AMBIENT WATER QUALITY MONITORING FOR SELECTED ORGANIC CHEMICALS AND HEAVY METALS IN THE RUSSIAN RIVER, 1983-84

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INTRODUCTION

The Russian River currently serves as the domestic water supply for over 300,000 people in Mendocino, Sonoma, and Marin counties. In addition, agricultural water supply, water contact recreation, fisheries, and aesthetics are major beneficial uses of the main stem Russian River and its major tributaries. Numerous communities with varying degrees of industrialization are located along U.S. Highway 101, which parallels the Russian River for about three-quarters of its length.

The Russian River flows in a southerly direction for about 177 kilometers (110 miles) from Mendocino County into Sonoma County, before turning to the west through a canyon entering the Pacific Ocean at Jenner. Total drainage area is 1485 square miles, characterized by relatively steep coastal mountains grading into alluvial valleys through which the river flows. Soils in the coastal ranges are unstable and erodable.

The climate of the area is Mediterranean-type with rainfall ranging from about 40 inches per year in the valleys to nearly 100 inches annually in the mountains. Hydrology is rainfall-runoff, regulated by Coyote Dam and Lake Mendocino in the upper reaches near Ukiah. Streamflows in the winter time are variable, dependent on rainfall and runoff conditions. Summertime flows are augmented by importation of Eel River water to the East Fork at Potter Valley. Construction of Warm Springs Dam on Dry Creek is complete, and operation of the dam to further regulate/augment flows in the lower river is scheduled for late 1985.

Eight major streams are tributary to the Russian River. From headwaters to mouth they are: the river's East Fork, Robinson Creek, Feliz Creek, Big Sulphur Creek, Maacama Creek, Dry Creek, Mark West Creek, and Austin Creek. The reader is referred to U.S. Army (1982) for more detailed information on the topography, hydrology, and geology of the Russian River drainage.

The prime beneficial uses that are supported by the Russian River and the possibility of spills and/or discharges of industrial and/or agricultural chemicals reaching the river necessitate close vigilance of its water quality. This study consisted of synoptic monitoring to describe the ambient water quality of the Russian River with respect to the occurrence of selected organic chemicals and heavy metals. Sample station locations were selected to bracket major municipal, industrial, and agricultural areas in the Russian River drainage (Figure 1). Sample analysis concentrated on those constitutents most likely to be found in the river and pose a threat to the health and safety of those using the river.

This report describes the monitoring program and its results, and makes recommendations regarding future monitoring. All raw data are contained in the Appendix, summarized data appear in the text.

