



**WATER QUALITY STUDY OF
LAKE LUZERNE & MILL CREEK:
TRIBUTARY OF
THE UPPER HUDSON RIVER**

**Hadley Luzerne High School
2008 River Watch Students:**

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ABSTRACT

In fall 2008, the Hadley–Luzerne River Watch team monitored four different sites along the Lake Luzerne and Mill Creek in Warren County, NY as well as one site on the Hudson River. All four sites are within walking distance of the Hadley Luzerne High School. Each site is located near areas with either high human usage or with interesting historical usage. Three of the sites are new except for Site 1 which is on Lake Luzerne. Site 1 was a new site in Spring 2008. Two of the three new sites are on Mill Creek. The 4th site is on the Hudson River below the confluence with Mill Creek.

We collected water samples at 4 sites and tested air temperature, water temperature, conductivity, pH, dissolved oxygen, phosphates, nitrates and alkalinity. At our second site we sampled macro invertebrates. At Site 1 and 3, we cultured water samples for the presence of fecal coliform, including *e. coli*.

The results for all of our tests were within acceptable ranges except for phosphates and coliform. Phosphates were high at Site 4 both tests and high for all of the sites were high for the second date. The coliform count for the water sample taken from Site 3 was above 200 coliforms per 100 ml.

BACKGROUND

Logging was a prime industry of the Adirondacks. Most of the timber in our area was cut in northern Saratoga County and Warren. The Lake Luzerne/Hadley area utilized the Hudson River in the logging industry to move the logs from the cutting areas to the paper mills in Glens Falls. One of the first paper mills built in the United States was built in the Lake Luzerne area in 1870, and was located on Mill Creek. Mill Creek was a natural resource that was used to power the mill. The power was obtained by having the flowing water turn a large water wheel. The water wheel powered a large grinding stone which turned the wooden sticks into pulp. A man named Alfred Pagenstecher started the Manufacturer's Paper Company and would go on to create the Hudson River Pulp and Paper Company in Corinth, NY (later International Paper). He figured this would be a profitable business because of the amount of lumber in the area.

Located next to Mill Creek, there is a 100 foot high brick smokestack near the Lake Luzerne Town Hall. This building belonged to the Garnar Leather Works. At its peak in the 1880s, the tannery handled processed hundreds of thousands of pelts. Most of the leather processed was used for covering books. A "liquor" called tannic acid was used in the tanning process. The tannic acid was made from the bark of hemlock trees. This was used for treating and preserving the leather. The tannery finally closed in Lake Luzerne in 1950.

A more recent impact on the Lake Luzerne and Mill Creek watershed is Eurasian milfoil. Milfoil is an invasive species. An invasive species is an organism that negatively affects the environment they invade. These impacts can be economic, environmental or ecological. At our Site One (Lake Luzerne), there is an invasion of milfoil. Milfoil spreads from lake to lake by people transporting small cuttings. The current treatment of the milfoil on Lake Luzerne is the use of opaque tarps that cut off the light to the plants. A local group of volunteers, "the Milfoil Pirates" scuba dive to remove the dead plants.

Site 1 is a beach access area on Lake Luzerne, across the street from the Hadley-Luzerne High School. This site contains a significant accumulation of milfoil. This beach is also called Wayside Beach. This site is a popular swimming area for many of the locals and summer residents in the summer time. Many cottages are located near Lake Luzerne. Many of the cottages are older and could be the source of pollution into the lake from failing septic systems. This site is located before Mill Creek. There is a lot of sand in this area.



