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Water Quality Assessment of Tributaries to the Snohomish River and Nonpoint Source Pollution TMDL Study

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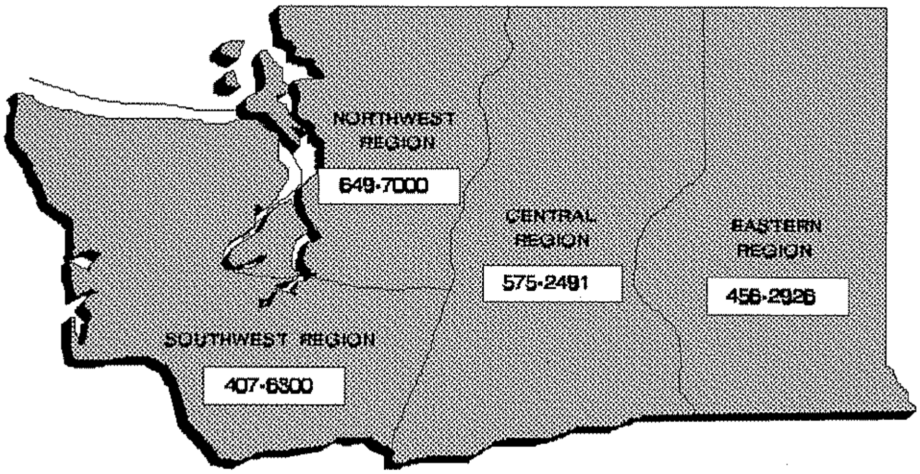

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Water Quality Assessment of Tributaries to the Snohomish River and Nonpoint Source Pollution TMDL Study

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Abstract

Water quality of tributaries in the Snohomish River drainage are assessed using data collected by Ecology and Snohomish County. Overall, water quality in Quilceda Creek, Allen Creek, French Creek, Woods Creek, the Marshland, and parts of the Pilchuck River violate water quality standards for fecal coliform. The violations are more extensive during the dry season (May - October). In addition, violations of the dissolved oxygen criterion occur during the dry season in Quilceda Creek, Allen Creek, French Creek, and the Marshland. Water quality in all of the study basins is being adversely impacted by nonpoint sources of pollution. Total maximum daily loads (TMDLs) and load allocations (LAs) are recommended for fecal coliform, but are also expected to mitigate other water quality concerns in the study area. Watershed management plans should be implemented under WAC 400-12 (the "nonpoint rule") to achieve necessary reductions and thus meet water quality standards.

Introduction

Problem Statement

Ecology's Northwest Regional Office (NWRO) is concerned about nonpoint pollutant loading to the following Snohomish River tributaries: Quilceda Creek, Allen Creek, French Creek, Woods Creek, the Marshland, and the Pilchuck River. They requested that the Watershed Assessment Section (WAS) assess the water quality of these drainage systems with respect to 303(d) listed parameters and impaired uses. Table 1 lists the 303(d) parameters for the drainages.

In addition to concerns about the water quality and impaired uses of Snohomish River tributaries, there is also concern about these systems' effects on the Snohomish Estuary as part of the Puget Sound. The Puget Sound Water Quality Authority (PSWQA) was established, in part, because of the potential water quality impacts from watersheds draining to the Sound. PSWQA developed a watershed management plan for protecting Puget Sound called "Puget Sound Water Quality Management Plan". The watershed management program is defined in the Washington Administrative Code Chapter 400-12 (WAC 400-12). As part of the PSWQA management program, counties ranked their specific drainage basins and subbasins with respect to water quality.

Currently, Quilceda Creek, Allen Creek, the Marshland, and French Creek are ranked under the WAC 400-12 management program. The Pilchuck River and Woods Creek are not ranked under the program, partly because water quality data to establish current conditions have not been available.

Background Information

Figure 1 is a map of the study area. The Snohomish River basin drains 1,978 square miles and discharges to Possession Sound. The Snohomish River is formed by the junction of two major rivers, the Skykomish and Snoqualmie. Historically, land-use in the basin has mostly been agriculture and forest, but it is rapidly becoming more urban. In the 1980s Snohomish County was the fastest growing county in the state (Fox and Hodgkin 1992). Increased urbanization and other land development are likely having a direct impact on water quality in the basin through alteration of stream banks, riparian vegetation, and near stream forest; and through increased contributions of organic material, nutrients, bacteria, and solids. Thornburgh (1993) reported that fish runs are diminished and many shellfish beds are closed due to declining water quality in the county.

A total maximum daily load (TMDL) study for point source discharges of oxygen-depleting substances to the lower Snohomish River Estuary system has been completed (Cusimano 1995, 1997). As part of this study, historical data were reviewed and water quality data collected on all the major tributaries to the system. Results of the review and data collection efforts suggest that major tributaries to the Snohomish River have poor water quality. The following is a brief basin description and summary of historical water quality for each of the study basins.

Quilceda/Allen Creek

Quilceda and Allen Creek flow south through the city of Marysville (see basin map in Appendix C). They are both designated Class A waters (WAC 173-201A). Their watersheds include about 49 square miles. Quilceda Creek drains roughly 38 square miles and Allen Creek the remaining 11 square miles of land. These co-located streams are just north of the Snohomish River delta in Snohomish County between the cities of Arlington and Everett. Both basins discharge to Ebey Slough, a side channel of the Snohomish River, which enters Possession Sound just to the west of the Quilceda Creek confluence.

Throughout the Quilceda/Allen Creek watersheds both residential and commercial development is growing. Snohomish County reports that the population of Marysville doubled from 1989-1994 and estimates the 1992 population within the watersheds was 40,600. Forecasts estimate that by 2012 the watershed population could reach 58,000.

The upper watershed is comprised primarily of agriculture and rural land uses, while commercial and industrial land uses are generally in the lower basin. Industrial areas comprise about 10% of the land area which includes: the Boeing Test Facility located on the Tulalip Reservation, the Arlington Airport, and Brashier's Industrial Park in Marysville. Land east of I-5 from 136th to 172nd NE is zoned industrial/business, but currently is only partially developed. Commercial development accounts for about 5% of the watershed, and is generally located adjacent to the I-5 corridor. Along Tulalip Road exists a casino, bingo parlor, and service facilities. Downtown Marysville has a commercial center extending northward along State Ave to 116th Ave NE. A small shopping center and gas stations/convenience stores are located along 172nd just east of I-5. The city of Marysville concentrates the residential development, covering about 25% of the watershed. The majority of new residential development has occurred in the Allen Creek basin. The remainder of the watershed is zoned agriculture (30%) or rural (30%). There are 251 farming enterprises in the watershed; 70 are commercial, with 15 of these being dairy farms. In the northern portion of the watershed agricultural areas are generally small farms or fallow fields. Small farms, low density single family homes, and forest lands are found in rural zoned areas. Forest lands are about 15% of the watershed, mostly located on the Tulalip Reservation or the eastern hillslopes (Quilceda/Allen Watershed Characterization; Carroll and Thornburgh, 1994).

Quilceda/Allen Creek are not meeting Class A standards. High levels of fecal coliform and nutrients have been reported in Quilceda and Allen Creek (Thornburgh *et al.*, 1991; Thornburgh and Leif, 1992; Cusimano, 1995). In addition, oxygen levels often violate the dissolved oxygen standard with concentrations less than 6.5 mg/L not uncommon during summer months (Thornburgh *et al.*, 1991; Cusimano, 1995). Total organic carbon concentrations of 4-5 mg/L have been found, which implies loading of organic material to the system (Cusimano, 1995).

Violations of the mercury, cadmium, and lead criteria (i.e., the pre-1992 total recoverable metal standards) have also been reported (Thornburgh and Leif, 1992).

Larson and Marti (1996) investigated the relationship between Quilceda Creek and the surficial aquifer in a seven square mile study area in the Marysville Trough. They found that ground water was a major contributor to streamflow, accounting for 46 to 60% of flow during times when surface runoff was absent (not raining). Ground water was not found to be a source of bacteria to the creek, but it was found to be an important source of total dissolved solids, nitrate, and chloride, as well as a minor source of total organic carbon, ammonium, and phosphorus.

Impaired uses of Quilceda and Allen Creek are primary contact recreation; secondary contact recreation; and, salmonid and other fish spawning, migration, rearing, and harvesting (Ecology, 1994). Probable sources of contaminants are urban and commercial runoff, septic systems, manure, fertilizers, and animal access to the creeks. A survey by the Tulalips identified direct animal access, failing septic systems, and over 350 sources of direct discharge degrading Quilceda/Allen Creeks water quality (Thornburgh, 1993).

Snohomish County (1994) completed an extensive watershed characterization of the Quilceda and Allen Creek drainages as part of a local watershed planning and management program under WAC 400-12. The watershed characterization and the Quilceda/Allen Watershed Management Plan provide a description of the physical, biological, and cultural features of the Quilceda and Allen Creek basins. The management plan is scheduled to be completed in early 1998.

Pilchuck River

Discharging to the Snohomish River at river mile (RM) 13.5, the Pilchuck River originates in the western slopes of the cascades and drains about 130 square miles of land. The Pilchuck River flows westward to the town of Granite Falls. From Granite Falls the river bends southward to its confluence with the Snohomish River just to the southeast of the city of Snohomish (see basin map in Appendix C). The average annual discharge is 364 cfs, making the Pilchuck River the largest tributary to the lower Snohomish River. The upper Pilchuck River watershed, above Granite Falls, drains a deep narrow trough in the upland forest of the western cascades. The river's flow response to rainfall can be very rapid. The upper Pilchuck River above the Snohomish Waterworks Dam (RM 26.8 to headwaters, WA-07-1040) is classified AA, "extraordinary," while the remaining lower river (WA-07-1030) is Class A, "excellent."

Approximately 39 miles in length the Pilchuck River basin drains roughly 130 square miles of land surface. Generally, available literature divides the Pilchuck River basin into two reaches: the lower Pilchuck River which starts at the confluence with the Snohomish River to about RM 8.4, at the OK Mill Road Bridge crossing, and the upper Pilchuck River from RM 8.4 to the headwaters. The lower Pilchuck River drains about 15.3 square miles of land, or 11.8% of the basin. There is little available information on the upper watershed. The majority of information is on the lower river and its tributaries.

Historically, the Pilchuck River has had a good riparian buffer. Low density residential development and small hobby farms dominate the land use in the basin. Reportedly, the Pilchuck River basin has had a decrease in commercial farms and an increase in hobby farms (Thornburgh *et al.*, 1991).

A Pilchuck River Reconnaissance Survey conducted by Snohomish County in 1993 documented water quality concerns in tributaries to the river. Machias, Centennial, Bunk Foss, Scott, and Sextant Creek in the lower basin were found to have good water quality but noted pollution concerns at numerous road crossings throughout the basin. Foam and suds in the streams and animal waste adjacent to the streams were commonly observed. The source of the problems appeared to be livestock access to the stream, inadequate pasture management, onsite sewage disposal systems, and fertilizer application. Livestock access was considered a particular problem evidenced by animals in or near the streams, lack of streamside vegetation, and eroded streambanks (Snohomish County Reconnaissance, Report 4).

The Ecology 305(b) report lists the Pilchuck River as a threatened waterbody due to potential impacts from further development. Contaminants of concern are sediment and bacteria. There are no historical water quality data available on the upper Pilchuck River. Appendix A contains graphs of data collected on the Pilchuck River at Ecology's ambient monitoring station (07B055) near the City of Snohomish from October 1981 to October 1996 (data were not collected from November 1993 to September 1995).

Little Pilchuck (Catherine) Creek

Little Pilchuck Creek enters the Pilchuck River at RM 8.5. The confluence of Little Pilchuck Creek is generally considered the basin divider for the upper and lower Pilchuck River. Little Pilchuck Creek is roughly 11.7 miles in length and covers approximately 33.6 square miles of land, which is about 26% of the Pilchuck River basin. Little Pilchuck Creek has two major tributaries, Catherine Creek and Star Creek. Catherine Creek is about 5.3 miles in length and has roughly 14.1 square miles of land draining to Little Pilchuck Creek.

The Little Pilchuck Creek basin starts in scrub and forested wetlands south of 156th Street NE and east of 107th Ave NE, roughly at an elevation of 500 feet. The majority of timber in the headwater areas has been logged in the last twenty years. The Little Pilchuck Creek basin still has extensive wetlands and the riparian corridor has cover of mixed conifers, deciduous trees, and brush. An estimated wetland area of between 2800 and 3500 acres (13 to 16% of the watershed) is within the Little Pilchuck Creek drainage. North of Highway 92 land use is mixed forested areas, wetlands, rural residential, hobby farms, and pasture. South of Highway 92 land use is medium density residential and commercial around the City of Lake Stevens and Lake Stevens.

About 5% of the watershed is within the city of Lake Stevens. Completion of Highway 2 trestle across the Snohomish floodplain and improvements to Highway 204, 9, and 92 make the Little Pilchuck basin attractive to the Everett housing market (Snohomish County Reconnaissance, Report 3).

Most of the lower portion of the Catherine Creek subbasin is in the proposed city of Lake Stevens urban growth area, with the rest of the Little Pilchuck Creek drainage designated medium density rural residential, with a density ranging from one dwelling unit per 2.3 to 5 acres (Snohomish County Reconnaissance, Report 3).

Although there are no water quality data available for Little Pilchuck and Catherine Creek, isolated pollution problems were seen at numerous road crossings throughout the Little Pilchuck Creek basin. Foam and suds in the streams and animal waste adjacent to the stream were commonly observed. The source of the problems appeared to be livestock access to the stream, inadequate pasture management, onsite sewage disposal systems, and fertilizer application. Livestock access was considered a particular problem evidenced by presence of animals in or near the streams, lack of streamside vegetation, and eroded streambanks. The county noted seven sites with serious water quality problems from nonpoint sources in the Little Pilchuck Creek basin. Six of the seven locations were livestock access and channel degradation, while the seventh was thought to be from a failed septic system (Snohomish County Reconnaissance, Report 3).

Dubuque Creek

Dubuque Creek is a tributary to the Pilchuck River located northeast of the city of Snohomish and southeast of Lake Stevens. Joining the river at approximately RM 8.5, the confluence of Dubuque Creek (and Little Pilchuck Creek) is generally considered the basin divider for the upper and lower Pilchuck River. Dubuque Creek has one major tributary - Panther Creek. The Dubuque Creek watershed covers approximately 13.3 square miles of land, which is about 10% of the Pilchuck River basin. Dubuque Creek drains about 7.2 square miles and Panther Creek about 6.1 square miles of land.

The Dubuque Creek portion of the basin flows in a north to south direction while the Panther Creek subbasin originates in the three lakes area and flows from the south to the north. The two merge a quarter mile before discharging to the Pilchuck River.

The basin is mostly forested with low density rural residential and hobby farms, and no major urban centers. Small amounts of concentrated residential and urban development occur around the Three Lakes area and confluence with the Pilchuck River.

There are no historical water quality data available for Dubuque Creek or Panther Creek.

French Creek

The French Creek watershed is about 28 square miles. French Creek is a Class A waterbody draining a portion of south central Snohomish County, north of Monroe and southeast of the city of Snohomish, some of which is part of the Snohomish River floodplain (see basin map in Appendix C). This right bank tributary to the Snohomish River is approximately 11 miles in length and includes about 27.5 square miles of land surface. Discharge of French Creek to the Snohomish River at about RM 15 is controlled by a pumping station (maintained by U. S. Department of Agriculture). Major subdrainages discharging into the French Creek basin include: Golf Course Creek, Stables Creek, Cripple Creek, Spada Creek, Lords Hill Tributaries, and Chain Lake Creek.

The French Creek watershed has two distinct characters. The lower portion of the drainage flows through the flat Snohomish River floodplain. It has been straightened and channelized by agriculture. The agricultural practices and lack of stream buffers along the lower reaches of the creek are causing water quality problems. The upper three-quarters of the French Creek watershed, above the Snohomish River floodplain, flow over gentle, largely forested slopes. Rural development in the upper watershed has more recently become significant, increasing runoff from land clearing and residential development activities.

The land uses in the upper reaches of the drainage are primarily a mix of residential development, hobby farms and pastures, forested areas, and several commercial equestrian centers. The lower reaches, in the floodplain area, are dominated by commercial agriculture and dairies. The National Wetlands Inventory identified from aerial photos 246 separate wetlands totaling 1,218 acres of wetlands in the basin. Many forested wetlands are missed by this method of inventory. Estimates of 2,400 to 3,000 acres are considered more realistic, or about 14% to 17% of the total French Creek watershed (Snohomish County Reconnaissance, Report 1).

A number of water quality studies have identified problems in the French Creek basin. Violations of fecal coliform and dissolved oxygen standards have been reported (Thornburgh *et al.*, 1991). Turbidity and nutrient levels are high (Thornburgh *et al.*, 1991; Cusimano, 1995). High concentrations of total organic carbon (8-10 mg/L), BOD (6 mg/L carbonaceous BOD), and low dissolved oxygen (<5 mg/L) have also been reported (Cusimano, 1995). Loading of oxygen-depleting substances and low dissolved oxygen water to the Snohomish River from French Creek have been estimated to be lowering dissolved oxygen concentrations in the river under critical summer low flow conditions (Cusimano, 1995, 1997). These monitoring results indicate French Creek is impaired and not suitable for primary contact recreation, secondary contact recreation, salmonid and other fish spawning, migration, rearing, and harvesting (Ecology, 1994).

As part of the WAC 400-12 local watershed planning and management program, Snohomish County is currently in the process of finalizing a watershed characterization for the French Creek drainage, similar to the one completed in Quilceda and Allen Creeks. A draft watershed characterization report was completed in April 1997 (Carroll and Thornburgh, 1997). A management plan for the drainage is being prepared and the watershed management committee will be developing recommendations for controlling nonpoint pollution.

The Marshland

Located southeast of Everett and southwest of the city of Snohomish, the Marshland drainage consists of a number of small Class A creeks which enter the Marshland, which is a channelized irrigation and drainage ditch system (see basin map in Appendix C). This drainage network and tributaries include about 24 square miles of land, primarily within the Snohomish River floodplain. The streams that drain to the Marshland originate in the residential areas of the ridge creating the south and west boundary of the floodplain. Some of the named tributary streams included in the Marshland drainage are: Wood Creek, Larimer Creek, Thomas Creek, and Garden Creek.

Resembling in many ways the French Creek drainage, the lowland portion of the Marshland watershed is in the floodplain of the Snohomish River where land use is dominated by commercial agriculture. The hillslopes above the Marshland agricultural area, where tributary streams originate, are primarily residential. After flowing through the commercial agricultural land, the Marshland discharge to the Snohomish River is controlled by a pumping station (maintained by the Snohomish County Diking District). Also, like French Creek, agricultural practices and no stream buffers along the channelized portion of the creek are causing water quality problems in the drainage. The Marshland is not classified as a waterbody of the State, but as a tributary to the Snohomish River, its water quality should meet Class A criteria.

A number of studies have identified water quality problems in the Marshland drainage. The Marshland tributaries have been found to violate copper and lead standards (i.e., the pre-1992 total recoverable standards) and have high sediment, fecal coliform, and nutrient concentrations (Thornburgh *et al.*, 1991). Dissolved oxygen concentrations of less than 2.5 mg/L have been measured in the drainage near the pump station (Cusimano, 1995). High turbidity levels have also been measured in the main drainage (Thornburgh *et al.*, 1991; Cusimano, 1995). Also, like French Creek, loading of oxygen-depleting substances and low dissolved oxygen water to the Snohomish River from the Marshland have been estimated to be lowering dissolved oxygen concentrations in the river under critical summer low flow conditions (Cusimano, 1995).

Woods Creek

Woods Creek is a large Class A tributary to the lower Skykomish River. Draining about 62 square miles of land, Woods Creek flows from the north around Lake Roesiger to the south, entering the river near the city of Monroe (see basin map in Appendix C). Land use in the lower portion of the creek is mostly residential (around the city of Monroe) and rural residential with some small scale non-commercial farms and several equestrian centers. Land use in the upper portion of the drainage is low-density rural residential and forest (and some tree farms).

Previous studies have identified water quality problems in the middle to lower watershed. Fecal coliform concentrations consistently violate water quality criteria throughout the year (Thornburgh *et al.*, 1991; Cusimano, 1995). The creek carries high levels of sediment during storm events (Thornburgh *et al.* 1991). Woods Creek also has high nutrient and total organic carbon concentrations and appears to be eutrophic based on chlorophyll *a* measurements of 7-14 μg/L taken during the summer (Cusimano, 1995).

Impaired uses of Woods Creek are primary contact recreation, secondary contact recreation, and salmonid spawning (Ecology, 1994). Probable sources of contaminants are agriculture, pasture land, animal holding, tree harvesting, forest management, road construction, channelization, removal of riparian vegetation, and streambank modification (Thornburgh, 1993).

Study Objectives

Objectives for the study include:

1. Evaluate the quality of existing water quality data on Quilceda Creek, Allen Creek, French Creek, Woods Creek, Marshland drainage, and the Pilchuck River for use in assessment of the condition of these drainages with emphasis on 303(d) listed parameters.

2. Conduct wet and dry season water quality sampling investigations to supplement existing data on the Pilchuck River, Woods Creek, and the Marshland.

3. Conduct a summer low flow water quality sampling investigation of French Creek and the Marshland to assess dissolved oxygen concentrations in these systems.

4. Provide Snohomish County with baseline water quality data from the Pilchuck River, the Marshland, and Woods Creek for evaluation and possible ranking under the Chapter 400-12 WAC process.

Methods

Study Design

There were two major parts to the design of this project: 1) acquiring and assessing Snohomish County's existing water quality data for the study drainages, and 2) collecting additional water quality data. A list of Snohomish County's long-term and intensive sampling sites in the study drainages is in Appendix B. Maps of the individual drainages with Snohomish County sampling sites annotated are in Appendix C. Water quality data for these sampling sites, collected from November 1992 to April 1996 by Snohomish County, were provided to Ecology by Kathy Thornburgh, Snohomish County, Surface Water Management Division.

Additional water quality data were collected by Ecology on French Creek, Woods Creek, the Pilchuck River, and the Marshland to supplement Snohomish County's existing data. Samples were collected on Woods Creek, Marshland, and the Pilchuck River bi-weekly from February 13 to April 9 (wet season) and July 23 to September 24 (dry season), 1996 at the sampling sites listed in Appendix B under "Ecology Water Quality Monitoring Sites." These sites are also annotated on the maps in Appendix C. Two of the Snohomish County sites (pump and fcdd) on French Creek and two sites on Woods Creek (wcmf and wcwf) were also sampled by Ecology during the dry season sampling. The seasonal sampling stations and schedule for field measurements and sample collection for laboratory analysis are listed in Appendix D.

Data Quality Objectives and Analytical Procedures

Analytical methods and the reporting or precision limits for field measurements and laboratory analyses conducted during the wet and dry season water quality surveys are listed in Table 2.

Sample Collection and Field Measurement Methods

All water quality samples collected for laboratory analysis were grab samples. The grabs were collected just below the water surface at wrist depth from the main body of stream flow, except at the Marshland and French Creek pump stations, where samples were collected from the standing pool using a telescoping extension rod. Replicate samples were collected at specified sites by repeating the sampling effort immediately after the first sample was collected. A minimum of one replicate set, which included all parameters, was collected each survey day.

All samples for laboratory analyses were preserved as specified by Manchester Environmental Laboratory (MEL) and delivered to MEL within 24 hours of collection. Throughout the study laboratory analyses were performed within holding times except the February 13 nitrite samples, which were flagged as estimates in the database. All field and laboratory measurements, target detection limits, and methods are listed in Table 2 and were performed in accordance with MEL (1994). Field sampling and measurement protocols followed those specified in WAS (1993) for temperature (alcohol and mercury thermometer), pH (Orion Model 250A meter and Triode pH electrode), conductivity (Beckman Model RB-5), dissolved oxygen (Winkler titration), and stream flow (Marsh-McBirney 201 and 2000).

The only USGS gaging station currently active in the study streams was located in the lower Pilchuck River near Snohomish (USGS Station #12155300). Discharge information for other study streams was unavailable. Flow measurements were collected at some of Ecology's stream sites in the study and are included in the data set listed in Appendix E. All discharge measurement protocols followed those described in WAS (1993).

Quality Control Procedures

Snohomish County data were collected, analyzed, and reported according to their ambient water quality monitoring program QAPP, which was reviewed and approved by Ecology (Thornburgh and Leif, 1992). Ecology data were reported by MEL as usable with data qualifiers noted.

Total variation for field sampling and laboratory analysis were assessed by collecting replicate samples. Approximately 10% of the total number of laboratory samples per parameter were replicate samples. Ten percent of the field measurements (pH, temperature, conductivity, dissolved oxygen and flow) were also replicated. Replicate precision for chemistry parameters was estimated by calculating the root mean square error of the coefficient of variation of the replicate pairs. The results are listed in Table 3. The replicate precision for Snohomish County nitrite-nitrate and total suspended solids data appear to be high relative to the Ecology data and historical precision found in other projects.

A laboratory comparability study was conducted on March 27 to assess the relative bias and comparability of Snohomish County and Ecology field and laboratory data. Ecology and Snohomish County sampling teams split samples collected at eight of the County's French Creek sample sites. Samples were analyzed by their respective laboratories for fecal coliform, nitrate-nitrite, total phosphorus, and total suspended solids. Field parameters for split sample comparisons included conductivity, dissolved oxygen, and temperature. Fecal coliform and conductivity data were found to be significantly different (paired t-test, $\propto = 0.05$). Snohomish County data were higher for these two variables. The data are presented in this report as either Ecology or Snohomish County data.

Data Assessment Procedures

Laboratory data reduction, review, and reporting followed procedures outlined in MEL's Users Manual (MEL 1994). All water quality data were entered into an Excel spreadsheet software program. Data were verified by reviewing 100% of the data after entry for errors. Snohomish County Data were transferred to Ecology in an electronic format (also EXCEL spreadsheet format).

Data analysis includes evaluation of data distribution characteristics and, when necessary, appropriate distribution transformations. Estimation of univariate statistical parameters and graphical presentation of the data (box plots, time series, regressions) were made using SYSTAT/SYGRAPH computer software.

Water Quality Data Results

The following is a summary of water quality data collected by Snohomish County and Ecology. Appendix E contains the County and Ecology data (separated by wet and dry seasons). In order to better show temporal and spatial differences, and to define seasonal allocation targets, the data were separated into dry (May-October) and wet (November-April) seasons. The seasons were established by simply grouping the highest and lowest 6 contiguous months average flows from the Pilchuck River USGS station near the City of Snohomish. It was assumed that the Pilchuck River flows would be representative of the seasonal changes in flows in the other basins.

Figures 2-15 show box plots of water quality variable concentrations by sampling station for both wet and dry season for the Ecology data. (Each box represents the interquartile range or the 50% of the data between the 25th and 75th percentiles; the line in the box is the median; the end of the whiskers are the minimum and maximum data point within 1.5 times the interquartile range; an "*" is an outlier between 1.5 and 3 times the interquartile range; and a "o" is an outlier greater than 3 times the interquartile range.) Figures 16-23 show box plots of water quality variable concentrations by sampling station for both wet and dry season for Snohomish County data. The data summarized in the figures are of three different types. The Snohomish County data are either monthly data collected for multiple years or biweekly data collected for approximately one year, whereas Ecology's data are seasonal data collected only in 1996. Each type of data is summarized based on the sampling site and can be determined by referencing the description of the sampling sites listed in Appendix B. When reviewing the figures, background concentrations (or the concentrations likely to exist without excessive nonpoint pollution) for each variable in all the drainages can be assumed to be approximately equal to those values measured at Ecology's sampling site PRUP on the Pilchuck River and WCUP on Woods Creek. The following is a summary of the major water quality variables. Snohomish County data for 1992-1995 have been summarized in more detail by Thornburgh (1996).

Fecal Coliform

The data indicate regular exceedences of the state water quality standard of 100 colonies/100 mL at most sampling stations in the study basins during both wet and dry seasons (Figures 2 and 16). All sampling stations, except the upstream Ecology station on Woods Creek, had exceedences during the dry season, with most median values greater than the standard.

Temperature

The state water quality standards require Class A streams to maintain temperatures below 18°C. All of the study basins are below the criterion during the wet season. Most of the temperature exceedences occurred in the French Creek and Marshland drainages, which are impounded at their lower end (Figures 3 and 17).

Dissolved Oxygen

The data indicate that dissolved oxygen concentrations in the French Creek and the Marshland drainages violate the criterion of 8 mg/L and are extremely low during the dry season (Figures 4 and 18). In addition, Allen Creek has oxygen concentrations below the criteria. The dissolved oxygen concentration in parts of these drainages during the dry season are at acute lethal levels for salmonids and are likely toxic to other aquatic life such as species of insects found in salmonid habitats (EPA, 1987).

One of the objectives of this study was to conduct an investigation of French Creek and the Marshland to assess dissolved oxygen concentrations in these systems. However, additional data were not collected because the causes of low dissolved oxygen in these systems is likely due to the high loading of oxygen-depleting organic substances as reflected in the nitrogen concentrations found in this survey, and the nitrogen, total organic carbon, and BOD levels found in previous surveys (Cusimano, 1995). The dissolved oxygen concentrations are probably also reduced by the impoundment of the waterbodies by the pumping stations.

The impact of discharge from the Marshland and French Creek on dissolved oxygen concentrations in the Snohmish River under summer low river flow was reviewed in the Snohomish River Estuary Dry Season TMDL Study - Phase II report (Cusimano, 1997). In the report, the daily average discharge (16.2 cfs from each system) was assumed to represent the controlled pumping rate for the two discharges. However, the actual average daily discharge period during the summer is about 8 hours per day (about 49 cfs for an 8 hour period). Therefore, it is possible that the impact of these discharges to the Snohomish River could be three times those estimated to occur in the TMDL report.

Nitrite/Nitrate

Nitrite/Nitrate are the products of nitrification/denitrification. High levels of these constituents indicate that organic material is being loaded to the water and that the oxygen consumption associated with the decay of organic material has occurred. Concentrations of nitrite/nitrate are usually less than 1 mg/L in most surface waters. Most of the sampling sites exceed 1 mg/L in the wet season and many exceed it in the dry season (Figures 6 and 19). Allen Creek had the highest concentrations.

Nitrite is usually only found in minute quantities in surface waters, because it is unstable in the presence of oxygen. The presence of nitrites in surface waters indicates active biological processes influenced by organic pollution. The nitrite data collected by Ecology (Figure 5) suggest that French Creek and the Marshland are receiving high levels of organic pollution.

Ammonia

In non-polluted waters, ammonia concentrations should be less than 0.1 mg/L and often below 0.01 mg/L. Although Snohomish County did not measure this potentially toxic constituent, Ecology data suggest that concentrations in French Creek and the Marshland are potentially toxic. During the summer, high ammonia levels in French Creek and the Marshland are likely depressing dissolved oxygen levels by 3-4 mg/L. Again, the ammonia data suggest that these drainages are receiving high levels of organic pollution.

Other Variables

In general, the other variables presented in the figures are consistent with those reported above and show that the study drainages are receiving nonpoint pollution. For example, the chlorophyll data presented in Figure 15 show that French Creek and the Marshland are eutrophic.

Nonpoint TMDLs

The Clean Water Act (CWA) Section 303(d) requires states to effect pollution controls on waterbody segments where technology-based controls are insufficient to reach water quality standards. To meet this requirement, a total daily maximum load (TMDL) must be established for each pollutant violating water quality criteria. The TMDL is the sum of point and nonpoint sources as wasteload (WLA) and load allocations (LA), respectively. Allocations are implemented through NPDES permits, grant projects, and nonpoint source controls. Thus, the TMDL process helps bring problem waterbodies into compliance with water quality standards.

The TMDL evaluation uses monitoring data and models to estimate pollutant loads that a waterbody can receive and still meet water quality standards. EPA's regulations [40 CFR 130.2(I)] state that "...TMDLs can be expressed in terms of either mass per time, toxicity or other appropriate measure...." EPA specified other appropriate measures as a key concept for establishing nonpoint pollutant source controls. In this TMDL analysis, concentration-based nonpoint TMDLs and LAs for fecal coliform are proposed, such that the state water quality standard can be met at all sampling locations.

Where a large nonpoint source component is included in the TMDL (as in the Snohomish River Tributary drainages) or where data contain a high degree of uncertainty, a phased TMDL approach is appropriate (EPA, 1991). The LAs under a phased TMDL are refined as specific nonpoint problems undergo control measures, and as additional data are obtained. Ecology has established the key steps of a phased TMDL as follows:

1. Define the beneficial uses affected
2. Determine the factors/causes
3. Determine the targets and priorities
4. Develop the pollution controls and identify resources
5. Monitor the results
6. Adjust the controls
7. Involve the public

In addressing the TMDL steps, the role of WAS is to determine the targets and priorities.

Targets and Priorities

The following targets and priorities for water quality improvements are based on Washington State's numeric standards for fecal coliform. The data reviewed in this report support the 303(d) listings presented in the problem statement for fecal coliform and dissolved oxygen. It is likely that water quality problems found in Quilceda, Allen, French, and Woods Creeks, the Marshland, and the Pilchuck River are related to land use and stream corridor issues. It is also likely that targeting fecal coliform for control will help manage other water quality issues as control measures are implemented in the drainages.

The fecal coliform concentration-based nonpoint TMDLs for each basin is simply the Freshwater Class A fecal coliform standard (WAC 173-201A-030-2):

> Fecal coliform organism levels shall not exceed a geometric mean (GM) value of 100 colonies/100 mL and not have more than 10 percent of all samples obtained for calculating the geometric mean value exceeding 200 colonies/100 mL.

To meet the TMDL, concentration-based LAs were established for all monitoring stations in the drainages. Tables 4 and 5 list the dry and wet season levels for both the geometric means and 90th percentiles for each site estimated from either Snohomish County or Ecology data. Tables 4 and 5 also list the geometric mean and percent reduction required to meet the standard at each site for both parts of the criteria. The percent reductions required by each part of the criteria were then compared, and the most restrictive criterion was used to establish the recommended target level, or LA. The allocations and percent reductions were calculated as follows:

1. Partition monthly data into wet and dry season.

2. Calculate the GM of the data for each of the major mainstem and subbasin sampling sites for each season in each drainage.

3. Determine the (log) distribution statistics for each season at each site and calculate the 90th percentile based on the mean, standard deviation, and Z-score. Adjust the distribution such that no more than 10% of the values exceed 200 colonies/100 mL. Then calculate the GM of the adjusted data. If the adjusted GM for a site is <100 colonies/100 mL, it will be the site LA. If the GM is >100 colonies/100 mL, the LA will then be 100 colonies/100 mL.

4. Determine the percent reduction required to meet the site specific LAs (using log data).

In summary, the fecal coliform TMDL is simply the concentration-based freshwater Class A water criteria. Load allocations are the site-specific geometric means needed to meet both parts of the water quality criteria. These site-specific LAs can be used as control points to monitor the success of management measures taken in the subbasins or along the mainstem of the drainages.

The target GMs for sites that were sampled by both Ecology and Snohomish County are similar. For example, the target GMs for stations WCMF and WCWF are 56 and 61 colonies/100 mL for Snohomish County data, and 56 and 77 colonies/100 mL for Ecology data.

Conclusions and Recommendations

- Both historical and current water quality data support the 303(d) listing of fecal coliform as one of the most significant water quality problems in Quilceda, Allen, French, and Woods Creeks, and the Pilchuck River. In addition, fecal coliform concentrations are also high in the Marshland, a waterbody not listed in the 303(d) list.
- Both historical and current water quality data support the 303(d) listing of lower French Creek for temperature. Temperatures were also found to exceed the criterion in the lower reach of Woods Creek and the Marshland.
- Overall, the data presented suggest that the water quality in all of the study basins is being adversely impacted by nonpoint pollution. The data also show that French Creek and the Marshland have the poorest water quality of the study basins. Poor water quality in these waterbodies is likely exacerbated by impoundment caused by the pump stations controlling discharge to the Snohomish River.
- Using data collected by Snohomish County and Ecology, phased TMDLs are recommended for fecal coliform in all of the study basins to help control nonpoint source pollution. Allocations for fecal coliform are based on meeting the water quality standard at site-specific control points (sampling sites) within each drainage during both wet (November-April) and dry (May-October) seasons. Implementing control measures for fecal coliform will likely mitigate other water quality concerns in the basins, such as high nutrient levels and low dissolved oxygen. A temperature TMDL should be developed for the lower portion of French Creek after the watershed characterization study is completed.
- Currently, Quilceda Creek, Allen Creek, the Marshland, and French Creek are ranked under the Puget Sound Water Quality Management Plan. Snohomish County has completed a watershed characterization and management plan for Quilceda and Allen Creek drainages, which includes recommendations for mitigating pollution. The county is currently working on characterizing and preparing a management plan for French Creek. The management plans and recommendations for these drainages should be implemented and activities related to mitigating nonpoint pollution in these drainages supported.
- Follow-up monitoring is needed to evaluate the effectiveness of pollution control measures or to document further degradation of water quality. Snohomish County's ambient monitoring program should be supported in this endeavor. However, the County's sample collection, analysis, and data entry procedures should be reviewed to improve replicate precision for nitrite-nitrate and total suspended solids analyses.
- The impact of discharges from the Marshland and French Creek on dissolved oxygen concentrations in the Snohomish River should be reviewed as part of the planned TMDL for the river.

