Lake Champlain
Lay Monitoring Program Report
2012

State of Vermont
Agency of Natural Resources
Department of Environmental Conservation

Watershed Management Division
Montpelier, Vermont

2012

LAKE CHAMPLAIN LAY MONITORING REPORT

prepared by

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ACKNOWLEDGMENTS

Without the dedicated cadre of volunteers who demonstrate their interest in and commitment to the health of their lake through weekly summer sampling, the Lay Monitoring Program would simply not have been possible. The long-standing success of this public-private partnership is evident in the more than 30 years of nutrient enrichment data that track the health of Vermont's lakes and ponds. In 2012 Lay Monitors donated nearly 900 hours of their time to make 685 sampling trips – thank you for your efforts which allow the story of our lakes to continue to be told.

The success of this program is also a direct result of the efforts of Amy Picotte, who served as the Lay Monitoring Coordinator for 20 years before handing over the reins in 2012. Her shoes are large ones to fill, and it is with great respect and gratitude that this responsibility is assumed.

Also, thank you to Amanda Northrop, the Lay Monitoring Program Assistant who logged many miles, always with good humor and a sense of adventure, retrieving samples and meeting with volunteers, statewide.

And finally, thank you to Dan McAvinney and Dan Needham, the Department of Environmental Conservation Laboratory chemists, and their staff, who processed hundreds of chlorophyll-a and phosphorus samples through the summer.

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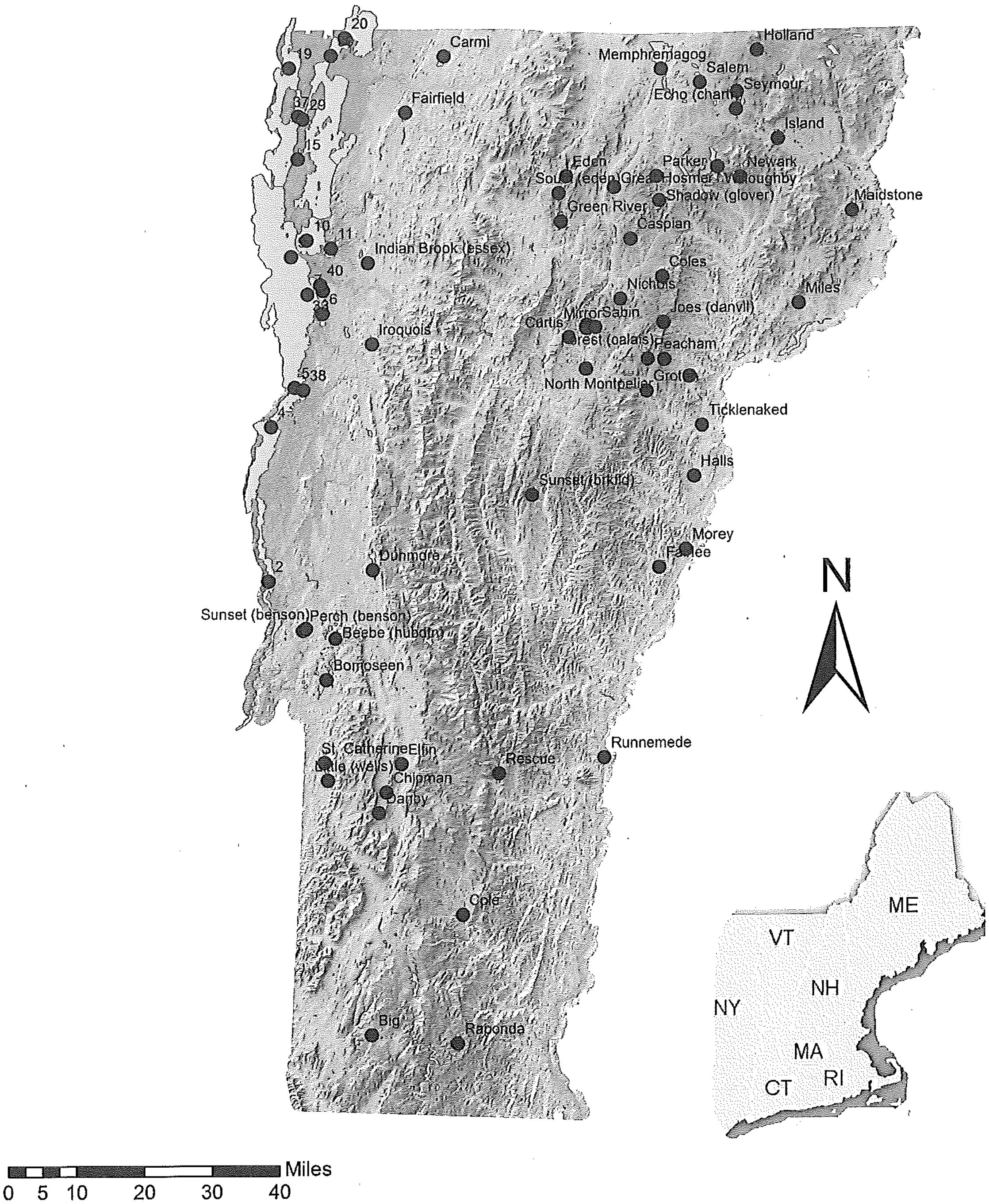


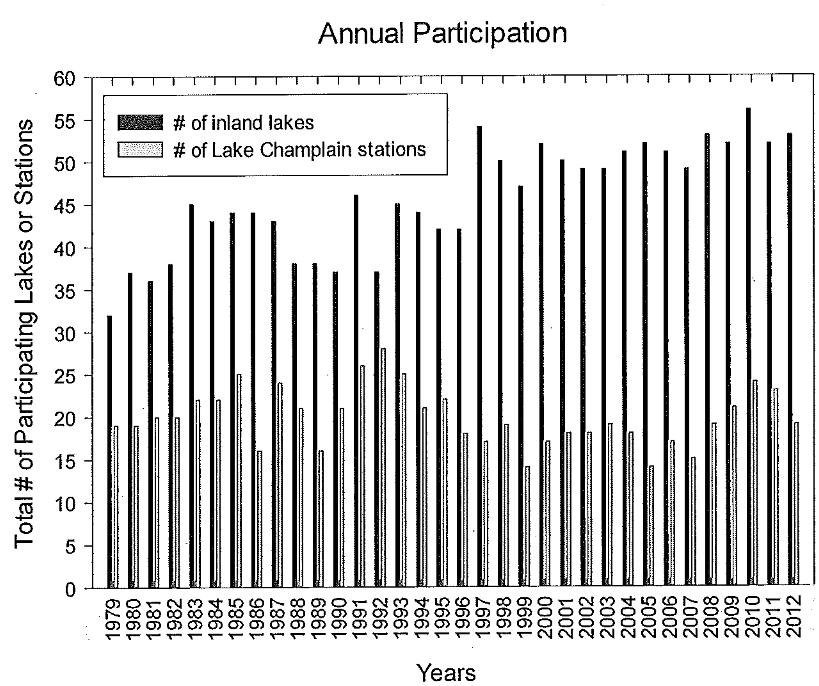
INTRODUCTION

The Vermont Lay Monitoring Program (LMP) is a citizen participation program in which volunteers are trained and equipped to conduct periodic water quality sampling on lakes. Since the initiation of the program in 1979, the principal objectives have been to accumulate an accurate water quality database on lakes and to inform lake residents about lake protection and biology. In detail, the goals of the program are:

1. to provide a perspective on the range of water quality conditions on Vermont lakes;
2. to describe water quality conditions on each lake participating in the Program;
3. to provide data useful in developing statistical eutrophication models for Vermont lakes;
4. to establish a database on each lake useful for documenting future changes in water quality;
5. to educate and involve lake residents in lake protection.

The Lay Monitoring Program was begun by the Vermont Department of Environmental Conservation (DEC) with an initial participation of 32 lakes and 19 Lake Champlain stations. Since then participation has increased to include a total of 89 lakes and 39 Lake Champlain stations. Figure 1 shows the total number of inland lakes and Lake Champlain stations sampled under the LMP each year since 1979.

Figure 1. Total Number of Participating LMP Lakes or Stations Per Year



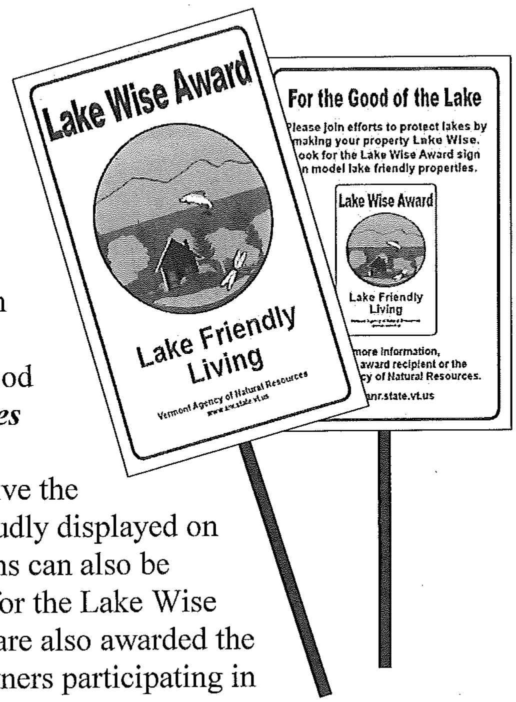
Lay Monitoring Program Annual Update

Vermont's more than 800 lakes and ponds are natural jewels left by glacial activity more than 10,000 years ago. Over time, they have provided waterways for human settlement, exploration, battles, and trade and commerce. Today, Vermont residents and visitors use lakes primarily for recreation, including fishing, boating, camping, and vacationing, and many Vermonters own homes or camps on the lakeshore.

For lakes to be resilient to human impacts on the land, their first line of defense is a well vegetated shore. Unfortunately, data show that developed sites have 96 percent fewer trees along the shores than undeveloped sites in Vermont, and that cleared shores pose the greatest threat to Vermont lakes. Naturally vegetated shores protect lake water quality, ecology, and bank stability. And healthy lakes benefit people, property values, and the tourism economy.

However, shoreland development and lake health need not be mutually exclusive. There are ways to develop a lakefront property, or to manage a lot with an existing house or camp, without detriment to the services naturally vegetated shorelands provide. A statewide shoreland regulation that outlines standards for lake friendly development would ensure new development doesn't degrade our treasured lakes and ponds. In addition, the new outreach and technical assistance program, Lake Wise, described below, will give lakeshore property owners the tools and resources needed to improve their own footprint on the lake.

Lake Wise



The Lake Wise Program is offered through the Vermont Lakes and Ponds Management and Protection Section to provide trainings in lake friendly shoreland management to Lake Associations and shoreland property owners. Through Lake Wise, participants receive technical assistance for fixing erosion and dirty runoff problems, which will protect lake quality and wildlife habitat.

Lake Wise participants managing their shores with good practices in the four categories of (1) ***Driveway;*** (2) ***Structures and Septic Systems***; (3) ***Recreation Areas***; and (4) ***Shorefront*** will receive the ***Lake Wise Award and Beautiful Sign***. This sign can be proudly displayed on model lake friendly properties. Informational Lake Wise signs can also be posted at public areas around the lake to alert others to look for the Lake Wise Award sign on well managed properties. Lake Associations are also awarded the "***Gold Award***," depending on the percentage of shoreland owners participating in Lake Wise.

The goal of Lake Wise is to establish a new normal, a new culture of lakeshore landscaping. A property that earns the Lake Wise Award will represent a "model" shoreland property. The Lake Wise Award certifies a property is well managed, using shoreland Best Management Practices, and is protecting the lake, improving or maintaining water quality and in-lake and on-shore wildlife habitat.

There are many ways to get involved with this exciting new initiative. Have your property evaluated, or serve as a Lake Wise Evaluator or a Lake Wise Scout. For more information, contact Amy Picotte at the Vermont Agency of Natural Resources at Amy.Picotte@state.vt.us or (802) 490-6128.

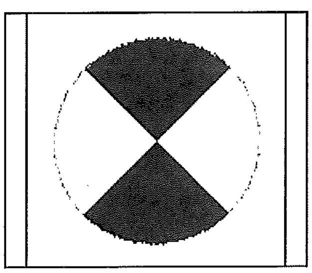
SECTION 1. THE PARAMETERS THE LMP USES TO MEASURE WATER QUALITY

The Lay Monitoring Program is concerned with measuring water quality as it relates to increased nutrient enrichment of lakes. Nutrient enrichment caused by human activities is the primary threat to Vermont lake water quality.

A variety of conditions may occur in a lake which is experiencing declining water quality due to excessive cultural nutrient enrichment. Nutrients in the water stimulate algae and rooted plant growth and the lake's "productivity" increases. As a result, the algae growth decreases water clarity and in some cases causes foul odors. Excessive rooted plant growth can interfere with boating, swimming, fishing, and other recreational uses. As these plants and algae die each year, they fall to the bottom, adding to the lake sediments. When the natural environment of a lake is altered, the types of fish and other wildlife the lake supports may also change.

In order to determine a lake's water quality, or productivity, the LMP measures the Secchi water clarity and the chlorophyll-a and total phosphorus concentration.

Water Clarity: Secchi Disk Transparency

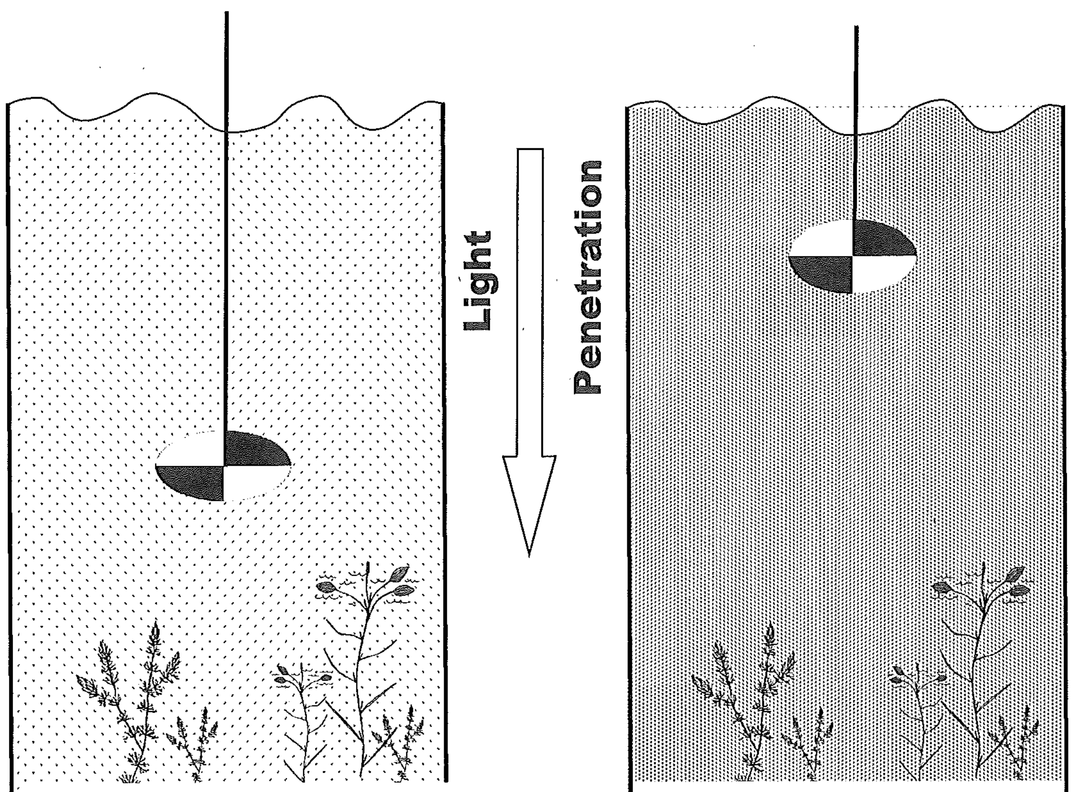


The Secchi disk reading is a measure of the clarity of lake water. The transparency of a lake's water is directly related to the amount of materials suspended in the water. Particulate matter, such as algae or silt, limits light penetration and reduces the water's clarity (Figure 2). Therefore, a Secchi disk transparency reading is a rough indication of a lake's water quality in terms of nutrient enrichment.

Some Vermont lakes have naturally "tea" colored water. This is very common in beaver ponds and in acidic lakes in some areas of the state. The color is due to the presence of dissolved organic acids, and can reduce the water's clarity. However, water color is not a major factor in most Lay Monitoring lakes. Other variables unrelated to nutrient enrichment can also influence the Secchi disk transparency reading, such as wave action and light reflection. These two variables can be minimized by sampling on calm days and taking the Secchi disk reading off the shaded side of the boat.

On a few of the Lay Monitoring inland lakes and Lake Champlain stations, the Secchi disk is often still visible at the bottom of the lake. If on a particular lake the Secchi disk is viewed to the bottom at 5 meters, this should be interpreted to mean the Secchi disk transparency is at least 5 meters. Such measurements are not an actual measure of water clarity (since the real reading would be deeper), and useful summer averages cannot be calculated.

The Secchi disk is widely used as a basic water quality indicator, and a Secchi disk transparency reading can often be related to the trophic state of a lake. An oligotrophic (deep, coldwater) lake usually has very clear water and therefore a deep Secchi disk reading. In contrary, a eutrophic (shallow, warmwater) lake usually supports large populations of algae and therefore has a shallow Secchi disk transparency reading. (The relationship between Secchi water clarity and chlorophyll-a, and Secchi water clarity and total phosphorus is shown in Figures 4 and 5.

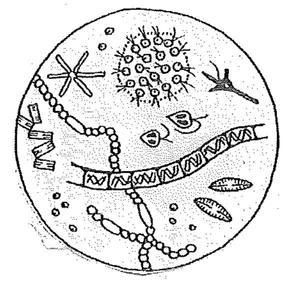


Clear lake having small algal population results in deep Secchi disk water clarity readings.

Turbid lake having large algal population results in shallow Secchi disk water clarity reading.

Figure 2. How Secchi Disk Measures Water Clarity

Chlorophyll-a Concentration



algae under microscope

Algal populations in a lake can be quantified by measuring the amount of chlorophyll-a in a water sample. Chlorophyll-a is the photosynthetic green pigment contained in all types of algae and other green plants. The amount of chlorophyll-a present in a water sample is directly proportional to the amount of algae living in the water. In the course of a year, algal populations normally follow a classic successional pattern from a peak population of diatoms (a group of algae which use silica to form glass shells for support and protection) in early spring to a variable summer algal population to a peak population of blue-green algae in the fall. The magnitude of the populations and the diversity of the species composition depend on factors such as the degree of nutrient enrichment in the lake and prevailing weather conditions.

Theoretically, if the Secchi disk transparency is related to the amount of particulate matter suspended in the water, it should also be related to the chlorophyll-a concentration of the water. If all other factors are constant, as algal populations and chlorophyll-a concentrations increase, the Secchi disk transparency should decrease. However, this relationship does not always hold true because Secchi disk transparency is influenced by several factors and because algal populations often inhabit water levels below the Secchi disk depth, thereby causing higher chlorophyll-a concentrations without affecting Secchi disk transparency.

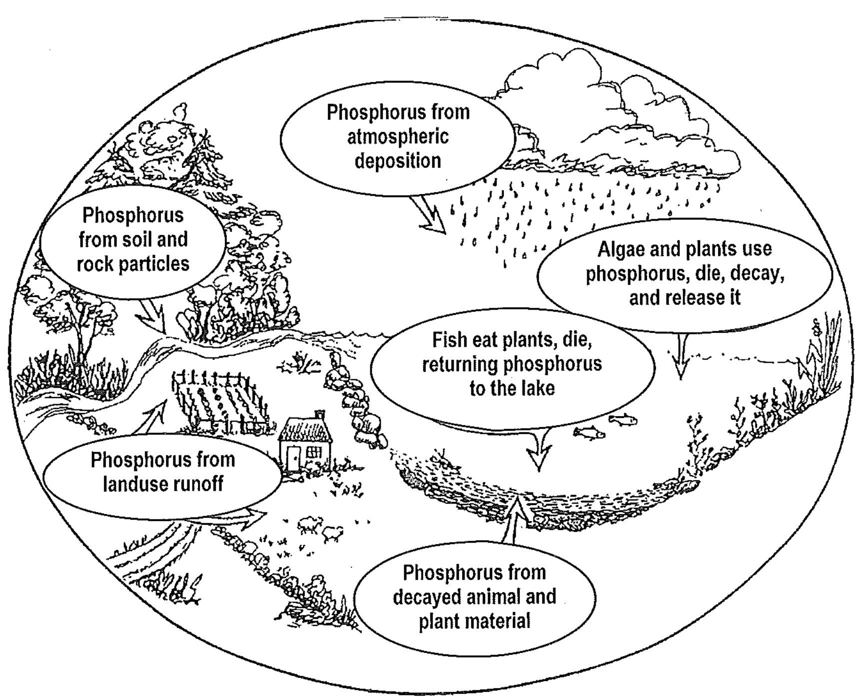
The chlorophyll-a concentration can often be related to the trophic state of a lake. An oligotrophic lake usually supports a small algal population and therefore has a low chlorophyll-a concentration. Conversely, a eutrophic lake usually supports large populations of algae and therefore has a high chlorophyll-a concentration. (The relationship between chlorophyll-a and Secchi water clarity, and chlorophyll-a and total phosphorus is shown and explained in Figures 4 and 6.)

