New Hampshire Volunteer River Assessment Program
2008 Cocheco River Watershed Water Quality Report

February 2009

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2008 Cocheco River Watershed Water Quality Report

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Cover Photo: Cocheco River, 12-CCH, Dover

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ACKNOWLEDGEMENTS

The New Hampshire Department of Environmental Services Volunteer River Assessment Program extends sincere thanks to the volunteers of the Cocheco River Watershed Coalition for their efforts during 2008. This report was created solely from the data collected by the volunteers listed below. Their time and dedication is an expression of their genuine concern for local water resources and has significantly contributed to our knowledge of river and stream water quality in New Hampshire.

2008 Cocheco River Watershed VRAP Volunteers

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1.0 INTRODUCTION

1.1. Purpose of Report

Each year the New Hampshire Volunteer River Assessment Program prepares and distributes a water quality report for each volunteer river monitoring group that is based solely on the water quality data collected by that group during a specific year. The reports summarize and interpret the data, particularly as they relate to New Hampshire's surface water quality standards, and serve as a teaching tool and guidance document for future monitoring activities by the individual volunteer groups.

1.2 Report Format

Each report includes the following:

- **Volunteer River Assessment Program Overview**

  This section includes a description of the history of VRAP, the technical support, training and guidance provided by NHDES, and how data is transmitted to the volunteers and used in surface water quality assessments.

- **Monitoring Program Description**

  This section provides a description of the volunteer group's monitoring program including monitoring objectives as well as a table and map showing sample station locations.

- **Results and Recommendations**

  Water quality data collected during the year are summarized on a parameter-by-parameter basis using: (1) a data summary table, which includes the number of samples collected, data ranges, the number of samples meeting New Hampshire water quality standards, and the number of samples adequate for water quality assessments at each station; (2) a discussion of the data; (3) a river graph showing the range of measured values at each station; and (4) a list of applicable recommendations.

  Sample results reported as less than the detection limit were assumed equal to one-half the detection limit on the river graphs. This approach simplifies the understanding of the parameter of interest, and specifically helps one to visualize how the river or watershed is functioning from upstream to downstream. In addition, this format allows the reader to better understand potential pollution areas and target those areas for additional sampling or environmental enhancements. Where applicable, the river graph also shows New Hampshire surface water quality standards or levels of concern for comparison purposes.

- **Appendix A – Water Quality Data**

  This appendix includes a spreadsheet detailing the data results and additional information such as data results which do not meet New Hampshire surface water quality standards, and data that are unusable for assessment purposes due to quality control requirements.

- **Appendix B – Interpreting VRAP Water Quality Parameters**

  This appendix provides a brief description of water quality parameters typically sampled by VRAP volunteers and their importance, as well as applicable state water quality criteria or levels of concern.

- **Appendix C – VRAP Volunteer Monitor Field Sampling Procedures Assessment *(Field Audits)***

  This appendix provides an overview of the VRAP Volunteer Monitor Field Sampling Procedures Assessment (field audit) process with respect to programmatic quality assurance/quality control (QA/QC) guidelines.

- **Appendix D – New Hampshire Watershed Report Cards**

  This appendix provides an overview of the New Hampshire Watershed Report Cards built from the 2008 305(b)/303(d) Surface Water Quality Reports.

- **Appendix E – Biological Data**

  This appendix includes a spreadsheet detailing biological data results including Order, common name, number of individuals found, group tolerance value, group biotic score, station biotic score, and narrative category.

- **Appendix F – Habitat Data**

  This appendix includes a spreadsheet detailing habitat data results such as surrounding land use, riparian habitat, in-stream characteristics, and erosion and other streamside impacts.

- **Appendix G – VBAP Sampling Methods**

  This appendix details sampling methods in association with the New Hampshire Volunteer Biological Assessment Program.

PROGRAM OVERVIEW

2.1 What is VRAP?

In 1998, the New Hampshire Volunteer River Assessment Program was established to promote awareness and education of the importance of maintaining water quality in New Hampshire's rivers and streams. VRAP aims to educate people about river and stream water quality and ecology and to improve water quality monitoring coverage for the protection of water resources.

Today, VRAP loans water quality monitoring equipment, provides technical support, and facilitates educational programs to volunteer groups on numerous rivers and watersheds throughout the state. VRAP volunteers conduct water quality monitoring on an ongoing basis and increase the amount of river water quality information available to local, state and federal governments, which allows for better watershed planning.

2.2 Why is VRAP Important?

VRAP establishes a regular volunteer-driven water sampling program to assist NHDES in evaluating water quality throughout the state. VRAP empowers volunteers with information about the health of New Hampshire's rivers and streams. Regular collection of water quality data allows for early detection of water quality changes allowing NHDES to trace potential problems to their source. Data collected by VRAP volunteers are directly contributing to New Hampshire's obligations under the Clean Water Act. Measurements taken by volunteers are used in assessing the water quality of New Hampshire's river and streams, and are included in reporting to the US Environmental Protection Agency.

2.3 How Does VRAP Work?

VRAP is a cooperative program between NHDES, river groups, local advisory committees, watershed associations, and individuals working to protect New Hampshire's rivers and streams. Volunteers are trained by VRAP staff in the use of water quality monitoring equipment at an annual training workshop. VRAP works with each group to establish monitoring stations and develop a sampling plan.

During the summer months, VRAP receives water quality data from trained volunteers. The data are reviewed for quality assurance, and are entered into the environmental monitoring database at NHDES. During the off-season, VRAP interprets the data and compiles the results into an annual report for each river. VRAP volunteers can use the data as a means of understanding the details of water quality, as well as guide future sampling efforts. NHDES can use the data for making surface water quality assessments, provided that the data met certain quality assurance/quality control guidelines.

2.4 What is VBAP?

The Volunteer Biological Assessment Program (VBAP) was established in 2005 to supplement biological data collected by the New Hampshire Department of Environmental Services Biomonitoring Unit. The Biomonitoring program regularly collects detailed biological data in order to complete water quality assessments of wadeable streams. VBAP serves to educate the public about water quality issues as interpreted through biological data, build a constituency of volunteers to practice sound water quality management at a local level, and build public support for water quality protection.

Since the program's establishment in 2005, VBAP has continued to work closely with watershed volunteers throughout New Hampshire providing technical assistance, field supervision, training in biological monitoring protocols, educational outreach, and annual biological data collection reports. In 2007, VBAP collaborated with the Volunteer River Assessment Program building greater strength and capability for the future.

2.5 Equipment and Sampling Schedule

VRAP frequently lends and maintains water quality monitoring equipment kits to VRAP groups throughout the state. The kits contain meters and supplies for routine water quality parameter measurements of turbidity, pH, dissolved oxygen, water temperature and specific conductance (conductivity). Other parameters such as nutrients, metals, and *E. coli* can also be studied, although VRAP does not always provide funds to cover laboratory analysis costs. Thus, VRAP encourages groups to pursue other fundraising activities such as association membership fees, special events, in-kind services (non-monetary contributions from individuals and organizations), and grant writing.

Each year, volunteers design and arrange a sampling schedule in cooperation with VRAP staff. Project designs are created through a review and discussion of existing water quality information, such as known and perceived problem areas or locations of exceptional water quality. The interests, priorities, and resources of the partnership determine monitoring locations, parameters, and frequency. VRAP typically recommends sampling every other week from May through September, and VRAP groups are encouraged to organize a long-term sampling program in order to begin to determine trends in river conditions.

2.6 Training and Technical Support

Each VRAP volunteer attends an annual training workshop to receive a demonstration of monitoring protocols and sampling techniques and the calibration and use of water quality monitoring equipment. During the training, volunteers have an opportunity for hands-on use of the equipment and receive instruction in the collection of samples for laboratory analysis. NHDES also provides equipment, supplies and staff support for VRAP groups participating in biological assessment activities.

VRAP groups conduct sampling according to a prearranged monitoring schedule and VRAP protocols. For groups participating in biological assessment, each station is sampled once annually during the month of September. VRAP staff aim to visit each group annually during a scheduled sampling event to verify that volunteers successfully follow the VRAP protocols (see Appendix C). If necessary, volunteers are re-trained during the visit, and the group's monitoring coordinator is notified of the result of the verification visit. VRAP groups forward water quality results to NHDES for incorporation into an annual report and state water quality assessment activities.

Groups participating in biological assessment activities attend two training sessions prior to sampling. The first training session provides information on the biological monitoring protocol and aquatic invertebrate identification. The second session provides instruction in field methods. An NHDES staff person assists volunteers with all biological assessment activities during the sampling period.

2.7 Data Usage

Annual Water Quality Reports

Water quality measurements repeated over time create a picture of the fluctuating conditions in rivers and streams and help to determine where improvements, restoration or preservation may benefit the river and the communities it supports. All data collected by volunteers are summarized in water quality reports that are prepared and distributed after the conclusion of the sampling period. VRAP groups can use the reports and data as a means of understanding the details of water quality, guiding future sampling efforts, or determining restoration activities.

New Hampshire Surface Water Quality Assessments

Along with data collected from other water quality programs, specifically the State Ambient River Monitoring Program, applicable volunteer data are used to support periodic NHDES surface water quality assessments. VRAP data are entered into NHDES's environmental monitoring database and are ultimately uploaded to the EPA database. Assessment results and the methodology used to assess surface waters are published by NHDES every two years (i.e., Section 305(b) Water Quality Reports) as required by the federal Clean Water Act. The reader is encouraged to log on to the NHDES web page to review the assessment methodology and list of impaired waters http://des.nh.gov/organization/divisions/water/wmb/swqa/index.htm/.

2.8 Quality Assurance/Quality Control

In order for VRAP data to be used in the assessment of New Hampshire's surface waters, the data must meet quality control guidelines as outlined in the VRAP Quality Assurance Project Plan (QAPP). The VRAP QAPP was approved by NHDES and reviewed by EPA in the summer of 2003. The QAPP is reviewed annually and is officially updated and approved every five years. The VRAP quality assurance/quality control (QA/QC) measures include a six-step approach to ensuring the accuracy of the equipment and consistency in sampling efforts.

- **Calibration:** Prior to each measurement, the pH and DO meters must be calibrated. Conductivity and turbidity meters are checked against a known standard before the first measurement and after the last one.

- **Replicate Analysis:** A second measurement by each meter is taken from the original sample at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the replicate analysis should be conducted at different stations. Replicates should be measured within 15 minutes of the original measurements.

- **6.0 pH Standard:** A reading of the pH 6.0 buffer is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the 6.0 pH standard check should be conducted at different stations.

- **Zero Oxygen Solution:** A reading of a zero oxygen solution is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the zero oxygen standard check should be conducted at different stations.

- **DI (De-Ionized) Turbidity Blank**: A reading of the DI blank is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the blank check should be conducted at different stations.

- **End of the Day Conductivity and Turbidity Meter Check:** At the conclusion of each sampling day, the conductivity and turbidity meters are re-checked against a known standard.

2.8.1 Measurement Performance Criteria

Precision is calculated for field and laboratory measurements through measurement replicates (instrumental variability) and is calculated for each sampling day. The use of VRAP data for assessment purposes is contingent on compliance with a parameter-specific relative percent difference (RPD) as derived from equation 1, below. Any data exceeding the limits of the individual measures are disqualified from surface water quality assessments. All data that exceeds the limits defined by the VRAP QAPP are acknowledged in the data tables with an explanation of why the data was unusable. Table 1 shows typical parameters studied under VRAP and the associated quality control procedures.

(Equation 1. Relative Percent Difference)

$$RPD = \frac{|x_1 - x_2|}{\frac{x_1 + x_2}{2}} \times 100 \%$$

where x_1 is the original sample and x_2 is the replicate sample

Table 1. Field Analytical Quality Controls

Water Quality Parameter	QC Check	QC Acceptance Limit	Corrective Action	Person Responsible for Corrective Action	Data Quality Indicator
Temperature	Measurement Replicate	RPD < 10% or Absolute Difference <0.8 C.	Repeat Measurement	Volunteer Monitors	Precision
Dissolved Oxygen	Measurement Replicate	RPD < 10%	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Precision
	Known Buffer (Zero O_2 Sol.)	RPD < 10% or Absolute Difference <0.4 mg/L	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Relative Accuracy
pH	Measurement Replicate	Absolute Difference <0.3 pH units	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Precision
	Known Buffer (pH = 6.0)	± 0.1 std units	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Accuracy
Specific Conductance	Measurement Replicate	RPD < 10% or Absolute Difference <5µS/cm	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Precision
	Method Blank (Zero Air Reading)	± 5.0 µS/cm	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Accuracy
Turbidity	Measurement Replicate	RPD < 10% or Absolute Difference <1.0 NTU	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Precision
	Method Blank (DI Water)	± 0.1 NTU	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Accuracy
Laboratory Parameters	Measurement Replicate	RPD < 20% or Absolute Difference less than ½ the mean value of the parameter in NHDES's Environmental Monitoring Database	Repeat Measurement	Volunteer Monitors	Precision

3.0 METHODS

In 1999, volunteers from the Cocheco River Watershed Coalition began monitoring water quality in the Cocheco River watershed. The goal of this effort was to provide water quality data from the Cocheco River relative to surface water quality standards and to allow for the assessment of the river for support of aquatic life and primary contact recreation (swimming). The establishment of a long-term monitoring program allows for an understanding of the river's dynamics, or variations on a station-by-station and year-to-year basis. The data can also serve as a baseline from which to determine any water pollution problems in the river and/or watershed. The Volunteer River Assessment Program has provided field training, equipment, financial assistance, and technical assistance.

During 2008, volunteers were trained in sampling methods and conducted water quality monitoring at 54 stations in the Cocheco River watershed (Table 2). Stations IDs are designated using a number indicating the relative position of the station and a three-letter code to identify the waterbody name. The higher the station number the more upstream the station is in the watershed. All stations monitored during 2008 are designated as Class B waters.

Water quality monitoring was conducted from February through September. In-situ measurements of water temperature, air temperature, dissolved oxygen, pH, turbidity and specific conductance were taken using handheld meters. Samples for *E.coli* were taken using bottles supplied by the NHDES laboratory as well as the Rochester Wastewater Treatment Facility and were stored on ice during transport from the field to either lab. Samples taken for total phosphorus, and chloride were taken using bottles supplied by the NHDES laboratory and were stored on ice during transport from the field to the lab. Table 3 summarizes the parameters measured, laboratory standard methods, and equipment used.

In 2008, volunteers also conducted biological assessments in the Cocheco River watershed. The goal of this effort is to complete "screening" level investigations of aquatic macroinvertebrate communities inhabiting the Cocheco River and surrounding tributaries. Annual biological sampling at designated stations throughout the watershed can provide an indication of biological community condition, general water quality and overall watershed health as well as highlight changes that occur over time. The program serves to provide supplementary biological data to the NHDES Biomonitoring Program, enhancing state wide monitoring efforts and tracking potential problem areas needing further investigation. NHDES provides field training, equipment, financial assistance, and technical assistance.

Table 2. Sampling Stations for the Cocheco River Watershed, NHDES VRAP, 2008

Station ID & AUID	Class	Waterbody Name	Location	Town	Elevation *(Rounded to the Nearest 100 Feet)*
01-XCR NHRIV600030601-04	**B**	**Sunrise Lake Inlet**	Pinkham Road Bridge	Middleton	700
02-XCH NHRIV600030601-04	**B**	**Sunrise Lake Outlet**	Nicola Road Bridge	Middleton	700
01-XCH NHRIV600030601-05	**B**	**Tributary to Cocheco River**	Silver Street Bridge	Middleton	700
02-HAY NHRIV600030601-05	**B**	**Hayes Brook**	Middletown Road Bridge	New Durham	600
06-ELA NHRIV600030601-02	**B**	**Ela River**	Davis Cross Road Bridge	New Durham	600
30-CCH NHRIV600030601-05	**B**	**Cocheco River**	Middletown Road Bridge	New Durham	700
27-CCH NHRIV600030601-02	**B**	**Cocheco River**	Spring Street Bridge	Farmington	300
03-MAR NHRIV600030601-08	**B**	**Mad River**	River Street Bridge	Farmington	500
26-CCH NHRIV600030601-02	**B**	**Cocheco River**	Central Street Bridge	Farmington	300
25-CCH NHRIV600030601-09	**B**	**Cocheco River**	South Main/Route 153 Bridge	Farmington	300
01-DMS NHRIV600030601-07	**B**	**Dames Brook**	Route 75 Bridge	Farmington	300
23-CCH NHRIV600030603-01	**B**	**Cocheco River**	Watson Corner Road Bridge	Farmington	300
22U-CCH NHRIV600030603-01	**B**	**Cocheco River**	Pike Industries	Farmington	300
01F-RAT NHRIV600030603-04	**B**	**Rattlesnake Brook**	Behind Auto Shop	Farmington	300
22-CCH NHRIV600030603-06	**B**	**Cocheco River**	Little Falls Bridge	Rochester	200
21-CCH NHIMP600030603-01	**B**	**Cocheco River**	Route 202A Bridge	Rochester	200
20J-CCH NHIMP600030602-02	**B**	**Cocheco River**	Bridge Street Bridge	Rochester	200
19-CCH NHRIV600030603-08	**B**	**Cocheco River**	Route 125 Bridge	Rochester	200

01-AXE NHRIV600030602-03	**B**	**Axe Handle Brook**	Route 125 Bridge	Rochester	200
08-WIL NHRIV600030603-10	**B**	**Willow Brook**	100M Upstream from Portland Ave Bridge	Rochester	200
06-WIL NHRIV600030603-10	**B**	**Willow Brook**	Portland Street	Rochester	200
05T-WIL NHRIV600030603-10	**B**	**Willow Brook**	Prospect Street	Rochester	200
05G-WIL NHRIV600030603-10	**B**	**Willow Brook**	Winter Street at Adams Ave	Rochester	200
05-WIL NHRIV600030603-10	**B**	**Willow Brook**	Western Ave	Rochester	200
05-WIL-PIPE NHRIV600030608-08	**B**	**Willow Brook**	Stormwater Pipe on Downstream Side of 05-WOR	Rochester	200
04-WIL NHRIV600030608-08	**B**	**Willow Brook**	Franklin Street Just North of Main St	Rochester	200
02-WIL NHRIV600030603-10	**B**	**Willow Brook**	Lowell Street	Rochester	200
02-XWD NHRIV600030603-10	**B**	**Unknown Tributary to Willow Brook**	Lowell Street	Rochester	200
01M-WIL NHRIV600030603-10	**B**	**Willow Brook**	Meadow Lane	Rochester	200
01-WIL NHRIV600030603-10	**B**	**Willow Brook**	Old Dover Road Bridge	Rochester	200
18-CCH NHIMP600030607-02	**B**	**Cocheco River**	Maple Street Bridge	Rochester	200
12-CCH NHRIV600030608-03	**B**	**Cocheco River**	Strafford County Farm	Dover	100
02-REY NHRIV600030608-04	**B**	**Reyners Brook**	Sixth Street	Dover	100
11-CCH NHIMP600030608-02	**B**	**Cocheco River**	Watson Road Bridge	Dover	100
01-IBK NHRIV600030608-06	**B**	**Indian Brook**	Sixth Street	Dover	100
10-CCH NHRIV600030608-05	**B**	**Cocheco River**	Whittier Street Birdge	Dover	100
02-BRR NHRIV600030608-15	**B**	**Berry Brook**	Sixth Street Bridge	Dover	100

01-LIB No AUID at 1 to 100,000	**B**	**Library Spring**	Off of Locust Street	Dover	100
01-CDR No AUID at 1 to 100,001	**B**	**Cedar Brook**	Fourth Street	Dover	100
07-CCH NHIMP600030608-04	**B**	**Cocheco River**	Central Avenue Bridge	Dover	100
02-CKT No AUID at 1 to 100,000	**B**	**Cricket Brook**	Cobble Hill Spring	Dover	100
01-CKT No AUID at 1 to 100,000	**B**	**Cricket Brook**	Cricket Brook Apartments	Dover	100
03-WAR NHRIV600030608-08	**B**	**Warren Brook**	Somersworth Road	Rollinsford	100
02-WAR NHRIV600030608-08	**B**	**Warren Brook**	Rollins Road	Rollinsford	100
05-TWO NHRIV600030608-08	**B**	**Twombley Brook**	Green Street	Rollinsford	100
01-YTN NHRIV600030608-09	**B**	**Yeaton Brook**	Goodwin Road	Rollinsford	100
03-CLM NHRIV60030608-10	**B**	**Clement Brook**	Goodwin Road	Rollinsford	100
02-CLM NHRIV600030608-10	**B**	**Clement Brook**	Rollins Road	Rollinsford	100
01-RNB NHRIV600030608-10	**B**	**Rollins Brook**	Rollins Road	Rollinsford	100
03-TWO NHRIV600030608-08	**B**	**Twombley Brook**	Rollins Road	Rollinsford	100
04-FHC NHRIV600030608-11	**B**	**Fresh Creek**	Route 4 Bridge	Rollinsford	100
03-FHC NHRIV600030608-11	**B**	**Fresh Creek**	Old Mill Lane	Rollinsford	100
00-FHC NHLAK600030608-01	**B**	**Fresh Creek**	Gulf Road	Dover	100
01-KNX NHRIV600030903-08	**B**	**Knox Marsh Brook**	Downstream of Route 155 Bridge	Dover	100
01-JNC NHRIV600030902-13	**B**	**Johnson Creek**	Downstream of Spruce Lane	Dover	100

Table 3. Sampling and Analysis Methods

Parameter	Sample Type	Standard Method	Equipment Used	Laboratory
Temperature	In-Situ	SM 2550	YSI 95	------
Dissolved Oxygen	In-Situ	SM 4500 O G	YSI 85	------
pH	In-Situ	SM 4500 H+	Oakton pH 11	------
Turbidity	In-Situ	EPA 180.1	LaMotte 2020e	------
Specific Conductance	In-Situ	SM 2510	YSI 85	------
E.coli	Bottle (Sterile)	SM 19 9213 D.3	------	NHDES
	Bottle (Sterile)	EPA 1103.1	------	Rochester WWTF
Total Phosphorous	Bottle (w/Preservative)	EPA 365.3	------	NHDES
Chloride	Bottle	SM D512C	------	NHDES Limnology Center

4.0 RESULTS AND RECOMMENDATIONS

Results and recommendations for each monitored parameter are presented in the following sections. For a description of the importance of each parameter and pertinent water quality criteria for these and other parameters, please see Appendix B, *"Interpreting VRAP Water Quality Parameters."*

4.1 Dissolved Oxygen

Between one and five measurements were taken in the field for dissolved oxygen concentration at 29 stations in the Cocheco River watershed (Table 4). Of the 70 measurements taken, all met quality assurance/quality control requirements and are usable for New Hampshire's 2010 surface water quality report to the US Environmental Protection Agency.