Lake Luzerne looking NE

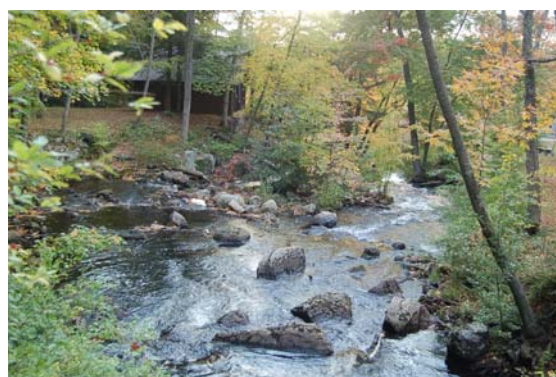


Milfoil tarps used to kill plants

Site 2 is located on Mill Creek across State Route 9N from Site 1. The site is where the old Paper Mill used to be. A museum that contains the original paper mill and grinding stone is located at this site. Site 2 is located downstream from a man-made dam in an area that is very rocky with many small water falls and pools. The water is also shaded by the many trees on either side of the stream.



Mill Creek looking upstream



Mill Creek looking downstream

Site 3 is located on Mill Creek downstream from Site 2. This site is also located next to the Lake Luzerne Town Hall on Main Street. It is also located next to the old Garner Tannery smokestack. The tannery closed in 1909. The water slows down from Site 2. In order to go down to the water and test it, you need to go down a little hill. The streambed in Site 3 has a more gradual slope in comparison to Site 2. The stream bed also contains rocks and boulders, but there is more sand and gravel compared to Site 2. Since Mill Creek flows under Main Street the road could be a source of automobile pollution. In the winter road salt could also have a significant impact on the water quality.



taken from bridge

Site 4 is located on the Hudson River above Rockwell Falls. It is approximately 100 feet below the confluence of Mill Creek and the Hudson River. On the far bank, approximately 100 yards, there is a gauging station that measures the flow of the water in the Hudson River. There are not many pollution sources upstream from this site. There are homes and other rural uses.



Hudson River looking upstream from Rockwell Falls



Confluence of Mill Creek and Hudson River from west bank of Hudson River in Hadley, NY

RESULTS

Macro-invertebrates

Macro-invertebrate includes organisms such as snails, worms, fly larvae, and crayfish. They are found under rocks and tree roots in the water. The type of animals that can survive in a stream are dependant on temperature, if it's too hot or too cold then some organisms can die. Organisms are also dependant on dissolved oxygen, or how much oxygen is available in the water to breathe. Organisms can only survive if the conditions in which they are living in are perfect for them. Because of their sensitivity to environmental conditions, aquatic invertebrates commonly are used as indicators of water quality. Macro-invertebrates such as stoneflies, caddis flies and mayflies are indicators of good water quality because they are sensitive to pollution. Some organisms that are pollution tolerant are crayfish, black fly larvae and leeches. They can indicate poor water quality because they can survive in poor water quality. However, just because one finds these organisms in a body of water does not mean the water quality is poor. These organisms that thrive in clean water, and can also live in bad water.

Site 2 was the area where we sampled freshwater invertebrates. We utilized kick nets as well as simply removing macro-invertebrates from rocks in the stream. The chart below lists types and number of insect specimens retrieved. In addition to the insects, 1 pouch snail was also collected.

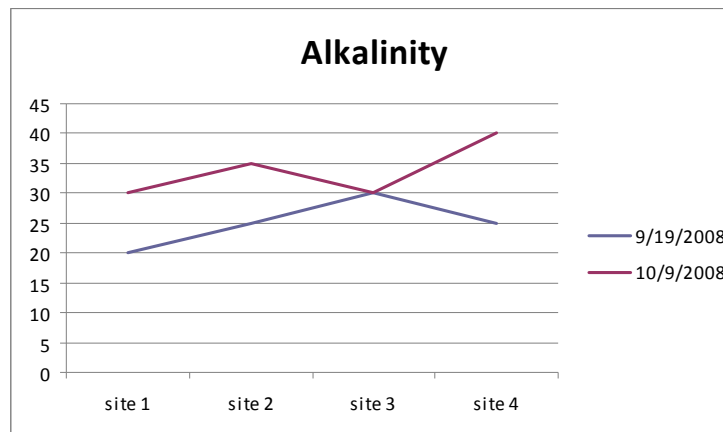
Order	Family	Number of Specimens
Ephemeroptera	Heptagenidae	6
Ephemeroptera	Baetidae	2
Plecoptera	Peltoperlidae	46
Trichoptera	Hydropshchidae	1
Trichoptera	Philopotamidae	8
Trichoptera	Rhyacophilidae	30
Odonata		2
Decapoda		2



