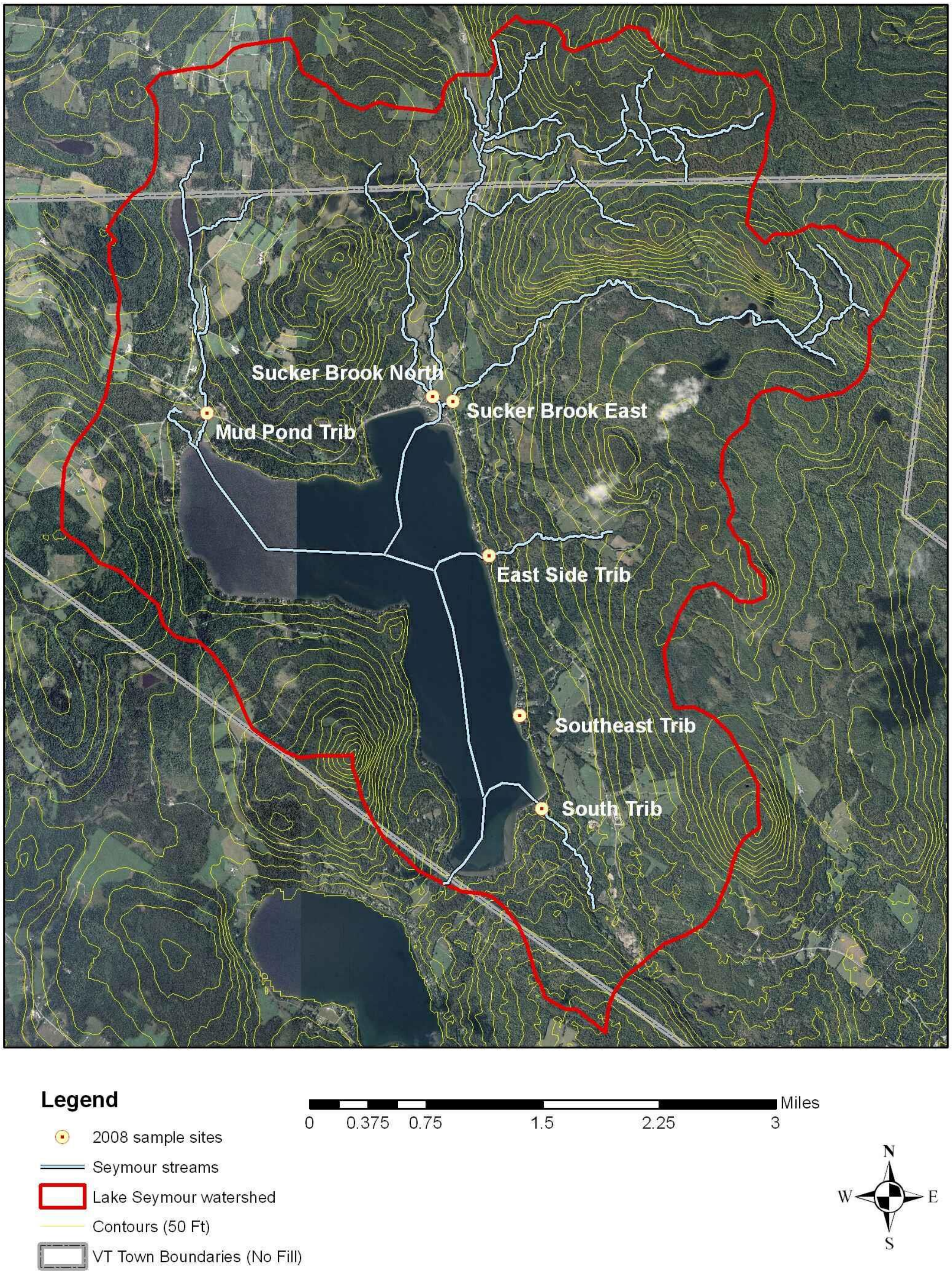
2008 SEYMOUR LAKE ASSOCIATION - LAROSA PARTNERSHIP ANNUAL REPORT: WATER QUALITY TESTING OF SIX SEYMOUR LAKE TRIBUTARIES

Introduction

Volunteers for the Seymour Lake Association (SLA) have completed their first year of water quality testing of six tributaries in their partnership with Neil Kamman of Vermont's Department of Environmental Conservation (DEC) and the LaRosa Laboratory. The goal was to obtain valid and useful data for levels of phosphorus, nitrogen and turbidity near the mouth of each of six tributaries of the lake. This included the collection of samples on eight designated dates and transporting them to the LaRosa Laboratory in Waterbury for testing. Nitrogen and phosphorus data meet all EPA quality assurance goals while the turbidity data did not. However the turbidity results still provide useful information and efforts will be made to meet quality assurance goals for this parameter next year. The location of the six tributaries is shown on the map on page 2. Over the years of this study, the question we will be seeking to answer is, **"Does the increased pollution of the lake come mainly from the alteration of the lake shore or are the tributaries which drain the land in the rest of the lake's watershed also contributing significant amounts of phosphorus and sediment to the lake?"** The SLA will use the information produced by this study to decide what programs, outreach efforts and educational initiatives it will implement in its role to protect the water quality of the lake. The SLA now realizes that in order to be effective it must provide informational programs to the SLA membership, other lakefront property owners and other Morgan residents.

The SLA became aware of the decline in lake water quality and the need to expand its lake protection programs during 2007. That is when we noticed that the yearly Vermont Lay Monitoring Reports for lake water quality have documented a significant decline in water clarity as well as a significant increase in phosphorus over the years 1996 – 2006. In 2007, the SLA learned from Neil Kamman, Ben Copans, Kellie Merrell and Susan Warren, all of the DEC, that such a decline in water quality has several likely causes. A major cause of additional phosphorus and sediment in a lake is the replacement of the natural vegetation on the lake shore land with lawns, driveways, access roads and buildings. This has been occurring at an accelerated rate on the shores of Seymour Lake in recent years; documentation can be found in the 2/15/08 presentation given by four DEC scientists and available on the SLA web site. Other major causes can be the result of land uses in the outer reaches of the watershed such as suburban runoff, roads, construction/development, forestry, ineffective septic systems and farming. The DEC scientists worked diligently during 2007- 2008 to educate the SLA and to recommend actions the Association might take to alleviate the declining water quality. Their recommendations led us to the question which this report begins to answer and to apply for participation in the LaRosa Partnership Program.