The Class B New Hampshire surface water quality standard for dissolved oxygen includes a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 percent of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be assessed as meeting dissolved oxygen standards. Table 4 reports only dissolved oxygen concentration as more detailed analysis is required to determine if instantaneous dissolved oxygen saturation measurements are above or below water quality standards.

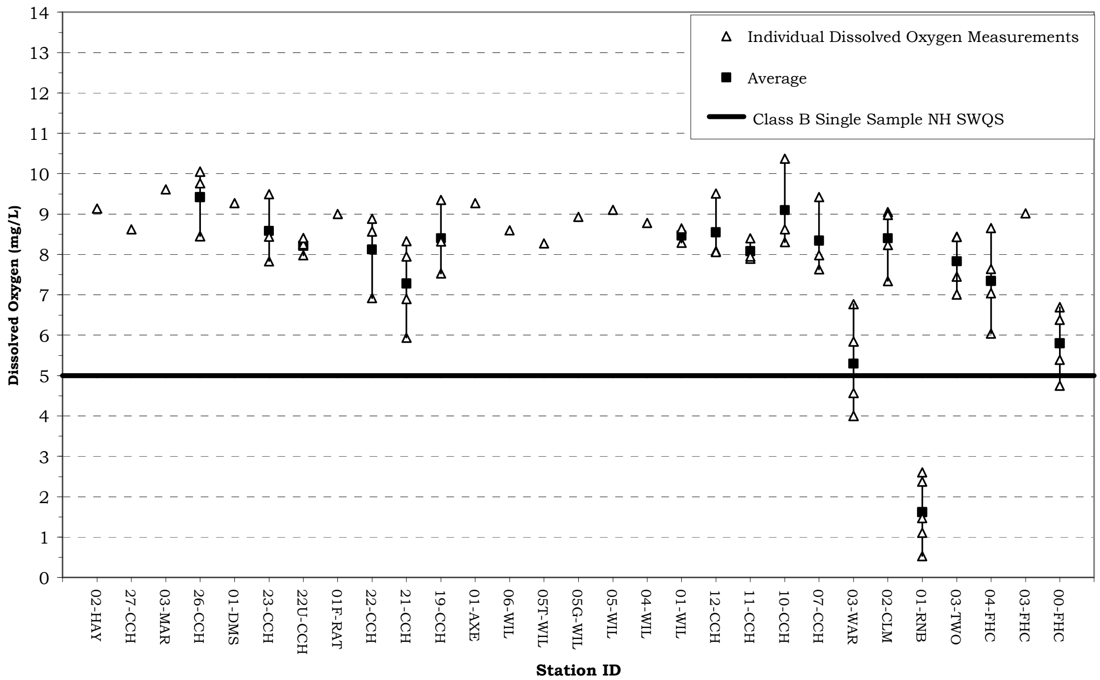
Dissolved oxygen concentration levels were variable with the average ranging from 1.62 mg/L at station 01-RNB to 9.42 mg/L at station 26-CCH (Figure 1). Stations 03-WAR, 01-RNB, and 00-FHC all had dissolved oxygen levels that were below the New Hampshire Class B surface water quality standard on one or more occasion. All five measurements in Rollins Brook at station 01-RNB failed to meet the standard. Levels of dissolved oxygen sustained above the standards are considered adequate for the support of aquatic life and other desirable water quality conditions.

Stations where the instantaneous dissolved oxygen standard was not met could potentially have a dissolved oxygen problem and further investigation is warranted. It should be noted however, that low dissolved oxygen levels may be the result of natural conditions (e.g., the presence of wetlands or stagnant water caused by a beaver dam).

Table 4. Dissolved Oxygen (mg/L) –Cocheco River Watershed, 2008

Station ID	Samples Collected	Data Range (mg/l)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
02-HAY	1	9.14	0	1
27-CCH	1	8.62	0	1
03-MAR	1	9.61	0	1
26-CCH	3	8.45 - 10.05	0	3
01-DMS	1	9.27	0	1
23-CCH	3	7.83 - 9.49	0	3
22U-CCH	3	7.98 - 8.41	0	3
01F-RAT	1	9.00	0	1
22-CCH	3	6.92 - 8.88	0	3
21-CCH	4	5.94 - 8.33	0	4
19-CCH	3	7.53 - 9.35	0	3
01-AXE	1	9.27	0	1
06-WIL	1	8.60	0	1
05T-WIL	1	8.27	0	1
05G-WIL	1	8.93	0	1
05-WIL	1	9.11	0	1
04-WIL	1	8.78	0	1
01-WIL	2	8.29 - 8.64	0	2
12-CCH	3	8.06 - 9.51	0	3
11-CCH	3	7.90 - 8.40	0	3
10-CCH	3	8.30 - 10.37	0	3
07-CCH	3	7.63 - 9.42	0	3
03-WAR	4	4.00 - 6.77	2	4
02-CLM	4	7.34 - 9.05	0	4
01-RNB	5	0.53 - 2.60	5	5
03-TWO	4	7.01 - 8.44	0	4
04-FHC	4	6.04 - 8.65	0	4
03-FHC	1	9.02	0	1
00-FHC	4	4.75 - 6.69	1	4
Total	**70**	_____	**8**	**70**

Figure 1. Dissolved Oxygen Statistics for the Cocheco River Watershed
June 2 - September 25, 2008, NHDES VRAP



Figures 2 and 3 illustrate the results of dissolved oxygen concentration and saturation levels obtained at one station in the Willow Brook watershed using submersible multiparameter dataloggers that were deployed from September 13 to September 19. Dataloggers were also deployed at stations 01-WIL nad 07-WIL but the data failed QA/QC checks and thus are not included in this report. The meters were programmed to take dissolved oxygen readings every 15 minutes over a multiple day period. In general the daily minimum is used to determine if the waterbodies are meeting the surface water quality standard for dissolved oxygen concentration (mg/L) and the 24 hour average is analyzed for % saturation of dissolved oxygen.

During the deployment, six full 24-hour periods were measured. At station 08-WIL dissolved oxygen concentration daily minimums were above the standard for the first four days and below the standard for the last three days (Figure 2). The daily average of dissolved oxygen % saturation was below the Class B surface water quality standard of 75% on all occasions at station 08-WIL (Figure 3).

Figures 2 and 3 also depict the typical cyclical variations in dissolved oxygen measurements one would expect to see during a 24-hour period in the summer. In general, dissolved oxygen levels are lowest in the early morning when there is low photosynthetic activity and a peak in respiration from organisms throughout the water column. This is the time of least oxygen production and greatest carbon dioxide emission. Peak dissolved oxygen levels occur when photosynthetic activity is at its peak. The greater the amount of photosynthetic activity the greater the production of oxygen as a byproduct of photosynthesis.

Figure 2: Dissolved Oxygen Concentration Statistics for the Willow Brook Watershed September 12 - 19, 2008, NHDES VRAP

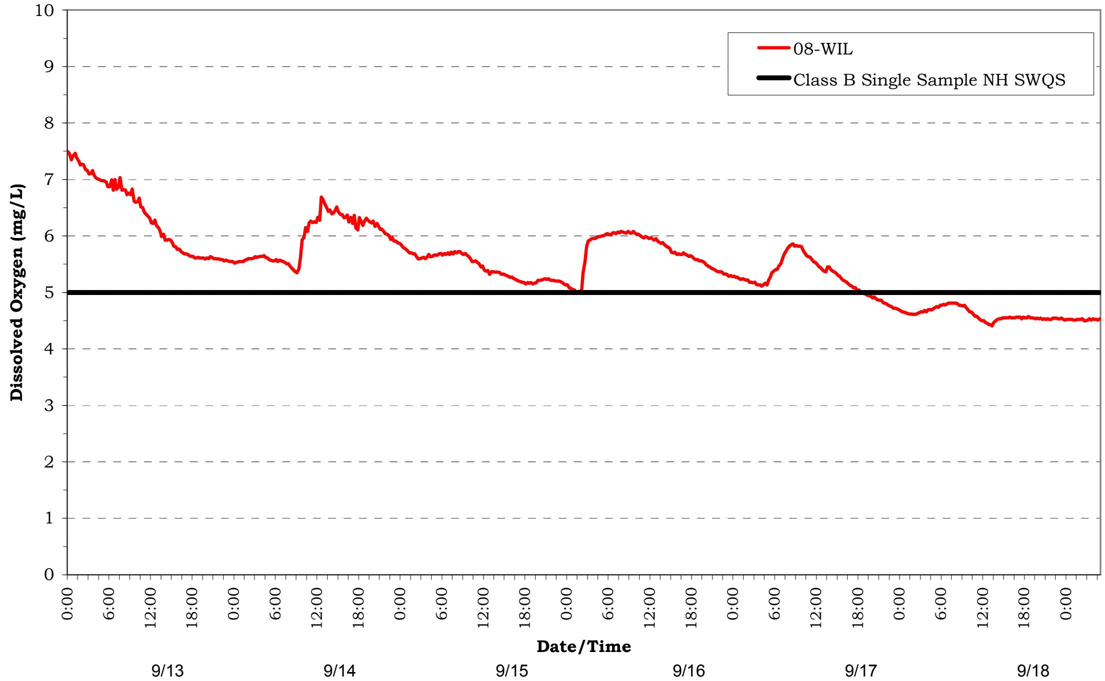
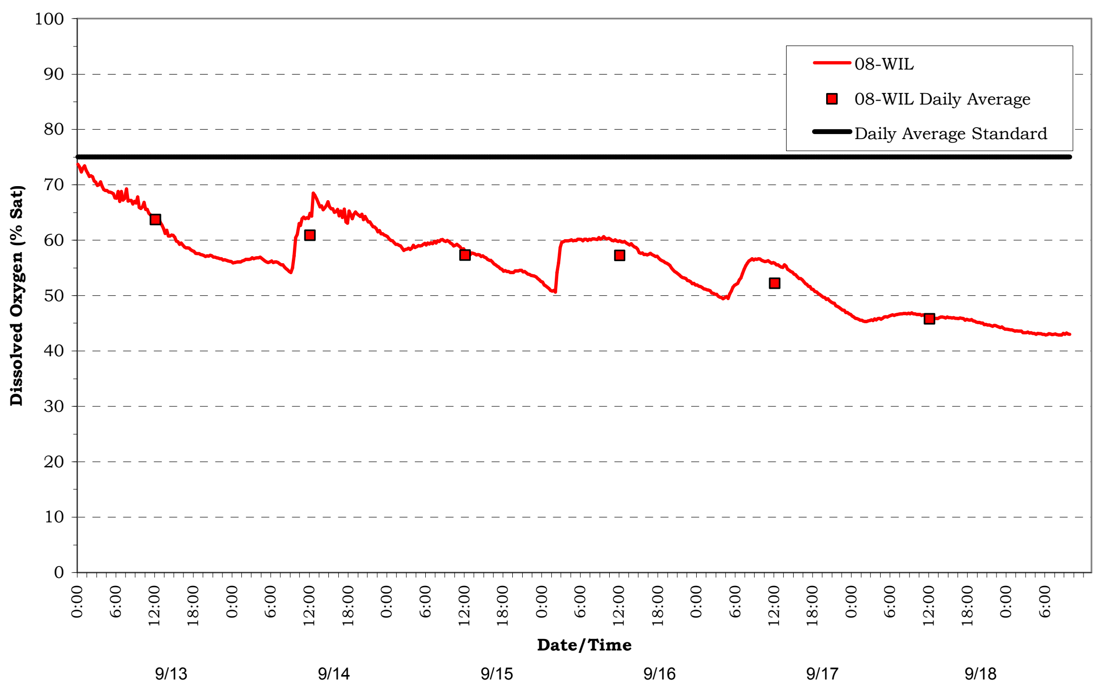


Figure 3: Dissolved Oxygen Saturation Statistics for the Willow Brook Watershed Septmeber 12 - 19, 2008, NHDES VRAP



Recommendations

- Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.

- If possible, take measurements between 5 a.m. and 10 a.m., which is when dissolved oxygen is usually the lowest, and between 2 p.m. and 7 p.m. when dissolved oxygen is usually the highest. In general, dissolved oxygen levels are lowest in the early morning when there is low photosynthetic activity and a peak in respiration from organisms throughout the water column. This is the time of least oxygen production and greatest carbon dioxide emission. Peak dissolved oxygen levels occur when photosynthetic activity is at its peak. The greater the amount of photosynthetic activity the greater the production of oxygen as a byproduct of photosynthesis.

- Continue incorporating the use of in-situ dataloggers to automatically record dissolved oxygen saturation levels during a period of several days. Stations sampled in the Willow Brook watershed in 2008 should be re-sampled in 2009.

4.2 pH

Between one and five measurements were taken in the field for pH at 29 stations in the Cocheco River watershed (Table 5). Of the 68 measurements taken, all met quality assurance/quality control requirements and are usable for New Hampshire's 2010 surface water quality report to the US Environmental Protection Agency.

The Class B New Hampshire surface water quality standard is 6.5 - 8.0, unless naturally occurring.

Table 5. pH Data Summary –Cocheco River Watershed, 2008

Station ID	Samples Collected	Data Range (standard units)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
02-HAY	1	6.09	1	1
27-CCH	1	5.93	1	1
03-MAR	1	6.06	1	1
26-CCH	3	6.11 - 6.42	3	3
01-DMS	1	5.72	1	1
23-CCH	3	5.81 - 6.13	3	3
22U-CCH	1	5.71 - 6.16	1	1
01F-RAT	1	5.25	1	1
22-CCH	3	5.98 - 6.07	3	3
21-CCH	4	5.63 - 6.23	4	4
19-CCH	3	6.18 - 6.48	3	3
01-AXE	1	5.9	1	1
06-WIL	1	5.03	1	1
05T-WIL	1	5.14	1	1
05G-WIL	1	5.31	1	1
05-WIL	1	5.51	1	1
04-WIL	1	5.93	1	1
01-WIL	2	5.99 - 6.29	2	2
12-CCH	3	6.22 - 6.52	2	3
11-CCH	3	6.19 - 6.5	2	3
10-CCH	3	6.15 - 6.73	2	3
07-CCH	3	6.18 - 6.84	1	3
03-WAR	4	5.97 - 6.49	4	4
02-CLM	4	6.43 - 6.78	1	4
01-RNB	5	5.86 - 6.19	5	5
03-TWO	4	6.54 - 6.77	0	4
04-FHC	4	6.54 - 6.76	0	4
03-FHC	1	6.68 - 6.68	0	1
00-FHC	4	6.18 - 6.79	2	4
Total	**68**	_____	**49**	**68**

All but three stations had one or more measurement that was below the New Hampshire Class B surface water quality standard minimum (Figure 4). In general, pH measurements were lower, and failed to meet the minimum standard on all occasions, in the upper portion of the watershed, and were higher, and met the minimum standard on more occasions, in the lower portion of the watershed.

Lower pH measurements are likely the result of natural conditions such as the soils, geology, or the presence of wetlands in the area. Rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels; after the spring melt or significant rain events, surface waters will generally have a lower pH.

Figure 4. pH Statistics for the Cocheco River Watershed
June 2 - September 25, 2008, NHDES VRAP

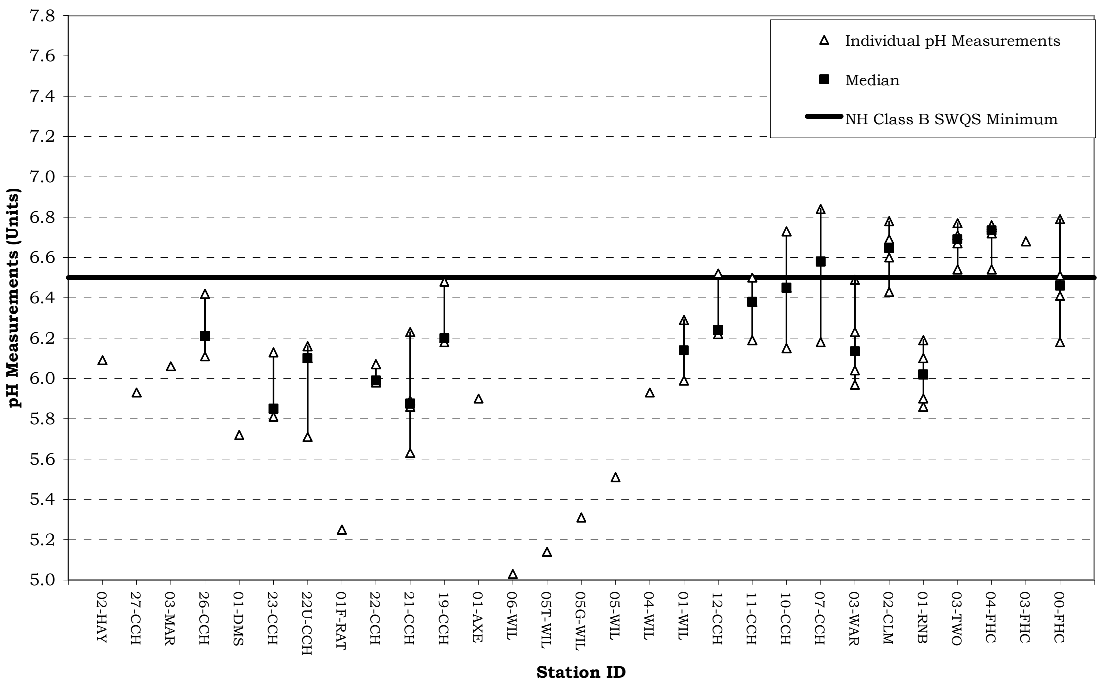
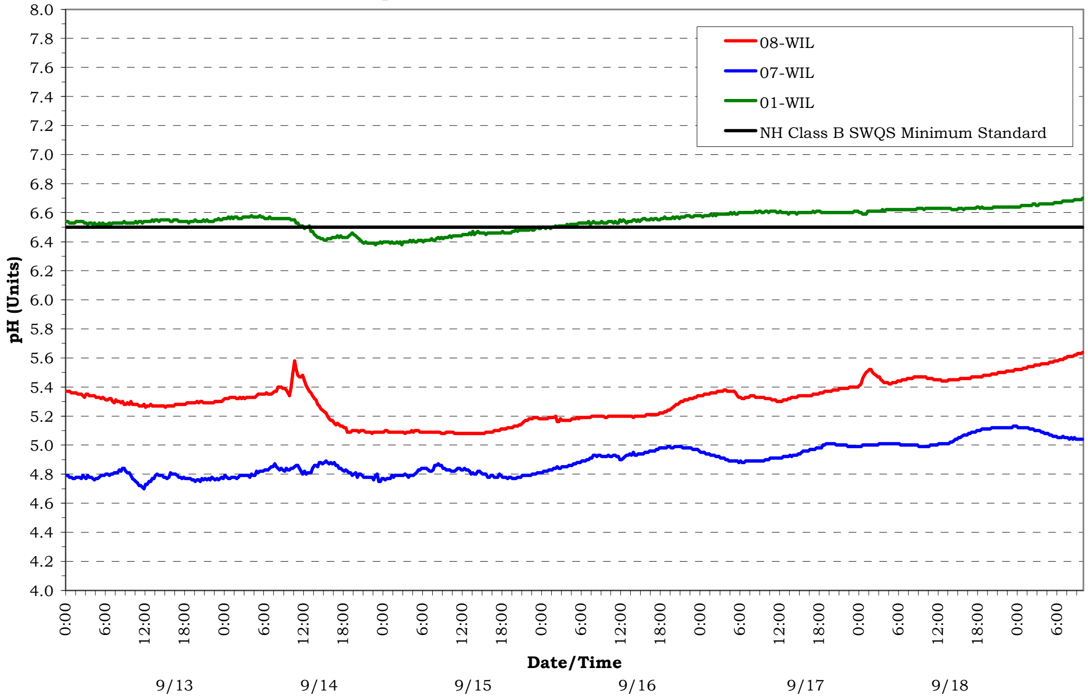


Figure 5 illustrates the results of pH measurements obtained at three stations in the Willow Brook watershed using submersible multiparameter dataloggers that were deployed from September 13 to September 19. On each occasion, the meters were programmed to take pH measurements every 15 minutes over a multiple day period. In general the daily minimum and maximum are used to determine if the waterbodies are meeting the surface water quality standard for pH.

During the deployment, pH measurements were below the minimum standard on all occasions at stations 08-WIL and 07-WIL. Station 01-WIL had some days below the minimum standard and some days above (Figure 5).

Figure 5: pH Statistics for the Willow Brook Watershed
September 12 - 19, 2008, NHDES VRAP



Recommendations

- Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.
- Consider sampling for pH in some of the tributaries and wetland areas that are influencing the pH of stations with measurements below state standards. Site conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands or other natural conditions, then the low pH measurements are not considered a violation of water quality standards. It is important to note that the New Hampshire water quality standard for pH is fairly conservative, thus pH levels slightly below the standard are not necessarily harmful to aquatic life. In this case, additional information about factors influencing pH levels is needed.
- Continue incorporating the use of in-situ dataloggers to automatically record pH during a period of several days. The use of these instruments is dependent upon availability, and requires coordination with NHDES.

4.3 Turbidity

Between one and five measurements were taken in the field for turbidity at 29 stations in the Cocheco River watershed [Table 6]. Of the 69 measurements taken, all met quality assurance/quality control requirements and are usable for New Hampshire's 2010 surface water quality report to the US Environmental Protection Agency.