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Figures

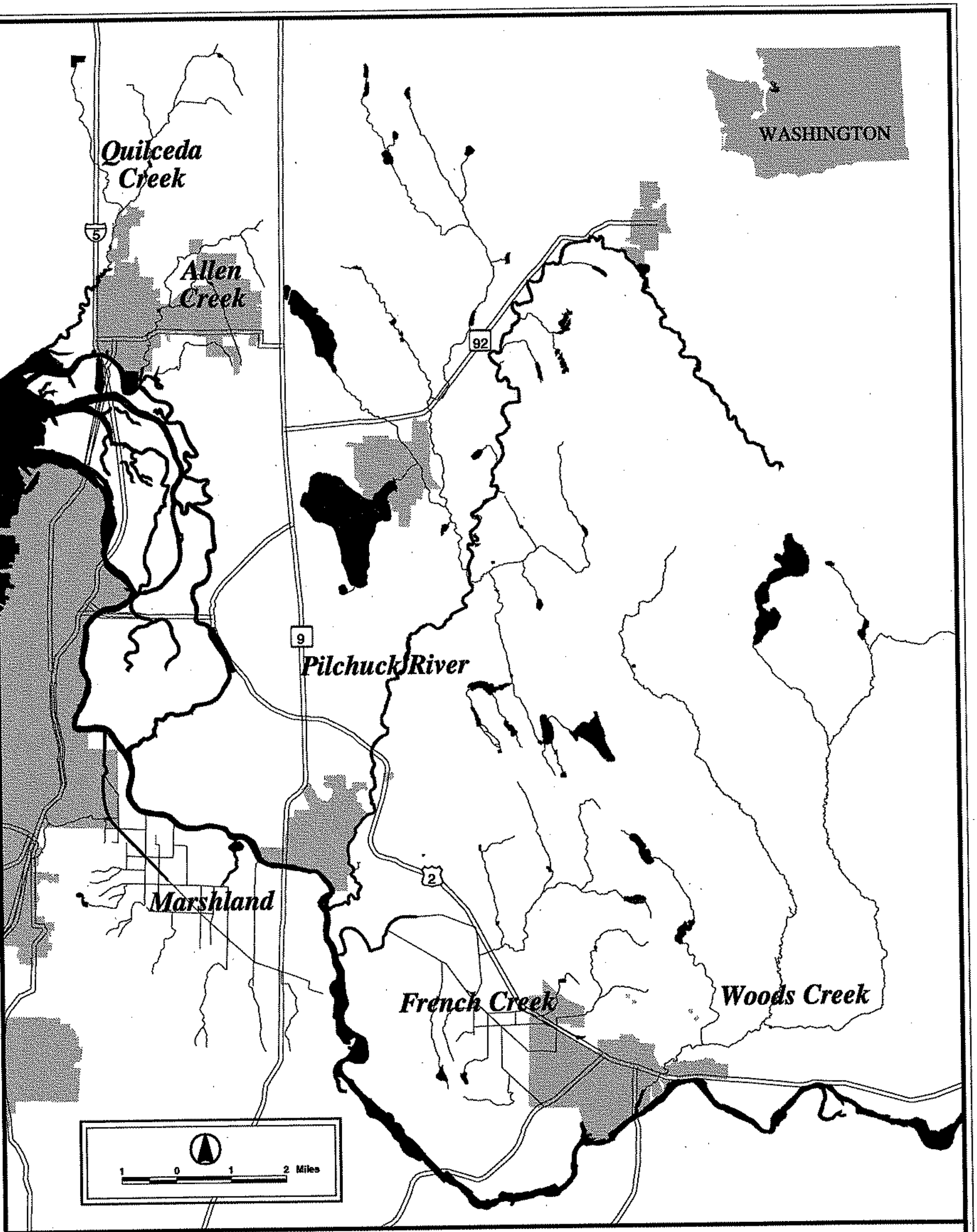


Figure 1. Study Area Map

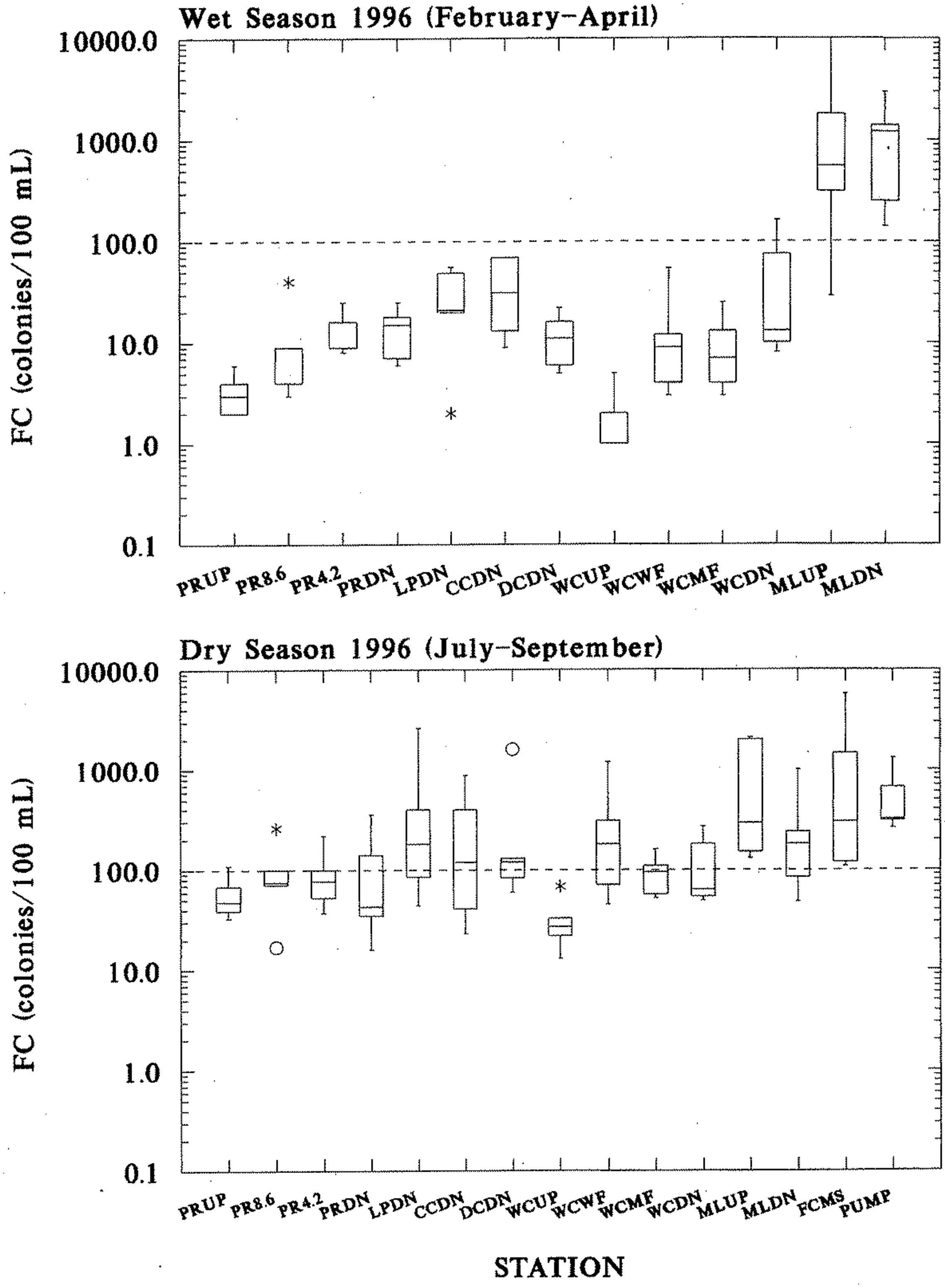


Figure 2. Ecology's Snohomish River tributary survey wet and dry season fecal coliform data; dashed line denotes water quality standard of a geometric mean not to exceed 100 colonies/100 mL.

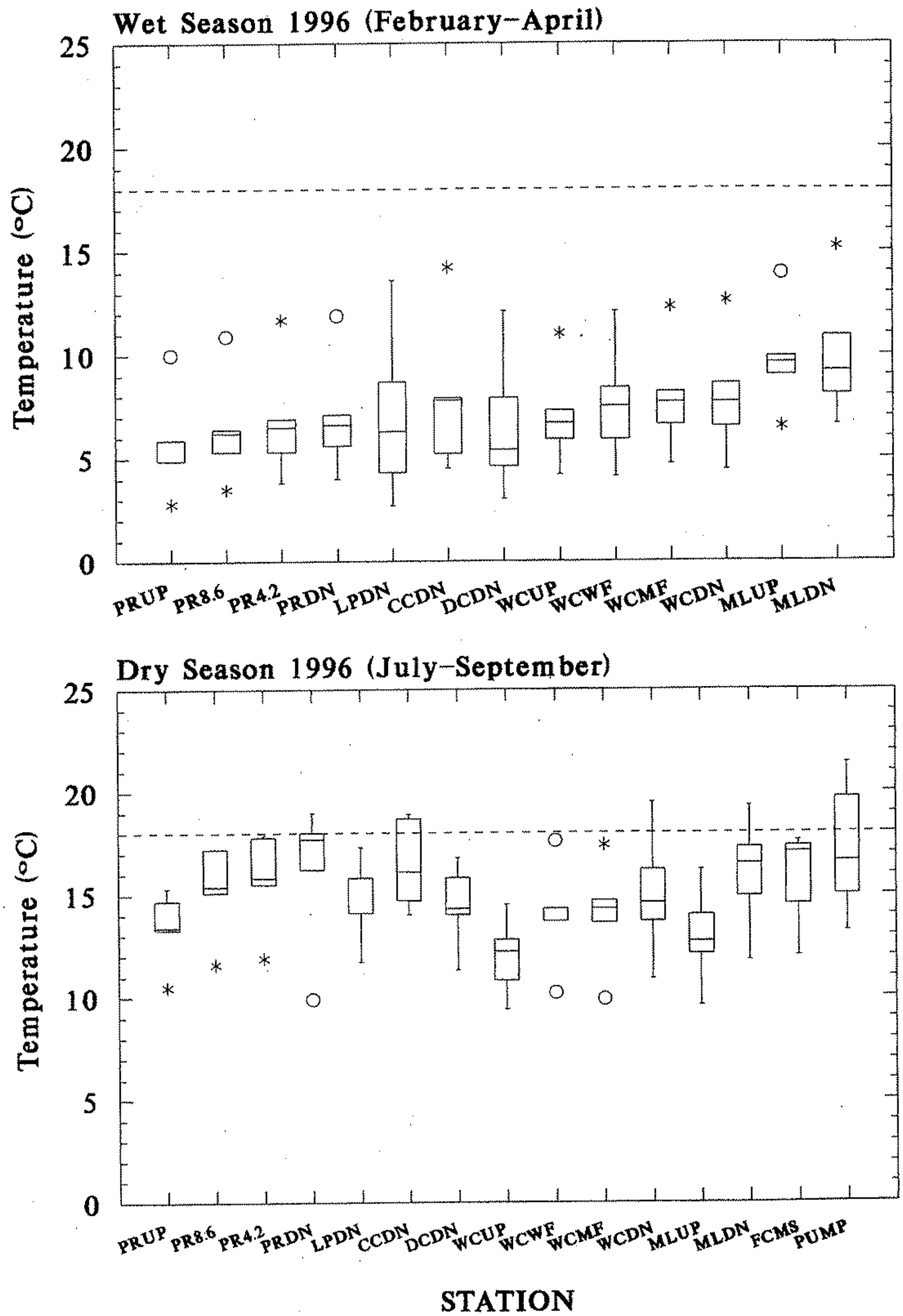


Figure 3. Ecology's Snohomish River tributary survey wet and dry season temperature data; dashed line denotes water quality standard of 18 degrees C.

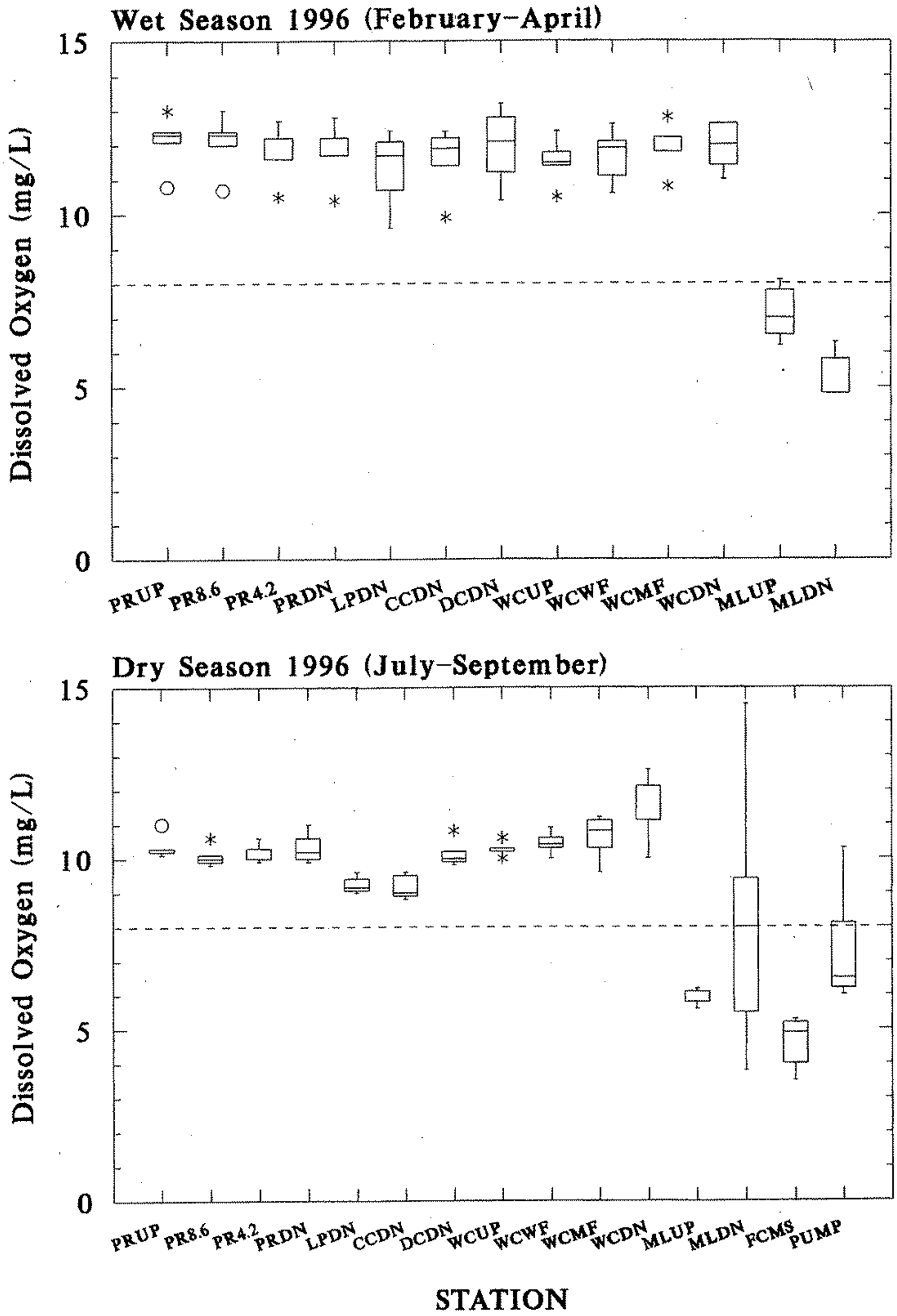
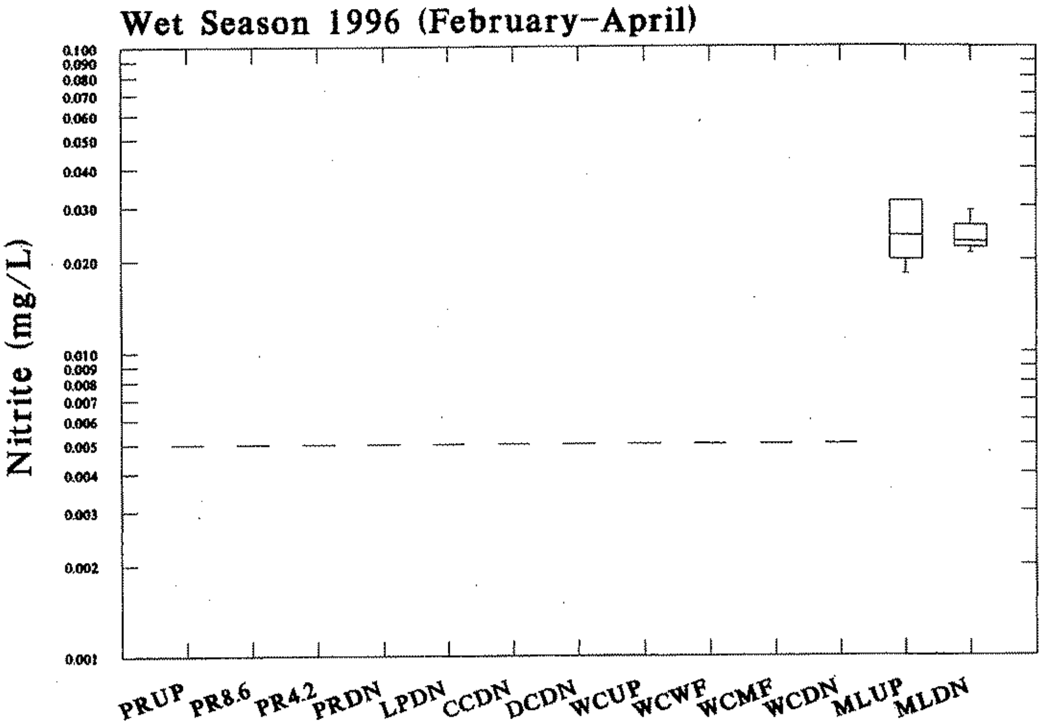


Figure 4. Ecology's Snohomish River tributary survey wet and dry season dissolved oxygen data; dashed line denotes Class A standard of 8 mg/L.



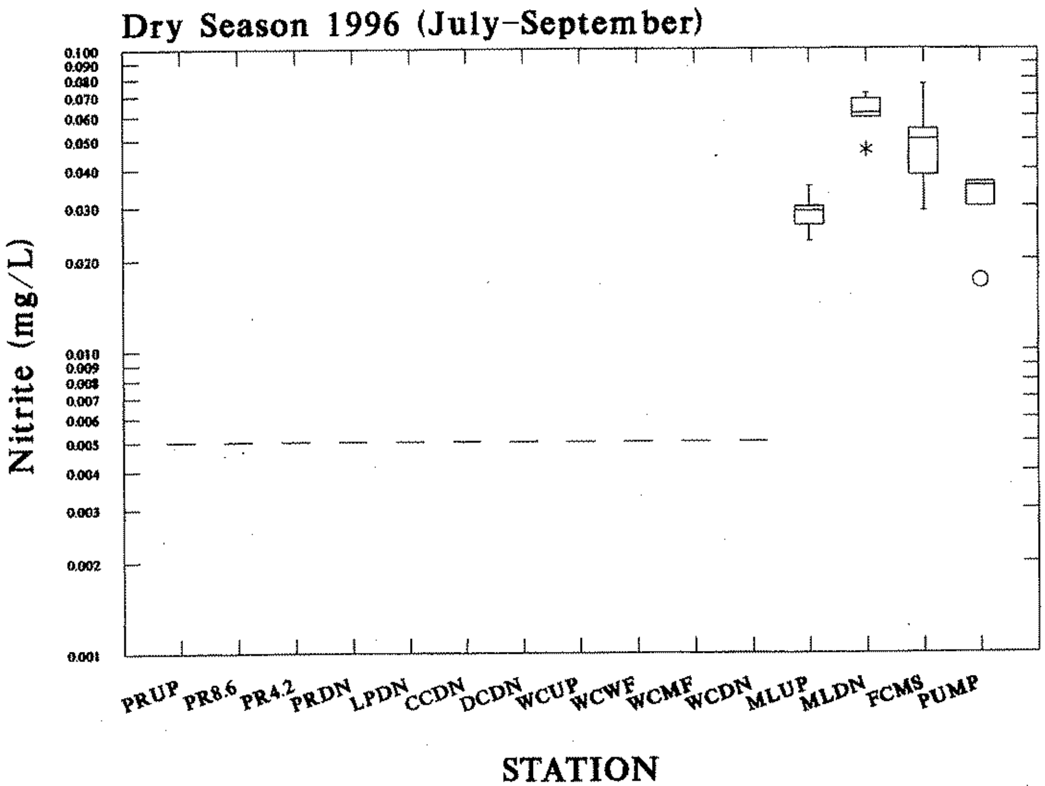


Figure 5. Ecology's Snohomish River tributary survey wet and dry season nitrite data.

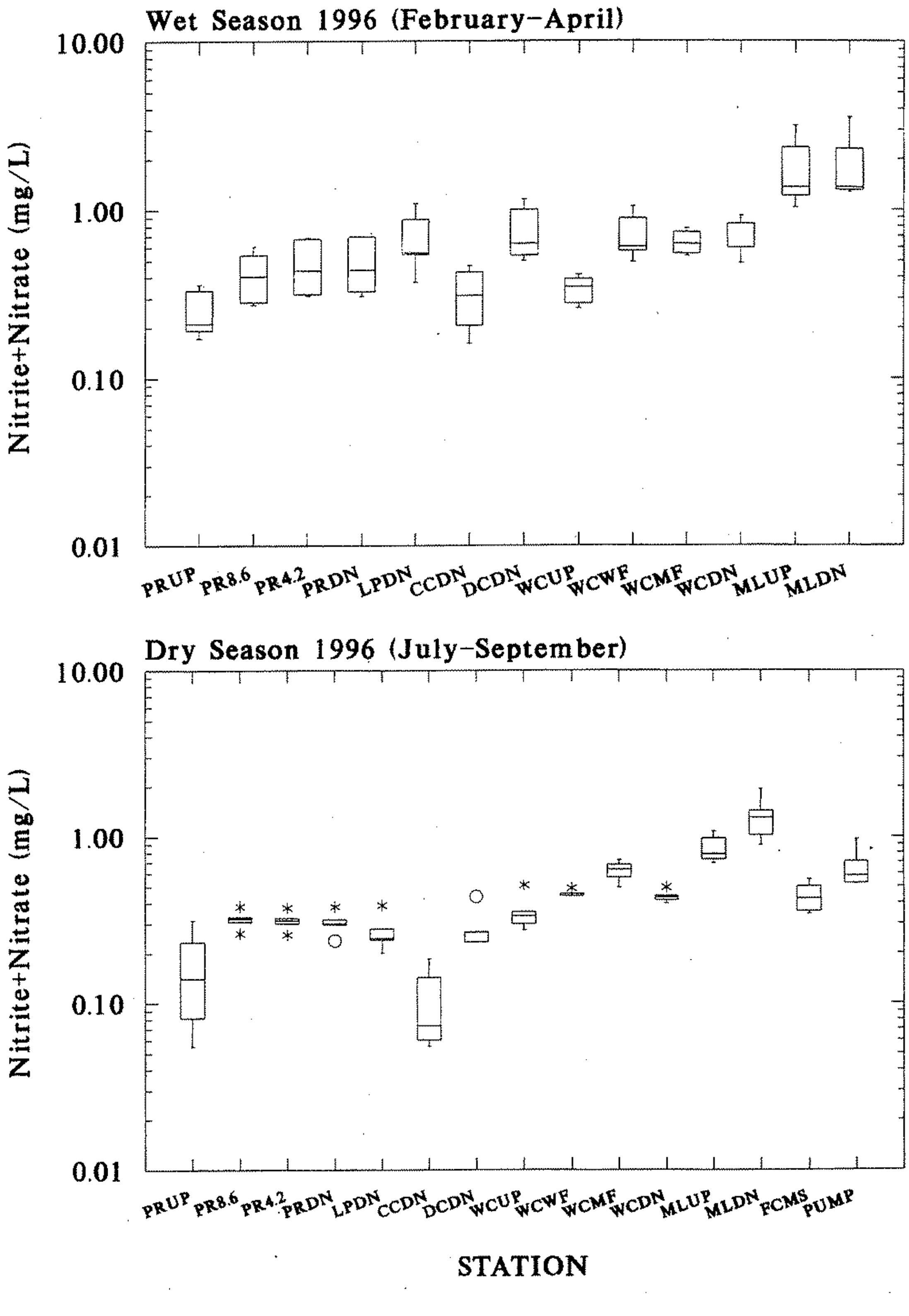


Figure 6. Ecology's Snohomish River tributary survey wet and dry season nitrite+nitrate data.

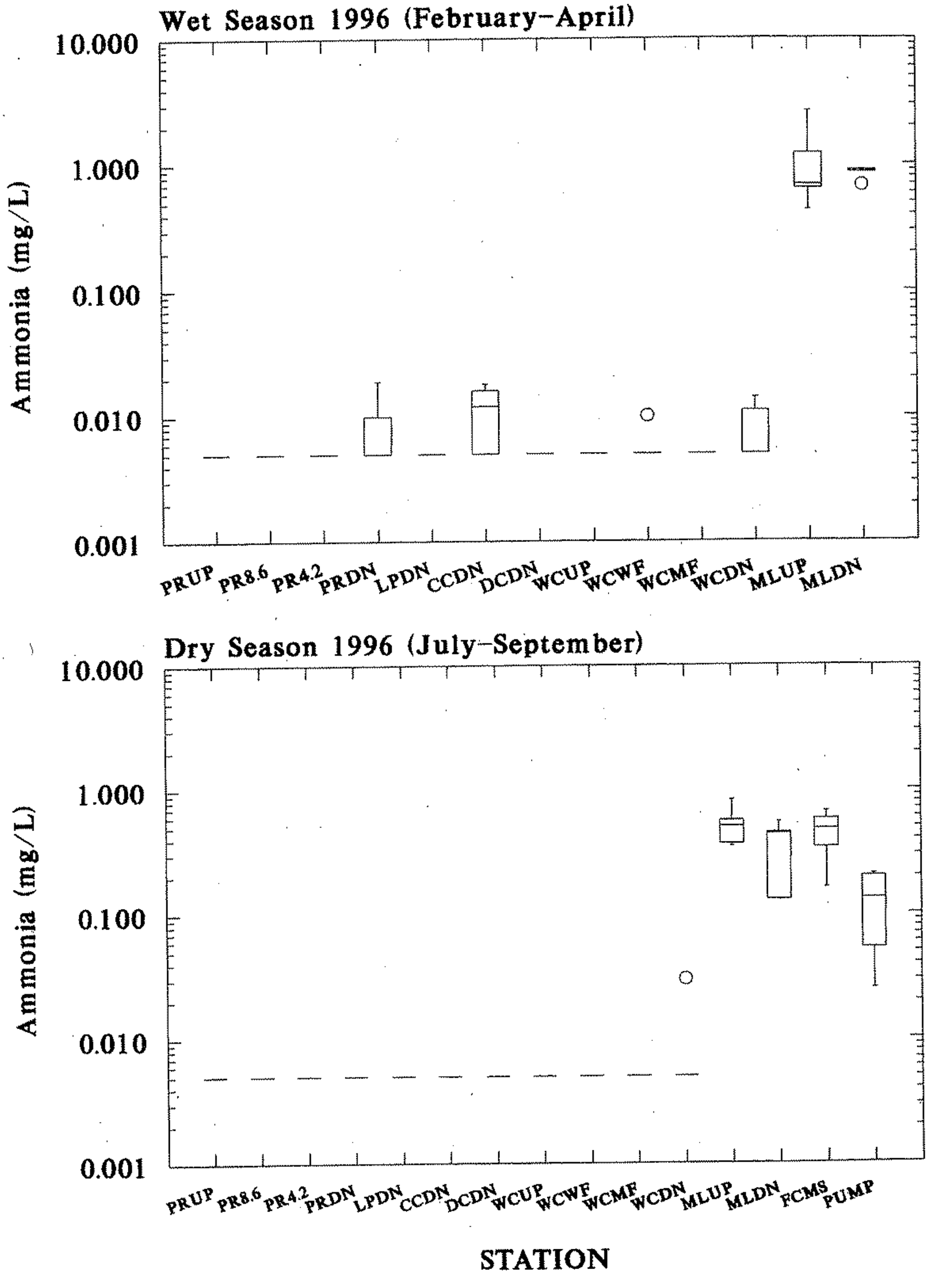


Figure 7. Ecology's Snohomish River tributary survey wet and dry season ammonia data.

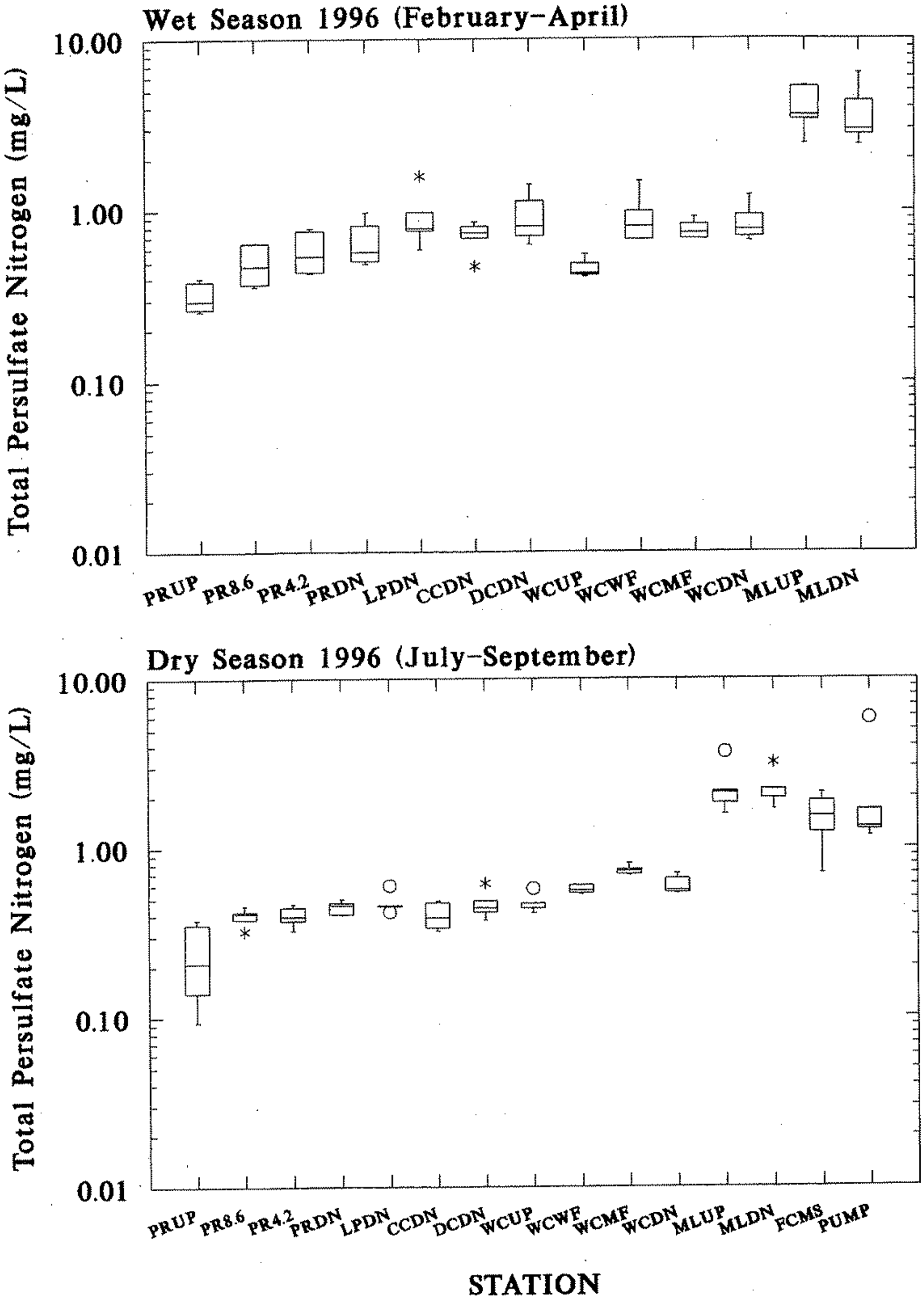


Figure 8. Ecology's Snohomish River tributary survey wet and dry season total persulfate nitrogen data.

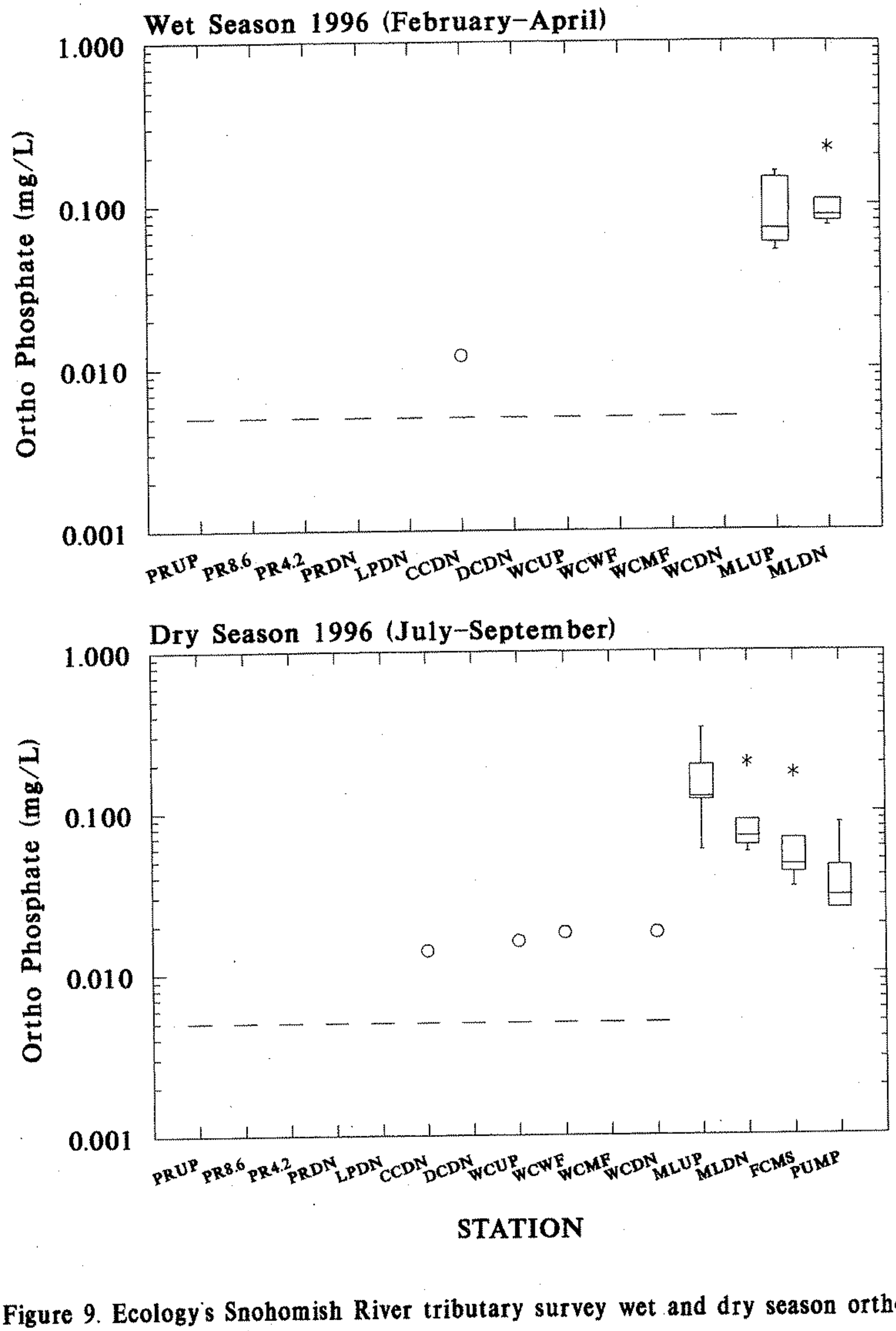


Figure 9. Ecology's Snohomish River tributary survey wet and dry season ortho phosphate data.

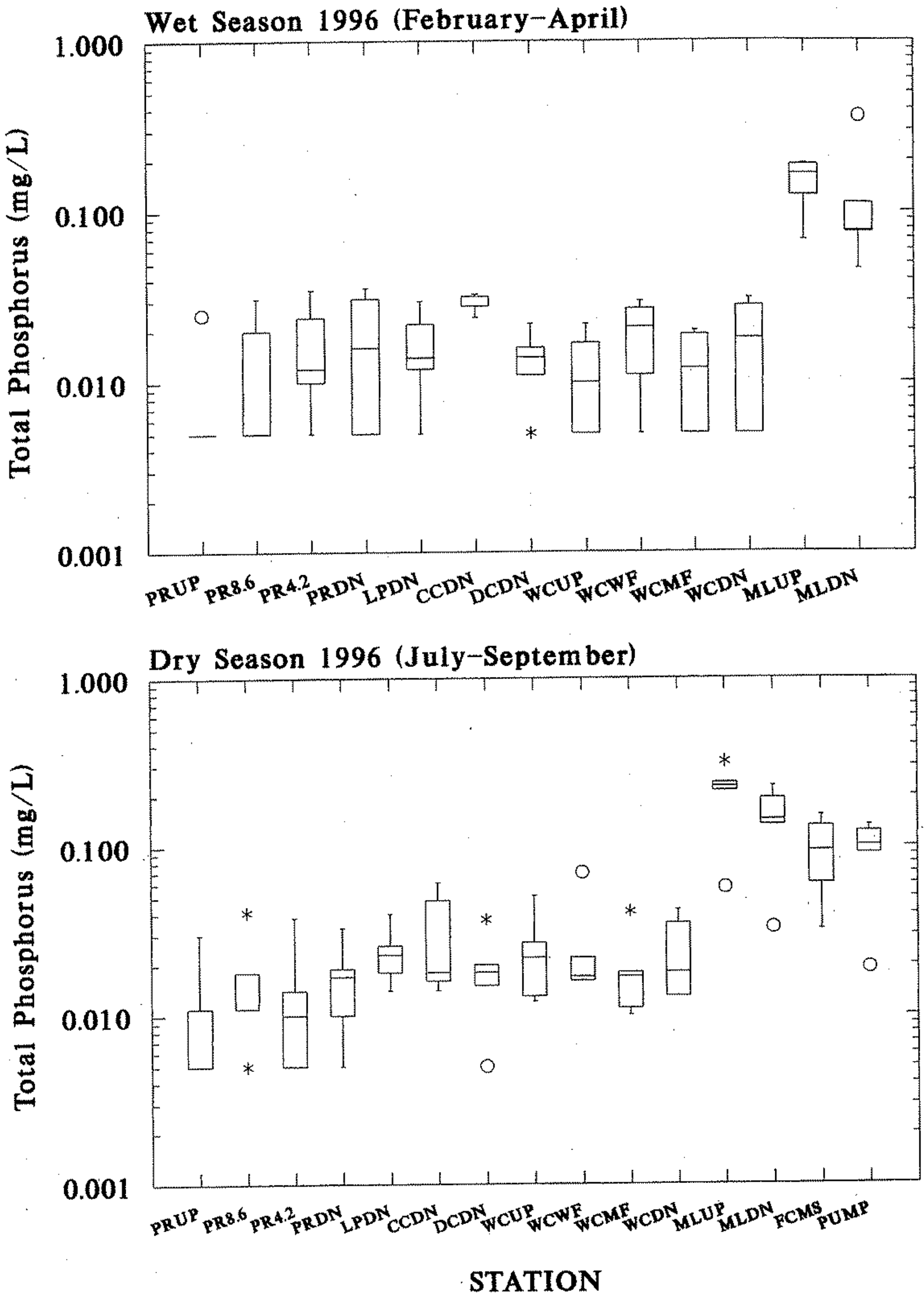


Figure 10. Ecology's Snohomish River tributary survey wet and dry season total phosphorus data.

