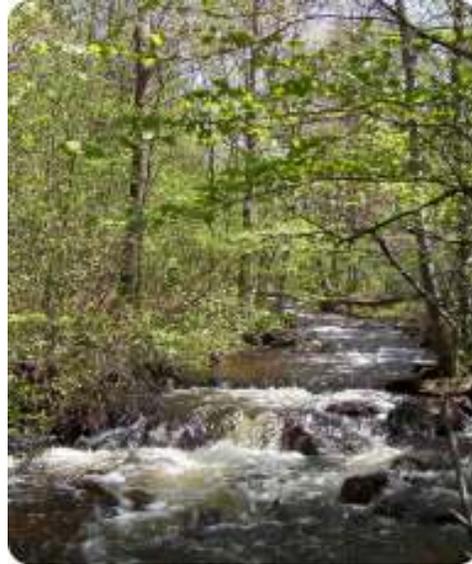


**New Hampshire Volunteer River Assessment Program  
2006 Peters Brook & Browns Brook  
Water Quality Report**



January 2007

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2006 Peters Brook & Browns 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](http://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: 01A-PET - Peters Brook & 02-BNB – Browns Brook

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## **ACKNOWLEDGEMENTS**

The New Hampshire Department of Environmental Services Volunteer River Assessment Program extends sincere thanks to the volunteers of the Hooksett 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 Hooksett Conservation Commission Volunteers**

Steve Couture, Coordinator

Timothy Johnson, Chair

Marcel LaBonville, Vice Chair

Donna Fitzpatrick, Secretary

Ray Guay, Planning Board Representative

Cindy Robertson

David Ross, Council Representative

James Walter

## **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](http://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 hands-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/](http://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.

### 2.1.1 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 <sub>2</sub> 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 2006, volunteers from the Hooksett Conservation Commission began water quality monitoring on Peters Brook and Browns Brook. The goal of this effort was to provide water quality data from these waterbodies relative to surface water quality standards and to allow for the assessment of the river for support of aquatic life. 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, financial assistance for laboratory costs, and technical assistance.

During 2006, trained volunteers from the Hooksett Conservation Commission monitored water quality at one station on Peters Brook and one station on Browns 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. Both Peters Brook and Browns Brook are designated as Class B waters.

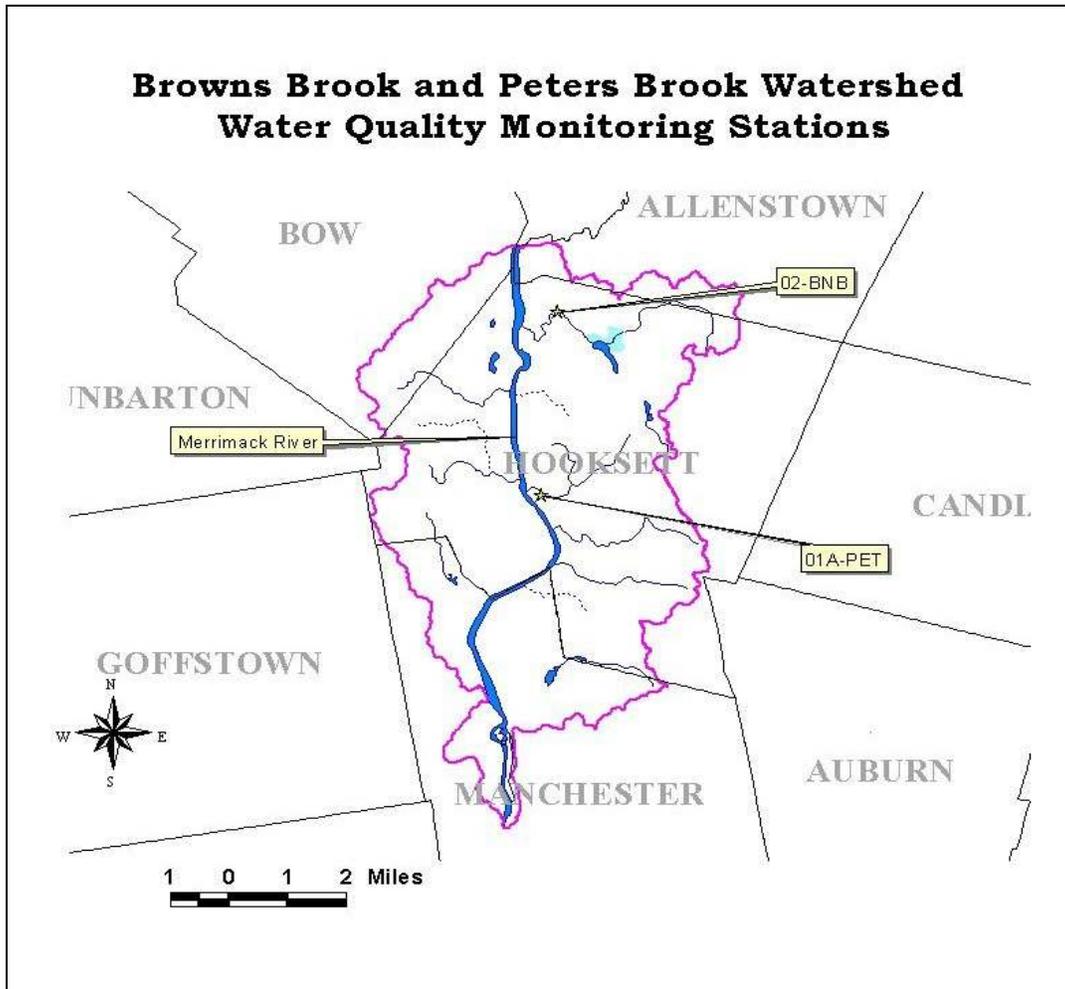
Water quality monitoring was conducted monthly from August to September. In-situ measurements of water temperature, air temperature, dissolved oxygen, pH, turbidity and specific conductance were taken using handheld meters provided by NHDES. Samples for *E.coli*, total phosphorus, chloride, hardness and metals 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.

