New Hampshire Volunteer River Assessment Program
2006 Hawkins Brook Water Quality Report

January 2007

NHDES R-WD-07-10

New Hampshire Volunteer River Assessment Program 2006 Hawkins Brook Water Quality Report

State of New Hampshire
Department of Environmental Services
Water Division
Watershed Management Bureau
P.O. Box 95
29 Hazen Drive
Concord, New Hampshire 03302-0095
www.des.nh.gov

Thomas S. Burack
Commissioner

Harry T. Stewart
Director
Water Division

Prepared By:

Ted Walsh
Jen Drociak
Katie Zink

January 2007

Cover Photo: Lake Winnipesaukee

TABLE OF CONTENTS

List of Figures and Tables

List of Appendices

ACKNOWLEDGEMENTS

The New Hampshire Department of Environmental Services Volunteer River Assessment Program extends sincere thanks to the volunteers of the Hawkins Brook VRAP group and the Meredith Conservation Commission for their efforts during 2006. 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.

2006 Hawkins Brook Volunteers

Ralph Pisapia

Paul Delfari

Dan MacFarlane

Dave Sias

1.0 INTRODUCTION

1.1. Purpose of Report

Each year the New Hampshire Volunteer River Assessment Program (VRAP) 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 (VRAP) 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 that 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 data results which do not meet New Hampshire surface water quality standards, and data that is unusable for assessment purposes due to quality control requirements.

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

  This appendix includes 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 – Glossary of River Ecology Terms**

  This appendix contains a list of terms commonly used when discussing river ecology and water quality.

- **Appendix D – Native Shoreland/Riparian Buffer Plantings for New Hampshire**

  This appendix contains a table of over ninety suggested native shoreland/riparian buffer plantings for New Hampshire. The table contains common name(s), Latin name, height, growth rate, rooting, light preference, soil preference, and associated wildlife and food value of each tree, shrub, and groundcover/herbaceous perennial species.

2.0 PROGRAM OVERVIEW

2.1 Past, Present, and Future

In 1998, the New Hampshire Department of Environmental Services established the New Hampshire Volunteer River Assessment Program (VRAP) 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. The water quality data collected by VRAP volunteers provides both NHDES and the program participants with invaluable information on the fluctuating conditions in rivers and streams and helps determine where improvements, restoration, or preservation may benefit the river and the communities it supports.

Today, VRAP continues to serve the public by providing services such as technical assistance, training in water quality monitoring protocols, quality assurance/quality control procedures, educational outreach, GIS assistance, and water quality reports. In 2006, VRAP supported 28 volunteer groups on numerous stream and river watersheds throughout the state. During 2006, VRAP volunteers monitored 298 river and stream stations providing over 9,000 water quality parameter measurements useable for Clean Water Act mandated water quality assessments.

2.2 Technical Support

VRAP lends and maintains water quality monitoring kits for volunteer groups throughout the state. The kits contain electronic meters and supplies for "in-the-field" measurements of water temperature, dissolved oxygen, pH, specific conductance (conductivity), and turbidity. These are the core parameters typically measured by volunteers. However, other water quality parameters, such as nutrients (total phosphorus, total Kjeldahl nitrogen, nitrate), metals, chloride and bacteria (*Escherichia coli*), can also be studied by volunteer groups. VRAP can provide limited to funds to assist groups in laboratory analysis. However due to limited VRAP funds, we encourage VRAP 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 to assist in laboratory fees or the purchase of water quality monitoring equipment.

VRAP typically recommends sampling every other week during the summer, and volunteer groups are encouraged to organize a long-term sampling program in order to begin to determine trends in river conditions. Each year volunteers design and arrange a sampling schedule in cooperation with NHDES 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.

Water quality measurements repeated over time create a picture of the fluctuating conditions in rivers and streams and help to determine what trends in water quality may be occurring. Water quality results are also used to determine if a river is meeting surface water quality standards. Volunteer monitoring results, meeting NHDES Quality Assurance and Quality Control (QA/QC) requirements, supplement the efforts of NHDES to assess the condition of New Hampshire surface waters. The New Hampshire Surface Water Quality Regulations are available on-line at www.des.nh.gov/rules/desadmin_list.htm#waterq or by calling (603) 271-1975.

