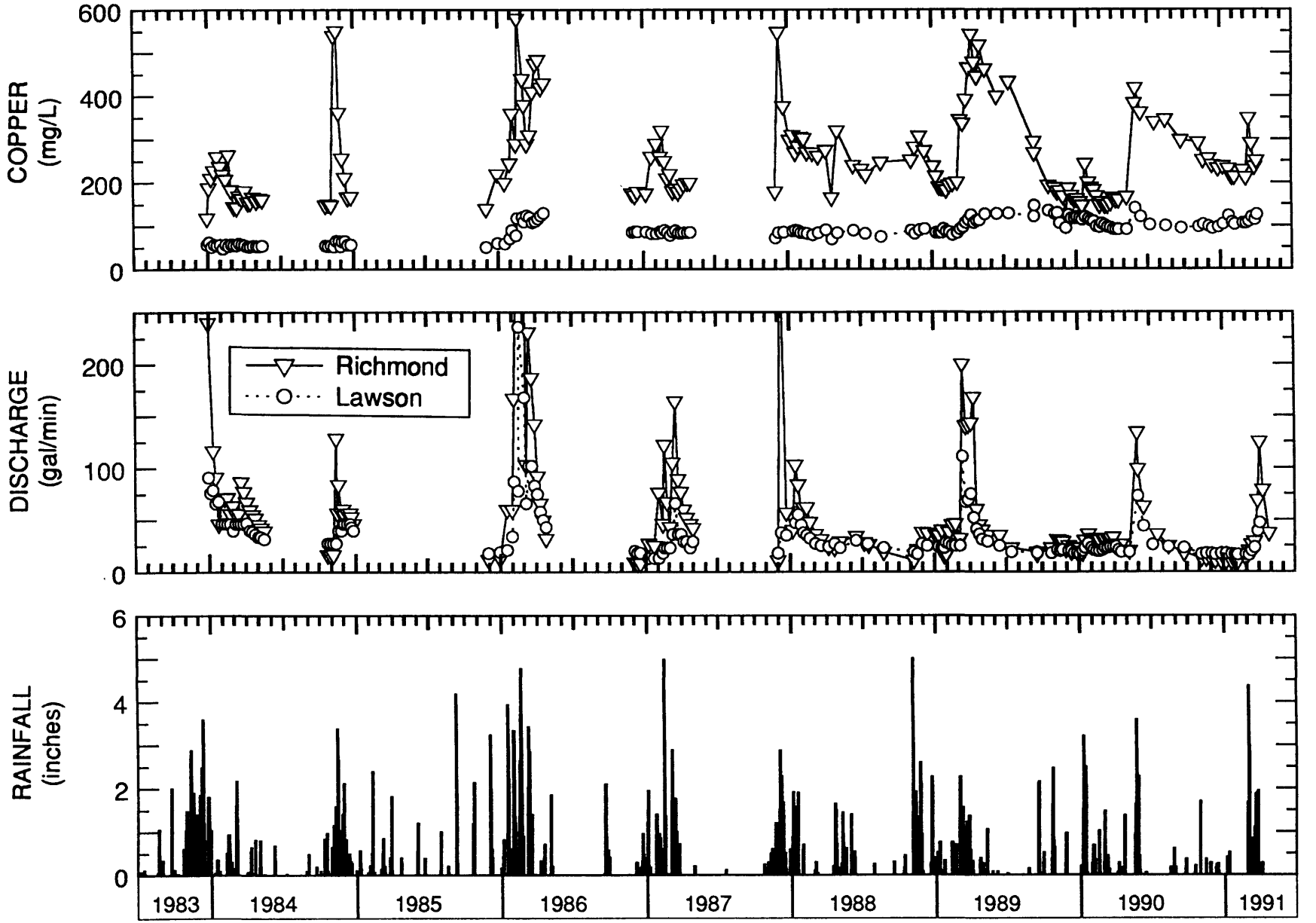

Figure C50. Copper concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1983-91.

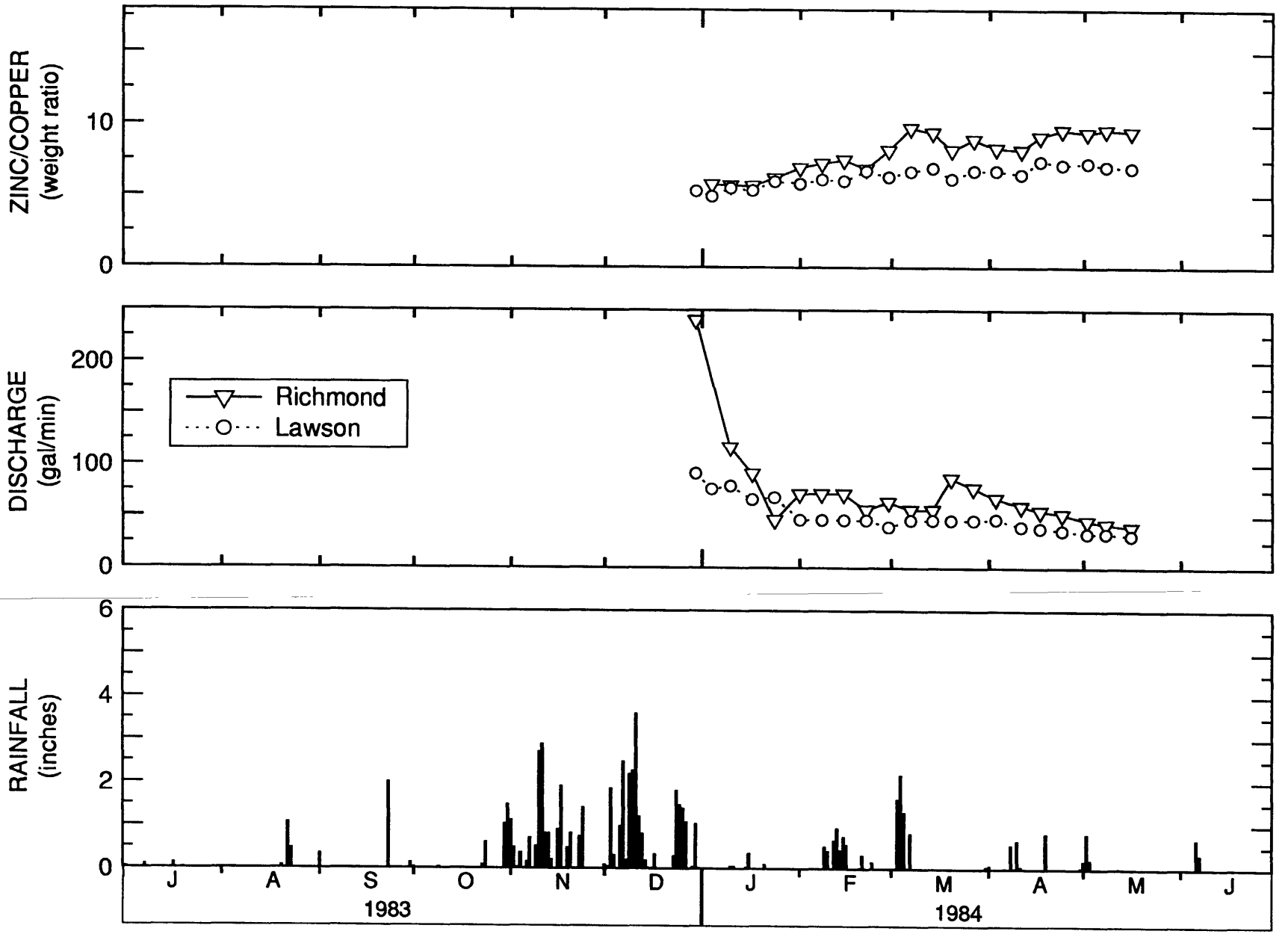

Figure C51. Zinc/copper ratios and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1983-84.

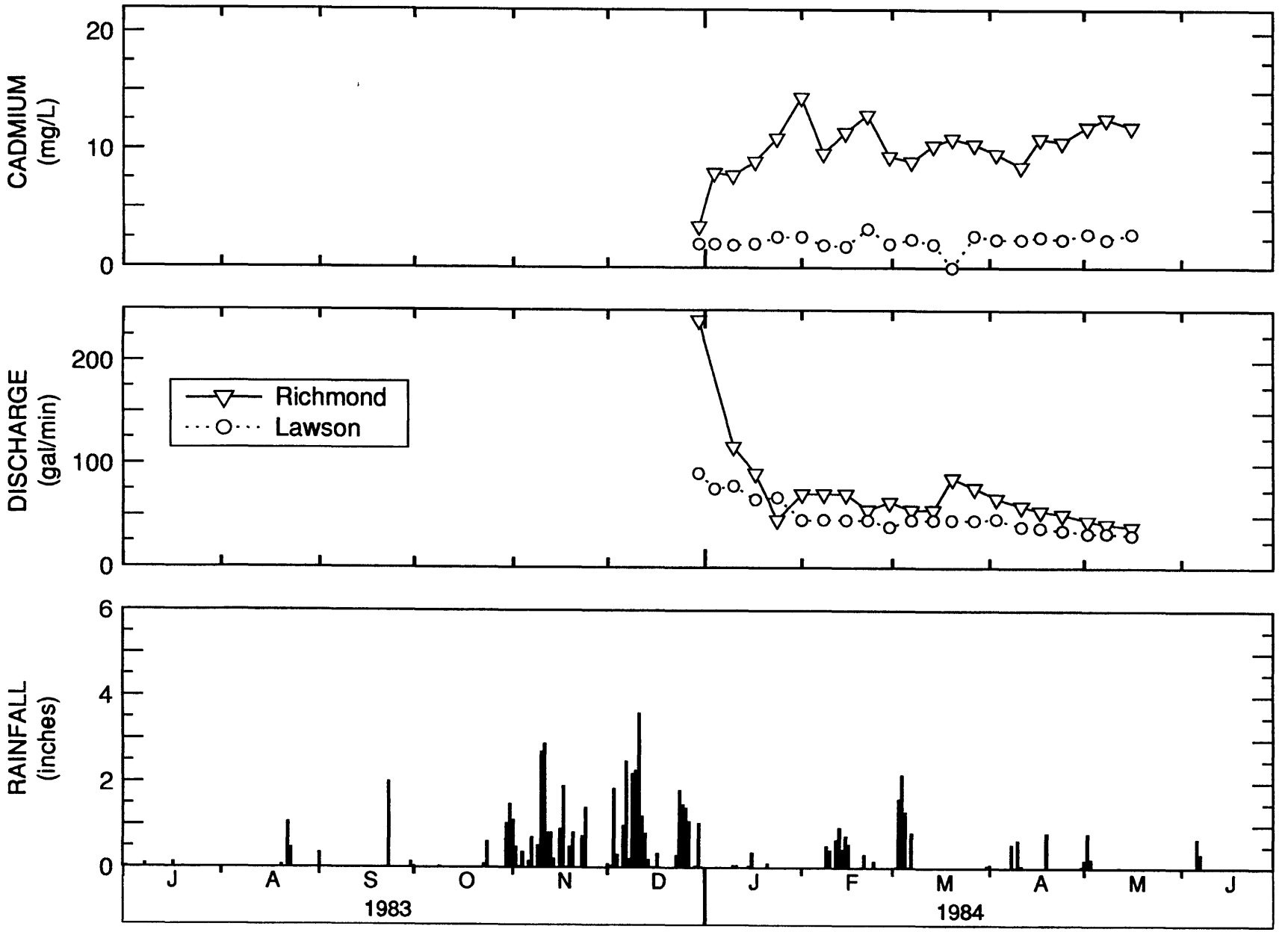

Figure C52. Cadmium concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1983-84.

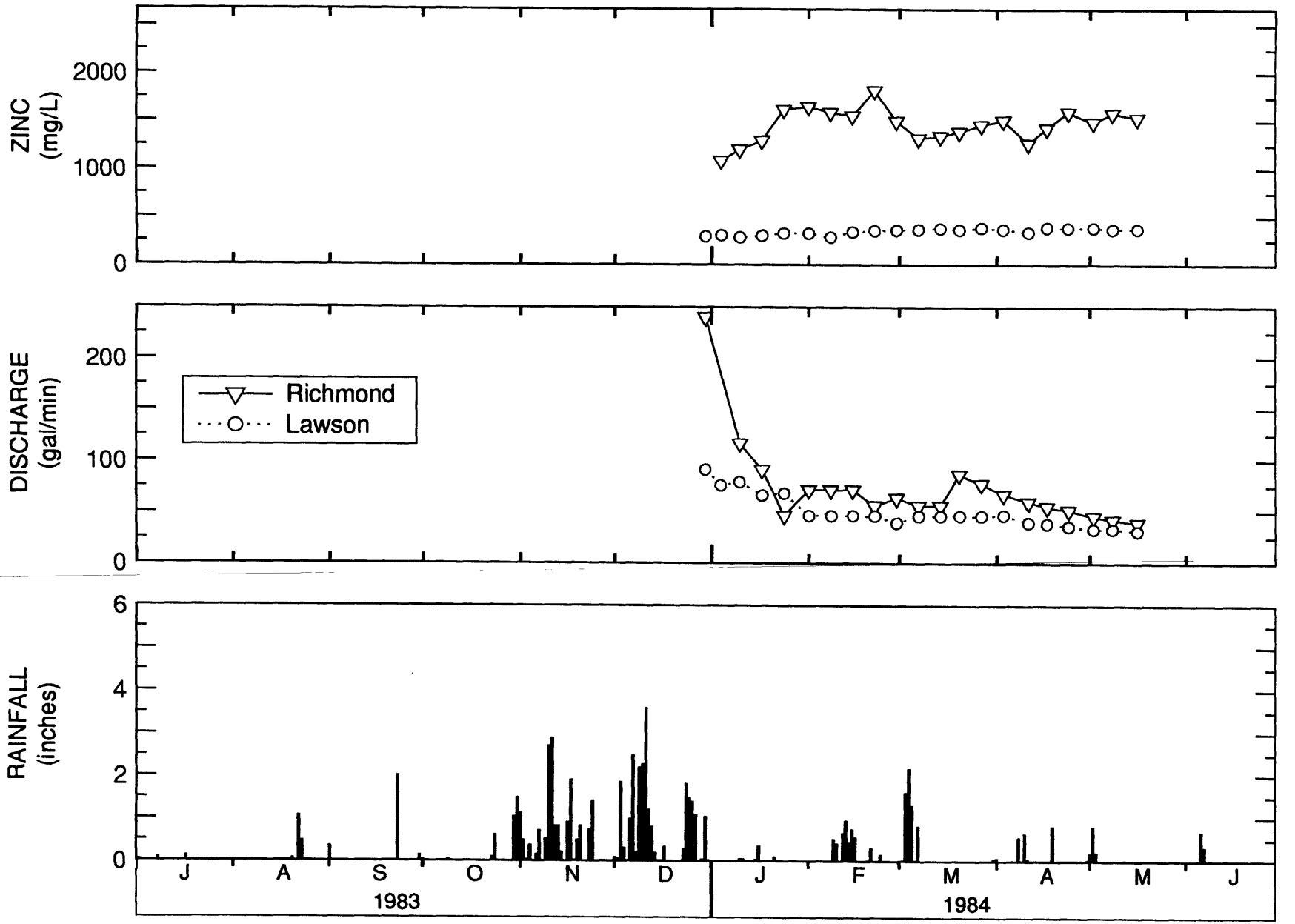

Figure C53. Zinc concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1983-84.

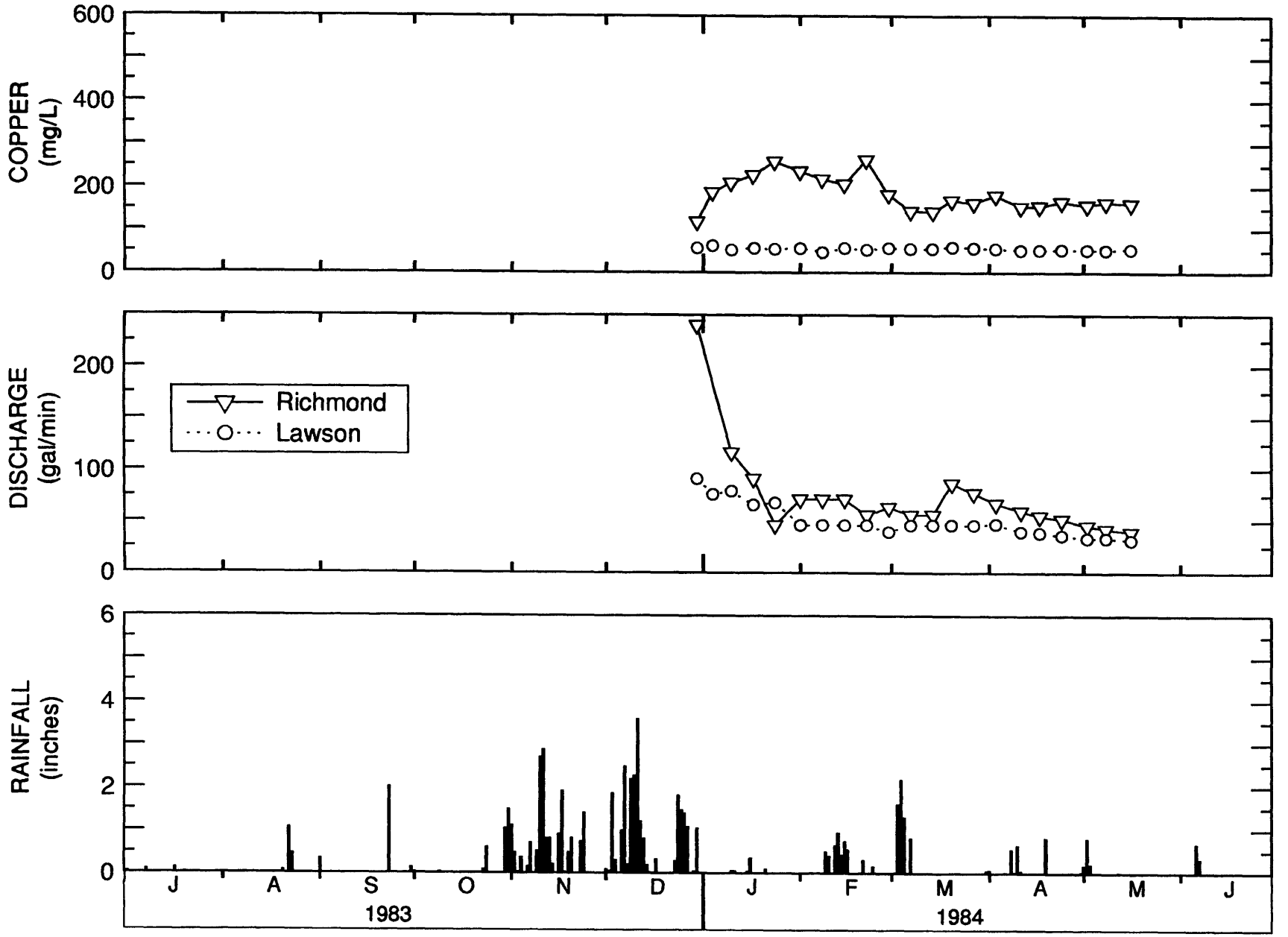

Figure C54. Copper concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1983-84.

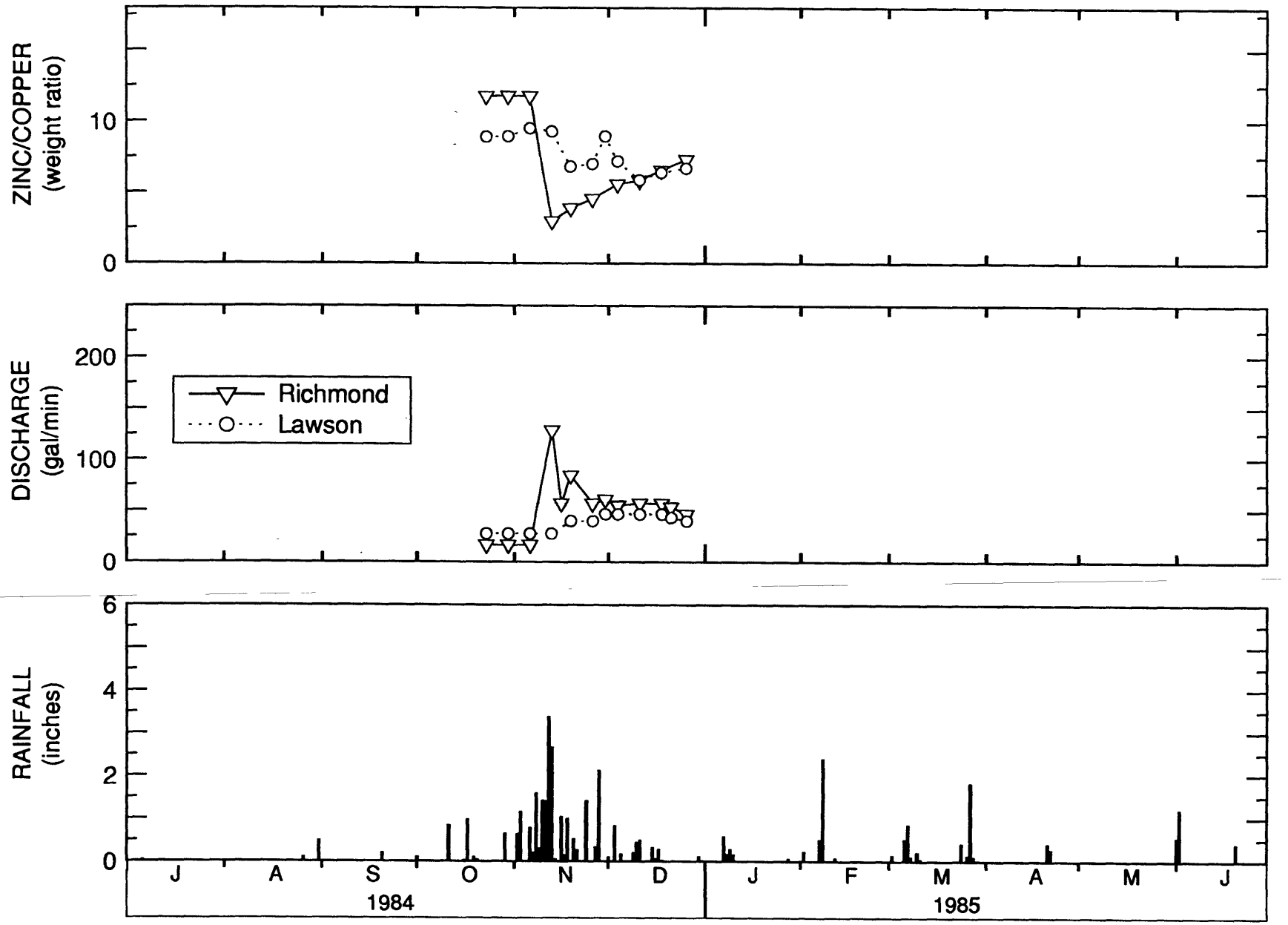

Figure C55. Zinc/copper ratios and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1984-85.