**Table 2. Sampling Stations for Peters Brook & Browns Brook, NHDES VRAP, 2006**

<b>NHDES Station ID</b>	<b>Waterbody Name</b>	<b>Location</b>	<b>Town/City</b>	<b>Elevation*</b>
<b>01A-PET</b>	Peters Brook	LeHeroux Road	Hooksett	300
<b>02-BNB</b>	Browns Brook	Pleasant Street	Hooksett	200

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

**Figure 1. Peters Brook & Browns Brook Monitoring Stations 2006**



**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 95	-----
pH	In-Situ	SM 4500 H+	Orion 210A+	-----
Turbidity	In-Situ	EPA 180.1	LaMotte 2020	-----
Specific Conductance	In-Situ	SM 2510	YSI 30	-----
<i>E.coli</i>	Bottle (Sterile)	SM 19 9213 D.3	-----	NHDES
Total Phosphorus	Bottle (w/Preservative)	EPA 365.3	-----	NHDES
Aluminum	Bottle (Sterile)	EPA 200.7	-----	NHDES
Copper, Lead	Bottle	EPA 200.8	-----	NHDES
Zinc, Hardness	Bottle	EPA 200.7	-----	NHDES
Chloride	Bottle	EPA 365.3	-----	NHDES

## 4.0 RESULTS AND RECOMMENDATIONS

### 4.1 Dissolved Oxygen

Three measurements were taken in the field for dissolved oxygen concentration at one station on Peters Brook and one station on Browns Brook in Hooksett (Table 4). Of the 6 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.

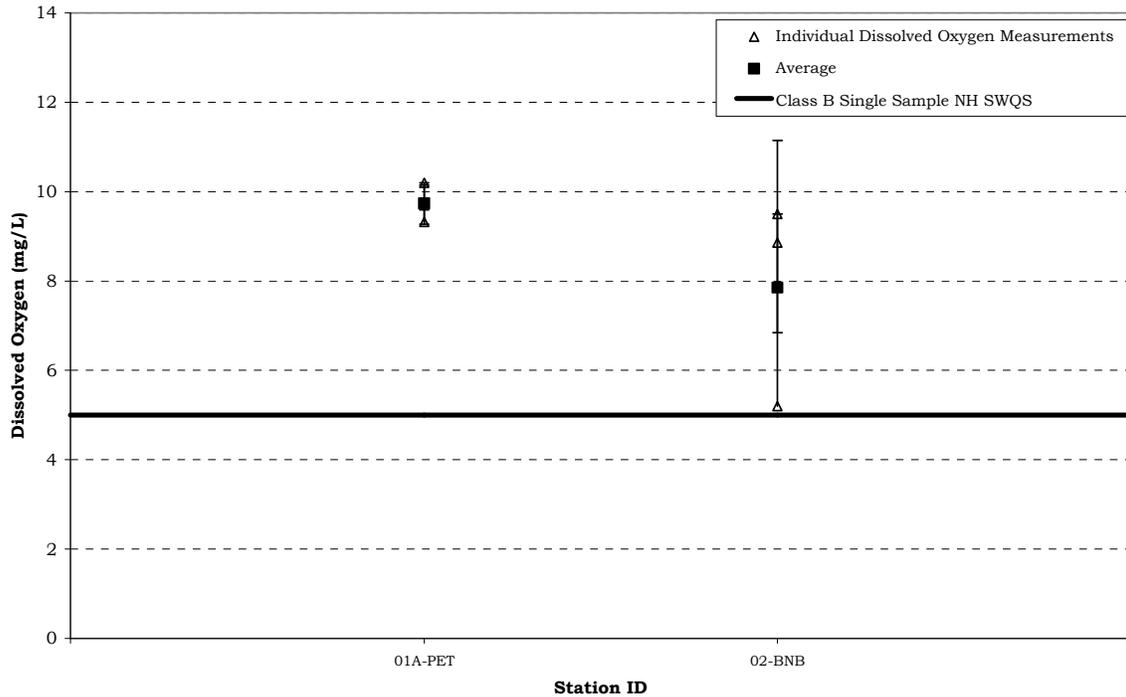
The Class B New Hampshire surface water quality standard for dissolved oxygen includes a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be assessed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

**Table 4. Dissolved Oxygen Concentration Data Summary – Peters Brook & Browns 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
01A-PET	3	9.32 - 10.2	0	3
02-BNB	3	5.20 - 9.50	0	3
<b>Total</b>	<b>6</b>	—	<b>0</b>	<b>6</b>

Dissolved oxygen concentration levels were above the Class B standard at all stations and on all occasions (Figure 2). The average concentration of dissolved oxygen ranged from 7.85 mg/L to 9.74 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.