2.3 Training and Guidance

Each VRAP volunteer attends an annual training session to receive a demonstration of monitoring protocols and sampling techniques. Training sessions are an opportunity for volunteers to receive an updated version of monitoring techniques. During the training, volunteers have an opportunity for hand-on use of the VRAP equipment and may also receive instruction in the collection of samples for laboratory analysis. Training is accomplished in approximately two hours, after which volunteers are certified in the care, calibration, and use of the VRAP equipment. In some cases, veteran group coordinators can attend a "train the trainer" session. In these trainings the group coordinator receives an update in sampling protocols and techniques and will then train the individual volunteers of their respective group.

VRAP groups conduct sampling according to a prearranged monitoring schedule and VRAP protocols. NHDES staff from the VRAP program aim to visit each group annually during a scheduled sampling events to verify that volunteers successfully follow the VRAP protocols. 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.

2.4 Data Usage

2.4.1 Annual VRAP Water Quality Reports

All data collected by volunteers are summarized in annual VRAP water quality reports that are prepared and distributed after the conclusion of the sampling period (typically fall or winter). Each volunteer group receives copies of the report. The volunteers can use the reports and data as a means of understanding the details of water quality, guiding future sampling efforts, or determining restoration activities.

2.4.2 New Hampshire Surface Water Quality Assessments

Along with data collected from other water quality programs, specifically the State Ambient River Monitoring Program (ARMP), applicable volunteer data are used to support periodic NHDES surface water quality assessments. VRAP data are entered into NHDES's Environmental Monitoring Database (EMD) and are ultimately uploaded to the Environmental Protection Agency's 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 www.des.nh.gov/wmb/swqa/.

2.5 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.

2.5.1 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. Table 1 shows typical parameters studied under VRAP and the associated quality control procedures.

(Equation 1)

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

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	RPD < 10% or 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 <0.5 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

During the summer of 2004, volunteers from the Lake Winnipesaukee Watershed Association began water quality monitoring on some of the tributaries feeding into Lake Winnipesaukee including Hawkins Brook. In 2006 volunteers from the town of Meredith sought to continue this monitoring and focus specifically on Hawkins Brook.

The goal of this effort was to provide water quality data from Hawkins Brook 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 will allow 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, and technical assistance.

During 2006, trained volunteers from the Hawkins Brook VRAP Group monitored water quality at five stations along Hawkins Brook (Figure 1, 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 in 2006 are designated as Class B waters.

Water quality monitoring was conducted monthly from April through September. In-situ measurements of water temperature, air temperature, dissolved oxygen, pH, turbidity and specific conductance were taken using handheld meters. Table 3 summarizes the parameters measured, laboratory standard methods, and equipment used.

Table 2. Sampling Stations for Hawkins Brook, NHDES VRAP, 2006

NHDES Station ID	Waterbody Name	Location	Town/City	Elevation*
07-HAW	Hawkins Brook	Route 3 Bridge - 1st Crossing	Meredith	500
06B-HAW	Hawkins Brook	Jenness Hill Road Bridge	Meredith	500
06A-HAW	Hawkins Brook	Flow on West Bank - 25 Feet Upstream of Jenness Hill Road Bridge	Meredith	500
05-HAW	Hawkins Brook	Route 3 Bridge - 2nd Crossing	Meredith	500
01-HAW	Hawkins Brook	Route 25 Bridge	Meredith	500

*Elevations have been rounded off to 100-foot increments for calibration of dissolved oxygen meter

