PHYSICAL AND CHEMICAL DATA FOR THE SACRAMENTO RIVER AT RIO VISTA, CALIFORNIA, JANUARY THROUGH MAY, 1983

Dana D. Harmon, Laurence E. Schemel, Stephen W. Hager, and Allan Y. Ota

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ABSTRACT

Physical and chemical data for the Sacramento River at Rio Vista, California, for the period of January to May, 1983 are presented in this report. Measurements include specific conductance, alkalinity, suspended particulate matter, and the dissolved inorganic nutrients: nitrite, nitrate + nitrite, ammonium, dissolved silica, and ortho-phosphate. Numerical results are tabulated and details of the methods are described.

INTRODUCTION

The biogeochemistry of waters in the Northern San Francisco Bay estuary is influenced by variability in the flow rate and the chemical composition of the freshwater (Schemel et al., 1984). A field sampling and analysis program was conducted during 1983 to characterize variations in the geochemistry of the inflow of the Sacramento River, the major inflow to San Francisco Bay (fig. 1). The study was conducted during the period of highest seasonal inflows: 1 January to 31 May, 1983 (fig. 2). This report presents the physical and chemical data for the Sacramento River at Rio Vista measured during this high flow time period. Measurements included specific conductance, alkalinity, suspended particulate matter (SPM), and the dissolved inorganic nutrients: ammonium, nitrite, nitrate + nitrite, dissolved silica, and ortho-phosphate. Scientific personnel and their primary areas of responsibility are listed in Table A.

EXPERIMENTAL DESIGN

Flow rates, chemical and biological properties, and sediment transport characteristics have been studied in several reaches and tributaries of the Sacramento River. During the period of this study, several locations in the tidal river downstream of the city of Sacramento were monitored at two-week to monthly intervals by the U. S. Geological Survey and the California Department of Water Resources. Much of this monitoring is conducted to assure compliance with water quality standards. The frequencies and natures of these monitoring programs do not allow resolution of chemical variability on time scales of days to weeks. During periods of high river flow, generally late-fall to early-spring, large changes in river chemical composition are caused by or related to short-term variations in river flow rate. To resolve these variations, the Sacramento River was sampled one to three times daily during periods of the highest flows and less frequently during other times.

The sampling location, Rio Vista, was selected primarily so that we could characterize the chemistry of the Sacramento River inflow to Northern San Francisco Bay during periods of high inflow. This required a sampling location below the point where water from the Yolo Bypass joins the Sacramento River. The mid-span of the Rio Vista bridge satisfied this requirement (fig. 1).

Preliminary analysis of hourly (instantaneous) specific conductance measurements from Rio Vista (Bureau of Reclamation, Sacramento, California, unpublished data) indicated that large variations can occur over shorter than daily time scales during periods of high flow. Consequently, daily measurements presented here might not represent mean daily concentrations. This is acceptable because mixing processes in the estuary probably remove (smooth) effects of short term variability in the river inflow (Loder and Reichard, 1980).

MATERIALS AND METHODS

Depth-integrated samples were collected from the midspan of the Rio Vista Bridge with a point-integrating sampler, US-P-72 (fig. 3). A one-liter linear polyethylene sample bottle was used in the sampler. The sampler collected water from one meter above the bottom to one meter below the surface. In order to avoid overfilling, and thus excluding water from shallow depths, the rate of retrieval of the sampler from depth was adjusted according to river flow rate. The sampling prodecure was performed one to three times every day. In addition, on one day each week, three additional sample bottles were collected. One of the four samples was stored in a refrigerator at Rio Vista until the following sample pick-up (3 or 4 days later). The three remaining samples were composited. The composite sample and the routine daily samples were subdivided for SPM and dissolved inorganic nutrient analysis. After analysis, the composite sample was compared to the stored sample, to determine storage effects for each of the anälyses. Theoretically, ammonium would be the nutrient most affected by storage. Effect of storage on nutrients for this study is illustrated in the plot of fresh versus refrigerated ammonium concentrations (fig. 4). Samples for alkalinity and specific conductance were collected with a bucket from surface waters and stored in amber polyethylene bottles until delivered to the laboratory.

Sample Preparation and Analysis

Dissolved nutrients. Due to the high concentrations of SPM found in the Sacramento River, samples were double filtered through two Sartorius[1] polycarbonate filter holders stacked in series. The top holder contained a 47 mm, Gelman type A-E glass fiber filter. The lower holder contained a 47 mm, 0.4 um poresize Nucleopore polycarbonate membrane filter. The vacuum was maintained at or below 17 kPa.

The filtered samples were stored in 30 ml amber Nalgene linear polyethylene bottles that had been preconditioned by storing them filled with 2.5 meq. bicarbonate water. Samples were frozen until time of analyses. The samples were stored frozen from one to four weeks. Silicate polymerizes when frozen (Grasshoff, 1976). In order to completely return the polymerized

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[1]The mention of brand names is for identification purposes and does not constitute endorsement by the U. S. Geological Survey.

silica to solution, the samples were allowed to thaw at room temperature for a minimum of 12 hours. After thawing and before analysis each sample were vigorously shaken.

The dissolved inorganic nutrients ammonium, nitrite, nitrate, ortho-phosphate and silica were analyzed on a Technicon Auto Analyzer II system modified for estuarine conditions. Samples were referenced to upscale standards and to blanks that were analyzed at two to four hour intervals. Artificial river water (1.0 meq. L^{-1} NaHCO3) and artificial seawater (Strickland and Parsons, 1968) were used as standards. The analyses were observed to be linear over the concentration ranges measured in the San Francisco Bay and Delta system.