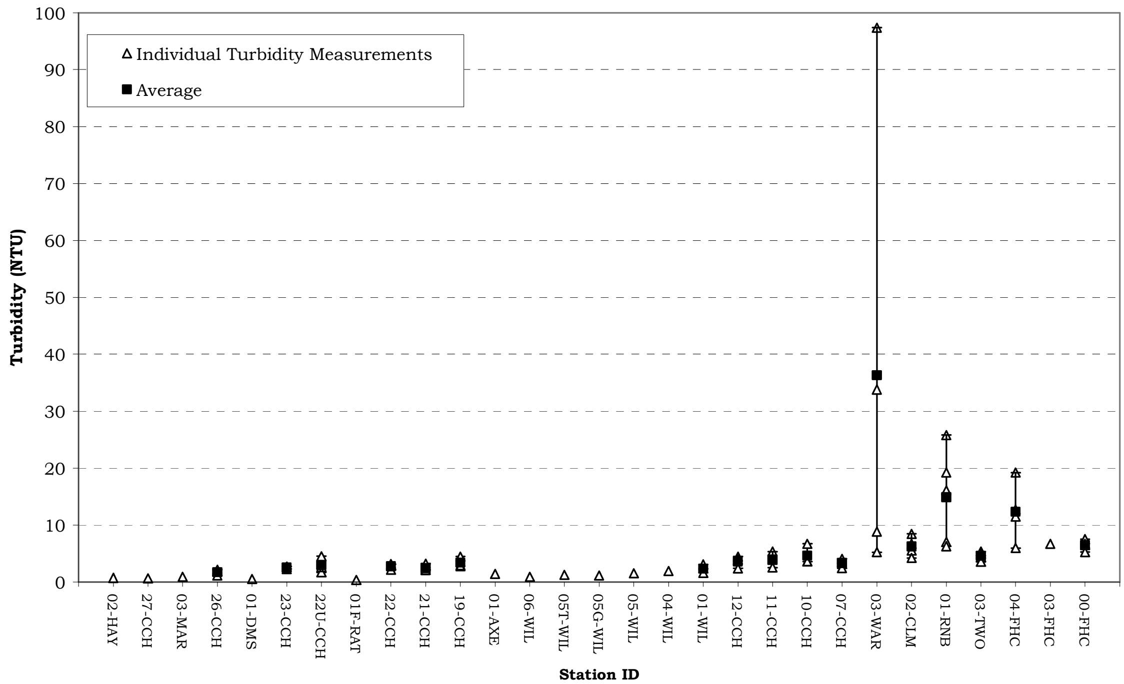
The Class B New Hampshire surface water quality standard for turbidity is less than 10 NTU above natural background. Samples that exceeded the 2008 average for a given station by more than 10 NTU are designated as "potentially not meeting standards". Higher turbidity measurements may be naturally occurring as they are influenced by precipitation, soil type, the composition of the streambed and the geology of the streambed.

Turbidity levels were variable with the average ranging 0.61 NTU in the upper watershed at station 27-CCH, to 36.32 NTU in Warren Brook at station 03-WAR (Figure 6). Stations 03-WAR and 01-RNB had one or more elevated measurements indicating potential turbidity problems. Although clean waters are associated with low turbidity there is a high degree of natural variability involved. Precipitation often contributes to increased turbidity by flushing sediment, organic matter and other materials from the surrounding landscape into surface waters. However, human activities such as removal of vegetation near surface waters and disruption of nearby soils can lead to dramatic increases in turbidity levels. In general it is typical to see a rise in turbidity in more developed areas due to increased runoff.

Table 6. Turbidity Data Summary – Cocheco River Watershed, 2008

Station ID	Samples Collected	Data Range (NTU)	Acceptable Samples Potentially Not Meeting NH Class B Standards	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
02-HAY	1	0.7	0	1
27-CCH	1	0.6	0	1
03-MAR	1	0.9	0	1
26-CCH	3	1.11 - 2.18	0	3
01-DMS	1	0.6	0	1
23-CCH	3	2.28 - 2.73	0	3
22U-CCH	3	1.7 - 4.54	0	3
01F-RAT	1	0.36	0	1
22-CCH	3	2.15 - 3.17	0	3
21-CCH	3	2.11 - 3.24	0	3
19-CCH	3	2.81 - 4.46	0	3
01-AXE	1	1.43	0	1
06-WIL	1	0.93	0	1
05T-WIL	1	1.26	0	1
05G-WIL	1	1.15	0	1
05-WIL	1	1.54	0	1
04-WIL	1	1.92	0	1
01-WIL	2	1.58 - 3.09	0	2
12-CCH	3	2.4 - 4.48	0	3
11-CCH	3	2.54 - 5.35	0	3
10-CCH	3	3.58 - 6.73	0	3
07-CCH	3	2.45 - 4.08	0	3
03-WAR	4	5.23 - 97.4	2	4
02-CLM	4	4.23 - 8.47	0	4
01-RNB	5	6.28 - 25.8	1	5
03-TWO	4	3.57 - 5.34	0	4
04-FHC	4	5.94 - 19.2	0	4
03-FHC	1	6.72	0	1
00-FHC	4	5.26 - 7.52	0	4
Total	**69**	_____	**3**	**69**

Figure 6. Turbidity Statistics for the Cocheco River Watershed
June 2 - September 25, 2008, NHDES VRAP



Recommendations

- Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.
- Collect samples during wet weather. This will help us to understand how the river responds to runoff and sedimentation.
- If a higher than normal turbidity measurement occurs, volunteers can investigate further by moving upstream and taking additional measurements. This will facilitate isolating the location of the cause of the elevated turbidity levels. In addition, take good field notes and photographs. If human activity is suspected or verified as the source of elevated turbidity levels, volunteers should contact NHDES.

4.4 Specific Conductance

Between one and six measurements were taken in the field for specific conductance at 43 stations in the Cocheco River watershed (Table 7). Of the 150 measurements taken, all met quality assurance/quality control requirements and are usable for New Hampshire's 2010 surface water quality report to the US Environmental Protection Agency.

New Hampshire surface water quality standards do not contain numeric criteria for specific conductance although in many fresh surface waters, specific conductance can be used as a surrogate to predict compliance with numeric water quality criteria for chloride.

Table 7. Specific Conductance Data Summary – Cocheco River Watershed, 2008

Station ID	Samples Collected	Data Range (µS/cm)	Acceptable Samples Not Meeting NH Class B Standards (µS/cm as chloride surrogate)	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
02-HAY	1	88.5	0	1
27-CCH	1	62.9	0	1
03-MAR	1	50.2	0	1
26-CCH	3	85.3 - 109.7	0	3
01-DMS	1	80.9	0	1
23-CCH	3	86.3 - 141	0	3
22U-CCH	3	98.5 - 173.5	0	3
01F-RAT	1	43	0	1
22-CCH	3	111.4 - 154.1	0	3
21-CCH	4	112.9 - 200.5	0	4
19-CCH	3	127.3 - 189.6	0	3
01-AXE	1	75.6	0	1
06-WIL	1	144.6	0	1
05T-WIL	1	126.2	0	1
05G-WIL	1	161.4	0	1
05-WIL	1	164	0	1
04-WIL	1	208.8	0	1
01-WIL	2	248.3 - 265.2	0	2
12-CCH	6	71 - 190	0	6
02-REY	6	199.8 - 287	0	6
11-CCH	6	73.7 - 225.6	0	6
01-IBK-E	6	491 - 1690	1	6
01-IBK-W	6	605 - 2060	2	6

10-CCH	6	80.2 - 233.3	0	6
02-BRR	6	590 - 1420	2	6
01-LIB	3	450 - 537	0	3
01-CDR	6	274 - 396.2	0	6
07-CCH	6	70.1 - 249.5	0	6
02-CKT	3	150 - 179	0	3
01-CKT	6	214 - 546	0	6
03-WAR	6	83.9 - 201.9	0	6
02-WAR	1	126.2	0	1
05-TWO	1	355.4	0	1
01-YTN	1	224.5	0	1
03-CLM	1	67.7	0	1
02-CLM	6	165.9 - 471.4	0	6
01-RNB	6	319.6 - 373.5	0	6
03-TWO	6	192.2 - 388.1	0	6
04-FHC	6	213.3 - 380	0	6
03-FHC	1	272.7	0	1
00-FHC	6	189.8 - 348.4	0	6
01-KNX	6	128 - 207	0	6
01-JNC	5	293 - 416.7	0	5
Total	**150**	_____	**0**	**150**

Specific conductance levels were highly variable with the average ranging from 43 µS/cm at station 01F-RAT to 1008 µS/cm at station 01-IBK-W (Figure 7). In general, some of the tributaries to the Cocheco River monitored in the towns of Dover and Rollinsford had higher specific conductance levels compared to other areas of the Cocheco River watershed. Stations 01-IBK-E and 01-IBK-W on Indian Brook in Dover and station 02-BRR on Berry Brook also in Dover had one or more specific conductance measurement that indicated a violation of the chronic standard for chlroride.

Higher specific conductance levels can be indicative of pollution from sources such as urban/agricultural runoff, road salt, failed septic systems, or groundwater pollution. The variable specific conductance levels indicate low pollutant levels at some stations and high pollutant levels at others. Further investigation into the higher specific conductance levels is warranted.

During 2008 the Cocheco River Watershed Coalition began monitoring specific conductance during the winter and early spring months to more fully assess the watershed for both specific conductance and chloride. Chloride and specific conductance are very closely related to one another and the protocols NHDES uses to assess waterbodies allows specific conductance to be used as a formal surrogate for chloride. Monitoring for specific conductance and chloride in the winter and early spring months will help determine what the impact of road salt application is in the watershed and indicated what time of year chloride levels tend to be highest. Specific conductance measurements taken during the winter and snowmelt months are indicted with a separate color in Figure 7.

Figure 7. Specific Conductance Statistics for the Cocheco River Watershed February 2 - September 25, 2008, NHDES VRAP

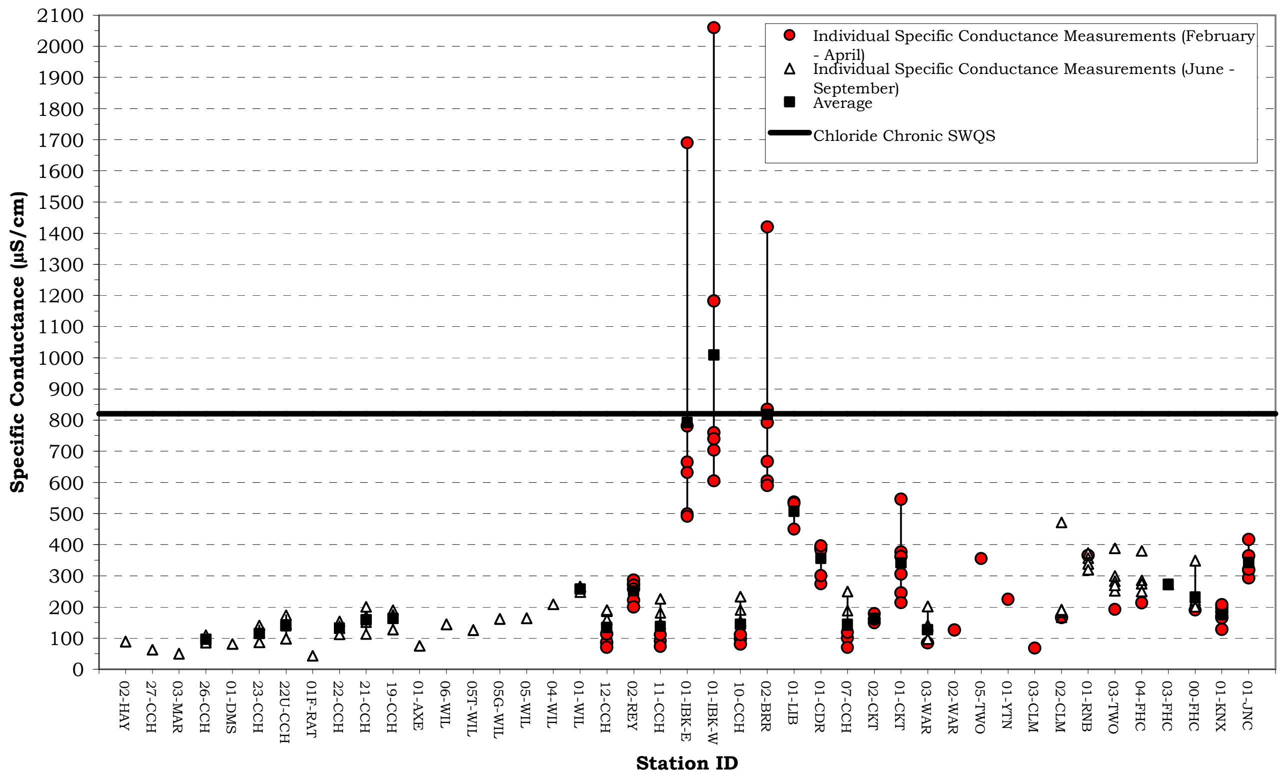
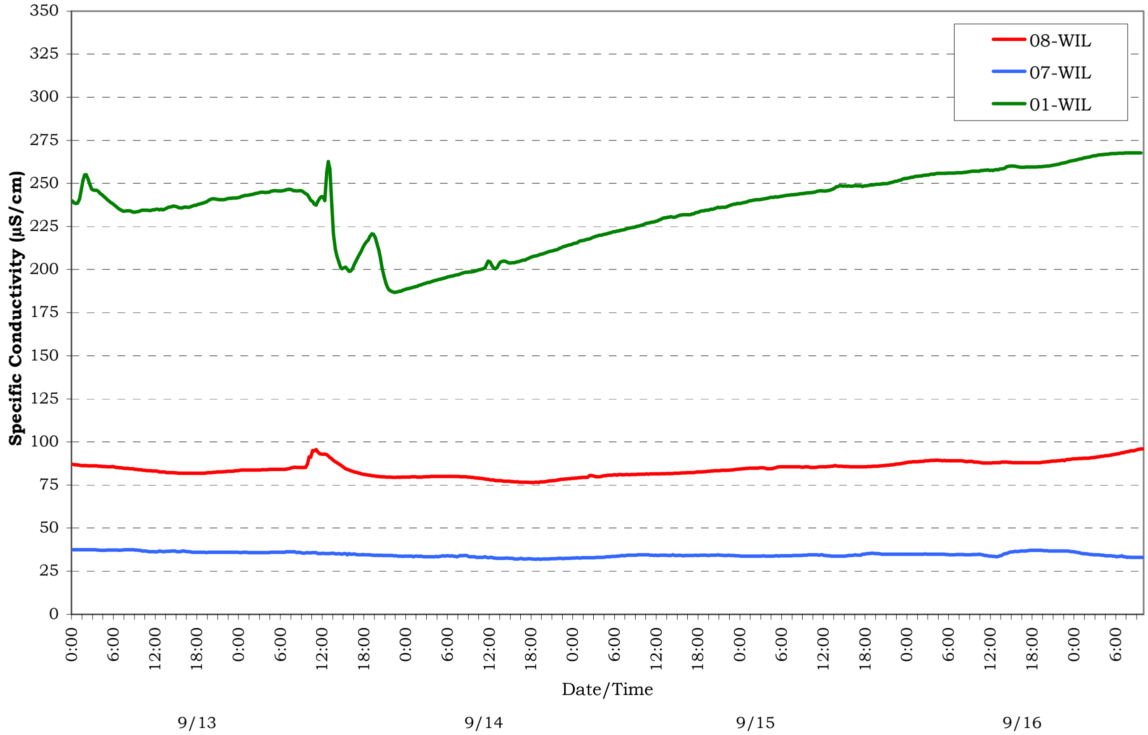


Figure 8 illustrates the results of specific conductance measurements obtained at three stations in the Willow Brook watershed using submersible multiparameter dataloggers that were deployed from September 13 to September 19. The meters were programmed to take specific conductance readings every 15 minutes over a multiple day period.

During the deployment, specific conductance measurements were highest at station 01-WIL, which fluctuated from just below 200 µS/cm to above 250 µS/cm, and were lowest at station 07-WIL which were under 50 µS/cm on all occasions. Measurements at station 08-WIL were under 100 µS/cm on all occasions.

Figure 8. Specific Conductance Statistics for the Willow Brook Watershed
September 12 - 19, 2008, NHDES VRAP



Recommendations

- Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.
- Consider collecting chloride samples at the same time that specific conductance is measured. During the late winter/early spring snowmelt, higher specific conductance levels are often seen due to elevated concentrations of chloride in the runoff. Conductivity levels are very closely correlated to chloride levels. Simultaneously measuring chloride and specific conductance will allow for a better understanding of their relationship.
- Continue incorporating the use of in-situ dataloggers to automatically determine specific conductance levels during rain events, snowmelt, and baseline dry weather conditions. The use of these instruments is dependent upon availability, and requires coordination with NHDES.

4.5 Water Temperature

Between one and five measurements were taken in the field for water temperature at 39 stations in the Cocheco River watershed from Farmington to Rollinsford (Table 8). Of the 98 measurements taken, all met quality assurance/quality control requirements and are usable for New Hampshire's 2010 surface water quality report to the US Environmental Protection Agency.

Although there is currently no numerical water quality criteria for water temperature, NHDES is in the process of collecting biological and water temperature data that will contribute to the development of a procedure for assessing rivers and stream based on water temperature and its corresponding impact to the biological integrity of the waterbody.

Table 8. Water Temperature Data Summary –Cocheco River Watershed, 2008

Station ID	Samples Collected	Data Range (°C)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
02-HAY	1	16.4	Not Applicable	1
27-CCH	1	19.0	N/A	1
03-MAR	1	16.8	N/A	1
26-CCH	3	13.1 - 21.2	N/A	3
01-DMS	1	16.3	N/A	1
23-CCH	3	12.8 - 20.1	N/A	3
22U-CCH	3	12.6 - 20.1	N/A	3
01F-RAT	1	17.7	N/A	1
22-CCH	3	12.7 - 19.9	N/A	3
21-CCH	4	13.6 - 21.4	N/A	4
19-CCH	3	13.6 - 20.7	N/A	3
01-AXE	1	15.1	N/A	1
06-WIL	1	15.4	N/A	1
05T-WIL	1	14.8	N/A	1
05G-WIL	1	15.2	N/A	1
05-WIL	1	15.6	N/A	1
04-WIL	1	15.6	N/A	1
01-WIL	2	15.2	N/A	2
12-CCH	5	14.7 - 20.9	N/A	5
02-REY	2	13.9 - 20.5	N/A	2
11-CCH	5	14.4 - 22.4	N/A	5
01-IBK-E	2	15.3 - 18.1	N/A	2
01-IBK-W	2	14.6 - 20.1	N/A	2
10-CCH	5	14.1 - 21.7	N/A	5

02-BRR	2	14.5 - 16.3	N/A	2
01-LIB	2	14.9 - 16.1	N/A	2
01-CDR	2	13.2 - 19.4	N/A	2
07-CCH	5	15.8 - 21.5	N/A	5
02-CKT	2	12.5 - 18.1	N/A	2
01-CKT	2	15.7 - 16	N/A	2
03-WAR	4	15.1 - 19.1	N/A	4
02-CLM	4	16.1 - 20.5	N/A	4
01-RNB	5	15.9 - 21.3	N/A	5
03-TWO	4	15.4 - 21.2	N/A	4
04-FHC	4	15.7 - 21.4	N/A	4
03-FHC	1	16.7	N/A	1
00-FHC	4	17.5 - 23.7	N/A	4
01-KNX	2	12.9 - 19.8	N/A	2
01-JNC	2	13.8 - 23.7	N/A	2
Total	**98**	_____	**N/A**	**98**

Figure 9 shows the results of instantaneous water temperature measurements taken at 39 stations in the Cocheco River watershed. The average water temperature varied from 14.8 °C. to 21.0 °C.

Figure 9. Water Temperature Statistics for the Cocheco River Watershed
June 2 - September 25, 2008, NHDES VRAP

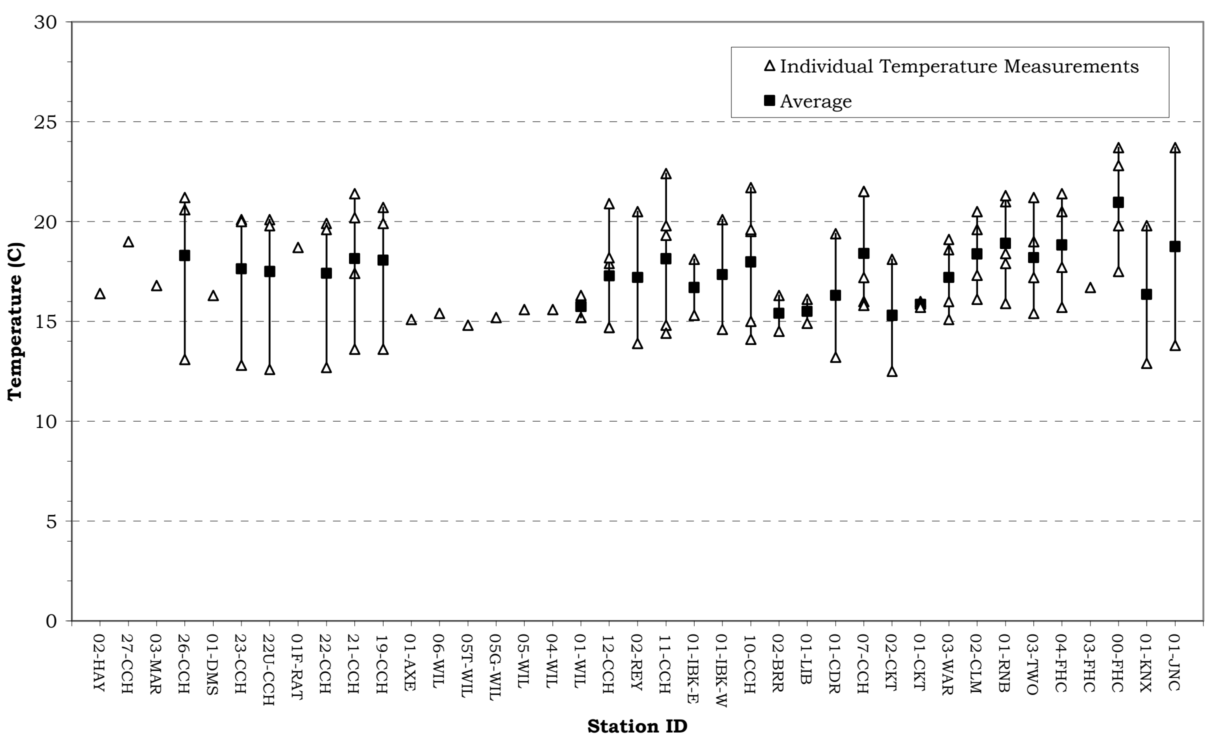
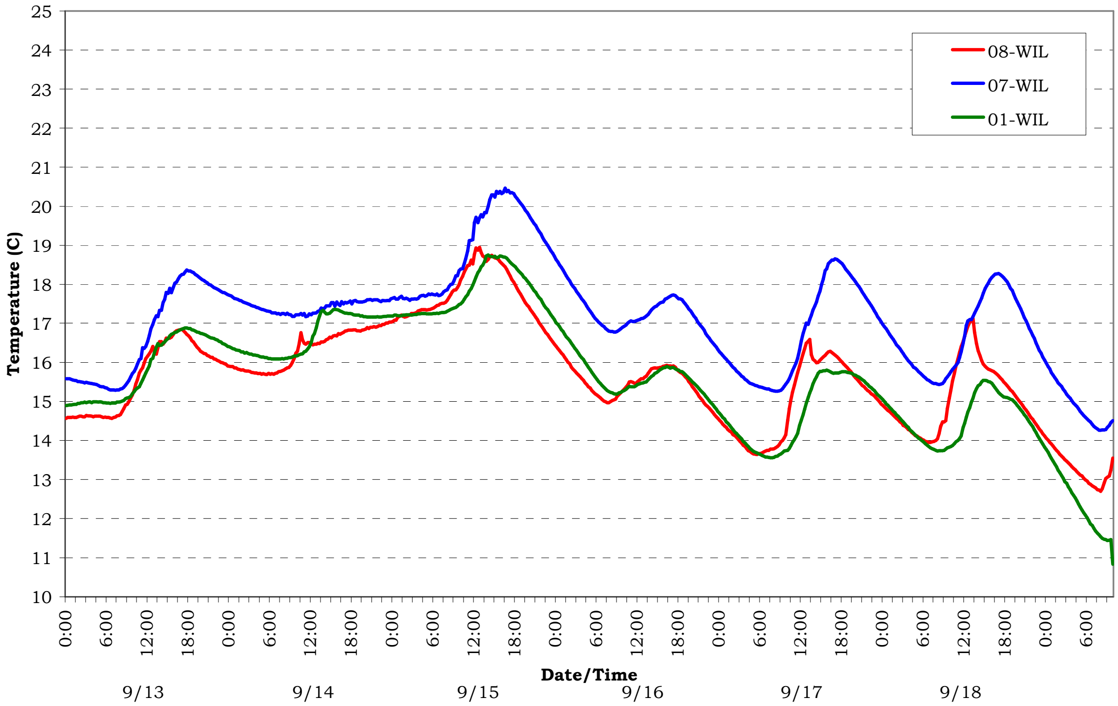


Figure 10 illustrates the results of water temperature measurements obtained at three stations in the Willow Brook watershed using submersible multiparameter dataloggers that were deployed from September 13 to September 19. The meters were programmed to take water temperature readings every 15 minutes over a multiple day period. During the deployment water temperature was highest at station 0107-WIL followed by station 08-WIL and 01-WIL.