**Figure 2. Dissolved Oxygen Statistics - Peter's Brook & Brown's Brook  
August 10 - September 14, 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.
- 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

Three measurements were taken in the field for pH at one station on Peters Brook and one station on Browns Brook in Hooksett [Table 5]. Of the 6 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.

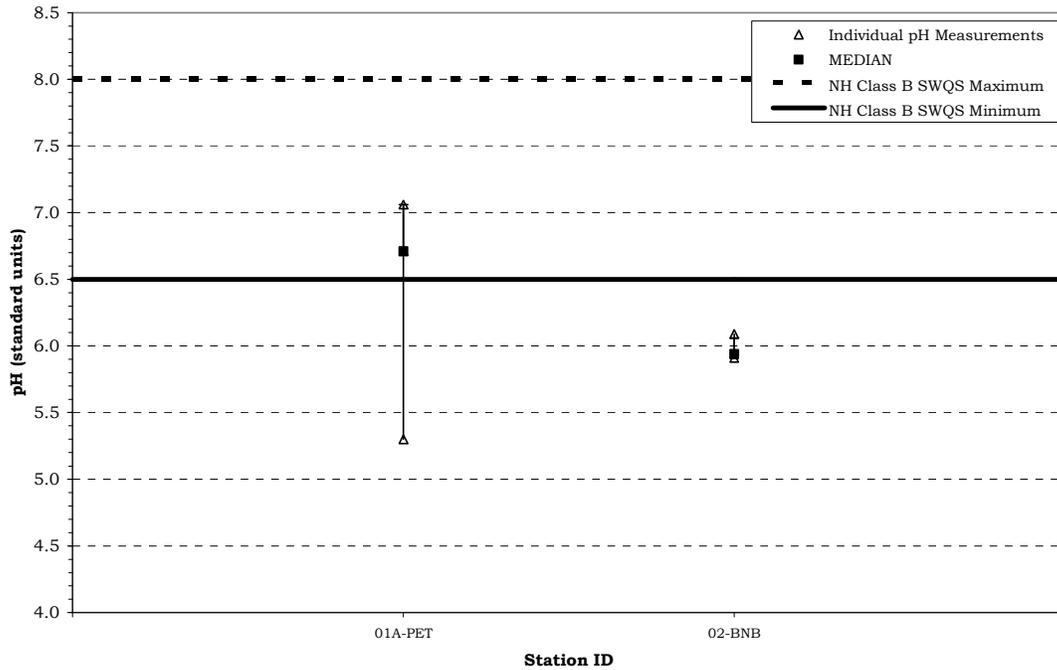
The Class B New Hampshire surface water quality standard is 6.5 - 8.0, unless naturally occurring.

**Table 5. pH Data Summary – Peters Brook & Browns Brook, 2006**

<b>Station ID</b>	<b>Samples Collected</b>	<b>Data Range (standard units)</b>	<b>Acceptable Samples Not Meeting NH Class B Standards</b>	<b>Number of Usable Samples for 2008 NH Surface Water Quality Assessment</b>
<b>01A-PET</b>	3	5.30 - 7.06	1	3
<b>02-BNB</b>	3	5.91 - 6.09	3	3
<b>Total</b>	<b>6</b>	—	<b>4</b>	<b>6</b>

A majority of the pH measurements were below the minimum New Hampshire surface water quality standard (Figure 3). 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 - Peter's Brook & Brown's Brook  
August 10 - September 14, 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

Three measurements were taken in the field for turbidity at one station on Peters Brook and one station on Browns Brook in Hooksett [Table 6]. Of the 6 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.