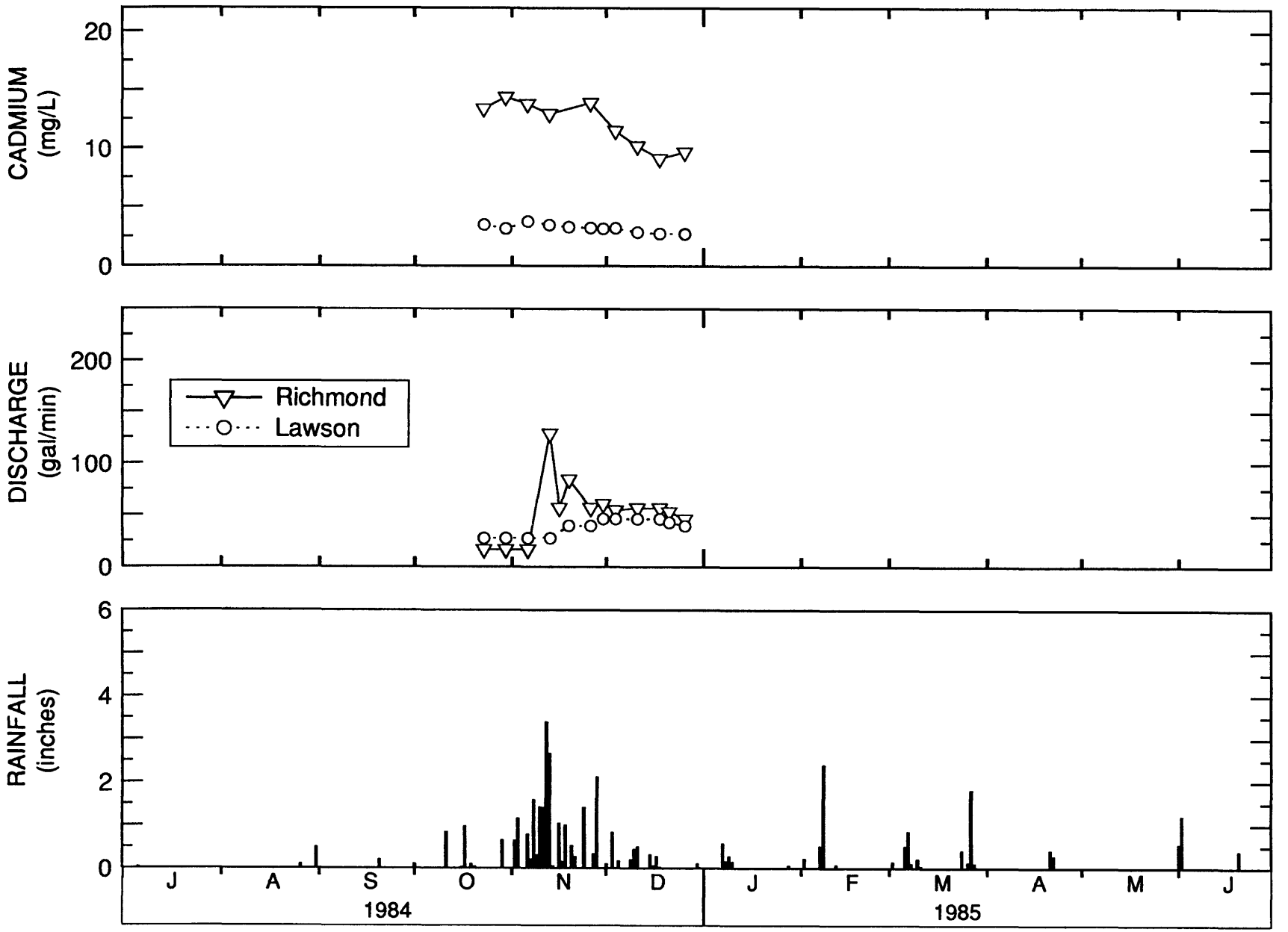

Figure C56. Cadmium concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1984-85.

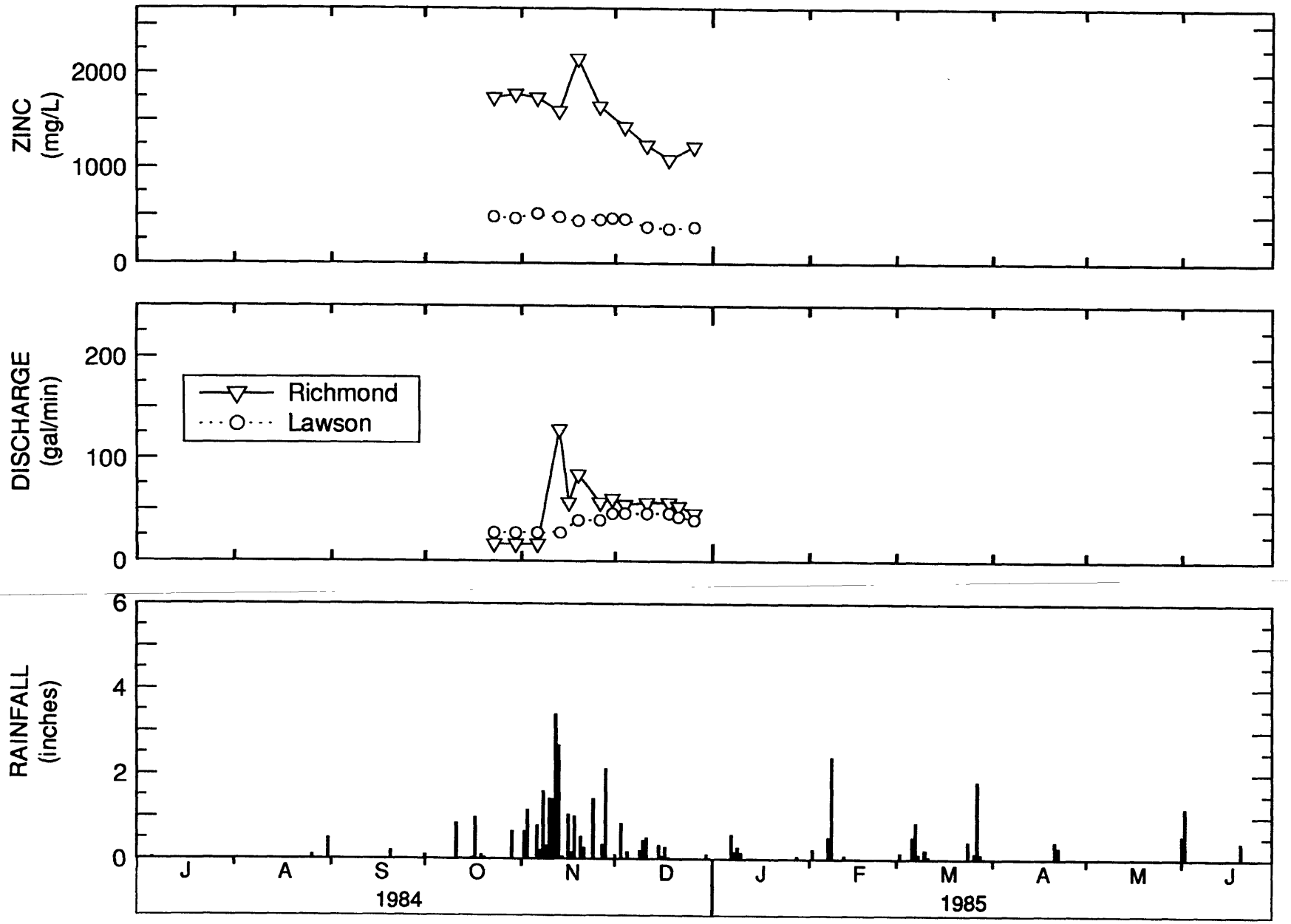

Figure C57. Zinc concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1984-85.

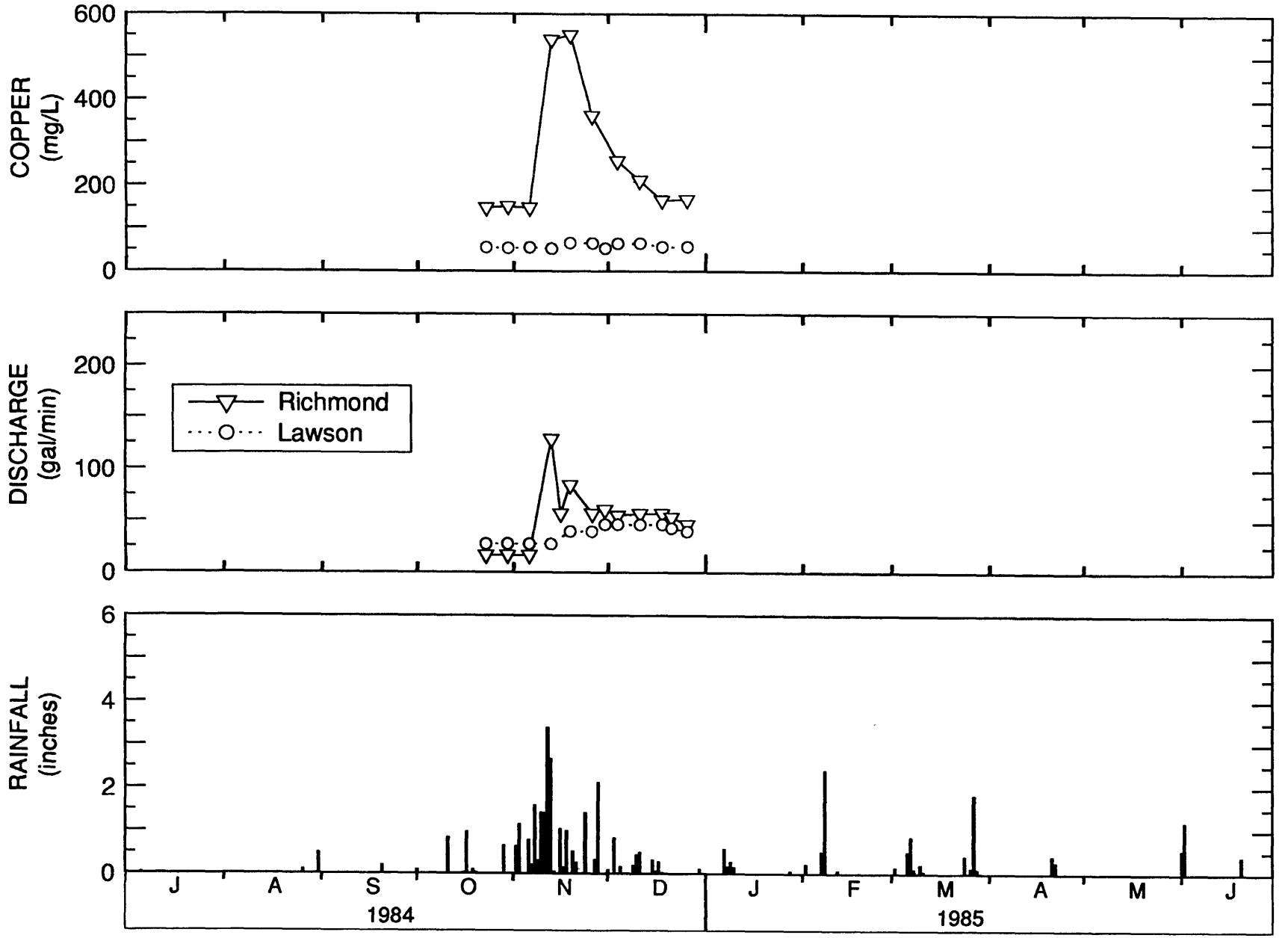

Figure C58. Copper concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1984-85.

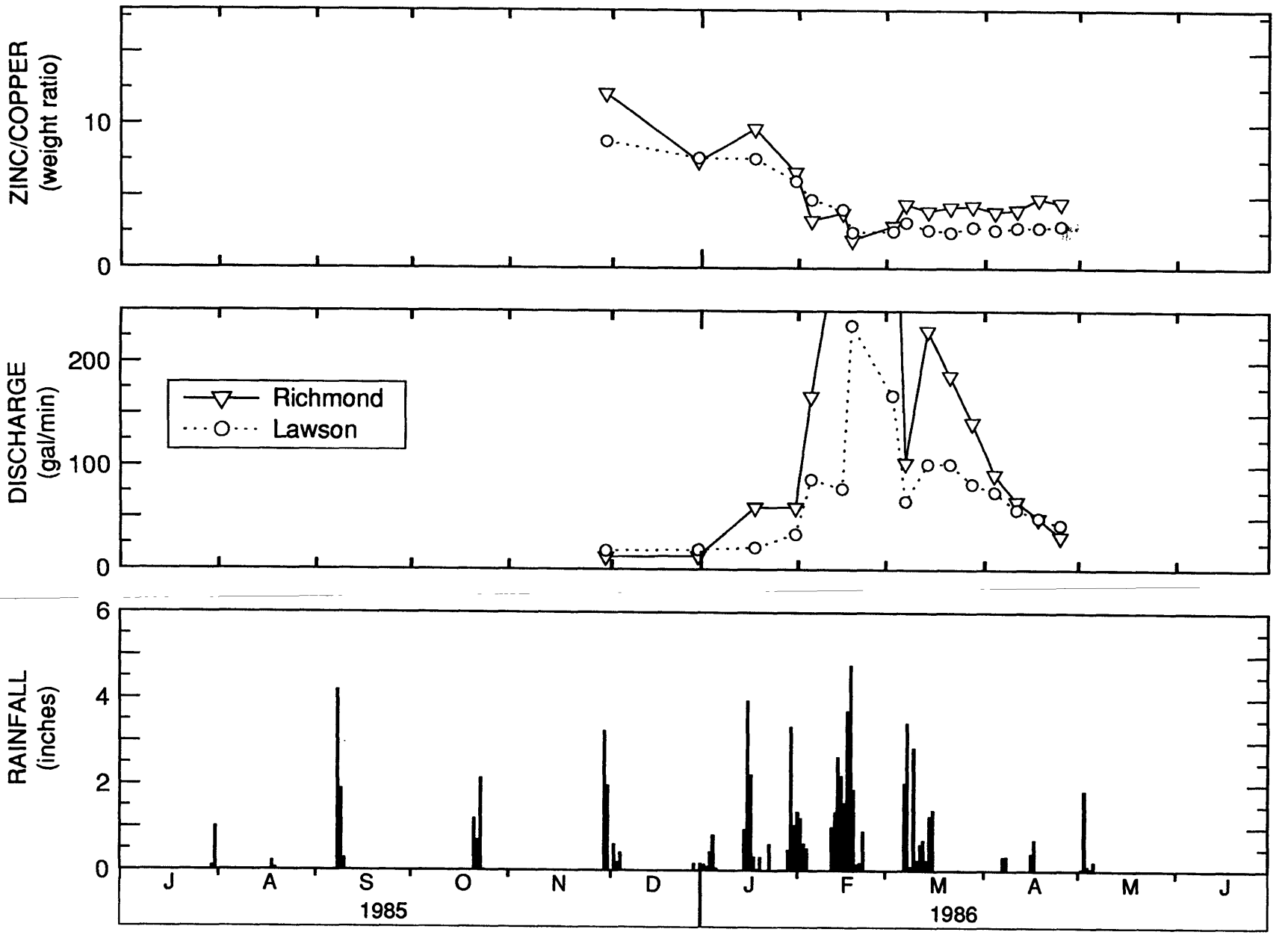

Figure C59. Zinc/copper ratios and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1985-86.

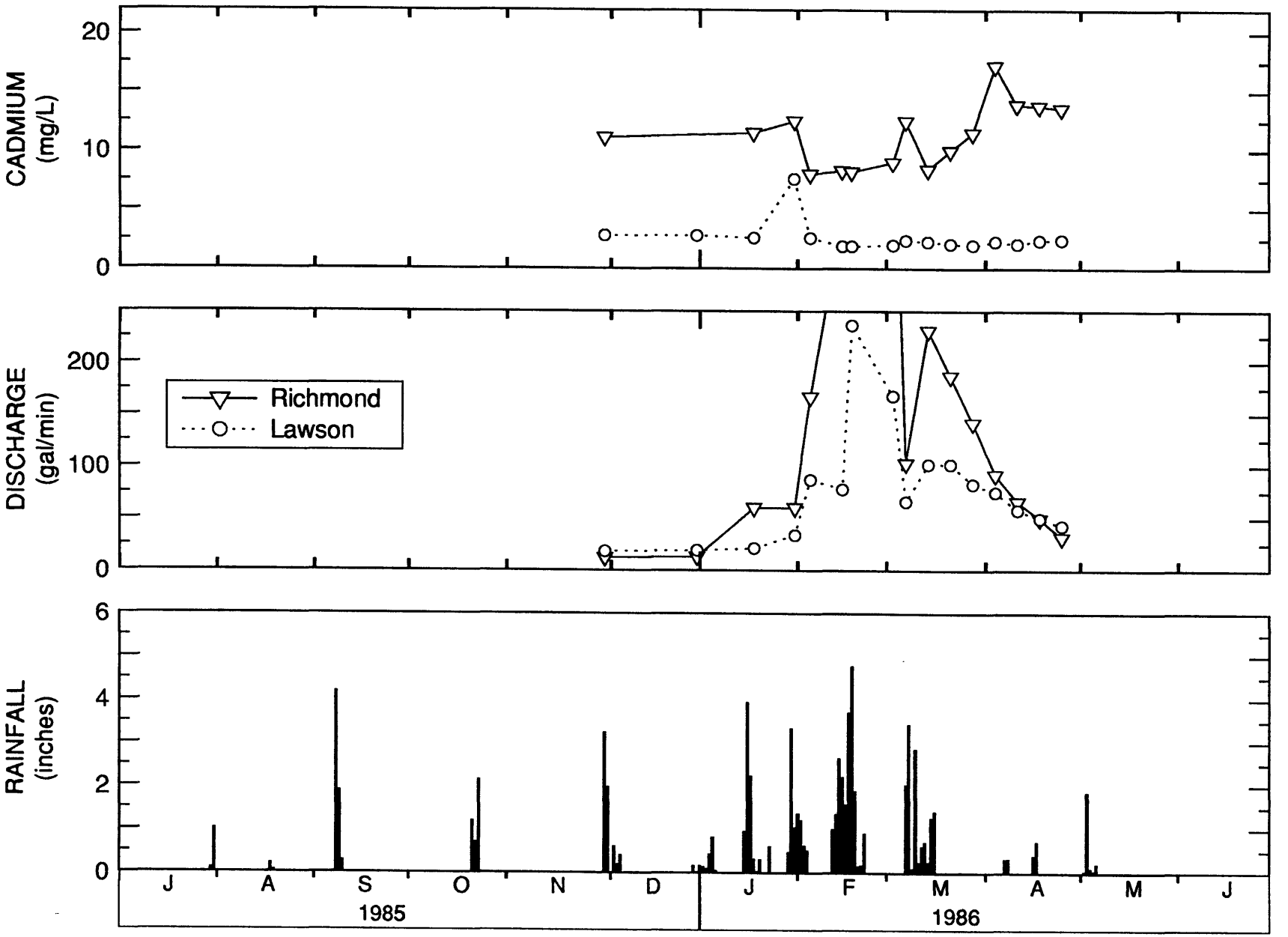

Figure C60. Cadmium concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1985-86.

