

**New Hampshire Volunteer River Assessment Program
2009 Gunnison Brook & South Branch Sugar River Watershed
Water Quality Report**



January 2010

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Water Quality Report**

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Cover Photo: Gunnison Brook, 01-GUN, Goshen

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The New Hampshire Department of Environmental Services Volunteer River Assessment Program extends sincere thanks to the volunteers of the Goshen Conservation Commission and the Gunnison Brook/South Branch Sugar River VRAP Group for their efforts during 2009. 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.

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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 is 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.

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 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.

2.5 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.

VRAP groups conduct sampling according to a prearranged monitoring schedule and VRAP protocols. 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'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.

2.6 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/>.

2.7 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 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.

2.7.1 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

During the summer of 2004, volunteers from the Goshen Conservation Commission began water quality monitoring in the Gunnison Brook and South Branch Sugar river watershed. The goal of this effort was to provide water quality data relative to surface water quality standards and to allow for the assessment of waterbodies 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, financial assistance for laboratory costs, and technical assistance.

During 2009, trained volunteers monitored water quality at one station along Gunnison Brook, one station along the south branch of the Sugar River, one station along Blood Brook, and one station along Giles Brook (Table 3). Stations IDs were designated using a three-letter code to identify the waterbody name plus a number indicating the relative position of the station. The higher the station number the more upstream the station is in the watershed. Gunnison Brook, the South Branch Sugar River watershed and their tributaries are designated as Class B waters. This class is used to apply the appropriate water quality standard.

Water quality monitoring was conducted from May to October. In-situ measurements of water temperature, dissolved oxygen, pH, turbidity and specific conductance were taken using handheld meters provided by NHDES. Samples for *E.coli* and total phosphorous were taken using sterile and/or preserved bottles supplied by the NHDES laboratory and were stored on ice during transport from the field to the lab. Table 2 summarizes the parameters measured, laboratory standard methods, and equipment used.

Table 2. 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	YSI 30	-----
Specific Conductance	In-Situ	SM 2510	LaMotte 2020	-----
<i>E.coli</i>	Bottle (Sterile)	SM 19 9213 D.3	-----	NHDES
Total Phosphorous	Bottle (w/Preservative)	EPA 365.3	-----	NHDES

Table 3. Sampling Stations for Gunnison Brook & South Branch Sugar River Watershed, NHDES VRAP, 2009

Station ID & AUID	Class	Waterbody Name	Location	Town	Elevation <i>(Rounded to the Nearest 100 Feet)</i>
02-BLD NHRIV801060403-10	B	Blood Brook	Route 31 Bridge	Goshen	1180
01-GIL NHRIV801060403-10	B	Giles Brook	Mummery Road Bridge	Goshen	1000
01-GUN NHRIV801060403-12	B	Gunnison Brook	Brook Road Bridge Upstream of Route 10	Goshen	1000
04-SSR NHRIV801060403-12	B	South Branch Sugar River	Lear Hill Road	Goshen	900

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

Ten measurements were taken in the field for dissolved oxygen concentration at four stations in the Gunnison Brook and South Branch Sugar River watersheds in Goshen (Table 4). Of the 40 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.

