Ossipee Lake Protection Program 2003 Season

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Ossipee Lake Protection Program

Executive Summary

In 2003 the Green Mountain Conservation Group and Ossipee Lake Alliance launched the Ossipee Lake Protection Program (OLPP). As the first comprehensive program that encompassed all of Ossipee Lake, the OLPP served to examine three parts of the health of the lake and its surrounding area. The fourteen tributaries were tested four times throughout the summer. In partnership with NH Department of Environmental Services, the deepest spot of each of the lake's five water bodies (Ossipee Lake, Berry Bay, Broad Bay, Leavitt Bay, and Danforth Pond) were test once a month June through August. Finally, lake recreation was examined and quantified through the Lake Environmental Assessment Plan (LEAP).

This was largest and most comprehensive program ever initiated on Ossipee Lake. The major successes of this project were:

- Collected a baseline of data for both the tributaries and deep water locations.
- United the six children's camps in the area and engaged them in water quality monitoring.
- Discovered a variable milfoil infestation in Leavitt Bay.
- Counted 337 boats at Ossipee Lake Natural Area on July 4.

A comprehensive assessment of the health of the water can only be achieved by observing water quality trends over a period of many years. As this was the pilot year for the OLPP and there is sparse historical data for the area, firm conclusions cannot yet be drawn. However, an important set of baseline data has been established. Continuing water quality monitoring efforts in the Ossipee Lake area over the long term will allow for observation of water quality trend over time and, in turn, the creation of strong conclusions of the state of the water. Thus, GMCG and OLA are working toward the long term sustainability of this program into the future.

1. Introduction

1.1 Green Mountain Conservation Group

The Green Mountain Conservation Group (GMCG) is a community-based, charitable organization dedicated to the protection and conservation of natural resources in the Ossipee Watershed in central Carroll County including the towns of Effingham, Freedom, Madison, Ossipee, Sandwich and Tamworth.

Founded in 1997, GMCG's mission is to coordinate and carry out environmental education, research, natural resource advocacy and voluntary land protection. GMCG is a networking and referral resource for area residents concerned about land use issues in their communities. It encourages individual and small group activism based on common sense and non-confrontational approaches to resolving problems. The guiding principle in its public education and activism is to present objective information in a neutral format with the belief that informed citizens will make good judgments about their area's natural resources.

During the summer of 2000 GMCG responded to growing concerns about Ossipee Lake by hosting a forum that featured a panel discussion by state experts and representatives of the New Hampshire Audubon Society and The Nature Conservancy. One of the conclusions drawn from the forum was that resolution of lake issues was being hampered by the lack of an organization representing the interests of a majority of the lake's stakeholders.

In 2000, GMCG worked with the University of New Hampshire Cooperative Extension and the Society for the Protection of the New Hampshire Forests to produce a series of Natural Resource Inventory (NRI) maps of each town in the Ossipee Watershed. The NRI maps include information on hydrology, soils, town conservation land, unfragmented land, public water supplies, known and potential contamination sites as well as co-occurrences of important resources. Copies of these maps were provided to each town in the watershed and are displayed at the town halls for public use.

A Water Quality Monitoring (WQM) program grew out of the NRI mapping project as a way to further study our natural resources and as a way to work with the broader community to plan for growth while protecting the environment. Since water does not recognize political boundaries, GMCG began working collaboratively on the WQM program with Saco River Corridor Commission (SRCC), an organization located in Maine.

Saco River Corridor Commission began its WQM program in 2001 and monitors 27 sites in twenty towns along the Saco River. GMCG modeled its Water Quality Program after SRCC. Beginning in 2002, GMCG monitored ten sites across the six towns in the Ossipee Waters, a subwatershed of the Saco Watershed. In 2003, GMCG increased the number of sites it tests from ten to fifteen. Together GMCG and SRCC monitor the quality of the water across two states, 26 towns and one watershed in the RIVERS (Regional Interstate Volunteers for the Ecosystems and Rivers of Saco) Program. These WQM programs enable the study the health of the entire watershed and track changes over time and educate the public.

1.2 Ossipee Lake Alliance

Ossipee Lake Alliance was formed in 2002 and is the first permanent organization dedicated to preserving and protecting Ossipee Lake and its surrounding land. The Alliance links concerned individuals, property owner associations, children's camps and environmental groups in a lake-wide community of interest for research, planning, education and advocacy to address environmental, quality of recreation and land use issues on the lake. As such, it reflects the need outlined at the GMCG lake management forum in 2000.

The Alliance was formed (initially as Broad Bay Alliance) in March 2002 to create public awareness of violations of environmental and land use laws at Ossipee Lake Marina in Freedom and the lack of enforcement of those violations by state agencies and local officials. Organizing support from GMCG and from all parts of the lake, the Alliance successfully opposed a plan to triple the size of the marina and ensured that wetlands the marina had filled were restored under state supervision.

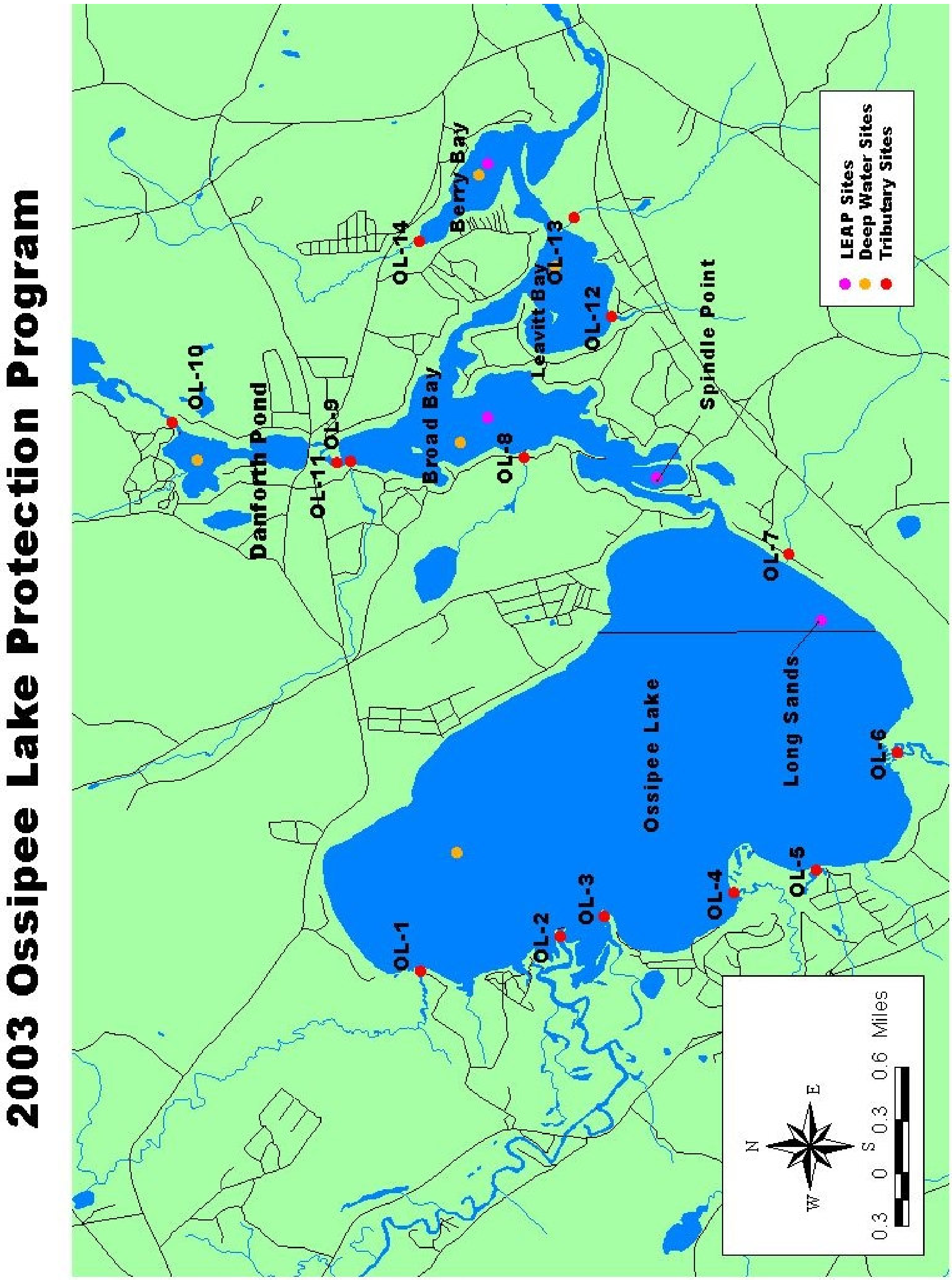
1.3 Ossipee Watershed

The Ossipee Watershed (Figure 1) is part of the Saco River Basin, which is an area of about 379 square miles located in Carroll and Grafton Counties, New Hampshire. It contains 82 lakes and ponds that cover about 9,400 acres in thirteen towns. At its widest point the watershed extends approximately 29 miles east and west and twenty-three miles north and south. Water from the Ossipee Watershed flows into the Saco River and through Maine to the Atlantic Ocean. The watershed's drainage area is bound by the mountains of the Sandwich Range to the northwest, the Ossipee Mountains to the south and the sandy pine barren lands of the Ossipee-Freedom-Effingham plains to the east. Elevations range from 375 feet at the Maine-New Hampshire border in Effingham to 4,060 feet on Mount Passaconway in Waterville.

The Ossipee Watershed contains New Hampshire's largest stratified-drift aquifer. This type of aquifer is unique because it recharges more rapidly than any other. As a result of this quick recharge, stratified drift aquifers allow pollution and contamination to be carried more rapidly into the underground water supply. Therefore, conservation of the recharge lands is vital to the protection of drinking water supplies in New Hampshire and Maine.

The Ossipee Watershed is one of New Hampshire's most rural areas but is under developmental pressure. A study by the Office of State Planning, co-authored by The Society for the Protection of New Hampshire Forests and The Nature Conservancy, predicts that the population of Carroll County will increase 50% by 2020.

Figure 1:


2003 Ossipee Lake Protection Program
OL-10
Danforth Pond
OL-9
OL-11
Broad Bay
OL-8
OL-14
Berry Bay
Leavitt Bay
OL-13
OL-12
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OL-7
Ossipee Lake
Long Sands
OL-6
OL-5
OL-4
OL-3
OL-2
OL-1
LEAP Sites
Deep Water Sites
Tributary Sites
N
E
S
W
0.3 0 0.3 0.6 Miles

1.4 Ossipee Lake

Ossipee Lake is the center of the Ossipee Watershed. Comprised of over 4000 acres of water, the lake consists of a main body of water known as Ossipee Lake (or the Main Lake) and five large connecting bodies of water: Berry Bay, Broad Bay, Leavitt Bay, Danforth Pond and Huckins Pond (Figure 2).

As one of New Hampshire's largest lakes, it is a major economic contributor to the towns of Freedom and Ossipee. A primary destination for vacationers, boaters and wildlife enthusiasts, its appeal has placed it under developmental pressure and environmental stress. Particularly vulnerable are its unique ecological assets, including two globally rare pondshore communities, a pine barrens, a kettlehole quaking bog and the largest stratified drift aquifer in NH.

In 1995 the Environmental Protection Agency listed Ossipee Lake as one of the top five areas in New Hampshire to protect. However, there still has been no public education program on the importance of the lake and its environmental assets and the lake does not have a management or stewardship plan.

1.5 Ossipee Lake Protection Program

In the spring of 2003, GMCG and OLA formed a partnership to create the Ossipee Lake Protection Program (OLPP). With funding from NH Department of Environmental Services and the NH Charitable Foundation, McCabe Environmental Award, the OLPP linked property owner associations, children's camps and environmental groups in planning, volunteer activities and advocacy to address quality of recreation, environmental and land use issues on Ossipee Lake.

1.5.1 Water Quality Monitoring

Increased population, rapid residential and commercial development and expanded recreational use have put pressure and stress on Ossipee Lake and its rivers, making it necessary to implement a comprehensive Water Quality Monitoring (WQM) program. Routine water sampling and testing are essential for early detection of changes in water quality so that problems can be traced to their source before the lake becomes aversely affected.

The OLPP WQM program was the most comprehensive program ever undertaken on Ossipee Lake to date. It encompassed sampling of both the tributaries and deepest points of the lake. Results of the initial WQM program will create a baseline of information on the lake. Subsequent annual sampling will create a database of information from which long term water quality trends can be discerned. These trends can be used to educate residents, businesses, elected officials and visitors about the need to protect the water quality of the lake and used as an information tool for community and local government decisions, including the establishment of a lake stewardship plan.

Water quality data provides an understanding of how land use and underlying geological controls affect the water in our lakes, rives and streams. Compiling water quality data will provide for the understanding of the effectiveness or harmfulness of specific land use practices in maintaining good water quality. These determinations can further guide us in making informed decisions to protect the watershed's and lake's natural resources. Minimally impaired, reference sites, might serve as a standard by which data from other sites are compared to determine the level of impairment.

Water quality data commonly reflect land-use variations but can also be associated with short-term climatic variations such as temperature and precipitation. For example, during dry periods pollutants accumulate in the uplands and are ultimately flushed into the receiving waters during storm events. However, some short-term data, such as immediately after a storm event, can be quite revealing.

1.5.2 Lake Environment Assessment Plan

Ossipee Lake's popularity has placed it under developmental pressure and environmental stress through rapid residential and commercial development and intense recreational uses that challenge the lake's carrying capacity. Currently, there is no lake management plan for Ossipee Lake, and use of the surrounding land falls under the jurisdiction of three different communities: Effingham, Freedom and Ossipee. These contributing factors put substantial stress on the natural resources of Ossipee Lake.

The Lake Environment Assessment Program (LEAP), used observational research techniques developed by the NHDES Lake Management and Protection Program to inventory and quantify environmental and quality of recreation issues on the lake. Volunteers used checklists to record recreational activities such as swimming, canoeing and picnicking, and established watercraft density by counting boats and boat types. Data collected during the 2003 LEAP 2003 will be used to guide and direct the creation of a Lake Management Plan in 2004-2006.

2.0 Methods

For further detail of methods for Water Quality Monitoring, refer to the Ossipee Lake and Tributaries Water Quality Monitoring Program QAPP (2003).

2.1 WQM—Tributary Testing

2.1.1 Testing Locations

Tributary testing occurred at each of the fourteen tributaries on Ossipee Lake (Figure 1). Table 1 includes a complete list of each site sampled.

Table 1: Descriptions of tributary testing sites

Site #	Tributary Name	Description
OL-1	**West Branch River**	This river starts at the south end of Silver Lake and flows into Lily Pond adjacent to the International Paper mill on Route 41. From there it flows south and crosses Ossipee Lake Road, forming the boundary between Freedom and Ossipee. It enters Ossipee Lake between Babcock Road in Freedom and Nichols Road in Ossipee.
OL-2	**Bearcamp River**	This river originates in the town of Sandwich and follows Route 113 through the town of Tamworth, crossing under Route 16 south of West Ossipee. It passes the Gitchie Gumie Campground before entering the main body of Ossipee Lake north of Deer Cove.
OL-3	**Patch Pond River**	The tributary at Patch Pond Point begins as a pond behind the housing development at Deer Cove. The point at which the water flows into Ossipee Lake is on the north side of Deer Cove, south of Meadow Cove.
OL-4	**Lovell River**	This river originates at Connor Pond in the Ossipee Mountain Range and flows under Route 16 at the Indian Mound Golf Club. It enters the main body of Ossipee Lake south of Deer Cove at the site of the Bluffs, a housing development.
OL-5	**Weetamoe Inlet**	This brook flows into the Main Lake at the former location of Camp Weetamoe, now used for private rental cottages. The brook flows under Route 16, a major state highway, and through the Indian Mound Shopping Center and the Indian Mound Golf Course.
OL-6	**Pine River**	Pine River is one of the lake's major tributaries. It is the location of the only state boat ramp providing access to Ossipee Lake. From that location it flows under Route 25 and passes several clusters of homes before entering the main lake at its southern end adjacent to Ossipee Lake Natural Area.
OL-7	**Red Brook**	This brook enters the southeast end of the main body of Ossipee Lake between Long Sands and Ossipee Lake Natural Area. It flows past the Heath Pond Bog Natural Area, passing the commercial operations of South African Pulp and Paper Industries.
OL-8	**Duck Pond Brook**	The headwaters of this brook in Duck Pond. It enters the north side of Broad Bay between Camp Huckins and Ossipee Lake Marina. This brook was dry in June and was not tested.
OL-9	**Cold Brook**	The headwaters of this brook are west of Trout Pond. It runs between Trout Pond and the Jackman Ridge along the Pequawket Trail and passes under the Ossipee Lake Road east of the Pequawket Trail. It subsequently enters the north side of Broad Bay between Camp Huckins and Ossipee Lake Marina.
OL-10	**Danforth Pond Outlet**	This brook flows into Danforth Pond from Huckins Pond, which is undeveloped. Although there is some use of this tributary by fishing boats with small engines and by personal watercraft.
OL-11	**Danforth Brook**	Danforth Brook flows from Danforth Pond, past Ossipee Lake Marina and into Broad Bay.
OL-12	**Phillips Brook**	This brook starts at Hanson Top and Davis Top. It crosses under Route 25 at Leavitt Road and enters Leavitt Bay, passing a housing development and campground near the point where it enters Leavitt Bay.
OL-13	**Leavitt Brook**	This brook starts at Hanson Top and Davis Top in the Green Mountain range. It crosses under Route 25 close to Camp Marist and enters the south end of Leavitt Bay between Leavitt Bay and the channel to Berry Bay on Camp Marist property.
OL-14	**Square Brook**	This brook passes through the Square Brook housing development on the northeast side of Ossipee Lake Road, passes under that road before entering the northwest end of Berry Bay.

2.1.2 Testing Schedule

Sampling began on June 23 and ended on August 9 (Table 2). Each site was tested four times (every other week) throughout this period. Sampling occurred between 7:00 and 9:00 am because of two factors that influence dissolved oxygen in streams. First, dissolved oxygen levels can be affected as water temperatures rise throughout the day. Second, after a night of carbon dioxide-producing respiration, aquatic plants and algae begin producing oxygen through photosynthesis, thereby altering oxygen levels in the water. In order to maintain consistent dissolved oxygen measurements, it is important to test at the same time of day during each sampling period.

Table 2: Sampling schedule.

Site #	Location	Day of Sampling	Camp	Dates Sampled
OL-7	Red Brook	Monday	None	June 23, July 7, July 21, August 4
OL-13	Leavitt Brook			
OL-14	Square Brook			
OL-1	West Branch River	Tuesday	Calumet	June 24, July 8, July 22, August 5
OL-2	Bearcamp River			
OL-3	Patch Pont Point River	Wednesday		June 25, July 9, July 23, August 6
OL-4	Lovell River			
OL-5	Weetamoe Brook		Cody	
OL-6	Pine River			
OL-9	Cold Brook	Thursday	Huckins	June 26, July 10, July 24, August 7
OL-11	Danforth Brook			
OL-12	Phillips Brook		Robin Hood	
OL-10	Huckins Pond Outflow	Friday	Tohko	June 27, July 11, July 25, August 8

2.1.3 Parameters

Seventeen parameters were tested in the tributary monitoring program. Four parameters were tested in the field by campers and GMCG interns (Table 3). These parameters were recorded on a data sheet (Appendix A) and replicated. For instructions on how to use field parameter equipment, refer to Appendix B.

Fourteen additional chemical parameters were tested (Table 4). Two water samples were collected in 250 ml bottles at each site. One sample was acidified with one milliliter of concentrated sulfuric acid then frozen. The other sample was filtered using a 47 mm diameter 0.45 micron mesh Whatman filter, stored in a 60 ml bottle and frozen.

Table 3: Field parameters tested.

Parameter	Units	Instument Used	Range	Accuracy
pH	pH units	YSI 60	0 to 14	±0.1 unit within 10°C of calibration ±0.2 unit within 20°C
Dissolved Oxygen	mg/l, %	YSI 550A	0-50 mg/L 0-500% air saturation	0-200 % : ±2% air sat. or ±2% of reading, whichever is greater 200-500% : ±6% of reading 0-20 mg/L : ±0.3 mg/L or ±2% of reading, whichever is greater 20-50 mg/L : ±6% of reading
Turbidity	NTU	HACH Model 2100P Portable Turbidimeter	0-1000 NTU	+\- 2% of reading
Temperature	˚C	HACH Non-mercury thermometer	-5 to 45˚C	+\- 0.3˚C

Table 4: Lab parameters tested.

Parameter	Units	Instrument Used	Description	Sample Preservative
Total Phosphorus (TP)	ppb	Milton-Roy 1001$^+$ Spectrophotometer	Std Methods Ascorbic Acid method. 10cm pathlenght cuvette	1 ml concentracted sulfuric acid and frozen
Dissolved Organic Carbon (DOC)	mg C/L	Shimadzu TOC 5000 with autosampler	High Temperature Catalytic Oxidation (HTCO)	Filtered and Frozen
Total Dissolved Nitrogen (TDN)	mg N/L	Shimadzu TOC 5000 coupled with an Antekk 720 N detector	HTCO with chemiluminescent N detection	
Nitrate (NO_3^-)	mg N/L	Lachat QuikChem AE	Automated Cd-Cu reduction	
Ammonium (NH_4^-)	mg N/L		Automated Phenate	
Dissolved Organic Nitrogen (DON)	mg N/L		DON=TDN-(NO_3^-+ NH_4^-)	
Phosphate (PO_4^{3-})	mg P/L	Lachat QuikChem AE	Automated Ascorbic Acid	
Silica (SiO_2)	mg SiO_2/L		Automated Molybdate Reactive Method	
Anions (Cl^-, SO_4^{2-})	mg/L	Ion Chromatograph	Anions via ion chromatography with suppressed conductivity	
Cations (Na^+, K^+, Ca^{2+}, Mg^{2+})	mg/L		Cations via ion chromatography and conductivity	

2.2 WQM—Deep Water Testing

Deep Water Testing was coordinated in partnership with NH Department of Environmental Sciences Volunteer Lake Assessment Program. Each of the five main bodies of Ossipee Lake (Ossipee Lake, Danforth Pond, Berry Bay, Leavitt Bay and Broad Bay) were sampled at their deepest point. It is an important adjunct to tributary testing because it provides a picture of the overall biological and chemical health of the lake system. Depending on the depth of the lake, during the summer the state's lakes typically stratify into two or three layers based on temperature. Due to the differences in the density and temperature of each of the layers, different biological and chemical reactions may occur which will affect water quality. Therefore, it is important to take samples from each layer of the lake.

For detailed description of VLAP sampling, procedures and parameters, refer to the NH DES Limnology Center Laboratory Manual and the Ossipee Lake and Tributaries Water Quality Monitoring Program QAPP (2003).

2.2.1 Testing Locations

Testing occurred at each of the five bodies of Ossipee Lake: Berry Bay, Broad Bay, Danforth Bay, Leavitt Bay and Ossipee Lake (Figure 1). Deep spots were found by triangulation using surrounding landscape and structures. Table 5 shows the deep spots and their respective depths.

Table 5: Deep water site depths.

Site	Depth (meters)
Berry Bay	12.5
Broad Bay	18
Danforth Pond	12
Leavitt Bay	13
Ossipee Lake	20

2.2.2 Testing Schedule

Deep water testing occurred on the following days: June 19, July 15, and August 12. Berry Bay, Broad Bay and Leavitt Bay were tested by one intern and one volunteer. Ossipee Lake and Danforth Bay were tested by a second intern with Camp Calumet and Danforth Bay Campground. Testing occurred between 9:00 am and 3:00 pm.