Figure 10. Temperature Statistics for the Willow Brook Watershed
September 12 - 19, 2008, NHDES VRAP



Water temperature is a critical parameter for aquatic life and has an impact on other water quality parameters such as dissolved oxygen concentrations, and the activity of bacteria in the water. Water temperature controls the metabolic and reproductive processes of aquatic species and can determine which fish and macroinvertabrate species can survive in a given river or stream.

A number of factors can have an impact on water temperature including the quantity and maturity of riparian vegetation along the shoreline, the rate of flow, the percent of impervious surfaces contributing stormwater, thermal discharges, impoundments and the influence of groundwater.

Recommendations

- Continue collecting water temperature data via both instantaneous readings and consider long-term deployment of NHDES water temperature dataloggers.

4.6 *Escherichia coli*/Bacteria

Between one and four samples were taken for *Escherichia coli* (*E. coli*) at 36 stations in Cocheco River watershed from Farmington to Rollinsford (Table 9). Of the 99 samples taken, all met quality assurance/quality control requirements and are usable for New Hampshire's 2010 surface water quality report to the US Environmental Protection Agency.

Class B New Hampshire surface water quality standards for *E.coli* are as follows:

$\leq$406 cts/100 ml, based on any single sample or
$\leq$126 cts/100 ml, based on a geometric mean calculated from three samples collected within a 60-day period.

17 stations had at least one or more *E.coli* measurement that exceeded the New Hampshire Class B single sample water quality standard (Figure 11). Most of the *E.coli* measurements taken in the Willow Brook watershed exceeded the standard. In addition, stations 06-ELA, 02-WIL, and 00-FHC all had elevated measurements, most notably on 7/22/08 and 9/8/08.

Figure 11. *Escherichia coli* Statistics for the Cocheco River Watershed August 22 - September 13 2008, NHDES VRAP

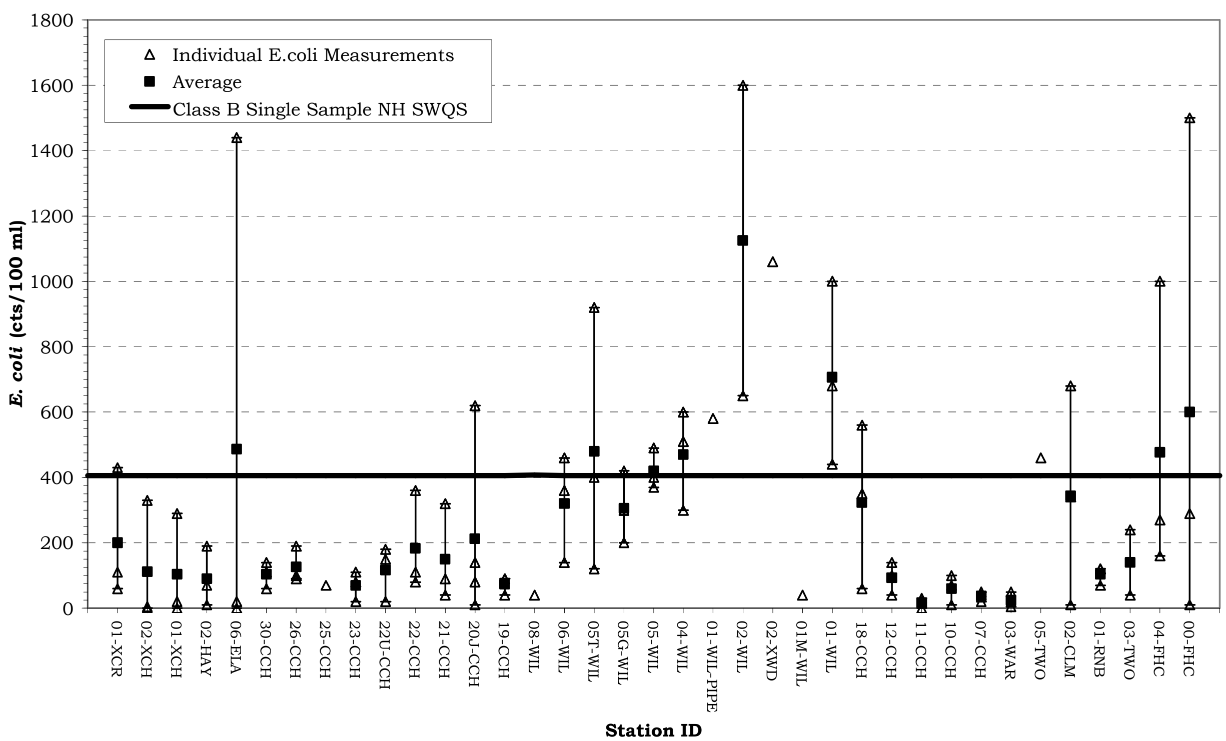


Table 9. *E.coli* Data Summary –Cocheco River Watershed, 2008

Station ID	Samples Collected	Data Range (cts/100ml)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
01-XCR	3	60 - 430	1	3
02-XCH	3	0 - 330	0	3
01-XCH	3	0 - 290	0	3
02-HAY	3	10 - 190	0	3
06-ELA	3	0 - 1440	1	3
30-CCH	3	60 - 140	0	3
26-CCH	3	90 - 190	0	3
25-CCH	1	70	0	1
23-CCH	3	20 - 110	0	3
22U-CCH	3	20 - 180	0	3
22-CCH	3	80 - 360	0	3
21-CCH	3	40 - 320	0	3
20J-CCH	4	10 - 620	1	4
19-CCH	3	40 - 90	0	3
08-WIL	1	40	0	1
06-WIL	3	140 - 460	1	3
05T-WIL	3	120 - 920	2	3
05G-WIL	4	200 - 420	1	4
05-WIL	3	370 - 490	1	3
04-WIL	3	300 - 600	2	3
01-WIL-PIPE	1	580	1	1
02-WIL	2	650 - 1600	2	2
02-XWD	1	1060	1	1
01M-WIL	1	40	0	1
01-WIL	3	440 - 1000	3	3
18-CCH	3	60 - 560	1	3
12-CCH	3	40 - 140	0	3
11-CCH	3	0 - 30	0	3
10-CCH	3	10 - 100	0	3
07-CCH	3	20 - 50	0	3
03-WAR	3	5 - 50	0	3
05-TWO	1	460	1	1
02-CLM	3	10 - 680	1	3
01-RNB	3	70 - 120	0	3
03-TWO	2	40 - 240	0	2
04-FHC	3	160 - 1000	1	3
00-FHC	3	10 - 1500	1	3
Total	**99**	_____	**22**	**99**

In order to fully determine whether a waterbody is meeting surface water standards for *E.coli* a geometric mean must be calculated. A geometric mean is calculated using three samples collected within a 60-day period. At all stations either one or two geometric means were calculated. Of the 31 geometric means calculated 13 exceeded the Class B geometric mean standard of 126 cts/100ml (Table 10).

Several factors can contribute to elevated *E. coli* levels, including, but not limited to rain storms, low river flows, the presence of wildlife (e.g., birds), agricultural practices, and the presence of septic systems along the river.

Table 10. *E. coli* Geometric Mean Data Summary –Cocheco River Watershed, 2008

Station ID	Geometric Means Calculated	Geometric Mean #1	Geometric Mean #2	Geometric Means Not Meeting NH Class B Standards	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
01-XCR	1	142		1	1
02-XCH	1	3		0	1
01-XCH	1	4		0	1
02-HAY	1	51		0	1
06-ELA	1	7		0	1
30-CCH	1	97		0	1
26-CCH	1	120		0	1
23-CCH	1	56		0	1
22U-CCH	1	81		0	1
22-CCH	1	147		1	1
21-CCH	1	105		0	1
20J-CCH	2	48	79	0	2
19-CCH	1	69		0	1
06-WIL	1	285		1	1
05T-WIL	1	353		1	1
05G-WIL	2	293	262	2	2
05-WIL	1	443		1	1
04-WIL	1	451		1	1
01-WIL	1	669		1	1
18-CCH	1	227		1	1
12-CCH	1	82		0	1
11-CCH	1	20		0	1
10-CCH	1	41		0	1
07-CCH	1	34		0	1
03-WAR	1	17		0	1
02-CLM	1	132		1	1
01-RNB	1	100		0	1
04-FHC	1	351		1	1
00-FHC	1	163		1	1
Total	**31**	_____	_____	**13**	**31**

Recommendations

- Continue collecting three samples within any 60-day period during the summer to allow for determination of geometric means. Samples need only be collected during the critical period of May 24 to September 15 for assessment purposes. This coincides with the peak contact recreation season.

- Further investigation should be conducted in the Willow Brook watershed due to the high bacteria levels measured during 2007 and 2008.

- Continue to document river conditions and station characteristics (including the presence of wildlife in the area during sampling).

- Continue to document river conditions and station characteristics (including the presence of wildlife in the area during sampling).At stations with particularly high bacteria levels volunteers can investigate further by moving upstream and taking additional measurements. This will facilitate isolating the location of the cause of the elevated bacteria levels. Those sampling should also look for any potential sources of bacteria such as emission pipes, failed septic systems, farm animals, pet waste, wildlife and waterfowl.

4.7 Total Phosphorus

One sample was taken for total phosphorus at 16 stations in the Cocheco River watershed from Farmington to Rollinsford (Table 11). Of the 16 samples taken, all met quality assurance/quality control requirements and are usable for New Hampshire's 2010 surface water quality report to the US Environmental Protection Agency.

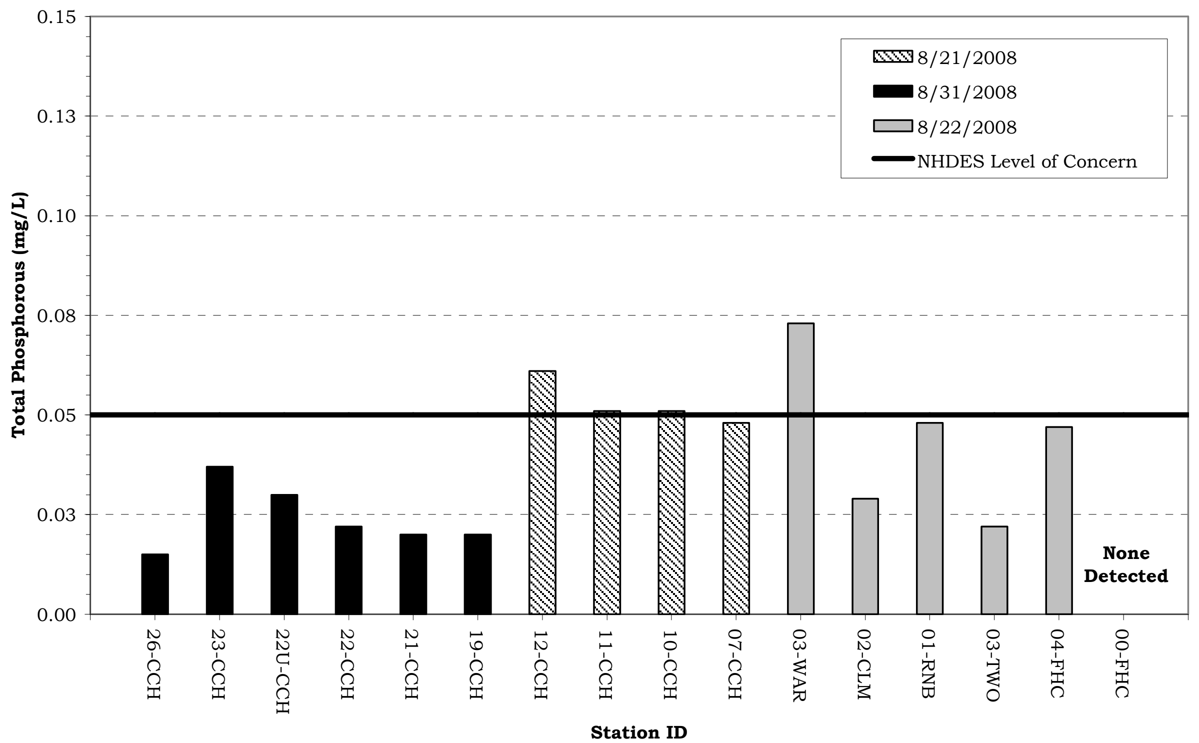
There is no numeric standard for total phosphorus for Class B waters. The narrative standard states that "unless naturally occurring, shall contain no phosphorus in such concentrations that would impair any existing or designated uses." The NHDES "level of concern" for total phosphorous is 0.05 mg/L.

Table 11. Total Phosphorus Data Summary –Cocheco River Watershed, 2008

Station ID	Samples Collected	Data Range (mg/L)	Acceptable Samples Exceeding NHDES Level of Concern	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
26-CCH	1	0.015	0	1
23-CCH	1	0.037	0	1
22U-CCH	1	0.030	0	1
22-CCH	1	0.022	0	1
21-CCH	1	0.020	0	1
19-CCH	1	0.020	0	1
12-CCH	1	0.061	1	1
11-CCH	1	0.051	1	1
10-CCH	1	0.051	1	1
07-CCH	1	0.048	0	1
03-WAR	1	0.073	1	1
02-CLM	1	0.029	0	1
01-RNB	1	0.048	0	1
03-TWO	1	0.022	0	1
04-FHC	1	0.047	0	1
00-FHC	ND	0.000	0	1
Total	**16**	_____	**4**	**16**

Four measurements exceeded the total phosphorus NHDES "level of concern" (Figure 12). Under undisturbed natural conditions phosphorus is at very low levels in aquatic ecosystems. Of the three nutrients critical for aquatic plant growth; potassium, nitrogen, and phosphorus, it is usually phosphorous that is the limiting factor to plant growth. When the supply of phosphorus is increased due to human activity, algae respond with significant growth.

Figure 12. Total Phosphorous Statistics for the Cocheco River Watershed
September 27, 2008 NHDES VRAP



A major source of excessive phosphorus concentrations in aquatic ecosystems can be wastewater treatment facilities, as sewage typically contains relatively high levels of phosphorus detergents. However, fertilizers used on lawns and agricultural areas can also contribute significant amounts of phosphorus.

Recommendations

- Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.

4.8 Chloride

Between one and five samples were taken for chloride at 31 stations in the Cocheco River watershed from Farmington to Rollinsford [Table 12]. Of the 85 measurements taken, all met quality assurance/quality control requirements and are usable for New Hampshire's 2010 surface water quality report to the US Environmental Protection Agency.

The Class B New Hampshire surface water quality standard for chloride is as follows:

Freshwater chronic criterion	230 mg/l
Freshwater acute criterion	860 mg/l

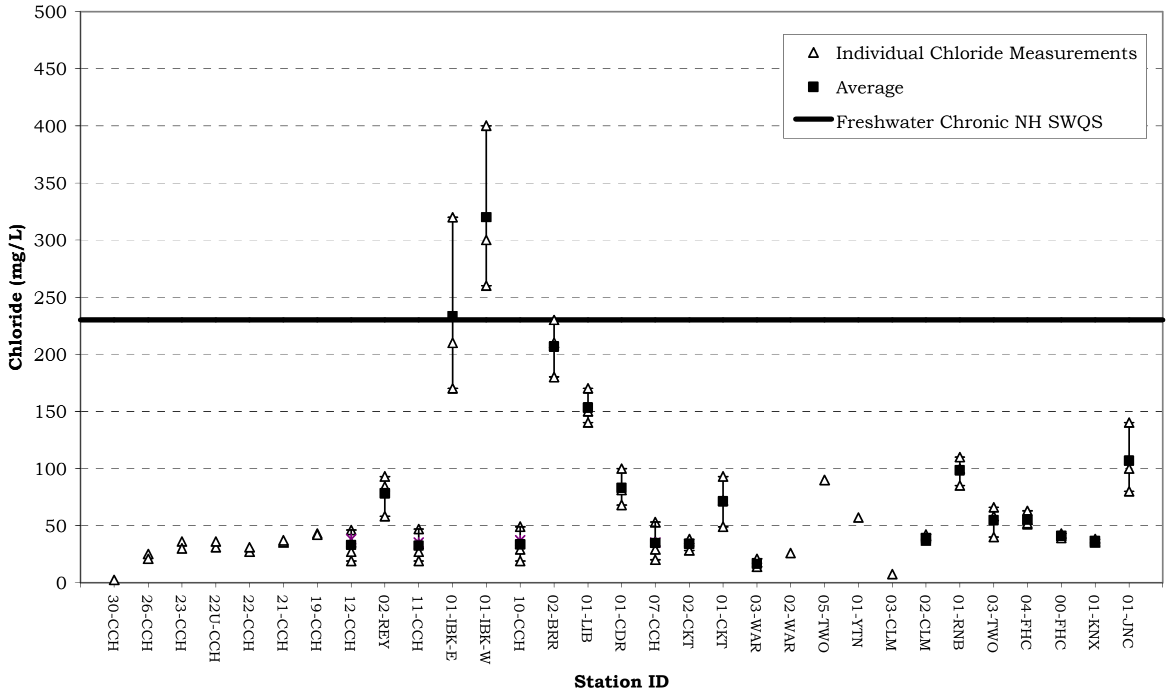
All but four measurements were below the New Hampshire Class B chronic surface water quality standard of 230 mg/L with the average ranging from 2.5 mg/L at station 26-CCH to 320 mg/L at station 01-IBK-W (Figure 13). The four measurements which exceeded the standard were taken at Indian Brook at stations 01-IBK-E, and 01-IBK-W in Dover. In general, the stations monitored in the town of Dover had higher chloride levels compared to other areas of the Cocheco River watershed.

Although chloride can originate from natural sources, most of the chloride that enters the environment is associated with the storage and application of road salt. Road salt readily dissolves and enters aquatic environments in ionic forms. As such, chloride-containing compounds commonly enter surface water, soil, and groundwater during late-spring snowmelt (since the ground is frozen during much of the late winter and early spring). Chloride ions are conservative, which means they are not degraded in the environment and tend to remain in solution, once dissolved. Chloride ions that enter ground water can ultimately be expected to reach surface water and, therefore, influence aquatic environments and humans. Additional human sources of chloride can come from fertilizers, septic systems, and underground water softening systems.

Table 12. Chloride Data Summary – Cocheco River Watershed, 2008

Station ID	Samples Collected	Data Range (mg/l)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
30-CCH	1	2.5	0	1
26-CCH	2	21 - 25	0	2
23-CCH	2	30 - 36	0	2
22U-CCH	2	31 - 36	0	2
22-CCH	2	27 - 31	0	2
21-CCH	2	35 - 37	0	2
19-CCH	2	42 - 43	0	2
12-CCH	5	19 - 46	0	5
02-REY	3	58 - 93	0	3
11-CCH	5	19 - 47	0	5
01-IBK-E	3	170 - 320	1	3
01-IBK-W	3	260 - 400	3	3
10-CCH	5	19 - 49	0	5
02-BRR	3	180 - 230	0	3
01-LIB	3	140 - 170	0	3
01-CDR	3	68 - 100	0	3
07-CCH	5	20 - 53	0	5
02-CKT	3	28 - 38	0	3
01-CKT	3	49 - 93	0	3
03-WAR	3	14 - 21	0	3
02-WAR	1	26	0	1
05-TWO	1	90	0	1
01-YTN	1	27	0	1
03-CLM	1	7.6	0	1
02-CLM	3	37 - 42	0	3
01-RNB	3	85 - 110	0	3
03-TWO	3	40 - 66	0	3
04-FHC	3	51 - 63	0	3
00-FHC	3	39 - 43	0	3
01-KNX	3	35 - 38	0	3
01-JNC	3	80 - 140	0	3
Total	**85**	_____	**4**	**85**

Figure 13. Chloride Statistics for the Cocheco River Watershed
February 22 - September 15 , 2008 NHDES VRAP



Recommendations

- Continue collecting chloride samples during both low-flow summer months and during snowmelt period in winter and early spring. It is critical that specific conductance be recorded when chloride samples are collected.

- Further investigation should be taken to determine sources of the high chloride levels in Indian Brook and Berrys Brook.

4.9 Biological Assessment

This section summarizes habitat and biological community condition data collected during the 2008 assessment season. A discussion of the results and recommendations for future actions is included.

Habitat Analysis

Surrounding land use, riparian habitat, and in-stream habitat were examined in the immediate observable area prior to collecting biological samples at each station. Findings were recorded on standardized data sheets included in the Volunteer Biological Assessment Program 2008 Draft Protocol.

Riparian Habitat

The surrounding land of six of the eight stations sampled in 2008 was composed of greater than 50 percent forest, two of which, 01-DMS and 02-HAY, were comprised entirely of forest. The surrounding land at the remaining two stations consisted of residential or commercial land. The total estimated width of the riparian zones varied widely, ranging from 20 feet to greater than 600 feet. In six of the eight stations the canopy covered between 40 and 75 percent of the stream. Only 02-HAY had a canopy covering greater than 75 percent of the stream, and 01F-RAT had a canopy covering less than 10 percent of the stream. Deciduous trees comprised a majority (>2/3) of vegetative canopy composition.