Figure 1. Hawkins Brook Watershed and Monitoring Stations 2006

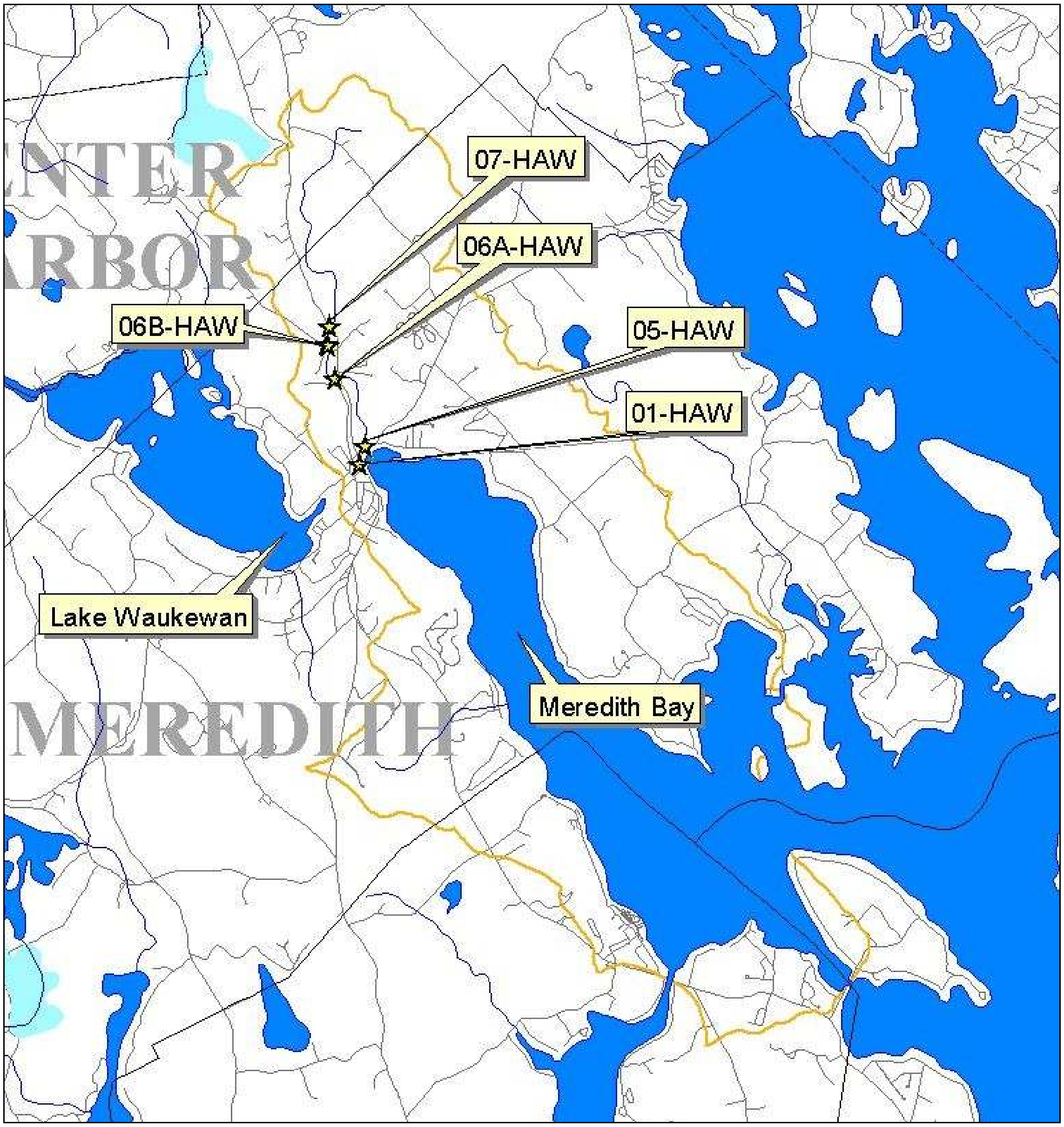


Table 3. Sampling and Analysis Methods

Parameter	Sample Type	Standard Method	Equipment Used	Laboratory
Temperature	In-Situ	SM 2550	YSI 85	------
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 2020 i/e	------
Specific Conductance	In-Situ	SM 2510	YSI 85	------

4.0 RESULTS AND RECOMMENDATIONS

4.1 Dissolved Oxygen

Between three and eight measurements were taken in the field for dissolved oxygen concentration at five stations Hawkins Brook in Meredith (Table 4). Of the 32 measurements taken, 26 met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2008 surface water quality report to the US Environmental Protection Agency.

