INTERIM STAFF REPORT

regarding

RUSSIAN RIVER WATER QUALITY MONITORING

by

North Coast Regional Water Quality Control Board
5550 Skylane Boulevard
Santa Rosa, California 95403

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CONTENTS

(RRREPORT)

I. EXECUTIVE SUMMARY

The Regional Board has been monitoring Russian River water quality since 1972. This staff report contains a summary and evaluation of Russian River water quality data collected from 1972 through 1992. The objective of this report is to communicate to the Regional Board and interested public the status of Russian River water quality and to provide recommendations based on the data evaluation.

Water quality parameters evaluated in this report include: nutrients (nitrate and total phosphate), bacteria (total and fecal coliform), physico-chemical (dissolved oxygen, temperature, total dissolved solids, pH, and specific conductance), toxic chemicals (based on Tables 1 and 2 of the State Inland Surface Waters Plan), and biological parameters (vascular plants and algae). Water quality objectives for many of the parameters are contained in the Water Quality Control Plan for the North Coast Region (Basin Plan) and the Inland Surface Waters Plan.

Significant improvements have been made in Russian River water quality since the 1970's. In particular, significant decreases in the levels of nutrients (i.e., nitrates and phosphates) and bacteria in the river and its tributaries can be attributed to increased levels of pollution control at municipal, industrial, and agricultural facilities, seasonal prohibitions disallowing discharges to the river during low flow recreational periods, and increased public awareness regarding water quality issues. Recent water quality data (1985 to 1992) demonstrate that, overall, the water quality of the Russian River and its tributaries is good. Currently, the water quality of the Russian River is sufficient to support, and in some cases enhance all of its beneficial uses.

Occasional exceedances of water quality objectives have been observed, particularly with regard to bacteria. These exceedances are and will continue to be dealt with through existing regulatory programs wherever trends or significant occurrences are found.

The next Russian River water quality monitoring update is scheduled near the end of this fiscal year to address issues of immediate concern, including expanded evaluations of the biological health of the river, revised monitoring strategies to address temperature, dissolved oxygen, and pH sampling problems, and cumulative impacts of permitted waste discharges on water quality. Thereafter, updates should be scheduled at least annually.

II. INTRODUCTION

The Regional Board has been monitoring Russian River water quality since 1972. Between 1972 and 1978 the Board participated in an intensive monitoring effort. The monitoring effort was scaled down for the years 1979 to 1985. The Board reestablished intensive water quality monitoring in the Laguna de Santa Rosa and Russian River in September, 1985.

The initial objective of the monitoring program established in September, 1985 was to identify and assess any adverse effects on these two water bodies resulting from wastewater discharged from the Laguna Regional Wastewater Treatment Plant (Laguna WTP). The monitoring program was then expanded to assess any adverse effects of wastewater discharges on the entire Russian River system. Monitoring provides current water quality information to support the Regional Board's regulatory functions, management decisions, and planning activities. The water quality information is currently being used to support the Russian River water quality model that has been designed by the UC Davis Water Quality Modeling group for the Regional Board. The model will be used to evaluate the individual and cumulative impacts of discharges to the Russian River. The model will assist Regional Board staff in updating water quality management plans for the Russian River.

Progress reports regarding the status of the Russian River water quality monitoring were presented to the Regional Board and the interested public on January 30, 1986, May 7, 1986, January 22, 1987, December 1, 1988, and April 26, 1989. The most recent report to the Board, on April 26, 1989, concluded that, for the most part, the water quality of the Russian River and its tributaries was good as measured by conventional means.

This report is the first in a series of recent updates. This report contains 1) a summary and written evaluation of data collected in fiscal years 1989-90, 1990-91, and 1991-92; 2) graphical presentations and evaluation of monitoring data collected from September, 1985 through September, 1992; and 3) comparisons of current data to data collected in the 1970's.

The Russian River Basin

The Russian River basin (Figure 1) is on the north coast of California primarily in Sonoma and Mendocino Counties (less than 1 percent is in Lake County). The basin is about 80 miles long and from 10 to 30 miles wide with its major axis generally paralleling the coastline. The mainstem of the Russian River is about 110 miles long and flows southward from its headwaters near Redwood and Potter Valleys to Mirabel Park where the direction of flow changes to westward as the river transects a part of the Coast Ranges. Principal tributaries of the Russian River are Big Sulphur Creek, Dry Creek, Mark West Creek (which receives flow from the Laguna de Santa Rosa) and Austin Creek. Most of the annual flow of the Russian River occurs during the wet-weather season (October to May). Russian River flow is augmented by releases from Coyote Dam (which impounds Lake Mendocino at the upper reaches of the Russian River) and Warm Springs Dam (which impounds Lake Sonoma at the upper reaches of Dry Creek) year-round,

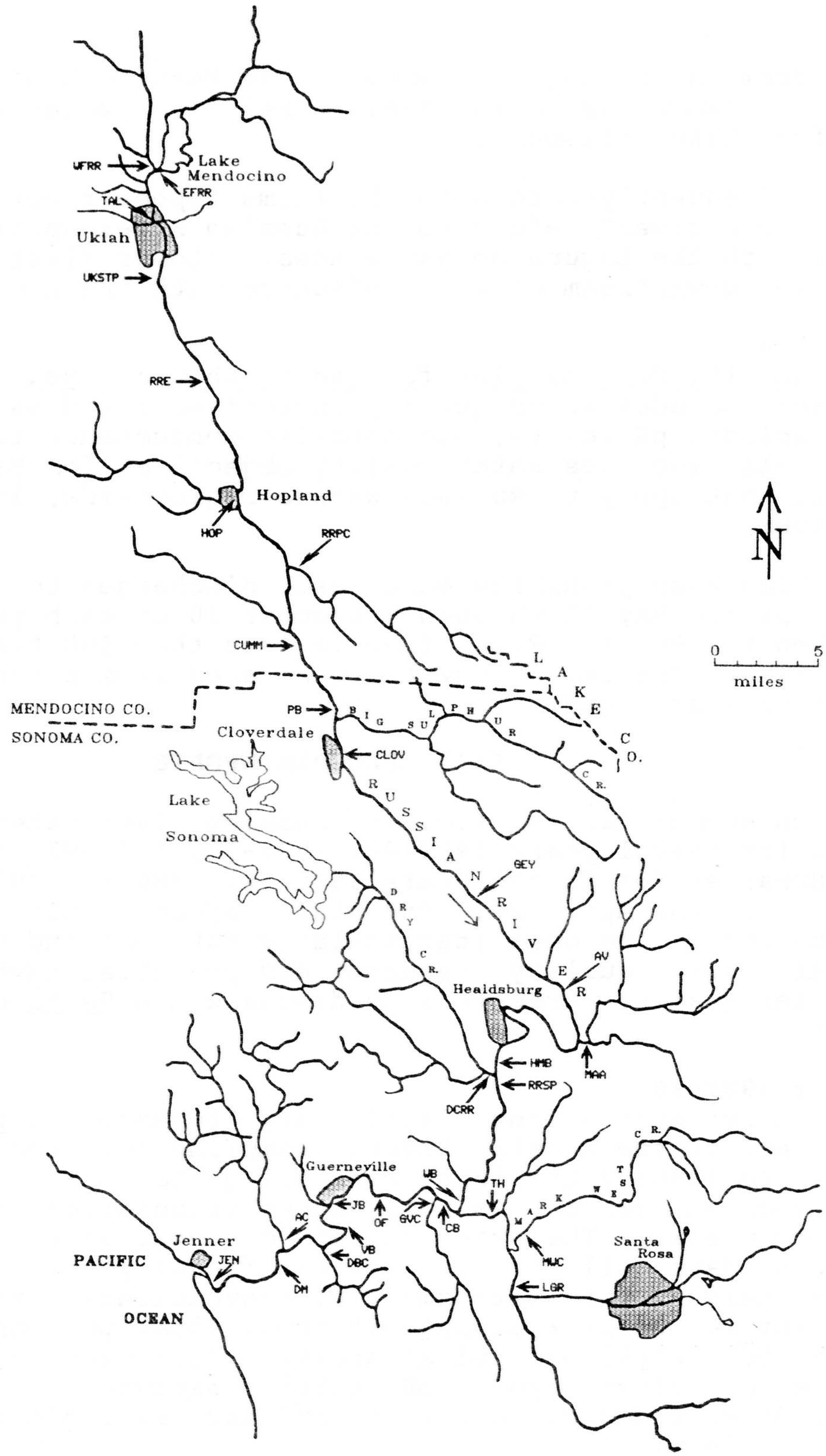


Figure 1. The Russian River drainage basin and locations of the major water quality monitoring stations.

primarily from May through September. The East Fork of the Russian River (upstream of Coyote Dam) also receives Eel River water which has been diverted from Lake Pillsbury.

This report frequently refers to the terms "upper river" and "lower river". "Upper river" refers to the Russian River upstream of the confluence with the Laguna de Santa Rosa. "Lower river" refers to the Russian River downstream of the confluence with the Laguna de Santa Rosa.

The Basin Plan

The Water Quality Control Plan for the North Coast Region (NCRWQCB, 1989) (Basin Plan) includes water quality objectives for dissolved oxygen, total dissolved solids, pH levels, and specific conductance for the Russian River. It also includes water quality objectives for bacteria and temperature that apply to surface waters region-wide, including the Russian River.

The Basin Plan also prohibits most waste discharges to the Russian River during the period May 15 through September 30 of each year and all other periods when the Russian River flow is less than 100 times greater than the waste flow. Treated groudwater generated from cleanup operations may be discharged year-round.

III. PROGRAM UPDATE

This section summarizes the focus of Russian River water quality monitoring for fiscal years 1989-90, 1990-91, 1991-92, and 1992-93. Similar summaries for fiscal years 1985-86, 1986-87, 1987-88, and 1988-89 can be found in the April 26, 1989 staff report. This summary contains some evaluation of the data (particularly nutrient and bacterial data) by fiscal year. Water quality standards and potential adverse impacts of the various water quality parameters is discussed in Section IV. Data Evaluation.

Fiscal Year 1989-90

During the first half of the fiscal year, the sampling program focused on the lower half of the Russian River. Sampling occurred on a monthly basis from August to January utilizing monitoring stations between Healdsburg Memorial Beach and Jenner, as well as two tributaries, the Laguna de Santa Rosa and Dry Creek. The water quality data collected serves as a comparison to data collected in previous fiscal years. Field and laboratory analyses were performed for conventional nutrients (ammonia, nitrate, nitrite, total kjeldahl nitrogen, total phosphate, and orthophosphate), physico-chemical analyses (temperature, specific conductance, dissolved oxygen, pH, total dissolved solids, total organic carbon and dissolved organic carbon) and bacteriological analyses (total and fecal coliform).

During the months of May and June, 1990 the sampling program was expanded to include monitoring stations along the entire river (from the headwaters at Coyote Dam to Duncans Mills) and tributaries that were flowing at the time of sampling (Big Sulphur Creek, Dry Creek, Laguna de Santa Rosa, Green Valley Creek, and Dutch Bill Creek). Each of the monitoring stations was sampled five different times during this two month period. Field and laboratory analyses were performed for the conventional nutrients and physico-chemical parameters listed in the preceding paragraph, as well as chlorophyll and phytoplankton densities. These data were collected to support the water quality modeling project as well as for comparison to data collected in previous fiscal years.

Table 1 is a summary of nitrate data for FY 1989-90. Nitrate concentrations were found to be low in the Russian River. Big Sulphur Creek and the Laguna de Santa Rosa appeared to contribute low concentrations of nitrate to the Russian River.

Table 1. Russian River Mainstem and Tributary Nitrate Data Summary for FY 1989-90 (Concentrations are in mg/l)

	Median	Range	Number of Observations
Upper River	0.05	<0.01-0.44	66
Lower River	0.10	0.02-1.0	53
Big Sulphur Creek	0.32	0.08-0.96	7
Dry Creek	0.05	0.01-0.32	11
Laguna @ Guern. Rd.	0.54	0.01-1.6	31
Green Valley Creek	0.08	0.03-0.31	6
Dutch Bill Creek	0.11	0.05-0.16	6

Total phosphate concentrations for FY 1989-90 are summarized in Table 2. Total phosphate concentrations in the Russian River were found to be low. In the upper river maximum concentrations typically occurred at the monitoring station identified as UKSTP. This monitoring station is located downstream of the City of Ukiah's discharge to the Russian River. Maximum total phosphate concentrations were highest downstream of the confluence with the Laguna de Santa Rosa. The Laguna de Santa Rosa and Green Valley Creek also appeared to contribute low concentrations of total phosphate to the river.

Table 2. Russian River Mainstem and Tributary Total Phosphate Data Summary for FY 1989-90 (Concentrations are in mg/l)

	Median	Range	Number of Observations
Upper River	0.02	<0.01-0.13	66
Lower River	0.08	<0.01-0.62	53
Big Sulphur Creek	0.01	<0.01-0.09	7
Dry Creek	0.02	<0.01-0.06	11
Laguna @ Guern. Rd.	0.09	<0.01-0.84	31
Green Valley Creek	0.13	0.09-0.24	6
Dutch Bill Creek	0.05	0.02-0.16	6

The Sonoma County Department of Environmental Health and the Regional Board participated in a joint monitoring effort of the popular swimming areas in the lower Russian River (Del Rio Woods, Healdsburg Memorial Beach, and Johnson's Beach). The bacteriological levels were generally low, meeting the Basin Plan objective for bacteria throughout the recreational season. Exceedances of the objective were noted at Healdsburg Memorial Beach and Johnson's Beach in mid-September.

Fiscal Year 1990-91
Sampling of four lower river stations (Johnson's Beach, Odd Fellows Bridge, Cooks Beach, and Wohler Bridge) and six stations on the Laguna de Santa Rosa occurred twice a week between December, 1990 and February, 1991.

On March 22, 1991 the State Water Resources Control Board and the Civil Engineering Department, UC Davis entered into an agreement to develop a water quality model for the Russian River. Monitoring for the remainder of the fiscal year served to fill the needs of the modeling project. During the month of April, 1991 the sampling program included monitoring stations along the entire river and tributaries that were flowing at the time of sampling (Big Sulphur Creek, Maacama Creek, Dry Creek, Laguna de Santa Rosa, Green Valley Creek, Dutch Bill Creek, and Austin Creek). Field and laboratory analyses were performed for conventional nutrients, physico-chemical parameters, and minerals (total dissolved solids, chloride, sulfate, sodium, iron, calcium, magnesium). Stream flow monitoring was conducted on the major tributaries.

A round-the-clock monitoring of two upper river stations (at the confluence with Pieta Creek and Alexander Valley Campground) and three lower river stations (Wohler Bridge Dam, Odd Fellows Bridge, and Duncans Mills) occurred in June for the purpose of documenting 24-hour trends in water quality parameters (nutrients and dissolved oxygen in particular). This monitoring was a necessary element to the development of the water quality model.

Nitrate data for FY 1990-91 is summarized in Table 3. Nitrate concentration ranges were higher for FY 1990-91 than for FY 1989-90 for all stations. Nitrate concentrations exceeding 0.8 mg/l only occurred at Wohler Bridge and downstream of the Laguna de Santa Rosa. Tributaries, including Big Sulphur Creek, Dry Creek, the Laguna de Santa Rosa, and Green Valley Creek, appeared to be contributing low levels of nitrate to the river.

Total phosphate data for FY 1990-91 is summarized in Table 4. Typical concentrations at most stations were less than 0.25 mg/l. Highest upper river concentrations occurred at the East Fork of the Russian River at the spillway from Coyote Dam. Concentrations of total phosphate did not peak at UKSTP as they did in FY 1989-90. Highest lower river concentrations occurred at Cook's Beach. The Laguna de Santa Rosa appeared to contribute total phosphate to the river.

Table 3. Russian River Mainstem and Tributary Nitrate Data Summary for FY 1990-91 (Concentrations are in mg/l)

	Median	Range	Number of Observations
Upper River	0.36	<0.01-0.86	42
Lower River	0.63	<0.01-2.4	49
Big Sulphur Creek	0.51	0.45-0.64	3
Dry Creek	0.78	0.25-0.85	3
Laguna @ Guern. Rd.	0.25	<0.01-8.8	21
Green Valley Creek	0.25	0.06-0.59	3

Table 4. Russian River Mainstem and Tributary Total Phosphate Data Summary for FY 1990-91 (Concentrations are in mg/l)

	Median	Range	Number of Observations
Upper River	0.03	<0.01-0.4	91
Lower River	0.07	<0.01-1.1	75
Big Sulphur Creek	<0.01	<0.01-0.05	3
Dry Creek	0.03	0.02-0.06	3
Laguna @ Guern. Rd.	0.19	0.05-2.8	21
Green Valley Creek	0.11	0.09-0.36	4

The Regional Board did not conduct bacteriological sampling during FY 1990-91. Information provided to the Regional Board of sampling conducted by the Sonoma County Department of Environmental Health indicated low bacterial levels, meeting the Basin Plan objective, at the popular swimming areas on the lower Russian River (Burke's Beach, Hilton Park, Midway Beach, Johnson's Beach, Monte Rio Beach, and Casini Ranch).

