# Water Quality in Rhode Island's Urban Rivers:

Blackstone, Moshassuck, Pawtuxet, Ten Mile, Woonasquatucket

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## River Rescue Results 1990-1995

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This publication is also sponsored in part by Rhode Island Sea Grant, under NOAA Grant No. NA36RG0503. The views expressed herein are those of the authors and do not necessarily reflect the views of NOAA or any of its sub-agencies. The U.S. Government is authorized to produce and distribute reprints for governmental purposes notwithstanding any copyright notation that may appear hereon.

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## River Rescue Results 1990 – 1995

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Virginia Lee

Coastal Resources Center
Rhode Island Sea Grant
University of Rhode Island

May 1996

# CONTENTS

# ACKNOWLEDGMENTS

River Rescue was conceived by Faye Sanders, Bob Oberg, and Linda Tissiere, employees of Citizens Bank, who worked with Virginia Lee, U.S. Program Manager at the University of Rhode Island Coastal Resources Center, to formulate this model of corporate stewardship for urban resources. Mark Formica, president of Citizens Bank, was responsible for the bank's continued support for the River Rescue monitoring program.

River Rescue has also benefited from collaborations with other volunteer monitoring programs in Rhode Island. We would like to specifically acknowledge the help provided by Linda Green, coordinator of the Rhode Island Watershed Watch Program, and Wenley Ferguson, coordinator of Save the Bay's BayWatcher Program.

During our five years of work on Providence's urban rivers, we had the opportunity to work with talented people at a number of other organizations. Jane Sherman, coordinator of the Woonasquatucket River Coalition, has devoted herself to raising local awareness of the Woonasquatucket River, and taught us about urban stewardship. Bill Cocroft, member of the Pawtuxet River Authority, loyally supported the River Rescue project and took over responsibility for River Rescue monitoring stations when the program ended. Bob Billington, president of the Blackstone Valley Tourism Council, worked with Citizens Bank and River Rescue throughout the program's life and adopted River Rescue monitoring on the Blackstone River when River Rescue ended. Ann O'Grady, a River Rescue volunteer and Warwick teacher, used River Rescue to build a school monitoring network for the Pawtuxet River. Through her efforts, hundreds of students were inspired to learn about rivers, to celebrate Pawtuxet River music and history, and to engage their local community in river protection.

We are grateful to the individuals who served on the River Rescue technical advisory board - URI faculty members Art Gold, Caroline Karp, Jim Latimer, Scott Nixon, Mike Pilson, Jim Quinn, Dan Urish, and Ray Wright; Rhode Island Department of Environmental Management staff Connie Carey, Chris Deacutis and Scott Millar and Save The Bay's Wenley Ferguson. URI students Dave Avery, Bridgette Holohan, Courtney Stirling, Nicholas Wolf, Jeff Johnson, Michael Conroy, and Kevin Zagrodny assisted with lab analyses, data entry and analysis, volunteer recruitment and training, and many other jobs for the River Rescue project.

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Most importantly, River Rescue was only possible through the dedication and hard work of many volunteers. We were fortunate to have the opportunity to work with this wonderful community of concerned citizens and we thank each one for contributing to the project.

# INTRODUCTION

The River Rescue project, a collaborative effort between Citizens Bank, the University of Rhode Island (URI) Coastal Resources Center (CRC), and Rhode Island Sea Grant, was designed to collect high quality environmental data on the urban rivers of Providence using trained citizen volunteers as field scientists. Citizens Bank provided promotional and financial support for the project, while CRC coordinated the technical aspects of monitoring. Rhode Island Sea Grant provided supplemental funding and technical assistance.

## Monitoring

Volunteers tested the water quality of the Blackstone, Moshassuck, Woonasquatucket, Pawtuxet, and Ten Mile Rivers once a month between October 1990 and August 1995. Air and water temperature, dissolved oxygen, pH, and hardness were measured in the field and samples were collected for later analysis at URI for nutrients, metals, hardness constituents, and total suspended solids. The results of each year of monitoring are presented in River Rescue Annual reports (Kerr, 1991, 1992, 1993) This report summarizes the project as a whole.

During the first year of the program, River Rescue also collected biweekly samples that were analyzed for non-aromatic petroleum hydrocarbons. Samples were collected at four stations - at the mouth of the Blackstone, Moshassuck, Pawtuxet, and Woonasquatucket Rivers between October 1, 1990 and August 4, 1991. The results of this study are contained in a separate report (Latimer et al., 1992).

In addition to chemical testing, River Rescue volunteers participated in other monitoring activities: Shoreline surveys were conducted along the rivers' shores to document the land use conditions of the river watersheds; in conjunction with the Narragansett Bay Commission, combined sewer overflows (CSOs) were examined during dry and wet weather to detect unwanted overflows; and volunteers conducted pipe detective monitoring to identify illegal point sources flowing into the rivers.

## Stewardship Promoting Activities

*Cleanups:* River Rescue volunteers have planned and participated in annual cleanups of the rivers, pulling hundreds of tires, shopping carts, construction debris, and other refuse from the water. Neighborhood businesses and residents participated in the cleanups with volunteers from Citizens Bank and URI.

*Ride for the Rivers:* Under their part of the River Rescue project, Citizens Bank sponsored an annual Ride for the Rivers, attracting biking enthusiasts from throughout New England to ride along the Blackstone, Seekonk, and Moshassuck Rivers.

*Advanced Water Quality Training:* River Rescue volunteers participated in advanced water quality training taught by URI staff during the summer of 1993. After completing the training, the volunteers conducted quality assurance inspections of all the River Rescue monitoring teams.

*Rhode Island Monitoring Conference*: In March 1994, River Rescue and Save The Bay sponsored a conference for volunteer monitors throughout Rhode Island. This conference

provided and opportunity for exchange of ideas between groups and helped to build essential links among the state's many volunteer monitoring programs.

*River Festivals*: River Rescue volunteers participated in the annual Providence Waterfront Festival and other local environmental fairs, providing educational materials to hundreds of festival visitors.

*Woonasquatucket River Greenway Project*: River Rescue worked with the National Park Service, the Providence Plan, the City of Providence Planning Department, Brown University, Save The Bay, and other organizations to develop community support for a greenway along the lower Woonasquatucket River. The greenway project was announced at a press conference on January 24, 1994. River Rescue completed two projects on the river — an indoor display detailing the history of the river and its current condition that was posted at the neighborhood branch of the Providence Public Library and an interpretive walk along the river that was offered for adults in both English and Spanish and for children.

### Outreach and Awards

*Renew America:* River Rescue was awarded a Certificate of Environmental Achievement by Renew America in 1992. It was also listed in the 1992 and 1994 editions of their *Environmental Success Index* directory.

*National Volunteer Monitoring Conferences:* River Rescue was presented at the Third (1992) and Fourth (1994) National Volunteer Monitoring Conferences. The program was highlighted for its successful business partnership and for its focus on urban waters.

*The Volunteer Monitor Newsletter:* River Rescue was featured in the Fall 1991 edition of the national volunteer monitoring newsletter.

## STUDY AREAS

### Blackstone River

The Blackstone River is the largest river draining into upper Narragansett Bay. It begins in Worcester, Mass., at the confluence of the Middle River and Mill Brook and enters the Seekonk River at the head of Narragansett Bay at Slater Mill in Pawtucket, R.I. The Blackstone drains an area of 472 square miles and has a average discharge of 862 cubic feet per second.

The Blackstone River has had a long history of industrial use, beginning in 1793 when Samuel Slater opened Slater Mill, the first U.S. cotton mill to use mechanical spinning machines. The river's power supported a burgeoning industry throughout the early 19th century, and by 1830 there was one dam for every mile of river along the Blackstone's main stem and tributaries.

The river valley became highly industrialized, supporting rubber plants, wire manufacturers, as well as textile mills. The river provided power, water, and a convenient site for waste disposal for these industries, as well as for the local towns that had grown to

support the industry. As a result of 150 years of abuse, in 1971 the Blackstone was dubbed "one of America's most polluted rivers" by *Audubon*.

Today, the quality of the Blackstone has improved significantly and there is increasing citizen interest in the river as a recreational resource for Rhode Island and Massachusetts. River Rescue monitored the Blackstone at three locations: B2 was located in Blackstone, Mass., Blons was located in Lonsdale upstream of the densely developed sections of the river, and B1 was located at the mouth of the river in Pawtucket, R.I.

## Pawtuxet River

The Pawtuxet River drains 232 square miles, or about one-fifth of Rhode Island, and has an average flow of 414 cubic feet per second at its mouth. It has two major branches: the North Branch, which begins at Scituate Reservoir — the major source of drinking water for the Providence metropolitan area, and the South Branch, which begins at the Flat River Reservoir in Coventry.

The Pawtuxet River has received both industrial waste and sewage discharges since the early 1800s. Today, treated wastewater from three cities — West Warwick, Warwick, and Cranston — is discharging to the river and makes up most of the flow in summer months. Waste from Hoechst Celanese Corporation and Original Bradford Soap and stormwater from sprawling suburban and urban neighborhoods and interstate highways also contaminate the river.

River Rescue monitored two stations on the Pawtuxet: P2 was located in West Warwick near the head of the main stem, and P1 was located at the mouth in Pawtuxet Village in Cranston, R.I. During 1994, River Rescue conducted a special study of the Pawtuxet River, sampling 12 stations along the main stem and branches. The results of this study are summarized in a separate report (Kerr et al., 1994)

## Moshassuck River

The Moshassuck is the smallest river included in the River Rescue program. The Moshassuck begins in Lincoln, R.I. and flows through Saylesville, Central Falls, and Pawtucket before joining with the Woonasquatucket River to flow into the Providence River in downtown Providence. The river's drainage area is 23.7 square miles and the river discharges an average of 41.9 cubic feet per second at its mouth.

Although the Moshassuck River was once severely polluted by industrial and human waste, today the river's quality is significantly improved. River Rescue monitored two stations on the Moshassuck: M2 was located near the northern border of Providence and station M1 was located near the river's confluence with the Woonasquatucket.

## Woonasquatucket River

The Woonasquatucket River begins in North Smithfield and flows through the heart of Providence where it meets the Moshassuck River and empties into the Providence River. Although the Woonasquatucket River is small, only 19 miles long and draining an area of about 51 square miles, it featured prominently in the early industrial development of Providence. During the early 1900s, the Woonasquatucket River was used as a water supply and wastewater receiving stream for numerous factories and mills. In 1922, approximately 7,200 people lived in the many small communities along the banks of the river and their sewage was discharged into the river.

The Woonasquatucket River has received increasing attention in recent years. Although neglected for years, the recent construction of Waterplace Park at the river's mouth has made the river visible and attractive. River Rescue monitored two stations on the Woonasquatucket: W2 was the upstream station near Centredale and station W1 was the downstream station at Valley Street in the Olneyville section of Providence.

### Ten Mile River

The Ten Mile River was highly impounded for industrial water power and water supply. It is now a slow-flowing river that discharges into the Seekonk River in East Providence. Although named the Ten Mile, the river is actually 20.7 miles long and drains an area of 53.1 square miles. The cities of Attleboro and North Attleboro discharge treated sewage into the river. During the summer these discharges make up the majority of the river's flow.

River Rescue sampled one station, TM1, located just upstream of Omega Pond at the mouth of the river.

## METHODS

### Volunteer Recruitment and Training

River Rescue volunteers were recruited from Citizens Bank employees and from the general public through media coverage and by word of mouth. Training sessions for new volunteers were conducted twice a year, in the spring and fall. Once trained, volunteers attended quality assurance sessions at the URI Graduate School of Oceanography. Quality assurance sessions were also held at least twice a year, sometimes in conjunction with the new volunteer training. Each volunteer was also visited in the field once a year for a quality assurance check.

River Rescue provided each volunteer with a sampling bucket and rope; dissolved oxygen, pH, and hardness test kits; thermometer; sample containers; 50 milliliter (ml) sampling syringe; filter holder, filters, and forceps. Volunteers were asked to provide distilled water for rinsing equipment and were responsible for travel to and from the sampling station. A description of the sampling stations is given in Table 1.

### Water Chemistry

*Collecting Water Samples*: Plastic mop buckets were used as sampling devices. Metal handles were removed from the buckets and replaced with cotton or plastic line before the buckets were used in the field.

Water samples were collected from the upstream side of road bridge crossings except as noted in Table 1. The bucket was lowered off the bridge, close to the midpoint of the flow of the river and quickly filled with surface water. The bucket was brought to the surface, emptied, and rinsed again with the river water. It was then lowered a third time and filled about two-thirds full. The water temperature was measured immediately, then dissolved oxygen measurements were made followed by pH and hardness. These measurements were recorded on field data sheets. After the field measurements were completed, the bucket was emptied on the grass and a second bucket of river water was collected.

## Table 1. River Rescue Sampling Stations

| RIVER | STA | DESCRIPTION |
|---|---|---|
| Moshassuck | M1 | At the USGS gage, upstream of the North Main/Charles St. crossing. Sampling conducted from the side of the river, just downstream of the foot bridge behind the Moshassuck Apts. |
| Moshassuck | M2 | From the upstream side of the road crossing outside of the Bonanza bus station in Providence, R.I. (exit 25 from I-95). |
| Woonasquatucket | W1 | Sampling conducted midstream from the upstream side of the road crossing at Valley St. in Providence, R.I. |
| Woonasquatucket | W2 | At Rte. 44 in North Providence. Sampling was conducted midstream from the downstream side of the bridge because flow is disrupted upstream by an island. |
| Pawtuxet | P1 | Sampling was conducted from the northern shore upstream of the dam at Broad St. in Cranston, R.I. |
| Pawtuxet | P2 | At East Ave. in West Warwick, R.I. Sampling was conducted from the upstream side of the road bridge. |
| Blackstone | B1 | At Main St. in Pawtucket, R.I. Sampling was conducted at mid-flow from the upstream side of the road crossing. |
| Blackstone | Blons | At Rte. 122 in Lonsdale, R.I. Sampling was conducted from midstream from the upstream side of the road bridge. |
| Blackstone | B2 | In Blackstone, Mass. Sampling conducted from the upstream side, or from the shore just upstream of, the Main St. road bridge. |
| Ten Mile | TM1 | At Roger Williams Ave. just upstream of Omega Pond. Sampling was conducted from the upstream side of the road bridge. |

Samples were taken from this bucket for total suspended solids (TSS), metals, and nutrient analyses.

*Temperature:* Air and water temperature were measured with an armored LaMotte thermometer (model 545). Water temperature was measured in the sample bucket immediately after collection. The thermometer was suspended in the water about 6 inches below the water surface for at least two minutes. The bucket was kept in the shade, if possible, during the measurement. Air temperature was then measured in the shade, giving the thermometer at least two minutes to equilibrate. Air and water temperatures were recorded on the field data sheet.

*Dissolved Oxygen*: La Motte dissolved oxygen (DO) test kits (7414/EDO), using the azide modification of the Winkler method, were used to analyze river water samples for oxygen content. This kit uses a direct reading titrator that can be read in 0.2 milligrams per liter (mg/l) DO increments. Two DO samples were collected from the well-mixed bucket. These samples were fixed and titrated separately in the field if weather permitted. Volunteers were given the option to tirate samples at home within eight hours of sample collection. Sample analysis was repeated if the replicate samples differed by more than 0.6 mg/l. The results of the titrations were recorded on the field data sheets. Fresh reagents were provided to the volunteers every 12 months.

*pH:* pH was measured in the field with a HACH kit (model 1470-06), which uses a bromthymol blue indicator and a color disk to estimate water pH. According to the manufacturer, the test is accurate to 0.1 pH between 5.5 and 8.5 pH. River Rescue volunteers found that the test was difficult to conduct on the naturally dark water sometimes found in all the rivers. Sample tubes were filled directly from the collection bucket after the temperature and oxygen measurements.

*Hardness:* Hardness was measured with a LaMotte Hardness kit (model 4824-DR/PHT-CM-DR). This kit uses EDTA titration to measure 0 to 200 parts per million (ppm) $CaCO_3$ in 4 ppm increments. Samples for analysis were collected from the collection bucket and results were recorded on the field data sheet.

Water hardness was also calculated from measured calcium ($Ca^{++}$) and magnesium ($Mg^{++}$) concentrations using:

$$Hardness\ (mg\ CaCO_3/L) = 2.497\ [Ca^{++}\ mg/L] + 4.118\ [Mg^{++}\ mg/L]$$

The hardness measured with the test kits was compared to the hardness calculated from calcium and magnesium concentrations. The measured values were extremely variable and since each drop of titrant was equivalent to 4 mg/l (CaCO3), the values were less accurate than the measured hardness values. The calculated hardness is therefore presented in this report and used to calculate stream metals criteria.

*Total Suspended Solids:* TSS samples were collected from the second bucket of water. The bucket was well mixed and poured into two clean 500 ml nalgene bottles. Samples were kept on ice in the field and then refrigerated until analysis. They were analyzed within one week.

In the lab, the river water samples were shaken, the volume was measured, and samples were then filtered onto pre-weighed 47 millimeter (mm) Gelman A/E glass fiber filters. Filters were dried over night in a 60 C oven and then reweighed. TSS was calculated using:

TSS = (mg final - mg initial) / volume in liters

*Nutrients:* Three samples were collected for nutrient analysis: one sample for dissolved inorganic nitrogen and phosphorus (DIN/DIP), a sample for dissolved organic nitrogen and phosphorus (DON/DOP), and a sample for particulate phosphorus (PP). Volunteers were provided with prepared sample bottles that were not opened until they were in the field and ready to introduce the sample. All sample bottles were prepared by soaking in acid and rinsing in distilled water. Four drops of chloroform were added to the empty, clean bottles used for DIN/DIP. The DON/DOP bottles were stored full of distilled water and emptied just prior to sample collection. Particulate phosphorus filters were stored in acid rinsed, pre-combusted scintillation vials.

In the field, water from the bucket was stirred and then quickly collected into a clean 60 ml syringe. The sample was drawn down to 50 ml. A 25 mm glass fiber filter in a Swin-Lok filter holder was attached to the syringe. The entire 50 ml of river water was slowly filtered and introduced into the DIN/DIP bottle. Once the filtration was complete, the filter holder was opened and the filter was carefully removed with a forceps and placed in a PP vial. A second sample was collected and filtered with a second filter holder loaded with a filter into the DON/DOP bottle. The second filter was then carefully removed with forceps and placed in a second PP vial. Bottles and vials were then placed on ice in the field. At home, PP filters and the DON/DOP samples were frozen until analysis. DIN/DIP samples were held in the refrigerator.

All nutrient samples were analyzed in Scott Nixon's laboratory at the URI Graduate School of Oceanography under the direction of Betty Buckley. Graduate student assistants conducted the analyses. Detection limits are summarized in Table 2.

DIN/DIP: Filtered river water samples of 50 ml were kept refrigerated until they could be analyzed for nitrate ($NO_3$), nitrite ($NO_2$), phosphate ($PO_4$), and ammonium ($NH_3$), on a Lachat Model 80 Flow Injection Ion Analyzer. Ammonium was determined by the phenate method (Environmental Protection Agency (EPA) 350.1). Nitrate and nitrite were determined using the colorimetric method from EPA 353.2. This follows the reduction of nitrate to nitrite with cadmium. Phosphorus was determined using the ascorbic acid reduction method from EPA 365.3. Automated regression of standard curves and integration of sample peaks yield concentration output directly.

DON/DOP: The method employed by River Rescue was designed to determine total nitrogen and phosphorous and then calculate dissolved organic N and P by subtracting the dissolved inorganic fraction from the whole. The method was adapted by Barbara Nowicki from Valderrama (1981). A filtered water sample is digested using the persulfate oxidation and then analyzed for nitrate and phosphate concentrations using the Lachat model 80 flow injection ion analyzer (FIA). Calculations are based on inorganic standard curves and an assumed 100 percent recovery.

Precision:

| | |
|---|---|
| Nitrogen | +-0.1 µM at the 10 µM level |
| | +-0.3 µM at the 60 µM level |
| Phosphorus | +-0.4 µM at the 1 µM level |

Range: Initial indications are that the digestion is less efficient at N concentrations above about 100 micromoles (µM). For this reason many River Rescue samples, especially the Pawtuxet River samples need to be diluted at least two times *before* digestion to ensure complete oxidation of all N and P.

**Table 2. Summary of Methods and Detection Limits**

| PARAMETER | METHOD | DETECTION |
|---|---|---|
| DO | Azide modification, Winkler method<br>LaMotte Chemical Direct Reading Titrator.<br>Performed in field by volunteers. | 0.2 mg/l |
| pH | Bromthymol Blue color reading by eye.<br>HACH Wide Range pH test kit.<br>Performed in field. | pH 5.5-8.5<br>0.1 pH units |
| TSS | Filtration through pre-weighed glass fiber filter. Standard Method* number 2540 D. | |
| $NH_3$ | Phenate method<br>EPA Method** 350.1 | 0.05 µM |
| $NO_2$ and $NO_3$ | Colorimetric method<br>EPA Method** 353.2 | 0.05 µM |
| $PO_4$ | EPA Method** 365.3 | 0.05 µM |
| DON and DOP | Persulfate digestion*** | 0.05 µM |
| PP | Solorzano and Sharp,**** 1980 | |

* American Public Health Association, American Water Works Association, Water Environment Federation, 1992. *Standard Methods for the Examination of Water and Wastewater, Seventeenth Edition.*. American Public Health Association Washington, DC.

** *EPA Methods for the Chemical Analysis of Water and Wastes.* 1983. EPA-600/4-79-020

*** Valderrama, J.C. 1981. The simultaneous analysis of total nitrogen and total phosphorus in natural waters. *Mar. Chem.* **10**:109-122.

**** Solorzano, L. and J. Sharp. 1980. Determination of total dissolved phosphorus and particulate phosphorus in natural waters. *Limnol. Oceanogr.* **25(4)**:754-758.

PP: Particulate phosphorus was analyzed using the method of Sororzano and Sharp (1980). The filters were dried with magnesium sulfate and baked at 450 C to decompose the organic phosphorus. The residue is the hydrolyzed with hot hydrochloric acid. The resulting orthophosphate is determined using the molybdate-ascorbic acid method as in Standard Methods 4500-P E.

Absorbances are read at 885 nanometers (nm) on a spectrophotometer and are then converted to concentrations using a calibration curve. Final values are corrected for phosphorus contributed by blanks and for the volume of water filtered.

*Metals:* Metals analyses and analyses for calcium and magnesium were performed by the laboratory of Raymond Wright, URI civil engineering professor. Metal sample bottles that were washed and prepared in the laboratory were provided to the volunteers. Bottles were prepared as follows: 1) washed with phosphorus-free detergent and rinsed with tap water; 2) rinsed three times with deionized water and filled with 3 percent deionized water/nitric acid solution ($HNO_3$) and allowed to soak for 48 hours. The acid soaking was repeated three times; 3) Bottles were then rinsed and filled with deionized water for use by the volunteers. Volunteers kept bottles closed until samples were collected. At the station, the bottle was emptied and then a sample was poured from the stirred collection bucket into the sample bottle. Samples were capped and stored at room temperature in the homes of the volunteers until analysis.

For total metals analysis, an experimentally determined volume of $HNO_3$ was added to the 60 ml bottles containing samples. The acid volume (approximately 1.2 ml of concentrated $HNO_3$ per 60 ml sample) was sufficient to keep the trace metals from adsorbing to surfaces or complexing. The samples were allowed to soak for one week to redissolve any metals that may have adsorbed onto the surface of the sample bottle. The samples were also refrigerated to prevent any change in concentration levels during the soaking period.

Dissolved cadmium, chromium, copper, lead, and nickel were analyzed by Atomic Absorption Spectroscopy (AAS) using a graphite furnace. Dissolved calcium and magnesium were analyzed using the flame method.

The Perkin-Elmer AAS, 5100 PC was equipped with a Zeeman/500 system designed to provide the graphite furnace with background correction. Such systems enhanced measurement sensitivity by reducing any interference in the sample background. An AS-60 Autosampler provided a continuous feed of samples to the furnace for each analysis run.

Typically, the autosampler tray was loaded with 28 samples. Calibration curves were developed using three standards. The concentrations used for calibration curves were calculated by Perkin-Elmer analytical software and were run before samples one and 18. In the event that any problems were detected during analyses, the samples after the last successful calibration standard were rerun.

The analyses were run for five separate metals at a time, with a normal run time for 28 samples of 14 to 16 hours. A longer run time was required if the machine had to dilute samples that were out of the range of the standards. Each sample was analyzed twice and the mean was reported. Additionally, a root mean square (RMS) error was done for each of these duplicate analyses. If a sample pair had a RMS error greater than 10 percent, it was analyzed again.

A Zeeman Graphite Furnace was used with the Perkin-Elmer 5100 PC to atomize the samples for spectroanalysis. The graphite tube was 'conditioned' (cyclic heating to 2600 C and

cooling to 20 C six times) between each metal sampling run to cleanse the tube of contaminants.

The Perkin-Elmer 3030B was used to analyze $Mg^{++}$ and $Ca^{++}$. An air-acetylene flame atomized the samples for spectroanalysis. Three standards were used for calibration and a fourth made to check the calibration curve. Again, the calibration curves were calculated by Perkin-Elmer analytical software. A calibration check was made every 15 samples to ensure the accuracy of the analysis.

Samples were manually fed to the sampling capillary. The program was set to analyze each sample three times and take the mean of the three samples. The RMS error was reported and the sample rerun if this error exceeded 10 percent. Dilutions were done manually if the sample exceeded the limits of the standards.

For quality control, samples were selected at random and spiked with a known metal concentration, usually one of the standard solutions that were prepared. A 90 percent recovery limit was used to check the accuracy of the analysis. If recovery was less than 90 percent, adjustments were made and the samples were rerun.

The detection limits for this analysis are:

| | |
|---|---|
| Cadmium | 0.05 µg/L |
| Chromium | 0.20 µg/L |
| Copper | 0.20 µg/L |
| Lead | 0.20 µg/L |
| Nickel | 0.20 µg/L |
| Magnesium | 0.05 mg/L |
| Calcium | 0.05 mg/L |

# RESULTS AND DISCUSSION

## Temperature

Air and water temperature profiles for each station are shown in Figures 1 – 6. The River Rescue stations show the seasonal temperature patterns expected in natural waters.

## pH

Figures 7 – 9 show the mean and range of pH measured at each River Rescue station. pH was consistently within normal ranges at all stations.

## Dissolved Oxygen

Aquatic plants and animals, like their terrestrial counterparts, need oxygen to survive. Oxygen gas dissolves in water and is normally found at concentrations of 5 to 15 milligrams of oxygen per liter of fresh water (mg $O_2$/L) in natural lakes, streams, and rivers. Swamp waters will often have lower concentrations. The EPA has determined that an oxygen concentration of 5 mg/L is the minimum safe level for most aquatic organisms. Rhode Island has adopted this level as the oxygen standard for all five rivers evaluated by River Rescue.

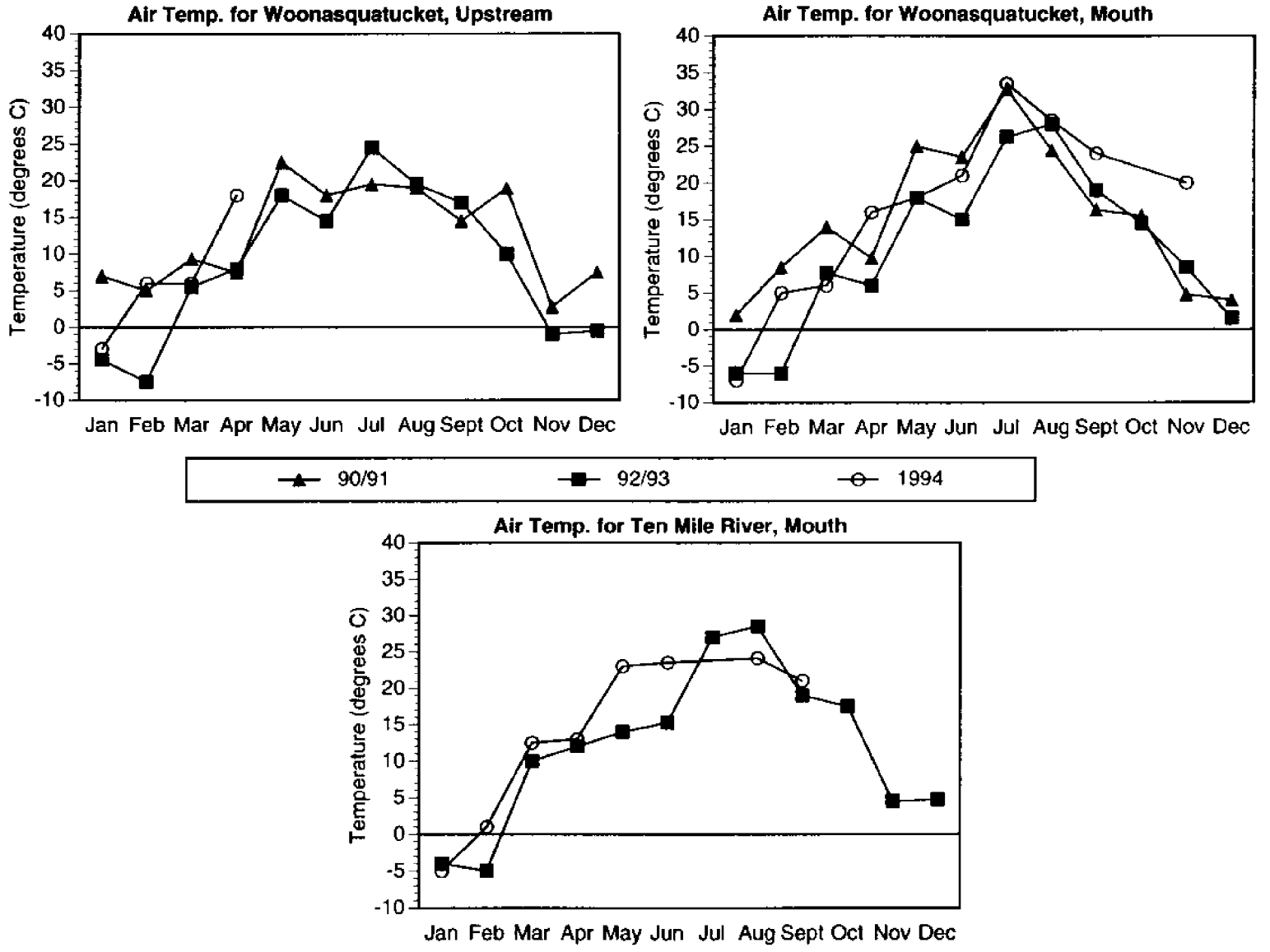



Figure 1. Air temperature at the two Woonasquatucket River stations and the Ten Mile River station show expected seasonal changes. The Woonasquatucket River stations are located at Rte. 44 in North Providence (upstream) and at Valley St. in Providence (mouth). The Ten Mile River station is located at Roger Williams Ave. in East Providence.

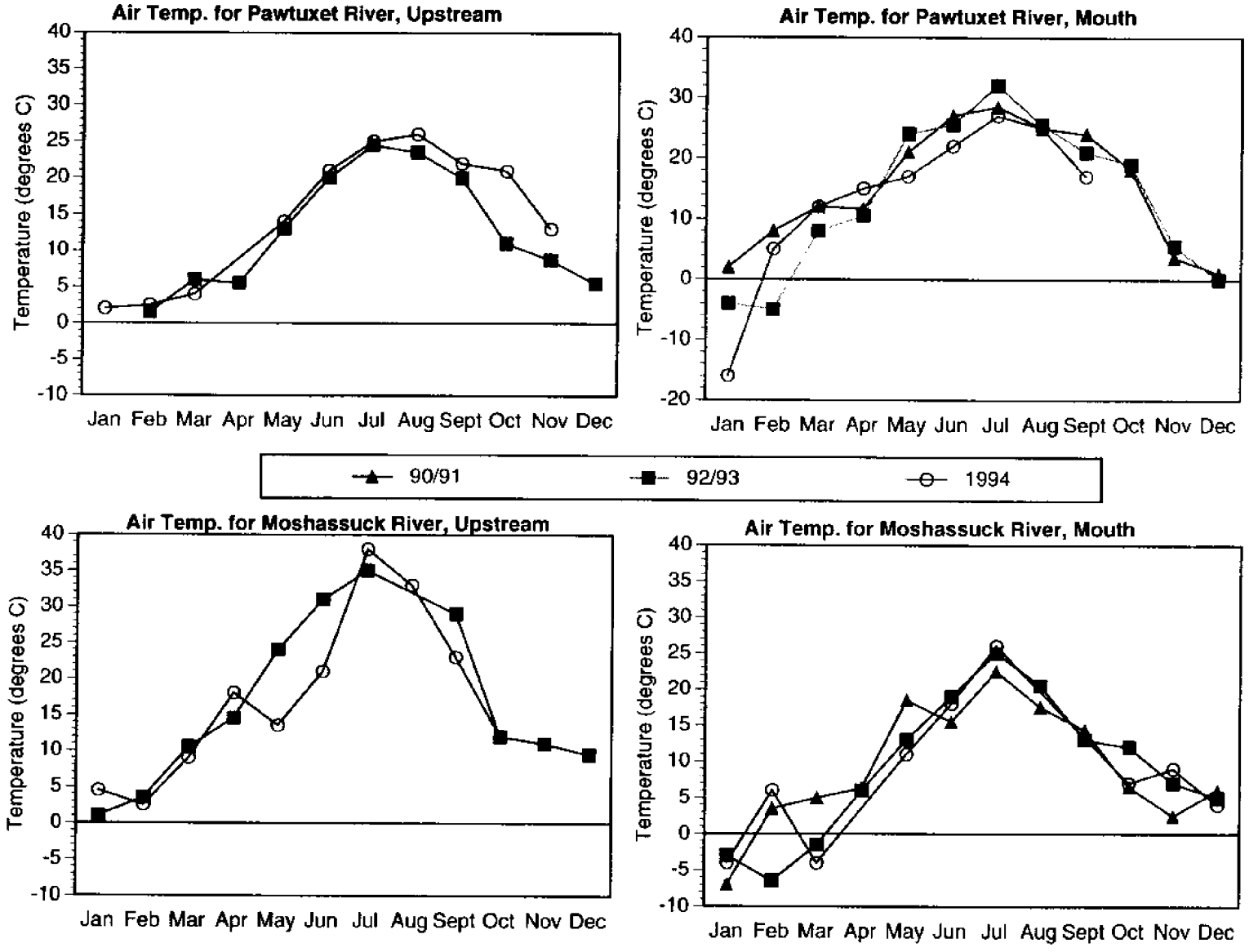



Figure 2. Air temperature at the Pawtuxet and Moshassuck River stations showed expected seasonal changes. The Pawtuxet River stations were located at Natick (East) Ave. in Warwick (upstream) and at Broad St. in Cranston (mouth). The Moshassuck River stations were located at the Bonanza Bus station in Providence (upstream) and at Charles St. in Providence (mouth).

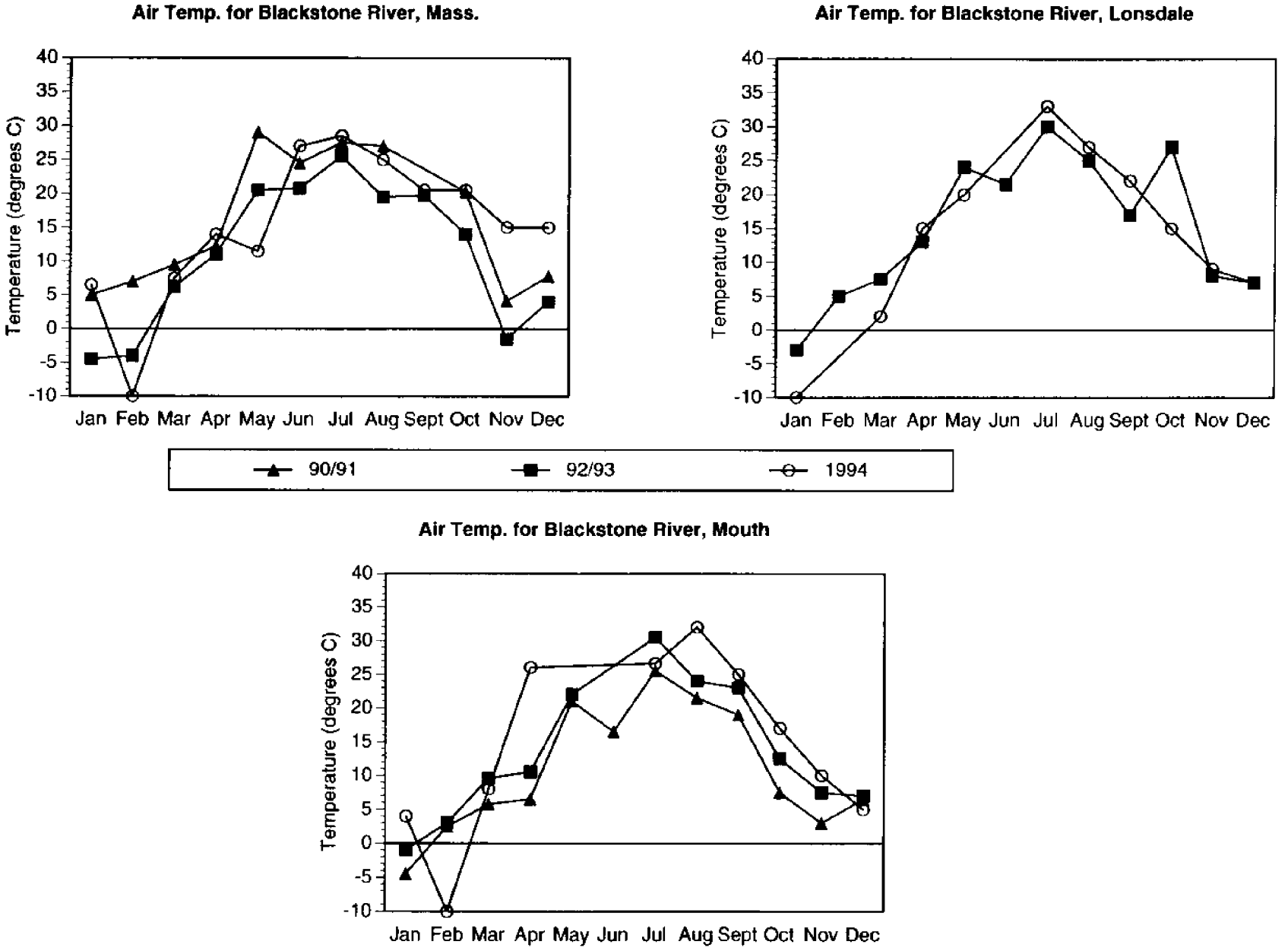



Figure 3. Air temperature at the Blackstone River stations showed expected seasonal changes. The Blackstone, Mass. station was the upstream site, the Lonsdale station was next, and the station at the mouth was located at Slater Mill in Pawtucket, R.I.

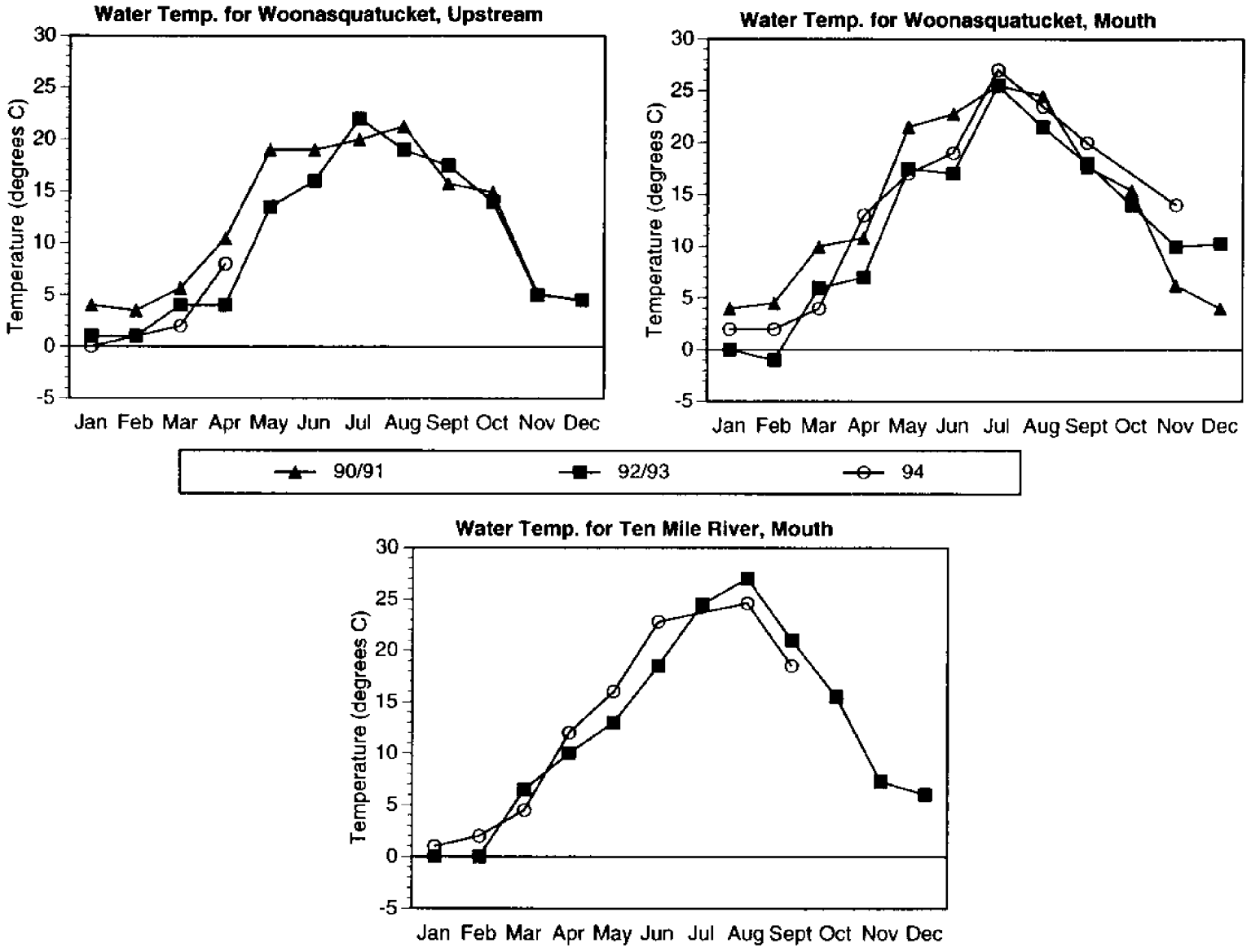



Figure 4. Water temperature at the two Woonasquatucket River stations and the Ten Mile River station show expected seasonal changes. Water temperature is needed to interpret seasonal changes in dissolved oxygen levels since oxygen solubility in water decreases with increasing temperature.

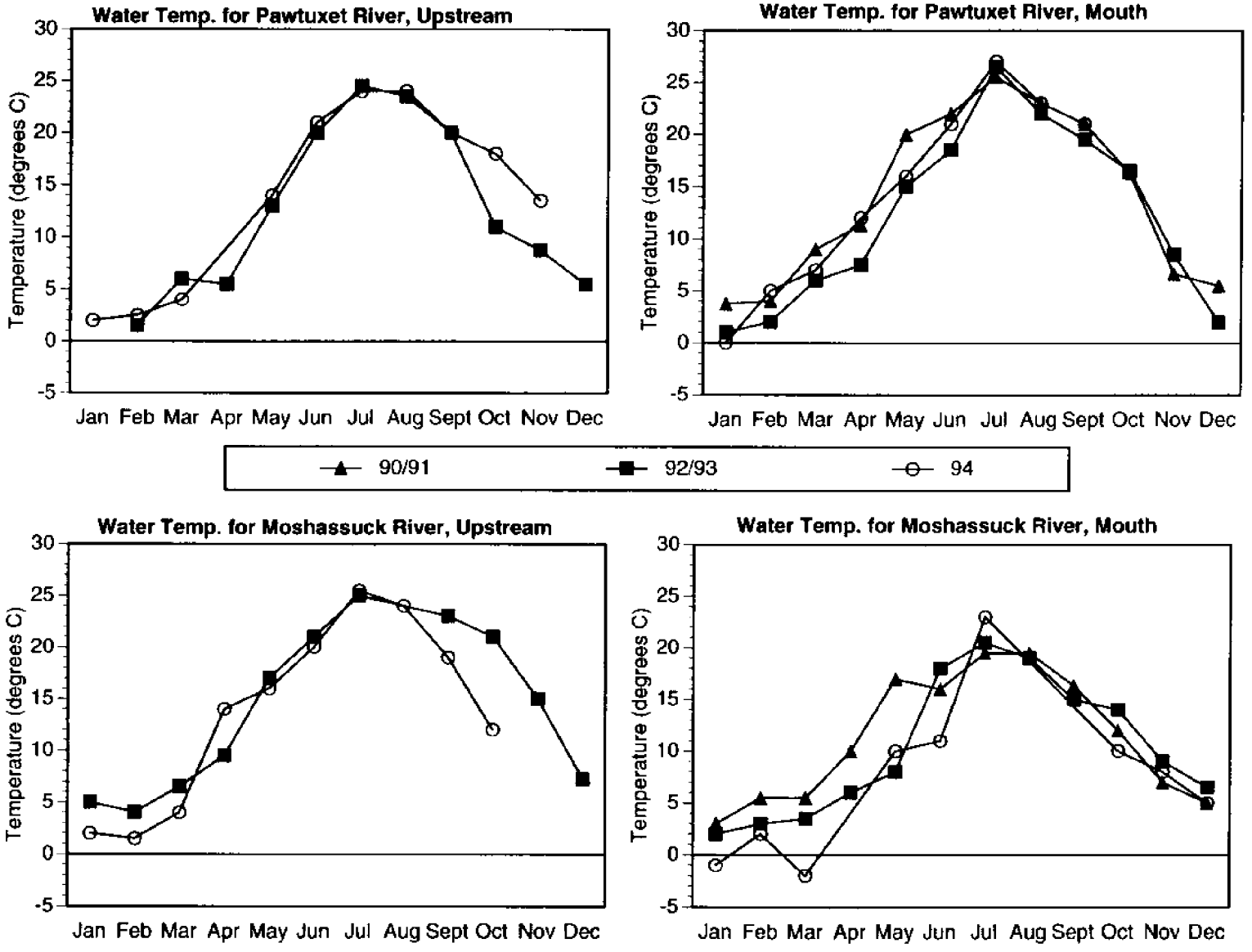



Figure 5. Water temperature in the Pawtuxet River and Moshassuck River showed the expected seasonal cycles. Monthly water temperatures showed little year to year change.

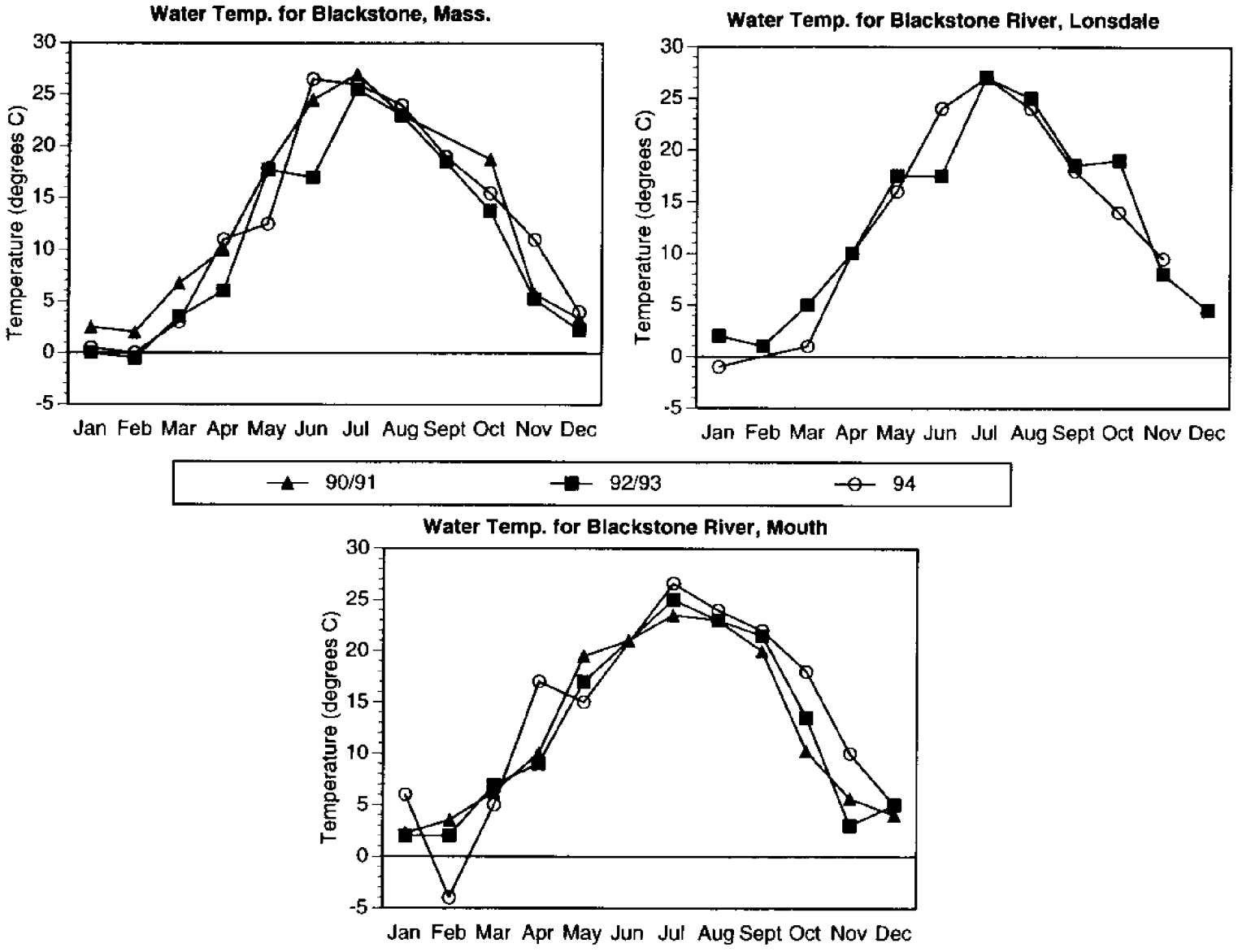



Figure 6. Water temperature in the Blackstone River followed expected seasonal patterns. The warm summer months are the critical time for aquatic organisms because of the combined stress of elevated temperature and low dissolved oxygen.

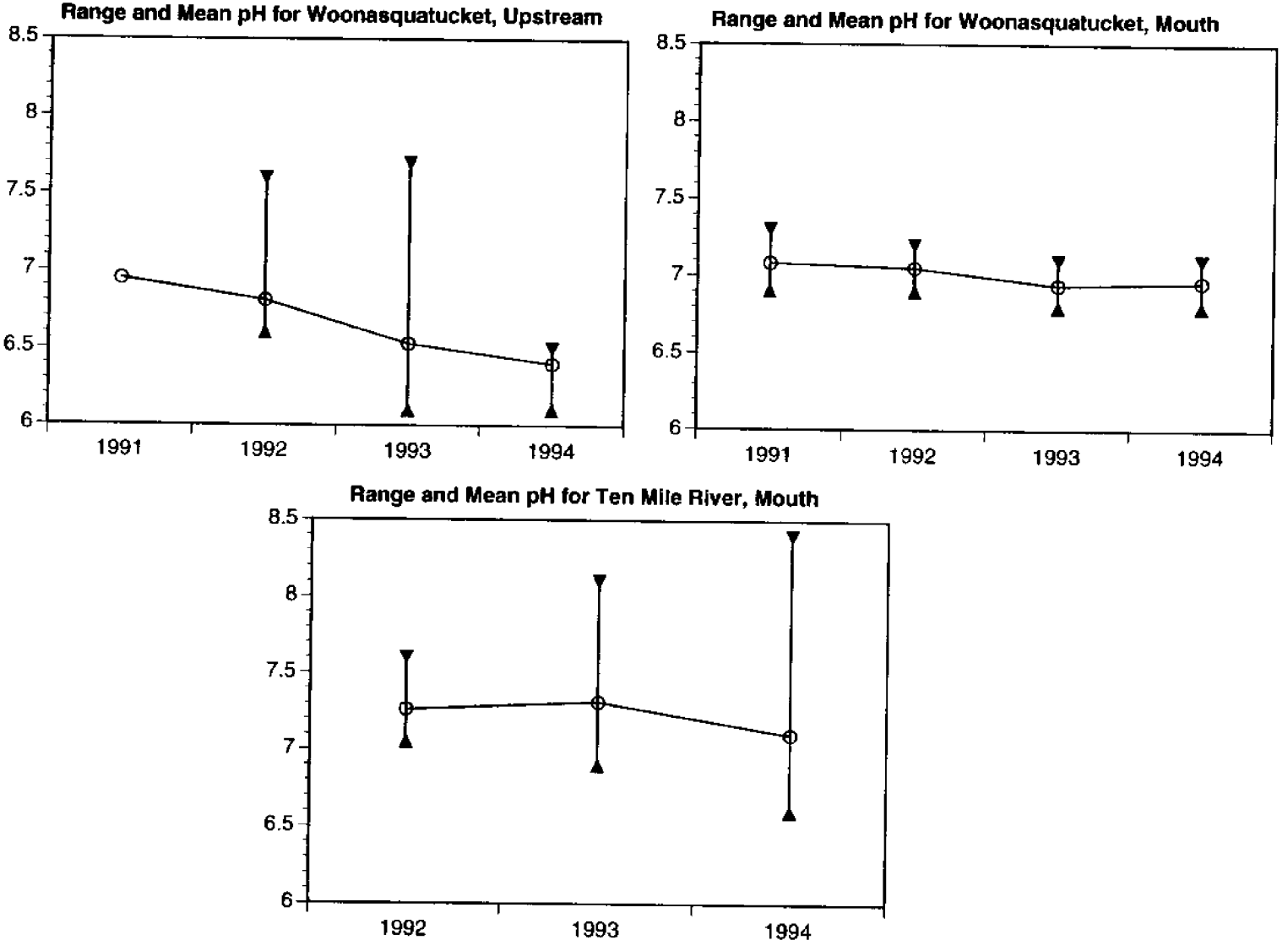



Figure 7. Monthly pH measurements were made on the Woonasquatucket River at Rte. 44 in North Providence (upstream) and at Valley St. in Providence (mouth) and on the Ten Mile River at Roger Williams Ave. in East Providence. The mean pH is plotted with the maximum and minimum measured value for the year. River pH consistently remained within acceptable levels.