2.2.3 Parameters

Ten parameters were analyzed for deep water testing sites (Table 6). Dissolved oxygen and temperature were only measured once on June 19 with a NH DES representative. All other parameters were tested each sampling day. Secchi disk, temperature and dissolved oxygen measurement occurred in the field at the time of sampling. The remaining seven parameters were tested at the NH DES Limnology Laboratory using samples collected in the field.

Table 6: Parameters for Deep Water Testing.

Parameters	**Units**	**Sampling Method**	**Sample Container**	**Preservative**
Temperature*	˚C	YSI 52 Portable Dissolved Oxygen Meter	None, measurement taken in water	None
Dissolved Oxygen*	mg/L	YSI 52 Portable Dissolved Oxygen Meter	None, measurement taken in water	None
Secchi Disk Water Clarity	meters	NHVLAP Deep Spot Sampling Method	Secchi Disk and Calibrated Chain	None
pH	pH units	Kemmerer Bottle	1000 ml translucent white plastic Nalgene sample bottle	None
Turbidity	NTU	Kemmerer Bottle	1000 ml translucent white plastic Nalgene sample bottle	None
Total Phosphorus – NHDES	µg/L	Kemmerer Bottle	Small brown, opaque phosphorus bottle 250 mL, Nalgene	Sulfuric Acid
ANC	mg/L $CaCO_3$	Kemmerer Bottle	1000 ml translucent white plastic Nalgene sample bottle	None
Conductivity	µS/cm	Kemmerer Bottle	1000 ml translucent white plastic Nalgene sample bottle	None
Chlorophyll-a	mg/m^3	Integrated Sampling tube	Dark amber bottle, 1000 mL Nalgene	Unfiltered, Dark, 4°C
Phytoplankton	Species counts	Sample water collected with plankton net	Small glass 250-mL jar	Lugol's Solution In 4°C

*Dissolved Oxygen and Temperature measurements occured during June when the DES biologist trains coordinators to use other equipment.

2.3 LEAP

2.3.1 Testing Locations

Research sites for the LEAP 2003 program have been identified by the Alliance in association with GMCG, state agencies and lake property owner associations. The LEAP survey was carried out in four locations (Table 7, Figure 1).

2.3.2 Testing Schedule

LEAP surveys were carried out by volunteers, summer camps and interns. Sampling occurred on five days throughout the summer: survey days were on July 4, July 5, July 6, July 19 and August 13. These days were selected to encompass a holiday weekend, a non-holiday weekend and a weekday. On each sampling day, surveys were carried out at 10 am, 2 pm and 4 pm. Some volunteers chose to sample at additional times. Additional dates were also sampled. LEAP surveys were also taken at some locations on July 12, July 13 and August 20.

2.3.3 Parameters

Survey participants were instructed to visit their site for fifteen minutes during the assigned time to observe various recreation uses of Ossipee Lake. Surveyors were given data sheets (Appendix C) to fill out while at their site. Quantitative data collected included: number of boats, number and type of motorized boats, number and type of non motorized boats. Qualitative observations were also recorded on the data sheet and examined the behavior and type of recreation that was occurring.

Table 7: LEAP survey sites and descriptions.

Broad Bay	Broad Bay is the center of the Ossipee Lake system and is the largest of the lake's three bays. Much of the shoreline has been developed with homes and also has two children's camps, a marina and a beach club serving a housing development that is not on the lake. Surveys were conducted in central Broad Bay where boat traffic from the main lake and Leavitt Bay converges.
Spindle Point & Cassie Cove Sand Bar	Rafting issues at Spindle Point and the Cassie Cove sand bar were documented in 2000 and resulted in a state hearing that limited the number of boats allowed to congregate there at the same time. Two years later, in August 2002, members of the Broad-Leavitt Bay Association documented the state's lack of enforcement of the ruling and the continued diminishment of the quality of recreation and character of the area, including excessive noise, drinking, rowdy behavior, swimmers interfering with boat channel traffic and littering.
Ossipee Lake Natural Area (Long Sands)	Ossipee Lake Natural Area, also known as Long Sands, is state-owned property that encompasses most of the southern portion of Ossipee Lake from Pine River to the Long Sands residential community at the entrance to the channel leading to Broad Bay. The property is a fragile wetland that contains a globally rare sandy pondshore community that exists nowhere else in the world. It is a prime destination for boaters. A 2002 study by state scientists had documented damage to the plant environment as well as littering and other human pollution.
Berry Bay Point	Berry Bay is the last and smallest in the chain of bays from Ossipee Lake to the Ossipee River dam. A large portion of land along the western shore of the channel connecting Berry Bay with Leavitt Bay is a privately owned, undeveloped wetland that terminates in a point of land with a small beach.

3.0 Summary and Discussion

3.1 WQM – Tributary

Tributary data is displayed in Appendix D.

3.1.1 Precipitation

Precipitation can have a significant impact on water quality. Periods of heavy rainfall, as well as the period of spring snowmelt, often coincide with the increased transport of pollutants and sediments into our surface waters that include lakes, streams and wetlands. Likewise, the water that infiltrates the soil and enters our surface waters as groundwater recharge can be laden with minerals that occur naturally, through the weathering of mineral formations, as well as, from human sources such as septic system effluent, leaching fertilizers and road salt applications. However, dry periods are often characterized by a reduction in the overland pollutant transport into our surface waters. During these dry periods, pollutants often accumulate in the watershed until the following heavy storm event or wet period provides a means of transporting debris, nutrients and other materials into our water bodies.

Precipitation during the first half of 2003 was less than the three year average of 2001-2003 (Figure 2). However, precipitation in July through August of 2003 was higher than the previous two years. Through anecdotal and observational evidence, precipitation in September through November of 2003 was also higher than the three year average.

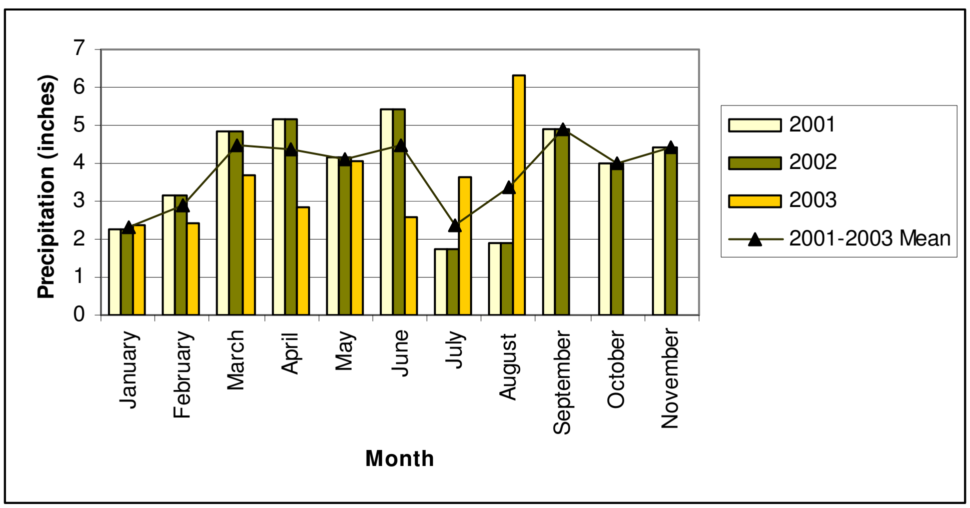

Figure 2: Tamworth precipitation, 2001-2003

3.1.2 Temperature

The temperature and range of temperatures that occur at the stream site will limit the types of stream organisms that can survive at their respective location. Processes such as the removal of shoreside vegetation that increases the water temperature generally have a negative impact on the aquatic organisms. Raising temperatures will also reduce the water's capacity to hold oxygen and, in turn, might further impact the suitability of these streams to harbor aquatic life, including certain fish species. For example, temperatures in excess of 19˚C are often considered intolerable to trout.

Temperatures were variable across the tributaries of Ossipee Lake (Figure 3). Water temperatures ranged from 16.4˚C at site OL-7 to 26.1˚C at site OL-10. This variation could be due a number of factors. Some of the Ossipee Lake tributary sites were sampled where river flow is minimal and there is an influx of lake water. Sampling of lake water will alter results. Sites with more riparian vegetative cover may be cooler. Tributaries with a lot of humic acids are warmer. There is also seasonal variation associated with ambient air temperatures. If tributaries are groundwater fed, as may be occurring at OL-7 they are likely cooler than streams that receive surface water recharge. Finally, temperatures found in Ossipee Lake tributaries could vary due to differences in stream length, wide and depth.

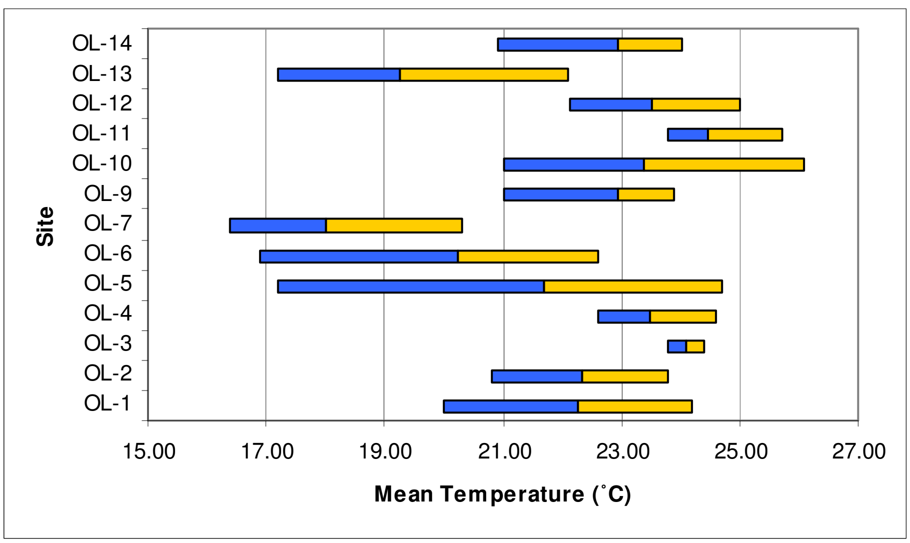

Figure 3: 2003 Ossipee Lake site tributary temperature comparison. Bars show range of temperatures. Darker bars shows range less than the mean. Lighter bars shows range greater than the mean. Mean value is at point where dark and light bars meet.

3.1.3 Dissolved Oxygen

Oxygen is an essential component for the survival of aquatic life. Submergent plants and algae create oxygen through photosynthesis during the day. Respiration by both plants and animals consume oxygen continually. Respiration is associated with the natural bacteria, fungi and other decomposers in the stream that break down organic matter that enters the stream from upland sources, as well as, from the water originating from up-gradient lakes, wetlands and the stream itself. Oxygen can also be replenished in the streams through the turbulent mixing of the air and water, particularly in fast flowing and rocky stream reaches that facilitates the rapid diffusion of atmospheric oxygen into the stream water.

The capacity of the water to hold oxygen is temperature dependent; warmer water has a lower capacity to hold oxygen. Thus, you will generally measure less in-stream dissolved oxygen during the summer months than during the early spring and late fall months. To account for this interdependence of temperature and dissolved oxygen content, the dissolved oxygen data are oftentimes expressed as percent saturation which reflects the oxygen measured relative to the water's capacity to hold oxygen at a given temperature.

The dissolved oxygen concentrations measured in Ossipee Lake during the summer of 2003 ranged from 0.70 mg/L at OL-7 to 8.59 mg/L at OL-11 (Figure 4). Very low oxygen concentrations should be expected at OL-7, despite its low temperatures. This site is exhibits low flow and drains a large wetland. Indeed, this site had by far the lowest range of dissolved oxygen concentrations.

Percent saturation ranged from 57.8% (OL-3) to 102.2% (OL-11; Figure 5) at all sites except for OL-7 where the percent saturation was less than 15%. Site OL-7 drains a wetland. Water is slow moving. If this area is stagnant enough, natural decomposition might also result in significant consumption of oxygen. OL-7 also displayed a high percentage of organic nitrogen (Section 3.1.9), indicating there is a lot of material to be decomposed at this site. According to the EPA, dissolved oxygen levels are considered critical when they fall below 5 mg/L. In addition to OL-7, OL-3 also fell below 5 mg/L. This, however, appeared to be a one time event.

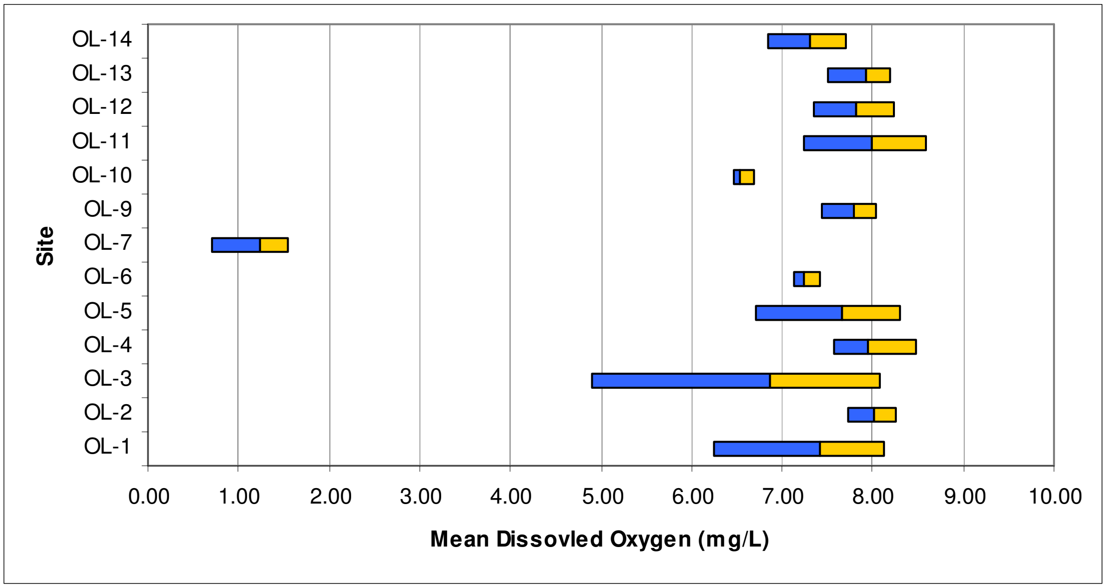

Figure 4: 2003 Ossipee Lake tributary dissolved oxygen concentrations inter site comparison. Bars show range of dissolved oxygen concentrations. Darker bars shows range less than the mean. Lighter bars shows range greater than the mean. Mean value is at point where dark and light bars meet.

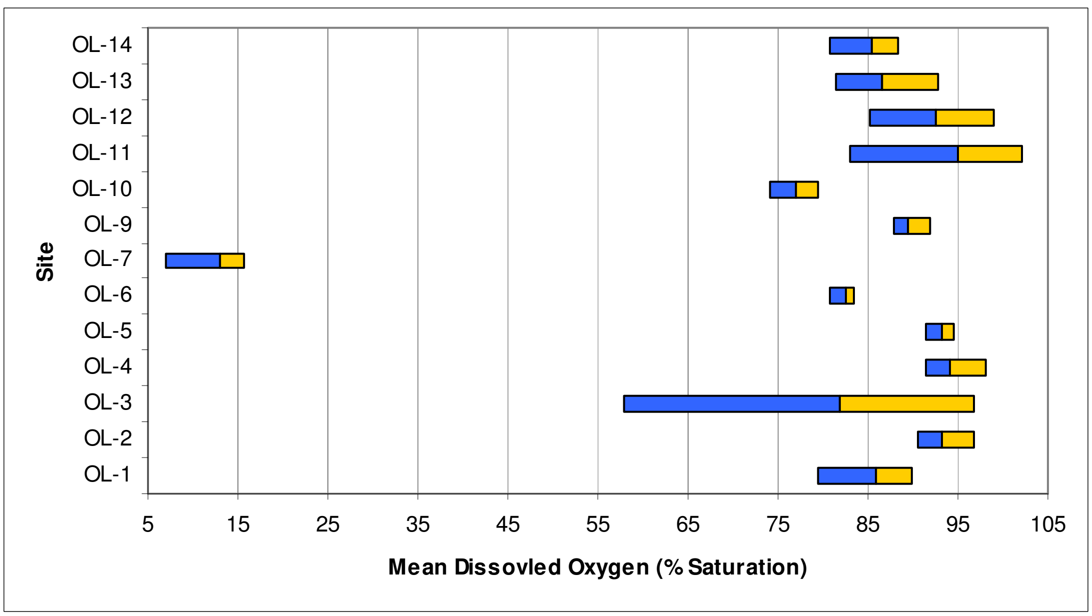

Figure 5: 2003 Ossipee Lake tributary dissolved oxygen percent saturations site comparison. Bars show range of dissolved oxygen percent saturation. Darker bars shows range less than the mean Lighter bars shows range greater than the mean. Mean value is at point where dark and light bars meet.

3.1.4 Turbidity

The amount of suspended material in the stream is referred to as the turbidity. Turbidity can be summarized by the amount of sediments, silt, algae, leaves, pollen and other solid debris that are suspended in the water column. The turbidity is measured with an electronic meter called a nephalometer and the turbidity is reported at nephalometric turbidity units (NTU). Many chemical pollutants and nutrient are commonly attached to silt particles and in some instances the turbidity might be used as a surrogate for other more expensive and involved analyses such as total phosphorus measurements (Figure 6). However, it does not appear than total phosphorus in Ossipee Lake tributaries is related to turbidity. Besides the chemical pollutants and nutrients that are commonly attached to silt particles, the silt particles themselves can cause great in-stream changes. Silts can cover up nesting and prime habitat areas and can be highly abrasive to the gill structure of many aquatic organisms.

The average turbidity in Ossipee Lake tributaries ranged from 0.43 NTU at site OL-1 to 3.10 NTU at OL-12 (Figure 7). All sites are within a healthy range.

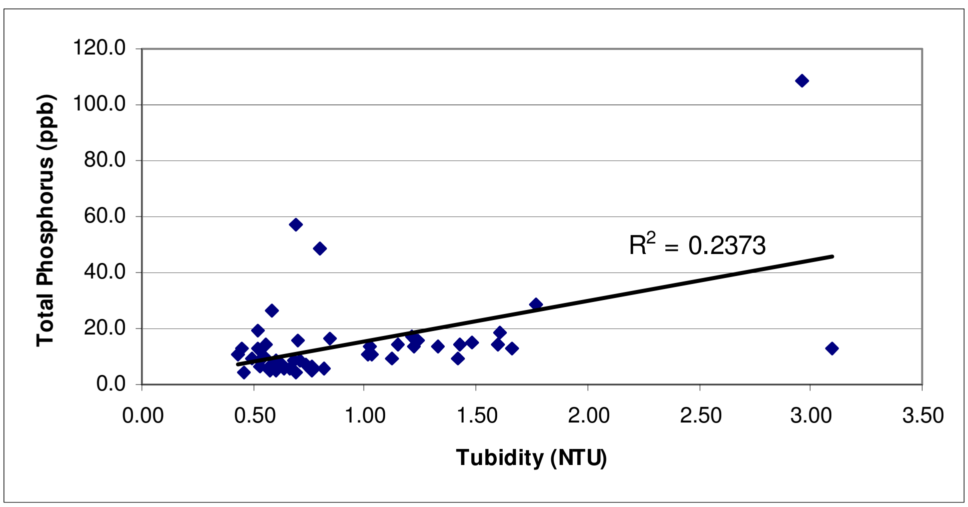

Figure 6: 2003 individual values of turbidity and phosphorus comparison in Ossipee Lake tributary sites.

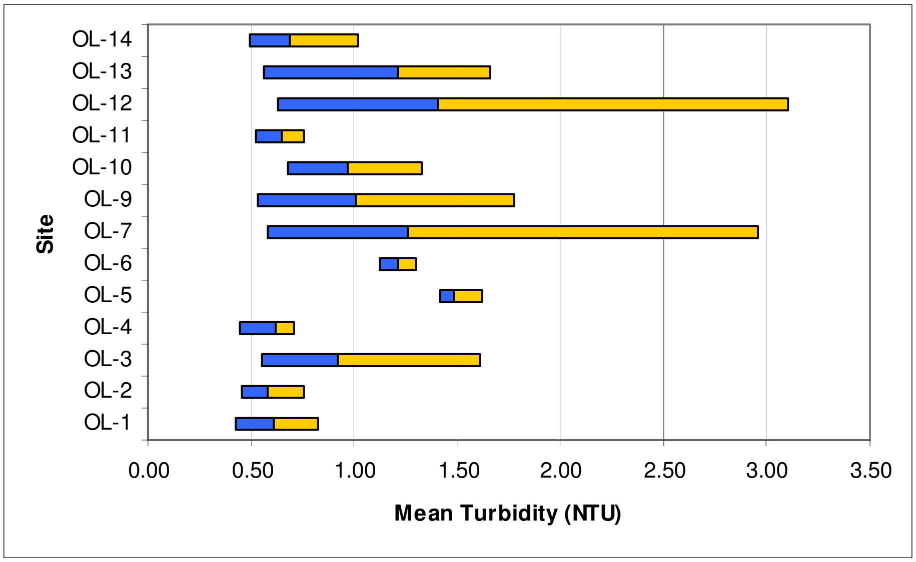

Figure 7: 2003 Ossipee Lake tributary site turbidity comparison. Bars show range of turbidity measurements. Darker bars shows range less than the mean. Lighter bars shows range greater than the mean. Mean value is at point where dark and light bars meet.

3.1.5 Total Phosphorus

Of the two nutrients most important to the growth of aquatic plants, nitrogen and phosphorus, it is generally observed that phosphorus is the more limiting to plant growth in freshwater systems. Phosphorus is primarily associated with human related activities within the watershed and is therefore important to monitor and control. The total phosphorus includes all dissolved phosphorus as well as the phosphorus contained in or adhered to suspended particles such as sediment and plankton. Total phosphorus will accumulate in the slow moving stream reaches and in impoundments where the particulate bound phosphorus settles out of the water column. These localized phosphorus rich regions can then serve as phosphorus sources that result in localized algal blooms and related water quality problems.

Total phosphorus on Ossipee Lake (2003) varied from 4.6 ppb (OL-2 and OL-4) to 108.6 ppb at OL-7 (Figure 8). Again, OL-7 is part of a large wetland complex. It is possible that the higher total phosphorus levels may be attributed to this wetland.