Fiscal Year 1991-92

The 1991-92 fiscal year started in September with another round-the-clock sampling of three river stations (at the confluence with Pieta Creek, Wohler Bridge Dam, and Odd Fellows Bridge) to monitor trends in nutrients and physico-chemical parameters. This monitoring effort provided data necessary in the preparation of the water quality model.

From March to June, 1992 monthly sampling of river and tributary stations was conducted to provide information for the water quality model. Field and laboratory analyses were performed for standard nutrients, physico-chemical, mineral, and bacteriological parameters. During Spring, 1992 nine river and tributary stations were sampled to monitor conformance with the water quality objectives for protection of freshwater aquatic life and protection of human health, set forth in Tables 1 and 2 of the California Inland Surface Waters Plan (SWRCB, 1991). Stream flow monitoring of tributaries was also performed.

Nitrate data for FY 1991-92 is summarized in Table 5. Nitrate concentrations were again found to be low in the Russian River. The concentration ranges for each monitoring station were similar to the FY 1989-90 ranges for that station and were lower than the concentrations found in FY 1990-91. There are no strong upstream to downstream trends exhibited in the data. Big Sulphur Creek, Dry Creek, the Laguna de Santa Rosa and Green Valley Creek appeared to contribute low concentrations of nitrate to the river.

Table 5. Russian River Mainstem and Tributary Nitrate Data Summary for FY 1991-92 (Concentrations are in mg/l)

	Median	Range	Number of Observations
Upper River	0.14	<0.01-0.48	63
Lower River	<0.01	<0.01-0.51	18
Big Sulphur Creek	0.36	0.33-0.44	3
Dry Creek	0.36	0.03-0.42	3
Laguna @ Trenton	0.06	0.04-1.20	3
Green Valley Creek	-	0.015-0.38	2

Total phosphate data for FY 1991-92 is summarized in Table 6. Total phosphate concentrations were again found to be low in the Russian River. Total phosphate concentrations were slightly higher in the lower river stations. The Laguna de Santa Rosa and Green Valley Creek appeared to be contributing low concentrations of total phosphate to the Russian River.

Table 6. Russian River Mainstem and Tributary Total Phosphate Data Summary for FY 1991-92 (Concentrations are in mg/l)

	Median	Range	Number of Observations
Upper River	0.04	0.01-0.05	35
Lower River	0.06	0.03-0.21	7
Big Sulphur Creek	0.02	0.01-0.05	3
Dry Creek	0.02	0.01-0.04	3
Laguna @ Trenton	0.59	0.58-0.97	3
Green Valley Creek	-	0.14-0.25	2

Regional Board sampling in June, 1992 of five locations along the Russian River (Talmage, two locations within the Healdsburg Memorial Beach area, Odd Fellows Beach, and Johnson's Beach) indicated conformance to the Basin Plan objective for bacteria. Sampling of six popular swimming beaches (Burke's Beach, Hilton Park, Midway Beach, Johnson's Beach, and Casini Ranch) conducted by the Sonoma County Department of Environmental Health, also indicated acceptable levels of fecal coliform bacteria in the swimming waters.

FY 1992-93

During September and October, 1992 the sampling program was designed to satisfy the data needs of the water quality model by following up on areas in need of more focused sampling as suggested by model simulations. Field and laboratory analyses were performed for physico-chemical parameters and total and fecal coliform at selected upper and lower river mainstem monitoring stations.

Russian River monitoring for the remainder of FY 1992-93 will be geared to satisfying the needs of the water quality model. Field and laboratory analyses for standard nutrients and physico-chemical parameters are anticipated. Any remaining funds will be used to conduct bacteriological analyses and sampling to monitor conformance with water quality objectives in Tables 1 and 2 of the Inland Surface Waters Plan.

Regional Board sampling of six locations along the Russian River (Talmage, Cloverdale, Geyserville, Healdsburg Memorial Beach, Odd Fellows, and Johnson's Beach) in the time period of September 8 to October 13, 1992 indicated conformance to the Basin Plan objective for bacteria. However, results of sampling conducted in the lower Russian River by the Sonoma County Department of Environmental Health and subsequently provided to the Regional Board indicated higher bacteriological levels exceeding the Basin Plan objective for bacteria at Healdsburg Memorial Beach, Hilton Park, Midway Beach, Johnson's Beach, Monte Rio Beach, and Duncan's Mills during July and August.

IV. DATA EVALUATION

Following is a summary and evaluation of some indicators of water quality in the Russian River utilizing water quality data collected since 1973.

A. NUTRIENTS

The Basin Plan contains a narrative objective for nutrients that states, "Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses."

Nitrate and phosphate are readily used by algae and vascular plants as primary nutrients. High concentrations of nitrate and phosphate can cause nuisance algae blooms and excessive aquatic plant growth, leading to low concentrations of dissolved oxygen during night hours as the algae and plants respire. This low dissolved oxygen can result in adverse impacts to aquatic life. Additionally, swings in pH occur as the plants photosynthesize in the daytime and respire at night.

Nutrient cycling in a stream system is complex and tied to the various interrelationships of primary producers (algae and aquatic macrophytes), nutrient inflow from surface and ground water and waste discharges, sediment-water interactions, and nutrient outflow (residence time in the stream). At any given point in time the various nutrient forms are a result of the actions of all those factors. The primary relationships in nutrient cycling are in plant productivity tying up the available nutrients, settling of particulate matter containing those tied-up nutrients (organic nitrogen and phosphorus), and release of the nutrients via decomposition in the sediments. Phosphate generally tends to bind to particulates if they are available and fall out of the water column. Nitrate is more mobile and tends to dissolve in the water. Both nutrients are most readily available in dissolved form.

Since summertime discharges of waste containing elevated nutrients are not allowed in the basin, most inputs are from cycling within Lakes Mendocino and Sonoma, and within the stream system itself.

Concentrations of total nitrate and total phosphate are currently low in the mainstem of the Russian River. This has not always been the case. The trend in nitrate and phosphate concentrations indicates stepwise decreases in nutrient concentrations in response to increased levels in pollution control and the implementation of seasonal prohibitions over time.

In the mid-1970's the Regional Board, Sonoma County Board of Supervisors and the Soil Conservation Service focused attention on reclamation of dairy wastes. Ponds were constructed at dairies in the Russian River basin to contain dairy wastes and eliminate these agricultural discharges.

Seasonal prohibitions for discharges to the Russian River were phased in over a ten year period starting in 1967. Prior to that time, wastewater treatment plants had historically discharged to the river and it's tributaries year-round.

In 1967, the Regional Board began to modify waste discharge requirements for publically owned treatment works to include a prohibition against dry-weather discharge and limiting discharges to one percent of the river's flow between September 30 and May 15. Implementation of the prohibitions generally required construction of new facilities with State and federal Clean Water Grant Funds. By 1978, all municipal dischargers in the Russian River basin had facilities on line that were designed to meet the terms of the seasonal prohibitions.

Secondary treatment was implemented for all municipal dischargers by the early 1970's. Tertiary treatment was added at the Laguna WTP in 1988, and at the Windsor WTP and Russian River Sanitation District in the early 1990's.

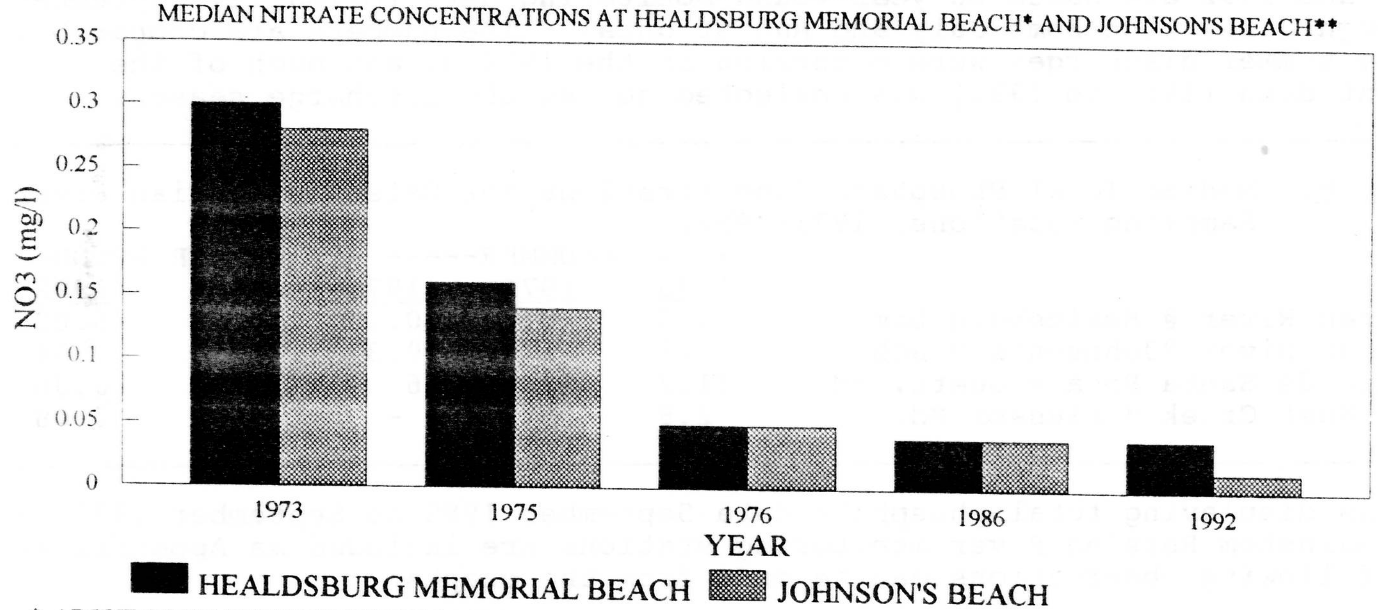
1. Nitrate

Nitrate concentrations have dropped in the mainstem of the Russian River since 1973, as shown in Table 7 and Figure 2. The median values for 1973, 1975, and 1976 are based on summer monitoring data, while the median values for 1986 and 1992 are based on year-round monitoring data (primarily September through June, with some July and August data). The numbers are comparable since summer discharges were occurring in the 1970's, and much of the recent data (1985 to 1992) was collected during the winter discharge season.

Table 7.	Median Nitrate Concentrations for Selected Russian River Sampling Locations, 1973-1992				
	-------SUMMER-------			-YEAR-ROUND-	
	1973[1]	1975	1976	1986	1992
Russian River @ Healdsburg Dam	0.30	0.16	<0.10	0.04	0.04
Russian River @ Johnson's Beach	0.28	0.14	<0.10	0.04	<0.03
Laguna de Santa Rosa @ Guern. Rd.	0.39	0.19	0.13	0.28	<0.03
Mark West Creek @ Slusser Rd.	0.20	0.40	0.34	0.07	0.16

FIGURE 2

MEDIAN NITRATE CONCENTRATIONS AT HEALDSBURG MEMORIAL BEACH* AND JOHNSON'S BEACH**



* ABOVE CONFLUENCE WITH THE LAGUNA DE SANTA ROSA
**BELOW CONFLUENCE WITH THE LAGUNA DE SANTA ROSA

Graphs displaying nitrate data for September 1985 through September 1992 for mainstem Russian River monitoring stations are included as Appendix 1. The following observations can be made from the graphs:

1) Generally speaking, nitrate concentrations are higher during wet-weather periods (typically October through May) than in dry-weather

[1] No seasonal discharge prohibition in effect

conditions. This trend is apparent in the mainstem Russian River, as well as its tributaries. Increases in nitrate concentrations most likely occur in response to runoff producing storm events and allowed discharges. The largest increases occur downstream of the Laguna.

2) Nitrate concentrations increase as one moves downstream along the Russian River. The most noticeable increases in nitrate concentrations in the Russian River occur downstream of the confluence with the Laguna de Santa Rosa.

3) Nitrate concentrations are lower river-wide now than they were in the mid-1970's.

2. Phosphate

Concentrations of total phosphate have exhibited a downward trend since 1973, as shown in Table 8 and Figure 3. The median values for 1973, 1975, and 1976 are based on summer monitoring data, while the median values for 1986 and 1992 are based on year-round monitoring data (primarily September through June, with some July and August data). The numbers are comparable since summer discharges were occurring in the 1970's, and much of the recent data (1985 to 1992) was collected during the discharge season.

Table 8. Median Total Phosphate Concentrations for Selected Russian River Sampling Locations, 1973-1992.

	SUMMER			YEAR-ROUND	
	1973[2]	1975	1976	1986	1992
Russian River @ Healdsburg Dam	1.3	0.6	<0.15	<0.02	<0.02
Russian River @Johnson's Beach	4.3	1.0	0.37	0.15	0.04
Laguna de Santa Rosa @ Guern. Rd.	71.2	12.4	16	-	0.36
Mark West Creek @ Slusser Rd.	2.8	0.7	-	-	0.08

Graphs displaying total phosphate data September 1985 to September 1992 for mainstem Russian River monitoring stations are included as Appendix 2. The following observations can be made from the graphs:

1) There are no clear seasonal or upstream to downstream trends in total phosphate concentrations on the upper Russian River extending from the headwaters at Coyote Dam to Alexander Valley. On any particular sampling date, the total phosphate concentrations are very similar for each upper river station.

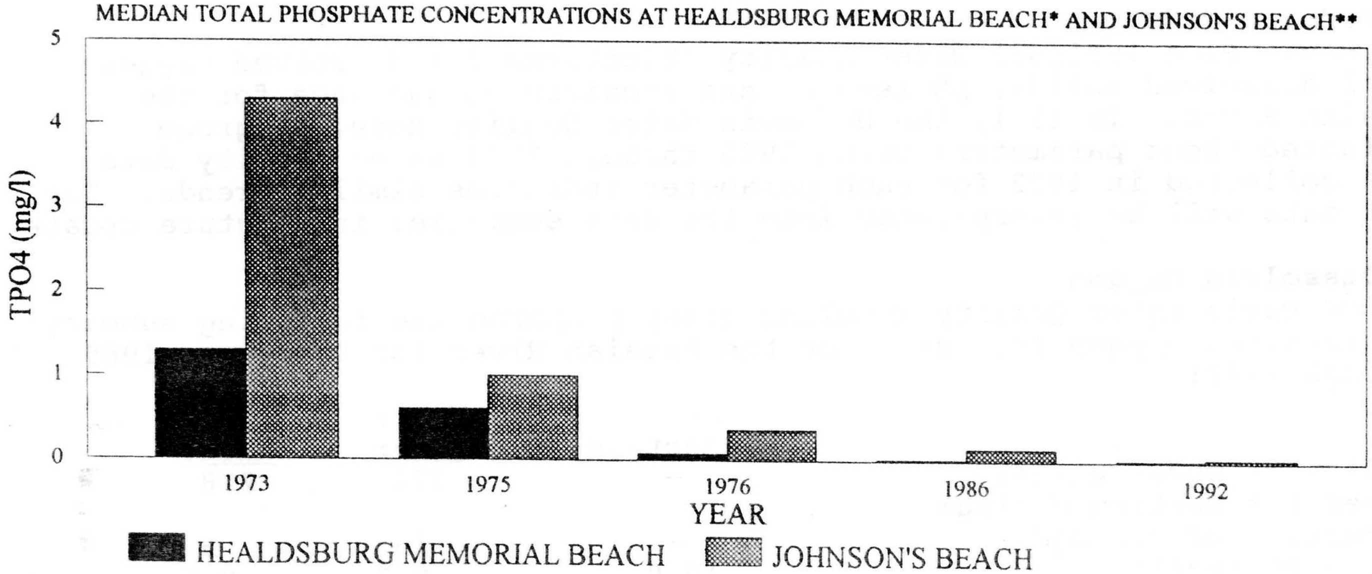
2) In the lower river, beginning at Healdsburg Memorial Beach, there is a clear seasonal trend in total phosphate concentrations, with highest concentrations occurring during the peak of the wet-weather season. The most noticeable increases in total phosphate concentrations occur in the Russian River downstream of the confluence with the Laguna de Santa Rosa.

[2] No seasonal discharge prohibition in effect.

3) Total phosphate concentrations are lower river-wide now than they were in the 1970's.

FIGURE 3

MEDIAN TOTAL PHOSPHATE CONCENTRATIONS AT HEALDSBURG MEMORIAL BEACH* AND JOHNSON'S BEACH**



* ABOVE CONFLUENCE WITH THE LAGUNA DE SANTA ROSA
**BELOW CONFLUENCE WITH THE LAGUNA DE SANTA ROSA

B. BACTERIOLOGICAL

Prior to and including 1976, fecal coliform levels in the Russian River, from Alexander Valley to Duncans Mills, consistently exceeded the Basin Plan's water quality objective for body contact recreation (fecal coliform MPN/100 ml of 50 or less for a median of five samples taken within a 30-day period). From 1985 to 1991, the objective was met in the Russian River with few exceptions. However, the results of more intensive monitoring of popular swimming areas in the lower Russian River by the Sonoma County Health Department during the peak of the recreational season in 1992 revealed exceedances of the Basin Plan objective for bacteria. The data suggests that the higher bacterial levels were localized to the most popular swimming areas, and are the result of high public use. These results raise concerns from both a water quality and public health perspective. This area of concern needs to be monitored closely early on in the next recreational season.