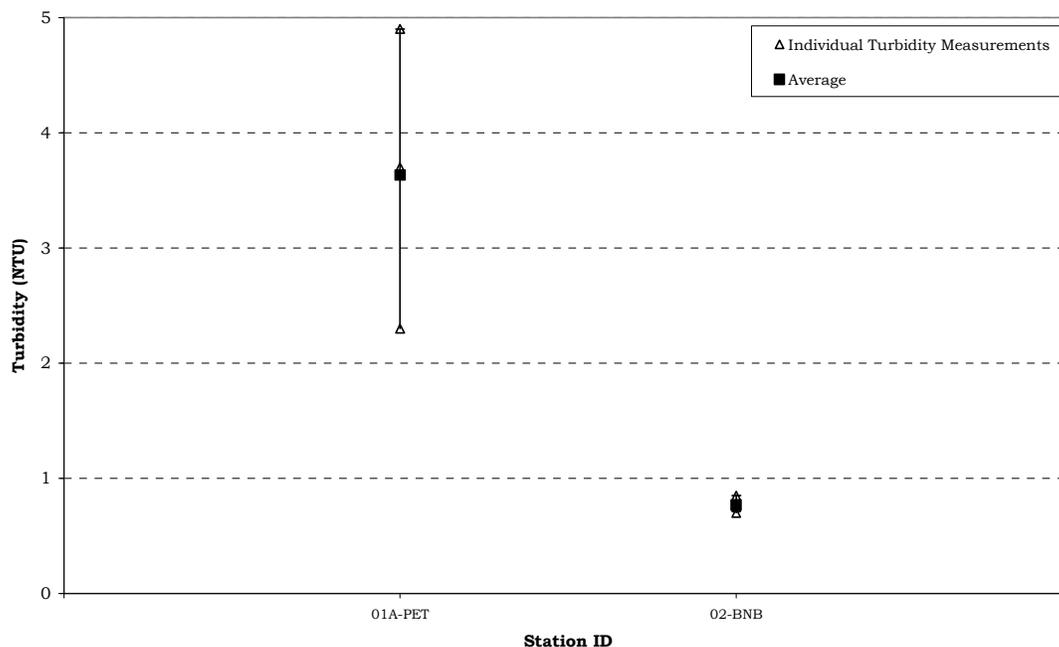
The Class B New Hampshire surface water quality standard for turbidity is less than 10 NTU above background.

**Table 6. Turbidity Data Summary - Peters Brook & Browns Brook, 2006**

<b>Station ID</b>	<b>Samples Collected</b>	<b>Data Range (NTU)</b>	<b>Acceptable Samples Not Meeting NH Class B Standards</b>	<b>Number of Usable Samples for 2008 NH Surface Water Quality Assessment</b>
<b>01A-PET</b>	3	2.3 - 4.9	0	3
<b>02-BNB</b>	3	0.7 - 0.85	0	3
<b>Total</b>	<b>6</b>	—	<b>0</b>	<b>6</b>

Turbidity levels were low on all occasions and at all stations with the average ranging from 0.8 NTU to 3.6 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 - Peter's Brook & Brown's Brook  
August 10 - September 14, 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

Three measurements were taken in the field for specific conductance at one station on Peters Brook and one station on Browns Brook in Hooksett [Table 7]. Of the 6 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.

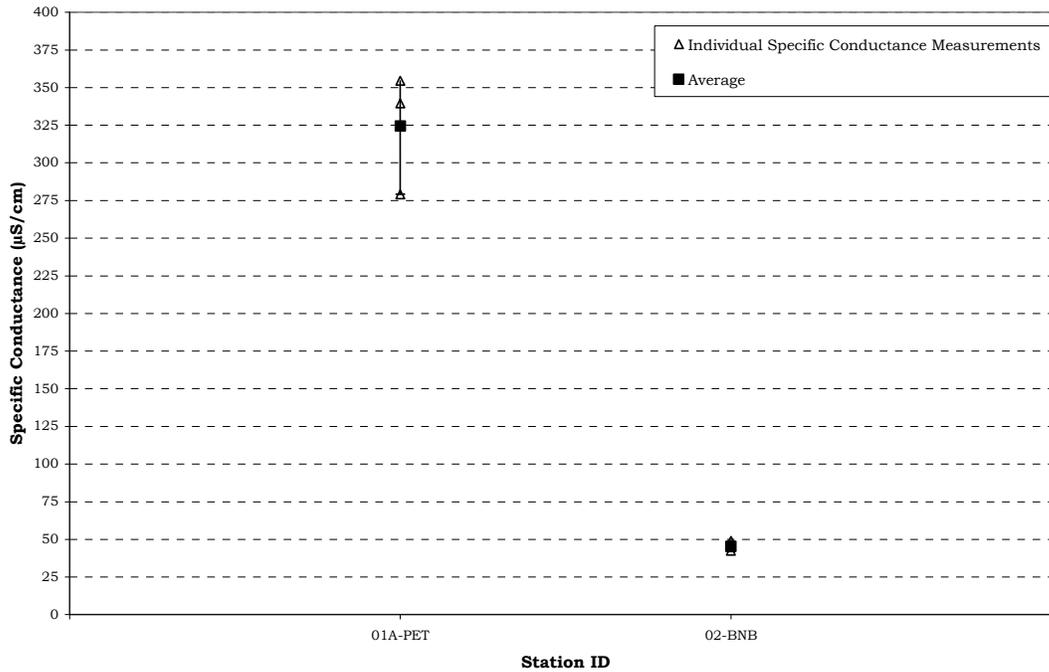
New Hampshire surface water quality standards do not contain numeric limits for specific conductance.

**Table 7. Specific Conductance Data Summary - Peters Brook & Browns Brook, 2006**

Station ID	Samples Collected	Data Range ( $\mu\text{S}/\text{cm}$ )	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2008 NH Surface Water Quality Assessment
<b>01A-PET</b>	3	279.1 - 354.4	0	3
<b>02-BNB</b>	3	42.3 - 49.1	0	3
<b>Total</b>	<b>6</b>	—	<b>N/A</b>	<b>6</b>

Specific conductance levels were relatively low at Station 02-BNB with the average being 45.4  $\mu\text{S}/\text{cm}$ . However, specific conductance levels were higher at Station 01A-PET with the average being 324.3  $\mu\text{S}/\text{cm}$  (Figure 5). Higher specific conductance levels can be indicative of pollution from sources such as urban/agricultural runoff, road salt, failed septic systems, or groundwater pollution.