Lake Seymour 2008 sample sites

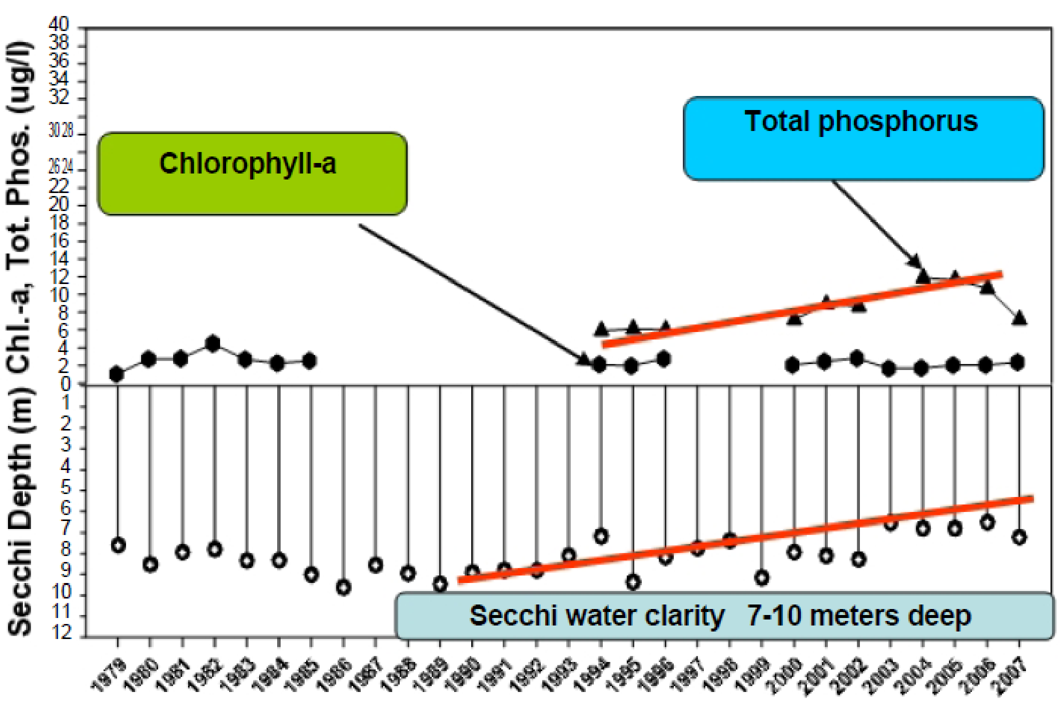


Project Description

Our project was designed under the guidance of Neil Kamman and Ben Copans. Neil is a DEC Lake Assessment Specialist who heads the LaRosa Partnership Program. Ben is the DEC Memphremagog Watershed Coordinator. Both gave us ongoing guidance, mentoring and training throughout our first year in the LaRosa Partnership Program. EPA Quality Control Protocols were followed by all participants. This included testing blank and duplicate samples, arranging for timely transport of the samples to the lab, cooling the samples appropriately during transport and using methods and containers that meet EPA standards. Spike samples were collected to be used in the laboratory for ensuring that the testing process met quality control standards. The elements of our project are listed below.

<u>Site Choice</u> –In order to optimize our data, we relied on Ben Copans' knowledge to choose the tributaries to be sampled and he also guided us in determining the exact collection site on each tributary. Tributaries were chosen based on amount of the watershed they drain as well as the steady flow throughout the year. The collection site on each tributary was chosen based on criteria such as safe access by samplers, certainty of obtaining tributary flow rather than lake water, suitable depth of water throughout the sampling season and the need to be as close to the lake as possible in order to be capturing water from the whole drainage into the tributary.

<u>Parameters Monitored</u> – Under Ben's guidance we arranged to monitor phosphorus, turbidity and nitrogen during this season. These parameters were chosen because of our concern about the increased levels of phosphorus and sediments in Seymour as shown by the Vermont Lay Monitoring Program during the past decade. Nitrogen was monitored to help us identify possible sources of the phosphorus. Raised phosphorus levels alone indicate that sediments are the source of the phosphorus. Elevated phosphorus levels are accompanied by elevated nitrogen levels are an indication the sewage, fertilizers and/or manures are the source of the phosphorus. Sediment entering the lake from a tributary is detected by measuring turbidity.



Lake Seymour Lay Monitoring data show statistically higher levels of total phosphorus and lower Secchi water clarity readings. Chlorophyll-a levels show no statistical change over time.

We also monitored stream depth in the South Tributary as a rough measure of stream flow for all the tributaries. Our tributaries are small and somewhat similar, so that measurement gave us a rough idea of the variation in flow over the season. Generally speaking, higher stream flow carries elevated levels of pollutants into a lake.

Training of Volunteers/Sampling Methods – All eight SLA volunteers attended several of the training sessions. Five of us attended the nearly day long training in Waterbury. Neil Kamman provided most of the instruction, but additional instruction was given by Lab Director Jerry Divincenzo, Alison Farnsworth who handles incoming samples, and Leslie Matthews DEC Invasives Specialist. In addition, Ben conducted two on site training sessions at our lake. He also responded promptly and fully to our frequent email and phone questions during the season. As each of our volunteers developed the needed skills, he/she trained others as the need arose. The spirit of collaboration among SLA volunteers, Memphremagog Watershed Association (MWA) volunteers and DEC professionals contributed greatly to the success of our program.

Landowner Permission – Three volunteers sought and received enthusiastic support from the landowners who allowed us access to our chosen sampling sites. Thank you notes were sent to them all.