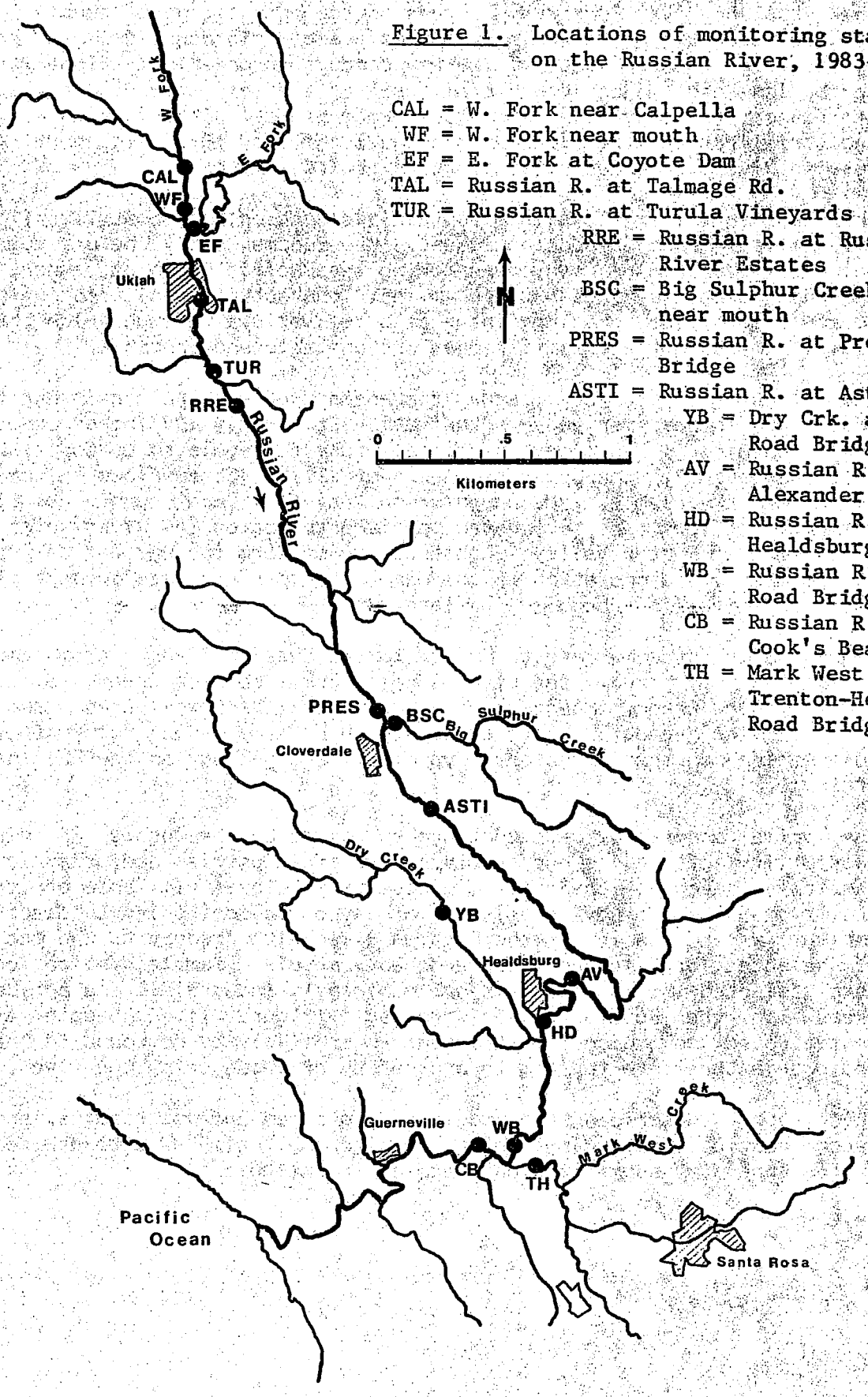

Figure 1. Locations of monitoring stations on the Russian River, 1983-84.

CAL = W. Fork near Calpella
WF = W. Fork near mouth
EF = E. Fork at Coyote Dam
TAL = Russian R. at Talmage Rd.
TUR = Russian R. at Turula Vineyards
RRE = Russian R. at Russian River Estates
BSC = Big Sulphur Creek near mouth
PRES = Russian R. at Preston Bridge
ASTI = Russian R. at Asti
YB = Dry Crk. at Yoakim Road Bridge
AV = Russian R. at Alexander Valley Br
HD = Russian R. below Healdsburg Dam
WB = Russian R. at Wohle Road Bridge
CB = Russian R. at Cook's Beach
TH = Mark West Creek at Trenton-Healdsburg Road Bridge

MATERIALS AND METHODS

Fifteen stations were sampled seven times from September of 1983 through April of 1984 for a variety of organic chemicals, heavy metals, and general chemistry (Table 1). With two exceptions, all stations were sampled each sampling run. The Turula station was abandoned due to inaccessibility during wintertime flow conditions, when the Russian River Estates station was substituted (Figure 1).

All samples were taken following EPA (1980) sampling protocols. When possible, samples were taken from the centroid of flow. All samples were placed on ice and returned to the laboratory the same day as sampled. Analyses for pH, conductance, and alkalinity were performed by Regional Board (RB) staff. All other analyses were done at a contract lab. Methodology followed that contained in Standard Methods for the Examination of Water and Wastewater (APHA 1980) and/or Methods for Chemical Analysis of Water and Wastes (EPA 1983). The exception was for formaldehyde, which was measured by an adaptation of a method for air samples involving distillation of sample followed by chromotropic acid colorimetry; the minimum detection was 0.04 mg/l. Standard protocols for quality control (EPA 1972) were employed on all sample analyses at both the contract laboratory and the RB lab.

Table 1. Sampling matrix for the Russian River monitoring denoting numbers of samples by constituent and location for the period from September 29, 1983 through April 10, 1984.

Constituent	CAL	WF	EF	TAL	TUR	RRE	PRES	BSC	ASTI	AV	HD	YB	WB	TH	CB
pH	7	7	7	7	3	4	7	7	7	7	7	7	7	7	7
Conductance	7	7	7	7	3	4	7	7	7	7	7	7	7	7	7
Alkalinity	7	7	7	7	3	4	7	7	7	7	7	7	7	7	7
Dissolved metals:															
Arsenic	7	7	7	7	3	4	7	7	7	7	7	7	7	7	7
Chromium	7	7	7	7	3	4	7	7	7	7	7	7	7	7	
Hexavalent Chromium	7	7	7	7	3	4	7	7	7	7	7	7	7	7	7
Copper	7	7	7	7	3	4	7	7	7	7	7	7	7	7	7
Volatile organics scan*	6	1	6	1	4	3	4	3	1	4	1	--	5	4	5
Total phenols**	6	--	6	--	4	3	4	3	--	5	--	--	4	4	4
Formaldehyde	6	1	6	1	4	4	4	5	1	6	1	--	6	6	7
Polychlorinated biphenyls	4	--	4	--	4	1	3	2	--	4	--	--	3	3	3
Phenoxy herbicides +	3	--	3	--	4	--	2	2	--	3	--	--	3	3	3
Pentachlorophenol	4	--	4	--	4	1	3	2	--	4	--	--	3	3	3
2,3,4,6-tetrachloro-phenol	4	--	4	--	4	1	3	2	--	4	--	--	3	3	3

* includes benzene, 1,1- and 1,2-dichloroethane, dichloromethane, 1,2- and 1,3-dichloropropane, cis- and trans-1,3-dichloropropene, isopropanol, methanol, methyl bromide, methyl ethyl ketone, toluene, 1,1,1-trichloroethane, trichloroethylene, trichloromethane, and m-,o-, p-xylene.

** total colorometric phenolic compounds.

+ includes 2,4-D, 2,4,5-T, and 2,4,5-TP,

RESULTS

General Chemistry

Alkalinity, pH, and conductance data characterize the Russian River as moderately buffered at slightly above neutral pH with moderate conductance (Table 2). Conductance and alkalinity for any single sampling date generally decreased with distance from the mouth (Figures 2 and 3). The pH varied only slightly (Table 2).