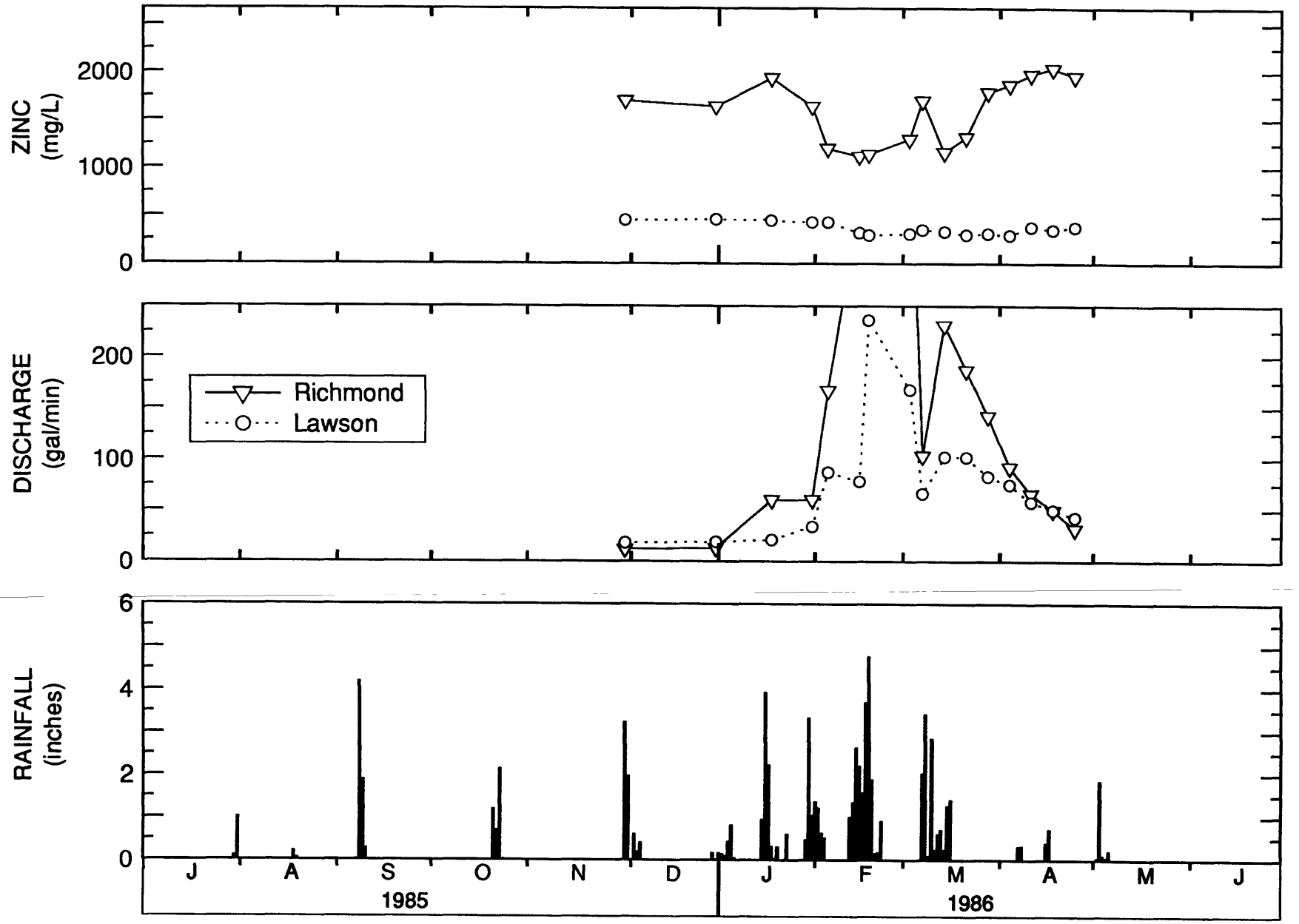

Figure C61. Zinc concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1985-86.

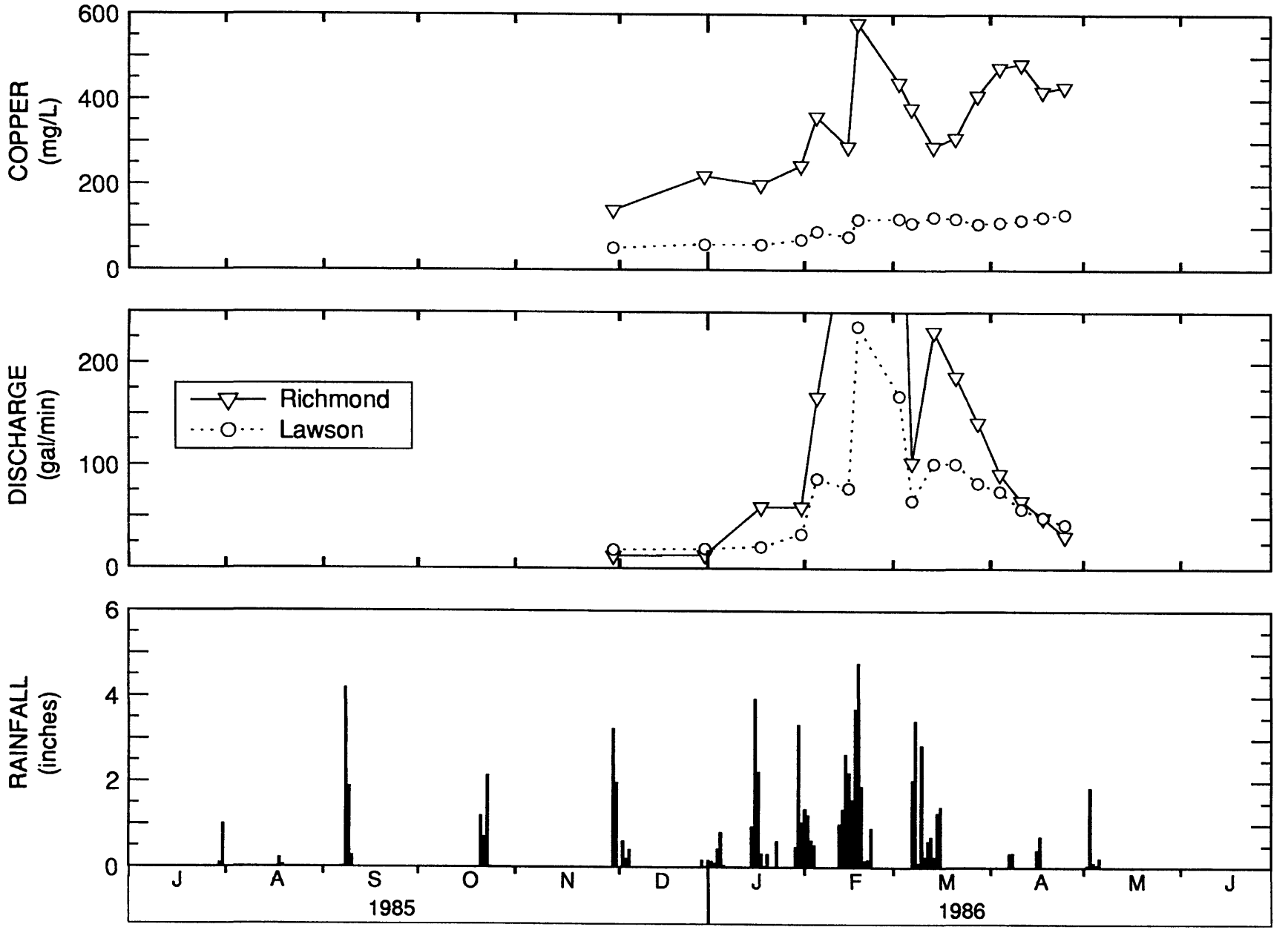

Figure C62. Copper concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1985-86.

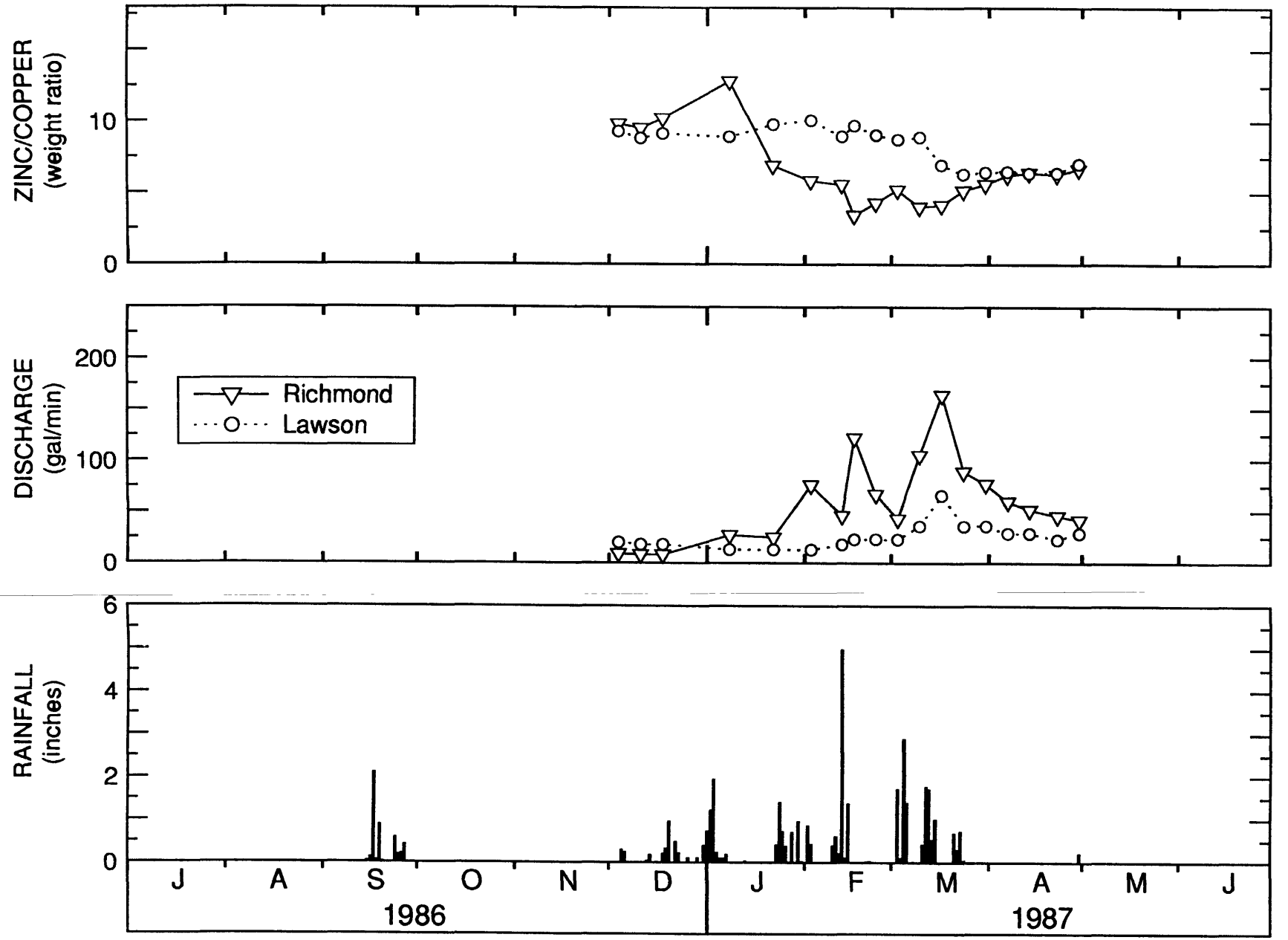

Figure C63. Zinc/copper ratios and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1986-87.

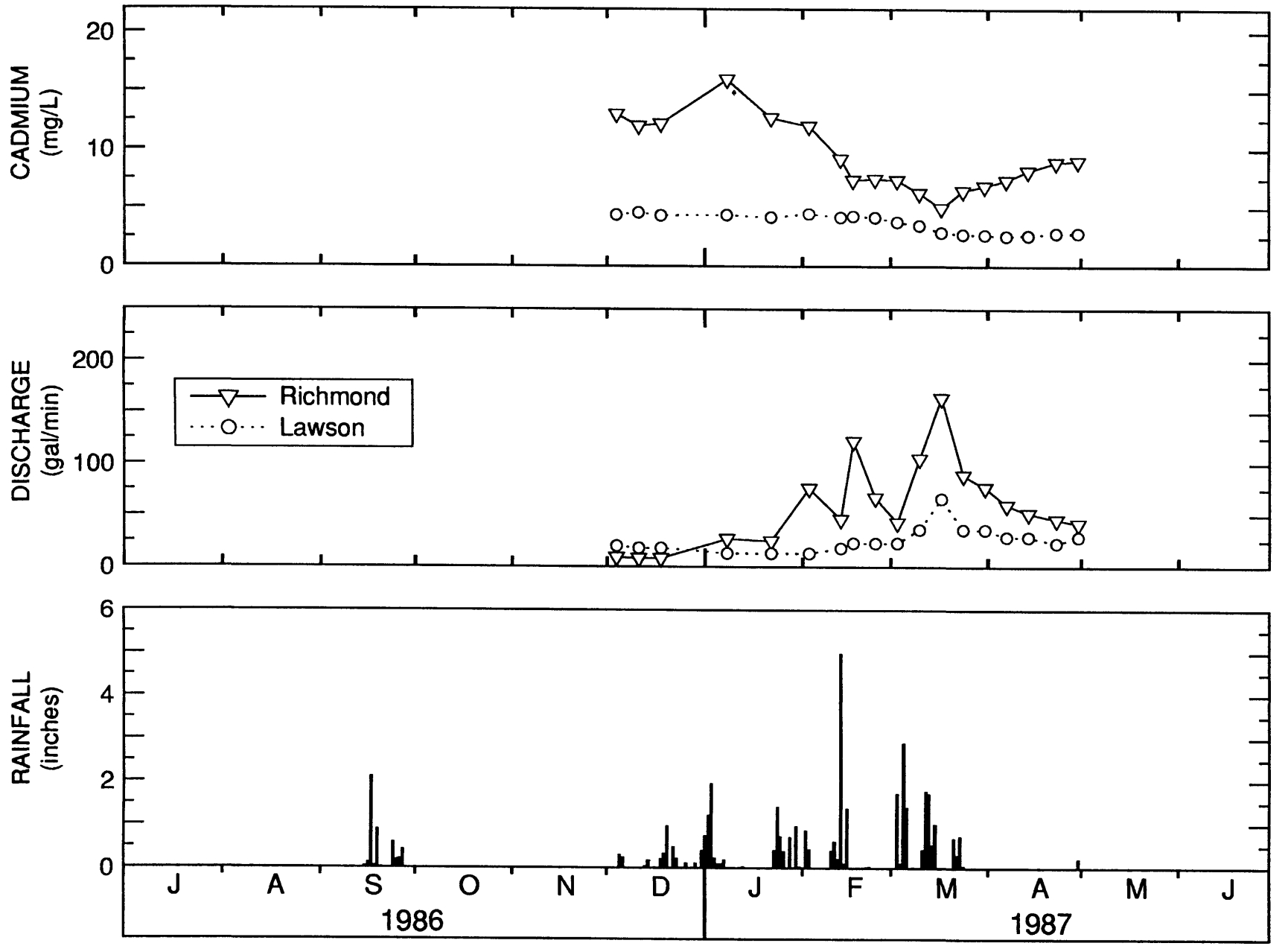

Figure C64. Cadmium concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1986-87.

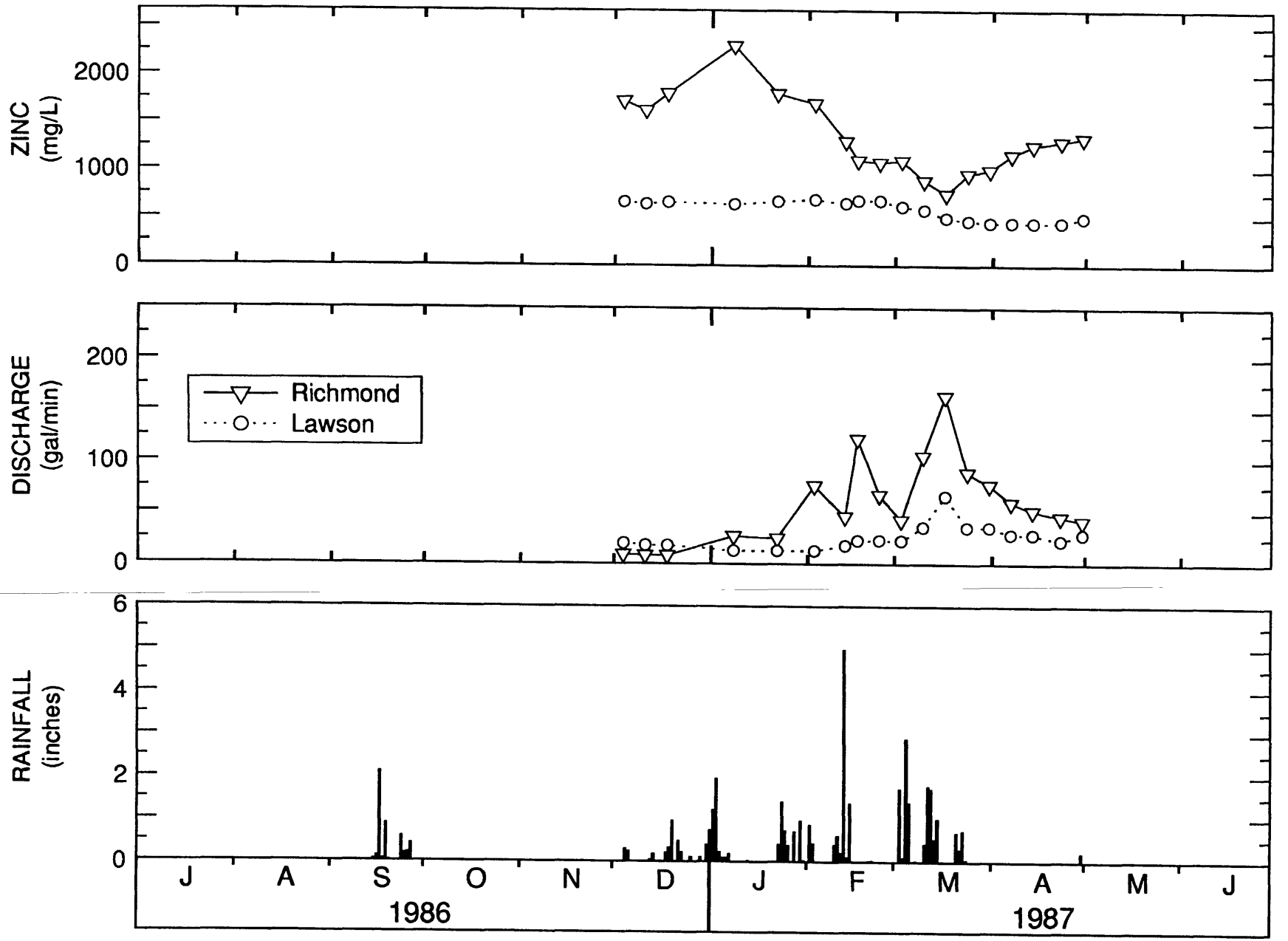

Figure C65. Zinc concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1986-87.

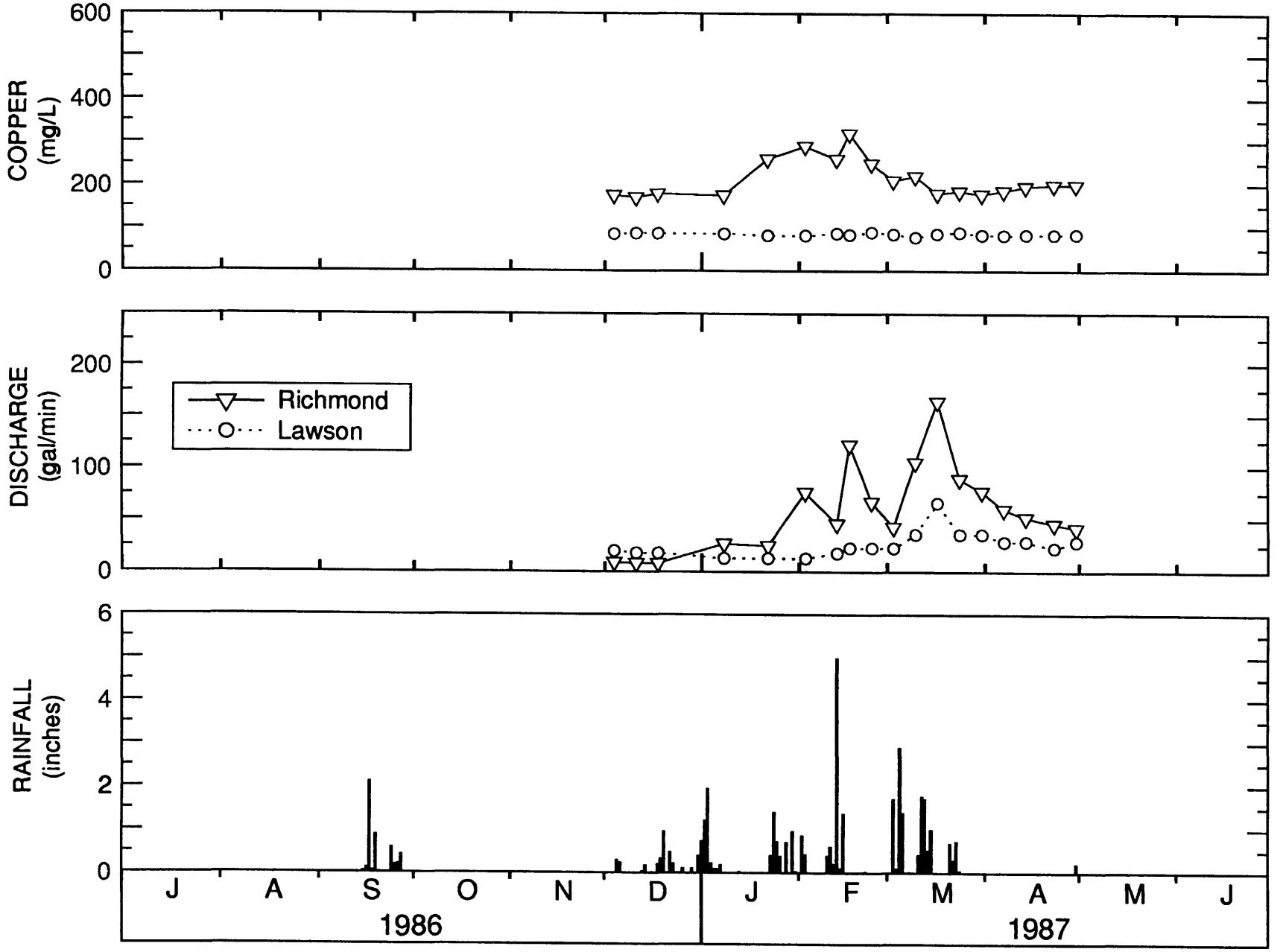

Figure C66. Copper concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1986-87.