Alkalinity

Alkalinity is the buffering capacity of the water. The higher the alkalinity, the water to neutralized acids. It is determined by the concentration of carbonate, bicarbonate, and hydroxide ions. The negative ions react with the hydrogen ions which are positively charged, this causes the ions to combine and be removed from the solution. As the hydrogen ions go down, the water is neutralized. If there is a lot of limestone, then the water is well buffered because the water moves the ions over the rocks which collect the ions and gets sent in to the soil.

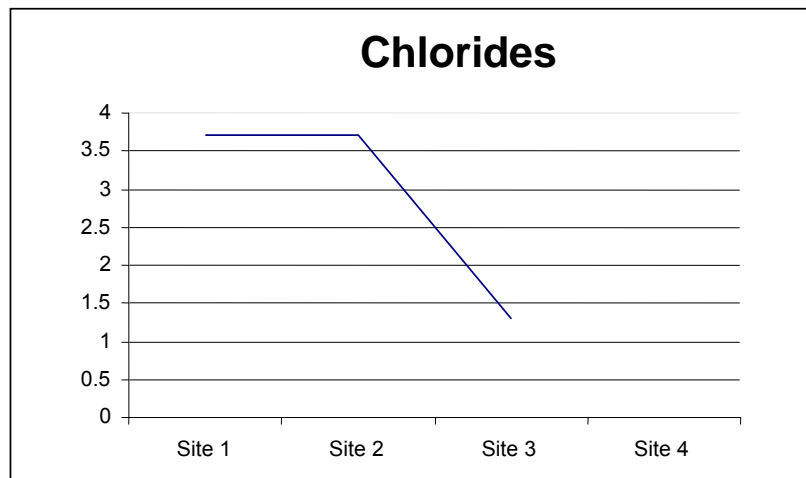
On September 19, we tested **Site 1** which was 20 mg/l, **Site 2** was 25 mg/l, **Site 3** was 30 mg/l, and **Site 4** was 25 mg/l. On October 9, we tested **Site 1** which was 30 mg/l, **Site 2** was 35 mg/l, **Site 3** was 30 mg/l, and **Site 4** was 40 mg/l.



Chlorides

Chlorides are one of the major negatively charged ions found in saltwater, and to a lesser extent in freshwater. Chloride are formed when salts dissolve in water. Many salts such as sodium chloride, calcium chloride, or magnesium chloride get in to the lakes and streams from weathering of minerals, and runoff from irrigated farmlands. Road salt can raise stream water chloride levels to over ten thousand mg/l and harm stream organisms. According to the Aquatic chemistry sheet less than 12 mg/l of chloride is typical of undisturbed forest and streams. Two hundred to a thousand mg/l of chlorides while some species can be affected other species are not harmed at all. Chloride exceeds more than one thousand mg/l most aquatic invertebrates are negatively affected.

The chloride concentrations were as follows: **Site 1** 3.7 mg/l, **Site 2** 3.7 mg/l, and **Site 3** 1.3 mg/l.