Of the three major tributaries monitored Big Sulphur Creek and Mark West Creek had significantly higher alkalinity and conductance than any of the other Russian River stations (Table 2).

Dissolved Metals

Minimum detection limits for metals analyses (arsenic excepted) varied with changes in suspended sediment levels. The lower detection limits were attained at lower suspended sediment levels. Detection levels were as follows: arsenic = 5 ug/l, chromium and hexavalent chromium = 5-10 ug/l, copper = 5-20 ug/l.

Dissolved metals were detected near the limits of detection on only three occasions, involving copper and chromium. Copper was detected at station "AV" at 30 ug/l on February 16, 1984, and at station "RRE" at 20 ug/l on April 10, 1984. Chromium (all valences) was detected at station "CAL" at 10 ug/l on April 10, 1984. (Raw data contained in Appendix)

Organics

Of those organic compounds analyzed only total phenolics and formaldehyde were detected during this monitoring program. (Minimum levels of detection for all organic analyses are included in the Appendix.) The occurrence of total phenolics was sporadic and showed no trend except on October 20, 1983, where a higher concentration from station "TH" apparently elevated phenolics in the Russian River from 25 mg/l at "WB" to 80 mg/l at "CB".

Formaldehyde ranging from non-detectable (at 10 ug/l) to 330 ug/l was detected in six of nine samples from the first sampling, September 29, 1983. Those analyses, however, are suspect for reasons discussed later in this report. Formaldehyde was detected again at the lower level of detection (40 ug/l) only at station "RRE" on April 10, 1984. It was later discovered that the pesticide bottles from the first sampling had received a final rinse with methyl chloride, which may contain small amounts of formaldehyde as a contaminant. Based on that and the results of subsequent samplings, the first sample set for formaldehyde was deemed suspect of contamination, and the data from the September 29, 1983, sampling not used. A separate monitoring program in the Ukiah area, however, did detect formaldehyde in the Russian River between the confluence of the East and West forks and station "TAL", and is the subject of a separate report (RWQCB 1984).

Table 2. Mean, range, and standard deviation for alkalinity, pH, and conductance at 15 Russian River stations from September 29, 1983 through April 10, 1984.

Station	Alkalinity (mg/L)	pH (standard units)	Conductance (umho/cm)
CAL	69/37-120/36*	7.4/5.9-8.2/0.7	168/100-286/82
WF	74/41-125/35	7.4/6.1-8.2/0.6	179/100-286/78
EF	63/35-78/14	7.5/6.3-8.1/0.6	144/104-173/22
TAL	60/36-78/15	7.4/6.2-8.0/0.6	141/110-178/27
TUR	67/35-83/27	7.7/7.5-8.0/0.3	155/99-194/50
RRE	63/51-88/17	7.3/6.4-7.6/0.6	148/110-210/43
PRES	73/36-95/21	7.5/6.4-8.0/0.5	164/108-205/36
BSC	114/51-160/40	7.8/7.4-8.2/0.4	272/139-394/106
ASTI	79/40-100/23	7.8/7.1-8.2/0.4	177/115-216/45
AV	83/43-110/26	7.6/6.7-8.1/0.5	194/125-243/50
YB	78/48-130/33	7.6/7.1-8.1/0.3	196/113-297/66
HD	86/43-115/28	7.8/7.4-8.2/0.3	180/127-259/56
WB	84/44-120/29	7.7/7.2-8.2/0.4	192/126-270/58
TH	118/33-210/65	7.5/6.9-7.9/0.3	339/128-578/168
CB	84/41-120/30	7.7/7.2-8.1/0.3	204/118-281/65

* mean/range/SD
Number of observations (n) = 7 for all stations except TUR and RRE, where n = 3 and 4, respectively.