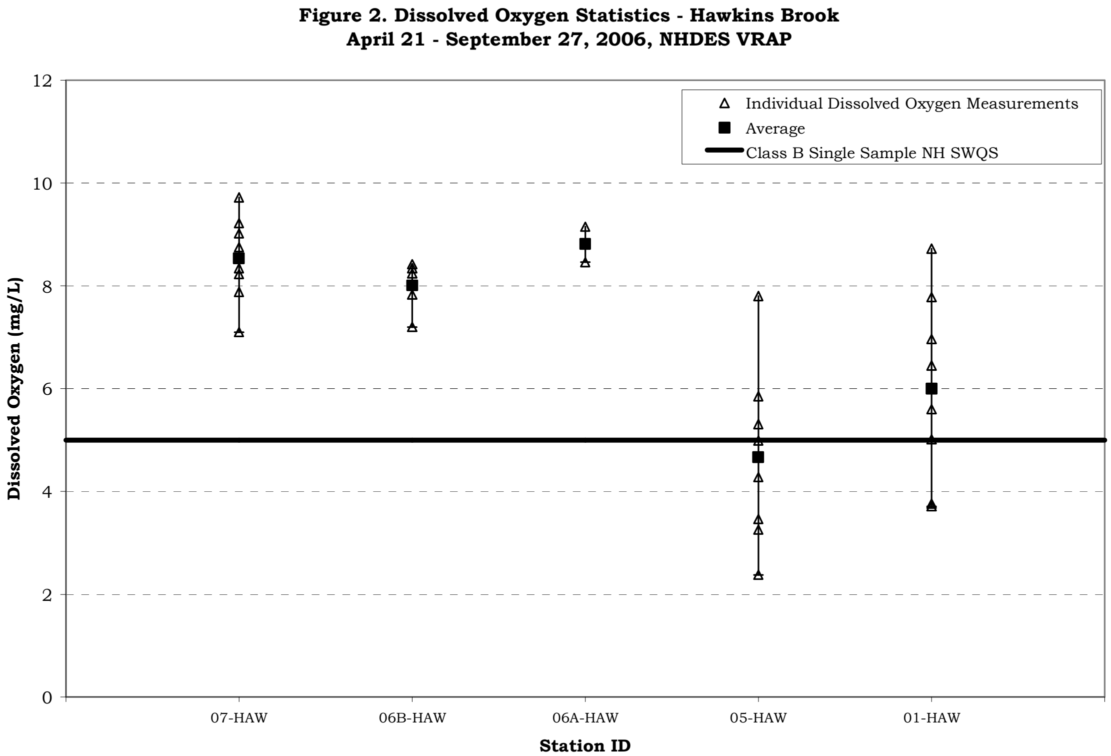
The Class B New Hampshire surface water quality standard for dissolved oxygen includes a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be assessed as 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.

Table 4. Dissolved Oxygen Concentration Data Summary – Hawkins Brook, 2006

Station ID	Samples Collected	Data Range (mg/l)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2008 NH Surface Water Quality Assessment
07-HAW	8	7.10 - 9.72	0	6
06B-HAW	5	7.20 - 8.42	0	3
06A-HAW	3	8.46 - 9.15	0	3
05-HAW	8	2.38 - 7.80	5	8
01-HAW	8	3.71 - 8.72	2	6
Total	**32**	____	**7**	**26**

Three stations (07-HAW, 06B-HAW, and 06A-HAW) had dissolved oxygen concentration levels that were always above the instantaneous New Hampshire surface water quality standard. Stations 05-HAW and 01-HAW had variable results with some measurements above the standard and some below (Figure 2). The average concentration of dissolved oxygen was also variable and ranged from 4.67 mg/L to 8.53 mg/L. 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).



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.
- Next year incorporate the use of in-situ dataloggers to automatically record dissolved oxygen saturation levels during a period of several days. This will allow for the calculation of the daily average for dissolved oxygen per cent saturation. Dataloggers can be put in the water for a period of several days and collect data at specific time intervals (e.g. every 15 minutes). The use of these instruments is dependent upon availability, and requires coordination with NHDES.

4.2 pH

Between three and eight measurements were taken in the field for pH at five stations on Hawkins Brook in Meredith [Table 5]. Of the 32 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 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.

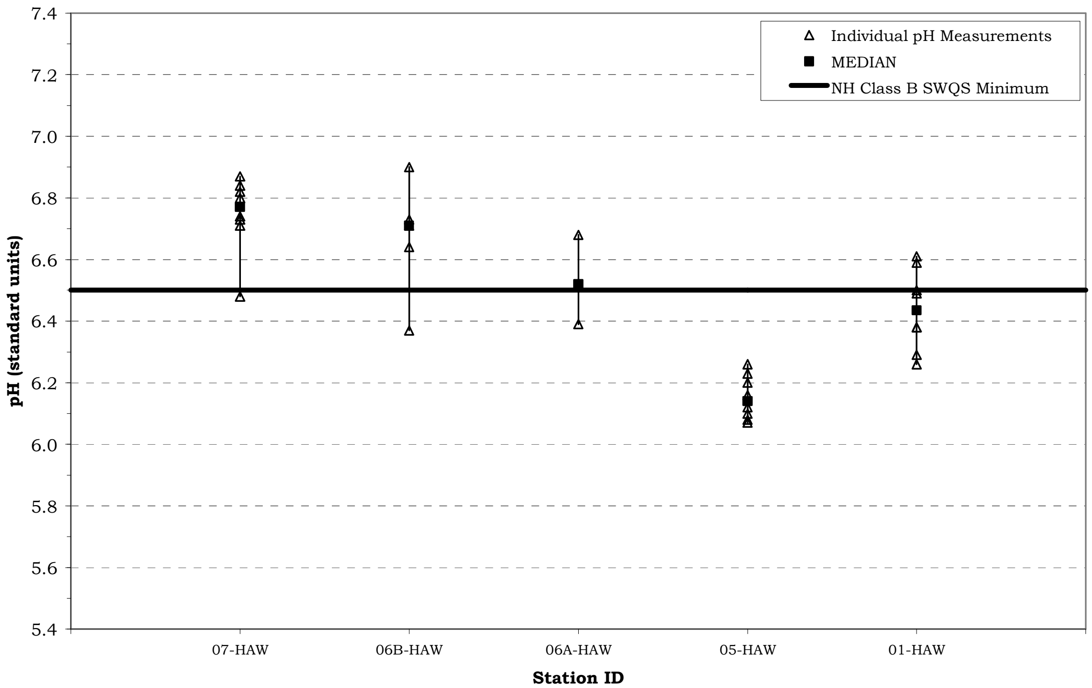
Table 5. pH Data Summary – Hawkins Brook, 2006