Increased levels of fecal coliform bacteria in surface waters can and do result from malfunctioning individual wastewater disposal systems.

Malfunctioning individual wastewater disposal systems are abated through the Sonoma County and Mendocino County Health Departments. In addition, the discharge of wastewater from existing or new individual systems utilizing subsurface disposal have been prohibited in areas of Sonoma and Mendocino Counties which have known problems with on-site wastewater disposal. Waiver prohibition areas have also been established by the local health departments in areas where geographical conditions may threaten or result in health hazards or water quality impairment.

C. PHYSICO-CHEMICAL

The Basin Plan includes water quality objectives for dissolved oxygen, total dissolved solids, pH levels, and specific conductance for the Russian River. In 1991, the UC Davis Water Quality Modeling group evaluated these parameters using 1985 through 1991 water quality data. Data collected in 1992 for each parameter indicates similar trends. The 1992 data will be incorporated into the data summaries in a future update.

1. Dissolved Oxygen

The UC Davis Water Quality Modeling group prepared the following summary of dissolved oxygen (DO) data for the Russian River for the years 1985 through 1991:

	Objective	Upper River	Lower River
Total # of Observations	-	374	278
Number Not Meeting Minimum Objective of 7.0 mg/l	-	13	5
Median DO (mg/l)	10.0	9.7	9.5
90th Percentile DO (mg/l)	7.5	8.0	8.2

In preparing this analysis, the UC Davis Water Quality Modeling Group pointed out that an important factor in evaluating dissolved oxygen levels is the time of day that sampling occurs. Dissolved oxygen varies on a daily basis, primarily from variation in biological production and consumption of oxygen. Algae and aquatic plants repire at night and in the early morning hours, using dissolved oxygen in the process. If the amount of respiration from algae and aquatic plant life is high, it can result in low dissolved oxygen level. Inadequate dissolved oxygen in surface waters produce adverse affects on fish and other aquatic life. In addition the absence of dissolved oxygen results in the odoriferous products of anaerobic decomposition.

While a site may meet a dissolved oxygen standard during daylight hours, it is possible the standard is not met during early morning hours, prior to sunrise. This in fact occurs on the Russian River and the Laguna de Santa Rosa. The existing dissolved oxygen objective and past sampling programs have not addressed this variation. The UC Davis group has provided recommendations on this matter.

2. Temperature

Russian River temperature ranges for the years 1985 through 1992 were 6.5 to 27.6 degrees celsius in the upper river, and 6.3 to 24.9 degrees celsius in the lower river. Lower flows, shallower depths and higher air temperatures that occur in the summer months contribute to increased river water temperatures. The nutrient cycles and enrichment impacts discussed in Section IV.A. are accelerated in warmer waters.

Dry Creek impacts the Russian River by lowering its temperature by approximately 4 degrees fahrenheit in the summer time. River temperature does not appear to be significantly affected by other tributaries.

The UC Davis Water Quality Modeling group studied the temperature characteristics of the Russian River in depth because it is a basic element of the model development. Although not an issue of compliance to Basin Plan objectives, temperature is an indicator of the dynamics of a river system. While analyzing past temperature measurements, the UC Davis group pointed out, for example, that some sampling locations are not accurate indicators of general trends in the river. Also, the summer dams located along the Russian River cause a slight increase in the temperature of the river water in the impounded areas.

3. Total Dissolved Solids

Total dissolved solids (TDS) is a measure of the amount of dissolved matter in water. It is influenced to the largest degree by groundwater inflow and waste discharges. In the absence of waste discharges, groundwater inflow to a river system and evaporation of water (leaving salts behind) results in general increases of TDS from upstream to downstream. Seasonally, as runoff becomes a larger portion of the river flow, TDS will decrease.

There are two sets of objectives for TDS for the Russian River: one for upstream of the confluence with the Laguna de Santa Rosa, and one for downstream. The U.C. Davis Water Quality Modeling group prepared the following summary of total dissolved solids data for the Russian River for the years 1985-1991:

	Upper River		Lower River	
	Objective	Observed	Objective	Observed
Total # of observations	-	301	-	215
Median TDS (mg/l)	150	150	170	150
90th Percentile TDS (mg/l)	170	200	200	200

The median total dissolved solids water quality objective is met in both the upper and lower river. The 90th percentile water quality objective is met in the lower river but not in the upper river.

No clear seasonal trends were observed in the monitoring data. TDS concentrations were generally higher in the lower river than in the upper river.

4. pH Level

pH is a measure of hydrogen ion activity in water, and should remain within a certain range to avoid adverse impacts to water quality beneficial uses. The pH objectives for the Russian River are: a minimum of 6.5 and a maximum of 8.5. It is influenced to the largest degree by algae and plant photosynthesis (which increases pH), and algae and aquatic plant respiration and decomposition of organic matter (which decreases pH), as well as waste discharges.

The U.C. Davis Water Quality Modeling group prepared the following summary of pH levels for the Russian River for the years 1985-1991:

	Upper River	Lower River
Total # of observations	367	286
# not meeting maximum pH objective of 8.5	13	6
# not meeting minimum pH objective of 6.5	0	0

The minimum pH objective was met in both the upper and lower river 100% of the time based on this monitoring data. The maximum pH objective was met in the upper river 96.5% of the time and in the lower river 97.9% of the time.

As with dissolved oxygen, pH responds to aquatic plant production, and may be lower in the morning than afternoon. The same concerns regarding timing of sampling with regard to objectives attainment applies and will be addressed in future monitoring.

5. Specific Conductance

Specific conductance (SC) is an indirect measure ot the dissolved solids in water, and increases with increases in dissolved solids. Specific conductance is measured in in the field and used as an indicator of changing conditions in a stream. Specific conductance is influenced by natural factors, such as groundwater inflow, and by various waste discharges.

There are two sets of objectives for specific conductance for the Russian River: one for upstream of the confluence with the Laguna de Santa Rosa, and one for downstream. The UC Davis Modeling group prepared the following summary of specific conductance levels for the Russian River for the years 1985-1991:

	Upper River		Lower River	
	Objective	Observed	Objective	Observed
Total # of observations	-	376	-	280
Median SC, umohs	250	225	285	260
90th Percentile SC, umohs	320	281	375	308

The specific conductance water quality objectives were met in both the upper and lower river on all sampling dates.

No clear seasonal trends were observed in the monitoring data. Specific conductance generally increases as one moves downstream. Big Sulphur Creek and the Laguna de Santa Rosa had higher specific conductance values than the mainstem. Specific conductance values increased slightly downstream of these two tributaries. Specific conductance also appears to increase in the impounded areas, such as at Healdsburg Memorial Beach and Johnson's Beach.

D. FLOW

The input of the tributaries varies significantly with season. Most of the Russian River tributaries flow during the wet-weather season, but the flows diminish to a trickle or dry up completely by mid to late summer. Dry Creek is the largest tributary to the Russian River during the dry weather season and contributes significantly to the Russian River's flow. On August 31, 1992, the flow from Lake Sonoma to Dry Creek was 109 cfs and the flow of the Russian River at Hacienda Bridge was 196 cfs.

Due to the nature of storm-generated runoff, transient effects on nutrient, solids, and metals concentrations have been observed. The highly variable and spatially oriented nature of runoff events precludes any other conclusions except from focused studies like the Laguna 205(j) study.

E. OBJECTIVES FOR TOXIC CHEMICALS FOR PROTECTION OF HUMAN HEALTH AND FRESHWATER AQUATIC LIFE, SET FORTH IN THE INLAND SURFACE WATERS PLAN (ISWP)

The State Board adopted the <u>Inland Surface Waters Plan</u> (SWRCB, 1991) (ISWP) in April, 1991. Tables 1 and 2 of the ISWP contain water quality objectives for an extensive list of noncarcinogenic and carcinogenic constituents, including heavy metals. The objectives are based on bioaccumulation and chronic effects to aquatic organisms and ingestion of aquatic organisms and water by humans. The objectives have toxic effects, carcinogenicity, and bioaccumulation factors built into them, therefore, if these objectives are being met in surface waters, freshwater aquatic organisms and human health should be protected.

During Spring, 1992, Regional Board staff sampled nine locations along the mainstem of the Russian River and its major tributary system and conducted a scan for the ISWP constituents. The sampling stations included: the headwaters of the Russian River below Lake Mendocino, Cloverdale, Wohler Bridge, Johnson's Beach, Laguna de Santa Rosa, Mark West Creek, Pool Creek, Windsor Creek, and Dry Creek.

The results indicated compliance with the levels set forth in the ISWP, and were below the level of laboratory detection in most cases. A comparison of laboratory detection limits with the water quality objectives listed in Tables 1 and 2 of the ISWP reveals that the method detection limit for many of the constituents is higher than the objective. Thus, some of the ISWP constituents cannot be detected if they are present at levels lower than the laboratory detection limit. The contract laboratory uses current EPA-approved methods which are the best accepted methods available. However, the Regional Board utilizes other sampling and analysis methods which would indicate if these constituents were present at low concentrations. These methods are described in the next section.

F. RUSSIAN RIVER TOXIC SUBSTANCES MONITORING PROGRAM (TSMP) AND STATE MUSSEL WATCH PROGRAM (SMW)

The State Mussel Watch Program (SMW) and Toxic Substances Monitoring Program (TSMP) are two statewide programs which utilize animal tissue analysis to detect pollutants which may be otherwise below detection limits. Specifically, toxic pollutants which bioconcentrate (from the ingestion of water) or bioaccumulate (from contaminated food supplies) are detected through the analysis of resident or transplanted aquatic organisms. The TSMP utilizes samples of resident fish (or other aquatic animals) to investigate freshwater, estuarine, and marine sites. The SMW utilizes resident and transplanted mussels to investigate marine and brackish water sites, and utilizes transplanted freshwater clams for fresh water sites. Both programs occasionally collect sediment samples for analysis, also. All work is performed under contractual agreements with the California Department of Fish and Game, with contract management by State Water Resources Control Board staff.

The Russian River has been included in sampling efforts under TSMP since 1978, and in sampling efforts under SMW since 1984. Since 1978, TSMP has analyzed more than thirty-five samples from the Russian River and its tributaries. Analysis variously included scans for total metals (TM), total organics (TO), or, alternately, specific, selected constituents of concern. Since 1984, SMW has analyzed about 34 samples from the Russian River, its tributaries, and the estuary at its mouth.

The results of the tissue analysis were highly variable, revealing no clear trends of human sources of contamination. In general, contaminants were found to be at concentrations which were either low or below the detection limits for the applicable analytical method. With respect to mercury, however, several samples over a period of several years yielded analytical results of concern. While the US Food and Drug Administration action level of 0.1 mg/kg was never exceeded, mercury values in excess of 0.05 mg/kg were not uncommon, particularly in samples from the three reservoirs: Lake Pillsbury, Lake Mendocino, and Lake Sonoma, and in tributary flows not heavily impacted by urban runoff or waste discharges. These data suggest background or geogenic sources, which may pose a threat to human health or wildlife. More focused investigation of this issue is underway.

In addition to the above mentioned applications of the SMW and TSMP to the acquisition of water quality data in the Russian River, NPDES monitoring requirements for the cities of Santa Rosa and Windsor include the deployment and analysis of freshwater clams to monitor their respective discharges. Neither SMW nor TSMP have been funded beyond FY 1992-93 as of this writing.

G. BIOLOGICAL HEALTH

Several questions have been raised over the last few years with regard to the biological health of the Russian River. Most concerns center around visible occurrences, notably aquatic plant growths, both vascular plants and algae. Additional concerns have been voiced regarding fish species, notably anadromous salmonids. The following section addresses some of those concerns, others to be addressed in future updates to this report.

1. Aquatic Vascular Plants
Early in its studies of the Russian River, the University of California, Davis, Water Quality Modeling Group found a significant difference in the dynamics of the Russian River when the summer dams are in place and when the summer dams are not in place. Ponding behind the dams, along with the seasonal increases in temperatures, results in increased aquatic plant activity in the shallows of the impounded areas (Camp Rose, Healdsburg Memorial Beach, Wohler Bridge, Johnson's Beach, Vacation Beach).

Recent complaints with regards to the Russian River biological health relate to increased amounts of rooted plants and attached algae on the Russian River substrate, throughout the entire reach of the mainstem. Preliminary staff identifications of the primary vascular aquatic plant species for which complaints have been received are Water Primrose, Water Purslane, and Aquatic Buttercup.

a. Water Primrose
Water Primrose (*Jussiaea spp.*) is a native to the United States and is found from the lower Columbia River in Washington south to Baja California in Mexico (Neihaus 1976). It is a perennial rooted aquatic herb with floating stems one to many feet long sometimes extending onto wet shores (Mason 1957). Water Primrose is common at the lower altitudes in California and often covers ponds, sloughs, small streams and ditches sometimes even causing an obstruction to navigation in small boat waterways (Mason 1957).

b. Water Purslane
Water (or Marsh) Purslane (*Ludwigia palustrus*) is widely distributed, found in wetlands in North America and Europe (Mason 1957). It has been reported in Hawaii and the Caribbean as well (USDI 1988). Purslane is a low growing, often prostrate, perennial aquatic herb that is rooted in the mud and floats on the water sometimes forming small mats up to two feet across (Mason 1957).

c. Ranunculus
The Ranunculus or Buttercup Family is well represented in California with Mason (1957) listing 14 wetland species occurring in the state, perhaps seven species occurring locally. The USDI (1988) lists 29 species of Ranunculus that may occur in California wetlands. Among the most common local species is Creeping Buttercup or Crowfoot (*Ranunculus repens* (L.)). A native of Europe, it has become naturalized in North America and Hawaii (Mason 1957, USDI 1988). It is a perennial herb with threadlike roots and long runners, often locally dominant, forming dense weedy patches (Becking 1982).

Spiny Buttercup (*Ranunculus muricatus* (L.)) is frequently found in marshy ground. A native of Europe, it has become naturalized in California and the western U.S. (Mason 1957). Water (or Aquatic) Buttercup (*Ranunculus aquatilis var. capillaceus* (Thuill.)) (*Ranunculus* *trichophyllus* (D. Chaix)) is a native of western U. S., Alaska and Europe and is commonly found in permanent pools or slow streams and ditches. It is a highly variable form with much variation exhibited in leaf morphology and flower size (Mason 1957). Other *Ranunculus* species that may occur in this area are: *Ranunculus bloomeri* (Wats.) (*R. orthorhyncus* (Hook.)) or Western Swamp Buttercup, *R. flabellaris* (Raf.) or Yellow Water Buttercup, *R. pusillis* (Poir. in Lam.) or Dwarf Buttercup, *R. lobii* (Hiern) or Lobb's Buttercup and *R. seleratus* (L.) or Cursed Buttercup (also Celery-leaved Buttercup) a naturalized native of Europe.

In discussing aquatic vegetation, it is important to realize some of the unique characteristics of their habits. Most of these plants are what is known as "R" selected species, that is, they are density independent and well adapted for rapid population increase, taking advantage of short-lived environments (Mason 1957). It is common for "R" selected species to undergo large variations in population size over time. Since they have evolved in highly variable habitats, they are able to take rapid advantage of suitable environmental conditions. Many have highly specialized and efficient seed dispersal and other propagation mechanisms.

Due to these factors, aquatic and amphibious plants are notorious for extending their ranges and often settling where they are not welcome. Aquatic plants have evolved a number of unique adaptations that allow them to capitalize on their environment. Flooded soils are often deficient in oxygen and many aquatic plants have developed mechanisms to deliver atmospherically derived oxygen to their root system. Some plants have modified their metabolic pathways to accommodate the problems of anoxic soil (Crawford 1987). While floating aquatic plants use nutrients directly from the water column, rooted aquatics such as *Jussiaea spp.*, *Ludwigia spp.*, and *Ranunculus spp.* can derive nutrition from the sediment and water (Llanan 1986). Relatively unproductive waters may support luxurious growths of rooted aquatics due to their ability to absorb nutrients from the sediment (Boyd 1979 as cited by Llanan 1986).

Though we have observed increased occurrence of aquatic plants in the Russian River, we have not observed differences in nutrient concentrations in the water to explain their prevalence. Water quality data do not support allegations that the nutrient input supporting the growth of these plants is coming from the water column, since the concentration of nutrients in the water column is low and bears no relationship to the presence of the plants. Rather, the substrate is probably providing nutrients to support the plant growth during periods of low flow and warmer temperatures. We have observed larger mats in shallow areas versus deep areas, e.g., the river upstream of the Wohler diversion dam sported large and luxuriant mats whereas within the deep ponded area we observed less growth. This is a direct consequence of the limited tolerance for submergence of rooted aquatic plants with floating leaves. Other conditions favorable to the growth of aquatic plants beyond depth and nutrients are long days with high light intensity, especially high light intensity in the water (i.e. clear water) (Crawford 1987). The drought situation we have experienced for the last few years likely has allowed the plants a stronger foothold earlier in the year and a longer growing period.