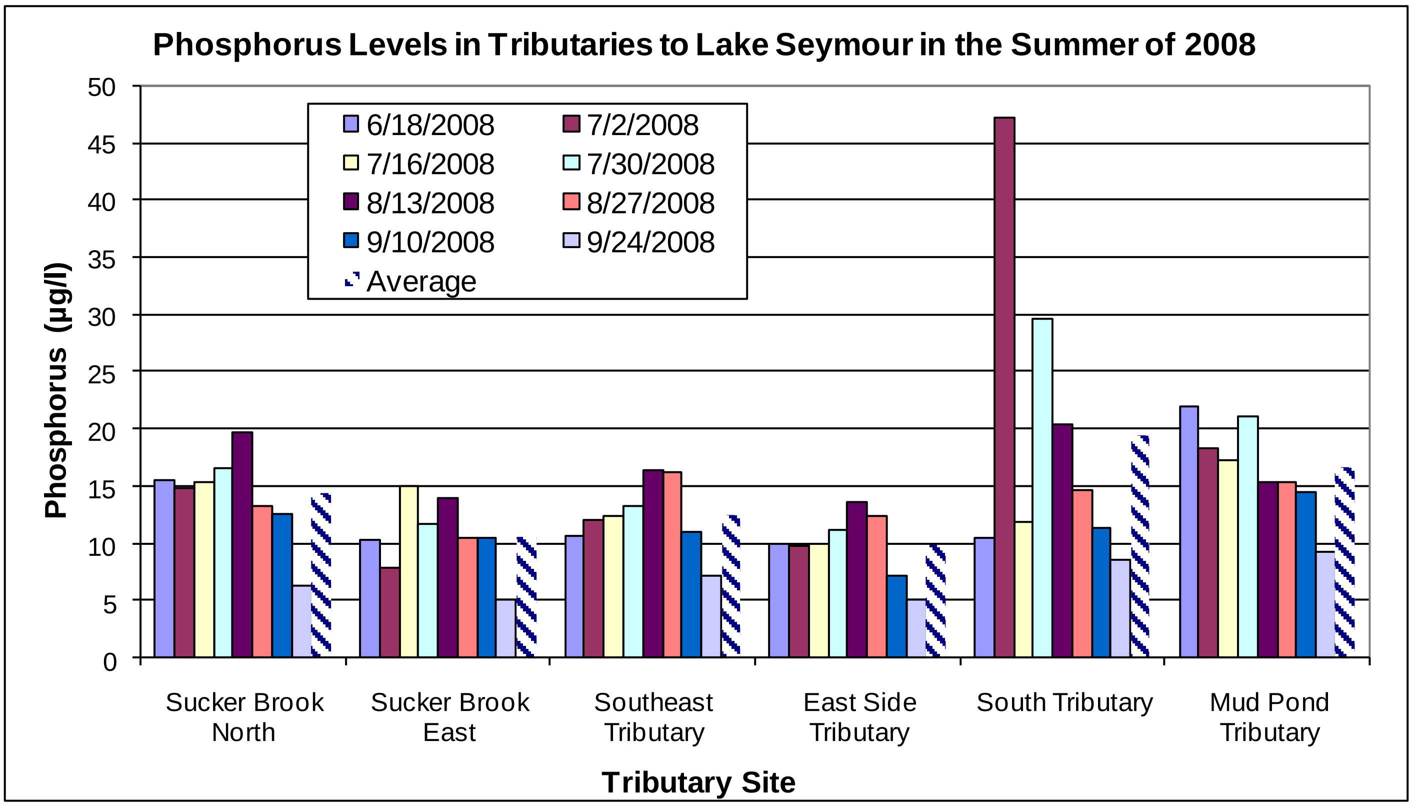
Transport of Samples – The samples needed to be kept cool and to reach the laboratory in the 36 hours following collection. We anticipated difficulty with this because of the long trip to Waterbury as well as the high gas prices. However, Ben Copans, Neil Kamman and two leaders of the Memphremagog Watershed Association (MWA) helped work out a plan for us to deliver our samples to the MWA volunteers in Newport. From there the MWA, Ben and Neil made certain that our samples were delivered to the lab.

Results

In this section are graphs presenting the data resulting from our sampling, discussion of the results and some recommendations for next year. Raw data can be found in the appendices. We have also provided additional graphs and a discussion of some of the observations that can be made from a study of the data. Although one year of data cannot establish trends, there are some useful observations and analyses that can be derived from the graphs which appear in this section. It is important to note that none of our samples were collected during rain events when the streams would carry a larger load of water which would likely carry greater amounts of nutrients and sediment into the lake. Even though the summer of 2008 had unusually high precipitation, our field data sheets document that our sampling dates did not coincide with the rain events. The sampling dates were predetermined by the LaRosa Laboratory schedule and our sample transport arrangements.