Total Phosphorus Concentration

By measuring the amount of nutrients in the water, the LMP measures the variable which most directly influences water quality. Phosphorus is the nutrient in shortest supply in Vermont lakes, therefore it is the one most likely to stimulate productivity, and the best nutrient to measure to track changes in productivity. Total phosphorus includes all the different chemical forms of phosphorus and measuring total phosphorus is an indication of the amount of phosphorus which is potentially available for algal growth.

Phosphorus enters a lake from a variety of sources such as rainfall, incoming streams, land runoff, ground water, and direct discharges. Within a lake, phosphorus that has accumulated in the bottom sediments may become re-suspended in the water under anaerobic (no oxygen) conditions. The phosphorus entering a lake can be derived from both natural and cultural sources. Phosphorus is contributed naturally to aquatic environments by the decomposition of organic matter and the erosion of phosphorus containing soils. Culturally, phosphorus is contributed to a lake system by people's activities in the drainage basin (Figure 3).

Figure 3. Sources of Phosphorus



Under natural conditions, the majority of phosphorus contributed to a lake system enters the lake during the spring when the flow of inlet streams is high due to snowmelt and spring rains. Cultural nutrient inputs, on the other hand, may occur at any time of the year. While the lake is in spring overturn, just after ice-out, the incoming phosphorus is distributed evenly throughout the lake. At this time, the total phosphorus concentration in a lake can be used to predict the amount of algal growth that will occur in the lake during the summer. Total phosphorus concentrations measured during the summer, on the other hand, reflect the amount of phosphorus contained in algae in the water, as well as the amount of phosphorus which is still available to the algae. Thus, spring total phosphorus concentration is related to the potential algal growth which will occur in a given season, while summer total phosphorus concentration is related to the algal growth occurring on a given sampling day, as well as the potential for future algal growth.

Theoretically, total phosphorus concentration should be directly related to chlorophyll-a concentration and indirectly related to Secchi disk transparency. Hence, total phosphorus concentration is related to the trophic state of a lake. An oligotrophic lake usually receives small amounts of total phosphorus in the spring and exhibits low total phosphorus concentrations throughout the summer. In turn, a eutrophic lake usually receives large quantities of total phosphorus in the spring and exhibits high total phosphorus concentrations throughout the summer. (The relationship between total phosphorus and Secchi water clarity, and total phosphorus and chlorophyll-a is shown in Figures 5 and 6.)

Although spring total phosphorus is sampled on many Lay Monitoring lakes, it is not collected from Lake Champlain. Summer total phosphorus is measured on Lake Champlain, as the phosphorus distribution in such a large lake is a dynamic system, which cannot be measured by sampling only during spring overturn. The dynamic system in Lake Champlain results from the constant redistribution of phosphorus via currents and mixing patterns in the lake, and from continual phosphorus inputs via the lake's tributaries and point source discharges such as sewage treatment plants.

SAMPLING OVERVIEW

The Lay Monitoring Program is divided into several sampling regimes. Each Lake Champlain monitor samples one of 42 stations, while "inland" lake (lakes other than Lake Champlain) monitors typically sample two stations per lake. **Basic** monitors measure Secchi disk transparency on a weekly basis. **Supplemental** monitors, which include all Lake Champlain monitors, sample Secchi disk transparency and chlorophyll-a and total phosphorus concentrations.

SAMPLING REGIME	Station #1			Station #2
	Secchi	Chlorophyll-a	Phosphorus	Secchi
Basic				X
Supplemental	X	X	X	X
Champlain	X	X	X	X

Basic monitoring of water clarity provides a good indication of water quality conditions. Supplemental monitoring is generally performed on inland lakes which have one or more of the following characteristics:

1) the lake is new to the program and chlorophyll-a and total phosphorus base line information is desired,

2) the lake has a history of water quality problems, or

3) a diagnostic study has been performed on the lake and restoration measures have been implemented.

SAMPLING PROCEDURES

Water Clarity (Secchi disk transparency)

Water clarity is measured using a Secchi disk, a metal disk painted with two black and two white quadrants. The Secchi disk is lowered slowly into the water and the lowest depth at which it is still visible is the Secchi disk transparency reading. Measurements are read in meters (1 meter = 3.3 feet) from a marked line attached to the center of the disk.

Algal Population Density (chlorophyll-a concentration) and Nutrient Enrichment (total phosphorus concentration)

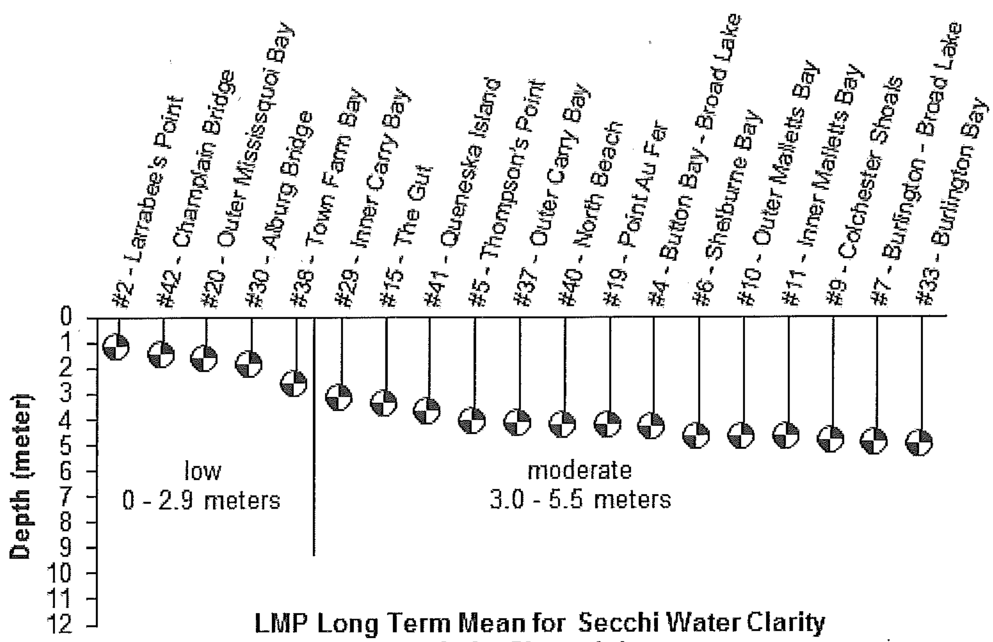
Supplemental monitors, in addition to taking Secchi disk readings, also collect water samples to be analyzed for chlorophyll-a and total phosphorus concentrations. Water samples are collected (in duplicate) by using a weighted garden hose, measured along its length in meters. The hose is lowered straight down into the water to a depth twice the Secchi disk reading. In this way a composite sample from the water's surface to the depth of the hose is contained in the hose. The hose is crimped shut at the water's surface and pulled up by reeling in a rope attached to the lower weighted end. When the weighted end is brought into the boat, the crimp is released and the water is emptied into a bucket. The appropriate bottle is filled with the water, and the hose is lowered once again in order to collect the duplicate sample.

Upon returning to shore, the monitor sets up a "home laboratory." The chlorophyll-a water samples are filtered through a simple filtration unit. The algae, and therefore the chlorophyll-a contained in the algae, are retained on the filter. The filter is folded, labeled and frozen. The phosphorus sample collected in a test tube, is stored on a shelf away from bright light. Chlorophyll-a samples are taken in duplicate, total phosphorus samples are not. Every two weeks the chlorophyll-a filters and phosphorus test tubes are picked up by LMP staff and transported to the Vermont DEC Laboratory in Waterbury for analysis.

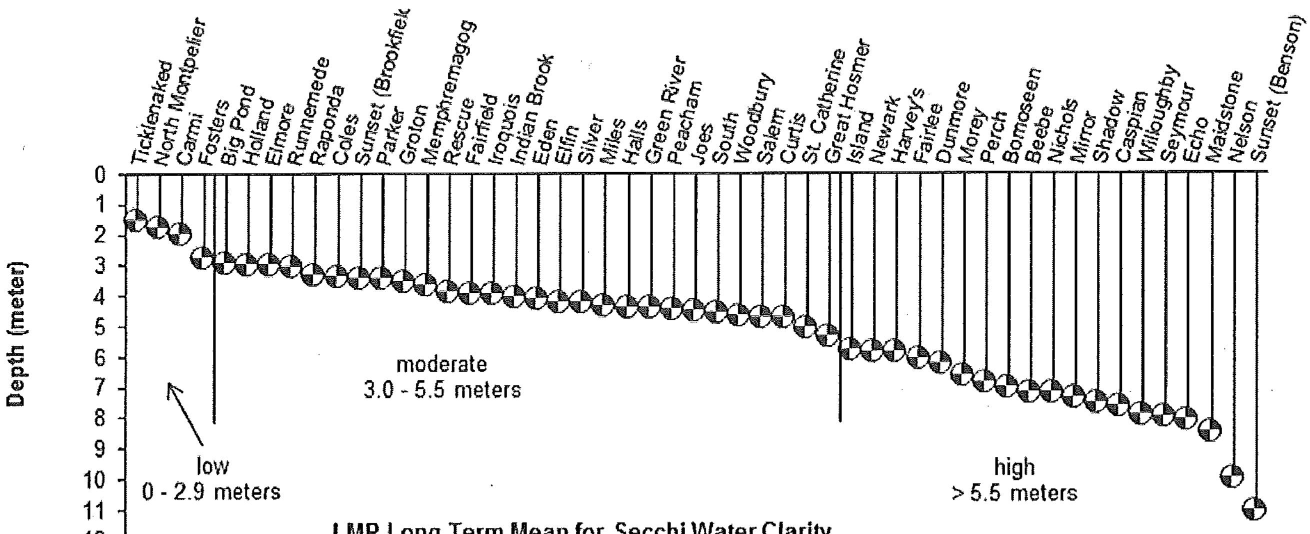
Chlorophyll-a concentration is analyzed using fluorometric determination. Total phosphorus is analyzed by the colorimetric, automated ascorbic acid method.

Secchi Water Clarity Long-Term Means

These graphs show the long-term mean for the inland lakes and Lake Champlain stations that participated in the LMP during 2012. Annual summer means are calculated from at least eight samples. **Long-Term Means** are based on averaging all the annual summer means. Some lakes or stations have been sampled since 1979 when the Lay Monitoring Program first started. The lakes (or stations) are ranked in order of increasing Secchi disk transparency with the lakes (or stations) with the lowest clarity on the left side and the graph and those with the greatest clarity at the right side of the graph. The groupings of "low," "moderate," and "high" are based on the range of clarity readings recorded in Vermont over the last 30 years.



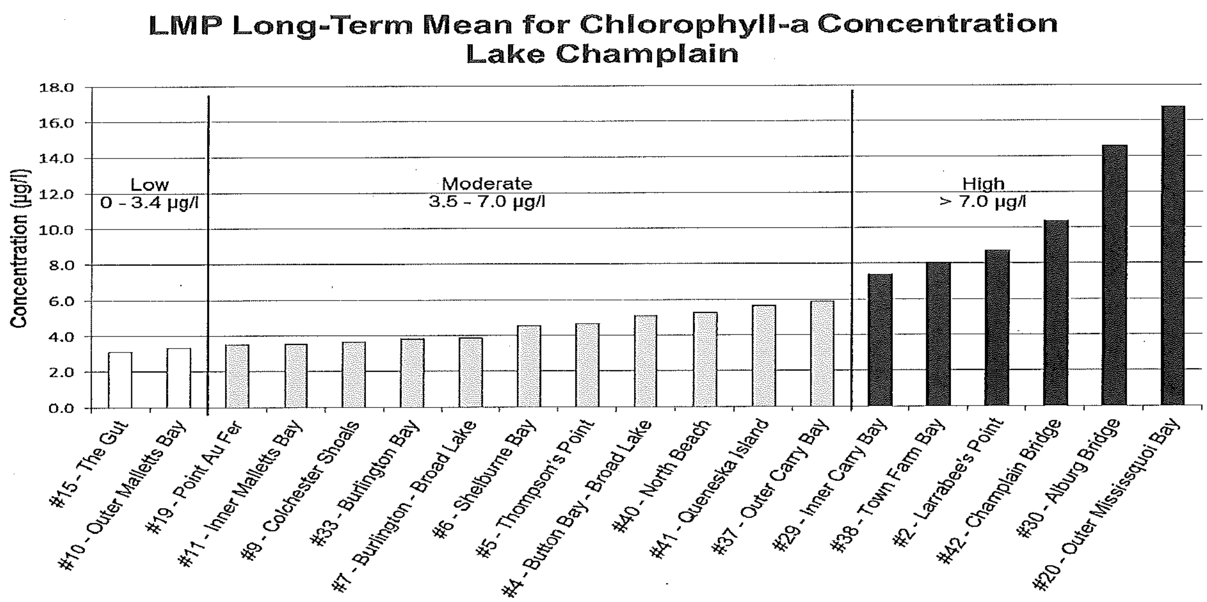
LMP Long Term Mean for Secchi Water Clarity
Lake Champlain

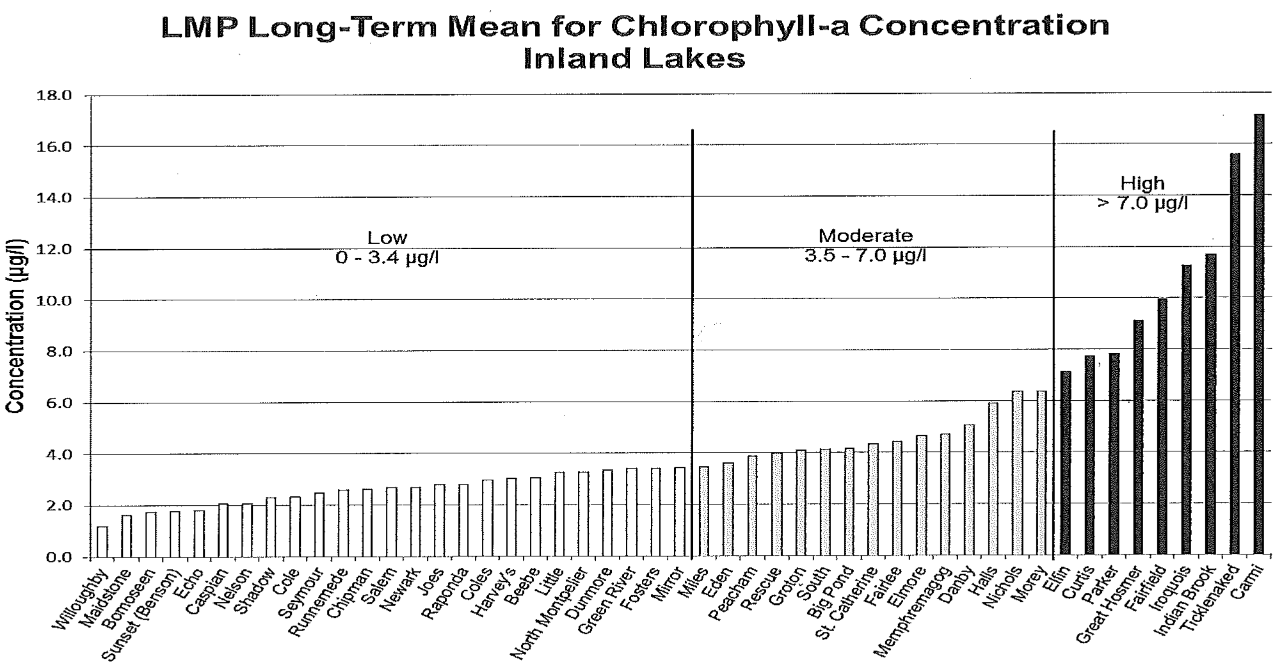


LMP Long Term Mean for Secchi Water Clarity
Inland Lakes

Chlorophyll-a Long-Term Means

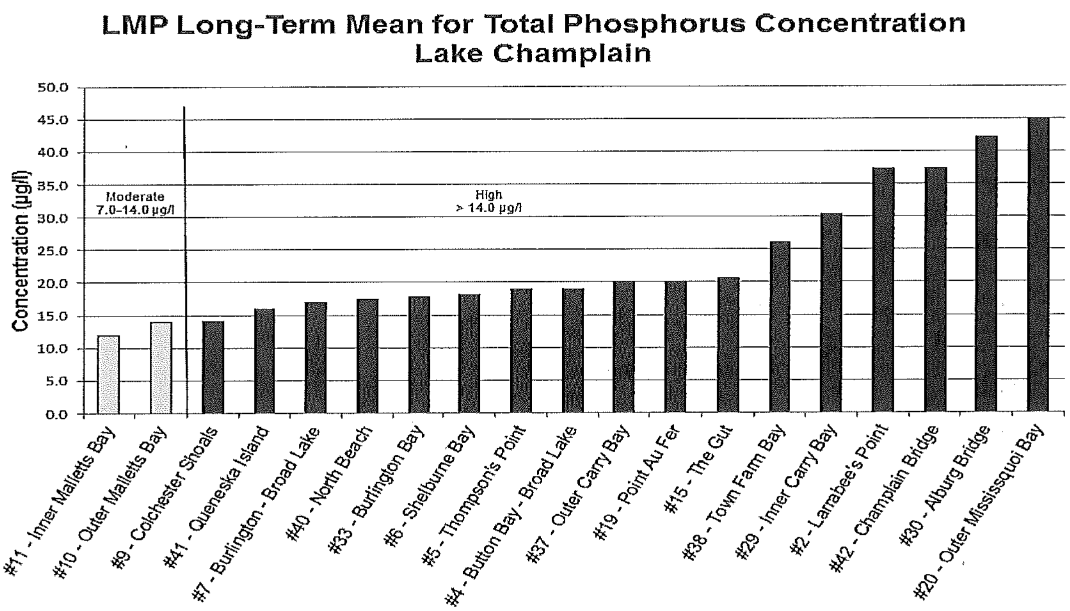
These graphs show the long-term mean for the inland lakes and Lake Champlain stations that participated in the LMP during 2012. Annual summer means are calculated from at least eight samples. **Long-Term Means** are based on averaging all the annual summer means. Some lakes or stations have been sampled since 1979 when the Lay Monitoring Program first started. The lakes or stations are ranked in order of increasing chlorophyll-a concentrations with the lakes or stations with the lowest chlorophyll-a levels on the left side of the graph and those with the greatest chlorophyll-a levels on the right side of the graph. The groupings of "low," "moderate" and "high" are based on the range of chlorophyll-a concentrations sampled in Vermont over the last 30 years.