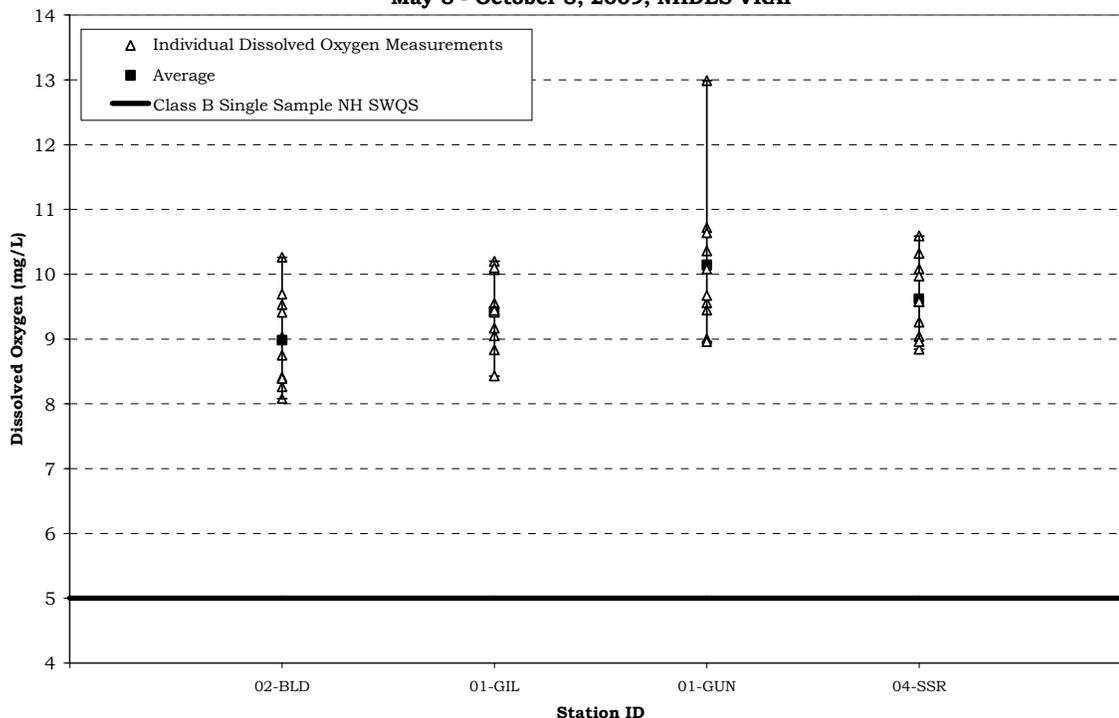
The Class B New Hampshire surface water quality standard for dissolved oxygen includes a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 percent of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be assessed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

Table 4. Dissolved Oxygen Concentration (mg/L) Summary – Gunnison Brook & South Branch Sugar River Watershed, 2009

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-BLD	10	8.08 - 10.26	0	10
01-GIL	10	8.43 - 10.20	0	10
01-GUN	10	8.96 - 12.99	0	10
04-SSR	10	8.84 - 10.59	0	10
Total	40	—	0	40

Dissolved oxygen concentration levels were above the New Hampshire Class B water quality standard at all stations on all occasions (Figure 1). The average concentration of dissolved oxygen was consistently above the standard at all stations ranging from 8.98 mg/L to 10.14 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 1. Dissolved Oxygen Concentration Statistics for the Gunnison Brook and South Branch Sugar River Watershed
May 8 - October 8, 2009, 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.
- Consider incorporating the use of in-situ dataloggers to automatically record dissolved oxygen saturation levels during a period of several days. The use of these instruments is dependent upon availability, and requires coordination with NHDES.

4.2 pH

Ten measurements were taken in the field for pH at four stations in the Gunnison Brook and South Branch Sugar River watershed in Goshen (Table 5). Of the 40 measurements taken, 39 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.

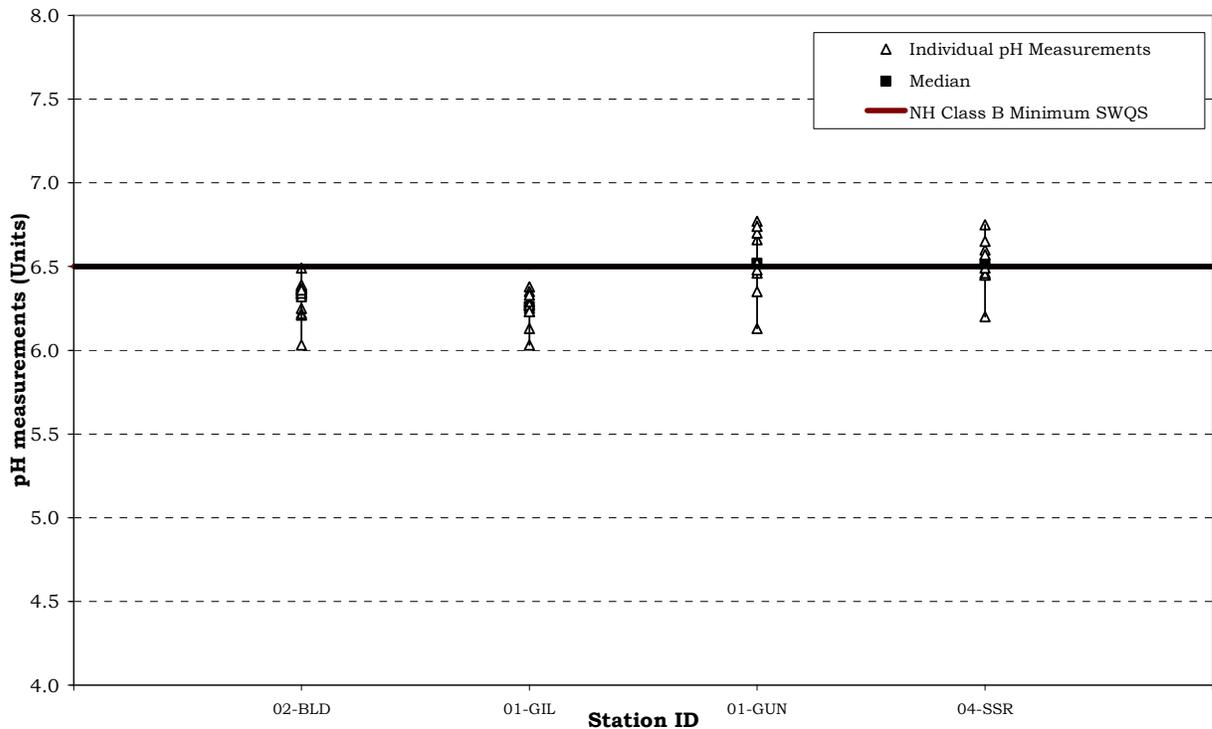
Table 5. pH Data Summary - Gunnison Brook/South Branch Sugar River Watershed, 2009