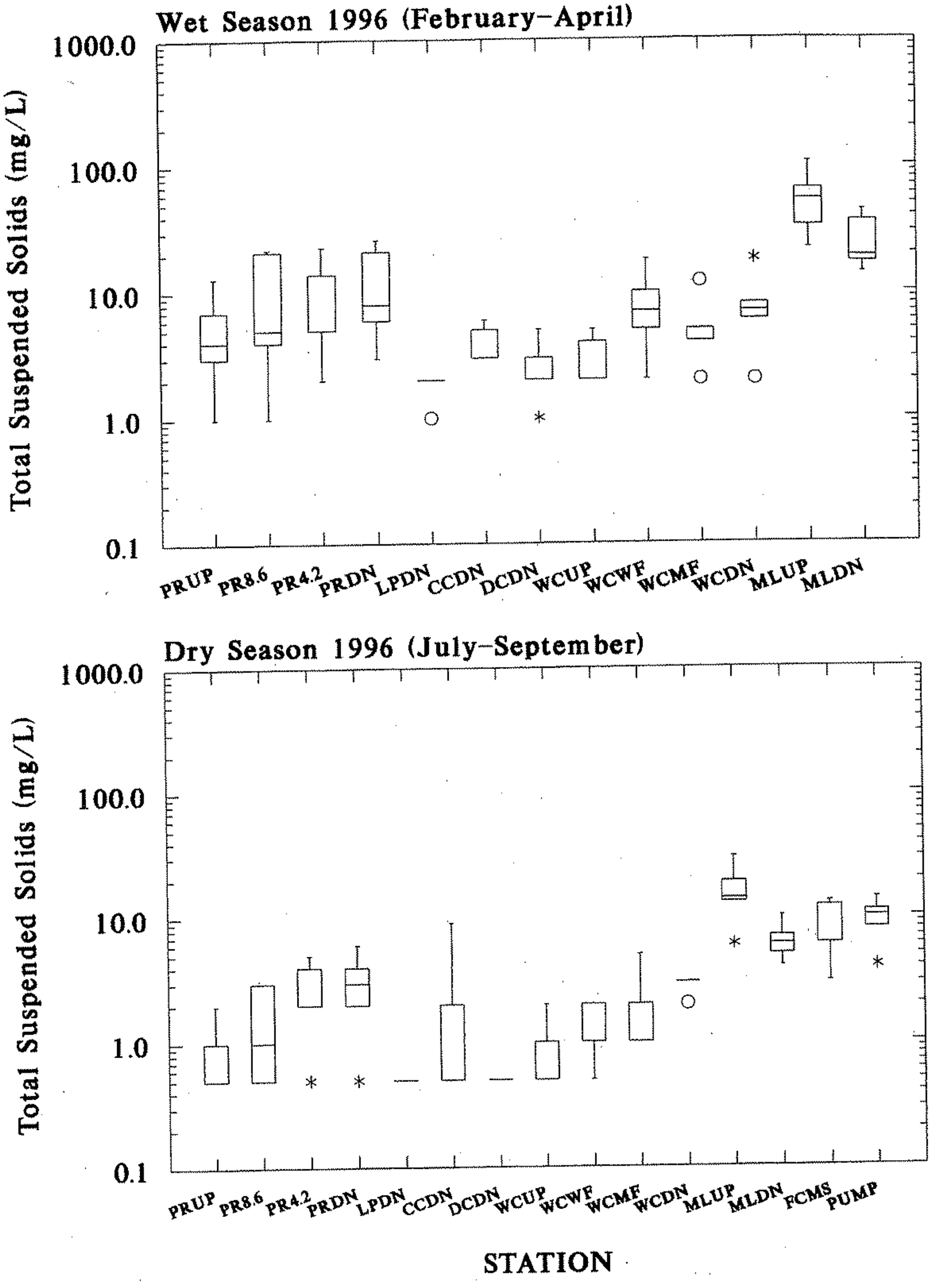


Figure 11. Ecology's Snohomish River tributary survey wet and dry season total suspended solids data.

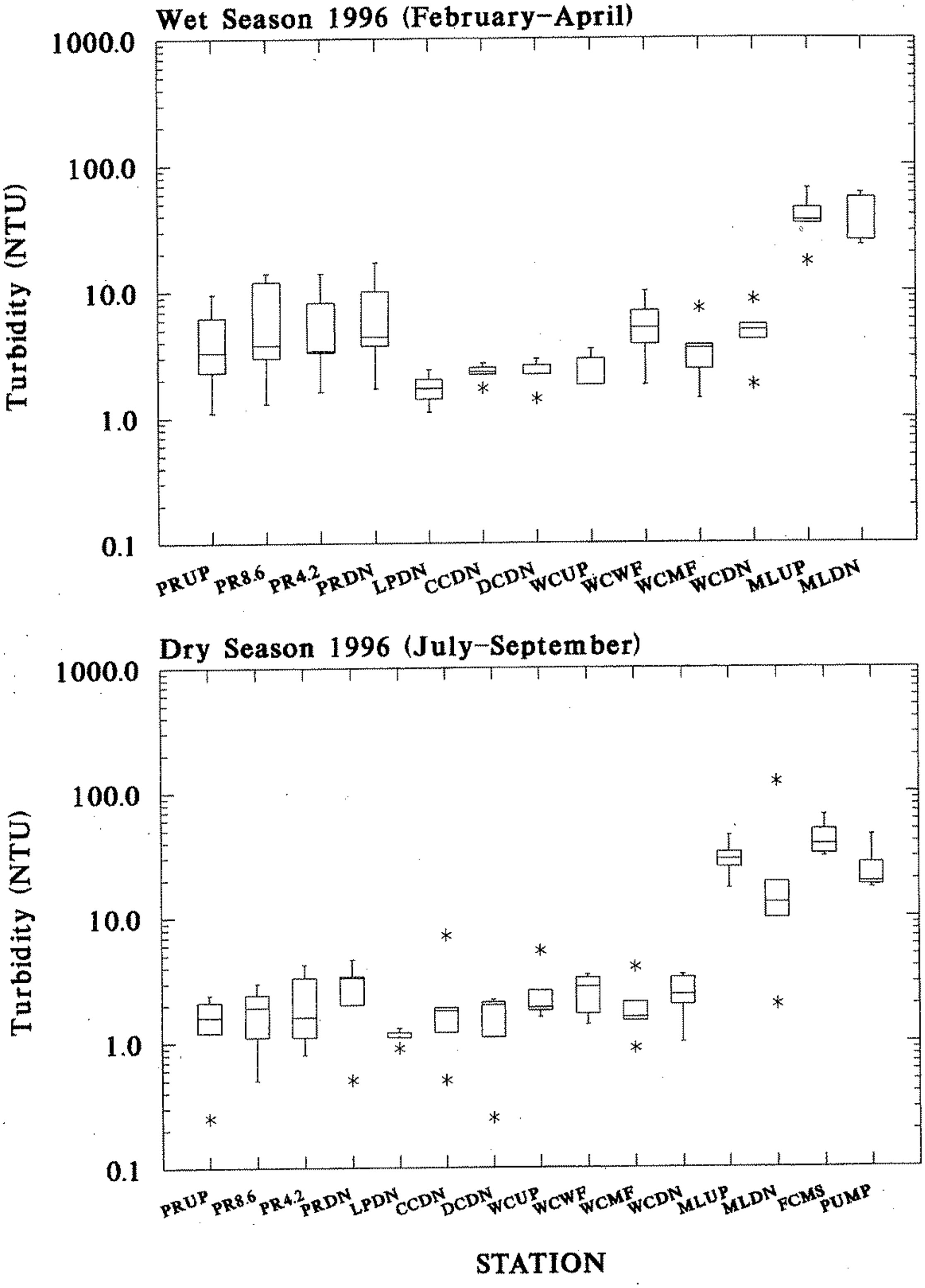


Figure 12. Ecology's Snohomish River tributary survey wet and dry season turbidity data.

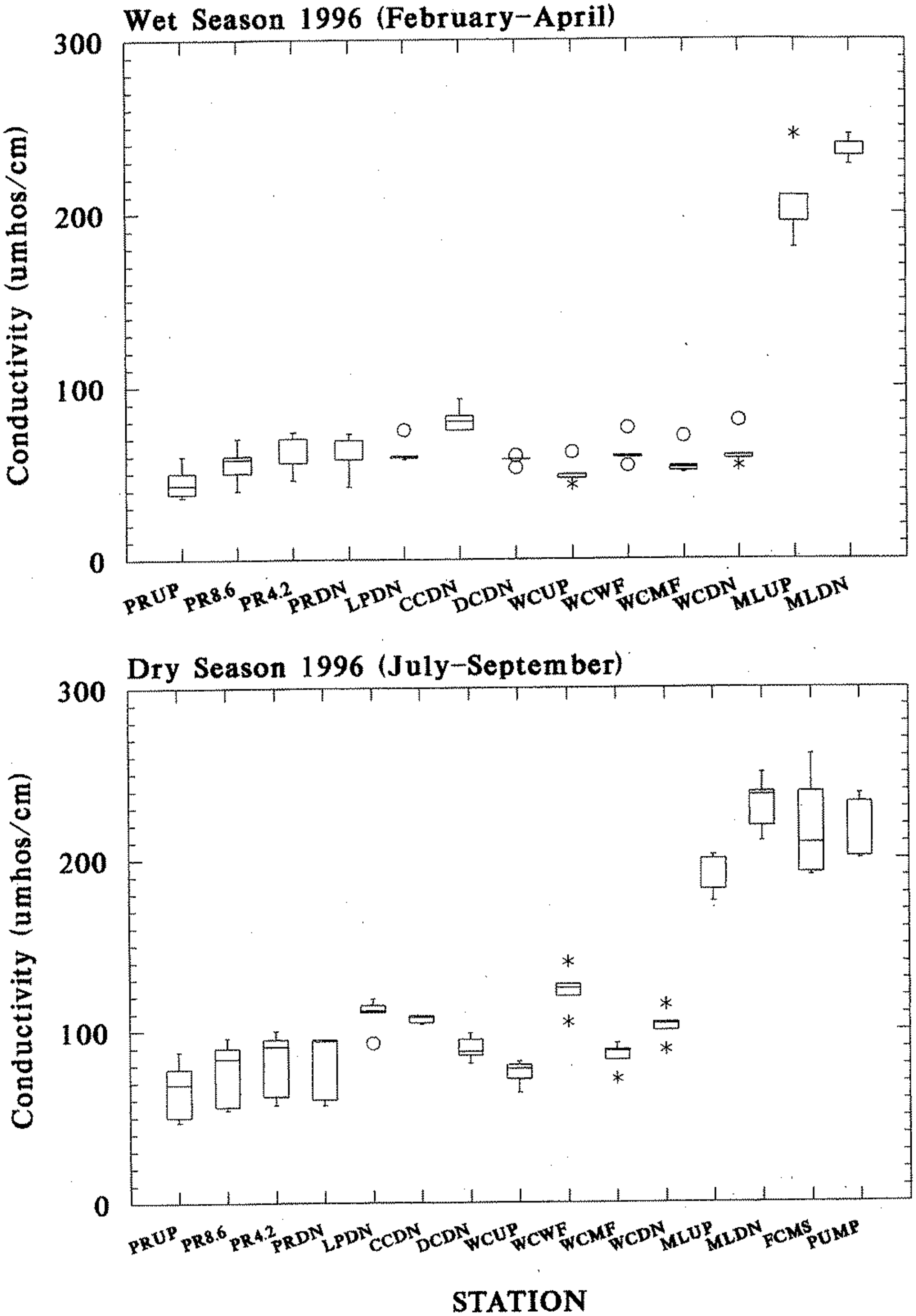
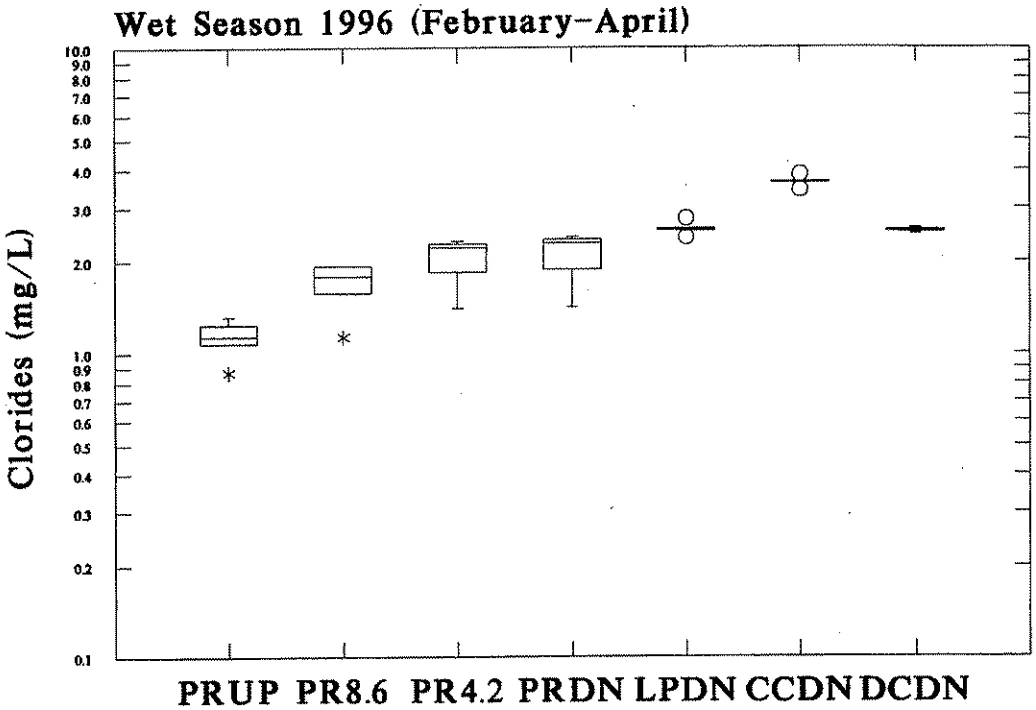


Figure 13. Ecology's Snohomish River tributary survey wet and dry season conductivity data.



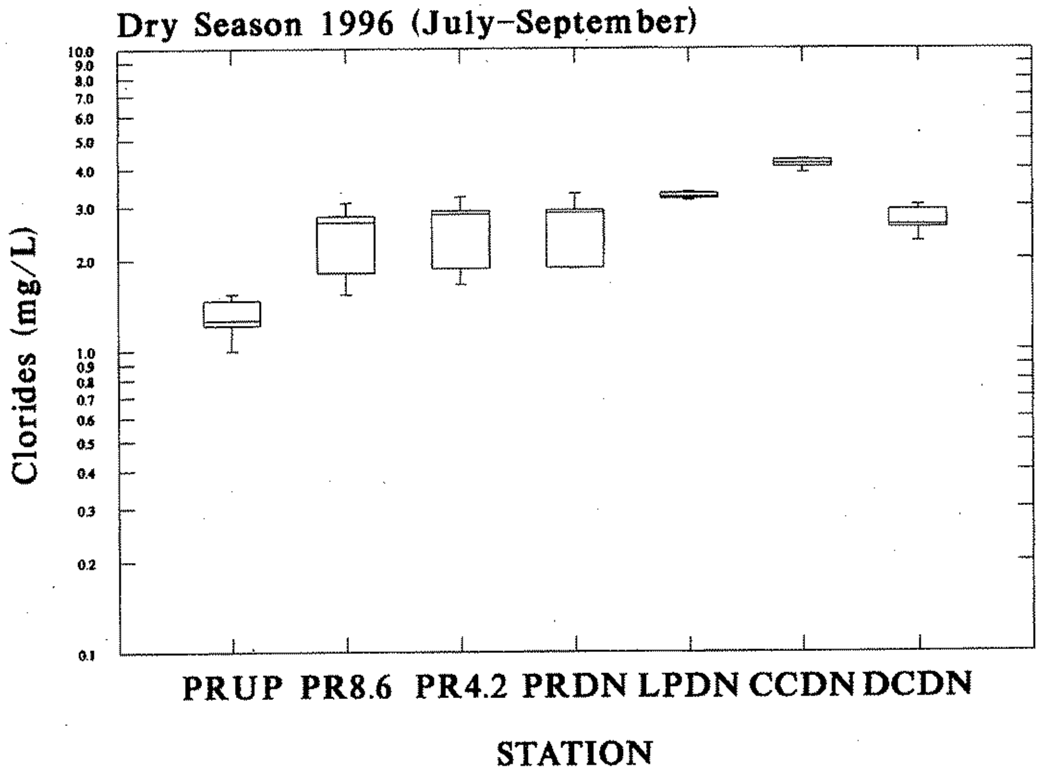


Figure 14. Ecology's Snohomish River tributary survey wet and dry season clorides data.

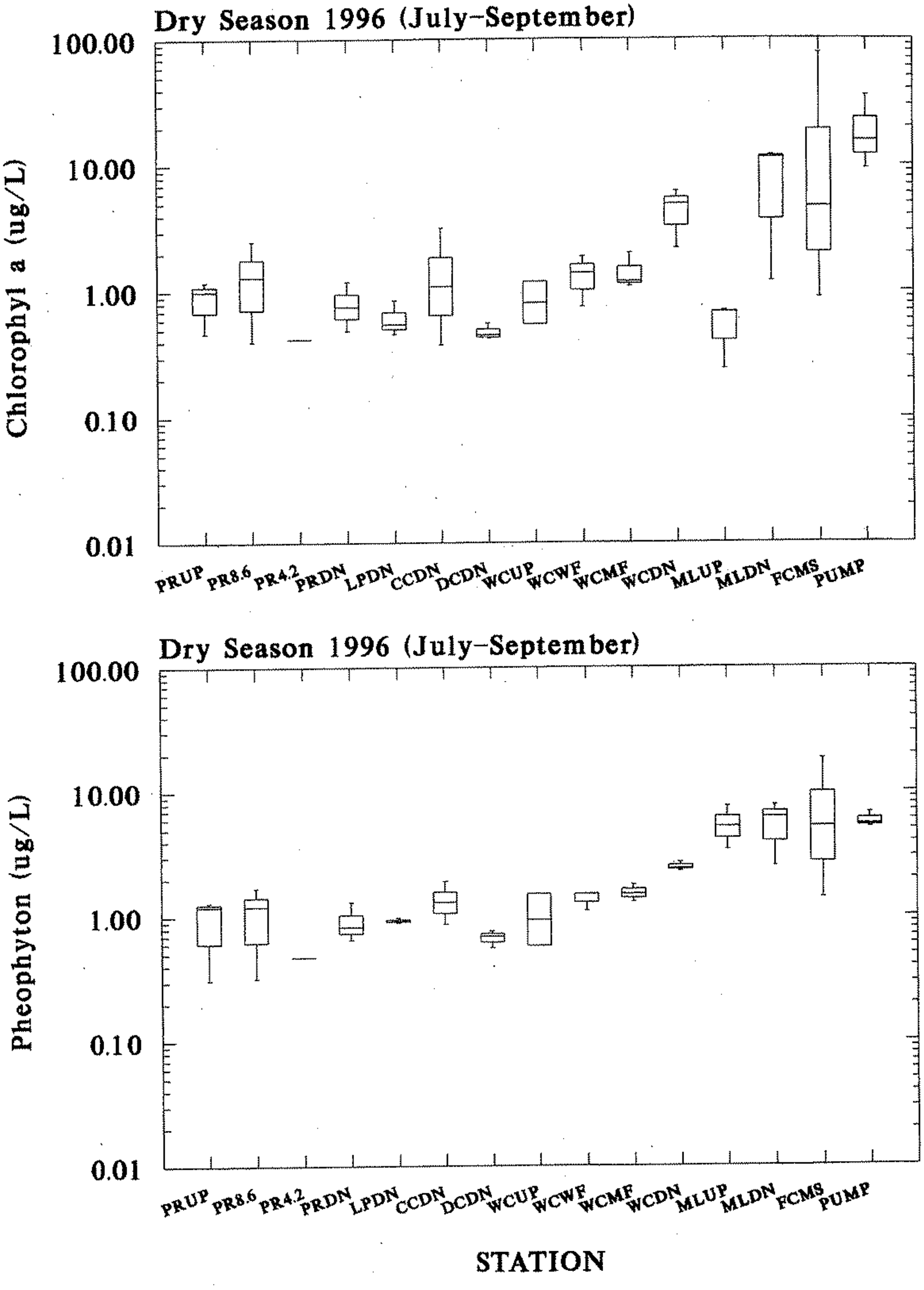


Figure 15. Ecology's Snohomish River tributary survey dry season chlorophyll a and pheophyton data.

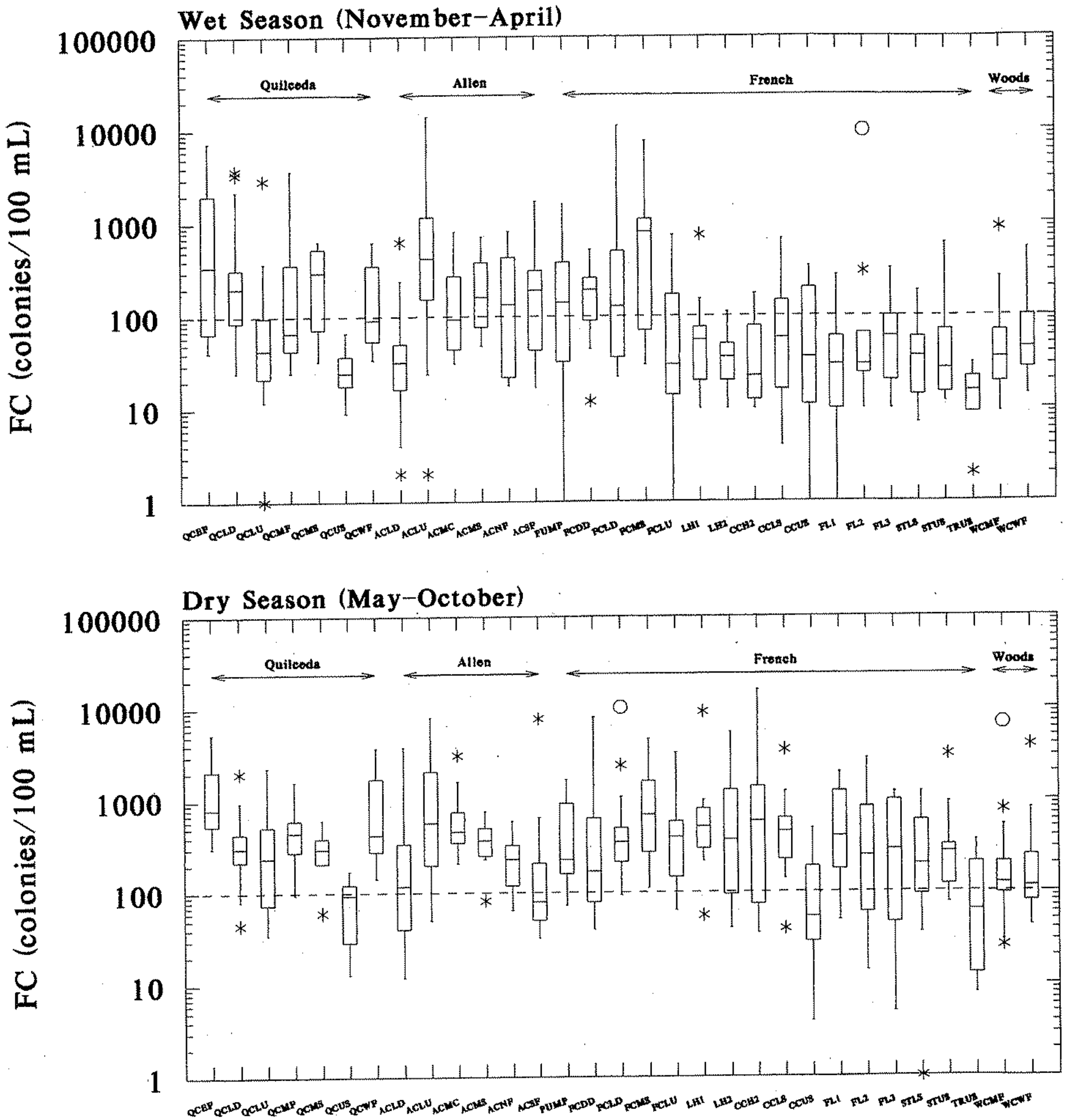


Figure 16. Snohomish County wet and dry season fecal coliform data; dashed line denotes water quality standard of a geometric mean not to exceed 100 colonies/100 mL.

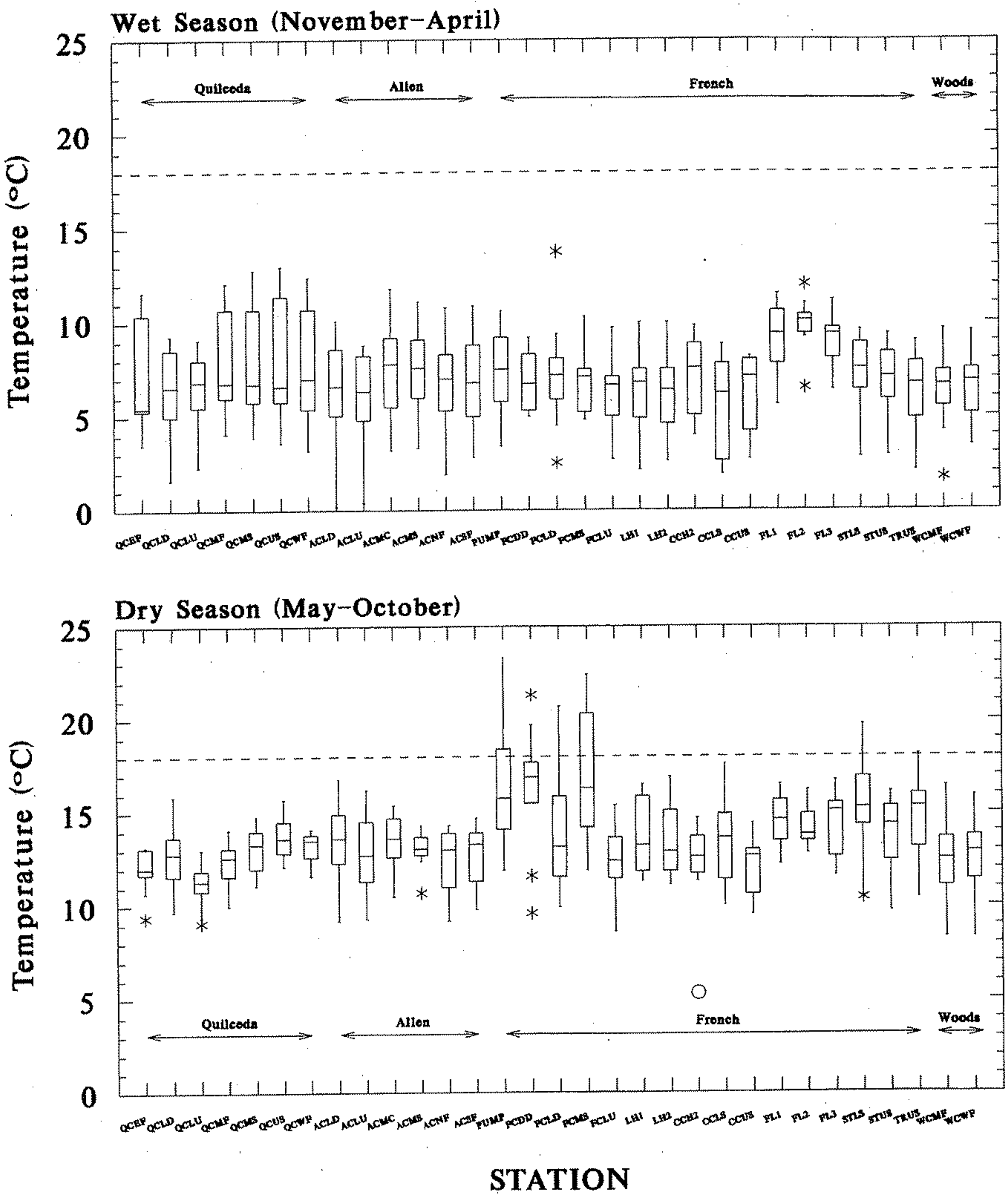


Figure 17. Snohomish County wet and dry season temperature data; dashed line denotes water quality standard of 18 degrees C.

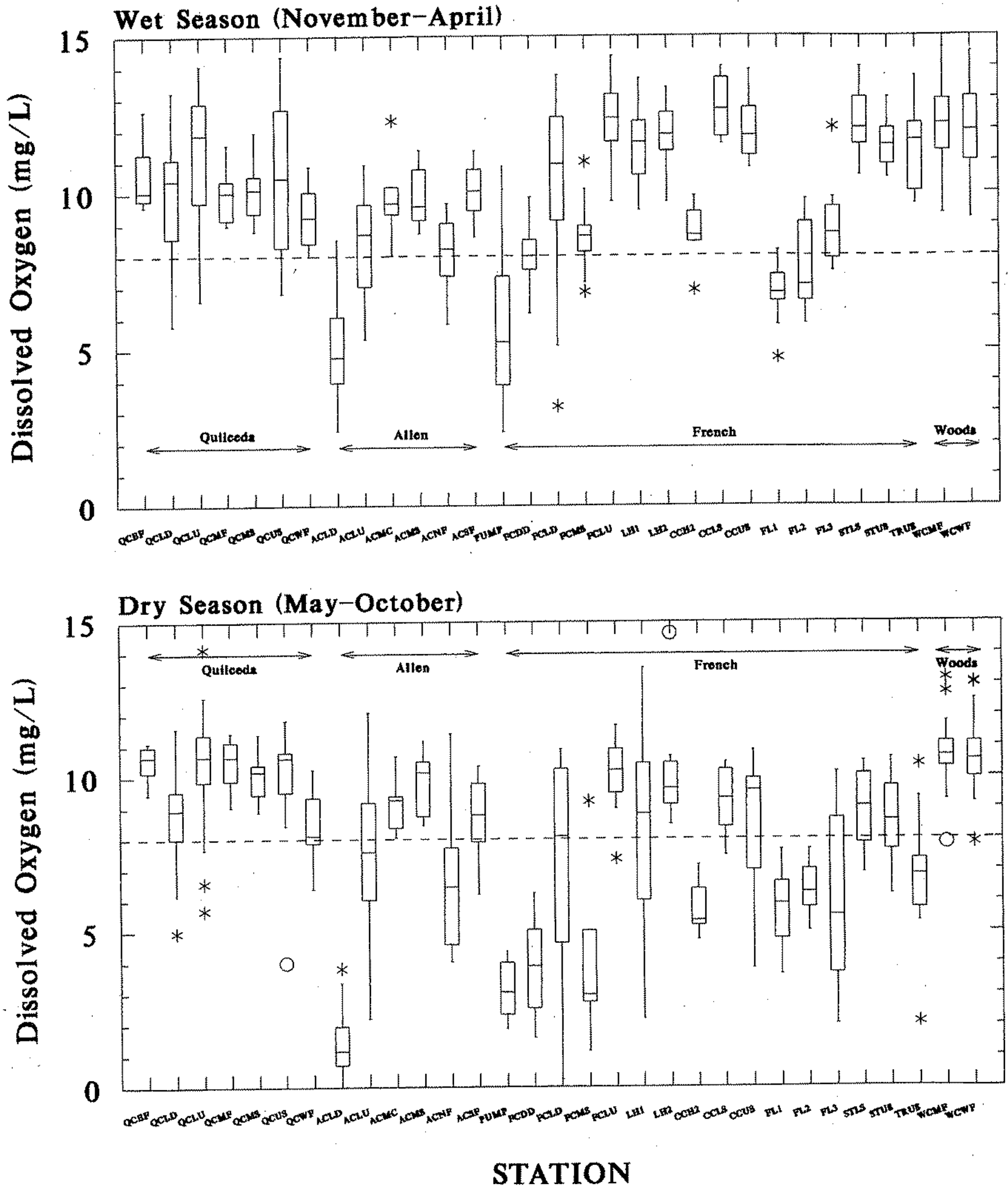


Figure 18. Snohomish County wet and dry season dissolved oxygen data; dashed line denotes Class A standard of 8 mg/L.

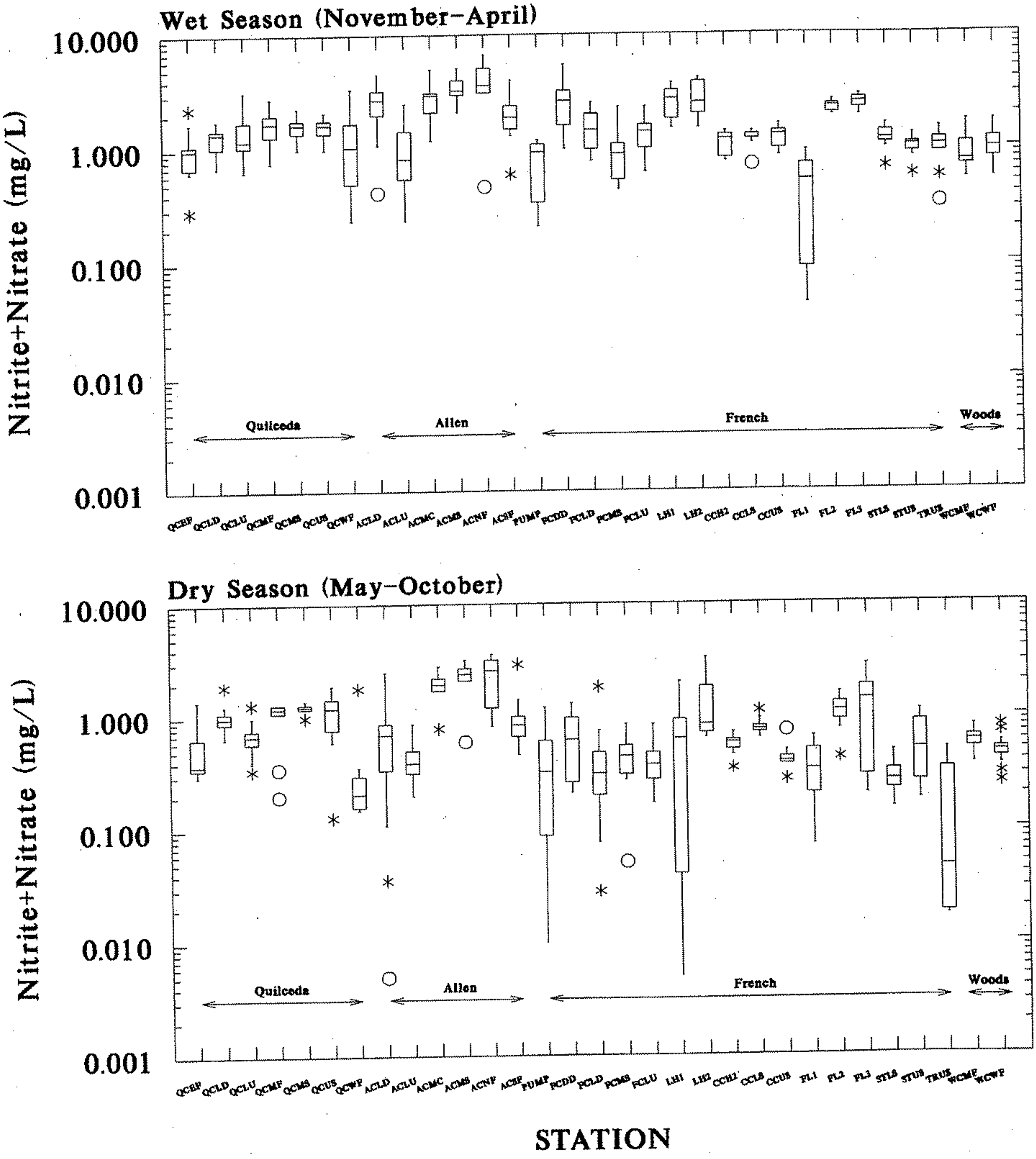


Figure 19. Snohomish County wet and dry season nitrite+nitrate data.

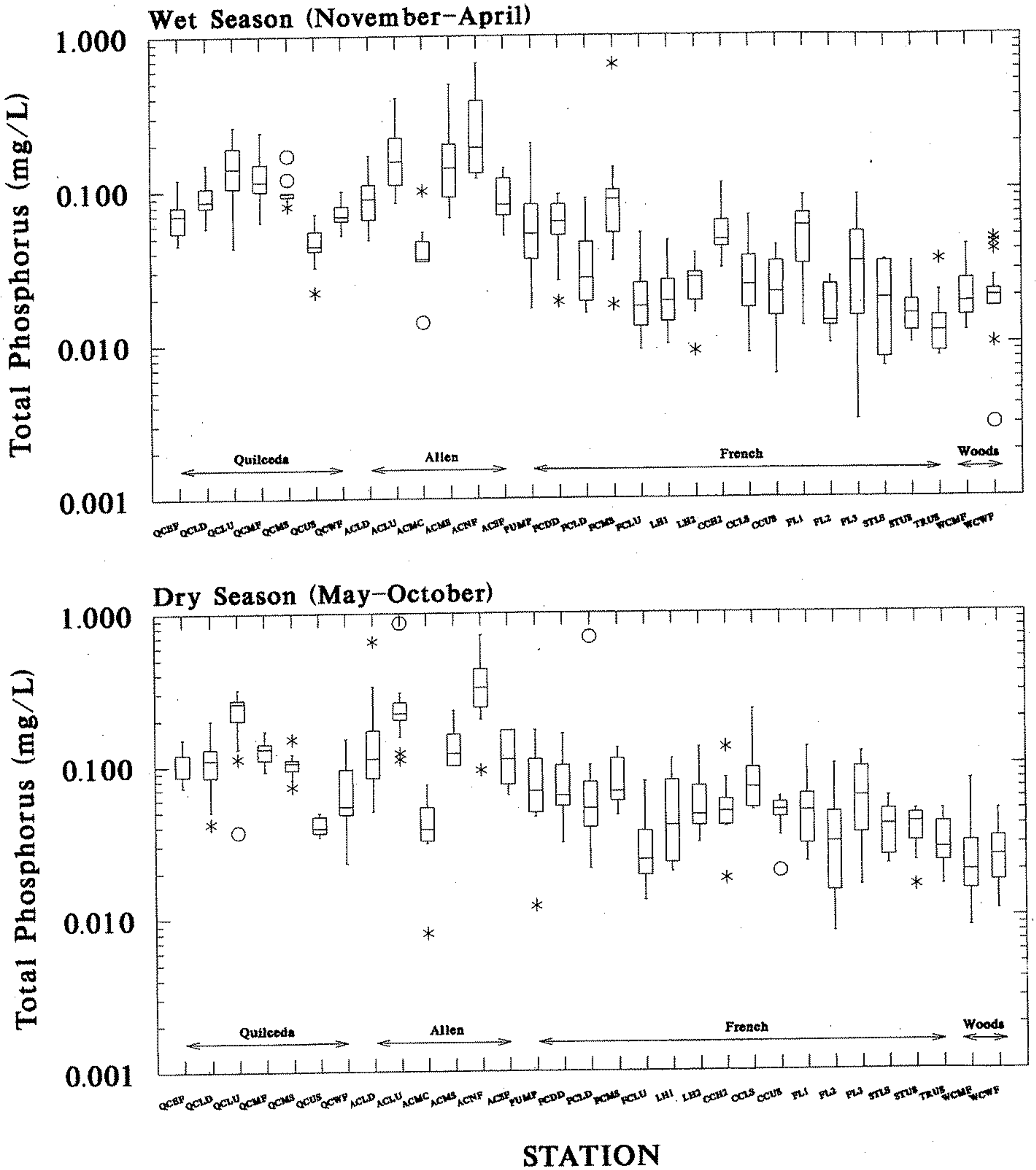


Figure 20. Snohomish County wet and dry season total phosphorus data.