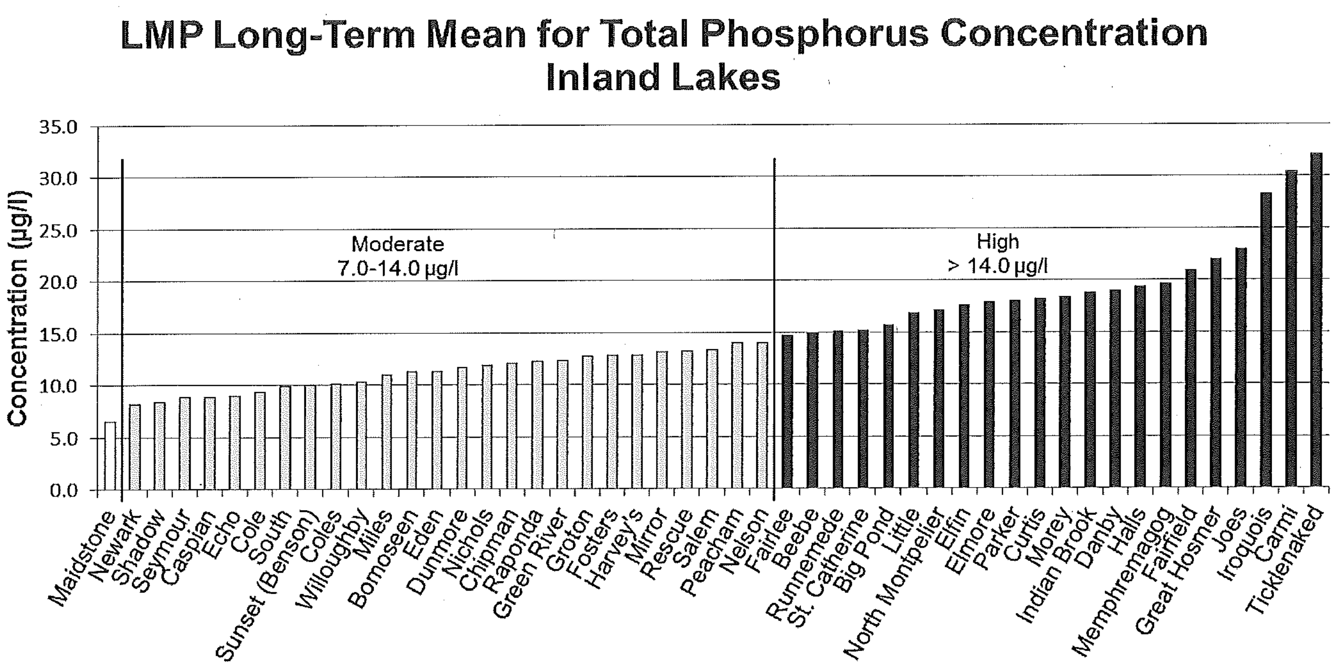




Total Phosphorus Long-Term Means

These graphs show the long-term mean for the inland lakes and Lake Champlain stations that participated in the LMP during 2012. Annual summer means are calculated from at least eight samples. **Long-Term Means** are based on averaging all the annual summer means. Some lakes or stations have been sampled since 1979 when the Lay Monitoring Program first started. The lakes or stations are ranked in order of increasing total phosphorus concentrations with the lakes or stations with the lowest phosphorus levels on the left side of the graph and those with the greatest phosphorus levels on the right side of the graph. The groupings of "low," "moderate," and "high" are based on the range of total phosphorus concentrations sampled in Vermont over the last 30 years.



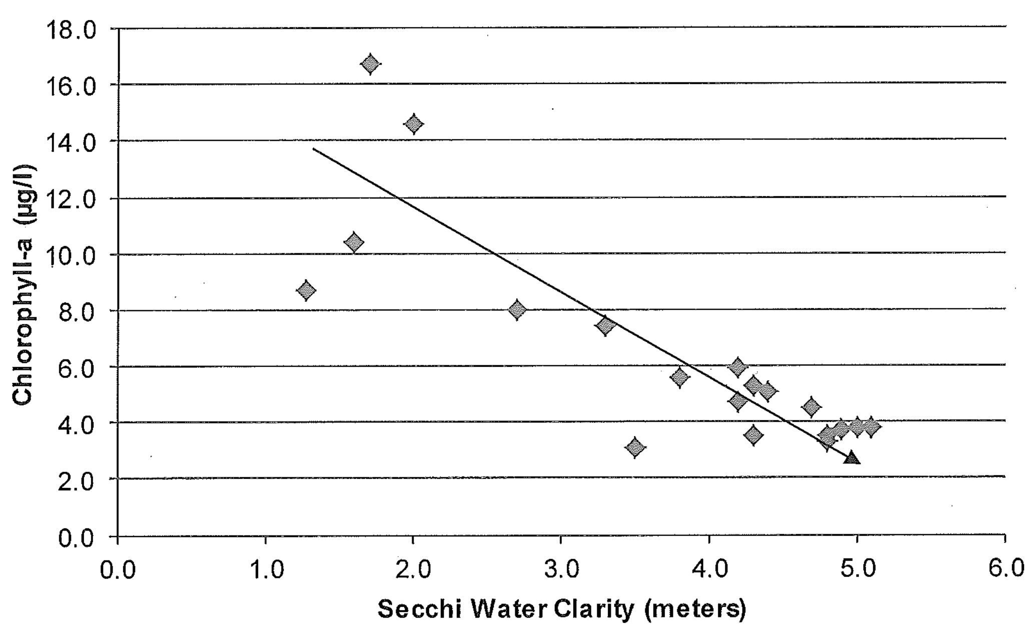


THE RELATIONSHIP OF LMP WATER QUALITY PARAMETERS

Figures 4-6 present the relationship of the Lake Champlain long-term data. The parameters sampled, Secchi disk transparency, chlorophyll-a, and total phosphorus are graphed against each other in order to observe how they are related to, and affected by, each other. Using the lake station data, three graphs were created: Secchi water clarity versus chlorophyll-a concentration; Secchi water clarity versus total phosphorus; and chlorophyll-a concentration versus total phosphorus.

Figure 4 below shows the relationship between Secchi water clarity and chlorophyll-a concentration, as mapped from the long-term Lake Champlain means. Each data point represents the Secchi/chlorophyll-a relationship for one station. In general this graph shows that when the chlorophyll-a concentration increases, there is a decrease in Secchi water clarity, as would be expected.

Figure 4. Long-Term LMP Means for Lake Champlain
Chlorophyll-a vs. Secchi Water Clarity



⟶ Indicates trend

Figure 5 portrays the relationship between Secchi water clarity and total phosphorus, as pictured from the long-term LMP means for Lake Champlain. Each data point represents the Secchi/total phosphorus relationship for one station. As would be expected, the graph shows that as the total phosphorus concentration increases, the Secchi disk water clarity decreases.

Figure 5. Long-Term LMP Means for Lake Champlain
Total Phosphorus vs. Secchi Water Clarity

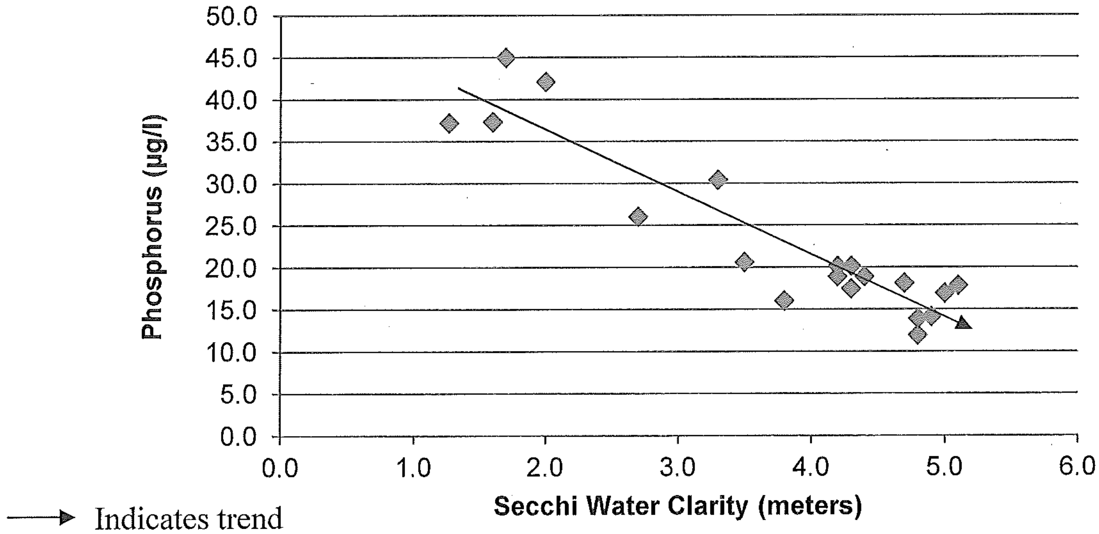
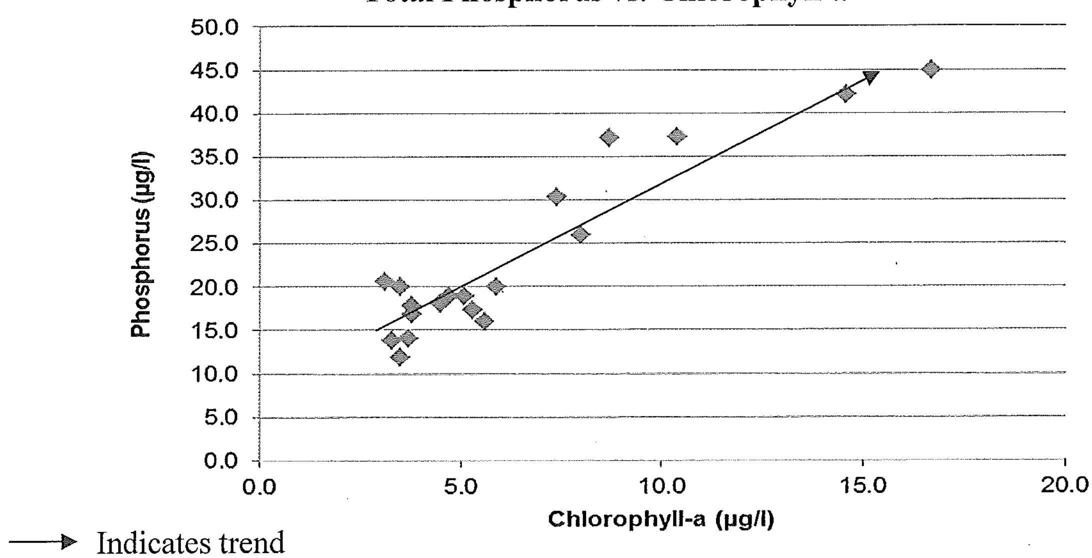


Figure 6 shows the relationship between chlorophyll-a and total phosphorus, as graphed from the long-term LMP means for Lake Champlain. Each data point represents the chlorophyll-a/total phosphorus relationship for one station. In general, as the total phosphorus concentration increases, the chlorophyll-a concentration also increases.

Figure 6. Long-Term LMP Means for Lake Champlain
Total Phosphorus vs. Chlorophyll-a



LAY MONITORING DATA ANALYSIS

A data analysis is conducted on all of the Lay Monitoring lakes and Lake Champlain stations. This analysis consists of:

1. calculating the summer annual means for each parameter sampled;
2. showing and comparing the long-term means for the inland lakes and Lake Champlain stations
3. designating the trophic state (eutrophic, mesotrophic, and oligotrophic) of each lake or Lake Champlain segment (see Figures 8-9) based on the long-term means of each parameter sampled.

Data analysis on inland lakes additionally involves: an evaluation of how many years of data are needed on each lake in order to establish the best possible database within a reasonable number of years. A database should describe current water quality conditions with enough accuracy to be useful in statistical analyses.

1. Summer Annual Means

The reliability of summer annual means for each water quality parameter depends on the sampling technique of the monitors and the frequency of the sampling. A summer average calculated from many samples of Secchi disk transparency, chlorophyll-a concentration, and total phosphorus will be more reliable and representative of the station's water conditions than an average determined from just a few samples. Summer averages based on sparse, inconsistent, or scattered sampling are considered weak and are not truly comparable with other stations (or lakes) or with other years. If a station was sampled seven weeks or less, then no annual means are calculated will not appear in the individual lake Annual Means Tables as such. Therefore, results presented in the Annual Data Tables of this report are considered reliable and truly representative of the water conditions. Since partial data sets may contain useful information, a record of which years each lake or station has been sampled is included in Appendix 1.

2. Comparison of Long-Term Means Between Stations and/or Lakes

The comparison between lakes and/or stations based on long-term means is presented on pages 11-13. The graphs show the Lay Monitoring lakes and the Lake Champlain stations according to the long-term mean for each of the parameters sampled. The stations and lakes are grouped, for purposes of comparison among themselves, into three general divisions: high, moderate, and low. The stations or lakes falling within the same division may be considered to have a similar degree of nutrient enrichment.

3. Trophic State

(See discussion of Lay Monitoring Data Applications on page 18.)

Sampling Sites within the Lake Champlain Basin

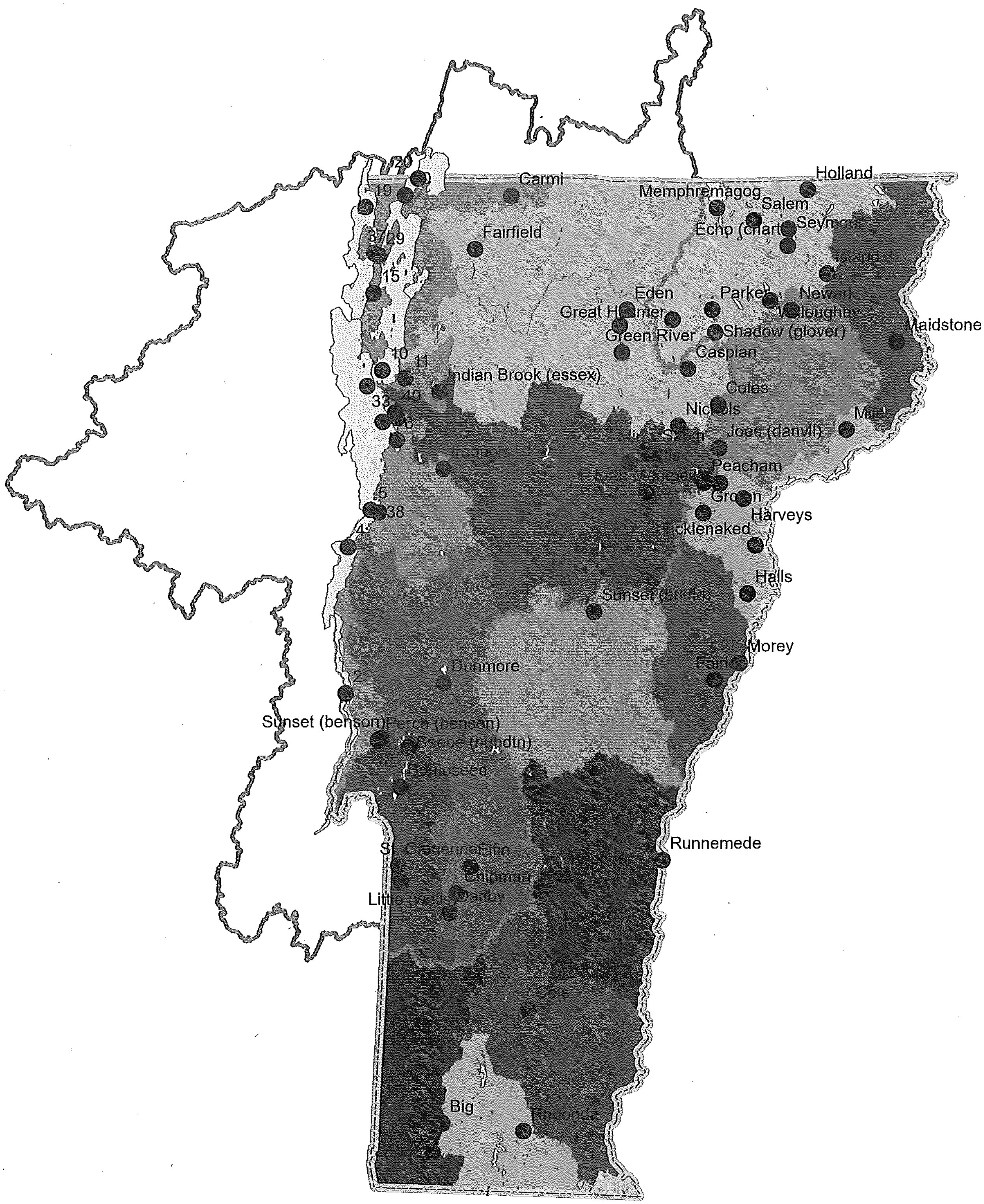


Figure 7. Shaded areas represent the 17 largest watersheds in Vermont.

LAY MONITORING DATA APPLICATIONS

The Lay Monitoring data measure lake nutrient enrichment. All lakes evolve through the process of eutrophication as they experience ongoing nutrient enrichment. Eutrophication is a lake's natural aging process whereby nutrients and sediments increase in the lake over time, increasing its productivity. A major emphasis of water quality management is to protect the natural process of eutrophication from the influences of culturally accelerated eutrophication. Lay Monitoring data help to detect culturally accelerated eutrophication, which occurs when the rate of nutrient enrichment increases because of human activity in a lake's watershed. (Figure 7 shows the size of Lake Champlain's watershed.)

Data from the Lay Monitoring Program show that lakes exhibit natural fluctuations in nutrient concentration from year to year. However, monitoring results can be used to detect significant, rapid, or smaller long-term increases in nutrient loading, which would most likely indicate cultural eutrophication. Lay Monitoring information helps to identify the changes in nutrient loading and alerts communities and lake residents to take corrective actions to prevent problems with their lake water quality.

Uses of Lay Monitoring Data

● Determining Water Quality Trends

Lay Monitoring data is used to establish the baseline conditions of a waterbody. These data can also be used to identify water quality improvement or degradation over time.

● Water Quality Assessments

Lay Monitoring data have been used to develop water quality assessments for Vermont's biennial "305(b) Report" to the U.S. Congress, named after the section of the Clean Water Act that requires the report. Data used for this purpose are evaluated in accordance with Vermont's Water Quality Assessment and Listing Methodology.

● Impaired and Priority Waters Listings

Following the development of water quality assessments, certain waters are "listed" based on the available data, which can include Lay Monitoring data. The federal Clean Water Act requires states to prepare a biennial list of waters that do not meet Water Quality Standards due to pollutants. This list of impaired (polluted) waters is called the "303(d) list," after the section of the Clean Water Act that requires the list. Vermont also prepares a list of waters that are state priorities for further study or remediation that do not fall within the limited scope of the 303(d) list. The state priority waters list includes, among others, waters in need of further assessment and waters altered by exotic species, flow regulation, or channel alteration. Data used for listing purposes are evaluated in accordance with Vermont's Water Quality Assessment and Listing Methodology.

● Legislative Process

Lay Monitoring data have been used in the legislative process and for the development of water quality standards. Data used for this purpose must be documented as quality-assured and based on reliable and reproducible field and analytical methods.

● TMDL (Total Maximum Daily Load)

Lay Monitoring data have been used for developing pollution control plans (so-called TMDL analyses) required for all impaired waters on Vermont's 303(d) list.

● Federal Funding for Remediation

Lay Monitoring data have been used to obtain federal funding for remediation projects. Funds go towards projects that cleanup waters with documented water quality problems. The highest quality data will carry the greatest weight when such data are used to direct remediation funds.

● Red Flag

Lay Monitoring data has been used to identify waters where water quality is questionable and requires more in-depth study. Once these waters have been brought to the attention of state and academic parties, professionals can conduct more rigorous research and monitoring.

Presented below are two applications of Lay Monitoring data on Lake Champlain.

A. Trophic States of Lake Champlain

Limnologists recognize that lakes naturally change or eutrophy. Eutrophication is a temporal phenomenon which occurs over a span of thousands of years. Limnologists have divided the gradual process of eutrophication into various stages of nutrient enrichment called trophic states. Generally, eutrophication is divided into three broad states -- oligotrophic, mesotrophic, and eutrophic. It is normal for all lakes to pass through these three states -- from oligotrophy through mesotrophy to eutrophy. The rate at which a lake eutrophies depends on the size and shape of the lake and the characteristics of its drainage basin.