Conductivity

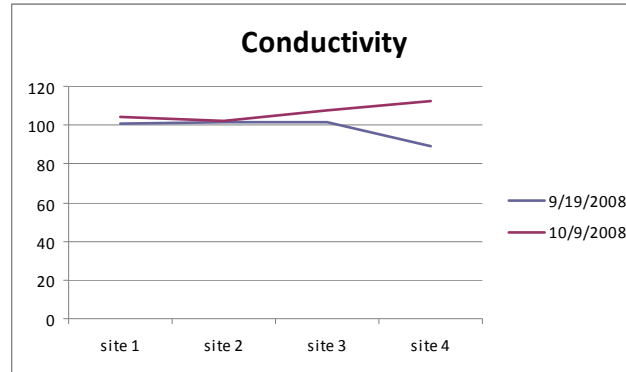
Conductivity is the ability to or the power of a material to conduct or transmit electricity, heat or sound. Conductivity is proportional to the amount of ions in a solution. A Conductivity meter is an accurate tool measuring the electrical conductivity in a solution. It works by applying a voltage between 2 or more electrodes in a solution. The meter then monitors the passing electrodes and ions that are in the solution.

Site 1 9/19 the conductivity was 101 $\mu\text{S/cm}$. 10/9 the conductivity was 104.4 $\mu\text{S/cm}$.

Site 2 9/19 the conductivity was 101.5 $\mu\text{S/cm}$. 10/9 the conductivity was 102.2 $\mu\text{S/cm}$.

Site 3 9/23 the conductivity was 101.5 $\mu\text{S/cm}$. 10/9 the conductivity was 107.6 $\mu\text{S/cm}$. **Site**

4 9/19 the conductivity was 89 $\mu\text{S/cm}$. 10/9 the conductivity was 112.5 $\mu\text{S/cm}$.

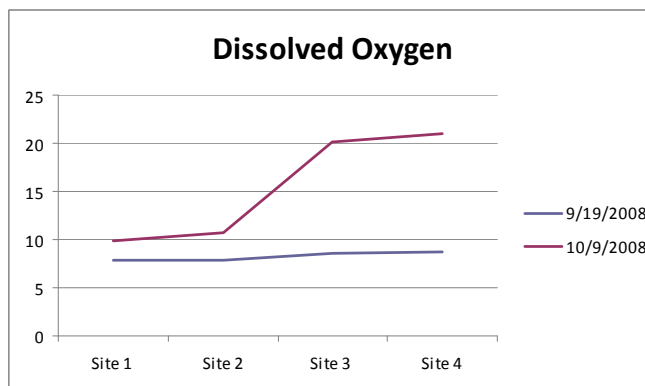


Dissolved Oxygen

Dissolved oxygen (DO) is the amount of oxygen that is dissolved into the water. DO is important for a body of water to be able to support aquatic life. The oxygen in the water can get there in several ways. One way it can get into the stream is the oxygen diffuses into the water because the air has a much higher concentration of oxygen, and things move from areas of high concentrations, the air, to areas of low concentration, the water. A river, waterfall or stream with high turbulence diffuses more oxygen from the air than a river, waterfall or stream with low turbulence because they come in contact more with air. A second way oxygen is added in the water is through the aquatic plants that photosynthesize and give off oxygen. The temperature of the water can affect the amount of DO. Cold water can hold more DO than warm water, and since temperatures vary during the day, so does the amount of oxygen in the water and this causes results to vary.

Dissolved oxygen normally ranges from 4.0 mg/L to 9.0 mg/L.

On 9/19 **Site 1** was 7.83 mg/L, **Site 2** was 7.85 mg/L, **Site 3** was 8.57 mg/L, and **Site 4** was 8.77 mg/L. On 10/9 **Site 1** was 9.79 mg/L, **Site 2** was 10.71 mg/L, **Site 3** was 20.14 mg/L (error), and **Site 4** was 20.97 mg/L (error). Due to time limitations we were unable to resample Sites 3 and 4.