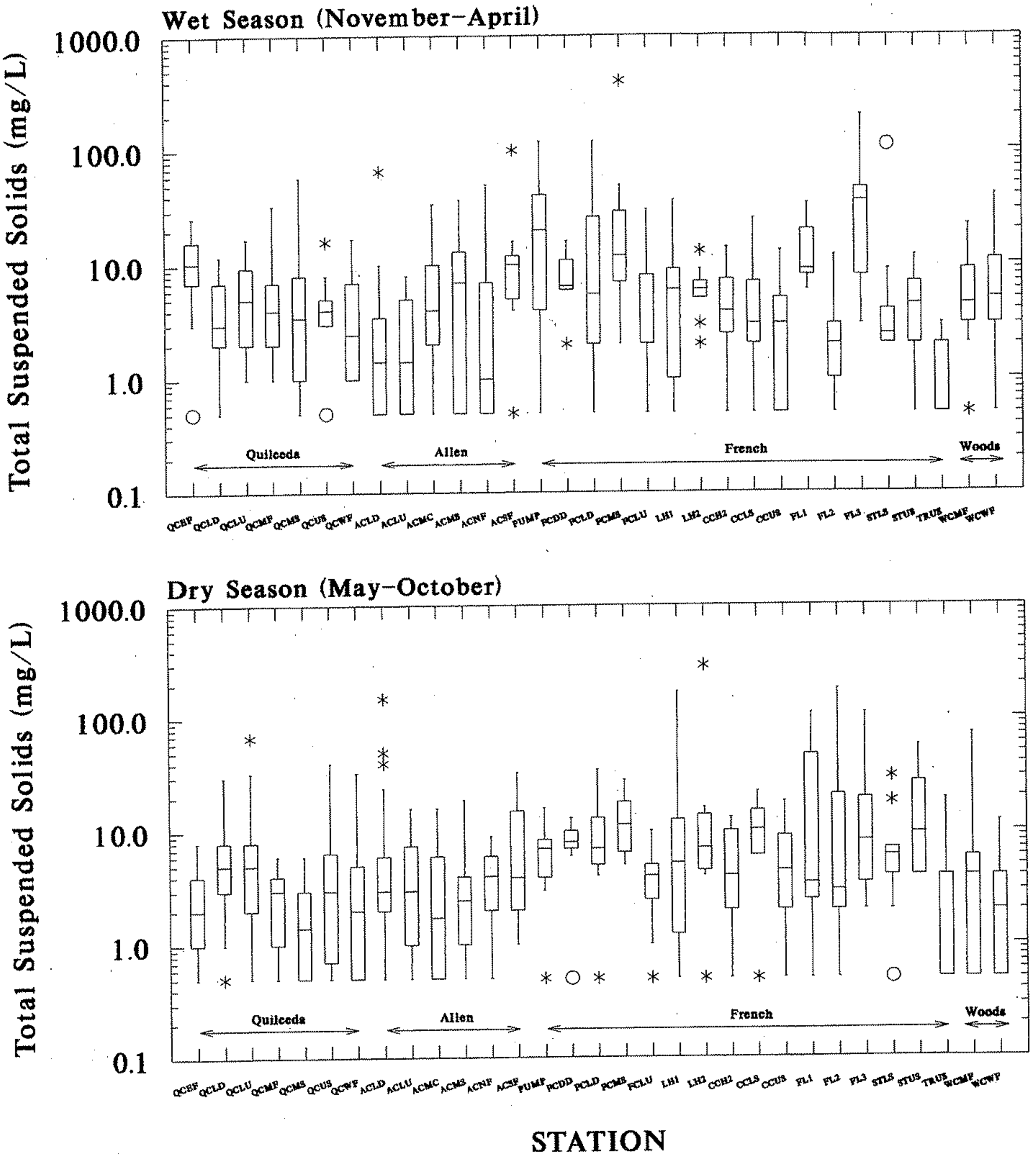


Figure 21. Snohomish County wet and dry season total suspended solids data.

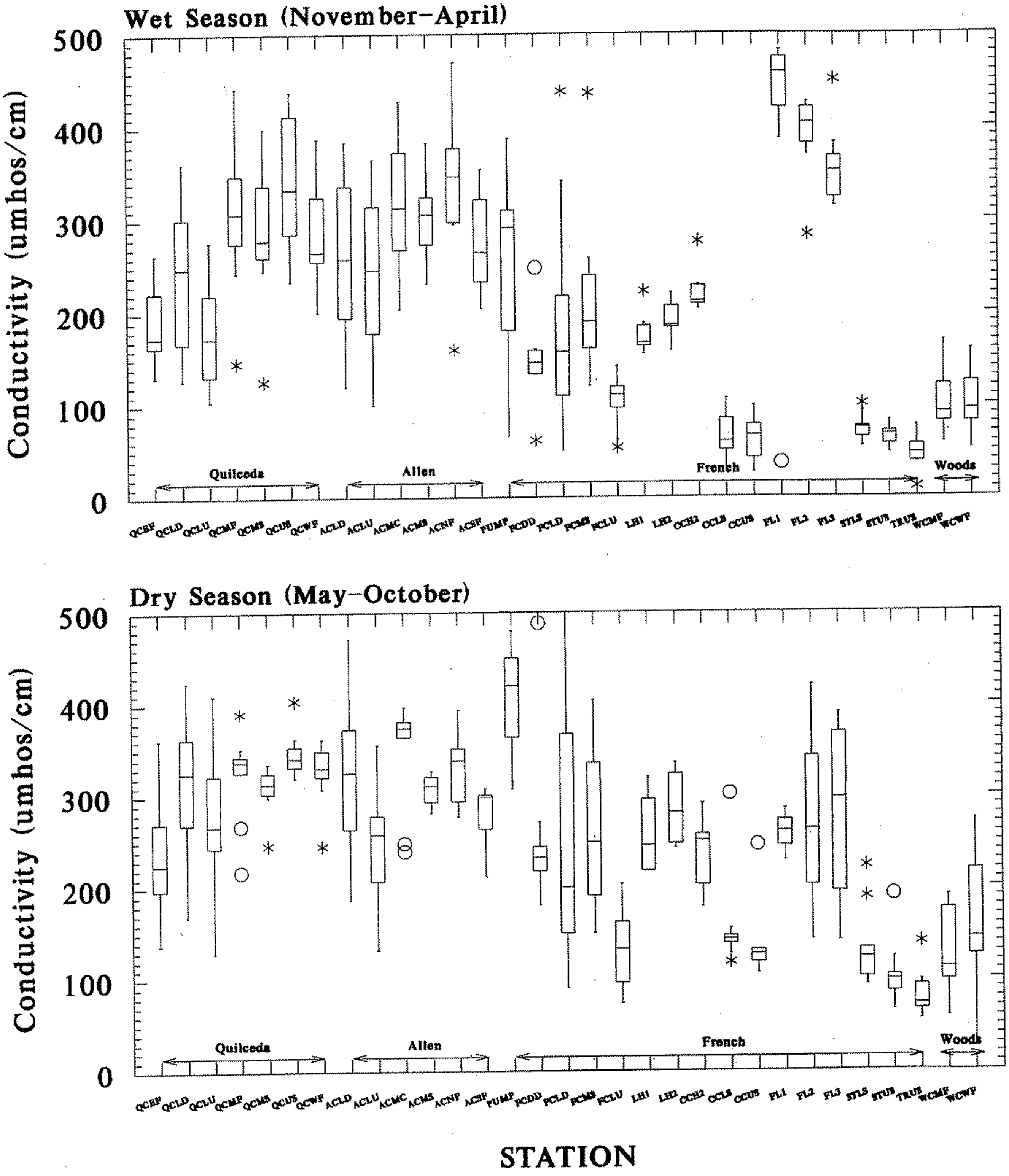


Figure 22. Snohomish County wet and dry season conductivity data.

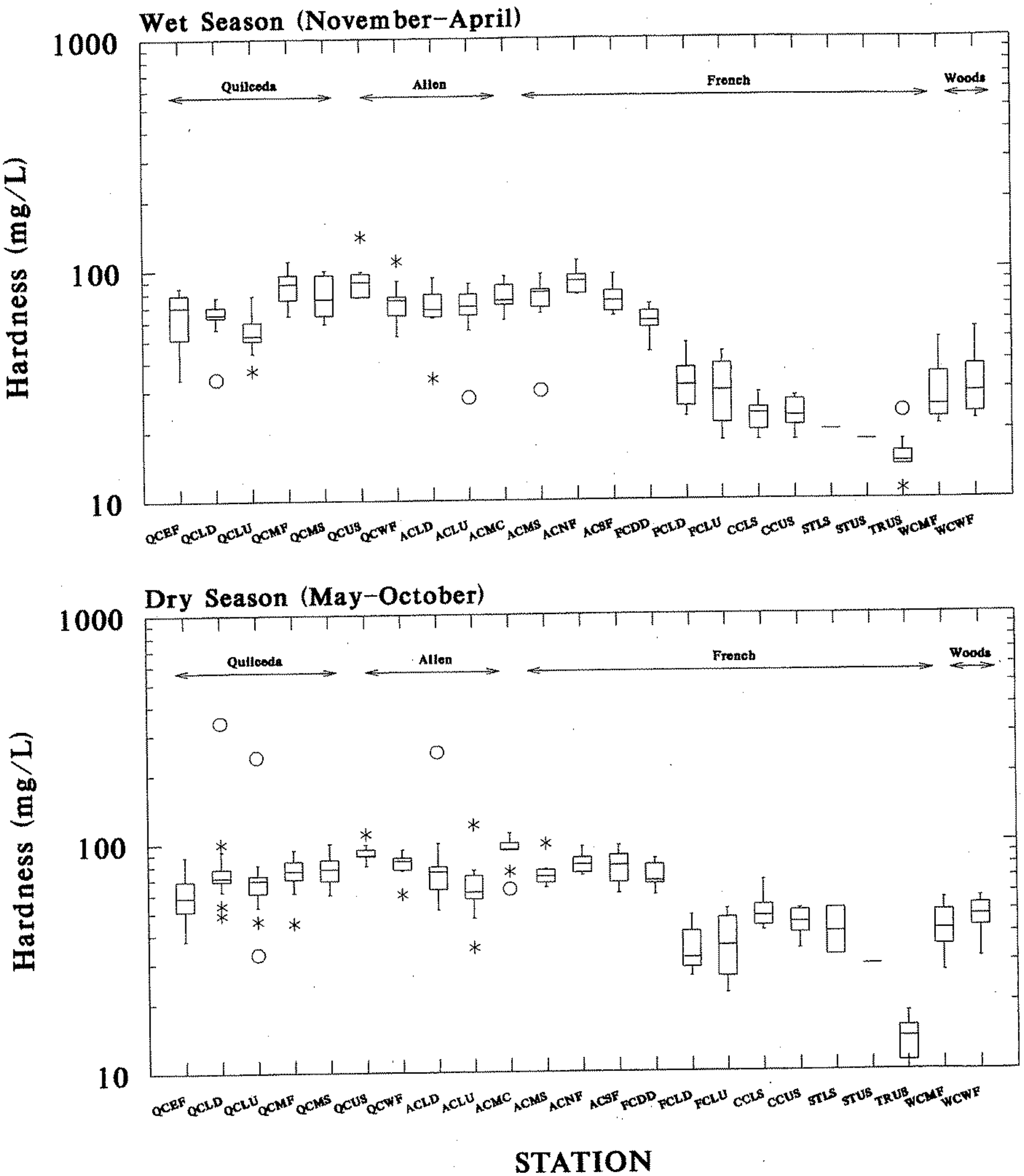


Figure 23. Snohomish County wet and dry season hardness data.

Tables

Table 1. 1994 '303(d) List for Quilceda Creek, Allen Creek, French Creek, Woods Creek, and the Pilchuck River.

Waterbody Segment Number	Waterbody Name*	Fecal Coliform	Temperature	Dissolved Oxygen
WA-07-1012	Quilceda Creek	X		X
WA-07-1015	Allen Creek	X		X
WA-07-1052	French Creek	X		X
WA-07-1163	Woods Creek	X		
WA-07-1030	Pilchuck River	X	X	
WA-07-1040	Pilchuck River		X	

* The Marshland drainage is not listed.

Table 2. Summary of field and laboratory measurements, precision or reporting limits, and methods.

Parameter (all measurements are of water except where sediment is indicated)	Precision Limit (for field measurements and turbidity) or Reporting Limit (all others)	Method[1]
Field Measurements		
Velocity	0.05 f/s	Current Meter
pH	0.1 SU	Field Meter/Electrode
Temperature	0.2 □C	Alcohol Thermometer
Dissolved Oxygen	0.06 mg/L	Gas Probe/Winkler Titration
Specific Conductivity	20 μmhos/cm	Field Meter/Conductivity Bridge
General Chemistry		
Fecal coliform	1cfu/100 mL	SM 18 Membrane Filter 9222D
Total suspended solids	1 mg/L	EPA 160.2
Ammonia nitrogen	0.01 mg/L	EPA 350.1
Nitrate + nitrite nitrogen	0.01 mg/L	EPA 353.2
Total persulfate nitrogen	0.01 mg/L	SM 4500 NO3-F Modified
Orthophosphate	0.01 mg/L	EPA 365.3
Total phosphorus	0.01 mg/L	EPA 365.3
Chloride	0.1 mg/L	EPA 300.0
Turbidity	1 NTU	EPA 180.1
Hardness	1 mg/L	EPA 130.2
Chlorophyll *a*[2]	0.05 μg/L	SM 10200H(3), Fluorometer

[1] For method reference see MEL 1994.
[2] Dry season only

Table 3. Field replicate pooled precision estimates.

Parameter	**Root Mean Square of the Coefficient of Variation (%)**	
	Ecology	Snohomish County
Fecal Coliform	23	25
Nitrite-Nitrate	1	17
Total Phosphorus	21	28
Total Suspended Solids	9	55
Conductivity	1	2
pH	<1	<1
Hardness		6
Temperature	<1	
Dissolved Oxygen	1	
Ammonia	6	
Nitrite	1	
Ortho-phosphate	5	
Total Persulfate Nitrogen	13	
Turbidity	9	
Chloride	<1	
Chlorophyll *a*	8	
Pheophyton	3	

Table 4. Snohomish County sampled drainages: wet and dry season fecal coliform geometric means, 90th percentiles, and recommended reductions needed to meet criteria.

Waterbody	Site	Drainage Area (acres)[a]	First Criterion: Geometric Mean <100 (colonies/100 mL)		Second Criterion: 90% of Samples < 200 (colonies/100 mL)		Recommended Target Levels Needed to Meet Criteria			
			Sample Geometric Mean		Sample 90th Percentile		Target Geometric Mean		Target Percent Reduction	
			Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season
Allen Creek	ACLU	490	392	664	5358	4,137	40	62	90	91
Allen Creek	ACMC	940	121	585	549	1,646	56	95	54	84
Allen Creek	ACSF	1,090	149	145	870	1,240	50	40	66	72
Allen Creek	ACNF	1,570	108	197	773	498	42	91	61	54
Allen Creek	ACMS	3,610	168	332	565	735	73	99	57	70
Allen Creek	ACLD	5,130	30	122	169	842	n/a	44	0	64
Quilceda Creek	QCLU	320	47	209	316	920	35	63	26	70
Quilceda Creek	QCEF	2,820	420	1,091	4,094	4,073	47	86	89	92
Quilceda Creek	QCUS	2,570	25	60	51	220	n/a	55	0	7
Quilceda Creek	QCWF	5,560	131	619	487	2,489	65	78	50	87
Quilceda Creek	QCMF	7,440	119	451	928	1,254	41	94	66	79
Quilceda Creek	QCMS	11,680	198	270	845	603	64	99	68	63
Quilceda Creek	QCLD	19,160	213	318	1,216	830	55	94	74	70
French Creek	FL1	80	23	407	207	2,113	22	64	2	84
French Creek	TRUS	220	11	52	40	353	n/a	36	0	32
French Creek	LH2	240	34	382	99	3,270	n/a	49	0	87
French Creek	FL3	430	48	179	214	2,267	46	35	5	80

Waterbody	Site	Drainage Area (acres)[a]	First Criterion: Geometric Mean <100 (colonies/100 mL)		Second Criterion: 90% of Samples < 200 (colonies/100 mL)		Recommended Target Levels Needed to Meet Criteria			
			Sample Geometric Mean		Sample 90th Percentile		Target Geometric Mean		Target Percent Reduction	
			Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season
French Creek	CCUS	540	29	66	366	446	21	38	29	42
French Creek	LH1	580	56	552	287	4,075	43	56	23	90
French Creek	FL2	830	71	220	1,034	2,456	26	39	64	82
French Creek	STUS	910	38	267	181	1,175	n/a	66	0	75
French Creek	STLS	980	32	136	124	1,878	n/a	32	0	77
French Creek	CCLS	1,740	39	394	547	1,877	22	67	44	83
French Creek	CCH2	1,950	31	428	121	6,392	n/a	39	0	91
French Creek	FCLU	3,530	39	357	310	1,337	29	76	24	79
French Creek	FCMS	7,150	441	682	6,098	3,822	40	66	91	90
French Creek	FCDD	17,170	135	283	555	3,064	61	42	55	85
French Creek	FCLD	17,170	180	396	1,780	1,645	40	72	78	82
French Creek	PUMP	17,680	87	346	1,862	1,589	23	67	73	81
Woods Creek	WCMF	18,920	45	158	252	780	38	56	15	64
Woods Creek	WCWF	17,020	56	160	216	686	53	61	6	62

[a] Estimate of drainage area upstream of sampling site.

Table 5. Ecology 1996 sampled drainages: wet and dry season fecal coliform geometric means, 90th percentiles, and recommended reductions needed to meet criteria.

Waterbody	Site	Drainage Area (acres)[a]	First Criterion: Geometric Mean <100 (colonies/100 mL)		Second Criterion: 90% of Samples < 200 (colonies/100 mL)		Recommended Target Levels Needed to Meet Criteria			
			Sample Geometric Mean		Sample 90th Percentile		Target Geometric Mean		Target Percent Reduction	
			Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season
Pilchuck River	PRUP	3,410	3	54	6	100	n/a	n/a	0	0
Pilchuck River	PR8.6	42,840	7	75	27	264	n/a	60	0	19
Pilchuck River	PR4.2	78,150	12	80	23	192	n/a	n/a	0	0
Pilchuck River	PRDN	82,620	12	66	27	320	n/a	47	0	29
Pilchuck River	LPDN	12,010	19	234	105	1,789	n/a	47	0	80
Pilchuck River	CCDN	8,990	28	132	94	936	n/a	44	0	67
Pilchuck River	DCDN	8,540	10	166	23	890	n/a	54	0	67
French Creek	FCMS[b]	7,150		502		4,536		50		90
French Creek	PUMP[b]	17,680		468		1,119		99		79
Marshland	MLUP	6,500P	617	473	10,017	2,771	40	61	93	87
Marshland	MLDN	14,580	705	177	3,633	784	69	61	90	65
Woods Creek	WCUP	8,230	2	28	4	61	n/a	n/a	0	0
Woods Creek	WCMF	18,920	8	87	23	159	n/a	n/a	0	0
Woods Creek	WCWF	17,020	9	185	49	974	n/a	56	0	70
Woods Creek	WCDN	39,890	26	96	148	261	n/a	77	0	20

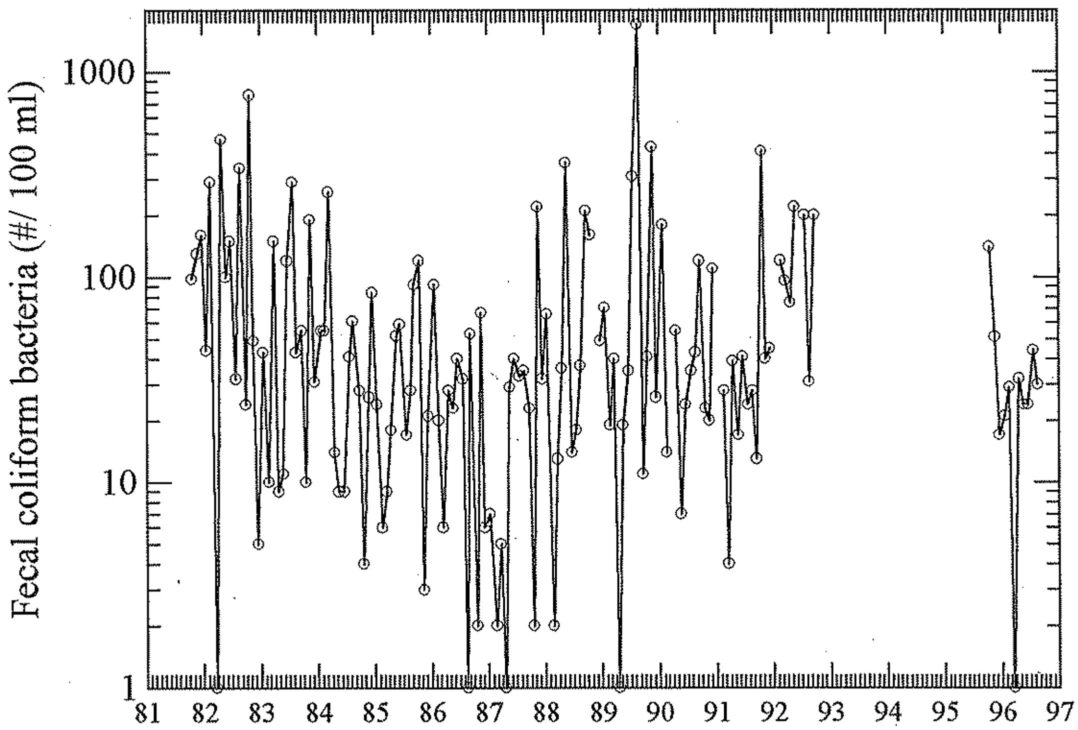
[a] Estimate of drainage area upstream of sampling site.
[b] No data collected by Ecology during the wet season.

Appendix A

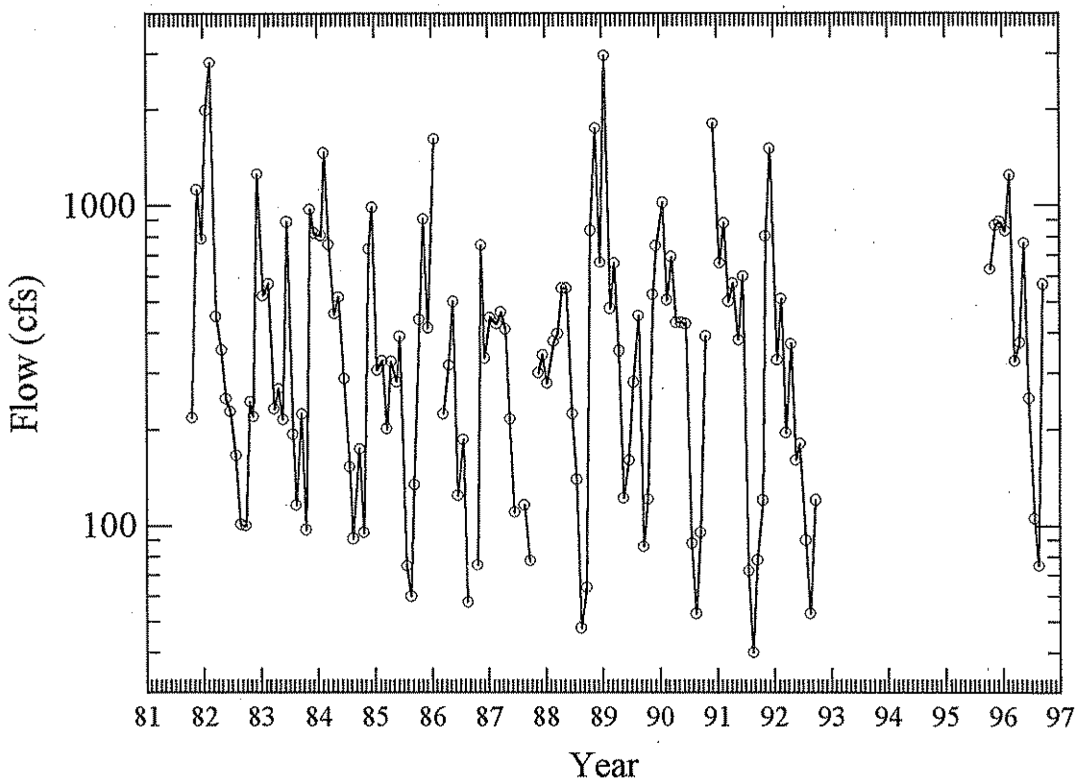
Ambient Monitoring Data from

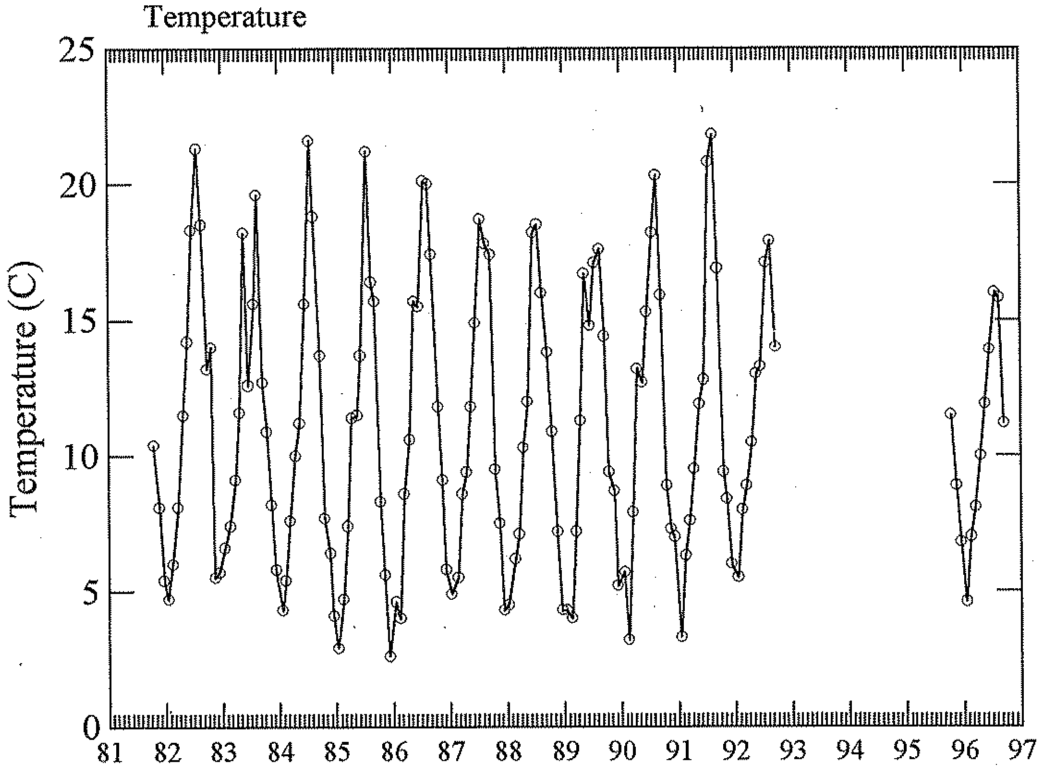
Ecology's Station 07B055

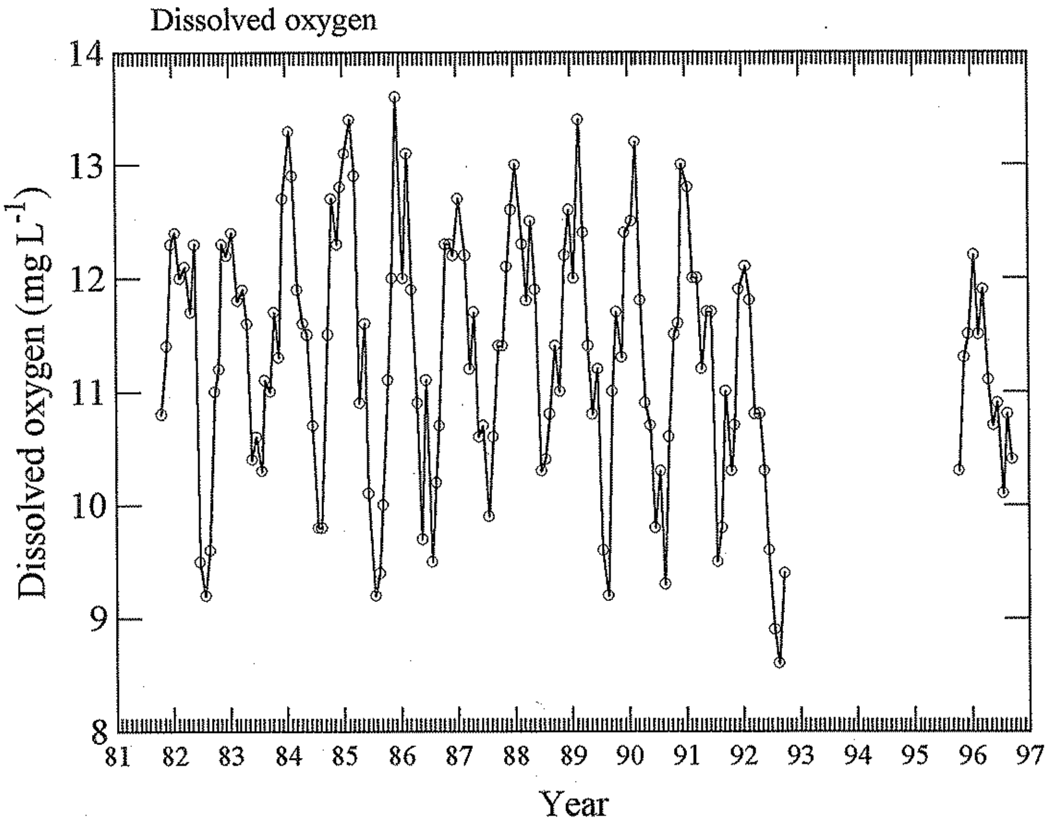
Fecal coliform bacteria



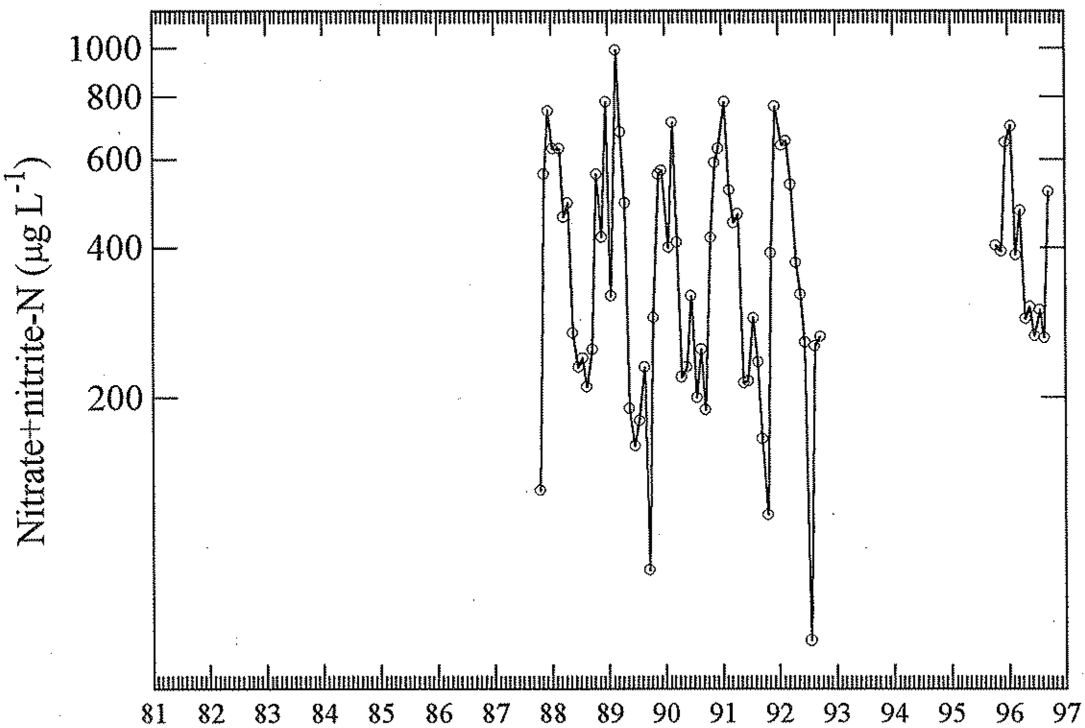
Flow



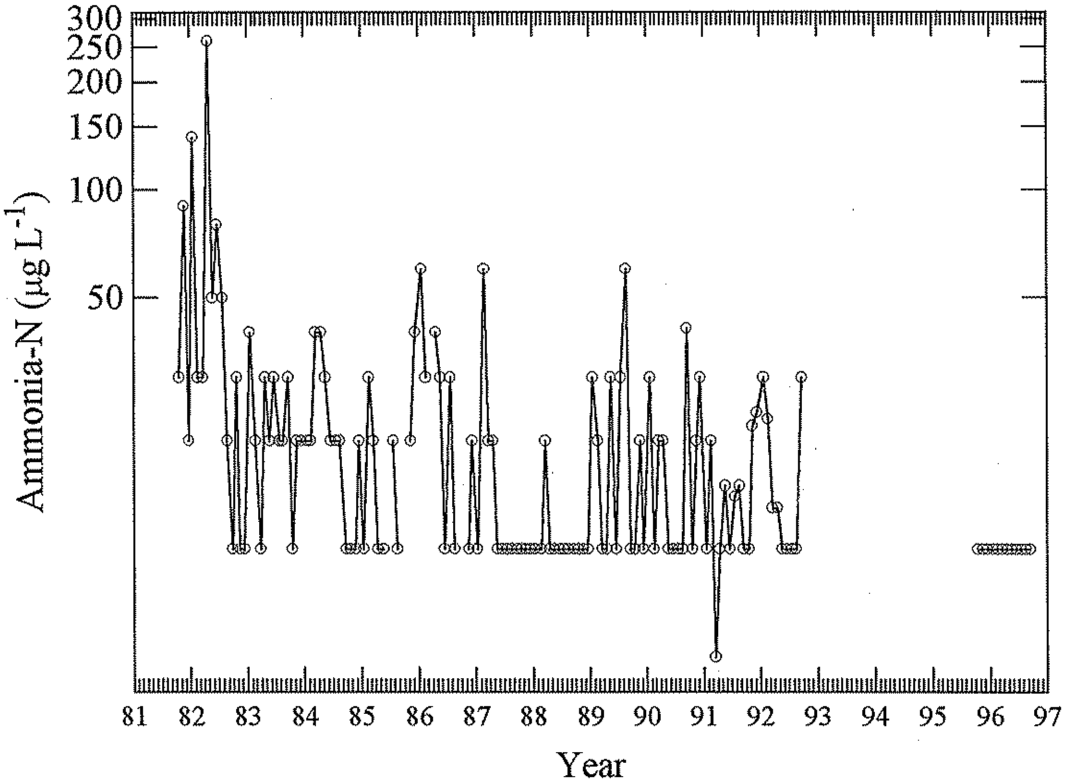

Temperature
Temperature (C)
0
5
10
15
20
25
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97


Dissolved oxygen
Dissolved oxygen (mg L-1)
8
9
10
11
12
13
14
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
Year