In-stream Habitat

Extremely high waters were reported at most sampling stations. The United States Geological Survey (USGS) gauging station in the Cocheco River recorded mean flows in the month of September at 227 cubic feet per second (cfs) in 2008 while in 2007 and 2006 mean flows were recorded at 13 and 21 respectively. Analysis revealed a statistically significant difference in mean September flows between 2006, 2007 and 2008 (One-way ANOVA; $F(2,81)=10.3433$, $p<0.001$). In addition, the maximum flow in September 2008 was 1,370 cfs while maximum flow in 2007 was only 43 cfs. Six stations were sampled during unusually high flows (01-DMS, 03-MAR, 27-CCH, 01-AXE, 03-FHC, 02-HAY); moderate flows were reported at only two stations (01F-RAT, 03-ROL). In addition, two stations, 10A-CCH and 21+D-CCH, were removed from the sampling queue due to dangerously high flows.

Riffles were the most common habitat within seven of the eight sampling reaches. Water color was described as clear at seven stations; cloudy water was reported at 03-FHC. A turbidity reading of 6.72 NTU at 03-FHC is well beneath the Class B New Hampshire surface water standard for turbidity (less than 10 NTU). At most stations woody debris was present but not frequently encountered. The stream substrate was comprised primarily of cobble. Gravel and boulder substrates were observed less frequently. At six of the eight stations the substrate was less than 50 percent embedded, and at 02-HAY the substrate was embedded greater than 75 percent. At seven of the sample stations, bank erosion was slight to moderate with only minor impacts to the stream suspected. Heavy erosion was reported at 02-HAY, where the eroded banks significantly impacted the streambed. In addition, large deposits of sand were apparent at 03-MAR.

Biological Community Condition

Biotic scores ranged from 2.89 to 5.84, with a mean of 4.29, corresponding to the "good" category (Table 13). Of the eight stations sampled, one station, 01-DMS, had a biotic score corresponding to the "excellent" category, while five stations had biotic scores corresponding to the "good" category, and two stations had biotic scores corresponding to the "fairly poor" category.

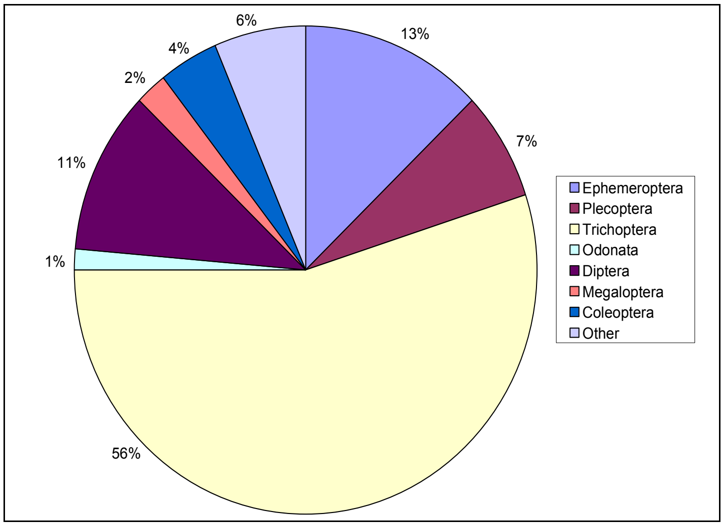
Table 13. Biological Assessment Data Summary - Cocheco River Watershed, 2008.

Station ID	Biotic Score	Narrative Category	EPT (%)
02-HAY	4.34	Good	67.61%
27-CCH	3.76	Good	75.00%
03-MAR	4.82	Fairly Poor	43.75%
01-DMS	2.89	Excellent	76.16%
01F-RAT	4.59	Good	35.29%
01-AXE	5.84	Fairly Poor	19.61%
01-RNB	4.15	Good	91.25%
03-FHC	3.94	Fairly Poor	69.26%
Mean Biotic Score	**4.29**	**Good**	**59.74%**

The percentage of EPT individuals refers to the total percentage of Ephemeroptera (mayfly nymphs), Plecoptera (stonefly nymphs), and Trichoptera (caddisfly larvae) individuals in a sample. Generally, the percent of EPT individuals increases with increasing water quality. The percentage of EPT individuals in the Cocheco River watershed varied widely from 19.61 percent to 91.25 percent. Samples from 27-CCH, 01-DMS, and 02-RNB were comprised of greater than 75 percent EPT individuals and samples from 03-MAR, 01F-RAT, and 01-AXE were comprised of less than 50 percent EPT individuals. The mean percentage of EPT individuals in the watershed was 59.74 percent.

In 2008, a total of 1,414 macroinvertebrates from 17 taxonomic groups were collected and identified by volunteers in the Cocheco River watershed. The number of individuals sorted at each station ranged from 51 to 594. The estimated macroinvertebrate abundance ranged from 51 to 2,368 individuals per sample. The most abundant taxonomic group in the watershed were the Trichoptorans (caddisfly larvae), comprising 56 percent of the total number if individuals collected (Figure 14). Ephemeroptera (mayfly nymphs) and Diptera (true flies) were also well represented in the total sample, accounting for 13 and 11 percent of the individuals, respectively.

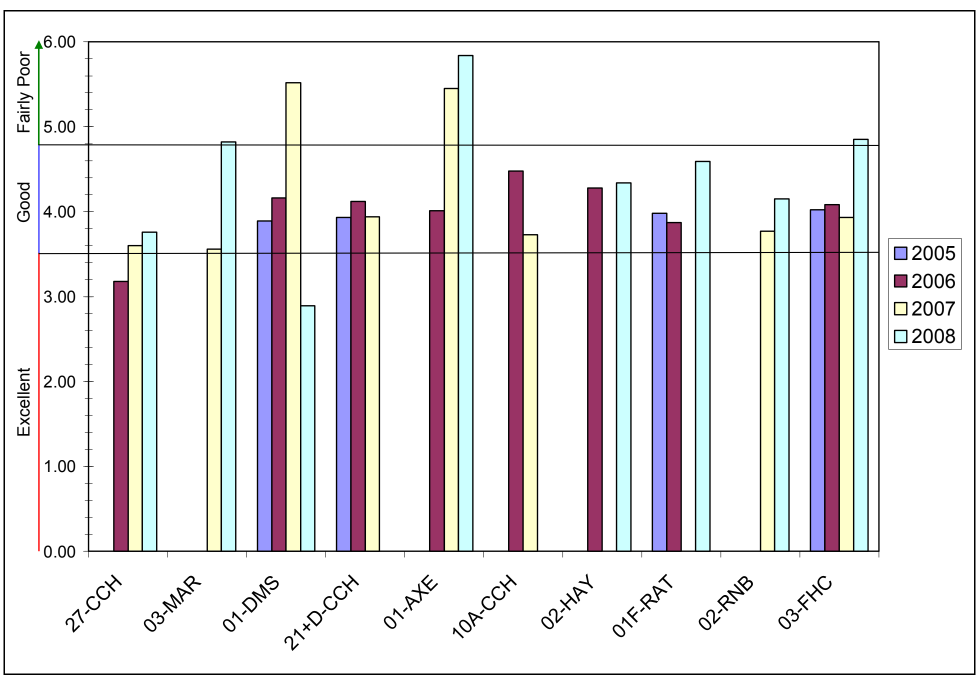
Figure 14. Biological Sample Composition Statistics - Cocheco River Watershed, 2008



Discussion

Compared to results from 2007, biotic scores increased at all but one station (Figure 15). The increasing biotic scores resulted in a change in narrative category at one station, 03-MAR. In 2007, this stream yielded a biotic score of 3.58, corresponding to the "good" category, and was composed of 91.53 percent EPT individuals. In 2008 the stream yielded a biotic score of 4.82, corresponding to the "fairly poor" category, and was composed of 43.75 percent EPT individuals.

Figure 15. Annual Biotic Scores – Cocheco River Watershed, 2005-2008.



01-DMS was the only station where a change in the biotic score and representative narrative category constituted an apparent improvement in community condition. This station, however, has experienced drastic changes in biotic scores over the past three years. In 2005 and 2006 results corresponded to the "good" category, with biotic scores of 3.89 and 4.21, respectively. In 2007 the biotic score was 5.72, corresponding to the "fairly poor" category and the sample was composed of only 25.00 percent EPT individuals. However, in 2008 the biotic score was 2.89 corresponding to the "excellent" category and was comprised of 76.16 percent EPT individuals, representing an improvement in community condition. These fluctuations in biotic score may be partially attributed to variations in flow between years.

In 2008, mean abundance of macroinvertebrates in the Cocheco River watershed was 551 individuals per sample and was lower than the mean abundances for 2007 (1,292) and 2006 (988).

Quality Control Test

No quality control sample was taken in the Cocheco River watershed.

Recommendations

- Consider closely monitoring water quality at 01-DMS through further physical, chemical, and biological sampling to determine the potential causes of the variable biotic scores observed over the past three years.

- Investigate the cause of sand deposits in the stream at 03-MAR.

- Consider closely monitoring water quality at 03-MAR to determine the cause of the "fairly poor" results.

- Assess the current biotic index and investigate potential ways to further improve the rating scale

- Continue annual sampling at all stations in order to develop a long-term data set to better understand trends.

APPENDIX A: 2008 COCHECO RIVER WATERSHED VRAP DATA

(blue)	Measurements not meeting New Hampshire surface water quality standards
(yellow)	Turbidity measuremets potentially not meeting New Hampshire surface water quality standards
(pink)	Total Phosphorous measurements exceeding NHDES level of concern
(diagonal line)	Measurements not meeting NHDES quality assurance/quality control standards

[A] Water quality data collected in association with VBAP sampling

[B] Chronic water quality standard

01-XCR, Sunrise Lake Inlet, Pinkham Road Bridge, Middleton

Date	Time of Sample	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean
Standard	**NA**	**<406**	**<126**
08/25/2008	09:45	60	
09/08/2008	08:25	430	
09/16/2008	08:00	110	142

02-XCH, Sunrise Lake Outlet, Nicola Road Bridge, Middleton

Date	Time of Sample	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean
Standard	**NA**	**<406**	**<126**
08/25/2008	09:50	5	
09/08/2008	08:40	330	
09/16/2008	08:10	0.01	3

01-XCH, Tributary to Cocheco River, Silver Street Bridge, Middlton

Date	Time of Sample	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean
Standard	**NA**	**<406**	**<126**
08/25/2008	10:10	0.01	
09/08/2008	09:00	290	
09/16/2008	08:30	20	4

02-HAY, Hayes Brook, Middlton Road Bridge, New Durham

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	<406	<126
08/25/2008	09:20							10	
09/02/2008[A]	09:20	9.14	95.7	6.09	0.74	88.5	16.4		
09/08/2008	08:10							190	
09/16/2008	07:40							70	51

06-ELA, Ela River, Davis Cross Road Bridge, New Durham

Date	Time of Sample	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean
Standard	NA	<406	<126
08/25/2008	09:10	0.01	
09/08/2008	07:54	1440	
09/16/2008	07:30	20	7

30-CCH, Cocheco River, Middletown Road Bridge, New Durham

Date	Time of Sample	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Chloride (mg/L)
Standard	NA	<406	<126	230[B]
08/25/2008	09:25	60		2.5
09/08/2008	08:20	110		
09/16/2008	07:50	140	97	

27-CCH, Cocheco River, Spring Street Bridge, Farmington

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA
09/02/2008[A]	12:30	8.62	92.9	5.93	0.61	62.9	19.0

03-MAR, Mad River, River Sreet Bridge, Farmington

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)
Standard	**NA**	**>5.0**	**>75% Daily Average**	**6.5-8.0**	**<10 NTU above backgrd**	**(µS/cm as chloride surrogate)**	**NA**
09/04/2008[A]	10:05	9.61	100.0	6.06	0.91	50.2	16.8

26-CCH, Cocheco River, Central Street Bridge, Farmington

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Total Phosphorus (mg/L)	Chloride (mg/L)
Standard	**NA**	**>5.0**	**>75% Daily Average**	**6.5-8.0**	**<10 NTU above backgrd**	**(µS/cm as chloride surrogate)**	**NA**	**<406**	**<126**	**NA**	**230[B]**
06/02/2008	10:40							100			25
06/30/2008	09:45							190			
07/31/2008	08:40							90	120		
08/01/2008	09:10	8.45	90.0	6.21	1.88	85.3	20.6				
08/26/2008	10:10	10.05	95.6	6.42	1.11	92.3	13.1				
08/31/2008	10:40	9.76	107.6	6.11	2.18	109.7	21.2			0.015	21

25-CCH, Cocheco River, South Main / Route 153 Bridge, Farmington

Date	Time of Sample	*E. coli* (CTS/100mL)
Standard	**NA**	**<406**
07/31/2008	08:30	70

01-DMS, Dames Brook, Route 75 Bridge, Farmington

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)
Standard	**NA**	**>5.0**	**>75% Daily Average**	**6.5-8.0**	**<10 NTU above backgrd**	**(µS/cm as chloride surrogate)**	**NA**
09/09/2008[A]	09:00	9.27	94.2	5.72	0.56	80.9	16.3

23-CCH, Cocheco River, Watson Corner Road Bridge, Farmington

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Total Phosphorus (mg/L)	Chloride (mg/L)
Standard	**NA**	**>5.0**	**>75% Daily Average**	**6.5-8.0**	**<10 NTU above backgrd**	**(µS/cm as chloride surrogate)**	**NA**	**<406**	**<126**	**NA**	**230[B]**
06/02/2008	10:30							20			36
06/30/2008	09:35							80			
07/31/2008	08:20							110	56		
08/01/2008	08:45	7.83	86.2	5.85	2.28	86.3	20.1				
08/26/2008	09:50	9.49	89.5	6.13	2.73	117.9	12.8				
08/31/2008	10:15	8.44	97.5	5.81	2.61	141.0	20.0			0.037	30

22U-CCH, Cocheco River, Pike Industries, Farmington

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Total Phosphorus (mg/L)	Chloride (mg/L)
Standard	**NA**	**>5.0**	**>75% Daily Average**	**6.5-8.0**	**<10 NTU above backgrd**	**(µS/cm as chloride surrogate)**	**NA**	**<406**	**<126**	**NA**	**230[B]**
06/02/2008	10:20							20			31
06/30/2008	09:20							180			
07/31/2008	08:10							150	81		
08/01/2008	08:35	7.98	95.0	6.16	2.62	98.5	20.1				
08/26/2008	09:30	8.25	83.2	6.10	1.70	145.6	12.6				
08/31/2008	10:30	8.41	94.1	5.71	4.54	173.5	19.8			0.030	36

01F-RAT, Rattlesnake Brook, Behind Auto Shop, Farmington

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)
Standard	**NA**	**>5.0**	**>75% Daily Average**	**6.5-8.0**	**<10 NTU above backgrd**	**(µS/cm as chloride surrogate)**	**NA**
09/04/2008[A]	13:15	9.00	96.5	5.25	0.36	43.0	18.7

22-CCH, Cocheco River, Little Falls Bridge, Rochester

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Total Phosphorus (mg/L)	Chloride (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	<406	<126	NA	230[B]
06/02/2008	10:10							110			27
06/30/2008	09:10							360			
07/01/2008	08:50	6.92	75.9	5.99	3.17	111.4	19.9				
07/31/2008	08:00							80	147		
08/26/2008	09:10	8.88	88.3	6.07	2.15	131.5	12.7				
08/31/2008	09:55	8.57	93.0	5.98	3.01	154.1	19.6			0.022	31

21-CCH, Cocheco River, Route 202A Bridge, Rochester

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Total Phosphorus (mg/L)	Chloride (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	<406	<126	NA	230[B]
06/02/2008	10:00							40			35
06/07/2008	09:30	5.94	62.4	6.23	2.11	200.5	17.4				
06/30/2008	08:59							320			
07/01/2008	08:10	6.90	77.8	5.89	2.22	112.9	21.4				
07/31/2008	08:55							90	105		
08/26/2008	08:45	8.33	80.0	5.63	2.12	151.5	13.6				
08/31/2008	09:45	7.95	87.6	5.86	3.24	168.8	20.2			0.020	37

20J-CCH, Cocheco River, Bridge Street Bridge, Rochester

Date	Time of Sample	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean
Standard	NA	<406	<126
06/16/2008	08:50	140	
07/22/2008	09:30	80	
07/31/2008	09:05	10	48
08/12/2008	08:55	620	79

19-CCH, Cocheco River, Route 125 Bridge, Rochester

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Total Phosphorus (mg/L)	Chloride (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	<406	<126	NA	230[B]
06/02/2008	09:45							40			43
06/30/2008	08:45							90			
07/01/2008	07:40	7.53	83.8	6.20	2.81	127.3	20.7				
07/31/2008	09:10							90	69		
08/26/2008	08:15	9.35	89.6	6.48	2.95	172.6	13.6				
08/31/2008	09:30	8.32	90.9	6.18	4.46	189.6	19.9			0.020	42

01-AXE, Axe Handle Brook, Route 125 Bridge, Rochester

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA
09/11/2008[A]	09:00	9.27	92.1	5.90	1.43	75.6	15.1

08-WIL, Willow Brook, 100 Meters Upstream from Portand Ave Bridge, Rochester

Date	Time of Sample	*E. coli* (CTS/100mL)
Standard	NA	<406
10/15/2008	14:15	40

06-WIL, Willow Brook, Portland Street, Rochester

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	<406	<126
06/16/2008	08:00							360	
06/17/2008	08:50	8.60	86.5	5.03	0.93	144.6	15.4		
07/22/2008	08:30							140	
08/12/2008	08:05							460	285

05T-WIL, Willow Brook, Prospect Street, Rochester

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean
Standard	**NA**	**>5.0**	**>75% Daily Average**	**6.5-8.0**	**<10 NTU above backgrd**	**(µS/cm as chloride surrogate)**	**NA**	**<406**	**<126**
06/16/2008	08:10							920	
06/17/2008	09:00	8.27	82.5	5.14	1.26	126.2	14.8		
07/22/2008	08:40							120	
08/12/2008	08:10							400	353

05G-WIL, Winter Street at Adams Ave., Rochester

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean
Standard	**NA**	**>5.0**	**>75% Daily Average**	**6.5-8.0**	**<10 NTU above backgrd**	**(µS/cm as chloride surrogate)**	**NA**	**<406**	**<126**
06/16/2008	08:15							420	
06/17/2008	09:30	8.93	88.8	5.31	1.15	161.4	15.2		
07/22/2008	08:20							200	
08/12/2008	08:15							300	293
08/31/2008	08:15							300	262

05-WIL, Western Ave., Rochester

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean
Standard	**NA**	**>5.0**	**>75% Daily Average**	**6.5-8.0**	**<10 NTU above backgrd**	**(µS/cm as chloride surrogate)**	**NA**	**<406**	**<126**
06/16/2008	08:20							370	
06/17/2008	09:50	9.11	91.5	5.51	1.54	164.0	15.6		
07/22/2008	08:10							400	
08/12/2008	08:30							490	443

05-WIL-PIPE, Stormwater Pipe on Downstream Side of 05-WOR, Rochester

Date	Time of Sample	*E. coli* (CTS/100mL)
Standard	NA	<406
08/12/2008	08:33	580

04-WIL, Willow Brook, Franklin Street Just North of Main Street, Rochester

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	<406	<126
06/16/2008	08:30							510	
06/19/2008	09:30	8.78	87.8	5.93	1.92	208.8	15.6		
07/22/2008	08:00							300	
08/12/2008	08:40							600	451

02-WIL, Willow Brook, Lowell Street, Rochester

Date	Time of Sample	*E. coli* (CTS/100mL)
Standard	NA	<406
06/16/2008	09:00	650
07/22/2008	09:00	1600

02-XWD, Unknown Tributary to Willow Brook, Lowell Street, Rochester

Date	Time of Sample	*E. coli* (CTS/100mL)
Standard	NA	<406
08/12/2008	09:10	1060

01M-WIL, Willow Brook, Meadow Lane, Rochester

Date	Time of Sample	*E. coli* (CTS/100mL)
Standard	NA	<406
07/22/2008	09:55	40

01-WIL, Willow Brook, Old Dover Road Bridge, Rochester

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	<406	<126
06/16/2008	09:15							440	
06/17/2008	08:00	8.29	85.7	6.29	3.09	265.2	15.2		
06/19/2008	09:50	8.64	88.6	5.99	1.58	248.3	16.3		
07/22/2008	09:10							1000	
08/12/2008	09:20							680	669

18-CCH, Cocheco River, Maple Street Bridge, Rochester

Date	Time of Sample	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean
Standard	NA	<406	<126
06/16/2008	09:30	350	
07/31/2008	09:20	60	
08/12/2008	09:35	560	227

12-CCH, Cocheco River, Strafford County Farm, Dover

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Total Phosphorus (mg/L)	Chloride (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	<406	<126	NA	230[B]
03/17/2008						85.9					27
04/12/2008						71.0	17.9				19
04/26/2008	12:45					113.0	14.7				35
06/02/2008	08:45							40			46
06/09/2008	09:00	8.08	90.8	6.22	4.48	190.0	20.9				
06/30/2008	08:30							140			
07/31/2008	09:35							100	82		
08/21/2008	09:00	8.06	86.4	6.52	3.92	159.7	18.2			0.061	38
09/25/2008	10:30	9.51	93.4	6.24	2.40	186.3	14.7				

02-REY, Reyners Brook, Sixth Street, Dover

Date	Time of Sample	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	NA	NA	NA	230[B]
02/02/2008		270.0		
02/16/2008		275.0		
03/07/2008		287.0		
03/17/2008		221.0		84
04/12/2008		199.8	20.5	58
04/26/2008	12:30	257.9	13.9	93

11-CCH, Cocheco River, Watson Road Bridge, Dover

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Total Phosphorus (mg/L)	Chloride (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	<406	<126	NA	230[B]
03/17/2008						90.9					27
04/12/2008						73.7	19.3				19
04/26/2008	13:00					111.1	14.4				34
06/02/2008	08:30							0.01			47
06/09/2008	08:25	7.90	90.9	6.38	5.35	225.6	22.4				
06/30/2008	08:15							30			
07/31/2008	09:45							20	20		
08/21/2008	09:30	7.95	86.7	6.50	3.88	146.3	19.8			0.051	35
09/25/2008	11:10	8.40	84.9	6.19	2.54	180.8	14.8				

01-IBK-E, Indian Brook, Sixth Street, Dover

Date	Time of Sample	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	NA	NA	NA	230[B]
02/02/2008		1690.0		
02/16/2008		665.0		
03/07/2008		632.0		
03/17/2008		498.0		210
04/12/2008		491.0	18.1	170
04/26/2008	11:45	781.0	15.3	320