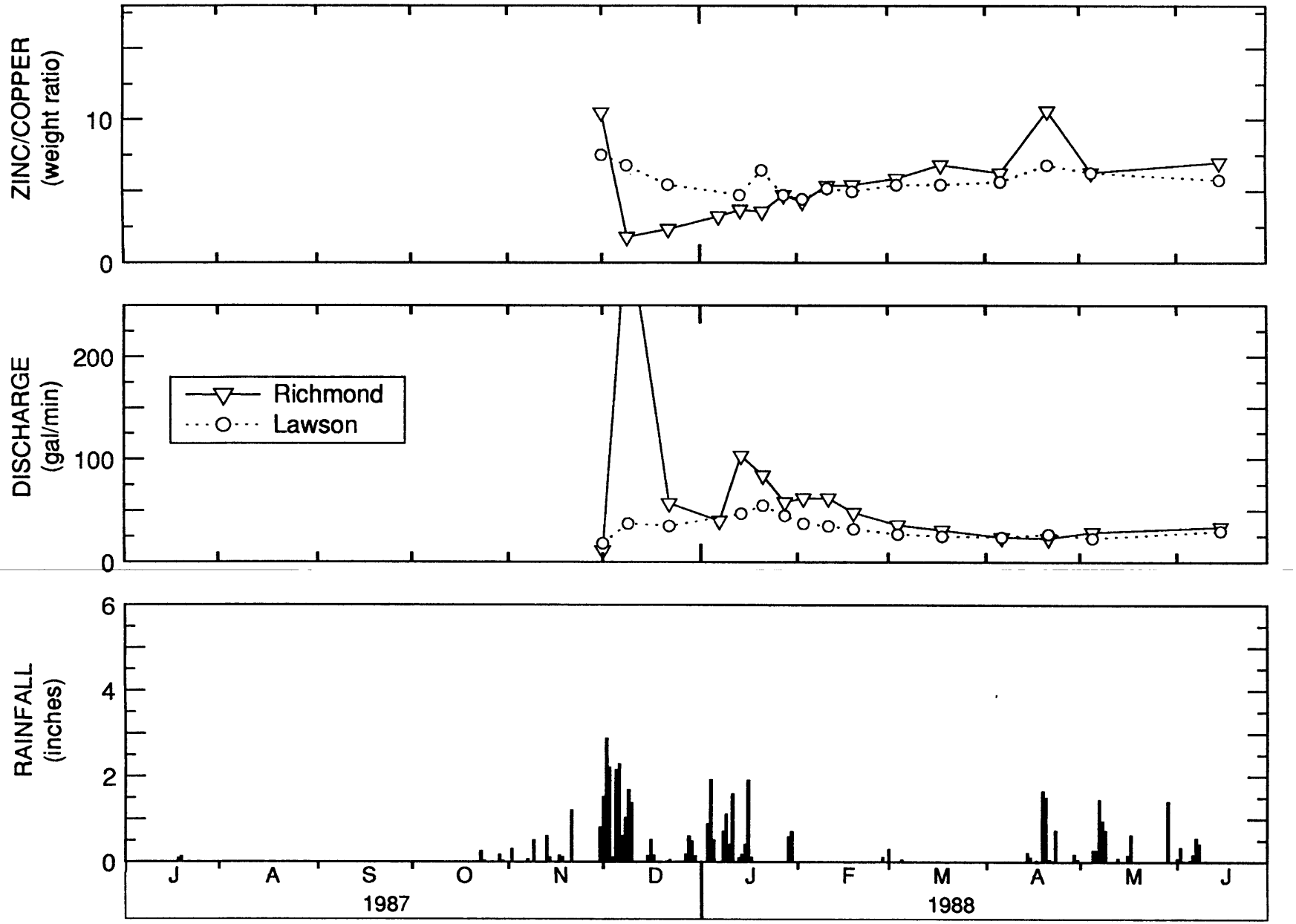

Figure C67. Zinc/copper ratios and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1987-88.

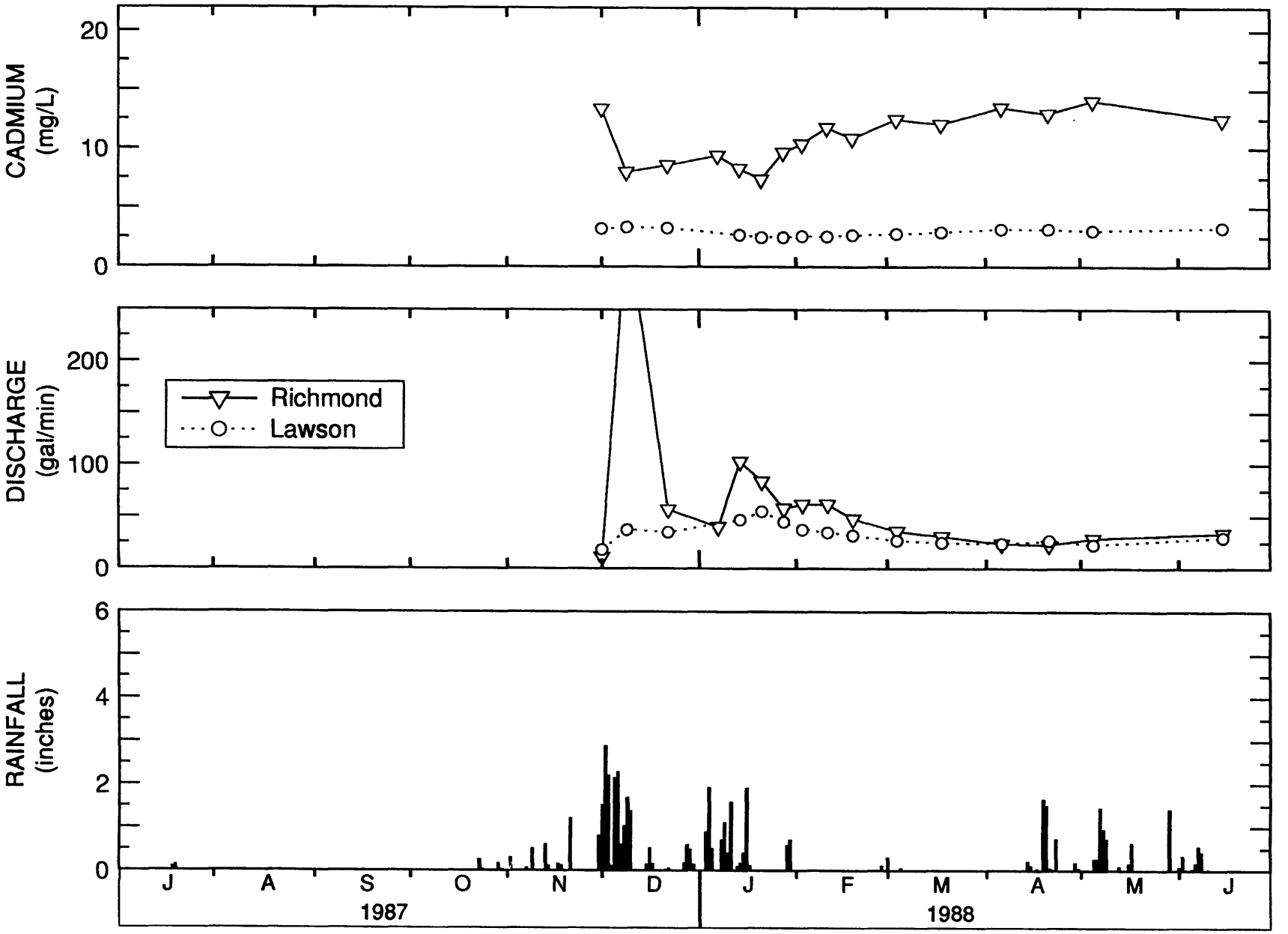

Figure C68. Cadmium concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1987-88.

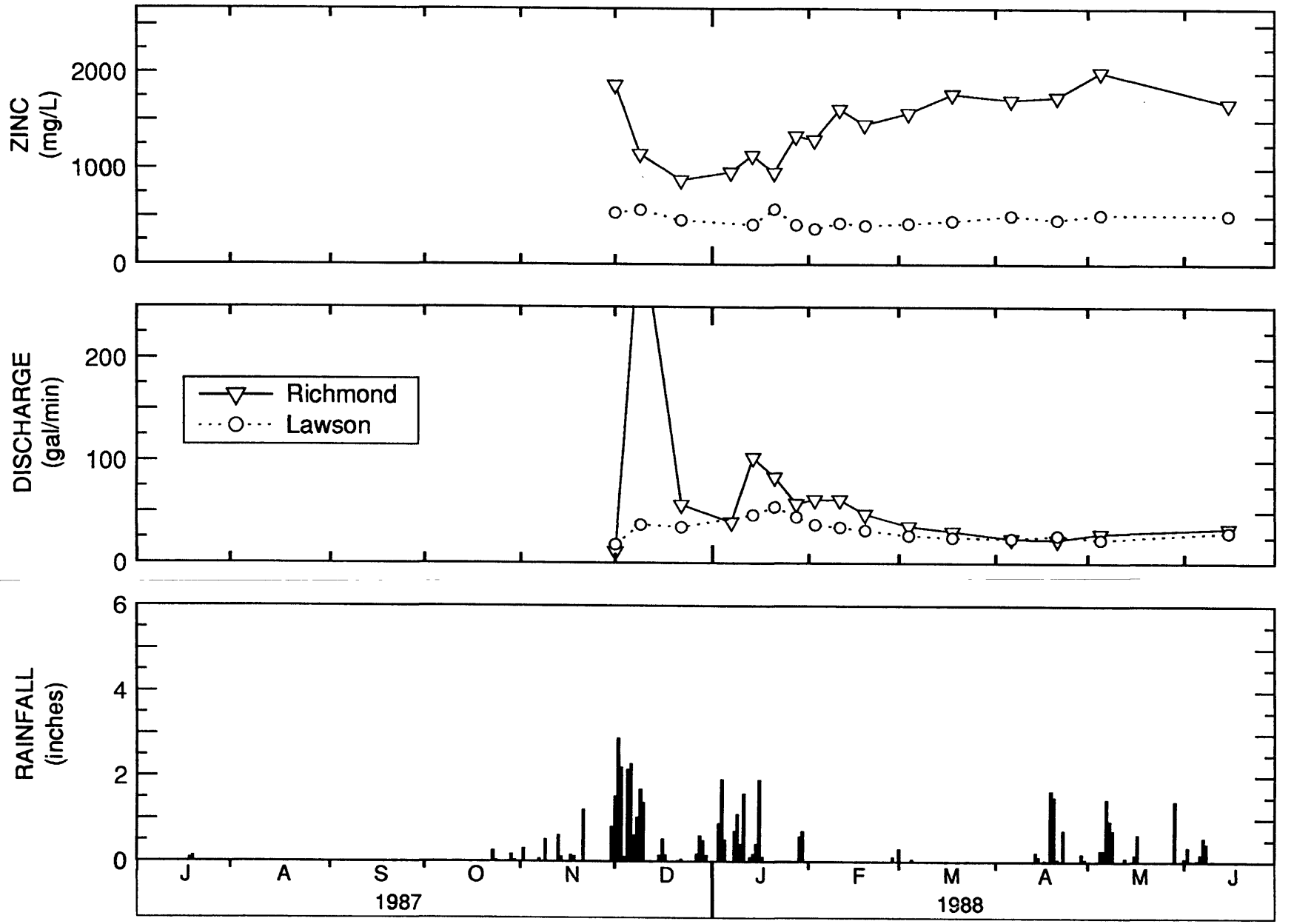

Figure C69. Zinc concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1987-88.

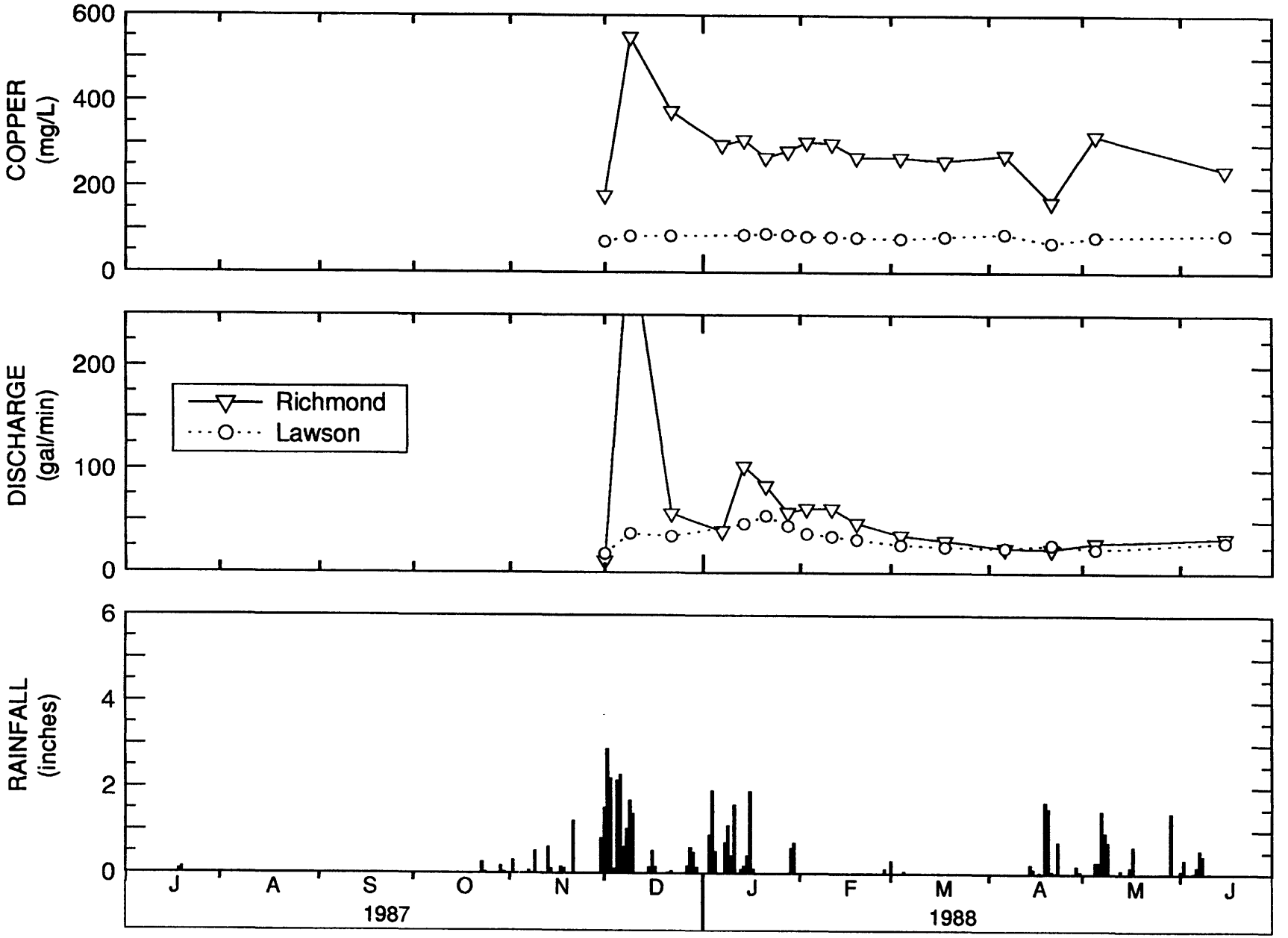

Figure C70. Copper concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1987-88.

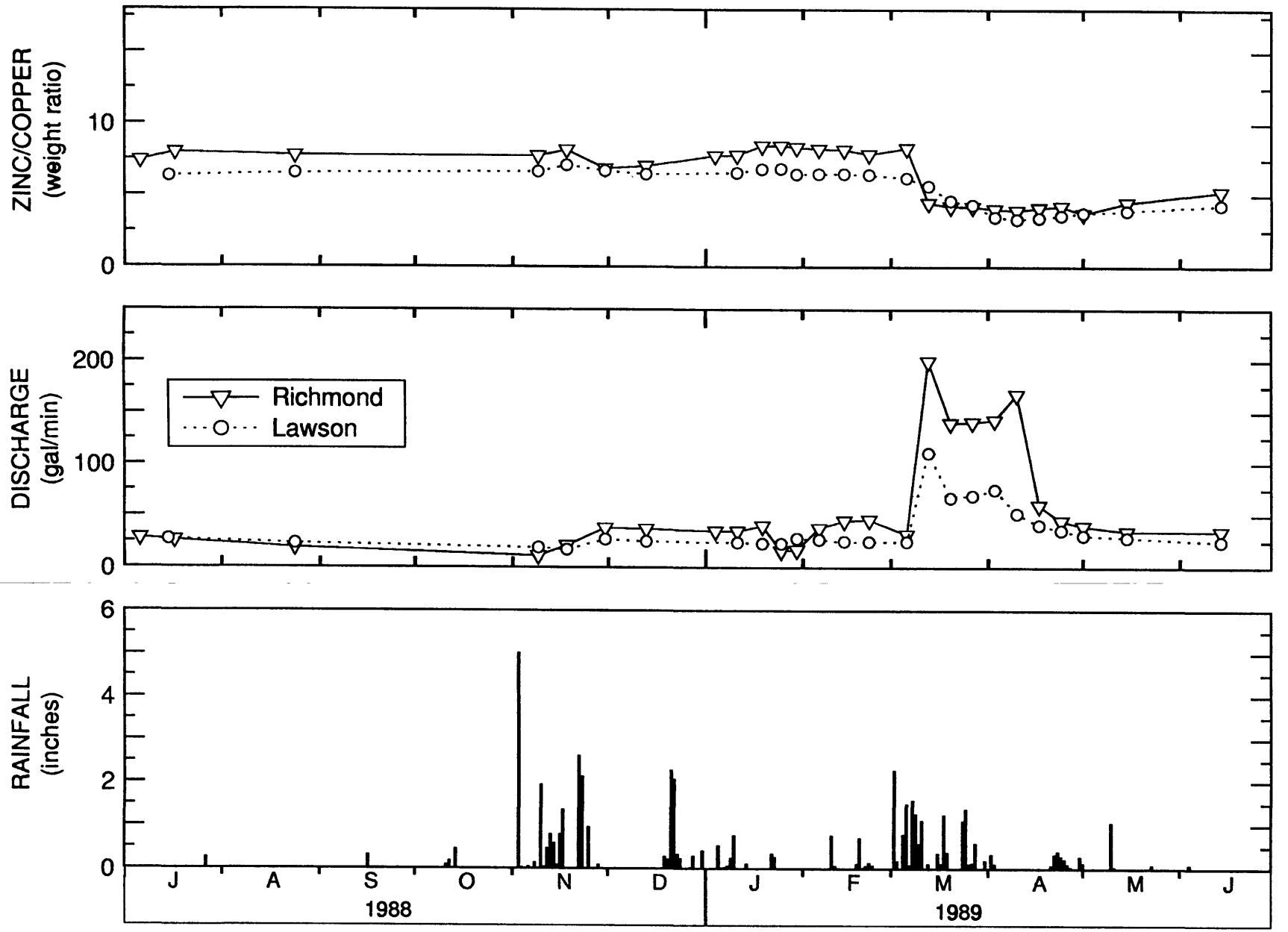

Figure C71. Zinc/copper ratios and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1988-89.

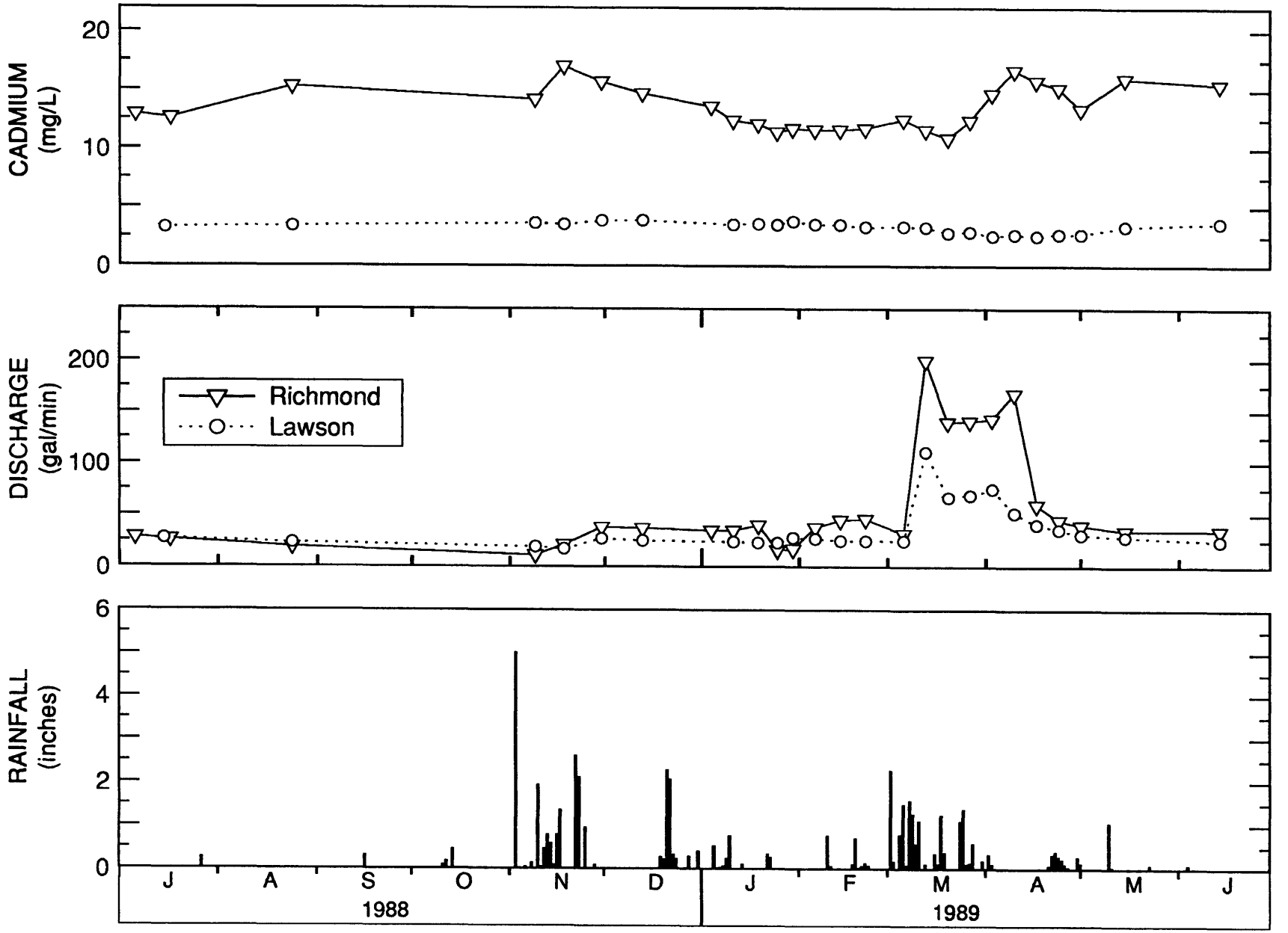

Figure C72. Cadmium concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1988-89.