The five analyses were maintained at 37^{o}C by a circulator that continuously pumped 37^{o}C water through specially-designed glass heating tubes inserted into the glass mixing coils of each manifold.

Ammonium. The ammonium method was an automated adaptation of the phenolhypochlorite method of Solorzano (1969), similar to that of Head (1971). By using a heating bath temperature of 37^{o} C, as recommended by Berg and Abdullah (1977), and by increasing reaction time, the method gives maximum color development, low blanks, and a high degree of reproducibility. The effect of salinity was minimized by reducing the amount of hypocholorite (bleach) in the oxidizing reagent. Estimated precision for the range of concentrations measured was + or -0.2 ug-at L^{-1}.

Nitrite. The nitrite method was an adaptation of Technicon (1973) method number AII-100-70W, with the cadmium column removed. The nitrite sample-ammonium chloride mixture was drawn from the debubbler which precedes the cadmium column in the nitrate + nitrite analysis in order to allow all five analyses to operate from a single Technicon proportioning pump. Estimated precision for the range of concentrations measured was + or -0.05 ug-at L^{-1}.

Nitrate ± nitrite. The nitrate + nitrite method was adapted from Technicon (1973) method number AII-100-70W with one additional twenty-turn coil added to increase reaction time for better color stability. In order to prevent cadmium column deterioration, 0.121g of copper sulfate was added to 200g of ammonium chloride in 18 L of deionized distilled water (Connors and Beland, 1976). The pH of this reagent was not adjusted. Estimated precision for the range of concentrations measured was + or -0.1 ug-at L^{-1}.

Dissolved Silica. The silica method was an adaptation of Technicon (1976) method AII-105-71W. A sample tube with half of the original delivery rate was used to extend the linear range to 350 ug-at L^{-1}. To increase reaction time for maximum color development, mixing coils were added before the addition of oxalic acid and after the addition of ascorbic acid. Estimated precision for the range of concentrations measured was + or -1 ug-at L^{-1}.

Ortho-phosphate. The ortho-phosphate method was a modification of Atlas et al. (1971), using ascorbic acid (70 g L^{-1} with 50 ml acetone L^{-1}) as a reducing agent. This modification allows analysis of samples predigested with hydrogen peroxide and ultraviolet light. To increase reaction time for maximum color development, mixing coil lengths were increased by a factor of 2. Estimated precision for the range of concentrations measured was + or -0.05 ug-at L^{-1}.

Suspended particulate matter. The concentration of suspended particulate matter (SPM) was determined gravimetrically. An aliquot of sample water was vacuum filtered through a preweighed 47 mm, 0.45 um pore size Selas Flotronics silver filter. The filter was air dried for a minimum of 4 weeks, then reweighed. Mean and median deviations of the SPM analysis are typically 1.4 mg L^{-1} and 0.9 mg L^{-1} (Hager and Harmon 1984).

Specific Conductance and Alkalinity. Specific conductance and alkalinity were determined on a surface sample taken with a plastic bucket. The alkalinity-salinity sample was stored in a plastic quart bottle for less than 24 hours before sample processing. An unfiltered aliquot was transferred to a 250 ml glass bottle with poly-seal cap for later specific conductance determination. Alkalinity samples were stored in 250 ml wide-mouth plastic bottles after filtration through glass fiber filters. Filters were pre-rinsed twice with sample water before the aliquot for analysis was taken. Alkalinity samples were stored at room temperature in the dark for periods ranging from a few days to months. Effects of sample storage were not tested. Results of Brewer and Goldman (1976) and Goldman and Brewer (1980) indicate that the changes in total alkalinity probably would be less than 0.050 meq. L^{-1}.

Specific conductance. Specific conductance was determined at 25^{o} C with an inductive bench salinometer (Beckman Model RS7B) relative to standard seawater (I.A.P.S.O., P92). The sensitivity of the instrument indicates a precision on the order of about 5 uS cm^{-1} or less.

Alkalinity. Alkalinity was determined by Gran titration at 25^{o}C. The method and apparatus are the same as that described by Schemel (1984) with the exception that a Brinkman semi-automated buret was used to add 0.010 mL aliquots of 0.5N HCl to the samples. The digital output of the buret was modified, as described in the instruction manual, so that titrant volumes could be determined to 0.0001 mL. Bicarbonate end points were usually reached with 0.3 - 0.4 mL of titrant. The largest error in the analysis is in the determination of the titrant concentration; we estimate this uncertainty to be about 0.0001 meq. L^{-1}. Other errors are the same as those described by Schemel (1984).

DATA

The data are presented in chronological order in Table D.