**Figure 5. Specific Conductance Statistics - Peter's Brook & Brown's Brook  
August 10 - September 14, 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

Three measurements were taken in the field for water temperature at one station on Peters Brook and one station on Browns Brook in Hooksett [Table 8]. Of the six 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.

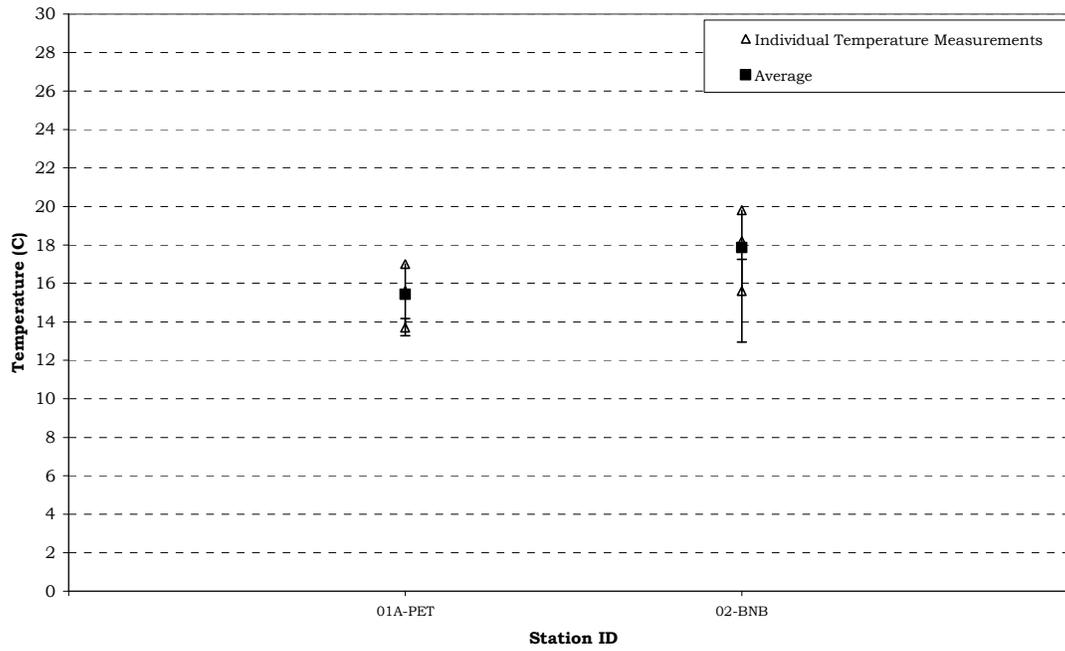
**Table 8. Water Temperature Data Summary – Peters Brook & Browns Brook, 2006**

<b>Station ID</b>	<b>Samples Collected</b>	<b>Data Range (°C)</b>	<b>Acceptable Samples Not Meeting NH Class B Standards</b>	<b>Number of Usable Samples for 2008 NH Surface Water Quality Assessment</b>
<b>01A-PET</b>	3	13.7 - 17.0	Not Applicable	3
<b>02-BNB</b>	3	15.6 - 19.8	N/A	3
<b>Total</b>	<b>6</b>	—	<b>N/A</b>	<b>6</b>

Figure 6 shows the results of instantaneous water temperature measurements taken at one station on Peters Brook and one station on Browns Brook. The average water temperature varied from 15.4 °C. to 17.9 °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 macroinvertebrate 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 - Peter's Brook & Brown's Brook  
August 10 - September 14, 2006, NHDES VRAP**



## Recommendations

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

## 4.6 Total Phosphorus

Three samples were taken for total phosphorus at one station on Peters Brook and one station on Browns Brook (Table 9). Of the 6 samples 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.

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.