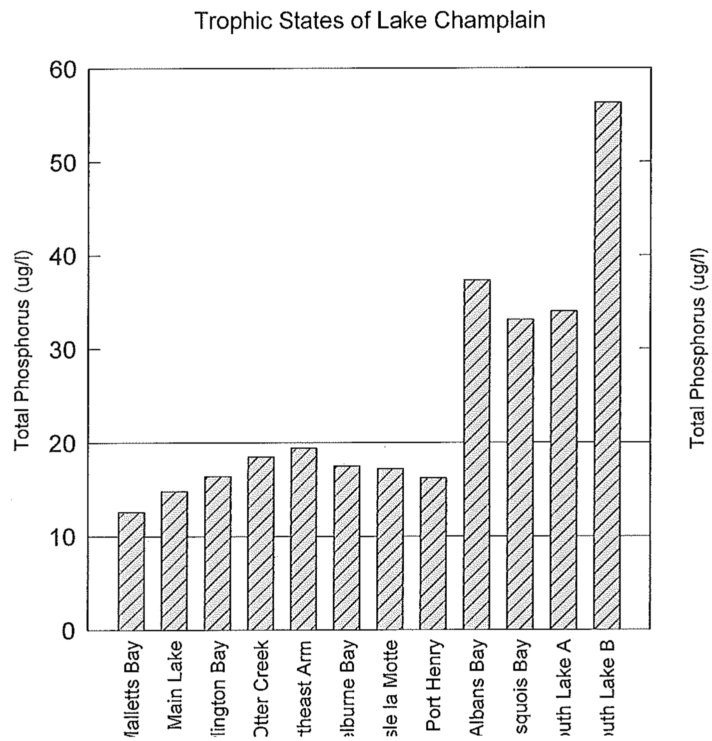


Figure 8. Trophic States of Lake Champlain

1979-2012 average summer total phosphorus concentrations in 12 segments of Lake Champlain, compared with conventional trophic state definitions (Reckhow ad Chapra, 1983).

Evaluating a lake by trophic state gives a sense of perspective to the level of nutrient enrichment. Lay Monitoring lakes other than Lake Champlain are mapped in Figure 9 according to trophic state. Because of its range in water qualities, Lake Champlain can not be assessed by just a single trophic state. Instead, data provided by the Lay Monitoring Program are used to evaluate the trophic state for different segments of Lake Champlain. Figure 8 compares the phosphorus concentrations of 12 segments of Lake Champlain to conventional trophic state levels (Reckhow and Chapra, 1983). No segment of Lake Champlain has a phosphorus concentration in the oligotrophic range (<10 ug/l). The phosphorus concentrations for the majority (eight) of segments of Lake Champlain fall within the range of mesotrophic (10-20 ug/l), while the other four segments share phosphorus concentrations in the eutrophic range (>20 ug/l). The primary reason to discuss Lake Champlain in terms of trophic states is to gain a clearer perspective on the current level of nutrient enrichment. In addition, it allows for water quality comparisons among Lake Champlain sections, as well as comparisons of Lake Champlain trophic states and those of other large lakes.

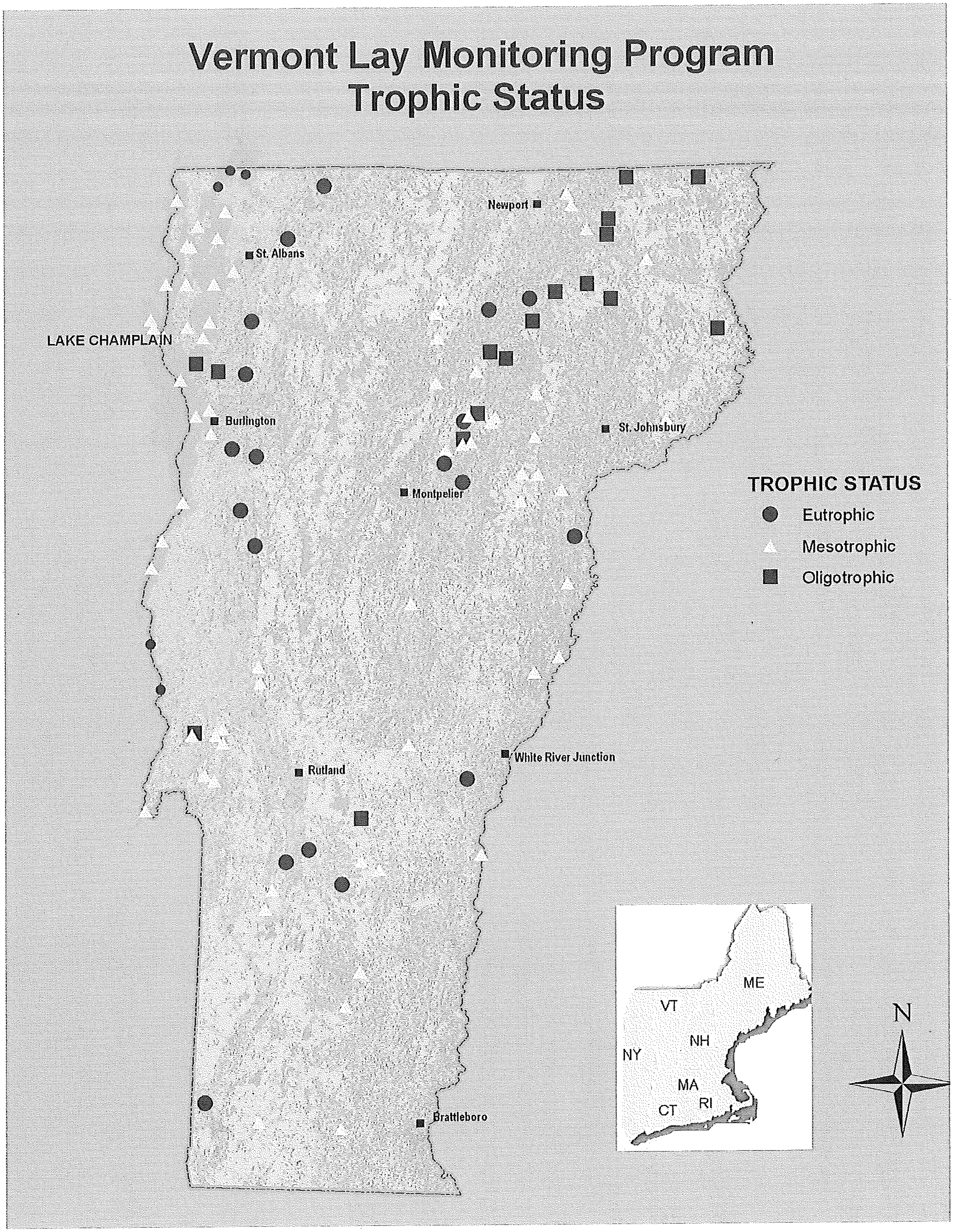


Figure 9. Inland Trophic States

B. Phosphorus Standards for Lake Champlain Are Established

In 1989, 10 years after the Lay Monitoring Program began, the Vermont Water Resources Board, a five-member appointed authority, began the process of revising the State water quality standards. The Board asked the Department of Environmental Conservation to provide technical assistance, including in the development of new phosphorus standards for Lake Champlain. The Lay Monitoring Program provided results from five years (1987-1991) of user survey data that related people's perception of water quality conditions to actual water quality sampling results.

The Vermont Lake User Survey Form was completed by monitors each time water samples were taken for phosphorus analysis. The tabulated results of hundreds of individual user survey forms provided a basis for linking actual phosphorus measurements to user perceptions of algae levels and recreational suitability. The results for Lake Champlain indicated that if the summer average total phosphorus concentration was below 14 ug/l, then essentially no lake users perceived "high algal levels" or found their enjoyment of the lake "substantially reduced" more than 1 percent of the time during the summer.

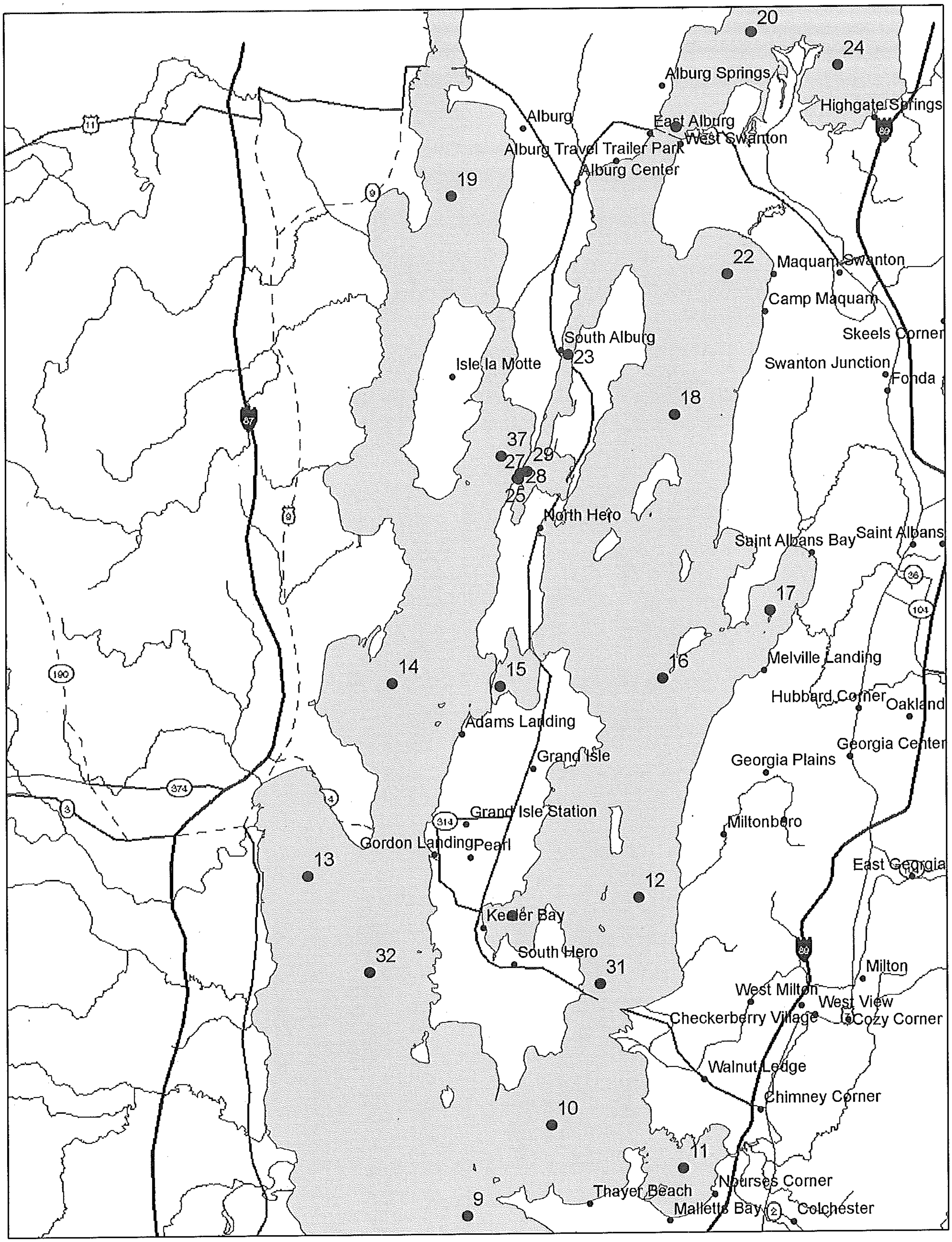
Phosphorus criteria for Vermont's portion of Lake Champlain were incorporated by the Water Resources Board into Vermont's new Water Quality Standards, effective in 1991 and still in use today. Phosphorus criteria were established for 12 segments of the lakes, as shown in Table 4. The 14 ug/l criterion was adopted as an appropriate phosphorus standard for much of Lake Champlain. In some cases, a stricter criterion of 10 ug\l was applied to protect segments of the lake where existing water quality is currently better than the 14 ug/l standard. In some of the more eutrophic bay areas of the lake, it was doubtful that the 14 ug/l value was realistically attainable or even representative of natural conditions, so the criteria were revised upwards in those cases. The phosphorus standards pertain to the euphotic zone (photosynthetic depth) in central, open water areas of each lake segment and not necessarily to inlet and small bay areas.

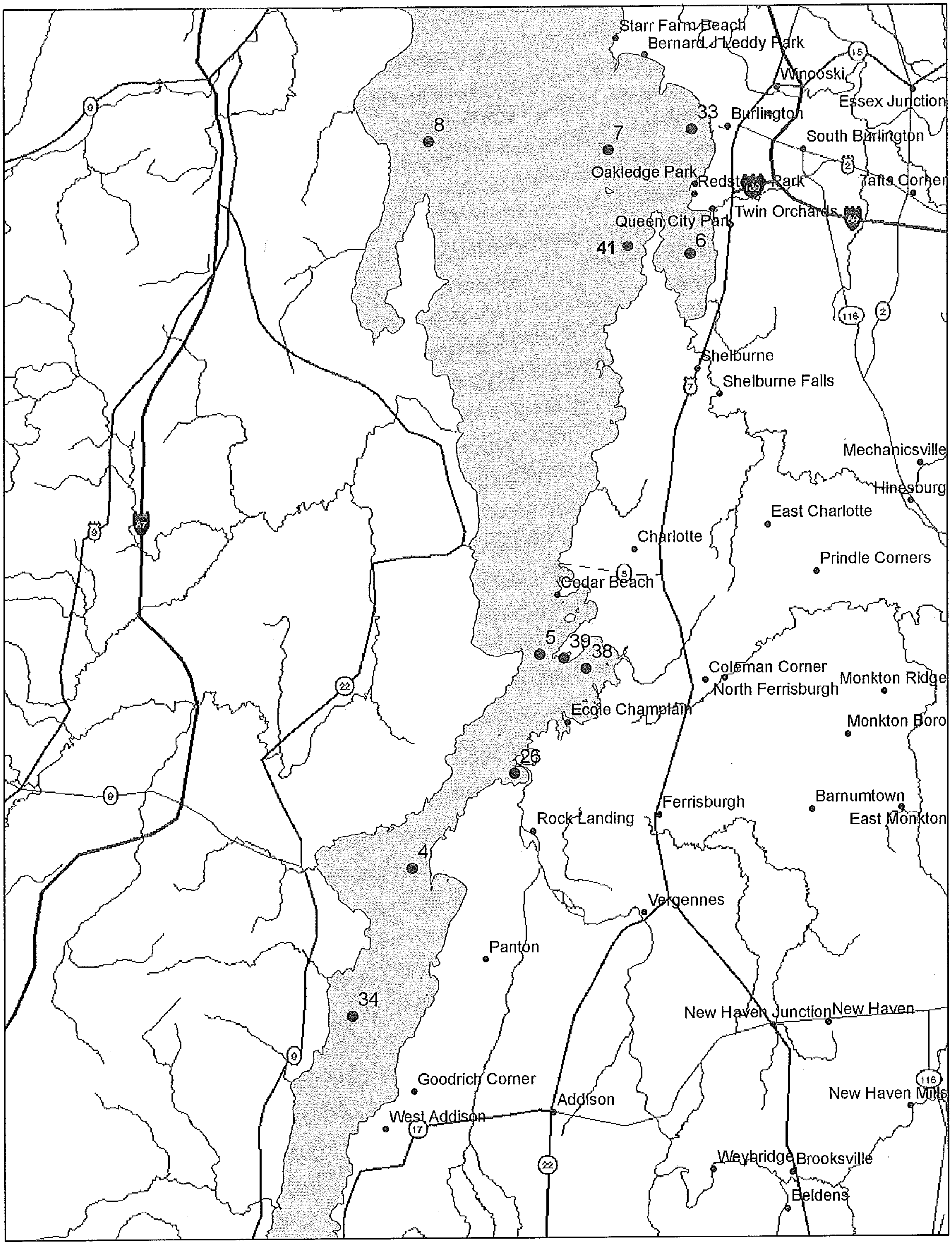
The Lay Monitoring Program contributed necessary information for the Vermont Water Resources Board to accomplish its task of developing numerical phosphorus standards for Lake Champlain. The Lay Monitoring Program will continue to measure the phosphorus concentrations, as well as chlorophyll-a concentrations and Secchi disk transparencies. The role of the Lay Monitoring Program continues to grow both in size as the lake participation increases, as well as in reputation as a recognized resource for management decisions in water quality.

Table 4. Total phosphorus criteria for Lake Champlain in Vermont's Water Quality Standards.

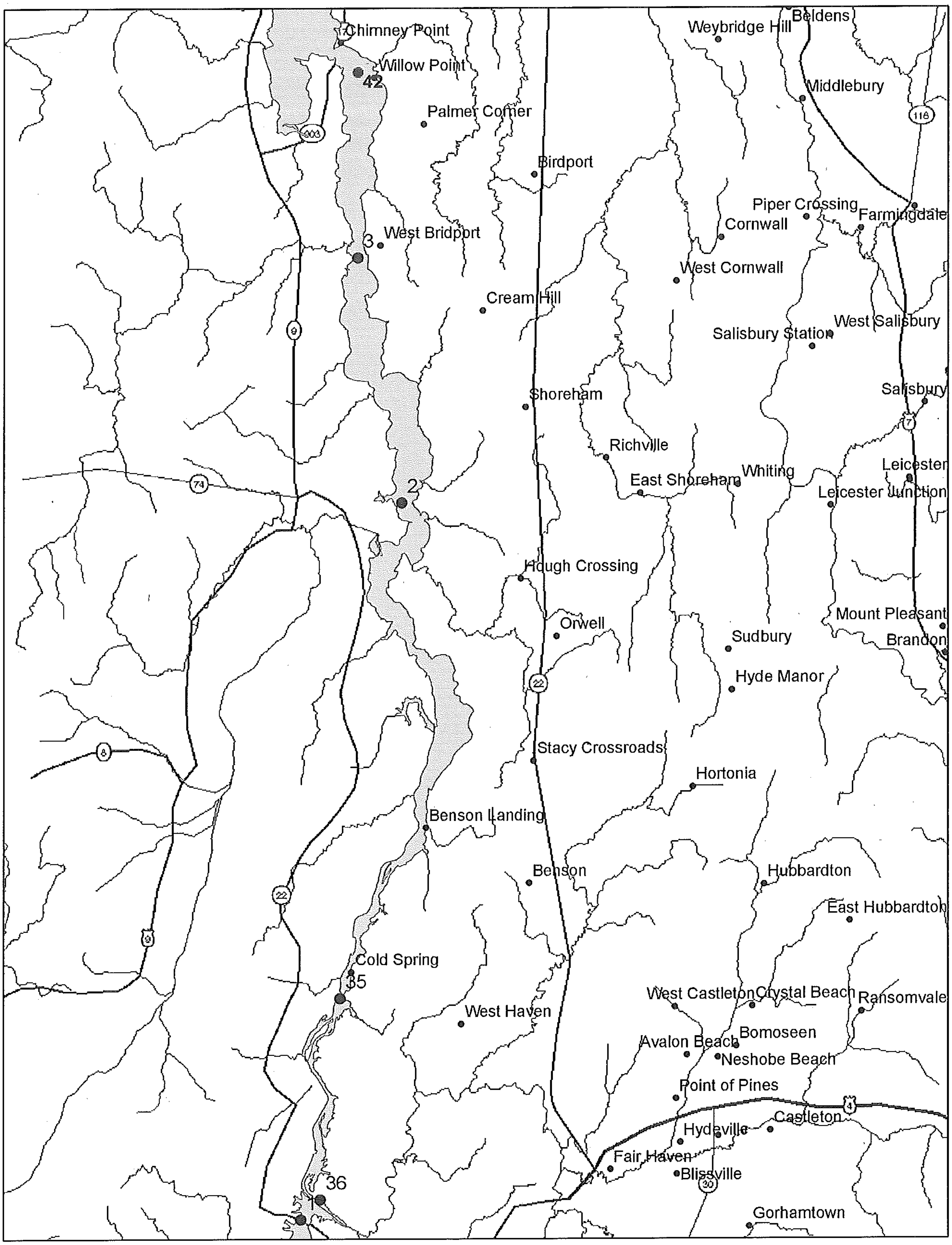
Lake Segment	Phosphorus Criterion (ug/l)
Malletts Bay	10
Main Lake	10
Port Henry	14
Burlington Bay	14
Shelburne Bay	14
Northeast Arm	14
Isle La Motte	14
Otter Creek	14
St. Albans Bay	17
South Lake A	25
Missisquoi Bay	25
South Lake B	54

SECTION 2. LAY MONITORING LAKE CHAMPLAIN STATIONS





Starr Farm Beach
Bernard J Leddy Park
Winooski
Essex Junction
33
Burlington
South Burlington
8
7
Oakledge Park
Redstone Park
Tafts Corner
Twin Orchards
Queen City Park
41
6
Shelburne
Shelburne Falls
Mechanicsville
Hinesburg
East Charlotte
Charlotte
Prindle Corners
Cedar Beach
5
39
38
Coleman Corner
North Ferrisburgh
Monkton Ridge
Ecole Champlain
Monkton Boro
26
Ferrisburgh
Barnumtown
Rock Landing
East Monkton
4
Vergennes
Panton
34
New Haven Junction
New Haven
Goodrich Corner
New Haven Mills
Addison
West Addison
Weybridge
Brooksville
Beldens


Chimney Point
Willow Point
42
Palmer Corner
Birdport
West Bridport
3
Cream Hill
Shoreham
Richville
East Shoreham
Whiting
2
Hough Crossing
Orwell
Stacy Crossroads
Benson Landing
Benson
Cold Spring
35
West Haven
36
1
Weybridge Hill
Beldens
Middlebury
Piper Crossing
Cornwall
Farmingdale
West Cornwall
West Salisbury
Salisbury Station
Salisbury
Leicester
Leicester Junction
Mount Pleasant
Sudbury
Brandon
Hyde Manor
Hortonia
Hubbardton
East Hubbardton
West Castleton
Crystal Beach
Ransomvale
Bomoseen
Avalon Beach
Neshobe Beach
Point of Pines
Castleton
Hydeville
Fair Haven
Blissville
Gorhamtown
903
9
74
22
8
116
7
4
30

LAY MONITORING LAKE CHAMPLAIN STATIONS

Lake Station **Page**

HOW LAY MONITORING DATA IS DISPLAYED

The data of each Lake Champlain station monitored in 2012 is presented in numerical order beginning on page 28. Each data page is organized according to the following sections.