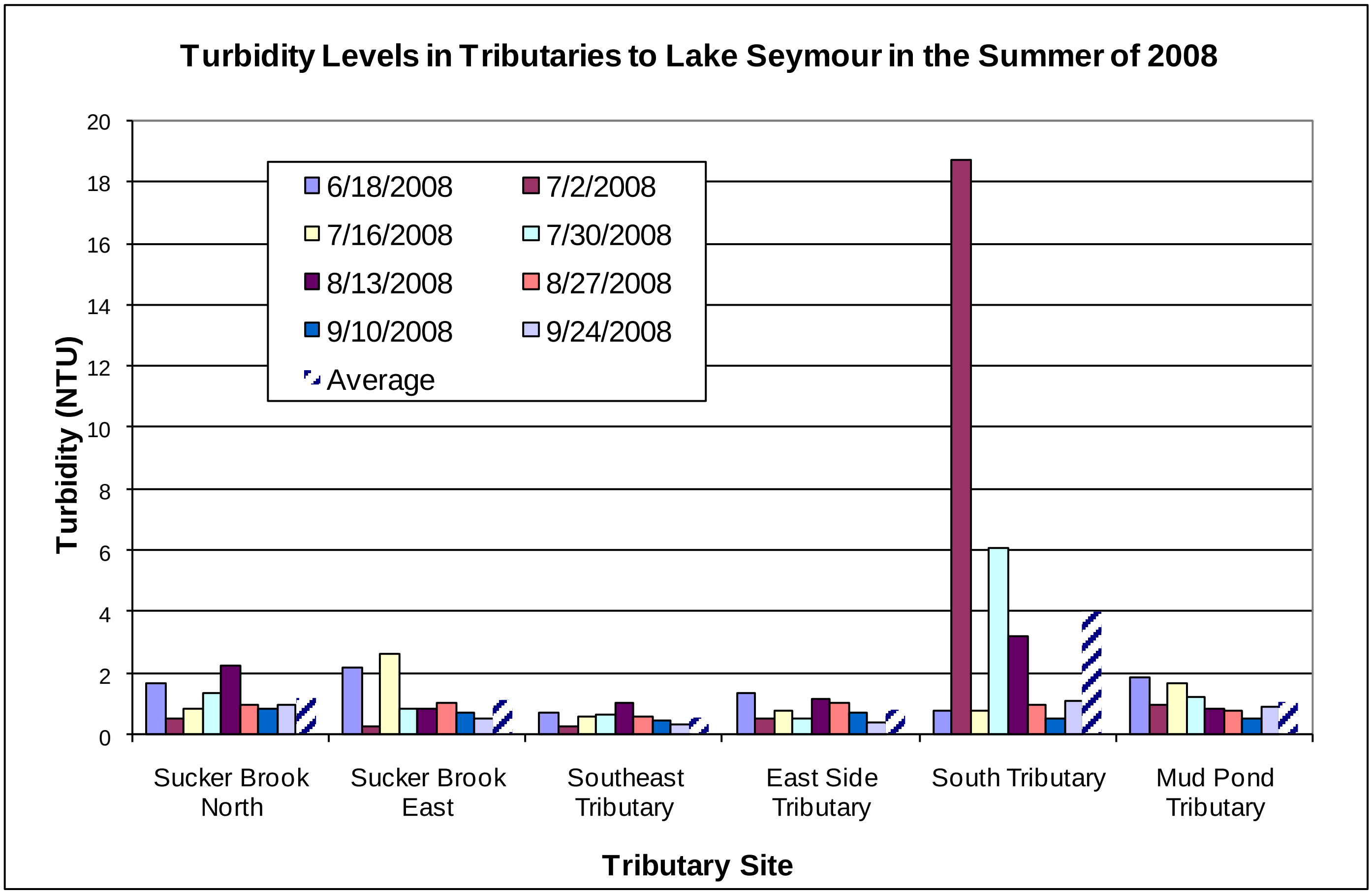
Phosphorus – Phosphorus from two types of sources can be found in streams. One likely source of phosphorus is soil particles contained in runoff where land is eroding. This occurs without elevated levels of nitrogen and generally with a close correlation to rainfall events. When nitrogen levels are also elevated, the likely sources of the phosphorus are sewage, fertilizers and/or manures all of which contain both phosphorus and nitrogen. Average phosphorus levels in the Seymour Lake tributaries ranged from lowest to highest in the following order: East Side Tributary, Sucker Brook East, Southeast Tributary, Sucker Brook North, Mud Pond Tributary and South Tributary. High phosphorus values do not seem to be related to high nitrogen values at any time. In general, the phosphorus levels were not significantly high during most of the testing period, but there were no samples taken during rainfall events that can often raise phosphorus levels significantly.

However, there are two exceptions. Notable spikes in phosphorus levels occurred on 7/2/08 at the South Tributary. The field data sheet filed by the volunteers for that date indicated that the water at this site was visually very cloudy in contrast to its previously observed clear state. The graph illustrates this spike clearly. There was a lesser spike on 7/30/08. This sample was collected by the same volunteer who noted on the field data sheet that the South Tributary was slightly cloudy, but not nearly as cloudy as on 7/2. We will add more visual inspections of the tributaries next year in the hope of learning the cause of these spikes in turbidity and phosphorus.



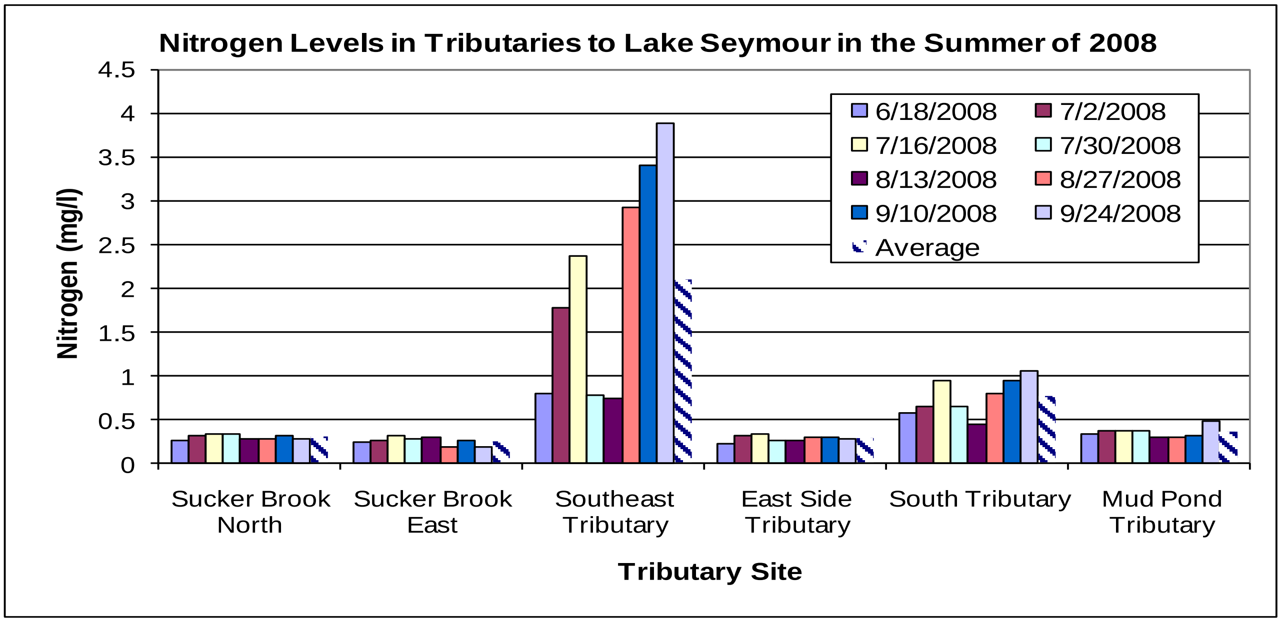
Turbidity – As explained in Appendix B, there was a problem on five of the eight sampling days with accuracy of our turbidity samples illustrated by the values reported on the blank turbidity samples for those five days. While we did not meet the Quality Control/Quality Assurance (QC/QA) requirements for turbidity, the high turbidity at the South Tributary on 7/2/2008 and 7/30/2008 corresponds with the high phosphorus levels on those two dates and are of a magnitude that is much greater than the discrepancy in the blank sample values. This indicates that the compromised samples are still useful.