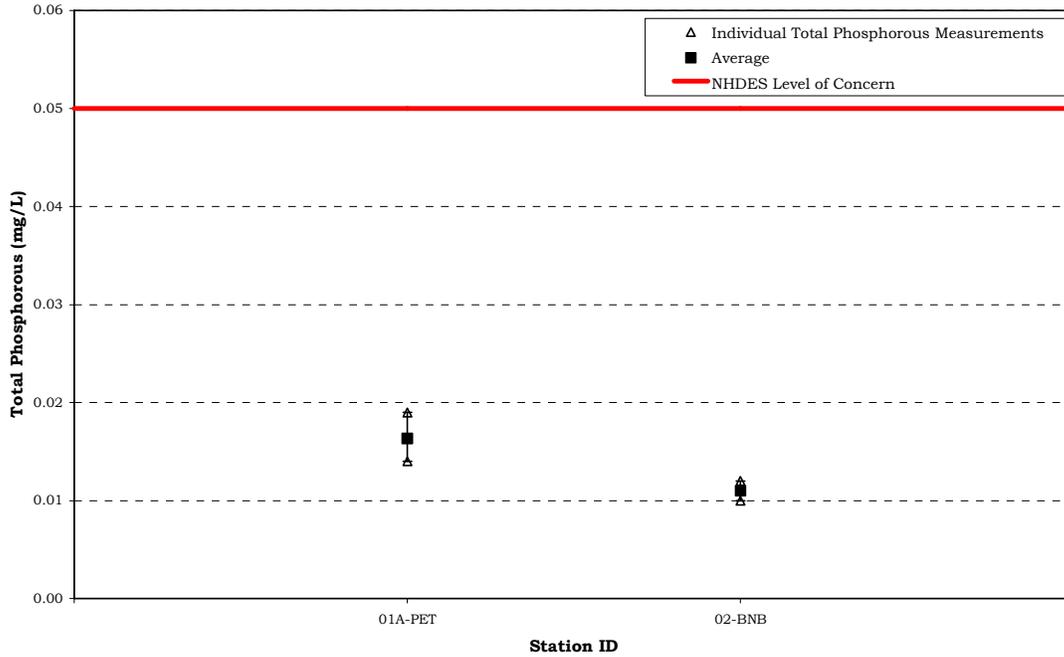
**Table 9. Total Phosphorus Data Summary – Peters Brook & Browns Brook, 2006**

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
<b>01A-PET</b>	3	0.014 - 0.019	0	3
<b>02-BNB</b>	3	0.01 - 0.012	0	3
<b>Total</b>	<b>6</b>	—	<b>0</b>	<b>6</b>

Total phosphorous levels were low and well below the NHDES "level of concern" at all stations. Under undisturbed natural conditions phosphorous is at very low levels in aquatic ecosystems. Of the three nutrients critical for aquatic plant growth- potassium, nitrogen, and phosphorous- it is usually phosphorous that is the limiting factor to plant growth. When the supply of phosphorous is increased due to human activity, algae respond with significant growth.

A major source of excessive phosphorous 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.

Figure 7. Total Phosphorous Statistics - Peter's Brook & Brown's Brook  
August 10 - September 14, 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.

## 4.7 *Escherichia coli*/Bacteria

Three samples were taken for *Escherichia coli* (*E. coli*) at one station on Peters Brook and one station on Browns Brook (Table 10). Of the 6 samples 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.

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

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

**Table 10. *E.coli* Data Summary - Peters Brook & Browns Brook, 2006**

Station ID	Samples Collected	Data Range (cts/100ml)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2008 NH Surface Water Quality Assessment
01A-PET	3	50 - 170	0	3
02-BNB	3	20 - 50	0	3
<b>Total</b>	<b>6</b>	—	<b>0</b>	<b>6</b>

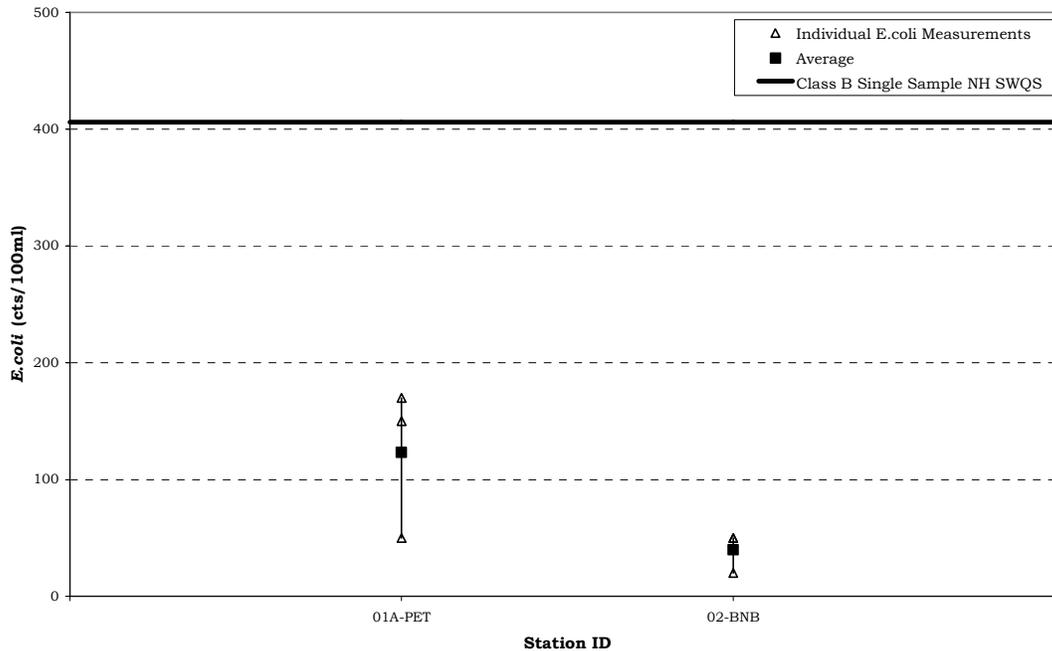
All bacteria measurements met New Hampshire surface water quality standards. In order to fully determine whether a waterbody is meeting surface water standards for *E.coli* a geometric mean must be calculated. A geometric mean is calculated using three samples collected within a 60-day period. A geometric mean was calculated at both stations and each was below the state water quality standard of < 126 counts/100 ml (Table 11).