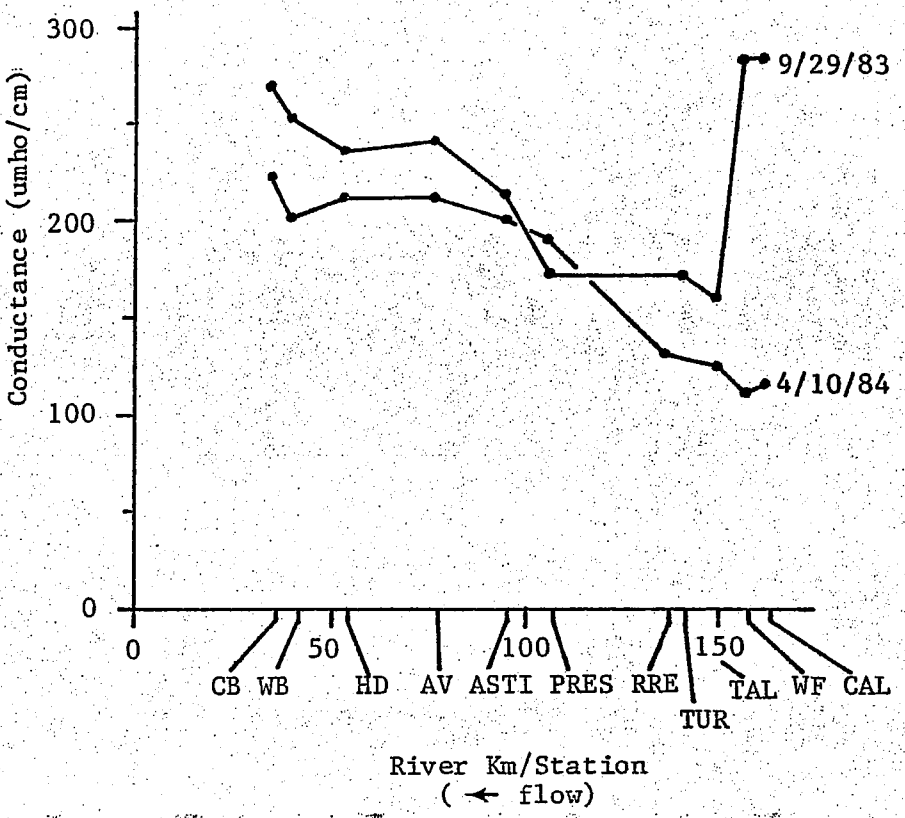

Figure 2. Conductance of Russian River on September 29, 1983 and April 10, 1984.

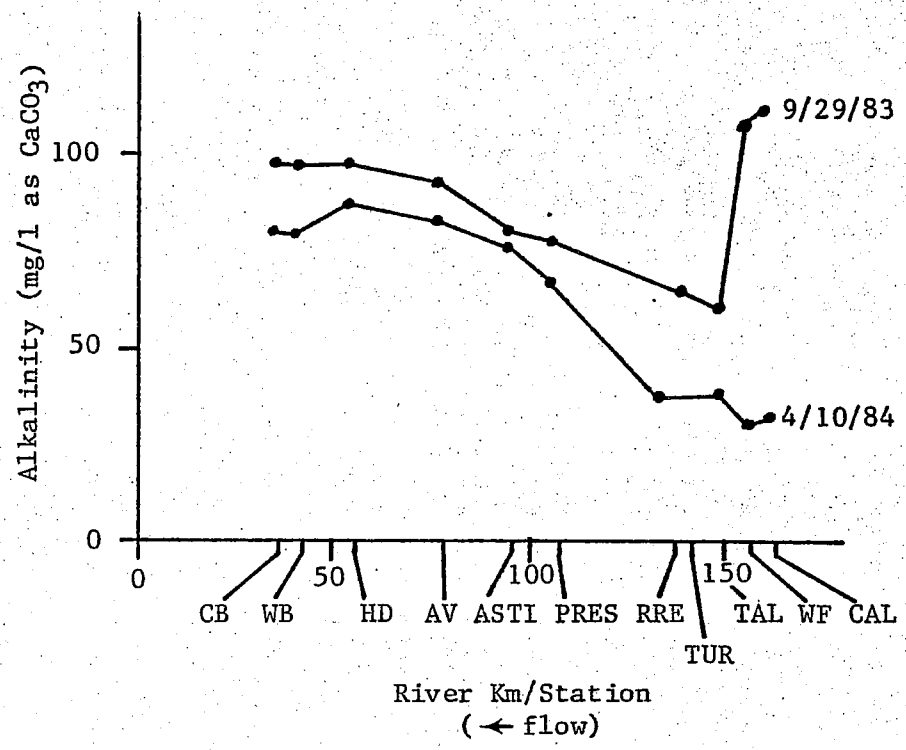

Figure 3. Total alkalinity of Russian River on September 29, 1983 and April 10, 1984.

DISCUSSION AND CONCLUSIONS

Although rather limited in scope, this monitoring program provided some answers to the questions of toxics monitoring in the Russian River basin. A synoptic survey of this type is limited in its ability to detect anything but constant discharge effects or some occasional/coincidental occurrences of toxic pollutants. The formaldehyde detected in the upper basin was a seasonal event, detected occasionally during the winter months in the river. The other constituents, however either do not exist in the river above the levels of detection, or the sampling simply missed those occurrences. Likely the latter is true. However, without more frequent sampling or more refined sampling methods, that still remains a question.

The high formaldehyde values for September 29, 1983 bear explanation. Those analyses were done on samples collected in bottles prepared for pesticide scans. All subsequent monitoring for formaldehyde was done with bottles specially prepared for formaldehyde sampling. It was later discovered that the pesticide bottles from the first sampling had received a final rinse with methyl chloride, which may contain small amounts of formaldehyde as a contaminant. Based on that and the results of subsequent samplings, the first sample set for formaldehyde was deemed suspect of contamination, and the data from the September 29, 1983, sampling was not used.

A separate monitoring program in the Ukaih area, however, did detect formaldehyde in the Russian River between the confluence of the East and West forks and station "TAL" (RWQCB 1984). That particular area is the subject of a more intensive effort for the winter of 1984-85, including both source and receiving water sampling. That sampling program should provide sufficient information to eliminate the known source in the near future. Further work is being done on other suspected sources in the immediate Ukiah area.

A federally funded program (Section 205(j) of the Water Quality Control Act of 1982) undertaken by State and Regional Board staff provides for some research and testing of innovative resin column sampling techniques in the Russian River basin. If successful, those studies should provide improved techniques of sampling the river over long periods of time, through accumulation of compounds on the resin during the sampling period. That accumulation of compounds over time will essentially integrate sporadic concentrations throughout the sampling period and provide increased detection sensitivity of toxic pollutants in the water column. The results of those studies may result in detection of other sources in the basin, which will become the focus of more intensive monitoring and enforcement efforts in the future.