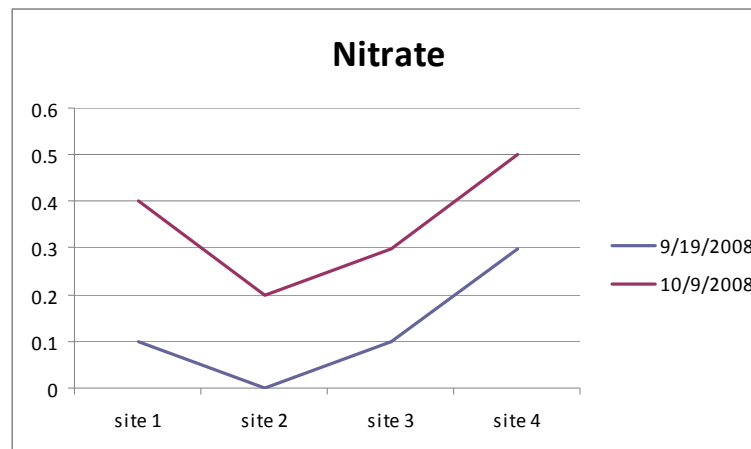
E. coli

E. coli are bacteria that normally live in the intestines of humans and animals. Although most strains are harmless, several are known to produce toxins that can cause diarrhea. The bacteria live in the intestines of some healthy cattle, and contamination of the meat may occur in the slaughtering process. Deer meat, venison, may also be infected. Fresh vegetables, unpasteurized fruit juices and raw milk have also caused outbreaks. With careless food handling any food product eaten raw can be contaminated by raw meat juices. Person-to-person transmission, especially in child care settings, can occur if infected people do not wash their hands after using the toilet or diapering children. Drinking contaminated water and swimming in contaminated shallow lakes may also cause infection.

We used the Ward's Coliscan Membrane system to culture water samples taken from Site 1 and Site 3. We were surprised when the Site 1 had less than 200 coliforms per 100 ml of sample and Site 3 had more than 200 coliforms.

Nitrates

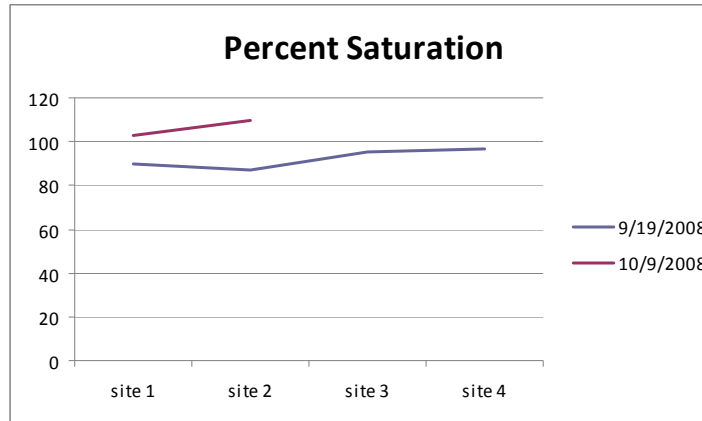
Nitrates are protein components found in all living cells. Nitrates are short-lived because they are converted by bacteria. Although they are short lived, they cause a serious illness in fish known as brown blood disease. 1.0 mg/L is bad for human babies, however, drinking water rarely exceeds 0.1 mg/L. Nitrates get in to water systems from poorly maintained septic systems that leak and leach through the ground to water. Nitrates also come from car emissions and other petroleum burning machines and industries. A typical undisturbed forest stream will have a nitrate level of 0.1mg/L. Nitrate levels of 1.0mg/L or higher could cause an algal bloom. All four of our sites are within the state limits none of the sites showed an excess amount of nitrates. All of our sights ranged from 0 mg/L to 0.5 mg/L.



Percent Saturation:

Percent saturation is the amount of oxygen dissolved into the water compared to the highest amount allowed at the same temperature. Most oxygen is dissolved into the water by turbulence. The higher the levels of oxygen the better, a percent saturation of 80-124% is excellent, but water can be over saturated and this can be dangerous to fish. This problem is mainly an issue around dams. The gas bubbles gather at the top of the water and then go under the water causing excessive levels of oxygen.