Station ID	Samples Collected	Data Range (standard units)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2008 NH Surface Water Quality Assessment
07-HAW	8	6.48 - 6.87	1	8
06B-HAW	5	6.37 - 6.90	1	5
06A-HAW	3	6.39 - 6.68	1	3
05-HAW	8	6.07 - 6.26	8	8
01-HAW	8	6.26 - 6.61	5	8
Total	**32**	_____	**16**	**32**

All stations had at least one pH measurement below the minimum New Hampshire surface water quality standard (Figure 3). Many of the pH measurements on Hawkins Brook were within the range of the state surface water quality standard (Figure 3). pH measurements at station 05-HAW were all below the minimum standard, while a majority of measurements at station 01-HAW were below the minimum standard.

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 3. pH Statistics - Hawkins Brook
April 21 - September 27, 2006, 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.

4.3 Turbidity

Between three and eight measurements were taken in the field for turbidity at five stations on Hawkins Brook in Meredith [Table 6]. Of the 32 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the US Environmental Protection Agency.

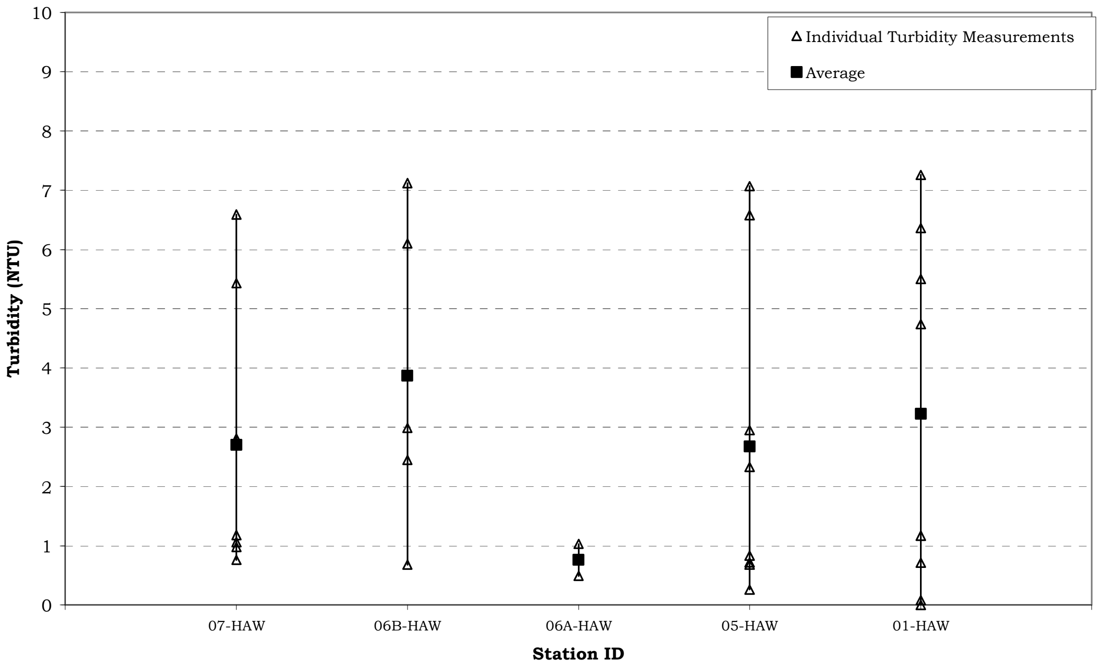
The Class B New Hampshire surface water quality standard for turbidity is less than 10 NTU above background.