**Table 11. *E.coli* Geometric Mean Summary – Peters Brook & Browns Brook, 2006**

Station ID	Geometric Means Calculated	Geometric Mean August 10, 2006 - September 14, 2006	Geometric Means Not Meeting NH Class B Standards	Number of Usable Samples for 2008 NH Surface Water Quality Assessment
01A-PET	1	108	0	1
02-BNB	1	37	0	1
<b>Total</b>	<b>2</b>	—	<b>0</b>	<b>2</b>

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.

**Figure 8. *Escherichia coli* Statistics - Peter's Brook & Brown's Brook  
August 10 - September 14, 2006, NHDES VRAP**



## Recommendations

- Continue collecting three samples within any 60-day period during the summer to allow for determination of geometric means.
- 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 and failed septic systems.

## 4.8 Chloride

Three measurements were taken for chloride at one station on Peters Brook and one station on Browns Brook in Hooksett [Table 8]. Of the 6 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.

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

**Table 12. Chloride Data Summary – Peters Brook & Browns 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
01A-PET	3	63 - 85		3
02-BNB	3	5 - 6		3
<b>Total</b>	<b>6</b>		<b>0</b>	<b>6</b>

Chloride concentrations were below the chronic Class B surface water quality standard at both of the stations sampled. 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.

### Recommendations

- Target additional sampling to those periods when chloride levels are likely to be highest (snowmelt).
- Continue to take specific conductance measurements simultaneously with chloride samples

## 4.9 Hardness

One sample was collected for hardness on Peters Brook and one on Browns Brook in Hooksett (Table 13). Of the two samples collected, both 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.

New Hampshire surface water quality standards do not contain numeric limits for Hardness. However, hardness levels are used to determine the station specific water quality standards for hardness dependent metals such as copper, lead, and zinc.

**Table 13. Hardness Data Summary – Peters Brook & Browns Brook, 2006**

<b>Station ID</b>	<b>Samples Collected</b>	<b>Data Range (mg/l)</b>	<b>Acceptable Samples Not Meeting NH Class B Standards</b>	<b>Number of Usable Samples for 2008 NH Surface Water Quality Assessment</b>
<b>01A-PET</b>	1	31.69	Not Applicable	1
<b>02-BNB</b>	1	8.57	N/A	1
<b>Total</b>	<b>2</b>	—	—	<b>2</b>

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.

### Recommendations

- Continue sampling hardness when metal samples are collected.

## 4.10 Aluminum

One sample was collected for aluminum on Peters Brook and one on Browns Brook in Hooksett (Table 14). Of the 2 samples taken, both 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 Aluminum is as follows:

Freshwater chronic criterion	0.087 mg/l
Freshwater acute criterion	0.75 mg/l

**Table 14. Aluminum Data Summary – Peters Brook & Browns 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
01A-PET	1	0.116 - 0.116	1	1
02-BNB	1	0.075 - 0.075	0	1
<b>Total</b>	<b>2</b>	—	<b>1</b>	<b>2</b>

The aluminum sample taken at 01A-PET was above the chronic standard. Aluminum is the most common metal in the earth's crust and occurs in many rocks and ores. Due to its high chemical reactivity, aluminum does not occur in nature as its pure metal state but is instead combined with other elements. Aluminum will exist in higher concentrations in those surface waters with lower pH levels. The more acidic waters allow higher amounts of aluminum to precipitate out from surrounding soils and substrate.

### Recommendations

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

## 4.11 Copper

One sample was collected for copper on Peters Brook and one on Browns Brook in Hooksett (Table 15). Of the two samples collected, both 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.

Class B New Hampshire surface water quality standards for copper are dependant on hardness. As hardness samples were collected simultaneously with copper the calculated standards are as follows:

Freshwater chronic criterion:	01A-PET	0.0047 mg/l
	02-BNB	0.0014 mg/l

**Table 15. Copper Data Summary – Peters Brook & Browns 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
01A-PET	1	<.005	0	1
02-BNB	1	<.005	0	1
<b>Total</b>	<b>2</b>	_____	<b>0</b>	<b>2</b>

Copper concentrations were below the laboratory detection limit at both stations. In this case where the laboratory detection limit for copper is <0.005 mg/L, half of that value or 0.0025 mg/L is used as a surrogate value to determine if the sample is below water quality standards. In the case of station 02-BNB, the surrogate value of 0.0025 mg/L is above the chronic water quality criteria. However, given that the surrogate value is based on a laboratory detection limit and the true value is unknown, the sample is not considered to be violating water quality standards and is listed as “insufficient information”.

Potential sources of elevated copper levels are the corrosion of plumbing, erosion of natural deposits, or pollution related to mining.

### Recommendations

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

## 4.12 Lead

One sample was collected for lead on Peters Brook and one on Browns Brook in Hooksett (Table 16). Of the two samples collected, both 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.