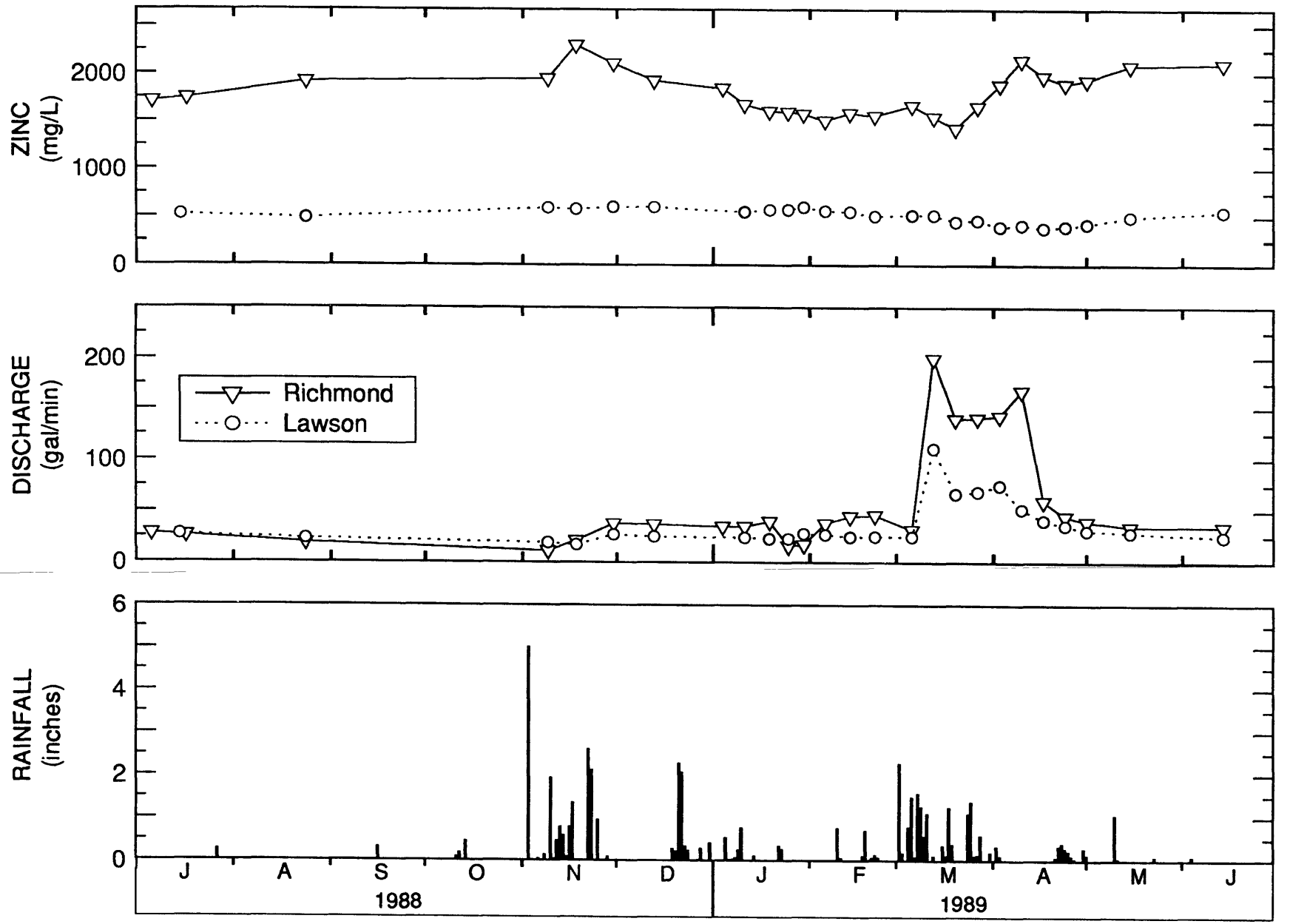

Figure C73. Zinc concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1988-89.

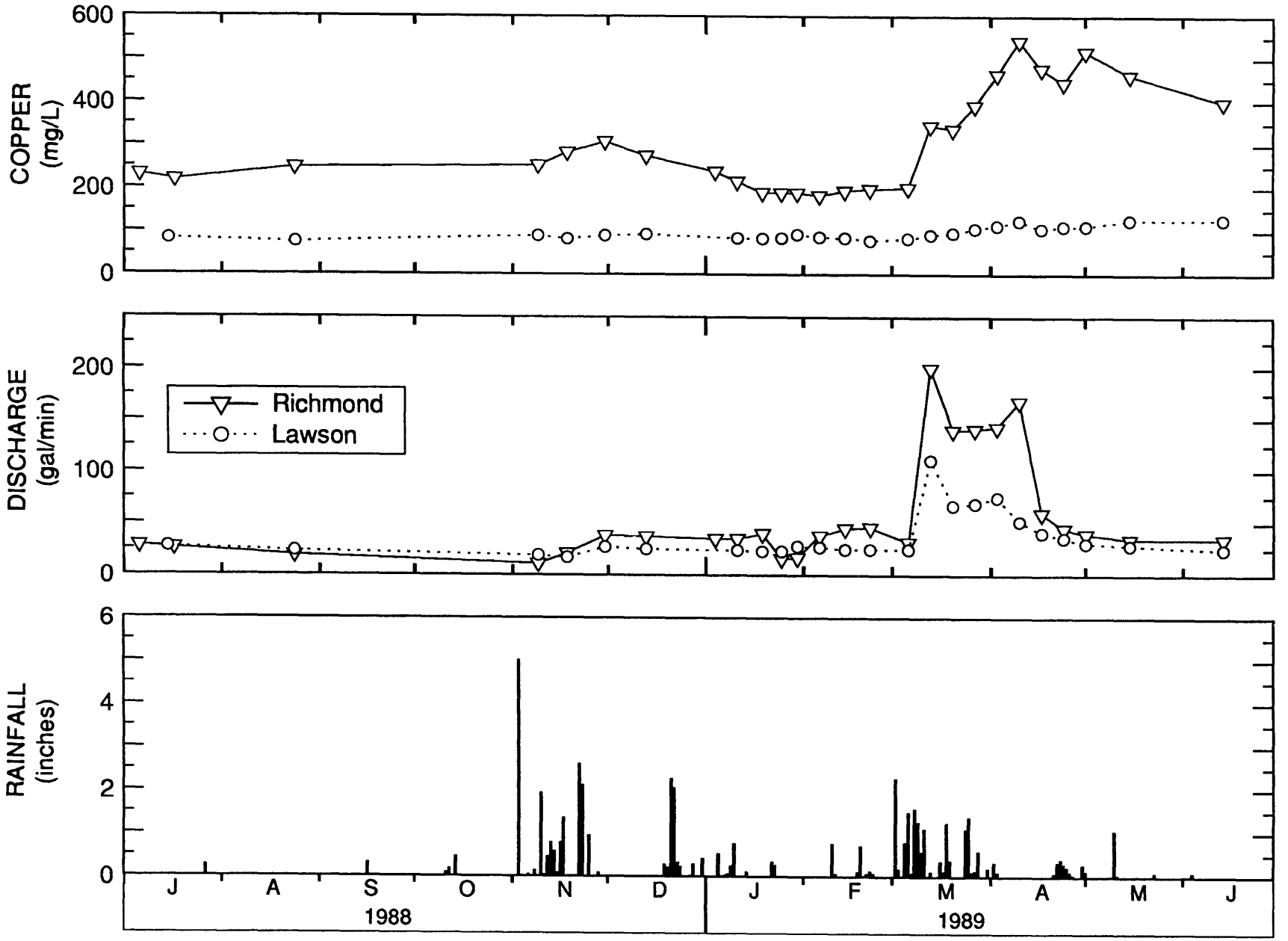

Figure C74. Copper concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1988-89.

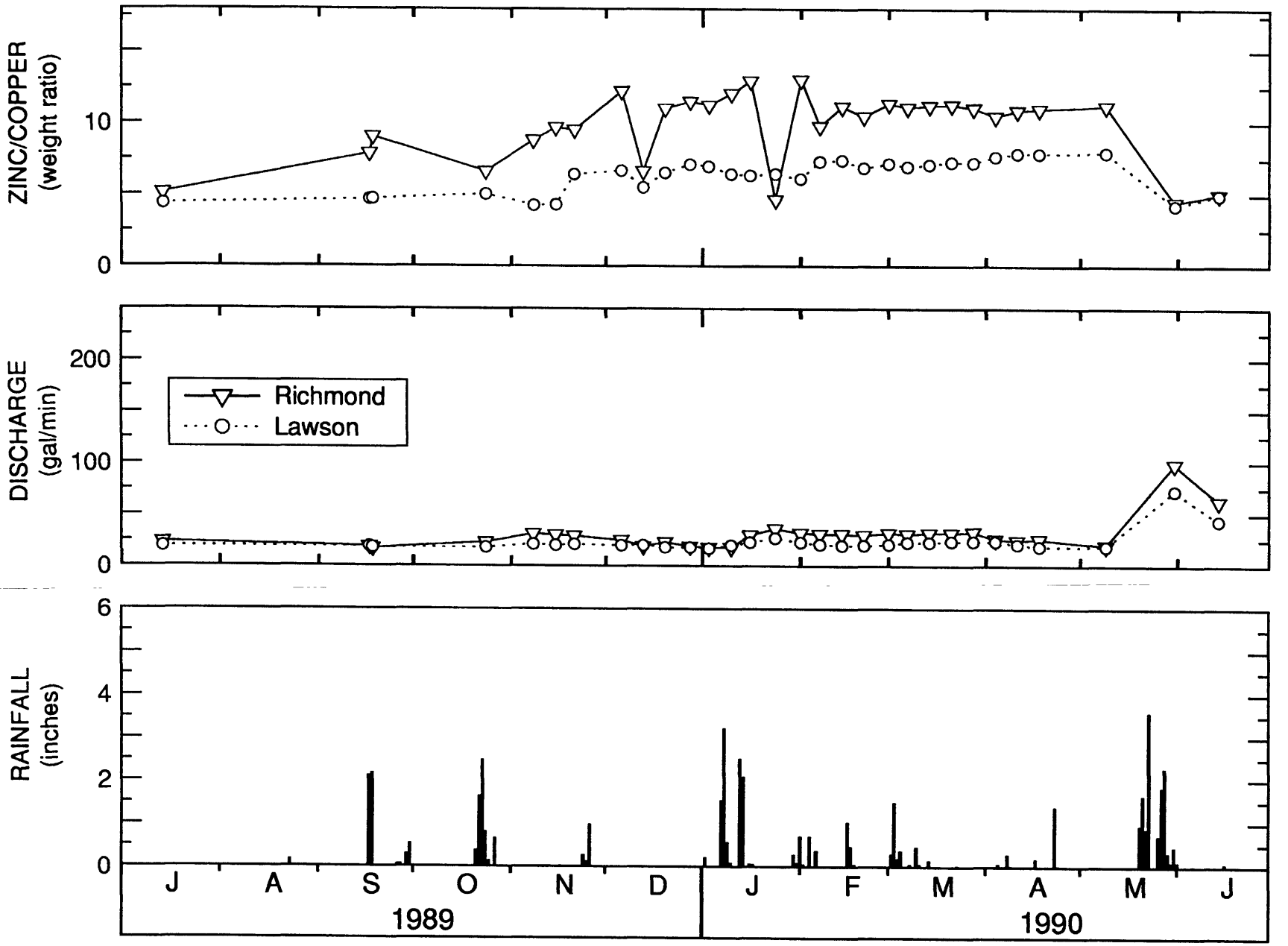

Figure C75. Zinc/copper ratios and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1989-90.

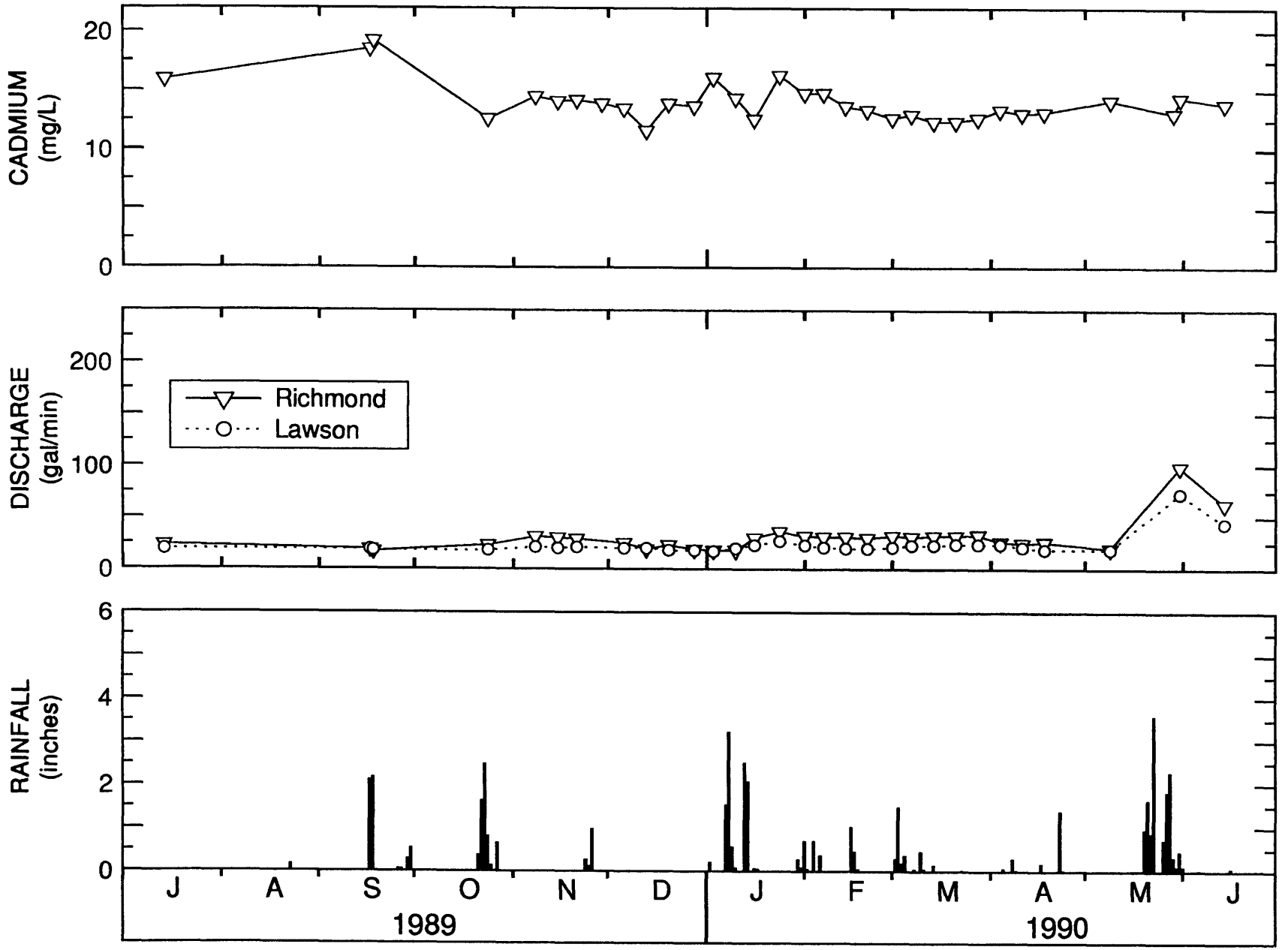

Figure C76. Cadmium concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1989-90.

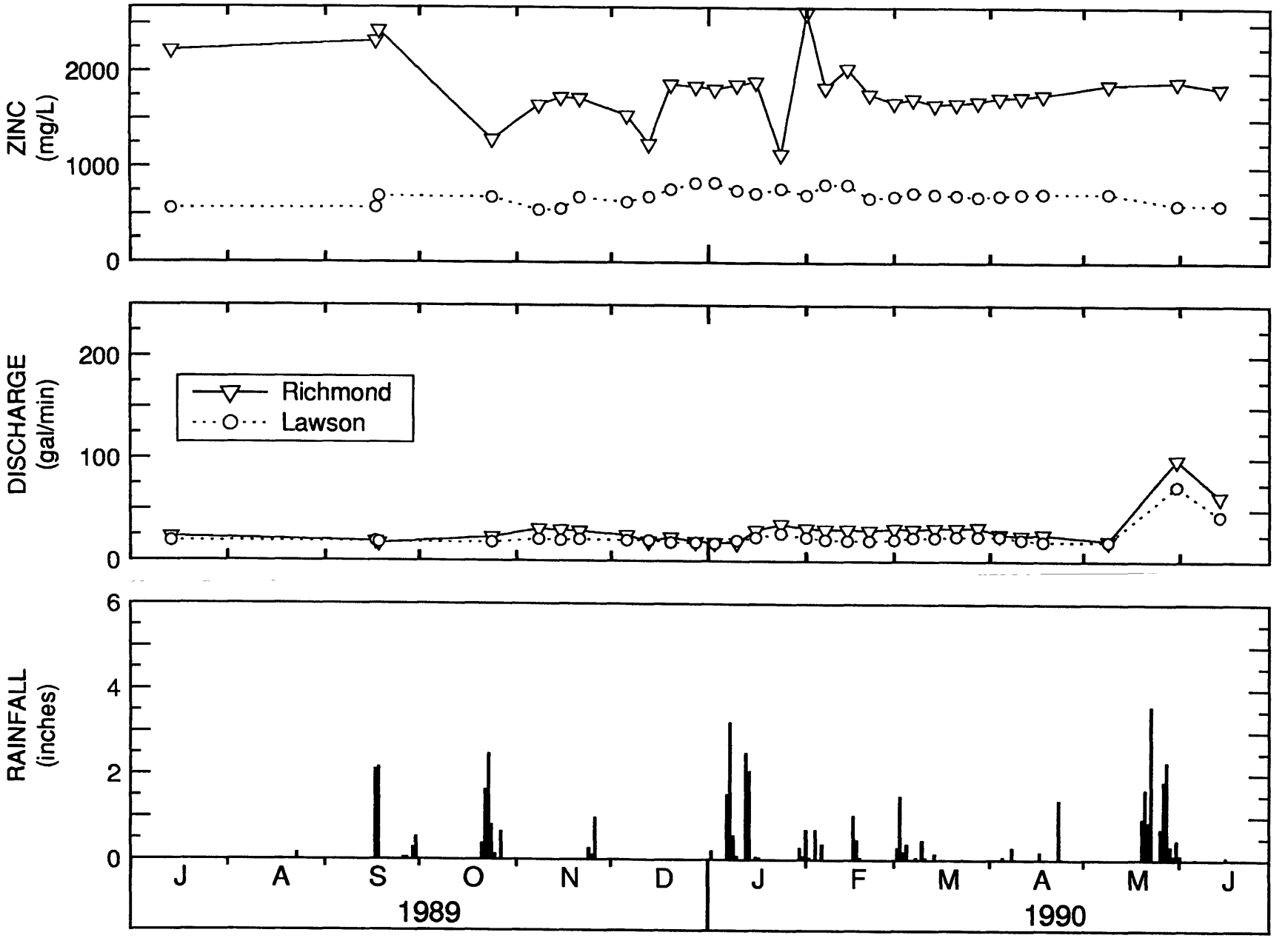

Figure C77. Zinc concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1989-90.