Station Name and #:

Stations are listed by the number assigned to them when they first became monitoring sites. The name used in association with the station number is descriptive of the area closest to the station location.

Lay Monitor(s):

People who sampled or assisted with sampling at least three weeks during the summer are included on this list. The principal monitor is listed first.

Compared to other lakes, the long-term mean indicates:

The long-term mean is an average of all the summer annual means available for each sampling parameter. Annual summer means are calculated from at least eight samples and from at least one sample taken during June, July, and August (there are a few exceptions for those stations that are only able to be sampled during July and August). This comparison of water quality at different sampling sites provides a perspective on the range of conditions within Lake Champlain.

Table of 2012 Summary:

This table presents the maximum, minimum, and mean values, as well as the number of observations for each parameter measured during the summer of 2012.

Table of Annual Data:

This table includes the annual summer means for each sampling parameter for however long the station has participated in the program. Annual summer means are calculated with a minimum of eight samples. If the Secchi disk was observed to the lake bottom during the summer, no numerical value was entered under that year, or if less than eight samples were collected, no annual mean would be calculated.

Graph of Summer Data:

The two-part graph presents the summer sampling results for Secchi disk transparency, chlorophyll-a concentration, and total phosphorus. Time is measured along the horizontal axis.

Secchi disk transparency, presented in the lower graph, is measured in meters along the left vertical axis. The vertical axis is descending for Secchi disk transparency, with 0 meter depth, or lake surface, located at the top of the graph.

Chlorophyll-a concentration and total phosphorus are presented in the top graph and measured in micrograms per liter (ug/l) along the left vertical axis.

LARRABEES POINT

Lake Champlain Station #2

Lay Monitor: Paul Saenger

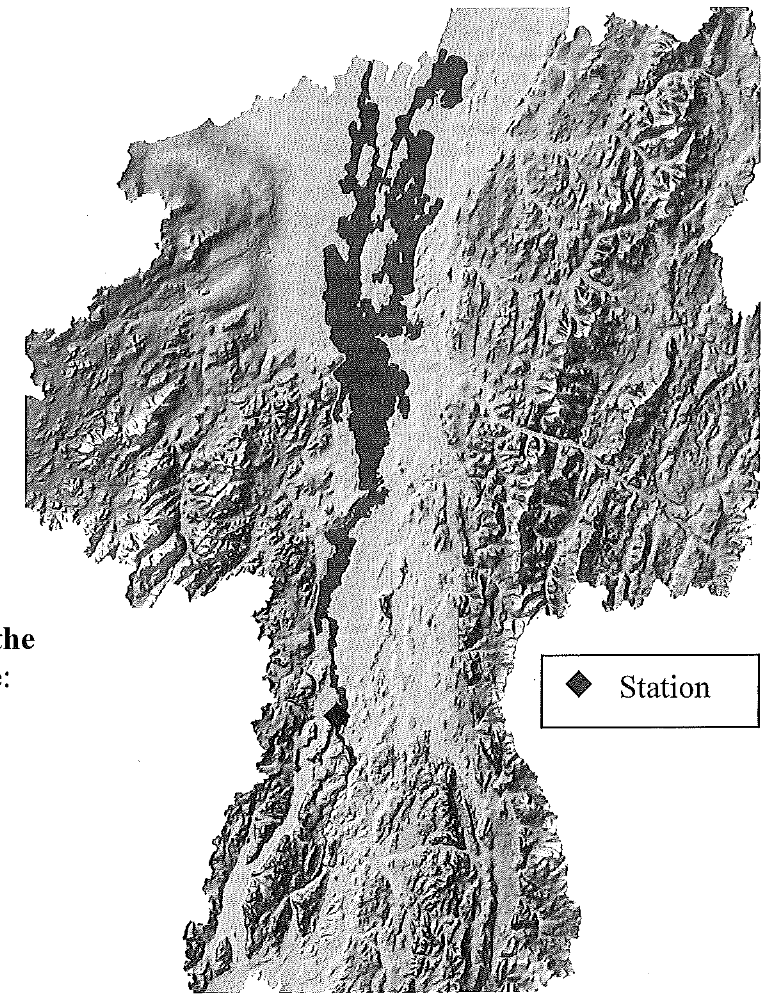
Former Lay Monitors:
Sally and Evan Littlefield

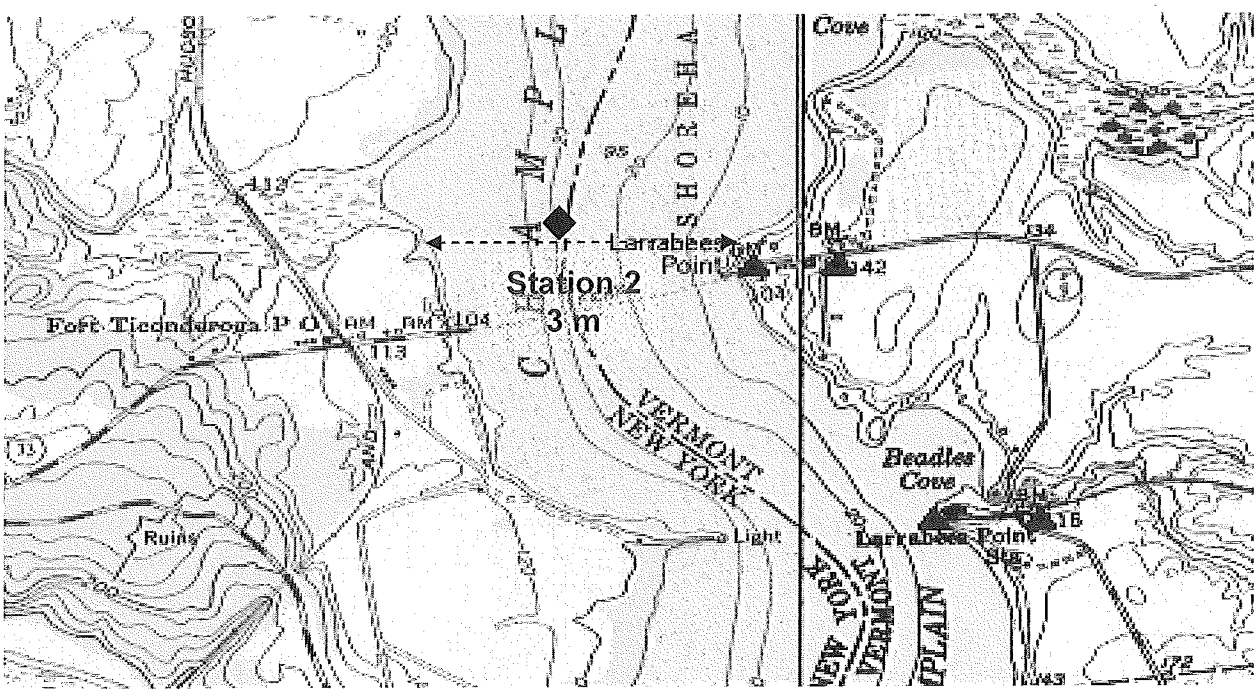
Location: station #2 is located in the South Lake section just north of the ferry crossing at Larrabees Point.

Coordinates: 43°51.21' N
73°22.58' W

Compared to other lake stations, the long-term summer means indicate:

Water clarity – low
Algal population density – high
Nutrient enrichment – high





Larrabee's Point

Annual Data

Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
1979	10	0.2	5.0	36	
1980	16	0.4	6.5	38	
1981	13	0.6	9.2	40	
1982	13	0.6	10	58	
1983	13	0.9	6.8	34	
1984	11	0.6	12	42	
1985	12	0.9	7.4	38	
1986	11	0.7	6.4	39	
1987	10	0.7	13	41	
1988	13	0.6	7.9	45	
1989	11	0.8	14	36	
1990	7				
1991	12	1.0	6.5	34	
1992	13	0.7	8.6	41	
1993	13	0.6	9.4	36	
1994	14	0.8	12	44	
1995	13	0.9	7.1	31	
1996	13	1.2	7.4	28	
1997	12	1.6	5.1	24	
1998	13	1.4	6.1	34	
1999	13	1.9	9.2	34	

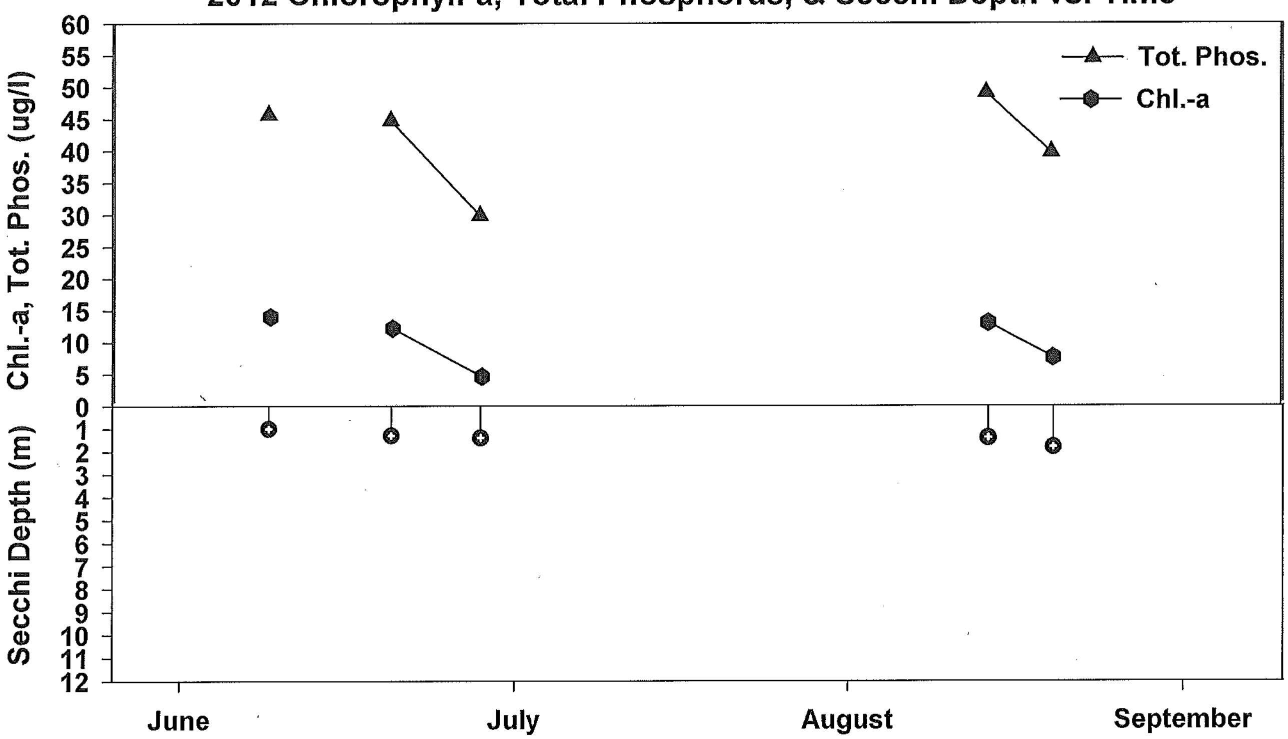
Annual Data

Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
2000	13	1.7	13	36	
2001	12	2.0	7.9	31	
2002	13	2.3	6.1	34	
2003	13	2.4	8.3	35	
2004	12	1.9	8.3	38	
2005	12	2.1	12	35	
2006	10	1.7	11	39	
2008	9	2.4	8.4	30	
2009	12	2.2	7.3	48	
2010	10	2.0	7.7	38	
2011	5				
2012	5				

2012 Summary

Parameter	Days	Min	Mean	Max
Secchi (m)	5	1.0	1.4	1.8
Chl-a (ug/l)	5	4.0	9.7	14
Summer TP (ug/l	5	30	42	49

2012 Chlorophyll-a, Total Phosphorus, & Secchi Depth vs. Time



BUTTON BAY BROAD LAKE

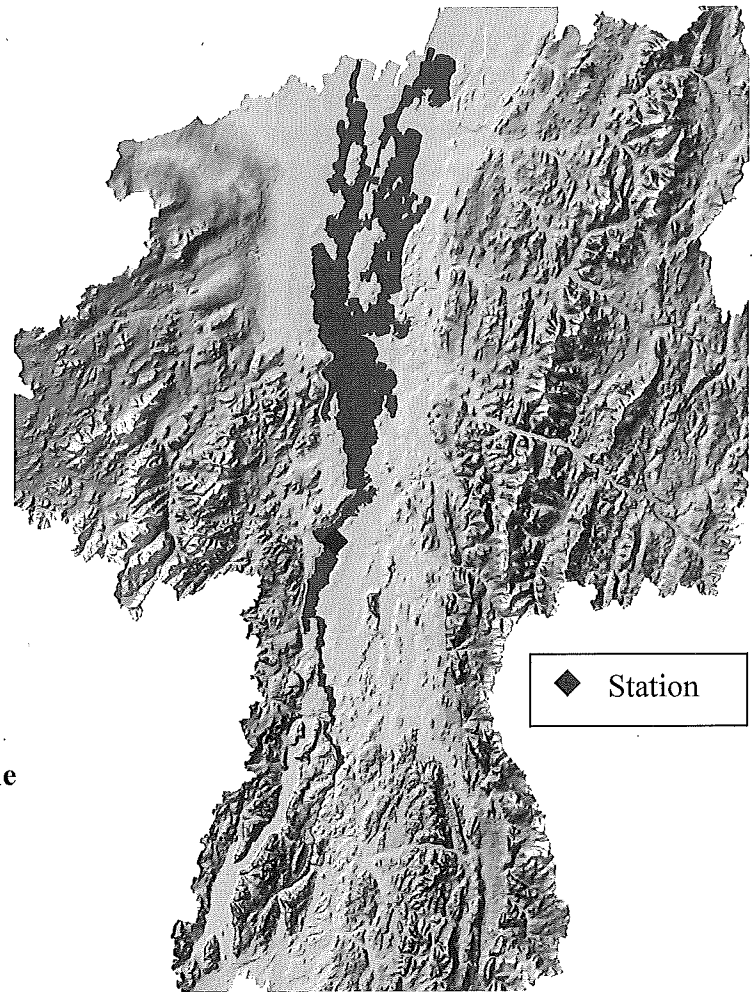
Lake Champlain Station #4

Lay Monitors: Richard Harter

Former Lay Monitors:
Cole and Vienna Shea
Amy and Sue Minor

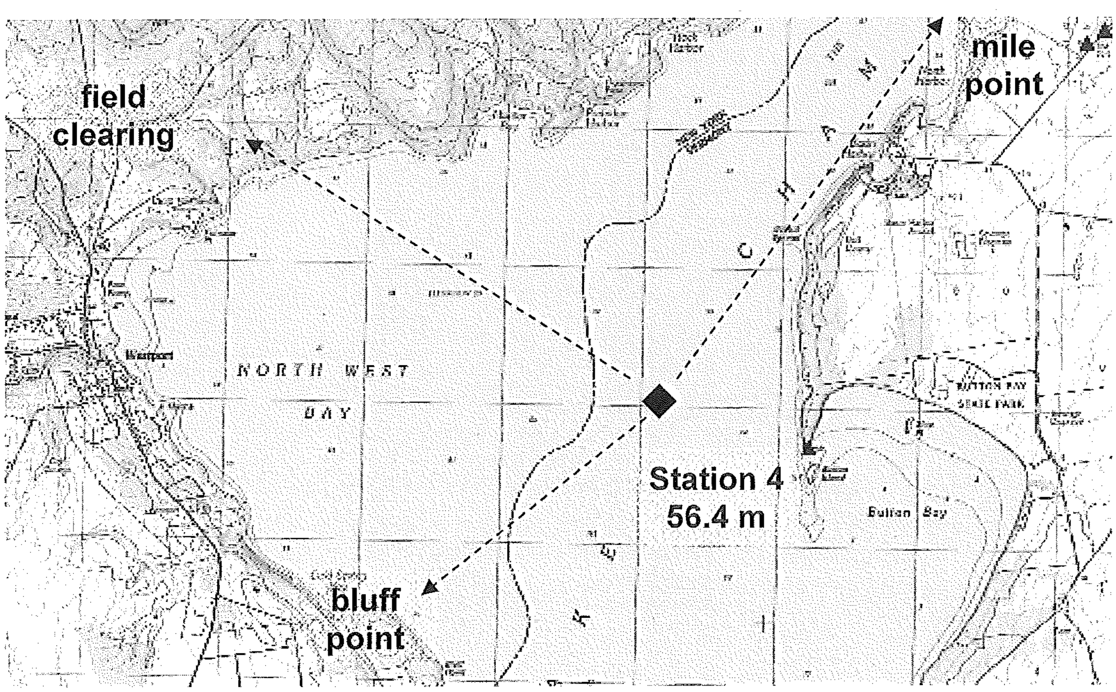
Location: station #4 is located in the Main Lake section between Button bay and Northwest Bay in approximately 175 ft. (53 m) of water.