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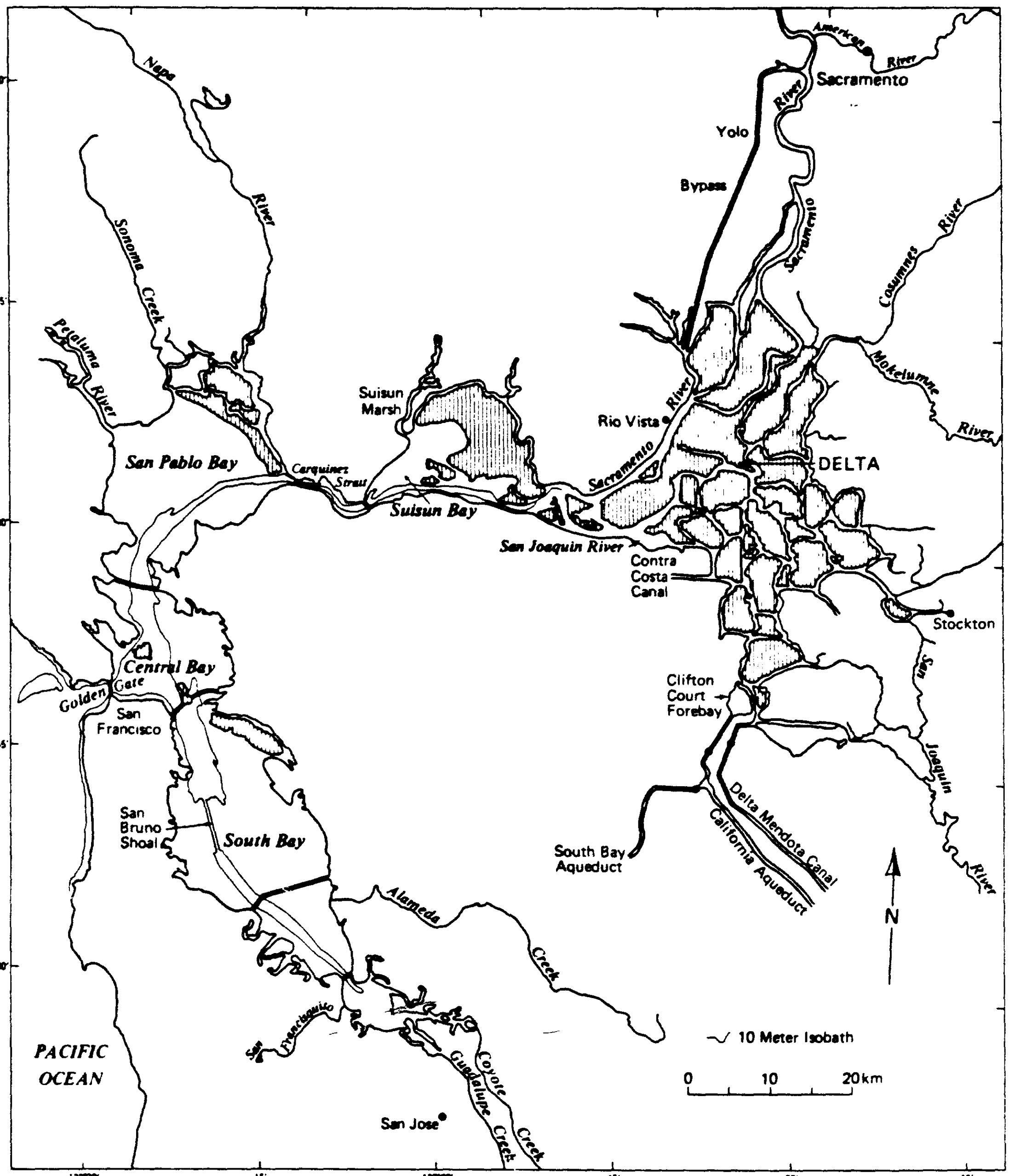

Figure 1. Sacramento River and environs from city of Sacramento to confluence with San Joaquin River.

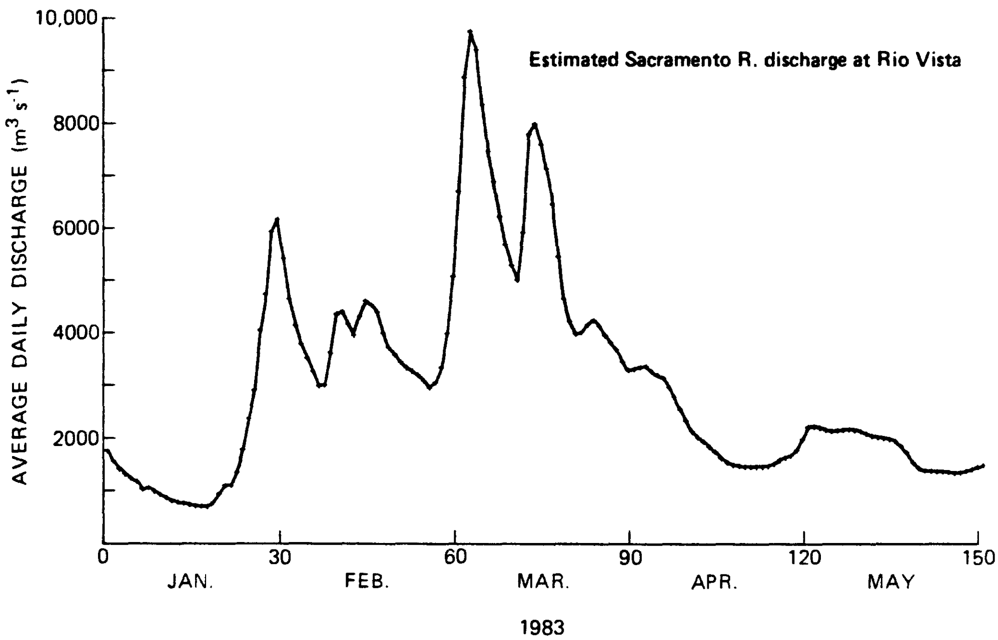

Figure 2. Estimates of daily Sacramento River discharge at Rio Vista, California, for January through May 1983. Estimates are the sum of Sacramento River discharge at Freeport plus Yolo Bypass discharge at Woodland. (U. S. Geological Survey District Office, Sacramento, California).