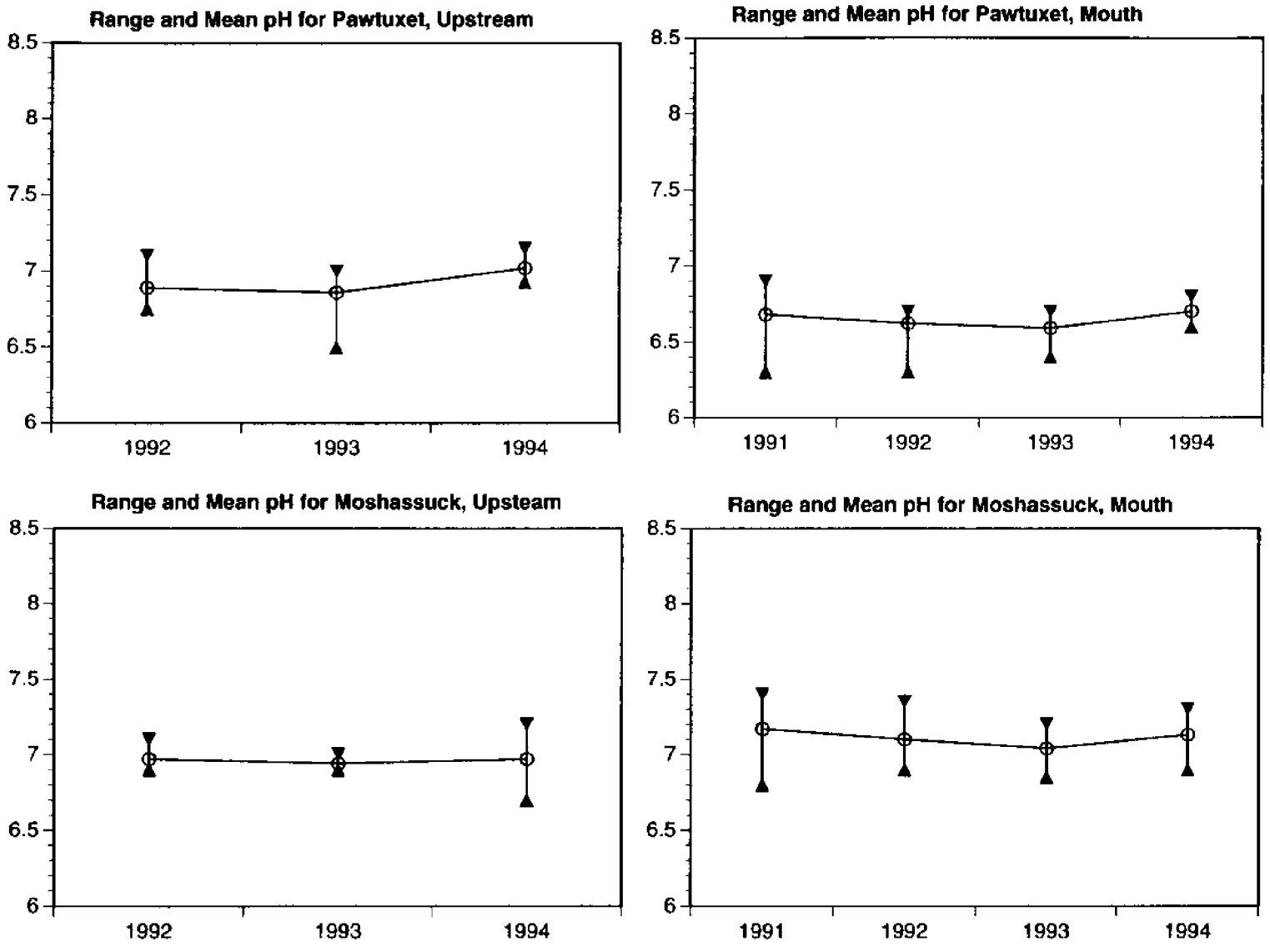



Figure 8. Monthly pH measurements were made on the Pawtuxet River at Natick Ave. in Warwick (upstream), at Broad St. in Cranston (mouth), on the Moshassuck River at the Bonanza Bus station in Providence (upstream),and at Charles St. in Providence (mouth). The pH consistenty remained within acceptable limits.

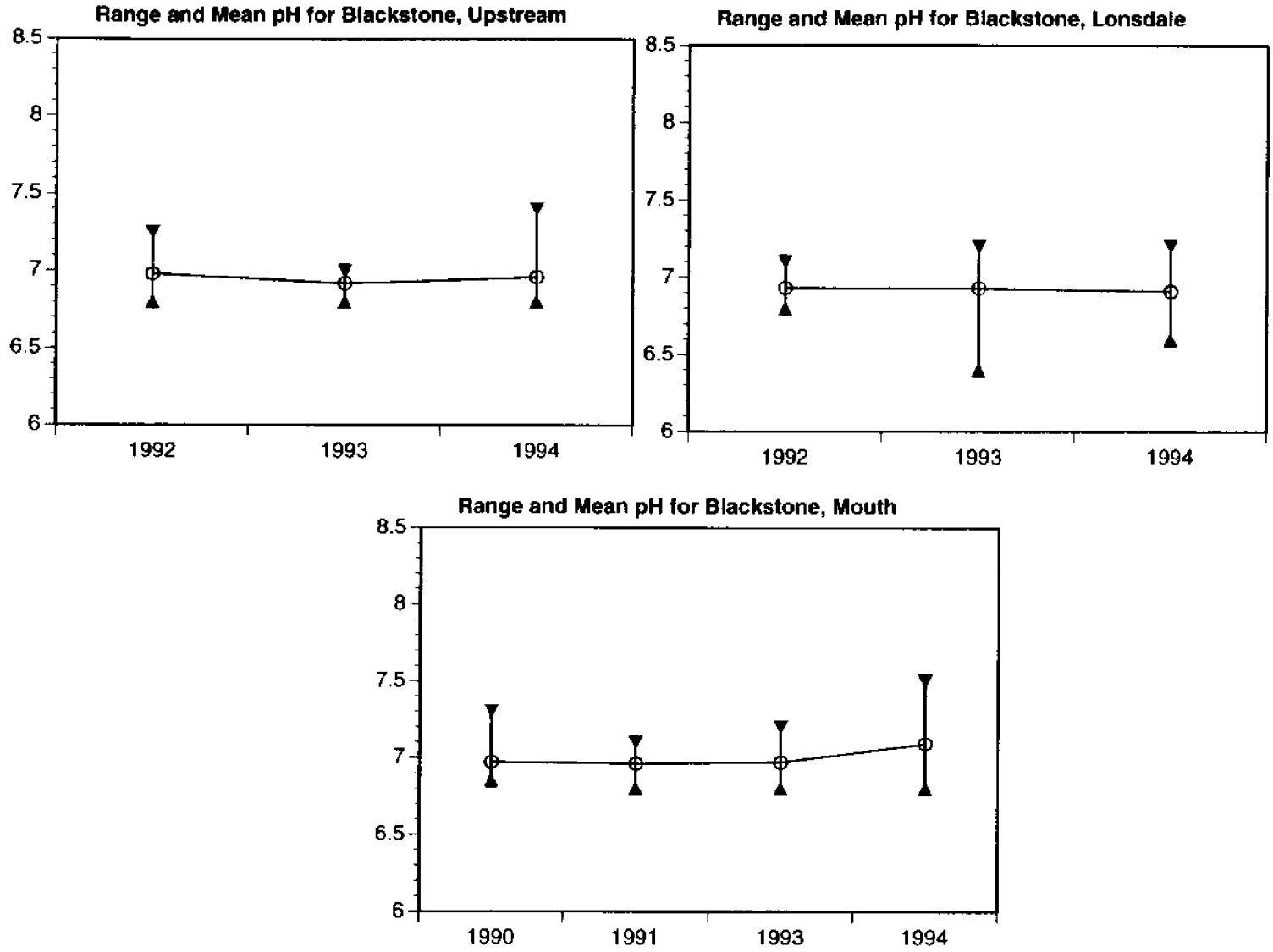



Figure 9. Monthly pH measurements were made at the three Blackstone River stations. The annual mean is plotted with the maximum and minimum measured pH value for the year. The pH of the Blackstone River consistently stayed between 6.5 and 7.5.

Normal, healthy streams, lakes, and rivers with visible plant growth show daily and seasonal changes in dissolved oxygen levels. On sunny days, dissolved oxygen is introduced into the water by the photosynthesis of green plants, such as algae and aquatic weeds, and increases during the course of the day, with the highest concentrations measured in the late afternoon. Dissolved oxygen is utilized by the respiration of these same plants; and during the night or on cloudy days when sunlight is reduced, the oxygen concentrations fall. Oxygen is also utilized by the respiration of other aquatic organisms including the bacteria that consume organic material in the water. In some waterbodies, the oxygen removed by respiration can exceed the oxygen that was produced by photosynthsis and concentrations fall below acceptable levels. Lowest oxygen concentrations were observed early in the morning before sunrise.

Water temperature also affects dissolved oxygen concentrations in water. Gases dissolve more easily in cooler water than in warmer water, so dissolved oxygen levels are always higher in natural water bodies during the cold winter months.

River Rescue volunteers sampled the rivers during daylight hours. Figures 10 – 12 show the results of the oxygen analyses. Oxygen levels at all 10 stations follow a predictable seasonal pattern, rising as the water cools in the fall, and decreasing during the warmer summer months. Summer concentrations at several stations drop very close to the level of 5 $mgO_2/L$ oxygen established by the R.I. Department of Environmental Management as safe for aquatic life.

Oxygen levels on the Pawtuxet River show significant changes from the upstream station at East Avenue in Warwick to the station at the mouth. Oxygen concentrations at the mouth of the Pawtuxet routinely fall below the 5 $mgO_2/L$ standard during the summer. Oxygen levels of 2 or 3 $mgO_2/L$ are routinely measured at this station between June and October. This depletion of oxygen is primarily caused by the decomposition of organic material discharged by wastewater treatment facilities for the cities of Cranston, Warwick, and West Warwick. The high levels of ammonia and organic nitrogen in this waste contributes significantly to the depressed oxygen levels measured at the river's mouth. All three cities are planning improvements for their wastewater treatment facilities to address the water quality of the lower Pawtuxet River.

Oxygen levels in the Blackstone River remained above the 5 $mgO_2/L$ standard except one measurement of 4.6 $mgO_2/L$ on August 14, 1994 at the Lonsdale station.

## Nitrogen and Phosphorus

Nitrogen and phosphorus are essential elements for all forms of life. Nitrogen is needed to build proteins, and phosphorus is essential to the metabolic reactions of both plants and animals. In many freshwater systems, plant growth is limited by the amount of phosphorus available. Although plant life is essential to a balanced aquatic ecosystem, excessive levels of nitrogen and phosphorus will produce an overabundance of aquatic plants that can choke the river's flow and destroy bottom habitats. Excessive levels of nutrients can also produce blooms of microscopic plants, called algae or phytoplankton. Phytoplankton blooms can color the water a pea-soup green, making it offensive to swimmers and boaters. When the phytoplankton die and decay, oxygen may be depleted from the water column causing fish kills.

Nitrogen and phosphorus are introduced to waters with sewage discharges from wastewater treatment plants, and seepage from septic systems, industrial waste discharges

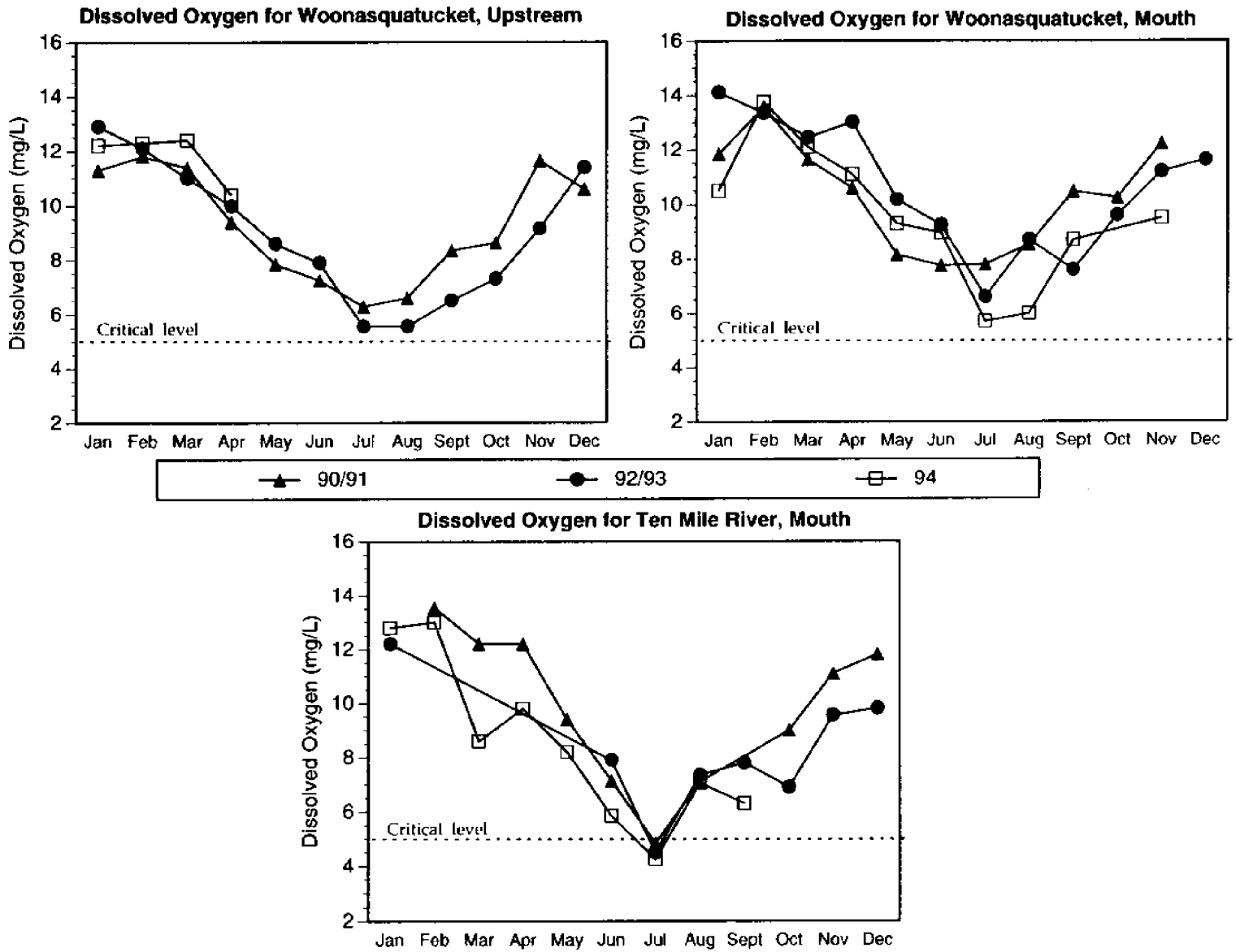



Figure 10. Dissolved oxygen concentrations on the Woonasquatucket River and Ten Mile River are low in the summer when the water is warm, and are higher in the winter when the water is colder. The Ten Mile River consistenly falls below the 5 mg/L level considered critical to aquatic organisms during July. The Woonasquatucket River sags close to the critical level, but never below it.

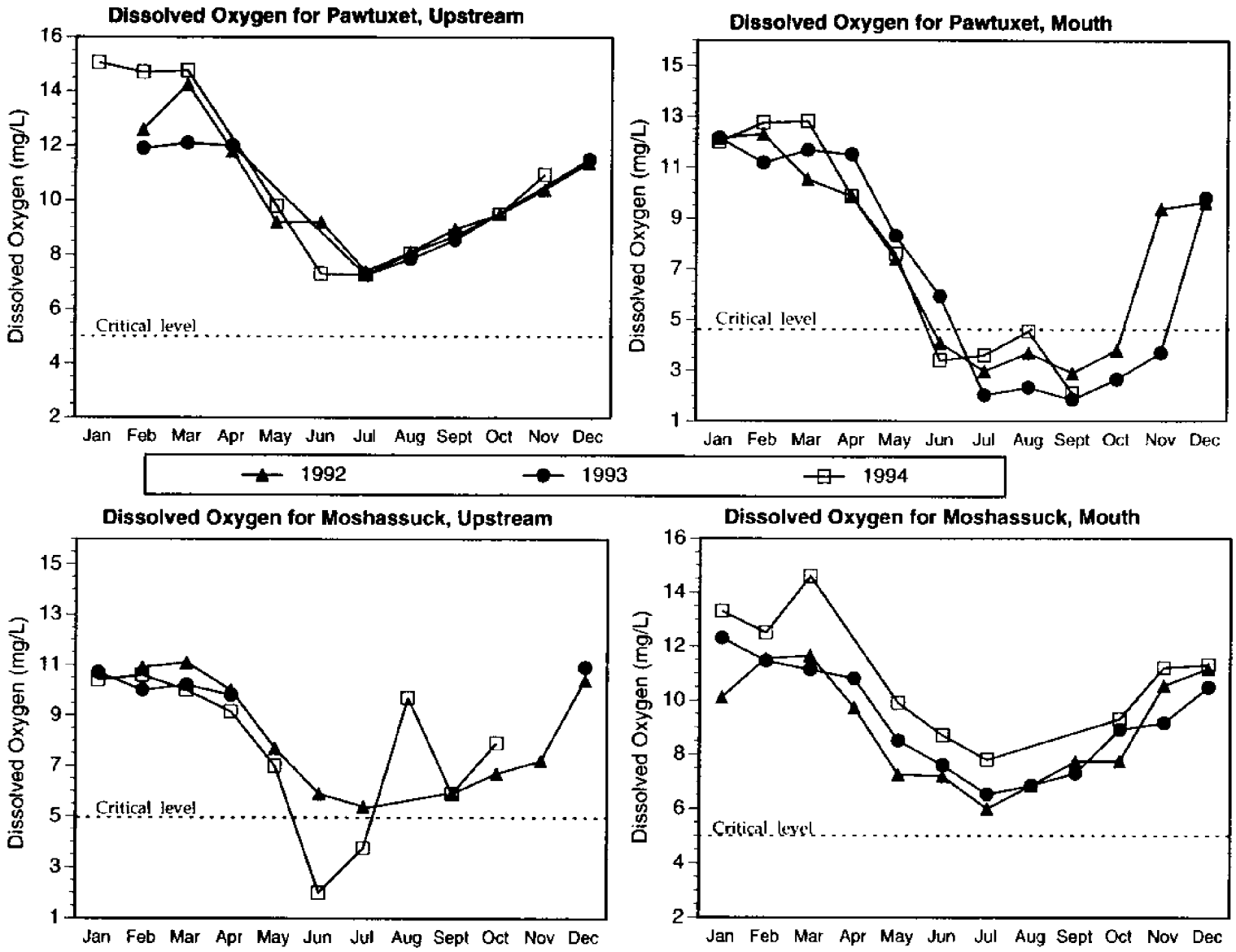



Figure 11. Dissolved oxygen concentrations in the Pawtuxet River and Moshassuck River vary with seasonal temperature changes. Oxygen levels in the lower Pawtuxet River consistently fall below the 5 mg/L critical level between June and October. Oxygen levels remained depressed through the sampling in November 1993. The Moshassuck River falls below the 5 mg/L critical level at the upper station at the Bonanza Bus station in Providence. The station at the Moshassuck River's mouth remained above critical levels.

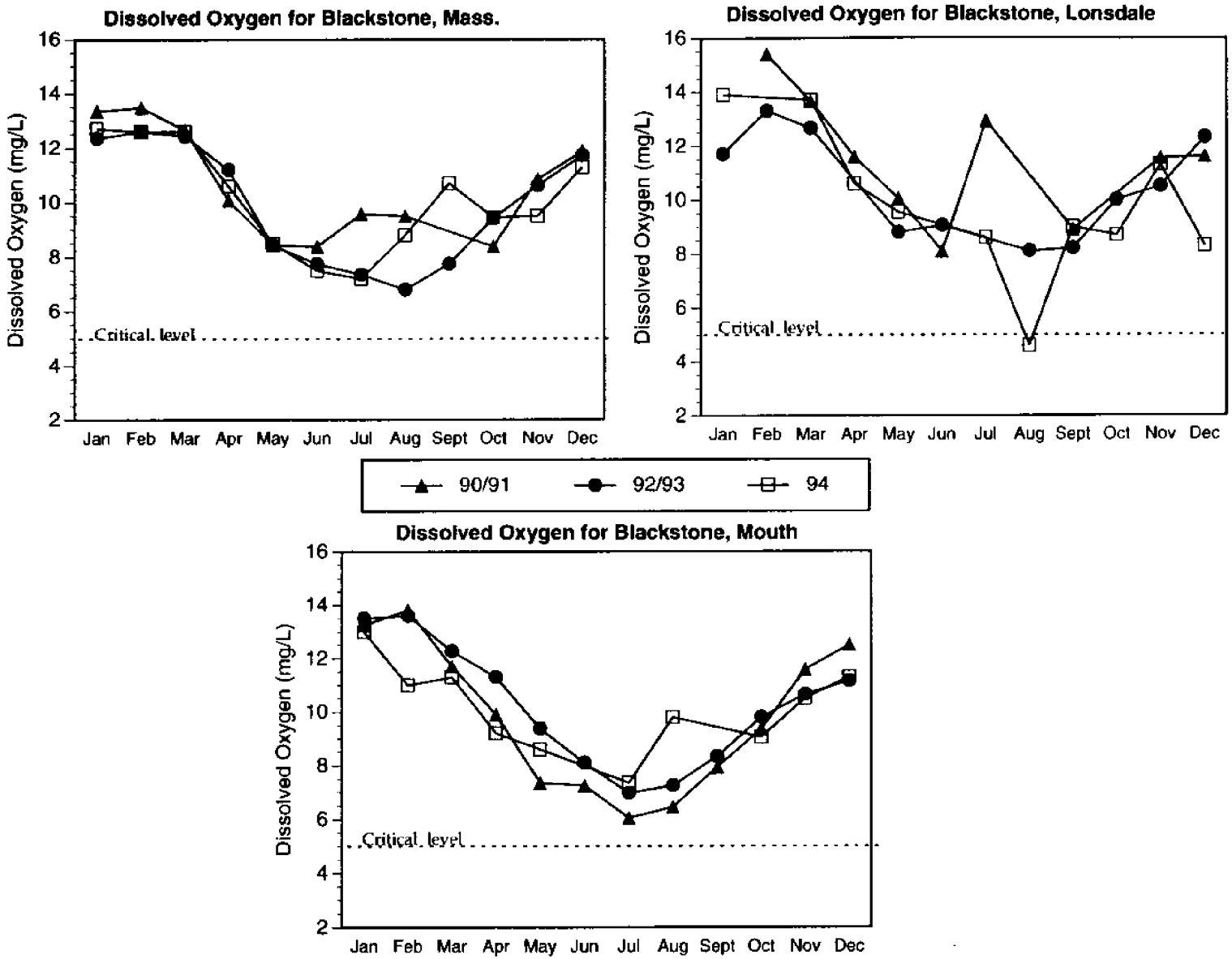



Figure 12. Dissolved oxygen concentrations in the Blackstone River remain above the 5 mg/L critical level except at the Lonsdale station in August 1994 when the concentration was 4.6 mg/L.

and stormwater discharges. Runoff from agricultural lands can carry excess fertilizer and animal wastes to nearby waterbodies.

Figures 13 – 15 show the average annual concentration of total dissolved phosphorus measured by River Rescue volunteers at each station. The highest phosphorus concentrations were measured in the lower Pawtuxet River station. This station is downstream of three major wastewater treatment facilities that contribute significant concentrations of phosphorus to the river. The Blackstone stations (B1, B2, and Blons), the Ten Mile River station, and the upper Woonasquatucket River station had intermediate levels of phosphorus, while the upstream Pawtuxet, the Moshassuck, and the lower Woonasquatucket River stations had less phosphorus.

Phosphorus concentrations at the stations remained relatively unchanged during the five years of River Rescue monitoring. Table 7 compares dissolved inorganic phosphorus concentrations measured at the mouth of the Blackstone, Moshassuck, Woonasquatucket and Pawtuxet Rivers in 1982 and 1983 to the overall average concentration measured at the mouth by River Rescue. Phosphorus concentrations have decreased in all four rivers, with changes of 72.8 percent in the Moshassuck, 50 percent in the Woonasquatucket, 39.2 percent in the Blackstone and 62.2 percent in the Pawtuxet.

Figures 16 – 18 show the average annual concentration of total dissolved nitrogen measured at each station. The highest concentrations were found at the lower Pawtuxet River station below the three wastewater treatment discharges. The Blackstone River had consistently high nitrogen concentrations, with the highest levels at the mid-station at Lonsdale. The Ten Mile and upper Woonasquatucket River station had moderate levels of dissolved inorganic nitrogen, while the lowest levels were found in the upper Pawtuxet, the Moshassuck, and the lower Woonasquatucket River stations.

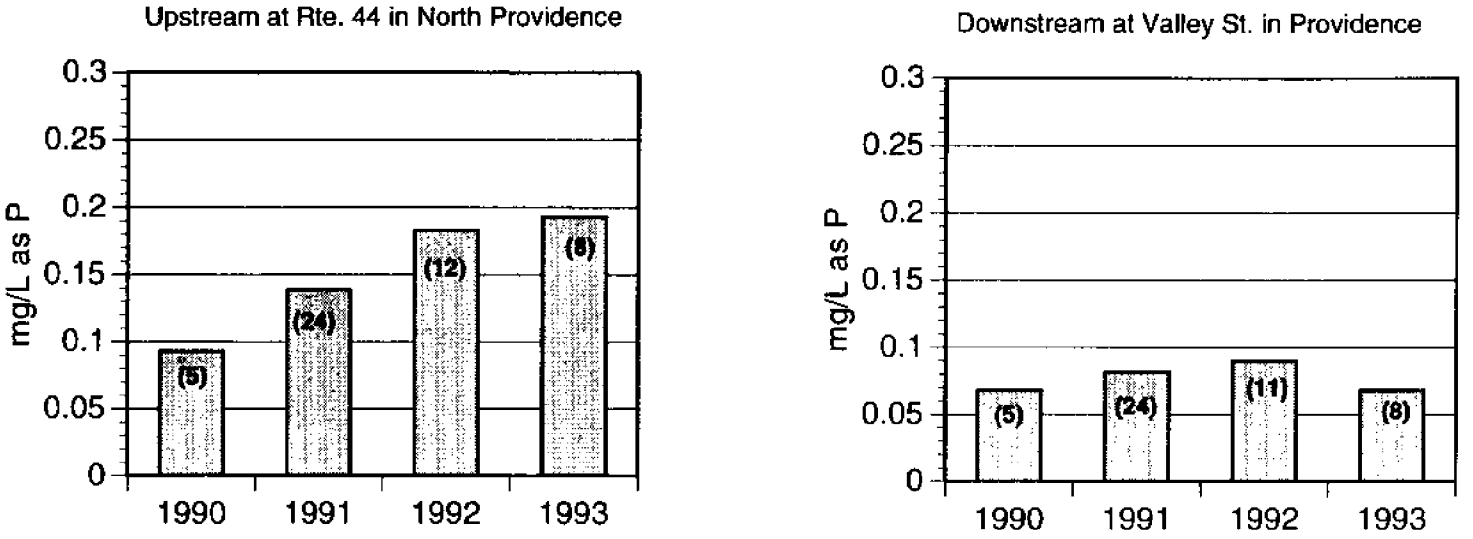
Table 7 compares dissolved inorganic nitrogen concentrations measured at the mouth of the Blackstone, Moshassuck, Woonasquatucket and Pawtuxet Rivers in 1982 and 1983 to the overall average concentration measured at the mouth by River Rescue. Nitrogen concentrations have decreased in the Moshassuck, Woonasquatucket and Blackstone, and increased in the Pawtuxet. The decrease in nitrogen is less than the decrease in phosphorus, with decreases of 25.6 % in the Moshassuck, 13.4 % in the Woonasquatucket, 39.8 % in the Blackstone and an increase of 17 % in the Pawtuxet.

## Metals

Providence's rivers have been affected by heavy metals for over 100 years. Inputs of toxic metals date back to the beginnings of the American Industrial Revolution. In the early 1800s, convenient fall points on the rivers provided the water power for textile mills and metals industries that manufactured machine parts. The Civil War brought munitions manufacturing; and after the war, metal working industries manufactured locomotives, tools, wire, and sewing machines. Jewelry manufacturing followed, becoming Providence's leading industry in 1880. Waste materials from all these industries were discharged into the rivers. Studies of Narragansett Bay's sediments clearly show the advent of the industrial discharges, with sharp increases in metals deposition in sediment strata corresponding to the mid-1800s.

Narragansett Bay and its tributary rivers continue to receive significant discharges of heavy metals. According to Nixon (1991), during 1986 and 1987, rivers and streams contributed over 60 percent of the cadmium entering the Bay, and about one-third of the chromium, copper, nickel, and lead. Sewage treatment plants (POTWs) contribute 13 percent of the

## Woonasquatucket River




## Moshassuck River

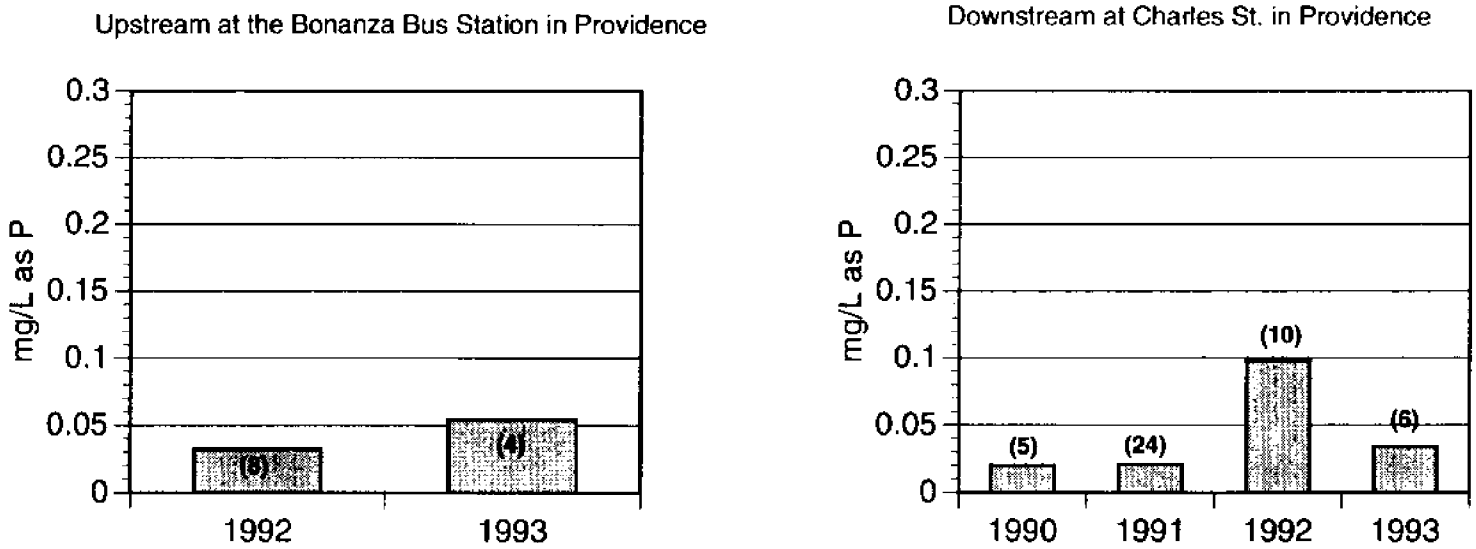
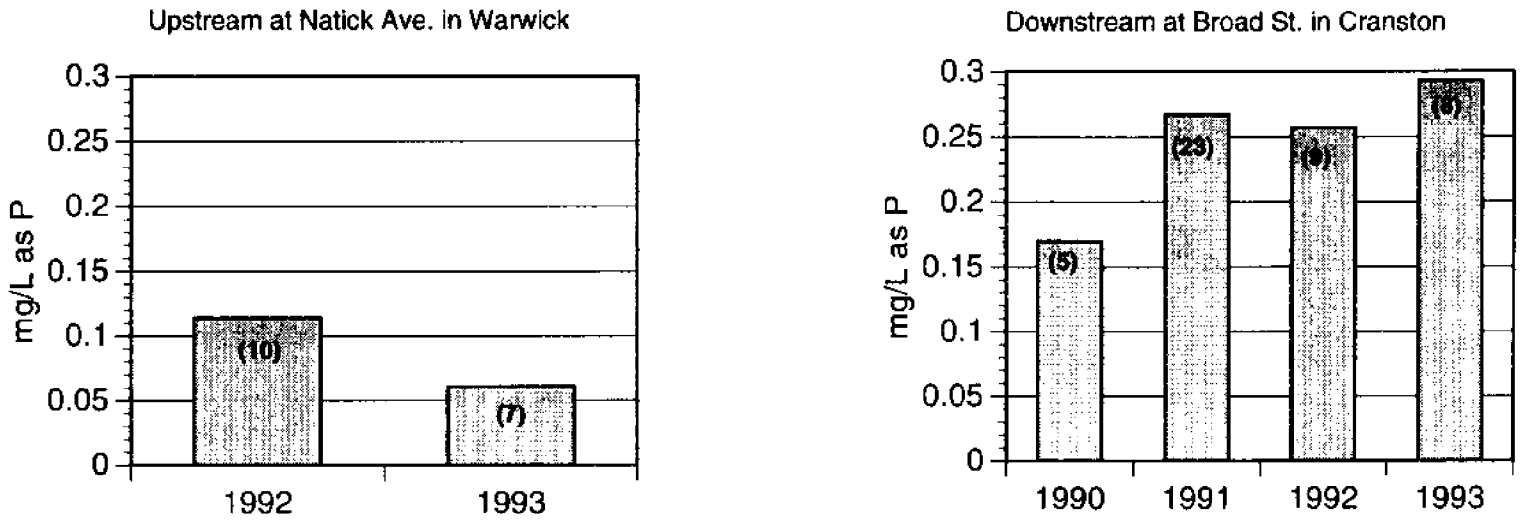



Figure 13. Average annual total dissolved phosphorus concentrations (mg/L as P) at the Woonasquatucket River and Moshassuck River stations. The number of samples for each year is shown in parentheses. The Moshassuck River stations and the lower Woonasquatucket River station had the lowest levels of phosphorus. The upper Woonasquatucket River station was slightly higher, perhaps because of the influence of the Smithfield wastewater discharge upstream of the station.

## Pawtuxet River




## Ten Mile River

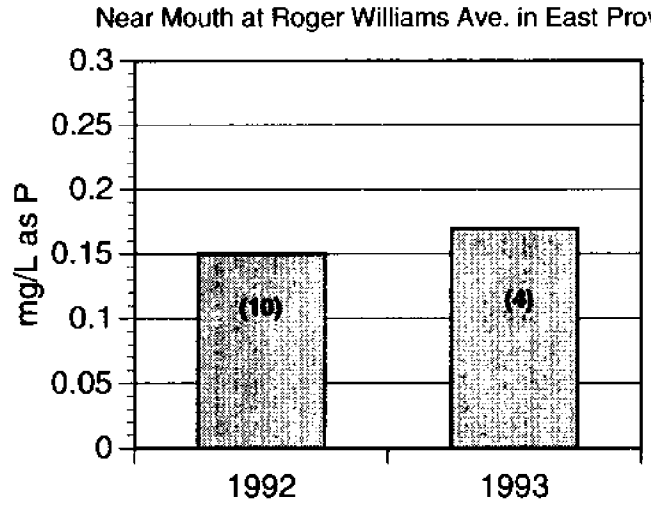



Figure 14. Average annual total dissolved phosphorus concentrations (mg/L as P) at the Pawtuxet and Ten Mile River stations. The number of samples for each year is shown in parentheses. Phosphorus concentrations are elevated in the lower Pawtuxet due to the wastewater discharges from Warwick, West Warwick, and Cranston.

## Blackstone River

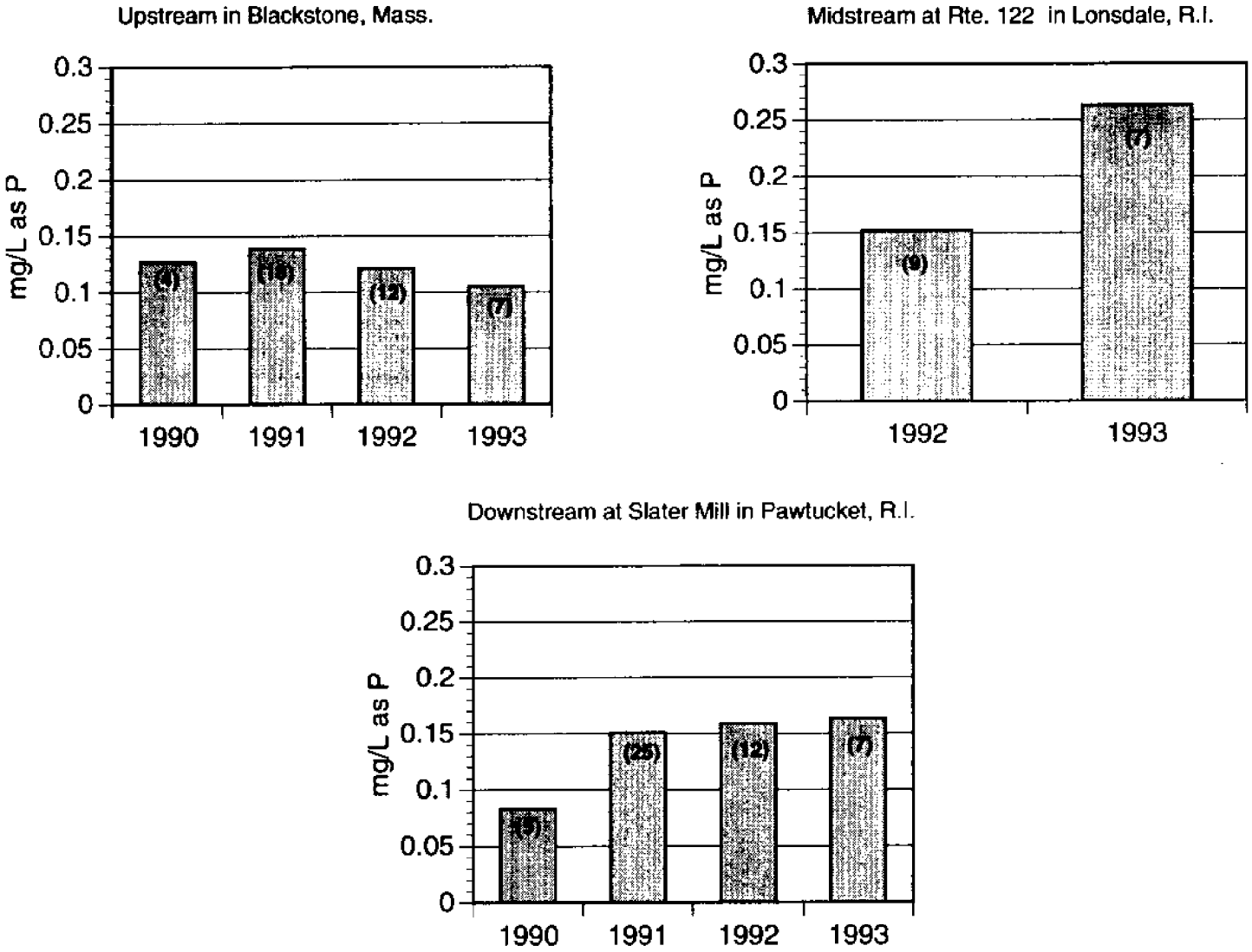
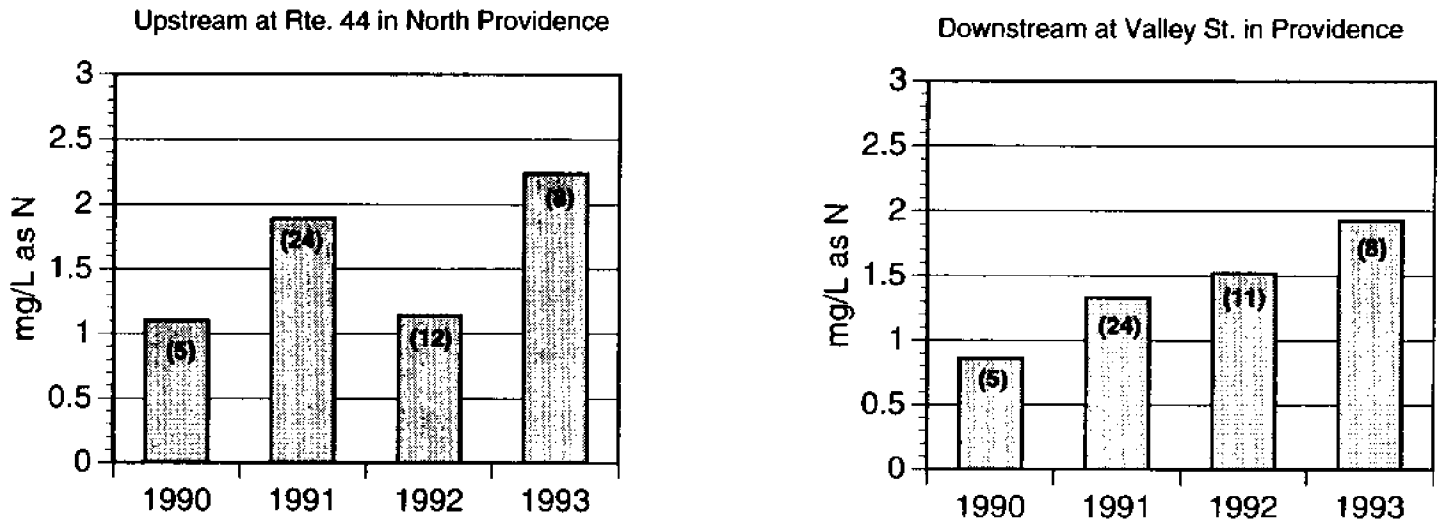



Figure 15. Average annual total dissolved phosphorus concentrations (mg/L as P) at the three Blackstone River stations. The number of samples averaged for each year is shown in parentheses. Phosphorus concentrations increase between Blackstone, Mass. and Lonsdale, then decrease at the mouth.

## Woonasquatucket River




## Moshassuck River

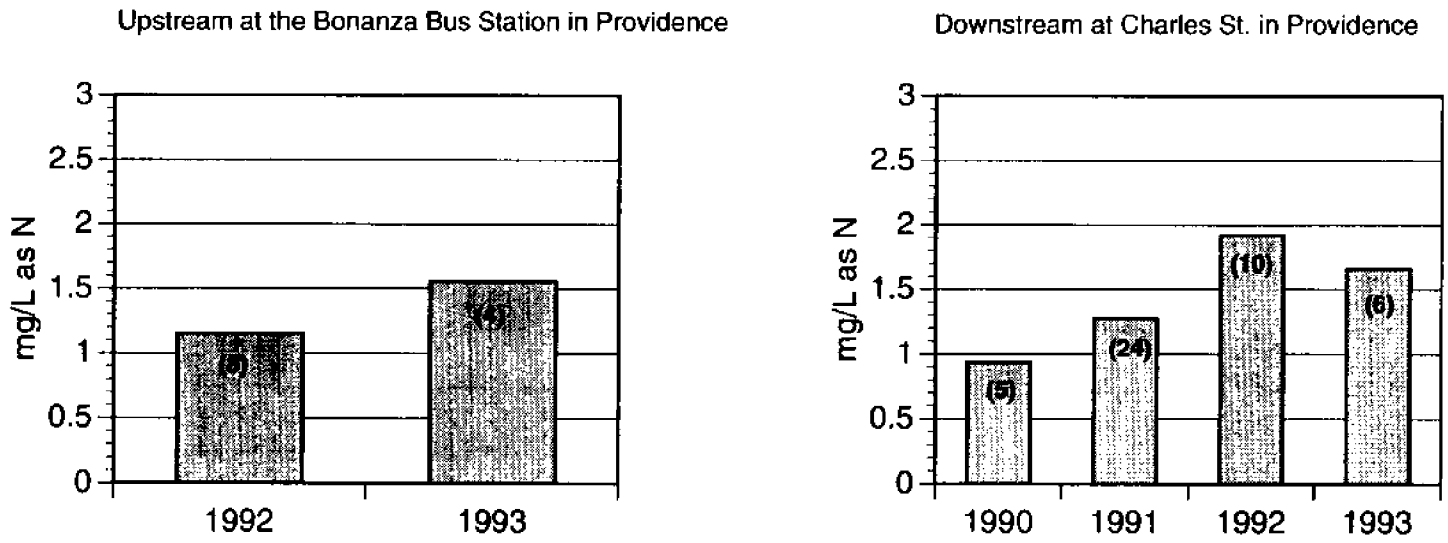
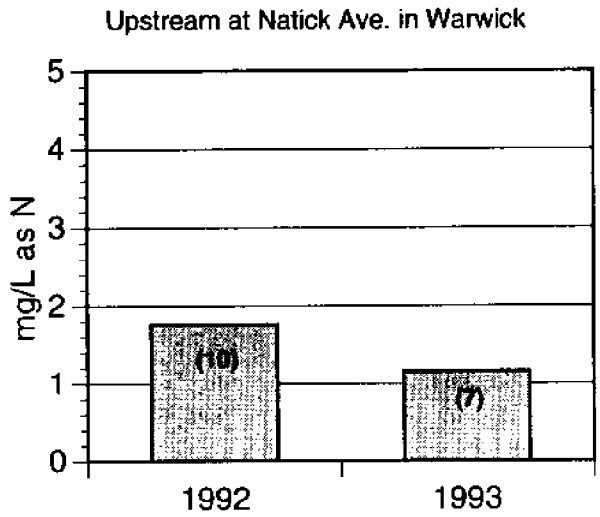
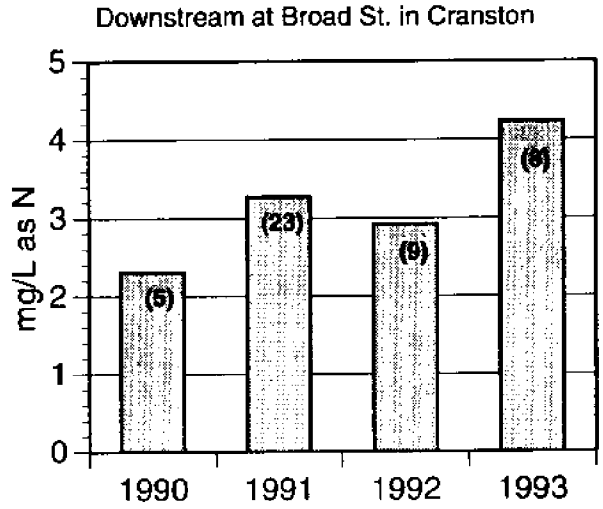



Figure 16. Average annual total dissolved nitrogen concentrations (mg/L as N) at the Woonasquatucket and Moshassuck River stations. THe number of samples collected each year is in parentheses. These four stations showed the lowest nitrogen concentrations of all the River Rescue stations.

## Pawtuxet River




## Ten Mile River

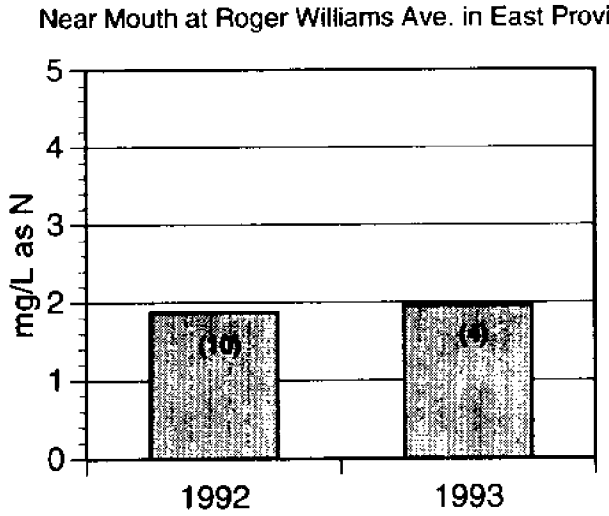



Figure 17. Average annual total dissolved nitrogen concentrations (mg/L as N) at the Pawtuxet River and Ten Mile River stations. The number of samples collected each year is shown in parentheses. Nitrogen concentrations are elevated in the lower Pawtuxet River due to wastewater discharges from Warwick, West Warwick, and Cranston.

## Blackstone River

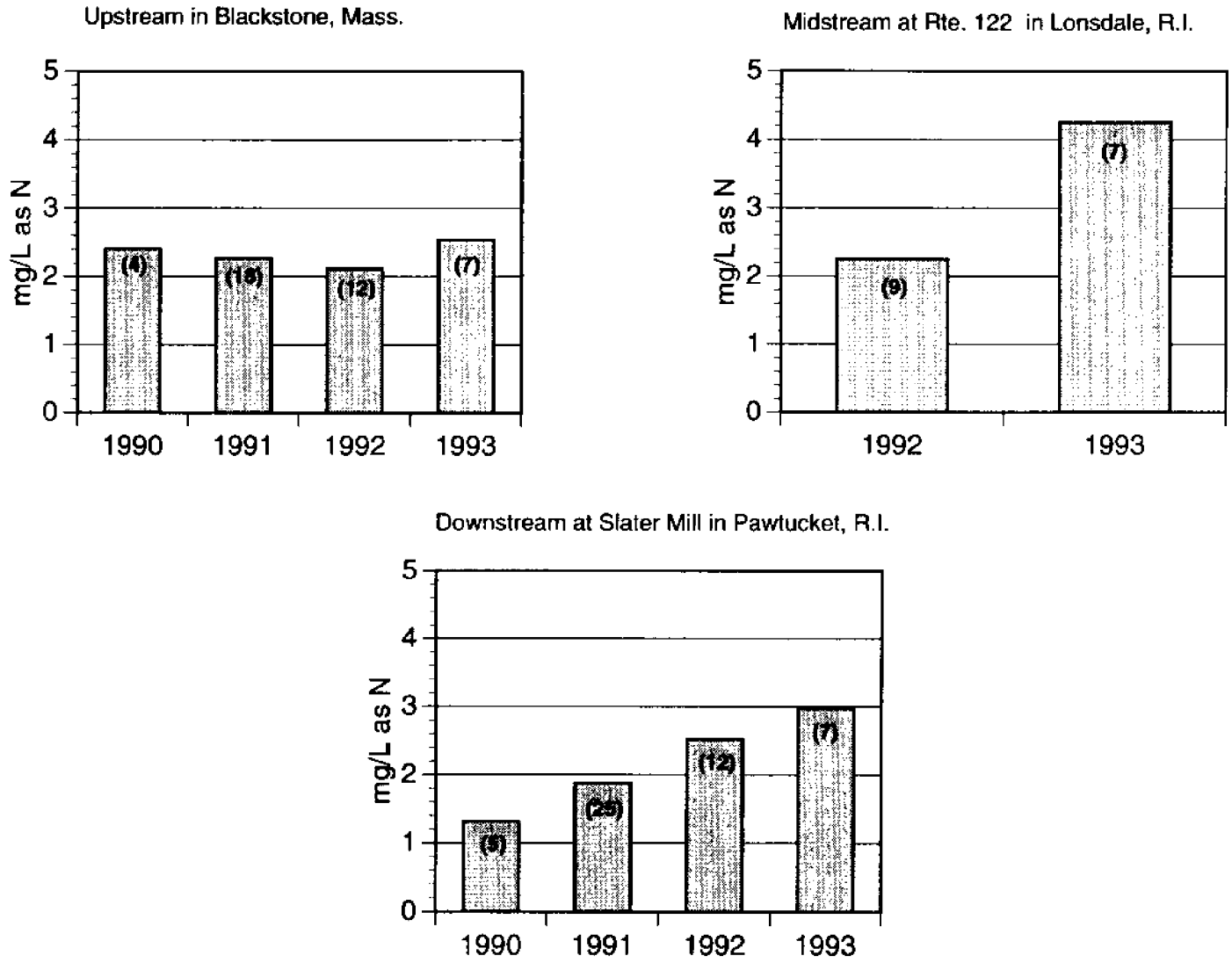



Figure 18. Average annual total dissolved nitrogen concentrations (mg/L as N) in the Blackstone River. The number of samples collected is shown in parentheses.

cadmium, 32 percent of the chromium, 41percent of the copper, 36 percent of the nickel and 16 percent of the lead entering the Bay.