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-BLD	10	6.03 - 6.49	10	10
01-GIL	10	6.03 - 6.38	10	10
01-GUN	10	6.13 - 11.00	4	9
04-SSR	10	6.20 - 6.75	4	10
Total	40	—	28	39

All measurements at stations 02-BLD and 01-GIL, and four measurements at stations 01-GUN and 04-SSR were below the New Hampshire Class B surface water quality standard minimum (Figure 2).

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 2. pH Statistics for the Gunnison Brook and South Branch Sugar River Watershed
May 8 - October 8, 2009, 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

Ten measurements were taken in the field for turbidity at four stations in the Gunnison Brook and South Branch Sugar River watershed in Goshen [Table 6]. Of the 40 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.

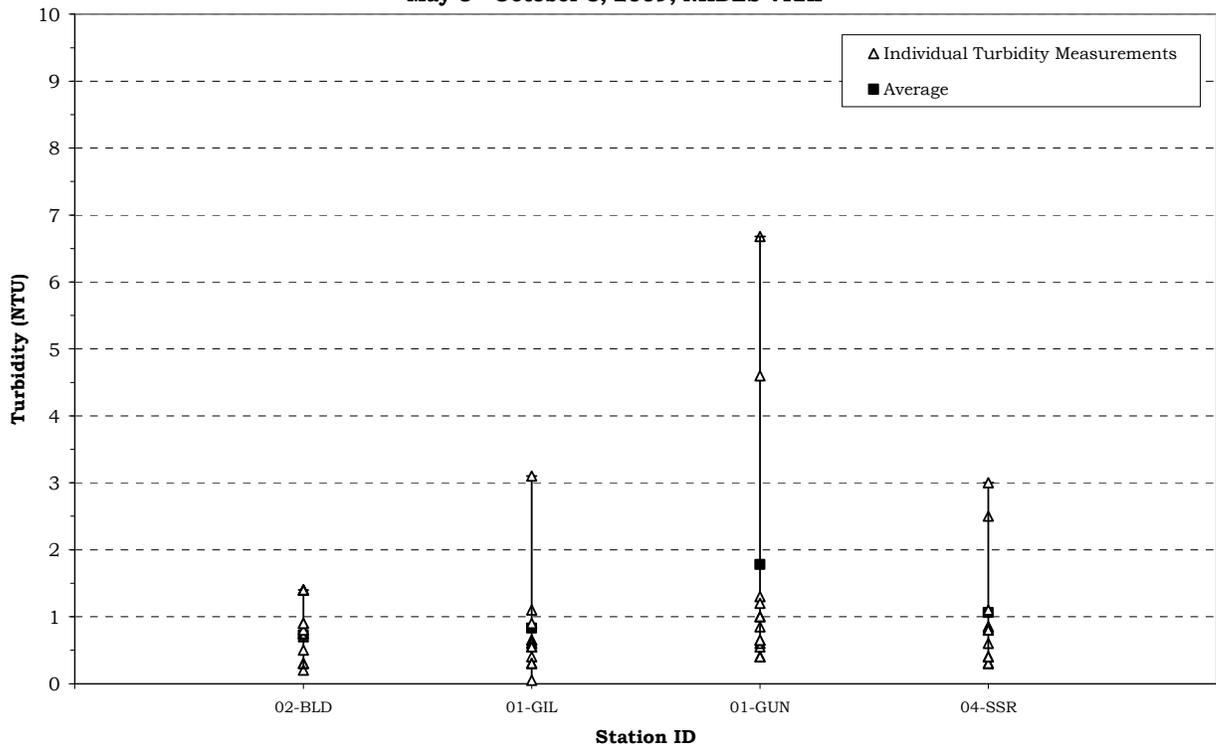
The Class B New Hampshire surface water quality standard for turbidity is less than 10 NTU above natural background.