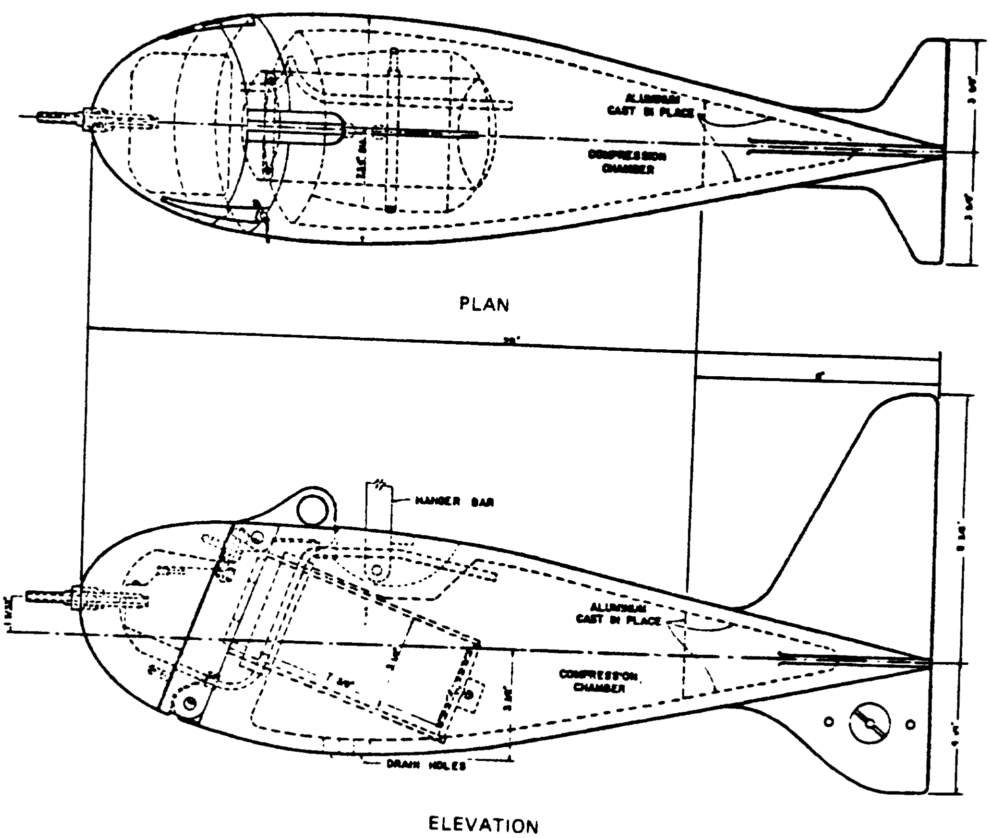

Figure 3. Point-integrating water and suspended sediment sampler.