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APPENDIX 1

Russian River station coding - 1983-84

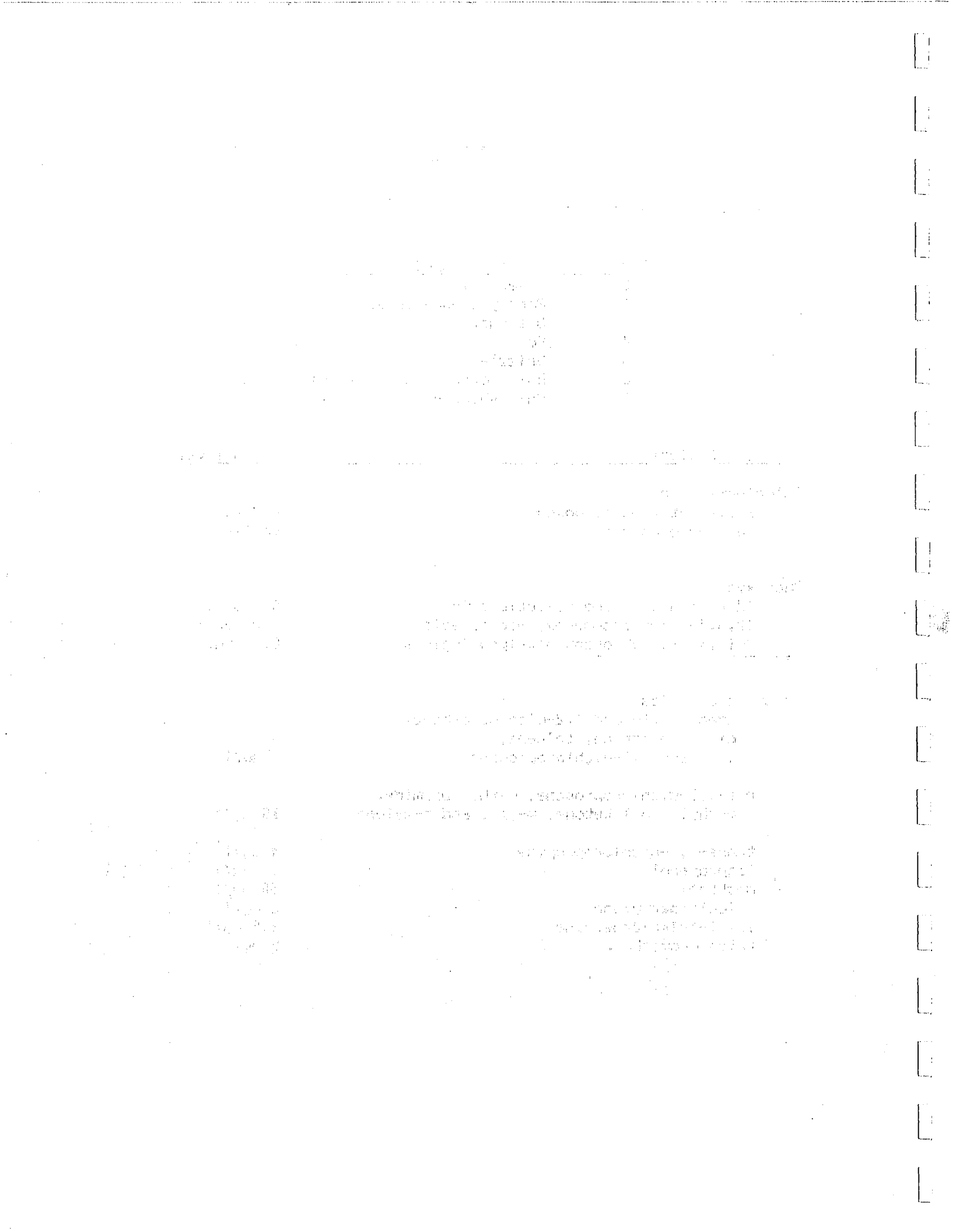
Station Descriptor	Acronym	STORET Code
W. Fk. Russian R. nr Calpella	CAL	WB01B0527041802
W. Fk. Russian R. nr Ukiah	WF	WB01B0527041801
E. Fk. Russian R. nr Ukiah	EF	WB01B0527040016
Russian R. at Talmage	TAL	WB01B0527040015
Russian R. at Turula Vineyard	TUR	WB01B0527040014
Russian R. at RR Estates	RRE	WB01B052704013A
Russian R. at Preston	PRES	WB01B0527040011
Big Sulphur Crk. nr Mouth	BSC	WB01B0527160001
Russian R. at Asti	ASTI	WB01B0527040010
Russian R. nr Jimtown	AV	WB01B0527040008
Russian R. at Healdsburg Dam	HD	WB01B0527040007
Dry Crk. at Yoakim Br.	YB	WB01B0527041501
Russian R. at Wohler Br.	WB	WB01B0527040006
Mark West Crk.at Trenton-Healdsburg Rd.	TH	WB01B0528050001
Russian R. at Cooks Beach	CB	WB01B052704005A

APPENDIX 2

WMO codes and analyte list for Russian River monitoring - 1983-84

Code	Weather condition
0	Clear skies
1	Partly cloudy skies
2	Overcast
4	Fog
5	Drizzle
6	Rain (other than showers)
8	Rain showers