Table 6. Turbidity Data Summary - Gunnison Brook/South Branch Sugar River Watershed, 2009

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-BLD	10	0.20- 1.40	0	10
01-GIL	10	0.05 - 3.10	0	10
01-GUN	10	0.40 - 6.68	0	10
04-SSR	10	0.30 - 3.00	0	10
Total	40	—	0	40

Turbidity levels were low at all stations on all occasions with the average ranging from 0.73 NTU to 1.78 NTU (Figure 3). 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 3. Turbidity Statistics for the Gunnison Brook and South Branch Sugar River Watershed
May 8 - October 8, 2009, 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

Ten measurements were taken in the field for specific conductance at four stations in the Gunnison Brook and South Branch Sugar River watershed in Goshen (Table 7). Of the 40 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.

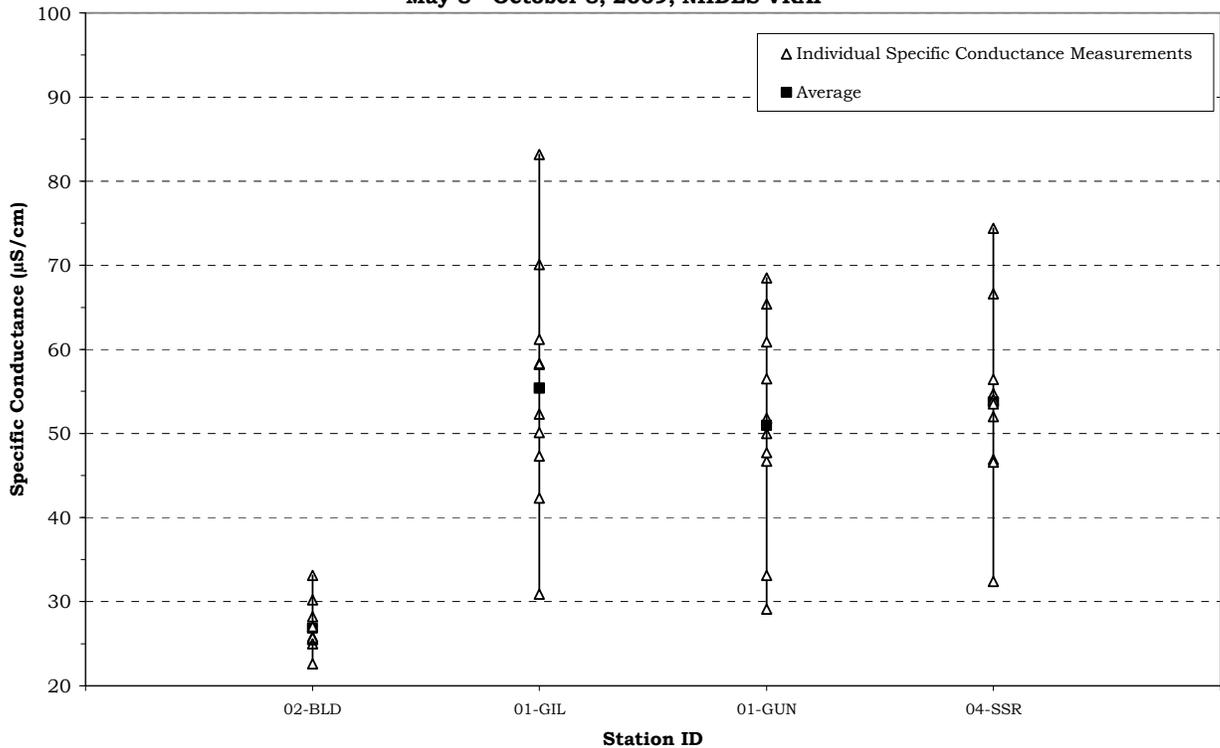
New Hampshire surface water quality standards do not contain numeric criteria for specific conductance although in many fresh surface waters, specific conductance can be used as a surrogate to predict compliance with numeric water quality criteria for chloride.