In summary, it is staff's assessment that:

1) the rooted aquatic plants with floating leaves observed in large mats in the Russian River drainage are native or naturalized,

2) the prevalence of those plants is the result of longer growing seasons during the recent drought,

3) the largest mats of this vegetation were observed in the shallow areas,

4) there are no differences in water column chemistry (including nutrients) that correlate with the growths, and

5) staff should incorporate semi-quantitative evaluations of aquatic plant growth in observations of the river during routine water quality sampling.

2. Aquatic Algae

Complaints also are commonly received in the late summer with regard to floating decaying mats of algae in slow moving areas of the Russian River. Though we often obtain samples of algae in the water column, we generally do not attempt to quantify algae attached to the bottom (benthic). On June 2, 1992, we obtained for identification and rough quantification, three grab samples of benthic algae with pieces of the substrate from the Russian River near or on the shoreline at Talmage Road near Ukiah, Cloverdale, and Healdsburg Memorial Beach.

The algae identified belong to four major divisions, blue-green algae (Cyanophyta), green algae (Chlorophyta), flagellated green algae (Euglenophyta), and diatoms (Chrysophyta).

a. Blue-green algae (Cyanophyta)

One genus of blue-green algae was identified in all three samples. *Oscillatoria spp.* is a cosmopolitan genus with 34 species described in the United States (VanLandingham 1982). It is found both in water and moist subaerial substrates and is described as an unbranched filamentous blue-green algae without any specialized cells (Prescott 1978, Sze 1986). Reproduction is by filament fragmentation involving distinct filament segments called hormogones (or hormogonia)(Fay 1983). According to Fay (1983) some species of *Oscillatoria spp.* are capable of fixing elemental nitrogen. In life, the filaments show a gliding motion which may be important for adjusting the density of the filaments in a mat in response to environmental conditions (Sze 1986). Light requirements for blue-greens are relatively low, giving *Oscillatoria spp.* a competitive advantage in low light intensities (Fay 1983). It is one of the few genera of blue-green algae found under a wide variety of pH and salinity regimes (VanLandingham 1982).

In the river or stream environment, many blue-greens including *Oscillatoria spp.* often grow on macro algae, such as *Cladophora spp.*, or on vascular plants as an epiphyte or non-destructive parasite, where they survive in stronger currents and enjoy a continuous supply of nutrients.

Blue-green algae are found in most waters, but they can dominate in enriched conditions, often forming a monoculture and crowding out other species. Although present in all three Russian River samples, *Oscillatoria spp.* does not occur in sufficient density to warrant concern.

b. Green Algae (Chlorophyta)
Five species of non-motile green algae were identified in the samples, *Chlorella spp.* by far the most common. *Chlorella spp.* occurs as a free living form, forming loose aggregates of small spherical or oval cells or as an algal symbiont in a number of invertebrates including *Paramecium* and *Chlorohydra viridissima* (or *Hydra viridis*) (Round 1981). *Chlorella spp.* seems to have the ability to produce thermolabile antibiotic substances which, in certain cases, can inhibit growth and multiplication in other algae (Davis 1955).

Next in abundance and in the same family as *Chlorella spp.* was *Ankistrodesmus spp.* Twelve species are found in the U. S., the most common being *A. folcatus* (Prescott 1978). It occurs as solitary or loosely clustered needles intermingled with other algae (Prescott 1978). In rivers, these algae are often trapped amongst debris and epiphytes and these masses form an inoculum which is maintained in the benthic habitat (Round 1981).

Another cosmopolitan genus, *Cladophora spp.*, was found in two of the samples. It is primarily a marine genus with a few freshwater species, by far the most common being *C. glomerata* (Sze 1986). *Cladophora spp.* is described as a multicellular, branching filamentous green algae attached by a holdfast of rhizoidal branches from its base. Each cell in the filament is surrounded by a thick wall (Sze 1986). Reproduction is commonly by fragmentation although sexual reproduction does occur (Sze 1986).

Larger algae, such as *Cladophora spp.*, which lack mucilaginous sheaths, are commonly colonized by other algae, the walls of the older cells often heavily covered with these epiphytes (Sze 1986). Flowing water and grazing, especially by snails, helps reduce these growths (Sze 1986). In one study Round (1981) found 220 species of epiphytic algae growing on *Cladophora glomerata* in a river and of these, 176 were diatoms, 27 were green algae and 19 were blue-green algae. Common diatoms that are epiphytic on *Cladophora* may include *Synedra*, *Gomphonema*, *Cocconeis*, *Amphora*, *Anchnanthes*, *Cymbella*, *Diatoma*, *Fragilaria*, *Navicula*, *Rhoicosphenia*, and *Nitzchia* (Round 1981), all of which were present in the Russian River samples.

Besides light, temperature, and nutrients, other environmental factors influencing the density of *Cladophora spp.* and other benthic forms are substrate type, current velocity and grazing by snails, crustacea and insect larvae (Sze 1986).

Three other green algae genera that were present in small numbers in the Russian River samples were *Pediastrum spp., Stigeoclonium spp.* and *Spirogyra spp.*

The genus *Pediastrum* contains a number of species varying only slightly in their shape and wall markings but all can be identified by their plate-like arrangement. The colony (coenobium) may contain as many as 32, 64 or 128 cells (always a multiple of 2) with the peripheral cells differentiated from the central cells (Sze 1986, Prescott 1978). The cell walls are highly resistant to decay and are often found in the fossil record (Prescott 1978). *Pediastrum spp.* colonies frequently occur immediately beneath a surface layer or in sand or loose soil (Prescott 1978).

Stigeoclonium spp. is another rather common fresh water algae with filaments forming erect branched tufts or plumes with the branches tapering into fine points (Prescott 1978). This genus shows considerable morphological variation depending on environmental conditions, and frequently grows epiphytically on macroalgae (Round 1981). Reproduction, not well studied, is by zoospores (Sze 1986).

Spirogyra spp. (or Water Silk) is a very common representative of the order Zygnematales in which there are over 300 species (Prescott 1978). *Spirogyra spp.* has one or more chloroplasts that spiral around the periphery of its cells. Filaments may grow attached to the bottom or entangled in free floating masses. Extensive mucilage is secreted around the cells (Sze 1986). There is no asexual reproductive stage but filaments readily fragment as a means of vegetative propagation; sexual reproduction is by means of conjugation (Sze 1986).

c. Flagellated green algae (Euglenophyta)

Small numbers of three genera of flagellated green algae were found in two of the three stations sampled, the most common being *Chlamydomonas spp.*, followed by *Euglena spp.* and *Phacus spp.*

Chlamydomonas spp. is very common in a wide range of freshwater environments with approximately 507 described species (Prescott 1978). Cells of this species are usually found actively swimming by means of a flagellum or whip on the forward end of the cell (anterior). Cells are ovoid and surrounded by a thin wall of glycoproteins rather than cellulose (Sze 1986). Under favorable conditions, *Chlamydomonas spp.* will undergo asexual reproduction. Sexual reproduction is relatively uncommon in the natural population and is usually induced by stress, often nitrogen depletion (Sze 1986).

Euglena spp. are elongate, slow moving organisms with an anterior flagellum and usually green in color (Prescott 1978). Worldwide in distribution, there are about 60 species in the U.S., most freshwater inhabitants (Prescott 1978). They tend to dominate in waters with high organic content, certainly not the case in these samples where the highest density was less than 2% of the total sample.

Phacus spp., another member of the Euglena family, commonly appears in the same habitat as *Euglena spp.* It was present in very low numbers in one sample.

All the algae discussed are common in natural situations, however the blue-green algae and euglenoids may dominate in enriched waters. The distribution of algal types in the benthic community from these samples is testimony to a balanced, clean and moderately productive system. Analysis of algae from water column samples will be done for an update to this report. In addition, future analysis of algal composition in the Laguna de Santa Rosa will provide an interesting comparison.

3. Other Aquatic Biota

Questions have been raised with regard to the health of other biota in the Russian River, especially the anadromous fish species. We have not analyzed data with regard to fish species in the system, however suggest that since water quality has remained reasonably constant throughout the river system in the last six years, any changes in fish populations most likely are the result of other factors. As time allows, we will investigate sources of data with regard to the other biota in the river system and report on the health of those populations to the extent we are able.

V. RELATIONAL EFFECTS

A. EFFECT OF URBAN AND AGRICULTURAL STORMWATER RUNOFF ON RUSSIAN RIVER WATER QUALITY

Conventional nutrients, physico-chemical, and ISWP constituents were also evaluated under the 205(j) project titled "Investigation for Nonpoint Source Pollutants in the Laguna de Santa Rosa, Sonoma County". Under this project water samples were collected for analysis at selected monitoring stations within the Laguna de Santa Rosa watershed during a number of storm events to characterize the storm generated runoff in the Laguna de Santa Rosa system. The final report for this project was released on September 24, 1992 and drew the following conclusions with regards to stormwater runoff from urban and agricultural areas in the Laguna watershed:

"For both Santa Rosa Creek and Roseland Creek, monitoring showed that 1) light storms generally resulted in little significant change in downstream station water quality, 2) relatively heavy storms sometimes initially raised total lead, zinc, copper, and chromium concentrations exceeding State Water Resources Control Board Inland Surface Waters Plan one-hour average objectives for the protection of aquatic life, 3) as a large storm continues, these levels then generally decreased at downstream stations, probably due to dilution, 4) nutrients were generally found in lower concentrations at the upstream urban runoff tributary stations than in the downstream main stem Laguna during storm events 5) several organics were detected occasionally, but in relatively low concentrations. Some metal concentrations are from natural geogenic sources and not susceptible to control from a nonpoint source control program."

B. EFFECT OF RIVER WATER QUALITY ON WATER SUPPLY SYSTEMS LOCATED ADJACENT TO THE RIVER

The Sonoma County Public Health Department evaluated each of the small public water systems (greater than 5 but less than 200 connections) located downstream of the confluence with Mark West Creek (Laguna system) to determine if the water systems are influenced by the Russian River water quality. Most of these water systems pump water from wells, but some use infiltration galleries buried in stream gravels. Thirteen systems were evaluated with regards to distance from the river, well construction, and by comparison of the water system water quality Russian River water quality.

Two systems were determined to be under direct influence by the river. The Redwood Water Company is no longer in service and is purchasing water from Russian River Utilities. The Rancho Del Paradiso Water Company uses an infiltration gallery and has been determined to be under surface water influence, particularly during flood stages. The Health Department is requiring an existing treatment upgrade of this system to bring it into compliance with state Surface Water Treatment Rule relating to public water systems.

The Sonoma County Water Agency is currently undertaking a demonstration study to determine whether the Agency's five Ranney collectors are under the direct influence of surface water according to the provisions of the Surface Water Treatment Rule. Sampling includes particle counts, turbidity, temperature, conductivity, and pH, bacteriological tests, and parasitological analyses. The study will continue until approximately April, 1993.

C. EFFECT OF GRAVEL MINING ON RUSSIAN RIVER WATER QUALITY

Historically, gravel mining on the Russian River took the form of in-stream and in-channel mining operations. In addition, discharges of wastewater from gravel washing operations were permitted. The gravel mining operations caused a significant increase in the turbidity and localized sedimentation of the Russian River. In 1974 the Regional Board issued waste discharge requirements to gravel mining operations on the river. These waste discharge requirements regulated the construction of road crossings and prohibited the direct discharge of wastewater from gravel mining operations. Currently, two methods of gravel mining are used on the Russian River: off-stream mining operations on terrace deposits, and in-stream bar-skimming operations. Waste discharges to the river from either type of operation is still prohibited. Public concern has been raised regarding the effects of gravel mining on the flow regime of the river and groundwater. The interception of groundwater by the large excavations along the river may indeed occur, but it is difficult to substantiate the extent to which they affect river and groundwater flow regimes and quality.

VI. CONCLUSIONS

Recent inquiries received by the Regional Board regarding the Russian River often fall into the following categories: the noticeable growth of rooted plants, questions as to the suitability of the Russian River for body contact recreation during the summer, complaints regarding trash along the Russian River, and concern over the possible impacts of gravel mining on the Russian River drainage basin.

Overall, the water quality of the Russian River and its tributaries is good as measured by available means. The water quality of the Russian River is sufficient to support, and in some cases enhance all of its beneficial uses.

The monitoring data evaluated for this report demonstrate that the quality of water in the Russian River has improved considerably since the early 1970's when water quality monitoring on the Russian River first began. These improvements in water quality can be attributed to increased levels of pollution control at municipal, industrial, and agricultural facilities that discharge to the river and its tributaries, seasonal prohibitions disallowing discharges to the river during low flow recreational periods, and increased public awareness regarding water quality issues.

As discussed previously in this report, occasional exceedances of water quality objectives have been observed in the Russian River and its tributaries. These exceedances are and will continue to be dealt with through existing regulatory programs wherever trends or significant occurrences are found. For example, exceedances of bacterial water quality objectives are dealt with by the local health departments. Exceedances of <u>Inland Surface Waters Plan</u> objectives will be addressed through the NPDES program, or if appropriate through the Nonpoint Source program.

VII. RECOMMENDATIONS

Based on the data evaluation in this report, staff recommends the following:

A) Revisit this data analysis with updated reports addressing the following issues:

   1) Cumulative impacts of permitted waste discharges on water quality;

   2) Revised monitoring strategies to address temperature, dissolved oxygen, and pH sampling problems;

   3) Concerns regarding the biological health of the Russian River, particularly concerns regarding fish species, notably anadromous salmonids;

4) Analysis of algal composition in the water column and from the Laguna de Santa Rosa;

5) Further discussion of bacteriological data, including summaries of the actual data

6) Significant trends or occurrences in the data that were not addressed in depth in this report, such as:

   a) the river-wide increase in nitrate concentrations in 1990-91, and

   b) evaluation of rainfall and streamflow data in conjunction with nutrient data to determine if peaks during the wet-weather season correspond to storm events, waste discharges, or both;

7) Incorporation of 1992 physico-chemical data into the data analysis.

B) Incorporate semi-quantitative evaluation of aquatic plant growth in monitoring programs;

C) Monitoring of bacteria levels at popular swimming areas along the Russian River early in the 1993 recreational season, to assess compliance with the Basin Plan bacterial water quality objective;

D) Continue to routinely monitor the Russian River to provide current data on the river system to:

   1) determine attainment of objectives and focus program activities;

   2) satisfy the needs of the Russian River water quality model;

   3) determine conformance of Russian River water quality with water quality objectives in Tables 1 and 2 of the Inland Surface Waters Plan, and

   4) compare to historical data.

E) Continue to deal with exceedances of water quality objectives through existing programs.

The next Russian River water quality monitoring update is scheduled near the end of this fiscal year to address issues of immediate concern, including issues identified in Recommendation A. Thereafter, updates should be scheduled at least annually.

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IX. APPENDICES

Appendices 1 and 2 which follow, contain graphs displaying trends in nitrate and phosphate concentrations versus time at several Russian River water quality monitoring stations. Monitoring dates are displayed on the x-axis as Julian dates.

Julian dates were chosen to display monitoring dates on the graphs because it is the only way to display a true time representation of monitoring events using computer generated graphs. If standard dates were used, the computer would assign equal spacing between all sampling dates even though this is not the case.

The Julian calendar assigns chronologic numbers to each day. Example conversions of standard calendar dates to Julian dates are displayed below for the beginning of each calendar quarter from January 1, 1985 through April 1, 1993. These converted dates are useful for interpreting the graphs that follow. The main body of the report contains staff's preliminary evaluation of the monitoring data based on the graphs.