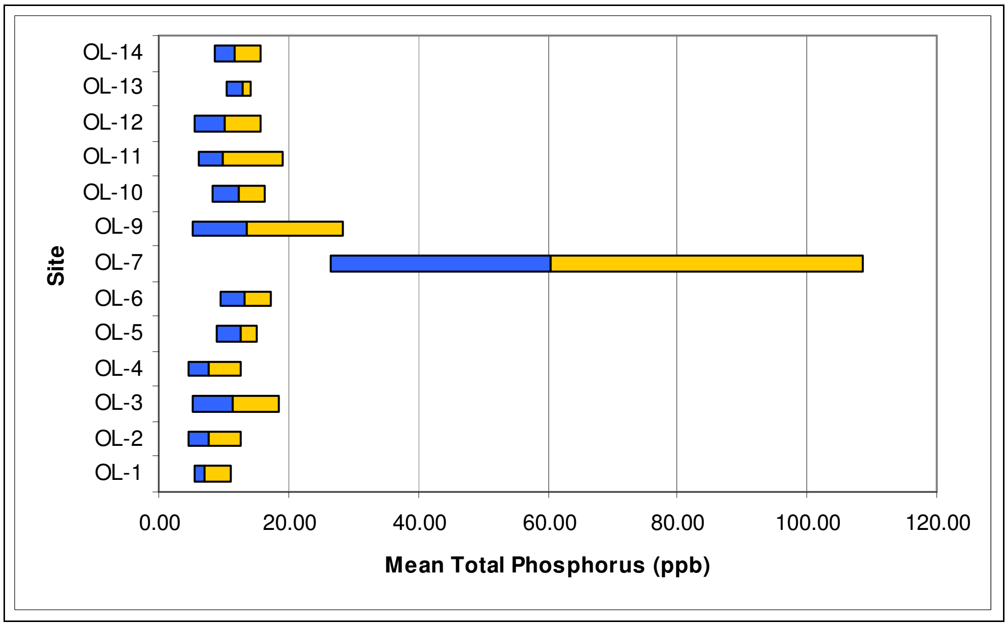

Figure 8: 2003 Ossipee Lake tributary site total phosphorus comparison. Bars show range of total phosphorus concentrations. Darker bars shows range less than the mean. Lighter bars shows range greater than the mean. Mean value is at point where dark and light bars meet.

3.1.6 Phosphate

Phosphorus is often the limiting nutrient in streams and phosphate is the most biologically available form of phosphorus. Phosphate, a component of total phosphorus is typically very low in natural systems. Total phosphorus and phosphate are related. However, it is impossible for phosphate to exceed total phosphorus. By examining the total phosphorus and phosphate data, it is clear that there have been not lab errors, and total phosphorus exceeds phosphate levels (Figure 9). Sewage and agricultural inputs will increase PO_4^{3-} levels. High levels of phosphate can lead to problematic algal blooms and eutrophication. Sometimes low light levels limit production in a phosphate rich environment. In Ossipee Lake tributary sites, phosphate concentrations ranged from zero at several sites to 44.0 µg P/L at OL-7 (Figure 10). All sites except for OL-7 had phosphate levels below 8.0 µg P/L. A phosphate rich environment could be explained by the wetland that OL-7 drains.

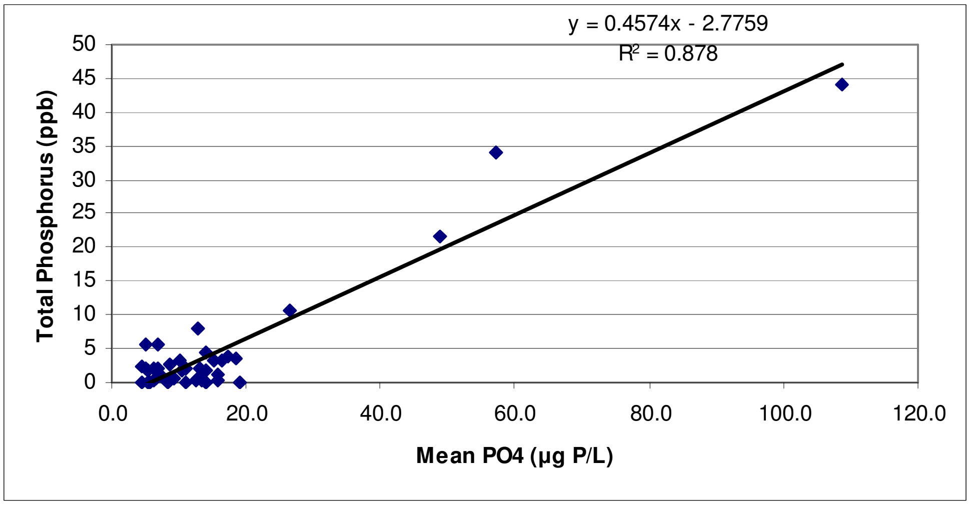

Figure 9: Comparison of total phosphorus and phosphate at Ossipee Lake tributary sites, 2003.

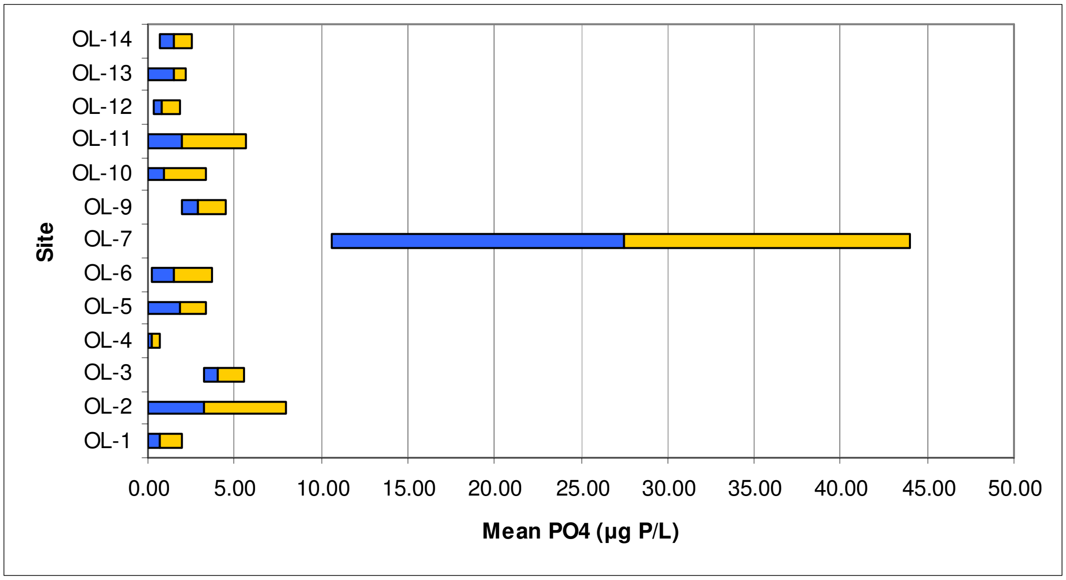

Figure 10: 2003 Ossipee Lake tributary site phosphate comparison. Bars show range of phosphate concentrations. Darker bars shows range less than the mean, lighter bars shows range greater than the mean. Mean value is at point where dark and light bars meet.

3.1.7 pH

The pH is a way of expressing the acidic level of stream water and is generally measured with an electrical probe sensitive to hydrogen ion activity. The pH scale has a range of one (very acidic) to fourteen (very "basic" or alkaline) and seven is neutral. The scale is neutral; changes in 1 pH unit reflect a ten times difference in hydrogen ion concentration. Most aquatic organisms tolerate a limited range of pH and most fish species require a pH of 5.5 or higher to grow and reproduce successfully. Wide pH fluctuations associated with industrial pollution and acid precipitation are generally considered the most sever acidic stressors to instream aquatic organisms. In New Hampshire, the spring runoff period is often considered the period during which the aquatic organisms are most susceptible to acid rain stress.

pH on Ossipee Lake Ranged from 3.93 (OL-7) to 6.83 at OL-13 (Figure 11) . All sites except for OL-7 had a pH of greater than or equal to 5.50. The site OL-7 drains a wetland. Therefore, presence of humic acids in wetlands would be cause for the low pH observed.

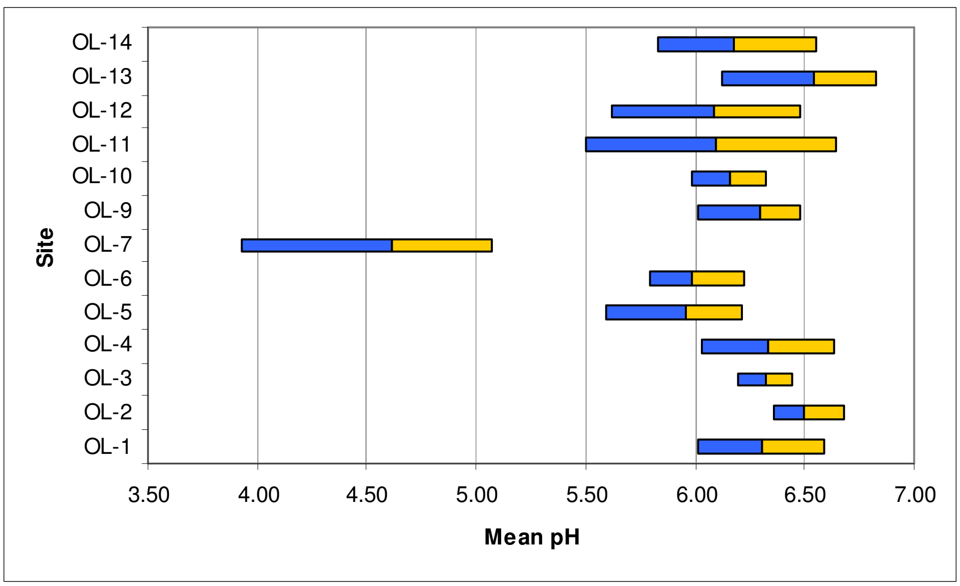

Figure 11: 2003 Ossipee Lake tributary site pH comparison. Bars show range of pH. Darker bars shows range less than the mean, lighter bars shows range greater than the mean. Mean value is at point where dark and light bars meet.

3.1.8 Dissolved Organic Carbon

Dissolved organic carbon occurs naturally, through leaching and breakdown of organic material. The brown color of stream water is due to DOC (although color is not always an indicator of DOC concentration). DOC can be naturally occurring. Most DOC in streams is terrestrially derived (comes from outside the stream). Forest soils and wetland are a source of DOC. In addition to natural sources, DOC can also come from anthropomorphic inputs. Dissolved organic carbon affects the complexation, solubility and mobility of heavy metals. Generally, if metals are present, they can complex with DOC and make their way to surface water. Chlorination of high DOC water can cause the formation of trihalomethanes, which have been linked to cancer, reproductive problems and other health issues.

Dissolved organic carbon levels varied on Ossipee Lake from 2.28 mg C/L at OL-13 to 22.44 mg C/L at OL-7 (Figure 12). High DOC values are to be expected at OL-7 because of the wetland system that is drains.

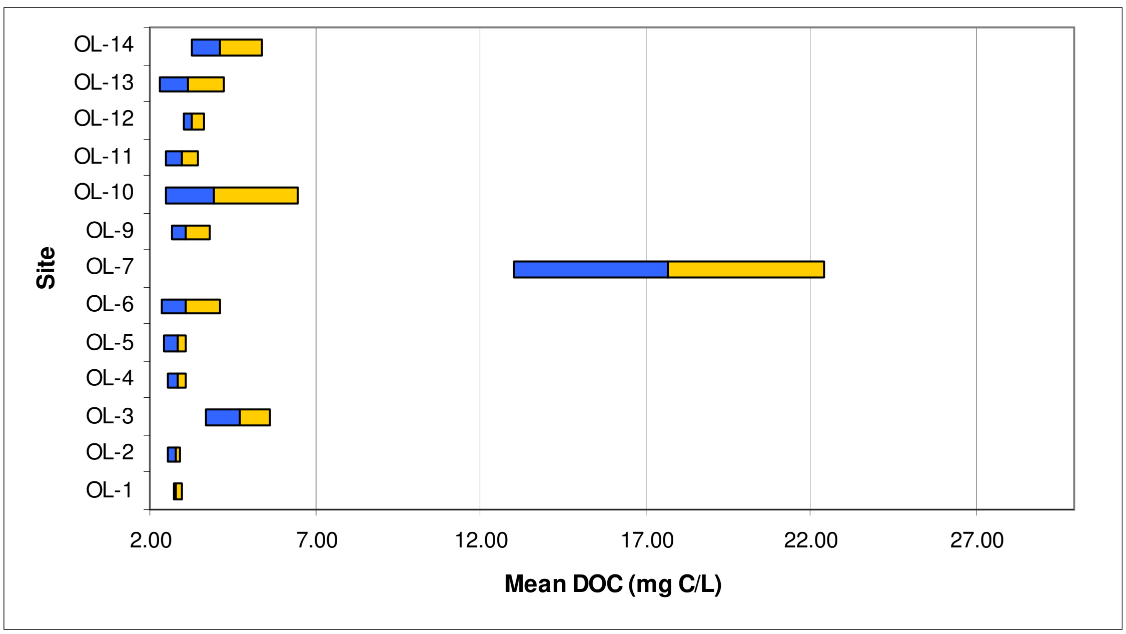

Figure 12: 2003 Ossipee Lake tributary site DOC comparison. Bars show range of DOC concentrations. Darker bars shows range less than the mean, lighter bars shows range greater than the mean. Mean value is at point where dark and light bars meet.

3.1.9 Nitrogen

Nitrogen is an important nutrient which is sometimes limiting in stream water, and unwanted algal blooms may result from excess nitrogen loading. Nitrogen is either organic or inorganic. Dissolved inorganic nitrogen (DIN) is the sum of the two forms of inorganic nitrogen, nitrate (NO_3^-) and ammonium (NH_4^+). Nitrate occurs naturally from nitrification of NH_4^+ to NO_3^-. Nitrification occurs in an oxic (oxygen rich) environment (such as stream water) where microbes convert NH_4^+ to nitrite (NO_2^-), and NO_2^- is quickly converted to NO_3^- for energy. The conversion of NO_2^- to NO_3^- is so fast that NO_2^- is usually undetectable in stream water, and NO_2^- is assumed to be zero. Elevated levels of nitrate indicate pollution from sewage, run off, agriculture or other anthropogenic activity. Nitrate contamination of drinking water can cause Methemoglobenemia, a serious illness in infants where respiration is inhibited. Ammonium is the preferred form of nitrogen for plant and microbial uptake since it is more energy efficient to use than nitrate. However, ammonium is typically very low in undisturbed streams. Ammonium is the product of organic breakdown and high levels of ammonium typically indicate some type of pollution (sewage, run off, agricultural). Dissolved organic nitrogen can be an important source of nitrogen for plants and microbes depending on the availability of DIN. In most undisturbed ecosystems, DON dominates TDN (DON is greater than DIN) and DIN tends to dominate TDN (DIN is greater than DON) in disturbed systems. Like DOC, DON complexes heavy metals and is generated largely in wetlands and forests soils.

Mean TDN concentrations among the Ossipee Lake tributary sites, with the exception of Red Brook (OL-7), were relatively low (Table 8 and Figure 13) and ranged from 0.09 mg/L (OL-9) and 0.51 mg/L at OL-7. Highest mean DON concentrations (0.44 mg N/L) were found at OL-7 suggesting wetland input mostly likely due to the wetland input. At all sites, mean nitrate concentration was less than 0.04 mg N/L. Mean ammonium concentration was less than 0.083 mg N/L at all sites.

Table 8: 2003 Ossipee Lake tributary nitrogen site comparison.

Site	N as NO3	N as NH4	TDN	DON	% NH4	% NO3	% DON	% inorganic N
OL-1	0.011	0.008	0.12	0.10	7.00%	9.31%	83.69%	16.31%
OL-2	0.026	0.083	0.14	0.11	59.85%	18.47%	76.52%	23.48%
OL-3	0.028	0.017	0.25	0.21	6.89%	11.18%	81.94%	18.06%
OL-4	0.012	0.010	0.12	0.10	8.00%	10.13%	81.87%	18.13%
OL-5	0.020	0.011	0.15	0.12	7.28%	13.50%	79.22%	20.78%
OL-6	0.038	0.020	0.17	0.11	11.86%	22.29%	65.85%	34.15%
OL-7	0.002	0.066	0.51	0.44	12.98%	0.39%	86.63%	13.37%
OL-9	0.009	0.013	0.11	0.09	11.05%	8.13%	80.82%	19.18%
OL-10	0.004	0.023	0.15	0.12	15.55%	2.32%	82.13%	17.87%
OL-11	0.006	0.007	0.13	0.11	5.39%	4.89%	89.72%	10.28%
OL-12	0.004	0.005	0.13	0.12	4.07%	2.95%	92.98%	7.02%
OL-13	0.012	0.026	0.10	0.07	25.11%	11.56%	66.94%	33.06%
OL-14	0.004	0.009	0.15	0.14	5.72%	2.46%	91.82%	8.18%

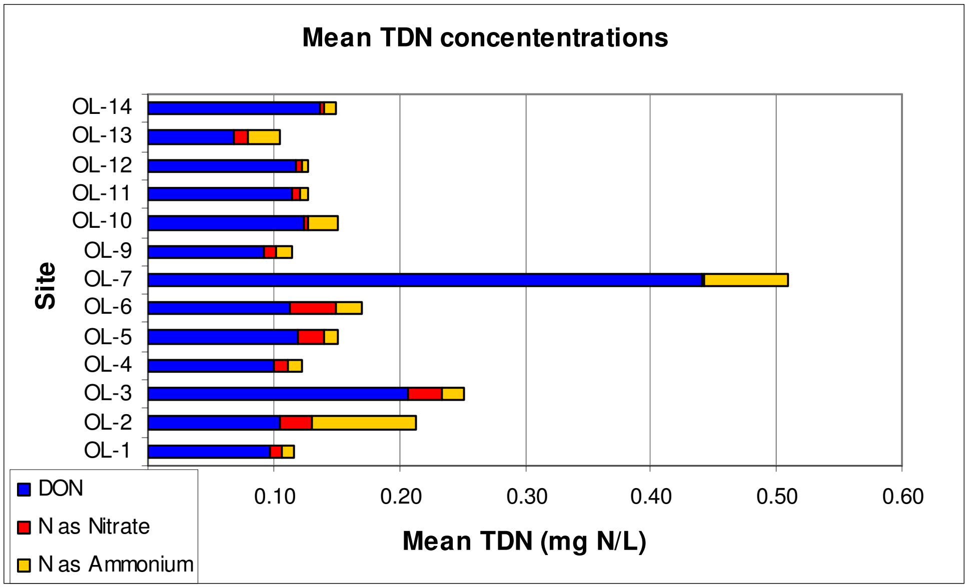

Figure XX: Mean TDN concentrations among the Ossipee Lake tributary sites for the 2003 sampling season with fractions of DON, Nitrate and Ammonium shown.

Mean DON comprised more than 65% of the mean TDN at all sites. At site OL-2 mean TDN was dominated by ammonium (59.85% of the TDN). Nitrate constituted 18.47% of the mean TDN at OL-2. Mean nitrate accounted for less than 23% of the mean TDN at all sites and mean ammonium concentration was less than 26% at all sites except for OL-2 and OL-9.

3.1.10 Dissolved Organic Matter

Dissolved organic carbon and DON are both part of dissolved organic matter (DOM). An organic compound found naturally more than likely contains both carbon (C) and nitrogen (N). The quantity of C and N found in DOM is indicated by DOC and DON. Researchers often look at the DOC:DON (or C:N) ratios to determine the quality of the DOM (or how digestible it is). A lower C:N ratio generally indicates higher quality (more digestible) DOM. Dissolved organic carbon and DON are often positively related to each other as they are chemically bound together (when DOC increases so does DON), but this relationship may vary over space and time. Dissolved organic carbon and DON are not necessarily controlled by the same mechanisms. By examining the linear regression in Figure 14, it does not appear that there is a strong linear relationship among the Ossipee Lake tributary sites. There is a lot of scatter around the line indicating that it may not be possible to accurately infer one from the other.

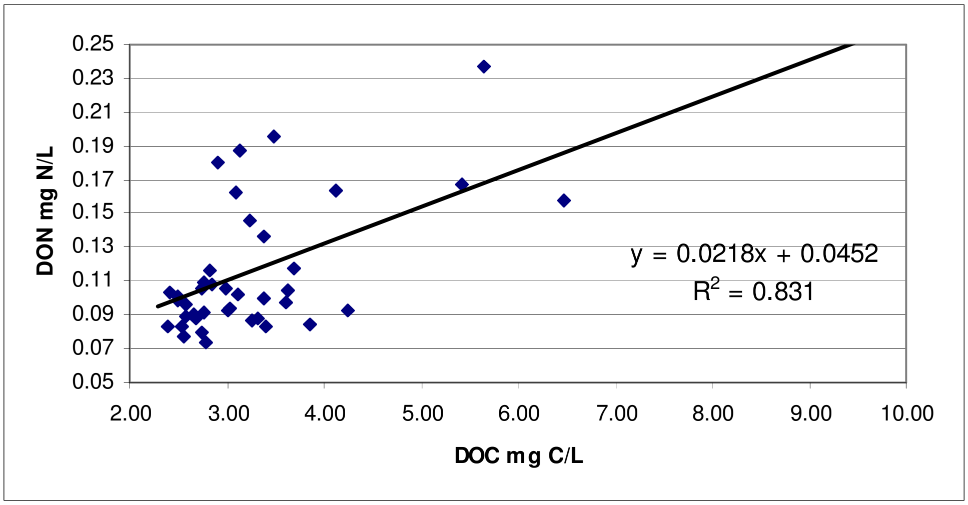

Figure 14: The relationship between DON and DOC for wimples collected from the Ossipee Lake tributary sites during the summer of 2003.

3.1.11 Sodium and Chloride

Sodium and chloride are present in nature, but higher levels can be indicative of road salt application and elevated chloride may indicate domestic sewage contamination. Natural levels can vary depending on geology For example, in the seacoast, sodium and chloride are quite high due to marine clays and sediments in the landscape. Sodium and chloride are typically related to each other. Sodium and chloride were related to each other in the Ossipee Lake tributary sites (Figure 15).

Mean sodium concentration ranged from 3.86 mg Na/L at site OL-7 to 14.75 mg Na/L at OL-13 (Figure 16). Mean chloride concentration ranged from 4.72 mg Cl/L at OL-7 and 25.13 mg Cl/L at OL-13 (Figure 17). All sites except for OL-13 were lower than 13 mg CL/L.

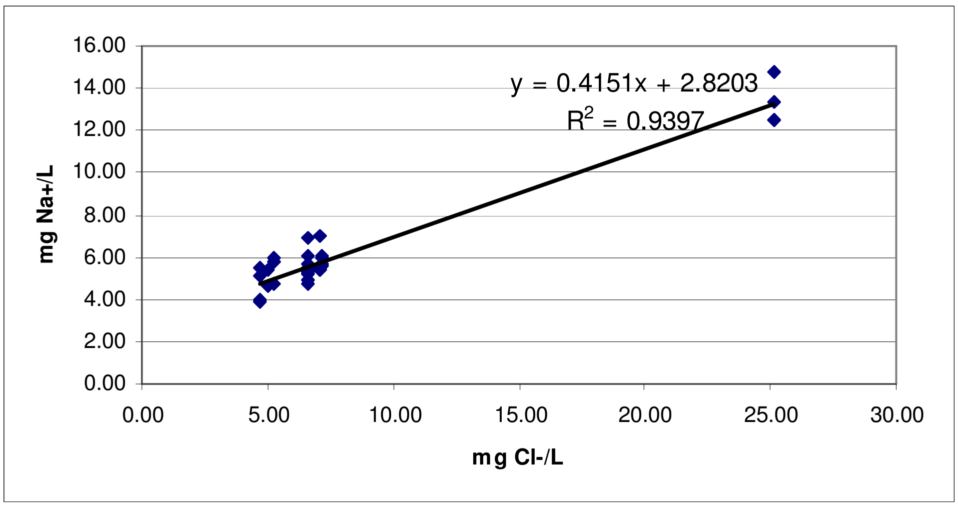

Figure 15: The relationship between sodium (Na^+) and chloride (Cl^-) concentrations among the Ossipee Lake tributary sampling sites during summer 2003.