Table 6. Turbidity Data Summary – Hawkins Brook, 2006

Station ID	Samples Collected	Data Range (NTU)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2008 NH Surface Water Quality Assessment
07-HAW	8	0.8 - 6.6	0	8
06B-HAW	5	0.7 - 7.1	0	5
06A-HAW	3	0.5 - 1.0	0	3
05-HAW	8	0.3 - 7.1	0	8
01-HAW	8	0.0 - 7.3	0	8
Total	**32**	_____	**0**	**32**

Turbidity levels were low at all stations and on all occasions with the average ranging from 0.8 NTU to 3.9 NTU (Figure 4). 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.

Figure 4. Turbidity Statistics - Hawkins Brook
April 21 - September 27, 2006, 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 three and eight measurements were taken in the field for specific conductance at five stations on Hawkins Brook in Meredith [Table 7]. Of the 34 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the US Environmental Protection Agency.

New Hampshire surface water quality standards do not contain numeric limits for specific conductance.

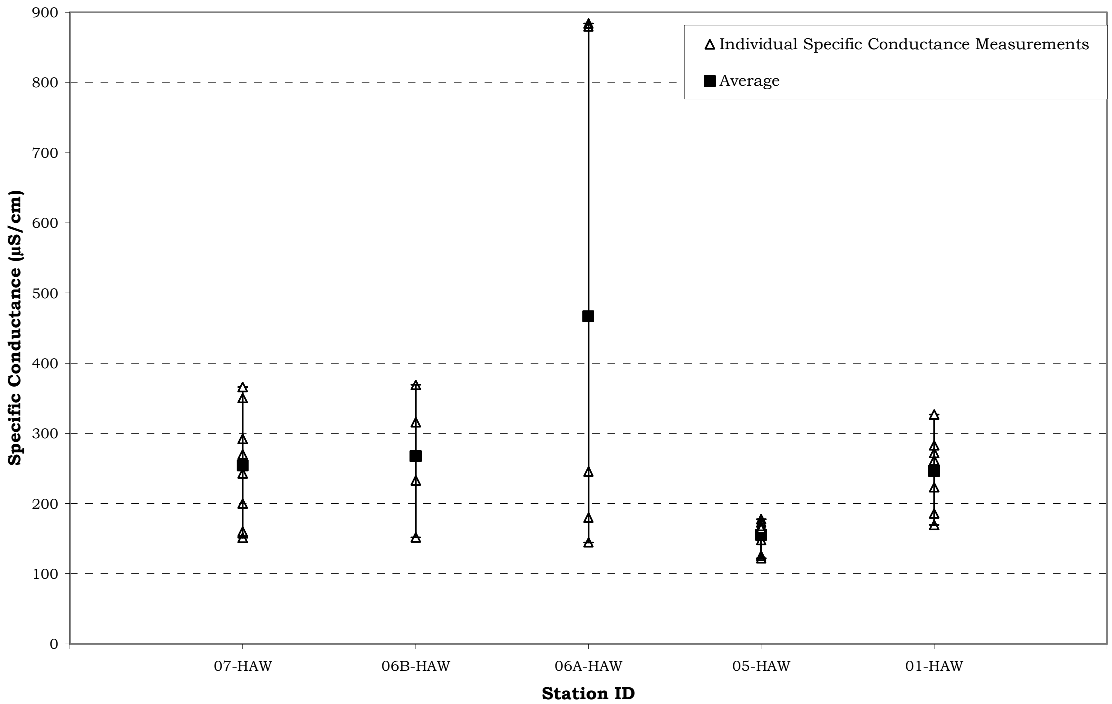
Table 7. Specific Conductance Data Summary – Hawkins Brook, 2006

Station ID	Samples Collected	Data Range (µS/cm)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2008 NH Surface Water Quality Assessment
07-HAW	8	151.3 - 366.2	Not Applicable	8
06B-HAW	5	152.0 - 369.2	N/A	5
06A-HAW	5	144.8 - 884	N/A	5
05-HAW	8	122.2 - 177.9	N/A	8
01-HAW	8	169.4 - 326.8	N/A	8
Total	**34**	_____	**N/A**	**34**

Specific conductance levels were variable with the average ranging from 155.3 µS/cm to 267.4 µS/cm (Figure 5). Station 06A-HAW had two specific conductance levels that were indicative of high impact. 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 in the Hawkins Brook watershed indicate low pollutant levels at some stations and potentially higher levels at others.