Coordinates: 44°11.03' N
73°22.52' W



Compared to other lake stations, the long-term summer means indicate:

Water clarity – moderate
Algal population density – moderate
Nutrient enrichment – high



Button Bay Broad Lake

Annual Data

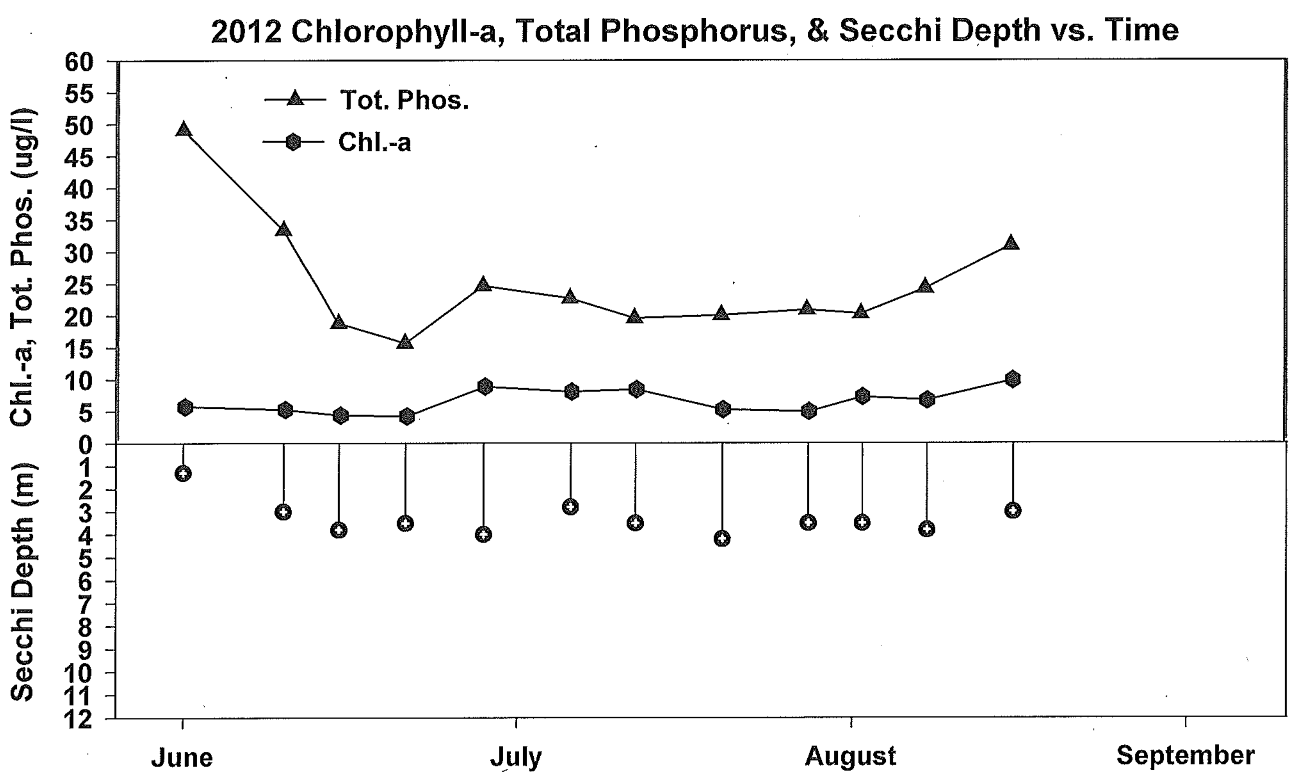
Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
1980	13	3.6	4.4	15	
1983	10	3.7	4.1	21	
1984	7				
1985	10	4.7	7.6	21	
1986	10	4.2	5.3	23	
1987	12	4.3	3.8	19	
1988	11	4.9	3.5	21	
1989	11	3.9	5.7	23	
1990	9	3.9	7.4	21	
1991	10	4.5	3.2	16	
1992	12	4.0	3.8	16	
1993	8	3.6	3.8	16	
1994	8	3.3	4.3	18	
1995	13	5.5	3.5	12	
1996	12	4.4	4.6	14	
1997	12	4.8	4.8	15	
1998	12	4.2	3.7	18	
1999	14	5.2	8.1	14	

Annual Data

Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
2000	12	4.9	4.0	16	
2001	11	5.8	3.8	17	
2002	11	6.1	2.7	13	
2003	10	5.7	3.6	15	
2004	11	5.3	4.4	14	
2005	9	3.9	7.6	28	
2006	11	3.8	7.9	25	
2007	8	4.7	5.1	19	
2008	7				
2009	11	3.8	6.5	24	
2010	12	4.6	4.7	19	
2011	11	3.0	8.8	29	
2012	12	3.3	6.0	25	

2012 Summary

Parameter	Days	Min	Mean	Max
Secchi (m)	12	1.3	3.3	4.2
Chl-a (ug/l)	12	3.6	6.0	9.3
Summer TP (ug/l	12	16	25	49



THOMPSON'S POINT

Lake Champlain Station #5

Lay Monitors: Nina and Jason Bacon

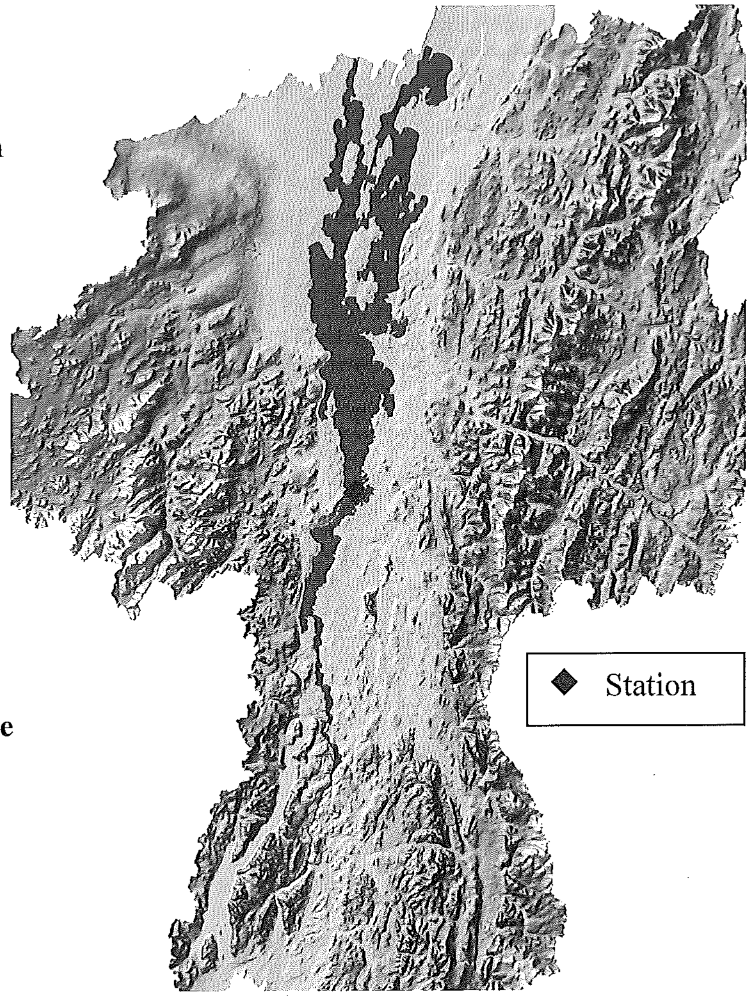
Former Lay Monitors:
John Fairbank
Tom Bates
Dan Cantrell

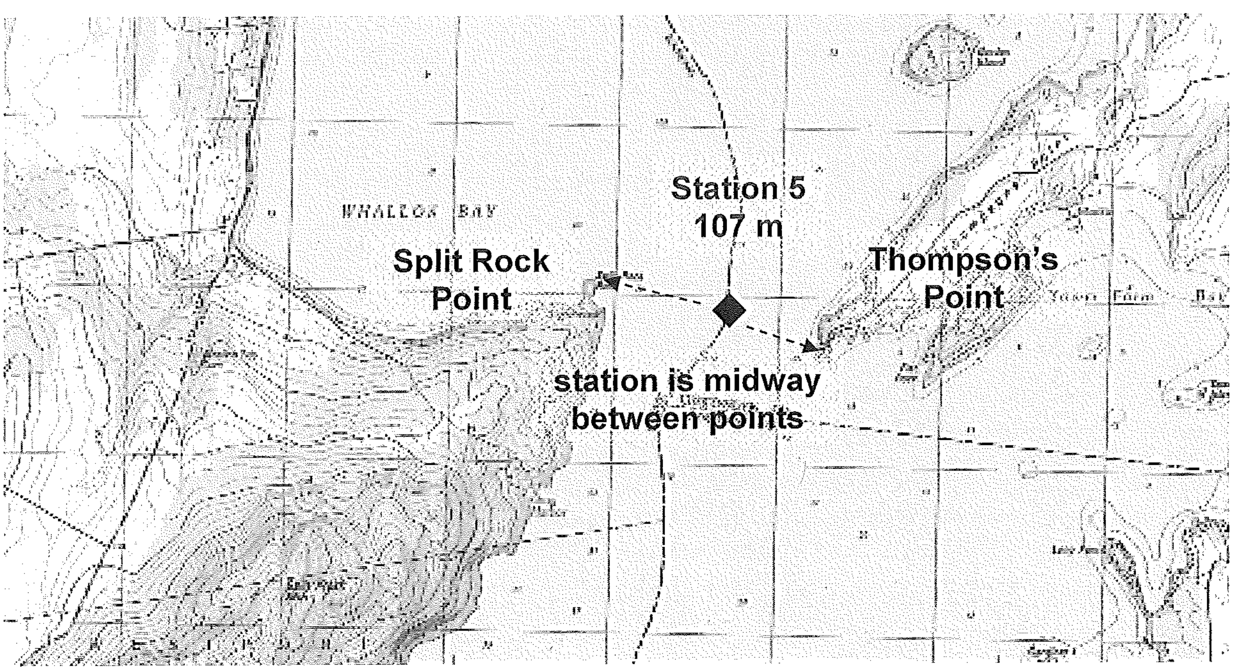
Location: station #5 is located in the Main Lake midway between Split Rock Point and Thompson's Point near the deepest spot in Lake Champlain (400 ft. or 122 m).

Coordinates: 44°16.12' N
73°18.78' W

Compared to other lake stations, the long-term summer means indicate:

Water clarity – moderate
Algal population density – moderate
Nutrient enrichment – high





Thompson's Point

Annual Data

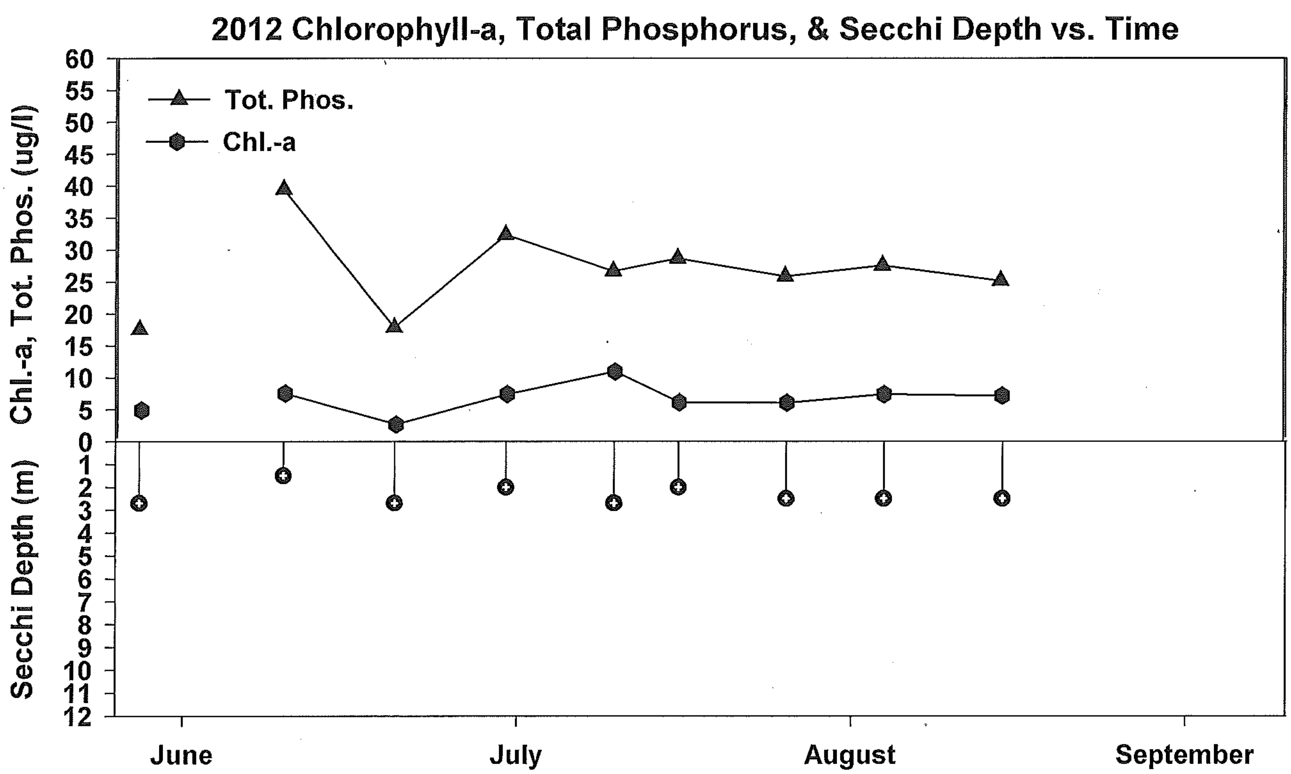
Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
1979	12	3.9	5.2	11	
1980	11	4.7	3.1	12	
1981	11	5.3	3.7	14	
1982	11	4.3	5.0	20	
1983	8	4.1	4.4	21	
1984	12	4.3	5.5	19	
1985	1				
1987	2				
1988	9	5.3	3.2	16	
1991	10	5.8	3.9	29	
1992	11	4.4	4.2	14	
1995	8	5.6	2.7		
1996	9	4.3	5.0	14	
1997	11	4.0	4.4	18	
1998	7				
1999	11	4.8	5.1	22	

Annual Data

Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
2000	12	3.6	6.9	24	
2001	9	4.2	2.7	21	
2002	11	4.5	2.8	18	
2003	10	4.6	3.7	17	
2004	8			19	
2005	11	3.1	7.3	21	
2006	9	3.5	6.3	22	
2007	10	4.7	3.7	12	
2008	9	3.3	5.2	24	
2009	10	3.0	4.7	17	
2010	10	3.8	4.5	17	
2011	9	2.5	7.3	21	
2012	9	2.3	6.1	27	

2012 Summary

Parameter	Days	Min	Mean	Max
Secchi (m)	9	1.5	2.3	2.7
Chl-a (ug/l)	9	2.0	6.1	10
Summer TP (ug/l	9	18	27	40



SHELBURNE BAY

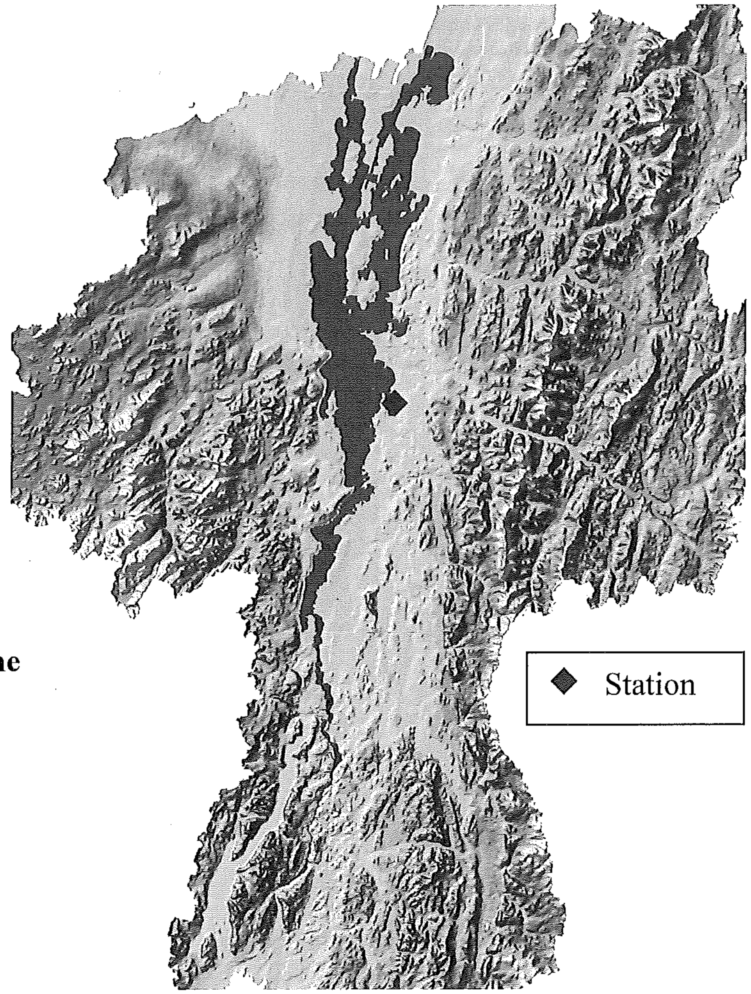
Lake Champlain Station #6

Lay Monitor: Wesley Eldred

Former Lay Monitors:
Craig Kolk
Sharon and Brent Decost

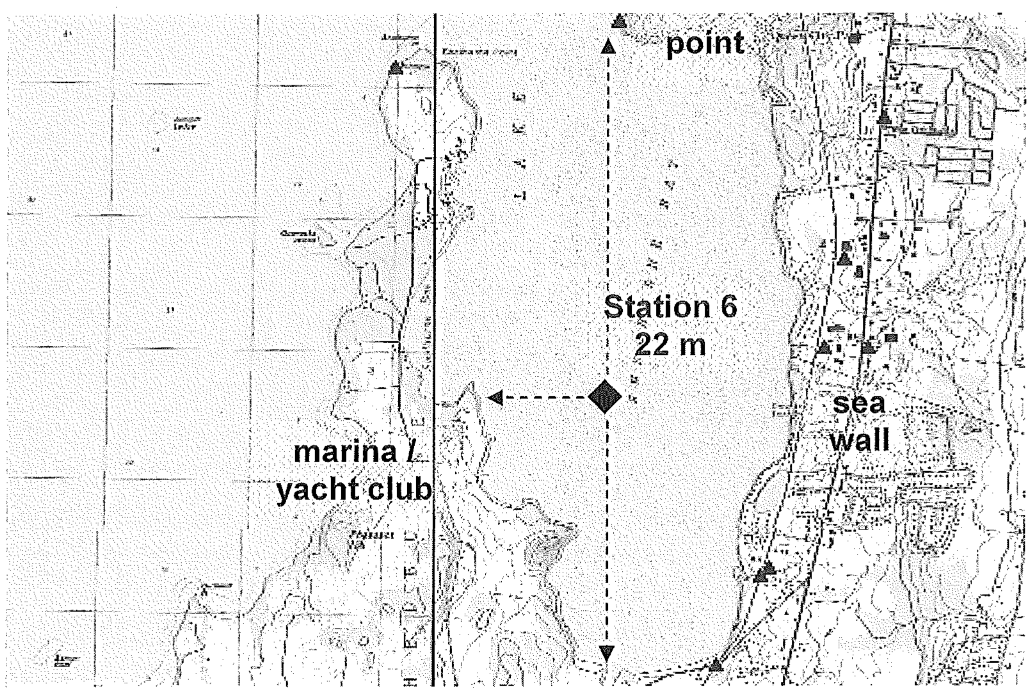
Location: station #6 is located in the Main Lake section in the middle of Shelburne Bay.