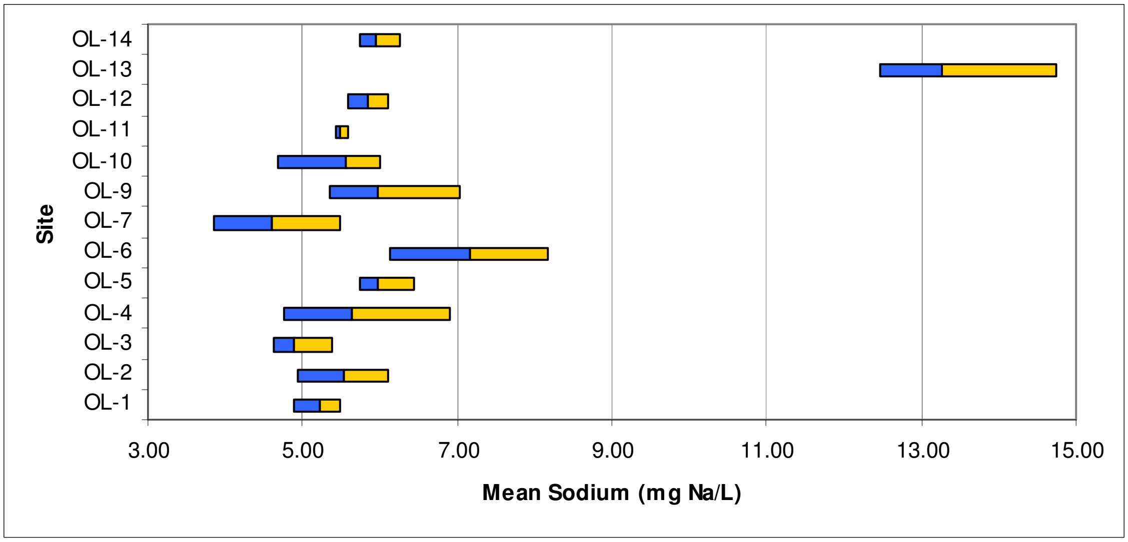

Figure 16: 2003 Ossipee Lake tributary site sodium comparison. Bars show range of sodium concentrations. Darker bars shows range less than the mean, lighter bars shows range greater than the mean. Mean value is at point where dark and light bars meet.

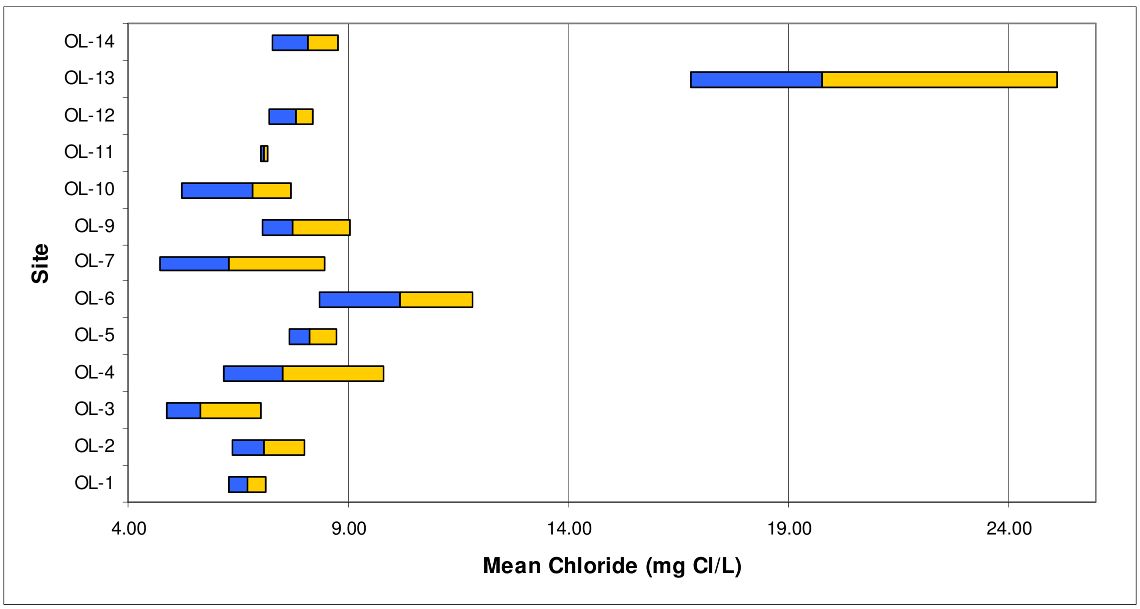

Figure 17: 2003 Ossipee Lake tributary site chloride comparison. Bars show range of chloride concentrations. Darker bars shows range less than the mean. Lighter bars shows range greater than the mean. Mean value is at point where dark and light bars meet.

3.1.12 Sulfate

Sulfate occurs naturally from weathering. Historically, acid rain resulted in elevated sulfate levels, but acid rain is not as problematic today. Sulfate concentrations ranged from 0.02 mg S/L at OL-7 and 1.11 mg S/L at OL-10 (Figure 18).

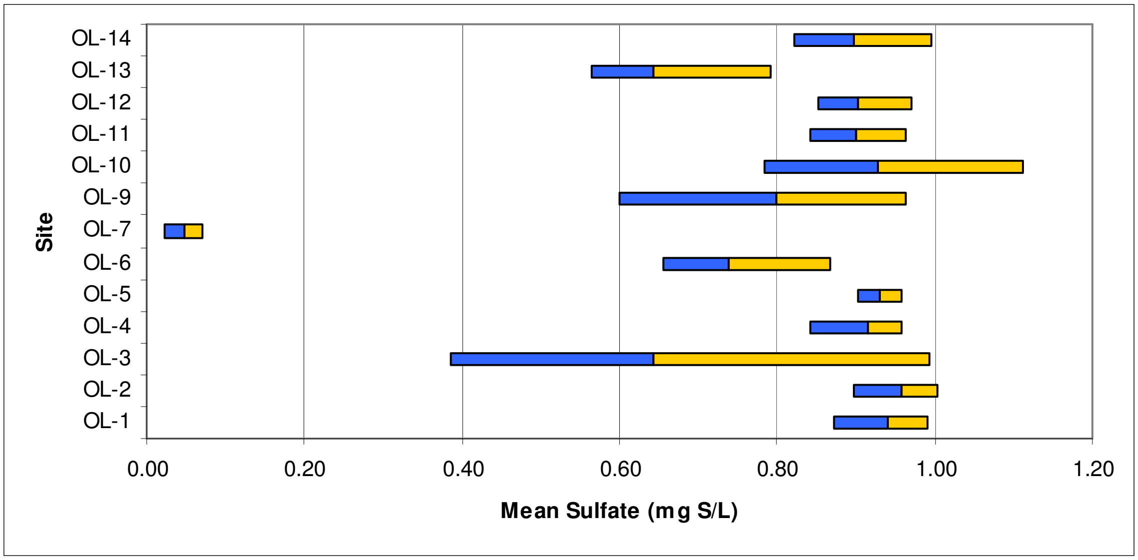

Figure 17: Ossipee Lake tributary site sulfate comparison. Bars show range of sulfate concentrations. Darker bars shows range less than the mean, lighter bars shows range greater than the mean. Mean value is at point where dark and light bars meet.

3.1.13 Silica

Silica is naturally produced during the weathering processes and is important for diatom growth and productivity. Silica can be used as a ground water tracer since groundwater has higher concentrations of SiO_2 than rain and run off. In the Ossipee Lake tributary sites, silica concentrations ranged from zero at OL-7 to 6.53 mg/L at OL-13 (Figure 19). All sites except for OL-7 had silca concentration of greater than 1.05 mg/L. Two sites had higher mean silica concentrations: OL-6 (4.28 mg/L) and OL-13 (5.79 mg/L). These sites could experience more groundwater recharge than other sites.

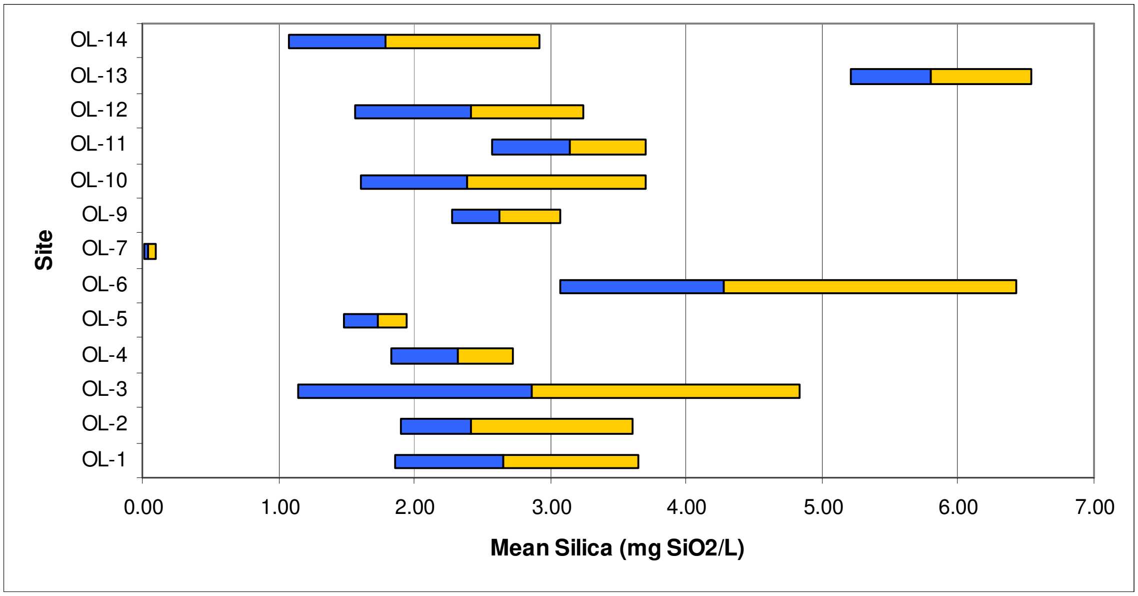

Figure 19: 2003 Ossipee Lake tributary site silica comparison. Bars show range of silica concentrations. Darker bars shows range less than the mean, lighter bars shows range greater than the mean. Mean value is at point where dark and light bars meet.

3.1.14 Potassium

Potassium occurs naturally from weathering and can be an important plant nutrient. Potassium concentrations ranged from 0.44 mg/L at several sites to 0.87 mg/L at OL-7 (Figure 20). Potassium concentrations in the Ossipee Lake tributary sites were slightly higher than concentrations were higher than concentrations historically found in the control watershed in the HBEF, which ranged from approximately 0.05 to 0.2 mg/L.

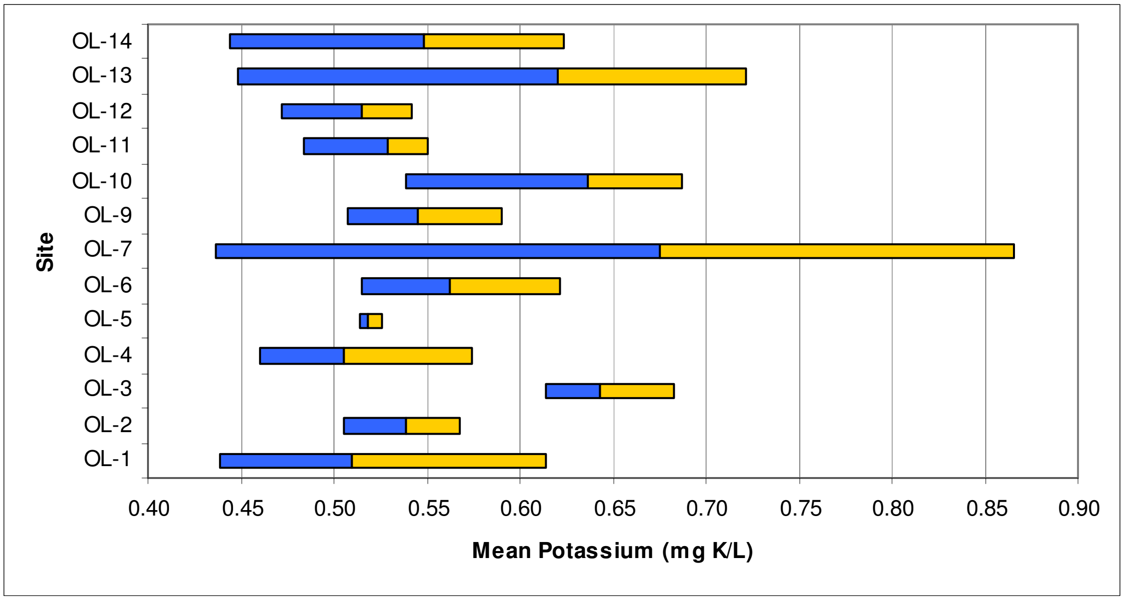

Figure 20: 2003 Ossipee Lake tributary site potassium comparison. Bars show range of potassium concentrations. Darker bars shows range less than the mean, lighter bars shows range greater than the mean. Mean value is at point where dark and light bars meet.

3.1.15 Calcium and Magnesium

Calcium and magnesium result primarily from the weathering of rocks and are used to determine water "hardness". In the Ossipee Lake tributary sites, calcium concentration ranges from 2.27 mg/L at OL-7 to 8.46 mg/L at OL-3 (Figure 21) and magnesium concentrations ranged from 0.37 mg/L at several sites to 0.97 mg/L at OL-3 (Figure 22). However, these higher values do not indicate that the Ossipee Lake tributary water would be classified as "hard".

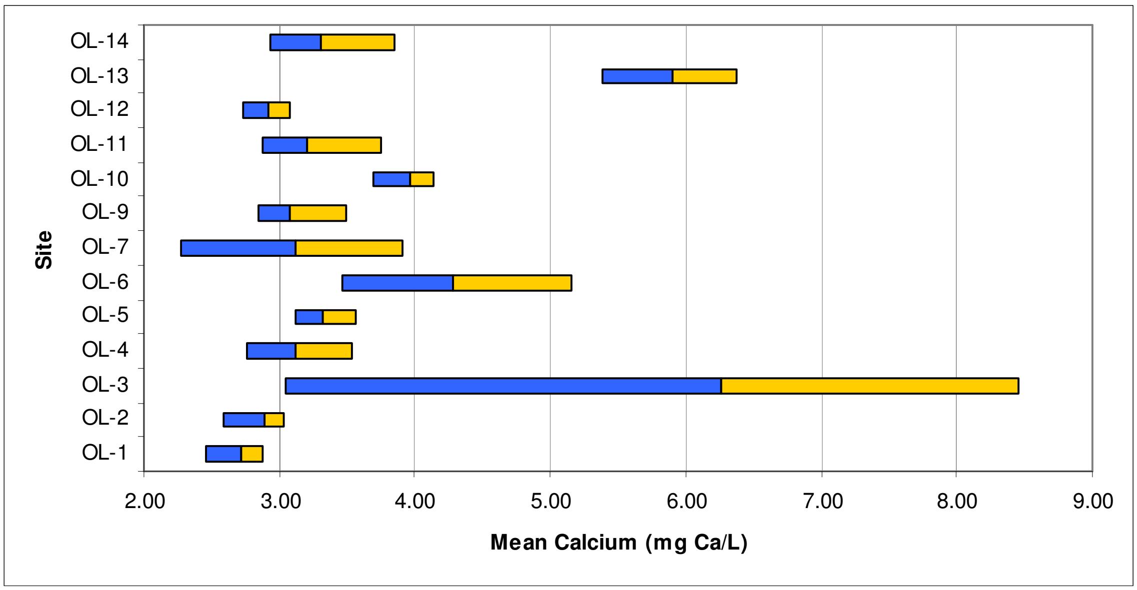

Figure 21: 2003 Ossipee Lake tributary site calcium comparison. Bars show range of calcium concentrations. Darker bars shows range less than the mean, lighter bars shows range greater than the mean. Mean value is at point where dark and light bars meet.

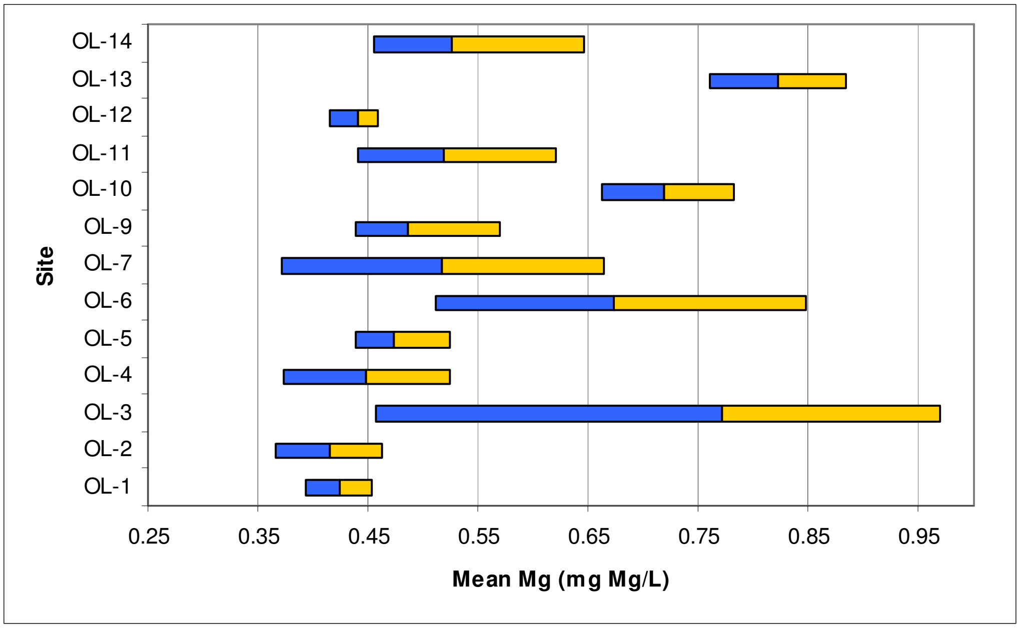

Figure 22: Ossipee Lake tributary site magnesium comparison. Bars show range of magnesium concentrations. Darker bars shows range less than the mean, lighter bars shows range greater than the mean. Mean value is at point where dark and light bars meet.

3.1.17 Relative Site Summaries

OL-1 West Branch River

With low turbidity and nutrients and high dissolved oxygen and pH, this site exhibits good water quality.

OL-2 Bearcamp River

DIN dominated TDN, indicating that this site may be impaired. DIN does not dominate at site GT-2 (upstream in the Bearcamp River) in the RIVERS program, suggesting the disturbance may be between these two sites.

OL-3 Patch Pond Point River

OL-3 experiences high levels of magnesium, calcium, potassium and silica. High silica levels suggest that this site may be ground water fed.

OL-4 Lovell River

With low turbidity and nutrients and high dissolved oxygen and pH, this site exhibits good water quality.

OL-5 Weetamoe Brook

With low turbidity and nutrients and high dissolved oxygen and pH, this site exhibits good water quality.

OL-6 Pine River
While this site has low turbidity levels and high dissolved oxygen concentrations, sodium and chloride are high, indicating a potential disturbance. This, along with the higher levels of Ca and Mg were not seen at the RIVERS program site GE-1, upstream on the Pine River. However, both Pine River sites experienced high silica levels indicating the stream is ground water fed. Indeed, the Pine River is located over a part of the aquifer that is very close to the surface.

OL-7 Red Brook
OL-7 exhibits many traits of a wetland system: low dissolved oxygen and high nitrogen and phosphorus. Indeed, this site drains a large shrub-dominated wetland. The low temperatures in Red Brook could suggest ground water inflow.

OL-9 Cold Brook
This site exhibited high levels of both total phosphorus and phosphate.

OL-10 Huckins Pond Outflow
With the elevated levels of phosphorus and DOC, it appears that this stream flows through a wetland. The high levels of phosphorus, calcium and magnesium could explain why Danforth Pond has high chlorophyll and ANC levels.

OL-11 Danforth Brook
With low turbidity and nutrients and high dissolved oxygen and pH, this site exhibits good water quality.

OL-12 Phillips Brook
The higher temperatures seen at this site could be due to the minimal shade and flow. A new infestation of variable milfoil was found at this site in 2003.

OL-13 Leavitt Brook
OL-13 exhibited high levels of magnesium, calcium, potassium, and silica. A high pH was also observed. The high pH could be due to the high levels of base cations such as Mg, Ca and K. High silica could indicate that this stream is ground water fed.

OL-14 Square Brook
With low turbidity and nutrients and high dissolved oxygen and pH, this site exhibits good water quality.

3.2 WQM—Deep Water Testing

All Deep Water testing data are displayed in Appendix E. NH DES will provide a complete analysis of all Deep Water data. At the time of writing, this report has not yet been completed. Please contact GMCG or NH DES for more information.

3.2.1 Temperature

Deep Lakes stratify into three distinct thermal zones during the summer months: a warm upper layer (epilimnion) that overlays a deep and cold layer (hypolimnion). These two layers are separated by a layer of rapidly decreasing temperatures (metalimnion), the thermocline, that forms a barrier to mixing during the summer months.

Temperature readings were gathered only during the first sampling period: June 19. Temperature values ranged from 6.8˚C at the bottom of Broad Bay to 21.4˚C at the surface of Danforth Pond. After spring turnover, warmest temperatures in a lake body are found at the surface and coolest temperatures are at the bottom. All five water bodies of Ossipee Lake display this trend (Figure 23).

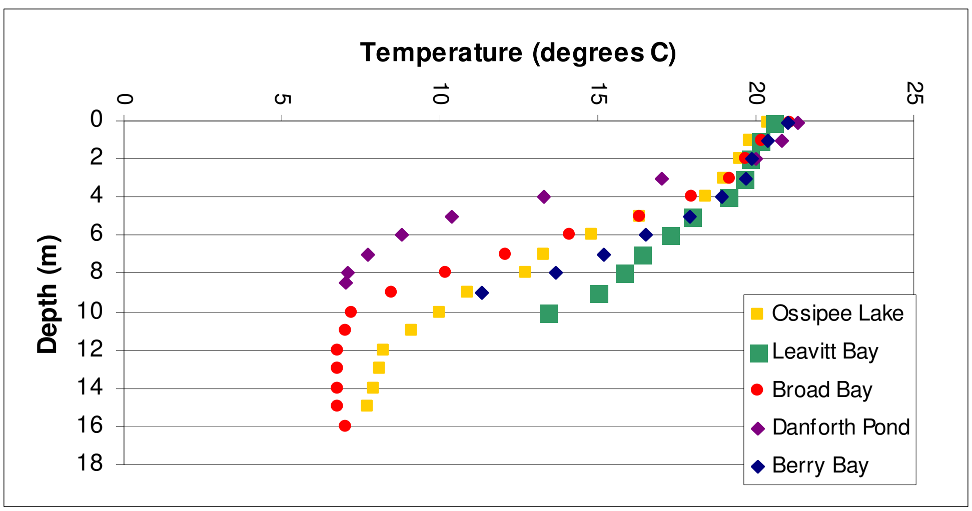

Figure 23: Temperature at different depths and water bodies of Ossipee Lake, 2003.