San Francisco, Calif. conducted an in-depth study of metals in their wastewater effluent, investigating activities that could potentially discharge metals into the plant (Filice and Brosseau, 1993). They found that heavy metals are introduced into wastewater during wet and dry weather from a variety of sources that are common in all urban settings. These same sources are potential sources of metals in the rivers studied by River Rescue and are shown in Tables 3 and 4.

Although heavy metals have been considered an industrial pollutant, recent studies show that residential wastewater can also be a significant source of heavy metals. The Sacramento, Calif. Regional County Sanitation District conducted a thorough investigation of toxic discharges from residential households (Burnam et al., 1994). For four weeks during the summer, daily measurements of wastewater flow and pollutant characteristics were made from six predominantly residential sections of their service area. Untreated water, finished supply water and tap water samples were also analyzed to determine background concentrations of the constituents and calculate changes in concentration occurring within the households. Although the specific concentrations measured are not applicable to Rhode Island, the general conclusions of residential inputs are valid.

They found that the service lines delivering water to residential households could introduce metals to the drinking water before it was used in the home. New distribution systems increased levels of copper and zinc, while older distribution systems showed increased levels of lead, mercury, and zinc. The paper did not define the age of old or new systems.

In comparing the water service line metal concentration to the concentration in the sewer samples, the authors found increases in all metals except arsenic. Cadmium concentrations were increased four to five times at all locations, while copper concentrations increased by a factor of 12 to 15. Lead concentrations increased by two to four times, chromium concentrations increased by 50 percent, while nickel increased by 20 percent to 50 percent. This suggests that residential waste can be a significant source of heavy metals to municipal wastewater plants and then to surface waters receiving wastewater inputs.

High concentrations of heavy metals are toxic to both humans and aquatic organisms. The EPA has analyzed the toxicity of metals to a variety of aquatic organisms and developed benchmark levels, or criteria, that should not be exceeded in a healthy ecosystem. Toxic substances affect organisms in two ways: High levels of chemicals will kill organisms immediately, and long term exposure to lower, non-lethal concentrations can affect the organism's behavior and reproductive success. EPA has therefore established "acute" criteria to protect against high level, short term exposures to toxic chemicals, and "chronic" criteria to protect against the longer term effects of lower concentrations. Acute and chronic criteria for metals vary with the hardness of the water.

**Table 3. Sources of Heavy Metals During Dry Weather**
(from Filice and Brosseau, 1993)

| METAL | WATER SUPPLY | RESIDENTIAL | REGULATED INDUSTRY | OTHER COMMERCIAL |
|---|---|---|---|---|
| Copper | Raw water supply<br>Pipeline corrosion | Root killer products<br>Algicides<br>Foods | Manufacturers of electrical equipment | Auto body shops<br>Commercial printers<br>Linen suppliers |
| Lead | Raw water supply<br>Pipeline corrosion | Paints<br>Photo processors<br>Auto fluids<br>Home plumbing | Hospitals<br>Radiator repair shops<br>Linen suppliers<br>Car washes | Sheet metal shops<br>Auto services<br>Painting services<br>Equipment renters |
| Nickel | Raw water supply<br>Pipeline corrosion | Paints | Metal platers<br>Hospitals | Auto services<br>Cleaners and laundries |

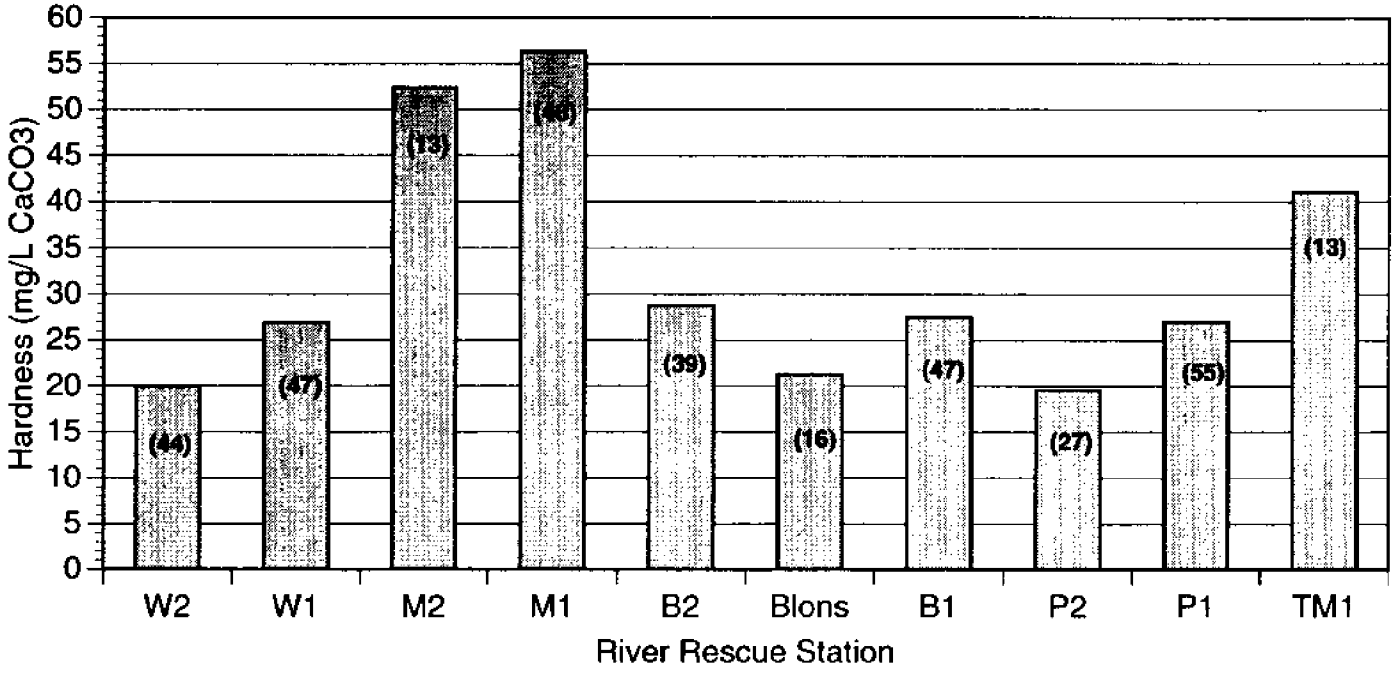
Rhode Island water quality regulations (RIDEM, 1988) specify that for waters classified A, B, and C,

> "The ambient concentration of a pollutant in a waterbody designated as suitable for fish and/or wildlife habitat shall not exceed the Ambient Water Quality Guidelines for the protection of aquatic organisms from chronic effects (see Appendix B), unless the chronic guideline is modified by the Director based on results of bioassay tests conducted in accordance with the terms and conditions provided in Appendix C."

Ambient water quality guidelines were used to calculate heavy metal acute and chronic criteria for the 10 River Rescue stations. These criteria are calculated from the water hardness (mg/L as CaCO3) shown in Figure 19 as long as it exceeded the minimum allowed hardness of 25 mg/L as CaCO3. The calculated criteria are shown in Tables 5 and 6.

**Table 4. Sources of Heavy Metals During Wet Weather**
(from Filice and Brosseau, 1993)

| METAL | GENERAL WET WEATHER SOURCES | COMMERCIAL AND INDUSTRIAL WET WEATHER SOURCES |
|---|---|---|
| Copper | Algicides<br>Brake linings<br>Paints and wood preservatives<br>Vehicle engine parts | Auto service and repair<br>Electrical equipment manufacturing and metal finishing<br>Points, inks, and printing |
| Cadmium | Gasoline<br>Oil and grease<br>Tires | Auto service and repair<br>Metal finishing |
| Chromium | Engine parts<br>Brake linings | Auto service and repair<br>Metal finishing |
| Lead | Batteries<br>Gasoline<br>Paints<br>Vehicle exhaust<br>Vehicle engine parts | Auto service and repair<br>Equipment rental |
| Nickel | Gasoline<br>Paints<br>Oil and grease<br>Brake linings | Local trucking<br>Auto service and repair |






**Rhode Island Fresh Water Criteria**

| | Acute (µg/L) | Chronic (µg/L) |
|---|---|---|
| Cadmium | $e^{(1.128 (\ln H) - 3.828)}$ | $e^{(0.7852 (\ln H) - 3.49)}$ |
| Chromium | $e^{(0.819 (\ln H) + 3.688)}$ | $e^{(0.819 (\ln H) + 1.561)}$ |
| Copper | $e^{(0.9422 (\ln H) - 1.464)}$ | $e^{(0.8545 (\ln H) - 1.465)}$ |
| Lead | $e^{(1.273 (\ln H) - 1.46)}$ | $e^{( 1.273 (\ln H) - 4.705)}$ |
| Nickel | $e^{(0.846 (\ln H) + 3.3612)}$ | $e^{(0.846 (\ln H) + 1.1645)}$ |

H = Hardness. Minimum hardness of 25 mg/L CaCO3 allowed in regression equations.

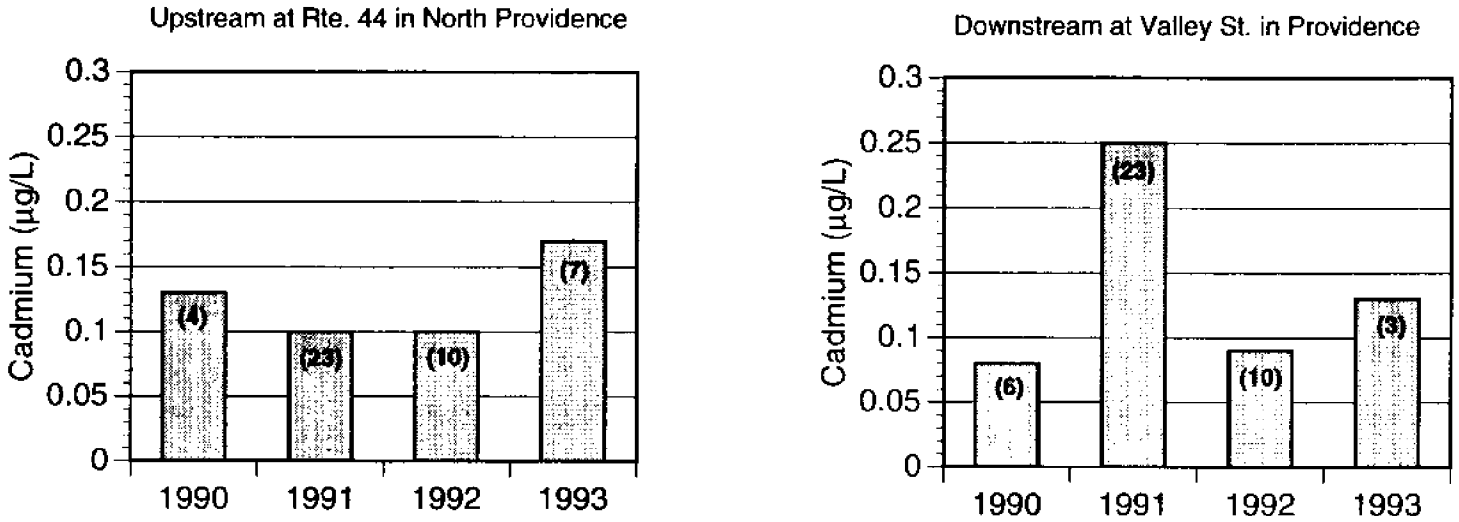
Figure 19. Average water hardness at River Rescue stations calculated from measured calcium and magnesium concentrations. This hardness was used in the criteria equations to calculate acute and chronic criteria for each station for the five metals analyzed by River Resuce.

**Table 5. Heavy Metals Acute Water Quality Criteria (µg/L) for River Rescue Stations**

| STA | AVG. HARD | HARD USED | Cd | Cr | Cu | Pb | Ni |
|---|---|---|---|---|---|---|---|
| W2 | 20.0 | 25 | 0.8 | 557.9 | 4.8 | 14.0 | 438.9 |
| W1 | 26.9 | 26.9 | 0.9 | 592.4 | 5.1 | 15.4 | 467.0 |
| M2 | 52.4 | 52.4 | 1.9 | 1022.2 | 9.6 | 35.8 | 820.4 |
| M1 | 56.3 | 56.3 | 2.0 | 1084.6 | 10.3 | 39.3 | 872.2 |
| B2 | 28.8 | 28.8 | 1.0 | 626.0 | 5.5 | 16.7 | 494.3 |
| Blons | 21.3 | 25 | 0.8 | 557.9 | 4.8 | 14.0 | 438.9 |
| B1 | 27.5 | 27.5 | 0.9 | 603.1 | 5.3 | 15.8 | 475.7 |
| P2 | 19.6 | 25 | 0.8 | 557.9 | 4.8 | 14.0 | 438.9 |
| P1 | 27.0 | 27.0 | 0.9 | 594.8 | 5.2 | 15.4 | 468.9 |
| TM1 | 41.0 | 41.0 | 1.4 | 837.0 | 7.7 | 26.3 | 667.3 |

*Cadmium:* The average annual cadmium concentration for each station is shown in Figures 20 – 22. The stations on the Woonasquatucket, Moshassuck, and upper Pawtuxet rivers were consistently below the chronic criteria, while the lower Pawtuxet, Ten Mile, and Blackstone rivers showed some exceedances of the criteria. In 1991, the lower Pawtuxet River station averaged twice the chronic criteria of 0.4 µg/L. During 1991, high levels of cadmium (above 1.0 µg/L) were measured at this station on April 29, June 24, July 10, July 21, August 5, September 3, and December 31. Concentrations above 1.0 µg/L were never found during subsequent years. The Ten Mile River exceeded the chronic cadmium criteria in 1992. Half of the 10 measurements equaled or exceeded the criteria of 0.6 µg/L with one sample of 2.7 µg/L taken on February 9. The three samples collected in 1993 were consistently below the criteria. High levels of cadmium were measured periodically in the Blackstone River in Blackstone, Mass., (3.9 µg/L on November 25, 1990 and 3.5 µg/L on June 9, 1991), and the average cadmium concentration for 1990, 1991, and 1992 exceeded the chronic criteria of 0.4 µg/L. The 1993 average concentration of 0.23 µg/L fell well below the criteria, suggesting that cadmium levels in the upper Blackstone River improved during the four-year study. This trend was also seen at the mouth of the Blackstone, although the change is much less dramatic.

## Woonasquatucket River




## Moshassuck River

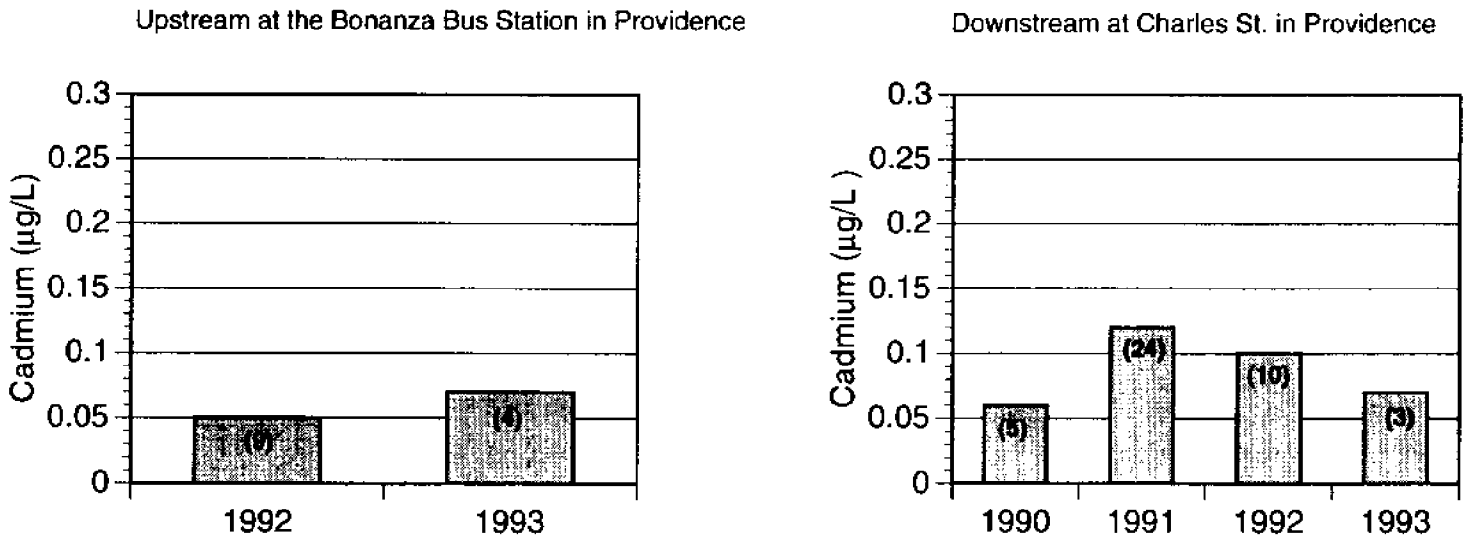
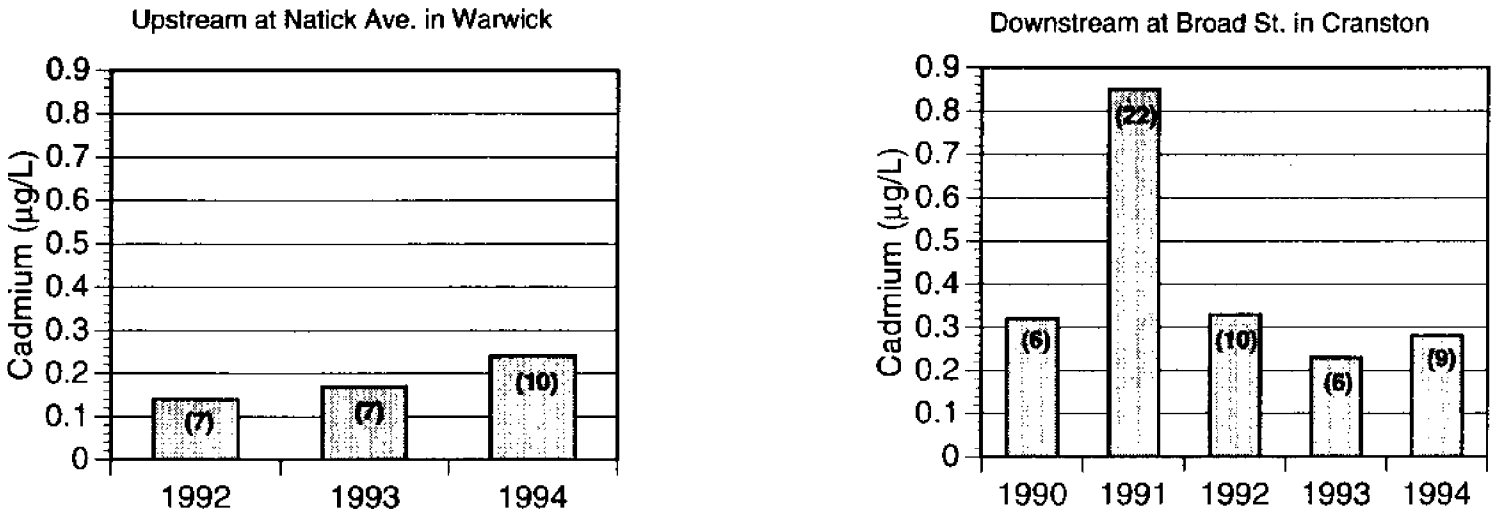



Figure 20. Average annual cadmium concentrations measured at River Rescue stations on the Woonasquatucket and Moshassuck rivers were consistently below the acute and chronic water quality criteria.

## Pawtuxet River




## Ten Mile River

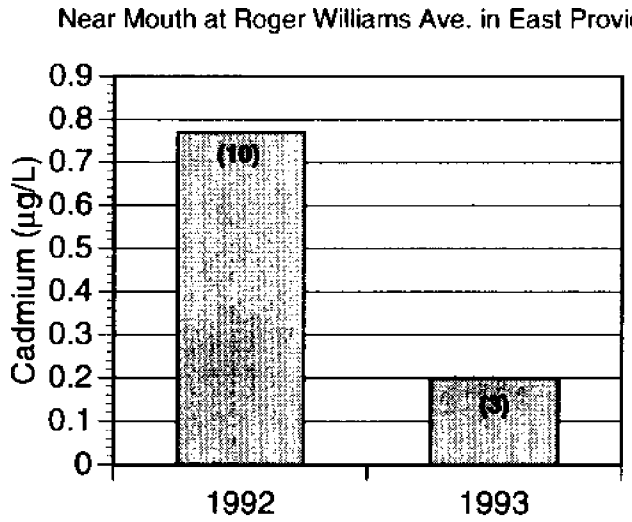



Figure 21. Average annual cadmium concentrations of the Pawtuxet and Ten Mile rivers were extremely variable. The lower Pawtuxet station exceeded the chronic criteria of 0.4 µg/L in 1991 and the Ten Mile station exceeded the chronic criteria of 0.6 µg/L in 1992. The number of samples collected is shown in parentheses.

## Blackstone River

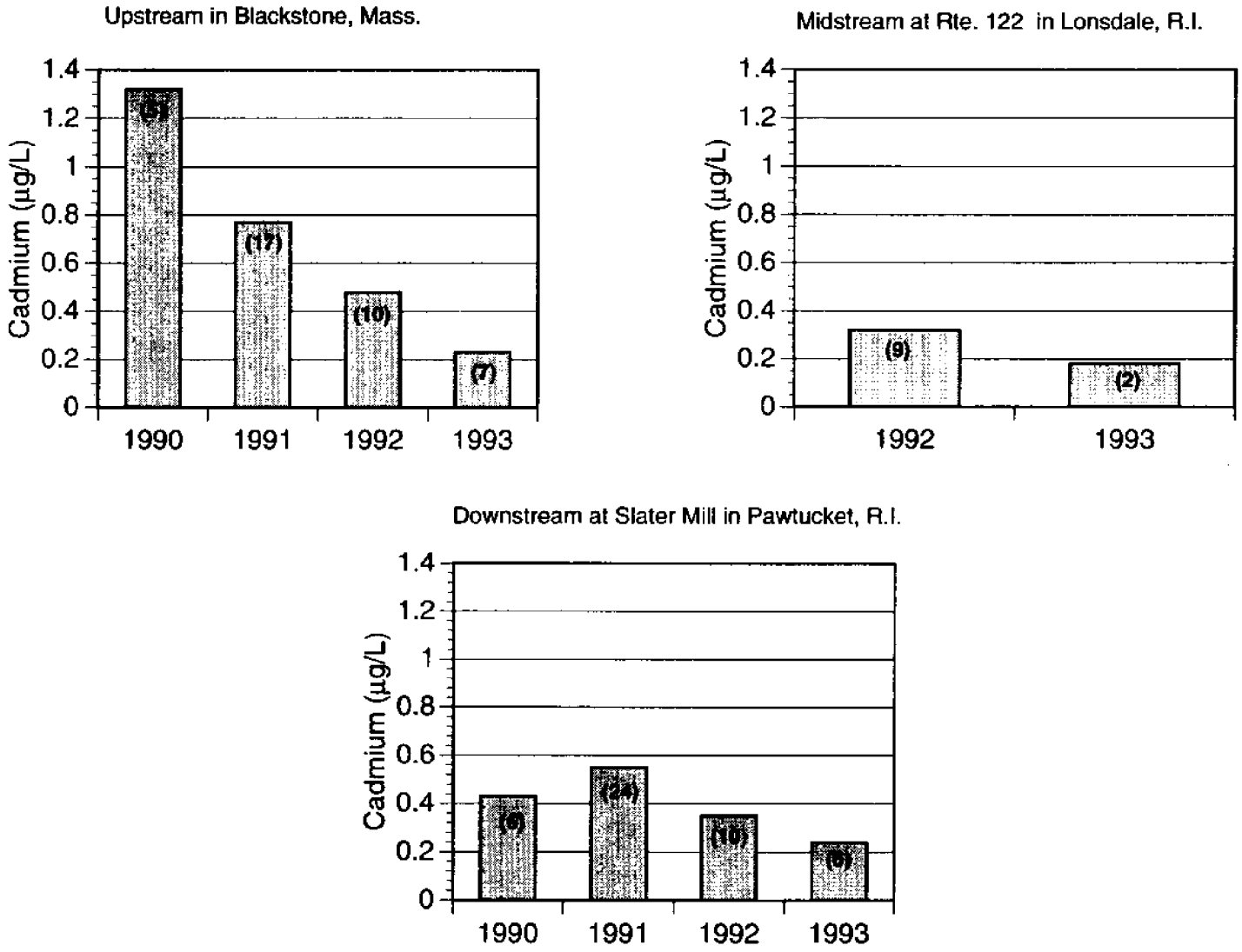



Figure 22. Average annual cadmium concentrations on the Blackstone River exceeded the chronic criteria in Blackstone, Mass. in 1990, 1991, and 1992. Cadmium concentrations decrease at the lower station, but violated the chronic standard in 1990 and 1991. The River Rescue data show decreases in cadmium concentrations during the four years of monitoring.

**Table 6. Heavy Metals Chronic Water Quality Criteria (µg/L) for River Rescue Stations**

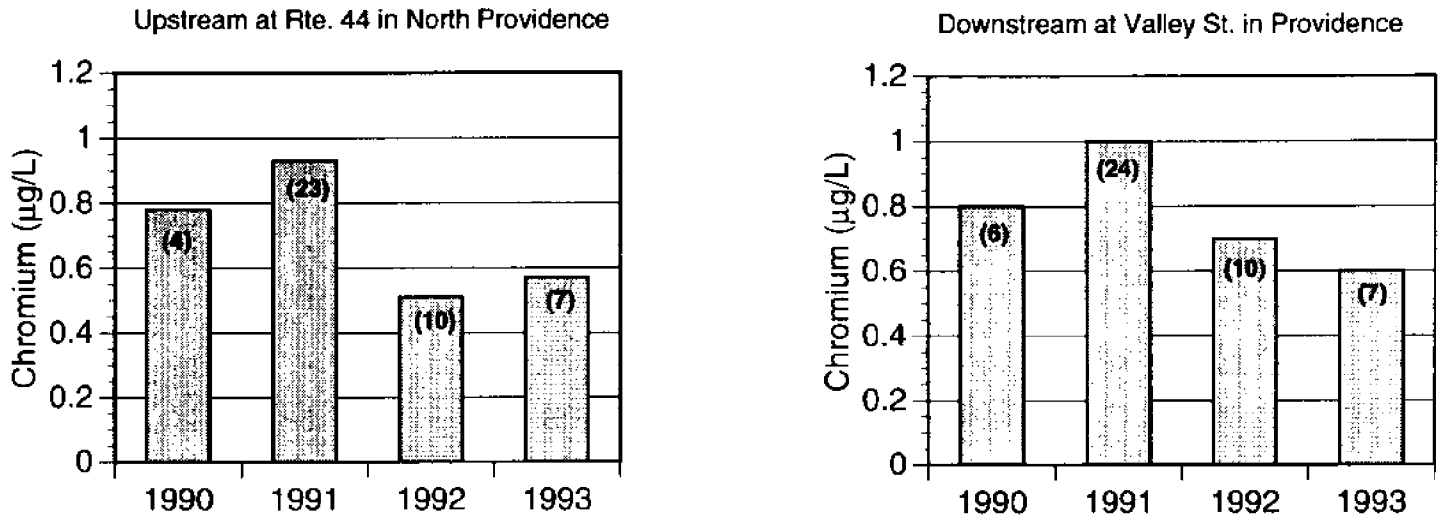
| STA | AVG. HARD | MIN HARD | Cd | Cr | Cu | Pb | Ni |
|---|---|---|---|---|---|---|---|
| W2 | 20.0 | 25 | 0.4 | 66.5 | 3.6 | 0.5 | 48.8 |
| W1 | 26.9 | 26.9 | 0.4 | 70.6 | 3.9 | 0.6 | 51.9 |
| M2 | 52.4 | 52.4 | 0.7 | 121.8 | 6.8 | 1.4 | 91.2 |
| M1 | 56.3 | 56.3 | 0.7 | 129.3 | 7.2 | 1.5 | 97.0 |
| B2 | 28.8 | 28.8 | 0.4 | 74.6 | 4.1 | 0.7 | 55.0 |
| Blons | 21.3 | 25 | 0.4 | 66.5 | 3.6 | 0.5 | 48.8 |
| B1 | 27.5 | 27.5 | 0.4 | 71.9 | 3.9 | 0.6 | 52.9 |
| P2 | 19.6 | 25 | 0.4 | 66.5 | 3.6 | 0.5 | 48.8 |
| P1 | 27.0 | 27.0 | 0.4 | 70.9 | 3.9 | 0.6 | 52.1 |
| TM1 | 41.0 | 41.0 | 0.6 | 99.8 | 5.5 | 1.0 | 74.2 |

Cadmium concentrations measured by River Rescue at the mouth of the Blackstone, Moshassuck, Woonasquatucket, and Pawtuxet rivers are compared to measurements made in 1985 and 1986 in Table 7. Cadmium levels have decreased by 79.3 percent in the Moshassuck, 35.7 percent in the Woonasquatucket, 66.4 percent in the Blackstone, and 54.8 percent in the Pawtuxet River.

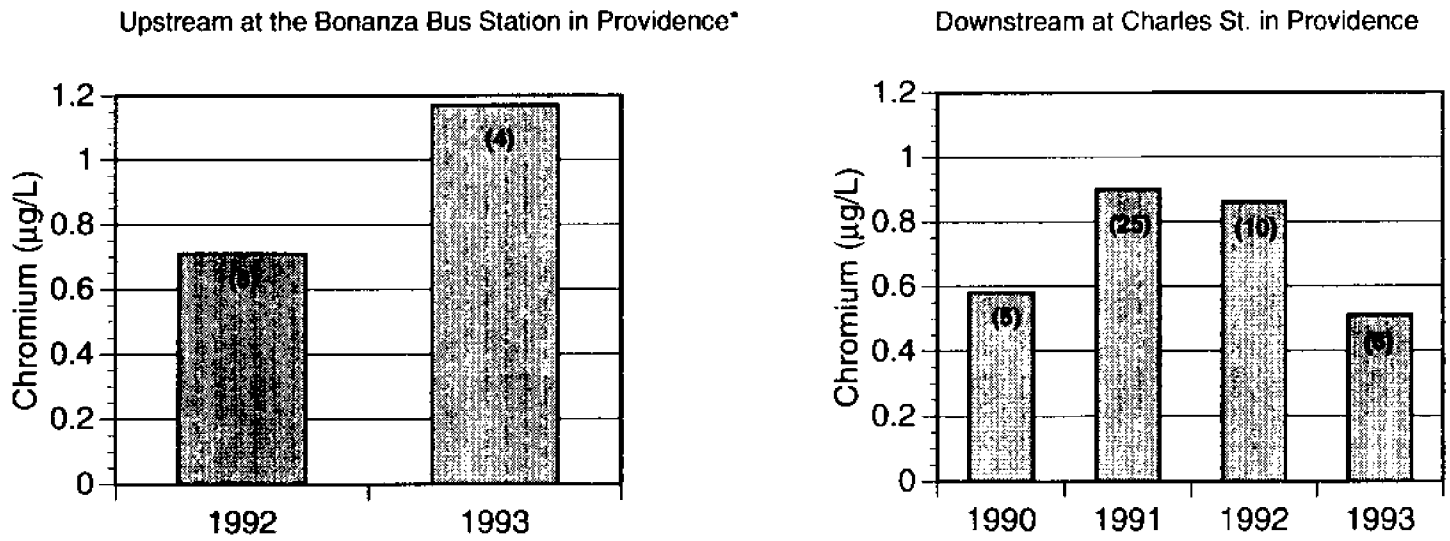
*Chromium:* Figures 23 – 25 show the average annual chromium concentrations measured at each River Rescue station. All stations fell well below the chronic and acute criteria. The highest concentrations of chromium were measured in the Ten Mile River, and the lowest concentrations were found in the upper Pawtuxet River. The Blackstone River had intermediate levels of chromium, which decreased from the upper Blackstone to the mouth.

Table 7 compares chromium concentrations measured by River Rescue at the mouth of the Blackstone, Moshassuck, Woonasquatucket, and Pawtuxet rivers to measurements made in 1985 and 1986. Chromium levels have decreased by 42.6 percent in the Moshassuck, 82.7 percent in the Woonasquatucket, 25.6 percent in the Blackstone and have increased by 4.7 percent in the Pawtuxet River.

## Woonasquatucket River



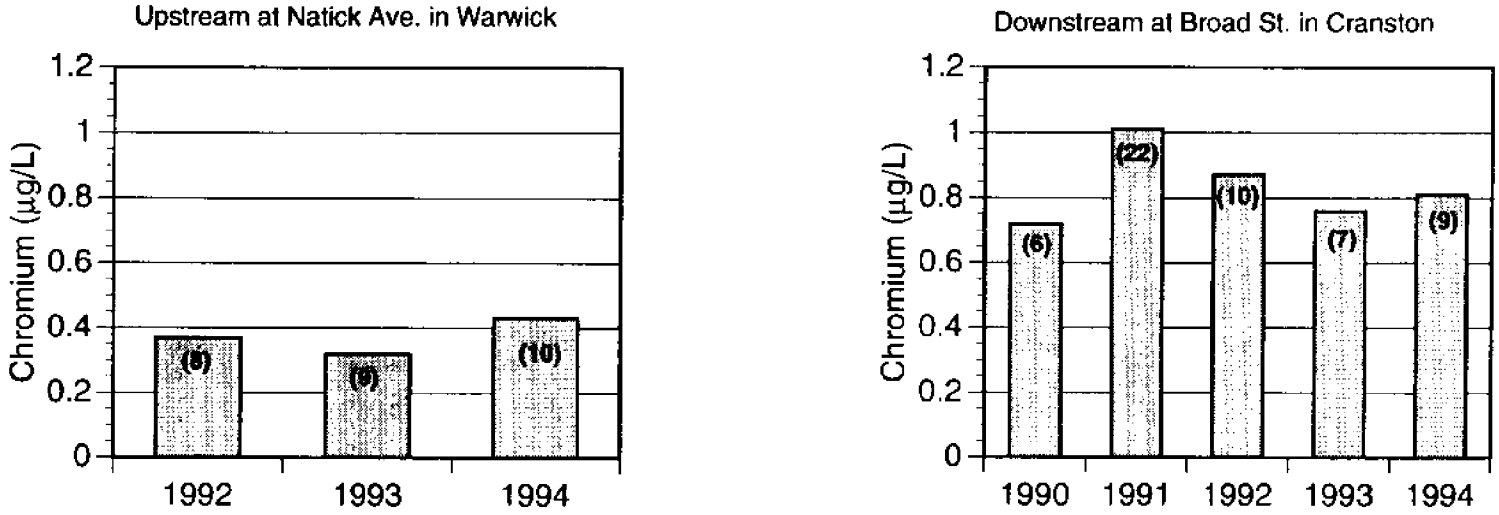

## Moshassuck River




* A rain influenced measurement of 17.9 µg/L collected on 10/13/92 was omitted from the analysis

Figure 23. Average annual chromium concentrations (µg/L) at River Rescue stations on the Woonasquatucket and Moshassuck rivers. The number of samples collected each year is shown in parentheses. Measured concentrations fell below both the acute and the chronic water quality criteria.

## Pawtuxet River




## Ten Mile River

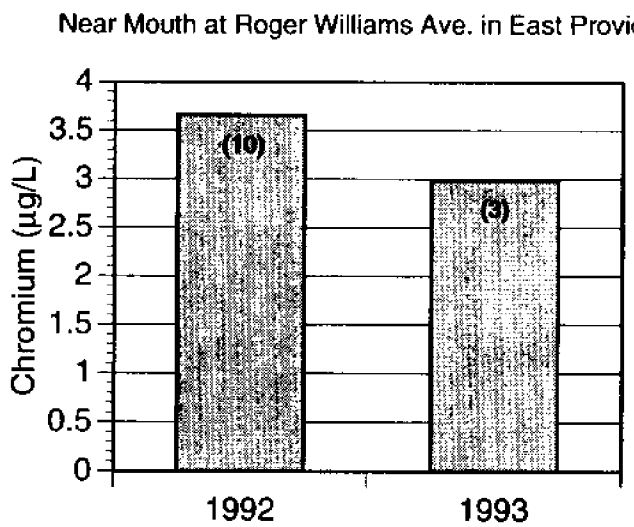



Figure 24. Average annual chromium concentrations on the Pawtuxet and Ten Mile rivers fell well below both the acute and chronic water quality criteria. The number of samples collected is shown in parentheses.

## Blackstone River

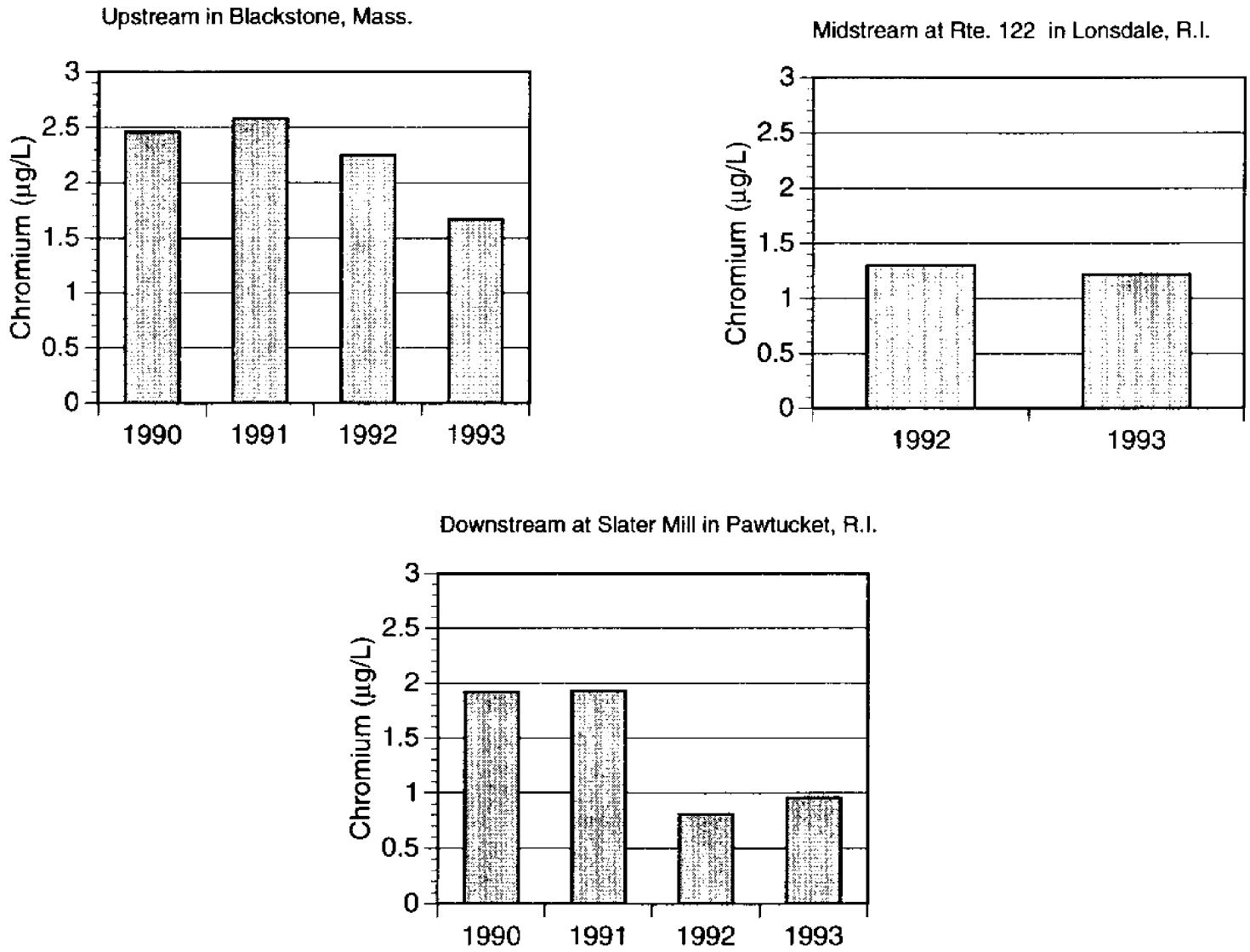



Figure 25. Average annual chromium concentrations on the Blackstone River were well below the acute and chronic water quality criteria. Chromium concentrations decreased from the upper Blackstone station to the downstream station at Slater Mill.

## Table 7. Changes in Pollutant Concentrations During the Last Decade

| Water Quality Constituent | Date | Moshassuck | Woonasqatucket | Blackstone | Pawtuxet |
|---|---|---|---|---|---|
| **Dissolved Inorganic Nitrogen** | 1982/83 * | 0.96 mg/L | 0.84 mg/L | 2.17 mg/L | 1.86 mg/L |
| | 1990/1995 | 0.71 mg/L | 0.73 mg/L | 1.31 mg/L | 2.18 mg/L |
| | % Change | 25.6 % | 13.4 % | 39.8 % | - 17.0 % |
| **Dissolved Inorganic Phosphorus** | 1982/83 * | 0.03 mg/L | 0.07 mg/L | 0.14 mg/L | 0.46 mg/L |
| | 1990/96 | 0.007 mg/L | 0.033 mg/L | 0.087 mg/L | 0.174 |
| | % Change | 72.8 % | 50.0 % | 39.2 % | 62.2 % |
| **Lead** | 1985/86 ** | 5.07 µg/L | 5.00 µg/L | 4.62 µg/L | 2.38 µg/L |
| | 1990/95 | 4.46 µg/L | 3.20 µg/L | 5.36 µg/L | 2.96 µg/L |
| | % Change | 12.0 % | 36.0 % | -16.0 % | -24.4 % |
| **Copper** | 1985/86 ** | 8.67 µg/L | 14.09 µg/L | 8.65 µg/L | 11.31 µg/L |
| | 1990/95 | 6.86 µg/L | 4.20 µg/L | 9.37 µg/L | 11.08 µg/L |
| | % Change | 20.9 % | 70.2 % | -8.3 % | 2.0 % |
| **Nickel** | 1985/86 ** | 27.01 µg/L | 26.38 µg/L | 14.98 µg/L | 20.72 µg/L |
| | 1990/95 | 2.67 µg/L | 2.30 µg/L | 5.47 µg/L | 6.8 µg/L |
| | % Change | 90.1 % | 91.3 % | 63.5 % | 67.2 % |
| **Cadmium** | 1985/86 ** | 0.53 µg/L | 0.28 µg/L | 1.34 µg/L | 1.15 µg/L |
| | 1990/95 | 0.11 µg/L | 0.18 µg/L | 0.45 µg/L | 0.52 µg/L |
| | % Change | 79.3 % | 35.7 % | 66.4 % | 54.8 % |
| **Chromium** | 1985/86 ** | 1.41 µg/L | 4.92 µg/L | 2.07 µg/L | 0.85 µg/L |
| | 1990/95 | 0.81 µg/L | 0.85 µg/L | 1.54 µg/L | 0.89 µg/L |
| | % Change | 42.6 % | 82.7 % | 25.6 % | -4.7 % |

* Taken from data provided by Nixon and Granger and used in Nixon, et al., 1995.
** Taken from data presented in Pilson and Hunt, 1989.

*Copper:* The average annual copper concentration at each River Rescue station is shown in Figures 26 – 28. The acute criteria for copper are stringent, ranging from 7 µg/L at station M1 (hardness of 56 mg/L CaCO3) to 3.6 µg/L at stations W2, Blons, and P2. All the stations except the upper Moshassuck exceeded the copper criteria during at least one year. The Blackstone and Pawtuxet rivers exceeded the chronic copper criteria at all stations during the entire study. The lower Pawtuxet River station showed high average copper concentrations during 1991 with concentrations above 20 µg/L consistently measured during June (2 samples), July (2 samples), August (1 sample), and September (1 sample). These high levels were not seen during subsequent summers, although fewer samples were collected. Copper levels in the Blackstone River were lower at the mouth than in Blackstone, Mass. However, in 1992 and 1993, the Lonsdale station had higher copper levels than either of the other two stations. The Blackstone data suggest that copper levels have decreased in the river since sampling began in 1990.

Table 7 compares copper concentrations measured by River Rescue at the mouth of the Blackstone, Moshassuck, Woonasquatucket, and Pawtuxet Rivers to measurements made in 1985 and 1986. Copper levels have decreased by 20.9 percent in the Moshassuck, 70.2 percent in the Woonasquatucket, and have remained unchanged in the Pawtuxet River. Concentrations have increased slightly (8 percent) in the Blackstone River.

*Lead:* Lead results are shown in Figures 29 – 31. Lead concentrations at all the stations were below the acute criteria but exceeded the chronic criteria. The only exception is the Ten Mile station, which was slightly below the 1.0 µg/L chronic criteria in 1993. Lead concentrations in the Woonasquatucket, lower Moshassuck and Pawtuxet Rivers showed little between-year variation. Lead increased in the upper Moshassuck, in the Blackstone River at Lonsdale, and decreased in the Ten Mile River.

Table 7 compares lead concentrations measured by River Rescue at the mouth of the Blackstone, Moshassuck, Woonasquatucket and Pawtuxet rivers to measurements made in 1985 and 1986. Lead levels have decreased in the Moshassuck (12 percent) and Woonasquatucket Rivers (36 percent) and have increased in the Blackstone (16 percent) and Pawtuxet Rivers (24 percent).

*Nickel:* Figures 32 – 34 show nickel concentrations at the River Rescue station. There were no violations of acute or chronic criteria at any station. The highest nickel concentrations were measured at the Ten Mile River station in 1992 and 1993. The Blackstone River had intermediate levels of nickel, and the data show concentrations decreasing over time and over the length of the river. Nickel concentrations in the Pawtuxet River increased significantly between the upstream station and the station at the mouth, but these data also show decreases over time. Nickel concentrations at the Woonasquatucket and Moshassuck river stations were low, and showed little between-station change.

Table 7 compares nickel concentrations measured by River Rescue at the mouth of the Blackstone, Moshassuck, Woonasquatucket, and Pawtuxet rivers to measurements made in 1985 and 1986. Nickel levels have decreased in the Moshassuck (90.1 percent), Woonasquatucket (91.3 percent), Blackstone (63.5 percent), and Pawtuxet Rivers (67.2 percent).

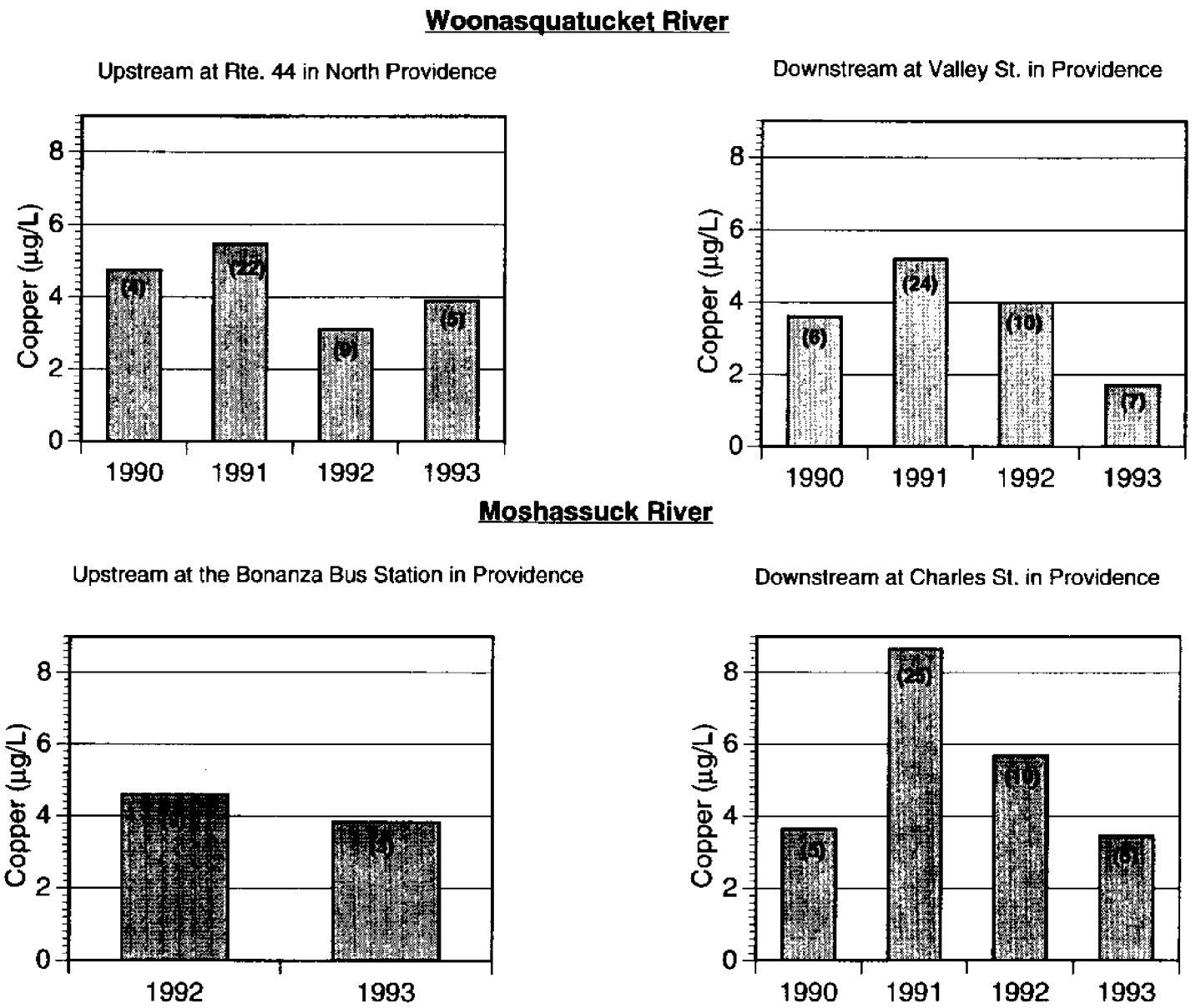
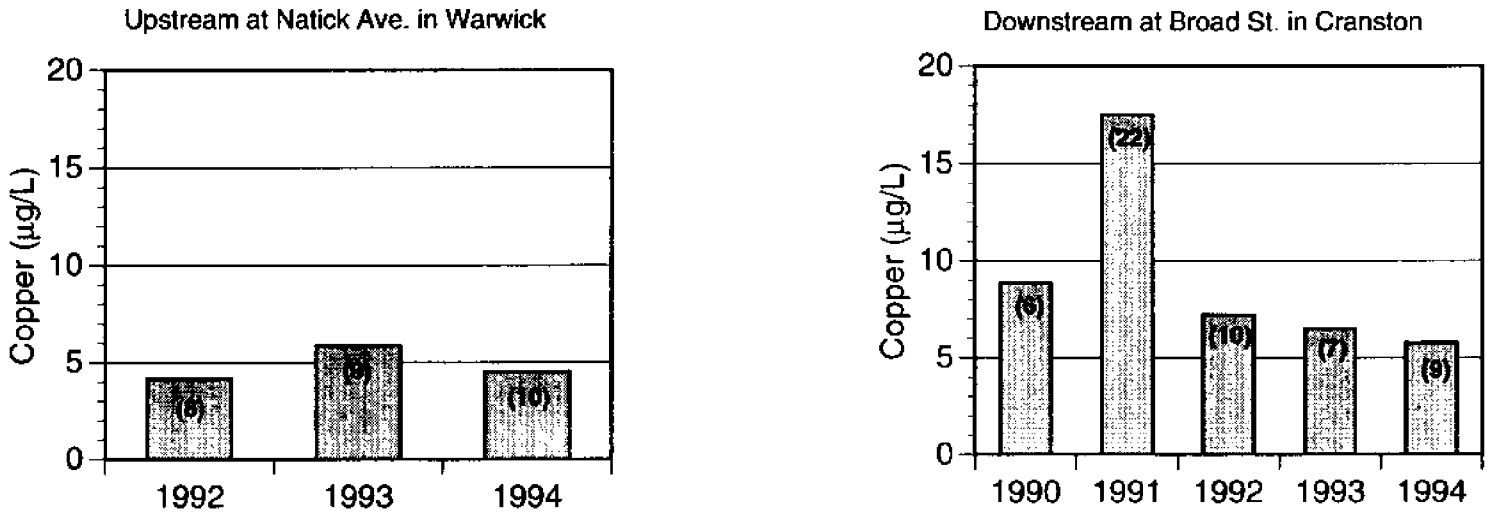



Figure 26. Average annual copper concentrations at River Rescue stations on the Woonasquatucket and Moshassuck rivers often exceed the chronic water quality standard. The Upper Woonasquatucket River station exceeded the chronic copper standard in 1990, 1991, and 1993, the downstream station exceeded the standard in 1991 and 1992. The upstream Moshassuck station did not exceed the copper standard, while the downstream Moshassuck station exceeded the chronic standard in 1991.