01-IBK-W, Indian Brook, Sixth Stree, Dover

Date	Time of Sample	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	**NA**	**NA**	**NA**	**230[B]**
02/02/2008		2060.0		
02/16/2008		760.0		
03/07/2008		703.0		
03/17/2008		605.0		260
04/12/2008		1182.0	20.1	400
04/26/2008	12:00	740.0	14.6	300

10-CCH, Cocheco River, Whittier Street Bridge, Dover

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Total Phosphorus (mg/L)	Chloride (mg/L)
Standard	**NA**	**>5.0**	**>75% Daily Average**	**6.5-8.0**	**<10 NTU above backgrd**	**(µS/cm as chloride surrogate)**	**NA**	**<406**	**<126**	**NA**	**230[B]**
03/17/2008						97.2					29
04/12/2008						80.2	21.7				19
04/26/2008	13:15					111.1	14.1				34
06/02/2008	08:10							10			49
06/09/2008	08:00	8.30	90.5	6.45	3.58	233.3	19.5				
06/30/2008	08:05							100			
08/21/2008	09:40	8.62	93.4	6.15	3.64	153.8	19.6			0.051	37
08/25/2008	08:00							70	41		
09/25/2008	11:30	10.37	102.1	6.73	6.73	190.5	15.0				

02-BRR, Berry Brook, Sixth Street Bridge, Dover

Date	Time of Sample	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	**NA**	**NA**	**NA**	**230[B]**
02/02/2008		1420.0		
02/16/2008		834.0		
03/07/2008		792.0		
03/17/2008		605.0		210
04/12/2008		590.0	16.3	180
04/26/2008	12:15	667.0	14.5	230

01-LIB, Library Spring, Off of Locust Street, Dover

Date	Time of Sample	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	**NA**	**NA**	**NA**	**230[B]**
03/26/2008		450.0		140
04/12/2008		537.0	16.1	150
04/26/2008	11:30	533.0	14.9	170

01-CDR, Cedar Brook, Fourth Street, Dover

Date	Time of Sample	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	**NA**	**NA**	**NA**	**230[B]**
02/02/2008		384.0		
02/16/2008		394.0		
03/07/2008		389.0		
03/17/2008		274.0		81
04/12/2008		300.5	19.4	68
04/26/2008	13:30	396.2	13.2	100

07-CCH, Cocheco River, Central Avenue Bridge, Dover

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Total Phosphorus (mg/L)	Chloride (mg/L)
Standard	**NA**	**>5.0**	**>75% Daily Average**	**6.5-8.0**	**<10 NTU above backgrd**	**(µS/cm as chloride surrogate)**	**NA**	**<406**	**<126**	**NA**	**230[B]**
03/17/2008						99.5					29
04/12/2008						70.1	16.0				20
04/26/2008	11:00					118.3	15.8				36
06/02/2008								20			53
06/09/2008	07:25	7.63	86.9	6.84	4.08	249.5	21.5				
06/30/2008	07:50							50			
08/21/2008	09:45	7.98	91.7	6.18	3.39	141.9	21.5			0.048	35
08/25/2008	07:50							40	34		
09/25/2008	11:55	9.42	96.9	6.58	2.45	188.5	17.2				

02-CKT, Cricket Brook, Cobble Hill Spring, Dover

Date	Time of Sample	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	NA	NA	NA	230[B]
03/26/2008		150.0		28
04/12/2008		179.0	18.1	36
04/26/2008	11:15	160.7	12.5	38

01-CKT, Cricket Brook, Cricket Brook Apartments, Dover

Date	Time of Sample	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	NA	NA	NA	230[B]
02/02/2008		546.0		
02/16/2008		377.0		
03/07/2008		362.0		
03/17/2008		245.0		72
04/12/2008		214.0	16.0	49
04/26/2008	10:45	305.2	15.7	93

03-WAR, Warren Brook, Somersworth Road, Rollinsford

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Total Phosphorus (mg/L)	Chloride (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	<406	<126	NA	230[B]
03/25/2008	11:00					83.9					14
07/12/2008	07:45	6.77	72.6	6.49	97.40	201.9	18.6				
08/02/2008	07:15	4.00	43.3	6.23	8.85	136.8	19.1				
08/22/2008	08:20	4.57	46.2	5.97	33.80	141.5	16.0	5		0.073	21
09/08/2008	07:20							50			
09/13/2008	07:40	5.84	58.1	6.04	5.23	97.7	15.1				
09/15/2008	06:40					96.6		20	17		14

02-WAR, Warren Brook, Rollins Road, Rollinsford

Date	Time of Sample	Specific Conductance (uS/cm)	Chloride (mg/L)
Standard	NA	NA	230[B]
03/25/2008	11:10	126.2	26

05-TWO, Twombley Brook, Green Street, Rollinsford

Date	Time of Sample	Specific Conductance (uS/cm)	*E. coli* (CTS/100mL)	Chloride (mg/L)
Standard	NA	NA	<406	230B
03/25/2008	11:45	355.4		90
09/08/2008	07:30		460	

01-YTN, Yeaton Brook, Goodwin Road, Rollinsford

Date	Time of Sample	Specific Conductance (uS/cm)	Chloride (mg/L)
Standard	NA	NA	230[B]
03/25/2008	11:35	224.5	57

03-CLM, Clement Brook, Goodwin Road, Rollinsford

Date	Time of Sample	Specific Conductance (uS/cm)	Chloride (mg/L)
Standard	NA	NA	230[B]
03/25/2008	11:40	67.7	7.6

02-CLM, Clement Brook, Rollins Road, Rollinsford

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Total Phosphorus (mg/L)	Chloride (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	<406	<126	NA	230[B]
03/25/2008	11:30					165.9					37
07/12/2008	08:25	7.34	80.6	6.78	8.47	471.4	19.6				
08/02/2008	07:45	8.23	92.2	6.69	5.54	191.1	20.5				
08/22/2008	09:05	9.05	94.3	6.60	6.70	183.6	17.3	10		0.029	38
08/23/2008	09:00	8.98	91.2	6.43	4.23	166.5	16.1				
09/08/2008	07:35							680			
09/15/2008	07:00					190.5		340	132		42

01-RNB, Rollins Brook, Rollins Road, Rollinsford

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Total Phosphorus (mg/L)	Chloride (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	<406	<126	NA	230[B]
03/25/2008	12:00					365.5					100
07/12/2008	08:50	0.53	6.3	6.19	25.80		21.0				
08/02/2008	08:15	1.47	16.7	6.10	19.20	338.2	21.3				
08/22/2008	09:30	1.11	11.8	6.02	16.10	373.5	18.4	70		0.048	110
09/08/2008	07:40							120			
09/13/2008	09:40					319.6		120	100		85
09/16/2008[A]	13:00	2.60	27.4	5.90	7.05	356.5	17.9				
09/24/2008	09:25	2.37	23.9	5.86	6.28	319.6	15.9				

03-TWO, Twombley Brook, Rollins Road, Rollinsford

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	Total Phosphorus (mg/L)	Chloride (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	<406	NA	230[B]
03/25/2008	11:20					192.2				40
07/12/2008	08:05	7.45	81.8	6.77	4.99	388.1	19.0			
08/02/2008	07:30	7.01	78.8	6.67	5.34	251.8	21.2			
08/22/2008	08:50	8.44	87.6	6.71	4.34	299.5	17.2	40	0.022	66
09/13/2008	08:40	8.43	84.5	6.54	3.57	282.3	15.4			
09/15/2008	06:55					269.3		240		58

04-FHC, Fresh Creek, Route 4 Bridge, Rollinsford

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Total Phosphorus (mg/L)	Chloride (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	<406	<126	NA	230[B]
03/25/2008	12:10					213.3					51
07/12/2008	09:10	6.04	67.3	6.75	19.20	380.0	20.5				
08/02/2008	08:35	7.04	80.3	6.76	12.70	274.0	21.4				
08/22/2008	09:50	7.64	80.0	6.72	11.50	285.0	17.7	160		0.047	63
09/08/2008	07:50							1000			
09/13/2008	09:40	8.65	87.5	6.54	5.94	249.2	15.7				
09/13/2008	09:50					249.2		270	351		52

03-FHC, Fresh Creek, Old Mill Lane, Rollinsford

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA
09/16/2008[A]	10:00	9.02	92.7	6.68	6.72	272.7	16.7

00-FHC, Fresh Creek, Gulf Road, Dover

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Total Phosphorus (mg/L)	Chloride (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	<406	<126	NA	230[B]
03/25/2008	12:20					189.8					41
07/12/2008	09:25	6.69	70.4	6.79	6.73	348.4	23.7				
08/02/2008	08:55	4.75	55.2	6.51	7.52	230.0	22.8				
08/22/2008	10:00	5.39	59.0	6.41	6.46	221.3	19.8	10		ND	43
09/08/2008	07:58							1500			
09/13/2008	09:55	6.38	67.5	6.18	5.26	200.2	17.5				
09/13/2008	10:00					200.2		290	163		39

01-KNX, Knox Marsh Brook, Downstream of 155 Bridge, Dover

Date	Time of Sample	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	NA	NA	NA	230[B]
02/02/2008		207.0		
02/16/2008		197.0		
03/07/2008		185.0		
03/17/2008	00:00	128.0		38
04/12/2008	00:00	170.4	19.8	35
04/26/2008	13:45	164.9	12.9	36

01-JNC, Johnson Creek, Downstream of Spruce Lane, Dover

Date	Time of Sample	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	NA	NA	NA	230[B]
02/16/2008		318.0		
03/07/2008		364.0		
03/17/2008	00:00	293.0		100
04/12/2008	00:00	320.1	23.7	80

04/26/2008	14:00	416.7	13.8	140

APPENDIX B:
Interpreting VRAP Water Quality Monitoring Parameters

Chemical Parameters

Dissolved Oxygen (DO)

- **Unit of Measurement:** concentration in milligrams per liter (mg/L) and percent saturation (%).
- **Description:** A measure of the amount of oxygen in the water: Concentration is a measure of the amount of oxygen in a volume of water; saturation is a measurement of the amount of oxygen in the water compared to the amount of oxygen the water can actually hold at full saturation. Both of these measurements are necessary to accurately determine whether New Hampshire surface water quality standards are met.
- **Importance**: Oxygen is dissolved into the water from the atmosphere, aided by wind and wave action, or by rocky, steep, or uneven stream beds. The presence of dissolved oxygen is vital to bottom-dwelling organisms as well as fish and amphibians. Aquatic plants and algae produce oxygen in the water during the day, and consume oxygen during the night. Bacteria utilize oxygen both day and night when they process organic matter into smaller and smaller particles.

Class A NH Surface Water Quality Standard: 6 mg/L at any place or time, or 75% minimum daily average – (unless naturally occurring).

Class B NH Surface Water Quality Standard: 5 mg/L at any place or time or 75% minimum daily average – (unless naturally occurring).

Several measurements of oxygen saturation taken in a 24-hour period must be averaged to compare to the 75 percent daily average saturation standard. The concentration of dissolved oxygen is dependent on many factors including temperature and sunlight, and tends to fluctuate throughout the day. Saturation values are averaged because a reading taken in the morning may be low due to respiration, while a measurement that afternoon may show that the saturation has recovered to acceptable levels. Water can become saturated with more than 100 percent dissolved oxygen.

pH

- **Unit of Measurement:** units (no abbreviation).
- **Description:** A measure of hydrogen ion activity in water, or, in general terms, the acidity of water. pH is measured on a logarithmic scale of 0 to 14, with 7 being neutral. A high pH indicates alkaline (or basic) conditions and a low pH indicates acidic conditions. pH is influenced by geology and soils, organic acids (decaying leaves and other matter), and human-induced acids from acid rain (which typically has a pH of 3.5 to 5.5).
- **Importance:** pH affects many chemical and biological processes in the water and this is important to the survival and reproduction of fish and other aquatic life. Different organisms flourish within different ranges of pH. Measurements outside of an organism's preferred range can limit growth and reproduction and lead to physiological stress. Low pH can also affect the toxicity of aquatic compounds such as ammonia and certain metals by making them more "available" for uptake by aquatic plants and animals. This can produce conditions that are toxic to aquatic life.

Class A NH Surface Water Quality Standard: Between 6.5 and 8.0 (unless naturally occurring).

Class B NH Surface Water Quality Standard: Between 6.5 and 8.0 (unless naturally occurring).

Sometimes, readings that fall below this range are determined to be naturally occurring. This is often a result of wetlands near the sample station. Wetlands can lower pH because the tannic and humic acids released by decaying plants can cause water to become more acidic.

pH Units	Category
<5.0	High Impact
5.0 – 5.9	Moderate to High Impact
6.0 – 6.4	Normal; Low Impact
6.5 – 8.0	Normal;
6.1 – 8.0	Satisfactory

Specific Conductance or Conductivity

- **Unit of Measurement:** micromhos per centimeter (umhos/cm) or microsiemens per centimeter (uS/cm).
- **Description:** The numerical expression of the ability of water to carry an electrical current at 25^{o} C and a measure of free ion (charged particles) content in the water. These ions can come from natural sources such as bedrock, or human sources such as stormwater runoff. Specific conductance can be used to indicate the presence of chlorides, nitrates, sulfates, phosphates, sodium, magnesium, calcium, iron, and aluminum ions. There is a difference between conductivity and specific conductance. Specific conductance measures the free ion content of water at a *specific* water temperature, whereas conductivity measures the free ion content of water at 25° C. VRAP uses the term "specific conductance" because our conductivity measurements account for temperature. In some studies and programs, the term "conductivity" is used. This term should only be used when the measurement *does not* adjust to a specific temperature.
- **Importance:** Specific conductance readings can help locate potential pollution sources because polluted water usually has a higher specific conductance than unpolluted waters. High specific conductance values often indicate pollution from road salt, septic systems, wastewater treatment plants, or urban/agricultural runoff. Specific conductance can also be related to geology. In unpolluted rivers and streams, geology and groundwater are the primary influences on specific conductance levels.

Class A NH Surface Water Quality Standard: No numeric standard.

Class B NH Surface Water Quality Standard: No numeric standard.

Although there is no formal standard for specific conductance, data collect by VRAP groups and NHDES indicated a very close relationship between specific conductance levels and chloride. In some cases NHDES can use specific conductance measurements as a surrogate for chloride levels. The data collected by NHDES indicate that the chronic chloride standard is correlated with a specific conductance level of approximately 850 µS/cm.

Specific Conductance *(uS/cm)*	**Category**
0 – 100	Normal
101 – 200	Low Impact
201 – 500	Moderate Impact
> 501	High Impact
> 850	Likely exceeding chronic chloride standard

Turbidity

- **Unit of Measurement:** Nephelometric Turbidity Units (abbreviated at NTU).
- **Description:** A measurement of the amount of suspended material in the water. This material, which is comprised of particles such as clay, silt, algae, suspended sediment, and decaying plant material, causes light to be scattered and absorbed, rather than transmitted in straight lines through the water.
- **Importance:** Higher turbidity increases water temperatures because suspended particles absorb more heat. This, in turn, reduces dissolved oxygen (DO) concentrations because warm water holds less DO than cold water. Higher turbidity also reduces the amount of light that can penetrate the water, which reduces photosynthesis and DO production. Suspended materials can clog fish gills, reducing disease resistance, lowering growth rates, and affecting egg and larval development. As the particles settle, they can blanket the stream bottom, especially in slower waters, and smother fish eggs and benthic macroinvertebrates. Clean waters are generally associated with low turbidity, but there is a high degree of natural variability involved. Rain events can increase turbidity in surface waters by flushing sediment, organic matter and other materials into the water. Human activities such as vegetation removal and soil disruption can also lead to dramatic increases in turbidity levels.

Class A NH Surface Water Quality Standard: As naturally occurs.

Class B NH Surface Water Quality Standard: Shall not exceed naturally occurring conditions bv more than 10 NTU.

Physical Parameters

Temperature

- **Unit of Measurement:** Degrees Celsius (° C)
- **Importance:** Water temperature is a critical parameter for aquatic life and has an impact on other water quality parameters such as dissolved oxygen concentrations, and bacteria activity in water. Water temperature controls the metabolic and reproductive processes of aquatic species and can determine which fish and macroinvertabrate species can survive in a given river or stream.

  A number of factors can have an impact on water temperature including the quantity and maturity of riparian vegetation, the rate of flow, the percent of impervious surfaces contributing stormwater, thermal discharges, impoundments and groundwater.

Class A NH Surface Water Quality Standard: No numeric standard; as naturally occurs.

Class B NH Surface Water Quality Standard: No numeric standard

Although there is currently no numerical water quality criteria for water temperature, NHDES is in the process of collecting biological and water temperature data that will contribute to the development of a procedure for assessing rivers and stream based on water temperature and its corresponding impact to the biological integrity of the waterbody.

Chlorophyll-a (Chlor a)

- **Unit of Measurement:** Milligrams per liter (mg/L).
- **Description:** An indicator of the biomass, or abundance, of planktonic algae in the river. The technical term "biomass" is used to represent "amount by weight." Chlorophyll-a can be strongly influenced by phosphorus, which is derived by natural and human activities.

Importance: Because algae is a plant and contains the green pigment chlorophyll-a, the concentration of chlorophyll-a found in the water gives an estimation of the concentration of algae. If the chlorophyll-a concentration increases, this indicates an increase in the algal population.

Class A NH Surface Water Quality Standard: No numeric standard.

Class B NH Surface Water Quality Standard: No numeric standard.

Chlorophyll-a *(mg/L)*	**Category**
< 3	Excellent
3 – 7	Good
7 – 15	Less than desirable
> 15	Nuisance

Total Phosphorus (TP)

- **Unit of Measurement:** Milligrams per liter (mg/L).
- **Description:** A measure of all forms of phosphorus in the water, including inorganic and organic forms. There are many sources of phosphorus, both natural and human. These include soil and rocks, sewage, animal manure, fertilizer, erosion, and other types of contamination.
- **Importance:** Phosphorus is a nutrient that is essential to plants and animals. However, excess amounts can cause rapid increases in the biological activity in water. Phosphorus is usually the "limiting nutrient" in freshwater streams, which means relatively small amounts can increase algae and chlorophyll-a levels. Algal blooms and/or excessive aquatic plant growth can decrease oxygen levels and make water unattractive. Phosphorus can indicate the presence of septic systems, sewage, animal waste, lawn fertilizer, road and construction erosion, other types of pollution, or natural wetlands and atmospheric deposition.

Class A NH Surface Water Quality Standard: No numeric standard; as naturally occurs.

Class B NH Surface Water Quality Standard: No numeric standard; as naturally occurring, shall contain no phosphorus in such concentrations that would impair any existing or designated uses.

Total Phosphorus *(mg/L)*	**Category**
< 0.010	Ideal
0.011 – 0.025	Average
0.026 – 0.050	More than desirable
> 0.051	Excessive (potential nuisance concentration)

Total Kjeldahl Nitrogen (TKN)

- **Unit of Measurement:** Milligrams per liter (mg/L).
- **Description:** A measure of the amount of ammonia and organic nitrogen in the water.
- **Importance:** High nitrogen levels can increase algae and chlorophyll-a levels in the river, but is generally less of a concern in fresh water than phosphorus. Nitrogen can indicate the presence of sewage, animal waste, fertilizer, erosion, or other types of pollution.

Class A NH Surface Water Quality Standard: No numeric standard; as naturally occurs.

Class B NH Surface Water Quality Standard: No numeric standard; as naturally occurring, shall contain no nitrogen in such concentrations that would impair any existing or designated uses.

TKN *(mg/L)*	**Category**
< 0.25	Ideal
0.26 – 0.40	Average
0.41 – 0.50	More than desirable
> 0.51	Excessive (potential nuisance concentration)

Other Parameters

Chloride

- **Unit of Measurement:** Milligrams per liter (mg/L).
- **Description:** The chloride ion (Cl-) is found naturally in some surface waters and groundwater. It is also found in high concentrations in seawater. Higher-than-normal chloride concentrations in freshwater is detrimental to water quality. In New Hampshire, applying road salt for winter accident prevention is a large source of chloride to the environment. Unfortunately, this has increased over time due to road expansion and increased vehicle traffic. Road salt (most often sodium chloride) readily dissolves and enters aquatic environments in ionic forms. Although chloride can originate from natural sources, most of the chloride that enters the environment is associated with the storage and application of road salt. As such, chloride-containing compounds commonly enter surface water, soil, and groundwater during late-spring snowmelt (since the ground is frozen during much of the late winter and early spring). Sodium chloride is also used on foods as table salt, and consequently is present in human waste. Thus, sometimes chloride in water can indicate sewage pollution. Saltwater intrusion can also elevate groundwater chlorides in drinking water wells near coastlines. Chloride ions are conservative, which means they are not degraded in the environment and tend to remain in solution, once dissolved. Chloride ions that enter ground water can ultimately be expected to reach surface water and, therefore, influence aquatic environments and humans.
- **Importance:** Research shows elevated chloride levels can be toxic to freshwater aquatic life. Among the species tested, freshwater aquatic plants and invertebrates tend to be the most sensitive to chloride. In order to protect freshwater aquatic life in New Hampshire, the state has adopted acute and chronic chloride criteria.

Acute Standard: 860 mg/L.

Chronic Standard: 230 mg/L.

Escherichia Coliform Bacteria *(E. coli)*

- **Unit of Measurement:** Counts per 100 milliliter (cts/100 mL).
- **Description:** An indicator of the potential presence of pathogens in fresh water. *E. coli* bacteria is a normal component in the large intestines of humans and other warm-blooded animals, and can be excreted in their fecal material. Organisms causing infections or disease (pathogens) are often excreted in the fecal material of humans and other warm-blooded animals.
- **Importance:** *E.coli* bacteria is a good indicator of fecal pollution and the possible presence of pathogenic organisms. In freshwater, *E. coli* concentrations help determine if the water is safe for recreational uses such as swimming.

  Several factors can contribute to elevated *E. coli* levels, including, but not limited to rain storms, low river flows, the presence of wildlife, and the presence of septic systems along the river.

Class A NH Surface Water Quality Standard: Unless naturally occurring, shall contain not more than either a geometric mean of 47 *E.coli* cts/100 mL based on at least three samples obtained over a sixty-day period, or greater than 153 *E.coli* cts/100 mL in any one sample.

Class B NH Surface Water Quality Standard: Unless naturally occurring, shall contain not more than either a geometric mean of 126 *E.coli* cts/100 mL based on at least three samples obtained over a sixty-day period, or greater than 406 *E.coli* cts/100 mL in any one sample.

Metals

Depending on the metal concentration, its form (dissolved or particulate), and the hardness of the water, trace metals can be toxic to aquatic life. Metals in dissolved form are generally more toxic than metals in the particulate form. The dissolved metal concentration is dependent on pH, as well as the presence of solids and organic matter that can bind with the metal to render it less toxic.