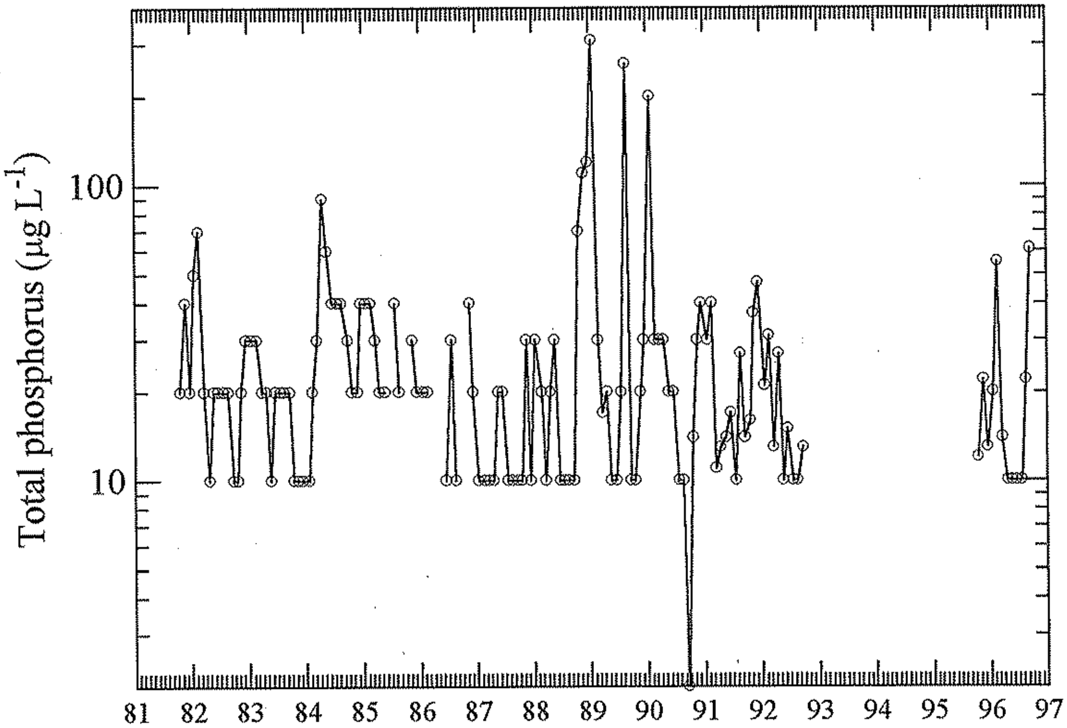
Nitrate+nitrite



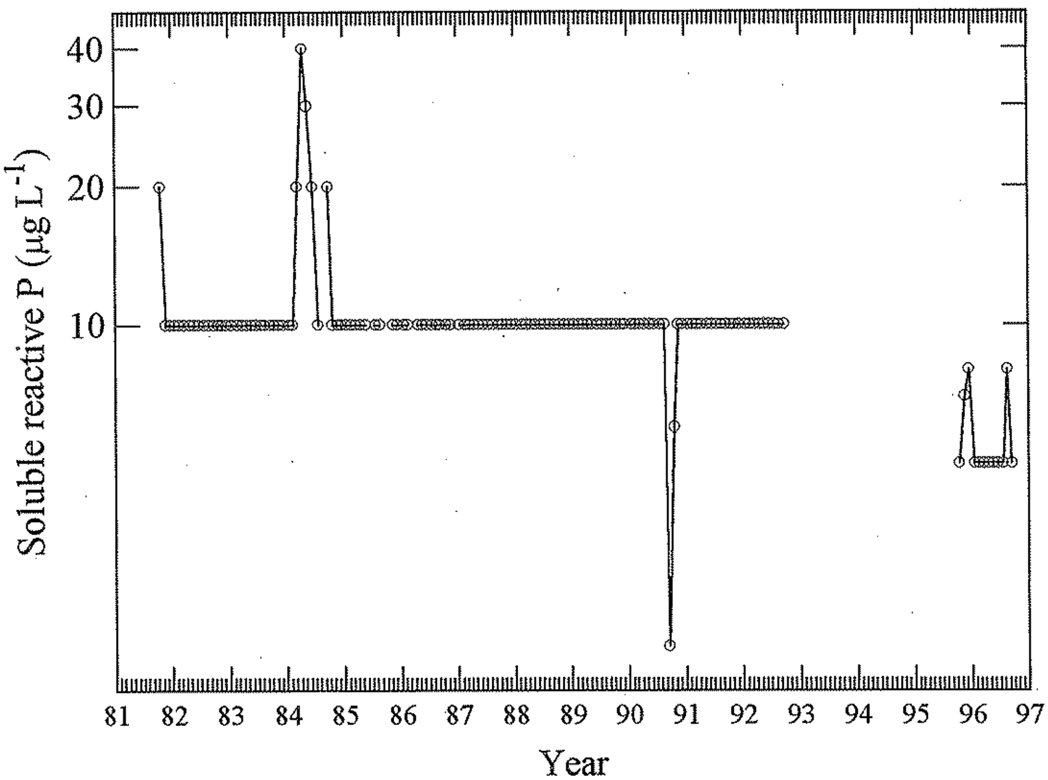
Ammonia



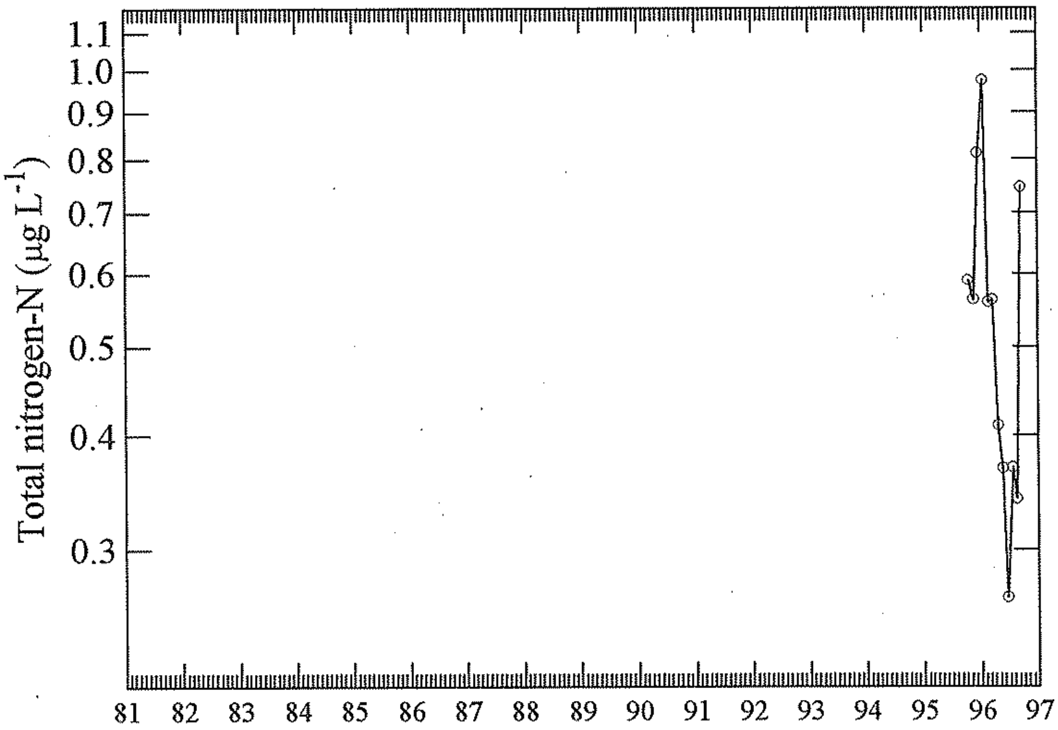
Total phosphorus

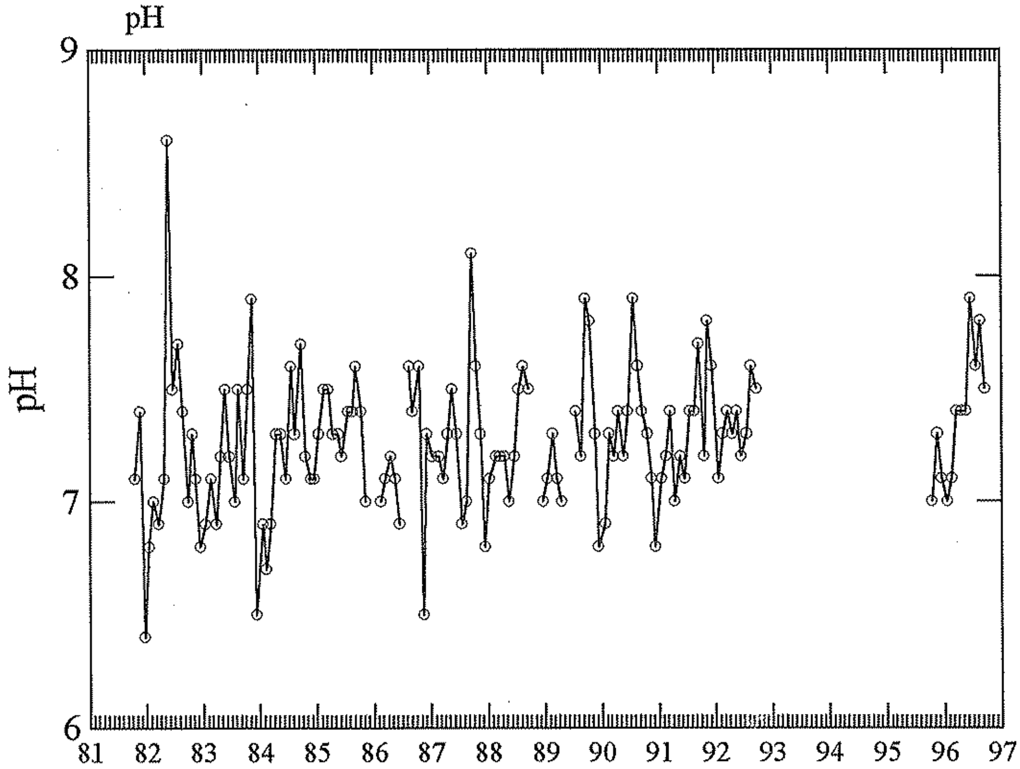


Soluble reactive phosphorus

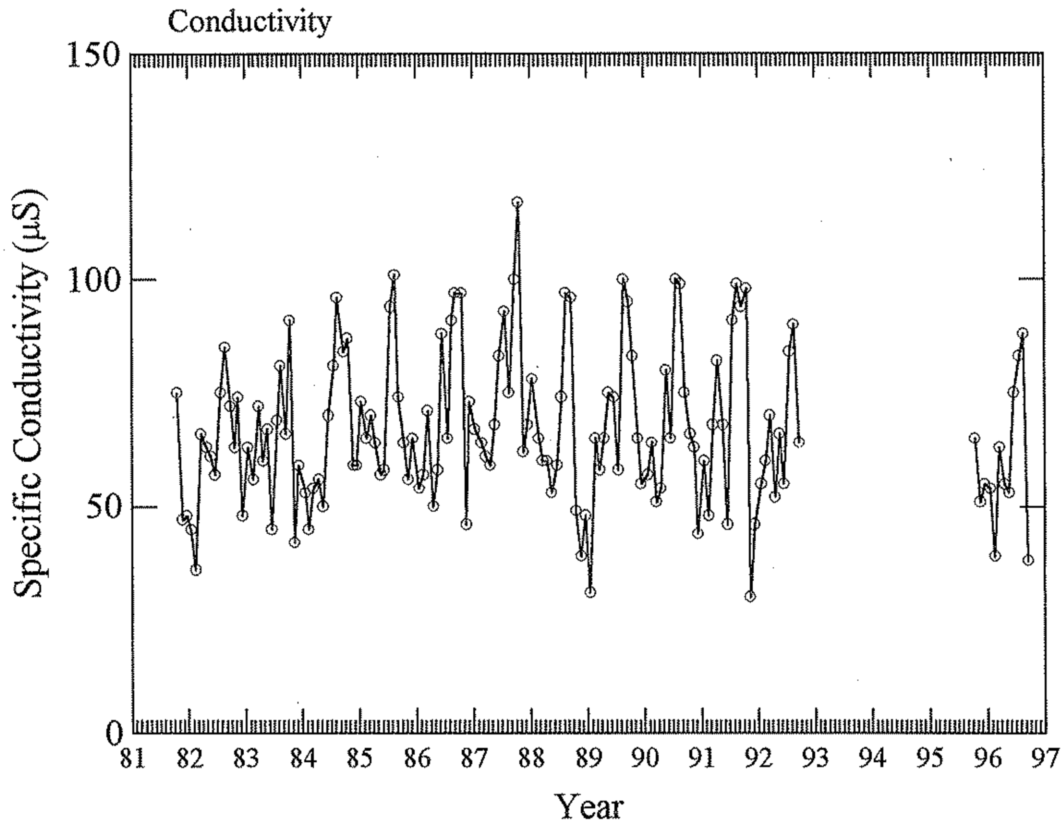


Total nitrogen



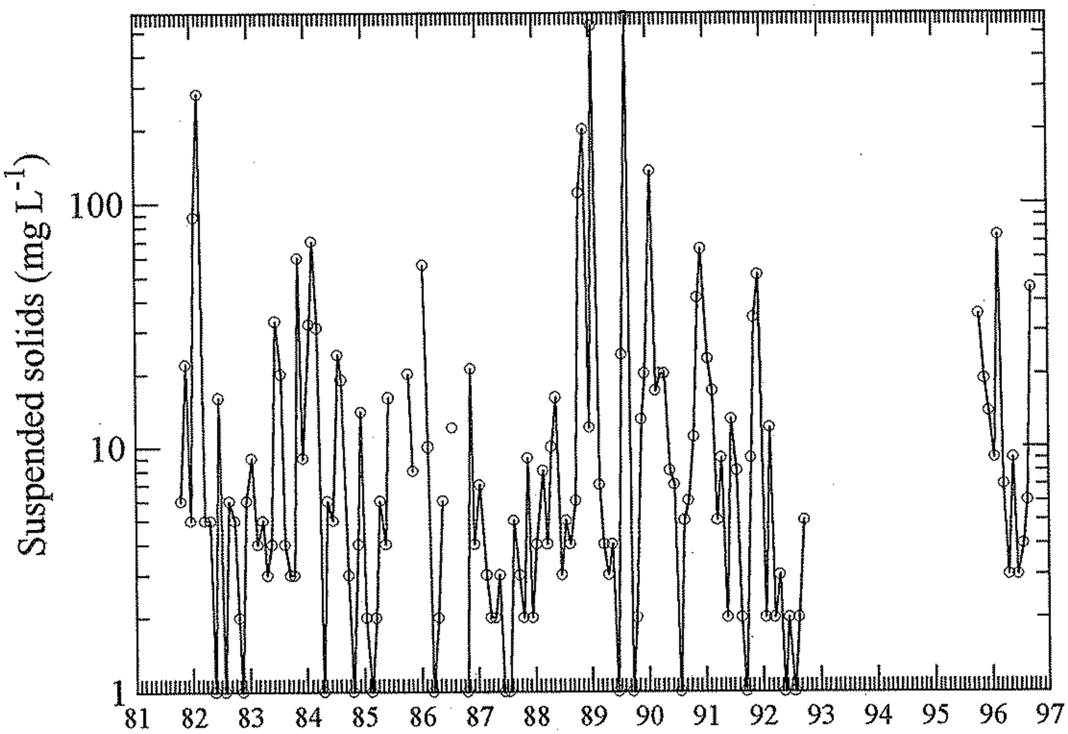


pH
9
8
7
6
pH
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97

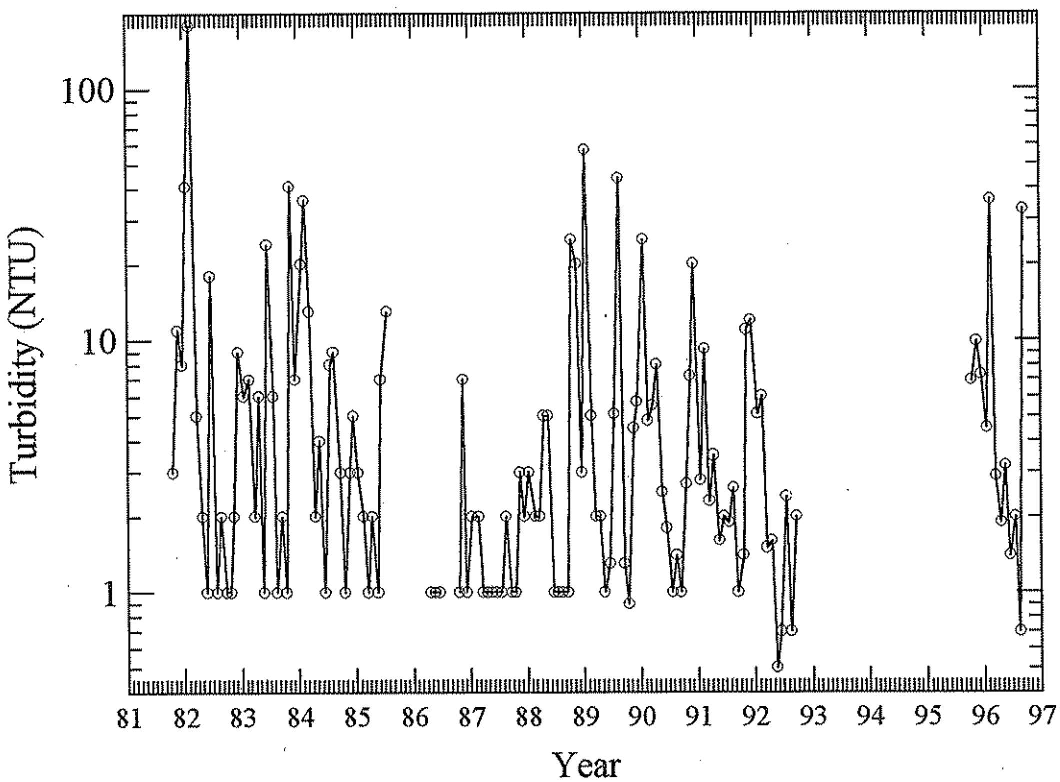


Conductivity
150
100
50
0
Specific Conductivity (µS)
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
Year

Total suspended solids



Turbidity



Appendix B

Water Quality Monitoring Sites

SNOHOMISH COUNTY
SURFACE WATER MANAGEMENT
WATER QUALITY MONITORING SITES
SNOHOMISH BASIN

Long-term monitoring sites sampled monthly, beginning in May 1992

Quilceda Creek

qclu- Quilceda Creek upstream at 67th Ave. NE and 172nd St. NE. Sample south of 172nd upstream of culvert by railroad tracks.

qcld- Quilceda Creek downstream at bridge at 88th St. NE. Sample upstream of bridge.

Allen Creek

aclu- Allen Creek upstream at 67th Ave. NE and 112th St. NE. Sample downstream of culvert and upstream of small tributary that comes in along 112th.

acld- Allen Creek downstream at 3rd St. in Marysville by pumping station. Sample south side of road, walk past vegetation into main flow to collect samples.

Long-term Monitoring Sites sampled monthly, beginning in September 1993

Woods Creek

wcmf- Woods Creek main fork at York horse farm on Yeager Road. Sample at covered bridge above confluence with west fork.

wcwf- Woods Creek west fork at the second bridge past York farm on Yeager Road at 13421 Yeager. Sample upstream of bridge.

French Creek

fclu- French Creek upstream at 167th Ave. south of Westwick Road. Park at Grange, sample below fish ladder.

fcld- French Creek downstream at Highway 2, second bridge east of Roosevelt Rd. Sample upstream of bridge, access from NE corner of bridge.

Quilceda and Allen Creeks assessment sites sampled 20 times from May 1993 - April 1994.

Allen Creek

acms- Allen Creek main stem, Grove Sts. between 51st and 59th Ave. NE. Sample on south side.

acmc- Allen Creek at Munson Creek, Grove St. between 60th and 67th Ave. NE. Sample on south side.

acnf- Allen Creek north fork, 67th Ave. NE, north of 88th St. NE, access through Doleshel Tree Farm, west side of 67th. Sample creek behind barn.

acsf- Allen Creek south fork, 67th Ave NE, north of 88th St. NE, access through Karl Kloster property across from tree farm on east side of 67th.

Quilceda Creek

qcms- Quilceda Creek main stem, Smoky Point Blvd. at 100th St. NE at El Toro Restaurant. Sample from south side of creek.

qcwf- Quilceda Creek west fork, 128th St. NE at bridge. Sample from south side of bridge.

qcmf- Quilceda Creek middle fork, 12300 51st Ave NE.

qcef- Quilceda Creek east fork, culvert on 56th Ave. NE, south of 132nd NE.

qcus- Quilceda Creek upper site, 136th St. NE, between Smoky Point Blvd and railroad tracks. Sample on south side of 136th.

French Creek assessment sites in the upper watershed, sampled 20 times from May 1994 through April 1995.

stus- Upper Stables Creek on 93rd St. SE at dead end.

stls- Lower Stables Creek on Westwick Road, west of 167th Ave, park at Grange. Sample upstream at 4' x 4' box culvert.

spus- Upper Spada Creek, sample at crossing on Storm Lake Rd, just north of intersection of Spada Rd.

spls- Lower Spada Creek on Spada Rd. just west of intersection with Trombley Rd.

ccus- Upper Cripple Creek, Trombley Rd, north of 117th St. SE. Sample downstream of Trombley at 2 CMP's.

ccls- Lower Cripple Creek, Robinhood Lane, south of 136th Pl SE.

trus- Trench Creek at 139th Dr. SE.

fcdd- Lower French Creek, Diking District upstream of Bridge 13 on Old Snohomish Monroe Highway.

<u>French Creek monitoring sites in the lower watershed, sampled twice monthly beginning in May 1995; probably will continue until spring 1996</u>.

French Creek

pump- French Creek mainstem at the pumping station. Access is through the Darlinger Farm on the Old Snohomish Monroe Highway. Take the farm road back along the dike to the pump station. Take water samples upstream of the pump station on the west side from the riprap.

lh1- Lord's Hill No. 1 on the Old Snohomish Monroe Highway just east of 134th Dr. SE. Park just past 134th on the right. Sample on the downstream side of the concrete box culvert. Take water samples farther downstream just below the concrete weir.

lh2- Lord's Hill No. 2 on the Old Snohomish Monroe Highway, east of Lord's Hill No. 1 and west of 144th St. SE. Park just past the site on the left near the fire hydrant and barbed wire fence. Sample downstream of concrete culvert.

fl3- Fryelands No. 3, south of the residential development on Fryelands Blvd. Park on the construction road. Enter the site by the telephone pole and through the barbed wire fence. Sample below the culvert and confluence of the stream from north.

fl2- Fryelands No. 2, just north of Wales St. at the south end of the lake on Fryelands Blvd. Park by the pump house. Sample downstream of the culvert, just north of the pump house. Take water samples at the culvert.

fl1- Fryelands No. 1, just south of Highway 2 on Fryelands Blvd. and north of the lake. Park on the construction road. Sample downstream of the culvert by the old blocked culvert.

cch2- Cripple Creek at Highway 2. Park at the piano store across from Fryelands Blvd. Sample at the upstream end of the concrete box culvert.

fcms- Mainstem French Creek at the bridge at Houck farm. Access the farm from Highway 2 across from Roosevelt Rd.

ECOLOGY
WATER QUALITY MONITORING SITES
SNOHOMISH BASIN

Pilchuck River

prdn- The Pilchuck River at the Old Snohomish-Monroe Highway crossing. Sample downstream from the bridge.

pr4.2- Pilchuck River below the Three Lakes Road bridge; RM 4.2. USGS gaging station ID. 12155400.

pr8.6- Pilchuck River at OK Mill Road crossing; RM 8.6. Sample upstream of OK Mill Road bridge, above the area of mixing from Dubuque Creek.

prup- Pilchuck River in the upper watershed. Sample downstream (appr. 400 m) of the Robe-Menzel Road bridge off Skinner Road.

lpdn- Little Pilchuck Creek above the confluence with Catherine Creek. Go west off North Machias Road onto 12th St.. Cross over the Centennial Trail. Within 0.1 mile a bridge crosses the confluence of two creeks. Little Pilchuck Creek is the first of the two streams. Sample upstream of the bridge.

ccdn- Catherine Creek above the confluence with Little Pilchuck Creek. Go west off North Machias Road onto 12th St. Cross over the Centennial Trail. Catherine Creek is the second of the two streams.

dcdn- Dubuque Creek downstream of OK Mill Road crossing. This monitoring site incorporates the Panther Creek subbasin.

Woods Creek

wcdn- Woods Creek at the foot bridge crossing located in Borlin Park; RM 0.1. Ecology AMS long-term monitoring site, ID. 07F055. USGS gaging station ID. 12141090 is located approximately 0.4 miles upstream.

wcmf- Woods Creek main fork at York horse farm on Yeager Road. Sampled at covered bridge above confluence with the west fork. A Snohomish County long-term monitoring site.

wcwf- Woods Creek west fork at the second bridge past York farm on Yeager Road at 13421 Yeager. Sample upstream of bridge. A Snohomish County long-term monitoring site.

wcup Woods Creek mainstem at the second upstream road crossing of Woods Creek Road. Sample upstream of the bridge.

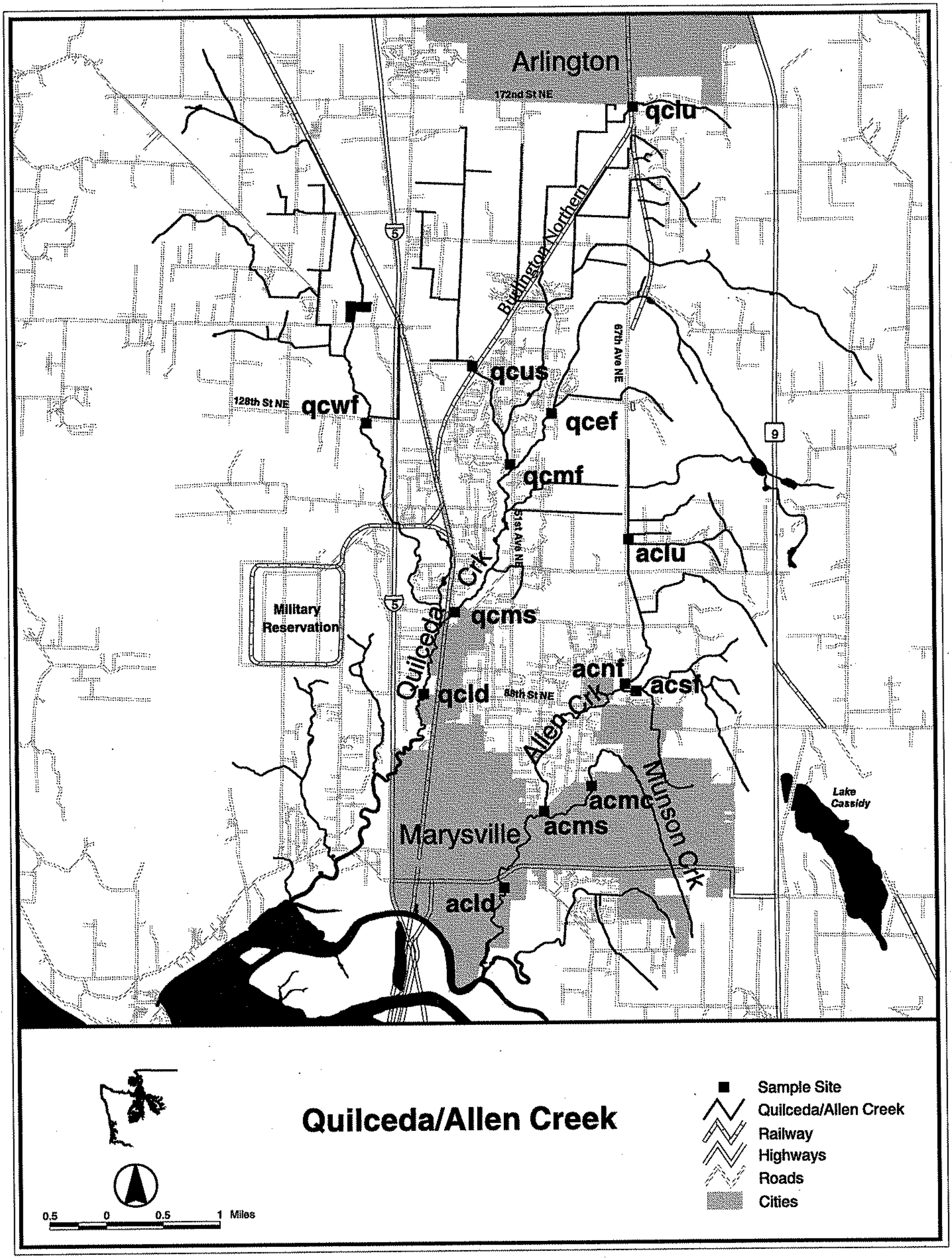
Marshland

mldn- The Marshland drainage at the pump station by Lowell-Snohomish Road. Sample upstream of pump station.

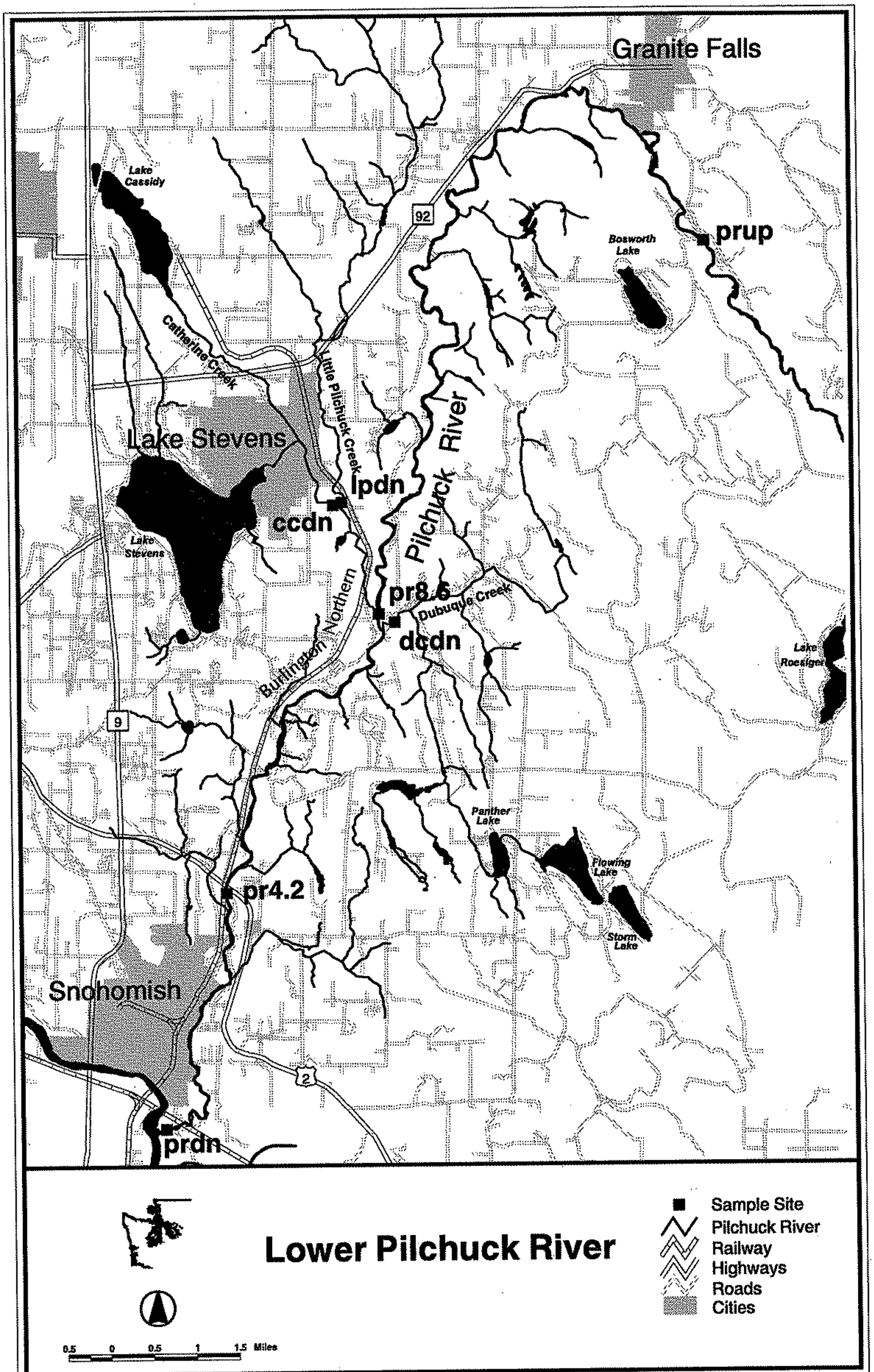
mlup- The Marshland drainage at the Marsh Road crossing. Sample downstream of the bridge.

Appendix C

Study Drainage Maps

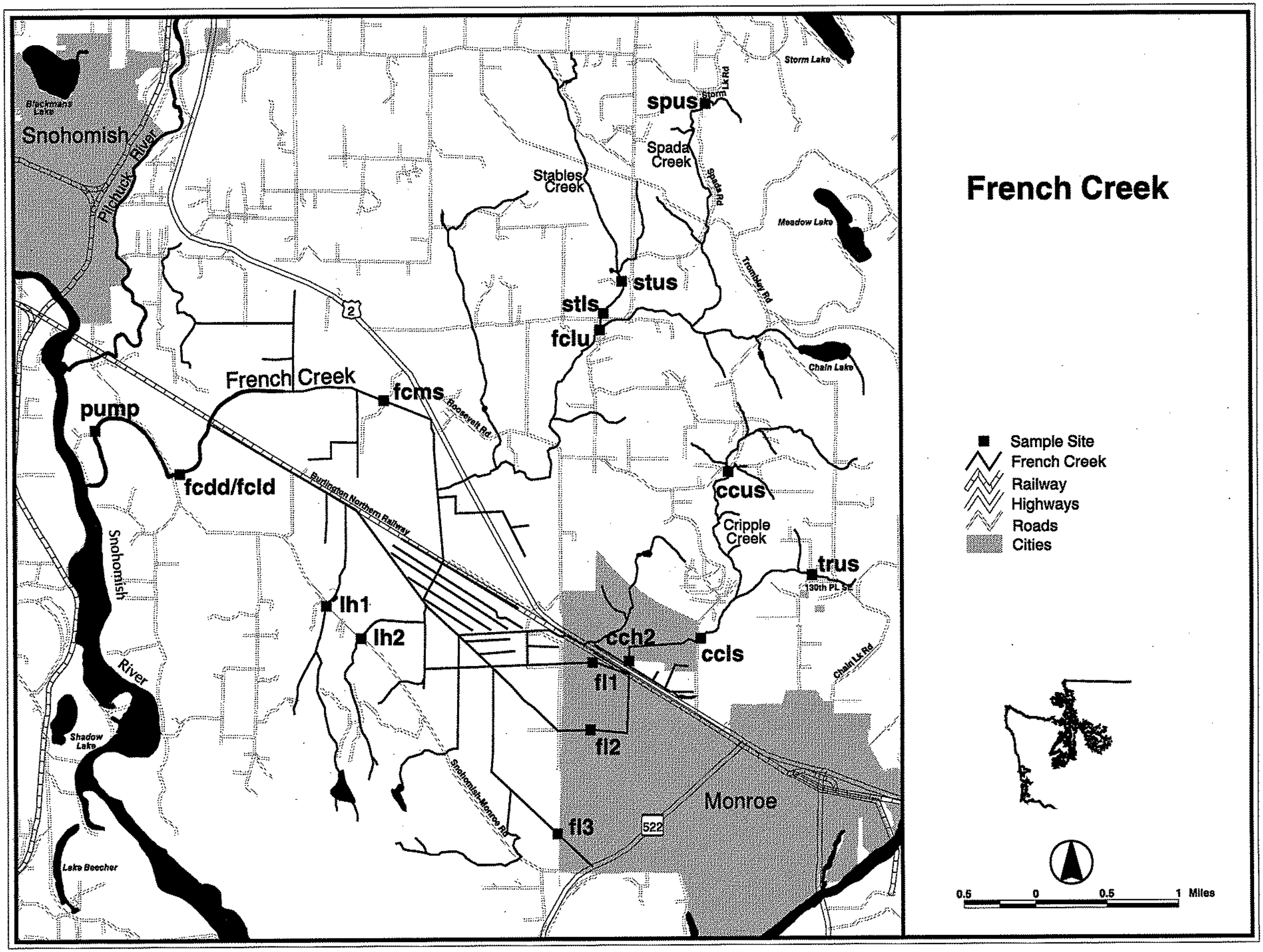


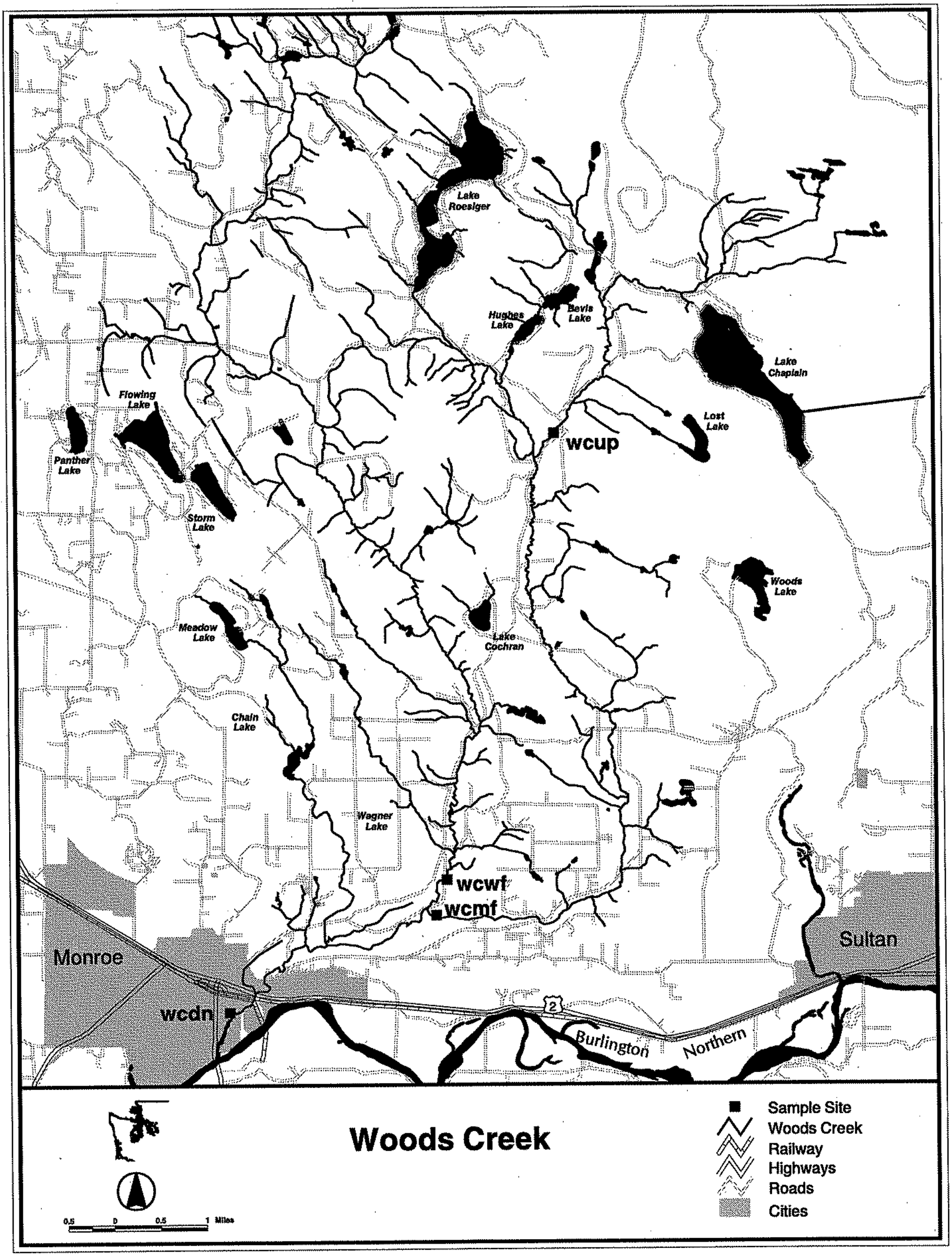
Quilceda/Allen Creek

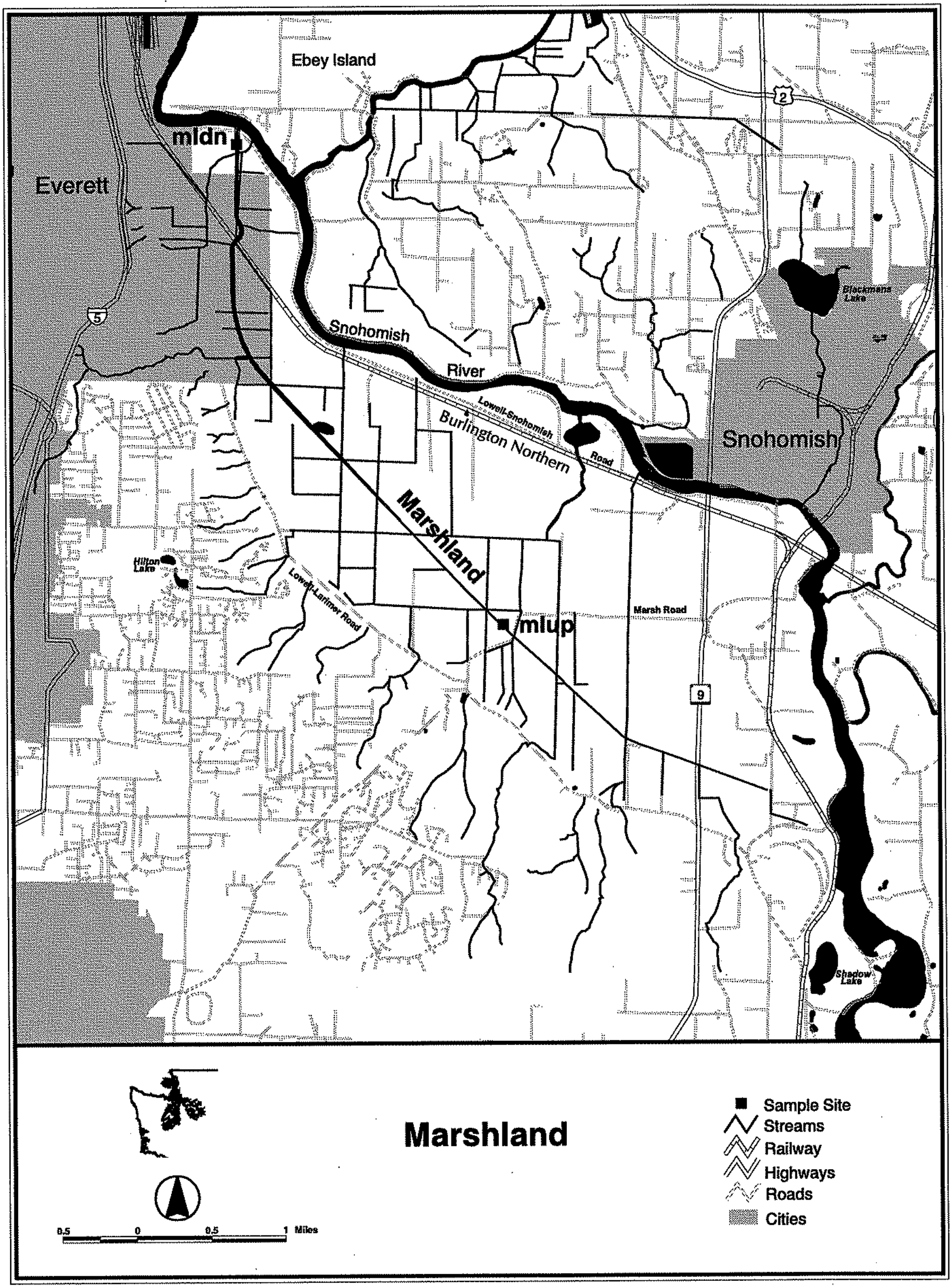


Lower Pilchuck River

French Creek




Lake Roesiger
Hughes Lake
Bevis Lake
Lake Chaplain
Lost Lake
wcup
Flowing Lake
Panther Lake
Storm Lake
Woods Lake
Meadow Lake
Lake Cochran
Chain Lake
Wagner Lake
wcwf
wcmf
Monroe
Sultan
wcdn
2
Burlington
Northern
Woods Creek
Sample Site
Woods Creek
Railway
Highways
Roads
Cities
0.5
0
0.5
1 Miles



Ebey Island
mldn
Everett
5
2
Snohomish
River
Lowell-Snohomish
Road
Burlington Northern
Snohomish
Blackmans Lake
Marshland
Hilton Lake
Lowell-Larimer Road
mlup
Marsh Road
9
Shadow Lake
Marshland
Sample Site
Streams
Railway
Highways
Roads
Cities
0.5 0 0.5 1 Miles

Appendix D

Sampling Schedule

Appendix D. Sampling schedule for biweekly wet (February 13 - April 15) and dry (July 30 - September 15) season sampling.