## Pawtuxet River




## Ten Mile River

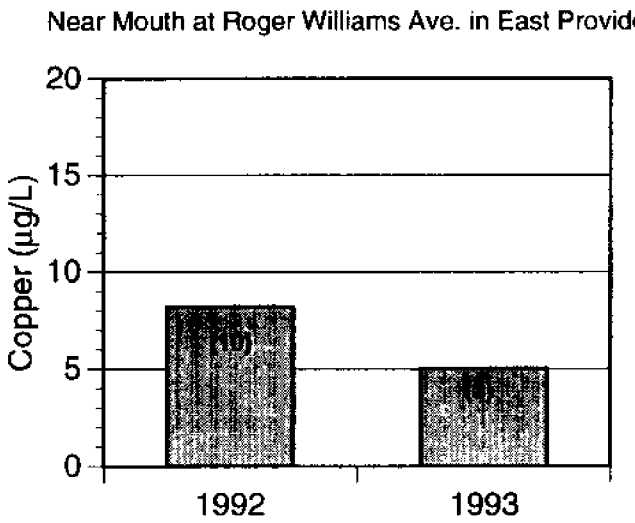



Figure 27. Average annual copper concentrations at River Rescue stations on the Pawtuxet consistently exceeded the chronic water quality criteria. The downstream Pawtuxet station exceeded the chronic standard of 5.2 µg/L during all five years. The Ten Mile River station exceeded the acute and chronic criteria in 1992, but was within acceptable limits in 1993.

## Blackstone River

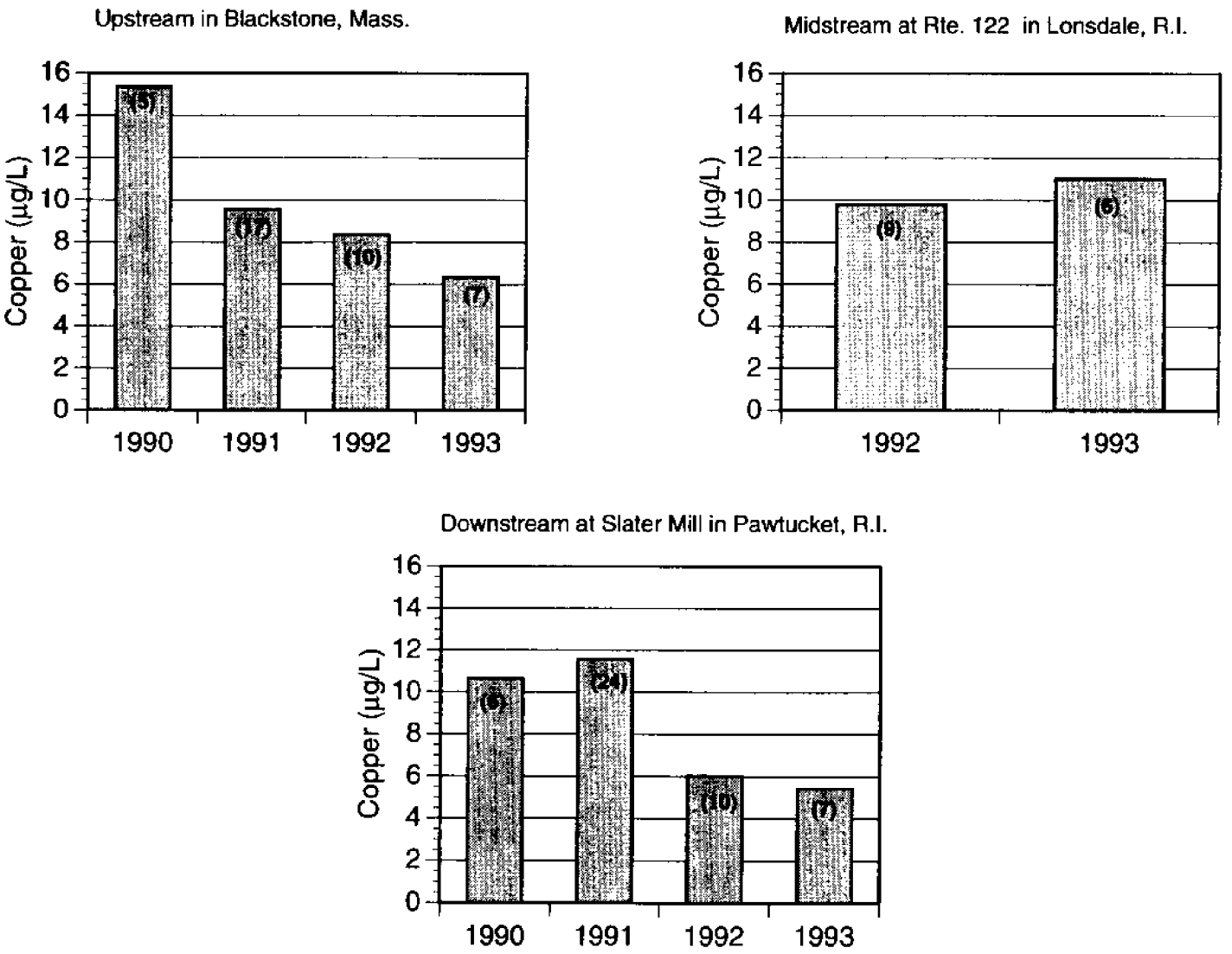
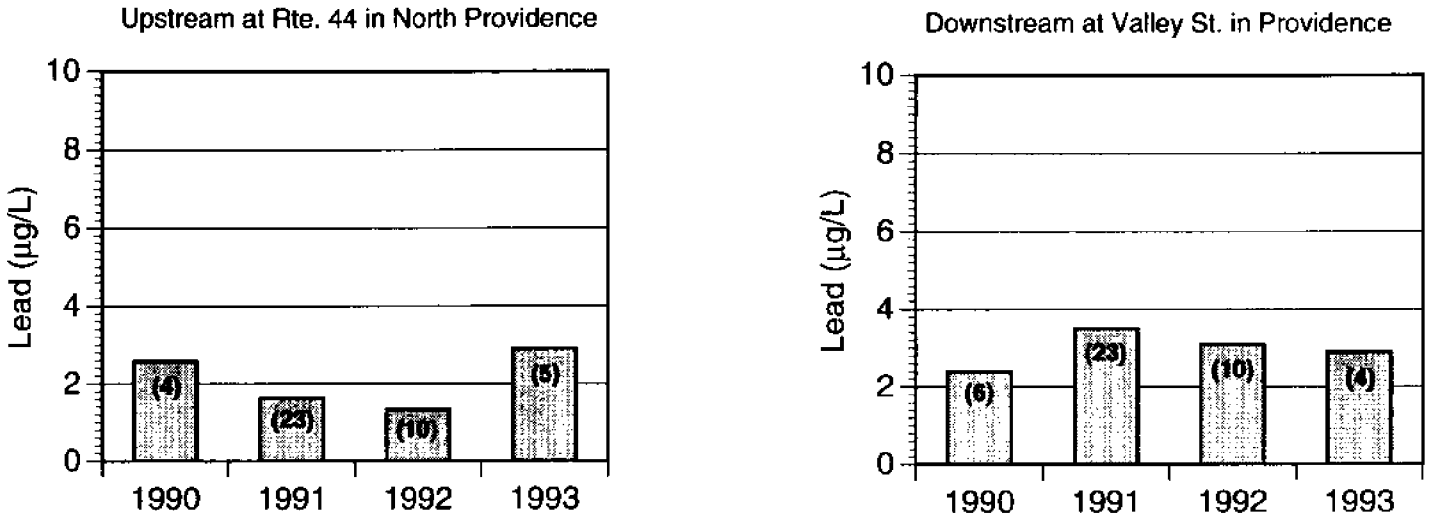



Figure 28. Average annual copper concentrations at stations on the Blackstone River seem to be decreasing over time. Copper concentrations were consistently high enough to exceed both the acute and chronic water quality criteria. The only exception was the downstream Slater Mill station, which fell just below the acute criteria of 5.3 µg/L in 1993.

## Woonasquatucket River




## Moshassuck River

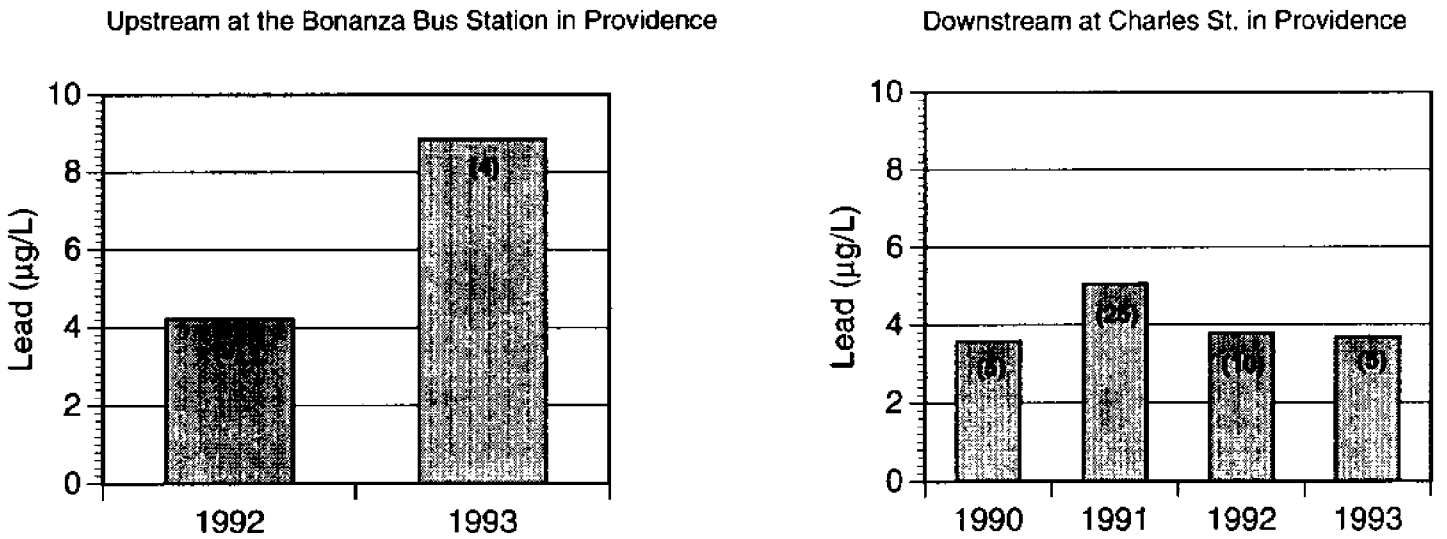
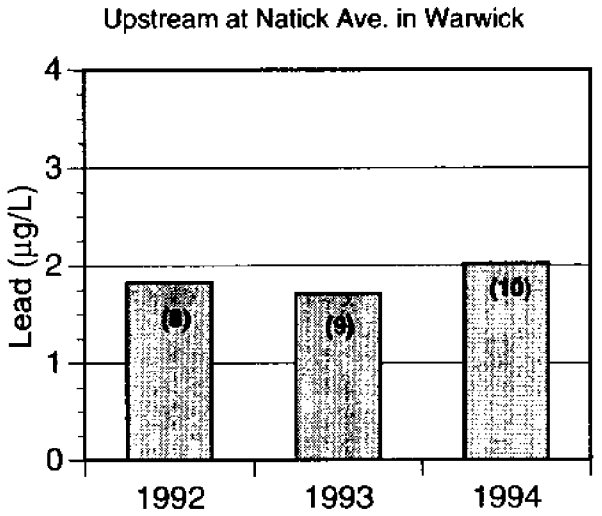
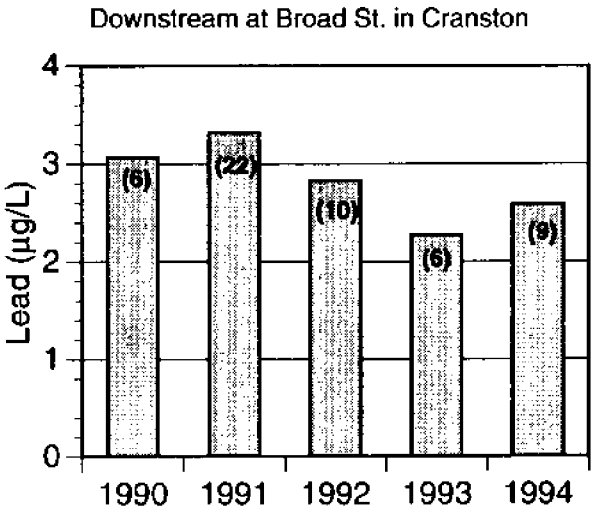



Figure 29. Average annual lead concentrations in the Woonasquatucket and Moshassuck rivers were consistently below the acute criteria, but above the chronic criteria that ranged from 0.5 to 1.5 µg/L.

## Pawtuxet River




## Ten Mile River

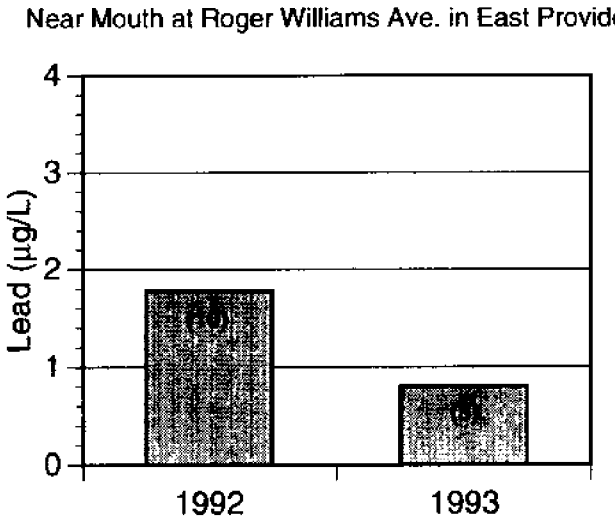



Figure 30. Average annual lead concentrations in the Pawtuxet River exceeded the chronic criteria, but were below the acute criteria during all years. Lead concentrations are higher at the downstream station than the upper Pawtuxet River station. The Ten Mile River station exceeded the chronic criteria in 1992, but was below it in 1991. It was below the acute criteria in both years.

## Blackstone River

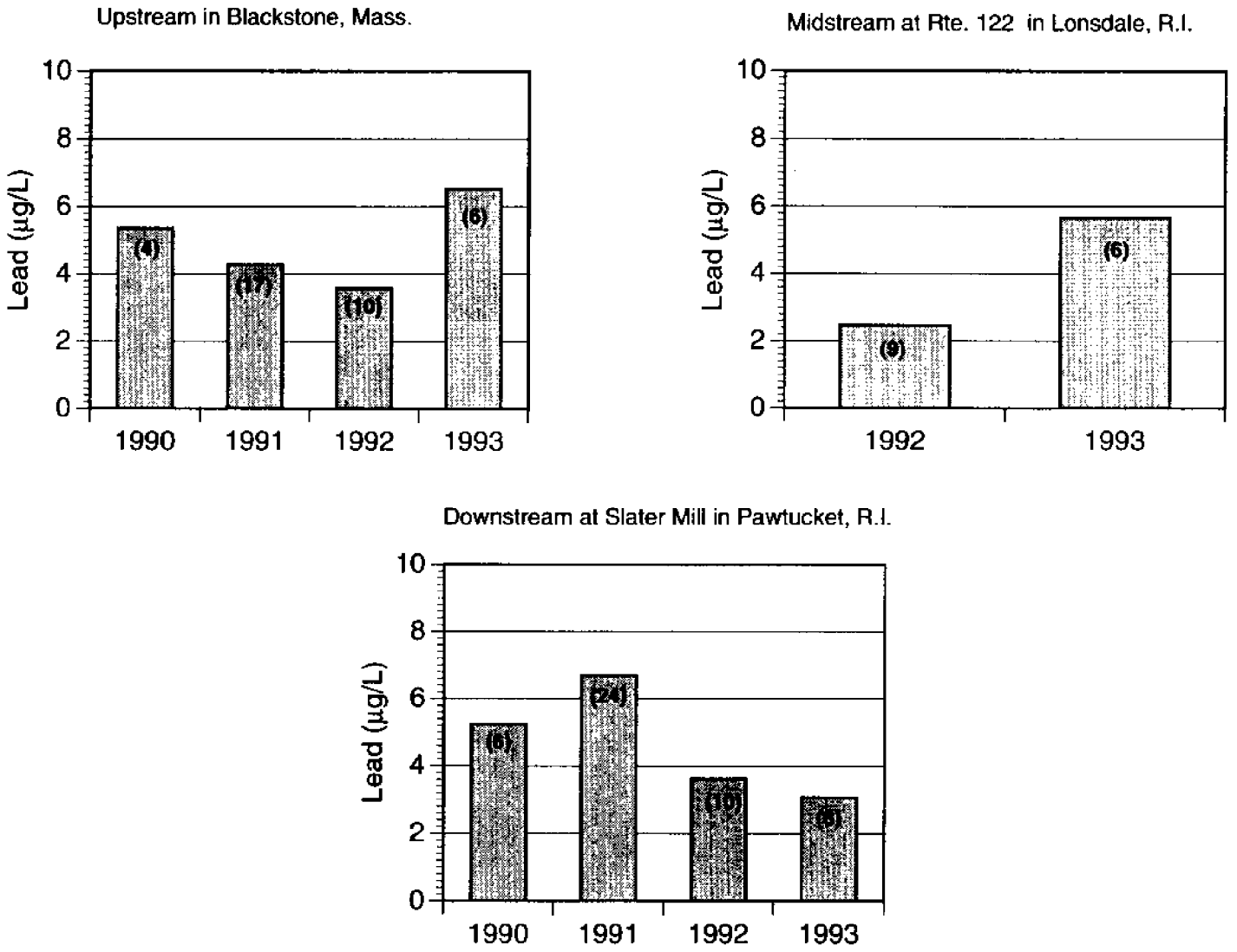
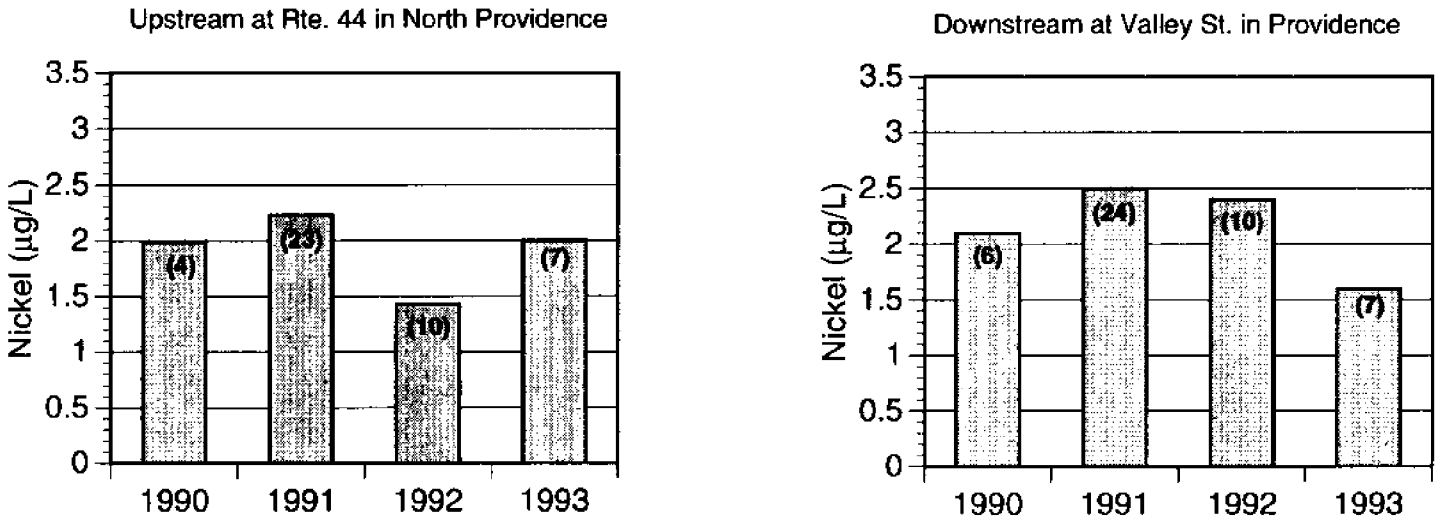



Figure 31. Average annual lead concentrations in the Blackstone River exceeded the chronic criteria and fell below the acute criteria during all years of sampling.

## Woonasquatucket River




## Moshassuck River

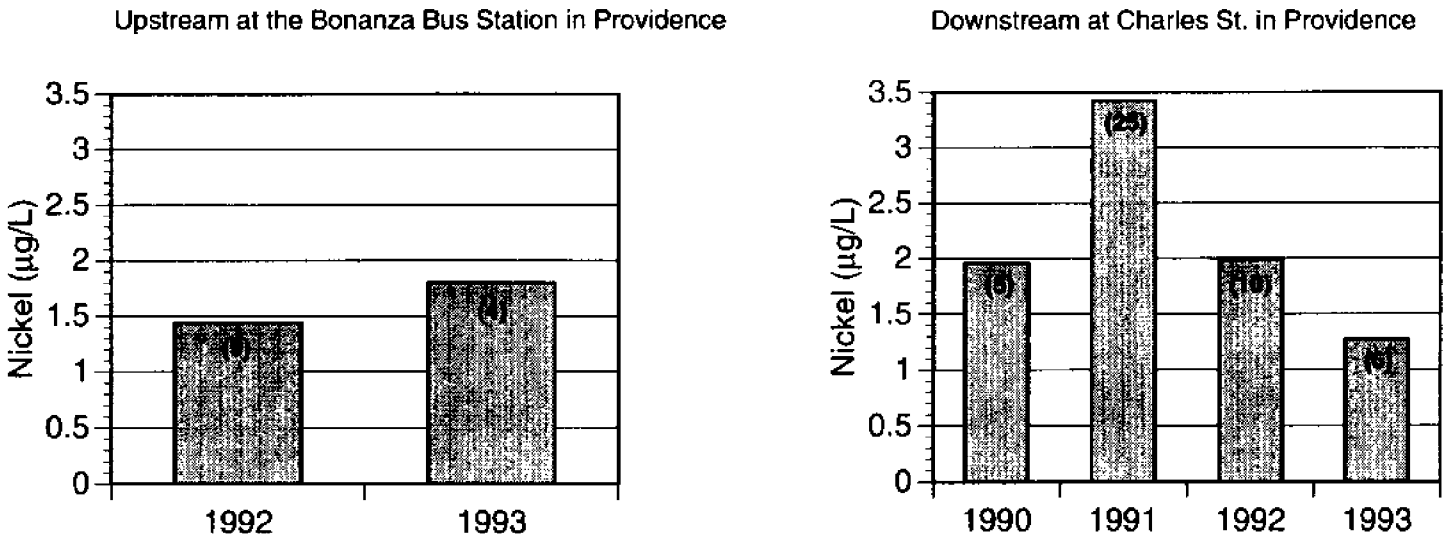
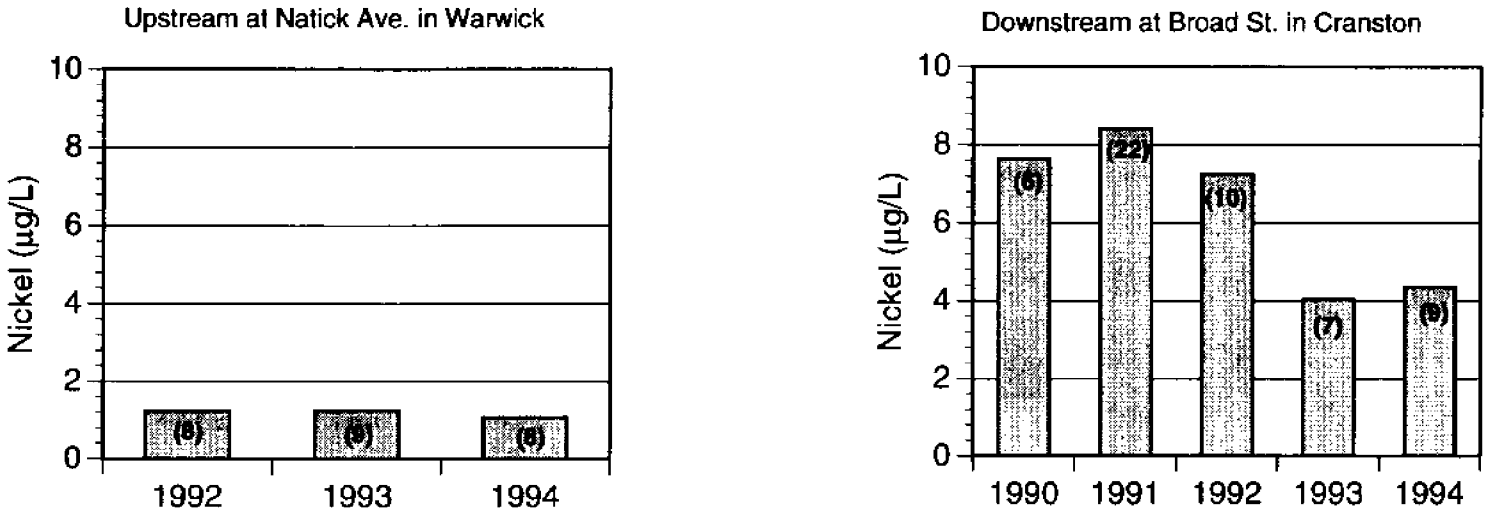



Figure 32. Average annual nickel concentrations on the Woonasquatucket and Moshassuck rivers are below the acute and chronic water quality criteria.

## Pawtuxet River




## Ten Mile River

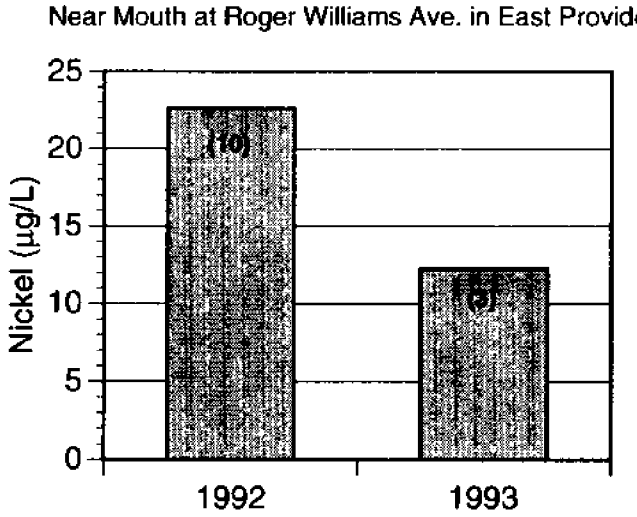



Figure 33. Average annual nickel concentrations increase at the lower Pawtuxet River station, but are below the acute and chronic water quality criteria. The Ten Mile River station had the highest nickel concentrations of all the River Rescue stations, but did not violate the water quality criteria.

## Blackstone River

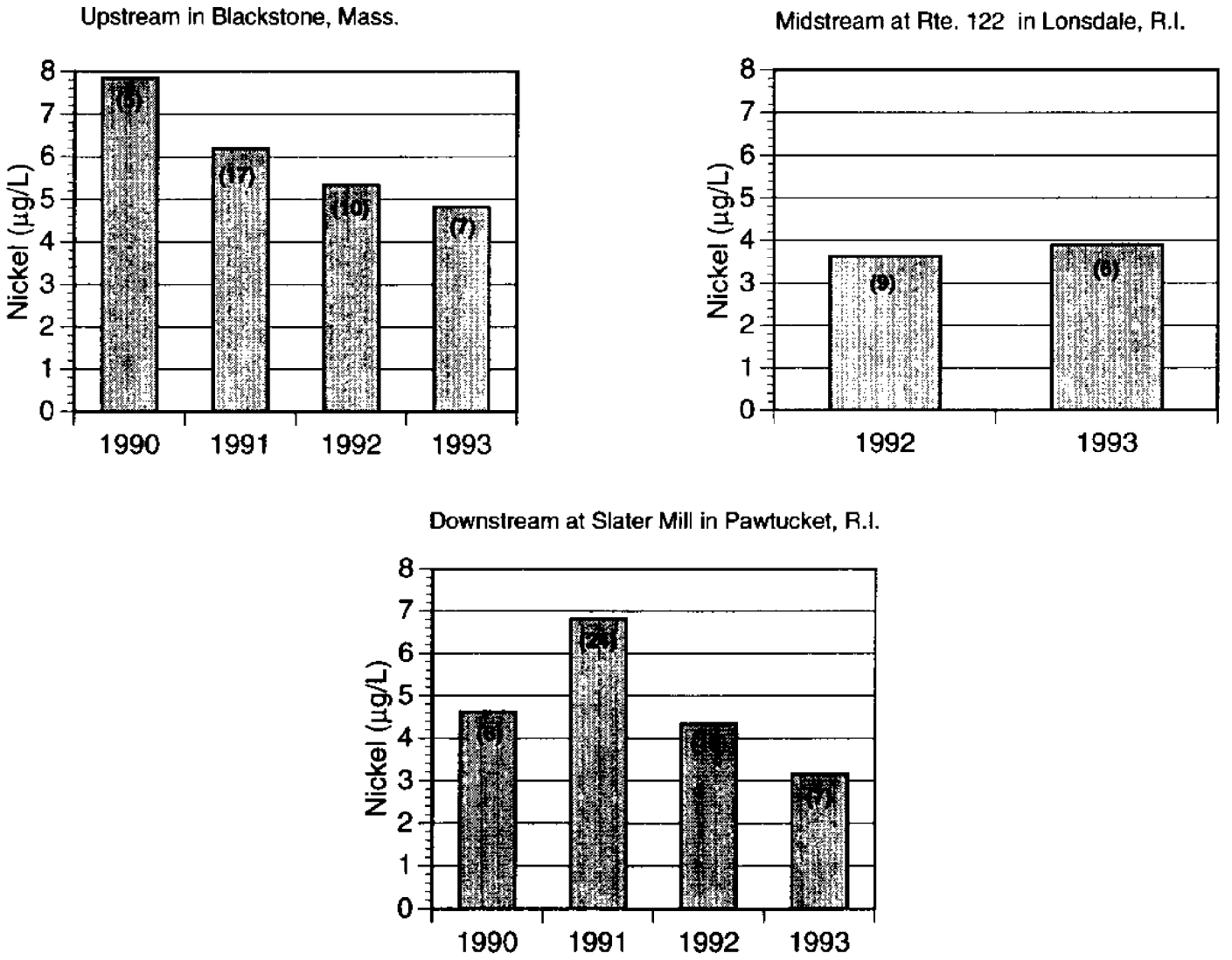



Figure 34. Average annual nickel concentrations on the Blackstone River are highest at the upstream station in Blackstone, Mass., decreasing at Lonsdale, and then increasing slightly at the mouth. Nickel concentrations were well below both the acute and chronic water quality criteria.

## CONCLUSIONS

- The River Rescue program used volunteers to create a comprehensive water quality database describing conditions in the rivers draining into Narragansett Bay. River Rescue data are more comprehensive than any other studies conducted on the rivers.
- The Woonasquatucket and Moshassuck Rivers flow through dense urban neighborhoods and have lost their natural condition. The rivers contain large quantities of debris, but River Rescue testing demonstrated that the chemical water quality of these rivers has improved dramatically over the last decade.
- The Pawtuxet River becomes significantly more polluted after receiving waste from the Warwick, West Warwick, and Cranston wastewater treatment plants. River Rescue data show increases of nitrogen, phosphorus, cadmium, chromium, copper, lead and nickel between the upper and lower Pawtuxet River stations. At it's mouth, the Pawtuxet River was the most polluted station sampled by River Rescue. When compared to historical data, the River Rescue data show improvements in cadmium, nickel, and phosphorus in the lower Pawtuxet River. Chromium and copper have changed little, while nitrogen and lead concentrations have increased.
- River Rescue data suggest that the quality of the Blackstone River has improved during the 1990s, especially for cadmium and nickel. Comparisons with historical data show decreases in chromium, cadmium, nickel, nitrogen, and phosporus while copper and lead have increased.

## RECOMMENDATIONS

- Water quality testing should continue on the Pawtuxet. Monitoring can be used to promote wastewater improvements and nonpoint source best management practices which are needed to improve the quality of the lower river.
- Intensive monitoring of all 10 River Rescue stations should be conducted periodically (perhaps for one year every five years) to document changes in water quality and detect problems.
- Efforts should be continued to promote community involvement in river monitoring and protection. Watershed associations should be encouraged for all five rivers to promote awareness, restoration, and public education.
- Data on pollutant concentrations when combined with discharge measurements, can be used to calculate pollutant loadings. It is important that the U. S. Geological Survey flow stations be maintained to assure accurate and regular measurements of discharge.

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## Appendix A

# River Rescue Volunteers 1990 - 1995

David Ahlquist
Bill Aldrich
Ray Alexander
Pat Antonelli
Patty Arden
Judith Armour
Jane Arsenault
Jill Arthrell
Michael Baris
Jonathan Barnes
Jim Beardwood
Lisa Begin
Donna Belmont
Cindy Benevides
Fred Bergemann
Mildred Bergemann
Evan Berube
Tom Bik
Judith Bland
David Bouchard
David Bowman
Edward Brassard
Mike Brillom
Bob Brown
Lorena Brown
Susan Brown
Brian Browne
Emily Burns
Brian Carroll
Sal Celeberto
Dennis Cesaro
Patricia Chamber
Patricia Chamberlain
Brenda Clement
Henry Cochran
Michael Conroy
Jeremy Cooper
Peter Cummings
Hugh Currie
Lyn Dazell
Gary Davis
Gena Di Bisio
Elaine Dickervitz
Eric Dickervitz
Carolyn Digby
Edmond Dubrevil
Steve Earl
Tom Eagan
Shawn Elwell

Bruce Evje
Olga Fino
Art Fluery
Robert Fluery
Melissa Fochler
Janice Fonseca
James Gallipeau
Richard Garrison
Cathie Gauvin
Michael Gerboli
Nancy Gronstrom
Kimberly Gold
Donald Gothburg
Jeff Hanna
Kurt Hanson
Michael Harpin
Jo Ann Harrington
Christine Herbert
Martha Hildebrandt
Mark Philip Holmes
Jasen M. Holt
Sharon Hudy
William Huntington
Jamal Kadri
Thomas Kean
Lisa Kent
Carolyn Knight
Marianne Knowles
Greg Kwiatkowsky
Alan Laflamme
Terry Lapierre
Charlotte Lawton
Thomas Leech
Peter Letoureau
Deena Liffmann
Steve MacIntyre
Eugenia Marks
David McElroy
Paul McElroy
Tom Mc Hugh
Jay Milgliaccio
Lisa Moniz
Roy Moquin
Bob Murphy
David Newton
Quincy Northup
Charles Obert
Bob Oberg
Ann O'Grady

Sean O'Leary
Jay Oliver
Jay Pafundi
Louise Parente
Jack Partridge
Nancy Peterson
Chris Petrarca
Lorine Petrarca
Ralph Petrarca
Pam Prescott
Ann Rajotte
Paula Rancourt
Jim Riordan
Brian Roy
Paula Roy
William Sabo
Ann Marie Saggerson
Michael Shalvey
Cynthia Shattuck
Christina Simao
Randy Souza
Mary Speare
Donna Spelman
John Stamp
Byron Steger
Tom Stevens
Mary K. Talbot
Carol Taylor
Pamela Toro
Charlie Valatka
Hank Vandersip
Phebe Vandersip
Allison Wald
Colleen Ware
Tim Warren
Doug Wilson
Greg Wolf
Lorrie Wright
Barbara Zuleger
Jimmy Zuleger
Robert Zuleger

# APPENDIX B

## River Rescue Data Tables

## Water Quality Parameters for River Rescue Stations

pH
Water and air temperature
Dissolved oxygen
TSS

## Woonasquatucket River at Rt. 44 in North Providence, RI
## Water Quality Parameters

| DATE | TIME | pH (su) | Water Temp. (C) | Air Temp (C) | First Diss. Oxy. (mg/l) | Second Diss. Oxy. (mg/l) | Average Diss. Oxy. (mg/l) | Diss. Oxy. Saturation (mg/l) | % SAT (%) | Total Susp. Solids (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1-Oct-90 | 13:00 | | 16 | 15 | 8.8 | 8.5 | 8.65 | 9.87 | 87.64 | |
| 15-Oct-90 | 6:00 | | 20.5 | 24 | 7.5 | 7.6 | 7.55 | 9.00 | 83.89 | |
| 29-Oct-90 | 6:30 | | 11 | 5 | 9.4 | 9.4 | 9.4 | 11.03 | 85.25 | |
| 13-Nov-90 | | | | | | | | | | |
| 26-Nov-90 | 6:30 | | 5 | 2 | 12.4 | 12.6 | 12.5 | 12.77 | 97.89 | |
| 10-Dec-90 | 6:30 | | 4 | 5 | 10.2 | 10.4 | 10.3 | 13.11 | 78.58 | |
| 7-Jan-91 | 11:00 | | 4 | 7.00 | 11.2 | 11.4 | 11.3 | 13.11 | 86.21 | |
| 21-Jan-91 | | | | | | | | | | |
| 3-Feb-91 | 16:00 | | 4 | 6.00 | 11.6 | 11.2 | 11.4 | 13.11 | 86.98 | |
| 19-Feb-91 | 15:00 | | 3 | 4 | 12.2 | 12.2 | 12.20 | 13.46 | 90.64 | |
| 3-Mar-91 | 15:00 | | 7 | 15 | 10.6 | 11 | 10.8 | 12.14 | 88.97 | |
| 17-Mar-91 | 9:00 | | 4 | 9 | 11.8 | 11.8 | 11.8 | 13.11 | 90.03 | |
| 31-Mar-91 | 8:00 | | 6 | 4 | 11.2 | 12 | 11.6 | 12.45 | 93.20 | |
| 14-Apr-91 | 8:00 | 6.95 | 9 | 6 | 9.7 | 9.4 | 9.5 | 11.56 | 82.19 | |
| 28-Apr-91 | 7:00 | | 12 | 9 | 9.4 | 9.2 | 9.3 | 10.78 | 86.29 | |
| 13-May-91 | 8:00 | | 16 | 21 | 8.4 | 8.6 | 8.5 | 9.87 | 86.12 | |
| 29-May-91 | 9:00 | | 22 | 24 | 7.2 | 7.2 | 7.2 | 8.74 | 82.34 | |
| 10-Jun-91 | 7:00 | | 18 | 14 | 6.95 | 6.85 | 6.9 | 9.47 | 72.88 | |
| 23-Jun-91 | 9:00 | | 20 | 22 | 7.6 | 7.6 | 7.6 | 9.09 | 83.59 | |
| 7-Jul-91 | 9:00 | | 19 | 21 | 6.6 | 6.4 | 6.5 | 9.28 | 70.07 | |
| 28-Jul-91 | 8:00 | | 21 | 18 | 6 | 6.1 | 6.05 | 8.92 | 67.86 | |
| 4-Aug-91 | 9:00 | | 20.5 | 19 | 5.6 | 5.8 | 5.7 | 9.00 | 63.31 | |
| 20-Aug-91 | 8:30 | | 22 | 19 | 7.4 | 7.6 | 7.5 | 8.74 | 85.78 | |
| 2-Sep-91 | | | | | | | | 14.62 | | |
| 15-Sep-91 | 10:00 | | 17.5 | 17 | 7.6 | 7.4 | 7.5 | 9.57 | 78.41 | |
| 30-Sep-91 | 9:00 | | 14 | 12 | 9.3 | 9.1 | 9.2 | 10.31 | 89.27 | |
| 16-Oct-91 | 9:30 | | 14 | 29 | 9.1 | 8.9 | 9.0 | 10.31 | 87.33 | |
| 27-Oct-91 | 8:30 | | 14 | 17.5 | 8.6 | 8.3 | 8.45 | 10.31 | 81.99 | |
| 13-Nov-91 | 8:00 | | 5 | 3 | 11.2 | 10.8 | 11.0 | 12.77 | 86.13 | |
| 25-Nov-91 | 8:00 | | 5.5 | 4 | 10.6 | 10.6 | 10.6 | 12.61 | 84.07 | |
| 10-Dec-91 | 14:00 | | 5 | 10 | 11.0 | 10.8 | 10.9 | 12.77 | 85.35 | |
| 12-Jan-92 | 12:00 | | 2 | -2 | 12.8 | 13.2 | 13 | 13.83 | 94.00 | |
| 9-Feb-92 | 12:00 | 6.60 | 2 | -3 | 11.2 | 11.2 | 11 | 13.83 | 80.98 | 2.90 |
| 9-Mar-92 | 9:00 | 6.70 | 5 | 6 | 11.2 | 11.2 | 11 | 12.77 | 87.70 | |
| 5-Apr-92 | 11:00 | 7.60 | 5 | 9 | 10.4 | 10.4 | 10 | 12.77 | 81.43 | 1.70 |
| 3-May-92 | 8:00 | 6.70 | 12 | 16 | 9.0 | 8.6 | 9 | 10.78 | 81.66 | 3.40 |
| 7-Jun-92 | 7:30 | 6.80 | 17 | 19 | 8.2 | 8.0 | 8 | 9.66 | 83.81 | nm |
| 12-Jul-92 | 8:00 | 6.83 | 20 | 22 | 6.5 | 6.5 | 6.5 | 9.09 | 71.49 | 1.00 |
| 10-Aug-92 | 8:00 | 6.60 | 17 | 16 | 5.6 | 5.6 | 5.6 | 9.66 | 57.94 | 2.80 |
| 6-Sep-92 | 8:00 | 6.70 | 17.5 | 17 | 6.5 | 6.4 | 6.5 | 9.57 | 67.43 | 0.10 |
| 4-Oct-92 | 8:00 | 6.80 | 14 | 10 | 7.4 | 7.2 | 7.3 | 10.31 | 70.83 | |
| 8-Nov-92 | 8:30 | 6.80 | 5 | -1 | 9.0 | 9.2 | 9.1 | 12.77 | 71.26 | 0.90 |
| 6-Dec-92 | 8:30 | 6.80 | 1 | -6 | 11.4 | 11.4 | 11.4 | 14.22 | 80.19 | 0.90 |
| 10-Jan-93 | 10:15 | 6.10 | 0 | -7 | 12.8 | | 12.8 | 14.62 | 87.55 | 1.40 |
| 7-Feb-93 | 10:00 | 7.70 | 0 | -12 | 12.8 | 13.6 | 13.2 | 14.62 | 90.28 | 1.20 |
| 8-Mar-93 | 9:00 | 6.00 | 3 | 5 | | | | | | 0.9 |
| 4-Apr-93 | 9:04 | 6.30 | 3 | 7 | | | | | | 0.8 |
| 9-May-93 | 10:00 | 6.50 | 15 | 20 | 8.2 | 8.2 | 8.20 | 10.08 | 81.32 | 3.44 |
| 6-Jun-93 | 8:30 | 6.60 | 15 | 10 | 7.9 | 7.7 | 7.80 | 10.08 | 77.35 | 0.6 |
| 11-Jul-93 | 10:00 | 6.35 | 24 | 27 | 4.6 | 4.6 | 4.6 | 8.42 | 54.64 | 1.7 |
| 14-Aug-93 | 10:00 | 6.50 | 21 | 23 | 5.6 | 5.4 | 5.5 | 8.92 | 61.69 | 0.5 |
| 14-Sep-93 | | | | | | | | 14.62 | 0.00 | |
| | | | | | | | | 14.62 | 0.00 | |
| 8-Nov-93 | 13:00 | 6.60 | 12 | 12 | 9.4 | 9 | 9.2 | 10.78 | 85.37 | |
| 13-Dec-93 | 13:00 | 6.70 | 8 | 5 | 11.8 | 11 | 11.4 | 11.84 | 96.26 | |
| 17-Jan-94 | 9:00 | 6.50 | 0 | -3 | 12.2 | 12.2 | 12.2 | 14.62 | 83.44 | |
| 6-Feb-94 | 11:30 | 6.50 | 1 | 6 | 12 | 12.6 | 12.3 | 14.22 | 86.52 | |
| 12-Mar-94 | 10:00 | 6.10 | 2 | 6 | 12.2 | 12.6 | 12.4 | 13.83 | 89.66 | |
| 10-Apr-94 | 11:30 | 6.50 | 8 | 18 | 10.4 | 10.4 | 10.4 | 11.84 | 87.81 | |
| Avg. 1990 | | | 11 | 10 | 9.7 | 9.7 | 9.7 | 11.15 | 86.65 | |
| Avg. 1991 | | 6.95 | 12 | 14 | 9.2 | 9.1 | 9.2 | 11.09 | 83.00 | |
| Avg. 1992 | | 6.81 | 10 | 8 | 9.1 | 9.1 | 9.1 | 11.60 | 77.39 | 1.71 |
| Avg. 1993 | | 6.54 | 10 | 9 | 9.1 | 8.5 | 9.1 | 11.86 | 63.45 | 1.32 |
| Avg. 1994 | | 6.40 | 3 | 7 | 11.7 | 12.0 | 11.8 | 13.63 | 86.86 | |
| Overall Avg. | | 6.65 | 11 | 11 | 9.4 | 9.3 | 9.4 | 11.53 | 78.76 | 1.52 |

## Woonasquatucket River at Valley St. in Providence, RI
## Water Quality Parameters

| DATE | TIME | pH (SU) | Water Temp. (C) | Air Temp. (C) | First Diss. Oxy. (mg/l) | Second Diss. Oxy. (mg/l) | Average Diss. Oxy. (mg/l) | Diss. Oxy. Saturation (mg/l) | % SAT (%) | Total Susp. Solids (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1-Oct-90 | 17:30 | | 18 | 16 | 7.6 | 7.8 | 7.7 | 9.47 | 81.34 | |
| 15-Oct-90 | 17:30 | | 19 | 21 | 8 | 8.2 | 8.1 | 9.28 | 87.32 | |
| 29-Oct-90 | 17:30 | | 9 | 5 | 10 | 10 | 10 | 11.56 | 86.51 | 7 |
| 13-Nov-90 | 17:30 | | 3 | 0 | 12 | 11.8 | 11.9 | 13.46 | 88.40 | 2.2 |
| 26-Nov-90 | 17:30 | | 7 | 6 | 11 | 11 | 11 | 12.14 | 90.62 | 0.5 |
| 12-Dec-90 | 17:00 | | 4 | 4 | | | | 13.11 | | |
| 6-Jan-91 | 12:30 | | 4 | 6 | 11.6 | 11.8 | 11.7 | 13.11 | 89.26 | 0.6 |
| 21-Jan-91 | 10:30 | | | -2 | 12.0 | 12.0 | 12.0 | 14.62 | | 2.9 |
| 3-Feb-91 | 13:30 | | 6 | 15 | 12.2 | 11.8 | 12.00 | 12.45 | 98.40 | 0.90 |
| 18-Feb-91 | 13:30 | | 3 | 2 | 15 | 15.2 | 15.10 | 13.46 | 112.17 | 1.4 |
| 3-Mar-91 | 13:30 | | 12 | 16 | 12.2 | 11.8 | 12 | 10.78 | 111.35 | 1.3 |
| 17-Mar-91 | 12:30 | | 8 | 12 | 11.4 | 11.2 | 11.3 | 11.84 | 95.41 | 1 |
| 1-Apr-91 | 17:15 | 6.95 | 8 | 4.5 | 9 | 10 | 9.5 | 11.84 | 80.21 | 1.3 |
| 14-Apr-91 | 12:30 | 6.95 | 13 | 12.8 | 11 | 11 | 11 | 10.54 | 104.40 | 1.2 |
| 28-Apr-91 | 12:45 | 6.90 | 11.5 | 12 | 11.2 | 11.4 | 11.3 | 10.90 | 103.66 | 2.2 |
| 12-May-91 | 12:30 | | 19 | 24 | 7.8 | 8.2 | 8 | 9.28 | 86.24 | |
| 27-May-91 | 12:30 | 7.10 | 24 | 26 | 8.6 | 8 | 8.3 | 8.42 | 98.60 | 0.2 |
| 10-Jun-91 | 17:15 | 7.15 | 24 | 28 | 7.9 | 7.5 | 7.7 | 8.42 | 91.47 | 1 |
| 23-Jun-91 | 11:15 | 7.15 | 21.5 | 19 | 7.4 | 8.2 | 7.8 | 8.83 | 88.35 | 0.8 |
| 8-Jul-91 | 17:30 | 7.10 | 24 | 31 | 8 | 8 | 8 | 8.42 | 95.03 | 1.4 |
| 21-Jul-91 | 11:05 | 7.15 | 27 | 34.5 | 7.6 | 7.6 | 7.6 | 7.97 | 95.38 | 0.9 |
| 4-Aug-91 | 10:30 | 7.10 | 24 | 20 | 8.5 | 8.6 | 8.55 | 8.42 | 101.57 | 1.8 |
| 18-Aug-91 | 10:30 | 7.30 | 25 | 29 | 8.5 | 8.5 | 8.5 | 8.26 | 102.86 | 0.2 |
| 2-Sep-91 | 17:00 | | 19 | 18 | 9.1 | 9.1 | 9.1 | 9.28 | 98.10 | |
| 15-Sep-91 | 12:45 | | 19 | 19 | 10.4 | 10.3 | 10.35 | 9.28 | 111.57 | 1.64 |
| 30-Sep-91 | 17:30 | | 15 | 12 | 12 | 12 | 12 | 10.08 | 119.00 | 1.95 |
| 13-Oct-91 | 12:30 | | 14 | 13 | 11.8 | 12 | 11.9 | 10.31 | 115.47 | 1.2 |
| 27-Oct-91 | 12:30 | | 17 | 21 | 12 | 11.8 | 11.9 | 9.66 | 123.13 | |
| 10-Nov-91 | 12:30 | | 6 | 4 | 13 | 13 | 13 | 12.45 | 104.43 | 32.85 |
| 24-Nov-91 | 16:15 | 7 | 9 | 9 | 13 | 13 | 13 | 11.56 | 112.46 | 3.27 |
| 12-Jan-92 | | | | | | | | | | 1.31 |
| 9-Feb-92 | 14:30 | 6.9 | 1 | -4 | 13 | 13 | 13 | 14.22 | 91.44 | 2.4 |
| 8-Mar-92 | 12:30 | 7.10 | 8 | 9.5 | 14.1 | 13.6 | 13.8 | 11.84 | 116.52 | |
| 4-Apr-92 | 10:15 | 7.10 | 7 | 6 | 13.8 | 13.75 | 13.775 | 12.14 | 113.47 | 1.7 |
| 3-May-92 | 12:30 | 7.20 | 16 | 18 | 11.5 | 11.6 | 11.55 | 9.87 | 117.02 | 2.7 |
| 6-Jun-92 | 11:00 | 6.70 | 18 | 16 | 9.4 | 9.4 | 9.4 | 9.47 | 99.29 | 15.8 |
| 12-Jul-92 | 9:30 | 7.10 | 24 | 24 | 8 | 8 | 8 | 8.42 | 95.03 | 1.3 |
| 10-Aug-92 | 10:45 | 7.20 | 20 | 24 | 10 | 10 | 10 | 9.09 | 109.98 | 1.6 |
| 6-Sep-92 | 9:45 | 7.10 | 16 | 14 | 9.6 | 9.4 | 9.5 | 9.87 | 96.25 | 0.3 |
| 4-Oct-92 | 12:30 | 7.00 | 16 | 16 | 9.2 | 9.2 | 9.2 | 9.87 | 93.21 | |
| 8-Nov-92 | 13:15 | 7.10 | 12 | 10 | 12.2 | 12.2 | 12.2 | 10.78 | 113.20 | 1.3 |
| 5-Dec-92 | 13:00 | 7.00 | 5.5 | 3 | 12.2 | 12.4 | 12.3 | 12.61 | 97.56 | 2.4 |
| 10-Jan-93 | 13:00 | 6.80 | 0 | -6 | 14.2 | 14 | 14.1 | 14.62 | 96.44 | 1.8 |
| 7-Feb-93 | 13:30 | 6.90 | -3 | -8 | 13.6 | 13.8 | 13.7 | 15.95 | 85.87 | 2.1 |
| 7-Mar-93 | 13:00 | 6.90 | 4 | 6 | 11.2 | 11 | 11.1 | 13.11 | 84.68 | 0.7 |
| 6-Apr-93 | 18:30 | 6.90 | | | 12.3 | 12.2 | 12.25 | | | 0.6 |
| 8-May-93 | 9:30 | 7.10 | 19 | 18 | 8.9 | 8.7 | 8.8 | 9.28 | 94.87 | 0.4 |
| 6-Jun-93 | 8:00 | 6.90 | 16 | 14 | 9 | 9.2 | 9.1 | 9.87 | 92.20 | 3.1 |
| 13-Jul-93 | 7:00 | 7.00 | 27 | 28.5 | 5.2 | 5.2 | 5.2 | 7.97 | 65.26 | 0.9 |
| 15-Aug-93 | 10:00 | 7.00 | 23 | 32 | 7.4 | 7.4 | 7.4 | 8.58 | 86.26 | 0.9 |
| 13-Sep-93 | 18:00 | 6.90 | 20 | 24 | 5.6 | 5.8 | 5.7 | 9.09 | 62.69 | |
| 12-Oct-93 | 18:30 | 7.10 | 12 | 13 | 10 | 10 | 10 | 10.78 | 92.79 | |
| 7-Nov-93 | 16:00 | 7.00 | 8 | 7 | 10.2 | 10.2 | 10.2 | 11.84 | 86.12 | |
| 12-Dec-93 | 12:00 | 6.80 | 15 | 0 | 11 | 10.9 | 10.95 | 10.08 | 108.59 | |
| 9-Jan-94 | 17:00 | 6.80 | 2 | -7 | 10.4 | 10.6 | 10.5 | 13.83 | 75.92 | |
| 13-Feb-94 | 13:00 | 6.90 | 2 | 5 | 13.7 | 13.8 | 13.75 | 13.83 | 99.42 | |
| 8-Mar-94 | 17:00 | 6.80 | 4 | 6 | 12 | 12.2 | 12.1 | 13.11 | 92.31 | |
| 5-Apr-94 | 13:30 | 6.90 | 13 | 16 | 11.2 | 11 | 11.1 | 10.54 | 105.35 | |
| 15-May-94 | 19:00 | 7.00 | 17 | 18 | 9.2 | 9.4 | 9.3 | 9.66 | 96.22 | |
| 16-Jun-94 | 14:30 | 6.90 | 19 | 21 | 8.9 | 9 | 8.95 | 9.28 | 96.48 | |
| 9-Jul-94 | 1700 | 7.00 | 27 | 33.5 | 5.8 | 5.6 | 5.7 | 7.97 | 71.53 | |
| 6-Aug-94 | 17:00 | 7.10 | 23.5 | 28.5 | 6 | 6 | 6 | 8.50 | 70.61 | |
| 10-Sep-94 | 13:00 | 7.10 | 20 | 24 | 8.8 | 8.6 | 8.7 | 9.09 | 95.68 | |
| 6-Nov-94 | 14:15 | 7.10 | 14 | 20 | 9.4 | 9.6 | 9.5 | 10.31 | 92.18 | |
| Avg. 1990 | | | 10 | 9 | 9.7 | 9.8 | 9.7 | 11.50 | 86.84 | 3.2 |
| Avg. 1991 | | 7.08 | 15 | 16 | 10.5 | 10.5 | 10.5 | 10.42 | 101.59 | 2.9 |
| Avg. 1992 | | 7.05 | 13 | 12 | 11.2 | 11.1 | 11.2 | 10.74 | 103.91 | 3.1 |
| Avg. 1993 | | 6.94 | 13 | 12 | 9.9 | 9.9 | 9.9 | 11.02 | 86.89 | 1.3 |
| Avg. 1994 | | 6.96 | 14 | 17 | 9.5 | 9.6 | 9.6 | 10.61 | 89.57 | |
| Overall Avg. | | 7.01 | 14 | 14 | 10.3 | 10.3 | 10.3 | 10.72 | 96.09 | 2.6 |