3.2.2 Dissolved Oxygen

Factors that influence dissolved oxygen in lakes are similar to those in tributary streams (Section 3.1.3). Water near the surface generally circulates freely due to wind-induced mixing, and, thus oxygen concentrations are normally near saturation. Phytoplankton also produces oxygen during and can drive the oxygen concentrations higher. In an unproductive lake (minimal organic matter) the rapidly decreasing temperatures in the thermocline correspond to increasing oxygen concentrations (cold water has a greater capacity to hold oxygen). Some lakes also support mid-lake algal populations that produce oxygen and further elevate the dissolved oxygen levels. Bottom water oxygen concentrations remain high in oligotrophic lakes since there is limited organic matter and respiration rates are low near the lake bottom. Alternatively, highly nutrient enriched lakes are characterized by significant accumulations of organic matter near the lake bottom and depleted oxygen concentrations.

Dissolved oxygen ranged from 1.28 mg/L at the bottom to Danforth Pond and 14.25 mg/L at the bottom of Broad Bay (Figure 24). Most values were above 8 mg/L except for Danforth Pond. The oxygen concentration on Danforth Pond was considerably lower than at its surface. This could be explained by eutrophication at depth in the pond. Danforth Pond is a shallow pond (40 feet). Thus, it could be possible that sunlight can penetrate through the lake and allow plankton to survive and consume oxygen. Danforth Pond is meso/eutrophic while Broad Bay is most likely oligo/mesotrophic. The bottom of both of these bays is likely out of the photic zone.

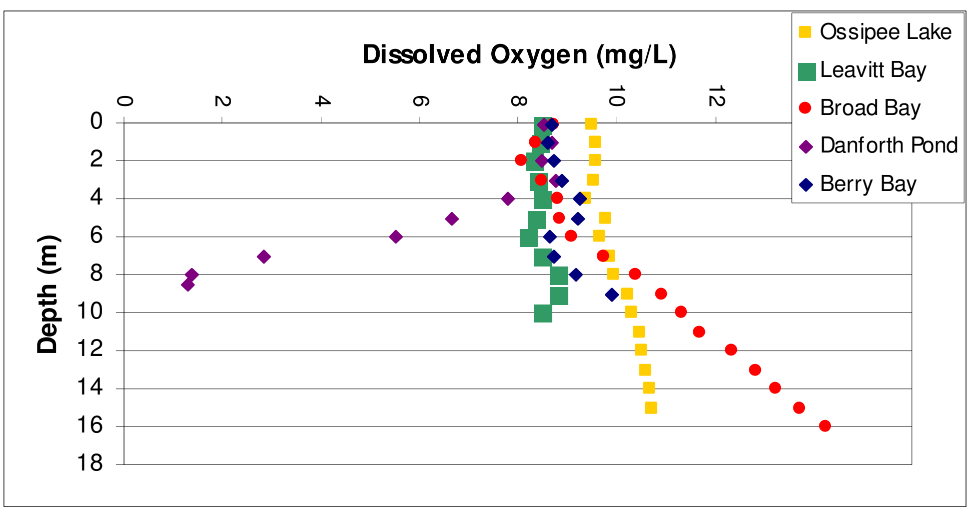

Figure 24: Dissolved Oxygen concentrations at different depths on Ossipee Lake, June 19, 2003.

3.2.3 Turbidity

Turbidity in a lake body is described similarly to turbidity in streams (Section 3.1.4). Turbidity in lakes is caused by suspended matter such as clay, silt and algae. Often, high turbidity readings can be attributed to construction. The mean turbidity for New Hampshire lakes is 1.0 NTU. A reading of 10 NTU over the lake's background turbidity reading is considered a water quality violation (VLAP Chemical Parameter Explanations Sheet). Lake turbidity is normally low in New Hampshire with the exception of highly nutrient enriched lakes or lakes that receive significant discharges of water. Higher turbidity in Danforth Bay suggests more algal growth (see chlorophyll data, Section 3.2.7) or high amounts of inorganic debris.

Mean turbidity was less than 1.00 NTU at all deep water testing locations except for Danforth Pond which ranged from 3.05 to 5.48 NTU (Figure 25).

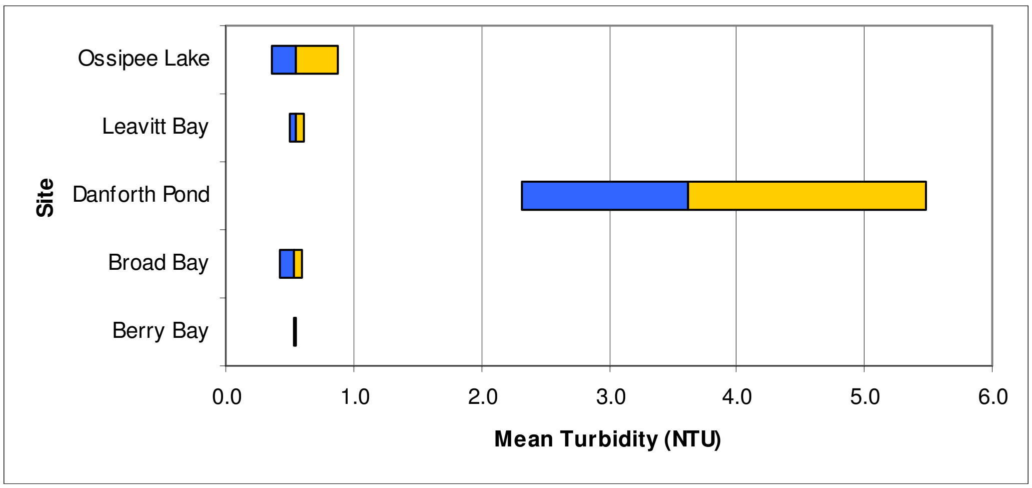

Figure 25: Ossipee Lake deep water turbidity inter site comparison. Bars show range of turbidity. Darker bars shows range less than the mean, lighter bars shows range greater than the mean. Mean value is at point where dark and light bars meet.

3.2.4 pH

Refer to Section 3.1.7 for information on pH. The pH in lakes is critical to fish survival and reproduction. According to NHDES (VLAP Chemical Parameter Explanations Sheet), a lake with a pH of less than 5 is considered acidified while a lake with a pH range of 6.1 to 8.0 is satisfactory.

Mean pH ranged from 6.28 in Broad Bay to 6.63 in Berry Bay (Figure 26). pH will be variable and is possibly associated with differences in the mineral content among lakes. Natural carbon dioxide output can also alter the pH. The epilimnion exhibited the highest pH, while the hypolimnion showed the lowest. Hypolimnetic pH is commonly lower in New Hampshire lakes and is associated with an accumulation of carbon dioxide, which, when dissolved in a aqueous medium, is in equilibrium with carbonic acid.

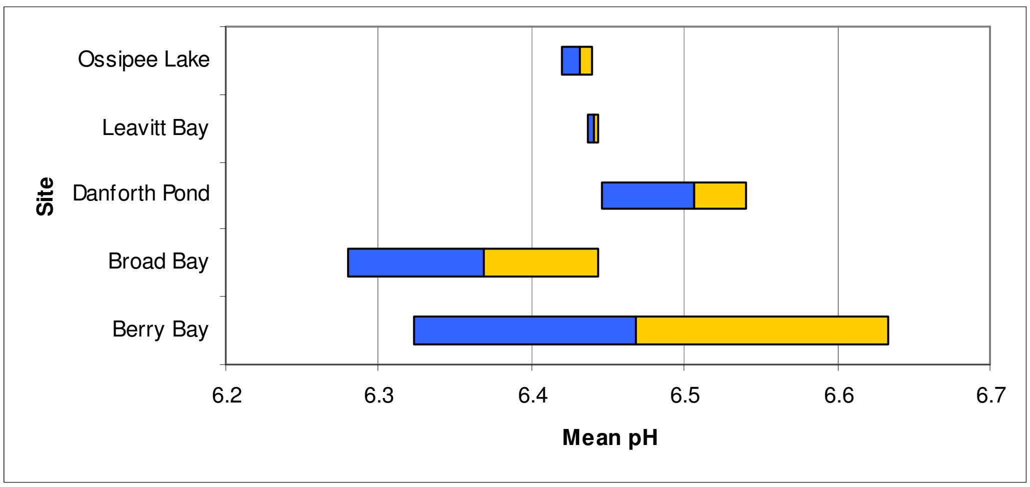

Figure XX: Ossipee Lake deep water pH inter site comparison. Bars show range of pH. Darker bars shows range less than the mean, lighter bars shows range greater than the mean. Mean value is at point where dark and light bars meet.

3.2.5 Acid Neutralizing Capacity (ANC)

ANC describes the ability of a body of water to resist the change in pH by neutralizing any acid inputs. ANC is a result of soil and bedrock type and natural mineral weathering. Anthropogenic activities (such as fertilizer applications) can also impact ANC. NH typical exhibits low ANC because the bedrock in the state is dominated by granite. With a low ANC and little ability for lakes to neutralize acid input, NH waterways are particularly threatened by acid deposition. According to NHDES (VLAP chemical Parameter Explanations Sheet), an ANC that is greater than 20 mg/L $CaCO_3$ is not sensitive to acid input while an ANC value of less than 10 mg/L $CaCO_3$ is considered highly sensitive.

At Ossipee Lake deep water testing sites, ANC ranged from 3.40 to 5.70 mg/L $CaCO^3$ at all sites except for Danforth Pond where the mean ANC value was 8.63 mg/L $CaCO^3$ (Figure 26).

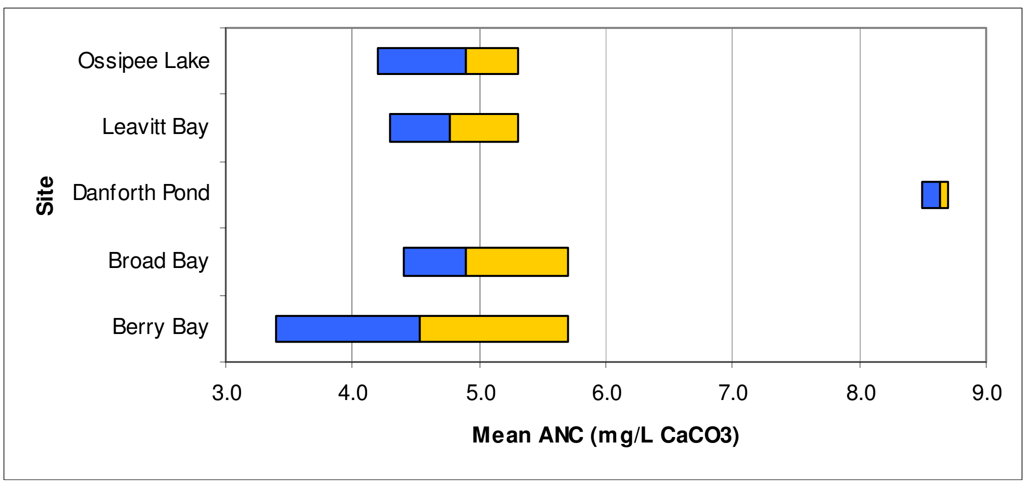

Figure 26: Ossipee Lake deep water ANC inter site comparison. Bars show range of ANC. Darker bars shows range less than the mean, lighter bars shows range greater than the mean. Mean value is at point where dark and light bars meet.

3.2.6 Total Phosphorus

For information on total phosphorus, refer to Section 3.1.5. Septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands are typical factors that cause elevated phosphorus in lakes (NHDES VLAP Chemical Parameter Explanations Sheet)

Mean total phosphorus at Ossipee Lake deep water sites ranged from 5.00 to 8.33 µg/L at all sites except for Danforth Pond where the concentration was much higher: 12.67 to 18.67 µg/L (Figure 28). With higher phosphorus levels, there will be more abundant algal growth. Algal growth, as represented by chlorophyll levels, will also manifest itself in higher turbidity levels.

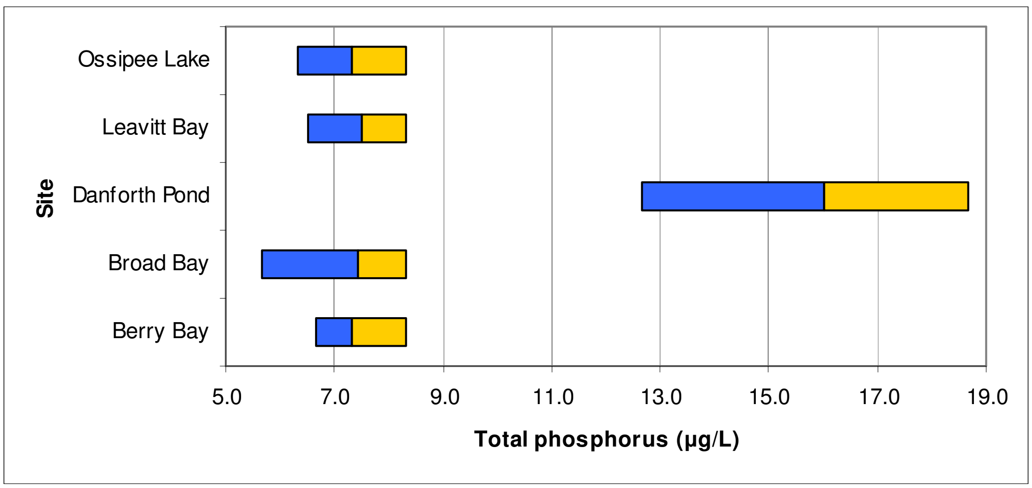

Figure 28: Ossipee Lake deep water total phosphorus inter site comparison. Bars show range of total phosphorus concentrations. Darker bars shows range less than the mean, lighter bars shows range greater than the mean.

3.2.7 Water Clarity (Secchi Disk Transparency)

Water clarity was measured using a secchi disk. Water clarity can be affected by algae, color and suspended particles in a lake. According to NHDES (VLAP Biological Parameter Explanation Sheet), a secchi disk reading that ranges from 2 to 4.5 meters is considered good while a reading less than 2 meters is poor and greater than 4.5 meters is exceptional. Secchi disk data in shallow lakes should be interpreted with caution as often the secchi disk can be visible at the bottom of the lake. This, however, was not the case with Danforth Pond, a shallow water body.

Secchi disk readings ranged from 1.85 meters on Danforth Pond and 6.20 meters on Leavitt Bay (Figure 29). Most readings fell within a "good" category.

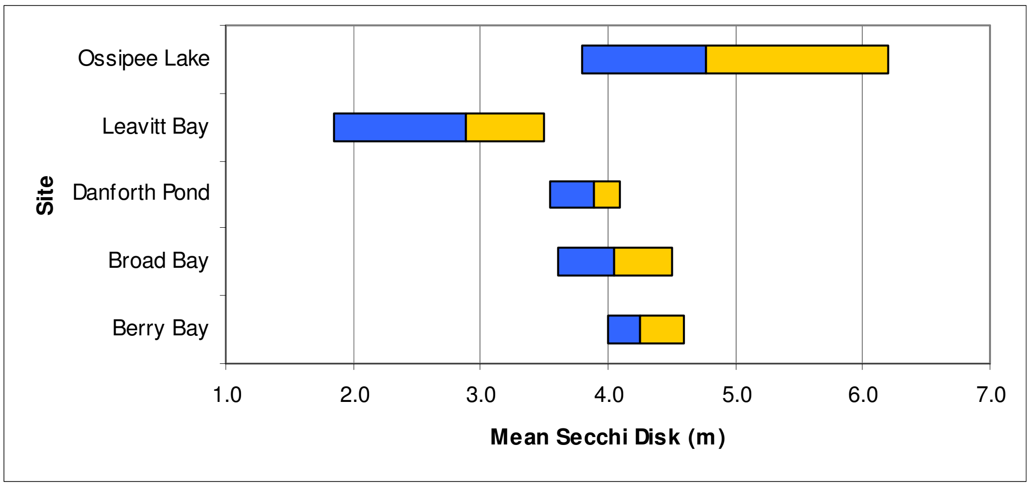

Figure 29: Ossipee Lake deep water sites secchi disk inter site comparison. Bars show range of secchi disk readings. Darker bars shows range less than the mean, lighter bars shows range greater than the mean. Mean value is at point where dark and light bars meet.

3.2.8 Conductivity

Conductivity measures the ability of water to carry an electrical current and is determined by the number of ionic particles present. NH lakes typically experience low conductivities due to “soft” water. Road salting, poor septic systems and urban and agricultural runoff are known causes of high turbidity. Variations in watershed geology cause natural differences in conductivity readings in different areas. However, in NH lakes, a conductivity reading that is greater than 100 umhos/com commonly indicates anthropomorphic pollution. (NH DES VLAP Chemical Parameter Explanations Sheet)

Conductivity at Ossipee Lake deep water sampling locations ranged from 43.07 µS/cm in Ossipee Lake to 54.22 µS/cm in Berry Bay (Figure 30).

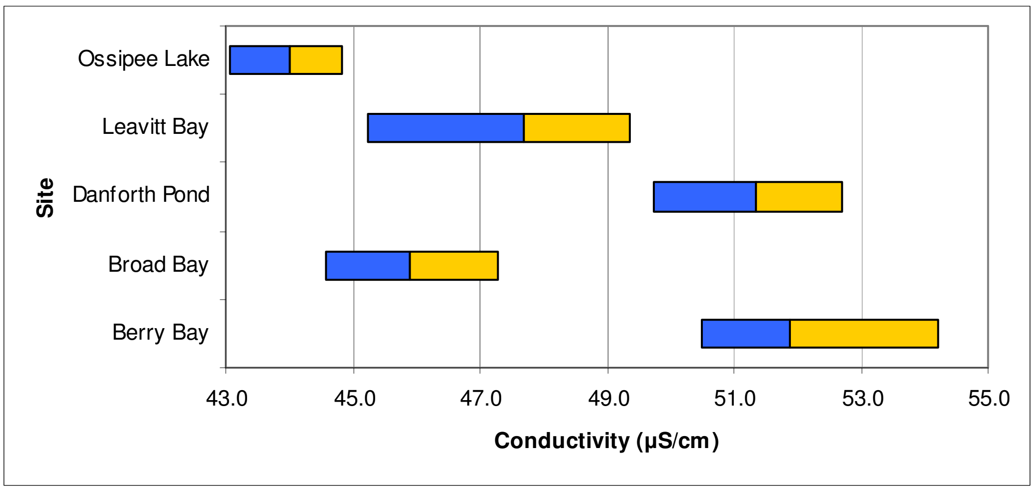

Figure 30: Ossipee Lake deep water conductivity inter site comparison. Bars show range of conductivity. Darker bars shows range less than the mean, lighter bars shows range greater than the mean. Mean value is at point where dark and light bars meet.

3.2.9 Chlorophyll

Chlorophyll is an indicator of algae abundance. The concentration of chlorophyll can provide an estimate of algae concentration. (NH DES VLAP Biological Parameter Explanations Sheet)

On Ossipee Lake, chlorophyll concentrations ranged from 1.26 mg/L on Broad Bay to 8.39 mg/L on Danforth Pond (Figure 31). Danforth Bay also showed the highest range in chlorophyll concentrations. Danforth Pond seemed to have higher production due to its higher chlorophyll levels. These high chlorophyll levels could be a result of elevated total phosphorus levels.

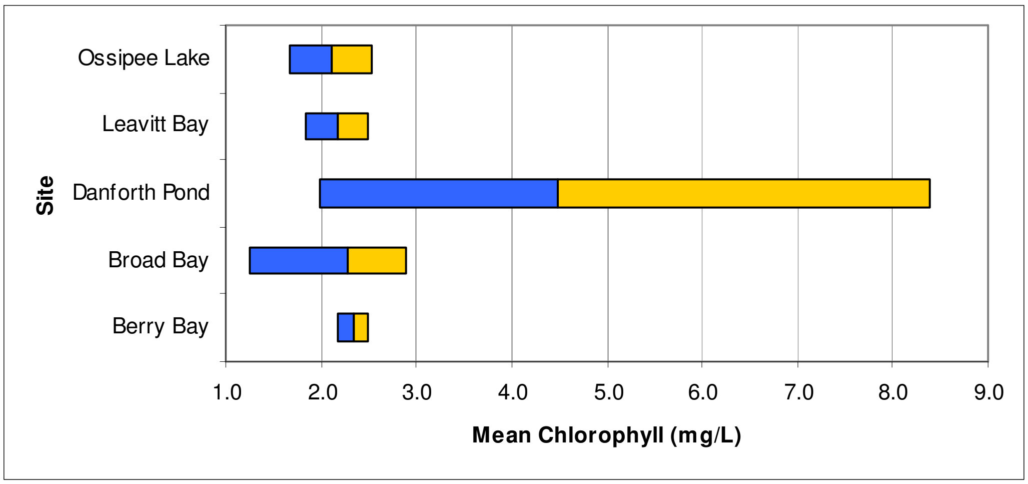

Figure 31: Ossipee Lake deep water chlorophyll inter site comparison. Bars show range of chlorophyll. Darker bars shows range less than the mean, lighter bars shows range greater than the mean. Mean value is at point where dark and light bars meet.

3.2.11 Phytoplankton

Results were not available at the time of writing. Please contact GMCG for this information.

3.3 LEAP

Eighty-four surveys were carried out during LEAP 2003 (Table 9). Broad Bay had the most number of surveys taken, while Berry Bay had the weakest coverage.

A total of 5603 boats were counted during the 2003 LEAP surveys (Appendix E). A maximum of 337 boats were counted during one survey at Long Sands on July 4 and on some surveys, no boats were counted at all. Fifty-five percent of the mean boats counted were at Long Sands, while only 26% were at Broad Bay, 12 % at Spindle Point and 7% in Berry Bay (Figure 32). However, when looking at the distribution of the total boat count, Spindle Point comprised only 1% of the total boat count.

Fourth of July weekend was the busiest day during the LEAP 2003 survey. Sixty-four percent of the boats counted occurred during this weekend (Figure XX). The highest number of surveys (26) and the highest number of boats (337, Long Sands) were recorded on July 4 (Table XX). Therefore, Long Sands experience the highest number of boat traffic during the LEAP 2003 surveys (Figure 33).

Table 9: Number of surveys taken at each date and location during LEAP 2003.

Date	Berry Bay	Broad Bay	Long Sands	Spindle Point	Total
4-Jul	4	14	2	6	26
5-Jul	5	7	8	4	24
6-Jul	2	7	4	4	17
12-Jul	0	0	3	0	3
13-Jul	0	0	1	0	1
19-Jul	0	3	2	5	10
20-Jul	0	0	2	0	2
13-Aug	0	1	0	6	7
Total	11	32	22	25	90

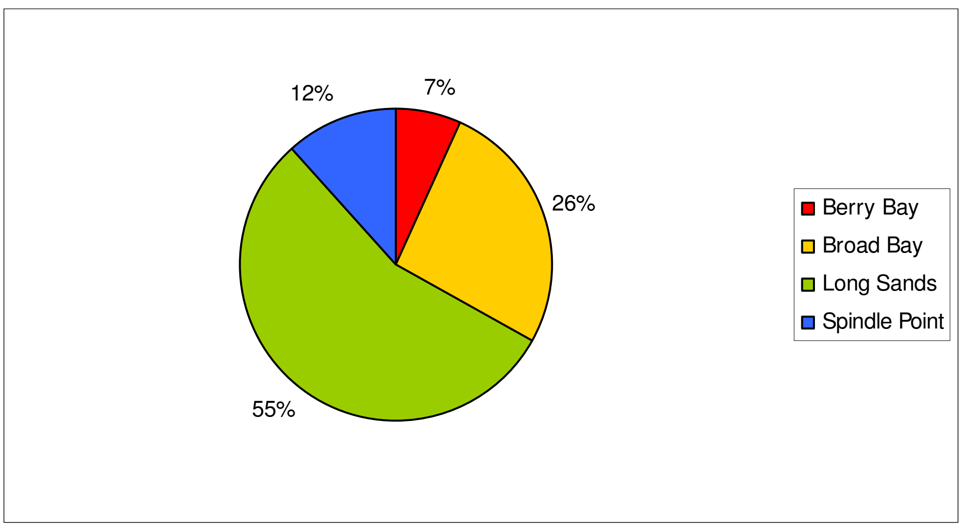

Figure 32: Mean boat distribution on Ossipee Lake, 2003.