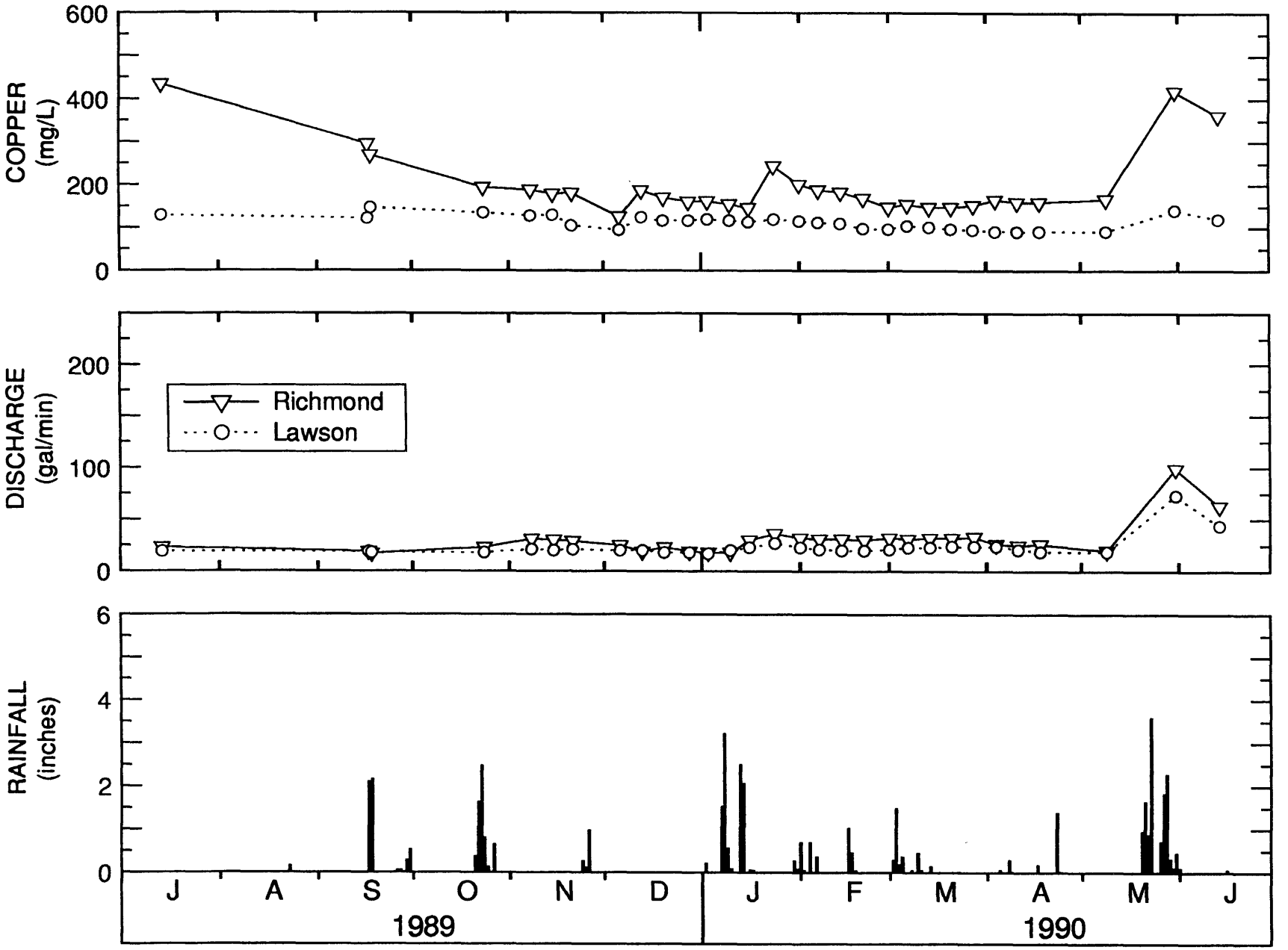

Figure C78. Copper concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1989-90.

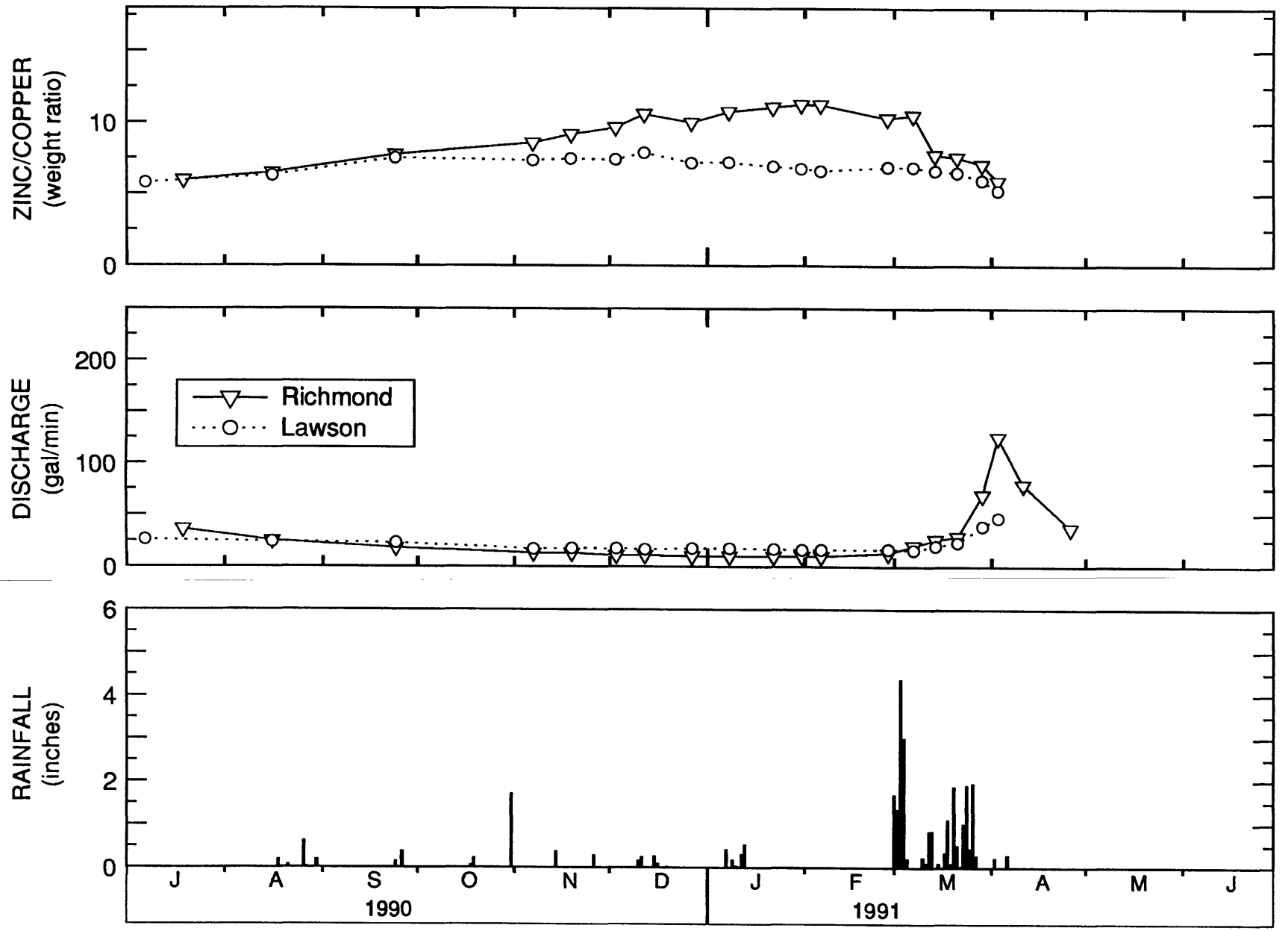

Figure C79. Zinc/copper ratios and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1990-91.

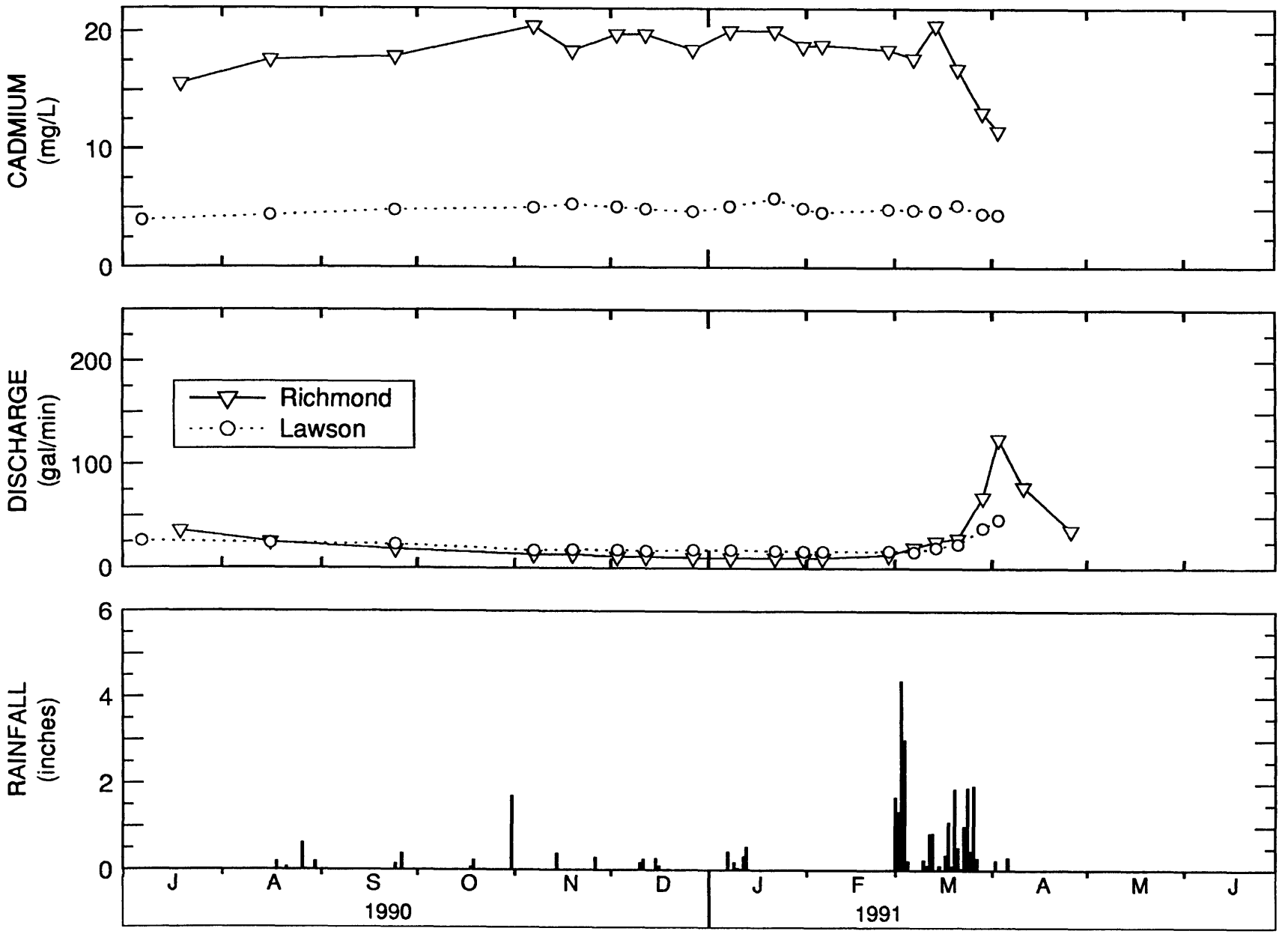

Figure C80. Cadmium concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1990-91.

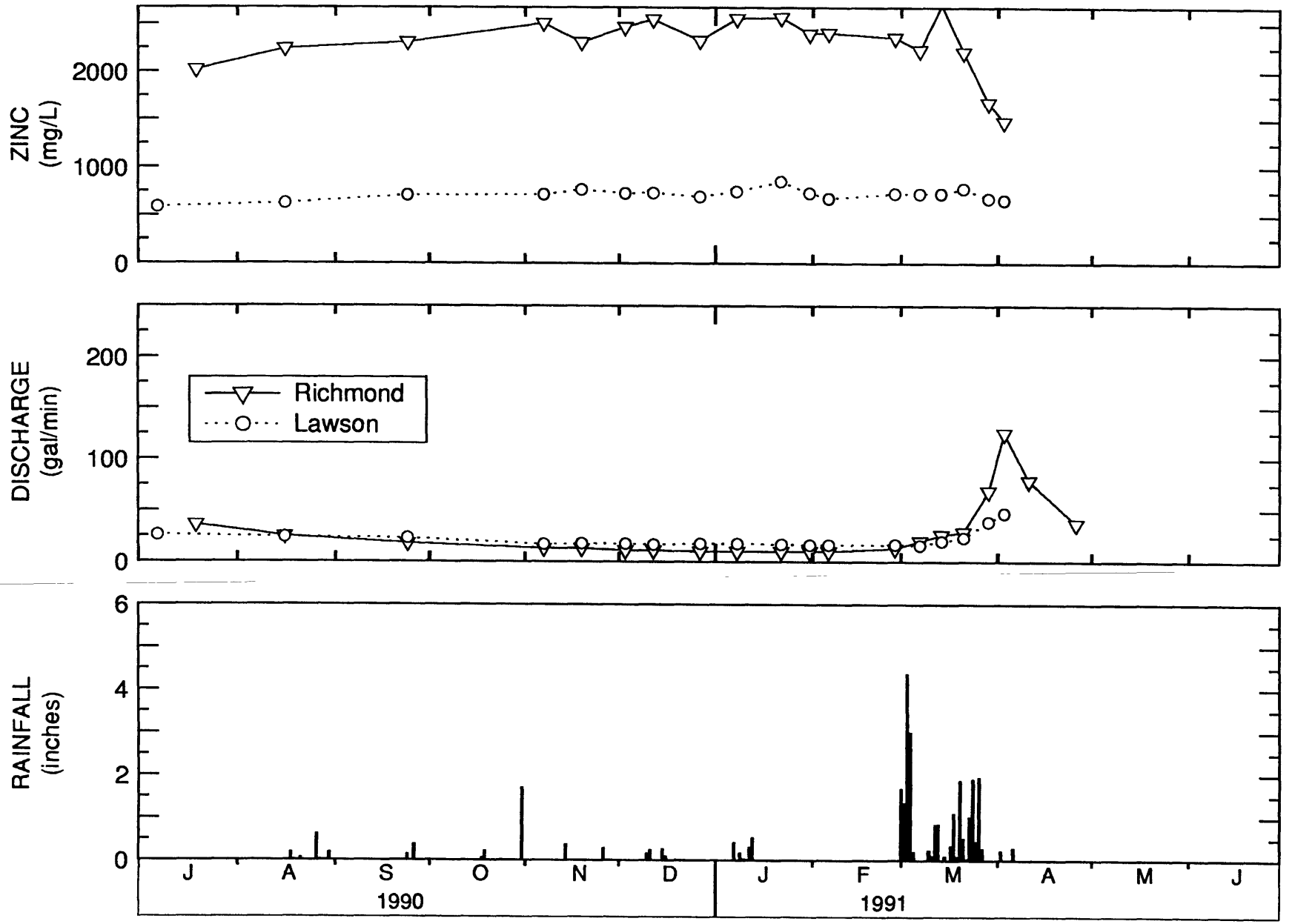

Figure C81. Zinc concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1990-91.

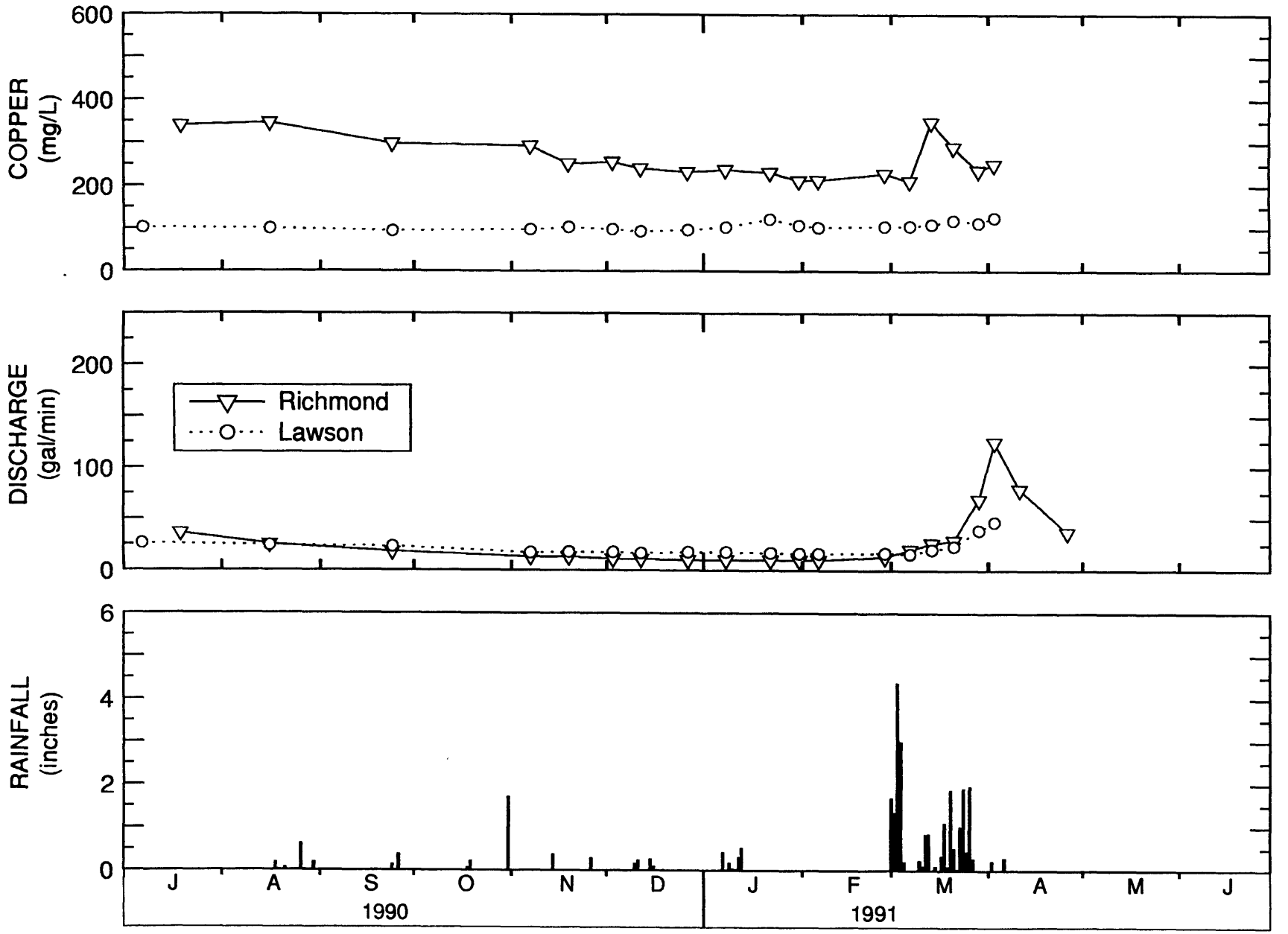

Figure C82. Copper concentrations and discharge of Richmond and Lawson portal effluents, and rainfall at Shasta Dam, 1990-91.

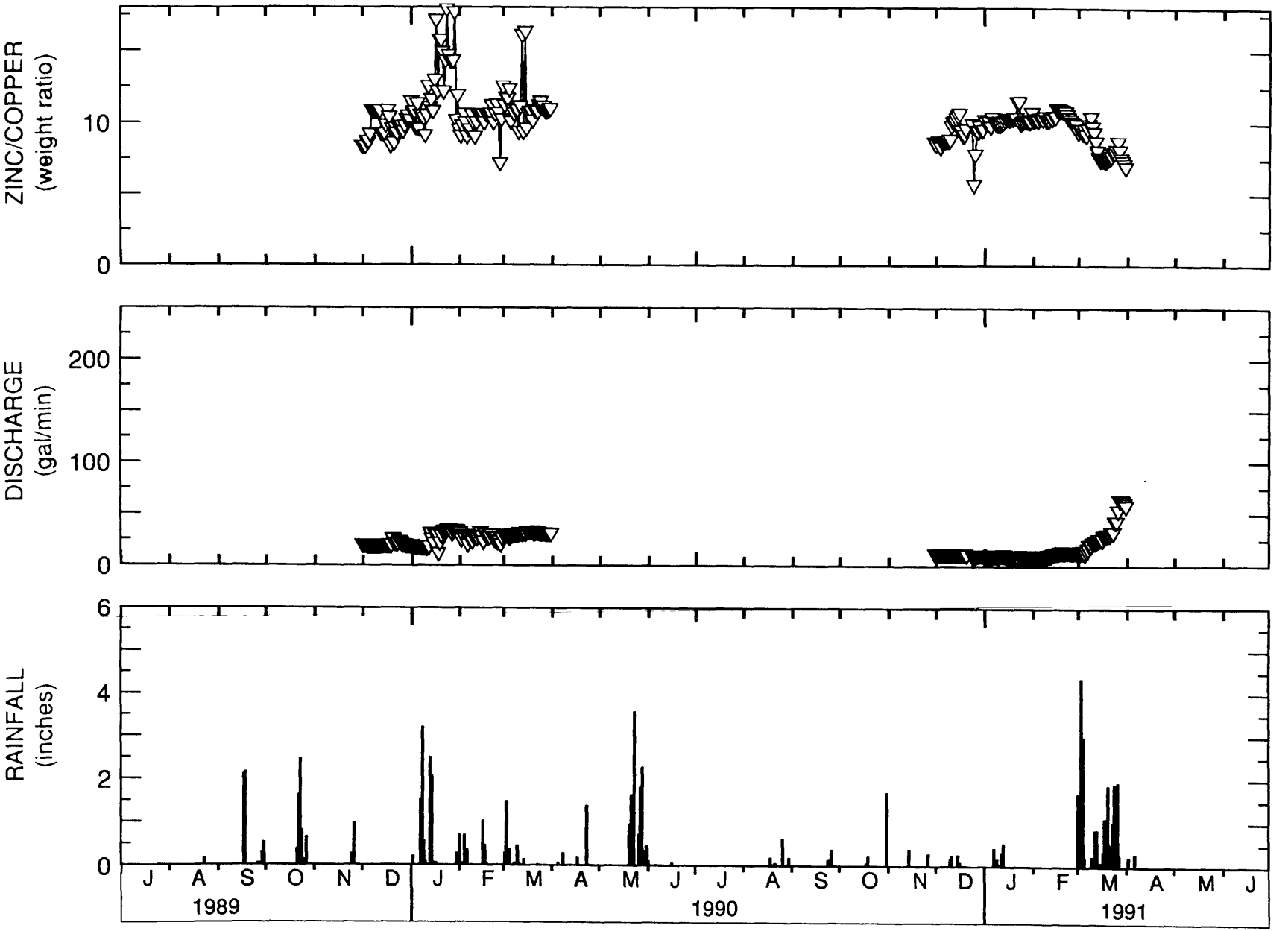

Figure C83. Zinc/copper ratios and discharge of Richmond Mine emergency treatment plant influent, and rainfall at Shasta Dam, 1989-91. Discharge, in gallons per minute, was obtained by dividing gallons per day by 1,440.