Figure 5. Specific Conductance Statistics - Hawkins Brook
April 21 - September 27, 2006, 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 conductivity 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 conductivity will allow for a better understanding of their relationship.

4.5 Water Temperature

Between four and eight measurements were taken in the field for water temperature at five stations on Hawkins Brook in Meredith [Table 8]. Of the 33 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2008 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.

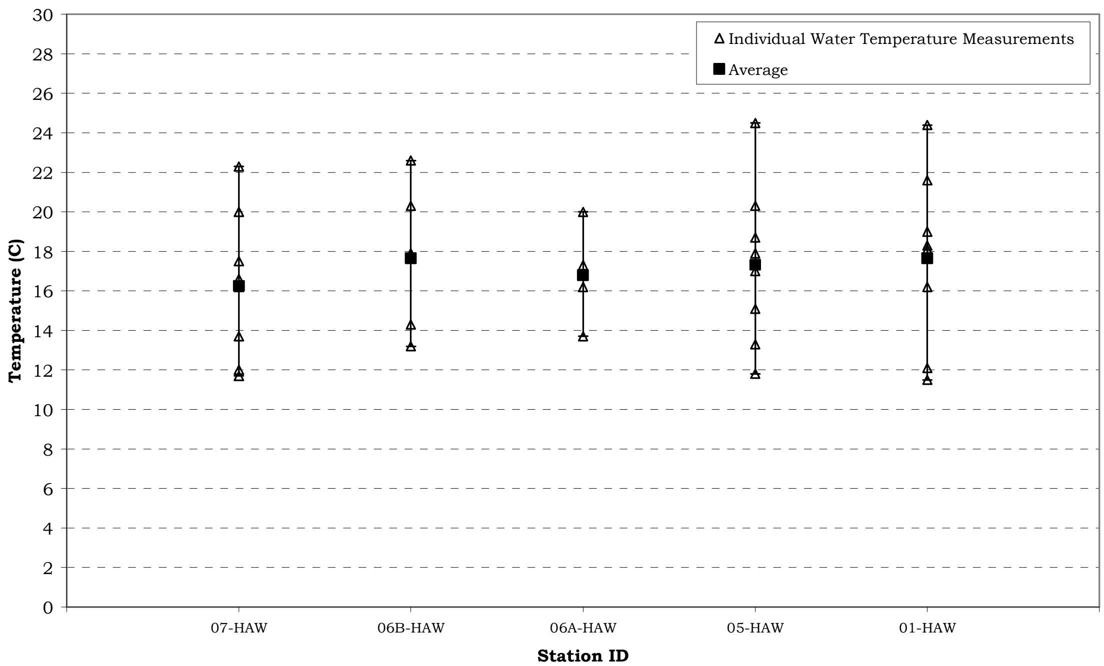
Table 8. Water Temperature Data Summary – Hawkins Brook, 2006

Station ID	Samples Collected	Data Range (°C)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2008 NH Surface Water Quality Assessment
07-HAW	8	11.7 - 22.3	Not Applicable	8
06B-HAW	5	13.2 - 22.6	N/A	5
06A-HAW	4	13.7 - 20.0	N/A	4
05-HAW	8	11.8 - 24.5	N/A	8
01-HAW	8	11.5 - 24.4	N/A	8
Total	**33**	_____	**N/A**	**33**

Figure 6 shows the results of instantaneous water temperature measurements taken at five stations in Hawkins Brook. The average water temperature varied from 16.3°C. to 17.7 °C. 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.

Figure 6. Water Temperature Statistics - Hawkins Brook
April 21 - September 27, 2006, NHDES VRAP



Recommendations

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

APPENDIX A

2006 Hawkins Brook Water Quality Data

2006 HAWKINS BROOK VRAP DATA

Measurements not meeting New Hampshire surface water quality standards

Measurements not meeting NHDES quality assurance/quality control standards

07-HAW, Hawkins Brook, Route 3 Bridge - 1st Crossing, Meredith

Date	Time of Sample	DO (mg/L)	DO (% sat.)	Water Temp. (°C)	Air Temp. (°C)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)
Standard	**NA**	**>5.0**	**>75% Daily Average**	**Narrative**	**NA**	**6.5-8.0**	**<10 NTU above backgrd**	**NA**
4/21/06	10:55	8.75	81.7	12.0	11.2	6.71	0.98	270.0
5/5/06	10:50	9.02	96.8	16.2	17.6	6.73	0.76	200.1
5/22/06	10:20	9.72	91.0	11.7	11.8	6.74	1.06	160.2
6/9/06	10:19	8.34	85.4	16.6	18.0	6.48	1.18	151.3
6/21/06	10:20	7.10	79.3	20.0	21.3	6.84	2.81	243.1
7/10/06	12:05	8.23	95.4	22.3	25.0	6.87	5.43	292.2
8/11/06	10:22	7.88	84.4	17.5	18.6	6.82	6.59	366.2
9/27/06	12:10	9.22	89.1	13.7	15.4	6.80	2.80	350.4