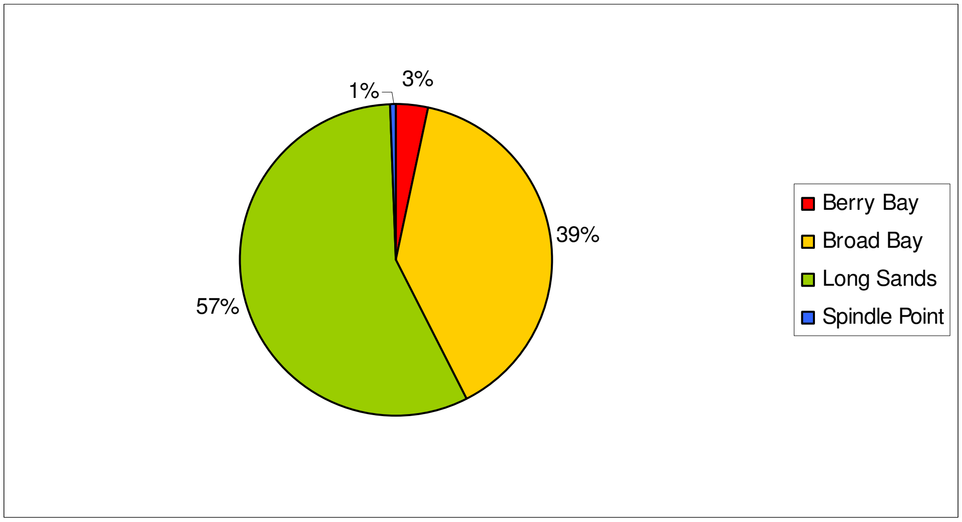

Figure 33: Total boat distribution on Ossipee Lake, 2003.

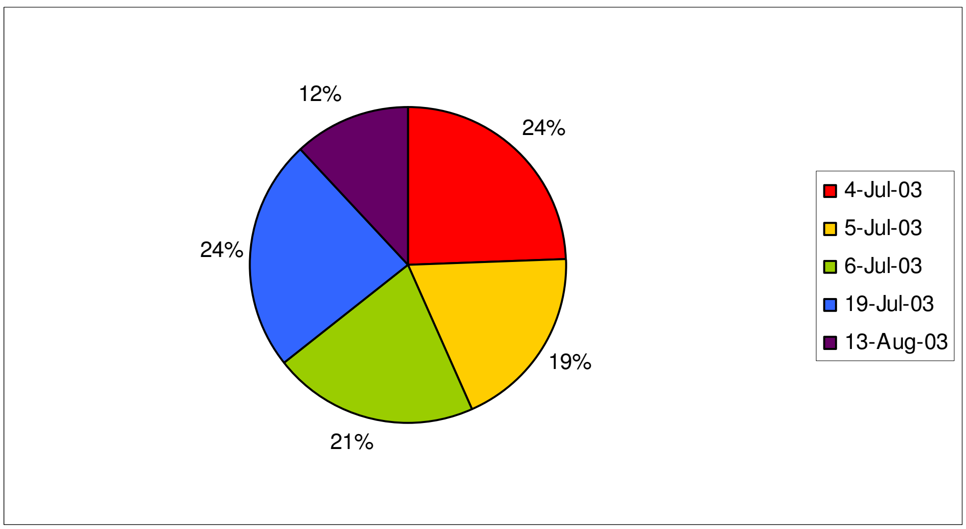

Figure 34: Mean distribution of boats over the course of the five schedule sampling days, LEAP 2003.

Mean boat counts were evenly distributed on all schedule survey days except for August 13 (Figure 34). July 4, 5, 6, and 19 were holidays or weekends. August 13 fell on a Wednesday. Thus, it appears that Ossipee Lake experiences a lower flow of traffic during midweek. However, the most consistent sampling occurred during the July survey dates; surveys were fewer and sparser in August. In fact, Berry Bay was only represented by LEAP survey on July 4, 5, and 6.

Type of boat is dominated by boats with inboard/outboard motors and pontoon boats at Berry Bay, Broad Bay, and Spindle Point (Figure 25). However, at Long Sands, pontoon boats largely dominated the boat type distribution (Figure 36). Long Sands has a reputation as a place to raft and recreate, it is expected that the majority of boats are pontoon boats. Figure 37 shows Longs Sands on July 4 at 12:00 pm when 337 boats were counted there.

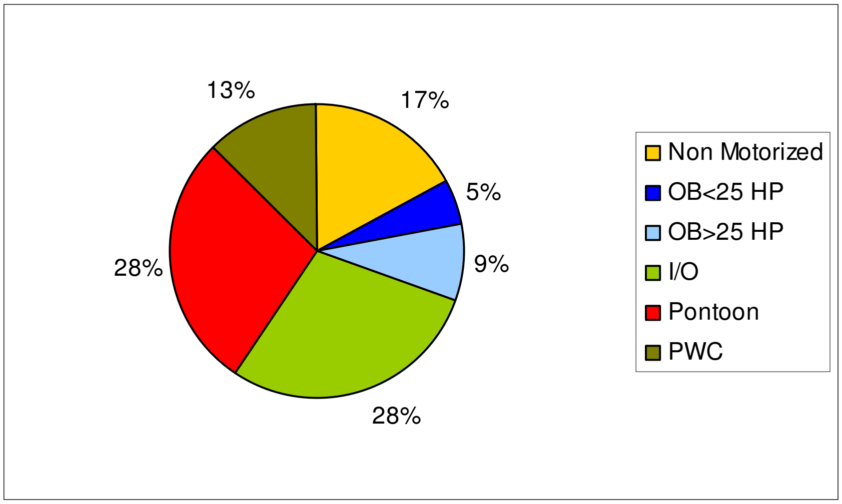

Figure 35: Boat type distribution on Ossipee Lake, LEAP 2003. OB indicated outboard motors, I/O indicates inboard/outboard motors.

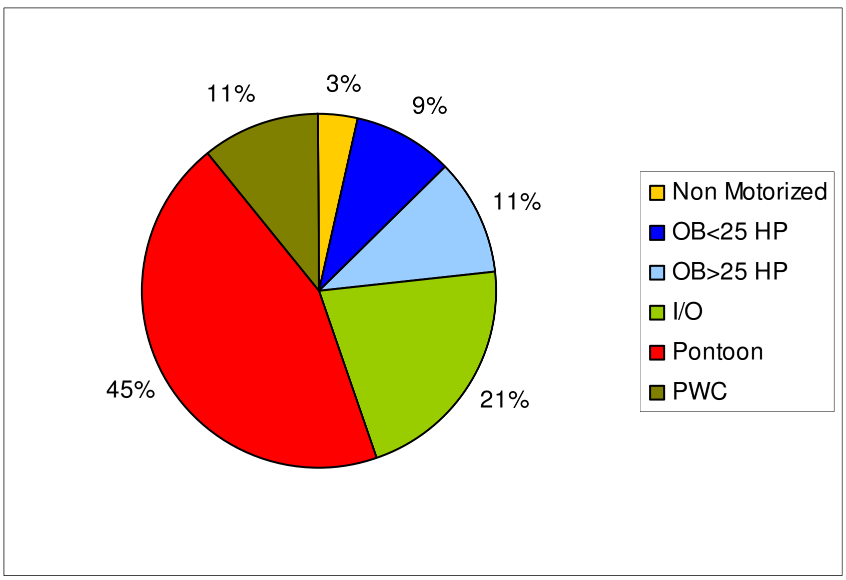

Figure 36: Boat type distribution at Long Sands, LEAP 2003. OB indicated outboard motors, I/O indicates inboard/outboard motors.

Figure 37: Boat type distribution at Long Sands, LEAP 2003.

4. Recommendations

- Continue the Ossipee Lake Protection Program to create a long-term monitoring program.
- Consider participating in a streamside assessment at each tributary site.
- Consider calculating or measuring acid neutralizing capacity at tributary.
- Next year, considering comparing more of the data with GMCG's RIVERS program data.

5. Works Cited

Green Mountain Conservation Group and Ossipee Lake Alliance. 2003 *Ossipee Lake and Tributaries Water Quality Monitoring Program QAPP.*

New Hampshire Department of Environmental Services. "VLAP Biological Parameters Explanation Sheet."

New Hampshire Department of Environmental Services. "VLAP Chemical Parameters Explanation Sheet."

New Hampshire Office of State Planning, Society for the Protection of New Hampshire Forests and The Nature Conservancy. *New Hampshire's Changing Landscape.*

Field Data Sheet

PART I – SITE AND SAMPLER IDENTIFICATION

Site Code Number______________________________ Sample Collection Date______________________________

Site Location_________________________________ Sample Collection Time Begin/Finish________________________

Field Samplers Names____

Signature of Sampler____

PART II – WEATHER CONDITIONS
Current Weather: □ Clear □ Partly Cloudy □ Mostly Cloudy □Fog □Haze □Sunny □Drizzle □Steady Rain □Downpour □Snow
(*check all that apply*)

Rainfall in previous 24 hours: □None □Light □Heavy _______inches

Source of rainfall information: _________________________________ (*i.e. rain gauge, regional weather report, etc.*)

PART III – SITE OBSERVATIONS (*check all that apply*)
Water Appearance: □Clear □Milky □Turbid □Foamy □Oily □Light/Dark Brown □Greenish □Other (*explain*)________________________

Water Odor: □None □Fishy □Chlorine □Rotten Eggs □Other(*explain*)____

Wildlife Observations:____

Floatable Observations (*i.e. leaves, foam, or debris*):____

Bottom Observations (*i.e. color, bottom type, silt, rocky, algae, sand etc.*)____

Local Observations (erosion, flooding, road work, littering or other disturbances)____

PART IV – EQUIPMENT INFORMATION
pH Meter Used____________ Calibration Completed yes / no Time Completed_______ a.m. Volunteer Initials________

DO Meter Used____________ Calibration Completed yes / no Time Completed_______ a.m. Volunteer Initials________

Turbidity Meter Used___________ Calibration completed by water quality staff once every 3 months

PART V – FIELD MEASUREMENTS

Depth that measurements were taken_______________________inches (*Indicate the depth of the* ***probe*** *in the water when taking the measurement).*

	Temperature	Turbidity	pH	Dissolved Oxygen	
Reading #1	° C	NTU		mg/l	% sat.
Reading #2	° C	NTU		mg/l	% sat.
	HACH Thermometer Reading ° C				

Averages (to be computed by staff)	° C	NTU		mg/l	% sat.

PART VI – SAMPLE COLLECTIONS

Time Silica, DOC,TDN, NH4, PO4, cations, anions sample collected	a.m.	Time Total Phosphorus sample collected	a.m.

REPLICATE SAMPLE COLLECTED? YES NO

Time Silica, DOC,TDN, NH4, PO4, cations, anions **replicate sample** collected	a.m.	Time Total Phosphorus **replicate sample** collected	a.m.

Test Sites Codes / Locations

OL-1 Ossipee Brook River
OL-2 Bear Camp River
OL-3 Patch Pond Point River
OL-4 Lovell River
OL-5 Weetamoe Brook
OL-6 Pine River
OL-7 Red Brook
OL-8 Duck Pond
OL-9 Cold Brook
OL-10 Huckins Pond Outflow
OL-11 Danforth Brook
OL-12 Phillips Brook
OL-13 Leavitt Brook
OL-14 Square Brook

Additional Comments (*i.e. problems with sampling procedures, etc.*)

____

APPENDIX B: OPERATING INSTRUCTIONS FOR FIELD EQUIMPMENT

YSI 550A Dissolved Oxygen Meter Calibration

Step 1:
Turn on the DO meter ½ hour before you begin calibrating.

Step 2:
Press and release both the ↑ and ↓ keys to enter into calibration mode. The screen will display ***CAL*** and **%**.

Step 3:
Press the ***ENTER*** (↵) key.

Step 4:
The screen will prompt you to enter the altitude. The number **5** should be displayed. If necessary, you the ↑ and ↓ keys to select the number **5**. Then press the ***ENTER*** (↵) key.

Step 5:
A percent saturation value will appear on the screen. Wait for the reading to stabilize. It has stabilized when the number to the nearest tenth has stopped fluctuating. Press the ***ENTER*** (↵) key.

Step 6:
The screen will prompt you to enter a salinity value and should display **0.0**. If the value displayed is not **0.0** use the ↑ and ↓ keys to select the number **0.0**. Press the ***ENTER*** (↵) key. The meter will return to normal operation and is ready for use.

Step 7:
If you are not taking a measurement right away, return the probe to its storage chamber.

YSI 60 pH Meter Calibration

Step 1:
Turn the pH meter on ½ hour before you calibrate.

Step 2:
Rinse the probe with distilled water.

Step 3:
Pour 30 ml of pH 7 (YELLOW) buffer solution in the graduated cylinder.

Step 4:
Immerse probe in the cylinder.

Step 5:
Press and release both the ↑ and ↓ keys at the same time. The meter will display ***CAL*** and stand will flash on the bottom of the screen. The main display will read **7.00** (sometimes it may read **4.00**).

Step 6:
Press and release the ***ENTER*** key. STAND will stop flashing and the decimal point in the pH value will start flashing.

Step 7:
Watch the decimal point. When the decimal point has stopped flashing, the reading is stable.

Step 8:
Press and hold the ***ENTER*** key until the display reads ***SAVE***.

Step 9:
The screen will now prompt you to use a new pH buffer solution. The display will ready either **4.01** or **10.01** (+/- 0.01). You will see ***CAL*** and ***SLOPE*** flashing at the bottom of the screen.

Step 10:
Remove probe from solution and rinse well with distilled water. Pour the pH meter back into its container and rinse the cylinder well with distilled water.

Step 11:
Pour 30 ml of pH 4 (RED) buffer solution in graduated cylinder.

Step 12:
Immerse probe in the cylinder.

Step 13:
Press and release the ***ENTER*** key. ***SLOPE*** will stop flashing and a second decimal point in the pH value will start flashing.

Step 14:
Watch the decimal point. When the decimal point has stopped flashing, the reading is stable.

Step 15:
Press and hold the ***ENTER*** key until the display reads ***SAVE***.

Step 16:
If you are a Tuesday through Friday volunteer, skip to Step 17.If you are a Monday volunteer, repeat Steps 9-15 with the pH 10 (BLUE) buffer solution for a 3 point calibration. When you have completed the 3 point calibration, the meter will return to normal operation.

Step 17:
STOP. You have completed the calibration. Press and release the ***MODE*** key to return to normal operation.

HACH Thermometer Measurement

Step 1:
Place HACH Thermometer in the water when you arrive at your test site.

Step 2:
After finishing with the pH meter, remove the HACH thermometer from the water.

Step 3:
Being careful not to touch the bottom of the thermometer, read the temperature on the thermometer. Record the temperature value on the data sheet.

Step 4:
Return thermometer to the cooler.

YSI 60 pH Meter Measurement

Step 1:
Gently place the probe in the water. Be sure that both the pH (glass bulb at bottom of probe) and the temperature (black nub at top of probe) sensors are completely immersed. The pH meter does not need to be stirred.

Step 2:
Allow the reading to stabilize. It has stabilized with the number to the nearest tenth has stopped fluctuating. However, if the reading is changing in one continual direction (example: pH value is slowly increasing 0.01 every few seconds) wait until the value is fluctuating back and forth between several values (example: pH value changes from 6.56 to 6.57 and then back to 6.56 again).

Step 3:
Record the pH value and the temperature.

Step 4:
Remove the probe from the water.

Step 5:
Repeat Steps 1-4 for a second reading.

Step 6:
If there is more than a 0.20 pH unit difference between the two readings, please take a third reading by repeating Steps 1-4 again.

Step 7:
Return the probe to the storage chamber.

Water Sample Collection

Step 1:

Label each bottle as follows:

Site Number	
Date	
Time	*Initials*

Note: The time written on each bottle should be the same.

Step 2:

Remove caps from both bottles and rinse with stream water. Make sure you pour the rinse water out downstream of where you are gathering the sample.

Step 3:

With the mouth of the bottle facing upstream, fill each bottle **SIMULTANEOUSLY** to the shoulder (where the bottle starts getting narrower at the top) and cap. Return samples to the cooler.

HACH 2100P Turbidimeter Turbidity Meter Measurement

Step 1:
Turn the turbidity meter on by pressing the ***POWER*** key. The display should read **0.00 NTU** and say ***AUTO RNG*** and ***SIG AVG*** at the bottom. If ***AUTO RNG*** and ***SIG AVG*** do not appear, press the ***MODE*** until they both appear.

Step 2:
Take two glass vials out of the box and rinse with stream water. Make sure you pour the rinse water out downstream of where you are gathering the sample.

Step 3:
With the mouth of the vial facing upstream, fill each vial to the top and cap.

Step 4:
Set one vial aside.

Step 5:
Thoroughly dry the vial with the paper towel provided. Do not handle the glass after this point. Hold the vial by the cap.

Step 6:
Place one drop of silicon oil on the vial. Use the black cloth to rub the oil over the vial and polish the glass.

Step 7:
Open the lid of the turbidity meter. Place the vial inside so the white diamond (sometimes a triangle) lines up with the marker on the meter.

Step 8:
Close the lid and press the ***READ*** button. ***NTU, AUTO RNG*** and ***SIG AVG*** will flash while the meter is establishing an average of the readings.

Step 9:
When ***NTU*** has stopped flashing, the reading has stabilized. Record this value.

Step 10:
Repeat Steps 5-9 with the second vial.

Step 11:
If the two readings differ by more than 0.20 NTU, please take a third reading by repeating Steps 2-9.

Step 12:
Pour the water out. Return the vials to the box. Turn the off meter of by pressing the ***POWER*** button.

YSI 550A Dissolved Oxygen Meter Measurement

Step 1:
Place the probe in the water and stir continuously with an even, steady rhythm.

Step 2:
Press the ***MODE*** key to change the measurement to **mg/l**.

Step 3:
Wait for the reading to stabilize. It has stabilized with the number to the nearest tenth has stopped fluctuating. However, if the reading is changing in one continual direction (example: value is slowly increasing 0.01 mg/l every few seconds) wait until the value is fluctuating back and forth between several values (example: pH value changes from 7.89 to 7.90 mg/l and then back to 7.89 mg/l again).

Step 4:
Record this value, but DO NOT REMOVE THE PROBE FROM THE WATER YET!!!

Step 5:
Press the ***MODE*** twice to change the measurement unit to % saturation. Record this value.

Step 6:
Remove the probe from the water.

Step 7:
Repeat Steps 1-6.

Step 8:
If there is more than a 0.20 mg/l difference between the two mg/l readings, please take a third reading by repeating Steps 1-6 again.

Step 9:
Return the probe to its storage chamber.

Sample Processing Sheet

Step 1:
Pull samples out of coolers as soon as they arrive to let them dry off.

Step 2:
When all bottles have arrived in the office, check labels. Add GMCG codes to sample number.
Acidified samples: *Site #, Week#, A*
Example: GO-2 3A
Filtered samples: *Site #, Week#, A*
Example: GO-2 3B

Step 3:
To clear up some of the bottles, grab all "A" bottles (to be acidified). Put in the blue dish pan with the acid. Put dish gloves on. Bring dish pan to sink.

Step 4:
Remove all the caps from all the bottles. Make sure bottle are filled only to shoulder. If water level is higher, dump excess in sink.

Step 5:
Add 1 mL of acid (just below the bulb on the pipette) to each bottle. Recap bottles.

Step 6:
Put bottles on lower shelf in freezer. Return acid to storage.

Step 7:
Fill out chain of custody form. For examples of this form, look in total phosphorus file.

Step 8:
Label 60 mL bottles (one for each "B" sample) with tape and complete labels (Step 2).

Step 9:
Gather filtering equipment and bring to sink.

Step 10:
Begin running about 6 cups of water through coffee maker.

Step 11:
Place one filter using the forceps (no fingers!) on the part of the filter with the black ring. Reassemble the filter.

Step 12:
Add syringe to set up.

Step 13:
Add 20 mL (approximate) of sample to syringe and filter through.

Step 14:
Shake and empty water from bottle. Separate syringe.

Step 15:
Repeat Steps 13-14 two more times.

Step 16:
Add syringe and filter 60 mL of sample.

Step 17:
Make sure filtered sample water level is at the shoulder of the bottle.

Step 18:
Undo filter set up. Remove and dispose of filter. Dump out remaining sample in 250 mL bottle.

Step 19:
Repeat Steps 11-18 for each "B" sample.

Step 20:
When filtering is complete, rinse all components of filtering system including syringe and forceps, with hot water from coffee pot. Leave filtering system to dry on paper towels on microwave.

Step 21:
250 mL bottles (now empty) get saved for UNH to wash. 60 mL bottles get placed in upper level of freezer.

Appendix C: LEAP Data Sheets

Ossipee Lake Environment Assessment Program
Field Data Sheet - 2003 Sampling Season

General Information

Bay Name & Specific Location:	____________________
Program Coordinator:	____________________
Field Monitor(s):	____________________
Date & Time Block:	____________________
Camp Name or Association:	

Shoreline (Check All That Apply):

☐ Homes	☐ Sand Bar	☐ Beach	☐ Wooded & Houses	☐ Wooded, No Houses
☐ Camp	☐ Marina	☐ Posted Land	☐ Other	

Weather Conditions

Current Weather (Check All That Apply):

☐ Clear	☐ Partly Cloudy	☐ Mostly Cloudy	☐ Fog	☐ Haze
☐ Sunny	☐ Drizzle	☐ Steady Rain	☐ Downpour	☐ Snow

Air Temperature (Check One):

☐ Less Than 40	☐ 40-60 Cool	☐ 61-80 Warm	☐ 80+ Hot

Wind Conditions (Check One):

☐ Calm	☐ Breezy	☐ Strong	☐ Gusty

Water Surface (Check One):

☐ Calm	☐ Ripples	☐ Small Waves	☐ Moderate Waves	☐ White Caps

Boat Counts - Specify Area:

Non-Power Boats	**Active**	**Inactive or Docked**	**Total**
Canoes			
Kayaks			
Rowboats			
Sailboats			
Wind Surfer			
Other (Specify)			
Subtotal			
Power Boats/Other Craft	Active	Inactive or Docked	**Total**
Outboard Less Than 25 HP			
Outboard Greater Than 25 HP			
Inboard or Outdrive (I/O)			
Pontoon			
PWC (Jet Ski) 2 Person			
Sea Plane			
Marine Patrol Boat			
Subtotal			
Total Boats/Other Craft			

Activities – Specify Area:

Lake Activities (Check All That Apply):	**Shore Activities (Check All That Apply):**
☐ Fishing	☐ Picnicking
☐ Swimming	☐ Walking
☐ Snorkeling or Scuba	☐ Biking
☐ Power Boating	☐ Camping
☐ Non-Power Boating (All Types)	☐ Hiking
☐ Waterskiing	☐ Horseback Riding
☐ Seaplanes	☐ Sunbathing/Relaxing
☐ Marine Patrol Activities	☐ Other

Visual Observations: Specify Area

Check All That Apply	Describe What You See
☐ Littering	
☐ Drinking	
☐ Loud Music	
☐ Trespassing	
☐ Hazardous Boating	
☐ Other	

Rafting

Total Boats Rafting	# People In Boats	# People Outside Boats	Location

Check All That Apply	Comments
☐ Boats Anchored In Water	
☐ Boats Tied To Shore	
☐ Boats Pulled Up On Shore	
☐ Boats Tied Together	

Use Space Below For Any Other Comments

Name:___________________________________ Please Initial:__________

Please return sheets to: P.O. Box 173; Freedom, NH 03836 or call 539-1859 for instructions on delivering them to the LEAP project's office in Freedom.