## Pawtuxet River at Natick (East) Ave. in Warwick, RI
## Water Quality Parameters

| DATE | TIME | pH (SU) | Water Temp. (C) | Air Temp. (C) | First Diss. Oxy. (mg/l) | Second Diss. Oxy. (mg/l) | Average Diss. Oxy. (mg/l) | Diss. Oxy. Saturation (mg/l) | % SAT % | Total Susp. Solids (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| 8-Feb-92 | 13:15 | 6.8 | 3 | 9 | 12.4 | 12.8 | 12.6 | 13.46 | 93.60 | 0.84 |
| 9-Mar-92 | 12:00 | 6.75 | 7 | 5 | 14.2 | 14.3 | 14.25 | 12.14 | 117.39 | |
| 4-Apr-92 | 9:00 | 6.8 | 6 | 5 | 11.8 | 11.8 | 11.8 | 12.45 | 94.79 | 1.4 |
| 4-May-92 | 9:00 | 6.95 | 13 | 15 | 9.2 | 9.2 | 9.2 | 10.54 | 87.31 | 2.5 |
| 7-Jun-92 | 9:00 | 6.7 | 24 | 25 | 9.2 | 9.2 | 9.2 | 8.42 | 109.29 | |
| 10-Jul-92 | 10:00 | 7.05 | 24 | 31 | 7.8 | 7.6 | 7.4 | 8.42 | 87.90 | 1.5 |
| 8-Aug-92 | 9:00 | 7 | 23 | 24 | 8 | 8.2 | 8.1 | 8.58 | 94.43 | 3 |
| 7-Sep-92 | 9:00 | 7 | 20 | 19 | 8.9 | 9 | 8.95 | 9.09 | 98.43 | 1.5 |
| 6-Oct-92 | 9:00 | 7.1 | 11 | 7 | 9.6 | 9.4 | 9.5 | 11.03 | 86.15 | |
| 7-Nov-92 | 13:00 | 6.9 | 9 | 6 | 10.4 | 10.4 | 10.4 | 11.56 | 89.97 | 1.2 |
| 7-Dec-92 | 10:45 | 6.75 | 3 | 4 | 11.4 | 11.4 | 11.4 | 13.46 | 84.69 | 1.2 |
| 10-Jan-93 | | | | | | | | | | 2 |
| 8-Feb-93 | 15:30 | 6.8 | 0 | 5 | 11.6 | 12.2 | 11.9 | 14.62 | 81.39 | 0.5 |
| 8-Mar-93 | 12:00 | 6.7 | 5 | 9 | 12.2 | 12 | 12.1 | 12.77 | 94.75 | 0.6 |
| 6-Apr-93 | 9:45 | 6.5 | 5 | 8 | 12 | 11.8 | 12 | 12.77 | 93.96 | 2.4 |
| 10-May-93 | | | | | | | | | | |
| 7-Jun-93 | 9:00 | 7 | 16 | 16 | | | | 9.87 | | 1.5 |
| 14-Jul-93 | 9:00 | 7 | 25 | 26 | 7.2 | 7.3 | 7.25 | | | 1.5 |
| 16-Aug-93 | 9:00 | 7 | 24 | 23 | 7.8 | 7.9 | 7.85 | 8.42 | 93.25 | 3.3 |
| 13-Sep-93 | 9:00 | 7 | 20 | 20 | 8.5 | 8.6 | 8.55 | 9.09 | 94.03 | |
| 6-Nov-93 | 1600 | | 8.5 | 13 | | | | 11.70 | | |
| 6-Dec-93 | 1510 | | 8 | 17 | 11.5 | | 11.5 | 11.84 | 97.10 | |
| 23-Jan-94 | 13:15 | 6.9 | 2 | -3 | 15 | 15.1 | 15.05 | 13.83 | 108.82 | |
| 6-Feb-94 | 16:50 | 6.9 | 2.5 | 7 | 14.8 | 14.6 | 14.7 | 13.64 | 107.74 | |
| 13-Mar-94 | 17:16 | 6.8 | 4 | 10 | 15 | 14.5 | 14.75 | 13.11 | 112.52 | |
| 8-May-94 | 800 | | 14 | 15 | 10 | 9.6 | 9.8 | 10.31 | 95.09 | |
| 12-Jun-94 | 1400 | 7 | 21 | 23 | 7 | 7.6 | 7.3 | 8.92 | 81.88 | |
| Avg. 1992 | | 6.9 | 13.0 | 13.6 | 10.3 | 10.3 | 10.3 | 10.8 | 94.9 | 1.6 |
| Avg. 1993 | | 6.9 | 12.4 | 15.2 | 10.1 | 10.0 | 10.2 | 11.4 | 92.4 | 1.7 |
| Avg. 1994 | | 6.9 | 8.7 | 10.4 | 12.4 | 12.3 | 12.3 | 12.0 | 101.2 | |
| Overall Avg. | | 6.9 | 11.9 | 13.6 | 10.7 | 10.7 | 10.7 | 11.3 | 95.7 | 1.7 |

## Pawtuxet River at Broad St. in Cranston
## Water Quality Parameters

| DATE | TIME | pH (SU) | Water Temp. (C) | Air Temp. (C) | First Diss. Oxy. (mg/l) | Second Diss. Oxy. (mg/l) | Average Diss. Oxy. (mg/l) | Diss. Oxy. Saturation (mg/l) | % SAT % | Total Susp. Solids (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1-Oct-90 | 13:15 | | 20 | 24 | 2.6 | 2.9 | 2.7 | 9.09 | 30.0 | |
| 15-Oct-90 | 9:30 | 6.6 | 20 | 16 | 4.2 | 4.6 | 4.4 | 9.09 | 48.4 | |
| 29-Oct-90 | 9:30 | 6.3 | 9 | 6.5 | 6.1 | 5.9 | 6.0 | 11.56 | 51.9 | 3.5 |
| 13-Nov-90 | 14:00 | | 6 | 2.5 | 10.6 | 10.0 | 10.3 | 12.45 | 82.8 | 3.8 |
| 26-Nov-90 | 9:00 | 6.6 | 7.5 | 5 | 8.6 | 8.8 | 8.7 | 11.99 | 72.6 | 1.3 |
| 10-Dec-90 | 9:30 | 6.75 | 6 | 6 | 10.3 | 10.6 | 10.5 | 12.45 | 84.0 | 3.8 |
| 6-Jan-91 | 2:00 | 6.7 | 4.5 | 5 | 12.0 | 12.0 | 12.0 | 12.94 | 92.7 | 2.8 |
| 21-Jan-91 | 10:00 | 6.7 | 3 | -1 | 12.4 | 12.2 | 12.3 | 13.46 | 91.4 | 2.3 |
| 3-Feb-91 | 13:00 | 6.7 | 5 | 14 | 11.9 | 12.1 | 12.0 | 12.77 | 94.0 | 1.8 |
| 18-Feb-91 | 13:00 | 6.75 | 3 | 2 | 12.6 | 12.6 | 12.6 | 13.46 | 93.6 | 2.1 |
| 3-Mar-91 | 13:15 | 6.7 | 11 | 16 | 9.8 | 9.7 | 9.8 | 11.03 | 88.4 | 3.7 |
| 18-Mar-91 | 16:30 | | 7 | 8 | 11.4 | 11.2 | 11.3 | 12.14 | 93.1 | 2.5 |
| 1-Apr-91 | 16:30 | 6.7 | 8 | 8 | 11.2 | 11.1 | 11.2 | 11.84 | 94.1 | 2.6 |
| 15-Apr-91 | 16:15 | 6.7 | 11 | 11 | 9.4 | 9.3 | 9.4 | 11.03 | 84.8 | 1.6 |
| 29-Apr-91 | 16:20 | 6.7 | 15 | 16 | 9.0 | 9.1 | 9.1 | 10.08 | 89.7 | 7.7 |
| 13-May-91 | 16:15 | 6.6 | 20 | 21 | 7.4 | 7.4 | 7.4 | 9.09 | 81.4 | 5.8 |
| 28-May-91 | | | | | | | | | | 2.8 |
| 10-Jun-91 | 16:00 | 6.8 | 22 | 27 | 4.6 | 4.4 | 4.5 | 8.74 | 51.5 | 4.3 |
| 24-Jun-91 | 16:10 | 6.6 | 22 | 27 | 3.8 | 3.6 | 3.7 | 8.74 | 42.3 | 1.2 |
| 10-Jul-91 | 1600 | 6.7 | 24 | 29 | 3.2 | 3.0 | 3.1 | 8.42 | 36.8 | 0.2 |
| 21-Jul-91 | 1410 | 6.8 | 27 | 28 | 2.9 | 2.8 | 2.9 | 7.97 | 35.8 | 0.5 |
| 5-Aug-91 | 16:10 | 6.9 | 23 | 25 | 3.7 | 3.7 | 3.7 | 8.58 | 43.1 | 0.5 |
| 18-Aug-91 | | | | | | | | | | 2.4 |
| 3-Sep-91 | 10:00 | | 21 | 24 | 2.9 | 3.0 | 2.9 | 8.92 | 32.5 | 2.3 |
| 14-Sep-91 | | | | | | | | | | 2.2 |
| 19-Sep-91 | | | | | | | | | | |
| 1-Oct-91 | 16:00 | | 16 | 20 | 4.0 | 4.2 | 4.1 | 9.87 | 41.6 | 1.4 |
| 15-Oct-91 | 4:00 | | 15 | 16 | 3.7 | 3.6 | 3.7 | 10.08 | 36.2 | 1.9 |
| 27-Oct-91 | 12:00p | | 16 | 25 | 1.9 | 1.9 | 1.9 | 9.47 | 19.8 | 1.7 |
| 12-Nov-91 | 4:00 | 6.6 | 7 | 5 | 9.6 | 9.9 | 9.8 | 12.14 | 80.3 | 22.1 |
| 26-Nov-91 | 6:00a | 6.5 | 6 | 2 | 8.8 | 8.7 | 8.8 | 12.45 | 70.3 | 3.0 |
| 10-Dec-91 | 4:15p | 6.7 | 7 | 3 | 7.8 | 8.0 | 7.9 | 12.14 | 65.1 | 1.9 |
| 31-Dec-91 | 2:15p | | 3 | 2 | 9.7 | 9.8 | 9.8 | 13.46 | 72.4 | |
| 8-Feb-92 | 12:00 | 6.7 | 4 | 1 | 11.2 | 11.4 | 11.3 | 13.11 | 86.2 | 1.7 |
| 8-Mar-92 | 12:00 | 6.7 | 8 | 11 | 11.0 | 11.0 | 11.0 | 11.84 | 92.9 | |
| 6-Apr-92 | 16:00 | 6.3 | 10 | 15 | 11.0 | 11.0 | 11.0 | 11.29 | 97.4 | 5.3 |
| 3-May-92 | | | | | | | | | | |
| 6-Jun-92 | 14:30 | 6.7 | 20 | 25 | 6.2 | 6.7 | 6.5 | 9.09 | 70.9 | 9.8 |
| 11-Jul-92 | 10:00 | 6.7 | 25 | 28 | 2.0 | 1.8 | 1.9 | 8.26 | 23.0 | 3.9 |
| 10-Aug-92 | 12:00 | 6.6 | 21 | 25 | 2.8 | 3.1 | 3.0 | 8.92 | 33.1 | 5.6 |
| 6-Sep-92 | 11:00 | 6.5 | 19 | 21 | 1.8 | 1.8 | 1.8 | 9.28 | 19.4 | 0.7 |
| 3-Oct-92 | 12:00 | 6.7 | 17 | 24 | 3.2 | 3.2 | 3.2 | 9.66 | 33.1 | |
| 8-Nov-92 | 14:00 | 6.6 | 7 | 4 | 4.2 | 4.4 | 4.3 | 12.14 | 35.4 | 1.1 |
| 6-Dec-92 | 12:30 | 6.7 | 2 | 0 | 10.0 | 9.6 | 9.8 | 13.83 | 70.9 | 4.1 |
| 10-Jan-93 | 13:00 | 6.7 | 1 | -4 | 12.1 | 12.2 | 12.2 | 14.22 | 85.5 | 2.2 |
| 5-Feb-93 | 13:00 | 6.7 | 0 | -11 | 11.3 | 10.8 | 11.1 | 14.62 | 75.6 | 5.6 |
| 5-Mar-93 | 11:00 | 6.7 | 4 | 5 | 12.2 | 12.5 | 12.4 | 13.11 | 94.2 | 0.8 |
| 3-Apr-93 | 13:30 | 6.4 | 5 | 6 | 11.8 | 12.2 | 12.0 | 12.77 | 94.0 | 5.5 |
| 2-May-93 | 11:15 | 6.5 | 15 | 24 | 8.2 | 8.4 | 8.3 | 10.08 | 82.3 | 3.2 |
| 5-Jun-93 | 12:00 | 6.7 | 17 | 26 | 5.4 | 5.4 | 5.4 | 9.66 | 55.9 | 4.7 |
| 10-Jul-93 | 10:30 | 6.65 | 28 | 36 | 2.0 | 2.3 | 2.2 | 7.83 | 27.5 | 1.6 |
| 8-Aug-93 | 10:00 | 6.5 | 23 | 26 | 1.6 | 1.8 | 1.7 | 8.58 | 19.8 | 0.4 |
| 12-Sep-93 | 10:00 | 6.4 | 20 | 21 | 1.8 | 2.0 | 1.9 | 9.09 | 20.9 | |
| 3-Oct-93 | 12:00 | 6.65 | 16 | 14 | 2.0 | 2.2 | 2.1 | 9.87 | 21.3 | |
| 7-Nov-93 | 11:00 | 6.6 | 10 | 7 | 3.0 | 3.2 | 3.1 | 11.29 | 27.5 | |
| | | | | | | | | | | |
| 16-Jan-94 | 11:00 | 6.7 | 0 | -16 | 12.0 | 12.0 | 12.0 | 14.62 | 82.1 | |
| 6-Feb-94 | 12:00 | 6.65 | 5 | 5 | 12.5 | 13.0 | 12.8 | 12.77 | 99.8 | |
| 13-Mar-94 | 12:00 | 6.6 | 7 | 12 | 12.6 | 13.0 | 12.8 | 12.14 | 105.4 | |
| 10-Apr-94 | 12:00 | 6.75 | 12 | 15 | 9.8 | 9.9 | 9.9 | 10.78 | 91.4 | |
| 8-May-94 | 12:00 | 6.7 | 16 | 17 | 7.4 | 7.8 | 7.6 | 9.87 | 77.0 | |
| 12-Jun-94 | 12:00 | 6.8 | 21 | 22 | 3.6 | 3.2 | 3.4 | 8.92 | 38.1 | |
| 10-Jul-94 | 17:00 | 6.7 | 27 | 27 | 3.6 | 3.6 | 3.6 | 7.97 | 45.2 | |
| 8-Aug-94 | 1720 | 6.8 | 23 | 25 | 4.8 | 4.3 | 4.6 | 8.58 | 53.0 | |
| 10-Sep-94 | 11:00 | 6.6 | 21 | 17 | 2.0 | 2.2 | 2.1 | 8.92 | 23.6 | |
| Avg. 1990 | | 6.6 | 11 | 10 | 7.1 | 7.1 | 7.1 | 11.1 | 61.6 | 3.1 |
| Avg. 1991 | | 6.7 | 13 | 14 | 7.6 | 7.5 | 7.5 | 10.8 | 66.6 | 3.2 |
| Avg. 1992 | | 6.6 | 13 | 15 | 6.3 | 6.4 | 6.4 | 10.7 | 56.2 | 4.0 |
| Avg. 1993 | | 6.6 | 13 | 14 | 6.5 | 6.6 | 6.6 | 11.0 | 54.9 | 3.0 |
| Avg. 1994 | | 6.7 | 15 | 14 | 7.6 | 7.7 | 7.6 | 10.5 | 68.4 | |
| Overall Avg. | | 6.6 | 13 | 14 | 7.1 | 7.2 | 7.1 | 10.8 | 62.4 | 3.3 |

## Moshassuck River at Charles St. in Providence, RI
## Water Quality Parameters

| DATE | TIME | pH (su) | Water Temp. (C) | Air Temp (C) | First Diss. Oxy. (mg/l) | Second Diss. Oxy. (mg/l) | Average Diss. Oxy. (mg/l) | Diss. Oxy. Saturation (mg/l) | % SAT (%) | Total Susp. Solic (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1-Oct-90 | 8:00 | | 15 | 12.5 | 6.4 | 6.2 | 6.3 | 10.08 | 62.48 | |
| 15-Oct-90 | 7:34 | | 18 | 16 | 8.6 | 8 | 8.3 | 9.47 | 87.67 | |
| 29-Oct-90 | 8:00 | | 8 | 7 | 9.4 | 9.2 | 9.3 | 11.84 | 78.53 | 1.25 |
| 13-Nov-90 | 7:25 | | 5 | -4 | 11.1 | 11.5 | 11.3 | 12.77 | 88.48 | 2 |
| 26-Nov-90 | 7:30 | | 6 | 5 | 11 | 10.8 | 10.9 | 12.45 | 87.56 | |
| 10-Dec-90 | 7:30 | | 4 | 6 | 12 | 11.2 | 11.6 | 13.11 | 88.49 | |
| 7-Jan-91 | 7:25 | | 6 | 0 | 11.8 | 11.2 | 11.5 | 12.45 | 92.38 | 2.25 |
| 23-Jan-91 | 7:05 | | 0 | -14 | 8.6 | 8.8 | 8.7 | 14.62 | 59.50 | 2.4 |
| 4-Feb-91 | 7:30 | | 7 | 5 | 11.2 | 11.2 | 11.2 | 12.14 | 92.26 | 1.3 |
| 19-Feb-91 | 7:30 | | 4 | 2 | 11.8 | 12 | 11.9 | 13.11 | 90.78 | 6.8 |
| 4-Mar-91 | 7:30 | | 6 | 5 | 11.2 | 11 | 11.1 | 12.45 | 89.17 | 2.1 |
| 18-Mar-91 | 7:30 | 7.05 | 5 | 5 | 12.4 | 12 | 12.2 | 12.77 | 95.53 | 2.2 |
| 1-Apr-91 | 11:30 | 7.20 | 4 | 7 | 10.4 | 10.8 | 10.6 | 13.11 | 80.86 | 2.6 |
| 15-Apr-91 | 7:30 | 7.05 | 10 | 4 | 9.6 | 9.6 | 9.6 | 11.29 | 85.05 | 2.2 |
| 29-Apr-91 | 7:30 | 7.05 | 16 | 8 | 9 | 9 | 9 | 9.87 | 91.18 | 3 |
| 13-May-91 | 7:25 | 7.20 | 16 | 18 | 7.7 | 7.5 | 7.6 | 9.87 | 77.00 | 1.7 |
| 28-May-91 | 7:45 | 7.15 | 18 | 19 | 7 | 6.8 | 6.9 | 9.47 | 72.88 | 11.1 |
| 10-Jun-91 | 7:30 | 7.10 | 17 | 16 | 7 | 7 | 7 | 9.66 | 72.43 | 2.2 |
| 24-Jun-91 | 7:30 | 7.15 | 15 | 15 | 7.7 | 7.1 | 7.4 | 10.08 | 73.38 | 1.5 |
| 8-Jul-91 | 7:25 | 7.30 | 18 | 20 | 6.2 | 6 | 6.1 | 9.47 | 64.43 | 2.2 |
| 22-Jul-91 | 7:30 | 7.40 | 21 | 25 | 6 | 5.8 | 5.9 | 8.92 | 66.18 | 1.9 |
| 5-Aug-91 | 7:30 | 7.25 | 19 | 18 | 7.2 | 6.8 | 7 | 9.28 | 75.46 | 2.2 |
| 20-Aug-91 | 7:30 | 7.50 | 20 | 17 | 6.8 | 6.6 | 6.7 | 9.09 | 73.69 | 1.4 |
| 3-Sep-91 | 7:40 | | 15 | 19 | 8.1 | 8.4 | 8.25 | 10.08 | 81.81 | 1.82 |
| 16-Sep-91 | 7:40 | | 22 | 16 | 5.8 | 6.1 | 5.95 | 8.74 | 68.05 | 2.82 |
| 30-Sep-91 | 7:30 | | 12 | 8 | 8.8 | 9.2 | 9 | 10.78 | 83.51 | 2.73 |
| 15-Oct-91 | | | 10 | 5 | 7.9 | 7.9 | 7.9 | 11.29 | 69.99 | 1.19 |
| 28-Oct-91 | 7:20 | | 14 | 8 | 7 | 7.2 | 7.1 | 10.31 | 68.89 | |
| 11-Nov-91 | 9:00 | 6.80 | 7 | 3 | 9.8 | 9.7 | 9.75 | 12.14 | 80.32 | 28.27 |
| 25-Nov-91 | 7:36 | | 7 | 2 | 10.4 | 10 | 10.2 | 12.14 | 84.03 | |
| 9-Dec-91 | 7:30 | | 6 | 11 | 10.6 | 10.2 | 10.4 | 12.45 | 83.55 | |
| 30-Dec-91 | 7:40 | | 4 | 1 | 11.1 | 11 | 11.05 | 13.11 | 84.30 | |
| 12-Jan-92 | | 6.90 | | | | | | | | 1.85 |
| 8-Feb-92 | 9:00 | 7.10 | 6 | -1 | 11 | 11.2 | 11.1 | 12.45 | 89.17 | 1.1 |
| 7-Mar-92 | 9:00 | 7.00 | 5 | 3 | 10.4 | 10.6 | 10.5 | 12.77 | 82.22 | |
| 4-Apr-92 | 8:30 | 7.15 | 6 | 5 | 11.4 | 11.6 | 11.5 | 12.45 | 92.38 | 2.1 |
| 2-May-92 | 8:30 | 7.10 | 8 | 13 | 8.4 | 8.6 | 8.5 | 11.84 | 71.77 | 5.8 |
| 6-Jun-92 | 10:30 | 6.95 | 18 | 19 | 7.6 | 7.6 | 7.6 | 9.47 | 80.28 | 9.7 |
| 11-Jul-92 | 8:20 | 7.20 | 20 | 24 | 6.9 | 7.1 | 7 | 9.09 | 76.99 | 10.1 |
| 10-Aug-92 | | 7.20 | 18 | 20 | 7.7 | 7.5 | 7.6 | 9.47 | 80.28 | 7.7 |
| 1-Sep-92 | | | | | | | | | | |
| 4-Oct-92 | 9:25 | 7.35 | 14 | 12 | 9 | 8.8 | 8.9 | 10.31 | 86.36 | 1.4 |
| 7-Nov-92 | 11:00 | 7.1 | 8 | 3 | 10.4 | 10 | 10.2 | 11.84 | 86.12 | |
| 5-Dec-92 | 8:30 | 7.10 | 5 | 1 | 10.8 | 10.9 | 10.85 | 12.77 | 84.96 | 1.8 |
| 9-Jan-93 | 8:30 | 7.20 | 2 | -3 | 12.2 | 12.4 | 12.3 | 13.83 | 88.94 | 1.4 |
| 6-Feb-93 | 10:45 | 7.10 | 0 | -12 | 12 | 11.6 | 11.8 | 14.62 | 80.71 | 1.4 |
| 6-Mar-93 | 9:00 | 7.10 | 2 | -6 | 11.5 | 12 | 11.75 | 13.83 | 84.96 | 0.9 |
| 4-Apr-93 | 14:30 | 7.10 | 6 | 7 | 10 | 10.2 | 10.1 | 12.45 | 81.14 | 2.5 |
| 8-May-93 | | | | | | | | | | |
| 5-Jun-93 | | | | | | | | | | |
| 10-Jul-93 | 8:30 | 7.10 | 21 | 26 | 6 | 6.1 | 6.05 | 8.92 | 67.86 | |
| 13-Aug-93 | 8:30 | 7 | 20 | 21 | 5.8 | 6.4 | 6.1 | 9.09 | 67.09 | |
| 18-Sep-93 | 8:30 | 6.85 | 15 | 13 | 7.4 | 7.2 | 7.3 | 10.08 | 72.39 | |
| | | | | | | | | | | |
| 6-Nov-93 | 8:45 | 7.00 | 10 | 11 | 8 | 8.2 | 8.1 | 11.29 | 71.76 | |
| 13-Dec-93 | 8:45 | 6.90 | 8 | 9 | 9.9 | 10.3 | 10.1 | 11.84 | 85.28 | |
| 9-Jan-94 | 14:30 | 7.00 | -1 | -4 | 13.1 | 13.5 | 13.3 | 15.04 | 88.40 | |
| 5-Feb-94 | 15:30 | 7.00 | 2 | 6 | 12.6 | 12.4 | 12.5 | 13.83 | 90.38 | |
| 12-Mar-94 | 8:50 | 6.90 | -2 | -4 | 14.8 | 14.4 | 14.6 | 15.49 | 94.26 | |
| | | | | | | | | | | |
| 14-May-94 | 830 | 7.20 | 10 | 11 | 9.8 | 10 | 9.9 | 11.29 | 87.70 | |
| 4-Jun-94 | 900 | 7.20 | 11 | 18 | 8.8 | 8.6 | 8.7 | 11.03 | 78.90 | |
| 23-Jul-94 | 910 | 7.30 | 23 | 26 | 8 | 7.8 | 7.8 | 8.58 | 90.93 | |
| | | | | | | | | | | |
| Avg. 1990 | | | 15.00 | 12.50 | 6.40 | 6.20 | 6.30 | 10.08 | 62.48 | |
| Avg. 1991 | | 7.17 | 11.50 | 9.35 | 8.89 | 8.80 | 8.85 | 11.10 | 79.10 | 3.90 |
| Avg. 1992 | | 7.10 | 10.80 | 9.90 | 9.36 | 9.39 | 9.38 | 11.25 | 83.05 | 4.62 |
| Avg. 1993 | | 7.04 | 9.33 | 7.33 | 9.20 | 9.38 | 9.29 | 11.77 | 77.79 | 1.55 |
| Avg. 1994 | | 7.10 | 7.17 | 8.83 | 11.18 | 11.08 | 11.13 | 12.54 | 88.43 | |
| Overall Avg. | | 7.11 | 10.35 | 8.83 | 9.35 | 9.31 | 9.33 | 11.44 | 80.90 | 3.70 |

# Moshassuck River at Bonanza Bus Station in Providence, RI
## Water Quality Parameters

| DATE | TIME | pH (SU) | Water Temp. (C) | Air Temp. (C) | First Diss. Oxy. (mg/l) | Second Diss. Oxy. (mg/l) | Average Diss. Oxy. (mg/l) | Diss. Oxy. Saturation (mg/l) | % SAT % | Total Susp. Solids (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10-Feb-92 | 15:00 | 6.9 | 0.05 | -2 | 11.2 | 10.6 | 10.9 | 14.60 | 74.66 | 3.1 |
| 16-Mar-92 | 13:00 | 7 | 5 | 3 | 11.2 | 11 | 11.1 | 12.77 | 86.92 | 1.9 |
| 5-Apr-92 | 11:00 | 7 | 9 | 10 | 10 | 10 | 10 | 11.56 | 86.51 | 2.7 |
| 3-May-92 | 11:58 | 7.1 | 17 | 24 | 7.6 | 7.8 | 7.7 | 9.66 | 79.67 | 7.5 |
| 8-Jun-92 | 11:00 | 7 | 21 | 31 | 6 | 5.8 | 5.9 | 8.92 | 66.18 | 1.3 |
| 11-Jul-92 | 12:20 | 6.9 | 25 | 35 | 5.6 | 5.2 | 5.4 | 8.26 | 65.35 | 6.2 |
| 1-Aug-92 | | | | | | | | | | |
| 6-Sep-92 | 14:00 | 6.9 | 23 | 29 | 6 | 5.8 | 5.9 | 8.58 | 68.78 | 12.6 |
| 13-Oct-92 | 18:40 | 7 | 21 | 12 | 6.6 | 6.8 | 6.7 | 8.92 | 75.15 | 8.6 |
| 9-Nov-92 | 13:00 | 6.9 | 15 | 11 | 7.6 | 6.8 | 7.2 | 10.08 | 71.40 | 5.1 |
| 6-Dec-92 | 12:20 | 7 | 8 | 10 | 10.4 | 10.4 | 10.4 | 11.84 | 87.81 | 7.6 |
| 12-Jan-93 | | 6.9 | 5 | 1 | 11 | 10.4 | 10.7 | 12.77 | 83.78 | 2.2 |
| 5-Feb-93 | 15:30 | 6.9 | 8 | 9 | 10 | 10 | 10 | 11.84 | 84.44 | 1.8 |
| 7-Mar-93 | 15:30 | 6.9 | 8 | 18 | 10.4 | 10 | 10.2 | 11.84 | 86.12 | 10.4 |
| 5-Apr-93 | 18:00 | 7 | 10 | 19 | 10 | 9.6 | 9.8 | 11.29 | 86.82 | 6 |
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| 4-Dec-93 | 9:00 | 7 | 6.5 | 9 | 10.8 | 11 | 10.9 | 12.29 | 88.68 | |
| 7-Jan-94 | 13:32 | 6.9 | 2 | 4.5 | 10.6 | 10.2 | 10.4 | 13.83 | 75.20 | |
| 6-Feb-94 | 12:34 | 6.9 | 1.5 | 2.5 | 10.8 | 10.4 | 10.6 | 14.02 | 75.60 | |
| 12-Mar-94 | 16:30 | 6.9 | 4 | 9 | 10.2 | 9.8 | 10 | 13.11 | 76.29 | |
| 10-Apr-94 | 15:50 | 7.03 | 14 | 18 | 8.9 | 9.4 | 9.15 | 10.31 | 88.78 | |
| 16-May-94 | 1730 | 7 | 16 | 13.5 | 7 | 7 | 7 | 9.87 | 70.92 | |
| 00-Jun-94 | 1810 | 6.7 | 20 | 21 | 2 | 2 | 2 | 9.09 | 22.00 | |
| 10-Jul-94 | 1315 | 7.2 | 25.5 | 38 | 3.8 | 3.7 | 3.75 | 8.19 | 45.80 | |
| 9-Aug-94 | 16:45 | 7 | 24 | 33 | | | | | | |
| 10-Sep-94 | 9:30 | 6.9 | 19 | 23 | | | | | | |
| 10-Oct-94 | 17:00 | 7.2 | 12 | 12 | 8 | 7.8 | 7.9 | 10.78 | 73.30 | |
| 12-Nov-94 | 10:20 | 6.9 | 8 | 14 | 6.6 | 6 | 6.3 | 11.84 | 53.19 | |
| 27-Dec-94 | 12:35 | 7 | 8 | 13 | 11.2 | 10.9 | 11.05 | 11.84 | 93.30 | |
| 7-Jan-95 | 10:00 | 6.9 | 8 | 13 | 4 | 4 | 4 | 11.84 | 33.77 | |
| Avg. 1992 | | 7.0 | 14.4 | 16.3 | 8.2 | 8.0 | 8.1 | 10.5 | 76.2 | 5.7 |
| Avg. 1993 | | 6.9 | 7.5 | 11.2 | 10.4 | 10.2 | 10.3 | 12.0 | 86.0 | 5.1 |
| Avg. 1994 | | 7.0 | 12.8 | 16.8 | 7.9 | 7.7 | 7.8 | 11.3 | 67.4 | |
| Overall Avg. | | 7.0 | 15.1 | 18.0 | 8.1 | 7.9 | 8.0 | 10.3 | 76.9 | 6.3 |

# Blackstone River in Blackstone, MA
## Water Quality Parameters

| DATE | TIME | pH (SU) | WATER T (C) | AIR T (C) | first Diss. Oxy. (mg/l) | Second Diss. Oxy. (mg/l) | Average Diss. Oxy. (mg/l) | Diss. Oxy. Saturation (mg/l) | % SAT (%) |
|---|---|---|---|---|---|---|---|---|---|
| 1-Oct-90 | 15:45 | | 16.50 | 19.50 | 9.00 | 9.10 | 9.05 | 9.37 | 96.56 |
| 15-Oct-90 | 11:30 | | 19.00 | 21.00 | 7.80 | 7.60 | 7.70 | 9.28 | 83.01 |
| 29-Oct-90 | | | | | | | | | |
| 13-Nov-90 | 10:00 | | 3.00 | -1.00 | 10.80 | 11.20 | 11.00 | 13.46 | 81.72 |
| 25-Nov-90 | 15:30 | | 8.00 | 14.00 | 11.20 | 11.00 | 11.10 | 11.84 | 93.73 |
| 10-Dec-90 | 11:15 | | 4.00 | 9.00 | 11.80 | 11.70 | 11.75 | 13.11 | 89.65 |
| 6-Jan-91 | 15:00 | | 3.00 | 4.00 | 12.60 | 13.00 | 12.90 | 13.46 | 95.84 |
| 20-Jan-91 | 12:00 | | 2.00 | 6.00 | 14.00 | 13.60 | 13.80 | 13.83 | 99.79 |
| 4-Feb-91 | 15:30 | | 4.00 | 14.00 | 12.40 | 12.80 | 12.60 | 13.11 | 96.13 |
| 17-Feb-91 | 15:30 | | 0.00 | 0.00 | 14.40 | 14.30 | 14.35 | 14.62 | 98.15 |
| 4-Mar-91 | 15:00 | | 6.50 | 8.50 | 12.80 | 12.40 | 12.60 | 12.29 | 102.50 |
| 17-Mar-91 | 15:00 | | 7.00 | 10.50 | 12.60 | 12.80 | 12.70 | 12.14 | 104.62 |
| 1-Apr-91 | 15:00 | | 7.00 | 8.50 | 11.60 | 11.80 | 11.70 | 12.14 | 96.38 |
| | | | | | | | | | |
| 29-Apr-91 | 15:30 | | 13.00 | 16.00 | 8.30 | 8.60 | 8.45 | 10.54 | 80.20 |
| 12-May-91 | 14:30 | | 18.00 | 29.00 | 8.30 | 8.60 | 8.45 | 9.47 | 89.26 |
| | | | | | | | | | |
| 9-Jun-91 | | | 26.00 | 30.00 | 8.60 | 8.80 | 8.70 | 8.11 | 107.23 |
| 22-Jun-91 | 16:00 | | 23.00 | 19.00 | 8.10 | 8.00 | 8.05 | 8.58 | 93.84 |
| 8-Jul-91 | 10:00 | | 27.00 | 26.00 | 8.05 | 7.85 | 7.95 | 7.97 | 99.77 |
| 22-Jul-91 | 16:00 | | 27.00 | 29.00 | 11.10 | 11.30 | 11.20 | 7.97 | 140.55 |
| 5-Aug-91 | 14:00 | | 23.00 | 27.00 | 9.40 | 9.60 | 9.50 | 8.58 | 110.75 |
| | | | | | | | | | |
| 10-Nov-91 | 14:20 | | 5.00 | 1.50 | 10.60 | 11.00 | 10.80 | 12.77 | 84.57 |
| 25-Nov-91 | 15:00 | | 7.00 | 2.00 | 10.30 | 10.70 | 10.50 | 12.14 | 86.50 |
| 8-Dec-91 | 11:00 | | 3.50 | 8.00 | 12.20 | 12.00 | 12.10 | 13.28 | 91.10 |
| 29-Dec-91 | 10:30 | | 2.00 | 5.00 | 11.70 | 12.00 | 11.85 | 13.83 | 85.68 |
| 12-Jan-92 | 12:00 | | 0.00 | -3.00 | 11.40 | 11.80 | 11.60 | 14.62 | 79.34 |
| 7-Feb-92 | 15:30 | | 0.00 | -1.00 | 12.70 | 12.90 | 12.80 | 14.62 | 87.55 |
| 6-Mar-92 | 16:45 | 7.10 | 5.00 | 6.50 | 12.40 | 12.40 | 12.40 | 12.77 | 97.09 |
| 7-Apr-92 | 11:00 | 6.90 | 8.50 | 12.50 | 10.50 | 10.50 | 10.50 | 11.70 | 89.74 |
| 3-May-92 | 13:20 | 6.80 | 16.00 | 20.00 | 8.40 | 8.00 | 8.20 | 9.87 | 83.08 |
| 7-Jun-92 | 15:30 | 6.80 | 19.00 | 26.00 | 7.70 | 8.00 | 7.85 | 9.29 | 84.62 |
| 12-Jul-92 | 16:15 | 7.25 | 24.00 | 24.00 | 8.70 | 8.70 | 8.70 | 8.42 | 103.35 |
| 12-Aug-92 | 16:20 | 7.00 | 23.00 | 20.00 | 7.90 | 7.90 | 7.90 | 8.58 | 92.09 |
| 7-Sep-92 | 16:00 | 7.00 | 19.00 | 20.00 | 8.40 | 8.20 | 8.30 | 9.28 | 89.48 |
| 3-Oct-92 | 10:30 | 7.10 | 13.50 | 19.50 | 9.50 | 10.00 | 9.75 | 10.42 | 93.57 |
| 9-Nov-92 | 8:20 | 6.90 | 4.00 | -7.50 | 10.70 | 10.90 | 10.80 | 13.11 | 82.39 |
| 6-Dec-92 | 13:15 | 6.90 | 1.50 | 1.00 | 11.60 | 11.70 | 11.65 | 14.02 | 83.09 |
| 10-Jan-93 | 13:30 | 6.80 | 0.00 | -6.00 | 13.00 | 13.20 | 13.10 | 14.62 | 89.60 |
| 7-Feb-93 | 15:30 | 6.95 | -1.00 | -7.00 | 12.30 | 12.50 | 12.40 | 15.04 | 82.42 |
| 7-Mar-93 | | 7.00 | 2.00 | 6.00 | 12.30 | 12.60 | 12.45 | 13.83 | 90.02 |
| 4-Apr-93 | 17:15 | 6.80 | 3.50 | 9.50 | 11.80 | 12.00 | 11.90 | 13.28 | 89.59 |
| 10-May-93 | 14:15 | 6.90 | 19.50 | 21.00 | 8.60 | 8.70 | 8.65 | 9.18 | 94.19 |
| 7-Jun-93 | 10:05 | 6.85 | 15.00 | 15.50 | 7.65 | 7.65 | 7.65 | 10.08 | 75.86 |
| 11-Jul-93 | 10:00 | 6.95 | 27.00 | 27.00 | 6.00 | 6.00 | 6.00 | 7.97 | 75.30 |
| 16-Aug-93 | 9:20 | 7.00 | 23.00 | 19.00 | 5.60 | 5.80 | 5.70 | 8.58 | 66.45 |
| 12-Sep-93 | 10:50 | 6.90 | 18.00 | 19.50 | 7.10 | 7.30 | 7.20 | 9.47 | 76.05 |
| 11-Oct-93 | 17:00 | 7.00 | 14.00 | 8.50 | 8.90 | 9.30 | 9.10 | 10.31 | 88.30 |
| 8-Nov-93 | 16:15 | 7.00 | 6.50 | 4.50 | 10.40 | 10.50 | 10.45 | 12.29 | 85.01 |
| 13-Dec-93 | 12:00 | 6.90 | 3.00 | 7.00 | 11.80 | 11.80 | 11.80 | 13.46 | 87.66 |
| 24-Jan-94 | 16:25 | 6.80 | 0.50 | 6.50 | 12.80 | 12.60 | 12.70 | 14.42 | 88.09 |
| 2-Feb-94 | 11:00 | 6.85 | 0.00 | -10.00 | 12.60 | 12.60 | 12.60 | 14.62 | 86.18 |
| 13-Mar-94 | 16:45 | 6.70 | 3.00 | 7.50 | 12.60 | 12.60 | 12.60 | 13.46 | 93.60 |
| 11-Apr-94 | 16:45 | 6.90 | 11.00 | 14.00 | 10.40 | 10.80 | 10.60 | 11.03 | 96.13 |
| 17-May-94 | 1511 | 6.80 | 12.50 | 11.50 | 8.60 | 8.40 | 8.50 | 10.66 | 79.77 |
| 20-Jun-94 | 1530 | 7.05 | 26.50 | 27.00 | 7.40 | 7.60 | 7.50 | 8.04 | 93.29 |
| 12-Jul-94 | 1335 | 7.05 | 26.00 | 28.50 | 7.00 | 7.40 | 7.20 | 8.11 | 88.74 |
| 6-Aug-94 | 1330 | 7.15 | 24.00 | 25.00 | 8.80 | 8.80 | 8.80 | 8.42 | 104.54 |
| 9-Sep-94 | 1700 | 7.40 | 19.00 | 20.50 | 10.60 | 10.80 | 10.70 | 9.28 | 115.35 |
| 9-Oct-94 | 17:15 | 7.00 | 15.50 | 20.50 | 9.30 | 9.60 | 9.45 | 9.98 | 94.73 |
| 9-Nov-94 | 15:10 | 7.00 | 11.00 | 15.00 | 9.50 | 9.50 | 9.50 | 11.03 | 86.15 |
| 3-Dec-94 | 13:00 | 6.80 | 4.00 | 15.00 | 11.20 | 11.40 | 11.30 | 13.11 | 86.20 |
| 11-Jan-95 | 1305 | 6.90 | 0.00 | | 12.80 | 12.80 | 12.80 | 14.62 | 87.55 |
| 6-Feb-95 | 1410 | 6.95 | 0.00 | -10.00 | 12.20 | 12.20 | 12.20 | 14.62 | 83.44 |

## Blackstone River at Rt. 122 in Lonsdale, RI.
## Water Quality Parameters

| Sampling Date | Sample Time | pH (SU) | H2O T (C) | AIR T (C) | first Diss. Oxy. (mg/l) | Second Diss. Oxy. (mg/l) | Average Diss. Oxy. (mg/l) | Diss. Oxy. Saturation (mg/l) | % SAT (%) |
|---|---|---|---|---|---|---|---|---|---|
| 9-Feb-92 | 17:00 | 7.10 | 0 | 4 | 15.40 | | 15.40 | 14.62 | 105.33 |
| 3-Mar-92 | 15:00 | 6.98 | 7 | 10 | 13.50 | 13.80 | 13.65 | 12.14 | 112.45 |
| 4-Apr-92 | 13:30 | 6.97 | 10 | 13 | 11.30 | 11.90 | 11.60 | 11.29 | 102.76 |
| 2-May-92 | 10:30 | 6.90 | 15 | 18 | 10.00 | 10.10 | 10.05 | 10.08 | 99.66 |
| 7-Jun-92 | | 6.80 | 10 | 13 | 8.00 | 8.20 | 8.10 | 11.29 | 71.76 |
| 13-Jul-92 | 13:30 | 6.95 | 27 | 30 | 12.80 | 13.00 | 12.90 | 7.97 | 161.89 |
| 5-Sep-92 | 9:45 | 6.90 | 19 | 20 | 9.20 | 8.60 | 8.90 | 9.28 | 95.94 |
| 7-Nov-92 | 15:45 | 6.95 | 8 | 6 | 11.70 | 11.40 | 11.55 | 11.84 | 97.52 |
| 5-Dec-92 | 11:25 | 6.80 | 4 | 3 | 11.60 | 11.60 | 11.60 | 13.11 | 88.49 |
| 9-Jan-93 | 14:15 | 6.40 | 2 | -3 | 11.60 | 11.80 | 11.70 | 13.83 | 84.60 |
| 14-Feb-93 | 13:15 | 6.80 | 2 | 6 | 13.20 | 13.40 | 13.30 | 13.83 | 96.17 |
| 6-Mar-93 | 13:00 | 6.90 | 3 | 5 | 12.50 | 12.80 | 12.65 | 13.46 | 93.97 |
| 12-May-93 | 17:45 | 7.00 | 20 | 30 | 8.80 | 8.80 | 8.80 | 9.09 | 96.78 |
| 14-Jun-93 | 17:45 | 7.00 | 25 | 30 | 9.10 | 9.00 | 9.05 | 8.26 | 109.52 |
| 12-Jul-93 | | | | | | | | | |
| 16-Aug-93 | 17:00 | 7.20 | 25 | 25 | 8.00 | 8.20 | 8.10 | 8.26 | 98.02 |
| 11-Sep-93 | 10:00 | 7.00 | 18 | 14 | 8.20 | 8.20 | 8.20 | 9.47 | 86.62 |
| 8-Oct-93 | 15:00 | 7.10 | 19 | 27 | 9.80 | 10.20 | 10.00 | 9.28 | 107.80 |
| 6-Nov-93 | 8:00 | 7.00 | 8 | 10 | 10.60 | 10.40 | 10.50 | 11.84 | 88.66 |
| 3-Dec-93 | 15:15 | 6.90 | 5 | 11 | 12.40 | 12.20 | 12.30 | 12.77 | 96.31 |
| 17-Jan-94 | 10:00 | 6.90 | 1- | 10- | 13.90 | 13.90 | 13.90 | | |
| 13-Mar-94 | 8:00 | 6.60 | 1 | 2 | 13.70 | 13.70 | 13.70 | 14.22 | 96.37 |
| 10-Apr-94 | 11:00 | 6.80 | 10 | 15 | 10.60 | 10.60 | 10.60 | | |
| 10-May-94 | 16:30 | 6.80 | 16 | 20 | 9.50 | 9.60 | 9.55 | 9.87 | 96.75 |
| 9-Jul-94 | 16:00 | 7.20 | 27 | 33 | 8.60 | 8.60 | 8.60 | 7.97 | 107.93 |
| 14-Aug-94 | 9:30 | 6.90 | 24 | 27 | 4.60 | 4.60 | 4.60 | 8.42 | 54.64 |
| 11-Sep-94 | 16:30 | 7.10 | 18 | 22 | 9.00 | 9.00 | 9.00 | 9.47 | 95.07 |
| 9-Oct-94 | 9:30 | 6.90 | 14 | 15 | 8.80 | 8.60 | 8.70 | 10.31 | 84.42 |
| 11-Nov-94 | 14:00 | 7.00 | 9.5 | 9 | 11.00 | 11.60 | 11.30 | 11.42 | 98.93 |
| 11-Dec-94 | 1500 | 6.90 | 4 | 7 | 8.60 | 8.60 | 8.60 | 13.11 | 65.61 |
| 8-Jan-95 | 1430 | 6.90 | 5 | 9 | 8.60 | 8.60 | 8.60 | 12.77 | 67.34 |