Table 7. Specific Conductance Data Summary - Gunnison Brook/South Branch Sugar River Watershed, 2009

Station ID	Samples Collected	Data Range ($\mu\text{S}/\text{cm}$)	Acceptable Samples Not Meeting NH Class B Standards ($\mu\text{S}/\text{cm}$ as chloride surrogate)	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
02-BLD	10	22.6 - 33.1	0	10
01-GIL	10	30.9 - 83.2	0	10
01-GUN	10	29.1 - 68.5	0	10
04-SSR	10	32.4 - 74.4	0	10
Total	40	—	0	40

Specific conductance levels were low at all station on all occasions with the average ranging from 26.9 $\mu\text{S}/\text{cm}$ to 55.4 $\mu\text{S}/\text{cm}$ (Figure 4). Higher specific conductance levels can be indicative of pollution from sources such as urban/agricultural runoff, road salt, failed septic systems, or groundwater pollution. Thus, the lower specific conductance levels generally indicate lower pollutant levels.

**Figure 4. Specific Conductance Statistics for the Gunnison Brook and South Branch Sugar River Watershed
May 8 - October 8, 2009, 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. Specific conductance levels are very closely correlated to chloride levels. Simultaneously measuring chloride and specific conductance will allow for a better understanding of their relationship.
- Consider 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

Ten measurements were taken in the field for water temperature at four stations in the Gunnison Brook and South Branch Sugar River watershed in Goshen (Table 8). Of the 40 measurements taken, 36 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 – Gunnison Brook/South Branch Sugar River Watershed, 2009

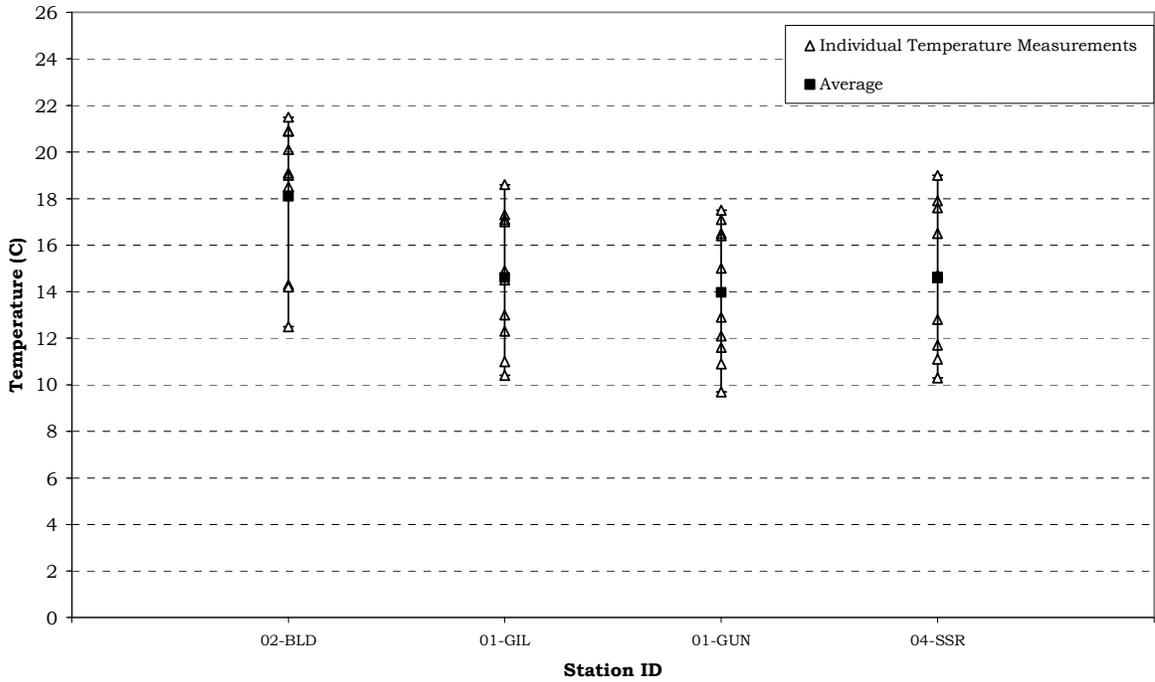
Station ID	Samples Collected	Data Range (°C)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
02-BLD	10	12.5 - 21.5	Not Applicable	9
01-GIL	10	10.4 - 18.6	N/A	9
01-GUN	10	9.7 - 17.5	N/A	9
04-SSR	10	10.3 - 19.0	N/A	9
Total	40	—	N/A	36