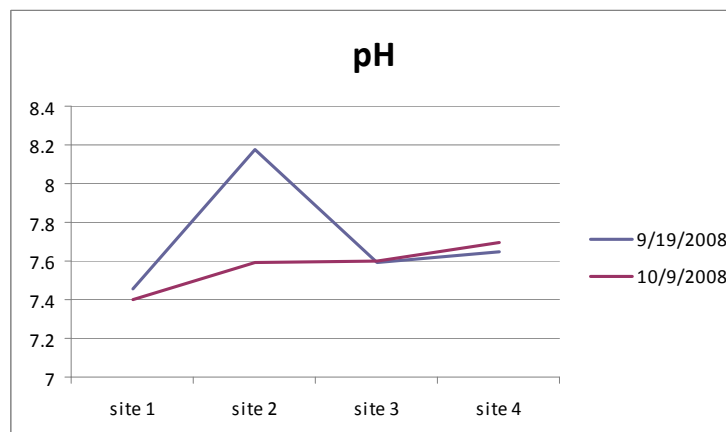
The percent saturation of **Site 1** on 9/19 was 90%, on 10/9 it was 103%. **Site 2** on 9/19 was 87% and on 10/9 it was 110%. **Site 3** results were 95% on 9/19 and an error on 10/9. **Site 4** we had 97% on 9/19 and another error on 10/9.



pH

pH is the measure of how acidic or basic the water is. The pH scale ranges from 0, which is highly acidic, to 14, which is highly basic. If the pH is 7, then the water is neither acidic or basic, or in other words neutral. Rocks around streams, rivers, and ponds can affect the pH of the water. Also acid rain can cause the water to become a little more acidic. If the pH of rain drops from 6 to 5, this tells us that the rain is 10 times more acidic than normal and can change the pH of the water.

When we tested on September 19, the pH of **Site 1** was 7.46, **Site 2** was 8.18, **Site 3** was 7.59 and **Site 4** was 7.65 which is all suitable for aquatic animals. On October 9, the pH of **Site 1** was 7.4, **Site 2** was 7.59, **Site 3** was 7.6, and **Site 4** was 7.7. This still means that all four of the test sites were still suitable for aquatic animals.