Class B New Hampshire surface water quality standards for lead are dependant on hardness. As, hardness samples were collected simultaneously with lead the calculated standards are as follows:

Freshwater chronic criterion:	01A-PET	.019 mg/l
	02-BNB	.00036 mg/l

**Table 16. Lead Data Summary – Peters Brook & Browns 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
01A-PET	1	<.001	0	1
02-BNB	1	<.001	0	1
<b>Total</b>	<b>2</b>	—	<b>0</b>	<b>2</b>

Lead concentrations were below the laboratory detection limit at both stations. In this case where the laboratory detection limit for lead is <0.001 mg/L, half of that value or 0.0005 mg/L is used as a surrogate value to determine if the sample is below water quality standards. At both stations the surrogate value is below the chronic standard.

Potential sources of elevated lead levels are the erosion of natural deposits, industrial discharges, and presence of lead in the streambed from sources such as fishing lures or lead ammunition.

### Recommendations

- Continue sampling at all stations, in order to develop a long-term data set to better understand trends as time goes on. Continue sampling hardness simultaneously with lead samples.

## 4.13 Zinc

One sample was collected for zinc on Peters Brook and one on Browns Brook in Hooksett (Table 17). Of the two samples collected, both 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.

Class B New Hampshire surface water quality standards for zinc are dependant on hardness. As, hardness samples were collected simultaneously with zinc the calculated standards are as follows:

Freshwater chronic criterion:	01A-PET	0.045 mg/l
	02-BNB	0.015 mg/l

**Table 17. Zinc Data Summary – Peters Brook & Browns 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
01A-PET	1	<.025	0	1
02-BNB	1	<.025	0	1
<b>Total</b>	<b>2</b>	—	<b>0</b>	<b>2</b>

Zinc concentrations were below the laboratory detection limit at both stations. In this case where the laboratory detection limit for lead is <0.025 mg/L, half of that value or 0.013 mg/L is used as a surrogate value to determine if the sample is below water quality standards. At both stations the surrogate value is below the chronic standard.

Potential sources of zinc are runoff from smelting and refining operations, industrial discharges, and weathering of bedrock. Zinc can also enter surface water via airborne sources such as atmospheric deposition as automobiles and fuel combustion.

### Recommendations

- Continue sampling at all stations in order to develop a long-term dataset to better understand trends as time going on. Continue sampling hardness simultaneously with zinc samples.

**APPENDIX A**

**2006 Peters Brook & Browns Brook Water Quality Data**

# 2006 PETER'S BROOK & BROWN'S BROOK VRAP DATA

	Measurements not meeting New Hampshire surface water quality standards
	Total Phosphorous measurements exceeding NHDES level of concern
	Measurements not meeting NHDES quality assurance/quality control standards
	Insufficient information to determine if sample is above or below standard

<sup>A</sup> Hardness dependent metal. The water quality standard is calculated based on the site specific hardness value.

<sup>B</sup> Chronic water quality standard

## 01A-PET, Peter's Brook, LeHeroux Road, Hooksett

Date	Time of Sample	DO (mg/L)	DO (% sat.)	Water Temp. (°C)	Air Temp. (°C)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	<i>E. coli</i> (CTS/100mL)	<i>E.coli</i> Geometric Mean	Total Phosphorus (mg/L)	Chloride	Hardness	Aluminum	Copper	Lead	Zinc
Standard	NA	>5.0	>75% Daily Average	Narrative	NA	6.5-8.0	<10 NTU above backgrd	NA	<406	<126	NA	230 mg/L <sup>A</sup>	mg/L	0.087 mg/L <sup>A</sup>	0.0047 mg/L <sup>A,B</sup>	0.019 mg/L <sup>A,B</sup>	0.045 mg/L <sup>A,B</sup>
8/10/06	06:58	10.20	106.0	17.0	16.6	5.30	4.9	354.4	50		0.014	78	31.69	0.116	<.005	<.001	<.025
8/30/06	06:50	9.32	93.4	15.6	16.8	7.06	3.7	279.1	150		0.019	63					
9/14/06	06:45	9.69	93.7	13.7	12.9	6.71	2.3	339.5	170	108	0.016	85					

## 02-BNB, Brown's Brook, Pleasant Street, Hooksett

Date	Time of Sample	DO (mg/L)	DO (% sat.)	Water Temp. (°C)	Air Temp. (°C)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	<i>E. coli</i> (CTS/100mL)	<i>E.coli</i> Geometric Mean	Total Phosphorus (mg/L)	Chloride	Hardness	Aluminum	Copper	Lead	Zinc
Standard	NA	>5.0	>75% Daily Average	Narrative	NA	6.5-8.0	<10 NTU above backgrd	NA	<406	<126	NA	230 mg/L <sup>A</sup>	mg/L	0.087 mg/L <sup>A</sup>	0.0014 mg/L <sup>A,B</sup>	0.0036 mg/L <sup>A,B</sup>	0.015 mg/L <sup>A,B</sup>
8/10/06	07:22	5.20	58.0	19.8	17.1	5.94	0.9	49.1	20		0.012	5	8.57	0.075	<.005	<.001	<.025
8/30/06	07:25	8.86	94.0	18.2	16.8	6.09	0.7	42.3	50		0.010	5					
9/14/06	07:15	9.50	95.6	15.6	14.4	5.91	0.8	44.7	50	37	0.011	6					