Appendix D: OLPP Tributary Data

Site	Parameter	Late June	Early July	Late July	Early August	Minimum	Mean	Median	Maximum
OL-1	Calcium mg Ca/L	2.46	2.69	2.87	2.87	2.46	2.72	2.78	2.87
OL-1	Chloride mg Cl/L	6.30	6.84	7.13	6.62	6.30	6.72	6.73	7.13
OL-1	DOC mg C/L	2.75	2.99	2.76	2.74	2.74	2.81	2.75	2.99
OL-1	DON mg N/L	0.11	0.11	0.09	0.08	0.08	0.10	0.10	0.11
OL-1	Magnesium mg Mg/L	0.40	0.39	0.45	0.45	0.39	0.42	0.42	0.45
OL-1	NH4 ug N/L	15	4	5	8	4.46	8.08	6.45	14.95
OL-1	Nitrate mg N/L	0.022	0.010	0.004	0.007	0.00	0.01	0.01	0.02
OL-1	pH	6.18	6.01	6.43	6.59	6.01	6.30	6.31	6.59
OL-1	PO4 ug P/L	2	1	0	0	0.00	0.67	0.37	1.96
OL-1	Potassium mg K/L	0.44	0.54	0.61	0.45	0.44	0.51	0.49	0.61
OL-1	SiO2 mg SiO2/L	1.85	3.00	3.65	2.13	1.85	2.66	2.56	3.65
OL-1	Sodium mg Na/L	4.89	5.25	5.49	5.24	4.89	5.22	5.24	5.49
OL-1	Sulfate mg S/L	0.92	0.98	0.99	0.87	0.87	0.94	0.95	0.99
OL-1	TDN mg N/L	0.15	0.12	0.10	0.09	0.09	0.12	0.11	0.15
OL-1	Temp (˚C)	22.1	24.2	20.0	22.8	20.0	22.3	22.5	24.2
OL-1	TP (ppb)	11.0	6.6	5.5	5.7	5.5	7.2	6.2	11.0
OL-1	Turbidity (NTU)	0.43	0.57	0.82	0.64	0.43	0.62	0.61	0.82
OL-2	Calcium mg Ca/L	2.59	3.04	2.99	2.96	2.59	2.89	2.97	3.04
OL-2	Chloride mg Cl/L	6.35	8.00	7.36	6.60	6.35	7.08	6.98	8.00
OL-2	DO (mg/l)	8.25	7.73	8.03	8.02	7.73	8.01	8.03	8.25
OL-2	DOC mg C/L	2.83	2.79	2.54	2.90	2.54	2.76	2.81	2.90
OL-2	DON mg N/L	0.12	0.07	0.08	0.15	0.07	0.11	0.10	0.15
OL-2	Magnesium mg Mg/L	0.37	0.43	0.40	0.46	0.37	0.41	0.41	0.46
OL-2	NH4 ug N/L	7	7	10		6.92	7.90	6.97	9.79
OL-2	Nitrate mg N/L	0.028	0.035	0.015	0.024	0.02	0.03	0.03	0.04
OL-2	pH	6.68	6.44	6.36	6.50	6.36	6.50	6.47	6.68
OL-2	PO4 ug P/L	2	3	0	8	0.00	3.29	2.57	8.00
OL-2	Potassium mg K/L	0.54	0.57	0.51	0.55	0.51	0.54	0.54	0.57
OL-2	SiO2 mg SiO2/L	1.90	3.60	1.90	2.28	1.90	2.42	2.09	3.60
OL-2	Sodium mg Na/L	4.95	6.09	5.68	5.42	4.95	5.53	5.55	6.09
OL-2	Sulfate mg S/L	0.96	1.00	0.97	0.90	0.90	0.96	0.96	1.00
OL-2	TDN mg N/L	0.15	0.12	0.11	0.18	0.11	0.14	0.13	0.18
OL-2	Temp (˚C)	22.8	23.8	22.0	20.8	20.8	22.4	22.4	23.8
OL-2	TP (ppb)	4.6	8.5	5.3	12.8	4.6	7.8	6.9	12.8
OL-2	Turbidity (NTU)	0.46	0.60	0.76	0.52	0.46	0.59	0.56	0.76
OL-3	Calcium mg Ca/L	7.26	3.05		8.46	3.05	6.26	7.26	8.46
OL-3	Chloride mg Cl/L	4.88	7.01		5.02	4.88	5.64	5.02	7.01
OL-3	DO (mg/l)	8.08	7.60		4.90	4.90	6.86	7.60	8.08
OL-3	DOC mg C/L	5.64	3.70		4.93	3.70	4.75	4.93	5.64
OL-3	DON mg N/L	0.24	0.12		0.26	0.12	0.21	0.24	0.26
OL-3	Magnesium mg Mg/L	0.88	0.46		0.97	0.46	0.77	0.88	0.97
OL-3	NH4 ug N/L	22	11		19	10.72	17.36	19.44	21.91
OL-3	Nitrate mg N/L	0.067	0.009		0.009	0.01	0.03	0.01	0.07
OL-3	pH		6.44		6.20	6.20	6.32	6.32	6.44
OL-3	PO4 ug P/L	3	6		3	3.24	4.09	3.47	5.58
OL-3	Potassium mg K/L	0.61	0.63		0.68	0.61	0.64	0.63	0.68

OL-3	**SiO2 mg SiO2/L**	4.83	2.61		1.15	1.15	2.86	2.61	4.83
OL-3	**Sodium mg Na/L**	4.63	5.37		4.68	4.63	4.89	4.68	5.37
OL-3	**Sulfate mg S/L**	0.55	0.99		0.38	0.38	0.64	0.55	0.99
OL-3	**TDN mg N/L**	0.33	0.14		0.29	0.14	0.25	0.29	0.33
OL-3	**Temp (˚C)**	24.1	24.4		23.8	23.8	24.1	24.1	24.4
OL-3	**TP (ppb)**	10.1	5.2		18.6	5.2	11.3	10.1	18.6
OL-3	**Turbidity (NTU)**	0.55	0.60		1.61	0.55	0.92	0.60	1.61
OL-4	**Calcium mg Ca/L**	2.76	3.54		3.07	2.76	3.12	3.07	3.54
OL-4	**Chloride mg Cl/L**	6.17	9.80		6.61	6.17	7.53	6.61	9.80
OL-4	**DO (mg/l)**	8.48	7.58		7.79	7.58	7.95	7.79	8.48
OL-4	**DOC mg C/L**	2.84	3.10		2.57	2.57	2.84	2.84	3.10
OL-4	**DON mg N/L**	0.11	0.10		0.09	0.09	0.10	0.10	0.11
OL-4	**Magnesium mg Mg/L**	0.37	0.52		0.45	0.37	0.45	0.45	0.52
OL-4	**NH4 ug N/L**	13	6		10	6.20	9.74	10.44	12.58
OL-4	**Nitrate mg N/L**	0.028	0.000		0.009	0.00	0.01	0.01	0.03
OL-4	**pH**		6.03		6.63	6.03	6.33	6.33	6.63
OL-4	**PO4 ug P/L**	0	0		1	0.00	0.28	0.17	0.67
OL-4	**Potassium mg K/L**	0.46	0.57		0.48	0.46	0.51	0.48	0.57
OL-4	**SiO2 mg SiO2/L**	2.41	1.83		2.73	1.83	2.32	2.41	2.73
OL-4	**Sodium mg Na/L**	4.75	6.90		5.27	4.75	5.64	5.27	6.90
OL-4	**Sulfate mg S/L**	0.94	0.96		0.84	0.84	0.91	0.94	0.96
OL-4	**TDN mg N/L**	0.15	0.11		0.11	0.11	0.12	0.11	0.15
OL-4	**Temp (˚C)**	22.6	24.6		23.3	22.6	23.5	23.3	24.6
OL-4	**TP (ppb)**	4.6	8.5	5.3	12.8	4.6	7.8	6.9	12.8
OL-4	**Turbidity (NTU)**	0.69	0.71		0.45	0.45	0.62	0.69	0.71
OL-5	**Calcium mg Ca/L**	3.26	3.12	3.56		3.12	3.31	3.26	3.56
OL-5	**Chloride mg Cl/L**	7.98	7.68	8.74		7.68	8.13	7.98	8.74
OL-5	**DO (mg/l)**	7.88	7.72	6.71	8.31	6.71	7.66	7.80	8.31
OL-5	**DOC mg C/L**	3.09	3.01	2.41		2.41	2.83	3.01	3.09
OL-5	**DON mg N/L**	0.16	0.09	0.10		0.09	0.12	0.10	0.16
OL-5	**Magnesium mg Mg/L**	0.44	0.46	0.52		0.44	0.47	0.46	0.52
OL-5	**NH4 ug N/L**	11	9	12		9.36	10.97	11.15	12.41
OL-5	**Nitrate mg N/L**	0.025	0.015	0.021		0.02	0.02	0.02	0.03
OL-5	**pH**	5.59		6.08	6.21	5.59	5.96	6.08	6.21
OL-5	**PO4 ug P/L**	3	0	2		0.00	1.83	2.18	3.31
OL-5	**Potassium mg K/L**	0.52	0.51	0.53		0.51	0.52	0.52	0.53
OL-5	**SiO2 mg SiO2/L**	1.48	1.79	1.94		1.48	1.73	1.79	1.94
OL-5	**Sodium mg Na/L**	5.73	5.73	6.43		5.73	5.97	5.73	6.43
OL-5	**Sulfate mg S/L**	0.93	0.96	0.90		0.90	0.93	0.93	0.96
OL-5	**TDN mg N/L**	0.20	0.12	0.14		0.12	0.15	0.14	0.20
OL-5	**Temp (˚C)**	22.5	24.7	17.2	22.4	17.2	21.7	22.5	24.7
OL-5	**TP (ppb)**	15.2	14.1		9.1	9.1	12.8	14.1	15.2
OL-5	**Turbidity (NTU)**	1.48	1.43	1.62	1.42	1.42	1.49	1.46	1.62
OL-6	**Calcium mg Ca/L**	4.22	5.16	3.47		3.47	4.28	4.22	5.16
OL-6	**Chloride mg Cl/L**	10.36	11.83	8.34		8.34	10.18	10.36	11.83
OL-6	**DO (mg/l)**	7.21	7.20	7.12	7.41	7.12	7.24	7.21	7.41
OL-6	**DOC mg C/L**	4.13	2.66	2.39		2.39	3.06	2.66	4.13
OL-6	**DON mg N/L**	0.16	0.09	0.08		0.08	0.11	0.09	0.16
OL-6	**Magnesium mg Mg/L**	0.66	0.85	0.51		0.51	0.67	0.66	0.85
OL-6	**NH4 ug N/L**	28	14	18		14.39	20.21	17.82	28.43

OL-6	**Nitrate mg N/L**	0.037	0.049	0.028		0.03	0.04	0.04	0.05
OL-6	**pH**	5.94		6.22	5.79	5.79	5.98	5.94	6.22
OL-6	**PO4 ug P/L**	4	0	1		0.18	1.51	0.62	3.72
OL-6	**Potassium mg K/L**	0.55	0.62	0.52		0.52	0.56	0.55	0.62
OL-6	**SiO2 mg SiO2/L**	6.42	3.34	3.07		3.07	4.28	3.34	6.42
OL-6	**Sodium mg Na/L**	7.18	8.17	6.14		6.14	7.16	7.18	8.17
OL-6	**Sulfate mg S/L**	0.66	0.69	0.87		0.66	0.74	0.69	0.87
OL-6	**TDN mg N/L**	0.23	0.15	0.13		0.13	0.17	0.15	0.23
OL-6	**Temp (˚C)**	20.9	22.6	16.9	20.5	16.9	20.2	20.7	22.6
OL-6	**TP (ppb)**	17.2	13.4		9.5	9.5	13.4	13.4	17.2
OL-6	**Turbidity (NTU)**	1.21	1.22	1.30	1.12	1.12	1.21	1.22	1.30
OL-7	**Calcium mg Ca/L**	2.27	3.49	3.91	2.82	2.27	3.12	3.15	3.91
OL-7	**Chloride mg Cl/L**	4.75	7.30	8.48	4.72	4.72	6.31	6.02	8.48
OL-7	**DO (mg/l)**	1.54	1.29	0.70	1.44	0.70	1.24	1.37	1.54
OL-7	**DOC mg C/L**	13.01	19.84	22.44	15.39	13.01	17.67	17.62	22.44
OL-7	**DON mg N/L**	0.43	0.46	0.45	0.44	0.43	0.44	0.44	0.46
OL-7	**Magnesium mg Mg/L**	0.37	0.59	0.66	0.45	0.37	0.52	0.52	0.66
OL-7	**NH4 ug N/L**	30	50	141	44	30.08	66.09	46.69	140.88
OL-7	**Nitrate mg N/L**	0.001	0.001	0.000	0.006	0.00	0.00	0.00	0.01
OL-7	**pH**	4.46	3.93	4.99	5.07	3.93	4.61	4.73	5.07
OL-7	**PO4 ug P/L**	11	44	34	22	10.62	27.51	27.72	43.99
OL-7	**Potassium mg K/L**	0.44	0.87	0.76	0.64	0.44	0.67	0.70	0.87
OL-7	**SiO2 mg SiO2/L**	0.04	0.02	0.10	0.03	0.02	0.05	0.04	0.10
OL-7	**Sodium mg Na/L**	3.86	5.11	5.48	3.94	3.86	4.60	4.53	5.48
OL-7	**Sulfate mg S/L**	0.07	0.03	0.02	0.07	0.02	0.05	0.05	0.07
OL-7	**TDN mg N/L**	0.46	0.51	0.59	0.49	0.46	0.51	0.50	0.59
OL-7	**Temp (˚C)**	16.4	18.6	16.7	20.3	16.4	18.0	17.7	20.3
OL-7	**TP (ppb)**	26.6	108.6	57.2	48.9	26.6	60.3	53.1	108.6
OL-7	**Turbidity (NTU)**	0.58	2.96	0.69	0.80	0.58	1.26	0.75	2.96
OL-9	**Calcium mg Ca/L**		2.88	2.85	3.49	2.85	3.07	2.88	3.49
OL-9	**Chloride mg Cl/L**		7.11	9.06	7.05	7.05	7.74	7.11	9.06
OL-9	**DO (mg/l)**		7.44	7.86	7.80	7.44	7.70	7.80	7.86
OL-9	**DOC mg C/L**		3.85	2.68	2.74	2.68	3.09	2.74	3.85
OL-9	**DON mg N/L**		0.08	0.09	0.11	0.08	0.09	0.09	0.11
OL-9	**Magnesium mg Mg/L**		0.44	0.45	0.57	0.44	0.49	0.45	0.57
OL-9	**NH4 ug N/L**		9	21	8	8.14	12.69	9.41	20.54
OL-9	**Nitrate mg N/L**		0.000	0.023	0.005	0.00	0.01	0.01	0.02
OL-9	**pH**		6.48	6.32	6.36	6.32	6.39	6.36	6.48
OL-9	**PO4 ug P/L**		2	4	2	1.98	2.88	2.19	4.48
OL-9	**Potassium mg K/L**		0.54	0.59	0.51	0.51	0.55	0.54	0.59
OL-9	**SiO2 mg SiO2/L**		2.55	2.27	3.07	2.27	2.63	2.55	3.07
OL-9	**Sodium mg Na/L**		5.36	7.04	5.53	5.36	5.98	5.53	7.04
OL-9	**Sulfate mg S/L**		0.96	0.60	0.83	0.60	0.80	0.83	0.96
OL-9	**TDN mg N/L**		0.09	0.13	0.12	0.09	0.11	0.12	0.13
OL-9	**Temp (˚C)**		23.9	23.2	23.6	23.2	23.6	23.6	23.9
OL-9	**TP (ppb)**		5.2	14.0	6.2	5.2	8.5	6.2	14.0
OL-9	**Turbidity (NTU)**		0.57	1.15	0.53	0.53	0.75	0.57	1.15
OL-10	**Calcium mg Ca/L**	4.00	4.06	4.14	3.69	3.69	3.97	4.03	4.14
OL-10	**Chloride mg Cl/L**	7.13	7.72	7.16	5.22	5.22	6.81	7.15	7.72
OL-10	**DO (mg/l)**	6.47	6.52	6.49	6.69	6.47	6.54	6.51	6.69

OL-10	DOC mg C/L	3.38	3.37	2.49	6.47	2.49	3.93	3.37	6.47
OL-10	DON mg N/L	0.14	0.10	0.10	0.16	0.10	0.12	0.12	0.16
OL-10	Magnesium mg Mg/L	0.68	0.75	0.78	0.66	0.66	0.72	0.72	0.78
OL-10	NH4 ug N/L	66	7	12	9	6.80	23.46	10.75	65.52
OL-10	Nitrate mg N/L	0.000	0.001	0.006	0.007	0.00	0.00	0.00	0.01
OL-10	pH	6.10	6.32	5.99	6.23	5.99	6.16	6.17	6.32
OL-10	PO4 ug P/L	3	0	0	0	0.00	0.96	0.25	3.33
OL-10	Potassium mg K/L	0.66	0.69	0.54	0.67	0.54	0.64	0.66	0.69
OL-10	SiO2 mg SiO2/L	3.70	2.18	2.05	1.60	1.60	2.38	2.11	3.70
OL-10	Sodium mg Na/L	5.75	6.00	5.76	4.69	4.69	5.55	5.75	6.00
OL-10	Sulfate mg S/L	1.11	0.98	0.84	0.79	0.79	0.93	0.91	1.11
OL-10	TDN mg N/L	0.20	0.11	0.12	0.17	0.11	0.15	0.15	0.20
OL-10	Temp (˚C)	26.1	21.0	23.3	23.2	21.0	23.4	23.3	26.1
OL-10	TP (ppb)	16.5	10.9	8.4	13.3	8.4	12.3	12.1	16.5
OL-10	Turbidity (NTU)	0.84	1.01	0.68	1.33	0.68	0.97	0.93	1.33
OL-11	Calcium mg Ca/L	3.06	2.87	3.15	3.75	2.87	3.21	3.10	3.75
OL-11	Chloride mg Cl/L	7.03	7.19	7.09	7.10	7.03	7.10	7.10	7.19
OL-11	DO (mg/l)	8.33	7.25	8.59	7.83	7.25	8.00	8.08	8.59
OL-11	DOC mg C/L	3.48	3.33	2.56	2.50	2.50	2.97	2.94	3.48
OL-11	DON mg N/L	0.20	0.09	0.08	0.10	0.08	0.11	0.09	0.20
OL-11	Magnesium mg Mg/L	0.53	0.44	0.48	0.62	0.44	0.52	0.51	0.62
OL-11	NH4 ug N/L	7	7	6	8	6.04	6.89	6.66	8.19
OL-11	Nitrate mg N/L	0.008	0.000	0.009	0.008	0.00	0.01	0.01	0.01
OL-11	pH	6.30	5.50	5.93	6.64	5.50	6.09	6.12	6.64
OL-11	PO4 ug P/L	0	6	0	2	0.04	2.01	1.19	5.61
OL-11	Potassium mg K/L	0.48	0.55	0.53	0.55	0.48	0.53	0.54	0.55
OL-11	SiO2 mg SiO2/L	3.70	2.57	3.04	3.28	2.57	3.15	3.16	3.70
OL-11	Sodium mg Na/L	5.45	5.44	5.44	5.59	5.44	5.48	5.45	5.59
OL-11	Sulfate mg S/L	0.93	0.96	0.86	0.84	0.84	0.90	0.90	0.96
OL-11	TDN mg N/L	0.21	0.09	0.09	0.11	0.09	0.13	0.10	0.21
OL-11	Temp (˚C)	25.7	24.0	24.3	23.8	23.8	24.5	24.2	25.7
OL-11	TP (ppb)	19.2	6.9	6.3	6.9	6.3	9.8	6.9	19.2
OL-11	Turbidity (NTU)	0.52	0.74	0.76	0.58	0.52	0.65	0.66	0.76
OL-12	Calcium mg Ca/L	2.73	2.95	2.93	3.07	2.73	2.92	2.94	3.07
OL-12	Chloride mg Cl/L	8.16	7.69	8.22	7.19	7.19	7.81	7.92	8.22
OL-12	DO (mg/l)	8.24	7.35	7.87	7.80	7.35	7.82	7.84	8.24
OL-12	DOC mg C/L	3.62	3.25	3.14	3.03	3.03	3.26	3.19	3.62
OL-12	DON mg N/L	0.10	0.09	0.19	0.09	0.09	0.12	0.10	0.19
OL-12	Magnesium mg Mg/L	0.42	0.46	0.44	0.45	0.42	0.44	0.44	0.46
OL-12	NH4 ug N/L	6	3	5	8	2.59	5.18	5.28	7.55
OL-12	Nitrate mg N/L	0.003	0.000	0.008	0.004	0.00	0.00	0.00	0.01
OL-12	pH	6.48	6.13	6.12	5.62	5.62	6.09	6.13	6.48
OL-12	PO4 ug P/L	0	0	1	2	0.29	0.85	0.61	1.88
OL-12	Potassium mg K/L	0.54	0.51	0.54	0.47	0.47	0.52	0.52	0.54
OL-12	SiO2 mg SiO2/L	1.89	3.24	3.00	1.56	1.56	2.42	2.44	3.24
OL-12	Sodium mg Na/L	5.97	5.70	6.10	5.59	5.59	5.84	5.83	6.10
OL-12	Sulfate mg S/L	0.91	0.97	0.88	0.85	0.85	0.90	0.90	0.97
OL-12	TDN mg N/L	0.11	0.09	0.20	0.11	0.09	0.13	0.11	0.20
OL-12	Temp (˚C)	25.0	22.6	24.3	22.1	22.1	23.5	23.5	25.0
OL-12	TP (ppb)	12.6	15.8	7.4	5.5	5.5	10.3	10.0	15.8