EXAMPLE CONVERSIONS OF STANDARD CALANDER DATES TO JULIAN DATES

STD DATE	JULIAN DATE	STD DATE	JULIAN DATE
850101	31048	891001	32782
850401	31138	900101	32874
850701	31229	900401	32964
851001	31321	900701	33055
860101	31413	901001	33147
860401	31503	910101	33239
860701	31594	910401	33329
871001	32051	910701	33420
880101	32143	911001	33512
880401	32234	920101	33604
880701	32325	920401	33695
881001	32417	920701	33786
890101	32509	921001	33878
890401	32599	930101	33970
890701	32690	930401	34060

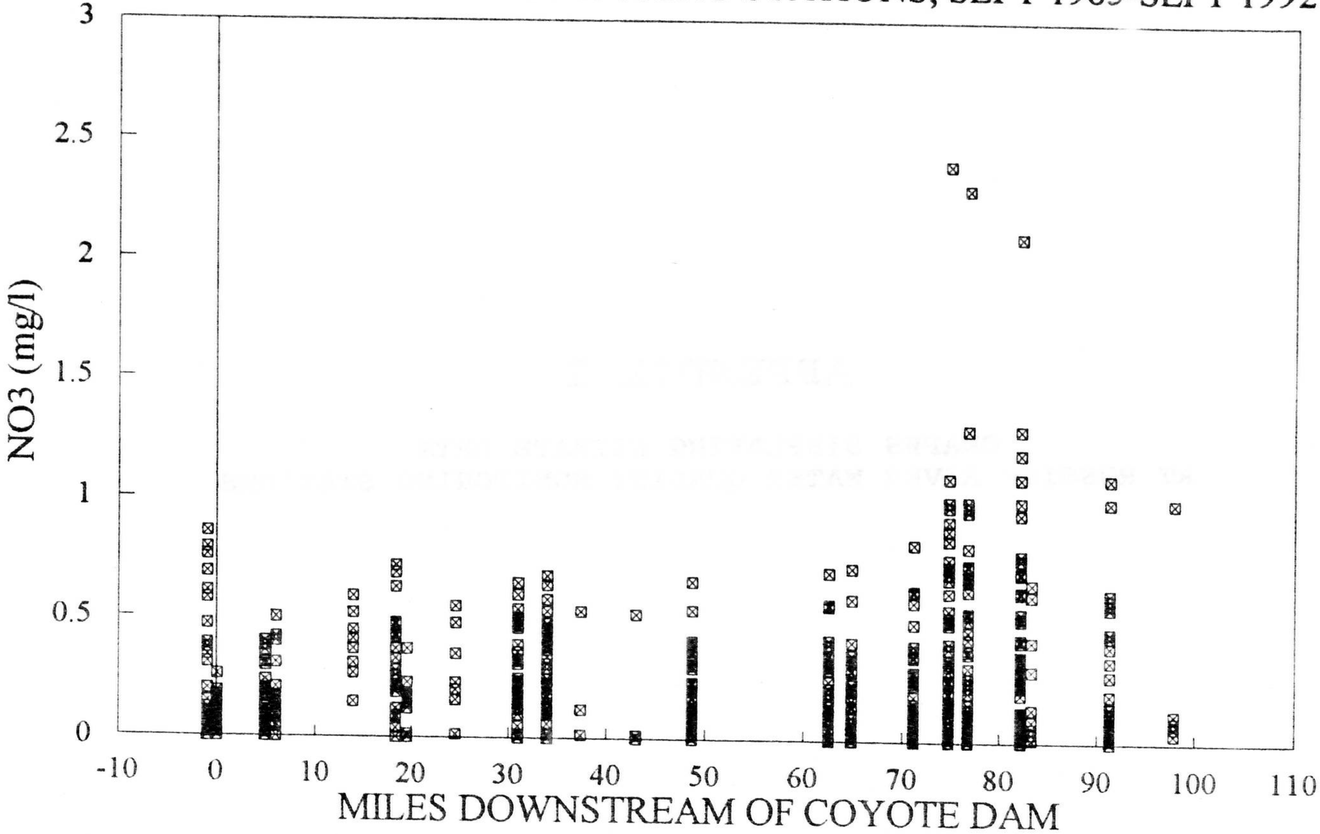
Since the numbers are chronological, if you know the number assigned to the beginning of a year, you can calculate the number assigned to any other day in that year by adding the number of days between the first day of the year and the date of interest. For example, January 1, 1985 has a Julian date of 31048. Therefore, January 2, 1985 has a Julian date of 31049.