Coordinates: 44°25.40' N
73°14.02' W



Compared to other lake stations, the long-term summer means indicate:

Water clarity – moderate
Algal population density – moderate
Nutrient enrichment – high



Shelburne Bay

Annual Data

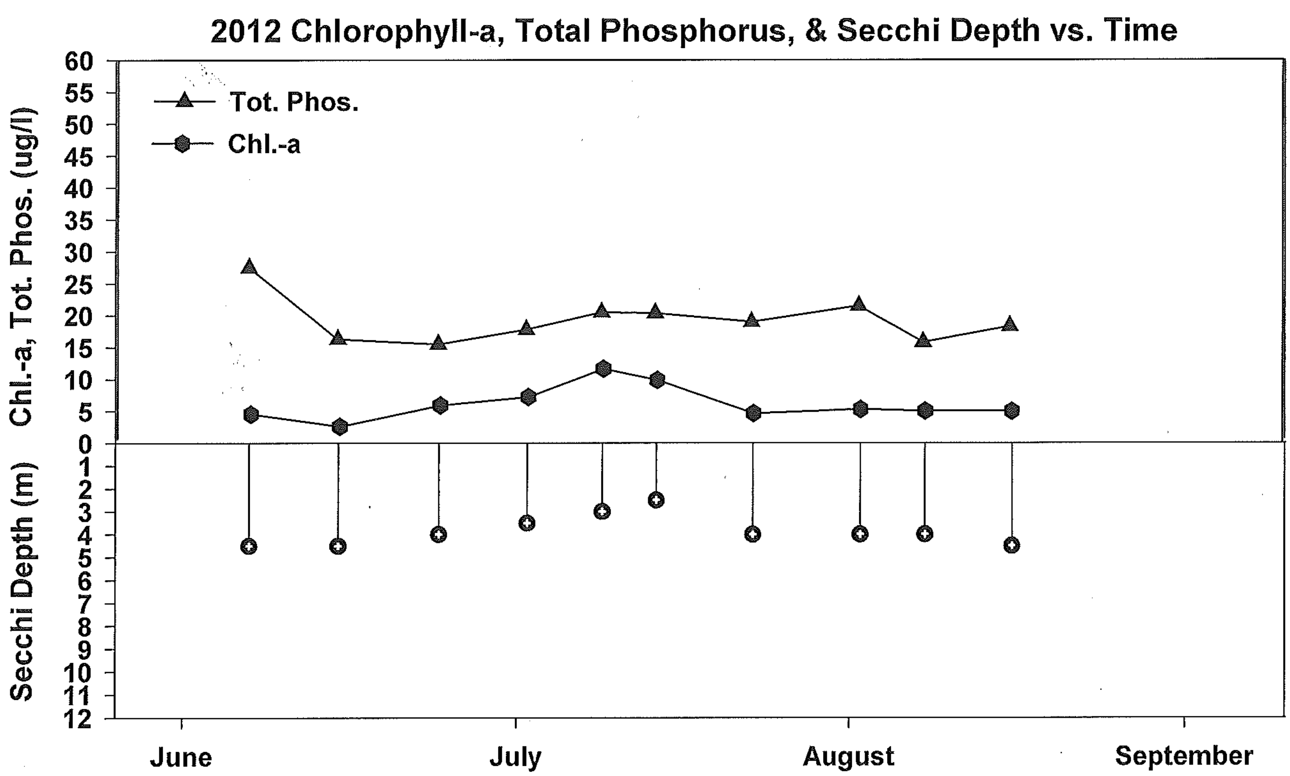
Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
1979	12	3.9	5.5	13	
1980	13	4.8	4.5	13	
1981	12	5.4	3.6	16	
1982	9	5.2	3.4	19	
1985	10	5.1	3.7	19	
1986	10	5.6	3.8	19	
1987	6				
1988	12	5.3	3.4	19	
1989	12	3.8	7.7	22	
1990	12	4.1	6.6	21	
1991	11	5.3	4.0	16	
1992	11	5.0	3.5	18	
1993	12	5.0	6.4	17	
1994	11	4.7	4.9	19	
1995	12	6.2	3.4	18	
1996	13	4.7	4.6	19	
1997	12	5.3	4.1	15	
1998	10	3.7	4.0	18	

Annual Data

Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
2000	11	4.6	4.1	19	
2001	13	4.9	3.3	16	
2002	12	5.4	2.7	15	
2003	11	5.3	3.1	16	
2004	12	4.8	3.9	16	
2005	12	4.2	6.0	19	
2006	10	4.3	5.2	20	
2007	12	4.8	4.6	17	
2008	13	4.3	4.5	22	
2009	12	4.5	4.3	22	
2010	13	5.2	3.8	19	
2011	14	3.1	8.2	25	
2012	10	3.9	5.6	19	

2012 Summary

Parameter	Days	Min	Mean	Max
Secchi (m)	10	2.5	3.9	4.5
Chl-a (ug/l)	10	2.0	5.6	11
Summer TP (ug/l	10	16	19	28



BURLINGTON BROAD LAKE

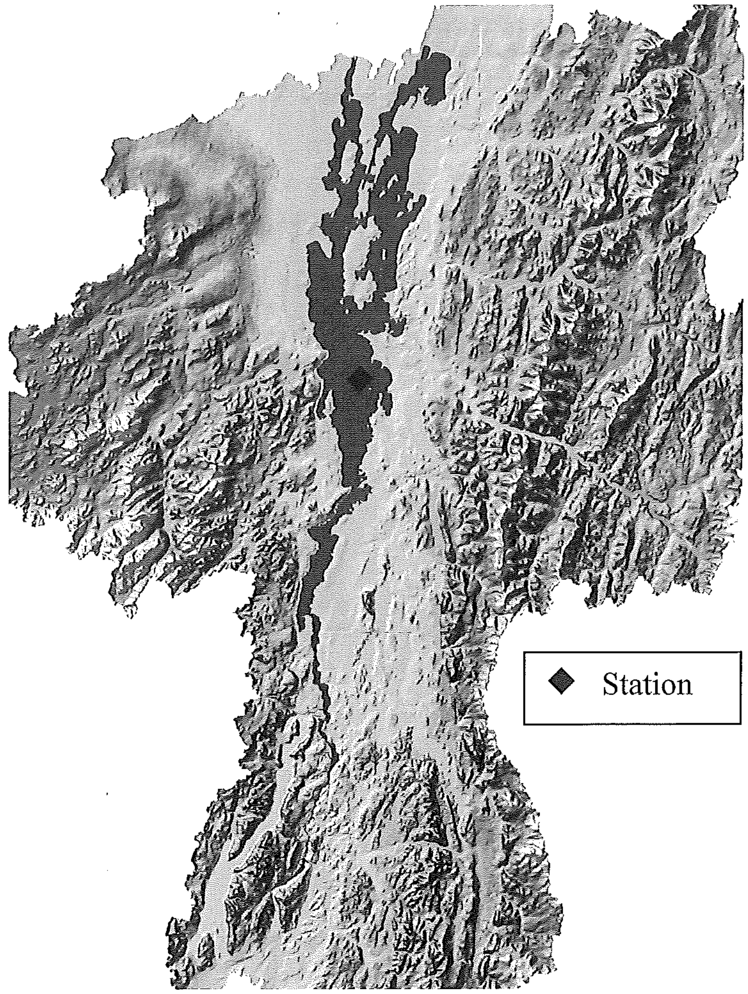
Lake Champlain Station #7

Lay Monitor: Jeremy King

Former Lay Monitors:
John Freeman
Ron Bouchard
Ron Seeley
Fred Fayette
Jacobs Sanford
Jim Manahan

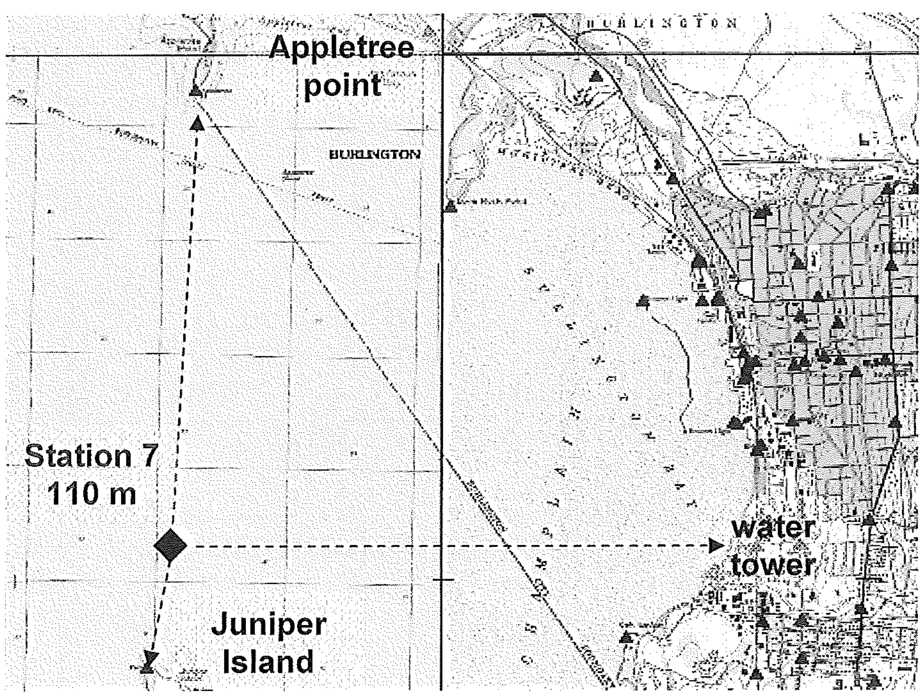
Location: station #7 is located in the Main Lake section midway between Juniper Island and Appletree Point.

Coordinates: 44°27.98' N
73°16.63' W



Compared to other lake stations, the long-term summer means indicate:

Water clarity – moderate
Algal population density – moderate
Nutrient enrichment – high



Burlington - Broad Lake

Annual Data

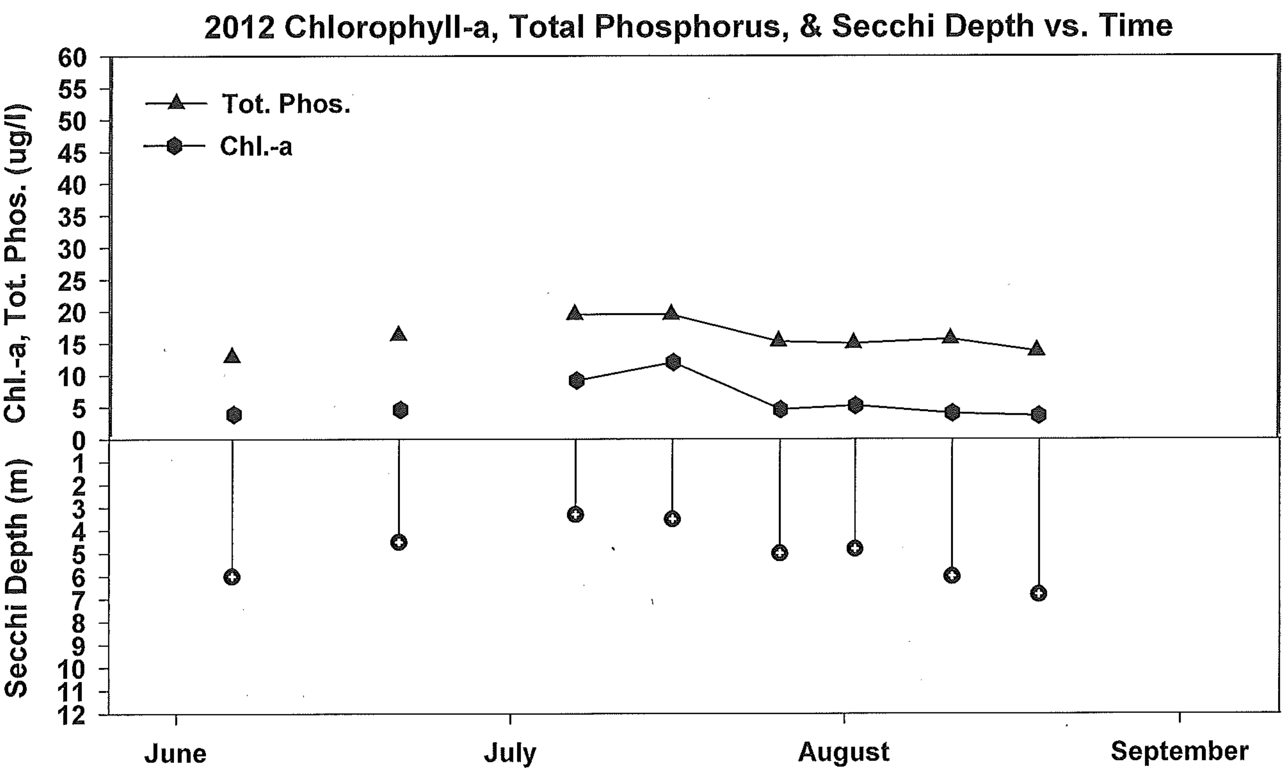
Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
1979	12	4.0	4.6	13	
1980	13	5.2	4.3	14	
1981	12	5.5	3,6	17	
1982	9	5.6	3.0	20	
1984	11	4.2	4.5	20	
1985	6				
1987	11	5.5	4.3	15	
1988	13	5.7	3.2	15	
1990	6				
1991	8	5.1	2.6	25	
1992	13	5.3	4.4	12	
1994	11	4.5	4.5	25	
1995	8	6.1	3.0	12	
1996	6				
1997	8	6.0	3.1	13	
1998	8	5.0		18	

Annual Data

Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
2000	7				
2001	8	2.6	2.9	24	
2002	9	3.8	1.4	17	
2004	10	5.9	3.5	14	
2005	13	5.1	5.8	15	
2006	11	4.5	4.9	16	
2007	11	5.2	3.8	14	
2008	10	5.1	4.0	17	
2009	9	5.2	3.5	18	
2010	9	5.5	3.3	15	
2011	10	4.0	4.9	20	
2012	8	5.0	5.3	16	

2012 Summary

Parameter	Days	Min	Mean	Max
Secchi (m)	8	3.3	5.0	6.8
Chl-a (ug/l)	8	3.0	5.3	12
Summer TP (ug/l	8	13	16	20



COLCHESTER SHOALS

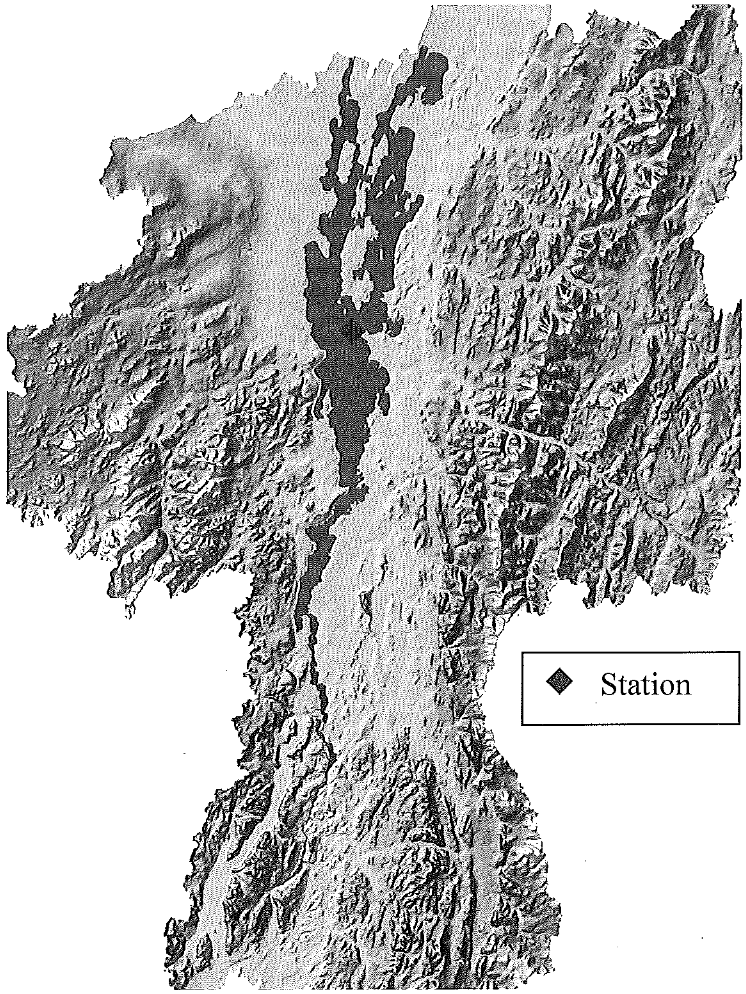
Lake Champlain Station #9

Lay Monitor: Paul Gervais

Former Lay Monitors:
Garet Livermore
Stephan Parker

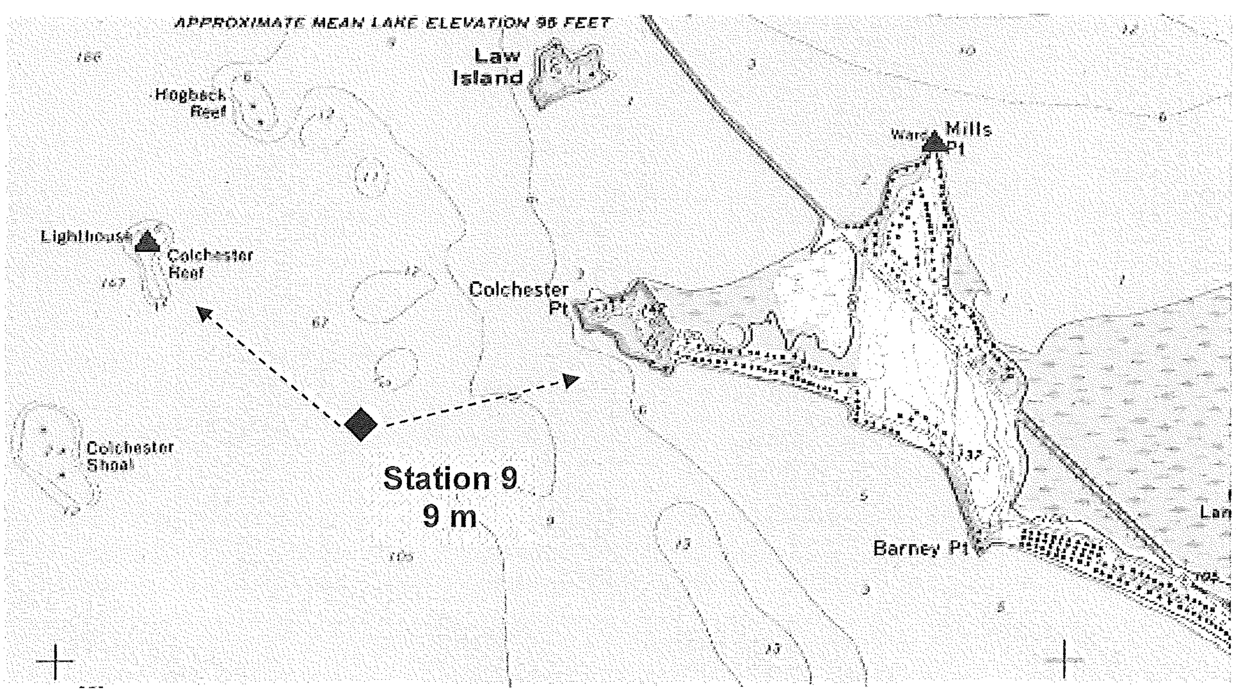
Location: station #9 is located in the Main Lake section off Colchester Point in approximately 30 ft. (9 m) of water.

Coordinates: 44°33.43' N
73°17.71' W



Compared to other lake stations, the long-term summer means indicate:

Water clarity – moderate
Algal population density – moderate
Nutrient enrichment – high



Colchester Shoals

Annual Data

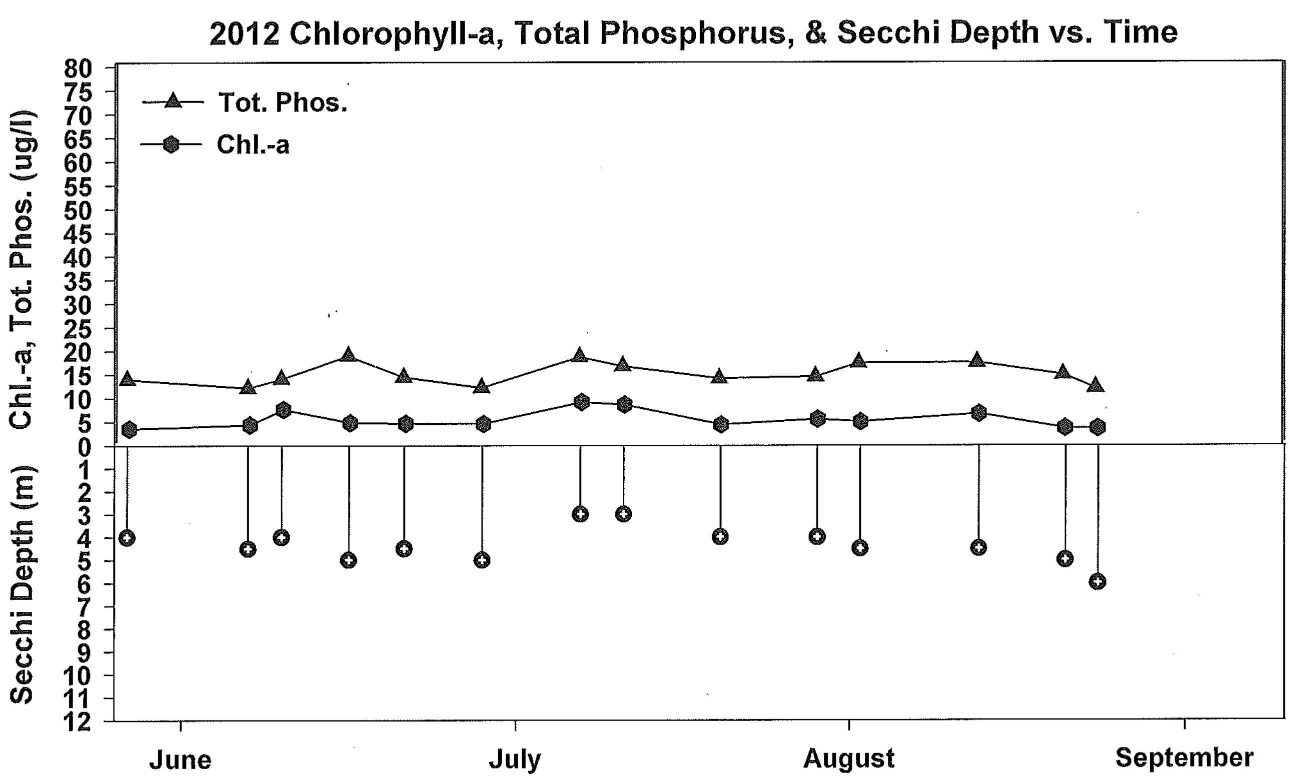
Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
1979	3				
1981	13	5.2	4.6	12	
1983	3				
1985	13	5.5	3.8	17	
1988	7				
1992	8	4.8	3.3	17	
1995	3				
1996	10	4.5	4.4	10	
1997	15	5.0	3.3	11	
1998	12	4.4	2.3	14	
1999	14	5.3	5.9	13	