OL-12	**Turbidity (NTU)**	3.10	1.24	0.63	0.66	0.63	1.41	0.95	3.10
OL-13	**Calcium mg Ca/L**	5.38	6.37	5.63	6.24	5.38	5.90	5.93	6.37
OL-13	**Chloride mg Cl/L**	19.16	16.80	18.04	25.13	16.80	19.78	18.60	25.13
OL-13	**DO (mg/l)**	8.19	7.50	8.03	8.00	7.50	7.93	8.02	8.19
OL-13	**DOC mg C/L**	2.28	3.40	2.58	4.24	2.28	3.12	2.99	4.24
OL-13	**DON mg N/L**	0.00	0.08	0.10	0.09	0.00	0.07	0.09	0.10
OL-13	**Magnesium mg Mg/L**	0.76	0.85	0.80	0.88	0.76	0.82	0.82	0.88
OL-13	**NH4 ug N/L**	14	32	29	27	14.09	25.52	27.82	32.35
OL-13	**Nitrate mg N/L**	0.003	0.012	0.013	0.019	0.00	0.01	0.01	0.02
OL-13	**pH**	6.12	6.61	6.83	6.60	6.12	6.54	6.61	6.83
OL-13	**PO4 ug P/L**	2	2	0	2	0.00	1.46	1.83	2.19
OL-13	**Potassium mg K/L**	0.45	0.68	0.64	0.72	0.45	0.62	0.66	0.72
OL-13	**SiO2 mg SiO2/L**	5.21	6.53	6.17	5.27	5.21	5.79	5.72	6.53
OL-13	**Sodium mg Na/L**	13.35	12.54	12.48	14.75	12.48	13.28	12.94	14.75
OL-13	**Sulfate mg S/L**	0.79	0.57	0.64	0.56	0.56	0.64	0.61	0.79
OL-13	**TDN mg N/L**	0.00	0.13	0.14	0.14	0.00	0.10	0.13	0.14
OL-13	**Temp (˚C)**	17.2	19.3	18.5	22.1	17.2	19.3	18.9	22.1
OL-13	**TP (ppb)**	10.5	13.2	14.0	14.1	10.5	13.0	13.6	14.1
OL-13	**Turbidity (NTU)**	1.03	1.66	1.60	0.56	0.56	1.21	1.32	1.66
OL-14	**Calcium mg Ca/L**	2.93	3.14	3.85		2.93	3.31	3.14	3.85
OL-14	**Chloride mg Cl/L**	8.25	8.78	7.29		7.29	8.10	8.25	8.78
OL-14	**DO (mg/l)**	7.70	7.32	7.35	6.85	6.85	7.31	7.34	7.70
OL-14	**DOC mg C/L**	3.25	3.62	5.42		3.25	4.09	3.62	5.42
OL-14	**DON mg N/L**	0.15	0.10	0.17		0.10	0.14	0.15	0.17
OL-14	**Magnesium mg Mg/L**	0.46	0.48	0.65		0.46	0.53	0.48	0.65
OL-14	**NH4 ug N/L**	7	5	14		5.12	8.52	6.93	13.52
OL-14	**Nitrate mg N/L**	0.002	0.002	0.007		0.00	0.00	0.00	0.01
OL-14	**pH**	6.29	5.83	6.05	6.55	5.83	6.18	6.17	6.55
OL-14	**PO4 ug P/L**	1	3	1		0.71	1.49	1.19	2.55
OL-14	**Potassium mg K/L**	0.44	0.58	0.62		0.44	0.55	0.58	0.62
OL-14	**SiO2 mg SiO2/L**	1.36	2.91	1.08		1.08	1.79	1.36	2.91
OL-14	**Sodium mg Na/L**	5.86	6.27	5.75		5.75	5.96	5.86	6.27
OL-14	**Sulfate mg S/L**	0.88	1.00	0.82		0.82	0.90	0.88	1.00
OL-14	**TDN mg N/L**	0.16	0.10	0.19		0.10	0.15	0.16	0.19
OL-14	**Temp (˚C)**	20.9	23.8	23.0	24.0	20.9	22.9	23.4	24.0
OL-14	**TP (ppb)**	15.7	8.7	9.2	13.5	8.7	11.8	11.4	15.7
OL-14	**Turbidity (NTU)**	0.70	0.53	0.49	1.02	0.49	0.69	0.62	1.02

Appendix E: Deep Water Testing Data

Site	Layer	Parameter	6/19/2003	7/5/2003	8/12/2003	Minimum	Mean	Median	Maximum
Berry Bay	**Epilimnion**	Cond	46.40	50.97	50.51	46.40	49.29	50.51	50.97
Berry Bay	**Epilimnion**	Depth (m)	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Berry Bay	**Epilimnion**	pH	6.47	6.62	6.71	6.47	6.60	6.62	6.71
Berry Bay	**Epilimnion**	TP (ug/l)	6	7	7	6.00	6.67	7.00	7.00
Berry Bay	**Epilimnion**	Turb (NTU)	0.50	0.55	0.50	0.50	0.52	0.50	0.55
Berry Bay	**Metalimnion**	Cond	51.68	51.95	50.40	50.40	51.34	51.68	51.95
Berry Bay	**Metalimnion**	Depth (m)	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Berry Bay	**Metalimnion**	pH	6.39	6.42	6.65	6.39	6.49	6.42	6.65
Berry Bay	**Metalimnion**	TP (ug/l)	6	10	6	6.00	7.33	6.00	10.00
Berry Bay	**Metalimnion**	Turb (NTU)	0.43	0.51	0.51	0.43	0.48	0.51	0.51
Berry Bay	**Hypolimnion**	Cond	51.68	51.95	50.40	50.40	51.34	51.68	51.95
Berry Bay	**Hypolimnion**	Depth (m)	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Berry Bay	**Hypolimnion**	pH	6.39	6.42	6.65	6.39	6.49	6.42	6.65
Berry Bay	**Hypolimnion**	TP (ug/l)	6	10	6	6.00	7.33	6.00	10.00
Berry Bay	**Hypolimnion**	Turb (NTU)	0.43	0.51	0.51	0.43	0.48	0.51	0.51
Berry Bay	**n/a**	ANC	3.4	4.5	5.7	3.40	4.53	4.50	5.70
Berry Bay	**n/a**	Chl	2.49	2.18	2.35	2.18	2.34	2.35	2.49
Berry Bay	**n/a**	Secchi (m)	4.2	4.6	4.0	4.00	4.26	4.17	4.60
Broad Bay	**Epilimnion**	Cond	45.13	48.50	48.91	45.13	47.51	48.50	48.91
Broad Bay	**Epilimnion**	Depth (m)	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Broad Bay	**Epilimnion**	pH	6.69	6.68	6.75	6.68	6.71	6.69	6.75
Broad Bay	**Epilimnion**	TP (ug/l)	5	9	7	5.00	7.00	7.00	9.00
Broad Bay	**Epilimnion**	Turb (NTU)	0.48	0.56	0.54	0.48	0.53	0.54	0.56
Broad Bay	**Metalimnion**	Cond	45.24	44.80	49.29	44.80	46.44	45.24	49.29
Broad Bay	**Metalimnion**	Depth (m)	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Broad Bay	**Metalimnion**	pH	6.35	6.26	6.46	6.26	6.36	6.35	6.46
Broad Bay	**Metalimnion**	TP (ug/l)	6	8	9	6.00	7.67	8.00	9.00
Broad Bay	**Metalimnion**	Turb (NTU)	0.41	0.68	0.56	0.41	0.55	0.56	0.68
Broad Bay	**Hypolimnion**	Cond	45.24	44.80	49.29	44.80	46.44	45.24	49.29
Broad Bay	**Hypolimnion**	Depth (m)	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Broad Bay	**Hypolimnion**	pH	6.35	6.26	6.46	6.26	6.36	6.35	6.46
Broad Bay	**Hypolimnion**	TP (ug/l)	6	8	9	6.00	7.67	8.00	9.00
Broad Bay	**Hypolimnion**	Turb (NTU)	0.41	0.68	0.56	0.41	0.55	0.56	0.68
Broad Bay	**n/a**	ANC	4.4	4.6	5.7	4.40	4.90	4.60	5.70
Broad Bay	**n/a**	Chl	2.68	1.26	2.89	1.26	2.28	2.68	2.89
Broad Bay	**n/a**	Secchi (m)	3.6	4.5		3.60	4.05	4.05	4.50
Danforth Pond	**Epilimnion**	Cond	51.37	53.61	52.24	51.37	52.41	52.24	53.61
Danforth Pond	**Epilimnion**	Depth (m)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Danforth Pond	**Epilimnion**	pH	6.81	6.85	6.73	6.73	6.80	6.81	6.85
Danforth Pond	**Epilimnion**	TP (ug/l)	11	12	12	11.00	11.67	12.00	12.00
Danforth Pond	**Epilimnion**	Turb (NTU)	0.43	0.45	0.59	0.43	0.49	0.45	0.59
Danforth Pond	**Metalimnion**	Cond	48.92	50.06	52.22	48.92	50.40	50.06	52.22
Danforth Pond	**Metalimnion**	Depth (m)	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Danforth Pond	**Metalimnion**	pH	6.43	6.62	6.64	6.43	6.56	6.62	6.64
Danforth Pond	**Metalimnion**	TP (ug/l)	10	15	11	10.00	12.00	11.00	15.00
Danforth Pond	**Metalimnion**	Turb (NTU)	0.58	0.76	0.76	0.58	0.70	0.76	0.76
Danforth Pond	**Hypolimnion**	Cond	48.92	50.06	52.22	48.92	50.40	50.06	52.22
Danforth Pond	**Hypolimnion**	Depth (m)	4.00	4.00	4.00	4.00	4.00	4.00	4.00

Danforth Pond	**Hypolimnion**	pH	6.43	6.62	6.64	6.43	6.56	6.62	6.64
Danforth Pond	**Hypolimnion**	TP (ug/l)	10	15	11	10.00	12.00	11.00	15.00
Danforth Pond	**Hypolimnion**	Turb (NTU)	0.58	0.76	0.76	0.58	0.70	0.76	0.76
Danforth Pond	**n/a**	ANC	8.5	8.7	8.7	8.50	8.63	8.70	8.70
Danforth Pond	**n/a**	Chl	1.99	3.10	8.39	1.99	4.49	3.10	8.39
Danforth Pond	**n/a**	Secchi (m)	4.0	3.6	4.1	3.55	3.88	4.00	4.10
Leavitt Bay	**Epilimnion**	Cond	44.68	48.46	49.02	44.68	47.39	48.46	49.02
Leavitt Bay	**Epilimnion**	Depth (m)	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Leavitt Bay	**Epilimnion**	pH	6.55	6.37	6.64	6.37	6.52	6.55	6.64
Leavitt Bay	**Epilimnion**	TP (ug/l)	7	8	8	7.00	7.67	8.00	8.00
Leavitt Bay	**Epilimnion**	Turb (NTU)	0.74	0.55	0.47	0.47	0.59	0.55	0.74
Leavitt Bay	**Metalimnion**	Cond	45.17	48.82	49.11	45.17	47.70	48.82	49.11
Leavitt Bay	**Metalimnion**	Depth (m)	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Leavitt Bay	**Metalimnion**	pH	6.55	6.37	6.65	6.37	6.52	6.55	6.65
Leavitt Bay	**Metalimnion**	TP (ug/l)	<5	8	8	8.00	8.00	8.00	8.00
Leavitt Bay	**Metalimnion**	Turb (NTU)	0.40	0.50	0.82	0.40	0.57	0.50	0.82
Leavitt Bay	**Hypolimnion**	Cond	45.17	48.82	49.11	45.17	47.70	48.82	49.11
Leavitt Bay	**Hypolimnion**	Depth (m)	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Leavitt Bay	**Hypolimnion**	pH	6.55	6.37	6.65	6.37	6.52	6.55	6.65
Leavitt Bay	**Hypolimnion**	TP (ug/l)	<5	8	8	8.00	8.00	8.00	8.00
Leavitt Bay	**Hypolimnion**	Turb (NTU)	0.40	0.50	0.82	0.40	0.57	0.50	0.82
Leavitt Bay	**n/a**	ANC	4.7	4.3	5.3	4.30	4.77	4.70	5.30
Leavitt Bay	**n/a**	Chl	2.49	1.85	2.18	1.85	2.17	2.18	2.49
Leavitt Bay	**n/a**	Secchi (m)	3.3	1.9	3.5	1.85	2.89	3.31	3.50
Ossipee Lake	**Epilimnion**	Cond	43.90	47.66	48.09	43.90	46.55	47.66	48.09
Ossipee Lake	**Epilimnion**	Depth (m)	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Ossipee Lake	**Epilimnion**	pH	6.67	6.77	6.83	6.67	6.76	6.77	6.83
Ossipee Lake	**Epilimnion**	TP (ug/l)	8	8	6	6.00	7.33	8.00	8.00
Ossipee Lake	**Epilimnion**	Turb (NTU)	0.48	0.40	0.49	0.40	0.46	0.48	0.49
Ossipee Lake	**Metalimnion**	Cond	43.41	43.62	42.12	42.12	43.05	43.41	43.62
Ossipee Lake	**Metalimnion**	Depth (m)	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Ossipee Lake	**Metalimnion**	pH	6.48	6.27	6.39	6.27	6.38	6.39	6.48
Ossipee Lake	**Metalimnion**	TP (ug/l)	8	10	6	6.00	8.00	8.00	10.00
Ossipee Lake	**Metalimnion**	Turb (NTU)	0.36	0.34	1.14	0.34	0.61	0.36	1.14
Ossipee Lake	**Hypolimnion**	Cond	43.41	43.62	42.12	42.12	43.05	43.41	43.62
Ossipee Lake	**Hypolimnion**	Depth (m)	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Ossipee Lake	**Hypolimnion**	pH	6.48	6.27	6.39	6.27	6.38	6.39	6.48
Ossipee Lake	**Hypolimnion**	TP (ug/l)	8	10	6	6.00	8.00	8.00	10.00
Ossipee Lake	**Hypolimnion**	Turb (NTU)	0.36	0.34	1.14	0.34	0.61	0.36	1.14
Ossipee Lake	**n/a**	ANC	4.2	5.2	5.3	4.20	4.90	5.20	5.30
Ossipee Lake	**n/a**	Chl	1.68	2.14	2.54	1.68	2.12	2.14	2.54
Ossipee Lake	**n/a**	Secchi (m)	4.3	6.2	3.8	3.80	4.77	4.30	6.20

Appendix F: LEAP data

				Non Power Boats							Power Boats						
Location	Date	Time	Total Boats	Canoe	Kayak	Row-boat	Sail-boat	Wind-surfer	Other	Total	OB< 25 HP	OB> 25 HP	I/O	Pon-toon	PWC	Other	Total
Berry Bay	**4-Jul-03**	2	22	0	0	0	0	0	0	0	3	4	7	6	2	0	22
Berry Bay	**4-Jul-03**	3	22	0	0	0	0	0	0	0	0	4	9	8	1	0	22
Berry Bay	**4-Jul-03**	4	14	0	0	0	1	0	0	1	0	2	9	0	2	0	13
Berry Bay	**4-Jul-03**	10	15	0	0	0	0	0	0	0	0	2	7	2	4	0	15
Berry Bay	**5-Jul-03**	2	16	0	0	0	0	0	0	0	0	0	10	5	1	0	16
Berry Bay	**5-Jul-03**	2	14	0	0	0	2	0	0	2	0	0	5	4	3	0	12
Berry Bay	**5-Jul-03**	4	13	0	0	0	0	0	0	0	0	0	5	7	1	0	13
Berry Bay	**5-Jul-03**	5	11	0	0	0	0	0	0	0	3	0	1	5	2	0	11
Berry Bay	**5-Jul-03**	10	15	0	0	0	0	0	0	0	0	1	10	2	2	0	15
Berry Bay	**6-Jul-03**	2	12	1	1	0	1	0	0	3	1	0	6	1	1	0	9
Berry Bay	**6-Jul-03**	4	15	0	0	0	0	0	0	0	1	0	8	5	1	0	15
Broad Bay	**4-Jul-03**	2	36	2	0	1	1	0	0	4	1	5	10	7	9	0	32
Broad Bay	**4-Jul-03**	2	188	16	6	0	25	1	0	48	4	7	83	32	14	0	140
Broad Bay	**4-Jul-03**	2	59	2	3	0	0	0	0	5	1	3	29	16	5	0	54
Broad Bay	**4-Jul-03**	2	81	1	1	0	15	0	0	17	4	7	20	17	16	0	64
Broad Bay	**4-Jul-03**	4	31	2	0	1	5	0	0	8	1	6	6	6	4	0	23
Broad Bay	**4-Jul-03**	5	75	2	2	0	15	0	0	19	4	14	17	14	7	0	56
Broad Bay	**4-Jul-03**	10	55	11	4	1	1	0	0	17	0	9	9	7	12	1	38
Broad Bay	**4-Jul-03**	10	32	0	2	0	0	0	1	3	0	1	15	10	3	0	29
Broad Bay	**4-Jul-03**	10	29	1	0	0	0	0	0	1	1	5	7	6	9	0	28
Broad Bay	**4-Jul-03**	10	32	2	0	1	1	0	0	4	1	6	9	10	2	0	28
Broad Bay	**4-Jul-03**	12	20	1	0	1	4	0	0	6	0	3	0	4	7	0	14
Broad Bay	**4-Jul-03**		39	1	0	1	6	0	5	13	0	15	0	6	5	0	26
Broad Bay	**4-Jul-03**		24	1	0	1	6	0	5	13	0	0	0	6	5	0	11
Broad Bay	**4-Jul-03**		22	2	0	1	5	0	0	8	0	1	0	7	6	0	14
Broad Bay	**5-Jul-03**	2	100	7	11	0	6	0	0	24	3	0	38	16	19	0	76
Broad Bay	**5-Jul-03**	2	55	0	0	0	0	0	0	0	3	2	21	17	12	0	55
Broad Bay	**5-Jul-03**	4	63	1	3	0	0	0	0	4	1	2	19	25	12	0	59
Broad Bay	**5-Jul-03**	4	47	0	1	0	0	0	0	1	2	4	14	16	10	0	46

Broad Bay	**5-Jul-03**	5	74	2	2	0	15	0	3	22	3	9	19	15	6	0	52
Broad Bay	**5-Jul-03**	10	70	11	1	2	21	0	1	36	3	2	8	7	14	0	34
Broad Bay	**5-Jul-03**	10	39	1	4	0	0	0	0	5	0	2	15	13	4	0	34
Broad Bay	**6-Jul-03**	1	63	2	5	0	18	0	0	25	1	1	12	12	12	0	38
Broad Bay	**6-Jul-03**	2	65	2	2	1	0	0	1	6	1	6	22	21	9	0	59
Broad Bay	**6-Jul-03**	4	60	0	2	0	7	0	1	10	1	1	23	12	13	0	50
Broad Bay	**6-Jul-03**	4	119	16	16	2	17	0	0	51	2	3	28	25	9	1	68
Broad Bay	**6-Jul-03**	4	80	5	4	0	22	3	1	35	2	9	11	15	8	0	45
Broad Bay	**6-Jul-03**	5	103	4	5	0	22	0	1	32	3	5	27	22	14	0	71
Broad Bay	**6-Jul-03**	10	20	1	0	0	1	0	1	3	0	3	4	4	6	0	17
Broad Bay	**19-Jul-03**	2	82	1	0	1	18	0	6	26	11	11	0	14	20	0	56
Broad Bay	**19-Jul-03**	2	104	11	9	1	17	0	0	38	1	5	30	24	6	0	66
Broad Bay	**19-Jul-03**	10	31	8	0	1	1	0	1	11	1	3	4	7	5	0	20
Broad Bay	**13-Aug-03**	2	47	7	8	0	5	0	0	20	1	5	10	3	8	0	27
Long Sands	**4-Jul-03**	3	337	1	2	0	0	0	0	3							334
Long Sands	**4-Jul-03**	10	35	0	0	0	0	0	0	0	1	1	19	8	6	0	35
Long Sands	**5-Jul-03**	2	307														
Long Sands	**5-Jul-03**	4	280														
Long Sands	**5-Jul-03**	12	80	2	3	0	0	0	0	5	4	4	34	22	11	0	75
Long Sands	**5-Jul-03**	12	49	1	0	0	0	0	0	1	0	20	0	22	6	0	48
Long Sands	**5-Jul-03**	12	49	1	0	0	0	0	0	1	20	0	0	20	8	0	48
Long Sands	**5-Jul-03**	12	48	2	0	0	8	1	0	11	20	0	0	14	3	0	37
Long Sands	**5-Jul-03**	12	43	1	0	0	0	0	0	1	16	0	0	20	6	0	42
Long Sands	**5-Jul-03**	12	64	1	0	0	0	0	0	1	0	31	4	22	6	0	63
Long Sands	**6-Jul-03**	2	187														
Long Sands	**6-Jul-03**	2	213	0	0	0	0	0	0	0	1	2	78	117	15	0	213
Long Sands	**6-Jul-03**	4	141														
Long Sands	**6-Jul-03**	11	39	0	0	0	0	0	0	0	0	0	19	15	5	0	39
Long Sands	**12-Jul-03**	2	32	0	0	0	0	0	0	0	2	5	0	19	6	0	32
Long Sands	**12-Jul-03**	2	63	0	2	0	0	0	0	2	3	13	0	40	5	0	61
Long Sands	**12-Jul-03**	2	173														
Long Sands	**13-Jul-03**	4	186														
Long Sands	**19-Jul-03**	2	167														
Long Sands	**19-Jul-03**	4	83														
Long Sands	**20-Jul-03**	2	171														

Long Sands	**20-Jul-03**	4	71														
Spindle Pt	**4-Jul-03**	3	64	2	3	0	0	0	0	5	2	25	16	14	2	0	59
Spindle Pt	**4-Jul-03**	6	28	0	0	0	0	0	0	0	0	0	11	17	0	0	28
Spindle Pt	**4-Jul-03**	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spindle Pt	**4-Jul-03**	12	50	1	0	2	0	0	0	3	18		19	8	2	0	47
Spindle Pt	**4-Jul-03**	12	31	1	1	0	0	0	0	2	1	0	15	9	4	0	29
Spindle Pt	**4-Jul-03**		52	0	1	0	0	0	0	1	7	12	7	20	5	0	51
Spindle Pt	**5-Jul-03**	1	31	1	1	0	0	0	0	2	0	0	16	9	4	0	29
Spindle Pt	**5-Jul-03**	2	24	0	0	0	0	0	1	1	4	0	14	4	1	0	23
Spindle Pt	**5-Jul-03**	4	68	2	0	0	0	0	4	6	2	0	36	14	10	0	62
Spindle Pt	**5-Jul-03**	12	13	1	0	0	0	0	0	1	3	0	3	6	0	0	12
Spindle Pt	**6-Jul-03**	2	21	0	0	0	0	0	0	0	0	0	12	8	1	0	21
Spindle Pt	**6-Jul-03**	4	51	1	2	0	0	0	0	3	0	0	39	6	1	2	48
Spindle Pt	**6-Jul-03**	10	3	0	0	0	0	0	0	0	0	0	1	1	1	0	3
Spindle Pt	**6-Jul-03**	12	14	0	0	0	0	0	1	1	0	0	8	3	2	0	13
Spindle Pt	**19-Jul-03**		22	0	0	0	0	0	0	0	0	4	7	9	2	0	22
Spindle Pt	**19-Jul-03**	2	22	0	0	0	0	0	0	0	0	0	14	6	2	0	22
Spindle Pt	**19-Jul-03**	10	6	0	3	0	0	0	0	3	1	1	0	0	1	0	3
Spindle Pt	**19-Jul-03**	10	19	1	0	0	0	0	0	1	1	0	16	1	0	0	18
Spindle Pt	**19-Jul-03**	12	8	0	0	0	0	0	0	0	0	0	3	4	1	0	8
Spindle Pt	**13-Aug-03**	2	42	4	0	2	0	1	0	7	1	3	5	22	4	0	35
Spindle Pt	**13-Aug-03**	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spindle Pt	**13-Aug-03**	4	58	4	2	5	0	1	0	12	1	6	7	27	5	0	46
Spindle Pt	**13-Aug-03**	10	42	4	0	2	0	1	0	7	1	4	4	23	3	0	35
Spindle Pt	**13-Aug-03**	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spindle Pt	**13-Aug-03**	12	2	0	0	0	0	0	0	0	0	0	0	2	0	0	2