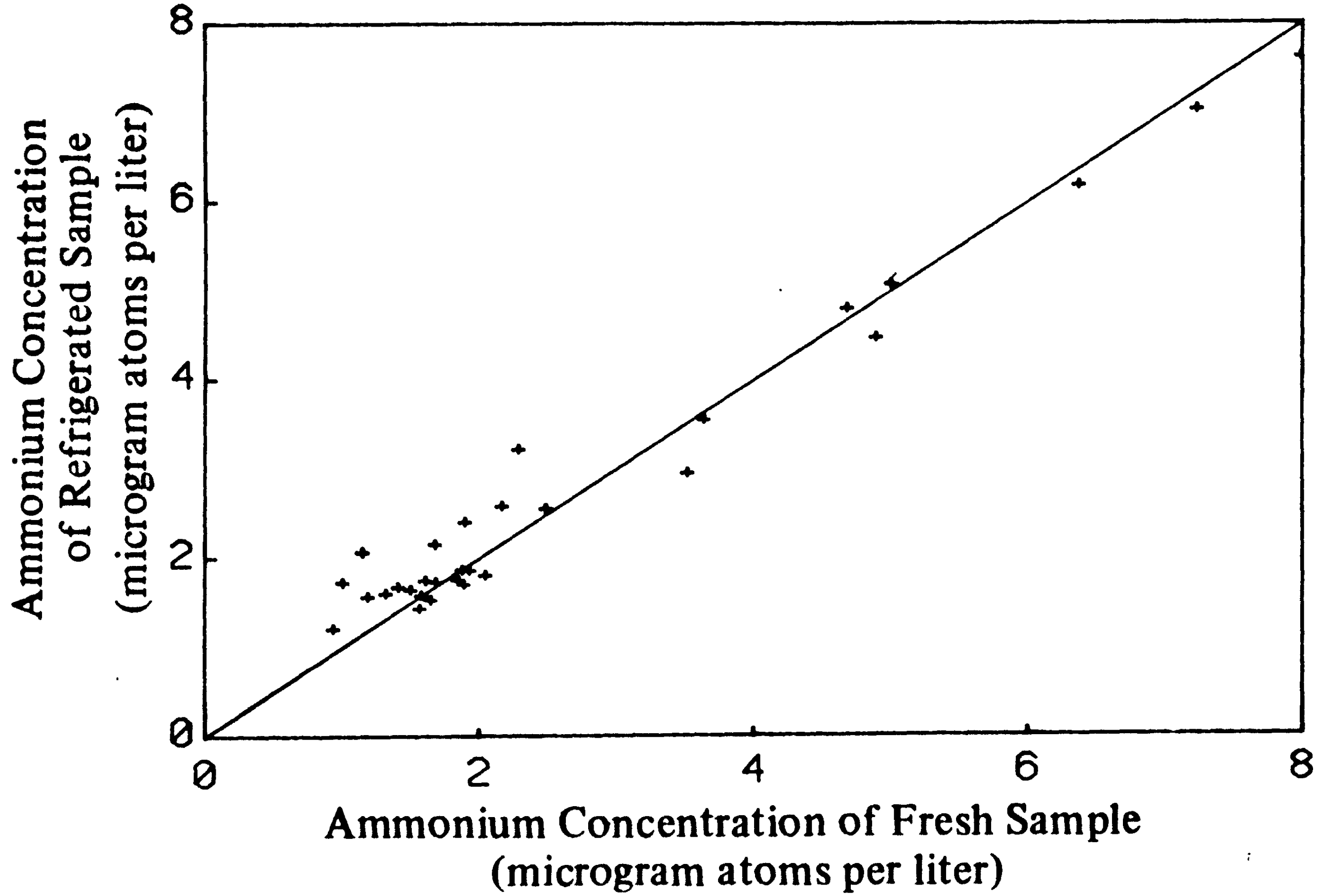

Figure 4. Storage effect on ammonium analyses.

TABLE A
List of Scientific Personnel

Stephen W. Hager	Dissolved nutrients Suspended Particulate Matter
Dana D. Harmon	Dissolved nutrients Suspended Particulate Matter
Cederick T. Henderson	US-P-72 Sampler Operator
Allan Y. Ota	Data Reduction
Laurence E. Schemel	Chief Scientist Specific conductance Alkalinity

TABLE B
ABBREVIATIONS TABLE

Column Title	Definition	Units
DAY OF YEAR	Julian Date	
TIME	Standard Time	Hours and Minutes
SPEC CONDUT	Specific Conductance	$uS\ cm^{-1}$
ALKALIN	Alkalinity	$meq\ L^{-1}$
NO2	Nitrite	uM [1/]
NO3+NO2	Nitrate + Nitrite	uM
NH3	Ammonium	uM
PO4	Ortho-Phosphate	uM
SIO2	Silica	uM
SUS PAR MATTER	Suspended Particulate Matter	$mg\ L^{-1}$

[1/] uM = micromolar = umoles L^{-1}. For these nutrients, uM (N,P,Si) = ug-at (N,P,Si) L^{-1} = microgram-atom per liter.

TABLE C

CONVERSION FACTORS

	From	To	Factor
Nitrite	uM[1/]	mg L^{-1}(N)	0.0140
Nitrate + nitrite	uM	mg L^{-1}(N)	0.0140
Ammonium	uM	mg L^{-1}(N)	0.0140
Ortho-phosphate	uM	mg L^{-1}(P)	0.0310
Dissolved silica	uM	mg L^{-1}(Si)	0.0281
Alkalinity	meq L^{-1}	mg L^{-1}($CaCO_3$)	100.

[1/] uM = micromolar = umoles L^{-1}. For these nutrients, uM (N,P,Si) = ug-at (N,P,Si) L^{-1} = microgram-atom per liter.

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DATE	FILE NUMBER	LOCATION
1 JAN 83	83001	RIO VISTA BRIDGE

DAY OF YEAR	TIME	SPEC CONDUT US/CM	ALKALIN MEQ/L	NO2 UM	NO3+NO2 UM	NH3 UM	PO4 UM	SIO2 UM	SUS PAR MATER MG/L
1	744	153.0	1.060	-	-	-	-	-	-
2	744	186.0	1.240	-	-	-	-	-	-
3	747	191.0	1.271	0.68	16.38	3.53	1.41	277	-
3	1200	-	-	-	-	-	-	-	38.4
4	750	216.0	1.415	1.11	17.62	3.41	1.02	260	40.7
5	735	236.0	1.542	0.55	16.85	3.70	1.32	262	32.4
6	730	237.0	1.561	0.43	17.02	4.37	1.45	263	28.0
6	1200	-	-	0.39	15.93	4.68	1.94	271	24.8
6	1201	-	-	-	-	-	-	-	-
7	725	216.0	1.450	0.34	15.99	4.59	1.93	274	36.8
8	745	245.0	1.604	-	-	-	-	-	-
9	800	216.0	1.433	-	-	-	-	-	-
10	755	213.0	1.407	-	-	-	-	-	-
10	1200	-	-	0.33	16.84	5.00	1.64	270	17.6
11	800	216.0	1.403	1.10	18.56	5.66	1.74	270	21.2
12	744	216.0	1.404	1.10	19.41	7.32	2.22	268	29.6
13	730	234.0	1.526	0.85	18.44	6.36	1.76	270	25.6
13	1200	-	-	0.46	18.70	6.37	2.02	269	19.6
14	740	211.0	1.370	0.55	18.02	6.24	1.69	272	26.4
15	715	211.0	1.400	0.55	18.95	6.78	1.90	272	24.4
16	715	197.0	1.278	0.43	17.84	6.94	1.74	271	19.2
17	722	191.0	1.265	0.57	17.92	6.70	1.79	272	18.4
17	1200	-	-	0.85	18.89	7.23	1.79	273	18.0
18	725	195.0	1.277	0.58	17.91	7.45	2.53	270	12.8
19	730	197.0	1.286	0.49	17.15	6.79	1.80	273	10.4
20	715	228.0	1.508	0.61	20.95	8.36	2.15	267	17.2
20	1200	-	-	0.73	20.36	7.99	2.10	267	16.0
21	745	242.0	1.479	0.56	22.32	6.85	2.06	265	18.0
22	725	238.0	1.470	0.52	23.98	5.89	2.12	268	16.8
23	720	236.0	1.441	0.56	29.16	6.93	2.30	254	33.6
24	743	214.0	1.264	3.61	27.93	7.15	2.36	241	44.0
24	1200	-	-	0.67	23.08	4.89	2.35	235	42.8
25	715	246.0	1.363	0.63	-	5.14	2.87	222	78.7
25	1530	134.0	0.857	0.48	17.61	2.69	1.63	218	82.7
26	700	158.0	0.913	0.42	16.99	3.09	1.78	202	77.3
26	1500	154.0	0.894	0.53	16.43	2.38	1.67	200	61.3
27	705	239.0	1.359	0.79	24.35	3.24	2.25	196	88.0
27	1200	-	-	0.92	22.51	3.64	2.99	199	158.0
27	1605	157.0	1.414	0.52	16.47	2.49	1.62	210	132.0
28	715	207.0	1.286	0.77	18.24	2.14	1.86	203	518.0
28	1610	174.0	1.151	0.51	13.70	1.99	1.46	195	254.0
29	705	163.0	1.037	0.62	14.54	1.74	1.70	207	644.0
29	1615	163.0	1.067	0.66	13.66	1.81	1.94	211	452.0
30	708	169.0	1.140	0.32	12.84	0.76	1.48	233	396.0
30	1630	164.0	1.121	0.31	11.96	1.08	1.34	227	224.0
31	658	159.0	1.071	0.29	10.48	1.32	1.39	215	358.0
31	1200	166.0	1.179	-	-	-	-	-	396.0
31	1605	160.0	1.116	0.31	10.26	2.22	1.39	212	333.0