Figure 5 shows the results of instantaneous water temperature measurements taken at four stations in the Gunnison Brook and South Branch Sugar River watershed. The average water temperature varied from 14.0 °C. to 18.1 °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 5. Water Temperature Statistics for the Gunnision Brook and South Branch Sugar River Watershed
May 8 - October 8, 2009, NHDES VRAP**



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

Two samples were collected for *Escherichia coli* (*E. coli*) at four stations in the Gunnison Brook and South Branch Sugar River watershed in Goshen (Table 9). Of the eight 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:

- <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 9. *E. coli* Data Summary - Gunnison Brook/South Branch Sugar River Watershed, 2009

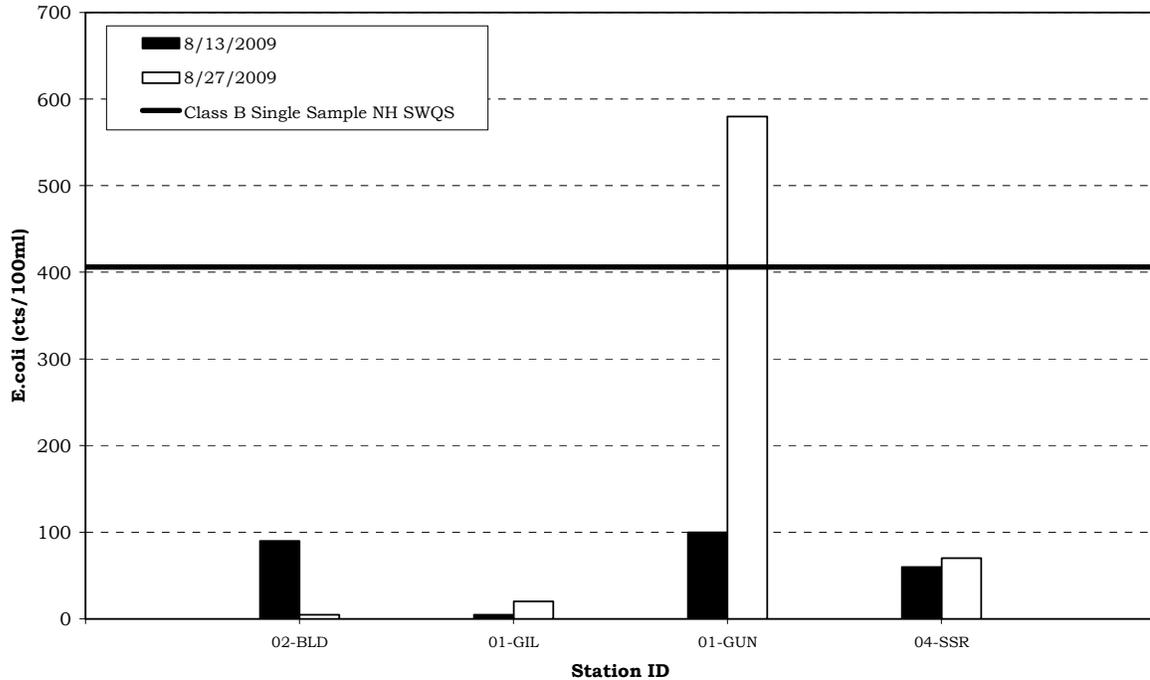
Station ID	Samples Collected	Data Range (cts/100ml)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
02-BLD	2	5 - 90	0	2
01-GIL	2	5 - 20	0	2
01-GUN	2	100 - 580	1	2
04-SSR	2	60 - 70	0	2
Total	8	—	1	8

One sample from station 01-GUN was above the New Hampshire Class B surface water quality standard (Figure 6).