Station	Temp	pH	Cond.	D.O.	FC	Nut 5	TPN	TSS	Turb.	Cl	Chloro *a*[1]	UBOD[1]
prdn	X	X	X	X	X	X	X	X	X	X	X	
pr4.2	X	X	X	X	X	X	X	X	X	X		
pr8.6	X	X	X	X	X	X	X	X	X	X	X	
prup	X	X	X	X	X	X	X	X	X	X	X	
lpdn	X	X	X	X	X	X	X	X	X	X	X	
ccdn	X	X	X	X	X	X	X	X	X	X	X	
dcdn	X	X	X	X	X	X	X	X	X	X	X	
wcdn	X	X	X	X	X	X	X	X	X		X	
wcmf	X	X	X	X	X	X	X	X	X		X	
wcwf	X	X	X	X	X	X	X	X	X		X	
wcup	X	X	X	X	X	X	X	X	X		X	X
mldn	X	X	X	X	X	X	X	X	X		X	X
mlup	X	X	X	X	X	X	X	X	X		X	X
pump[2]	X	X	X	X	X	X	X	X	X		X	X
fcms[2]	X	X	X	X	X	X	X	X	X		X	X

[1] Only collected during dry season sampling;
[2] Stations sampled only during dry season.

Appendix E

Snohomish County and Ecology Data

Appendix E.1. Snohomish County dry season ambient water quality data.

Sampe Data	Station ID	Cond (µmhos/cm)	Temp (°C)	DO (mg/L)	pH (units)	FC (#/100 mL)	NO_2/NO_3 (mg/L)	TP (mg/L)	TSS (mg/L)	HARD (mg/L)
05/11/93	QCEF	138	12.0	10.2	6.5	540	0.820	0.080	0.5	38
05/25/93	QCEF	197	13.1	9.4	7.8	2100	0.380	0.110	2	49
06/14/93	QCEF	311	13.2	9.5	7.6	570	0.360	0.086	7	51
06/28/93	QCEF	198	12.0	11.0	7.7	882	0.300	0.120	4	55
07/13/93	QCEF	270	12.0	11.1	7.7	5100	0.650	0.120	4	62
07/26/93	QCEF	201	12.8	10.8	7.5	750	0.370	0.073	8	53
08/16/93	QCEF	230	13.1	10.7	7.6	1830	0.320	0.120	2	86
09/14/93	QCEF	222	10.7	11.1	7.6	5300	0.350	0.120	2	66
09/27/93	QCEF	362	11.7	10.4	7.6	370	1.40	0.150	0.5	88
10/12/93	QCEF	227	9.4	10.6	7.4	310	0.420	0.130	1	69
05/11/92	QCLD	356	9.7	10.5	8.1	274	0.930	0.120	7	69
06/08/92	QCLD	365	14.4	9.4	7.4	330	1.10	0.150	12	69
07/06/92	QCLD	336	14	8.4	7.1	200	0.830	0.160	3	74
08/11/92	QCLD	329	14.5	8.4	7.1	240	0.860	0.087	4	72
09/08/92	QCLD	297	13.1	8.0	7.0	963	0.930	0.120	1	340
10/12/92	QCLD	322	11.6	6.2	7.3	81	1.10	0.058	0.5	78
05/06/93	QCLD	238	11.4	5.0	7.2	640	1.20	0.083	8	63
06/08/93	QCLD	269	11.4	9.7	7.2	840	0.990	0.200	26	70
07/07/93	QCLD	340	13.6	11.2	7.7	240	0.970	0.120	7	78
08/04/93	QCLD	316	15.9	8.8	7.5	420	0.940	0.130	10	76
09/09/93	QCLD	314	13.6	9.6	7.5	182	1.00	0.150	13	93
10/07/93	QCLD	312	11.8	9.4	7.5	127	1.90	0.150	1	71
05/16/94	QCLD	424	11.3	9.0	6.9	200	1.00	0.050	6	54
06/08/94	QCLD	201	13.7	7.2	6.7	400	1.00	0.140	0.5	62
07/14/94	QCLD	202	13.6	11.6	7.5	45	0.800	0.100	8	100
08/04/94	QCLD	207	15.1	10.7	7.9	180	0.650	0.130	5	49
09/14/94	QCLD	169	12.8	7.0	7.2	360	0.840	0.100	0.5	84
10/14/94	QCLD	194	10.2	8.6	7.2	300	0.920	0.110	5	69
05/02/95	QCLD	-	11.2	9.4	6.7	2000	0.870	0.042	30	-
06/08/95	QCLD	-	12.5	9.5	7.0	300	1.20	0.063	5	-
07/10/95	QCLD	-	14.0	8.9	6.9	420	1.00	0.098	2	-
08/09/95	QCLD	365	12.8	7.7	6.9	460	1.10	0.090	4	-
09/20/95	QCLD	362	12.6	8.0	7.0	-	1.10	0.075	4	-
10/02/95	QCLD	363	12.0	7.0	6.7	673	0.890	0.083	4	-
05/06/96	QCLD	310	10.4	10.1	7.0	310	0.794	0.085	5	-
06/04/96	QCLD	355	13.4	9.0	6.9	360	0.897	0.112	7	-
07/15/96	QCLD	402	14.4	9.2	6.9	290	1.26	0.112	2	-
08/07/96	QCLD	406	12.2	-	6.8	290	1.13	0.129	15	-
09/09/96	QCLD	406	12.1	8.9	6.9	510	1.13	0.092	3	-
05/11/92	QCLU	288	9.5	11.3	7.9	35	0.990	0.200	8	73
06/08/92	QCLU	296	11.5	9.9	7.6	270	0.830	0.250	6	70
07/06/92	QCLU	292	11.7	9.6	7.3	106	0.770	0.300	20	70
08/11/92	QCLU	254	12.1	9.0	7.2	270	0.600	0.270	8	73
09/08/92	QCLU	255	11.1	9.6	7.4	575	1.00	0.320	10	240
10/12/92	QCLU	270	10.3	6.6	6.9	50	0.640	0.240	2	74
05/06/93	QCLU	135	10.1	5.7	7.0	240	0.760	0.130	68	33
06/08/93	QCLU	244	11.1	10.9	7.0	36	0.710	0.250	6	67
07/07/93	QCLU	262	11.5	11.2	7.9	52	0.590	0.260	6	81
08/04/93	QCLU	265	12.8	10.4	7.6	71	0.550	0.280	4	74
09/09/93	QCLU	253	11.9	12.0	7.7	680	0.640	0.270	5	70
10/07/93	QCLU	261	10.8	12.6	7.4	210	1.30	0.280	1	67
05/16/94	QCLU	360	9.8	11.3	7.2	78	0.630	0.140	0.5	53
06/08/94	QCLU	163	11.2	7.7	7.4	500	0.520	0.290	0.5	61
07/14/94	QCLU	163	12.0	12.1	7.5	420	0.400	0.180	4	55
08/04/94	QCLU	164	12.2	11.4	7.6	850	0.340	0.280	0.5	46
09/14/94	QCLU	129	11.6	14.1	7.3	0	0.460	0.240	2	69
10/14/94	QCLU	410	9.4	11.4	7.3	2300	0.550	0.037	33	65

Sampe Date	Station ID	Cond (μmhos/cm)	Temp (°C)	DO (mg/L)	pH (units)	FC (#/100 mL)	NO_2/NO_3 (mg/L)	TP (mg/L)	TSS (mg/L)	HARD (mg/L)
05/02/95	QCLU	-	10.0	10.7	7.2	1082	0.710	0.180	14	-
06/08/95	QCLU	-	12.6	10.4	7.6	400	0.610	0.270	5	-
07/10/95	QCLU	-	13.0	9.9	7.5	117	0.700	0.260	5	-
08/09/95	QCLU	328	11.4	9.3	7.2	680	0.840	0.250	4	-
09/20/95	QCLU	322	11.0	10.6	7.0	-	0.570	0.260	5	-
10/02/95	QCLU	275	11.3	9.9	6.9	550	0.650	0.210	11	-
05/06/96	QCLU	208	9.1	11.5	6.9	47	0.835	0.112	5	-
06/04/96	QCLU	274	11.3	10.6	7.1	130	0.837	0.182	1	-
07/15/96	QCLU	327	12.3	10.9	7.2	67	0.713	0.258	4	-
08/07/96	QCLU	336	10.9	12.1	7.1	130	0.707	0.272	1	-
09/09/96	QCLU	333	11.4	11.1	7.5	380	0.684	0.280	3	-
05/11/93	QCMF	268	11.9	9.9	6.9	96	1.10	0.100	0.5	71
05/25/93	QCMF	343	14.1	9.1	7.4	280	1.30	0.130	3	70
06/14/93	QCMF	326	12.7	9.0	7.4	470	0.200	0.092	6	45
06/28/93	QCMF	327	12.5	10.5	7.7	610	1.20	0.150	3	76
07/13/93	QCMF	391	12.9	11.1	7.7	427	1.30	0.170	4	94
07/26/93	QCMF	335	13.7	10.8	7.7	470	1.20	0.120	4	76
08/16/93	QCMF	340	13.1	10.5	7.6	1620	1.30	0.140	1	81
09/14/93	QCMF	352	11.6	10.9	7.6	430	1.30	0.130	5	92
09/27/93	QCMF	217	10.0	11.4	7.5	1240	0.350	0.110	3	61
10/12/93	QCMF	343	11.1	11.1	7.3	260	1.20	0.140	0.5	84
05/11/93	QCMS	246	12.9	9.4	7.7	210	1.20	0.094	0.5	60
05/25/93	QCMS	303	14.8	8.9	7.6	290	1.20	0.150	3	80
06/14/93	QCMS	309	13.7	9.0	7.5	460	1.00	0.110	1	65
06/28/93	QCMS	299	13.0	10.3	7.7	390	1.30	0.120	6	70
07/13/93	QCMS	335	14.0	10.4	7.6	309	1.20	0.110	4	100
07/26/93	QCMS	312	14.1	10.7	7.6	320	1.20	0.081	1	69
08/16/93	QCMS	315	13.6	9.7	7.5	240	1.30	0.100	2	100
09/14/93	QCMS	327	11.7	10.4	7.6	620	1.30	0.073	3	80
09/27/93	QCMS	325	12.0	11.4	7.8	210	1.40	0.110	0.5	85
10/12/93	QCMS	321	11.1	10.0	7.5	61	1.40	0.100	0.5	75
05/11/93	QCUS	320	12.1	10.6	6.3	94	1.90	0.039	40	80
05/25/93	QCUS	404	14.3	8.4	8.4	150	1.40	0.049	0.5	89
06/14/93	QCUS	341	13.0	11.0	7.7	173	1.50	0.034	1	90
06/28/93	QCUS	327	12.7	11.8	7.6	44	1.20	0.046	7	88
07/13/93	QCUS	344	14.7	10.6	7.6	13	0.600	0.034	6	110
07/26/93	QCUS	336	13.6	10.6	7.8	100	1.00	0.039	3	88
08/16/93	QCUS	363	15.7	4.0	7.9	19	0.130	0.047	0.5	99
05/11/93	QCWF	245	13.8	8.0	7.4	144	1.80	0.150	10	60
05/25/93	QCWF	325	13.7	7.1	8.0	580	0.170	0.055	0.5	76
06/14/93	QCWF	330	13.7	8.2	7.5	250	0.240	0.120	3	77
06/28/93	QCWF	307	12.8	9.3	7.4	1730	0.160	0.095	5	83
07/13/93	QCWF	362	14.1	6.4	7.6	1900	0.160	0.053	0.5	94
07/26/93	QCWF	321	13.3	9.0	7.4	310	0.360	0.048	2	80
08/16/93	QCWF	349	14.1	7.9	7.5	1220	0.180	0.069	0.5	85
09/14/93	QCWF	331	11.7	10.2	7.4	310	0.150	0.023	33	89
09/27/93	QCWF	349	12.6	9.4	7.4	280	0.250	0.046	1	86
10/12/93	QCWF	336	11.6	8.1	7.5	3700	0.300	0.053	2	87
05/11/92	ACLD	340	10.3	3.8	7.0	172	0.770	0.072	1	100
06/08/92	ACLD	418	14.1	1.6	6.7	340	0.660	0.110	6	74
07/06/92	ACLD	264	15.4	1.1	6.6	38	0.120	0.170	3	58
08/11/92	ACLD	297	16.2	0.6	6.6	220	0.260	0.150	6	76
09/08/92	ACLD	301	12.6	1.2	6.5	764	0.490	0.100	2	250
10/12/92	ACLD	304	11.8	1.6	6.3	12	0.820	0.065	0.5	76
05/06/93	ACLD	235	12.2	2.0	7.1	340	1.60	0.066	4	63
06/08/93	ACLD	361	13.6	3.4	7.2	15	0.810	0.120	3	79
07/07/93	ACLD	318	13.7	3.3	7.4	17	1.40	0.130	5	85
08/04/93	ACLD	333	16.8	1.0	7.1	43	1.00	0.270	10	85
09/09/93	ACLD	310	15.6	1.9	7.2	27	0.830	0.650	40	72
10/07/93	ACLD	308	12.6	1.5	6.9	470	2.50	0.110	1	76
05/16/94	ACLD	446	12.3	2.0	6.7	190	0.930	0.050	0.5	59

Sampe Data	Station ID	Cond (µmhos/cm)	Temp (°C)	DO (mg/L)	pH (units)	FC (#/100 mL)	NO_2/NO_3 (mg/L)	TP (mg/L)	TSS (mg/L)	HARD (mg/L)
06/08/94	ACLD	199	14.1	1.1	6.2	360	0.590	0.170	0.5	65
07/14/94	ACLD	198	15.4	0.6	6.8	150	0.290	0.330	150	61
08/04/94	ACLD	198	16.8	0.4	7.1	140	0.130	0.250	21	51
09/14/94	ACLD	197	13.0	1.0	6.5	12	0.036	0.320	50	79
10/14/94	ACLD	187	10.6	1.7	6.8	2000	0.540	0.065	21	67
05/03/95	ACLD	-	10.9	3.2	6.4	3800	0.840	0.086	3	-
06/08/95	ACLD	-	12.9	2.1	6.5	70	0.870	0.083	4	-
07/10/95	ACLD	-	14.9	0.6	6.5	1000	0.400	0.180	5	-
08/09/95	ACLD	353	14.2	0.5	6.2	182	0.110	0.110	4	-
09/20/95	ACLD	355	13.6	0.1	6.2	-	0.005	0.075	0.5	-
10/02/95	ACLD	373	12.6	0.3	6.5	100	0.340	0.081	24	-
05/06/96	ACLD	472	10.7	1.1	6.3	33	1.76	0.158	2	-
06/04/96	ACLD	361	14.6	0.8	6.5	75	0.695	0.152	2	-
07/15/96	ACLD	416	16.2	1.3	6.4	65	1.09	0.132	2	-
08/07/96	ACLD	379	13.8	-	6.5	58	0.755	0.111	1	-
09/09/96	ACLD	382	9.2	1.0	6.7	81	0.652	0.098	2	-
05/11/92	ACLU	298	9.7	9.7	7.4	1520	0.320	0.180	11	76
06/08/92	ACLU	260	15.1	2.2	6.9	200	0.000	0.240	13	58
07/06/92	ACLU	259	15.3	5.3	6.9	573	0.350	0.250	3	63
08/11/92	ACLU	207	15.6	4.1	6.8	194	0.270	0.220	8	64
09/08/92	ACLU	224	12.7	6.4	6.8	1050	0.740	0.290	6	120
10/12/92	ACLU	341	11.6	5.2	6.8	50	0.870	0.210	0.5	61
05/06/93	ACLU	244	11.0	4.5	7.1	5400	0.700	0.860	16	72
06/08/93	ACLU	266	12.7	5.8	7.5	1800	0.520	0.220	0	73
07/07/93	ACLU	232	11.7	7.8	7.5	840	0.600	0.240	3	74
08/04/93	ACLU	227	15.0	5.1	7.3	450	0.410	0.290	5	61
09/09/93	ACLU	209	12.7	10.9	7.7	173	0.490	0.250	3	65
10/07/93	ACLU	203	11.1	9.6	7.3	410	0.560	0.210	0.5	61
05/16/94	ACLU	298	10.2	9.0	7.3	200	0.420	0.110	0.5	47
06/08/94	ACLU	132	12.4	6.3	7.2	7800	0.450	0.300	3	58
07/14/94	ACLU	134	13.6	12.1	7.4	2600	0.290	0.280	13	48
08/04/94	ACLU	136	15.6	7.4	7.5	710	0.200	0.260	3	35
09/14/94	ACLU	148	11.3	10.5	7.2	570	0.280	0.270	0.5	57
10/14/94	ACLU	147	9.3	9.2	7.3	400	0.390	0.220	7	57
05/02/95	ACLU	-	10.5	9.3	6.6	3600	0.290	0.120	10	-
06/08/95	ACLU	-	15.1	8.3	7.0	70	0.350	0.230	0.5	-
07/10/95	ACLU	-	16.2	7.6	7.1	117	0.380	0.210	0.5	-
08/09/95	ACLU	283	12.4	7.1	6.8	836	0.470	0.200	3	-
09/20/95	ACLU	355	13.6	-	6.2	-	0.390	0.220	4	-
10/02/95	ACLU	257	11.7	7.4	6.7	8000	0.420	0.270	8	-
05/06/96	ACLU	294	9.9	9.1	6.6	3900	0.573	0.110	7	-
06/04/96	ACLU	271	13.6	6.3	6.6	80	0.316	0.161	2	-
07/15/96	ACLU	268	14.5	7.9	6.8	430	0.391	0.192	2	-
08/07/96	ACLU	276	12.2	-	6.9	550	0.312	0.155	1	-
09/09/96	ACLU	278	13.2	8.4	7.0	2400	0.353	0.232	1	-
05/12/93	ACMC	248	14.1	9.3	7.3	210	1.70	0.045	6	63
05/26/93	ACMC	376	13.6	8.3	7.5	620	2.20	0.035	1	94
06/15/93	ACMC	240	15.4	8.0	7.4	3100	0.790	0.061	7	75
06/29/93	ACMC	373	13.6	9.3	7.2	500	1.80	0.075	16	93
07/12/93	ACMC	381	13.6	10.1	7.5	1600	2.10	0.033	0.5	100
07/27/93	ACMC	375	15.3	9.2	7.5	410	1.80	0.042	3	94
08/18/93	ACMC	364	14.7	8.4	7.5	750	1.70	0.053	3	94
09/13/93	ACMC	382	12.6	9.1	7.4	310	2.60	0.008	1	100
09/28/93	ACMC	397	10.9	9.4	7.4	430	2.80	0.032	0.5	110
10/11/93	ACMC	371	10.5	10.7	7.5	350	2.10	0.031	0.5	93
05/12/93	ACMS	306	12.7	8.7	7.4	82	2.90	0.160	4	72
05/26/93	ACMS	327	13.7	8.7	7.7	280	2.70	0.130	2	75
06/15/93	ACMS	676	13.5	8.4	7.4	760	2.10	0.230	19	77
06/29/93	ACMS	294	12.9	9.3	7.5	250	0.60	0.100	7	99
07/12/93	ACMS	316	13.2	10.1	7.7	570	3.20	0.150	2	76
07/27/93	ACMS	321	14.3	10.2	7.6	390	2.70	0.110	1	70

Sampe Date	Station ID	Cond (μmhos/cm)	Temp (°C)	DO (mg/L)	pH (units)	FC (#/100 mL)	NO_2/NO_3 (mg/L)	TP (mg/L)	TSS (mg/L)	HARD (mg/L)
08/18/93	ACMS	323	14.3	10.6	7.4	420	2.30	0.160	3	71
09/13/93	ACMS	281	12.7	10.1	7.5	500	2.50	0.100	3	67
09/28/93	ACMS	312	12.4	10.5	7.6	350	2.20	0.110	0.5	64
10/11/93	ACMS	287	10.7	11.2	7.6	230	2.10	0.100	0.5	65
05/12/93	ACNF	352	12.0	7.7	7.1	64	3.60	0.270	5	85
05/26/93	ACNF	308	13.7	7.2	7.4	330	2.30	0.200	4	72
06/15/93	ACNF	294	13.3	5.7	7.1	220	2.90	0.430	6	87
06/29/93	ACNF	347	12.7	5.0	7.2	260	3.20	0.400	4	82
07/12/93	ACNF	331	13.9	4.6	7.2	120	3.60	0.390	2	79
07/27/93	ACNF	394	14.1	4.2	7.2	67	3.20	0.270	2	86
08/18/93	ACNF	347	14.3	4.0	7.4	240	0.850	0.480	3	72
09/13/93	ACNF	277	11.0	9.2	7.2	180	1.50	0.093	8	79
09/28/93	ACNF	281	10.4	11.4	7.6	350	1.20	0.240	0.5	74
10/11/93	ACNF	383	9.2	7.2	7.4	600	0.820	0.720	9	96
05/12/93	ACSF	249	12.0	10.3	7.6	63	1.40	0.075	2	60
05/26/93	ACSF	273	13.4	6.7	7.2	100	1.00	0.170	15	67
06/15/93	ACSF	212	13.9	8.1	7.4	7700	0.660	0.120	33	61
06/29/93	ACSF	264	13.2	9.2	7.5	650	2.90	0.170	5	71
07/12/93	ACSF	301	13.6	8.3	7.2	170	0.540	0.120	1	88
07/27/93	ACSF	308	14.7	6.2	7.5	40	0.990	0.065	2	97
08/18/93	ACSF	301	14.6	7.9	7.5	32	0.460	0.170	16	93
09/13/93	ACSF	301	11.3	10.1	7.5	210	0.770	0.064	13	80
09/28/93	ACSF	1024	11.0	9.4	7.4	56	0.910	0.100	3	82
10/11/93	ACSF	299	9.8	9.8	7.3	50	0.700	0.089	2	79
05/23/95	PUMP	-	16.2	4.4	6.7	72	0.770	0.120	10	-
06/13/95	PUMP	-	17.0	2.2	-	127	0.480	0.170	7	-
07/20/95	PUMP	-	23.3	-	7.1	200	0.010	0.012	5	-
08/03/95	PUMP	-	19.8	4.0	7.0	1018	0.082	0.052	0.5	-
08/17/95	PUMP	420	15.0	2.5	6.6	-	0.360	0.100	7	-
08/30/95	PUMP	480	15.3	1.9	6.2	227	0.290	0.066	3	-
09/27/95	PUMP	540	13.2	3.1	6.9	1682	0.094	0.046	7	-
10/17/95	PUMP	307	11.9	4.1	6.3	838	1.20	0.069	16	-
05/25/94	FCDD	488	17.1	5.1	6.9	5800	0.850	0.160	6	59
06/14/94	FCDD	244	15.8	3.5	6.9	640	0.900	0.130	11	66
06/30/94	FCDD	218	16.7	2.3	7.3	210	1.30	0.031	8	69
07/19/94	FCDD	221	19.7	6.3	7.0	8000	0.260	0.074	7	67
08/11/94	FCDD	271	21.3	5.6	6.0	136	0.210	0.100	8	67
08/23/94	FCDD	233	17.6	2.5	7.0	40	0.340	0.064	10	66
09/07/94	FCDD	232	17.7	4.2	7.1	65	0.260	0.063	7	79
09/19/94	FCDD	197	15.5	1.6	6.7	79	0.450	0.059	0.5	80
10/03/94	FCDD	244	11.6	4.4	7.1	230	1.00	0.053	9	82
10/18/94	FCDD	180	9.6	3.6	6.8	83	0.970	0.054	13	85
09/15/93	FCLD	179	12.5	9.4	7.2	220	0.240	-	13	45
10/13/93	FCLD	184	11.4	10.6	7.5	94	0.200	0.024	0.5	48
05/18/94	FCLD	185	11.3	10.5	7.2	600	0.490	0.050	5	26
06/09/94	FCLD	91	13.3	7.1	7.3	440	0.310	0.050	0.5	28
07/11/94	FCLD	99	14.6	10.9	6.9	2400	0.200	0.039	4	29
08/01/94	FCLD	118	12.4	8.5	7.3	1100	0.028	0.021	35	29
09/12/94	FCLD	111	12.1	10.6	7.1	410	0.180	0.063	5	37
10/11/94	FCLD	150	10.6	10.1	6.7	118	0.076	0.039	7	34
05/05/95	FCLD	-	10.7	10.4	6.8	500	0.480	0.021	5	-
06/06/95	FCLD	-	14.3	0.7	6.6	300	0.330	0.690	21	-
07/11/95	FCLD	-	18.0	2.9	6.4	220	0.280	0.090	4	-
08/07/95	FCLD	200	15.8	-	6.3	354	0.200	0.100	7	-
09/18/95	FCLD	374	15.9	0.3	6.4	118	0.310	0.046	6	-
10/04/95	FCLD	279	13.0	2.9	6.2	500	1.80	0.068	20	-
05/08/96	FCLD	314	9.9	8.1	6.2	210	0.473	0.059	13	-
06/03/96	FCLD	331	15.4	6.2	6.1	390	0.746	0.077	7	-
07/16/96	FCLD	460	20.7	9.8	6.9	320	0.444	0.085	25	-
08/06/96	FCLD	492	17.0	4.6	6.6	10200	0.470	0.032	7	-
09/10/96	FCLD	436	16.2	6.1	6.8	179	0.487	0.054	7	-

Sampe Date	Station ID	Cond (μmhos/cm)	Temp (°C)	DO (mg/L)	pH (units)	FC (#/100 mL)	NO_2/NO_3 (mg/L)	TP (mg/L)	TSS (mg/L)	HARD (mg/L)
10/14/96	FCLD	367	11.7	4.6	6.3	-	-	-	-	-
05/23/95	FCMS	-	14.2	5.0	-	2600	0.590	0.110	5	-
06/13/95	FCMS	-	16.3	2.8	-	4600	0.270	0.130	10	-
07/20/95	FCMS	-	21.7	-	6.9	112	0.051	0.054	28	-
08/03/95	FCMS	-	22.4	3.2	6.8	200	0.460	0.062	6	-
08/17/95	FCMS	232	-	-	6.5	-	0.500	0.064	17	-
08/30/95	FCMS	404	18.9	2.7	6.4	370	0.340	0.071	13	-
09/27/95	FCMS	266	14.2	1.2	6.3	1000	0.420	0.110	19	-
10/17/95	FCMS	150	11.9	9.2	6.5	700	0.850	0.047	7	-
09/15/93	FCLU	134	12.1	11.5	7.3	150	0.400	-	7	51
10/13/93	FCLU	135	12.4	11.6	7.4	550	0.700	0.022	3	51
05/18/94	FCLU	158	11.6	10.5	7.6	140	0.480	0.050	3	22
06/09/94	FCLU	75	12.9	7.3	7.1	450	0.840	0.050	5	24
07/11/94	FCLU	85	13.6	11.6	7.1	1136	0.350	0.024	0.5	28
08/01/94	FCLU	97	12.8	9.6	7.3	1827	0.170	0.060	0.5	33
09/12/94	FCLU	109	11.3	11.1	7.1	600	0.220	0.078	10	43
10/11/94	FCLU	95	10.2	11.0	7.0	854	0.230	0.024	5	38
05/05/95	FCLU	-	10.8	10.7	6.8	64	0.470	0.019	5	-
06/06/95	FCLU	-	11.2	10.5	6.7	145	0.370	0.013	4	-
07/11/95	FCLU	-	14.8	9.0	7.1	480	0.300	0.018	2	-
08/07/95	FCLU	178	13.7	9.0	6.6	3300	0.360	0.037	5	-
09/18/95	FCLU	164	14.3	9.4	6.4	230	0.230	0.025	2	-
10/04/95	FCLU	131	11.7	9.5	6.4	250	0.550	0.028	10	-
05/08/96	FCLU	74	8.6	10.2	6.5	128	0.474	0.020	1	-
06/03/96	FCLU	118	13.9	10.3	6.6	188	0.461	0.017	3	-
07/16/96	FCLU	160	15.4	9.4	6.8	121	0.419	0.023	4	-
08/06/96	FCLU	185	13.2	10.0	6.8	400	0.306	0.025	4	-
09/10/96	FCLU	203	12.2	10.0	6.8	580	0.251	0.014	3	-
05/23/95	LH1	-	11.3	8.3	7.3	410	0.860	0.023	3	-
06/13/95	LH1	-	15.4	8.3	-	-	0.600	0.110	3	-
07/20/95	LH1	-	16.3	2.2	6.5	56	0.010	0.020	9	-
08/03/95	LH1	-	16.5	3.7	6.9	518	0.005	0.023	0.5	-
08/17/95	LH1	219	12.9	13.5	6.4	9100	1.00	0.062	170	-
08/30/95	LH1	272	12.3	10.4	6.8	218	0.160	0.040	0.5	-
09/27/95	LH1	320	13.6	9.3	6.9	1000	0.650	0.100	13	-
10/17/95	LH1	217	11.4	10.5	6.9	660	2.00	0.040	12	-
05/23/95	LH2	-	11.3	8.5	6.5	78	1.10	0.039	5	-
06/13/95	LH2	-	14.1	9.0	-	41	0.760	0.130	4	-
07/20/95	LH2	-	16.9	-	7.7	115	0.670	0.031	12	-
08/03/95	LH2	-	16.1	9.6	8.0	620	0.640	0.041	5	-
08/17/95	LH2	252	12.4	14.6	6.7	1500	3.30	0.059	290	-
08/30/95	LH2	311	12.6	10.6	6.9	224	0.740	0.054	0.5	-
09/27/95	LH2	335	13.2	9.2	7.2	5400	0.930	0.088	16	-
10/17/95	LH2	243	11.1	10.2	7.0	1100	3.00	0.041	10	-
05/23/95	CCH2	-	12.4	7.1	-	50	0.620	0.049	2	-
06/13/95	CCH2	-	12.9	5.3	-	74	0.540	0.130	3	-
07/20/95	CCH2	-	14.7	5.9	6.8	98	0.600	0.018	4	-
08/03/95	CCH2	-	14.5	5.2	7.1	591	0.610	0.043	0.5	-
08/17/95	CCH2	178	-	-	6.1	15700	0.450	0.059	10	-
08/30/95	CCH2	291	12.1	5.2	6.6	800	0.580	0.040	0.5	-
09/27/95	CCH2	257	12.8	4.7	6.2	3500	0.500	0.082	13	-
10/17/95	CCH2	202	11.3	5.4	6.6	1400	0.340	0.051	11	-
10/31/95	CCH2	250	5.3	6.9	6.8	36	0.710	0.039	4	-
05/25/94	CCLS	302	12.1	10.2	7.7	140	1.10	0.050	0.5	43
06/14/94	CCLS	127	11.4	7.5	7.3	510	0.800	0.050	0.5	43
06/30/94	CCLS	138	14.0	9.5	7.7	40	0.940	0.073	6	45
07/19/94	CCLS	141	15.5	8.0	7.8	630	0.710	0.110	15	48
08/10/94	CCLS	145	17.6	9.0	7.0	226	0.630	0.089	15	41
08/24/94	CCLS	144	14.6	8.4	7.6	3500	0.770	0.058	19	47
09/06/94	CCLS	142	13.3	10.0	7.1	1236	0.750	0.095	15	68