- DATA NOT AVAILABLE

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DATE	FILE NUMBER	LOCATION
1 FEB 83	83032	RIO VISTA BRIDGE

DAY OF YEAR	TIME	SPEC CONDUT US/CM	ALKALIN MEQ/L	NO2 UM	NO3+NO2 UM	NH3 UM	PO4 UM	SIO2 UM	SUS PAR MATER MG/L
32	715	161.0	1.000	0.23	11.04	1.80	1.32	222	331.0
32	1609	169.0	1.149	0.32	11.24	1.30	1.31	230	307.0
33	653	168.0	1.245	0.24	11.47	1.87	1.30	240	208.0
33	1605	187.0	1.130	0.27	11.25	1.75	1.47	257	192.0
34	725	184.0	-	0.25	11.76	2.19	1.31	261	145.0
34	1200	-	-	0.22	11.02	-	1.43	280	124.0
34	1545	193.0	-	0.16	11.28	2.03	1.19	269	145.0
35	10	191.0	1.333	0.17	11.04	1.74	1.34	275	136.0
35	807	178.0	1.234	0.21	11.41	2.40	1.17	272	116.0
36	15	185.0	1.272	0.21	11.37	2.05	1.11	280	94.0
36	810	183.0	1.279	0.24	11.53	2.47	1.18	279	104.0
37	15	179.0	1.229	0.28	12.27	1.89	1.59	279	82.0
37	810	191.0	1.306	0.24	11.97	2.12	1.27	287	77.0
38	10	198.0	1.286	0.21	15.43	2.56	1.49	284	92.5
38	815	204.0	1.373	0.21	14.70	2.51	1.44	287	-
38	1200	-	-	0.20	15.21	3.52	1.44	285	81.5
39	12	208.0	1.355	0.22	16.29	2.59	1.48	276	116.0
39	805	214.0	1.429	0.19	13.88	2.12	1.31	263	132.0
40	20	197.0	1.312	0.19	13.90	1.91	1.26	270	95.5
40	745	210.0	1.367	0.21	16.03	2.21	1.47	261	94.5
41	703	208.0	1.395	0.20	17.20	2.12	1.32	256	107.0
41	1610	199.0	1.316	0.20	15.63	1.87	9.39	265	-
42	803	183.0	1.248	0.19	13.48	1.52	1.12	263	110.0
42	1553	159.0	1.051	0.19	12.55	1.77	1.19	249	83.5
43	755	179.0	1.212	0.17	12.28	1.24	1.00	264	88.5
43	1603	175.0	1.176	0.18	12.07	1.87	1.04	256	86.5
44	750	193.0	1.308	0.18	12.90	1.17	1.00	273	116.0
44	1620	194.0	1.321	0.20	13.52	1.68	1.19	264	98.5
45	810	203.0	1.374	0.19	13.68	1.36	1.09	269	97.5
45	1200	198.0	1.354	0.27	13.41	1.32	1.19	267	106.0
45	1605	183.0	1.239	0.26	12.86	1.80	1.02	244	84.0
46	804	181.0	1.242	0.23	11.99	1.60	1.00	253	109.0
46	1610	180.0	1.239	0.25	12.09	1.58	0.87	258	104.0
47	756	169.0	1.147	0.24	11.45	1.69	0.90	259	78.5
47	1615	177.0	1.223	0.22	11.21	1.73	0.90	264	79.0
48	755	184.0	1.248	0.25	11.14	1.64	0.78	262	80.0
48	1200	185.0	1.275	0.26	11.40	1.57	0.82	271	87.2
49	755	154.0	1.043	0.22	10.44	1.94	0.99	249	51.2
49	805	184.0	1.255	0.21	11.44	1.79	0.86	263	72.4
50	805	170.0	1.183	0.21	11.46	1.81	0.83	268	66.0
51	757	192.0	1.331	0.24	11.31	2.07	0.72	268	55.6
52	1200	188.0	1.316	0.25	11.41	1.89	0.71	270	59.6
52	805	187.0	1.309	0.21	11.50	1.55	0.67	288	55.6
53	759	196.0	1.356	0.21	11.03	1.40	0.66	286	68.0
54	755	196.0	1.369	0.21	10.97	1.29	0.67	289	59.2
55	1200	196.0	1.370	0.22	10.57	1.58	0.76	264	60.0
55	758	185.0	1.317	0.15	10.38	1.07	0.65	273	53.0
56	758	194.0	1.349	0.19	11.96	1.75	0.97	268	154.0
57	755	189.0	1.288	0.20	12.03	1.57	0.82	271	158.0
58	752	211.0	1.394	0.33	15.69	2.45	1.37	247	93.5
59	1605	174.0	1.193	0.30	13.38	2.56	1.28	237	89.5