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. During 2009, a geometric mean was not calculated since only two samples were collected.

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 6. *Escherichia coli* Statistics for the Gunnison Brook and South Branch Sugar River Watershed August 13 & August 27 2009, NHDES VRAP



Recommendations

- Collect 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.

4.7 Total Phosphorus

Two samples were collected for total phosphorous at four stations in the Gunnison Brook and South Branch Sugar River watershed in Goshen (Table 10). Of the eight 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.

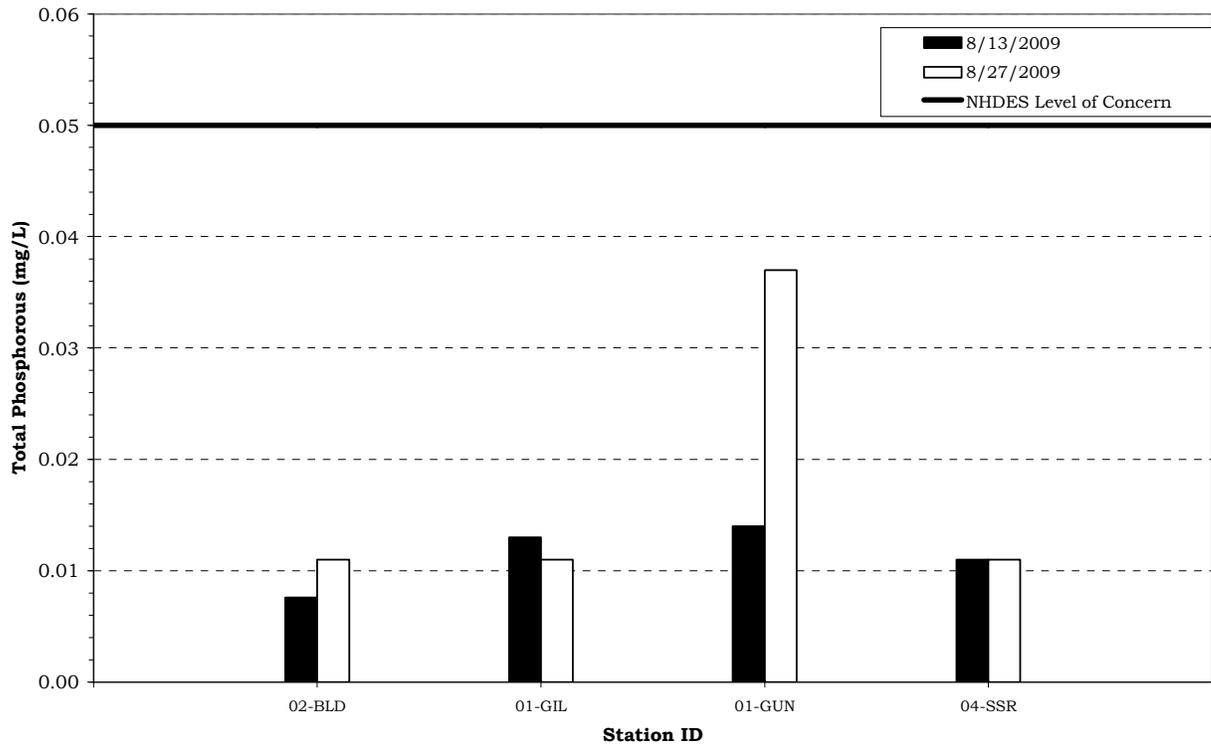
Table 10. Total Phosphorus Data Summary – Gunnison Brook/South Branch Sugar River Watershed, 2009

Station ID	Samples Collected	Data Range (mg/l)	Acceptable Samples Above NHDES Level of Concern	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
02-BLD	2	0.0076 - 0.011	0	2
01-GIL	2	0.011 - 0.013	0	2
01-GUN	2	0.014 - 0.037	0	2
04-SSR	2	0.011 - 0.011	0	2
Total	8	—	0	8

Total phosphorous levels were below the NHDES “level of concern” at all stations on all occasions (Figure 7). 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 the Gunnison Brook and South Branch Sugar River Watershed August 13 & August 27, 2009 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.