06B-HAW, Hawkins Brook, Jenness Hill Road Bridge, Meredith

Date	Time of Sample	DO (mg/L)	DO (% sat.)	Water Temp. (°C)	Air Temp. (°C)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)
Standard	**NA**	**>5.0**	**>75% Daily Average**	**Narrative**	**NA**	**6.5-8.0**	**<10 NTU above backgrd**	**NA**
5/22/06	10:45	8.42	85.5	14.3	14.8	6.37	0.68	152.0
6/21/06	10:45	7.20	80.6	20.3	20.9	6.64	2.45	232.8
7/10/06	12:30	8.34	97.4	22.6	25.0	6.71	6.10	266.7
8/11/06	10:55	7.83	83.5	17.9	18.2	6.90	7.12	369.2
9/27/06	12:40	8.24	78.4	13.2	15.4	6.73	2.99	316.2

06A-HAW, Hawkins Brook, Flow on West Bank - 25 Feet Upstream of Jenness Hill Road Bridge, Meredith

Date	Time of Sample	DO (mg/L)	DO (% sat.)	Water Temp. (°C)	Air Temp. (°C)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)
Standard	**NA**	**>5.0**	**>75% Daily Average**	**Narrative**	**NA**	**6.5-8.0**	**<10 NTU above backgrd**	**NA**
4/21/06	11:30	8.83	85.7	13.7	11.4	6.68	1.03	245.8
5/5/06	11:10	9.15	94.5	17.3	19.8	6.52	0.49	180.2
6/9/06	11:15	8.46	85.6	16.2	17.7	6.39	0.77	144.8
7/10/06	10:52							880.0
8/11/06	10:52			20.0	18.2			884.0

05-HAW, Hawkins Brook, Route 3 Bridge - 2nd Crossing, Meredith

Date	Time of Sample	DO (mg/L)	DO (% sat.)	Water Temp. (°C)	Air Temp. (°C)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)
Standard	**NA**	**>5.0**	**>75% Daily Average**	**Narrative**	**NA**	**6.5-8.0**	**<10 NTU above backgrd**	**NA**
4/21/06	12:14	5.31	51.1	13.3	12.0	6.23	0.68	162.5
5/5/06	11:25	5.85	62.2	17.9	20.1	6.20	0.83	148.1
5/22/06	11:16	7.80	74.4	11.8	11.9	6.08	0.26	125.8
6/9/06	11:40	4.99	51.7	17.0	18.1	6.07	0.72	122.2
6/21/06	11:20	2.38	26.3	20.3	20.9	6.26	2.95	177.9
7/10/06	13:15	3.46	40.7	24.5		6.16	6.58	173.2
8/11/06	11:05	3.26	34.9	18.7	18.1	6.10	7.07	164.6
9/27/06	13:00	4.28	42.2	15.1	16.1	6.12	2.33	168.2

01-HAW, Hawkins Brook, Route 25 Bridge, Meredith

Date	Time of Sample	DO (mg/L)	DO (% sat.)	Water Temp. (°C)	Air Temp. (°C)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)
Standard	**NA**	**>5.0**	**>75% Daily Average**	**Narrative**	**NA**	**6.5-8.0**	**<10 NTU above backgrd**	**NA**
4/21/06	10:03	5.60	51.7	11.5	10.2	6.38	0.00	272.5
5/5/06	09:30	7.78	83.5	19.0	20.4	6.38	0.71	223.1
5/22/06	09:30	8.72	80.7	12.1	12.3	6.61	1.17	185.7
6/9/06	09:45	6.45	66.5	16.2	17.1	6.26	0.08	169.4
6/21/06	09:45	3.71	42.3	21.6	22.3	6.29	6.36	249.8
7/12/06	11:00	5.01	59.5	24.4	23.3	6.49	5.50	282.8
8/11/06	09:43	3.76	40.3	18.3	17.5	6.50	7.26	326.8
9/27/06	11:40	6.96	73.9	18.1	18.4	6.59	4.74	261.9