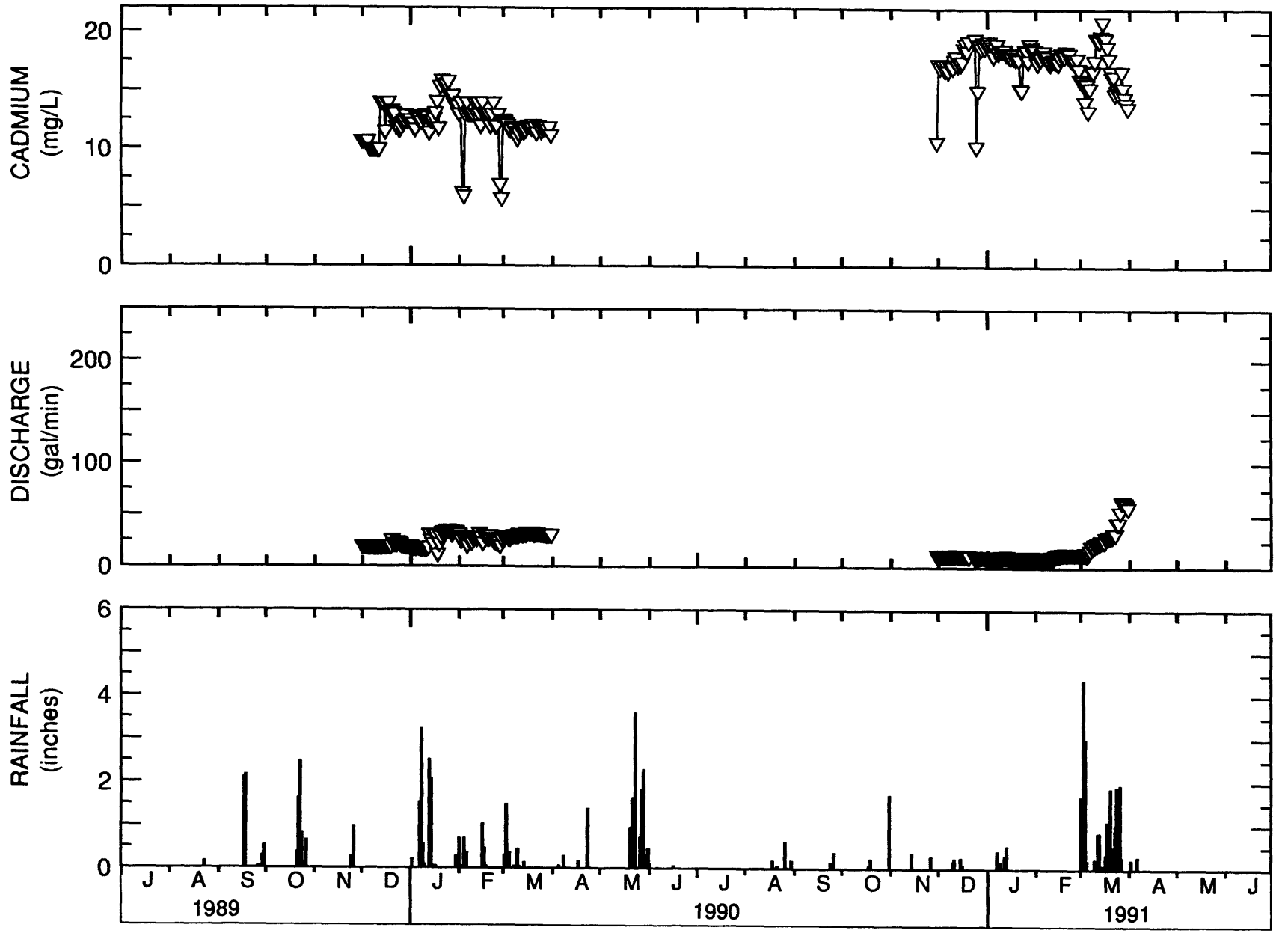

Figure C84. Cadmium concentrations and discharge of Richmond Mine emergency treatment plant influent, and rainfall at Shasta Dam, 1989-91. Discharge, in gallons per minute, was obtained by dividing gallons per day by 1,440.

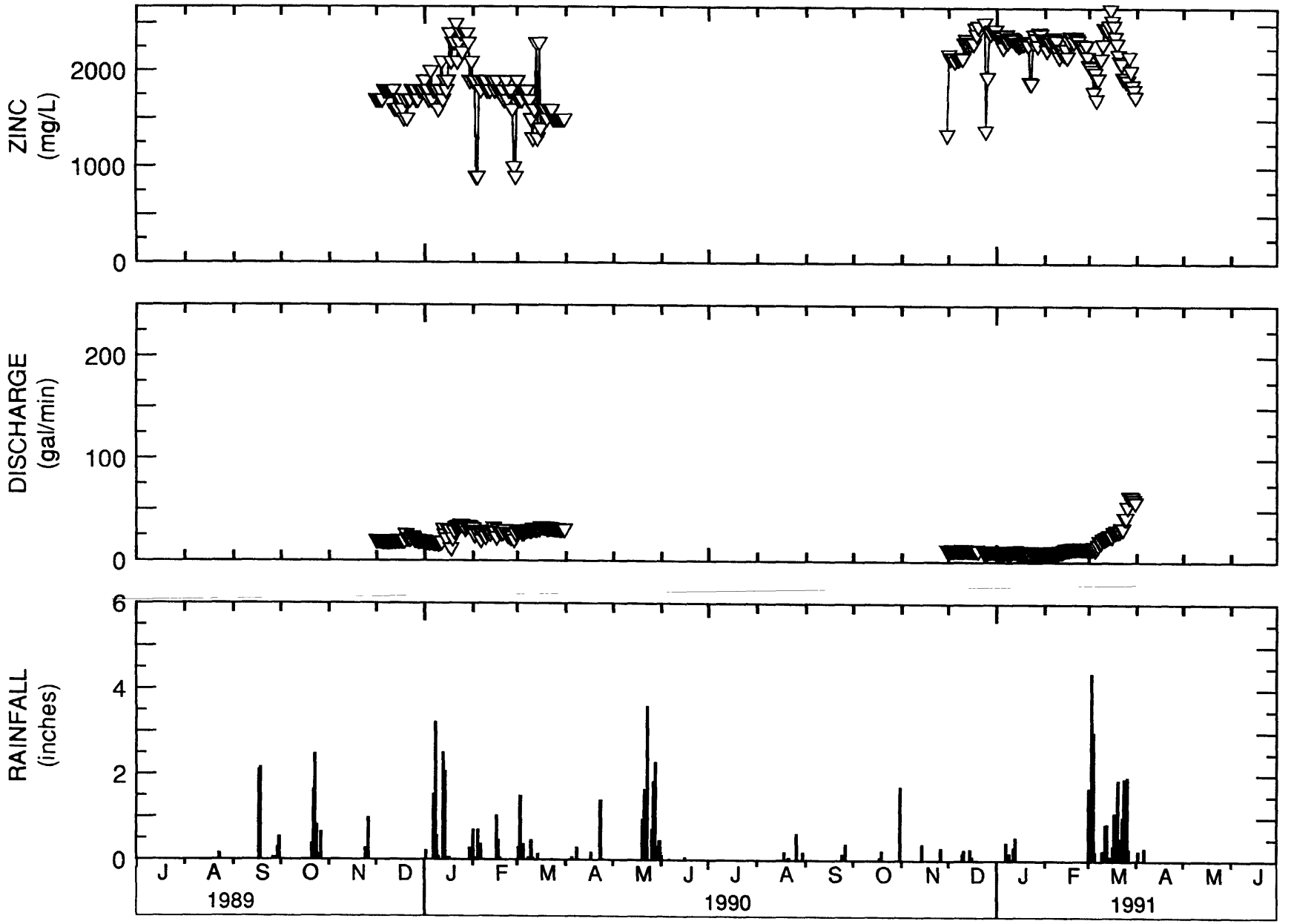

Figure C85. Zinc concentrations and discharge of Richmond Mine emergency treatment plant influent, and rainfall at Shasta Dam, 1989-91. Discharge, in gallons per minute, was obtained by dividing gallons per day by 1,440.

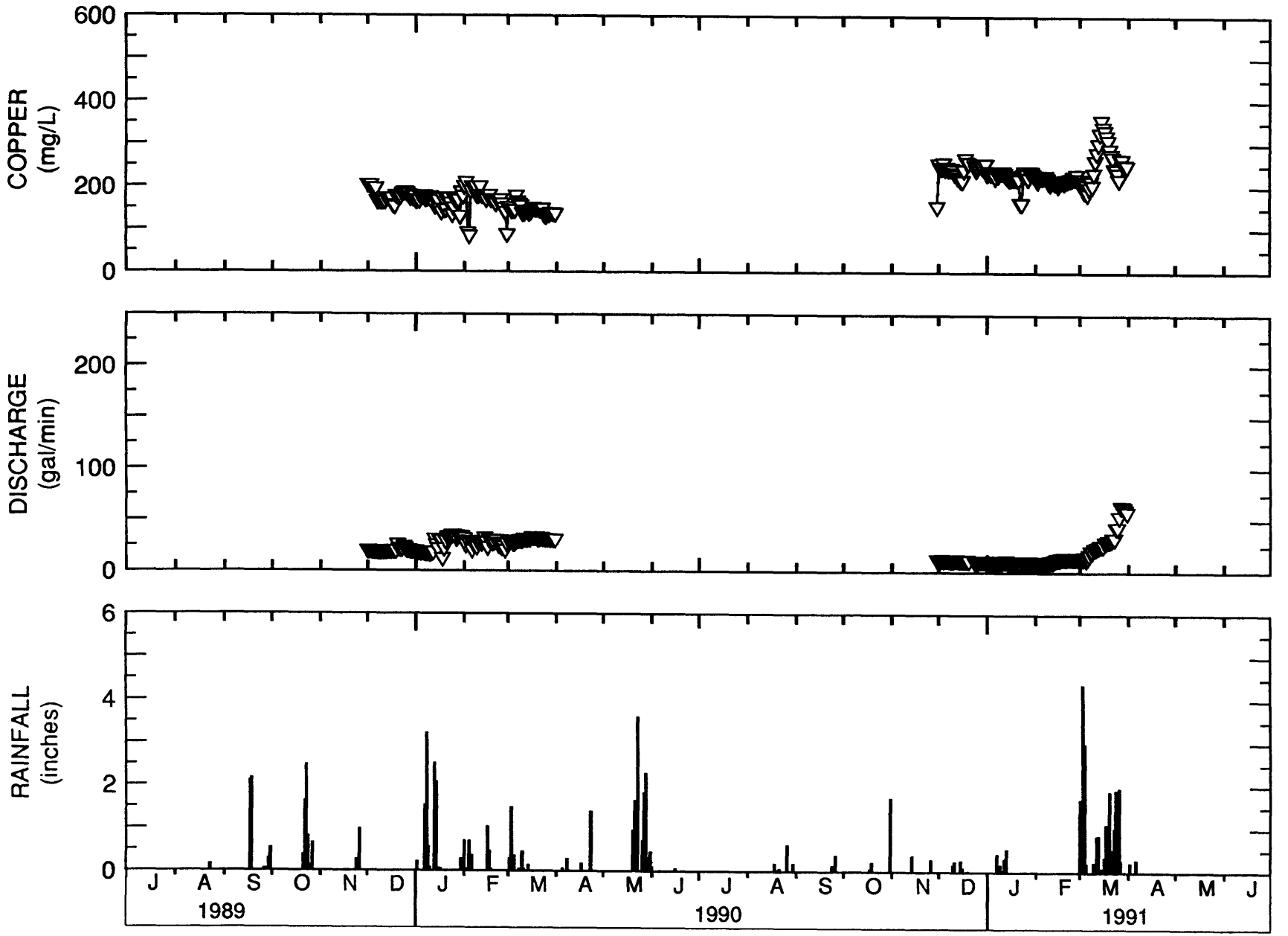

Figure C86. Copper concentrations and discharge of Richmond Mine emergency treatment plant influent, and rainfall at Shasta Dam, 1989-91. Discharge, in gallons per minute, was obtained by dividing gallons per day by 1,440.

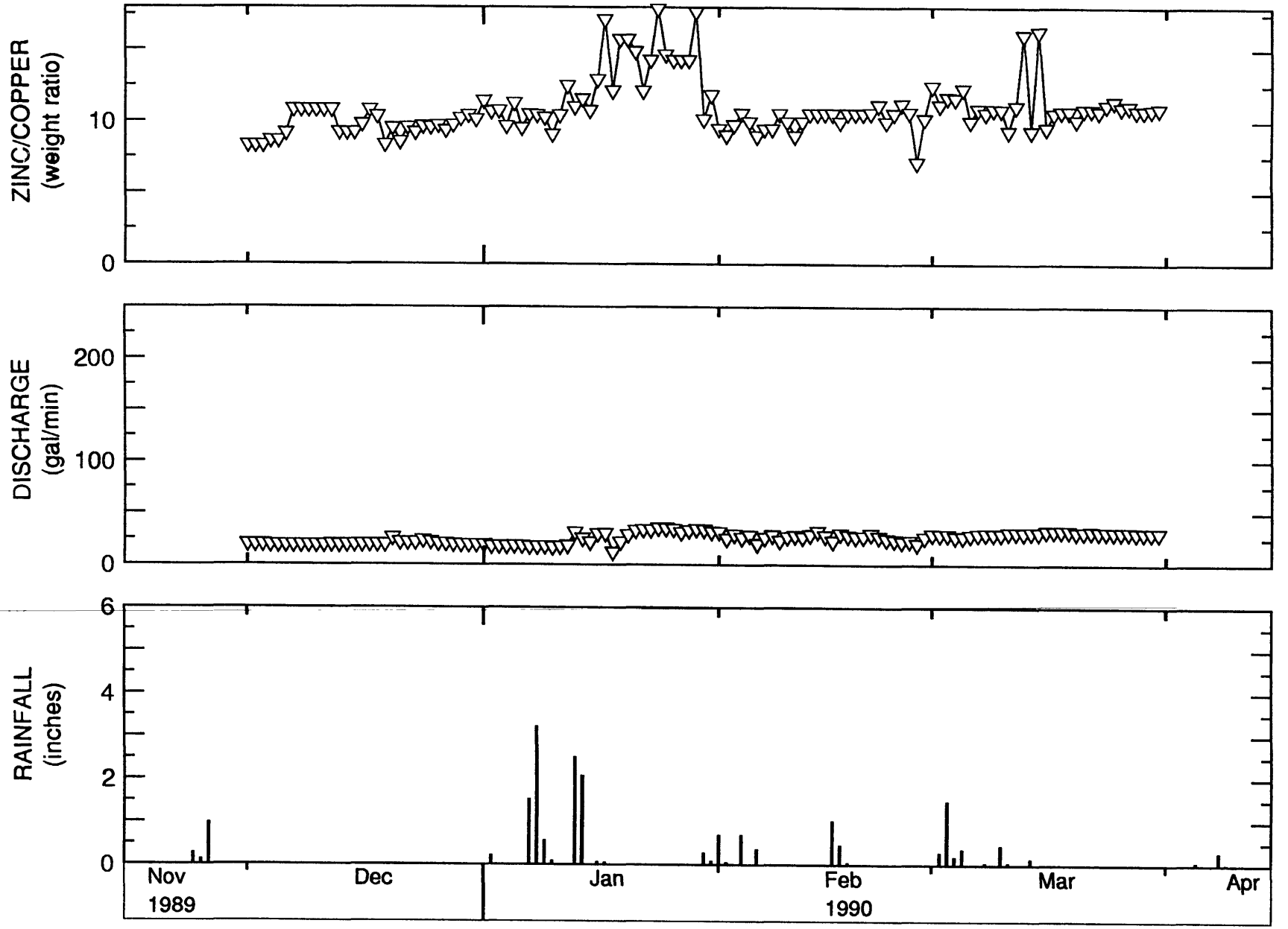

Figure C87. Zinc/copper ratios and discharge of Richmond Mine emergency treatment plant influent, and rainfall at Shasta Dam, 1989-90. Discharge, in gallons per minute, was obtained by dividing gallons per day by 1,440.

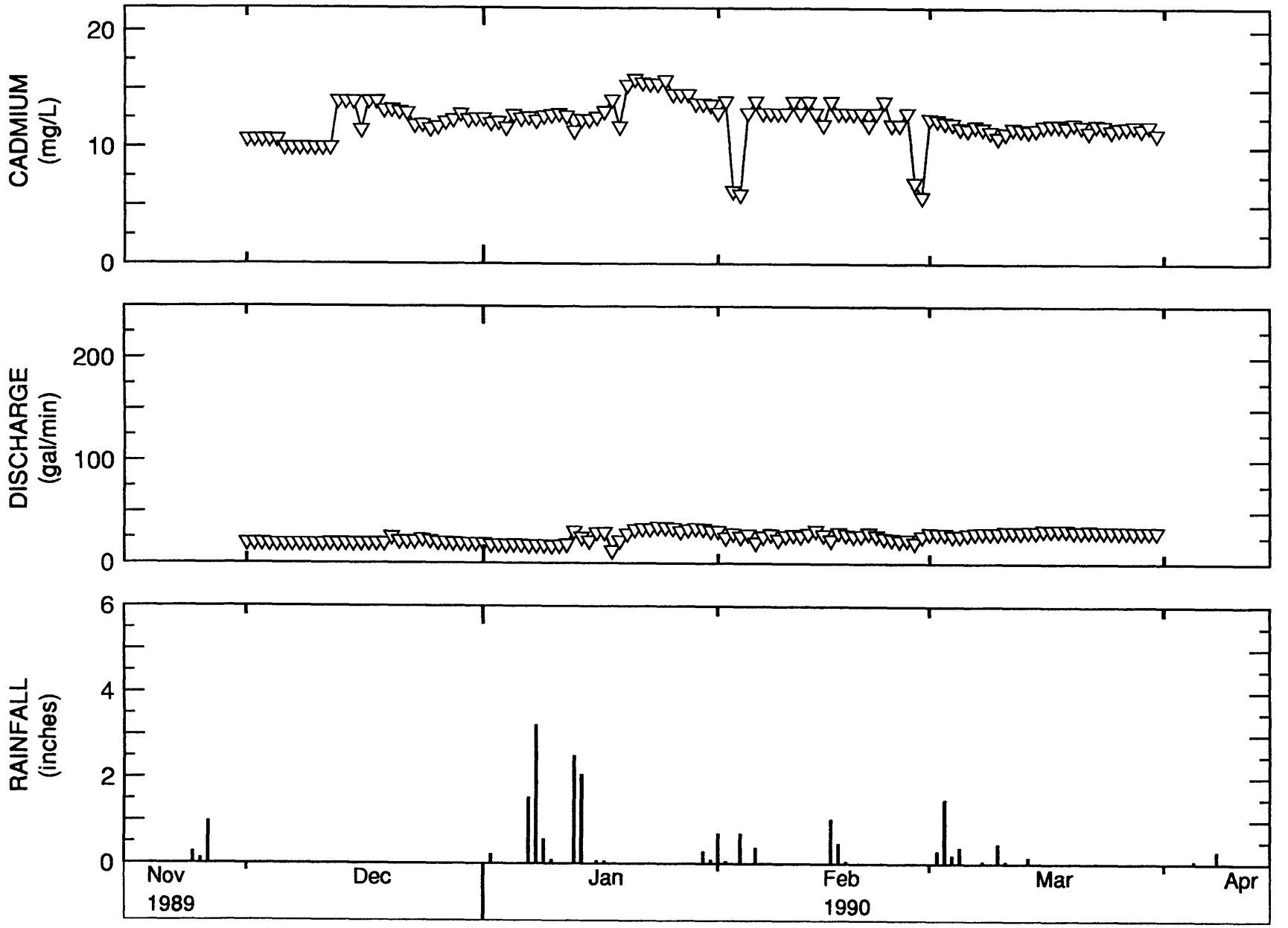

Figure C88. Cadmium concentrations and discharge of Richmond Mine emergency treatment plant influent, and rainfall at Shasta Dam, 1989-90. Discharge, in gallons per minute, was obtained by dividing gallons per day by 1,440.

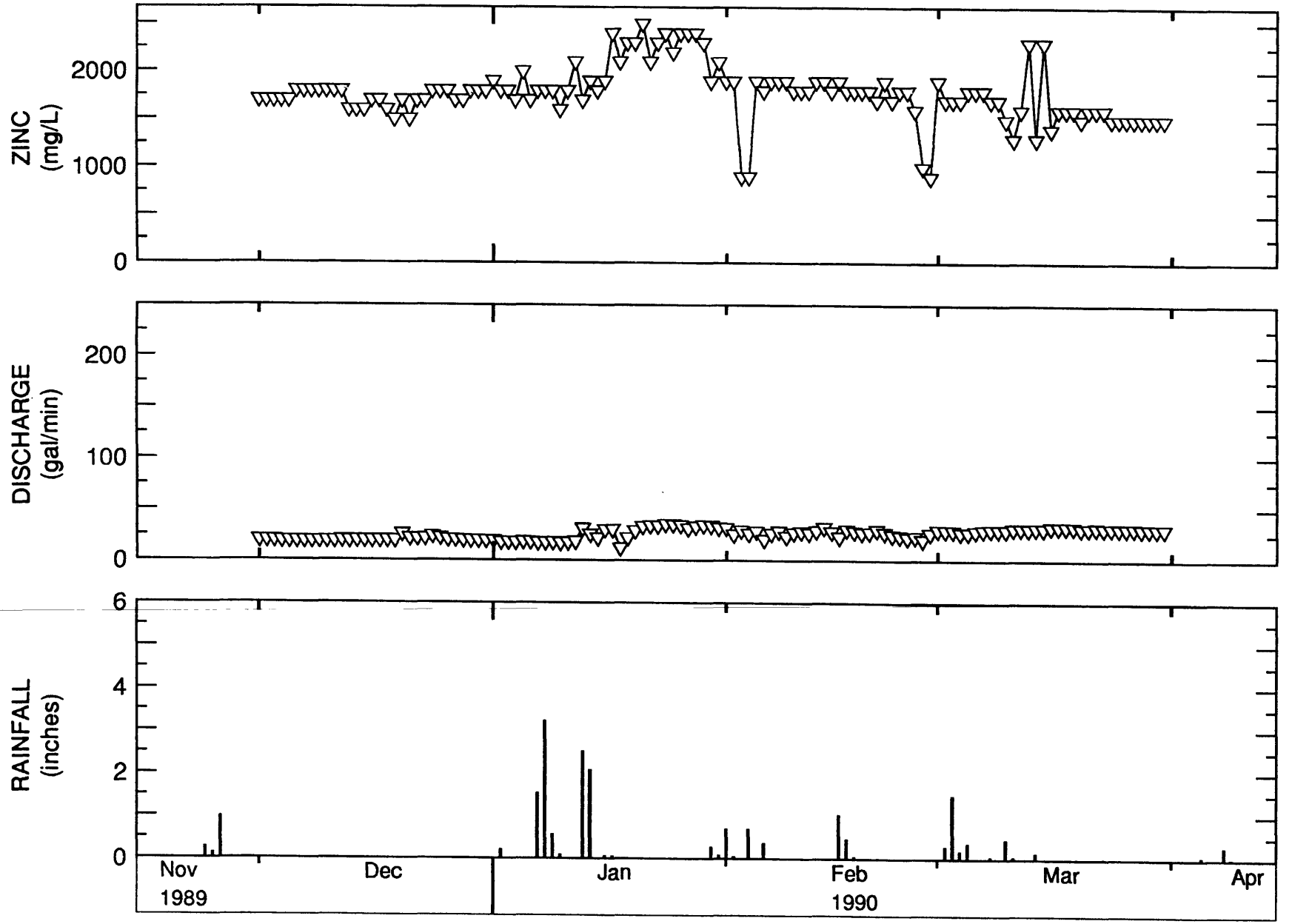

Figure C89. Zinc concentrations and discharge of Richmond Mine emergency treatment plant influent, and rainfall at Shasta Dam, 1989-90. Discharge, in gallons per minute, was obtained by dividing gallons per day by 1,440.