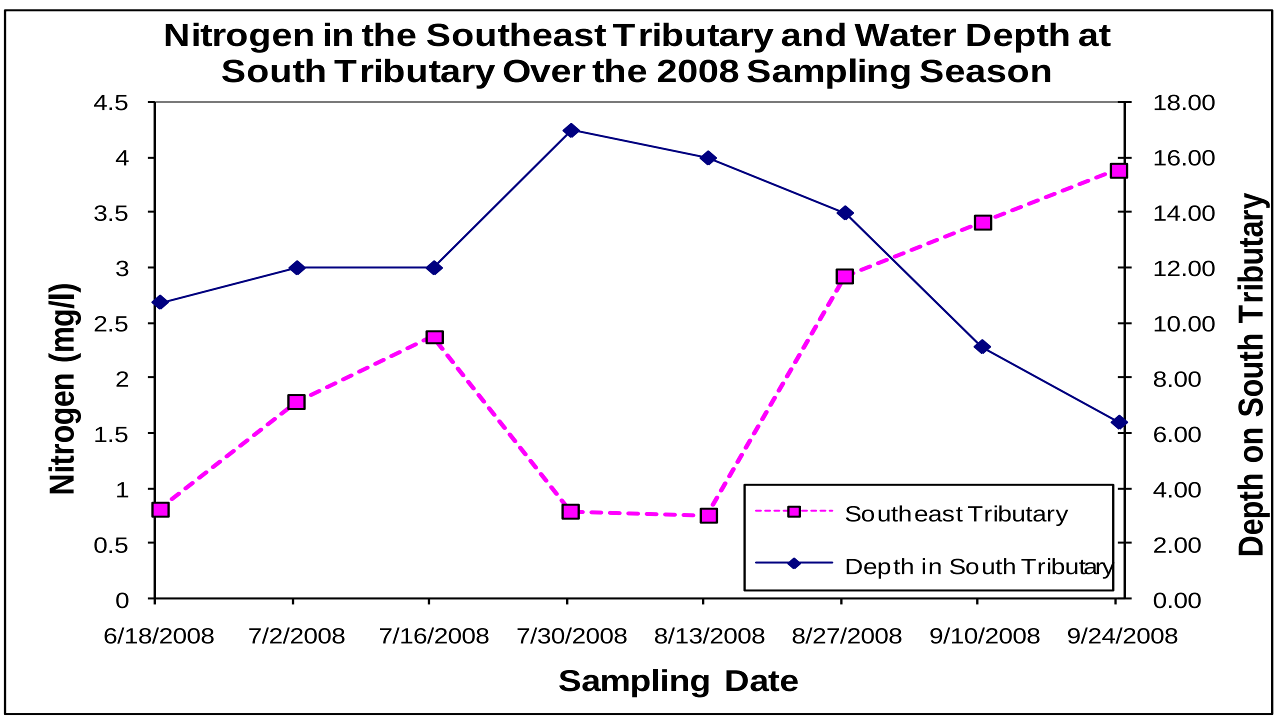
Reviewing our 2008 results, and keeping in mind that the samples were not collected during the many rain events of the summer, it appears that level of sediment that entered the lake during clear weather was low. As with phosphorus, two spikes in turbidity occurred on the South Tributary with the higher spike on 7/2 and a lower one on 7/30. Perhaps our planned visual inspections will give us more information about these occurrences next summer.



Nitrogen – We tested samples for nitrogen because of its usefulness in indicating the probable source of phosphorus. When both nitrogen and phosphorus levels are elevated, then that indicates sewage, fertilizers and/or manures as the source of the phosphorus. Five of the tributaries show consistently low levels of nitrogen. The natural range for streams is considered to be below 2 mg/l. All of the results for these five tributaries are well within that limit, indicating that the phosphorus levels of those tributaries do not have sewage, fertilizers or manures as a source of the phosphorus.

The Southeast Tributary has different results. Five of the eight regular samples collected from the Southeast Tributary had levels ranging from 1.8 mg/l to 3.9 mg/l with an average of 2.09 mg/l. Levels of nitrogen in the Southeast Tributary seem to have an negative correlation with the depth measured at the South tributary. There also seems to be a general increase in nitrogen levels over the summer independent of the water depth which makes a precise relationship between the depth and nitrogen hard to establish. However, the general negative correlation between nitrogen levels and depth indicates that the primary source of nitrogen is not from surface runoff but from either a point source of nitrogen or a nonpoint source of nitrogen that enters the stream through groundwater at a relatively consistent rate during both high and low flows. In both these cases, higher flows cause the nitrogen concentration to go down during higher flows due to the diluting effect of the surface runoff while lower flows result in a spike in the concentration. We plan to add stream walks to our program next year in order to seek out the reason for these elevated nitrogen levels. Some possible sources of nitrogen include nitrogen leaching from agricultural lands, lawns, or septic systems and entering the stream through the groundwater or direct discharges of milk house waste, manure or from failing septic systems.





Conclusions

The SLA has benefited from the LaRosa Partnership Program in the following ways:

1. The SLA now has a group of experienced volunteers trained in collecting water samples using EPA standards.

2. The trained volunteers significantly increased their knowledge of water quality testing, the condition of the lake and the six tributaries, and the science of lake assessment.

3. Baseline data for identifying nutrient and sediment sources from the six tributaries has been established.

4. Awareness regarding water quality issues has increased among property owners in the neighborhoods of the tributaries.

Discussion

Because this was the first year of systematic testing of the six tributaries and the fact that none of our sampling was done during a rain event, conclusions about the overall phosphorus loading from tributaries are tentative at best. We can say that during our sampling period there were high nitrogen levels on the Southeast Tributary. High levels of nitrogen usually have sewage, fertilizer and/or manures as a source. Even though we did not capture samples during a rain event, there were occasional high phosphorus and turbidity levels on the South Tributary. This suggests that in those cases there was a rise in erosion and/or runoff in the South Tributary.