Hardness is primarily a measure of the calcium and magnesium ion concentrations in water, expressed as calcium carbonate. The hardness concentration affects the toxicity of certain metals. New Hampshire water quality regulations include numeric criteria for a variety of metals. Since dissolved metals are typically found in extremely low concentrations, the potential contamination of samples collected for trace metals analyses has become a primary concern of water quality managers. To prevent such contamination and to ensure reliable results, the use of “clean techniques” is becoming more and more frequent when sampling for dissolved metals. Because of this, sampling for metals may be more costly and require additional effort than in the past.

New Hampshire Volunteer River Assessment Program

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2008

APPENDIX C:

2008 VRAP Field Audit

On August 22, 2008 VRAP staff visited volunteers from the Lower Cocheco River Watershed – Rollinsford VRAP group to conduct a field audit. VRAP staff aim to visit each group annually during a scheduled sampling event to verify that volunteers successfully follow the VRAP protocols. If necessary, volunteers are re-trained during the visit, and the group is notified of the result of the verification visit. During the visit, volunteers were assessed in the following five categories:

1) **Overall Sampling Procedures**

   Appropriate storage of meters, sample collection, laboratory sample collection and transportation, beginning and end of day meter checks, collecting a field replicate, performing QA/QC Meter Checks, and ensuring that all calibration and sampling data are properly documented on the 2008 VRAP Field Data Sheet and the Laboratory Services Login & Custody Sheet.

2) **Turbidity**

   Inspecting and cleaning of glass turbidity vials prior to measurement of standards and samples, performing the *Initial Turbidity Meter Check,* calibrating the meter to a known standard at the beginning of the sampling day, recording the value of the DI turbidity blank *(QA/QC Meter Check)* once during the sampling day, and performing the *End of the Day Meter Check* at the conclusion of the sampling day.

3) **pH**

   Inspecting the pH electrode prior to sampling, calibrating to both pH 7.0 and 4.0 buffers prior to each measurement, rinsing and wiping the pH electrode probe prior to and after the measurement of standards and samples, allowing the pH measurement to stabilize prior to recording the measurement, and recording the value of the 6.0 buffer *(QA/QC Meter Check)* once during the sampling day.

4) **Water Temperature/Dissolved Oxygen**

   Ensuring that the meter is allowed an adequate time to stabilize prior to the first calibration, the meter is calibrated prior to each measurement, the calibration value is properly recorded, the chamber reading is properly recorded, that sufficient time is allowed for readings to stabilize, and that a zero oxygen check (*QA/QC Meter Check)* is completed during the sampling day.

5) **Specific Conductance**

   Performing the *Initial Conductivity Meter Check* using a known standard, allowing for the meter to properly stabilize before recording measurements, properly cleaning the probe between stations, and performing the *End of the Day Meter Check* at the conclusion of the sampling day.

During the field sampling procedures assessment, VRAP staff offered important reminders and suggestions to ensure proper sampling techniques and re-trained volunteers in the areas needing improvement. Afterwards, the volunteers were sent a follow-up e-mail providing written reminders and suggestions of the methods that need improvement. Overall, the Lower Cocheco River Watershed - Rollinsford VRAP group did an excellent job. It is important to ensure that all volunteers attend an annual VRAP training workshop prior to the sampling season and to familiarize themselves with proper sampling techniques. Please remember to schedule an annual field audit in 2009.

APPENDIX D:
New Hampshire Watershed Report Cards
Built from the 2008 305(b)/303(d) Surface Water Quality Reports

305(b)/303(d) Integrated Report Background
http://des.nh.gov/organization/divisions/water/wmb/swqa/

The Surface Water Quality Assessment Program produces two surface water quality documents every two years, the "305(b) Report" and the "303(d) List". As the two documents use the same data and assessment methodology, the 305(b) Report and 303(d) List were combined into one Integrated Report. The Integrated Report describes the quality of New Hampshire's surface waters and an analysis of the extent to which all such waters provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife, and allow recreational activities in and on the water.

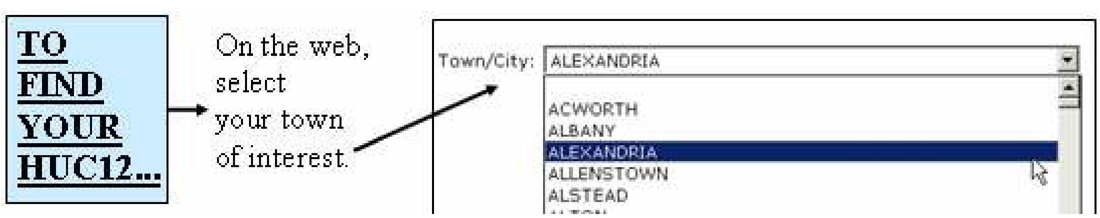
Each Watershed Report Card covers a single 12 digit Hydrologic Unit Code (HUC12), on average a 34 square mile area. Each Watershed Report Card has three components;

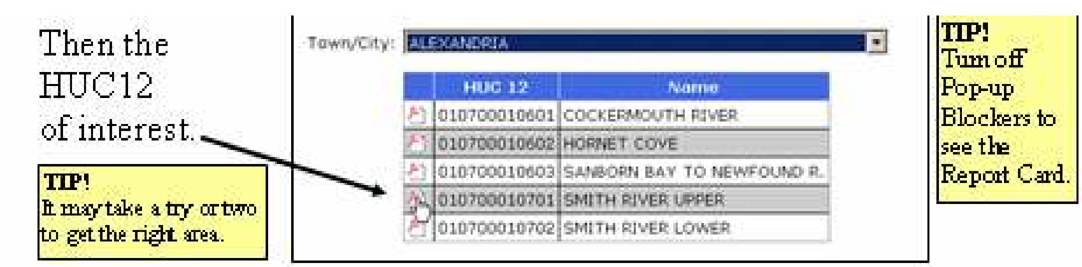
1. **Report Card:** A one page card that summarizes the overall use support for Aquatic Life, Primary Contact (i.e. Swimming), and Secondary Contact (i.e. Boating) Designated Uses on every Assessment Unit ID (AUID) within the HUC12.

2. **HUC 12 Map:** A map of the watershed with abbreviated labels for each AUID within the HUC12.

3. **Assessment Details:** Anywhere from one to forty pages with the detailed assessment information for each and every AUID in the Report Card and Map.

How to Find Your HUC12 Watershed Report Card:
http://des.nh.gov/organization/divisions/water/wmb/swqa/report_cards.htm
then go to: http://www2.des.nh.gov/SWQA





What are Assessment Units?

Each waterbody is divided into smaller segments called Assessment Units (AUs). In general, AUs are the basic unit of record for conducting and reporting the results of all water quality assessments. AUs are intended to be representative of homogenous segments: consequently, sampling stations within an AU can be assumed to be representative of the segment. Many factors can influence the homogeneity of a segment. Factors used to establish homogenous

AUs for assessments include: waterbody type, HUC12 boundaries, water quality standards, pollutant sources, Maximum AU size for rivers and streams, major changes in land use, stream order/location of major tributaries, public water supplies, outstanding resource waters, shellfish program categories, designated beaches, and cold water fish spawning areas.

Assessment Unit IDs (AUIDs) for each of the stations your group monitored in 2008 can be found in the sampling station table in this year's VRAP report. Similarly, a list of all current and historic sampling stations for your group can be found on the VRAP webpage at http://des.nh.gov/organization/divisions/water/wmb/vrap/index.htm.

How are the Surface Water Quality Assessment Determinations Made?

All readily available data with reliable Quality Assurance/Quality Control is used in the biennial surface water quality assessments. For a full understanding of how the Surface Water Quality Standards (Env-Wq 1700) are translated into surface water quality assessments we urge the reader to review the 2008 Consolidated Assessment and Listing Methodology (CALM) at http://des.nh.gov/organization/divisions/water/wmb/swqa/2008/index.htm (Appendices 4 & 5)

Where Can I find More Advanced Resources?

Additional resources including GIS shapefiles (Appendix 12) of all AUIDs in a sortable EXCEL file (Appendix 22) of the detailed assessments are available at http://des.nh.gov/organization/divisions/water/wmb/swqa/2008/index.htm.

How Are Assessments Coded in the Report Card?

Assessment outcomes are displayed on a color scale as well as an alpha numeric scale that provides additional distinctions for the designated use and Parameter level assessments as outlined in the table below.

		Severe	Poor	Likely Bad	No Data	Likely Good	Marginal	Good
		Not Supporting, Severe	Not Supporting, Marginal	Insufficient Information – Potentially Not Supporting	No Data	Insufficient Information – Potentially Full Supporting	Full Support, Marginal	Full Support, Good
Category	**Description**							
*Category 2	Meets standards						2-M or 2-OBS	2-G
Category 3	Insufficient Information			3-PNS	3-ND	3-PAS		
Category 4	Does not Meet Standards;							
4A	TMDL^ Completed	4A-P	4A-M or 4A-T					
4B	Other enforceable measure will correct the issue.	4B-P	4B-M or 4B-T					
4C	Non-pollutant (i.e. exotic weeds)	4C-P	4C-M					
Category 5	TMDL^ Needed	5-P	5-M or 5-T					

* "Category 1" only exists at the Assessment Unit Level.
^ TMDL stands for Total Maximum Daily Load studies (http://des.nh.gov/organization/divisions/water/wmb/tmdl/index.htm)

For More Information:

Ken Edwardson, NHDES Surface Water Quality Assessment Program Coordinator
(603) 271-8864 - Kenneth.Edwardson@des.nh.gov

WATERSHED 305(b) ASSESSMENT SUMMARY REPORT:

HUC 12 010600030601

HUC 12 NAME UPPER COCHECO RIVER

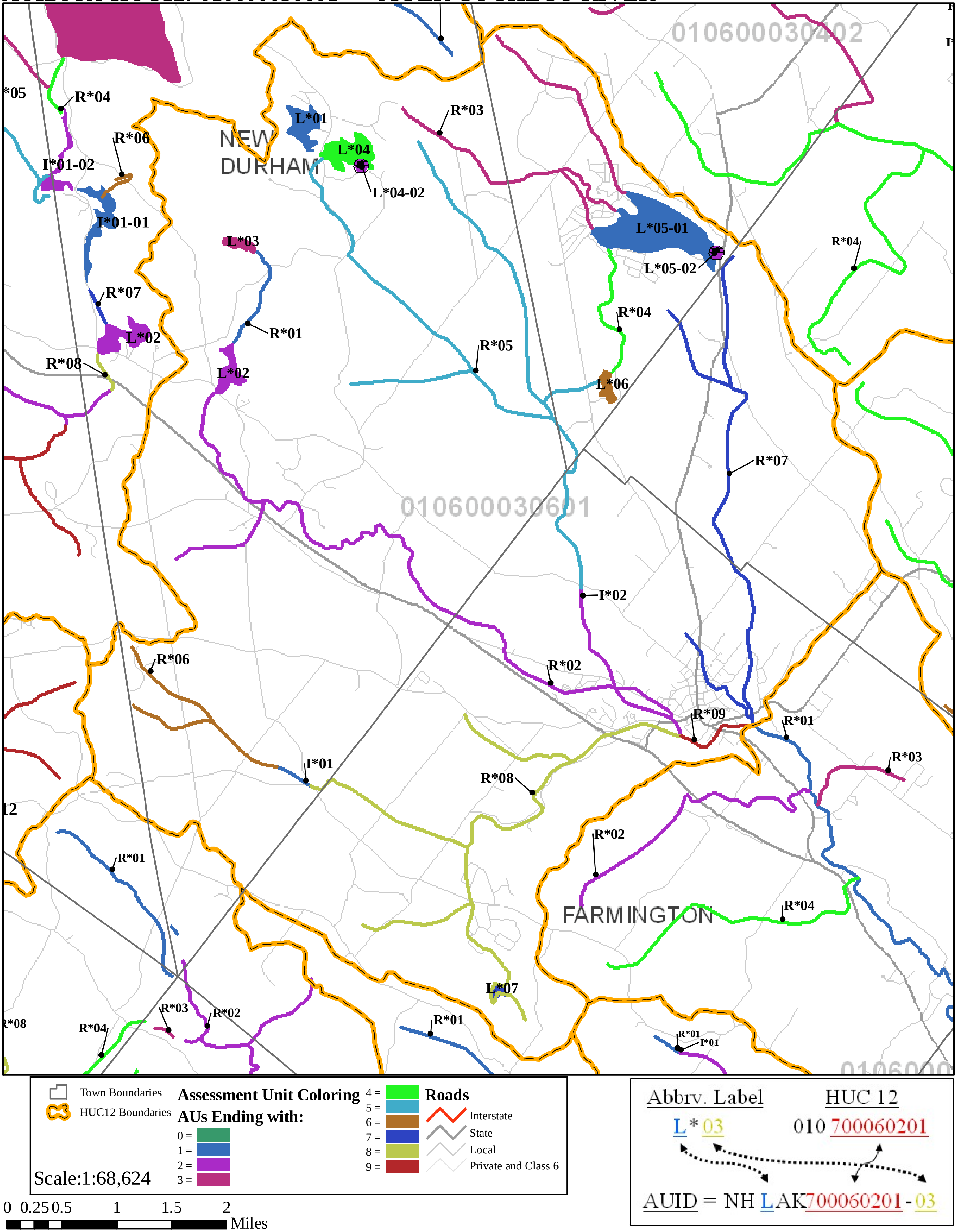
(Locator map on next page only applies to this HUC12)

Assessment Cycle 2008

Good	Full Support Good
Marginal	Full Support Marginal
Likely Good	Insufficient Information – Potentially Full Support
No Data	No Data
Likely Bad	Insufficient Information – Potentially Not Support
Poor	Not Support Marginal
Severe	Not Support Severe

ASSESSMENT UNIT ID	MAP LABEL	ASSESSMENT UNIT NAME	AQUATIC LIFE	SWIMMING	BOATING	FISH CONSUMP.
NHIMP600030601-01	I*01	BRANCH MAD RIVER	3-ND	3-ND	3-ND	4A-M
NHIMP600030601-02	I*02	COCHECO RIVER - COCHECO DAM I	3-ND	3-ND	3-ND	4A-M
NHLAK600030601-01	L*01	CHALK POND	3-PAS	2-G	2-G	4A-M
NHLAK600030601-02	L*02	CLUB POND	3-ND	3-ND	3-ND	4A-M
NHLAK600030601-03	L*03	COLDRAIN POND	3-ND	3-ND	3-ND	4A-M
NHLAK600030601-04	L*04	MARCHS POND	3-PAS	2-G	2-G	4A-M
NHLAK600030601-04-02	L*04-02	MARCHS POND - BIRCH HILL SUMMER CAMP BEACH	3-PAS	2-G	2-G	4A-M
NHLAK600030601-05-01	L*05-01	SUNRISE LAKE	4A-M	2-M	2-G	4A-M
NHLAK600030601-05-02	L*05-02	SUNRISE LAKE - TOWN BEACH	4A-M	5-P	2-G	4A-M
NHLAK600030601-06	L*06	CURRIER POND	3-ND	3-ND	3-ND	4A-M
NHLAK600030601-07	L*07	NUBBLE POND	3-ND	3-ND	3-ND	4A-M
NHRIV600030601-01	R*01	UNNAMED BROOK - TO CLUB POND	3-ND	3-ND	3-ND	4A-M
NHRIV600030601-02	R*02	COCHECO RIVER	5-M	5-P	2-M	4A-M
NHRIV600030601-03	R*03	COCHECO RIVER	5-P	2-G	2-G	4A-M
NHRIV600030601-04	R*04	COCHECO RIVER	3-ND	3-ND	3-ND	4A-M
NHRIV600030601-05	R*05	COCHECO RIVER - HAYES BROOK	5-M	2-M	2-G	4A-M
NHRIV600030601-06	R*06	UNNAMED BROOK - BRANCH OF MAD RIVER	3-ND	3-ND	3-ND	4A-M
NHRIV600030601-07	R*07	DAMES BROOK	5-P	5-M	2-M	4A-M
NHRIV600030601-08	R*08	MAD RIVER	5-P	2-M	2-M	4A-M
NHRIV600030601-09	R*09	COCHECO RIVER	5-M	5-M	2-G	4A-M

AUIDs for HUC12: 010600030601 - UPPER COCHECO RIVER



WATERSHED 305(b) ASSESSMENT SUMMARY REPORT:

HUC 12 010600030602

HUC 12 NAME AXE HANDLE BROOK

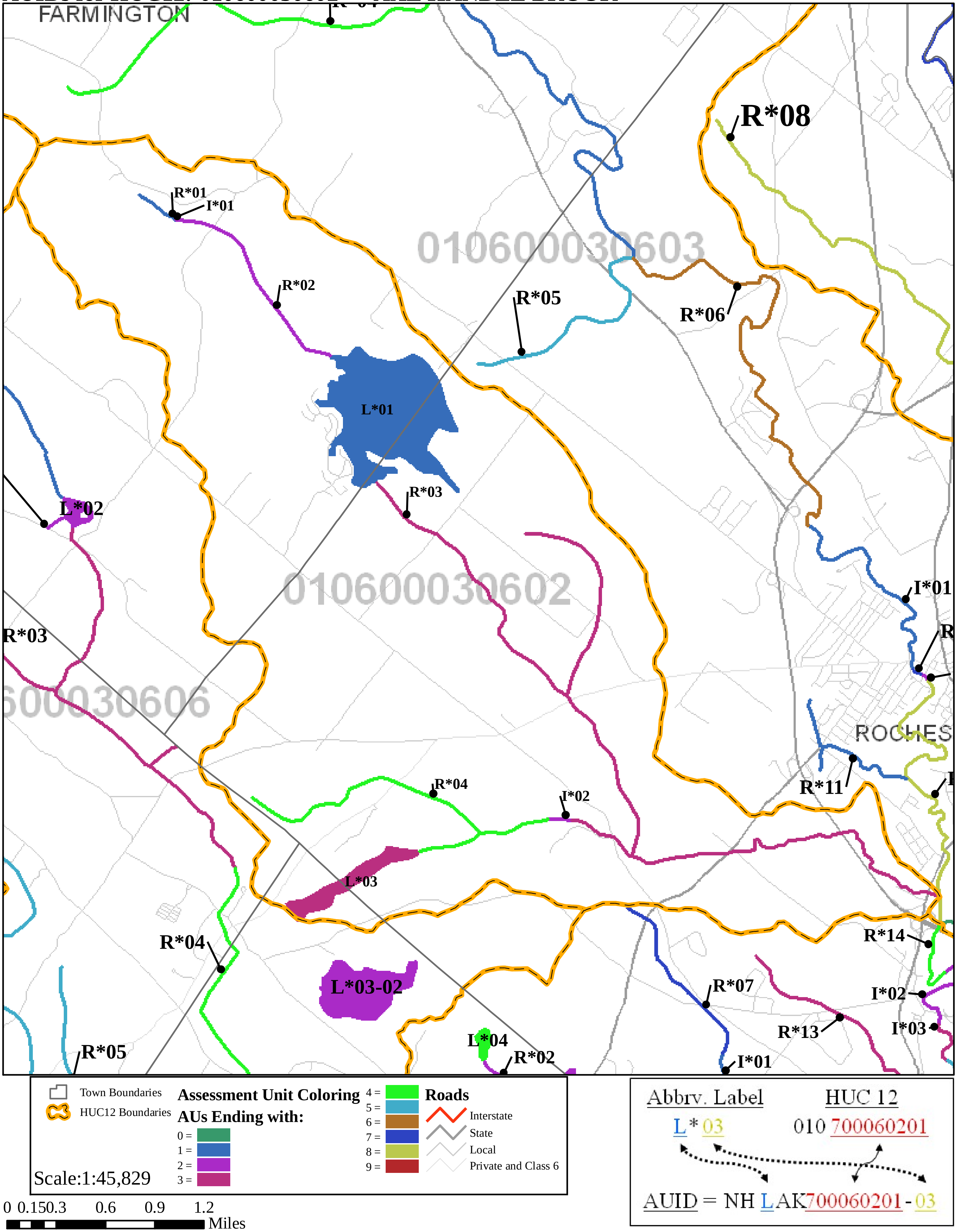
(Locator map on next page only applies to this HUC12)

Assessment Cycle 2008

Good		Full Support Good
Marginal		Full Support Marginal
Likely Good		Insufficient Information – Potentially Full Support
No Data		No Data
Likely Bad		Insufficient Information – Potentially Not Support
Poor		Not Support Marginal
Severe		Not Support Severe

ASSESSMENT UNIT ID	MAP LABEL	ASSESSMENT UNIT NAME	AQUATIC LIFE	SWIMMING	BOATING	FISH CONSUMP.
NHIMP600030602-01	I*01	UNKNOWN RIVER - BOUCHARD POND	3-ND	3-ND	3-ND	4A-M
NHIMP600030602-02	I*02	HOWARD BROOK - WITCHER POND	3-ND	3-ND	3-ND	4A-M
NHLAK600030602-01	L*01	BAXTER LAKE	5-M	2-M	2-G	4A-M
NHLAK600030602-03	L*03	ROCHESTER RESERVOIR	4A-P	5-M	3-PAS	4A-M
NHRIV600030602-01	R*01	UNNAMED BROOK - UPPER REACH TO BAXTER LAKE	3-ND	3-ND	3-ND	4A-M
NHRIV600030602-02	R*02	UNNAMED BROOK - TO BAXTER LAKE	3-ND	3-PAS	3-PAS	4A-M
NHRIV600030602-03	R*03	AXE HANDLE BROOK - HOWARD BROOK	5-M	5-M	5-M	4A-M
NHRIV600030602-04	R*04	HOWARD BROOK	3-ND	3-ND	3-ND	4A-M

AUIDs for HUC12: 010600030602 - AXE HANDLE BROOK



WATERSHED 305(b) ASSESSMENT SUMMARY REPORT:

HUC 12 010600030603

HUC 12 NAME MIDDLE COCHECO RIVER

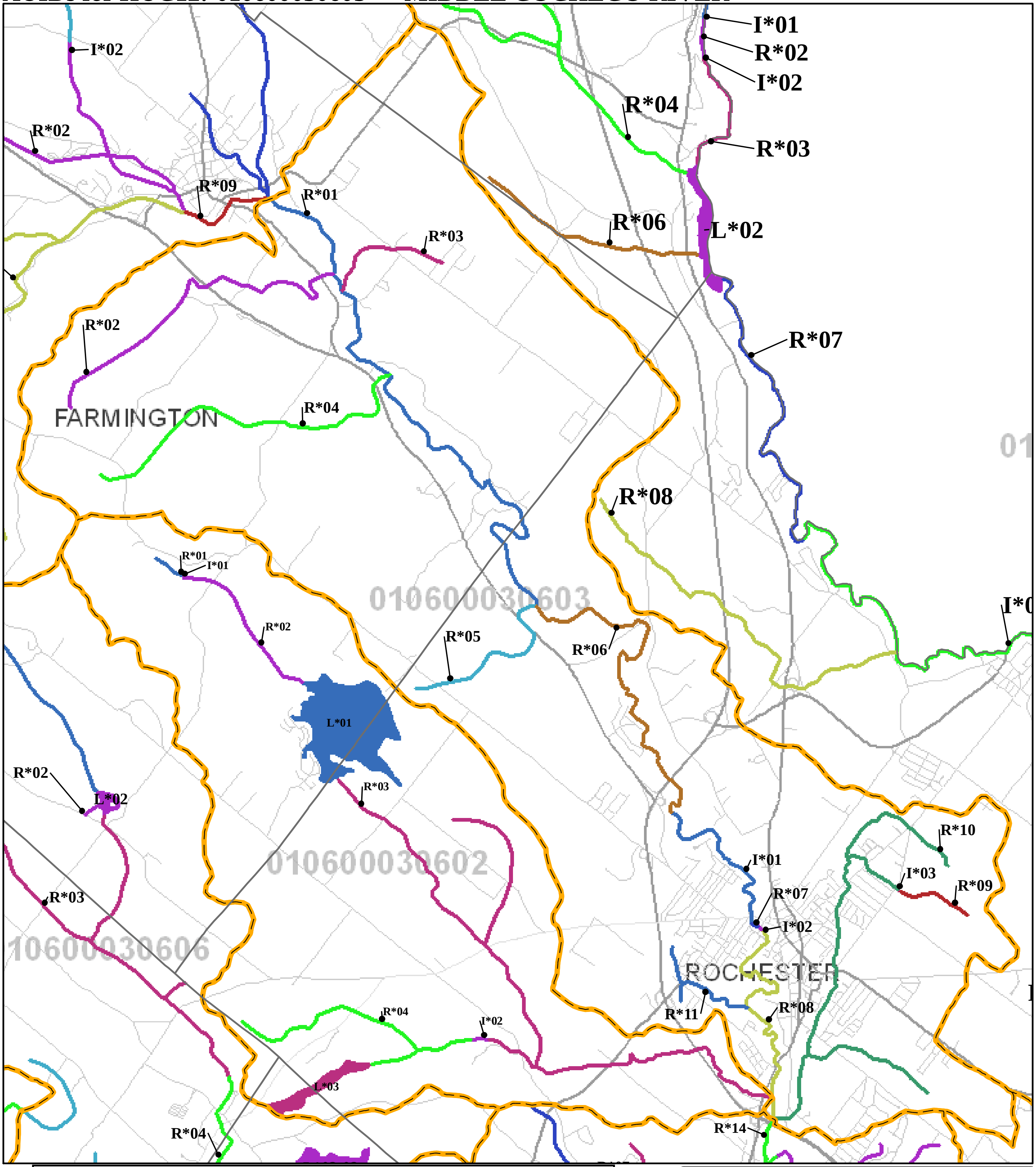
(Locator map on next page only applies to this HUC12)

Assessment Cycle 2008

Good		Full Support Good
Marginal		Full Support Marginal
Likely Good		Insufficient Information – Potentially Full Support
No Data		No Data
Likely Bad		Insufficient Information – Potentially Not Support
Poor		Not Support Marginal
Severe		Not Support Severe

ASSESSMENT UNIT ID	MAP LABEL	ASSESSMENT UNIT NAME	AQUATIC LIFE	SWIMMING	BOATING	FISH CONSUMP.
NHIMP600030603-01	I*01	COCHECO RIVER - CITY DAM 1	5-P	5-M	2-G	4A-M
NHIMP600030603-02	I*02	COCHECO RIVER - HATFIELD DAM	3-ND	3-ND	3-ND	4A-M
NHIMP600030603-03	I*03	UNKNOWN RIVER - FRANKLIN HEIGHTS DETENTION POND II	3-ND	3-ND	3-ND	4A-M
NHRIV600030603-01	R*01	COCHECO RIVER	5-P	5-P	2-G	4A-M
NHRIV600030603-02	R*02	POKAMOONSHINE BROOK	5-P	5-M	2-G	4A-M
NHRIV600030603-03	R*03	HOWARD BROOK - AXE HANDLE BROOK - RICKERS BROOK - UNNAMED BROOK	3-ND	3-ND	3-ND	4A-M
NHRIV600030603-04	R*04	RATTLESNAKE RIVER	5-P	3-PAS	3-PAS	4A-M
NHRIV600030603-05	R*05	UNNAMED BROOK - TO COCHECO RIVER	3-ND	3-ND	3-ND	4A-M
NHRIV600030603-06	R*06	COCHECO RIVER	5-P	5-P	2-M	4A-M
NHRIV600030603-07	R*07	COCHECO RIVER	3-ND	3-PAS	3-PAS	4A-M
NHRIV600030603-08	R*08	COCHECO RIVER	5-P	5-P	2-M	4A-M
NHRIV600030603-09	R*09	UNNAMED BROOK - TO FRANKLIN HEIGHTS DETENTION POND	3-ND	3-ND	3-ND	4A-M
NHRIV600030603-10	R*10	WORDLEY BROOK - UNNAMED BROOKS	3-PAS	5-P	2-M	4A-M
NHRIV600030603-11	R*11	HURD BROOK	5-P	3-ND	3-ND	4A-M

AUIDs for HUC12: 010600030603 - MIDDLE COCHECO RIVER



Town Boundaries
HUC12 Boundaries

Assessment Unit Coloring
AUs Ending with:
0 =
1 =
2 =
3 =
4 =
5 =
6 =
7 =
8 =
9 =

Roads
Interstate
State
Local
Private and Class 6

Scale:1:64,353

0 0.2 0.4 0.8 1.2 1.6 Miles

Abbrv. Label | HUC 12
L * 03 | 010 700060201

AUID = NH LAK700060201 - 03

WATERSHED 305(b) ASSESSMENT SUMMARY REPORT:

HUC 12 010600030608

HUC 12 NAME LOWER COCHECO RIVER

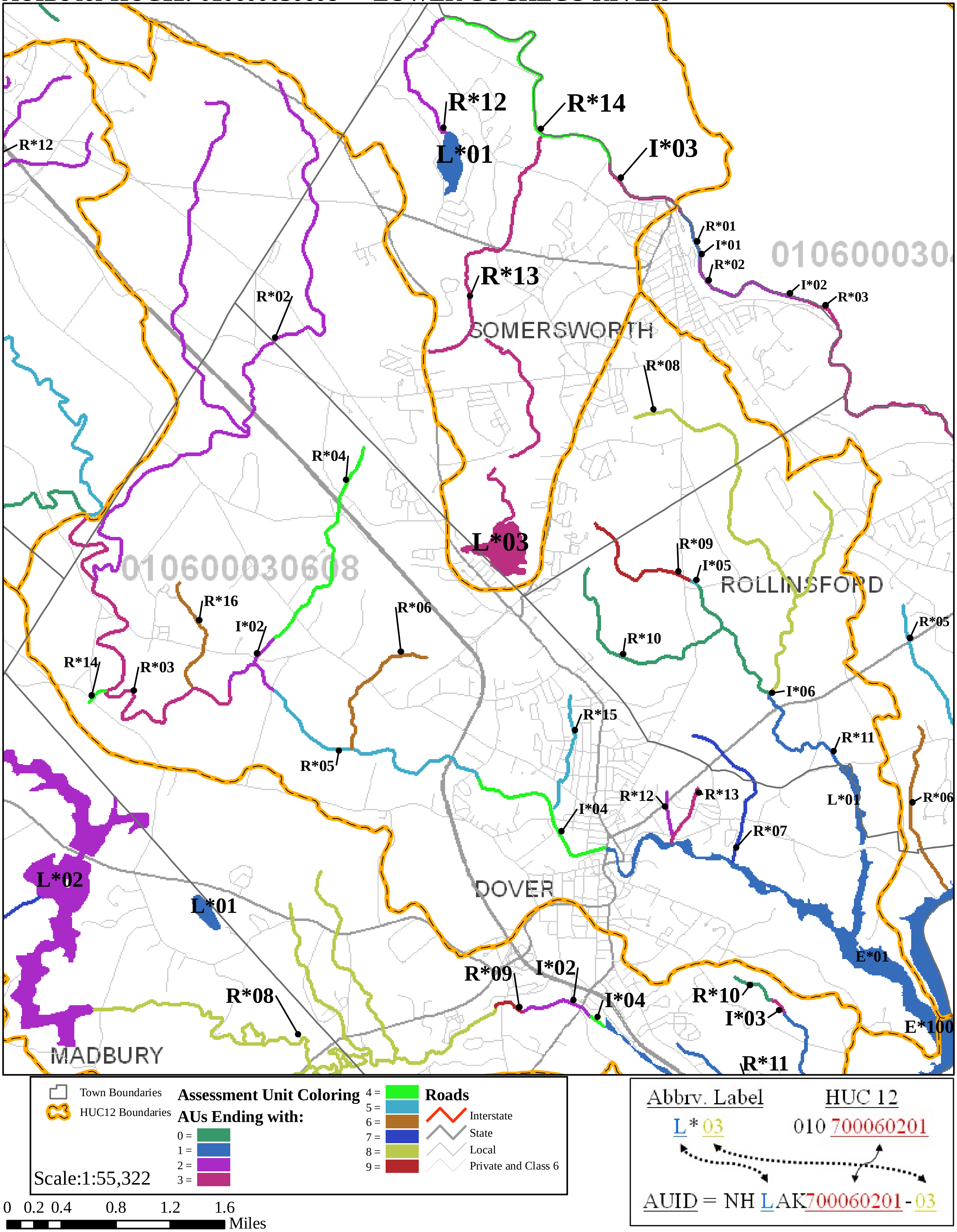
(Locator map on next page only applies to this HUC12)

Assessment Cycle 2008

Good		Full Support Good
Marginal		Full Support Marginal
Likely Good		Insufficient Information – Potentially Full Support
No Data		No Data
Likely Bad		Insufficient Information – Potentially Not Support
Poor		Not Support Marginal
Severe		Not Support Severe

ASSESSMENT UNIT ID	MAP LABEL	ASSESSMENT UNIT NAME	AQUATIC LIFE	SWIMMING	BOATING	FISH CONSUMP.
NHEST600030608-01	E*01	COCHECO RIVER	5-P	5-P	5-P	5-M
NHIMP600030608-02	I*02	COCHECO RIVER - WATSON-WALDRON DAM POND	5-P	5-M	2-G	4A-M
NHIMP600030608-04	I*04	COCHECO RIVER - CENTRAL AVE DAM	5-P	5-M	2-G	4A-M
NHIMP600030608-05	I*05	UNKNOWN RIVER - CONSERVATION POND	3-ND	3-ND	3-ND	4A-M
NHIMP600030608-06	I*06	FRESH CREEK - FARM POND	3-ND	3-ND	3-ND	4A-M
NHLAK600030608-01	L*01	FRESH CREEK POND	5-M	5-M	2-M	4A-M
NHRIV600030608-02	R*02	BLACKWATER BROOK-CLARK BROOK	3-ND	5-P	2-M	4A-M
NHRIV600030608-03	R*03	COCHECO RIVER	5-P	5-M	2-G	4A-M
NHRIV600030608-04	R*04	REYNERS BROOK	3-ND	5-P	2-M	4A-M
NHRIV600030608-05	R*05	COCHECO RIVER	5-P	5-M	2-G	4A-M
NHRIV600030608-06	R*06	INDIAN BROOK	3-ND	5-P	2-M	4A-M
NHRIV600030608-07	R*07	EMERSON BROOK	3-ND	3-ND	3-ND	4A-M
NHRIV600030608-08	R*08	FRESH CREEK - TWOMBLY BROOK	5-P	5-P	3-PNS	4A-M
NHRIV600030608-09	R*09	UNNAMED BROOK - ROLLINS BROOK	3-PNS	3-PNS	2-M	4A-M
NHRIV600030608-10	R*10	ROLLINS BROOK	5-P	5-P	2-M	4A-M
NHRIV600030608-11	R*11	FRESH CREEK	5-M	5-P	3-PNS	4A-M
NHRIV600030608-12	R*12	UNNAMED TRIBUTARY - TO COCHECO RIVER (DOVER (DOWNSTREAM OF PORTLAND AVE))	3-ND	3-ND	3-ND	4A-M
NHRIV600030608-13	R*13	UNNAMED TRIBUTARY - TO COCHECO RIVER - (DOVER (UPSTREAM OF ATLANTIC AVE))	3-ND	3-ND	3-ND	4A-M
NHRIV600030608-14	R*14	UNNAMED TRIB. TO COCHECO RIVER, DOVER (FROM LANDFILL)	5-M	3-ND	3-ND	4A-M
NHRIV600030608-15	R*15	BERRY BROOK	5-M	5-P	2-M	4A-M
NHRIV600030608-16	R*16	JACKSON BROOK	3-ND	5-P	2-M	4A-M

AUIDs for HUC12: 010600030608 - LOWER COCHECO RIVER



Appendix E:
2008 Cocheco River Watershed Biological Data

Order	Common Name	Tolerance Value	02-HAY	27-CCH	03-MAR	01-DMS	01F-RAT	01-AXE	02-RNB	03-FHC
Ephemeroptera	Mayfly Nymph	3	7	25	18	51	1	2	12	66
Plecoptera	Stonefly Nymph	1	5	20	10	59	5	0	0	0
Trichoptera	Caddisfly Larvae	4	36	66	14	21	12	8	530	94
Odonata	Dragonfly Nymph	7	6	1	0	0	2	0	0	4
	Damselfly Nymph	3	0	0	0	0	0	0	0	4
Diptera	Black Fly Larvae	7	1	14	19	1	4	4	3	13
	Midge Larvae	6	1	2	25	1	13	0	0	2
	Most True Flies	4	2	6	3	13	5	5	4	14
Megaloptera	Alderfly	4	0	0	0	0	0	0	0	0
	Fishfly Larvae or Hellgrammite	0	0	3	0	6	4	2	5	10
Coleoptera	Beetle & Beetle-like	7	5	0	0	8	2	0	2	2
	Riffle Beetle	4	3	6	2	4	0	5	1	2
	Water Penny	4	3	2	0	0	0	2	3	9
Other	Aquatic Worms	8	2	3	5	6	3	17	1	0
	Clams & Mussels	7	0	0	0	0	0	0	2	0
	Crayfish	7	0	0	0	0	0	0	0	8
	Scuds	8	0	0	0	2	0	6	1	3
	Snails	7	0	0	0	0	0	0	0	0
	Sowbug	7	0	0	0	0	0	0	30	0
Total Macroinvertebrates			**71**	**148**	**96**	**172**	**51**	**51**	**594**	**231**
Total Biotic Score			**308**	**556**	**463**	**497**	**234**	**298**	**2463**	**911**
Final Biotic Score			**4.34**	**3.76**	**4.82**	**2.89**	**4.59**	**5.84**	**4.15**	**3.94**
Percent EPT			**67.61%**	**75.00%**	**43.75%**	**76.16%**	**35.29%**	**19.61%**	**91.25%**	**69.26%**
Abundance			**142**	**2368**	**384**	**459**	**68**	**51**	**625**	**308**

Appendix F:
2008 Cocheco River Watershed Habitat Data

Station ID	Surrounding Land Use	RIPARIAN HABITAT			IN-STREAM CHARACTERISTICS				Erosion & Other Streamside Impacts
		Dominant Vegetative Type	Width of Riparian Zone (ft)	% Canopy Cover/ % tree type	Most Prevalent Habitat Type	Water Color/ Stream Flow	Substrate/ % Embededness	Aquatic Vegetation	
02-HAY	Forest (100%)	Trees	R ~ 20-100 L ~ >500	>75% 20 % D 80 % C	Riffles & Pools	Clear High	Cobble & Boulder >75%	Algae & Moss	R: heavy erosion L: moderate erosion Recent timber harvest within 100' of R Gravel road crossing upstream, dust accumulating on banks
27-CCH	Residential (100%)	Trees	R ~ 20-100 L ~ 0-20	40-75% 50% D 50% C	Riffles	Clear High	Gravel 0-25%	None	Moderate erosion on left bank Slight erosion on right bank
03-MAR	Forest / Minimal Residential	Trees	R ~ 100-500 L ~ >500	40-75% 75% D 25% C	Runs	Clear High	Boulder 25-50%	Moss	Moderate erosion on both banks Braiding & flood chutes common Evaluate road maintenance practices for potential impacts to stream
01-DMS	Forest 100%	Trees & Shrubs	R ~ 0-20 L ~ 100-500	40-75% 100% D	Riffles	Clear High	Cobble 0-25%	Plants	Slight erosion on right bank
01F-RAT	Residential (50%) Commercial (50%)	Trees	R ~ 20-100 L ~ 0-20	<10% 100% D	Riffles	Clear Moderate	Cobble 25-50%	Moss & Algae	Slight erosion on both banks Bank armoring
01-AXE	Commercial (50%) Forest (50%)	Trees & Shrubs	R ~ >500 L ~ 20-100	40-75% 100% D	Riffles	Clear Very High	Gravel 0-25%	None	Slight to moderate erosion on both banks Heavy construction 150' upstream
01-RNB	Forest (50%) / Agricultural (50%)	Trees & Grasses	R ~ 0-20 L ~ 100-500	40-75% 95% D 5% C	Riffles	Clear / Reddish Moderate	Cobble 25-50%	Algae & Moss	Slight erosion on both banks
03-FHC	Forest / Field/Pasture	Trees & Shrubs	R ~ >500 L ~ 100-500	40-75% 60% D 40% C	Riffles & Runs	Cloudy High	Cobble 50-75%	Algae	Slight to moderate erosion on both banks Invasive riparian plants present (honeysuckle & multiflora rose)

Note: Data is derived from a standardized Field Volunteer Biomonitoring Habitat Data Sheet included in the Volunteer Biological Assessment Program 2008 Draft Protocol instructions. R = Right bank, L = Left bank, D = Deciduous, C = Coniferous

Appendix G: 2008 Biological Sampling Methods

Background

Macroinvertebrates are organisms capable of being seen by the naked eye such as immature and adult aquatic insects, mollusks, worms, leeches, and crayfish. These organisms have different abilities to tolerate pollution, vary in their habitat preferences, and reflect the shared effects of multiple pollutants and environmental conditions integrated over time. Thus, they are often used as indicators of aquatic community condition.

The New Hampshire Volunteer Biological Assessment Program (VBAP) assists volunteers in the collection and identification of macroinvertebrates throughout NH's streams. Each year, volunteers collect and identify macroinvertebrates and VBAP staff summarizes the data in annual reports for each group. These reports contribute to knowledge about aquatic community conditions and serve as guidance for future monitoring activities. Prior to sampling, VBAP volunteers are trained in sampling techniques, identification, and biotic index computation. Volunteers are also trained to collect and record basic habitat, physical and chemical parameters.

Sampling Station Description

Sampling stations are chosen based on input from VBAP volunteers. All stations must be accessible, wadeable and approximately 50 to 200 feet in length. They must also contain at least one riffle with mixed cobble substrate. Whenever possible, stations must be located upstream of major human influences such as bridges.

Sampling and Data Collection

At each sampling station, volunteers record station information, select the sampling reach, identify five sampling locations within the reach and assess instream and riparian habitat. To avoid disrupting biological communities, volunteers do not walk in the stream and always collect samples from downstream to upstream. At each collection site, volunteers designate a 1/5 m^2 sampling area and place a 500 micron mesh kicknet immediately downstream of that area. One volunteer holds the net perpendicular to stream flow with the opening of the net facing upstream and the bottom firmly against the substrate (Image 1). A second volunteer agitates the sampling area upstream of the net by using both hands to scrub the rocks within the sample area for 30 seconds and then uses both feet to disturb the sediment within the sample area for 30 seconds.

After agitation, macroinvertebrates should be trapped in the net. The downstream volunteer slowly lifts the net out of the water, being careful not to let any bugs wash downstream. This process is repeated at each sampling location until a total of five samples are collected.

Sorting and Identification

After collection, the entire sample is transferred into a plastic dish pan fitted with 500 micron wire mesh. The sample is mixed for 15 seconds and then divided into four equal portions. One portion is randomly selected for sorting and transferred to a separate tray. The remaining portions are kept in the dish pan and submersed in a plastic basin with water to prevent desiccation. Volunteers sort the selected portion for one hour. During that time, spoons, forceps, or pipettes are used to place specimens into individual containers for identification. If the first portion is completely sorted before one hour had elapsed, an additional portion is selected and sorted. After one hour, specimens are counted and identified to coarse taxonomic groups. Additionally, cumulative sorting effort and estimated total abundance are calculated.

Biotic Index and Accessory Metric Computation

Individual taxonomic groups are each assigned a tolerance value ranging from zero to ten (Table 1). More tolerant groups have a higher tolerance value than less tolerant groups. To compute a taxonomic-specific biotic score VBAP multiplies the number of individuals in a sample by the individual's tolerance value. To compute the final biotic score, VBAP sums the taxonomic-specific biotic scores and then divides by the number of total individuals identified. The Final biotic scores correspond to three categories: excellent (0-3.5), good (3.5-4.8), or fairly poor (>4.8).

Table 1: **Order, common name, and tolerance value of aquatic common macroinvertebrates**

Order	Common Name	Tolerance Value
Ephemeroptera	Mayfly nymph	3
Plecoptera	Stonefly nymph	1
Trichoptera	Caddisfly larvae	4
Odonata	Dragonfly nymph	3
	Damselfly nymph	7
Diptera	Black fly larvae	7
	Midge larvae	6
	Most true flies	4
Megaloptera	Alderfly	4
	Fishfly or hellgrammite	0
Coleoptera	Riffle beetle	4
	Water penny	4
	Beetle and beetle-like	7
Others	Crayfish	6
	Snails	7
	Aquatic worms	8
	Scuds	8
	Sowbugs	7
	Clams and mussels	8

Abundance, which estimates the total number of organisms within the sample, is calculated by multiplying the number of individuals sorted by the fraction of the sample sorted. The percentage of EPT (Ephemeroptera, Plecoptera, and Trichoptera) individuals within the sample is also calculated to provide an estimate of the amount of least tolerant taxa present at each site.

Water Chemistry

In addition to biological sampling, basic water quality data including pH, dissolved oxygen, specific conductance, and temperature are collected whenever possible using VRAP Standard Operating Procedures (SOPs) and handheld meters provided by NHDES.

Quality Control Test

Quality control samples were not collected in the 2008 season.