- DATA NOT AVAILABLE

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ESTUARINE RESEARCH GROUP

DATE	FILE NUMBER	LOCATION
1 MAR 83	83060	RIO VISTA BRIDGE

DAY OF YEAR	TIME	SPEC CONDUT US/CM	ALKALIN MEQ/L	NO2 UM	NO3+NO2 UM	NH3 UM	PO4 UM	SIO2 UM	SUS PAR MATER MG/L
60	758	203.0	1.383	0.32	22.75	2.56	1.57	247	147.0
60	1200	-	1.418	0.47	16.94	2.49	1.57	244	197.0
60	1608	204.0	1.390	0.34	15.59	2.31	1.30	234	177.0
61	755	188.0	1.320	0.31	12.90	1.55	1.29	234	267.0
61	1605	205.0	1.436	0.39	12.90	2.36	1.91	229	232.0
62	750	179.0	1.407	0.29	10.49	1.44	1.16	249	543.0
62	1650	184.0	1.337	0.24	9.37	1.96	1.30	232	472.0
62	2345	174.0	1.253	0.25	8.65	1.74	1.31	230	426.0
63	755	170.0	1.246	0.32	8.56	2.01	1.67	228	446.0
63	1200	167.0	1.234	0.22	8.40	1.65	1.04	239	471.0
63	2340	157.0	1.162	0.25	8.00	2.42	1.65	210	774.0
64	758	166.0	1.117	0.26	7.91	1.98	1.70	207	773.0
65	805	165.0	1.133	0.33	8.80	2.35	1.94	207	659.0
65	1608	162.0	1.158	0.30	9.02	2.04	1.82	213	636.0
66	753	166.0	1.197	0.31	9.28	1.71	1.77	213	512.0
66	1200	162.0	1.191	0.28	9.42	1.21	1.77	217	521.0
66	1557	166.0	1.176	0.26	9.84	1.53	1.54	214	466.0
67	756	172.0	1.208	0.24	10.32	1.28	1.17	236	391.0
67	1605	174.0	1.236	0.27	10.42	1.72	1.36	243	377.0
68	750	180.0	1.275	0.32	11.27	1.59	0.89	234	282.0
68	1605	179.0	1.278	0.26	11.14	1.45	0.75	253	253.0
69	805	185.0	1.319	0.29	11.77	1.67	0.75	258	218.0
69	1200	183.0	1.313	0.29	11.86	1.87	0.93	259	206.0
69	1615	199.0	1.320	0.31	11.65	1.63	0.82	247	188.0
70	755	186.0	1.339	0.36	12.05	1.57	0.84	247	168.0
70	1615	187.0	1.339	0.38	12.04	1.86	1.01	247	176.0
71	815	186.0	1.325	0.37	12.15	1.54	0.82	243	156.0
71	1610	180.0	1.278	0.38	12.09	1.84	1.15	245	148.0
72	759	212.0	1.467	0.40	16.29	2.10	1.13	259	141.0
72	1555	187.0	1.376	0.34	13.21	1.70	1.06	252	177.0
73	755	195.0	1.388	0.33	13.40	1.54	0.92	263	175.0
73	1200	192.0	1.368	0.32	13.53	1.46	0.84	263	172.0
73	1555	194.0	-	0.28	13.78	1.72	0.92	260	177.0
74	750	176.0	1.266	0.31	11.94	1.42	0.82	251	266.0
74	1610	164.0	1.176	0.33	10.20	1.81	0.90	247	239.0
75	755	165.0	1.175	0.30	10.58	1.58	0.92	257	202.0
75	1605	161.0	1.152	0.29	10.25	1.56	0.84	251	172.0
76	805	161.0	1.161	0.29	10.13	1.42	0.93	251	245.0
76	1200	164.0	1.183	0.36	10.11	1.65	0.79	247	290.0
76	1610	168.0	1.176	0.31	10.34	1.74	0.93	242	241.0
77	755	165.0	1.166	0.33	10.64	1.24	0.84	247	229.0
77	1555	170.0	1.207	0.37	11.57	1.64	0.98	249	194.0
78	803	175.0	1.198	0.32	11.37	1.41	0.86	258	160.0
78	1600	178.0	1.197	0.29	11.84	1.42	0.79	255	137.0
79	758	176.0	1.243	0.29	11.67	1.22	0.77	246	125.0
79	1558	186.0	1.300	0.36	12.45	1.66	1.01	244	103.0
80	803	191.0	1.328	0.31	13.14	1.54	0.88	249	99.0
80	1200	184.0	1.304	0.34	12.48	1.61	0.76	252	101.0
80	1625	200.0	1.354	0.30	14.21	1.61	0.84	248	102.0
81	745	190.0	1.332	0.31	13.17	1.32	0.80	250	94.8
82	750	197.0	1.360	0.33	14.33	1.93	1.19	250	139.0
83	748	205.0	1.422	0.45	15.28	2.14	1.27	249	146.0
83	1200	184.0	1.273	0.36	14.33	1.85	1.04	244	142.0