# Blackstone River at Slater Mill in Pawtucket, RI
## Water Quality Parameters

| DATE | TIME | pH (SU) | Water Temp. (C) | Air Temp. (C) | First Diss. Oxy. (mg/l) | Second Diss. Oxy. (mg/l) | Average Diss. Oxy. (mg/l) | Diss. Oxy. Saturation (mg/l) | % SAT (%) | Total Susp.Solid (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1-Oct-90 | 16:00 | | | | 8.20 | 8.20 | 8.20 | 9.16 | 89.29 | |
| 15-Oct-90 | 7:30 | | | | 7.80 | 8.20 | 8.00 | 9.09 | 87.99 | |
| 29-Oct-90 | 7:40 | | | 7.50 | 10.90 | 11.00 | 10.95 | 11.29 | 97.01 | 7.00 |
| 13-Nov-90 | 7:20 | | 4.00 | -1.00 | 11.90 | 11.90 | 11.90 | 13.11 | 90.79 | 2.20 |
| 26-Nov-90 | 7:30 | | 7.50 | 6.00 | 11.20 | 11.20 | 11.20 | 11.99 | 93.40 | 0.50 |
| 10-Dec-90 | 7:30 | | 5.00 | 6.00 | 12.40 | 12.20 | 12.30 | 12.77 | 96.32 | 3.00 |
| 7-Jan-91 | 8:00 | | 4.00 | 0.00 | 13.20 | 13.20 | 13.20 | 13.11 | 100.71 | 3.40 |
| 22-Jan-91 | 9:15 | | 0.50 | -9.00 | 13.60 | 13.00 | 13.30 | 14.42 | 92.24 | 2.40 |
| 4-Feb-91 | 7:30 | | 4.00 | 2.00 | 14.20 | 14.40 | 14.30 | 13.11 | 109.10 | 1.70 |
| 19-Feb-91 | 7:30 | | 3.00 | 5.00 | 13.20 | 13.40 | 13.30 | 13.46 | 98.81 | 1.60 |
| 4-Mar-91 | 7:30 | | 7.50 | 6.50 | 11.60 | 11.40 | 11.50 | 11.99 | 95.91 | 3.90 |
| 18-Mar-91 | 7:30 | | 5.00 | 5.00 | 12.00 | 11.80 | 11.90 | 12.77 | 93.19 | 1.20 |
| 1-Apr-91 | 7:30 | 6.90 | 6.00 | 4.50 | 11.00 | 11.10 | 11.05 | 12.45 | 88.78 | 3.40 |
| 15-Apr-91 | 7:30 | 6.85 | 10.00 | 7.00 | 9.60 | 9.50 | 9.55 | 11.29 | 84.60 | 2.70 |
| 29-Apr-91 | 7:30 | 6.85 | 14.00 | 8.00 | 9.20 | 9.00 | 9.10 | 10.31 | 88.30 | 3.70 |
| 13-May-91 | 7:30 | 6.85 | 17.00 | 19.00 | 7.80 | 8.00 | 7.90 | 9.66 | 81.74 | 3.70 |
| 28-May-91 | 7:45 | 6.85 | 22.00 | 23.00 | 6.80 | 6.80 | 6.80 | 8.74 | 77.77 | 3.20 |
| 10-Jun-91 | 7:30 | 7.10 | 21.00 | 18.00 | 7.20 | 7.20 | 7.20 | 8.92 | 80.76 | 3.80 |
| 24-Jun-91 | 7:15 | 7.10 | 21.00 | 15.00 | 7.40 | 7.20 | 7.30 | 8.92 | 81.88 | 0.60 |
| 8-Jul-91 | 7:30 | 7.30 | 21.00 | 27.00 | 6.90 | 6.90 | 6.90 | 8.92 | 77.40 | 8.70 |
| 22-Jul-91 | 7:30 | 7.10 | 26.00 | 24.00 | 5.40 | 5.00 | 5.20 | 8.11 | 64.09 | 2.80 |
| 5-Aug-91 | 7:30 | 7.10 | 21.00 | 21.00 | 6.60 | | 6.60 | 8.92 | 74.03 | 3.50 |
| 19-Aug-91 | 7:30 | 7.05 | 25.00 | 22.00 | 6.40 | 6.20 | 6.30 | 8.26 | 76.24 | 3.10 |
| 3-Sep-91 | 7:30 | | 20.00 | 16.00 | 7.60 | 7.80 | 7.70 | 9.09 | 84.69 | 2.16 |
| 16-Sep-91 | 7:30 | | 20.00 | 22.00 | 8.10 | 8.00 | 8.15 | 9.09 | 89.64 | 2.34 |
| 30-Sep-91 | | | | | | | | | | 3.91 |
| 15-Oct-91 | 7:30 | | 9.50 | 5.00 | 9.80 | | 9.80 | 11.42 | 85.80 | 1.73 |
| 28-Oct-91 | 7:30 | | 11.00 | 10.00 | 9.50 | 9.50 | 9.50 | 11.03 | 86.15 | |
| 14-Nov-91 | 7:30 | 6.90 | 7.00 | 6.00 | 11.60 | 11.80 | 11.70 | 12.14 | 96.38 | 5.64 |
| 25-Nov-91 | 7:15 | 6.90 | 4.00 | 1.00 | 11.60 | 11.40 | 11.50 | 13.11 | 87.73 | 6.19 |
| 9-Dec-91 | 7:20 | 6.90 | 6.00 | 12.00 | 12.00 | 11.40 | 11.70 | 12.45 | 93.99 | 0.99 |
| 30-Dec-91 | 13:00 | | 0.00 | 2.00 | 13.80 | 13.60 | 13.70 | 14.62 | 93.70 | |
| 12-Jan-92 | 13:00 | 6.80 | 2.00 | -1.00 | 13.40 | 13.60 | 13.50 | 13.83 | 97.61 | 1.52 |
| 7-Feb-92 | 14:30 | 7.00 | 2.00 | 3.00 | 13.60 | | 13.60 | 13.83 | 98.34 | 2.20 |
| 9-Mar-92 | 14:30 | 7.08 | 10.80 | 10.20 | 13.00 | 12.20 | 12.60 | 11.08 | 113.73 | |
| 2-Apr-92 | 15:00 | 7.00 | 7.00 | 10.00 | 11.40 | 11.20 | 11.30 | 12.14 | 93.09 | 2.50 |
| 2-May-92 | 15:00 | 6.85 | | | 9.80 | 10.00 | 9.90 | 14.62 | 67.71 | |
| 5-Jun-92 | 17:00 | 6.90 | | | 8.10 | 8.10 | 8.10 | 14.62 | 55.40 | 0.40 |
| 12-Jul-92 | 10:00 | 7.05 | 24.00 | 30.00 | 7.30 | 6.90 | 7.10 | 8.42 | 84.34 | |
| 8-Aug-92 | 10:00 | 6.90 | 23.00 | 28.00 | 7.00 | 7.00 | 7.00 | 8.58 | 81.60 | 4.40 |
| 14-Sep-92 | 16:00 | 7.10 | 21.00 | 17.00 | 9.20 | | 9.20 | 8.92 | 103.20 | 2.50 |
| 6-Oct-92 | 17:00 | 7.10 | 13.00 | 14.00 | 10.40 | 10.40 | 10.40 | 10.54 | 98.70 | 2.30 |
| 10-Nov-92 | 14:00 | 6.90 | 6.00 | 7.00 | 10.40 | 10.60 | 10.50 | 12.45 | 84.35 | 0.50 |
| 5-Dec-92 | | | | | | | | | | 4.40 |
| 10-Jan-93 | | | | | | | | | | 1.60 |
| 8-Feb-93 | | | | | | | | | | 0.90 |
| 8-Mar-93 | 14:00 | 6.85 | 3.00 | 9.00 | 12.00 | 11.90 | 11.95 | 13.46 | 88.77 | 0.60 |
| 6-Apr-93 | 14:30 | 6.70 | 11.00 | 11.00 | 11.40 | 11.20 | 11.30 | 11.03 | 102.47 | 3.60 |
| 4-May-93 | 15:00 | 6.95 | 17.00 | 22.00 | 8.80 | 8.90 | 8.85 | 9.66 | 91.57 | 2.50 |
| 6-Jun-93 | | | | | | | | | | 5.10 |
| 12-Jul-93 | 10:30 | 7.20 | 26.00 | 31.00 | 7.00 | 6.70 | 6.85 | 8.11 | 84.43 | 1.60 |
| 18-Aug-93 | 19:00 | 7.10 | 23.00 | 20.00 | 7.60 | 7.40 | 7.50 | 8.58 | 87.43 | 16.20 |
| 14-Sep-93 | 13:00 | 7.10 | 22.00 | 29.00 | 7.30 | 7.60 | 7.45 | 8.74 | 85.20 | 6.40 |
| 5-Oct-93 | 17:00 | 7.10 | 14.00 | 11.00 | 9.10 | 9.30 | 9.20 | 10.31 | 89.27 | 2.40 |
| 8-Nov-93 | 11:30 | 6.80 | 0.00 | 8.00 | 10.80 | 10.80 | 10.80 | 14.62 | 73.87 | |
| 12-Dec-93 | 11:30 | 6.90 | 5.00 | 7.00 | 11.20 | 11.10 | 11.15 | 12.77 | 87.31 | |
| 12-Jan-94 | 10:00 | 6.90 | 6.00 | 4.00 | 13.00 | 13.00 | 13.00 | 12.45 | 104.43 | |
| 2-Feb-94 | 10:30 | 6.80 | -4.00 | -10.00 | 11.00 | 11.00 | 11.00 | 16.44 | 66.90 | |
| 15-Mar-94 | 12:00 | 6.80 | 5.00 | 8.00 | 11.40 | 11.20 | 11.30 | 12.77 | 88.48 | |
| 30-Apr-94 | 14:30 | 7.10 | 17.00 | 26.00 | 9.00 | 9.40 | 9.20 | 9.66 | 95.19 | |
| 12-May-94 | 12:00 | 6.90 | 15.00 | | 8.60 | 8.60 | 8.60 | 10.08 | 85.28 | |
| | | | | | | | | 14.62 | 0.00 | |
| 12-Jul-94 | 16:30 | 7.50 | 26.60 | 26.60 | 7.60 | 7.10 | 7.35 | 8.03 | 91.58 | |
| 11-Aug-94 | 15:00 | 7.40 | 24.00 | 32.00 | 10.00 | 9.60 | 9.80 | 8.42 | 116.41 | |
| 13-Sep-94 | 18:00 | 7.50 | 22.00 | 25.00 | | | | 8.74 | | |
| 20-Oct-94 | 16:30 | 7.00 | 16.00 | 17.00 | 8.90 | 9.20 | 9.05 | 9.47 | 95.60 | |
| 13-Nov-94 | 15:00 | 7.30 | 10.00 | 10.00 | 10.60 | 10.40 | 10.50 | 11.29 | 93.02 | |
| 4-Dec-94 | 8:30 | 6.80 | 5.00 | 5.00 | 11.40 | 11.20 | 11.30 | 12.77 | 88.48 | |

# Ten Mile River at Roger Williams Ave. in East Providence
## Water Quality Parameters

| DATE | TIME | pH (SU) | Water Temp. (C) | Air Temp. (C) | First Diss. Oxy. (mg/l) | Second Diss. Oxy. (mg/l) | Average Diss. Oxy. (mg/l) | Diss. Oxy. Saturation (mg/l) | % SAT (%) | Total Susp. Solids (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| 9-Fe b-92 | 10:00 | 7 | 0 | -5 | 13.2 | 13.7 | 13.55 | 14.62 | 92.68 | 0.85 |
| 8-Mar-92 | 10:30 | 7.2 | 6.5 | 10 | 12 | 12.4 | 12.2 | 12.29 | 99.25 | |
| 4-Apr-92 | 12:00 | 7.25 | 10 | 12 | 12.2 | 12.2 | 12.2 | 11.29 | 108.08 | 5.5 |
| 2-May-92 | 8:00 | 7.1 | 13 | 14 | 9.2 | 9.6 | 9.4 | 10.54 | 89.21 | 7.3 |
| 6-Jun-92 | 8:00 | 7.05 | 19 | 17.5 | 7.1 | 7.2 | 7.15 | 9.28 | 77.08 | 1.4 |
| 11-Jul-92 | 8:00 | 7.7 | 23 | 25 | 5 | 4.7 | 4.85 | 8.58 | 56.54 | 3.9 |
| 10-Aug-92 | 16:30 | 7.6 | 28 | 28 | 6.9 | 7.3 | 7.1 | 7.83 | 90.70 | 7.9 |
| 4-Oct-92 | 10:30 | 7.2 | 15 | 16 | 9.2 | 8.8 | 9 | 10.08 | 89.25 | 3.1 |
| 8-Nov-92 | 14:00 | 7.35 | 6 | 4 | 11 | 11.2 | 11.1 | 12.45 | 89.17 | |
| 6-Dec-92 | 13:40 | 7.1 | 3 | 0 | 12 | 11.6 | 11.8 | 13.46 | 87.66 | 2.7 |
| 10-Jan-93 | 12:15 | 6.9 | 0 | -4 | 11.6 | 12.8 | 12.2 | 14.62 | 83.44 | 2 |
| 6-Jun-93 | 17:00 | 7.1 | 18 | 13 | 8.1 | 7.7 | 7.9 | 9.47 | 83.45 | 1.3 |
| 11-Jul-93 | 12:00 | 7 | 26 | 29 | 4.2 | 4.8 | 4.5 | 8.11 | 55.46 | 1.5 |
| 15-Aug-93 | 13:00 | 8.1 | 26 | 29 | 7.5 | 7.2 | 7.35 | 8.11 | 90.59 | 3.3 |
| 11-Sep-93 | 13:00 | 7.5 | 21 | 19 | 7.6 | 8 | 7.8 | 8.92 | 87.49 | |
| 4-Oct-93 | 15:00 | 7.65 | 16 | 19 | 7.2 | 6.6 | 6.9 | 9.87 | 69.91 | |
| 7-Nov-93 | 13:00 | 7.1 | 8.5 | 5 | 9.5 | 9.6 | 9.55 | 11.70 | 81.62 | |
| 5-Dec-93 | 11:15 | 7.1 | 9 | 9.5 | 9.8 | 9.8 | 9.8 | 11.56 | 84.78 | |
| 19-Jan-94 | 11:10 | 6.9 | 1 | -5 | 12.8 | 12.8 | 12.8 | | | |
| 6-Feb-94 | 10:10 | 6.7 | 2 | 1 | 12.8 | 13.2 | 13 | 13.83 | 94.00 | |
| 19-Mar-94 | 9:32 | 6.6 | 4.5 | 12.5 | 8.4 | 8.8 | 8.6 | 12.94 | 66.47 | |
| 10-Apr-94 | 11:00 | 6.9 | 12 | 13 | 9.9 | 9.7 | 9.8 | 10.78 | 90.93 | |
| 8-May-94 | 15:00 | 6.9 | 16 | 23 | 8.1 | 8.3 | 8.2 | 9.87 | 83.08 | |
| 12-Jun-94 | 1:00 | 7 | 22.8 | 23.5 | 5.8 | 5.9 | 5.85 | 8.61 | 67.94 | |
| 10-Jul-94 | 11:00 | 6.9 | | | 4.2 | 4.3 | 4.25 | 14.62 | 29.07 | |
| 9-Aug-94 | 11:40 | 7.6 | 24.6 | 24.1 | 7.1 | 7 | 7.05 | 8.32 | 84.69 | |
| 11-Sep-94 | 10:35 | 8.4 | 18.5 | 21 | 6.4 | 6.2 | 6.3 | 9.37 | 67.23 | |
| 6-Dec-94 | 1100 | 7.1 | 8 | 19.5 | 10.5 | 10.5 | 10.5 | 11.84 | 88.66 | |
| 16-Jan-95 | 1037 | 8 | 7 | 20 | 11 | 10.8 | 10.9 | 12.14 | 89.79 | |
| Avg. 1992 | | 7.26 | 12 | 12 | 9.8 | 9.9 | 9.8 | 11.04 | 87.96 | 4.1 |
| Avg. 1993 | | 7.31 | 16 | 15 | 8.2 | 8.3 | 8.3 | 10.30 | 79.59 | 2.0 |
| Avg. 1994 | | 7.10 | 12 | 15 | 8.6 | 8.7 | 8.6 | 11.13 | 74.67 | |
| Overall Avg. | | 7.24 | 13 | 14 | 9.0 | 9.1 | 9.0 | 10.90 | 81.36 | 3.4 |

## Nutrient Parameters for River Rescue Stations

Dissolved Nitrite
Dissolved Nitrate
Dissolved Ammonia
Dissolved Inorganic Nitrogen
Total Dissolved Nitrogen
Dissolved Organic Nitrogen
Dissolved Inorganic Phosphorus
Total Dissolved Phosphorus
Dissolved Organic Phosphorus
Particulate Phosphorus
Total P

## Woonasquatucket River at Rt. 44 in North Providence, RI
## Nutrient Concentrations

| Date | Diss. NO2+NO3 (mg/l as N) | Diss. NO2 (mg/l as N) | Diss. NO3 (mg/l as N) | Diss. NH4 (mg/l as N) | Diss. Inorg. N (mg/l as N) | Total Diss. N (mg/l as N) | Diss. Org. N (mg/l as N) | Diss. Inorg. P (mg/l as P) | Total Diss. P (mg/l as P) | Diss. Org. P (mg/l as P) | Particulate P (mg/l as P) | Total P (mg/l as P) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15-Oct-90 | 0.248 | 0.009 | 0.239 | 0.006 | 0.254 | 1.588 | 1.334 | 0.078 | 0.161 | 0.083 | 0.087 | 0.248 |
| 29-Oct-90 | 0.020 | 0.003 | 0.018 | 0.009 | 0.030 | 0.804 | 0.775 | 0.016 | 0.072 | 0.056 | 0.067 | 0.138 |
| 13-Nov-90 | 0.152 | 0.011 | 0.142 | 0.010 | 0.162 | 0.716 | 0.554 | 0.015 | 0.059 | 0.044 | 0.074 | 0.133 |
| 26-Nov-90 | 0.246 | 0.019 | 0.227 | 0.308 | 0.554 | 1.284 | 0.730 | 0.034 | 0.095 | 0.061 | 0.076 | 0.171 |
| 10-Dec-90 | 0.226 | 0.002 | 0.224 | 0.007 | 0.233 | 1.113 | 0.880 | 0.004 | 0.075 | 0.072 | | |
| 7-Jan-91 | 0.489 | 0.012 | 0.476 | 0.218 | 0.706 | 1.164 | 0.458 | 0.047 | 0.063 | 0.016 | 0.081 | 0.145 |
| 3-Feb-91 | 0.450 | 0.013 | 0.437 | 0.048 | 0.498 | 1.626 | 1.129 | 0.017 | 0.046 | 0.029 | 0.093 | 0.139 |
| 19-Feb-91 | 0.368 | 0.005 | 0.363 | 0.457 | 0.826 | 1.826 | 1.000 | 0.044 | 0.119 | 0.075 | 0.078 | 0.197 |
| 3-Mar-91 | 0.320 | 0.006 | 0.314 | 0.159 | 0.479 | 0.631 | 0.152 | 0.021 | 0.051 | 0.031 | 0.092 | 0.143 |
| 17-Mar-91 | 0.195 | 0.003 | 0.192 | 0.069 | 0.264 | 0.700 | 0.436 | 0.007 | 0.046 | 0.039 | 0.091 | 0.137 |
| 31-Mar-91 | 0.342 | 0.003 | 0.340 | 0.009 | 0.351 | 0.801 | 0.450 | 0.004 | 0.086 | 0.083 | 0.070 | 0.156 |
| 14-Apr-91 | 0.349 | 0.003 | 0.346 | 0.017 | 0.366 | 1.010 | 0.643 | 0.000 | 0.091 | 0.091 | 0.076 | 0.167 |
| 28-Apr-91 | 0.191 | 0.011 | 0.180 | 0.074 | 0.264 | 0.605 | 0.340 | 0.012 | 0.037 | 0.024 | 0.043 | 0.080 |
| 13-May-91 | 0.231 | 0.005 | 0.226 | 0.186 | 0.416 | 0.591 | 0.174 | 0.003 | 0.029 | 0.026 | 0.076 | 0.105 |
| 29-May-91 | 0.334 | 0.024 | 0.310 | 0.360 | 0.694 | 2.224 | 1.530 | 0.018 | 0.120 | 0.103 | 0.047 | 0.168 |
| 10-Jun-91 | 1.066 | 0.007 | 1.059 | 0.050 | 1.116 | 2.207 | 1.091 | 0.072 | 0.159 | 0.087 | 0.024 | 0.183 |
| 23-Jun-91 | 2.707 | 0.008 | 2.699 | 0.068 | 2.775 | 3.013 | 0.238 | 0.112 | 0.183 | 0.070 | 0.025 | 0.208 |
| 7-Jul-91 | 0.990 | 0.034 | 0.956 | 0.076 | 1.066 | 2.375 | 1.309 | 0.294 | 0.424 | 0.130 | 0.029 | 0.453 |
| 26-Jul-91 | 4.455 | 0.037 | 4.418 | 0.572 | 5.028 | 9.522 | 4.495 | 0.250 | 0.347 | 0.097 | 0.076 | 0.423 |
| 4-Aug-91 | 0.885 | 0.008 | 0.877 | 0.155 | 1.040 | 3.019 | 1.979 | 0.200 | 0.331 | 0.132 | 0.062 | 0.393 |
| 20-Aug-91 | 0.355 | 0.018 | 0.336 | 0.257 | 0.611 | 2.189 | 1.577 | 0.029 | 0.134 | 0.105 | 0.028 | 0.163 |
| 2-Sep-91 | 0.896 | 0.004 | 0.892 | 0.419 | 1.314 | 2.606 | 1.292 | 0.278 | 0.431 | 0.154 | 0.029 | 0.461 |
| 15-Sep-91 | 0.928 | 0.008 | 0.920 | 0.093 | 1.021 | 2.260 | 1.239 | 0.206 | 0.313 | 0.107 | 0.025 | 0.338 |
| 30-Sep-91 | 0.002 | 0.005 | 0.000 | 0.203 | 0.204 | 0.867 | 0.663 | 0.002 | 0.033 | 0.031 | 0.028 | 0.061 |
| 16-Oct-91 | 0.303 | 0.005 | 0.298 | 0.706 | 1.010 | 1.525 | 0.516 | 0.038 | 0.056 | 0.018 | 0.018 | 0.074 |
| 27-Oct-91 | 0.054 | 0.005 | 0.048 | 0.378 | 0.432 | 0.765 | 0.333 | 0.011 | 0.061 | 0.050 | 0.016 | 0.077 |
| 13-Nov-91 | 0.073 | 0.011 | 0.061 | 0.271 | 0.344 | 0.618 | 0.274 | 0.003 | 0.031 | 0.028 | 0.018 | 0.049 |
| 25-Nov-91 | 0.241 | 0.006 | 0.234 | 0.089 | 0.330 | 1.345 | 1.015 | 0.003 | 0.050 | 0.047 | 0.020 | 0.069 |
| 10-Dec-91 | 0.233 | 0.026 | 0.207 | 0.014 | 0.247 | 1.847 | 1.600 | 0.006 | 0.087 | 0.082 | 0.020 | 0.107 |

## Woonasquatucket River at Rt. 44 in North Providence, RI
## Nutrient Concentrations

| Date | Diss. NO2+NO3 (mg/l as N) | Diss. NO2 (mg/l as N) | Diss. NO3 (mg/l as N) | Diss. NH4 (mg/l as N) | Diss. Inorg. N (mg/l as N) | Total Diss. N (mg/l as N) | Diss. Org. N (mg/l as N) | Diss. Inorg. P (mg/l as P) | Total Diss. P (mg/l as P) | Diss. Org. P (mg/l as P) | Particulate P (mg/l as P) | Total P (mg/l as P) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12-Jan-92 | 0.000 | 0.004 | 0.000 | 0.076 | 0.076 | 0.973 | 0.897 | 0.002 | 0.063 | 0.061 | 0.017 | 0.080 |
| 9-Feb-92 | 0.421 | 0.012 | 0.409 | 0.278 | 0.699 | 1.126 | 0.427 | 0.048 | 0.064 | 0.016 | 0.019 | 0.083 |
| 9-Mar-92 | 0.494 | 0.001 | 0.493 | 0.148 | 0.642 | 1.387 | 0.745 | 0.056 | 0.114 | 0.059 | 0.019 | 0.133 |
| 5-Apr-92 | 0.003 | 0.002 | 0.001 | 0.088 | 0.091 | 0.857 | 0.766 | 0.001 | 0.054 | 0.053 | 0.019 | 0.073 |
| 3-May-92 | 0.183 | 0.003 | 0.181 | 0.151 | 0.334 | 0.386 | 0.052 | 0.004 | 0.058 | 0.054 | 0.017 | 0.074 |
| 7-Jun-92 | 0.175 | 0.011 | 0.164 | 0.058 | 0.233 | 0.930 | 0.697 | 0.007 | 0.030 | 0.023 | 0.012 | 0.042 |
| 12-Jul-92 | 0.494 | 0.003 | 0.491 | 0.137 | 0.630 | 1.618 | 0.988 | 0.187 | 0.274 | 0.088 | 0.302 | 0.577 |
| 10-Aug-92 | 0.700 | 0.015 | 0.686 | 0.198 | 0.899 | 1.716 | 0.817 | 0.261 | 0.705 | 0.444 | 0.439 | 1.144 |
| 6-Sep-92 | 0.010 | 0.003 | 0.007 | 0.613 | 0.623 | 0.493 | 0.000 | 0.157 | 0.444 | 0.287 | 0.090 | 0.533 |
| 4-Oct-92 | 0.692 | 0.033 | 0.659 | 0.184 | 0.876 | 1.864 | 0.988 | 0.022 | 0.217 | 0.195 | 0.065 | 0.282 |
| 8-Nov-92 | 0.799 | 0.002 | 0.797 | 1.043 | 1.842 | 1.074 | 0.000 | 0.159 | 0.046 | 0.000 | 0.050 | 0.095 |
| 6-Dec-92 | 0.264 | 0.009 | 0.255 | 0.274 | 0.538 | 1.280 | 0.742 | 0.071 | 0.126 | 0.056 | 0.153 | 0.279 |
| 10-Jan-93 | 0.391 | 0.004 | 0.386 | 0.232 | 0.622 | 1.294 | 0.672 | 0.004 | 0.039 | 0.035 | 0.062 | 0.102 |
| 7-Feb-93 | 0.469 | 0.007 | 0.462 | 0.609 | 1.078 | 2.500 | 1.422 | 0.034 | 0.088 | 0.054 | 0.269 | 0.357 |
| 8-Mar-93 | 0.423 | 0.007 | 0.416 | 0.333 | 0.756 | 1.229 | 0.474 | 0.013 | 0.039 | 0.026 | 0.026 | 0.065 |
| 4-Apr-93 | 0.255 | 0.005 | 0.250 | 0.320 | 0.575 | 1.020 | 0.445 | 0.006 | 0.013 | 0.007 | 0.022 | 0.035 |
| 9-May-93 | 0.630 | 0.002 | 0.628 | 0.798 | 1.428 | 3.062 | 1.634 | 0.143 | 0.178 | 0.035 | 0.084 | 0.262 |
| 6-Jun-93 | 0.501 | 0.002 | 0.500 | 1.188 | 1.689 | 2.150 | 0.460 | 0.066 | 0.156 | 0.090 | 0.013 | 0.169 |
| 11-Jul-93 | 1.465 | 0.084 | 1.381 | 0.045 | 1.511 | 3.489 | 1.978 | 0.333 | 0.537 | 0.204 | 0.113 | 0.650 |
| 14-Aug-93 | 1.632 | 0.008 | 1.624 | 0.449 | 2.081 | 3.148 | 1.067 | 0.349 | 0.496 | 0.146 | 0.030 | 0.526 |
| | | | | | | | | | | | | |
| Avg. 1990 | 0.179 | 0.009 | 0.170 | 0.068 | 0.246 | 1.101 | 0.855 | 0.029 | 0.093 | 0.063 | 0.076 | 0.173 |
| Avg. 1991 | 0.686 | 0.011 | 0.675 | 0.206 | 0.892 | 1.889 | 0.997 | 0.070 | 0.139 | 0.069 | 0.049 | 0.187 |
| Avg. 1992 | 0.353 | 0.008 | 0.345 | 0.271 | 0.624 | 1.142 | 0.593 | 0.081 | 0.183 | 0.111 | 0.100 | 0.283 |
| Avg. 1993 | 0.721 | 0.015 | 0.706 | 0.497 | 1.218 | 2.237 | 1.019 | 0.119 | 0.193 | 0.075 | 0.077 | 0.271 |
| Overall Avg. | 0.558 | 0.011 | 0.548 | 0.255 | 0.813 | 1.682 | 0.887 | 0.076 | 0.154 | 0.080 | 0.069 | 0.224 |

## Woonasquatucket River at Valley St. in Providence, RI
## Nutrient Concentrations

| DATE | Diss. NO2+NO3 (mg/l as N) | Diss. NO2 (mg/l as N) | Diss. NO3 (mg/l as N) | Diss. NH4 (mg/l as N) | Diss. Inorg. N (mg/l as N) | Total Diss. N (mg/l as N) | Diss. Org. N (mg/l as N) | Diss. Inorg. P (mg/l as P) | Total Diss. P (mg/l as P) | Diss. Org P (mg/l as P) | Particulate P (mg/l as P) | Total P (mg/l as P) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15-Oct-90 | 0.002 | 0.003 | 0.000 | 0.009 | 0.011 | 0.974 | 0.964 | 0.022 | 0.087 | 0.065 | 0.068 | 0.155 |
| 29-Oct-90 | 0.003 | 0.003 | 0.000 | 0.008 | 0.011 | 0.562 | 0.551 | 0.020 | 0.031 | 0.011 | 0.085 | 0.116 |
| 13-Nov-90 | 0.305 | 0.014 | 0.291 | 0.007 | 0.312 | 0.808 | 0.496 | 0.013 | 0.053 | 0.040 | 0.124 | 0.177 |
| 26-Nov-90 | 0.322 | 0.026 | 0.296 | 0.095 | 0.418 | 1.043 | 0.625 | 0.059 | 0.101 | 0.042 | 0.077 | 0.178 |
| 12-Dec-90 | 0.211 | 0.002 | 0.209 | 0.004 | 0.215 | 0.923 | 0.709 | 0.004 | 0.070 | 0.066 | 0.084 | 0.154 |
| 6-Jan-91 | 0.474 | 0.002 | 0.472 | 0.187 | 0.661 | 1.395 | 0.734 | 0.052 | 0.089 | 0.037 | 0.045 | 0.134 |
| 21-Jan-91 | 0.395 | 0.009 | 0.386 | 0.177 | 0.572 | 1.363 | 0.791 | 0.027 | 0.072 | 0.045 | 0.036 | 0.108 |
| 3-Feb-91 | 0.569 | 0.032 | 0.536 | 0.082 | 0.651 | 1.141 | 0.490 | 0.021 | 0.062 | 0.040 | 0.062 | 0.123 |
| 18-Feb-91 | 0.298 | 0.003 | 0.296 | 0.271 | 0.569 | 1.240 | 0.671 | 0.032 | 0.075 | 0.044 | 0.065 | 0.140 |
| 3-Mar-91 | 0.528 | 0.007 | 0.521 | 0.076 | 0.604 | 0.083 | 0.000 | 0.010 | 0.017 | 0.007 | 0.096 | 0.114 |
| 17-Mar-91 | 0.212 | 0.018 | 0.193 | 0.098 | 0.310 | 0.931 | 0.621 | 0.005 | 0.052 | 0.047 | 0.088 | 0.141 |
| 1-Apr-91 | 0.299 | 0.003 | 0.296 | 0.065 | 0.364 | 0.953 | 0.589 | 0.005 | 0.045 | 0.040 | 0.080 | 0.125 |
| 14-Apr-91 | 0.344 | 0.003 | 0.341 | 0.139 | 0.483 | 1.103 | 0.620 | 0.009 | 0.081 | 0.072 | 0.088 | 0.169 |
| 28-Apr-91 | 0.475 | 0.005 | 0.470 | 0.007 | 0.482 | 0.951 | 0.469 | 0.005 | 0.047 | 0.042 | 0.064 | 0.111 |
| 12-May-91 | 0.514 | 0.022 | 0.491 | 0.027 | 0.541 | 0.767 | 0.226 | 0.031 | 0.048 | 0.017 | 0.049 | 0.097 |
| 27-May-91 | 0.586 | 0.031 | 0.555 | 0.006 | 0.592 | 1.239 | 0.647 | 0.046 | 0.031 | 0.000 | 0.076 | 0.107 |
| 10-Jun-91 | 0.346 | 0.004 | 0.342 | 0.078 | 0.424 | 1.813 | 1.389 | 0.036 | 0.102 | 0.066 | 0.028 | 0.130 |
| 23-Jun-91 | 0.390 | 0.006 | 0.384 | 0.035 | 0.425 | 1.863 | 1.439 | 0.029 | 0.109 | 0.080 | 0.032 | 0.141 |
| 8-Jul-91 | 0.152 | 0.005 | 0.147 | 0.196 | 0.348 | 1.237 | 0.890 | 0.030 | 0.124 | 0.095 | 0.037 | 0.162 |
| 21-Jul-91 | 0.008 | 0.008 | 0.000 | 0.034 | 0.041 | 0.675 | 0.634 | 0.012 | 0.060 | 0.048 | 0.112 | 0.172 |
| 4-Aug-91 | 1.256 | 0.029 | 1.227 | 0.367 | 1.623 | 2.610 | 0.987 | 0.064 | 0.149 | 0.085 | 0.140 | 0.289 |
| 18-Aug-91 | 1.866 | 0.009 | 1.856 | 0.110 | 1.975 | 3.307 | 1.332 | 0.073 | 0.178 | 0.105 | 0.082 | 0.260 |
| 2-Sep-91 | 0.713 | 0.007 | 0.706 | 0.017 | 0.731 | 1.347 | 0.616 | 0.009 | 0.083 | 0.074 | 0.021 | 0.104 |
| 15-Sep-91 | 1.180 | 0.011 | 1.169 | 0.015 | 1.195 | 2.128 | 0.932 | 0.089 | 0.172 | 0.083 | 0.037 | 0.209 |
| 30-Sep-91 | 0.507 | 0.017 | 0.490 | 0.090 | 0.597 | 1.465 | 0.868 | 0.034 | 0.114 | 0.080 | 0.015 | 0.129 |
| 13-Oct-91 | 0.375 | 0.010 | 0.365 | 0.200 | 0.575 | 0.983 | 0.868 | 0.036 | 0.050 | 0.014 | 0.021 | 0.071 |
| 27-Oct-91 | 0.243 | 0.009 | 0.233 | 0.144 | 0.386 | 1.176 | 0.790 | 0.045 | 0.111 | 0.066 | 0.019 | 0.130 |
| 10-Nov-91 | 0.304 | 0.006 | 0.299 | 0.124 | 0.428 | 1.007 | 0.579 | 0.003 | 0.034 | 0.032 | 0.020 | 0.055 |
| 24-Nov-91 | 0.284 | 0.007 | 0.277 | 0.183 | 0.467 | 1.173 | 0.707 | 0.008 | 0.062 | 0.054 | 0.019 | 0.081 |

## Woonasquatucket River at Valley St. in Providence, RI
## Nutrient Concentrations

| DATE | Diss. NO2+NO3 (mg/l as N) | Diss. NO2 (mg/l as N) | Diss. NO3 (mg/l as N) | Diss. NH4 (mg/l as N) | Diss. Inorg. N (mg/l as N) | Total Diss. N (mg/l as N) | Diss. Org. N (mg/l as N) | Diss. Inorg. P (mg/l as P) | Total Diss. P (mg/l as P) | Diss. Org P (mg/l as P) | Particulate P (mg/l as P) | Total P (mg/l as P) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9-Feb-92 | 0.213 | 0.017 | 0.197 | 0.007 | 0.220 | 1.321 | 1.101 | 0.016 | 0.091 | 0.075 | 0.026 | 0.117 |
| 8-Mar-92 | 1.185 | 0.004 | 1.181 | 0.647 | 1.832 | 2.219 | 0.387 | 0.070 | 0.112 | 0.042 | 0.020 | 0.133 |
| 4-Apr-92 | 0.511 | 0.004 | 0.507 | 0.069 | 0.579 | 1.398 | 0.819 | 0.009 | 0.081 | 0.072 | 0.028 | 0.110 |
| 3-May-92 | 0.436 | 0.006 | 0.429 | 0.341 | 0.777 | 0.803 | 0.026 | 0.046 | 0.075 | 0.028 | 0.028 | 0.103 |
| 6-Jun-92 | 0.379 | 0.015 | 0.364 | 0.507 | 0.886 | 1.922 | 1.036 | 0.029 | 0.082 | 0.053 | | |
| 12-Jul-92 | 0.461 | 0.005 | 0.455 | 0.143 | 0.603 | 1.604 | 1.001 | 0.009 | 0.069 | 0.060 | 0.080 | 0.149 |
| 10-Aug-92 | 0.242 | 0.006 | 0.237 | 0.013 | 0.255 | 1.064 | 0.809 | 0.028 | 0.110 | 0.082 | 0.070 | 0.180 |
| 6-Sep-92 | 0.816 | 0.010 | 0.806 | 0.528 | 1.344 | 0.494 | 0.000 | 0.020 | 0.086 | 0.065 | | |
| 4-Oct-92 | 0.737 | 0.019 | 0.718 | 0.459 | 1.197 | 2.332 | 1.135 | 0.111 | 0.081 | 0.000 | | |
| 8-Nov-92 | 0.930 | 0.027 | 0.902 | 0.597 | 1.527 | 2.318 | 0.791 | 0.131 | 0.139 | 0.009 | 0.066 | 0.205 |
| 5-Dec-92 | 0.429 | 0.022 | 0.407 | 0.021 | 0.450 | 1.259 | 0.809 | 0.017 | 0.062 | 0.044 | 0.075 | 0.136 |
| 10-Jan-93 | 0.539 | 0.008 | 0.531 | 0.357 | 0.896 | 1.648 | 0.753 | 0.032 | 0.055 | 0.023 | 0.130 | 0.184 |
| 7-Feb-93 | 0.699 | 0.009 | 0.690 | 0.763 | 1.462 | 1.881 | 0.419 | 0.015 | 0.047 | 0.031 | 0.015 | 0.061 |
| 7-Mar-93 | 0.566 | 0.008 | 0.558 | 0.350 | 0.916 | 1.509 | 0.592 | 0.012 | 0.046 | 0.034 | 0.038 | 0.085 |
| 6-Apr-93 | 0.790 | 0.008 | 0.782 | 0.139 | 0.929 | 1.496 | 0.567 | 0.007 | 0.040 | 0.033 | 0.038 | 0.078 |
| 8-May-93 | 0.933 | 0.006 | 0.927 | 0.087 | 1.020 | 1.729 | 0.709 | 0.009 | 0.034 | 0.025 | 0.048 | 0.081 |
| 6-Jun-93 | 0.869 | 0.001 | 0.868 | 0.954 | 1.823 | 2.554 | 0.731 | 0.069 | 0.099 | 0.030 | 0.048 | 0.147 |
| 13-Jul-93 | 0.773 | 0.027 | 0.746 | 0.148 | 0.922 | 2.190 | 1.268 | 0.100 | 0.150 | 0.050 | 0.174 | 0.324 |
| 15-Aug-93 | 0.664 | 0.006 | 0.658 | 0.472 | 1.136 | 2.405 | 1.269 | 0.018 | 0.076 | 0.058 | 0.029 | 0.105 |
| Avg. 1990 | 0.169 | 0.010 | 0.159 | 0.025 | 0.193 | 0.862 | 0.669 | 0.023 | 0.068 | 0.045 | 0.087 | 0.156 |
| Avg. 1991 | 0.513 | 0.011 | 0.502 | 0.114 | 0.627 | 1.331 | 0.745 | 0.030 | 0.082 | 0.053 | 0.056 | 0.138 |
| Avg. 1992 | 0.576 | 0.012 | 0.564 | 0.303 | 0.879 | 1.521 | 0.719 | 0.044 | 0.090 | 0.048 | 0.049 | 0.142 |
| Avg. 1993 | 0.729 | 0.009 | 0.720 | 0.409 | 1.138 | 1.927 | 0.789 | 0.033 | 0.068 | 0.035 | 0.065 | 0.133 |
| Overall Avg. | 0.528 | 0.011 | 0.517 | 0.197 | 0.725 | 1.425 | 0.739 | 0.033 | 0.080 | 0.048 | 0.060 | 0.140 |

## Moshassuck River at Bonanza Bus Station in Providence, RI
## Nutrient Concentrations

| Sampling Date | Diss. NO2+NO3 (mg/l as N) | Diss. NO2 (mg/l as N) | Diss. NO3 (mg/l as N) | Diss. NH4 (mg/l as N) | Diss. Inorg. N (mg/l as N) | Total Diss. N (mg/l as N) | Diss. Org. N (mg/l as N) | Diss. Inorg. P (mg/l as P) | Total Diss. P (mg/l as P) | Diss. Org. P (mg/l as P) | Particulate p (mg/l as P) | Total P (mg/l as P) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10-Feb-92 | 0.731 | 0.007 | 0.724 | 0.262 | 0.993 | 1.374 | 0.381 | 0.013 | 0.010 | | 0.020 | 0.030 |
| 16-Mar-92 | 0.589 | 0.009 | 0.581 | 0.094 | 0.683 | 1.162 | 0.479 | 0.005 | 0.027 | 0.021 | 0.033 | 0.059 |
| 5-Apr-92 | 0.486 | 0.010 | 0.476 | 0.009 | 0.495 | 0.840 | 0.345 | 0.003 | 0.016 | 0.013 | 0.021 | 0.037 |
| 3-May-92 | 0.461 | 0.008 | 0.453 | 0.544 | 1.005 | 0.830 | | 0.038 | 0.094 | 0.055 | 0.056 | 0.149 |
| 8-Jun-92 | 0.292 | 0.020 | 0.272 | 0.179 | 0.471 | 1.031 | 0.559 | 0.018 | 0.041 | 0.024 | 0.010 | 0.051 |
| 11-Jul-92 | 0.652 | 0.039 | 0.613 | 0.037 | 0.689 | 1.365 | 0.676 | 0.019 | 0.033 | 0.015 | 0.072 | 0.106 |
| 6-Sep-92 | 0.704 | 0.020 | 0.683 | 0.288 | 0.991 | 1.361 | 0.370 | 0.007 | 0.019 | 0.012 | 0.000 | 0.000 |
| 6-Dec-92 | 0.546 | 0.013 | 0.533 | 0.174 | 0.719 | 1.259 | 0.539 | 0.011 | 0.020 | 0.009 | 0.113 | 0.133 |
| 12-Jan-93 | 0.831 | 0.012 | 0.819 | 0.326 | 1.157 | 1.613 | 0.456 | 0.012 | 0.018 | 0.006 | 0.042 | 0.060 |
| 5-Feb-93 | 0.931 | 0.012 | 0.919 | 0.323 | 1.254 | 1.502 | 0.248 | 0.018 | 0.055 | 0.037 | 0.061 | 0.116 |
| 7-Mar-93 | 0.641 | 0.016 | 0.625 | 0.404 | 1.045 | 1.650 | 0.805 | 0.028 | 0.068 | 0.039 | 0.006 | 0.074 |
| 5-Apr-93 | 0.436 | 0.009 | 0.427 | 0.236 | 0.672 | 1.267 | 0.595 | 0.011 | 0.074 | 0.063 | 0.080 | 0.155 |
| Avg. 1992 | 0.558 | 0.016 | 0.542 | 0.198 | 0.756 | 1.153 | 0.479 | 0.014 | 0.032 | 0.021 | 0.041 | 0.071 |
| Avg. 1993 | 0.710 | 0.012 | 0.697 | 0.322 | 1.032 | 1.558 | 0.526 | 0.017 | 0.054 | 0.036 | 0.047 | 0.101 |
| Overall Avg. | 0.608 | 0.015 | 0.594 | 0.240 | 0.848 | 1.288 | 0.496 | 0.015 | 0.040 | 0.027 | 0.043 | 0.081 |

## Moshassuck River at Charles St. in Providence, RI
## Nutrient Concentrations

| Sampling Date | Diss. NO2+NO3 (mg/l as N) | Diss. NO2 (mg/l as N) | Diss. NO3 (mg/l as N) | Diss. NH4 (mg/l as N) | Diss. Inorg. N (mg/l as N) | Total Diss. N (mg/l as N) | Diss. Org. N (mg/l as N) | Diss. Inorg. P (mg/l as P) | Total Diss. P (mg/l as P) | Diss. Org. P (mg/l as P) | Particulate P (mg/l as P) | Total P (mg/l as P) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15-Oct-90 | 0.230 | 0.004 | 0.226 | 0.004 | 0.234 | 0.864 | 0.629 | 0.002 | 0.031 | 0.028 | 0.101 | 0.132 |
| 29-Oct-90 | 0.413 | 0.011 | 0.403 | 0.006 | 0.420 | 1.083 | 0.663 | 0.002 | 0.012 | 0.009 | 0.063 | 0.075 |
| 13-Nov-90 | 0.401 | 0.008 | 0.393 | 0.064 | 0.465 | 0.805 | 0.340 | 0.004 | 0.019 | 0.015 | 0.059 | 0.078 |
| 26-Nov-90 | 0.554 | 0.012 | 0.542 | 0.116 | 0.670 | 0.969 | 0.299 | 0.006 | 0.017 | 0.012 | 0.132 | 0.149 |
| 10-Dec-90 | 0.474 | 0.013 | 0.462 | 0.014 | 0.489 | 0.947 | 0.459 | 0.004 | 0.020 | 0.016 | 0.082 | 0.102 |
| 7-Jan-91 | 0.765 | 0.011 | 0.754 | 0.089 | 0.854 | 1.125 | 0.271 | 0.006 | 0.012 | 0.006 | 0.081 | 0.094 |
| 23-Jan-91 | 0.803 | 0.010 | 0.793 | 0.074 | 0.877 | 1.608 | 0.732 | 0.006 | 0.020 | 0.014 | 0.086 | 0.106 |
| 4-Feb-91 | 0.813 | 0.011 | 0.802 | 0.127 | 0.940 | 1.258 | 0.318 | 0.008 | 0.011 | 0.004 | 0.063 | 0.074 |
| 19-Feb-91 | 0.809 | 0.013 | 0.796 | 0.204 | 1.014 | 1.881 | 0.867 | 0.005 | 0.014 | 0.009 | 0.083 | 0.097 |
| 4-Mar-91 | 0.434 | 0.007 | 0.427 | 0.074 | 0.508 | 0.607 | 0.099 | 0.002 | 0.012 | 0.011 | 0.166 | 0.178 |
| 18-Mar-91 | 0.652 | 0.010 | 0.641 | 0.004 | 0.656 | 0.624 | 0.000 | 0.004 | 0.006 | 0.002 | 0.051 | 0.057 |
| 1-Apr-91 | 0.762 | 0.011 | 0.751 | 0.037 | 0.799 | 1.710 | 0.911 | 0.001 | 0.017 | 0.015 | 0.039 | 0.056 |
| 15-Apr-91 | 0.613 | 0.014 | 0.599 | 0.074 | 0.687 | 2.048 | 1.361 | 0.003 | 0.011 | 0.008 | 0.050 | 0.061 |
| 29-Apr-91 | 0.464 | 0.008 | 0.456 | 0.008 | 0.472 | 0.842 | 0.370 | 0.000 | 0.003 | 0.002 | 0.037 | 0.039 |
| 13-May-91 | 0.440 | 0.015 | 0.426 | 0.137 | 0.578 | 0.707 | 0.129 | 0.004 | 0.030 | 0.026 | 0.039 | 0.069 |
| 10-Jun-91 | 0.575 | 0.031 | 0.544 | 0.193 | 0.768 | 1.966 | 1.199 | 0.009 | 0.031 | 0.022 | 0.033 | 0.064 |
| 24-Jun-91 | 0.695 | 0.037 | 0.658 | 0.385 | 1.080 | 2.138 | 1.057 | 0.007 | 0.014 | 0.008 | 0.037 | 0.052 |
| 8-Jul-91 | 0.643 | 0.010 | 0.633 | 0.006 | 0.650 | 1.463 | 0.813 | 0.008 | 0.051 | 0.043 | 0.066 | 0.118 |
| 22-Jul-91 | 0.542 | 0.013 | 0.529 | 0.002 | 0.544 | 1.296 | 0.752 | 0.007 | 0.016 | 0.009 | 0.032 | 0.048 |
| 5-Aug-91 | 0.467 | 0.026 | 0.441 | 0.003 | 0.470 | 2.115 | 1.645 | 0.009 | 0.030 | 0.021 | 0.030 | 0.060 |
| 3-Sep-91 | 0.711 | 0.004 | 0.707 | 0.022 | 0.733 | 1.146 | 0.413 | 0.005 | 0.018 | 0.014 | 0.000 | 0.018 |
| 16-Sep-91 | 0.667 | 0.015 | 0.652 | 0.048 | 0.714 | 1.314 | 0.599 | 0.006 | 0.029 | 0.023 | 0.029 | 0.058 |
| 30-Sep-91 | 0.481 | 0.011 | 0.470 | 0.053 | 0.534 | 0.960 | 0.426 | 0.005 | 0.046 | 0.041 | 0.011 | 0.057 |
| 15-Oct-91 | 0.456 | 0.039 | 0.417 | 0.031 | 0.487 | 1.023 | 0.535 | 0.008 | 0.008 | 0.000 | 0.015 | 0.024 |
| 28-Oct-91 | 0.433 | 0.018 | 0.416 | 0.051 | 0.484 | 0.983 | 0.499 | 0.003 | 0.025 | 0.022 | 0.015 | 0.040 |
| 11-Nov-91 | 0.325 | 0.007 | 0.318 | 0.001 | 0.325 | 0.567 | 0.241 | 0.004 | 0.026 | 0.022 | 0.030 | 0.056 |
| 25-Nov-91 | 0.389 | 0.068 | 0.321 | 0.004 | 0.394 | 0.719 | 0.326 | 0.002 | 0.023 | 0.021 | 0.016 | 0.039 |
| 9-Dec-91 | 0.626 | 0.014 | 0.613 | 0.068 | 0.694 | 1.254 | 0.560 | 0.005 | 0.025 | 0.020 | 0.015 | 0.040 |
| 30-Dec-91 | 0.678 | 0.015 | 0.663 | 0.000 | 0.678 | 1.248 | 0.570 | 0.006 | 0.014 | 0.007 | 0.016 | 0.030 |

## Moshassuck River at Charles St. in Providence, RI
## Nutrient Concentrations

| Sampling Date | Diss. NO2+NO3 (mg/l as N) | Diss. NO2 (mg/l as N) | Diss. NO3 (mg/l as N) | Diss. NH4 (mg/l as N) | Diss. Inorg. N (mg/l as N) | Total Diss. N (mg/l as N) | Diss. Org. N (mg/l as N) | Diss. Inorg. P (mg/l as P) | Total Diss. P (mg/l as P) | Diss. Org. P (mg/l as P) | Particulate P (mg/l as P) | Total P (mg/l as P) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8-Feb-92 | 0.807 | 0.013 | 0.794 | 0.133 | 0.940 | 3.351 | 2.410 | 0.008 | 0.170 | 0.162 | 0.016 | 0.186 |
| 7-Mar-92 | 0.745 | 0.002 | 0.743 | 0.297 | 1.042 | 1.515 | 0.473 | 0.007 | 0.041 | 0.033 | 0.036 | 0.077 |
| 4-Apr-92 | 0.635 | 0.007 | 0.628 | 0.000 | 0.635 | 1.043 | 0.407 | 0.002 | 0.027 | 0.025 | 0.019 | 0.046 |
| 2-May-92 | 0.704 | 0.014 | 0.690 | 0.099 | 0.803 | 0.664 | 0.000 | 0.006 | 0.013 | 0.007 | 0.026 | 0.039 |
| 6-Jun-92 | 0.285 | 0.015 | 0.270 | 0.035 | 0.321 | 0.882 | 0.561 | 0.009 | 0.038 | 0.029 | 0.061 | 0.098 |
| 11-Jul-92 | 0.720 | 0.029 | 0.691 | 0.317 | 1.037 | 1.250 | 0.213 | 0.055 | 0.027 | 0.000 | 0.067 | 0.094 |
| 10-Aug-92 | 1.483 | 0.054 | 1.429 | 0.001 | 1.484 | 1.072 | 0.000 | 0.011 | 0.039 | 0.028 | 0.132 | 0.171 |
| 1-Sep-92 | 0.614 | 0.020 | 0.594 | 0.175 | 0.789 | 1.340 | 0.551 | 0.005 | 0.033 | 0.028 | 0.000 | 0.033 |
| 4-Oct-92 | 0.782 | 0.026 | 0.757 | 0.144 | 0.926 | 6.605 | 5.679 | 0.002 | 0.555 | 0.553 | 0.000 | 0.555 |
| 5-Dec-92 | 0.644 | 0.013 | 0.631 | 0.256 | 0.900 | 1.476 | 0.575 | 0.011 | 0.034 | 0.023 | 0.077 | 0.112 |
| 9-Jan-93 | 0.850 | 0.007 | 0.843 | 0.187 | 1.037 | 1.644 | 0.607 | 0.004 | 0.009 | 0.005 | 0.022 | 0.031 |
| 6-Feb-93 | 0.927 | 0.023 | 0.905 | 0.181 | 1.108 | 1.242 | 0.133 | 0.007 | 0.036 | 0.029 | 0.056 | 0.092 |
| 6-Mar-93 | 0.747 | 0.009 | 0.737 | 0.191 | 0.938 | 1.197 | 0.259 | 0.002 | 0.027 | 0.025 | 0.021 | 0.048 |
| 4-Apr-93 | 0.473 | 0.007 | 0.466 | 0.062 | 0.534 | 1.973 | 1.439 | 0.003 | 0.040 | 0.037 | 0.031 | 0.071 |
| 8-May-93 | 0.389 | 0.018 | 0.371 | 0.055 | 0.444 | 1.648 | 1.204 | 0.005 | 0.027 | 0.022 | 0.046 | 0.072 |
| 5-Jun-93 | 0.465 | 0.045 | 0.420 | 0.457 | 0.923 | 2.252 | 1.330 | 0.020 | 0.067 | 0.047 | 0.072 | 0.139 |
| Avg. 1990 | 0.414 | 0.009 | 0.405 | 0.041 | 0.455 | 0.934 | 0.478 | 0.004 | 0.020 | 0.016 | 0.087 | 0.107 |
| Avg. 1991 | 0.593 | 0.017 | 0.576 | 0.071 | 0.664 | 1.275 | 0.612 | 0.005 | 0.021 | 0.015 | 0.043 | 0.064 |
| Avg. 1992 | 0.742 | 0.019 | 0.723 | 0.146 | 0.888 | 1.920 | 1.087 | 0.012 | 0.098 | 0.089 | 0.043 | 0.141 |
| Avg. 1993 | 0.642 | 0.018 | 0.624 | 0.189 | 0.831 | 1.659 | 0.829 | 0.007 | 0.034 | 0.027 | 0.041 | 0.076 |
| Overall Avg. | 0.613 | 0.017 | 0.596 | 0.100 | 0.713 | 1.432 | 0.732 | 0.007 | 0.039 | 0.033 | 0.048 | 0.087 |