Sampe Date	Station ID	Cond (µmhos/cm)	Temp (°C)	DO (mg/L)	pH (units)	FC (#/100 mL)	NO_2/NO_3 (mg/L)	TP (mg/L)	TSS (mg/L)	HARD (mg/L)
09/20/94	CCLS	147	14.9	9.1	7.2	250	0.750	0.069	7	53
10/03/94	CCLS	155	11.1	10.2	7.6	450	0.630	0.230	22	53
10/19/94	CCLS	118	10.0	10.5	7.5	460	0.710	0.052	6	56
05/25/94	CCUS	246	12.2	9.7	6.7	29	0.730	0.050	0.5	35
06/14/94	CCUS	106	10.6	7.0	7.2	189	0.430	0.050	6	40
06/30/94	CCUS	113	12.7	10.1	6.4	4	0.490	0.020	9	45
07/19/94	CCUS	125	13.0	9.5	7.3	490	0.380	0.034	12	40
08/10/94	CCUS	131	12.9	9.7	7.1	450	0.270	0.055	5	34
08/24/94	CCUS	131	12.6	9.3	7.0	145	0.370	0.056	0.5	44
09/06/94	CCUS	132	14.4	4.8	7.9	40	0.380	0.059	4	48
09/20/94	CCUS	126	13.9	3.8	7.1	61	0.370	0.045	3	51
10/03/94	CCUS	128	9.5	10.8	7.1	19	0.410	0.061	18	50
10/19/94	CCUS	118	10.1	9.9	7.3	48	0.400	0.049	2	50
05/23/95	FL1	-	13.5	6.4	-	49	0.570	0.048	4	-
06/13/95	FL1	-	14.8	5.0	-	540	0.450	0.130	3	-
07/20/95	FL1	-	16.5	7.6	7.1	122	0.650	0.023	0.5	-
08/03/95	FL1	-	16.5	6.8	7.3	254	0.340	0.051	2	-
08/17/95	FL1	228	-	-	6.3	2000	0.330	0.023	110	-
08/30/95	FL1	532	13.4	4.5	6.8	300	0.072	0.039	3	-
09/27/95	FL1	261	14.6	3.6	6.3	1000	0.190	0.057	26	-
10/17/95	FL1	285	12.2	5.9	6.6	1540	0.220	0.071	85	-
05/23/95	FL2	-	13.4	7.5	-	14	1.40	0.011	3	-
06/13/95	FL2	-	13.8	6.3	-	51	1.20	0.100	3	-
07/20/95	FL2	-	14.7	7.6	6.9	0	1.10	0.008	2	-
08/03/95	FL2	-	16.2	6.0	7.1	72	1.10	0.039	0.5	-
08/17/95	FL2	264	-	-	6.1	2800	1.60	0.033	12	-
08/30/95	FL2	420	13.5	6.5	6.8	782	1.10	0.020	2	-
09/27/95	FL2	142	15.1	5.0	6.2	900	0.420	0.029	36	-
10/17/95	FL2	262	12.8	5.6	6.6	247	0.750	0.060	180	-
05/23/95	FL3	-	13.3	8.4	5.5	48	1.60	0.016	2	-
06/13/95	FL3	-	15.3	8.8	-	154	1.50	0.110	4	-
07/20/95	FL3	-	16.7	2.3	6.7	45	0.340	0.024	15	-
08/03/95	FL3	-	15.7	2.0	6.9	530	0.250	0.052	11	-
08/17/95	FL3	346	-	-	6.4	1209	2.10	0.120	3	-
08/30/95	FL3	390	11.6	10.1	6.9	5	2.80	0.064	6	-
09/27/95	FL3	141	15.1	5.0	6.3	1000	0.200	0.083	25	-
10/17/95	FL3	249	11.9	5.5	6.5	1000	1.30	0.059	110	-
05/26/94	STLS	223	14.4	10.1	7.1	36	0.480	0.050	7	0
06/13/94	STLS	101	14.3	6.9	6.7	280	0.360	0.050	2	32
06/27/94	STLS	123	17.1	10.0	7.0	300	0.330	0.024	0.5	0
07/17/94	STLS	124	19.7	9.5	7.2	1	0.330	0.022	5	0
08/08/94	STLS	133	16.9	7.1	7.2	780	0.150	0.025	6	0
08/22/94	STLS	189	16.3	8.6	7.1	1209	0.260	0.061	30	0
09/08/94	STLS	100	15.5	7.8	7.2	600	0.230	0.057	18	51
09/19/94	STLS	109	15.0	7.8	7.2	100	0.220	0.050	4	0
10/05/94	STLS	130	10.5	10.5	7.3	140	0.270	0.032	7	0
10/17/94	STLS	93	10.4	10.1	7.1	94	0.150	0.031	6	-
05/26/94	STUS	191	12.4	9.7	7.0	120	0.890	0.050	16	0
06/13/94	STUS	87	12.6	6.8	6.5	320	0.980	0.050	27	29
06/27/94	STUS	101	14.7	10.1	7.2	300	0.650	0.032	5	0
07/17/94	STUS	102	16.1	9.0	6.7	76	0.510	0.023	4	0
08/08/94	STUS	104	15.2	7.6	7.4	3100	0.500	0.031	4	0
08/22/94	STUS	123	15.8	6.2	7.2	127	1.10	0.016	6	0
09/08/94	STUS	85	15.3	8.2	7.3	936	0.270	0.043	4	29
09/19/94	STUS	65	14.0	7.8	6.8	280	0.260	0.046	28	0
10/05/94	STUS	96	11.1	9.4	7.6	260	0.260	0.047	56	0
10/17/94	STUS	77	9.7	10.6	7.1	78	0.180	0.040	15	-
05/25/94	TRUS	139	15.3	6.3	7.1	63	0.050	0.050	0.5	16
06/14/94	TRUS	68	10.7	5.3	6.9	12	0.500	0.050	4	15
06/30/94	TRUS	72	16.0	2.1	7.3	13	0.046	-	2	18

Sampe Date	Station ID	Cond (u mhos/cm)	Temp (°C)	DO (mg/L)	pH (units)	FC (#/100 mL)	NO_2/NO_3 (mg/L)	TP (mg/L)	TSS (mg/L)	HARD (mg/L)
08/10/94	TRUS	93	18.1	6.9	7.0	310	0.017	0.026	0.5	10
08/24/94	TRUS	98	17.1	7.3	7.6	210	0.340	0.023	19	13
09/06/94	TRUS	78	14.5	9.3	7.5	360	0.018	0.023	0.5	15
09/20/94	TRUS	66	15.9	6.8	7.0	78	0.380	0.030	0.5	0
10/03/94	TRUS	66	13.1	5.7	7.4	20	0.018	0.034	14	10
10/19/94	TRUS	55	10.4	10.4	6.7	8	0.027	0.016	0.5	12
09/16/93	WCMF	158	11.3	13.2	7.8	49	0.610	-	25	56
10/13/93	WCMF	172	11.4	12.7	7.3	26	0.680	0.013	0.5	46
05/18/94	WCMF	178	10.6	10.6	7.0	120	0.600	0.050	5	27
06/09/94	WCMF	98	12.5	7.8	7.3	6800	0.580	0.050	0.5	36
07/11/94	WCMF	103	15.6	9.9	7.6	123	0.520	0.031	0.5	37
08/01/94	WCMF	116	16.4	10.7	7.8	85	0.400	0.020	4	34
09/12/94	WCMF	99	12.8	10.7	7.7	119	0.370	0.043	0.5	49
10/11/94	WCMF	86	10.8	11.6	6.8	530	0.490	0.079	7	50
05/05/95	WCMF	-	10.8	10.9	7.1	30	0.590	0.009	3	-
06/06/95	WCMF	-	10.8	11.0	6.9	64	0.800	-	4	-
07/11/95	WCMF	-	13.6	10.5	7.1	108	0.710	0.021	0.5	-
08/07/95	WCMF	58	13.0	-	7.0	780	0.750	0.017	0.5	-
09/18/95	WCMF	174	13.7	9.2	7.6	118	0.590	0.016	72	-
10/04/95	WCMF	105	11.3	10.7	6.8	200	0.550	0.030	13	-
05/08/96	WCMF	80	8.3	11.8	6.4	174	0.498	0.015	4	-
06/03/96	WCMF	108	13.7	10.2	6.7	150	0.500	0.021	12	-
07/16/96	WCMF	188	14.8	10.3	7.0	280	0.797	0.011	3	-
08/06/96	WCMF	178	12.9	11.1	7.0	140	0.548	0.017	2	-
09/10/96	WCMF	190	12.2	10.4	7.4	220	0.607	0.015	4	-
09/16/93	WCWF	196	11.4	12.2	7.7	93	0.570	-	6	54
10/13/93	WCWF	196	11.3	13.0	7.4	43	0.700	0.020	1	51
05/18/94	WCWF	195	12.2	10.7	7.0	50	0.490	0.050	2	31
06/09/94	WCWF	113	15.2	7.9	6.8	114	0.420	0.050	0.5	43
07/11/94	WCWF	130	15.5	11.3	7.7	103	0.410	0.025	0.5	44
08/01/94	WCWF	139	15.9	10.8	7.8	360	0.300	0.030	0.5	42
09/12/94	WCWF	128	12.9	13.0	7.5	65	0.250	0.048	0.5	52
10/11/94	WCWF	129	11.1	12.5	7.4	59	0.360	0.034	4	57
05/05/95	WCWF	-	10.8	10.7	6.9	78	0.470	0.015	3	-
06/06/95	WCWF	-	11.4	10.4	7.0	109	0.520	0.017	0.5	-
07/11/95	WCWF	-	14.1	10.0	6.9	122	0.460	0.017	0.5	-
08/07/95	WCWF	29	13.2	9.5	6.9	800	0.520	0.026	2	-
09/18/95	WCWF	241	13.4	9.4	6.7	3900	0.410	0.016	4	-
10/04/95	WCWF	150	11.6	9.9	6.7	500	0.790	0.033	12	-
05/08/96	WCWF	76	8.3	10.9	6.6	150	0.479	0.023	7	-
06/03/96	WCWF	124	13.3	10.2	6.7	170	0.470	0.027	6	-
07/16/96	WCWF	273	15.0	9.2	7.1	79	0.470	0.011	2	-
08/06/96	WCWF	249	13.1	10.1	7.0	540	0.427	0.022	1	-
09/10/96	WCWF	269	12.5	10.5	7.2	131	0.420	0.025	1	-

Appendix E.1. Snohomish County wet season ambient water quality data.

Sample Date	Station ID	Cond (µmhos/cm)	Temp (°C)	DO (mg/L)	pH (units)	FC (#/100 mL)	NO_2/NO_3 (mg/L)	TP (mg/L)	TSS (mg/L)	HARD (mg/L)
11/15/93	QCEF	263	7.4	11.7	7.7	420	0.640	0.120	26	85
11/29/93	QCEF	222	5.5	12.6	7.4	250	-	0.110	23	79
12/16/93	QCEF	162	5.3	9.9	7.3	41	2.30	0.048	13	70
12/29/93	QCEF	181	3.8	10.2	7.4	66	1.00	0.080	7	61
01/19/94	QCEF	164	5.3	9.6	7.3	2000	1.10	0.073	8	51
02/01/94	QCEF	164	3.5	10.3	7.4	610	1.10	0.067	11	44
02/22/94	QCEF	131	5.4	9.8	7.3	66	1.70	0.054	16	34
03/14/94	QCEF	172	11.6	11.3	7.0	280	0.290	0.063	3	72
03/30/94	QCEF	175	10.4	9.6	7.1	3600	0.790	0.077	10	70
04/18/94	QCEF	248	11.6	9.9	7.4	7400	0.690	0.045	0.5	80
11/04/92	QCLD	280	9.1	5.8	7.4	340	0.810	0.087	0.5	75
12/07/92	QCLD	294	5.7	7.4	7.4	220	1.10	0.100	3	77
01/13/93	QCLD	166	1.6	8.9	7.1	240	1.50	0.130	10	34
02/02/93	QCLD	168	4.9	8.3	6.7	25	1.50	0.069	3	57
03/03/93	QCLD	195	8.2	7.2	7.4	380	1.50	0.110	0.5	67
04/06/93	QCLD	216	8.2	6.1	7.6	80	1.60	0.087	5	60
11/04/93	QCLD	321	9.2	10.4	7.5	120	-	0.086	1	70
12/06/93	QCLD	288	3.9	13.0	7.2	42	1.80	0.080	2	74
01/13/94	QCLD	258	9.1	8.1	7.5	72	1.80	0.088	2	69
02/09/94	QCLD	289	4.4	9.6	7.3	63	1.50	0.088	3	76
03/07/94	QCLD	260	6.5	12.1	7.3	54	1.70	0.084	0.5	65
04/13/94	QCLD	339	9.3	9.9	7.5	105	1.10	0.072	0.5	67
11/07/94	QCLD	192	6.5	10.6	7.2	300	0.700	0.082	2	63
12/05/94	QCLD	160	2.0	13.2	6.9	94	0.920	0.066	3	64
01/10/95	QCLD	162	5.1	12.6	6.9	3370	1.30	0.110	7	56
02/09/95	QCLD	127	4.9	11.1	7.3	230	1.30	0.060	8	65
03/08/95	QCLD	129	6.6	10.7	7.0	230	1.20	0.086	8	64
04/06/95	QCLD	168	9.0	10.8	7.3	200	0.960	0.078	7	64
11/06/95	QCLD	361	6.6	10.0	6.7	127	0.920	0.058	2	-
12/13/95	QCLD	225	8.4	9.2	6.8	1400	1.40	0.150	4	-
01/03/96	QCLD	309	8.7	10.5	7.1	2200	1.40	0.130	7	-
02/07/96	QCLD	238	6.1	10.5	6.9	-	1.40	0.110	3	-
03/04/96	QCLD	335	6.4	11.4	7.4	140	1.40	0.097	10	-
04/03/96	QCLD	318	7.8	11.1	7.1	3700	0.990	0.081	12	-
11/04/92	QCLU	242	9.1	6.7	6.9	42	0.720	0.230	10	78
12/07/92	QCLU	213	5.9	7.6	7.0	25	1.30	0.200	9	68
01/13/93	QCLU	138	2.3	9.4	6.8	100	1.30	0.190	1	60
02/02/93	QCLU	125	4.9	9.7	7.1	13	2.20	0.120	5	52
03/03/93	QCLU	173	7.0	7.8	7.6	100	1.20	0.200	5	57
04/06/93	QCLU	216	7.8	6.6	7.5	12	0.960	0.130	4	44
11/04/93	QCLU	249	9.0	13.7	7.5	94	-	0.260	1	61
12/06/93	QCLU	240	5.0	13.8	7.8	44	3.20	0.140	11	67
01/13/94	QCLU	204	8.3	9.8	7.5	23	2.60	0.120	2	49
02/09/94	QCLU	217	4.6	10.6	7.1	45	1.20	0.190	1	59
03/07/94	QCLU	221	6.2	12.8	7.2	16	2.50	0.093	2	52
04/13/94	QCLU	237	8.3	11.4	7.0	35	1.70	0.066	1	45
11/07/94	QCLU	158	7.5	12.4	7.2	149	0.690	0.220	6	56
12/05/94	QCLU	126	3.4	13.8	7.3	43	1.20	0.150	9	53
01/10/95	QCLU	104	5.6	14.1	7.3	370	1.90	0.110	17	37
02/09/95	QCLU	121	6.0	11.8	7.4	42	1.10	0.140	3	52
03/08/95	QCLU	117	7.3	11.6	7.4	2900	1.00	0.140	5	50
04/06/95	QCLU	126	8.4	11.9	7.5	61	0.940	0.140	6	51
11/06/95	QCLU	277	6.9	12.2	7.5	20	0.640	0.190	2	-
12/13/95	QCLU	172	8.1	11.1	6.9	1	1.80	0.043	12	-

Sampe Date	Station ID	Cond (umhos/cm)	Temp (°C)	DO (mg/L)	pH (units)	FC (#/100 mL)	NO_2/NO_3 (mg/L)	TP (mg/L)	TSS (mg/L)	HARD (mg/L)
01/03/96	QCLU	168	7.9	12.3	6.8	54	1.50	0.076	8	-
02/07/96	QCLU	153	5.4	13.0	6.9	-	1.70	0.056	12	-
03/04/96	QCLU	-	6.1	13.3	7.4	20	1.20	0.120	3	-
04/03/96	QCLU	187	6.8	12.2	7.1	190	1.20	0.099	10	-
11/15/93	QCMF	360	8.8	11.3	7.4	360	2.00	0.150	4	95
11/29/93	QCMF	348	7.3	11.6	7.5	3700	1.00	0.170	6	110
12/16/93	QCMF	276	6.2	9.0	7.4	25	2.80	0.120	7	75
12/29/93	QCMF	339	6.0	9.2	7.3	65	1.70	0.120	4	96
01/19/94	QCMF	298	6.3	9.0	7.3	84	1.80	0.100	1	86
02/01/94	QCMF	312	4.1	9.9	7.4	49	1.70	0.094	8	70
02/22/94	QCMF	243	6.0	10.1	7.2	680	2.00	0.240	33	64
03/14/94	QCMF	146	10.7	10.2	7.3	31	0.760	0.100	2	90
03/30/94	QCMF	303	10.7	10.4	7.4	43	1.60	0.110	3	79
04/18/94	QCMF	442	12.1	9.8	7.2	69	1.30	0.063	1	100
11/15/93	QCMS	338	8.9	10.2	-	360	1.50	0.120	1	100
11/29/93	QCMS	338	7.3	12.0	7.4	83	1.10	0.097	2	96
12/16/93	QCMS	246	6.2	8.8	7.3	55	2.30	0.098	58	64
12/29/93	QCMS	292	5.8	9.4	7.6	240	1.70	0.092	6	76
01/19/94	QCMS	283	5.8	9.3	7.2	73	1.80	0.098	7	69
02/01/94	QCMS	270	3.9	10.1	7.6	530	1.80	0.088	8	62
02/22/94	QCMS	260	5.7	11.1	7.2	480	2.00	0.170	18	59
03/14/94	QCMS	126	10.7	10.6	7.4	33	1.00	0.098	0.5	75
03/30/94	QCMS	274	10.7	10.5	7.3	610	1.60	0.093	2	81
04/18/94	QCMS	399	12.8	9.9	7.6	640	1.40	0.080	1	99
11/15/93	QCUS	412	5.7	13.9	7.7	25	1.00	0.041	16	140
11/29/93	QCUS	438	6.5	11.7	7.4	19	1.00	0.044	3	93
12/16/93	QCUS	272	7.0	6.8	7.1	24	1.40	0.071	8	77
12/29/93	QCUS	343	5.8	8.3	7.2	18	1.80	0.061	0.5	89
01/19/94	QCUS	343	6.7	8.3	7.2	18	2.00	0.042	3	86
02/01/94	QCUS	324	3.6	9.6	7.4	28	2.10	0.032	4	77
02/22/94	QCUS	286	6.3	8.1	7.2	37	1.70	0.055	5	77
03/14/94	QCUS	234	13.0	11.4	7.3	42	1.70	0.044	4	89
03/30/94	QCUS	313	11.4	14.4	7.3	9	1.60	0.054	4	99
04/18/94	QCUS	436	12.0	12.7	7.2	67	1.40	0.022	0.5	97
11/15/93	QCWF	387	8.6	9.9	7.5	90	0.240	0.052	1	90
11/29/93	QCWF	325	7.6	10.6	7.7	70	0.500	0.078	7	110
12/16/93	QCWF	325	5.9	8.3	7.2	52	3.40	0.099	2	68
12/29/93	QCWF	270	5.4	8.4	7.2	390	1.40	0.065	1	74
01/19/94	QCWF	257	6.4	8.0	7.0	54	1.60	0.080	17	64
02/01/94	QCWF	256	3.2	9.4	7.4	300	1.70	0.068	9	59
02/22/94	QCWF	200	5.1	9.1	7.3	94	2.10	0.100	1	52
03/14/94	QCWF	236	11.7	10.9	7.0	34	0.240	0.064	5	77
03/30/94	QCWF	261	10.7	10.0	7.2	350	0.790	0.069	3	75
04/18/94	QCWF	372	12.4	8.9	7.4	630	0.690	0.055	1	76
11/04/92	ACLD	305	8.7	2.4	7.3	46	1.10	0.081	2	79
12/08/92	ACLD	325	4.3	3.9	7.0	120	2.70	0.087	1	80
01/13/93	ACLD	180	0.2	5.9	7.3	18	3.20	0.057	0.5	34
02/02/93	ACLD	192	4.5	5.3	7.2	2	3.60	0.071	0.5	93
03/03/93	ACLD	199	7.2	4.8	7.2	33	2.80	0.070	0.5	62
04/06/93	ACLD	196	8.1	3.5	7.3	8	2.10	0.059	7	65
11/04/93	ACLD	319	9.0	4.2	7.1	32	2.00	0.094	4	67
12/06/93	ACLD	258	3.5	6.6	7.1	4	4.60	0.150	2	83
01/13/94	ACLD	345	9.0	3.3	7.1	9	4.00	0.110	0.5	71
02/09/94	ACLD	336	3.2	5.1	7.1	22	3.00	0.088	0.5	71
03/07/94	ACLD	337	6.6	7.6	7.2	7	3.60	0.090	2	67
04/13/94	ACLD	384	10.1	3.5	7.0	21	2.10	0.110	0.5	74
11/07/94	ACLD	179	7.8	6.3	6.8	630	0.420	0.140	1	64
12/05/94	ACLD	204	1.4	8.4	6.8	20	2.90	0.087	66	89
01/10/95	ACLD	241	5.6	6.8	6.5	240	2.50	0.093	2	62
02/09/95	ACLD	120	5.7	4.8	6.8	51	2.50	0.059	2	69
03/08/95	ACLD	144	6.3	4.6	6.8	90	2.00	0.061	4	63

Sampe Date	Station ID	Cond (μmhos/cm)	Temp (°C)	DO (mg/L)	pH (units)	FC (#/100 mL)	NO_2/NO_3 (mg/L)	TP (mg/L)	TSS (mg/L)	HARD (mg/L)
04/06/95	ACLD	172	9.4	4.3	7.2	18	1.40	0.055	0.5	62
11/06/95	ACLD	-	5.7	4.0	6.9	40	1.30	0.048	7	-
12/13/95	ACLD	257	8.5	5.5	6.7	190	2.70	0.170	0.5	-
01/03/96	ACLD	357	8.8	3.3	6.8	43	3.30	0.098	0.5	-
02/07/96	ACLD	268	6.6	8.5	6.6	-	2.90	0.150	10	-
03/04/96	ACLD	369	5.8	4.4	6.8	15	3.40	0.120	1	-
04/03/96	ACLD	356	7.3	5.5	6.8	50	1.70	0.099	3	-
11/04/92	ACLU	341	8.7	5.8	7.5	2	0.490	0.190	0.5	73
12/08/92	ACLU	345	4.7	5.7	7.0	900	0.580	0.190	3	79
01/13/93	ACLU	124	0.4	7.9	7.3	40	0.880	0.095	0.5	28
02/02/93	ACLU	162	4.4	7.3	7.1	24	1.30	0.100	0.5	79
03/03/93	ACLU	181	7.8	7.1	7.4	1500	0.720	0.280	2	68
04/06/93	ACLU	180	8.1	6.2	7.6	1200	0.530	0.120	2	64
11/04/93	ACLU	366	8.6	8.7	7.5	420	0.600	0.160	1	76
12/06/93	ACLU	351	3.5	7.9	7.0	8600	1.60	0.400	6	88
01/13/94	ACLU	268	8.8	5.4	7.1	320	1.70	0.240	0.5	72
02/09/94	ACLU	232	2.7	9.6	6.8	68	0.920	0.110	0.5	63
03/07/94	ACLU	228	6.3	10.7	7.1	14000	2.00	0.240	0.5	65
04/13/94	ACLU	356	8.8	9.1	7.4	340	1.00	0.160	0.5	76
11/07/94	ACLU	208	6.1	8.7	6.6	550	0.470	0.180	5	80
12/05/94	ACLU	192	2.0	9.6	6.2	420	0.620	0.150	0.5	79
01/10/95	ACLU	177	4.9	9.1	6.6	964	0.910	0.230	2	65
02/09/95	ACLU	151	5.7	9.2	6.8	1154	0.770	0.100	0.5	64
03/08/95	ACLU	100	6.7	10.5	6.9	29	0.660	0.110	5	55
04/06/95	ACLU	152	8.3	10.4	7.2	1600	0.440	0.110	5	63
11/06/95	ACLU	295	5.9	9.7	7.0	750	0.240	0.110	0.5	-
12/13/95	ACLU	262	8.2	7.0	6.8	200	2.50	0.210	7	-
01/03/96	ACLU	285	8.4	7.9	6.7	300	1.90	0.130	0.5	-
02/07/96	ACLU	294	6.4	6.4	6.7	-	2.00	0.250	8	-
03/04/96	ACLU	285	6.1	10.9	6.9	118	0.940	0.100	7	-
04/03/96	ACLU	334	6.9	10.3	7.0	6000	0.520	0.084	4	-
11/16/93	ACMC	355	8.0	10.2	7.4	810	1.60	0.040	0.5	94
12/01/93	ACMC	373	8.4	12.3	7.3	730	1.20	0.100	34	72
12/15/93	ACMC	428	7.6	8.0	6.8	31	5.00	0.047	10	71
12/28/93	ACMC	316	3.2	10.0	7.1	44	3.00	0.035	2	86
01/20/94	ACMC	289	5.5	9.4	7.3	36	3.00	0.035	0.5	74
01/31/94	ACMC	310	3.9	9.8	7.3	150	3.30	0.035	8	68
02/23/94	ACMC	204	6.0	9.5	7.2	68	3.10	0.054	13	61
03/15/94	ACMC	265	9.2	10.2	7.3	270	2.70	0.035	4	74
03/31/94	ACMC	268	9.9	9.3	7.0	89	2.90	0.037	2	90
04/18/94	ACMC	375	11.8	8.9	7.5	97	2.10	0.014	4	77
11/16/93	ACMS	304	7.9	11.2	-	90	2.10	0.160	0.5	82
12/01/93	ACMS	325	7.5	11.4	7.4	720	3.10	0.200	13	96
12/15/93	ACMS	232	7.7	9.4	7.1	48	5.10	0.490	37	30
12/28/93	ACMS	312	3.3	10.0	7.1	220	3.30	0.081	5	82
01/20/94	ACMS	334	6.1	8.8	7.1	570	4.00	0.140	7	74
01/31/94	ACMS	309	3.9	9.8	7.4	150	4.00	0.110	11	79
02/23/94	ACMS	276	6.0	9.1	7.3	380	4.20	0.260	21	65
03/15/94	ACMS	274	9.1	10.8	7.4	61	3.20	0.091	7	81
03/31/94	ACMS	265	10.0	9.4	7.3	76	3.00	0.000	0.5	69
04/18/94	ACMS	384	11.1	8.7	7.6	173	2.80	0.067	0.5	81
11/16/93	ACNF	295	6.6	7.2	7.2	18	0.470	0.380	0.5	78
12/01/93	ACNF	470	7.6	7.5	7.0	430	3.60	0.280	7	95
12/15/93	ACNF	385	7.4	5.8	6.8	29	6.70	0.670	0.5	110
12/28/93	ACNF	344	1.9	9.3	7.2	820	3.50	0.130	24	91
01/20/94	ACNF	357	5.3	7.4	7.0	22	4.60	0.180	0.5	93
01/31/94	ACNF	350	2.9	8.7	7.1	300	5.10	0.200	50	88
02/23/94	ACNF	337	5.7	8.1	7.2	490	5.70	0.480	4	110
03/15/94	ACNF	160	8.3	9.7	7.3	300	3.70	0.160	1	79
03/31/94	ACNF	298	9.5	9.0	7.0	60	3.10	0.120	1	79
04/18/94	ACNF	378	10.8	8.4	7.4	20	3.10	0.120	0.5	85

Sampe Date	Station ID	Cond (μmhos/cm)	Temp (°C)	DO (mg/L)	pH (units)	FC (#/100 mL)	NO_2/NO_3 (mg/L)	TP (mg/L)	TSS (mg/L)	HARD (mg/L)
11/16/93	ACSF	355	6.8	10.9	7.2	190	0.600	0.069	5	81
12/01/93	ACSF	265	.	11.4	7.3	120	2.00	0.083	16	81
12/15/93	ACSF	221	7.5	8.6	6.9	43	4.00	0.051	5	63
12/28/93	ACSF	304	2.8	10.3	7.1	17	1.80	0.079	100	87
01/20/94	ACSF	322	5.0	9.0	7.0	1700	2.40	0.120	10	66
01/31/94	ACSF	261	3.0	9.7	7.4	190	2.60	0.073	12	64
02/23/94	ACSF	205	5.6	10.0	7.3	29	2.30	0.130	11	73
03/15/94	ACSF	234	8.8	10.8	7.2	310	1.70	0.098	10	96
03/31/94	ACSF	266	9.7	10.1	6.9	370	1.50	0.140	4	74
04/18/94	ACSF	325	10.9	9.5	7.4	300	1.30	0.066	0.5	71
10/31/95	PUMP	309	7.5	2.9	6.0	10	1.20	0.081	9	.
11/15/95	PUMP	311	10.6	2.4	6.2	140	0.940	0.083	0.5	.
12/07/95	PUMP	86	5.2	7.3	6.2	1	0.250	0.041	91	.
12/20/95	PUMP	388	7.5	4.7	6.3	370	1.10	0.200	20	.
01/10/96	PUMP	292	7.9	5.7	6.5	380	1.10	0.032	33	.
02/13/96	PUMP	66	5.8	10.6	6.4	1600	0.340	0.017	120	.
02/28/96	PUMP	217	3.4	10.9	6.8	909	0.750	0.076	41	.
03/13/96	PUMP	313	9.3	3.9	5.8	32	1.10	0.052	4	.
03/27/96	PUMP	181	9.2	5.3	6.3	33	0.210	0.036	4	.
11/15/94	FCDD	248	8.4	6.2	6.5	300	4.20	0.094	13	67
11/28/94	FCDD	136	6.3	7.6	6.5	44	3.20	0.051	6	66
12/12/94	FCDD	133	5.3	7.8	6.3	260	2.50	0.019	2	71
01/17/95	FCDD	134	6.5	.	6.4	12	5.40	0.075	6	.
01/30/95	FCDD	161	7.9	8.0	6.2	90	2.70	0.090	11	60
02/16/95	FCDD	146	5.2	8.3	6.7	118	1.60	0.056	10	60
02/28/95	FCDD	154	5.0	9.3	6.4	240	1.50	0.026	16	60
03/15/95	FCDD	.	8.3	9.9	6.6	154	2.90	0.052	7	44
03/27/95	FCDD	159	7.0	8.5	6.6	240	1.60	0.070	6	56
04/12/95	FCDD	62	9.2	7.3	6.5	520	0.990	0.081	6	55
11/01/93	FCLD	162	7.7	12.8	7.6	61	0.820	0.027	2	48
12/09/93	FCLD	156	6.3	12.8	6.9	34	2.40	0.026	5	36
01/12/94	FCLD	158	7.3	9.1	6.9	36	2.50	0.019	4	34
02/07/94	FCLD	154	2.5	11.3	7.3	71	2.00	0.017	0.5	39
03/10/94	FCLD	110	7.1	12.1	7.2	30	2.00	0.020	2	44
04/14/94	FCLD	168	9.2	10.2	6.9	22	1.40	0.018	2	34
11/10/94	FCLD	126	8.1	12.3	7.2	320	0.780	0.051	7	29
12/08/94	FCLD	50	13.8	13.8	6.8	101	1.40	0.024	4	27
01/09/95	FCLD	75	4.5	15.3	6.6	200	1.60	0.031	2	24
02/08/95	FCLD	68	6.0	12.4	7.0	24	1.50	0.019	6	24
03/06/95	FCLD	75	4.5	12.6	6.8	60	1.10	0.016	3	23
04/04/95	FCLD	.	9.4	10.9	6.8	350	0.820	0.027	12	27
11/07/95	FCLD	342	7.8	5.1	6.6	1818	1.60	0.062	29	.
12/12/95	FCLD	173	5.9	9.1	6.8	11000	1.10	0.041	120	.
01/04/96	FCLD	218	6.2	10.4	6.6	500	1.90	0.044	38	.
02/06/96	FCLD	238	4.7	9.6	6.4	160	2.00	0.046	26	.
03/06/96	FCLD	438	7.3	3.2	6.3	1509	0.840	0.063	38	.
04/02/96	FCLD	337	8.9	8.4	6.4	1500	0.980	0.088	22	.
10/31/95	FCMS	.	5.9	8.6	6.4	70	1.10	0.035	3	.
11/15/95	FCMS	259	10.3	6.9	6.0	70	2.30	0.100	11	.
12/07/95	FCMS	188	5.0	8.8	6.8	30	0.890	0.098	7	.
12/20/95	FCMS	436	7.1	7.2	6.7	6400	1.10	0.053	2	.
01/10/96	FCMS	222	7.5	8.2	6.4	7600	1.60	0.140	12	.
02/13/96	FCMS	121	5.2	11.0	6.2	1100	0.530	0.018	29	.
02/28/96	FCMS	190	4.8	10.1	6.7	800	0.440	0.061	400	.
03/13/96	FCMS	135	9.0	8.1	6.2	100	0.610	0.087	23	.
03/27/96	FCMS	544	7.3	9.0	6.6	1000	0.440	0.650	49	.
11/01/93	FCLU	119	7.8	13.1	7.7	200	.	0.021	1	39
12/09/93	FCLU	108	6.1	13.4	6.9	32	2.10	0.017	13	37
01/12/94	FCLU	101	7.0	9.7	6.8	8	2.30	0.018	2	44
02/07/94	FCLU	111	2.7	11.2	7.2	7	1.80	0.014	2	39
03/10/94	FCLU	96	7.0	12.4	7.3	11	1.90	0.012	1	40

Sampe Date	Station ID	Cond (umhos/cm)	Temp (°C)	DO (mg/L)	pH (units)	FC (#/100 mL)	NO_2/NO_3 (mg/L)	TP (mg/L)	TSS (mg/L)	HARD (mg/L)
04/14/94	FCLU	142	9.2	11.3	6.9	20	1.40	0.013	0.5	37
11/10/94	FCLU	117	7.9	12.3	7.1	55	0.710	0.053	5	24
12/08/94	FCLU	53	3.9	14.4	6.9	63	1.20	0.021	4	22
01/09/95	FCLU	69	5.0	15.5	6.6	28	1.50	0.011	0.5	21
02/08/95	FCLU	69	6.6	12.5	6.8	26	1.40	0.009	2	21
03/06/95	FCLU	62	5.0	13.0	6.7	14	1.00	0.012	2	18
04/04/95	FCLU	-	9.7	11.2	6.8	330	0.810	0.020	8	22
11/07/95	FCLU	134	6.7	12.0	6.9	740	0.620	0.035	10	-
12/12/95	FCLU	111	7.1	11.6	6.3	1	1.60	0.015	6	-
01/04/96	FCLU	103	6.3	12.5	6.8	170	1.50	0.039	18	-
02/06/96	FCLU	120	4.2	13.6	5.7	190	1.30	0.034	30	-
03/06/96	FCLU	122	5.8	12.0	6.6	20	1.10	0.013	2	-
04/02/96	FCLU	115	7.1	13.3	7.2	88	0.650	0.025	2	-
10/31/95	LH1	222	3.8	11.8	6.4	740	1.80	0.012	0.5	-
11/15/95	LH1	188	10.0	9.5	6.5	40	3.20	0.047	36	-
12/07/95	LH1	167	4.9	11.5	6.7	10	3.70	0.019	7	-
12/20/95	LH1	164	6.8	12.3	6.7	20	3.20	0.023	5	-
01/10/96	LH1	155	7.5	10.6	6.5	75	3.10	0.014	9	-
02/13/96	LH1	156	6.7	10.5	6.8	20	2.70	0.014	6	-
02/28/96	LH1	164	2.1	13.7	6.7	69	2.40	0.010	35	-
03/13/96	LH1	184	7.0	12.3	6.9	152	1.80	0.026	1	-
03/27/96	LH1	185	8.1	11.6	7.0	55	1.50	0.026	0.5	-
10/31/95	LH2	220	3.8	11.8	6.9	36	1.50	0.027	5	-
11/15/95	LH2	185	10.0	9.7	6.6	50	2.40	0.039	3	-
12/07/95	LH2	185	4.6	11.9	6.3	20	4.00	0.024	6	-
12/20/95	LH2	187	6.4	12.6	6.2	110	3.80	0.029	7	-
01/10/96	LH2	159	7.5	11.3	6.9	44	4.10	0.016	9	-
02/13/96	LH2	166	6.2	11.1	6.9	30	3.10	0.019	13	-
02/28/96	LH2	184	2.6	12.1	6.8	97	2.50	0.009	5	-
03/13/96	LH2	207	7.5	12.8	7.5	13	2.00	0.029	6	-
03/27/96	LH2	214	7.1	13.4	7.0	10	1.70	0.030	2	-
11/15/95	CCH2	212	9.8	6.9	6.5	60	0.860	0.047	6	-
12/07/95	CCH2	209	5.0	8.5	6.7	20	1.30	0.048	5	-
12/20/95	CCH2	213	7.3	8.5	6.7	172	1.40	0.110	14	-
01/10/96	CCH2	209	8.0	8.8	6.4	100	1.30	0.040	0.5	-
02/13/96	CCH2	204	5.1	9.9	6.8	10	1.30	0.046	2	-
02/28/96	CCH2	227	4.0	9.5	6.8	13	1.10	0.031	3	-
03/13/96	CCH2	230	9.7	8.4	6.8	12	0.780	0.060	3	-
03/27/96	CCH2	276	7.8	9.3	7.0	25	0.760	0.066	9	-
11/16/94	CCLS	107	5.6	13.7	6.7	400	1.10	0.039	4	25
11/30/94	CCLS	46	7.8	15.4	6.9	680	1.40	0.068	18	20
12/13/94	CCLS	68	2.4	12.5	7.2	0	1.20	0.024	2	29
01/18/95	CCLS	60	6.1	14.0	6.8	35	1.30	0.010	7	21
02/01/95	CCLS	51	8.1	11.6	6.5	58	1.30	0.024	3	18
02/13/95	CCLS	84	1.9	13.7	7.3	11	1.40	0.021	2	28
03/01/95	CCLS	85	2.6	15.4	6.8	4	1.30	0.017	3	24
03/14/95	CCLS	-	8.8	12.0	6.6	145	1.30	0.009	25	18
03/29/95	CCLS	53	6.3	12.8	7.0	16	1.30	0.026	0.5	25
04/11/95	CCLS	28	7.8	11.6	7.3	135	0.710	0.037	3	23
11/16/94	CCUS	26	5.7	11.6	6.8	220	0.910	0.043	0.5	26
11/30/94	CCUS	42	7.9	12.7	6.7	200	1.60	0.035	13	21
12/13/94	CCUS	80	3.0	11.5	6.9	11	1.20	0.034	0.5	28
01/18/95	CCUS	67	6.3	13.8	6.9	58	1.40	0.022	3	22
02/01/95	CCUS	70	8.0	10.8	6.8	18	1.50	0.018	5	20
02/13/95	CCUS	99	2.7	12.6	6.9	1	1.40	0.021	3	28
03/01/95	CCUS	78	4.2	13.9	6.6	22	1.30	0.006	0.5	24
03/14/95	CCUS	-	8.1	11.2	6.7	340	0.980	0.010	4	18
03/29/95	CCUS	48	7.9	12.0	6.8	2	1.30	0.015	2	27
04/11/95	CCUS	40	8.2	10.8	7.2	61	0.850	0.026	7	22
10/31/95	FL1	470	7.8	4.7	6.8	160	0.054	0.062	6	-