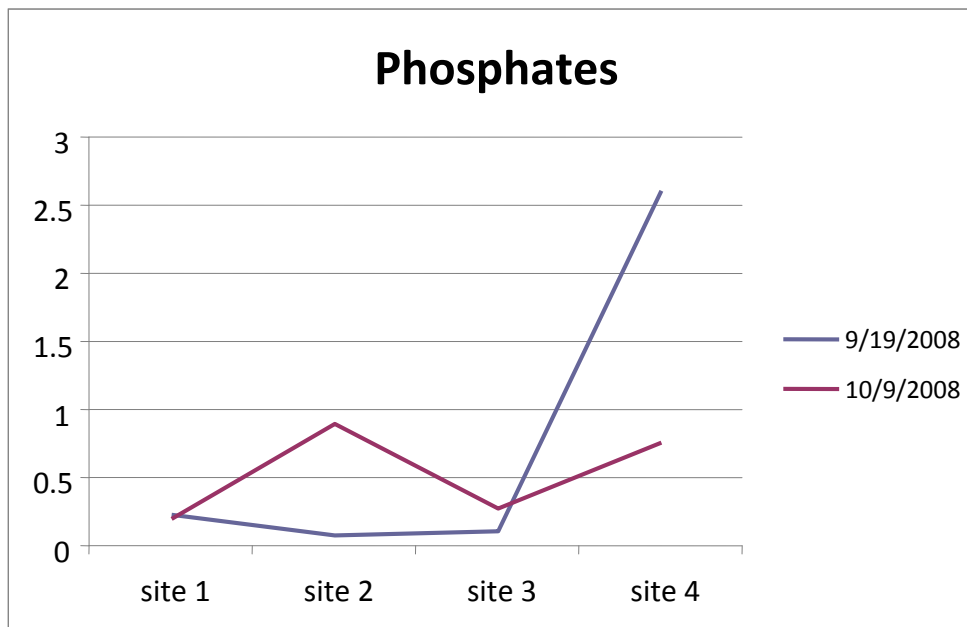


Phosphate

Phosphorus is a natural element that is found in rocks, and soil. The phosphate ions that are from the break down or weathering of rocks are released into the surrounding groundwater, streams, and soil. All organisms require phosphates to use as a nutrient to support growth. Plants and algae in the water take up phosphate from the water making all the insects and fish that eat those plants and algae gain phosphorus, they also gain phosphorus from consuming each other. As the plants and animals die, bacteria and fungi break down the dead materials releasing phosphate and other nutrients back into the environment where it again can support new life.

When there is too much phosphate added to a pond or a lake, excessive plant growth is likely to occur. Phosphate is one of three essential plant nutrients in most fertilizers. Increased phosphate levels may increase growth of crops, lawns, and gardens; they can also stimulate the growth of algae and other aquatic vegetation.

At **Site 1** on September 19th, we got a reading of 0.23mg/L from the water. At the same site on October 9th, we got a reading of 0.2 mg/L. At **Site 2**, we got 0.08mg/L on September 19th. On October 9th, we got 0.9mg/L. **Site 3** had a reading of 0.11mg/L on September 19rd. The Phosphate reading on October 9th was 0.27mg/L. At **Site 4** the phosphate level was 2.60mg/L on September 19th. On October 9th, the reading was 0.76mg/L.



DISCUSSION

For all of our sites the pH readings were in an excellent range. The readings are indicative of our alkalinity measurements. The bedrock contains limestone which buffers the lake and stream from potential lowering of pH from carbon, nitrates, and sulfurs from factories in the Midwest. The emissions are put into the air by the factories and carried by rain clouds and they return to the earth in the form of acid rain over the Adirondacks.

Dissolved Oxygen (DO) is the measure of oxygen in the water. Our group uses the Winkler test. Our DO readings were also in an excellent range, perfect for a diverse fish population. During the second test, two of the sites had readings much higher than the first test, but the students were new to the Winkler test, so it could have been because of human error.

At Site 2 we tested for macro-invertebrates. Macro-invertebrates are a good way to see if a stream is healthy quick. If you find certain freshwater invertebrates which are pollution intolerant than you know that the stream is in healthy condition. If you find only pollution tolerant insects, the stream quality probably isn't good. When we sampled macro-invertebrates at Site 2 we found a diverse population of pollution intolerant macros so the water quality is good.

We did Coliscan tests from water samples at Site 1 and Site 3. The Coliscan set-up tests to see how much Coliform bacteria is in the water. You take a 100 ml sample and send it through filter. You then take the filter and put it in a Petri dish with the Coliscan MF (plus) nutrient and let incubate. After the incubation period we counted the number of colonies. The Coliscan test showed a lot less colonies from the lake water compared to the stream water by the old tannery smoke stack. There is one house located between Site 1 and Site 3. More samples should be taken to identify possible sources of the coliform.

We tested for phosphates at all four sites. Phosphates help plants grow. They are most commonly found in human and animal wastes. Phosphates can get in to the water by surface runoff of fertilizers and pesticides. Phosphates are good for water plants, although, too much can cause an algae bloom. Phosphate levels from the initial sampling day were fine except Site 4 was high. During the second time testing, all four sites were high. Human error could have played a big roll in our results because many students were new to the testing. Also leaching septic systems close to the water could have caused the high phosphate levels.

High levels of nitrates can also encourage plant growth. Nitrates in drinking water can contribute to health problems in infants. The nitrates interfere with the oxygen attached to the hemoglobin molecules in their blood. The test results showed that the nitrate levels for all four of our sites were fine.

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