APPENDIX I

GRAPHS DISPLAYING NITRATE DATA
AT RUSSIAN RIVER WATER QUALITY MONITORING STATIONS

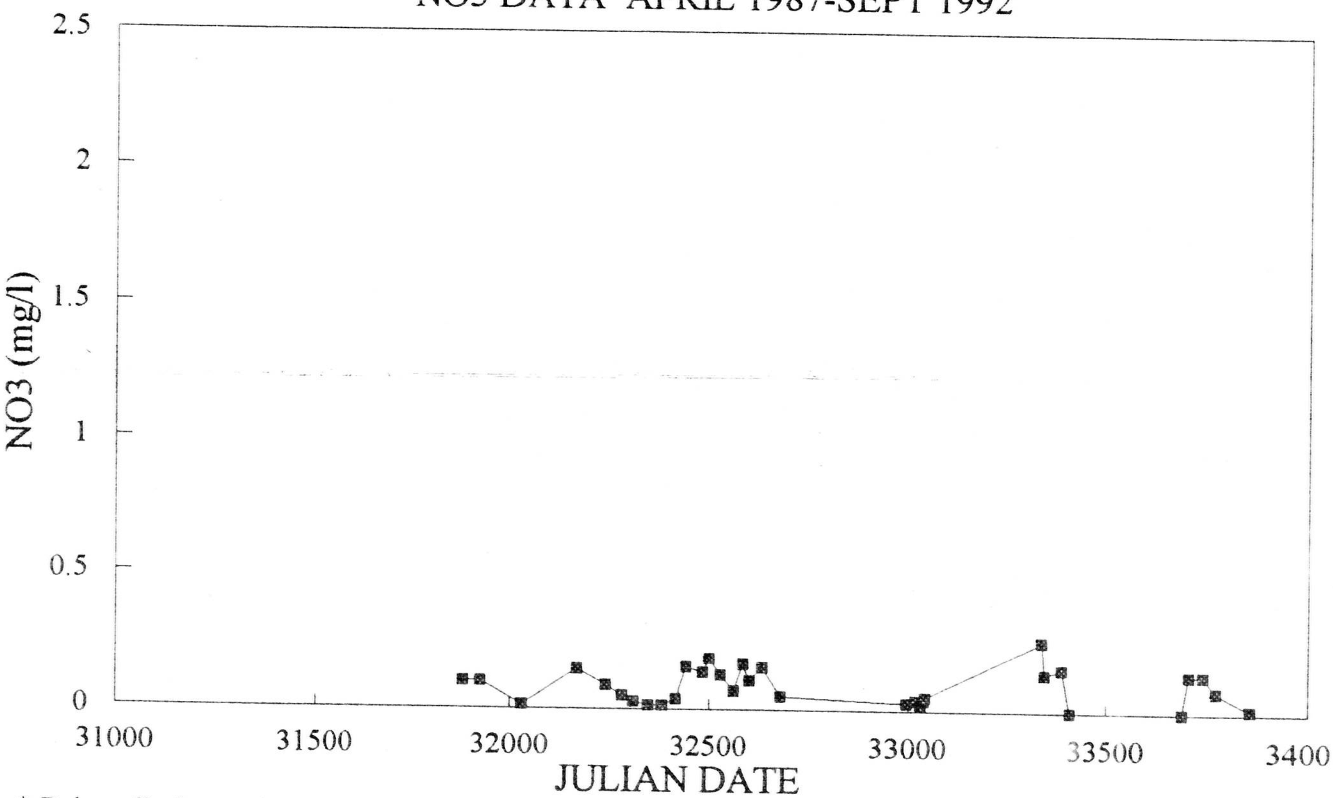
RUSSIAN RIVER NITRATE DATA

FOR ALL MAINSTEM MONITORING STATIONS, SEPT 1985-SEPT 1992



EAST FORK RUSSIAN RIVER*

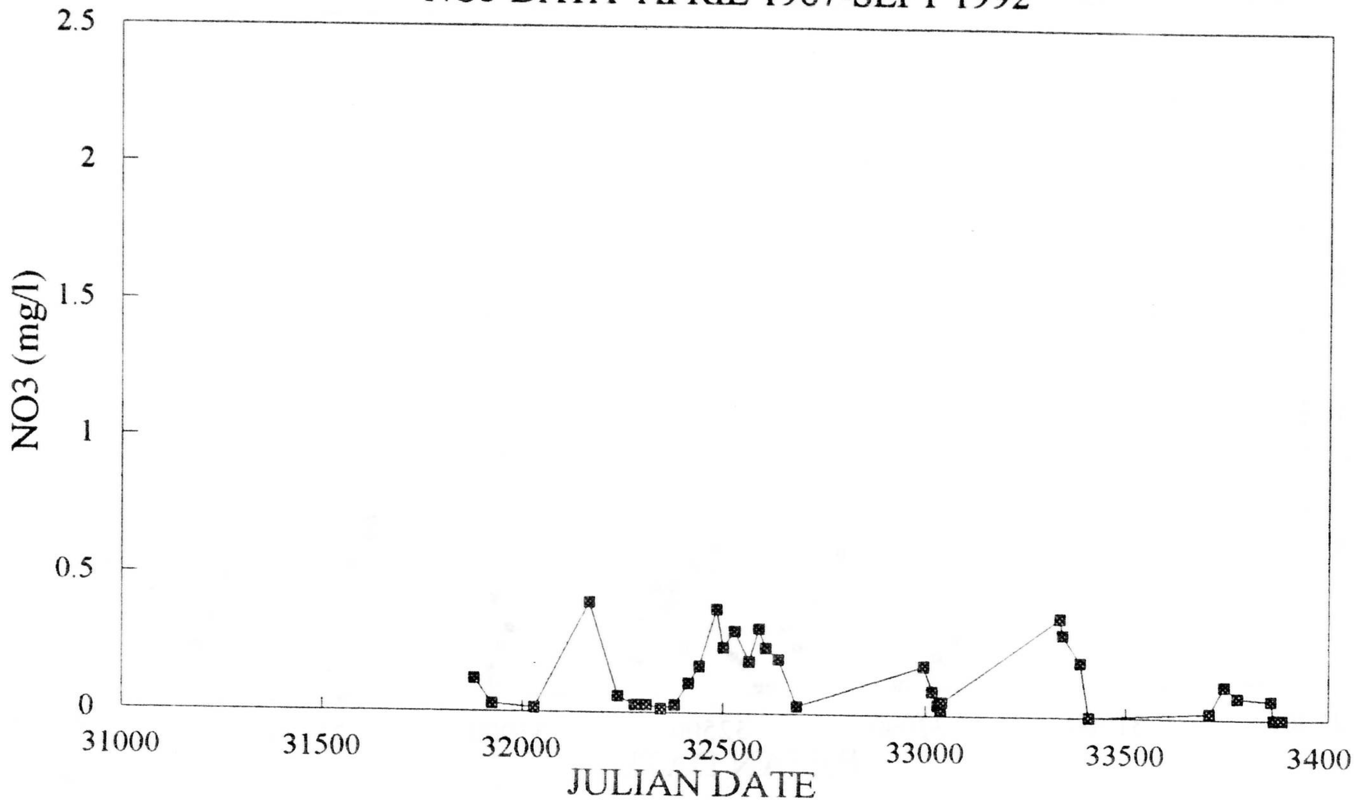
NO3 DATA APRIL 1987-SEPT 1992



* Below discharge from Coyote Dam

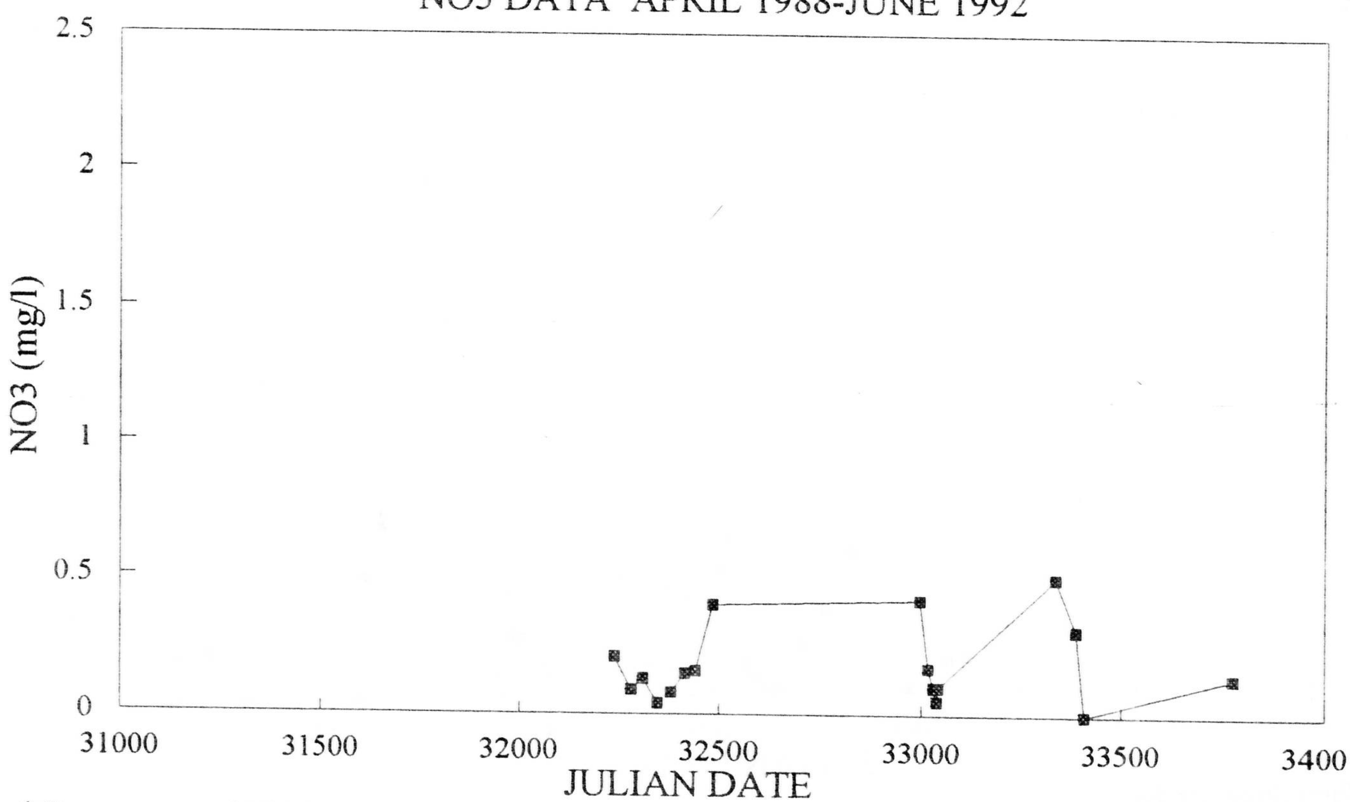
RUSSIAN RIVER AT TALMAGE

NO3 DATA APRIL 1987-SEPT 1992



RUSSIAN RIVER AT UKIAH*

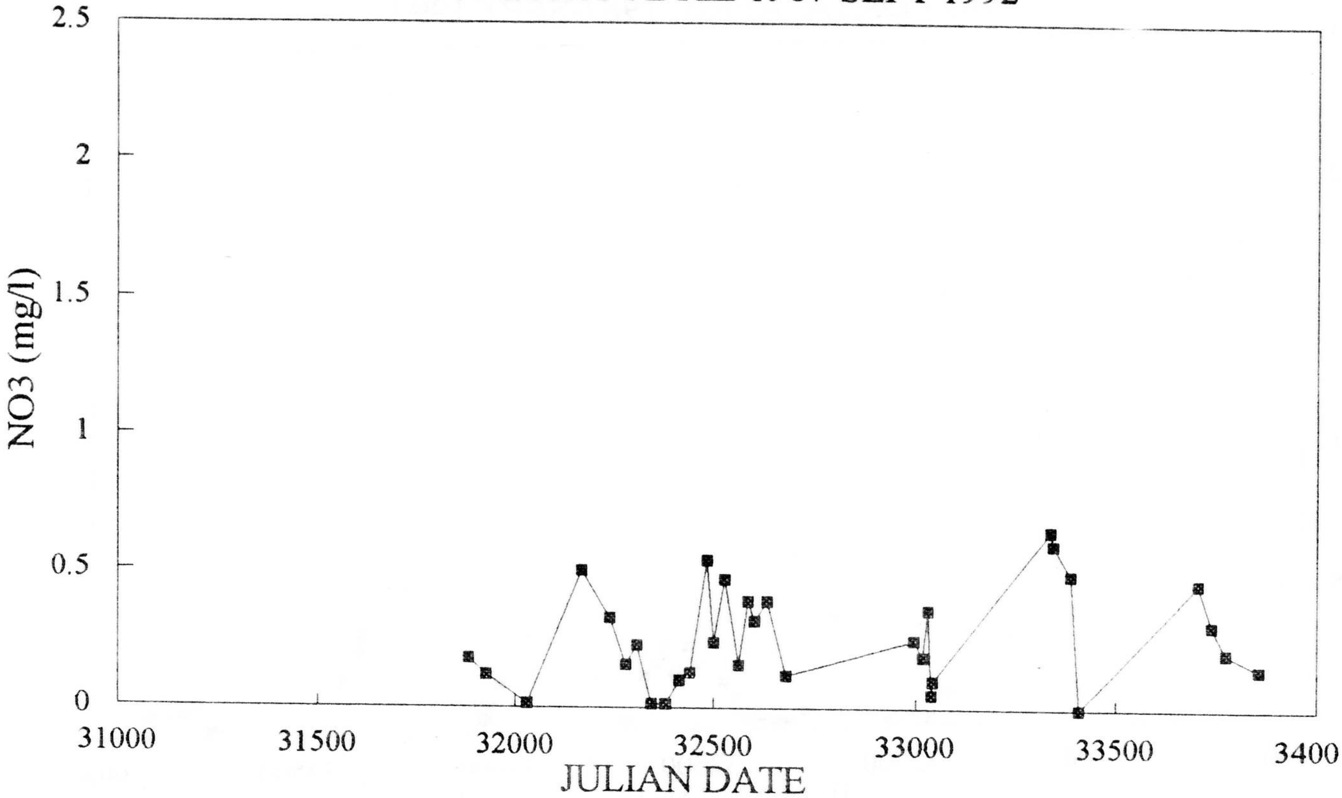
NO3 DATA APRIL 1988-JUNE 1992