## Pawtuxet River at Natick (East) Ave.
## Nutrient Concentrations

| Sampling Date | Diss. NO2+NO3 (mg/l as N) | Diss. NO2 (mg/l as N) | Diss. NO3 (mg/l as N) | Diss. NH4 (mg/l as N) | Diss. Inorg. N (mg/l as N) | Total Diss. N (mg/l as N) | Diss. Org. N (mg/l as N) | Diss. Inorg. P (mg/l as P) | Total Diss. P (mg/l as P) | Diss. Org. P (mg/l as P) | Particulate P (mg/l as P) | Total P (mg/l as P) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8-Feb-92 | 0.371 | 0.008 | 0.362 | 0.167 | 0.538 | 1.078 | 0.541 | 0.004 | 0.011 | 0.007 | 0.011 | 0.021 |
| 9-Mar-92 | 0.367 | 0.004 | 0.363 | 0.302 | 0.669 | 1.555 | 0.886 | 0.003 | 0.029 | 0.026 | 0.008 | 0.037 |
| 4-Apr-92 | 0.030 | 0.002 | 0.028 | 0.002 | 0.032 | 0.770 | 0.738 | 0.002 | 0.052 | 0.050 | 0.009 | 0.061 |
| 4-May-92 | 0.401 | 0.016 | 0.385 | 0.577 | 0.978 | 0.863 | | 0.016 | 0.055 | 0.039 | 0.007 | 0.062 |
| 7-Jun-92 | 0.032 | 0.008 | 0.024 | 0.051 | 0.084 | 1.372 | 1.288 | 0.011 | 0.055 | 0.044 | 0.018 | 0.072 |
| 10-Jul-92 | 0.378 | 0.013 | 0.365 | 0.303 | 0.681 | 1.561 | 0.880 | 0.022 | 0.056 | 0.034 | 0.033 | 0.089 |
| 8-Aug-92 | 0.384 | 0.036 | 0.348 | 0.128 | 0.512 | 1.259 | 0.747 | 0.050 | 0.232 | 0.182 | 0.054 | 0.286 |
| 7-Sep-92 | 0.400 | 0.010 | 0.390 | 0.096 | 0.497 | 1.361 | 0.864 | 0.002 | 0.019 | 0.017 | 0.033 | 0.052 |
| 6-Oct-92 | 0.557 | 0.013 | 0.544 | 0.217 | 0.774 | 6.561 | 5.787 | 0.142 | 0.560 | 0.418 | 0.063 | 0.623 |
| | | | | | | | | | | | | |
| 7-Dec-92 | 0.311 | 0.006 | 0.305 | 0.006 | 0.316 | 1.201 | 0.885 | 0.023 | 0.072 | 0.050 | 0.035 | 0.107 |
| 10-Jan-93 | 0.331 | 0.008 | 0.322 | 0.001 | 0.332 | 1.296 | 0.964 | 0.001 | 0.030 | 0.029 | 0.012 | 0.042 |
| 8-Feb-93 | 0.227 | 0.003 | 0.224 | 0.105 | 0.332 | 0.145 | 0.000 | 0.001 | 0.003 | 0.002 | 0.145 | 0.148 |
| 8-Mar-93 | 0.381 | 0.008 | 0.373 | 0.136 | 0.517 | 1.408 | 0.891 | 0.007 | 0.030 | 0.024 | 0.016 | 0.046 |
| 6-Apr-93 | 0.231 | 0.010 | 0.221 | 0.144 | 0.375 | 0.598 | 0.222 | 0.011 | 0.007 | 0.000 | 0.013 | 0.019 |
| 10-May-93 | 0.516 | 0.017 | 0.500 | 0.209 | 0.725 | 1.904 | 1.180 | 0.011 | 0.027 | 0.016 | 0.037 | 0.064 |
| 7-Jun-93 | 0.329 | 0.011 | 0.318 | 0.297 | 0.627 | 1.950 | 1.324 | 0.000 | 0.051 | 0.051 | 0.027 | 0.078 |
| | | | | | | | | | | | | |
| 16-Aug-93 | 0.389 | 0.016 | 0.373 | 0.152 | 0.540 | 0.793 | 0.253 | 0.011 | 0.278 | 0.266 | 0.014 | 0.292 |
| | | | | | | | | | | | | |
| Avg. 1992 | 0.323 | 0.012 | 0.311 | 0.185 | 0.508 | 1.758 | 1.402 | 0.028 | 0.114 | 0.087 | 0.027 | 0.141 |
| Avg. 1993 | 0.344 | 0.010 | 0.333 | 0.149 | 0.493 | 1.156 | 0.690 | 0.006 | 0.061 | 0.055 | 0.038 | 0.098 |
| Overall Avg. | 0.332 | 0.011 | 0.320 | 0.170 | 0.502 | 1.510 | 1.091 | 0.019 | 0.092 | 0.074 | 0.031 | 0.124 |

## Pawtuxet River at Broad St. in Cranston, RI
## Nutrient Concentrations

| Sampling Date | Diss. NO2+NO3 (mg/l as N) | Diss. NO2 (mg/l as N) | Diss. NO3 (mg/l as N) | Diss. NH4 (mg/l as N) | Diss. Inorg. N (mg/l as N) | Total Diss. N (mg/l as N) | Diss. Org. N (mg/l as N) | Diss. Inorg. P (mg/l as P) | Total Diss. P (mg/l as P) | Diss. Org. P (mg/l as P) | Particulate P (mg/l as P) | Total P (mg/l as P) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15-Oct-90 | 0.626 | 0.004 | 0.622 | 0.013 | 0.639 | 2.971 | 2.332 | 0.051 | 0.139 | 0.088 | 0.132 | 0.271 |
| 29-Oct-90 | 1.148 | 0.004 | 1.144 | 1.202 | 2.350 | 1.554 | 0.000 | 0.180 | 0.118 | 0.000 | 0.140 | 0.259 |
| 13-Nov-90 | 0.554 | 0.030 | 0.524 | 0.299 | 0.853 | 1.806 | 0.953 | 0.077 | 0.182 | 0.105 | 0.137 | 0.319 |
| 26-Nov-90 | 0.904 | 0.064 | 0.841 | 1.015 | 1.919 | 2.780 | 0.861 | 0.172 | 0.273 | 0.102 | 0.179 | 0.453 |
| 10-Dec-90 | 0.577 | 0.002 | 0.575 | 0.745 | 1.323 | 2.427 | 1.104 | 0.074 | 0.136 | 0.062 | 0.155 | 0.291 |
| 6-Jan-91 | 0.624 | 0.048 | 0.576 | 0.787 | 1.411 | 2.019 | 0.608 | 0.121 | 0.111 | 0.000 | 0.185 | 0.296 |
| 21-Jan-91 | 0.499 | 0.012 | 0.487 | 0.082 | 0.580 | 1.503 | 0.922 | 0.019 | 0.058 | 0.040 | 0.111 | 0.169 |
| 3-Feb-91 | 0.567 | 0.014 | 0.553 | 0.512 | 1.079 | 2.280 | 1.201 | 0.044 | 0.110 | 0.066 | 0.094 | 0.204 |
| 18-Feb-91 | 0.539 | 0.007 | 0.532 | 0.838 | 1.377 | 2.266 | 0.890 | 0.047 | 0.108 | 0.061 | 0.117 | 0.224 |
| 3-Mar-91 | 0.636 | 0.012 | 0.624 | 0.992 | 1.628 | 2.624 | 0.996 | 0.039 | 0.107 | 0.067 | 0.133 | 0.239 |
| 18-Mar-91 | 0.514 | 0.011 | 0.503 | 0.958 | 1.472 | 3.161 | 1.689 | 0.058 | 0.149 | 0.091 | 0.144 | 0.293 |
| 1-Apr-91 | 0.389 | 0.004 | 0.385 | 0.366 | 0.754 | 2.137 | 1.383 | 0.053 | 0.119 | 0.067 | 0.143 | 0.262 |
| 15-Apr-91 | 0.718 | 0.004 | 0.714 | 1.034 | 1.752 | 2.314 | 0.562 | 0.151 | 0.241 | 0.090 | 0.129 | 0.370 |
| 29-Apr-91 | 0.535 | 0.006 | 0.529 | 0.844 | 1.378 | 4.120 | 2.742 | 0.148 | 0.209 | 0.061 | 0.131 | 0.340 |
| 13-May-91 | 0.551 | 0.032 | 0.520 | 1.106 | 1.658 | 2.238 | 0.581 | 0.103 | 0.215 | 0.112 | 0.137 | 0.352 |
| 28-May-91 | | | | | | | | | | | | |
| 10-Jun-91 | 1.090 | 0.016 | 1.074 | 2.329 | 3.419 | 4.850 | 1.430 | 0.419 | 0.549 | 0.130 | 0.092 | 0.641 |
| 24-Jun-91 | 1.793 | 0.011 | 1.782 | 2.600 | 4.393 | 5.347 | 0.954 | 0.588 | 0.694 | 0.106 | 0.109 | 0.803 |
| 10-Jul-91 | 2.317 | 0.008 | 2.309 | 1.873 | 4.190 | 6.880 | 2.690 | 0.567 | 0.725 | 0.158 | 0.068 | 0.793 |
| 21-Jul-91 | 2.069 | 0.058 | 2.011 | 2.659 | 4.728 | 7.385 | 2.658 | 0.626 | 0.917 | 0.291 | 0.063 | 0.980 |
| 5-Aug-91 | 1.322 | 0.122 | 1.200 | 0.514 | 1.836 | 3.120 | 1.284 | 0.174 | 0.287 | 0.114 | 0.055 | 0.342 |
| 3-Sep-91 | 3.959 | 0.045 | 3.914 | 1.066 | 5.025 | 6.761 | 1.736 | 0.415 | 0.607 | 0.192 | 0.085 | 0.692 |
| 1-Oct-91 | 1.375 | 0.012 | 1.363 | 0.324 | 1.699 | 1.901 | 0.202 | 0.208 | 0.145 | 0.000 | 0.042 | 0.187 |
| 15-Oct-91 | 1.076 | 0.010 | 1.066 | 0.597 | 1.674 | 2.020 | 0.346 | 0.098 | 0.158 | 0.060 | 0.045 | 0.203 |
| 27-Oct-91 | 1.275 | 0.081 | 1.194 | 1.200 | 2.475 | 2.229 | 0.000 | 0.292 | 0.193 | 0.000 | 0.051 | 0.245 |
| 12-Nov-91 | 0.697 | 0.010 | 0.687 | 0.504 | 1.201 | 1.337 | 0.136 | 0.058 | 0.072 | 0.014 | 0.050 | 0.122 |
| 26-Nov-91 | 0.718 | 0.011 | 0.707 | 0.633 | 1.351 | 1.340 | 0.000 | 0.106 | 0.091 | 0.000 | 0.041 | 0.133 |
| 10-Dec-91 | 1.228 | 0.005 | 1.223 | 1.906 | 3.134 | 3.946 | 0.812 | 0.200 | 0.298 | 0.098 | 0.055 | 0.352 |
| 31-Dec-91 | 1.190 | 0.010 | 1.180 | 1.399 | 2.589 | 3.450 | 0.862 | 0.112 | 0.238 | 0.126 | 0.063 | 0.301 |
| 6-Feb-92 | 0.582 | 0.017 | 0.565 | 1.219 | 1.801 | 2.389 | 0.588 | 0.128 | 0.144 | 0.016 | 0.034 | 0.178 |
| 8-Mar-92 | 0.632 | 0.009 | 0.623 | 0.514 | 1.146 | 1.817 | 0.670 | 0.072 | 0.112 | 0.040 | 0.042 | 0.153 |
| 6-Apr-92 | 0.003 | 0.000 | 0.003 | 0.369 | 0.372 | 2.135 | 1.763 | 0.001 | 0.215 | 0.215 | 0.049 | 0.264 |
| 6-Jun-92 | 0.567 | 0.039 | 0.528 | 1.117 | 1.684 | 3.430 | 1.746 | 0.055 | 0.170 | 0.115 | 0.120 | 0.291 |
| 11-Jul-92 | 1.866 | 0.082 | 1.783 | 1.357 | 3.222 | 5.346 | 2.124 | 0.193 | 0.462 | 0.269 | 0.193 | 0.655 |
| 10-Aug-92 | 0.949 | 0.085 | 0.864 | 0.361 | 1.310 | 2.560 | 1.249 | 0.070 | 0.281 | 0.212 | 0.081 | 0.362 |
| 6-Sep-92 | 1.122 | 0.064 | 1.058 | 1.161 | 2.283 | 4.039 | 1.755 | 0.174 | 0.393 | 0.220 | 0.094 | 0.488 |
| 8-Nov-92 | 1.309 | 0.008 | 1.301 | 1.298 | 2.607 | 3.502 | 0.895 | 0.220 | 0.418 | 0.198 | 0.057 | 0.475 |
| 6-Dec-92 | 0.703 | 0.021 | 0.682 | 0.479 | 1.182 | 2.432 | 1.250 | 0.067 | 0.159 | 0.091 | 0.165 | 0.324 |

## Pawtuxet River at Broad St. in Cranston, RI
## Nutrient Concentrations

| Sampling Date | Diss. NO2+NO3 (mg/l as N) | Diss. NO2 (mg/l as N) | Diss. NO3 (mg/l as N) | Diss. NH4 (mg/l as N) | Diss. Inorg. N (mg/l as N) | Total Diss. N (mg/l as N) | Diss. Org. N (mg/l as N) | Diss. Inorg. P (mg/l as P) | Total Diss. P (mg/l as P) | Diss. Org. P (mg/l as P) | Particulate P (mg/l as P) | Total P (mg/l as P) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10-Jan-93 | 0.536 | 0.009 | 0.527 | 0.600 | 1.137 | 1.849 | 0.712 | 0.063 | 0.148 | 0.085 | 0.110 | 0.258 |
| 6-Feb-93 | 0.796 | 0.013 | 0.783 | 1.375 | 2.171 | 3.246 | 1.075 | 0.126 | 0.197 | 0.071 | 0.035 | 0.232 |
| 6-Mar-93 | 0.561 | 0.010 | 0.552 | 0.800 | 1.362 | 2.333 | 0.972 | 0.090 | 0.109 | 0.019 | 0.059 | 0.168 |
| 3-Apr-93 | 0.271 | 0.006 | 0.265 | 0.094 | 0.365 | 1.221 | 0.856 | 0.006 | 0.032 | 0.026 | 0.119 | 0.151 |
| 2-May-93 | 1.024 | 0.002 | 1.022 | 0.802 | 1.826 | 2.079 | 0.253 | 0.071 | 0.095 | 0.024 | 0.115 | 0.211 |
| 5-Jun-93 | 0.818 | 0.014 | 0.804 | 3.319 | 4.137 | 6.118 | 1.980 | 0.446 | 0.454 | 0.008 | 0.194 | 0.648 |
| 10-Jul-93 | 1.866 | 0.615 | 1.251 | 4.103 | 5.969 | 7.753 | 1.784 | 0.334 | 0.541 | 0.208 | 0.084 | 0.626 |
| 8-Aug-93 | 3.630 | 0.598 | 3.032 | 3.477 | 7.107 | 9.242 | 2.135 | 0.612 | 0.768 | 0.155 | 0.081 | 0.848 |
| Avg. 1990 | 0.762 | 0.021 | 0.741 | 0.655 | 1.417 | 2.307 | 1.050 | 0.111 | 0.170 | 0.071 | 0.149 | 0.319 |
| Avg. 1991 | 1.070 | 0.023 | 1.047 | 1.047 | 2.209 | 3.271 | 1.073 | 0.202 | 0.267 | 0.084 | 0.089 | 0.356 |
| Avg. 1992 | 0.917 | 0.042 | 0.875 | 0.909 | 1.825 | 2.920 | 1.095 | 0.107 | 0.257 | 0.150 | 0.084 | 0.340 |
| Avg. 1993 | 1.188 | 0.158 | 1.029 | 1.821 | 3.009 | 4.230 | 1.221 | 0.218 | 0.293 | 0.075 | 0.100 | 0.393 |
| Overall Avg. | 1.025 | 0.050 | 0.975 | 1.108 | 2.179 | 3.257 | 1.101 | 0.174 | 0.259 | 0.096 | 0.096 | 0.355 |

## Blackstone River at Blackstone, MA
## Nutrient Concentrations

| Sampling Date | Diss. NO2+NO3 (mg/l as N) | Diss. NO2 (mg/l as N) | Diss. NO3 (mg/l as N) | Diss. NH4 (mg/l as N) | Diss. Inorg N (mg/l as N) | Total Diss. N (mg/l as N) | Diss. Org. N (mg/l as N) | Diss. Inorg. P (mg/l as P) | Total Diss. P (mg/l as P) | Diss. Org. P (mg/l as P) | Particulate P (mg/l as P) | Total P (mg/l as P) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15-Oct-90 | 0.410 | 0.004 | 0.406 | 0.007 | 0.417 | 1.721 | 1.304 | 0.050 | 0.113 | 0.063 | 0.203 | 0.316 |
| 29-Oct-90 | | | | | | | | | | | | |
| 13-Nov-90 | 0.647 | 0.013 | 0.634 | 0.684 | 1.331 | 2.460 | 1.128 | 0.046 | 0.101 | 0.055 | 0.116 | 0.217 |
| 25-Nov-90 | 0.900 | 0.055 | 0.845 | 1.837 | 2.737 | 3.421 | 0.684 | 0.089 | 0.211 | 0.122 | 0.156 | 0.367 |
| 10-Dec-90 | 0.709 | 0.001 | 0.708 | 0.367 | 1.077 | 2.039 | 0.963 | 0.031 | 0.084 | 0.053 | 0.200 | 0.284 |
| 6-Jan-91 | 0.750 | 0.003 | 0.747 | 1.013 | 1.763 | 3.095 | 1.332 | 0.082 | 0.124 | 0.042 | 0.143 | 0.267 |
| 20-Jan-91 | 0.690 | 0.005 | 0.684 | 0.536 | 1.225 | 2.202 | 0.977 | 0.039 | 0.097 | 0.058 | 0.140 | 0.237 |
| 4-Feb-91 | 2.206 | 0.002 | 2.204 | 0.007 | 2.213 | 2.810 | 0.597 | 0.043 | 0.099 | 0.056 | 0.203 | 0.302 |
| 17-Feb-91 | 0.634 | 0.005 | 0.629 | 0.713 | 1.347 | 1.970 | 0.623 | 0.043 | 0.065 | 0.022 | 0.092 | 0.157 |
| 4-Mar-91 | 0.538 | 0.002 | 0.536 | 0.158 | 0.696 | 2.146 | 1.449 | 0.007 | 0.083 | 0.076 | 0.147 | 0.230 |
| 17-Mar-91 | 0.707 | 0.022 | 0.685 | 0.377 | 1.084 | 2.365 | 1.281 | 0.024 | 0.059 | 0.034 | 0.068 | 0.126 |
| 1-Apr-91 | 0.721 | 0.004 | 0.717 | 0.360 | 1.081 | 1.924 | 0.844 | 0.031 | 0.129 | 0.098 | 0.089 | 0.218 |
| 15-Apr-91 | | | | | | | | | | | | |
| 29-Apr-91 | 1.009 | 0.005 | 1.004 | 0.171 | 1.180 | 1.428 | 0.248 | 0.050 | 0.069 | 0.020 | 0.105 | 0.174 |
| 12-May-91 | 0.913 | 0.004 | 0.910 | 0.327 | 1.240 | 2.493 | 1.253 | 0.034 | 0.087 | 0.053 | 0.106 | 0.193 |
| 28-May-91 | | | | | | | | | | | | |
| 9-Jun-91 | 1.532 | 0.001 | 1.531 | 0.016 | 1.548 | 3.028 | 1.481 | 0.086 | 0.239 | 0.152 | 0.077 | 0.315 |
| 22-Jun-91 | 1.127 | 0.001 | 1.127 | 0.016 | 1.143 | 2.667 | 1.524 | 0.117 | 0.244 | 0.127 | 0.068 | 0.312 |
| 8-Jul-91 | 1.472 | 0.001 | 1.472 | 0.010 | 1.482 | 2.837 | 1.354 | 0.185 | 0.319 | 0.134 | 0.126 | 0.445 |
| 22-Jul-91 | 1.221 | 0.003 | 1.218 | 0.288 | 1.509 | 2.264 | 0.755 | 0.305 | 0.361 | 0.056 | 0.107 | 0.468 |
| 5-Aug-91 | 1.496 | 0.003 | 1.493 | 0.013 | 1.509 | 2.923 | 1.414 | 0.211 | 0.275 | 0.064 | 0.119 | 0.394 |
| | | | | | | | | | | | | |
| 10-Nov-91 | 0.837 | 0.012 | 0.825 | 0.244 | 1.081 | 1.138 | 0.057 | 0.060 | 0.067 | 0.007 | 0.037 | 0.103 |
| 25-Nov-91 | 0.518 | 0.019 | 0.499 | 0.260 | 0.778 | 0.764 | | 0.038 | 0.032 | | 0.038 | 0.069 |
| 8-Dec-91 | 0.566 | 0.021 | 0.544 | 0.415 | 0.981 | 1.897 | 0.916 | 0.009 | 0.067 | 0.058 | 0.029 | 0.096 |
| 29-Dec-91 | 0.942 | 0.007 | 0.935 | 1.340 | 2.282 | 2.903 | 0.621 | 0.020 | 0.079 | 0.059 | 0.048 | 0.127 |
| 12-Jan-92 | 0.770 | 0.025 | 0.744 | 1.507 | 2.277 | 2.881 | 0.604 | 0.083 | 0.117 | 0.034 | 0.034 | 0.151 |
| 7-Feb-92 | 0.843 | 0.020 | 0.823 | 1.036 | 1.879 | 3.351 | 1.472 | 0.075 | 0.170 | 0.095 | 0.054 | 0.224 |
| 6-Mar-92 | 1.244 | 0.006 | 1.237 | 1.196 | 2.440 | 2.790 | 0.350 | 0.122 | 0.172 | 0.049 | 0.063 | 0.234 |
| 7-Apr-92 | 0.864 | 0.003 | 0.861 | 0.380 | 1.244 | 1.855 | 0.611 | 0.009 | 0.075 | 0.066 | 0.073 | 0.148 |
| 3-May-92 | 1.126 | 0.008 | 1.118 | 0.191 | 1.318 | 1.103 | | 0.020 | 0.088 | 0.068 | 0.054 | 0.142 |
| 7-Jun-92 | 0.659 | 0.045 | 0.614 | 0.053 | 0.712 | 1.529 | 0.817 | 0.035 | 0.104 | 0.069 | 0.060 | 0.164 |
| 12-Jul-92 | 1.067 | 0.033 | 1.034 | 0.076 | 1.142 | 1.689 | 0.547 | 0.131 | 0.150 | 0.020 | 0.257 | 0.408 |
| 12-Aug-92 | 1.483 | 0.054 | 1.429 | 0.001 | 1.484 | 2.361 | 0.877 | 0.133 | 0.239 | 0.107 | 0.180 | 0.419 |
| 7-Sep-92 | 0.364 | 0.007 | 0.357 | 0.333 | 0.698 | 1.964 | 1.266 | 0.033 | 0.033 | 0.160 | 0.075 | 0.107 |
| 3-Oct-92 | 1.618 | 0.021 | 1.597 | 0.166 | 1.784 | 2.553 | 0.769 | 0.168 | 0.168 | 0.163 | 0.090 | 0.259 |
| 9-Nov-92 | 0.801 | 0.072 | 0.729 | 0.613 | 1.414 | 1.683 | 0.268 | 0.092 | 0.092 | 0.074 | 0.091 | 0.183 |
| 6-Dec-92 | 0.639 | 0.023 | 0.616 | 0.650 | 1.289 | 1.653 | 0.363 | 0.049 | 0.049 | 0.051 | 0.036 | 0.085 |

## Blackstone River at Blackstone, MA
## Nutrient Concentrations

| Sampling Date | Diss. NO2+NO3 (mg/l as N) | Diss. NO2 (mg/l as N) | Diss. NO3 (mg/l as N) | Diss. NH4 (mg/l as N) | Diss. Inorg N (mg/l as N) | Total Diss. N (mg/l as N) | Diss. Org. N (mg/l as N) | Diss. Inorg. P (mg/l as P) | Total Diss. P (mg/l as P) | Diss. Org. P (mg/l as P) | Particulate P (mg/l as P) | Total P (mg/l as P) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10-Jan-93 | 0.715 | 0.015 | 0.700 | 0.159 | 0.874 | 1.678 | 0.804 | 0.027 | 0.027 | 0.010 | 0.111 | 0.138 |
| 7-Feb-93 | 0.834 | 0.035 | 0.799 | 1.468 | 2.302 | 3.053 | 0.751 | 0.014 | 0.014 | 0.038 | 0.165 | 0.179 |
| 4-Apr-93 | 0.441 | 0.006 | 0.434 | 0.152 | 0.593 | 1.155 | 0.562 | 0.004 | 0.028 | 0.024 | 0.088 | 0.116 |
| 10-May-93 | 2.332 | 0.003 | 2.329 | 0.001 | 2.333 | 2.327 | 0.000 | 0.006 | 0.067 | 0.061 | 0.121 | 0.188 |
| 7-Jun-93 | 1.242 | 0.037 | 1.206 | 0.254 | 1.497 | 3.406 | 1.909 | 0.076 | 0.116 | 0.041 | 0.220 | 0.337 |
| 11-Jul-93 | 1.170 | 0.053 | 1.117 | 0.073 | 1.244 | 2.726 | 1.483 | 0.133 | 0.217 | 0.084 | 0.006 | 0.223 |
| 18-Aug-93 | 2.411 | 0.007 | 2.405 | 0.082 | 2.493 | 3.244 | 0.751 | 0.125 | 0.291 | 0.166 | 0.157 | 0.448 |
| Avg. 1990 | 0.667 | 0.018 | 0.648 | 0.724 | 1.390 | 2.410 | 1.020 | 0.054 | 0.127 | 0.073 | 0.169 | 0.296 |
| Avg. 1991 | 0.993 | 0.007 | 0.987 | 0.348 | 1.341 | 2.270 | 0.984 | 0.077 | 0.139 | 0.066 | 0.097 | 0.235 |
| Avg. 1992 | 0.957 | 0.027 | 0.930 | 0.517 | 1.473 | 2.118 | 0.722 | 0.079 | 0.121 | 0.080 | 0.089 | 0.210 |
| Avg. 1993 | 1.240 | 0.023 | 1.217 | 0.436 | 1.676 | 2.543 | 0.868 | 0.053 | 0.105 | 0.058 | 0.130 | 0.235 |
| Overall Avg. | 0.999 | 0.017 | 0.982 | 0.449 | 1.447 | 2.292 | 0.892 | 0.071 | 0.126 | 0.069 | 0.108 | 0.234 |

## Blackstone River at Rt. 122, Lonsdale, RI
## Nutrient Concentrations

| Sampling Date | Diss. NO2+NO3 (mg/l as N) | Diss. NO2 (mg/l as N) | Diss. NO3 (mg/l as N) | Diss. NH4 (mg/l as N) | Diss. Inorg. N (mg/l as N) | Total Diss. N (mg/l as N) | Diss. Org. N (mg/l as N) | Diss. Inorg P (mg/l as P) | Total Diss. P (mg/l as P) | Diss. Org. P (mg/l as P) | Priculate P (mg/l as P) | Total P (mg/l as P) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9-Feb-92 | 1.202 | 0.018 | 1.184 | 0.784 | 1.985 | 3.156 | 1.171 | 0.045 | 0.136 | 0.091 | 0.033 | 0.169 |
| 3-Mar-92 | 0.745 | 0.002 | 0.744 | 0.556 | 1.302 | 2.790 | 1.488 | 0.053 | 0.172 | 0.118 | 0.044 | 0.216 |
| 4-Apr-92 | 0.671 | 0.000 | 0.670 | 0.389 | 1.060 | 1.855 | 0.795 | 0.042 | 0.075 | 0.033 | 0.034 | 0.109 |
| 2-May-92 | 0.970 | 0.004 | 0.965 | 0.133 | 1.103 | 0.989 | 0.000 | 0.067 | 0.123 | 0.056 | 0.040 | 0.163 |
| 7-Jun-92 | 0.559 | 0.036 | 0.522 | 0.012 | 0.571 | 1.815 | 1.244 | 0.032 | 0.094 | 0.063 | 0.044 | 0.138 |
| 13-Jul-92 | 1.170 | 0.046 | 1.125 | 0.616 | 1.786 | 3.167 | 1.381 | 0.102 | 0.222 | 0.120 | 0.091 | 0.313 |
| 5-Sep-92 | 1.345 | 0.056 | 1.289 | 0.136 | 1.481 | 2.994 | 1.513 | 0.090 | 0.254 | 0.164 | 0.029 | 0.283 |
| 7-Nov-92 | 0.797 | 0.010 | 0.787 | 0.670 | 1.467 | 1.459 | 0.000 | 0.118 | 0.202 | 0.084 | 0.076 | 0.278 |
| 5-Dec-92 | 0.616 | 0.019 | 0.598 | 0.519 | 1.135 | 2.038 | 0.903 | 0.026 | 0.093 | 0.067 | 0.015 | 0.108 |
| 9-Jan-93 | 0.623 | 0.008 | 0.615 | 0.411 | 1.034 | 4.211 | 3.177 | 0.006 | 0.066 | 0.060 | 0.090 | 0.156 |
| 14-Feb-93 | 0.606 | 0.004 | 0.603 | 0.800 | 1.407 | 2.940 | 1.533 | 0.002 | 0.068 | 0.065 | 0.060 | 0.128 |
| 6-Mar-93 | 0.735 | 0.020 | 0.715 | 1.457 | 2.192 | 3.955 | 1.763 | 0.051 | 0.078 | 0.028 | 0.124 | 0.203 |
| 12-May-93 | 2.095 | 0.006 | 2.089 | 0.285 | 2.380 | 2.898 | 0.518 | 0.074 | 0.117 | 0.044 | 0.106 | 0.223 |
| 14-Jun-93 | 3.342 | 0.004 | 3.338 | 0.001 | 3.342 | 5.526 | 2.184 | 0.055 | 0.509 | 0.454 | 0.032 | 0.541 |
| 12-Jul-93 | 1.703 | 0.027 | 1.677 | 0.020 | 1.723 | 5.427 | 3.704 | 0.088 | 0.319 | 0.231 | 0.033 | 0.352 |
| 16-Aug-93 | 2.796 | 0.045 | 2.752 | 0.044 | 2.840 | 4.822 | 1.982 | 0.404 | 0.680 | 0.276 | 0.093 | 0.773 |
| Avg. 1992 | 0.897 | 0.021 | 0.876 | 0.424 | 1.321 | 2.251 | 0.944 | 0.064 | 0.152 | 0.088 | 0.045 | 0.198 |
| Avg. 1993 | 1.700 | 0.016 | 1.684 | 0.431 | 2.131 | 4.254 | 2.123 | 0.097 | 0.263 | 0.165 | 0.077 | 0.339 |
| Overall Avg. | 1.249 | 0.019 | 1.230 | 0.427 | 1.675 | 3.128 | 1.460 | 0.079 | 0.201 | 0.122 | 0.059 | 0.260 |

# Blackstone River at Slater Mill, Pawtucket, RI
## Nutrient Concentrations

| Sampling Date | Diss. NO2+NO3 (mg/l as N) | Diss. NO2 (mg/l as N) | Diss. NO3 (mg/l as N) | Diss. NH4 (mg/l as N) | Diss. Inorg. N (MG/L ASN) | Total Diss. N (MG/L AS N) | Diss. Org. N (mg/l as N) | Diss. Inorg. P (mg/l as P) | Total Diss. P (MG/L AS P) | Diss. Org. P (mg/l as P) | Particulate P (mg/l as P) | Total P (MG/L AS P) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15-Oct-90 | 0.122 | 0.005 | 0.117 | 0.012 | 0.134 | 1.016 | 0.882 | 0.035 | 0.077 | 0.042 | 0.234 | 0.312 |
| 29-Oct-90 | 0.514 | 0.004 | 0.511 | 0.008 | 0.522 | 0.849 | 0.327 | 0.023 | 0.034 | 0.011 | 0.104 | 0.138 |
| 13-Nov-90 | 0.526 | 0.010 | 0.516 | 0.010 | 0.536 | 1.208 | 0.671 | 0.033 | 0.088 | 0.056 | 0.089 | 0.177 |
| 26-Nov-90 | 0.842 | 0.053 | 0.789 | 0.648 | 1.490 | 1.806 | 0.316 | 0.115 | 0.147 | 0.032 | 0.140 | 0.287 |
| 10-Dec-90 | 0.602 | 0.004 | 0.598 | 0.395 | 0.997 | 1.704 | 0.708 | 0.031 | 0.068 | 0.037 | 0.065 | 0.133 |
| 7-Jan-91 | 0.789 | 0.028 | 0.762 | 0.462 | 1.251 | 2.471 | 1.220 | 0.019 | 0.088 | 0.068 | 0.085 | 0.173 |
| 22-Jan-91 | 0.638 | 0.010 | 0.628 | 0.615 | 1.253 | 1.592 | 0.338 | 0.114 | 0.117 | 0.003 | 0.133 | 0.251 |
| 4-Feb-91 | 0.711 | 0.015 | 0.696 | 0.584 | 1.295 | 1.975 | 0.680 | 0.048 | 0.119 | 0.071 | 0.155 | 0.273 |
| 19-Feb-91 | 0.634 | 0.003 | 0.631 | 0.630 | 1.264 | 1.973 | 0.710 | 0.039 | 0.053 | 0.014 | 0.084 | 0.137 |
| 4-Mar-91 | 0.597 | 0.003 | 0.594 | 0.446 | 1.043 | 1.389 | 0.346 | 0.035 | 0.084 | 0.049 | 0.190 | 0.275 |
| 18-Mar-91 | 0.646 | 0.010 | 0.636 | 0.181 | 0.827 | 1.561 | 0.734 | 0.007 | 0.052 | 0.046 | 0.110 | 0.163 |
| 1-Apr-91 | 0.613 | 0.003 | 0.610 | 0.207 | 0.820 | 1.388 | 0.568 | 0.021 | 0.084 | 0.063 | 0.085 | 0.169 |
| 15-Apr-91 | 1.302 | 0.004 | 1.299 | 0.431 | 1.733 | 2.089 | 0.355 | 0.077 | 0.261 | 0.185 | 0.092 | 0.353 |
| 29-Apr-91 | 0.898 | 0.045 | 0.853 | 0.249 | 1.148 | 1.047 | 0.000 | 0.023 | 0.056 | 0.033 | 0.065 | 0.121 |
| 13-May-91 | 0.862 | 0.004 | 0.858 | 0.043 | 0.905 | 1.512 | 0.606 | 0.025 | 0.084 | 0.059 | 0.087 | 0.172 |
| 28-May-91 | 1.843 | 0.112 | 1.730 | 0.070 | 1.913 | 2.189 | 0.277 | 0.064 | 0.090 | 0.026 | 0.107 | 0.197 |
| 10-Jun-91 | 1.440 | 0.008 | 1.432 | 0.014 | 1.454 | 2.903 | 1.449 | 0.077 | 0.214 | 0.137 | 0.067 | 0.281 |
| 24-Jun-91 | 1.808 | 0.008 | 1.800 | 0.381 | 2.189 | 3.110 | 0.920 | 0.243 | 0.291 | 0.048 | 0.053 | 0.344 |
| 8-Jul-91 | 1.407 | 0.006 | 1.401 | 0.008 | 1.415 | 2.713 | 1.297 | 0.048 | 0.161 | 0.112 | 0.099 | 0.259 |
| 22-Jul-91 | 1.768 | 0.031 | 1.738 | 0.047 | 1.816 | 3.053 | 1.237 | 0.335 | 0.394 | 0.058 | 0.062 | 0.455 |
| 5-Aug-91 | 0.818 | 0.084 | 0.735 | 0.329 | 1.147 | 2.318 | 1.171 | 0.070 | 0.469 | 0.399 | 0.077 | 0.545 |
| 19-Aug-91 | 0.912 | 0.015 | 0.897 | 0.182 | 1.094 | 2.027 | 0.933 | 0.177 | 0.274 | 0.097 | 0.126 | 0.400 |
| 3-Sep-91 | 0.748 | 0.006 | 0.742 | 0.080 | 0.828 | 1.795 | 0.967 | 0.086 | 0.188 | 0.102 | 0.050 | 0.238 |
| 16-Sep-91 | 1.080 | 0.014 | 1.066 | 0.296 | 1.377 | 2.156 | 0.779 | 0.212 | 0.298 | 0.086 | 0.035 | 0.333 |
| 30-Sep-91 | 0.366 | 0.006 | 0.359 | 0.005 | 0.371 | 1.487 | 1.116 | 0.008 | 0.068 | 0.061 | 0.040 | 0.108 |
| 15-Oct-91 | 4.149 | 0.023 | 4.126 | 0.139 | 4.288 | 1.054 | 0.000 | 0.115 | 0.095 | 0.000 | 0.035 | 0.130 |
| 28-Oct-91 | 0.397 | 0.090 | 0.307 | 0.442 | 0.839 | 0.921 | 0.082 | 0.081 | 0.067 | 0.000 | 0.033 | 0.100 |
| 14-Nov-91 | 0.008 | 0.005 | 0.003 | 0.087 | 0.096 | 0.774 | 0.679 | 0.193 | 0.051 | 0.000 | 0.032 | 0.083 |
| 25-Nov-91 | 0.403 | 0.028 | 0.375 | 0.127 | 0.530 | 1.064 | 0.534 | 0.281 | 0.038 | 0.000 | 0.038 | 0.076 |
| 30-Dec-91 | 0.400 | 0.014 | 0.386 | 0.005 | 0.405 | 2.378 | 1.972 | 0.021 | 0.078 | 0.057 | 0.025 | 0.103 |
| 12-Jan-92 | 0.688 | 0.022 | 0.666 | 0.869 | 1.557 | 1.948 | 0.392 | 0.019 | 0.083 | 0.065 | 0.021 | 0.104 |
| 7-Feb-92 | 0.764 | 0.023 | 0.761 | 0.277 | 1.061 | 2.775 | 1.714 | 0.021 | 0.111 | 0.090 | 0.036 | 0.147 |
| 9-Mar-92 | 0.510 | 0.006 | 0.504 | 0.814 | 1.324 | 2.435 | 1.111 | 0.058 | 0.188 | 0.130 | 0.009 | 0.197 |
| 2-Apr-92 | 0.863 | 0.002 | 0.861 | 0.375 | 1.237 | 1.520 | 0.283 | 0.058 | 0.079 | 0.021 | 0.020 | 0.099 |
| 2-May-92 | 1.019 | 0.003 | 1.016 | 0.003 | 1.022 | 2.104 | 1.082 | 0.030 | 0.153 | 0.123 | 0.017 | 0.171 |
| 5-Jun-92 | 0.607 | 0.011 | 0.596 | 0.029 | 0.636 | 2.182 | 1.545 | 0.039 | 0.142 | 0.103 | 0.020 | 0.163 |
| 12-Jul-92 | 0.845 | 0.014 | 0.831 | 0.359 | 1.205 | 2.287 | 1.082 | 0.052 | 0.127 | 0.075 | 0.043 | 0.170 |
| 8-Aug-92 | 1.799 | 0.043 | 1.756 | 0.249 | 2.048 | 4.203 | 2.155 | 0.029 | 0.297 | 0.268 | 0.144 | 0.441 |
| 14-Sep-92 | 1.582 | 0.071 | 1.511 | 0.239 | 1.821 | 3.368 | 1.547 | 0.096 | 0.241 | 0.144 | 0.006 | 0.246 |
| 6-Oct-92 | 1.501 | 0.058 | 1.443 | 0.382 | 1.883 | 2.963 | 1.080 | 0.100 | 0.233 | 0.133 | 0.063 | 0.296 |
| 10-Nov-92 | 0.783 | 0.010 | 0.773 | 0.627 | 1.410 | 2.325 | 0.915 | 0.081 | 0.150 | 0.069 | 0.059 | 0.208 |
| 5-Dec-92 | 0.667 | 0.019 | 0.648 | 0.475 | 1.142 | 2.190 | 1.048 | 0.031 | 0.101 | 0.070 | 0.041 | 0.142 |

## Blackstone River at Slater Mill, Pawtucket, RI
## Nutrient Concentrations

| Sampling Date | Diss. NO2+NO3 (mg/l as N) | Diss. NO2 (mg/l as N) | Diss. NO3 (mg/l as N) | Diss. NH4 (mg/l as N) | Diss. Inorg. N (MG/L ASN) | Total Diss. N (MG/L AS N) | Diss. Org. N (mg/l as N) | Diss. Inorg. P (mg/l as P) | Total Diss. P (MG/L AS P) | Diss. Org. P (mg/l as P) | Particulate P (mg/l as P) | Total P (MG/L AS P) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10-Jan-93 | 0.672 | 0.004 | 0.668 | 0.513 | 1.185 | 1.777 | 0.593 | 0.042 | 0.070 | 0.028 | 0.019 | 0.089 |
| 8-Feb-93 | 0.710 | 0.024 | 0.687 | 1.300 | 2.010 | 4.073 | 2.063 | 0.041 | 0.087 | 0.046 | 0.173 | 0.260 |
| 8-Mar-93 | 0.683 | 0.009 | 0.674 | 1.130 | 1.813 | 2.111 | 0.298 | 0.055 | 0.073 | 0.019 | 0.068 | 0.142 |
| 4-May-93 | 1.478 | 0.023 | 1.455 | 0.369 | 1.847 | 2.249 | 0.402 | 0.070 | 0.082 | 0.012 | 0.031 | 0.113 |
| 6-Jun-93 | 1.252 | 0.009 | 1.243 | 0.371 | 1.624 | 4.075 | 2.452 | 0.188 | 0.201 | 0.013 | 0.105 | 0.305 |
| 12-Jul-93 | 1.369 | 0.021 | 1.347 | 0.065 | 1.434 | 2.801 | 1.367 | 0.140 | 0.169 | 0.028 | 0.074 | 0.243 |
| 18-Aug-93 | 3.299 | 0.048 | 3.251 | 0.260 | 3.560 | 5.243 | 1.684 | 0.534 | 0.568 | 0.034 | 0.078 | 0.647 |
| Avg. 1990 | 0.521 | 0.015 | 0.506 | 0.215 | 0.736 | 1.317 | 0.581 | 0.047 | 0.083 | 0.036 | 0.126 | 0.209 |
| Avg. 1991 | 1.010 | 0.023 | 0.987 | 0.243 | 1.252 | 1.878 | 0.759 | 0.097 | 0.151 | 0.071 | 0.079 | 0.230 |
| Avg. 1992 | 0.971 | 0.024 | 0.947 | 0.392 | 1.362 | 2.525 | 1.163 | 0.051 | 0.159 | 0.108 | 0.040 | 0.199 |
| Avg. 1993 | 1.235 | 0.019 | 1.217 | 0.536 | 1.771 | 2.976 | 1.204 | 0.135 | 0.163 | 0.028 | 0.071 | 0.234 |
| Overall Average | 0.987 | 0.022 | 0.966 | 0.322 | 1.310 | 2.153 | 0.909 | 0.087 | 0.148 | 0.069 | 0.073 | 0.221 |

## Ten Mile River at Roger Williams Ave. in East Providence
## Nutrient Concentrations

| Sampling Date | Diss. NO2+NO3 (mg/l as N) | Diss. NO2 (mg/l as N) | Diss. NO3 (mg/l as N) | Diss. NH4 (mg/l as N) | Diss. Inorg. N (mg/l as N) | Total Diss. N (mg/l as N) | Diss. Org. N (mg/l as N) | Diss. Inorg. P (mg/l as P) | Total Diss. P (mg/l as P) | Diss. Org. P (mg/l as P) | Particulate P (mg/l as P) | Total P (mg/l as P) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9-Feb-92 | 1.67 | 0.03 | 1.64 | 0.01 | 1.67 | 2.57 | 0.89 | 0.133 | 0.184 | 0.051 | 0.042 | 0.226 |
| 8-Mar-92 | 1.69 | 0.00 | 1.69 | 0.34 | 2.03 | 2.31 | 0.28 | 0.179 | 0.228 | 0.049 | 0.036 | 0.264 |
| 4-Apr-92 | 0.81 | 0.00 | 0.81 | 0.37 | 1.18 | 1.75 | 0.57 | 0.050 | 0.152 | 0.103 | 0.046 | 0.199 |
| 2-May-92 | 0.97 | 0.01 | 0.96 | 0.31 | 1.28 | 1.00 | 0.00 | 0.025 | 0.114 | 0.090 | 0.051 | 0.165 |
| 6-Jun-92 | 0.62 | 0.01 | 0.61 | 0.04 | 0.66 | 2.19 | 1.53 | 0.033 | 0.151 | 0.118 | 0.068 | 0.219 |
| 11-Jul-92 | 0.12 | 0.01 | 0.11 | 0.24 | 0.36 | 1.21 | 0.84 | 0.005 | 0.101 | 0.096 | 0.052 | 0.153 |
| 10-Aug-92 | 0.09 | 0.01 | 0.08 | 0.16 | 0.25 | 0.88 | 0.64 | 0.195 | 0.239 | 0.044 | 0.086 | 0.325 |
| 4-Oct-92 | 1.31 | 0.03 | 1.28 | 0.11 | 1.42 | 1.62 | 0.20 | 0.048 | 0.109 | 0.061 | | |
| 8-Nov-92 | 2.01 | 0.04 | 1.97 | 0.20 | 2.22 | 2.70 | 0.48 | 0.047 | 0.066 | 0.019 | 0.021 | 0.086 |
| 6-Dec-92 | 1.10 | 0.05 | 1.06 | 0.14 | 1.25 | 2.45 | 1.20 | 0.130 | 0.201 | 0.071 | 0.211 | 0.412 |
| 10-Jan-93 | 1.18 | 0.01 | 1.16 | 0.14 | 1.32 | 2.78 | 1.46 | 0.032 | 0.147 | 0.115 | 0.076 | 0.223 |
| 6-Jun-93 | 1.06 | 0.05 | 1.01 | 0.17 | 1.23 | 2.68 | 1.44 | 0.087 | 0.101 | 0.014 | 0.013 | 0.114 |
| 11-Jul-93 | 0.10 | 0.04 | 0.06 | 0.03 | 0.12 | 1.60 | 1.48 | 0.129 | 0.170 | 0.042 | 0.154 | 0.325 |
| 15-Aug-93 | 0.02 | 0.02 | 0.00 | 0.11 | 0.13 | 0.79 | 0.66 | 0.233 | 0.278 | 0.045 | 0.091 | 0.368 |
| Avg. 1992 | 1.04 | 0.02 | 1.02 | 0.19 | 1.23 | 1.87 | 0.66 | 0.08 | 0.15 | 0.07 | 0.07 | 0.23 |
| Avg. 1993 | 0.59 | 0.03 | 0.56 | 0.11 | 0.70 | 1.96 | 1.26 | 0.12 | 0.17 | 0.05 | 0.08 | 0.26 |
| Overall Avg. | 0.91 | 0.02 | 0.89 | 0.17 | 1.08 | 1.90 | 0.83 | 0.09 | 0.16 | 0.07 | 0.07 | 0.24 |

**Heavy Metal Concentrations for River Rescue Statations**

Chromium
Nickel
Copper
Lead
Cadmium
Calcium
Magnesium
Hardness

# Woonasquatucket River at Rt. 44 in North Providence, RI
## Heavy Metal Concentrations

| Sampling Date | Chromium (ug/l) | Nickel (ug/l) | Copper (ug/l) | Lead (ug/l) | Cadmium (ug/l) | Total Calcium (mg/l) | Total Magnesium (mg/l) | Hardness (mg/l CaCo3) |
|---|---|---|---|---|---|---|---|---|
| 15-Oct-90 | 0.70 | 2.40 | 2.80 | 1.10 | 0.05 | 6.2 | 1.80 | 22.9 |
| 29-Oct-90 | 0.90 | 2.20 | 11.40 | 6.00 | 0.38 | 4.6 | 1.60 | 18.1 |
| 13-Nov-90 | | | | | | | | |
| 26-Nov-90 | 0.80 | 1.70 | 1.90 | 1.20 | 0.03 | 4.1 | 2.00 | 18.5 |
| 10-Dec-90 | 0.70 | 1.60 | 2.90 | 2.00 | 0.06 | 4.3 | 2.00 | 19.0 |
| 7-Jan-91 | 1.00 | 2.30 | 4.20 | 3.60 | 0.08 | 3.9 | 2.00 | 18.0 |
| 19-Feb-91 | 0.30 | 2.80 | 3.90 | 1.60 | 0.08 | 5.4 | 1.60 | 20.1 |
| 3-Mar-91 | 0.30 | 3.30 | 9.60 | 2.60 | 0.29 | 5.3 | 1.20 | 18.2 |
| 17-Mar-91 | 0.30 | 0.80 | 4.80 | 1.20 | 0.05 | 5.2 | 1.10 | 17.5 |
| 31-Mar-91 | 0.80 | 1.70 | 2.30 | 1.00 | 0.08 | 6.4 | 1.19 | 20.9 |
| 14-Apr-91 | 2.50 | 1.80 | 9.60 | 2.60 | 0.15 | 6.8 | 1.51 | 23.2 |
| 28-Apr-91 | 1.10 | 2.00 | 4.10 | 2.20 | 0.11 | 6.8 | 1.56 | 23.4 |
| 13-May-91 | 1.10 | 0.90 | 2.70 | 0.80 | 0.05 | 5.5 | 1.77 | 21.0 |
| 29-May-91 | 0.90 | 1.90 | 4.80 | 0.90 | 0.14 | 7.9 | 1.36 | 25.3 |
| 10-Jun-91 | 0.60 | 1.70 | 5.10 | 1.20 | 0.11 | 7.9 | 2.08 | 28.3 |
| 23-Jun-91 | 0.90 | 5.10 | | 1.80 | 0.13 | 8.9 | 1.99 | 30.4 |
| 7-Jul-91 | 0.90 | 3.50 | 7.40 | 1.10 | 0.15 | 8.8 | 2.01 | 30.3 |
| 28-Jul-91 | 0.90 | 3.60 | 5.50 | 1.20 | 0.14 | 9.1 | 1.57 | 29.2 |
| 4-Aug-91 | 0.70 | 3.30 | 5.20 | 0.70 | 0.05 | 8.7 | 1.28 | 27.0 |
| 20-Aug-91 | 0.60 | 2.10 | 6.80 | 0.80 | 0.08 | 6.7 | 1.61 | 23.4 |
| 2-Sep-91 | 0.80 | 4.10 | 4.30 | 1.10 | 0.06 | 8.5 | 1.48 | 27.3 |
| 15-Sep-91 | 0.80 | 2.50 | 3.90 | 1.10 | 0.06 | 7.2 | 0.96 | 21.9 |
| 30-Sep-91 | 1.00 | 0.40 | 5.80 | 1.30 | 0.05 | 8.9 | 1.25 | 27.4 |
| 16-Oct-91 | 1.30 | 1.60 | 13.40 | 3.40 | 0.24 | 8.4 | 1.29 | 26.3 |
| 27-Oct-91 | 1.00 | 1.80 | 4.30 | 1.00 | 0.05 | 6.4 | 0.94 | 19.9 |
| 13-Nov-91 | 1.10 | 1.10 | 4.30 | 1.80 | 0.05 | 7.8 | 1.13 | 24.1 |
| 25-Nov-91 | 1.30 | 1.40 | 4.40 | 2.30 | 0.08 | 8.4 | 1.34 | 26.5 |
| 10-Dec-91 | 1.10 | 1.70 | 3.90 | 2.10 | 0.06 | 5.9 | 1.12 | 19.3 |
| 12-Jan-92 | 0.20 | 0.40 | 1.50 | 1.20 | 0.10 | 4.0 | 1.60 | 16.6 |
| 9-Feb-92 | 0.20 | 0.20 | 1.10 | 0.20 | 0.20 | 4.0 | 0.80 | 13.3 |
| 9-Mar-92 | 0.40 | 1.70 | 3.50 | 1.40 | 0.10 | 4.2 | 2.00 | 18.7 |
| 5-Apr-92 | 0.50 | 0.20 | 2.30 | 0.50 | 0.05 | 4.5 | 2.00 | 19.5 |
| 3-May-92 | 0.20 | 1.60 | 2.50 | 1.00 | 0.10 | 5.0 | 1.60 | 19.1 |
| 7-Jun-92 | 0.50 | 1.70 | 2.50 | 4.10 | 0.05 | 5.1 | 2.10 | 21.4 |
| 12-Jul-92 | 0.80 | 2.10 | 4.10 | 1.30 | 0.05 | 6.9 | 2.40 | 27.1 |
| 10-Aug-92 | 0.90 | 2.70 | 5.90 | 1.80 | 0.10 | 6.1 | 2.20 | 24.3 |
| 6-Sep-92 | 0.20 | 2.80 | 4.50 | 0.70 | 0.09 | 7.2 | 0.83 | 21.4 |
| 6-Dec-92 | 1.20 | 0.90 | | 1.20 | 0.16 | 6.0 | 0.93 | 18.8 |
| 10-Jan-93 | 0.89 | 1.00 | | 4.50 | 0.09 | | 0.13 | 0.5 |
| 7-Feb-93 | 0.85 | 0.90 | | 4.20 | 0.13 | | 0.18 | 0.7 |
| 8-Mar-93 | 0.64 | 1.20 | 2.80 | 1.70 | 0.13 | 1.0 | 0.27 | 3.6 |
| 4-Apr-93 | 0.31 | 1.40 | 3.00 | 1.10 | 0.26 | 1.0 | 0.20 | 3.3 |
| 9-May-93 | 0.76 | 4.30 | 8.60 | 3.00 | 0.28 | 3.0 | 0.61 | 10.0 |
| 6-Jun-93 | 0.32 | 1.10 | 1.90 | | 0.12 | 6.0 | 0.86 | 18.5 |
| 11-Jul-93 | 0.19 | 4.10 | 3.20 | | 0.16 | 5.0 | 0.75 | 15.6 |
| Avg. 1990 | 0.78 | 1.98 | 4.75 | 2.58 | 0.13 | 4.80 | 1.85 | 19.60 |
| Avg. 1991 | 0.93 | 2.23 | 5.47 | 1.63 | 0.10 | 7.17 | 1.45 | 23.86 |
| Avg. 1992 | 0.51 | 1.43 | 3.10 | 1.34 | 0.10 | 5.30 | 1.65 | 20.01 |
| Avg. 1993 | 0.57 | 2.00 | 3.90 | 2.90 | 0.17 | 3.20 | 0.43 | 7.47 |
| Overall Avg. | 0.76 | 1.99 | 4.67 | 1.80 | 0.11 | 6.02 | 1.37 | 19.99 |