Analyte	Detection level
Chlorinated Phenols	
2,3,4,6-tetrachlorophenol	varies
pentachlorophenol	varies
Phenoxys	
(2,4-dichlorophenoxy)acetic acid	0.2 ug/l
(2,4,5-trichlorophenoxy)acetic acid	0.01 ug/l
2-(2,4,5-trichlorophenoxy)propionic acid	0.01 ug/l
Volatile Organics	
benzene, 1,1- and 1,2-dichloroethane, dichloromethane, toluene, 1,2- and 1,3-dichloropropane	1 ug/l
cis-1,3-dichloropropene, methyl bromide, methyl ethyl ketone, m-,p-, and o-xylene	10 ug/l
trans-1,3-dichloropropene	4 ug/l
isopropanol	15 ug/l
methanol	50 ug/l
trichloroethylene	2 ug/l
1,1,1-trichloroethane	2.5 ug/l
trichloromethane	5 ug/l



APPENDIX 3

Raw data for Russian River monitoring of 1983-84

RUSSIAN RIVER DATA - SEPT 29, 1983
all data in ug/l unless otherwise noted

Station *	CAL	WF	EF	TAL	TUR	PRES	BSC	ASTI
Time	1000	1042	1035	1055	1130	1205	1230	1240
Weather **	2	2	2	2	2	2	2	2
Water temp. (C)	17	18	17	17	17	18	19	18
Alkalinity (mg/l)	120	125	78	78	82	95	160	98
Conductance (umho/cm)	285	285	160	160	175	175	395	215
pH (units)	8.2	8.2	8.1	8.0	8.0	8.0	8.0	8.2
Copper +	<10 ug/l at all stations sampled							
Arsenic	<5 ug/l at all stations sampled							
Chromium	<5 ug/l at all stations sampled							
Chromium (+VI)	<5 ug/l at all stations sampled							
Phenolics	<10		<10		<10	30	<10	
Pentachlorophenol	<0.1		<0.1		<0.1	<0.1	<0.1	
Tetrachlorophenol	<0.1		<0.1		<0.1	<0.1	<0.1	
Formaldehyde ++	<10		80		<10	80	70	
Phenoxys^	below level of detection at all stations sampled							
PCB's	<0.02		<0.02		<0.02	<0.02	<0.02	
Volatile organics^	below level of detection at all stations sampled							

Station	AV	YB	HD	WB	TH	CB
Time	1330	1355	1420	1510	1445	1530
Weather	2	2	2	2	2	2
Water temp. (C)	19	19	20	20	20	20
Alkalinity (mg/l)	110	130	115	115	210	115
Conductance (umho/cm)	245	295	240	255	540	270
pH (units)	8.1	8.1	8.0	8.1	7.9	8.1
Copper	<10 ug/l at all stations sampled					
Arsenic	<5 ug/l at all stations sampled					
Chromium	<5 ug/l at all stations sampled					
Chromium (+VI)	<5 ug/l at all stations sampled					
Phenolics	<10			<10	30	<10
Pentachlorophenol	<0.1			<0.1	<0.1	<0.1
Tetrachlorophenol	<0.1			<0.1	<0.1	<0.1
Formaldehyde	60			330	<10	320
Phenoxys	below level of detection at all stations sampled					
PCB's	<0.02			<0.02	<0.02	<0.02
Volatile organics	below level of detection at all stations sampled					

* refer to Appendix 1 for a listing of stations
** WMO codes
+ all metals are as dissolved
++ values suspect due to methylene chloride/formaldehyde contamination
^ refer to Appendix 2 for a listing of analytes and detection levels

RUSSIAN RIVER DATA - OCT 20, 1983

all data in ug/l unless otherwise noted

Station	CAL	WF	EF	TAL	TUR	PRES	BSC	ASTI
Time	0956	1055	1031	1115	1140	1230	1235	1300
Weather **	2	1	2	1	1	1	1	1
Water temp. (C)	15	16	19	19	18	17	15	17
Alkalinity (mg/l)	120	120	75	77	83	90	160	100
Conductance (umho/cm)	280	280	175	180	195	205	415	215
pH (units)	7.7	7.8	7.6	7.6	7.6	7.9	8.2	8.1
Copper +	<5 ug/l at all stations sampled							
Arsenic	<5 ug/l at all stations sampled							
Chromium	<10 ug/l at all stations sampled							
Chromium (+VI)	<10 ug/l at all stations sampled							
Phenolics	<10		<10		110			
Pentachlorophenol	<0.1		<0.1		<0.1			
Tetrachlorophenol	<0.1		<0.1		<0.1			
Formaldehyde	<10		<10		<10			
Phenoxys^	below level of detection at all stations sampled							
PCB's	<0.02		<0.02		<0.02			
Volatile organics^	below level of detection at all stations sampled							

Station	AV	YB	HD	WB	TH	CB
Time	1330	1320	1420	1530	1445	1630
Weather	1	1	1	1	1	1
Water temp. (C)	19	18	18	19	18	18
Alkalinity (mg/l)	105	120	115	120	200	120
Conductance (umho/cm)	250	260	260	270	580	280
pH (units)	7.9	7.7	7.9	8.0	7.9	8.0
Copper +	<5 ug/l at all stations sampled					
Arsenic	<5 ug/l at all stations sampled					
Chromium	<10 ug/l at all stations sampled					
Chromium (+VI)	<10 ug/l at all stations sampled					
Phenolics	<10			25	130	80
Pentachlorophenol	<0.1			<0.1	<0.1	<0.1
Tetrachlorophenol	<0.1			<0.1	<0.1	<0.1
Formaldehyde	<10			<10	<10	<10
Phenoxys	below level of detection at all stations sampled					
PCB's	<0.02			<0.02	<0.02	<0.02
Volatile organics	below level of detection at all stations sampled					