* Downstream of Ukiah STP

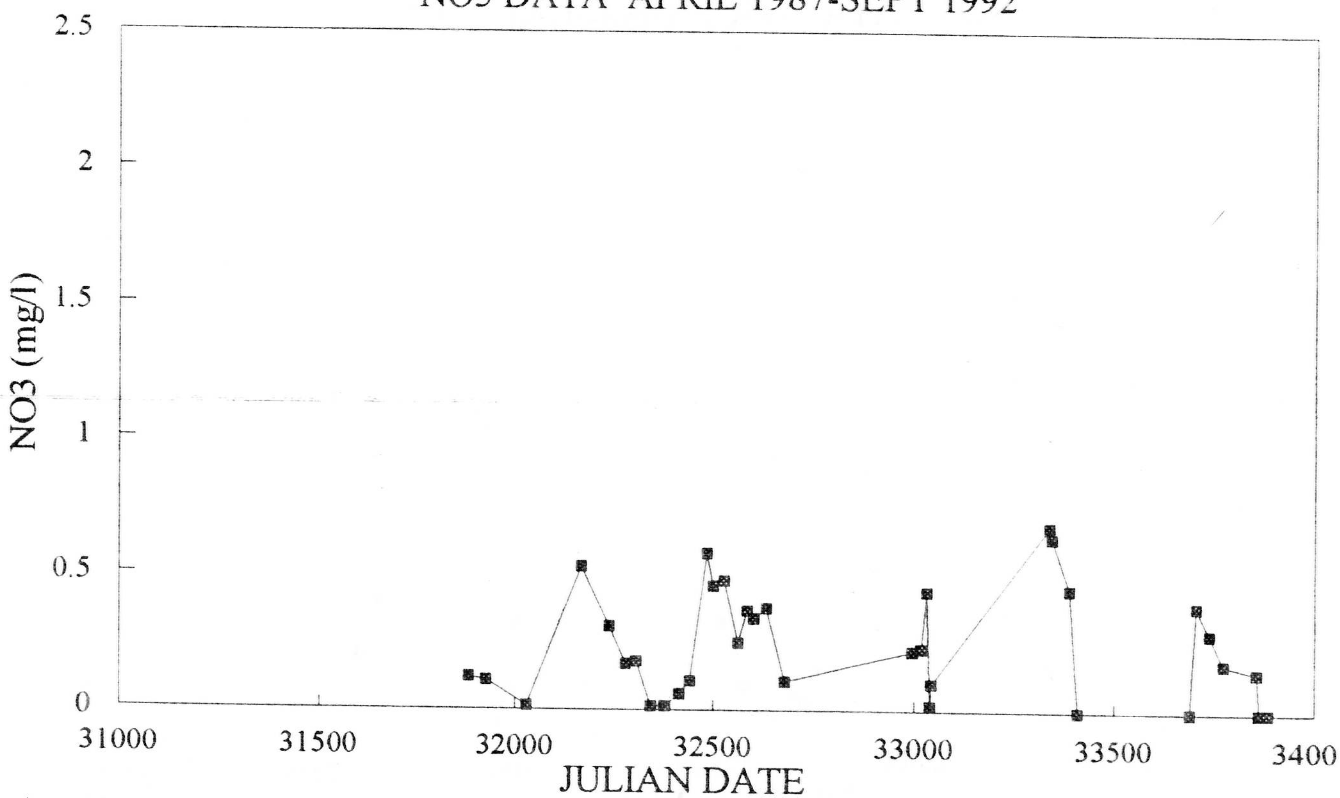
RUSSIAN RIVER AT PRESTON BRIDGE

NO3 DATA APRIL 1987-SEPT 1992



RUSSIAN RIVER AT CLOVERDALE*

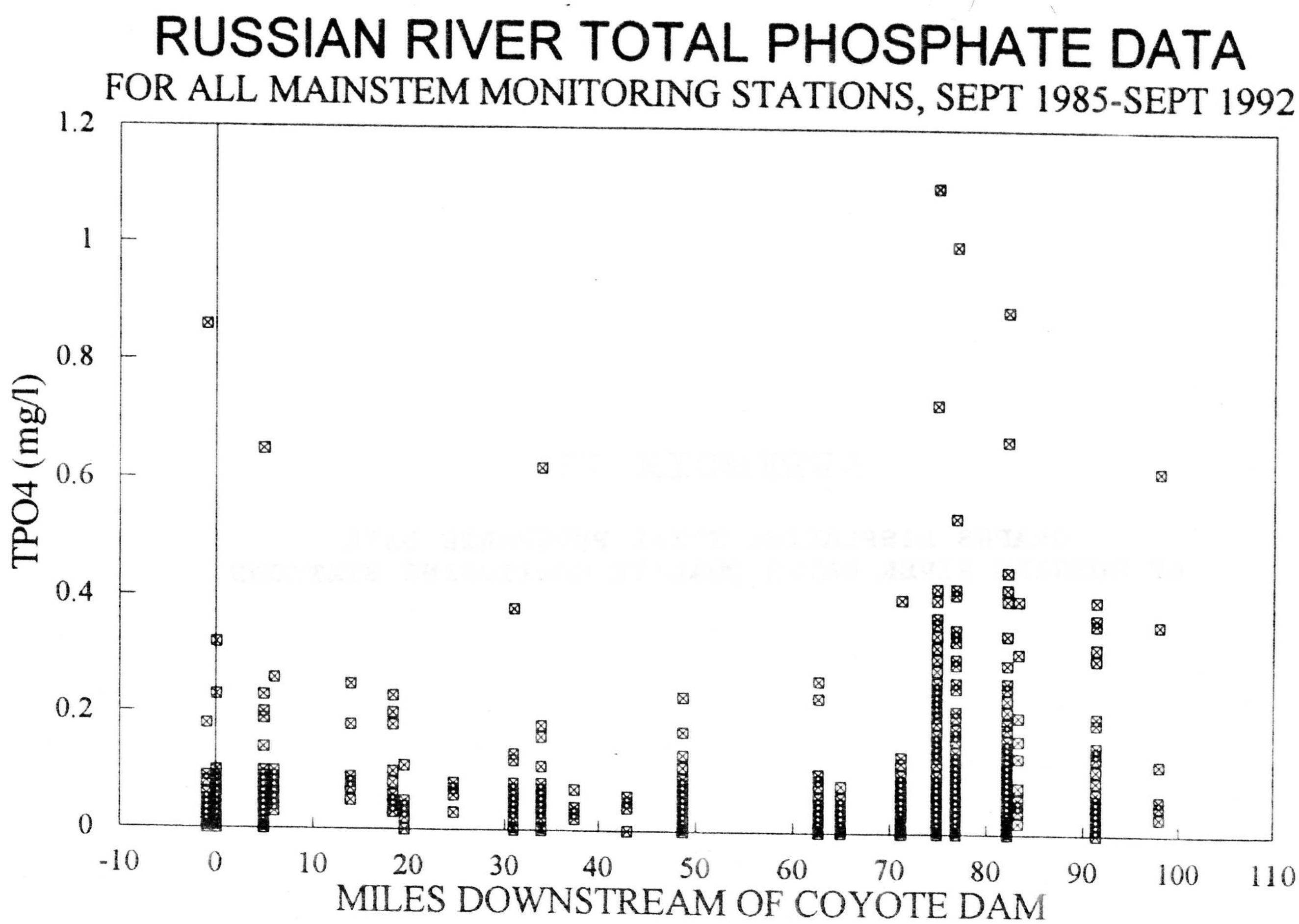
NO3 DATA APRIL 1987-SEPT 1992

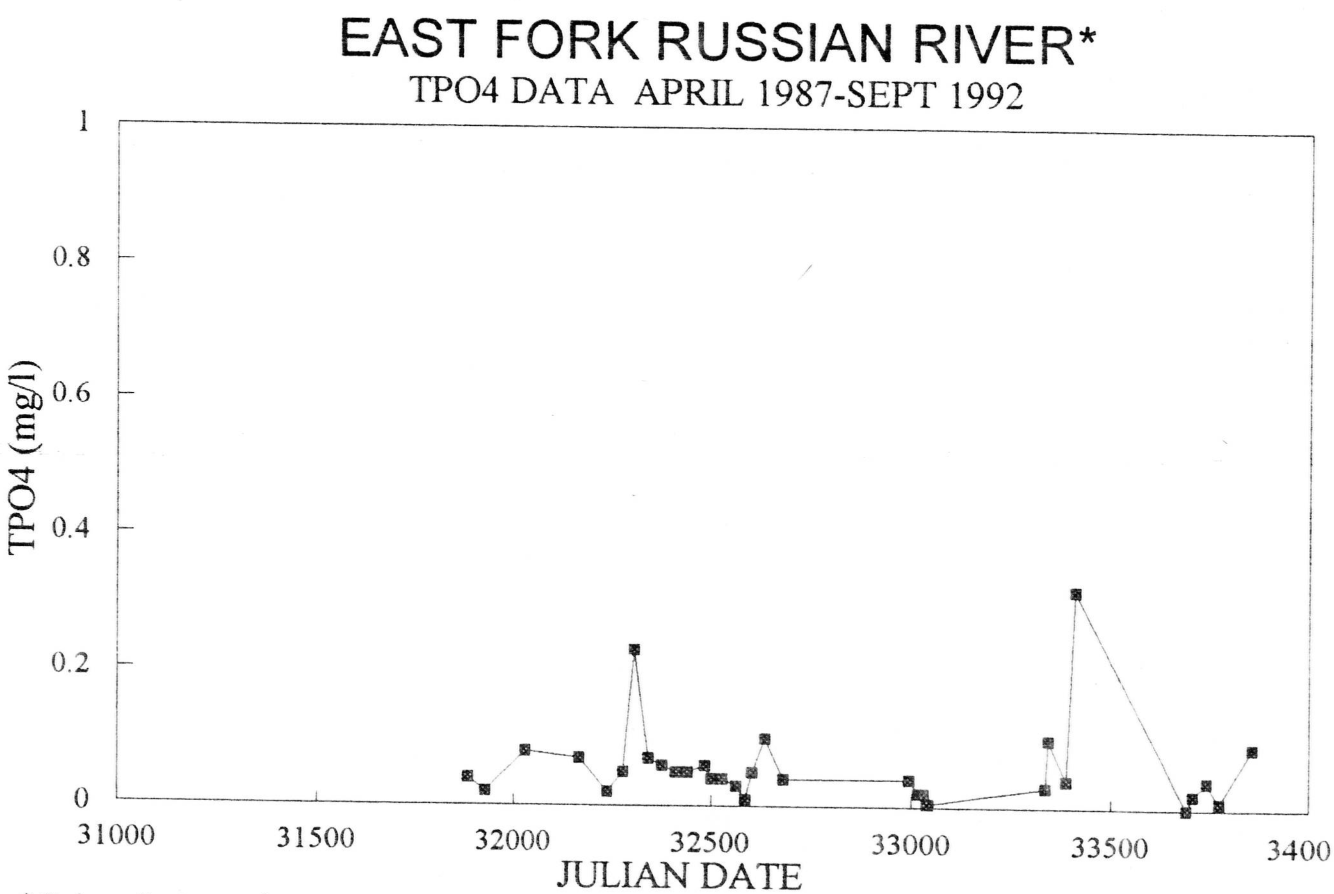


* At First Street Bridge

APPENDIX II

GRAPHS DISPLAYING TOTAL PHOSPHATE DATA AT RUSSIAN RIVER WATER QUALITY MONITORING STATIONS

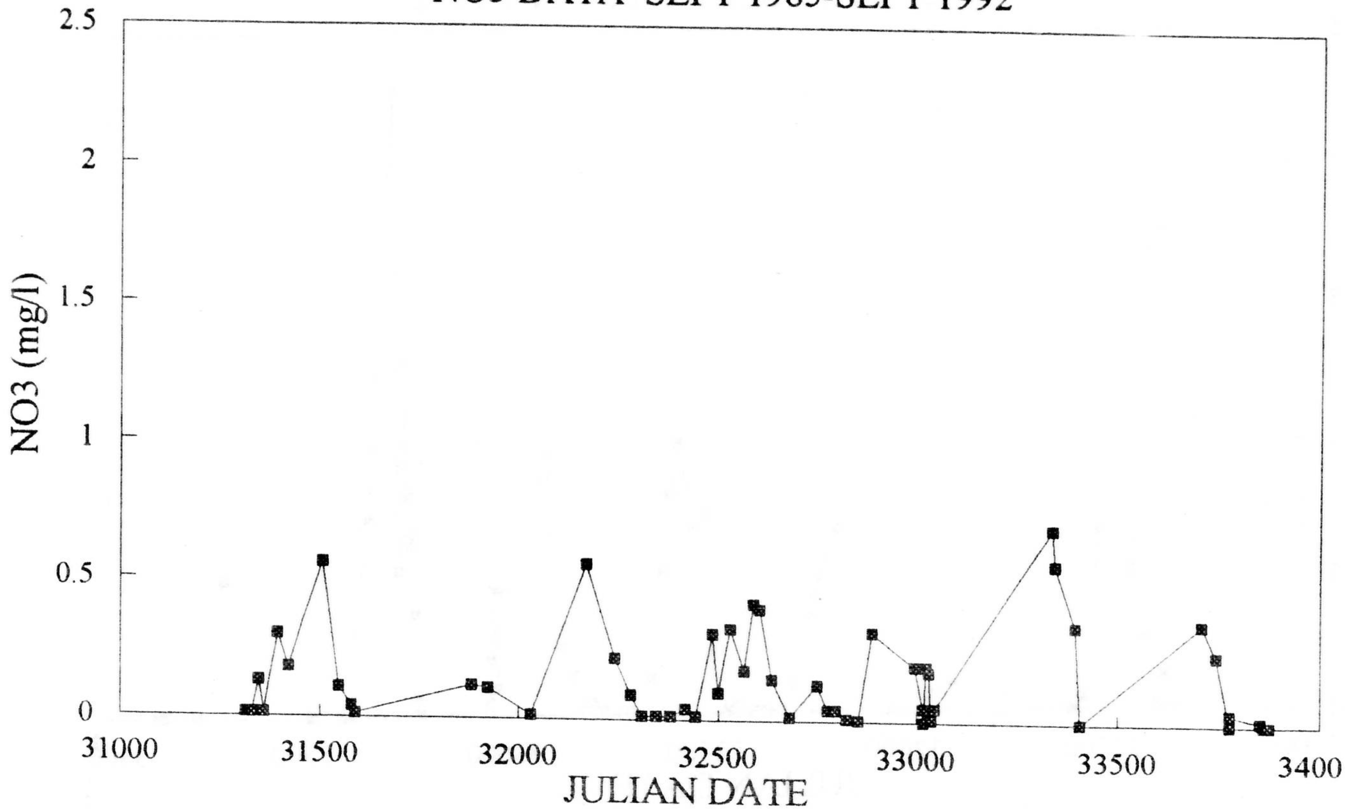




* Below discharge from Coyote Dam

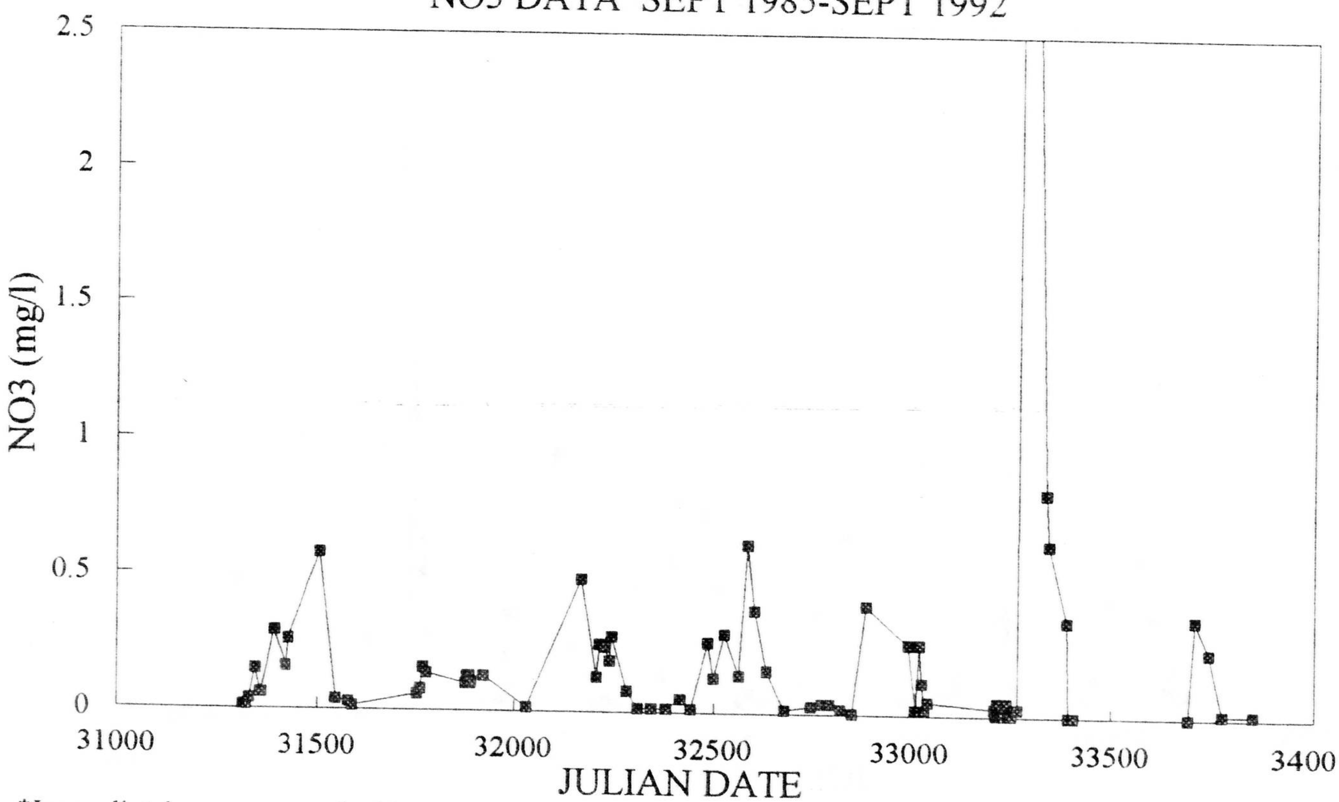
RUSSIAN RIVER AT HEALDSBURG MEMORIAL BEACH