Except for the spikes mentioned above, both the turbidity and nitrogen levels were well within the "natural range" as defined in the Vermont DEC's Volunteer Surface Water Monitoring Guide. Phosphorus levels were also generally within the "natural range". However, the average of all phosphorus tributary geometric means of 12.9 µg/l is only slightly higher than Vermont Lay Monitoring data (averaging 11.7 µg/l during 2004, 2005 and 2006) for the lake at least during the days on which we sampled none of which were during rain events. If we can capture samples during a rain event next year, then we might be able to make a judgment concerning whether the amount of phosphorus entering the lake from the tributaries is insufficient by itself to account for the elevated phosphorus levels that were present during the 1996-2006 time frame.

Recommendations

We recommend that the following actions be implemented by the SLA volunteers during the 2009 season if we again are successful in our application for inclusion in the LaRosa Partnership Program.

- Continue to monitor nitrogen, phosphorus and turbidity in the six tributaries to gather sufficient data to establish trends and to obtain a more representative set of samples that include samples taken during rain events.

- Work to improve the accuracy of our turbidity samples by adopting the following practices as suggested by Ben Copans.

    - Making sure everyone washes the blank bottles carefully 3x with a plentiful supply of distilled water.
    - Being careful that there is no contamination of the distilled water itself by preventing any dirt from getting into this bottle.
    - Making sure everyone washes duplicate and regular samples 3x with water from each site being careful not to stir up sediments and then takes a sample upstream from where the bottles were washed to prevent sample contamination with stirred up water.
    - Emphasizing that duplicate samples should be taken at the same spot in the stream and that extreme care should be taken to prevent stirring up sediments that might get into the sample.

- Obtain landowners' permission to conduct stream walks in each tributary during the summer. This will enable us to document land uses, bank erosion, and condition of stream bank buffers. The priorities for walking streams are the South and Southeast Tributaries, followed by the Mud Pond and Sucker Brook North Tributaries, and finally the Sucker Brook East and East Side Tributaries.

- Establish a program of systematic visual inspection of all tributary sites at weekly intervals during the season, particularly for the South Tributary. This will enable us to better understand the frequency and extent of the turbidity spikes that we observed in the 2008 season.

- Improve the format of the field data sheets and increase the training in the importance of their use.

Data Reliability

Data was analyzed for:

- Precision – by taking 10% of samples as duplicate samples

- Accuracy – by taking 10% of samples as field blanks, spiked samples and method samples

- Representativeness – by the choice of sampling locations to represent the primary flow of each tributary

- Completeness – by collecting valid data for eight sampling dates was collected to meet the proposal goals

- Comparability - by collecting samples according to EPA QAPP protocols, making our data comparable to Vermont Lay Monitoring data as well as to other LaRosa Partnership data from other watersheds

Data reliability was ensured by following the processes described below:

- Laboratory – The LaRosa Laboratory uses EPA standards to ensure that the work of the scientists and their equipment provides valid data.

- Volunteers – Volunteers received general training and individual training from professionals. Volunteers trained and retrained one another as needed. All volunteers discussed how to refine the procedures used and referred questions to the SLA Program Coordinator who then sought help from Ben and Neil when appropriate. Usually, two or more volunteers worked together to enhance quality control.

- Equipment Use - Collection bottles were provided by the Laboratory and were handled according to lab protocols. Coolers with ice packs were used to maintain the proper temperature when samples were transported. Transport of samples was done on the appropriate time schedule for optimum results.

Acknowledgements

The collaboration of the SLA and the LaRosa Laboratory in this LaRosa Partnership is largely due to the efforts of the DEC's Neil Kamman, Kellie Merrell, Ben Copans and Susan Warren to educate the SLA about the water quality conditions in the lake as well as how our actions in the watershed affect the lake. Ben Copans, Neil Kamman, Jerry Divincenzo and Alison Farnsworth provided training in the science and quality control protocols so that we had the expertise to produce valid data. Fritz Gerhardt, Melissa Dyer and Jason Benoit of the NorthWoods Stewardship center provided information and their report "*Restoring Water Quality in the Lake Memphremagog Basin: Water Quality in the Four Vermont Tributaries*". King Boyd and Don Hendrich of the Memphremagog Watershed Association provided help in writing our Partnership Proposal, moral support and help in the transport of our samples to the lab in Waterbury.

The work of arranging sampling sites with property owners, collecting the samples and outreach to lake shore residents was done by eight SLA members: Tom Pombar, Erik Lessing, Reed Hubbard, Ron Kolar, Mary Killian, Tracey Shadday, Bruce Barter and Peggy Barter. All participated with enthusiasm and dedication to quality. All of the property owners gave their permission and voiced complete support for this program. Our sampling would have been difficult or perhaps impossible without their support. Finally, in addition to his guidance for the entire season, Ben Copans provided basic copies of the graphs and charts for this report as well providing help in interpreting the meaning of the collected data.

References

Dyer, M. and F. Gerhardt.2007. *Restoring Water Quality in the Lake Memphremagog Basin: Water Quality in Four Vermont Tributaries.* NorthWoods Stewardship Center, East Charleston, Vermont.

Picotte, A. *2007 Vermont Lay Monitoring Report.* Vermont Agency of Natural Resources. Waterbury, Vermont.

Picotte, A. and L. Boudette. 2005. *Vermont Volunteer Surface Water Monitoring Guide.* Vermont Department of Environmental Conservation, Waterbury Vermont.