- DATA NOT AVAILABLE

U S GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

ESTUARINE RESEARCH GROUP

DATE	FILE NUMBER	LOCATION
1 MAR 83	83060	RIO VISTA BRIDGE

84	750	207.0	1.443	0.28	14.64	1.23	0.88	251	166.0
85	758	194.0	1.362	0.31	13.69	1.21	0.95	248	127.0
86	750	186.0	1.309	0.29	11.96	1.44	0.85	242	120.0
87	758	194.0	1.383	0.30	12.22	1.30	0.78	247	126.0
87	1200	199.0	1.419	0.31	12.45	1.57	0.89	245	129.0
88	803	197.0	1.406	0.23	12.83	1.21	0.75	251	104.0
89	749	209.0	1.469	0.28	14.24	1.73	0.83	251	80.0
90	755	192.0	1.334	0.23	13.23	2.00	0.82	249	69.5
90	1200	210.0	1.480	0.26	14.35	1.01	0.76	253	90.0

- DATA NOT AVAILABLE

U S GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

ESTUARINE RESEARCH GROUP

DATE	FILE NUMBER	LOCATION
1 APR 83	83091	RIO VISTA BRIDGE

DAY OF YEAR	TIME	SPEC CONDUT US/CM	ALKALIN MEQ/L	NO2 UM	NO3+NO2 UM	NH3 UM	PO4 UM	SIO2 UM	SUS PAR MATER MG/L
91	757	171.0	1.309	0.25	11.35	1.08	0.65	-	64.5
93	758	189.0	1.375	0.00	10.81	1.25	0.60	269	64.5
95	758	184.0	1.335	-	9.74	0.99	0.73	259	236.0
96	1200	166.0	1.214	0.01	9.38	1.20	0.68	259	119.0
97	810	177.0	1.287	0.13	9.79	1.49	0.80	266	94.8
99	755	162.0	1.152	0.10	8.55	1.27	0.67	265	83.6
101	800	239.0	1.622	0.15	15.17	1.59	0.70	262	100.0
103	750	167.0	1.190	0.06	12.14	1.71	0.60	257	74.8
104	1200	256.0	1.768	0.19	13.10	1.15	0.77	250	84.8
105	810	164.0	-	0.11	11.64	2.02	0.70	262	66.8
107	810	149.0	1.072	0.10	11.18	2.58	0.90	258	123.0
109	760	197.0	1.394	0.12	11.05	2.22	0.81	250	35.2
110	1200	148.0	1.071	0.07	11.59	2.17	0.85	235	90.0
111	750	180.0	1.269	0.07	11.65	2.60	0.70	242	52.4
113	800	191.0	1.331	0.13	11.55	2.92	0.75	239	63.6
115	750	195.0	1.350	0.16	11.61	2.78	0.94	242	54.4
116	1200	246.0	1.657	0.17	12.63	2.29	1.04	237	58.0
117	750	171.0	1.168	0.22	11.47	2.53	0.87	241	42.8
119	760	143.0	0.973	0.23	9.71	3.09	0.91	243	94.0

- DATA NOT AVAILABLE

U S GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

ESTUARINE RESEARCH GROUP

DATE	FILE NUMBER	LOCATION
1 MAY 83	83121	RIO VISTA BRIDGE

DAY OF YEAR	TIME	SPEC CONDUT US/CM	ALKALIN MEQ/L	NO2 UM	NO3+NO2 UM	NH3 UM	PO4 UM	SIO2 UM	SUS PAR MATER MG/L
121	800	144.0	0.969	0.14	10.95	2.59	0.87	239	56.8
123	830	167.0	1.130	0.15	8.01	2.28	0.95	231	64.4
124	1200	202.0	1.356	0.19	9.27	1.90	0.85	235	74.8
125	750	194.0	1.312	0.25	9.81	3.54	0.98	239	56.8
127	750	202.0	1.382	0.26	9.26	2.59	0.88	246	52.0
129	800	214.0	1.458	0.22	8.83	2.12	0.83	245	65.6
131	750	221.0	1.521	0.21	8.77	1.76	0.81	246	99.2
132	1200	211.0	1.479	0.24	9.43	1.88	0.87	248	85.6
133	800	143.0	0.962	0.17	9.84	4.37	0.80	253	58.0
135	800	124.0	0.844	0.14	6.91	1.94	0.83	253	48.4
137	810	121.0	0.827	0.15	6.21	2.19	0.91	253	41.6
139	740	146.0	0.983	0.26	6.32	2.72	0.76	252	27.6
139	1200	128.0	0.900	0.13	6.89	2.05	0.77	250	65.2
141	740	149.0	1.017	0.22	10.60	3.55	0.86	247	45.6
143	740	146.0	-	0.17	8.75	2.59	0.79	247	45.2
145	750	126.0	0.857	0.16	7.96	2.36	0.93	246	28.0
146	1000	-	0.868	0.24	7.78	2.38	0.83	241	72.4
148	1300	161.0	1.038	-	-	-	-	-	122.0
150	1210	141.0	0.913	-	-	-	-	-	71.2

- DATA NOT AVAILABLE