Sampe Date	Station ID	Cond (μ mhos/cm)	Temp (°C)	DO (mg/L)	pH (units)	FC (#/100 mL)	NO_2/NO_3 (mg/L)	TP (mg/L)	TSS (mg/L)	HARD (mg/L)
11/15/95	FL1	37	11.5	5.8	6.7	60	0.440	0.058	34	-
12/07/95	FL1	420	8.6	6.8	7.0	30	0.950	0.057	9	-
12/20/95	FL1	442	9.4	7.4	7.0	270	0.760	0.070	8	-
01/10/96	FL1	386	9.9	6.8	7.0	10	0.630	0.033	7	-
02/13/96	FL1	458	7.7	6.5	7.0	30	0.690	0.013	25	-
02/28/96	FL1	476	5.6	7.8	6.9	10	0.150	0.033	11	-
03/13/96	FL1	474	10.6	7.0	7.1	1	0.044	0.091	9	-
03/27/96	FL1	482	10.8	8.2	7.1	7	-	0.084	20	-
10/31/95	FL2	382	9.4	5.9	6.6	60	1.90	0.011	3	-
11/15/95	FL2	283	12.0	5.8	6.5	300	2.10	0.027	12	-
12/07/95	FL2	383	9.5	6.6	6.8	10	2.60	0.013	5	-
12/20/95	FL2	404	10.2	7.1	6.7	9700	2.50	0.021	2	-
01/10/96	FL2	370	10.1	6.8	6.8	30	2.40	0.010	0.5	-
02/13/96	FL2	420	9.2	8.0	6.9	30	2.40	0.013	0.5	-
02/28/96	FL2	420	6.5	9.1	6.9	65	2.30	0.014	1	-
03/13/96	FL2	422	10.4	9.3	7.0	24	2.00	0.024	2	-
03/27/96	FL2	426	11.0	9.8	6.9	20	1.90	0.025	3	-
10/31/95	FL3	321	6.4	7.5	6.3	320	2.20	0.053	14	-
11/15/95	FL3	324	11.1	7.7	6.5	60	2.60	0.027	68	-
12/07/95	FL3	314	8.1	8.0	6.8	10	2.90	0.015	45	-
12/20/95	FL3	382	9.7	9.1	6.8	20	2.50	0.079	47	-
01/10/96	FL3	361	9.4	7.9	6.8	50	1.90	0.003	200	-
02/13/96	FL3	341	9.5	8.7	6.8	60	2.40	0.012	36	-
02/28/96	FL3	450	7.9	9.6	7.1	10	2.00	0.092	8	-
03/13/96	FL3	353	9.4	9.9	6.9	120	2.70	0.034	3	-
03/27/96	FL3	368	11.2	12.1	6.9	100	2.70	0.039	7	-
11/14/94	STLS	71	8.2	12.5	-	56	1.10	0.035	3	-
11/29/94	STLS	92	6.5	13.1	6.8	7	1.60	0.017	2	-
12/14/94	STLS	75	4.1	12.8	7.0	59	1.40	0.034	110	-
01/19/95	STLS	55	6.4	14.0	6.9	24	1.40	-	3	-
01/31/95	STLS	62	8.9	10.6	6.9	8	1.00	-	9	-
02/14/95	STLS	75	2.8	13.0	6.7	183	1.20	0.023	2	-
02/27/95	STLS	100	6.9	11.4	6.7	20	1.10	0.007	2	-
03/13/95	STLS	-	8.3	11.6	6.7	77	1.30	-	4	20
03/28/95	STLS	76	9.6	11.5	6.9	14	1.20	-	2	-
04/10/95	STLS	64	9.1	11.6	7.1	59	0.680	0.008	2	-
11/14/94	STUS	50	7.9	11.5	6.7	71	0.980	0.034	7	-
11/29/94	STUS	67	6.3	13.0	6.7	15	1.30	0.016	4	-
12/14/94	STUS	71	4.1	12.1	7.0	49	1.10	0.015	2	-
01/19/95	STUS	47	5.9	15.7	6.9	14	1.10	0.010	0.5	-
01/31/95	STUS	57	8.4	10.5	6.9	610	0.830	0.014	7	-
02/14/95	STUS	74	2.9	13.0	6.6	97	0.910	0.018	5	-
02/27/95	STUS	83	5.9	11.5	6.6	15	1.00	0.019	2	-
03/13/95	STUS	-	8.0	10.9	6.8	32	1.20	0.012	6	18
03/28/95	STUS	60	9.4	11.9	6.8	23	1.10	0.011	2	-
04/10/95	STUS	71	8.6	10.9	7.3	12	0.580	0.022	12	-
11/16/94	TRUS	61	6.1	12.0	6.7	11	0.330	0.035	2	24
11/30/94	TRUS	10	7.8	9.9	6.0	22	0.910	0.022	3	16
12/13/94	TRUS	52	2.1	10.1	5.9	17	1.10	0.015	0.5	18
01/18/95	TRUS	44	5.6	12.5	5.8	14	1.20	0.014	3	14
02/01/95	TRUS	38	7.4	9.6	6.2	31	1.10	0.011	0.5	14
02/13/95	TRUS	47	3.2	11.4	6.0	2	1.20	0.013	0.5	16
03/01/95	TRUS	56	4.9	13.7	6.1	2	1.00	0.009	2	14
03/14/95	TRUS	-	7.9	10.5	6.2	25	1.50	0.009	0.5	11
03/29/95	TRUS	77	9.0	12.2	6.4	20	0.990	0.008	0.5	15
04/11/95	TRUS	37	8.7	11.9	6.6	9	0.560	0.011	0.5	14
11/01/93	WCMF	169	8.6	13.9	7.6	37	-	0.016	2	48
12/09/93	WCMF	142	6.4	13.0	6.8	43	1.70	0.022	8	28
01/12/94	WCMF	140	7.3	9.3	7.0	41	1.50	0.020	5	25
02/08/94	WCMF	115	1.7	11.3	7.2	9	1.10	0.017	3	32

Sampe Data	Station ID	Cond (umhos/cm)	Temp (°C)	DO (mg/L)	pH (units)	FC (#/100 mL)	NO_2/NO_3 (mg/L)	TP (mg/L)	TSS (mg/L)	HARD (mg/L)
03/10/94	WCMF	91	7.2	12.1	7.3	16	1.50	0.017	6	50
04/14/94	WCMF	112	7.9	11.4	7.3	15	1.10	0.012	3	39
11/10/94	WCMF	93	8.1	12.8	7.2	39	0.540	0.043	4	25
12/08/94	WCMF	58	4.5	14.1	7.1	21	0.720	0.023	4	21
01/09/95	WCMF	71	5.5	14.6	6.9	33	0.910	0.012	4	22
02/08/95	WCMF	62	5.7	12.6	6.8	21	0.960	0.013	0.5	22
03/07/95	WCMF	64	4.9	12.4	6.9	19	0.750	0.015	11	23
04/04/95	WCMF	-	9.6	11.0	6.9	260	0.700	0.017	5	26
11/07/95	WCMF	131	6.7	10.6	6.8	873	0.670	0.039	20	-
12/12/95	WCMF	83	7.4	11.3	6.8	20	0.750	0.025	9	-
01/04/96	WCMF	81	6.3	11.4	6.7	880	0.840	0.032	22	-
02/06/96	WCMF	91	4.2	13.9	6.7	100	0.660	0.027	9	-
03/06/96	WCMF	121	6.6	12.1	6.8	14	0.760	0.012	3	-
04/02/96	WCMF	81	7.4	12.3	7.3	68	0.530	0.026	3	-
11/01/93	WCWF	159	8.7	13.9	7.6	47	0.880	0.020	0.5	42
12/09/93	WCWF	150	6.3	13.0	7.2	62	1.40	-	4	31
01/12/94	WCWF	138	7.3	9.2	7.3	14	1.70	0.017	7	29
02/07/94	WCWF	120	3.4	10.4	7.4	20	1.60	0.020	2	38
03/10/94	WCWF	89	7.2	11.9	7.3	27	1.30	0.018	1	55
04/14/94	WCWF	124	7.9	11.2	7.2	16	1.10	0.010	3	38
11/10/94	WCWF	81	8.1	12.0	7.1	36	0.600	0.044	5	29
12/08/94	WCWF	55	4.3	12.9	7.0	27	0.990	0.020	5	23
01/09/95	WCWF	67	5.1	14.5	6.7	300	0.980	0.020	6	22
02/08/95	WCWF	52	5.9	12.1	6.9	49	1.00	0.010	4	24
03/07/95	WCWF	63	4.9	12.9	6.9	29	0.780	0.018	0.5	23
04/04/95	WCWF	-	9.5	10.8	6.9	73	0.690	0.021	11	26
11/07/95	WCWF	114	7.1	11.0	7.1	527	0.960	0.047	6	-
12/12/95	WCWF	86	7.1	9.5	6.6	30	1.10	0.022	21	-
01/04/96	WCWF	94	6.6	13.3	6.5	190	1.20	0.040	40	-
02/06/96	WCWF	87	3.4	13.9	6.7	230	0.830	0.019	34	-
03/06/96	WCWF	159	6.2	11.3	6.9	44	0.800	0.017	4	-
04/02/96	WCWF	111	7.5	11.9	7.0	100	0.540	0.027	14	-

Appendix E.2. Ecology wet season ambient water quality data.

Sample Data	Lab Number	Station ID	Time	Flow (cfs)	Cond (umhos/cm)	Temp (°C)	DO (mg/L)	FC (#/100 mL)	Cl (mg/L)	NH_3 (mg/L)	NO_2 (mg/L)	NO_2/NO_3 (mg/L)	Ortho P (mg/L)	TP (mg/L)	TPN (mg/L)	TSS (mg/L)	Turb (NTU)
2/13/96	96078080	PRDN	1135	877	57	5.6	12.2	26	2.30	0.01 U	0.01 UJ	0.713	0.01 U	0.030	0.872	21	9.9
2/13/96	96078081	PR4.2	1105	877	56	5.3	12.2	9	2.22	0.01 U	0.01 UJ	0.676	0.01 U	0.024	0.792	14	8.2
2/13/96	96078082	PR8.6	1035	676	58	5.3	12.3	4	1.79	0.01 U	0.01 UJ	0.540	0.01 U	0.020	0.651	21	12
2/13/96	96078083	PRUP	0855	507	50	4.9	12.3	6	1.24	0.01 U	0.01 UJ	0.334	0.01 U	0.01 U	0.386	7	6.2
2/13/96	96078084	LPDN	1000	52.9	58	4.3	12.1	20	2.54	0.01 U	0.01 UJ	1.09	0.01 U	0.012	1.59	2	1.4
2/13/96	96078085	CCDN	0945	47.7	75	5.2	11.9	9	3.59	0.016	0.01 UJ	0.468	0.012	0.032	0.861	5	2.3
2/13/96	96078086	DCDN	1025	50.2	58	4.6	12.8	11	2.57	0.01 U	0.01 UJ	1.16	0.01 U	0.011	1.41	5	2.6
2/13/96	96078087	WCDN	1410	300	60	6.5	12.0	13	-	0.011	0.01 UJ	0.925	0.01 U	0.031	1.22	18	8.5
2/13/96	96078088	WCMF	1345	143	53	6.6	12.2	7	-	0.01 U	0.01 UJ	0.772	0.01 U	0.020	0.909	12	7.3
2/13/96	96078089	WCWF	1320	136	59	5.9	12.1	4	-	0.010	0.01 UJ	1.05	0.01 U	0.027	1.47	18	10
2/13/96	96078090	WCUP	1250	49.8	47	5.9	11.8	2	-	0.01 U	0.01 UJ	0.413	0.01 U	0.010	0.555	5	3.5
2/13/96	96078091	MLDN	1515		233	8.1	4.8	140	-	0.677	0.021 J	3.55	0.079	0.359	6.26	17	23
2/13/96	96078092	MLUP	1500		210	9.0	7.0	310	-	0.643	0.031 J	3.15	0.058	0.190	5.30	22	17
2/13/96	96078094	*PRDN*	1150	877	60	5.7	12.1	11	2.30	0.014	0.01 UJ	0.677	0.01 U	0.032	1.09	21	10
2/27/96	96098080	PRDN	1145	596	69	4.0	12.8	7	2.41	0.019	0.01 U	0.698	0.01 U	0.016	0.821	8	3.7
2/27/96	96098081	PR4.2	1115	596	70	3.8	12.7	9	2.33	0.01 U	0.01 U	0.685	0.01 U	0.012	0.765	5	3.3
2/27/96	96098082	PR8.6	1040	464	60	3.5	13.0	4	1.94	0.01 U	0.01 U	0.608	0.01 U	0.01 U	0.644	4	3.0
2/27/96	96098083	PRUP	0900	349	43	2.8	13.0	4	1.32	0.01 U	0.01 U	0.362	0.01 U	0.01 U	0.404	4	3.3
2/27/96	96098084	LPDN	1010	34.7	59	2.7	12.4	49	2.52	0.01 U	0.01 U	0.878	0.01 U	0.014	0.979	2	2.0
2/27/96	96098085	CCDN	1000	31.4	83	4.5	12.4	13	3.61	0.018	0.01 U	0.428	0.01 U	0.028	0.809	3	2.2
2/27/96	96098086	DCDN	1030	33.0	58	3.0	13.2	6	2.53	0.01 U	0.01 U	1.00	0.01 U	0.014	1.13	3	2.6
2/27/96	96098093	WCDN	1415	204	55	4.4	12.6	8	-	0.012	0.01 U	0.821	0.01 U	0.019	0.947	8	5.5
2/27/96	96098088	WCMF	1340	97.7	54	4.7	12.8	4	-	0.01 U	0.01 U	0.734	0.01 U	0.012	0.829	5	3.5
2/27/96	96098089	WCWF	1325	91.7	54	4.1	12.6	9	-	0.01 U	0.01 U	0.889	0.01 U	0.021	0.987	10	7.0
2/27/96	96098090	WCUP	1300	34.4	47	4.2	12.4	1 U	-	0.01 U	0.01 U	0.388	0.01 U	0.01 U	0.488	2	1.8
2/27/96	96098091	MLDN	1550		240	6.6	5.8	250	-	0.898	0.023	2.31	0.107	0.077	4.32	19	25
2/27/96	96098092	MLUP	1515		180	6.5	8.1	29	-	0.434	0.018	2.34	0.052	0.124	3.57	53	36
2/27/96	96098094	*WCDN*	1400	204	54	4.4	12.6	13	-	0.015	0.01 U	0.838	0.01 U	0.017	0.923	8	5.4
3/12/96	96118080	PRDN	1050	900	42	7.1	11.7	15	1.42	0.01 U	0.01 U	0.329	0.01 U	0.036	0.505	26	17
3/12/96	96118081	PR4.2	1030	900	46	6.9	11.6	16	1.40	0.01 U	0.01 U	0.317	0.01 U	0.035	0.436	23	14
3/12/96	96118082	PR8.6	1010	693	40	6.4	12.0	9	1.13	0.01 U	0.01 U	0.275	0.01 U	0.031	0.363	22	14
3/12/96	96118083	PRUP	0845	520	36	5.9	12.1	3	0.867	0.01 U	0.01 U	0.193	0.01 U	0.025	0.266	13	9.6
3/12/96	96118084	LPDN	0940	54.3	60	8.7	10.7	56	2.55	0.01 U	0.01 U	0.557	0.01 U	0.030	0.787	2	2.4
3/12/96	96118085	CCDN	0930	48.9	80	7.8	11.4	69	3.63	0.012	0.01 U	0.311	0.01 U	0.033	0.741	3	2.5
3/12/96	96118086	DCDN	1000	51.5	53	7.9	11.2	22	2.49	0.01 U	0.01 U	0.630	0.01 U	0.022	0.810	3	2.9

SITE ID = Replicate sample for that survey.

\- = No analysis for that parameter.

J = The analyte was positively identified; the numerical result is an estimate.

U = The analyte was not detected at or above the detection limit shown.

UJ = The analyte was not detected at or above the estimated detection limit shown.

Sample Data	Lab Number	Station ID	Time	Flow (cfs)	Cond (umhos/cm)	Temp (°C)	DO (mg/L)	FC (#/100 mL)	Cl (mg/L)	NH_3 (mg/L)	NO_2 (mg/L)	NO_2/NO_3 (mg/L)	Ortho P (mg/L)	TP (mg/L)	TPN (mg/L)	TSS (mg/L)	Turb (NTU)
3/12/96	96118087	WCDN	1300	308	58	8.6	11.4	75	-	0.01 U	0.01 U	0.594	0.01 U	0.028	0.766	7	4.9
3/12/96	96118088	WCMF	1240	148	51	8.2	11.8	13	-	0.01 U	0.01 U	0.551	0.01 U	0.019	0.681	5	3.7
3/12/96	96118089	WCWF	1220	140	59	8.4	11.1	54	-	0.01 U	0.01 U	0.602	0.01 U	0.030	0.804	7	5.1
3/12/96	96118090	WCUP	1145	51.1	43	7.3	11.4	1	-	0.01 U	0.01 U	0.278	0.01 U	0.022	0.420	4	2.9
3/12/96	96118091	MLDN	1500		229	10.9	4.8	3000 J	-	0.896	0.021	1.28	0.094	0.129	2.91	14	24
3/12/96	96118092	MLUP	1440		195	9.9	6.2	1800 J	-	1.22	0.024	1.36	0.071	0.188	3.37	65	45
3/12/96	96118094	*MLDN*	1515		228	10.9	4.8	2900 J	-	0.882	0.022	1.26	0.079	0.094	3.02	14	26
3/26/96	96138080	PRDN	1200	236	73	6.6	12.2	6	2.37	0.01 U	0.01 U	0.440	0.01 U	0.01 U	0.572	3	1.7
3/26/96	96138081	PR4.2	1130	236	75	6.5	12.1	4	2.27	0.01 U	0.01 U	0.437	0.01 U	0.011	0.538	2	1.5
3/26/96	96138082	PR8.6	1100	193	70	6.2	12.4	3	1.94	0.01 U	0.01 U	0.403	0.01 U	0.01 U	0.476	1	1.3
3/26/96	96138083	PRUP	0915	148	60	4.9	12.4	2	1.14	0.01 U	0.01 U	0.212	0.01 U	0.01 U	0.259	1	1.1
3/26/96	96138084	LPDN	1030	11.5	75	6.3	11.7	2	2.76	0.01 U	0.01 U	0.544	0.01 U	0.022	0.765	1	1.1
3/26/96	96138085	CCDN	1015	10.7	93	7.9	12.2	31	3.83	0.01 U	0.01 U	0.161	0.01 U	0.024	0.472	3	1.7
3/26/96	96138086	DCDN	1045	11.1	60	5.4	12.1	5	2.50	0.01 U	0.01 U	0.537	0.01 U	0.016	0.711	1	1.4
3/26/96	96138087	WCDN	1415	82.6	80	7.7	12.6	8	-	0.01 U	0.01 U	0.597	0.01 U	0.01 U	0.701	2	1.8
3/26/96	96138088	WCMF	1345	39.4	71	7.7	11.8	3	-	0.01 U	0.01 U	0.628	0.01 U	0.01 U	0.736	2	1.4
3/26/96	96138089	WCWF	1330	35.4	76	7.5	11.9	3	-	0.01 U	0.01 U	0.568	0.01 U	0.011	0.675	2	1.8
3/26/96	96138090	WCUP	1300	14.8	62	6.7	11.5	1 U	-	0.01 U	0.01 U	0.349	0.01 U	0.017	0.427	2	1.8
3/26/96	96138091	MLDN	1520		240	9.2	6.3	1400	-	0.857	0.026	1.36	0.222	0.076	2.41	44	55
3/26/96	96138092	MLUP	1500		195	9.6	7.8	550	-	0.686	0.02	1.21	0.159	0.068	2.44	105	65
3/26/96	96138094	*PR4.2*	1115	236	73	6.5	12.3	11	2.29	0.01 U	0.01 U	0.435	0.01 U	0.01 U	0.543	2	1.6
4/9/96	96158080	PRDN	1130	470	58	11.9	10.4	25	1.88	0.01 U	0.01 U	0.309	0.01 U	0.01 U	0.488	6	4.4
4/9/96	96158081	PR4.2	1110	470	56	11.7	10.5	25	1.84	0.01 U	0.01 U	0.311	0.01 U	0.01 U	0.432	5	3.4
4/9/96	96158082	PR8.6	1030	370	50	10.9	10.7	40	1.58	0.01 U	0.01 U	0.285	0.01 U	0.01 U	0.372	5	3.8
4/9/96	96158083	PRUP	0850	279	38	10.0	10.8	2	1.08	0.01 U	0.01 U	0.173	0.01 U	0.01 U	0.298	3	2.3
4/9/96	96158084	LPDN	0940	26.6	61	13.6	9.6	15	2.39	0.01 U	0.01 U	0.373	0.01 U	0.01 U	0.571	1	1.7
4/9/96	96158085	CCDN	0930	29.3	75	14.2	9.9	69	3.41	0.01 U	0.01 U	0.206	0.01 U	0.028	0.687	6	2.7
4/9/96	96158086	DCDN	1015	27.9	58	12.1	10.4	16	2.46	0.01 U	0.01 U	0.499	0.01 U	0.01 U	0.629	2	2.2
4/9/96	96158087	WCDN	1400	148	60	12.6	11.0	160	-	0.01 U	0.01 U	0.483	0.01 U	0.01 U	0.660	6	4.1
4/9/96	96158088	WCMF	1340	70.5	50	12.3	10.8	25	-	0.01 U	0.01 U	0.534	0.01 U	0.01 U	0.678	4	2.4
4/9/96	96158089	WCWF	1315	65.7	60	12.1	10.6	12	-	0.01 U	0.01 U	0.489	0.01 U	0.01 U	0.671	5	3.8
4/9/96	96158090	WCUP	1240	25.4	49	11.0	10.5	5	-	0.01 U	0.01 U	0.260	0.01 U	0.01 U	0.409	2	1.8
4/9/96	96158091	MLDN	1515		245	15.2	5.8	1200	-	0.866	0.029	1.31	0.074	0.046	2.77	36	60
4/9/96	96158092	MLUP	1440		245	13.9	6.5	10000	-	2.63	0.031	1.03	0.145	0.166	5.21	33	34
4/9/96	96158094	*LPDN*	0955	26.6	60	13.6	9.6	27	-	0.01 U	0.01 U	0.375	0.01 U	0.01 U	0.610	2	1.7

SITE ID = Replicate sample for that survey.

- = No analysis for that parameter.

J = The analyte was positively identified; the numerical result is an estimate.

U = The analyte was not detected at or above the detection limit shown.

Appendix E.2. Ecology dry season ambient water quality data.

Sample Data	Lab Number	Station ID	Time	Flow (cfs)	Cond (umhos/cm)	Temp (°C)	DO (mg/L)	pH (units)	FC (#/100 mL)	CHLOR *a* (ug/L)	PHEO (ug/L)	Cl (mg/L)	NH_3 (mg/L)	NO_2 (mg/L)	NO_2/NO_3 (mg/L)	Ortho P (mg/L)	TP (mg/L)	TPN (mg/L)	TSS (mg/L)	TURB (NTU)
7/23/96	96308020	PRDN	1215	94.8	94	19.0	10.0	7.7	35	1.2	1.3	2.91	0.01 U	0.01 U	0.318	0.01 U	0.010	0.405	2	2.0
7/23/96	96308021	PR4.2	1130	94.8	91	17.9	10.0	7.7	53	-	-	2.83	0.01 U	0.01 U	0.324	0.01 U	0.01 U	0.395	2	1.6
7/23/96	96308022	PR8.6	1045	87.5	84	17.2	9.8	7.5	71	2.5	1.7	2.65	0.01 U	0.01 U	0.320	0.01 U	0.011	0.380	1	1.9
7/23/96	96308023	PRUP	0850	68.7	69	14.7	10.2	7.4	33	1.2	1.2	1.46	0.01 U	0.01 U	0.140	0.01 U	0.01 U	0.208	1	1.2
7/23/96	96308024	LPDN	1010	2.61	112	15.8	9.1	7.5	44	0.55	0.97	3.21	0.01 U	0.01 U	0.385	0.01 U	0.026	0.600	1 U	1.1
7/23/96	96308025	CCDN	0945	2.24	105	18.9	8.8	7.5	400	1.1	1.3	4.14	0.01 U	0.01 U	0.060	0.01 U	0.018	0.387	2	1.8
7/23/96	96308026	DCDN	1035	2.48	88	15.8	10.0	7.8	60	0.56	0.76	2.54	0.01 U	0.01 U	0.265	0.01 U	0.018	0.488	1 U	2.0
7/23/96	96308027	WCDN	1500	30.6	104	19.5	12.0	8.6	49	7.6	2.5	-	0.01 U	0.01 U	0.430	0.01 U	0.016	0.545	3	2.2
7/23/96	96308028	WCMF	1430	14.3	88	17.4	9.6	7.9	95	1.1	1.3	-	0.01 U	0.01 U	0.677	0.01 U	0.017	0.697 J	2	1.5
7/23/96	96308029	WCWF	1400	10.5	127	17.6	10.6	7.9	45	1.9	1.5	-	0.01 U	0.01 U	0.435	0.01 U	0.016	0.538	2	3.3
7/23/96	96308030	WCUP	1320	6.42	80	14.5	10.2	7.6	22	0.55	0.58	-	0.01 U	0.01 U	0.333	0.01 U	0.027	0.440	2	2.6
7/23/96	96308031	MLDN	1855		250	17.3	9.4	7.4	180	11.4	2.5	-	0.442	0.071	0.885	0.089	0.192	2.22	6	19
7/23/96	96308032	MLUP	1815		200	16.2	6.1	6.9	2100	0.68	7.5	-	0.560	0.023	0.786	0.119	0.317	2.10	30	45
7/23/96	96308033	PUMP	1720		238	21.4	8.1	6.9	1300	15.6	5.1	-	0.207	0.036	0.709	0.030	0.122	1.66	11	27
7/23/96	96308034	FCMS	1620		239	25.9	5.3	6.8	5700 J	4.7	5.2	-	0.663	0.054	0.357	0.047	0.152	2.11	12	38
7/23/96	96308035	*WCDN*	1515	30.6	103	19.5	12.1	8.6	76	4.7	2.3	-	0.01 U	0.01 U	0.431	0.01 U	0.020	0.539	2	1.8
8/6/96	96328020	PRDN	1645	97.9	57	17.7	9.9	7.4	140 J	-	-	1.87	0.01 U	0.01 U	0.300	0.01 U	0.01 U	0.458	4	3.3
8/6/96	96328021	PR4.2	1610	97.9	57	17.8	9.9	7.4	100	-	-	1.87	0.01 U	0.01 U	0.301	0.01 U	0.01 U	0.467	4	3.3
8/6/96	96328022	PR8.6	1545	89.6	54	17.2	9.9	7.6	100	-	-	1.80	0.01 U	0.01 U	0.307	0.01 U	0.01 U	0.457	3	2.4
8/6/96	96328023	PRUP	1400	70.4	47	15.3	10.3	7.5	68	-	-	1.21	0.01 U	0.01 U	0.233	0.01 U	0.01 U	0.352	1	2.4
8/6/96	96328024	LPDN	1505	2.89	111	17.3	9.6	7.4	180 J	-	-	3.33	0.01 U	0.01 U	0.244	0.01 U	0.014	0.460	1 U	1.3
8/6/96	96328025	CCDN	1450	2.48	104	18.7	8.9	7.5	23	-	-	4.26	0.01 U	0.01 U	0.073	0.01 U	0.014	0.338	1 U	1.2
8/6/96	96328026	DCDN	1530	2.77	86	16.8	9.8	7.7	130	-	-	2.59	0.01 U	0.01 U	0.232	0.01 U	0.01 U	0.444	1 U	1.1
8/6/96	96328027	WCDN	1130	32.0	100	13.7	11.1	7.5	180	-	-	-	0.01 U	0.01 U	0.396	0.01 U	0.013	0.559	3	2.4
8/6/96	96328028	WCMF	1215	15.0	83	14.3	10.8	7.6	160	-	-	-	0.01 U	0.01 U	0.567	0.01 U	0.011	0.744	1	2.1
8/6/96	96328029	WCWF	1235	11.2	120	14.3	10.3	7.5	310 J	-	-	-	0.01 U	0.01 U	0.438	0.01 U	0.016	0.601	1	1.7
8/6/96	96328030	WCUP	1255	6.64	72	12.8	10.3	7.4	68	-	-	-	0.01 U	0.01 U	0.274	0.01 U	0.012	0.469	1 U	5.4
8/6/96	96328031	MLDN	0850		237	14.9	5.5	7.0	1000	-	-	-	0.547	0.068	1.30	0.201	0.033	2.20	7	120
8/6/96	96328032	MLUP	0935		200	12.7	6.1	6.9	2000	-	-	-	0.822	0.029 J	0.729	0.332 J	0.057	2.15	13	25
8/6/96	96328033	PUMP	1015		233	15.0	6.5	7.1	320	-	-	-	0.200	0.035 J	0.521	0.085 J	0.019	1.27	4	18
8/6/96	96368034	FCMS	1050		209	17.1	3.5	6.8	1400	-	-	-	0.570	0.051 J	0.346	0.171 J	0.028	1.57	7	30
8/6/96	96368035	*FCMS*	1105		209	17.0	3.5	6.8	1500	-	-	-	0.582	0.050	0.342	0.176	0.092 J	1.48	5	31
8/20/96	96348020	PRDN	1620	82.4	95	18.0	10.6	7.3	16	0.76	0.82	3.31	0.01 U	0.01 U	0.237	0.01 U	0.019	0.498	1 U	0.5
8/20/96	96348021	PR4.2	1035	82.4	100	15.5	10.0	7.2	77	-	-	3.22	0.01 U	0.01 U	0.257	0.01 U	0.014	0.326	2	0.8
8/20/96	96348022	PR8.6	1010	77.9	96	15.1	10.1	7.2	75	1.3	1.2	3.09	0.01 U	0.01 U	0.262	0.01 U	0.018	0.323	1 U	0.5
8/20/96	96348023	PRUP	0750	61.8	88	13.3	10.1	7.2	48	1.0	1.3	1.54	0.01 U	0.01 U	0.055	0.01 U	0.01 U	0.094	1 U	0.5 U
8/20/96	96348024	LPDN	0915	1.48	119	14.1	9.2	7.2	400	0.46	0.89	3.31	0.01 U	0.01 U	0.279	0.01 U	0.018	0.456	1 U	0.9
8/20/96	96348025	CCDN	0900	1.27	109	16.1	9.6	7.3	41	0.38	0.86	4.28	0.01 U	0.01 U	0.055	0.01 U	0.016	0.324	1 U	0.5
8/20/96	96348026	DCDN	0950	1.28	99	14.0	9.9	7.4	83	0.45	0.69	2.91	0.01 U	0.01 U	0.233	0.01 U	0.015	0.373	1 U	0.5 U

SITE ID = Replicate sample for that survey.

\- = No analysis for that parameter.

J = The analyte was positively identified; the numerical result is an estimate.

U = The analyte was not detected at or above the detection limit shown.

Sample Date 1996	Lab Number	Station ID	Time	Flow (cfs)	Cond (umhos/cm)	Temp (°C)	DO (mg/L)	pH (units)	FC (#/100 mL)	CHLOR a (ug/L)	PHEO (ug/L)	Cl (mg/L)	NH_3 (mg/L)	NO_2 (mg/L)	NO_2/NO_3 (mg/L)	Ortho P (mg/L)	TP (mg/L)	TPN (mg/L)	TSS (mg/L)	TURB (NTU)
8/20/96	96348027	WCDN	1420	25.0	115	16.2	12.6	8.4	49	4.9	2.7	-	0.01 U	0.01 U	0.415	0.01 U	0.013	0.537	2	1.0
8/20/96	96348028	WCMF	1355	11.7	93	14.7	11.1	8.2	57	2.0	1.8	-	0.01 U	0.01 U	0.634	0.01 U	0.010	0.730	1	0.9
8/20/96	96348029	WCWF	1335	7.92	140	14.3	10.4	7.8	1200	0.75	1.1	-	0.01 U	0.01 U	0.488	0.018	0.017	0.602	1	1.4
8/20/96	96348030	WCUP	1255	5.53	78	12.2	10.3	7.7	27	LA	LA	-	0.01 U	0.01 U	0.354	0.016	0.013	0.439	1 U	1.8
8/20/96	96348031	MLDN	1740		239	19.3	14.5	7.5	84	12.0	7.7	-	0.129	0.059	1.02	0.070	0.144	1.68	5	13
8/20/96	96348032	MLUP	1650		200	14.1	5.9	7.3	290	0.59	5.6	-	0.502	0.026	0.698	0.066	0.230	1.59	17	30
8/20/96	96348033	PUMP	1515		233	19.7	10.3	7.1	260	35.4	5.4	-	0.053	0.030	0.580	0.025	0.091	1.16	8	17
8/20/96	96348034	FCMS	1145		261	17.0	4.9	7.0	120	77.0	18.3	-	0.481	0.076	0.423	0.042	0.132	1.89	13	65
8/20/96	96348035	*MLUP*	1705		203	14.0	5.8	7.0	290	0.81	4.7	-	0.509	0.026	0.689	0.050	0.245	1.55	12	28
9/3/96	96368020	PRDN	1525	76.1	95	16.2	10.2	7.8	360 J	-	-	2.85	0.01 U	0.01 U	0.297	0.01 U	0.017	0.403	3	3.4
9/3/96	96368021	PR4.2	1500	76.1	95	15.8	10.3	7.7	220	-	-	2.90	0.01 U	0.01 U	0.313	0.01 U	0.010	0.372	1 U	1.1
9/3/96	96368022	PR8.6	1435	73.2	90	15.4	10.0	7.6	260	-	-	2.79	0.01 U	0.01 U	0.328	0.01 U	0.011	0.413	1 U	1.1
9/3/96	96368023	PRUP	1305	58.2	78	13.4	10.3	7.8	110	-	-	1.26	0.01 U	0.01 U	0.082	0.01 U	0.011	0.139	1 U	1.6
9/3/96	96368024	LPDN	1355	0.91	115	14.1	9.0	7.4	2600	-	-	3.13	0.01 U	0.01 U	0.239	0.01 U	0.023	0.419	1 U	1.2
9/3/96	96368025	CCDN	1340	0.78	108	14.7	9.0	7.5	880 J	-	-	4.03	0.01 U	0.01 U	0.184	0.014	0.061	0.487	9	7.2
9/3/96	96368026	DCDN	1425	0.68	95	14.3	10.2	8.0	1600 J	-	-	2.28	0.01 U	0.01 U	0.268	0.01 U	0.020	0.419	1 U	2.2
9/3/96	96368027	WCDN	1105	22.3	105	14.6	10.0	7.7	270 J	-	-	-	0.030	0.01 U	0.495	0.018	0.042	0.703	3	3.5
9/3/96	96368028	WCMF	1135	10.4	89	13.6	10.3	7.9	110	-	-	-	0.01 U	0.01 U	0.723	0.01 U	0.018	0.809	1	1.6
9/3/96	96368029	WCWF	1150	6.62	125	13.7	10.0	7.8	180	-	-	-	0.01 U	0.01 U	0.452	0.01 U	0.022	0.531	1 U	3.5
9/3/96	96368030	WCUP	1225	5.08	82	10.8	10.0	7.4	33	-	-	-	0.01 U	0.01 U	0.509	0.01 U	0.022	0.574	1 U	1.6
9/3/96	96368031	MLDN	0840		210	16.5	8.0	7.5	48	-	-	-	0.130	0.046	1.43	0.056	0.134	1.95	4	9.8
9/3/96	96368032	MLUP	0915		175	12.1	6.2	6.9	130	-	-	-	0.347	0.035	0.977	0.195	0.226	1.83	19	33
9/3/96	96368033	PUMP	0950		200	16.6	6.0	7.0	310	-	-	-	0.025	0.017	0.524	0.046	0.101	1.32	10	19
9/3/96	96368034	FCMS	1030		190	17.6	4.0	6.9	120	-	-	-	0.164	0.038	0.500	0.071	0.113	1.18	3	32
9/3/96	96368035	*FCMS*	1045		189	17.7	4.0	6.9	96	-	-	-	0.160	0.039	0.500	0.066	0.076	1.27	3	31
9/24/96	96398020	PRDN	0930	231	60	9.9	11.0	7.5	43	0.49	0.65	1.88	0.01 U	0.01 U	0.378	0.01 U	0.033	0.472	6	4.6
9/24/96	96398021	PR4.2	1420	231	62	11.9	10.6	7.4	37	0.42	0.47	1.65	0.01 U	0.01 U	0.373	0.01 U	0.038	0.446	5	4.2
9/24/96	96398022	PR8.6	1400	190	56	11.6	10.6	7.3	17	0.40	0.32	1.53	0.01 U	0.01 U	0.380	0.01 U	0.041	0.420	3	3.0
9/24/96	96398023	PRUP	1245	145	50	10.5	11.0	7.4	39	0.47	0.31	0.996	0.01 U	0.01 U	0.313	0.01 U	0.030	0.377	2	2.1
9/24/96	96398024	LPDN	1335	11.2	93	11.7	LA	7.5	85	0.85	0.92	3.18	0.01 U	0.01 U	0.199	0.01 U	0.040	0.454	1 U	1.1
9/24/96	96398025	CCDN	1320	10.5	109	14.0	9.5	7.5	120	3.2	1.9	3.86	0.01 U	0.01 U	0.142	0.01 U	0.048	0.475	2	1.9
9/24/96	96398026	DCDN	1350	10.8	81	11.3	10.8	7.4	120	0.42	0.56	3.01	0.01 U	0.01 U	0.434	0.01 U	0.037	0.617	1 U	2.1
9/24/96	96398027	WCDN	1115	72.5	89	10.9	11.1	7.5	54	2.2	2.3	-	0.01 U	0.01 U	0.440	0.01 U	0.035	0.656	3	3.3
9/24/96	96398028	WCMF	1140	34.5	72	9.9	11.2	7.8	52	1.2	1.5	-	0.01 U	0.01 U	0.493	0.01 U	0.041	0.685	5	4.0
9/24/96	96398029	WCWF	1150	30.2	105	10.2	10.9	7.7	71	1.4 J	1.5 J	-	0.01 U	0.01 U	0.452	0.01 U	0.070	0.560	2	2.8
9/24/96	96398030	WCUP	1215	13.2	64	9.4	10.6	7.6	13	1.2	1.5	-	0.01 U	0.01 U	0.299	0.01 U	0.051	0.412	1	1.9
9/24/96	96398031	MLDN	0745		219	11.8	3.8	6.6	240	1.2	6.2	-	0.451	0.061	1.93	0.062	0.228	3.17	10	2.0
9/24/96	96398032	MLUP	0845		183	9.5	5.3	7.0	160	0.22	3.4	-	0.366	0.030	1.07	0.116	0.229	5.51	6	22
9/24/96	96398033	PUMP	1000		201	13.2	6.2	7.0	670	9.4	6.7	-	0.133	0.036	0.959	0.025	0.133 J	5.80	14	45
9/24/96	96398034	FCMS	1040		192	12.0	5.2	6.8	300	0.88	1.4	-	0.342	0.029	0.551	0.034	0.032	0.703 J	6	50
9/24/96	96398035	*MLUP*	0900		181	9.6	5.8	7.0	140	0.25	3.4	-	0.368	0.030	1.07	0.131	0.198	1.80	5	12

SITE ID = Replicate sample for that survey.

- = No analysis for that parameter.

J = The analyte was positively identified; the numerical result is an estimate.

U = The analyte was not detected at or above the detection limit shown.

LA = Lab accident; sample lost.