Appendix A – Raw Data, Averages, and Geometric Means

Results of the 2008 Sampling of Six Tributaries of Seymour Lake *

2008 Seymour Lake Tributary Nitrogen Levels mg/l										
Site	6/18/2008	7/2/2008	7/16/2008	7/30/2008	8/13/2008	8/27/2008	9/10/2008	9/24/2008	Average	Geometric Mean
Sucker Brook North	0.25	**0.31**	0.33	0.34	0.27	0.27	0.32	0.27	0.30	0.29
Sucker Brook East	0.24	0.25	**0.31**	0.28	0.29	0.18	**0.255**	0.18	0.25	0.24
Southeast Tributary	0.80	1.78	2.37	0.78	**0.74**	2.92	3.41	3.89	2.09	1.72
East Side Tributary	0.23	0.31	0.34	0.26	0.26	**0.305**	0.29	0.28	0.28	0.28
South Tributary	**0.58**	0.64	0.94	0.64	0.44	0.80	0.94	1.06	0.76	0.73
Mud Pond Tributary	0.33	0.37	0.37	**0.37**	0.30	0.29	0.31	**0.475**	0.35	0.35

2008 Seymour Lake Tributary Phosphorus Levels (µg/l)										
Site	6/18/2008	7/2/2008	7/16/2008	7/30/2008	8/13/2008	8/27/2008	9/10/2008	9/24/2008	Average	Geometric Mean
Sucker Brook North	15.5	**14.75**	15.4	16.5	19.7	13.2	12.6	6.3	14.2	13.6
Sucker Brook East	10.3	7.8	**14.9**	11.6	13.9	10.5	**10.4**	5.0	10.6	10.1
Southeast Tributary	10.6	12.1	12.4	13.3	**16.45**	16.2	10.9	7.2	12.4	12.0
East Side Tributary	10.0	9.8	9.9	11.1	13.6	**12.35**	7.2	5.0	9.9	9.5
South Tributary	**10.5**	47.2	11.9	29.7	20.4	14.7	11.3	8.6	19.3	16.3
Mud Pond Tributary	21.9	18.3	17.2	**21.05**	15.4	15.4	14.4	**9.15**	16.6	16.1

2008 Seymour Lake Tributary Turbidity Levels (NTU)										
Site	6/18/2008	7/2/2008	7/16/2008	7/30/2008	8/13/2008	8/27/2008	9/10/2008	9/24/2008	Average	Geometric Mean
Sucker Brook North	1.68	**0.50**	0.82	1.33	2.25	0.97	0.86	0.97	1.17	1.07
Sucker Brook East	2.15	0.24	**2.635**	0.81	0.85	1.03	**0.695**	0.48	1.11	0.87
Southeast Tributary	0.71	0.27	0.60	0.66	**1.02**	0.56	0.46	0.30	0.57	0.53
East Side Tributary	1.36	0.49	0.76	0.52	1.14	**1.05**	0.72	0.41	0.81	0.74
South Tributary	**0.75**	18.70	0.75	6.08	3.20	0.93	0.49	1.08	4.00	1.78
Mud Pond Tributary	1.87	0.94	1.65	**1.2**	0.81	0.79	0.51	**0.905**	1.08	1.00

* Values listed above in bold print are the average of the regular sample and the duplicate sample.

Appendix B – Sampling Precision Indicated by Duplicate Sample Data and Relative Percent Difference (RPD)

*Calculating RPD:
RPD = (Result 1 – result 2) ÷ [(Result 1 + result 2) ÷ 2] × 100

Sampling Date	Parameter Tested	Regular Sample	Duplicate Sample	RPD*
6/18/2008	Nitrogen	0.57	0.59	3%
	Phosphorus	10.30	10.70	4%
	Turbidity	0.97	0.53	59%
7/2/2008	Nitrogen	0.30	0.32	6%
	Phosphorus	14.50	15.00	3%
	Turbidity	0.51	0.49	4%
7/16/2008	Nitrogen	0.32	0.30	6%
	Phosphorus	15.20	14.60	4%
	Turbidity	2.60	2.67	3%
7/30/2008	Nitrogen	0.37	0.37	0%
	Phosphorus	20.70	21.40	3%
	Turbidity	0.81	1.59	65%
8/13/2008	Nitrogen	0.74	0.74	0%
	Phosphorus	16.90	16.00	5%
	Turbidity	0.95	1.09	14%
8/27/2008	Nitrogen	0.32	0.29	10%
	Phosphorus	12.70	12.00	6%
	Turbidity	1.14	0.96	17%
9/10/2008	Nitrogen	0.26	0.25	4%
	Phosphorus	9.90	10.90	10%
	Turbidity	0.76	0.63	19%
9/24/2008	Nitrogen	0.48	0.47	2%
	Phosphorus	9.00	9.30	3%
	Turbidity	0.91	0.90	1%

Parameter Tested	Ideal RPD	Actual RPD
Nitrogen	≤30%	5%
Phosphorus	≤20%	4%
Turbidity	≤15%	23%

The chart to the left shows that the data for nitrogen and phosphorus is highly precise and therefore valid and usable. The precision of the turbidity data is skewed by the extremely low levels reported. For this reason the turbidity data can also be considered valid and useable.

Appendix C – Blank Samples as Indicators of Sampling Accuracy

Sampling Date	Parameter Tested	Actual Blank Values	Ideal Blank Values
6/18/2008	Nitrogen	0.1	0.1
	Phosphorus	5	5
	Turbidity	0.2	0.2
7/2/2008	Nitrogen	0.1	0.1
	Phosphorus	5	5
	Turbidity	0.2	0.2
7/16/2008	Nitrogen	0.1	0.1
	Phosphorus	5	5
	Turbidity	**0.33**	0.2
7/30/2008	Nitrogen	0.1	0.1
	Phosphorus	5	5
	Turbidity	**0.46**	0.2
8/13/2008	Nitrogen	0.1	0.1
	Phosphorus	5	5
	Turbidity	0.2	0.2
8/27/2008	Nitrogen	0.1	0.1
	Phosphorus	5	5
	Turbidity	**1.22**	0.2
9/10/2008	Nitrogen	0.1	0.1
	Phosphorus	5	5
	Turbidity	**0.32**	0.2
9/24/2008	Nitrogen	0.1	0.1
	Phosphorus	5	5
	Turbidity	**0.34**	0.2