# Woonasquatucket River at Valley St. in Providence, RI
## Heavy Metal Concentrations

| Sampling Date | Chromium (ug/l) | Nickel (ug/l) | Copper (ug/l) | Lead (ug/l) | Cadmium (ug/l) | Total Calcium (mg/l) | Total Magnesium (mg/l) | Hardness (mg/l CaCO3) |
|---|---|---|---|---|---|---|---|---|
| 1-Oct-90 | 1.10 | 2.3 | 2.5 | 1.5 | 0.01 | 10.0 | 2.40 | 34.9 |
| 15-Oct-90 | 0.90 | 2.9 | 7.5 | 3.7 | 0.08 | 8.2 | 1.80 | 27.9 |
| 29-Oct-90 | 0.90 | 2.3 | 2.4 | 2.4 | 0.07 | 6.0 | 1.50 | 21.2 |
| 13-Nov-90 | 0.60 | 1.4 | 2.1 | 2.1 | 0.17 | 5.6 | 1.70 | 21.0 |
| 26-Nov-90 | 0.60 | 1.8 | 2.4 | 2.9 | 0.07 | 6.0 | 1.70 | 22.0 |
| 12-Dec-90 | 0.60 | 1.9 | 4.6 | 1.9 | 0.06 | 6.0 | 1.70 | 22.0 |
| 6-Jan-91 | 0.60 | 2.3 | 2.3 | 2.8 | 0.03 | 6.0 | 1.50 | 21.2 |
| 21-Jan-91 | 0.60 | 2.2 | 1.9 | 2.0 | 0.06 | 7.2 | 2.00 | 26.2 |
| 3-Feb-91 | 0.50 | 2.6 | 1.5 | 1.9 | 0.03 | 6.6 | 2.50 | 26.8 |
| 18-Feb-91 | 0.50 | 3.3 | 6.5 | 3.1 | 0.05 | 6.8 | 1.90 | 24.8 |
| 3-Mar-91 | 0.60 | 3.4 | 3.6 | 2.5 | 0.04 | 7.2 | 1.70 | 25.0 |
| 17-Mar-91 | 0.30 | 2.3 | 5.0 | 1.6 | 0.05 | 7.2 | 1.60 | 24.6 |
| 1-Apr-91 | 4.20 | 1.6 | 2.2 | 2.0 | 0.08 | 7.8 | 2.00 | 27.7 |
| 14-Apr-91 | 2.40 | 1.9 | 2.5 | 1.8 | 0.19 | 9.7 | 1.95 | 32.3 |
| 28-Apr-91 | 1.80 | 3.4 | 10.8 | 8.9 | 0.34 | 8.0 | 1.71 | 27.0 |
| 12-May-91 | 1.30 | 1.7 | 3.2 | 2.3 | 0.04 | 8.8 | 2.00 | 30.2 |
| 27-May-91 | 1.10 | 1.8 | 3.1 | 2.4 | 0.08 | 8.9 | 2.30 | 31.7 |
| 10-Jun-91 | 0.40 | 1.7 | 2.4 | 1.5 | 3.04 | 11.5 | 1.64 | 35.5 |
| 23-Jun-91 | 0.50 | 2.4 | 4.6 | 2.2 | 0.09 | 13.3 | 2.68 | 44.2 |
| 8-Jul-91 | 0.60 | 2.7 | 5.7 | 3.9 | 0.09 | 13.1 | 2.40 | 42.6 |
| 21-Jul-91 | 0.70 | 1.6 | 2.9 | 10.1 | 0.08 | 17.3 | 2.61 | 53.9 |
| 4-Aug-91 | 1.30 | 4.1 | 9.8 | 9.9 | 0.32 | 9.9 | 1.79 | 32.1 |
| 18-Aug-91 | 0.60 | 2.4 | 3.2 | 2.5 | 0.14 | 10.3 | 2.64 | 36.6 |
| 2-Sep-91 | 0.40 | 1.6 | 2.7 | 1.8 | 0.05 | 10.4 | 2.11 | 34.7 |
| 15-Sep-91 | 0.20 | 1.7 | 5.5 | 2.5 | 0.14 | 11.0 | 1.80 | 34.9 |
| 30-Sep-91 | 1.60 | 2.2 | 8.3 |  | 0.05 | 7.3 | 1.40 | 24.0 |
| 13-Oct-91 | 1.00 | 1.5 | 3.9 | 1.9 | 0.11 | 10.1 | 1.42 | 31.1 |
| 27-Oct-91 | 1.40 | 2.2 | 4.4 | 2.8 |  | 9.3 | 1.45 | 29.2 |
| 10-Nov-91 | 0.20 | 8.8 | 21.4 | 7.9 | 0.30 | 8.6 | 1.20 | 26.4 |
| 24-Nov-91 | 0.60 | 1.0 | 6.4 | 1.3 | 0.28 | 6.5 | 1.74 | 23.4 |
| 12-Jan-92 |  |  |  |  |  |  |  |  |
| 9-Feb-92 | 0.80 | 1.8 | 4.8 | 2.2 | 0.05 | 5.1 | 2.00 | 21.0 |
| 8-Mar-92 | 0.80 | 3.1 | 3.3 | 2.5 | 0.05 | 6.9 | 2.10 | 25.9 |
| 4-Apr-92 | 0.30 | 0.2 | 2.4 | 1.3 | 0.05 | 6.5 | 2.00 | 24.5 |
| 3-May-92 | 0.30 | 1.7 | 5.7 | 3.8 | 0.10 | 6.7 | 1.40 | 22.5 |
| 6-Jun-92 | 2.80 | 5.8 | 8.4 | 4.9 | 0.30 | 4.3 | 2.00 | 19.0 |
| 12-Jul-92 | 0.40 | 1.6 | 4.1 | 4.4 | 0.10 | 10.7 | 1.90 | 34.5 |
| 10-Aug-92 | 1.20 | 2.5 | 3.3 | 3.9 | 0.10 | 10.4 | 2.80 | 37.5 |
| 6-Sep-92 | 0.20 | 2.5 | 3.4 | 2.5 | 0.09 | 9.3 | 0.93 | 27.1 |
| 4-Oct-92 | 0.20 | 1.0 | 1.6 | 0.3 | 0.04 | 9.7 | 0.96 | 28.2 |
| 8-Nov-92 | 0.20 | 3.5 | 3.1 | 5.3 | 0.06 | 8.9 | 1.10 | 26.6 |
| 5-Dec-92 |  |  |  |  |  |  |  |  |
| 10-Jan-93 | 0.95 | 1.9 | 0.7 |  |  | 5.0 | 1.00 | 16.6 |
| 7-Feb-93 | 0.92 | 1.9 | 0.5 |  |  | 6.0 | 1.18 | 19.8 |
| 7-Mar-93 | 0.85 | 1.6 | 2.4 | 4.5 | 0.07 | 1.0 | 0.54 | 4.7 |
| 6-Apr-93 | 0.42 | 1.6 | 1.8 | 1.1 | 0.08 | 4.0 | 0.90 | 13.7 |
| 8-May-93 | 0.45 | 1.0 | 2.8 | 2.4 |  | 7.0 | 1.37 | 23.1 |
| 6-Jun-93 | 0.17 | 1.0 | 1.2 |  |  | 7.0 | 1.10 | 22.0 |
| 13-Jul-93 | 0.71 | 2.1 | 2.7 | 3.5 | 0.25 |  | 0.45 | 1.9 |
| Avg. 1990 | 0.78 | 2.1 | 3.6 | 2.4 | 0.08 | 7.0 | 1.8 | 24.8 |
| Avg. 1991 | 0.98 | 2.5 | 5.2 | 3.5 | 0.25 | 9.3 | 1.9 | 31.1 |
| Avg. 1992 | 0.72 | 2.4 | 4.0 | 3.1 | 0.09 | 7.9 | 1.7 | 26.7 |
| Avg 1993 | 0.64 | 1.6 | 1.7 | 2.9 | 0.13 | 5.0 | 0.9 | 14.5 |
| Overall Avg. | 0.85 | 2.3 | 4.2 | 3.2 | 0.18 | 8.1 | 1.7 | 26.9 |

## Moshassuck River at Bonanza Bus Station in Providence, RI
## Heavy Metal Concentrations

| Sampling Date | Chromium (ug/l) | Nickel (ug/l) | Copper (ug/l) | Lead (ug/l) | Cadmium (ug/l) | Total Calcium (mg/l) | Total Magnesium (mg/l) | Hardness (mg/l CaCO3) |
|---|---|---|---|---|---|---|---|---|
| 10-Feb-92 | 0.4 | 0.9 | 3.4 | 4.1 | 0.05 | 17.6 | 4.4 | 62.07 |
| 16-Mar-92 | 0.5 | 0.4 | 5.5 | 3.7 | 0.05 | 15.2 | 3.8 | 53.60 |
| 5-Apr-92 | 0.5 | 0.5 | 5.6 | 5.9 | 0.05 | 16.7 | 4.6 | 60.64 |
| 3-May-92 | 0.5 | 1 | 7.8 | 3.6 | 0.05 | 17.8 | 4.4 | 62.57 |
| 8-Jun-92 | 0.5 | 0.2 | 3.8 | 4.5 | 0.05 | 16 | 3.6 | 54.78 |
| 11-Jul-92 | 0.4 | 2.1 | 3.8 | 4.4 | 0.05 | 24.3 | 5.9 | 84.97 |
| 6-Sep-92 | 0.6 | 1.1 | 3.3 | 1.1 | 0.05 | 14.5 | 2.23 | 45.39 |
| 13-Oct-92 | 17.9 | 2 | 5.9 | 9.5 | 0.09 | 15.4 | 1.89 | 46.24 |
| 9-Nov-92 | 2.3 | 4.8 | 2.2 | 1.1 | 0.04 | 13.7 | 2.14 | 43.02 |
| 12-Jan-93 | 1.04 | 2 | 1.6 | 3.8 | 0.05 | 11 | 1.17 | 32.29 |
| 5-Feb-93 | 1.08 | 1.6 |  | 21.5 | 0.05 | 14 | 1.9 | 42.78 |
| 7-Mar-93 | 2.01 | 2.3 | 5.8 | 2.8 | 0.13 | 19 | 2.71 | 58.60 |
| 5-Apr-93 | 0.54 | 1.3 | 4.1 | 7.3 | 0.06 | 11 | 1.51 | 33.69 |
| Avg. 1992 | 2.62 | 1.44 | 4.59 | 4.21 | 0.05 | 16.80 | 3.66 | 57.03 |
| Avg. 1993 | 1.17 | 1.80 | 3.83 | 8.85 | 0.07 | 13.75 | 1.82 | 41.84 |
| Overall Avg. | 2.17 | 1.55 | 4.40 | 5.64 | 0.06 | 15.86 | 3.10 | 52.36 |

# Moshassuck River at Charles St. in Providence, RI
## Heavy Metal Concentrations

| Sampling Date | Chromium (ug/l) | Nickel (ug/l) | Copper (ug/l) | Lead (ug/l) | Cadmium (ug/l) | Total Calcium (mg/l) | Total Magnesium (mg/l) | Hardness (mg/l CaCO3) |
|---|---|---|---|---|---|---|---|---|
| 1-Oct-90 | 0.5 | 2.5 | 3.1 | 2.1 | 0.04 | 24 | 5.9 | 84.2 |
| 15-Oct-90 | 0.9 | 1.5 | 5.3 | 7.1 | 0.04 | 15 | 4.5 | 56.0 |
| 13-Nov-90 | 0.4 | 2 | 3.1 | 2.7 | 0.04 | 14.5 | 4 | 52.7 |
| 26-Nov-90 | 0.4 | 1.9 | 3.4 | 2.7 | 0.07 | 17 | 5 | 63.0 |
| 10-Dec-90 | 0.7 | 1.9 | 3.3 | 3.3 | 0.1 | 17.5 | 4.5 | 62.2 |
| 23-Jan-91 | 0.8 | 2 | 2.6 | 2.3 | 0.06 | 15 | 3.2 | 50.6 |
| 4-Feb-91 | 0.5 | 2.5 | 4.6 | 2.2 | 0.07 | 17.5 | 4.5 | 62.2 |
| 19-Feb-91 | 0.6 | 3.8 | 11.5 | 9.3 | 0.28 | 18.5 | 6.3 | 72.1 |
| 4-Mar-91 | 1.3 | 3.7 | 10.6 | 15.4 | 0.13 | 8.8 | 2.5 | 32.3 |
| 18-Mar-91 | 0.3 | 1.9 | 2.3 | 1.9 | 0.03 | 13.5 | 3.9 | 49.8 |
| 1-Apr-91 | 0.5 | 0.7 | 4.6 | 2.3 | 0.06 | 9.1 | 3.91 | 38.8 |
| 15-Apr-91 | 3.9 | 1.6 | 10.1 | 2.5 | 0.07 | 20.3 | 3.76 | 66.2 |
| 29-Apr-91 | 0.4 | 1.3 | 3.7 | 2.9 | 0.11 | 17.1 | 3.51 | 57.2 |
| 13-May-91 | 1.5 | 3 | 12.8 | 2.8 | 0.15 | 18.7 | 4.06 | 63.4 |
| 28-May-91 | 1 | 4.8 | 15.2 | 10.3 | 0.29 | 22.5 | 4.74 | 75.7 |
| 10-Jun-91 | 0.2 | 2 | 3.8 | 1.9 | 0.03 | 23.7 | 4.38 | 77.2 |
| 24-Jun-91 | 0.5 | 3 | 4.2 | 4.5 | 0.11 | 27.1 | 5.6 | 90.7 |
| 8-Jul-91 | 0.9 | 5.3 | 9.1 | 12.8 | 0.13 | 20.1 | 4.02 | 66.7 |
| 22-Jul-91 | 0.5 | 2.8 | 5.1 | 5.6 | 0.13 | 26.2 | 5.71 | 88.9 |
| 5-Aug-91 | 0.2 | 4.4 | 18.9 | 6.2 | 0.19 | 16.2 | 3.4 | 54.5 |
| 20-Aug-91 | 1.1 | 2.8 | 7.9 | 11.6 | 0.09 | 9.7 | 2.61 | 35.0 |
| 3-Sep-91 | 0.3 | 2.1 | 3.9 | 2.1 | | 18.4 | 4.7 | 65.3 |
| 16-Sep-91 | 0.4 | 4.4 | 8.8 | 3.5 | 0.12 | 17.2 | 3.69 | 58.1 |
| 30-Sep-91 | 1.2 | 1.9 | 18.2 | 4.1 | 0.12 | 14.3 | 3.52 | 50.2 |
| 15-Oct-91 | 0.6 | 1 | 7.1 | 1.4 | 0.09 | 16.4 | 3.7 | 56.2 |
| 28-Oct-91 | 0.9 | 0.9 | 3.3 | 1.8 | 0.1 | 16.8 | 3.64 | 56.9 |
| 11-Nov-91 | 0.7 | 1.2 | 6.1 | 3.1 | 0.06 | 11.9 | 2.93 | 41.8 |
| 25-Nov-91 | 1.9 | 23.4 | 24.2 | 6.9 | 0.26 | 13.2 | 2.01 | 41.2 |
| 9-Dec-91 | 0.7 | 1.8 | 6.7 | 2.9 | 0.08 | 14.8 | 3.96 | 53.3 |
| 30-Dec-91 | 1.6 | 3.2 | 11.3 | 6.3 | 0.18 | 13.9 | 3.39 | 48.7 |
| 8-Feb-92 | 0.5 | 0.9 | 1.6 | 1.3 | 0.05 | 16.3 | 3.4 | 54.7 |
| 7-Mar-92 | 0.2 | 1.6 | 2 | 1.2 | 0.05 | 18 | 4.2 | 62.2 |
| 4-Apr-92 | 0.2 | 0.5 | 3.7 | 1.7 | 0.05 | 15.9 | 3.9 | 55.8 |
| 2-May-92 | 0.3 | 2.3 | 7 | 5.2 | 0.1 | 16 | 3.4 | 54.0 |
| 6-Jun-92 | 0.7 | 2.6 | 7.4 | 9.1 | 0.2 | 8.3 | 2.2 | 29.8 |
| 11-Jul-92 | 1.5 | 3.6 | 6.9 | 6.5 | 0.2 | 22.3 | 5 | 76.3 |
| 10-Aug-92 | 2.4 | 2 | 6.3 | 8.4 | 0.1 | 13.4 | 3.3 | 47.0 |
| 1-Sep-92 | 0.8 | 1.3 | 3.8 | 1.1 | 0.03 | 14.6 | 2.2 | 45.5 |
| 4-Oct-92 | 0.6 | 2.6 | 9.7 | 1.4 | 0.1 | 16.3 | 2.06 | 49.2 |
| 7-Nov-92 | 1.4 | 2.5 | 8.4 | 1.9 | 0.12 | 13.8 | 1.95 | 42.5 |
| 9-Jan-93 | 0.8 | 0.9 | 1.3 | 1.8 | 0.05 | 20 | 2.9 | 61.9 |
| 6-Feb-93 | 0.93 | 0.7 | | 12.5 | | 12 | 1.61 | 36.6 |
| 6-Mar-93 | 0.16 | 0.6 | 1.1 | 0 | | 21 | 2.95 | 64.6 |
| 4-Apr-93 | 0.38 | 1.6 | 4.7 | 2.3 | | 9 | 1.34 | 28.0 |
| 8-May-93 | 0.46 | 2.3 | 5 | | 0.05 | 17 | 1.94 | 50.4 |
| 5-Jun-93 | 0.33 | 1.5 | 5.1 | 1.8 | 0.1 | 20 | 2.31 | 59.5 |
| Avg. 1990 | 0.58 | 1.96 | 3.64 | 3.58 | 0.06 | 17.60 | 4.78 | 63.63 |
| Avg. 1991 | 0.90 | 3.42 | 8.66 | 5.06 | 0.12 | 16.84 | 3.91 | 58.12 |
| Avg. 1992 | 0.86 | 1.99 | 5.68 | 3.78 | 0.10 | 15.49 | 3.16 | 51.70 |
| Avg. 1993 | 0.51 | 1.27 | 3.44 | 3.68 | 0.07 | 16.50 | 2.18 | 50.16 |
| Overall Avg. | 0.81 | 2.67 | 6.86 | 4.46 | 0.11 | 16.58 | 3.61 | 56.29 |

## Pawtuxet River at Natick (East) Ave. in Warwick, RI
## Heavy Metal Concentrations

| Sampling Date | Chromium (ug/l) | Nickel (ug/l) | Copper (ug/l) | Lead (ug/l) | Cadmium (ug/l) | Total Calcium (mg/l) | Total Magnesium (mg/l) | Hardness (mg/l CaCO3) |
|---|---|---|---|---|---|---|---|---|
| 8-Feb-92 | 0.2 | 0.2 | 4.1 | 0.5 | 0.05 | 4 | 1.8 | 17.40 |
| 9-Mar-92 | 0.2 | 0.2 | 2.3 | 0.9 | 0.05 | 3.4 | 2 | 16.73 |
| 4-Apr-92 | 0.2 | 0.2 | 2.8 | 0.8 | 0.05 | 3.2 | 1.8 | 15.40 |
| 4-May-92 | 0.2 | 5.8 | 8 | 2.1 | 0.5 | 7.4 | 1.9 | 26.30 |
| 7-Jun-92 | 0.4 | 0.2 | 3.4 | 3.9 | 0.05 | 4.8 | 1.7 | 18.99 |
| 10-Jul-92 | 0.3 | 1.4 | 4.4 | 2.7 | 0.20 | 19.2 | 1.9 | 55.77 |
| 6-Aug-92 | 0.8 | 1.4 | 7.4 | 2.9 | 0.10 | 5.5 | 1.9 | 21.56 |
| 7-Dec-92 | 0.63 | 0.4 | 0.8 | 0.8 | | 6 | 0.7 | 17.86 |
| 10-Jan-93 | 0.67 | 0.7 | 2.2 | 2.1 | 0.06 | | 0.14 | 0.58 |
| 8-Feb-93 | 0.03 | 0.6 | 1.4 | 1.7 | 0.07 | 3 | 0.54 | 9.71 |
| 8-Mar-93 | 0.63 | 0.6 | 3.9 | 1.8 | 0.1 | 4 | 0.26 | 11.06 |
| 6-Apr-93 | 0.06 | 0.2 | 1.1 | 0.7 | | 3 | 0.59 | 9.92 |
| 10-May-93 | 0.26 | 1.8 | 7.8 | 2 | 0.18 | 7 | 0.65 | 20.16 |
| 7-Jun-93 | 0.3 | 2.7 | 7.9 | 3 | 0.1 | 7 | 0.74 | 20.53 |
| 14-Jul-93 | 0.22 | 1 | 3.2 | 0.5 | 0.19 | 9 | 0.74 | 25.52 |
| 6-Nov-93 | 0.5 | 1.9 | 14.9 | 2.3 | | 4.2 | 2.2 | 19.55 |
| 6-Dec-93 | 0.2 | 1.7 | 10.3 | 1.3 | 0.5 | 3.7 | 2.3 | 18.71 |
| 23-Jan-94 | 0.2 | 0.9 | 2.3 | 0.2 | 0.5 | 9.2 | 2.4 | 32.86 |
| 6-Feb-94 | 0.2 | 1.1 | 3.7 | 0.7 | 0.5 | 4.6 | 2 | 19.72 |
| 13-Mar-94 | 0.2 | 0.2 | 3.7 | 1 | 0.5 | 2.2 | 1.4 | 11.26 |
| | | | | | | | | 0.00 |
| 8-May-94 | 0.28 | 0.65 | 3.8 | 2.06 | 0.2 | 3.89 | 1.25 | 14.86 |
| 12-Jun-94 | 0.38 | 1.98 | 5.7 | 3.32 | 0.2 | 6.64 | 1.65 | 23.37 |
| 10-Jul-94 | 0.65 | 1.19 | 5.43 | 1.89 | 0.07 | 5.17 | 1.25 | 18.06 |
| 7-Aug-94 | 0.57 | 0.78 | 5.49 | 1.95 | 0.12 | 5.06 | 1.31 | 18.03 |
| 11-Sep-94 | 0.67 | 1.56 | 6.07 | 3.27 | 0.08 | 5.11 | 1.29 | 18.07 |
| 9-Oct-94 | 0.52 | | 4.18 | 1.88 | 0.08 | 6.75 | 1.65 | 23.65 |
| 19-Nov-94 | 0.64 | | 2.72 | 3.97 | 0.1 | 13.65 | 2.17 | 43.02 |
| Avg. 1992 | 0.37 | 1.23 | 4.15 | 1.83 | 0.14 | 6.69 | 1.71 | 23.75 |
| Avg. 1993 | 0.32 | 1.24 | 5.86 | 1.71 | 0.17 | 5.11 | 0.91 | 15.08 |
| Avg. 1994 | 0.43 | 1.07 | 4.51 | 2.02 | 0.24 | 6.23 | 1.64 | 20.26 |
| Overall Avg. | 0.37 | 1.18 | 4.85 | 1.86 | 0.19 | 6.03 | 1.42 | 19.59 |

## Pawtuxet River at Broad St. in Cranston, RI
## Heavy Metal Concentrations

| Sampling Date | Chromium (ug/l) | Nickel (ug/l) | Copper (ug/l) | Lead (ug/l) | Cadmium (ug/l) | Total Calcium (mg/l) | Total Magnesium (mg/l) | Hardness (mg/l CaCO3) |
|---|---|---|---|---|---|---|---|---|
| 1-Oct-90 | 0.6 | 14.7 | 8.7 | 0.8 | 0.41 | 13 | 2.2 | 41.5 |
| 15-Oct-90 | 1 | 7.7 | 6.8 | 4.9 | 0.22 | 7.4 | 2.2 | 27.5 |
| 29-Oct-90 | 0.7 | 8.5 | 7.4 | 3.2 | 0.36 | 7.6 | 2.2 | 28.0 |
| 13-Nov-90 | 0.8 | 5.4 | 13.1 | 4.8 | 0.34 | 7.2 | 1.8 | 25.4 |
| 26-Nov-90 | 0.6 | 5.4 | 5.4 | 2.4 | 0.29 | 6 | 1.9 | 22.8 |
| 10-Dec-90 | 0.6 | 4.1 | 11.7 | 2.3 | 0.27 | 6 | 1.4 | 20.7 |
| 6-Jan-91 | 0.8 | 4.9 | 6.4 | 2.8 | 0.34 | 4.3 | 2 | 19.0 |
| 21-Jan-91 | 0.5 | 3.7 | 6 | 2.1 | 0.26 | 4 | 1.7 | 17.0 |
| 3-Feb-91 | 0.4 | 6 | 4.3 | 1.2 | 0.27 | 6.4 | 1.6 | 22.6 |
| 18-Feb-91 | 0.2 | 4.9 | 4.5 | 1.6 | 0.27 | 5.7 | 1.4 | 20.0 |
| 3-Mar-91 | 0.2 | 3.5 | 5.1 | 1.6 | 0.28 | 5.5 | 1.7 | 20.7 |
| 18-Mar-91 | 0.3 | 4.3 | 4.9 | 2.3 | 0.22 | 6.2 | 1.5 | 21.7 |
| 15-Apr-91 | 2.2 | 9.5 | 14.6 | 2.7 | 0.65 | 9.9 | 1.92 | 32.6 |
| 29-Apr-91 | 1.7 | 8.6 | 29.5 | 5.6 | 1.31 | 8.5 | 1.62 | 27.9 |
| 13-May-91 | 1.1 | 8.4 | 15 | 3 | 0.77 | 8.1 | 1.93 | 28.2 |
| 10-Jun-91 | 0.6 | 8 | 24.1 | 3.2 | 0.72 | 16.1 | 1.78 | 47.5 |
| 24-Jun-91 | 1.8 | 12.3 | 39.9 | 5.9 | 1.44 | 19.6 | 1.91 | 56.8 |
| 10-Jul-91 | 1.6 | 25.4 | 75.5 | 7.8 | 2.29 | 17.1 | 2.71 | 53.9 |
| 21-Jul-91 | 1.2 | 13.9 | 30.8 | 8.4 | 2.45 | 17.7 | 2.23 | 53.4 |
| 5-Aug-91 | 0.2 | 8.4 | 24.2 | 1.9 | 1.19 | 14.9 | 1.25 | 42.4 |
| 3-Sep-91 | 0.3 | 13.6 | 24.6 | 1.7 | 1.11 | 10.9 | 1.36 | 32.8 |
| 1-Oct-91 | 1.1 | 0.2 | 0.4 | 0.4 | 0.05 | 6.1 | 0.84 | 16.7 |
| 15-Oct-91 | 1.9 | 10.7 | 14.7 | 2.8 | 0.69 | 8.3 | 1.14 | 25.4 |
| 27-Oct-91 | 1.3 | 9.7 | 15.2 | 2.1 | 0.86 | 11.6 | 1.7 | 36.0 |
| 12-Nov-91 | 1.1 | 2.6 | 10.2 | 4.9 | 0.96 | 6.2 | 0.8 | 18.8 |
| 26-Nov-91 | 0.8 | 3.5 | 6.7 | 2.2 | 0.79 | 6.1 | 2.6 | 25.9 |
| 10-Dec-91 | 1.6 | 8.1 | 11.8 | 4.5 | 0.62 | 7.9 | 1.31 | 25.1 |
| 31-Dec-91 | 1.4 | 15.1 | 16.5 | 4.3 | 1.10 | 6.9 | 0.95 | 21.1 |
| 8-Feb-92 | 0.6 | 5.6 | 7.8 | 0.8 | 0.40 | 5.2 | 1.8 | 20.4 |
| 8-Mar-92 | 0.8 | 2.8 | 9 | 3.8 | 0.10 | 4.5 | 1.9 | 19.1 |
| 6-Apr-92 | 0.5 | 1.8 | 5.3 | 2 | 0.20 | 5.4 | 2.1 | 22.1 |
| 6-Jun-92 | 1.9 | 4 | 11.5 | 9.9 | 0.60 | 7.5 | 2.1 | 27.4 |
| 11-Jul-92 | 0.6 | 7.2 | 6.9 | 2.2 | 0.40 | 18.1 | 2.8 | 56.7 |
| 10-Aug-92 | 1.2 | 3.3 | 7.6 | 4.5 | 0.30 | 7.2 | 2.2 | 27.0 |
| 6-Sep-92 | 1.3 | 27.8 | 6.6 | 0.7 | 0.45 | 9.2 | 0.84 | 26.4 |
| 3-Oct-92 | 0.7 | 11.05 | 8.2 | 1.4 | 0.4 | 9 | 1.17 | 27.3 |
| 8-Nov-92 | 0.1 | 6.4 | 6.1 | 0.9 | 0.29 | 10.4 | 1.17 | 30.8 |
| 6-Dec-92 | 0.98 | 2.5 | 3.2 | 2.1 | 0.13 | 8 | 1.02 | 24.2 |
| 10-Jan-93 | 0.98 | 2.8 | 1.8 | 2 | | 8 | 0.97 | 24.0 |
| 6-Feb-93 | 0.98 | 3.7 | 5 | 1.7 | 0.36 | 4 | 0.39 | 11.6 |
| 6-Mar-93 | 0.91 | 4.4 | 5.4 | 2.1 | 0.18 | 4 | 0.42 | 11.7 |
| 3-Apr-93 | 0.52 | 1.3 | 3.7 | 1.8 | 0.06 | 3 | 0.15 | 8.1 |
| 2-May-93 | 0.38 | 6.4 | 7.6 | 2 | 0.18 | 5 | 0.68 | 15.3 |
| 5-Jun-93 | 1.17 | 4.6 | 11 | 4 | 0.4 | 6 | 0.8 | 18.3 |
| 10-Jul-93 | 0.38 | 5.1 | 10.9 | | 0.21 | 10 | 1.01 | 29.1 |
| 15-Jan-94 | 1.5 | 6 | 7.7 | 3.7 | 0.1 | 7.3 | 3 | 30.6 |
| 6-Feb-94 | 0.7 | 4 | 4.6 | 2.7 | 0.1 | 6.9 | 3.1 | 30.0 |
| 13-Mar-94 | 0.5 | 0.2 | 3.3 | 1.6 | 0.1 | 4.8 | 2.5 | 22.3 |
| 10-Apr-94 | 0.84 | 3.71 | 6.18 | 1.34 | 0.4 | 8.07 | 1.82 | 23.1 |
| 8-May-94 | 0.58 | 6.14 | 7.9 | 2.67 | 0.6 | 7.81 | 2.34 | 29.1 |
| 12-Jun-94 | 0.72 | 8.52 | 10.23 | 2.39 | 0.5 | 11.2 | 2.84 | 39.7 |
| 10-Jul-94 | 1.15 | 6.34 | 4.8 | 3.62 | 0.3 | 8.23 | 2.06 | 29.0 |
| 7-Aug-94 | 0.84 | 3.03 | 1.87 | 3.44 | 0.33 | 3.82 | 1.55 | 15.9 |
| 9-Oct-94 | 0.65 | 1.19 | 5.43 | 1.89 | 0.07 | 5.17 | 1.25 | 18.1 |
| 8-Jan-95 | 0.84 | 3.03 | 1.87 | 3.44 | 0.33 | 3.82 | 1.55 | 15.9 |
| Avg. 1990 | 0.72 | 7.65 | 8.85 | 3.07 | 0.32 | 7.87 | 1.95 | 27.67 |
| Avg. 1991 | 1.01 | 8.42 | 17.50 | 3.32 | 0.85 | 9.45 | 1.63 | 30.34 |
| Avg. 1992 | 0.87 | 7.25 | 7.22 | 2.83 | 0.33 | 8.45 | 1.71 | 28.14 |
| Avg. 1993 | 0.76 | 4.04 | 6.49 | 2.27 | 0.23 | 5.71 | 0.63 | 16.87 |
| Avg. 1994 | 0.81 | 4.35 | 5.78 | 2.59 | 0.28 | 6.81 | 2.28 | 26.41 |
| Overall Avg. | 0.89 | 6.80 | 11.08 | 2.96 | 0.52 | 8.09 | 1.66 | 27.03 |

# Blackstone River in Blackstone, MA
## Heavy Metal Concentrations

| Sampling Date | Chromium (ug/l) | Nickel (ug/l) | Copper (ug/l) | Lead (ug/l) | Cadmium (ug/l) | Total Calcium (mg/l) | Total Magnesium (mg/l) | Hardness (mg/l CaCO3) |
|---|---|---|---|---|---|---|---|---|
| 1-Oct-90 | 1.70 | 12.20 | 13.10 | 4.90 | 0.46 | 11.50 | 2.30 | 38.19 |
| 15-Oct-90 | 4.20 | 8.60 | 20.60 | 9.60 | 1.13 | 4.30 | 2.00 | 18.97 |
| 13-Nov-90 | 1.90 | 4.40 | 10.80 | 3.60 | 0.67 | 4.00 | 1.70 | 16.99 |
| 25-Nov-90 | 2.80 | 9.80 | 24.50 | | 3.88 | 8.00 | 2.20 | 29.04 |
| 10-Dec-90 | 1.70 | 4.20 | 7.80 | 3.30 | 0.47 | 5.60 | 2.00 | 22.22 |
| 6-Jan-91 | 3.10 | 5.50 | 9.90 | 5.50 | 0.53 | 6.00 | 2.00 | 23.22 |
| 20-Jan-91 | 2.20 | 6.70 | 8.30 | 4.00 | 0.49 | 6.00 | 2.00 | 23.22 |
| 17-Feb-91 | 1.70 | 4.20 | 7.50 | 3.50 | 0.52 | 8.00 | 2.00 | 28.21 |
| 4-Mar-91 | 4.00 | 3.90 | 11.60 | 6.20 | 0.55 | 5.50 | 1.80 | 21.15 |
| 17-Mar-91 | 1.20 | 4.90 | 6.50 | 2.30 | 0.41 | 9.60 | 2.30 | 33.44 |
| 1-Apr-91 | 6.00 | 3.80 | 9.60 | 3.10 | 0.76 | 8.10 | 2.20 | 29.29 |
| 29-Apr-91 | 2.80 | 6.30 | 9.80 | 4.80 | 0.64 | 9.40 | 2.10 | 32.12 |
| 12-May-91 | 3.50 | 5.40 | 11.50 | 5.80 | 0.72 | 9.80 | 2.00 | 32.71 |
| 9-Jun-91 | 2.20 | 6.80 | 9.90 | 5.30 | 3.49 | 13.30 | 2.72 | 44.41 |
| 22-Jun-91 | 1.90 | 7.40 | 10.60 | 5.30 | 0.54 | 13.40 | 2.51 | 43.80 |
| 8-Jul-91 | 2.50 | 7.30 | 9.70 | 4.60 | 0.50 | 14.30 | 2.83 | 47.36 |
| 22-Jul-91 | 1.50 | 7.60 | 8.30 | 1.60 | 0.36 | 14.80 | 2.96 | 49.14 |
| 5-Aug-91 | 2.60 | 11.80 | 11.80 | 5.40 | 0.46 | 13.50 | 2.60 | 44.42 |
| 10-Nov-91 | 2.10 | 6.80 | 9.60 | 3.90 | 0.88 | 10.80 | 1.38 | 32.65 |
| 25-Nov-91 | 2.00 | 7.10 | 12.80 | 4.70 | 0.67 | 10.70 | 1.96 | 34.79 |
| 8-Dec-91 | 2.30 | 4.70 | 6.40 | 3.00 | 0.67 | 11.50 | 2.37 | 38.48 |
| 29-Dec-91 | 2.30 | 5.10 | 8.80 | 3.80 | 0.83 | 9.30 | 1.87 | 30.92 |
| 7-Feb-92 | 1.70 | 4.10 | 11.80 | 2.70 | 1.00 | 8.08 | 2.02 | 28.49 |
| 7-Apr-92 | 1.00 | 4.80 | 7.30 | 2.20 | 0.60 | 8.60 | 2.60 | 32.18 |
| 3-May-92 | 1.40 | 3.80 | 5.40 | 2.50 | 0.20 | 8.20 | 2.50 | 30.77 |
| 7-Jun-92 | 2.70 | 5.40 | 10.50 | 6.60 | 0.60 | 4.50 | 2.10 | 19.88 |
| 12-Jul-92 | 3.10 | 6.20 | 8.30 | 3.80 | 0.40 | 10.10 | 2.60 | 35.93 |
| 12-Aug-92 | 3.80 | 7.30 | 12.60 | 6.30 | 0.70 | 8.90 | 2.80 | 33.75 |
| 7-Sep-92 | 1.10 | 5.30 | 7.20 | 1.10 | 0.37 | 9.80 | 1.20 | 29.41 |
| 3-Oct-92 | 3.15 | 6.95 | 9.35 | 2.20 | 0.43 | 9.70 | 1.01 | 28.38 |
| 9-Nov-92 | 2.20 | 5.50 | 5.20 | 1.50 | 0.36 | 10.10 | 1.10 | 29.75 |
| 6-Dec-92 | 2.31 | 4.00 | 5.90 | 6.90 | 0.17 | 9.00 | 1.43 | 28.36 |
| 10-Jan-93 | 1.92 | 2.80 | 4.00 | 2.60 | 0.24 | | 0.43 | 1.77 |
| 7-Feb-93 | 1.09 | 4.60 | 2.50 | 7.00 | 0.20 | 4.00 | 0.82 | 13.36 |
| 7-Mar-93 | 3.87 | 5.10 | 7.00 | 18.70 | 0.30 | 4.00 | 0.74 | 13.04 |
| 4-Apr-93 | 0.88 | 3.60 | 8.20 | 2.50 | 0.33 | 2.00 | 0.55 | 7.26 |
| 10-May-93 | 1.57 | 4.30 | 8.10 | 3.50 | 0.24 | 7.00 | 1.07 | 21.89 |
| 7-Jun-93 | 1.98 | 6.30 | 8.60 | 4.90 | 0.17 | 7.00 | 1.14 | 22.17 |
| 11-Jul-93 | 0.41 | 7.10 | 6.00 | | 0.15 | 10.00 | 1.46 | 30.98 |
| Avg. 1990 | 2.46 | 7.84 | 15.36 | 5.35 | 1.32 | 6.68 | 2.04 | 25.08 |
| Avg. 1991 | 2.58 | 6.19 | 9.56 | 4.28 | 0.77 | 10.24 | 2.21 | 34.67 |
| Avg. 1992 | 2.25 | 5.34 | 8.36 | 3.58 | 0.48 | 8.70 | 1.94 | 29.69 |
| Avg. 1993 | 1.67 | 4.83 | 6.34 | 6.53 | 0.23 | 5.67 | 0.89 | 15.78 |
| Overall Avg. | 2.32 | 5.94 | 9.42 | 4.57 | 0.67 | 8.64 | 1.88 | 28.77 |

## Blackstone River at Rt. 122 in Lonsdale, RI
## Heavy Metal Concentrations

| Sampling Date | Chromium (ug/l) | Nickel (ug/l) | Copper (ug/l) | Lead (ug/l) | Cadmium (ug/l) | Total Calcium (mg/l as Ca) | Total Magnesium (mg/l as Mg) | Hardness (mg/l as CaCO3) |
|---|---|---|---|---|---|---|---|---|
| 9-Feb-92 | 1.00 | 3.40 | 6.00 | 1.40 | 0.50 | 5.50 | 2.00 | 21.97 |
| 3-Mar-92 | 1.30 | 6.40 | 8.60 | 2.00 | 0.30 | 6.10 | 2.00 | 23.47 |
| 4-Apr-92 | 1.30 | 2.20 | 8.20 | 2.50 | 0.40 | 6.20 | 2.30 | 24.95 |
| 2-May-92 | 1.30 | 2.60 | 7.20 | 2.20 | 0.30 | 7.20 | 2.80 | 29.51 |
| 7-Jun-92 | 2.70 | 2.90 | 31.30 | 6.80 | 0.50 | 3.60 | 1.90 | 16.81 |
| 13-Jul-92 | 1.00 | 5.70 | 8.40 | 1.60 | 0.30 | 9.70 | 2.60 | 34.93 |
| 5-Sep-92 | 0.60 | 3.40 | 9.20 | 1.00 | 0.25 | 9.20 | 1.12 | 27.58 |
| 7-Nov-92 | 0.60 | 3.70 | 5.90 | 1.70 | 0.28 | 11.10 | 1.15 | 32.45 |
| 5-Dec-92 | 1.86 | 2.40 | 3.40 | 3.00 | 0.09 | 7.00 | 1.18 | 22.34 |
| 9-Jan-93 | 1.66 | 3.10 | 8.40 | 3.90 | 0.25 | 3.00 | 0.83 | 10.91 |
| 14-Feb-93 | 1.41 | 3.90 | 6.70 | 21.70 | 0.11 |  | 0.30 | 1.24 |
| 6-Mar-93 | 1.96 | 3.20 | 13.30 | 3.10 |  | 1.00 | 0.54 | 4.72 |
|  |  |  |  |  |  | 6.00 | 1.00 | 19.10 |
| 12-May-93 | 0.67 | 4.10 | 15.40 | 2.20 |  | 8.00 | 0.98 | 24.01 |
| 14-Jun-93 | 1.01 | 4.90 | 16.40 | 2.70 |  | 7.00 | 1.39 | 23.20 |
| 12-Jul-93 | 0.61 | 4.20 | 6.00 | 0.30 |  | 7.00 | 1.37 | 23.12 |
| Avg. 1992 | 1.30 | 3.63 | 9.80 | 2.47 | 0.32 | 7.29 | 1.89 | 26.00 |
| Avg. 1993 | 1.22 | 3.90 | 11.03 | 5.65 | 0.18 | 5.33 | 0.92 | 15.19 |
| Overall Avg. | 1.27 | 3.74 | 10.29 | 3.74 | 0.30 | 6.51 | 1.47 | 21.27 |

# Blackstone River at Slater Mill in Pawtuxet, RI
## Heavy Metal Concentrations

| Sampling Date | Chromium (ug/l) | Niockel (ug/l) | Copper (ug/l) | Lead (ug/l) | Cadmium (ug/l) | Total Calcium (mg/l) | Total Magnesium (mg/l) | Total Hardness (mg/l CaCO3) |
|---|---|---|---|---|---|---|---|---|
| 1-Oct-90 | 1.60 | 6.10 | 13.00 | 2.70 | 0.35 | 9.50 | 2.00 | 31.96 |
| 15-Oct-90 | 4.10 | 6.20 | 17.50 | 12.40 | 0.64 | 2.20 | 1.00 | 9.61 |
| 29-Oct-90 | 1.50 | 3.40 | 10.40 | 5.50 | 0.40 | 3.90 | 2.00 | 17.97 |
| 13-Nov-90 | 1.50 | 3.40 | 7.40 | 3.50 | 0.35 | 3.60 | 2.40 | 18.87 |
| 26-Nov-90 | 1.30 | 3.70 | 7.10 | 4.10 | 0.37 | 6.00 | 2.00 | 23.22 |
| 10-Dec-90 | 1.50 | 4.90 | 8.50 | 3.20 | 0.48 | 4.60 | 2.00 | 19.72 |
| 7-Jan-91 | 1.30 | 4.20 | 9.90 | 11.20 | 0.48 | 6.20 | 2.00 | 23.72 |
| 22-Jan-91 | 1.00 | 3.50 | 5.00 | 2.10 | 0.35 | 4.00 | 1.90 | 17.81 |
| 4-Feb-91 | 1.20 | 3.40 | 7.40 | 2.80 | 0.38 | 6.00 | 1.80 | 22.39 |
| 19-Feb-91 | 0.80 | 3.70 | 7.40 | 5.20 | 0.46 | 6.60 | 1.90 | 24.30 |
| 18-Mar-91 | 0.60 | 3.30 | 5.70 | 1.90 | 0.30 | 7.60 | 1.90 | 26.80 |
| 1-Apr-91 | 6.00 | 2.70 | 7.50 | 3.20 | 0.53 | 9.20 | 2.19 | 31.99 |
| 15-Apr-91 | 1.10 | 5.20 | 6.50 | 4.20 | 0.43 | 11.50 | 2.44 | 38.76 |
| 29-Apr-91 | 2.40 | 4.60 | 8.10 | 7.10 | 0.66 | 8.90 | 1.79 | 29.59 |
| 13-May-91 | 2.40 | 4.00 | 8.30 | 5.10 | 0.49 | 8.40 | 1.85 | 28.59 |
| 28-May-91 | 1.50 | 5.00 | 9.00 | 5.90 | 0.44 | 11.80 | 2.42 | 39.43 |
| 10-Jun-91 | 1.20 | 5.30 | 11.90 | 5.00 | 0.43 | 12.40 | 2.89 | 42.86 |
| 24-Jun-91 | 1.50 | 6.60 | 12.80 | 3.20 | 0.45 | 14.30 | 3.08 | 48.39 |
| 8-Jul-91 | 1.00 | 4.70 | 9.00 | 5.10 | 0.26 | 14.50 | 2.62 | 47.00 |
| 22-Jul-91 | 1.20 | 6.70 | 9.30 | 1.40 | 0.33 | 16.10 | 2.86 | 51.98 |
| 5-Aug-91 | 1.50 | 5.70 | 10.10 | 3.60 | 0.43 | 12.40 | 2.50 | 41.26 |
| 19-Aug-91 | 0.90 | 6.10 | 40.60 | 3.40 | 0.62 | 13.60 | 1.67 | 40.84 |
| 3-Sep-91 | 0.90 | 7.00 | 8.00 | 2.30 | 0.35 | 11.40 | 1.60 | 35.05 |
| 16-Sep-91 | 1.00 | 5.20 | 9.60 | 4.50 | 0.47 | 11.60 | 1.34 | 34.48 |
| 30-Sep-91 | 3.70 | 30.10 | 31.20 | 32.40 | 1.43 | 6.30 | 1.43 | 21.62 |
| 15-Oct-91 | 1.90 | 5.90 | 9.20 | 4.50 | 0.75 | 9.00 | 1.26 | 27.66 |
| 28-Oct-91 | 2.10 | 12.40 | 13.40 | 11.30 | 0.91 | 9.90 | 1.81 | 32.17 |
| 14-Nov-91 | 3.50 | 3.80 | 8.50 | 5.70 | 0.64 | 4.30 | 0.80 | 14.03 |
| 25-Nov-91 | 5.70 | 20.90 | 22.30 | 20.50 | 1.04 | 3.80 | 1.16 | 14.27 |
| 30-Dec-91 | 1.80 | 3.70 | 7.50 | 8.90 | 0.50 | 12.80 | 1.54 | 38.30 |
| 7-Feb-92 | 0.90 | 2.90 | 1.00 | 1.90 | 0.40 | 5.50 | 2.00 | 21.97 |
| 9-Mar-92 | 0.90 | 7.50 | 5.80 | 4.20 | 0.50 | 6.10 | 2.00 | 23.47 |
| 2-Apr-92 | 0.90 | 4.80 | 1.30 | 4.80 | 0.15 | 5.30 | 2.00 | 21.47 |
| 2-May-92 | 0.50 | 3.90 | 7.30 | 4.10 | 0.70 | 6.40 | 2.10 | 24.63 |
| 5-Jun-92 | 1.00 | 2.60 | 8.10 | 4.20 | 0.20 | 6.60 | 2.80 | 28.01 |
| 12-Jul-92 | 0.90 | 3.90 | 5.40 | 3.60 | 0.20 | 9.00 | 2.50 | 32.77 |
| 8-Aug-92 | 1.40 | 6.00 | 11.10 | 5.80 | 0.40 | 9.60 | 2.70 | 35.09 |
| 14-Sep-92 | 0.20 | 4.00 | 5.80 | 1.50 | 0.24 | 8.70 | 0.98 | 25.76 |
| 6-Oct-92 | 0.90 | 4.00 | 6.70 | 4.00 | 0.39 | 10.30 | 1.23 | 30.78 |
| 10-Nov-92 | 0.50 | 3.80 | 7.70 | 2.10 | 0.27 | 10.20 | 0.95 | 29.38 |
| 10-Jan-93 | 1.51 | 2.70 | 3.50 | 3.80 | 0.21 | 3.00 | 0.26 | 8.56 |
| 8-Feb-93 | 1.28 | 3.70 | 2.80 | | 0.20 | 9.00 | 1.42 | 28.32 |
| 8-Mar-93 | 1.12 | 3.00 | 7.00 | 2.40 | 0.67 | 3.00 | 0.70 | 10.37 |
| 6-Apr-93 | 0.94 | 2.60 | 5.90 | 4.80 | 0.17 | 1.00 | 0.44 | 4.31 |
| 4-May-93 | 1.03 | 2.60 | 6.90 | 3.20 | 0.12 | 5.00 | 0.85 | 15.99 |
| 6-Jun-93 | 0.33 | 3.20 | 4.80 | 0.80 | 0.06 | 9.00 | 1.34 | 27.99 |
| 12-Jul-93 | 0.54 | 4.30 | 7.10 | 3.40 | | 9.00 | 1.47 | 28.53 |
| Avg. 1990 | 1.92 | 4.62 | 10.65 | 5.23 | 0.43 | 4.97 | 1.90 | 20.23 |
| Avg. 1991 | 1.93 | 6.82 | 11.59 | 6.69 | 0.55 | 9.69 | 1.95 | 32.22 |
| Avg. 1992 | 0.81 | 4.34 | 6.02 | 3.62 | 0.35 | 7.77 | 1.93 | 27.33 |
| Avg. 1993 | 0.96 | 3.16 | 5.43 | 3.07 | 0.24 | 5.57 | 0.93 | 17.72 |
| Overall Avg. | 1.54 | 5.47 | 9.37 | 5.36 | 0.45 | 8.07 | 1.78 | 27.49 |

## Ten Mile River at Roger Williams Ave. in East Providence
## Heavy Metal Concentrations

| Sampling Date | Chromium (ug/l) | Nickel (ug/l) | Copper (ug/l) | Lead (ug/l) | Cadmium (ug/l) | Total Calcium (mg/l) | Total Magnesium (mg/l) | Hardness (mg/l CaCO3) |
|---|---|---|---|---|---|---|---|---|
| 9-Feb-92 | 6.5 | 26.5 | 10.3 | 1.5 | 2.70 | 11.8 | 2.6 | 40.17 |
| 8-Mar-92 | 6.2 | 26.6 | 11.8 | 1.2 | 0.90 | 11.3 | 3.7 | 43.45 |
| 4-Apr-92 | 4.6 | 20.4 | 9.1 | 1.1 | 0.80 | 12.3 | 3.6 | 45.54 |
| 2-May-92 | 4.5 | 22.8 | 8.4 | 1.9 | 0.70 | 13.5 | 3 | 46.06 |
| 6-Jun-92 | 3 | 26.3 | 10.4 | 3.4 | 0.60 | 13.4 | 2.8 | 44.99 |
| 11-Jul-92 | 1.2 | 20.6 | 10 | 3.9 | 0.50 | 17.1 | 2.9 | 54.64 |
| 10-Aug-92 | 1.6 | 20 | 5.4 | 1 | 0.30 | 17.7 | 2.6 | 54.90 |
| 4-Oct-92 | 0.2 | 19.2 | 4.4 | 0.2 | 0.29 | 10.2 | 1.52 | 31.73 |
| 8-Nov-92 | 1.5 | 24.3 | 5.7 | 1.3 | 0.52 | 9.8 | 1.27 | 29.70 |
| 6-Dec-92 | 7.32 | 19.4 | 6.5 | 2.3 | 0.37 | 13 | 1.54 | 38.80 |
| 10-Jan-93 | 6.83 | 16 | 5.3 | 2.2 | 0.35 | 4 | 0.87 | 13.57 |
| 6-Jun-93 | 0.99 | 10.6 | 4.4 | 0.1 | 0.09 | 15 | 1.87 | 45.16 |
| 11-Jul-93 | 1.11 | 10.2 | 5.4 | 0.1 | 0.15 | 15 | 1.73 | 44.58 |
| Avg 1992 | 3.66 | 22.61 | 8.20 | 1.78 | 0.77 | 13.01 | 2.55 | 43.00 |
| Avg 1993 | 2.98 | 12.27 | 5.03 | 0.80 | 0.20 | 11.33 | 1.49 | 34.44 |
| Overall Avg. | 3.50 | 20.22 | 7.47 | 1.55 | 0.64 | 12.62 | 2.31 | 41.02 |