* refer to Appendix 1 for a listing of stations
** WMO codes (Appendix 2)
+ all metals are as dissolved
^ refer to Appendix 2 for a listing of analytes and detection levels

RUSSIAN RIVER DATA - NOV 17, 1983
all data in ug/l unless otherwise noted

Station	CAL	WF	EF	TAL	TUR	PRES	BSC	ASTI
Time	1010	1025	1035	1100	1130	1215	1230	1325
Weather **	2	2	2	2	2	2	2	2
Water temp. (C)	12	12	15	14	13	14	13	13
Alkalinity (mg/l)	37	65	35	36	35	36	51	40
Conductance (umho/cm)	110	190	105	110	100	110	140	115
pH (units)	7.5	7.4	7.5	7.4	7.5	7.5	7.4	7.5
Copper +	<20 ug/l at all stations sampled							
Arsenic	<5 ug/l at all stations sampled							
Chromium	<10 ug/l at all stations sampled							
Chromium (+VI)	<10 ug/l at all stations sampled							
Phenolics	<10		<10		<10	<10	<10	
Pentachlorophenol	<0.12		<0.12		<0.12	<0.12	<0.12	
Tetrachlorophenol	<0.2		<0.2		<0.2	<0.2	<0.2	
Formaldehyde	<40		<40		<40	<40	<40	
Phenoxys^	below level of detection at all stations sampled							
PCB's	<0.02		<0.02		<0.02	<0.02	<0.02	
Volatile organics^	below level of detection at all stations sampled							

Station	AV	YB	HD	WB	TH	CB
Time	1350	1425	1500	1530	1520	1615
Weather **	5	2	2	2	2	2
Water temp. (C)	15	15	15	15	14	15
Alkalinity (mg/l)	43	50	43	44	33	41
Conductance (umho/cm)	125	150	125	125	130	120
pH (units)	7.5	7.4	7.5	7.5.	7.5	7.5
Copper	<20 ug/l at all stations sampled					
Arsenic	<5 ug/l at all stations sampled					
Chromium	<10 ug/l at all stations sampled					
Chromium (+VI)	<10 ug/l at all stations sampled					
Phenolics	<10			<10	<10	<10
Pentachlorophenol	<0.12			<0.12	<0.12	<0.12
Tetrachlorophenol	<0.2			<0.2	<0.2	<0.2
Formaldehyde	<40			<40	<40	<40
Phenoxys	below level of detection at all stations sampled					
PCB's	<0.02			<0.02	<0.02	<0.02
Volatile organics	below level of detection at all stations sampled					

* refer to Appendix 1 for a listing of stations
** WMO codes (Appendix 2)
+ all metals are as dissolved
^ refer to Appendix 2 for a listing of analytes and detection levels

RUSSIAN RIVER DATA - DEC 15, 1983

all data in ug/l unless otherwise noted

Station	CAL	WF	EF	TAL	RRE	PRES	BSC	ASTI
Time	0925	1020	1000	1030	1100	1140	1200	1220
Weather **	2	2	2	2	2	2	1	1
Water temp. (C)	12	12	12	13	13	13	14	13
Alkalinity (mg/l)	50	50	60	58	60	67	88	72
Conductance (umho/cm)	115	120	135	135	140	155	180	145
pH (units)	7.5	7.5	7.6	7.6	7.6	7.7	7.7	7.7
Copper +	<20 ug/l at all stations sampled							
Arsenic	<5 ug/l at all stations sampled							
Chromium	<5 ug/l at all stations sampled							
Chromium (+VI)	<5 ug/l at all stations sampled							
Phenolics	<10		<10		<10	<10	<10	
Pentachlorophenol	<0.1		<0.1		<0.1	<0.1	<0.1	
Tetrachlorophenol	<0.1		<0.1		<0.1	<0.1	<0.1	
Formaldehyde					<40			
PCB's	<0.02		<0.02		<0.02	<0.02	<0.02	
Volatile organics^	below level of detection at all stations sampled							

Station	AV	YB	HD	WB	TH	CB
Time	1315	0815	1340	1500	1410	1530
Weather **	1	4	1	1	1	2
Water temp. (C)	14	13	14	13	13	13
Alkalinity (mg/l)	75	48	74	65	80	65
Conductance (umho/cm)	150	115	150	155	230	145
pH (units)	7.7	7.8	7.7	7.7	7.6	7.7
Copper	<20 ug/l at all stations sampled					
Arsenic	<5 ug/l at all stations sampled					
Chromium	<5 ug/l at all stations sampled					
Chromium (+VI)	<5 ug/l at all stations sampled					
Phenolics	<10			<10	<10	<10
Pentachlorophenol	<0.1			<0.1	<0.1	<0.1
Tetrachlorophenol	<0.1			<0.1	<0.1	<0.1
Formaldehyde						<40
PCB's	<0.02			<0.02	<0.02	<0.02
Volatile organics	below level of detection at all stations sampled					

* refer to Appendix 1 for a listing of stations
** WMO codes (Appendix 2)
+ all metals are as dissolved
^ refer to Appendix 2 for a listing of analytes and detection limits