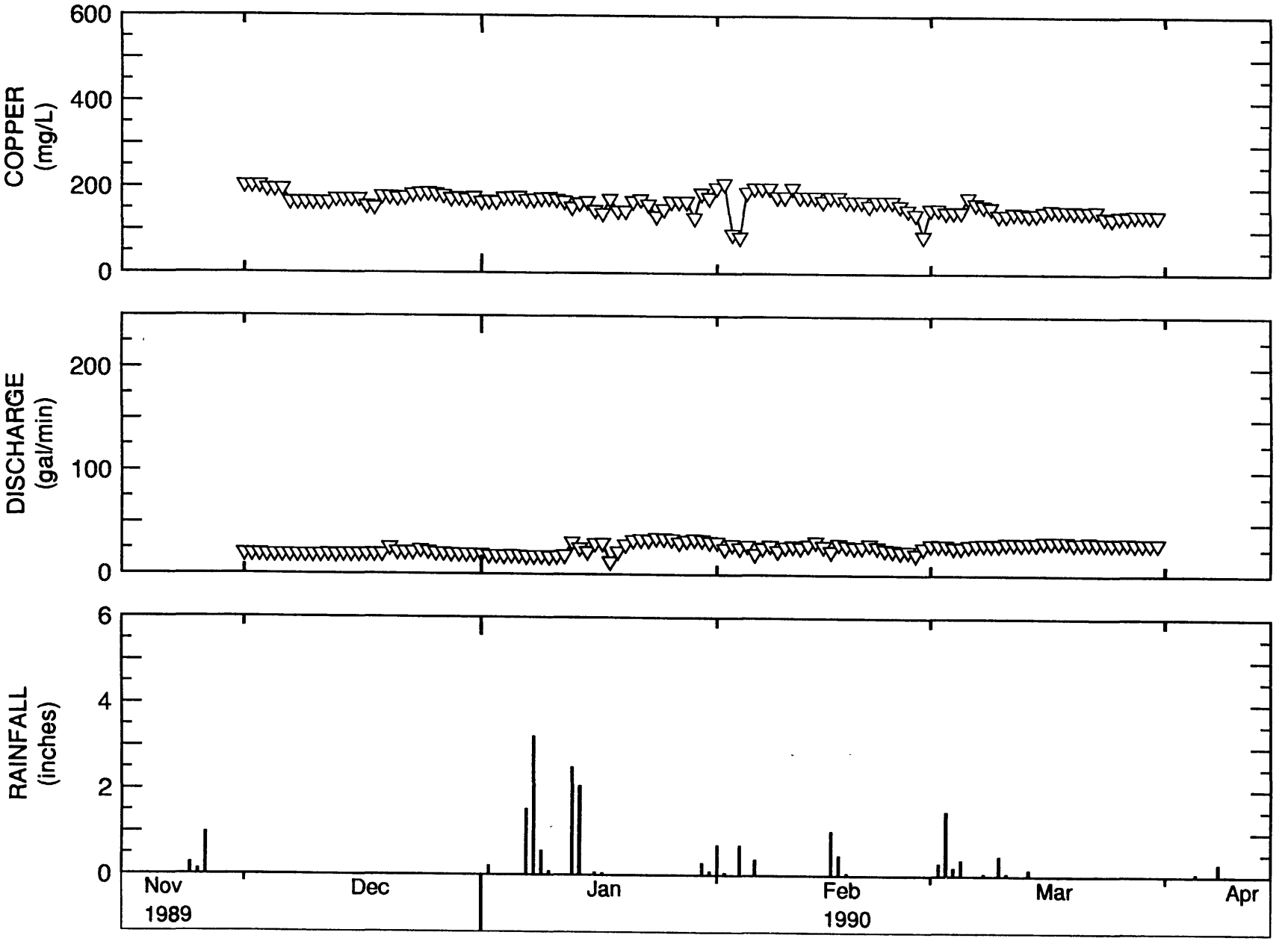

Figure C90. Copper concentrations and discharge of Richmond Mine emergency treatment plant influent, and rainfall at Shasta Dam, 1989-90. Discharge, in gallons per minute, was obtained by dividing gallons per day by 1,440.

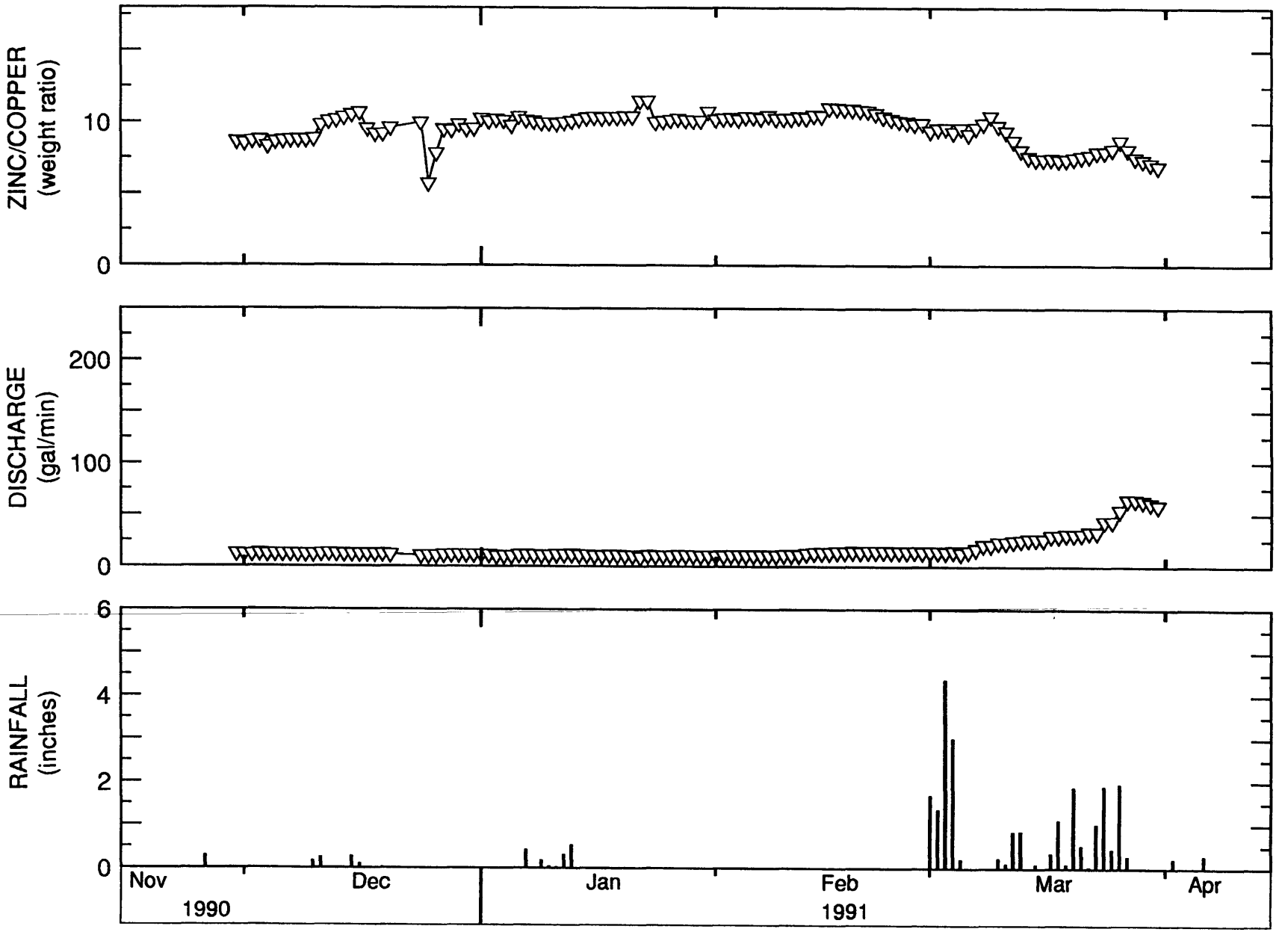

Figure C91. Zinc/copper ratios and discharge of Richmond Mine emergency treatment plant influent, and rainfall at Shasta Dam, 1990-91. Discharge, in gallons per minute, was obtained by dividing gallons per day by 1,440.

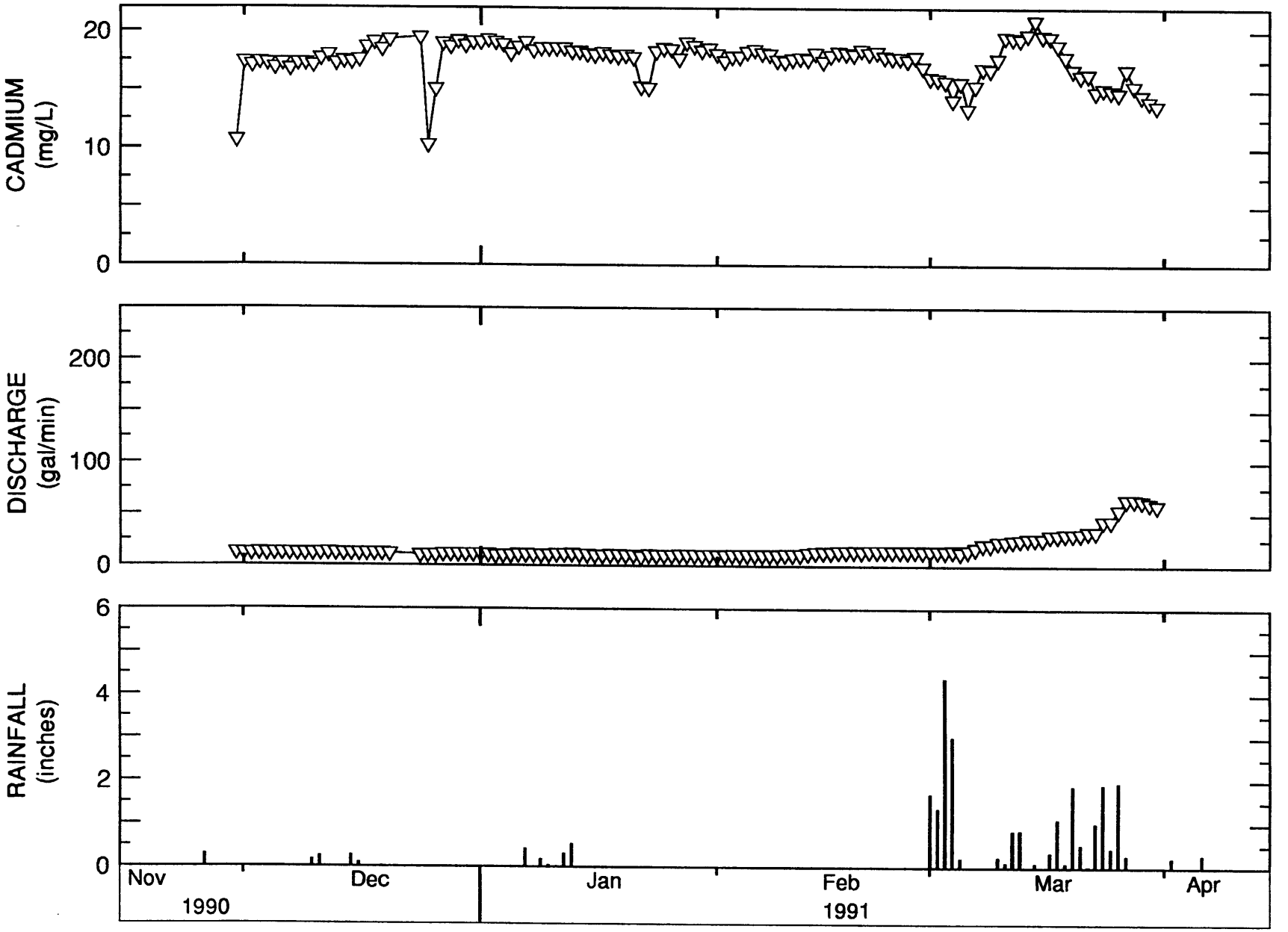

Figure C92. Cadmium concentrations and discharge of Richmond Mine emergency treatment plant influent, and rainfall at Shasta Dam, 1990-91. Discharge, in gallons per minute, was obtained by dividing gallons per day by 1,440.

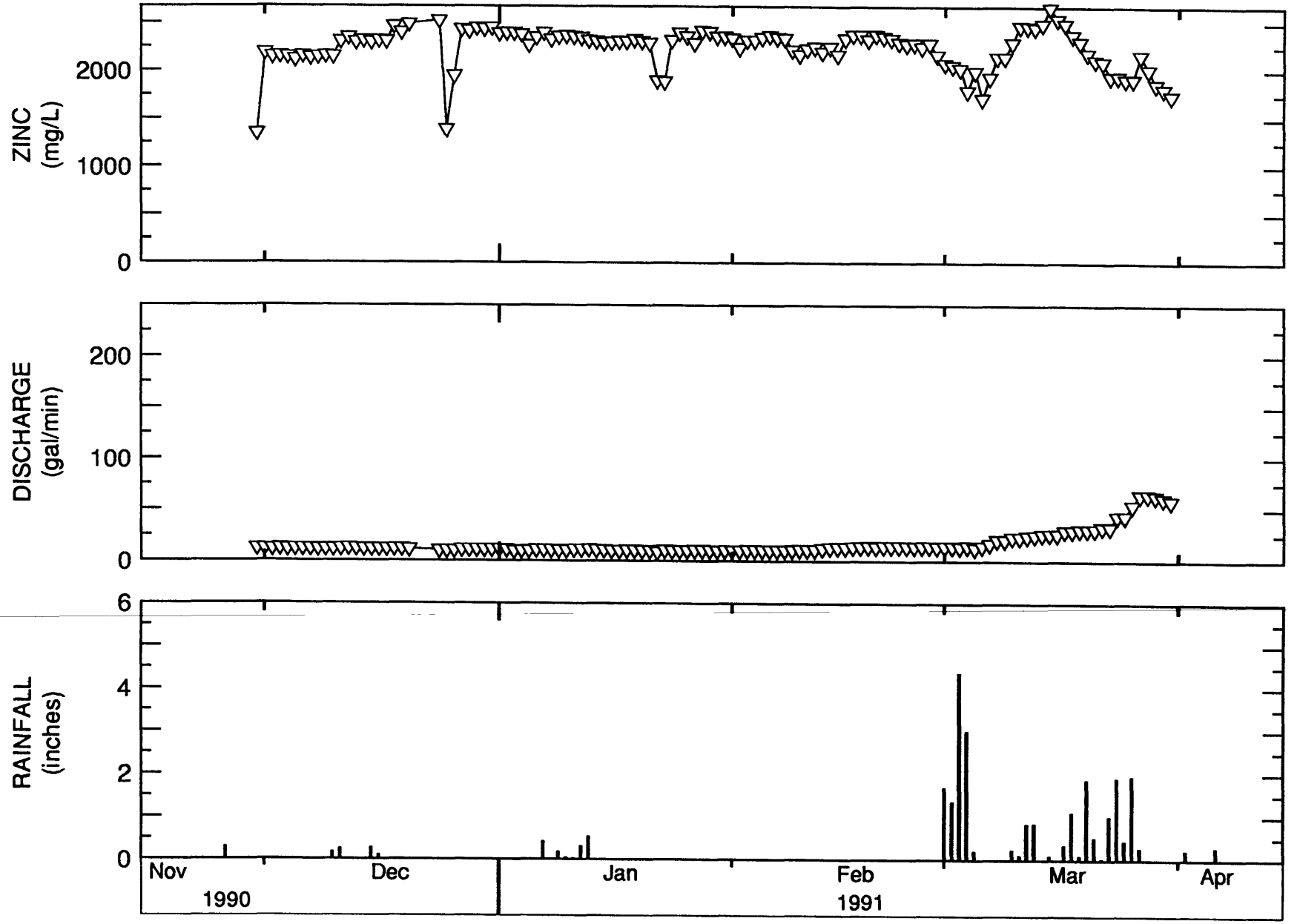

Figure C93. Zinc concentrations and discharge of Richmond Mine emergency treatment plant influent, and rainfall at Shasta Dam, 1990-91. Discharge, in gallons per minute, was obtained by dividing gallons per day by 1,440.

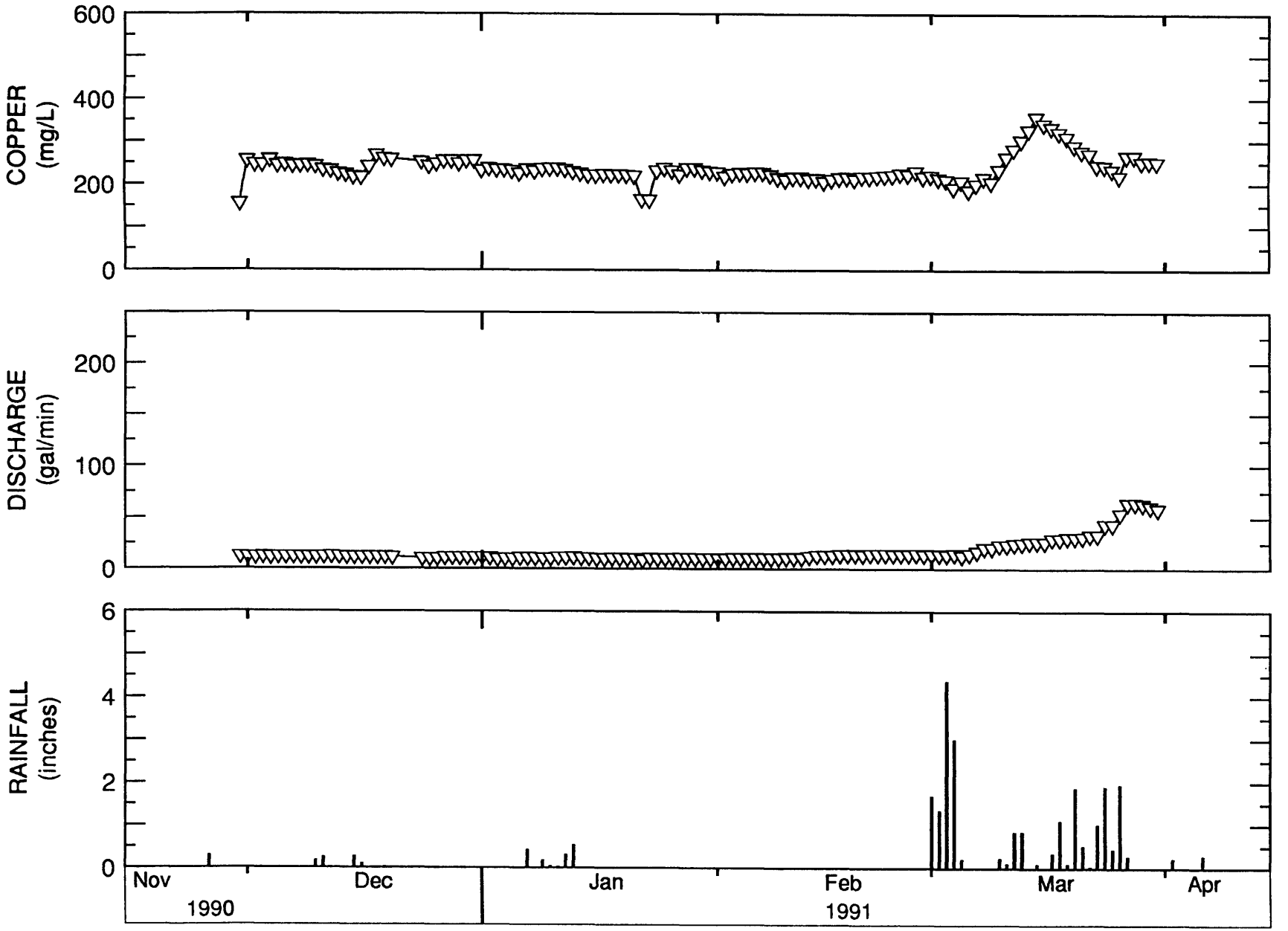

Figure C94. Copper concentrations and discharge of Richmond and Mine emergency treatment plant influent, and rainfall at Shasta Dam, 1990-91. Discharge, in gallons per minute, was obtained by dividing gallons per day by 1,440.