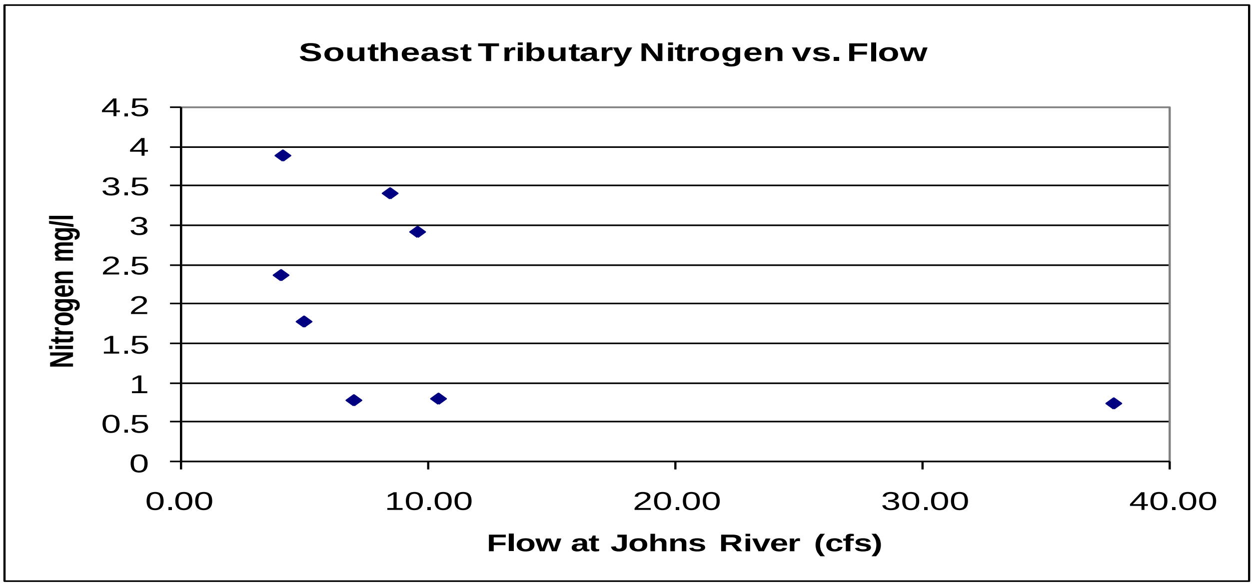
All nitrogen and phosphorus samples are shown to be accurate and valid.

The chart to the left shows that on five collection dates (bold values on the chart) there was a problem with turbidity sample accuracy. We need to seek help to identify the reason for this problem, because we are unable to do so ourselves. Both the accurate and inaccurate samples were collected by the same volunteers, the equipment and distilled water used was from the LaRosa Laboratory, and the protocols taught in the training sessions were followed each time.

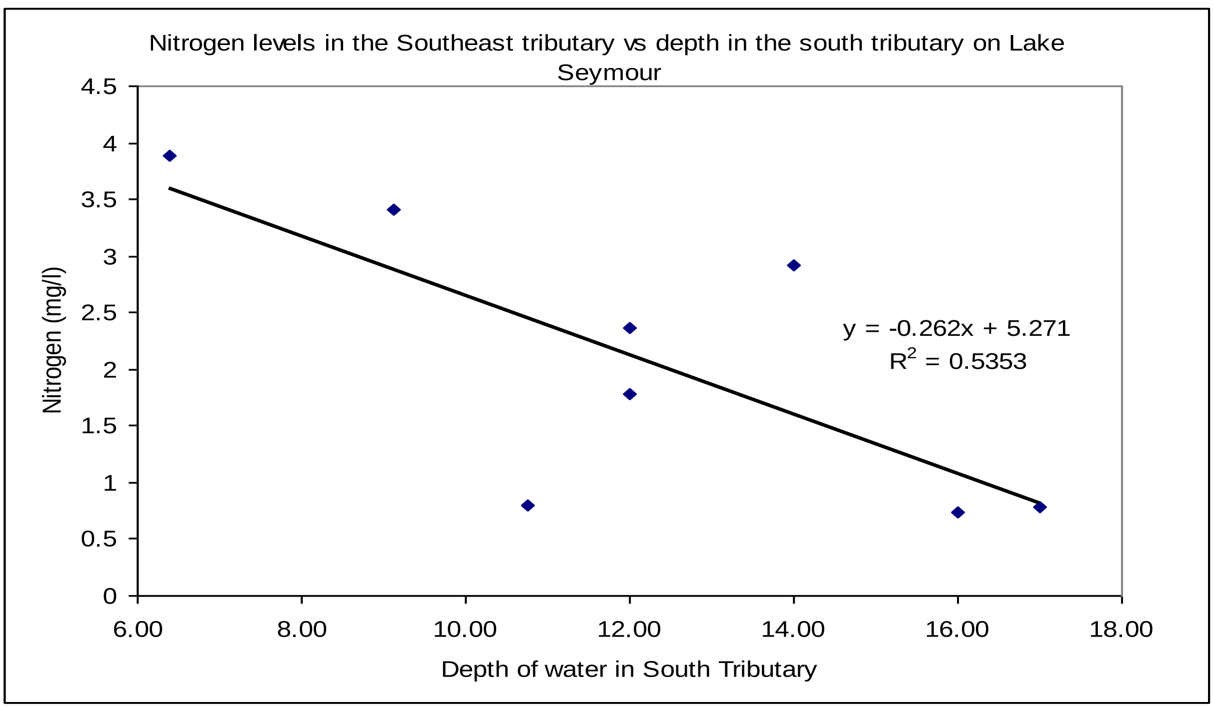
The protocol for collecting blank samples is:

1. use a lab provided container identical to the container used for the regular sample
2. go to the sampling site and while positioned in the tributary rinse the sample container 3 times with the lab provided distilled water
3. fill the rinsed container with distilled water and cover as usual

Appendix D – Flow Data - Comparison of Nitrogen Levels in Lake Seymour's Southeast Tributary to Flow



Site	6/18/2008	7/2/2008	7/16/2008	7/30/2008	8/13/2008	8/27/2008	9/10/2008	9/24/2008
Flow on Johns River	10.44	5.00	4.07	7.02	37.77	9.60	8.49	4.15
Southeast Tributary	0.8	1.78	2.37	0.78	0.74	2.92	3.41	3.89



Comparison of Nitrogen Levels in Southeast Tributary to Depth at the South Tributary								
Site	6/18/2008	7/2/2008	7/16/2008	7/30/2008	8/13/2008	8/27/2008	9/10/2008	9/24/2008
Depth (Inches)	10.75	12.00	12.00	17.00	16.00	14.00	9.13	6.38
Southeast Tributary	0.8	1.78	2.37	0.78	0.74	2.92	3.41	3.89