RUSSIAN RIVER DATA - JAN 19 ,1984

all data in ug/l unless otherwise noted

Station	CAL	WF	EF	TAL	RRE	PRES	BSC	ASTI
Time	0945	1000	1015	1040	1100	1130	1145	1245
Weather **	0	0	0	0	0	0	0	0
Water temp. (C)	7	7	10	9	10	9	8	10
Alkalinity (mg/l)	66	68	62	67	88	81	120	90
Conductance (umho/cm)	165	165	145	165	210	190	285	215
pH (units)	7.5	7.6	7.6	7.5	7.5	7.4	7.8	7.8
Copper +	<20 ug/l at all stations sampled							
Arsenic	<5 ug/l at all stations sampled							
Chromium	<5 ug/l at all stations sampled							
Chromium (+VI)	<5 ug/l at all stations sampled							
Formaldehyde	<13		<13		<13	<13	<13	
Volatile organics^	below level of detection at all stations sampled							

Station	AV	YB	HD	WB	TH	CB
Time	1340	1315	1350	1430	1500	1450
Weather **	2	2	2	2	2	2
Water Temp. (C)	10	12	10	11		11
Alkalinity (mg/l)	93	61	94	89	120	91
Conductance (umho/cm)	220	225	140	210	385	235
pH (units)	7.7	7.4	7.6	7.4	7.4	7.4
Copper	<20 ug/l at all stations sampled					
Arsenic	<5 ug/l at all stations sampled					
Chromium	<5 ug/l at all stations sampled					
Chromium (+VI)	<5 ug/l at all stations sampled					
Formaldehyde	<13			<13		<13
Volatile organics	below level of detection at all stations sampled					

* refer to Appendix 1 for a listing of stations
** WMO codes (Appendix 2)
+ all metals are as dissolved
^ refer to Appendix 2 for a listing of analytes and detection limits

RUSSIAN RIVER DATA - FEB 16, 1984

all data in ug/l unless otherwise noted

Station	CAL	WF	EF	TAL	RRE	PRES	BSC	ASTI
Time	0945	1040	1020	1110	1140	1210	1245	1315
Weather **	1	1	1	1	1	1	1	1
Water temp. (C)	8	8	9	10	9	9	10	10
Alkalinity (mg/l)	42	41	66	51	51	55	88	60
Conductance (umho/cm)	100	100	140	110	110	130	200	130
pH (units)	5.9	6.1	6.3	6.2	6.4	6.4	7.4	7.1
Copper +	<20	<20	<20	<20	<20	<20	<20	<20
Arsenic	<5 ug/l at all stations sampled							
Chromium	<10 ug/l at all stations sampled							
Chromium (+VI)	<10 ug/l at all stations sampled							
Phenolics	<10		<10		<10	<10	<10	
Formaldehyde	<40		<40		<40	<40	<40	

Station	AV	YB	HD	WB	TH	CB
Time	1340	1405	1435	1525	1505	1550
Weather	1	1	1	1	1	1
Water temp. (C)	10	12	11	10	11	10
Alkalinity (mg/l)	54	66	59	59	80	60
Conductance (umho/cm)	160	160	130	130	240	150
pH (units)	6.7	7.1	7.4	7.2	6.9	7.2
Copper	30	<20	<20	<20	<20	<20
Arsenic	<5 ug/l at all stations sampled					
Chromium	<10 ug/l at all stations sampled					
Chromium (+VI)	<10 ug/l at all stations sampled					
Phenolics	<10			<10	<10	<10
Formaldehyde	<40			<40	<40	<40

* refer to Appendix 1 for a listing of stations
** WMO codes (Appendix 2)
+ all metals are as dissolved
^ refer to Appendix 2 for a listing of analytes and detection limits

RUSSIAN RIVER DATA - APR 10, 1984
all data in ug/l unless otherwise noted

Station	CAL	WF	EF	TAL	RRE	PRES	BSC	ASTI
Time	0930	1000	1015	1045	1135	1215	1230	1320
Weather **	8	2	2	2	2	1	1	1
Water temp. (C)	11	11	10	11	11	12	14	14
Alkalinity (mg/l)	49	48	66	55	54	84	130	93
Conductance (umho/cm)	115	115	150	130	135	190	290	205
pH (units)	7.6	7.6	7.7	7.7	7.7	7.9	8.4	8.1
Copper +	<20 ug/l at all stations sampled							
Arsenic	<5 ug/l at all stations sampled							
Chromium	10	<10	<10	<10	<10	<10	<10	<10
Chromium (+VI)	<10 ug/l at all stations sampled							
Formaldehyde	<40	<40	<40	<40	40	<40	<40	<40
Volatile organics^	below level of detection at all stations sampled							

Station	AV	YB	HD	WB	TH	CB
Time	1350	1420	1445	1540	1515	1605
Weather	1	1	1	1	1	1
Water temp. (C)	15	14	15	16	15	15
Alkalinity (mg/l)	100	69	105	97	105	98
Conductance (umho/cm)	215	170	215	205	270	225
pH (units)	8.0	7.4	8.2	8.2	7.6	8.0
Copper +	<20 ug/l at all stations sampled					
Arsenic	<5 ug/l at all stations sampled					
Chromium	<10	<10	<10	<10	<10	<10
Chromium (+VI)	<10 ug/l at all stations sampled					
Formaldehyde	<40	<40	<40	<40	<40	<40
Volatile organics	below level of detection at all stations sampled					

* refer to Appendix 1 for a listing of stations
** WMO codes (Appendix 2)
+ all metals are as dissolved
^ refer to Appendix 2 for a listing of analytes and detection limits