NO3 DATA SEPT 1985-SEPT 1992



RUSSIAN RIVER AT WOHLER* BRIDGE

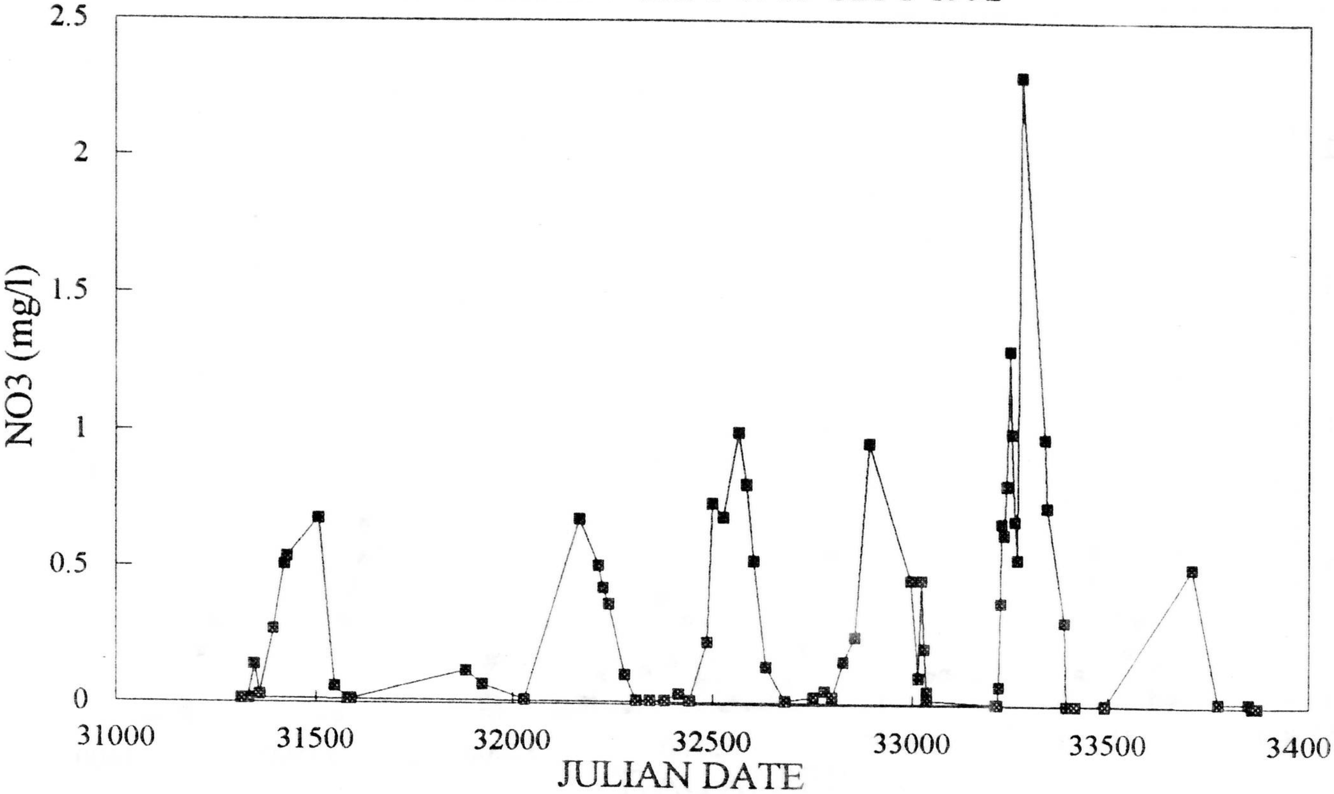
NO3 DATA SEPT 1985-SEPT 1992



*Immediately upstream of rubber dam

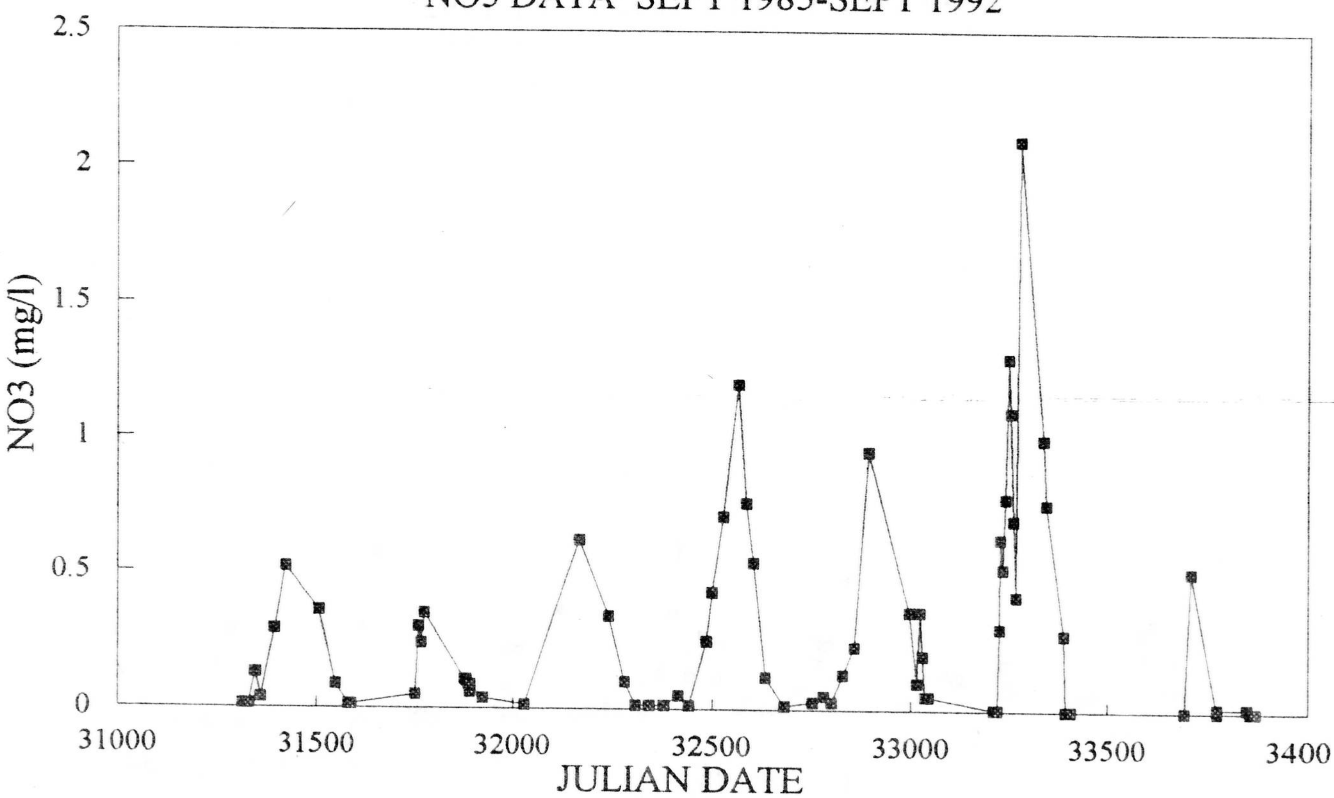
RUSSIAN RIVER AT ODDFELLOWS BRIDGE

NO3 DATA SEPT 1985-SEPT 1992



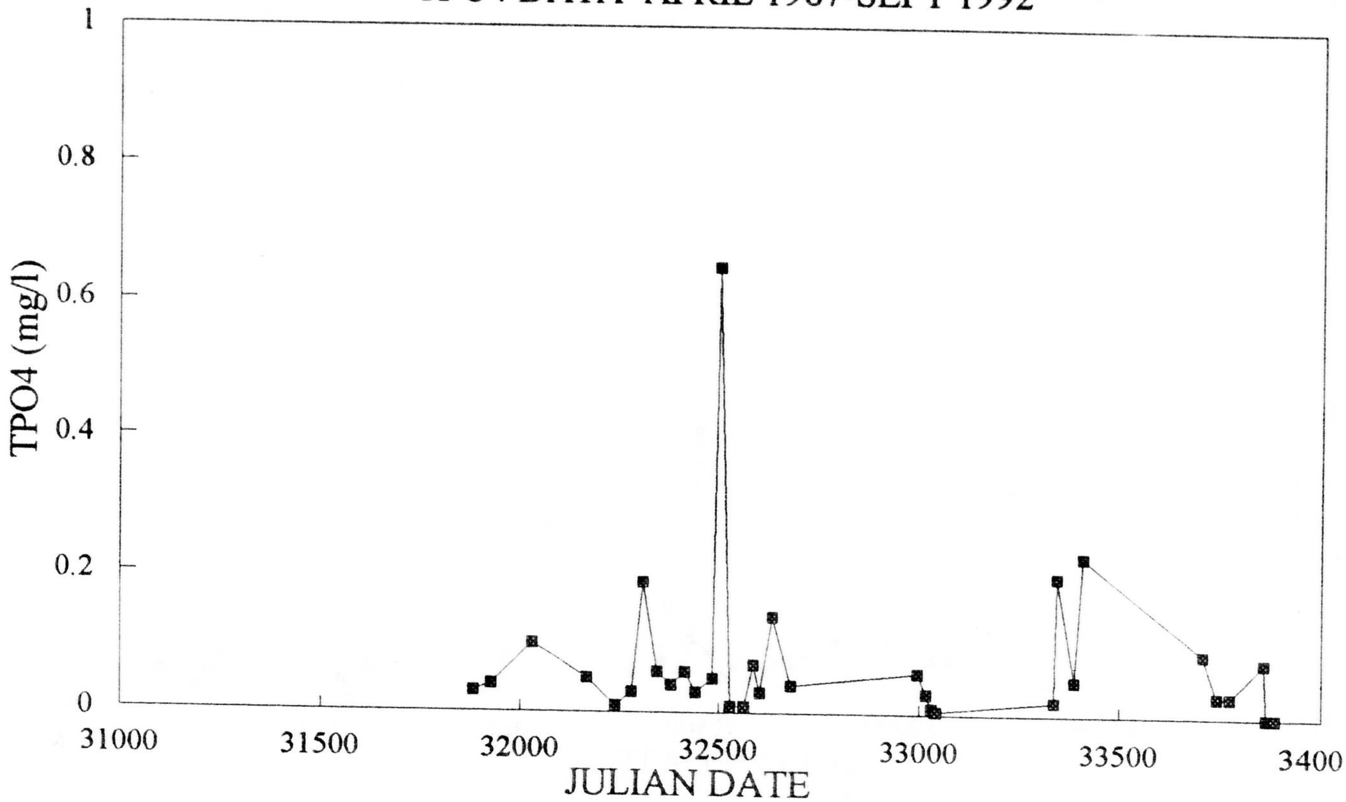
RUSSIAN RIVER AT JOHNSON'S BEACH

NO3 DATA SEPT 1985-SEPT 1992



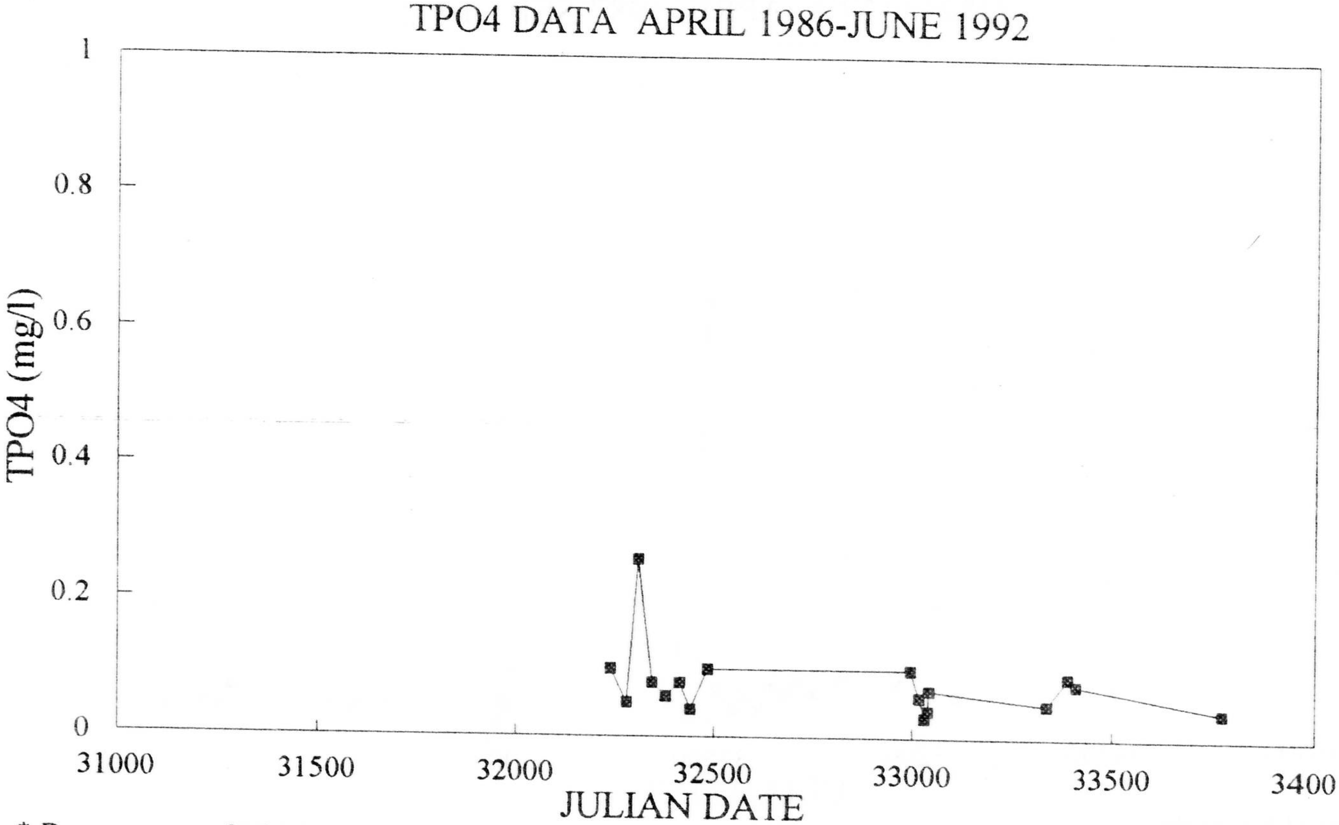
RUSSIAN RIVER AT TALMAGE

TPO4 DATA APRIL 1987-SEPT 1992



RUSSIAN RIVER AT UKIAH*

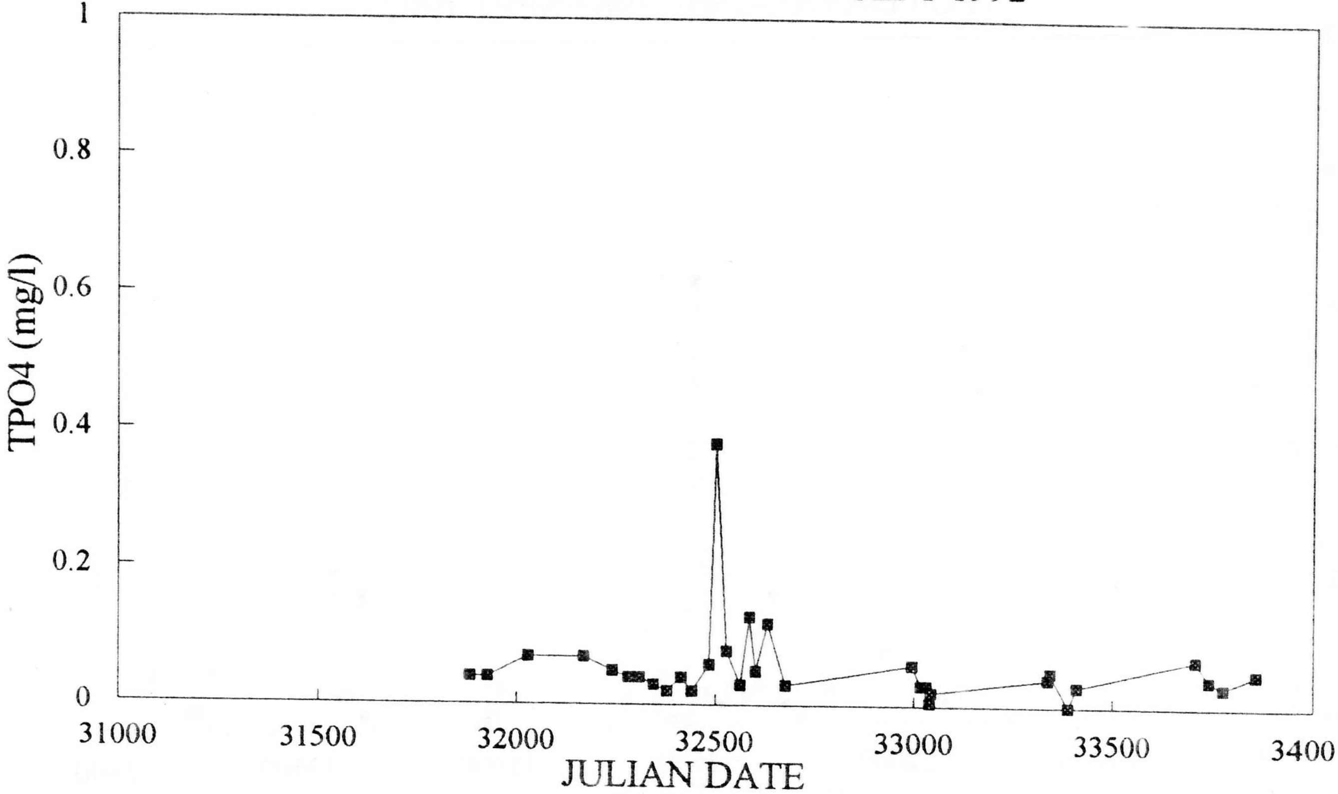
TPO4 DATA APRIL 1986-JUNE 1992



* Downstream of Ukiah STP

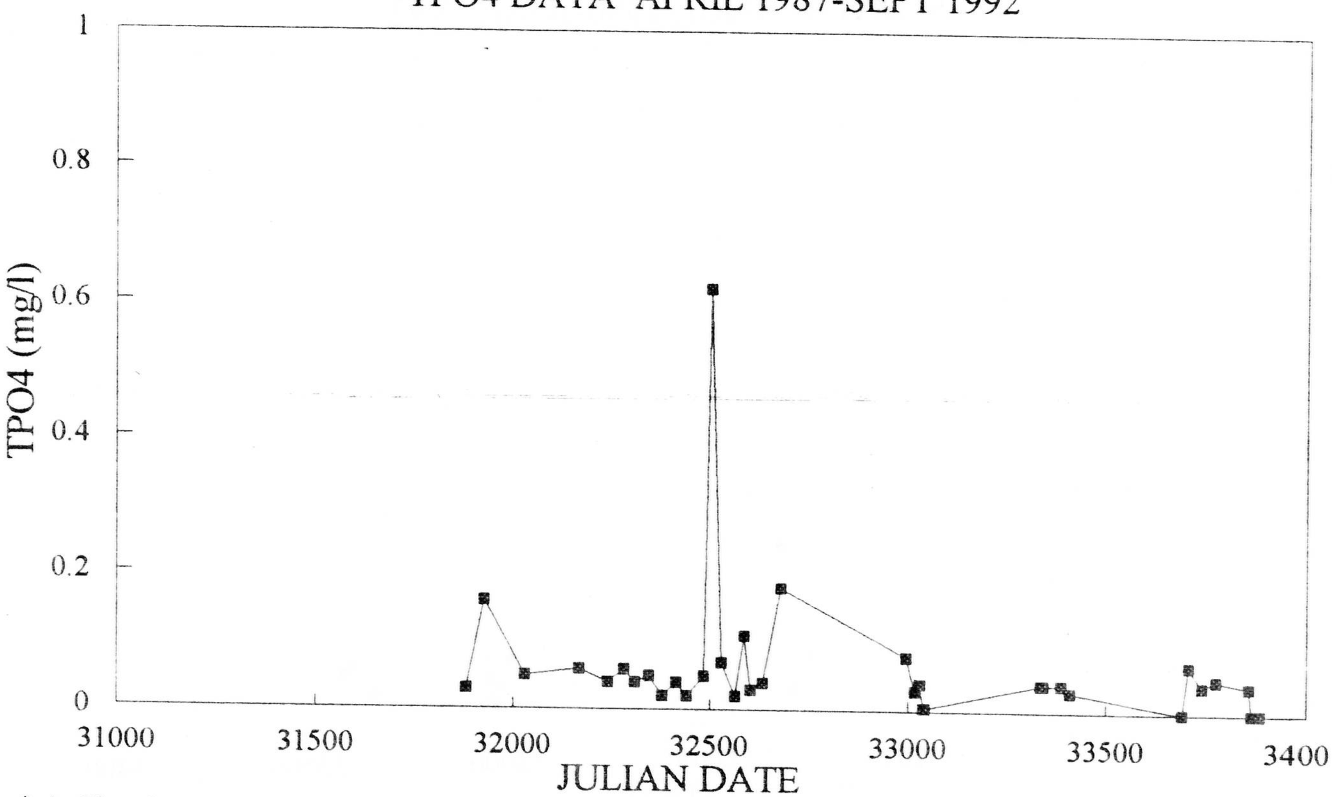
RUSSIAN RIVER AT PRESTON BRIDGE

TPO4 DATA APRIL 1987-SEPT 1992



RUSSIAN RIVER AT CLOVERDALE*

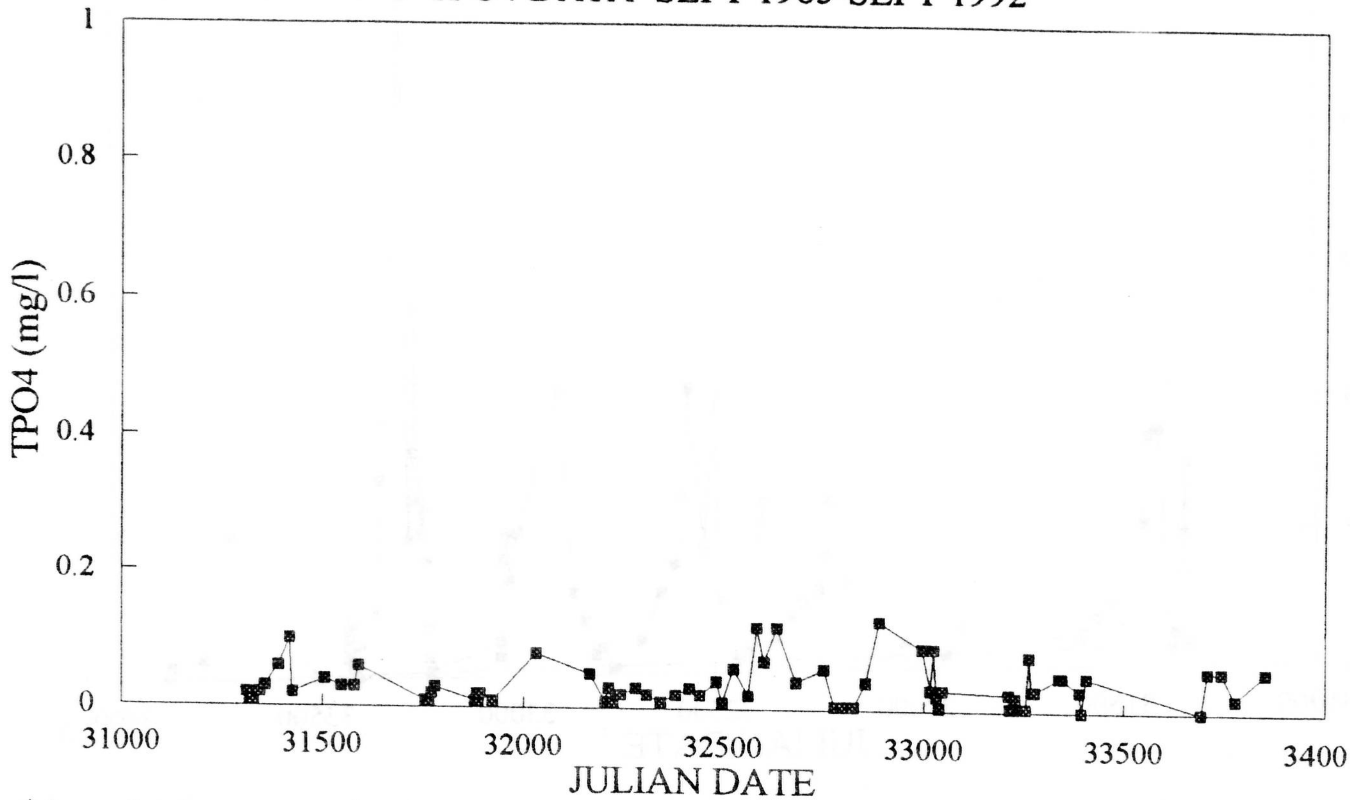
TPO4 DATA APRIL 1987-SEPT 1992



* At First Street Bridge

RUSSIAN RIVER AT WOHLER BRIDGE*

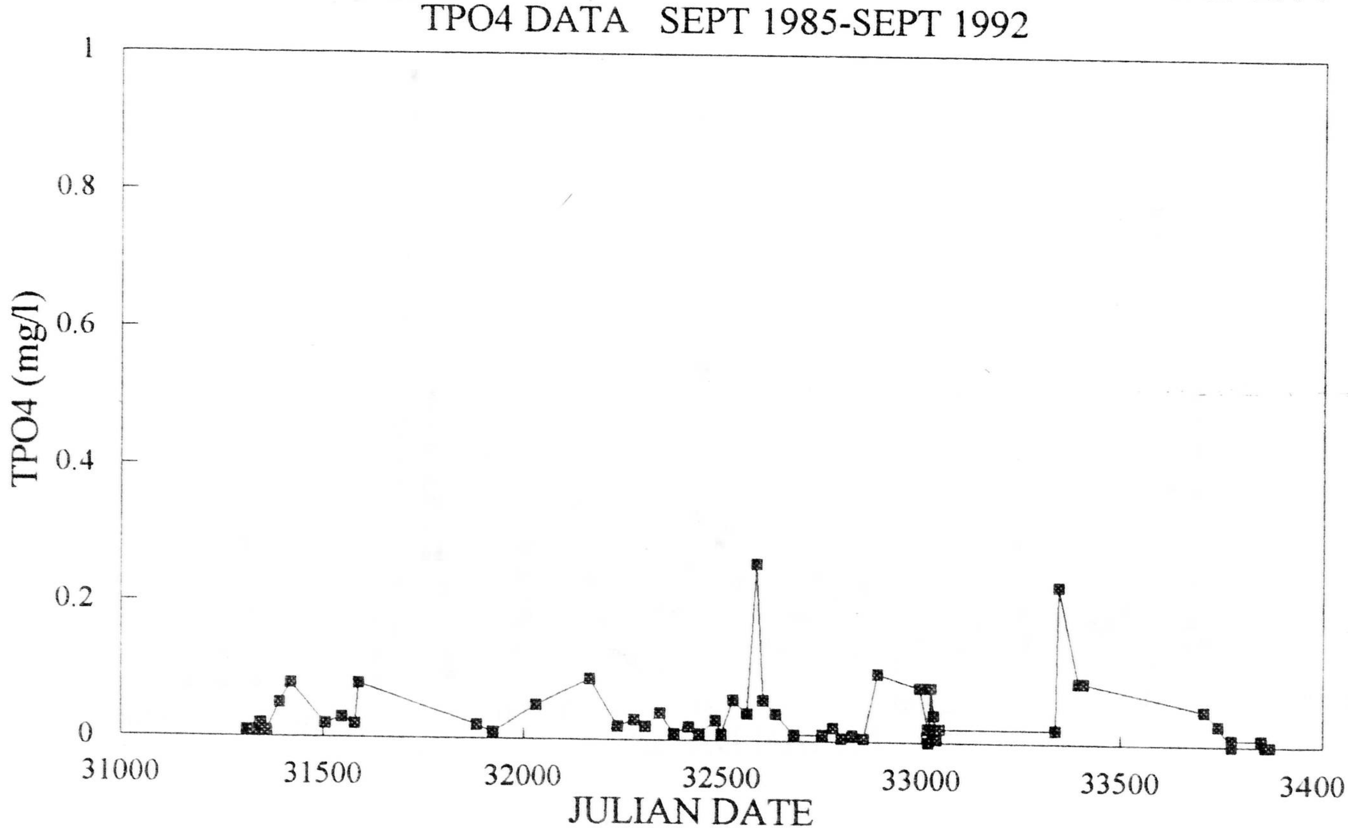
TPO4 DATA SEPT 1985-SEPT 1992



* Immediately upstream of rubber dam

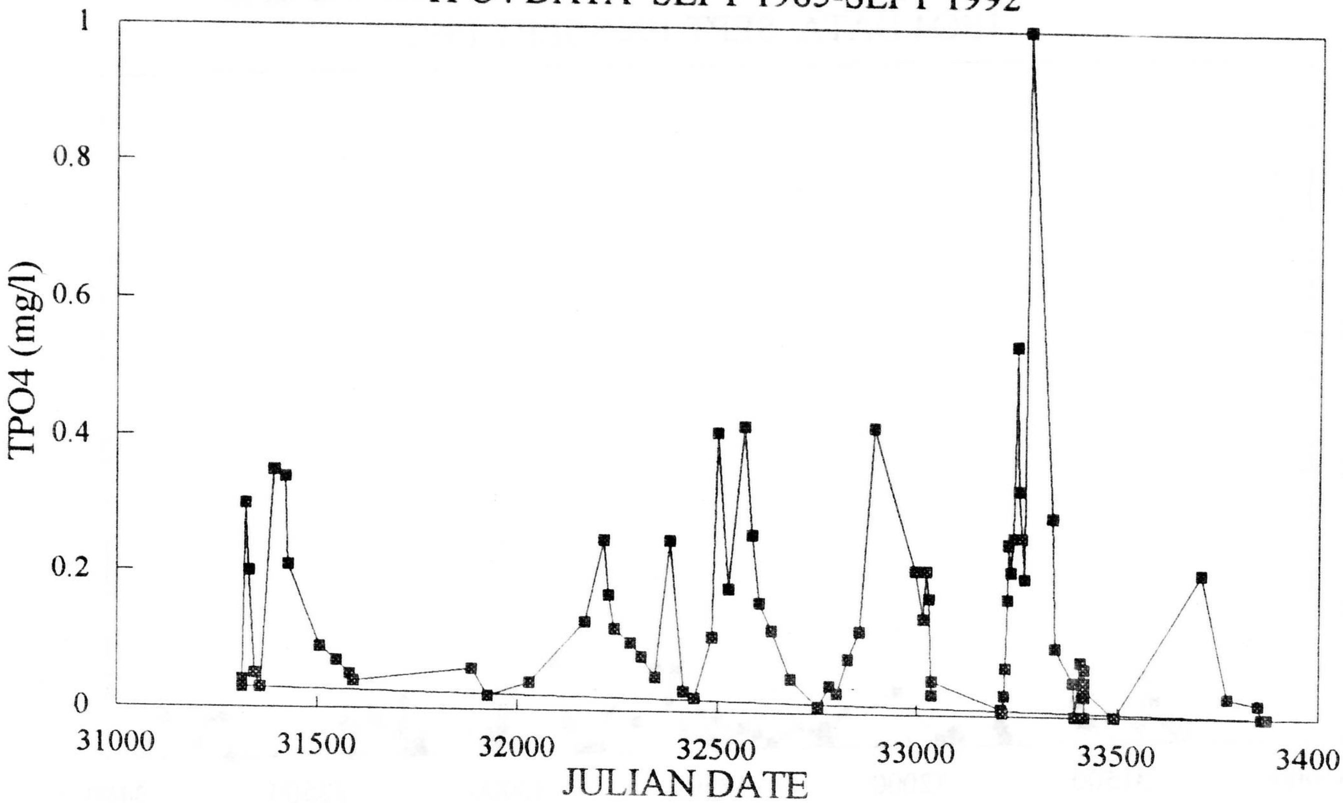
RUSSIAN RIVER AT HEALDSBURG MEMORIAL BEACH

TPO4 DATA SEPT 1985-SEPT 1992



RUSSIAN RIVER AT ODDFELLOWS BRIDGE

TPO4 DATA SEPT 1985-SEPT 1992



RUSSIAN RIVER AT JOHNSON'S BEACH

TPO4 DATA SEPT 1985-SEPT 1992