Annual Data

Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
2000	11	5.3	2.7	14	
2001	12	5.1	3.4	12	
2002	14	5.1	2.6	12	
2003	11	6.0	2.2	11	
2004	12	5.2	3.5	13	
2005	12	4.7	3.8	14	
2006	11	4.5	3.9	16	
2007	12	4.9	3.7	14	
2008	14	4.9	3.5	14	
2009	14	4.8	4.1	15	
2010	17	5.1	3.2	15	
2011	13	3.7	4.7	22	
2012	14	4.4	4.6	15	

2012 Summary

Parameter	Days	Min	Mean	Max
Secchi (m)	14	3.0	4.4	6.0
Chl-a (ug/l)	14	2.7	4.6	8.4
Summer TP (ug/l	14	12	15	19



OUTER MALLETS BAY

Lake Champlain Station #10

Lay Monitors:
Steffen and Kathryn Parker

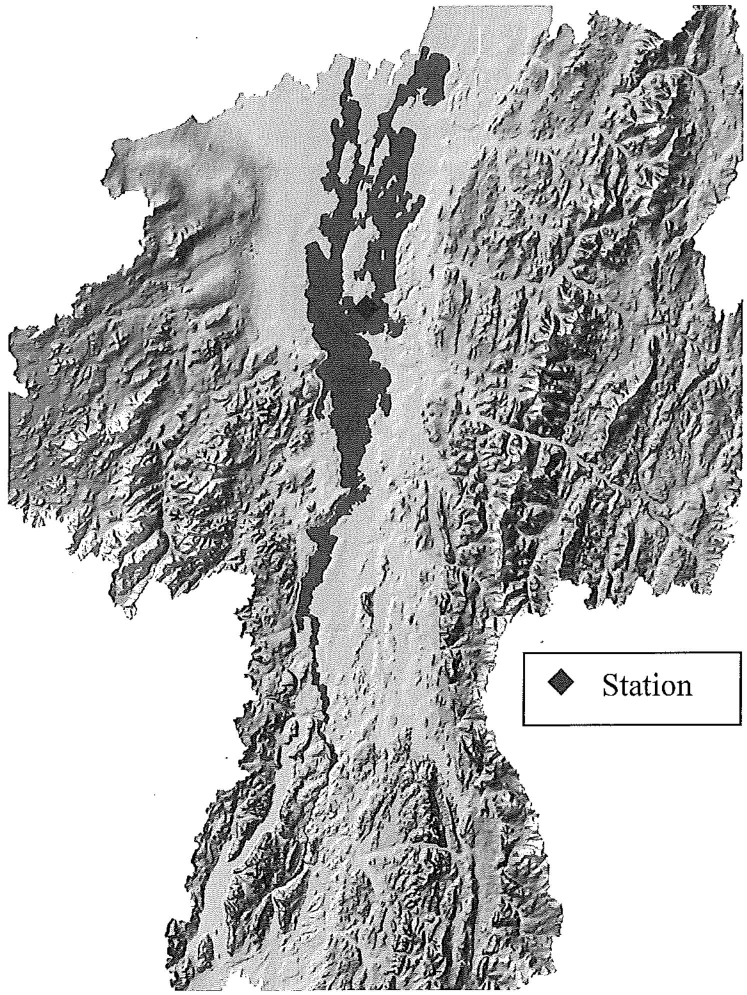
Former Lay Monitors:
Kelley DesLauriers
Jeremy King
Nancy Jacobus
Dick Kimball
Bob Fredericks
Jim Wood

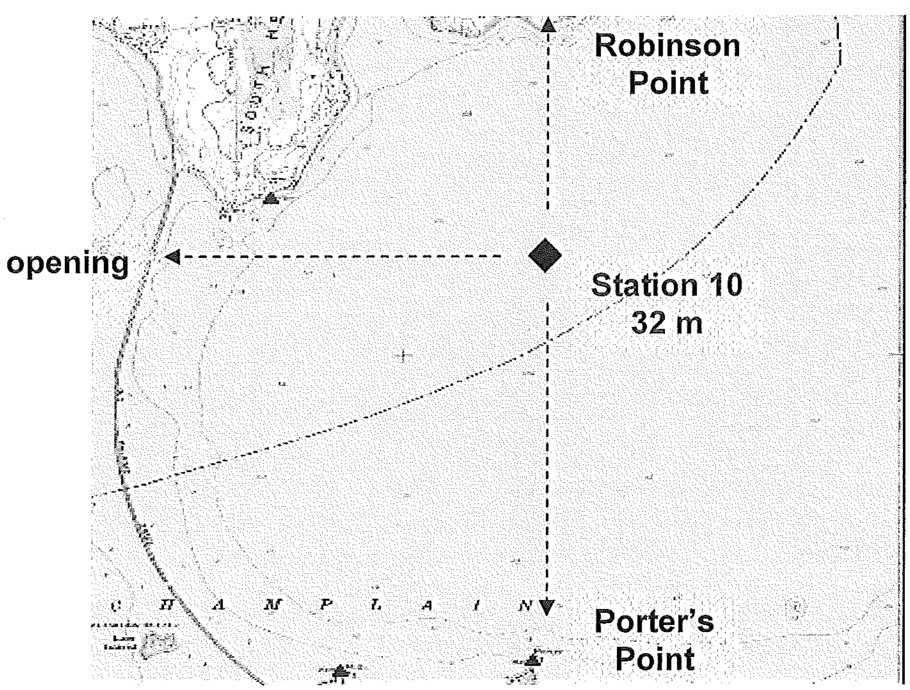
Location: station #10 is located midway between Porter's Point and Robinson Point.

Coordinates: 44°34.92' N
73°16.87' W

Compared to other lake stations, the long-term summer means indicate:

Water clarity – moderate
Algal population density – low
Nutrient enrichment – moderate





Outer Malletts Bay

Annual Data

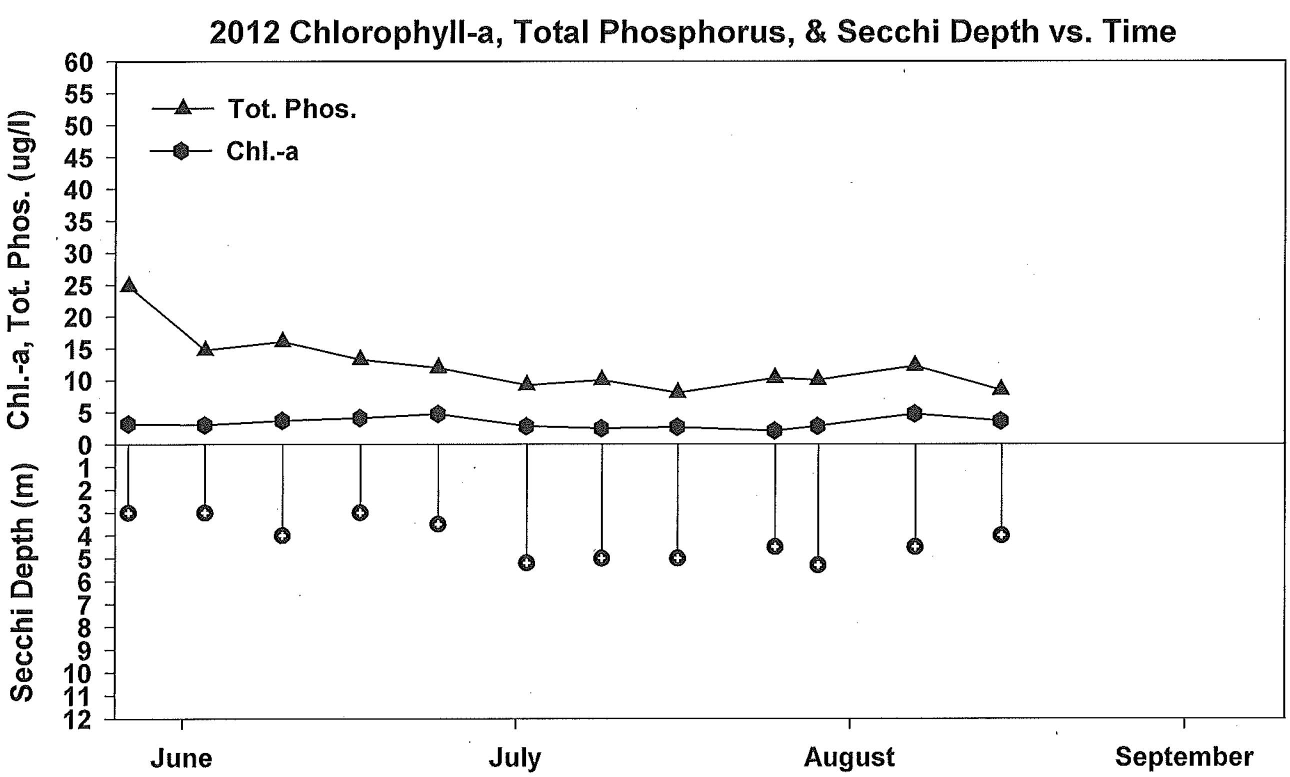
Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
1979	17	5.6	3.3	6.2	
1980	12	7.0	3.4	7.2	
1981	8	6.0	3.4	13	
1984	10	4.8	3.6	15	
1985	8	4.8			
1987	7				
1989	6				
1990	7				
1991	10	6.1	1.4	10	
1992	11	7.0	2.6	11	
1993	9	5.8	4.5	16	
1994	12	5.3	2.0	9.4	
1995	10	6.2	2.6	8.8	
1996	10	4.8	3.7	12	
1997	11	4.9	2.8	14	
1998	11	3.7	3.6	18	
1999	12	4.0	5.5	14	

Annual Data

Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
2000	14	4.6	3.0	18	
2001	11	4.5	3.2	20	
2002	13	3.4	3.9	18	
2003	13	5.3	4.1	15	
2004	9	5.0	2.1	14	
2005	9	5.0	3.5	15	
2006	17	4.1	3.7	14	
2007	17	4.8	3.9	11	
2008	13	3.9	3.2	15	
2009	19	4.4	3.1	13	
2010	15	4.3	3.6	12	
2011	15	3.7	3.1	16	
2012	12	4.2	3.3	12	

2012 Summary

Parameter	Days	Min	Mean	Max
Secchi (m)	12	3.0	4.2	5.3
Chl-a (ug/l)	12	2.0	3.3	4.7
Summer TP (ug/l	12	8.1	12	25



INNER MALLETS BAY

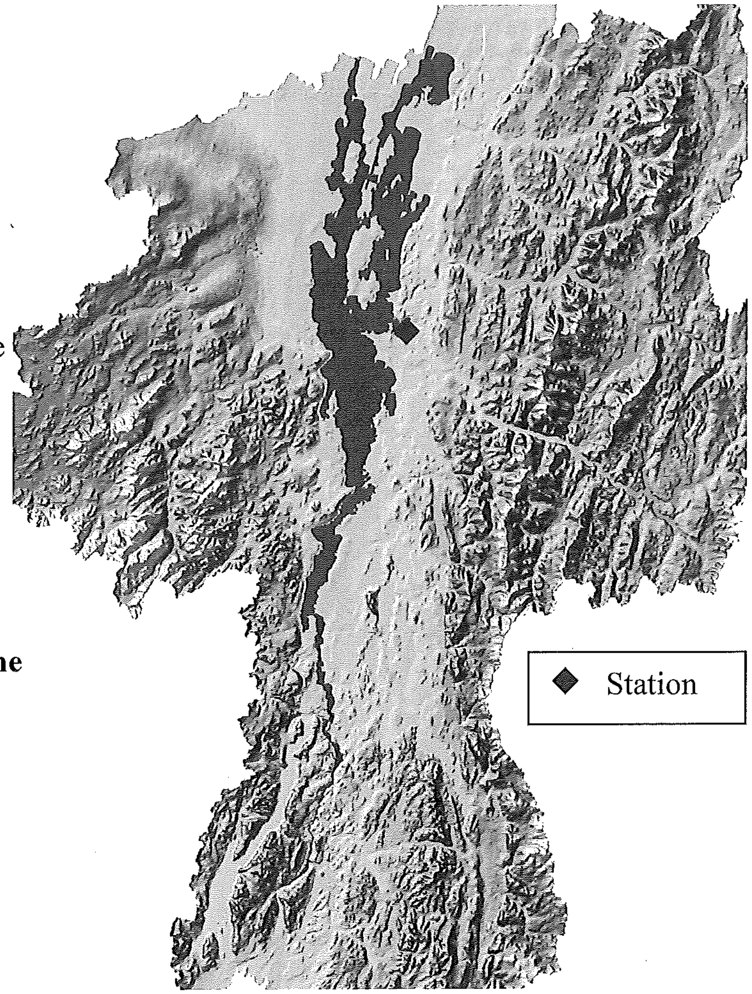
Lake Champlain Station #11

Lay Monitors:
Steffen and Kathryn Parker

Former Lay Monitors:
Bill Dunningham

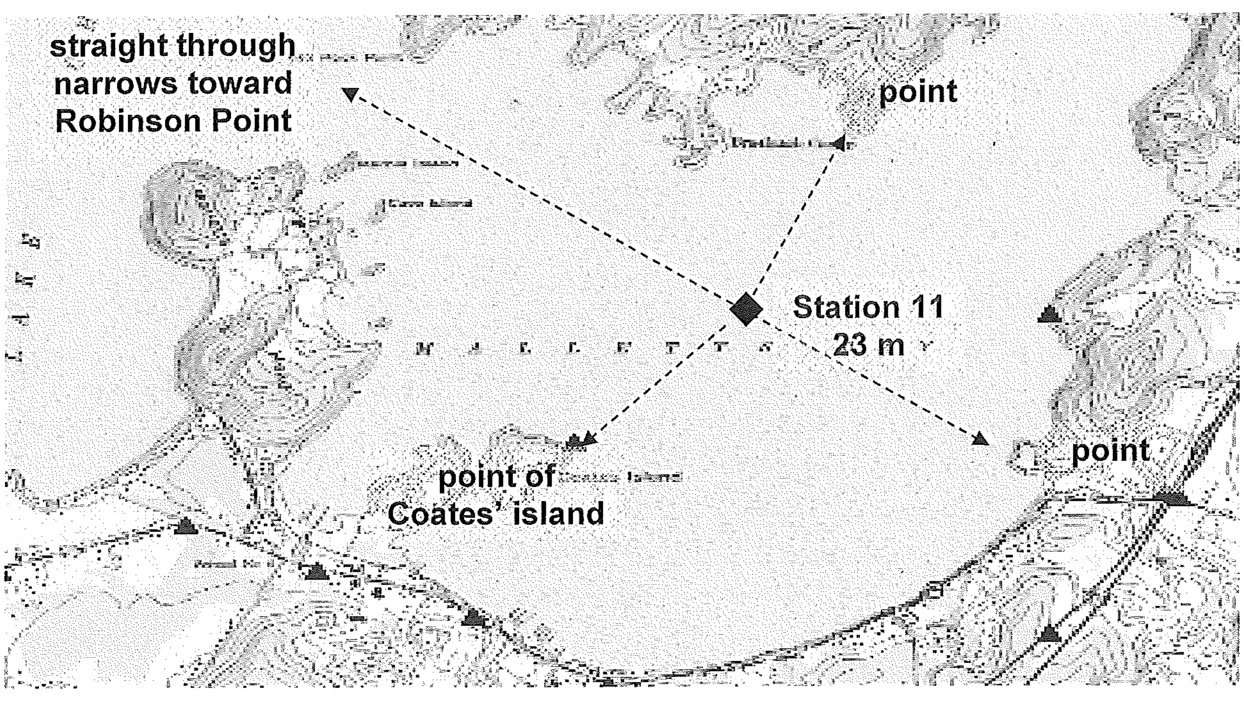
Location: station #11 is located in the inner section of Malletts Bay in approximately 75 ft. of water.

Coordinates: 44°33.90' N
73°12.50' W



Compared to other lake stations, the long-term summer means indicate:

Water clarity – moderate
Algal population density – moderate
Nutrient enrichment – moderate



Inner Malletts Bay

Annual Data

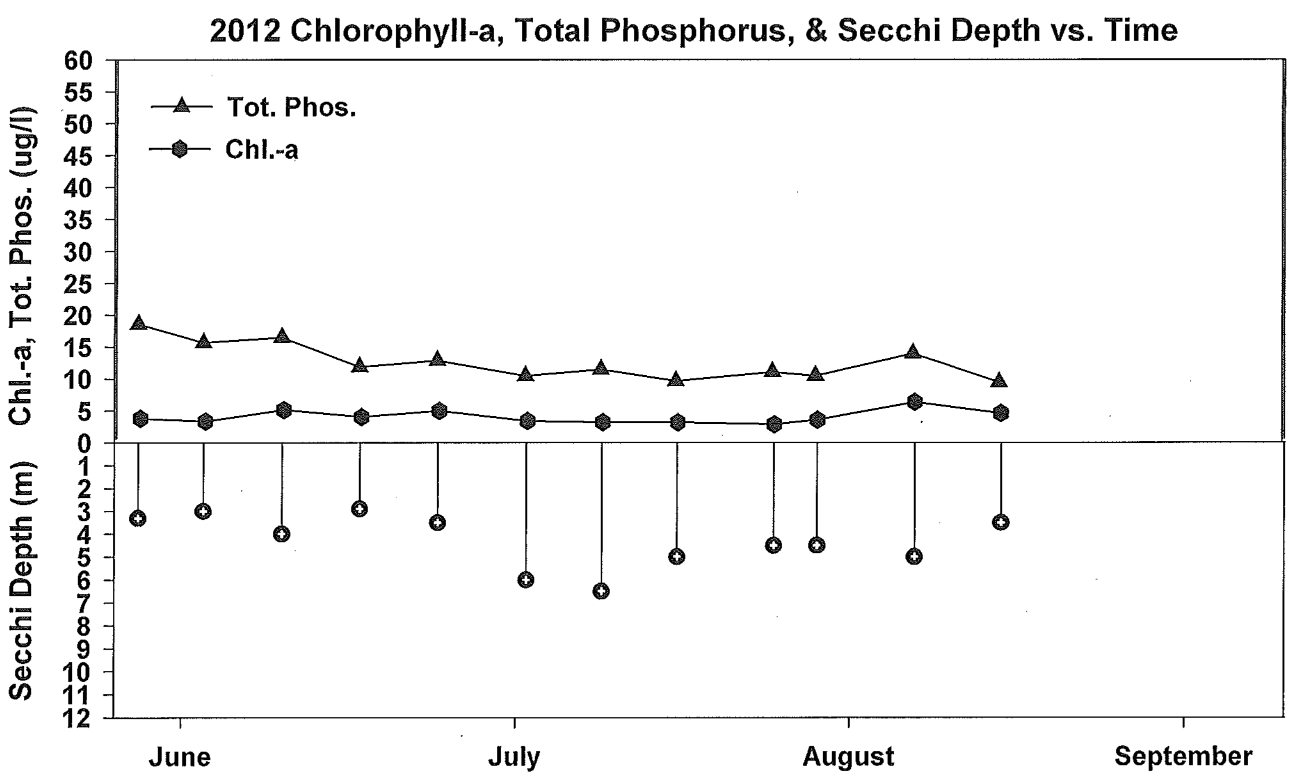
Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
1979	17	4.6	3.3	7.8	
1980	13	6.6	3.1	6.6	
1981	8	6.1	4.1	9.6	
1983	12	6.1	3.8	12	
1984	13	4.2	4.5	12	
1985	11	5.2	4.1	13	
1987	13	4.5	3.7	15	
1988	11	5.0	2.8	11	
1989	13	4.9	4.4	12	
1990	13	4.7	4.5	11	
1991	13	5.2	1.7	11	
1992	12	5.7	2.4	10	
1993	10	4.9	3.2	8.9	
1994	12	4.8	2.2	9.3	
1995	11	5.8	3.0	9.6	
1996	13	4.1	4.2	14	
1997	14	4.8	2.8	12	
1998	16	3.7	3.2	16	
1999	18	4.9	5.7	12	

Annual Data

Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
2000	15	5.2	2.4	13	
2001	17	4.6	4.1	12	
2002	17	3.9	3.4	15	
2003	16	5.7	5.2	12	
2004	15	4.4	3.6	12	
2005	12	4.7	3.4	12	
2006	19	4.2	3.8	14	
2007	18	4.7	4.1	10	
2008	13	4.5	3.7	15	
2009	19	4.2	3.0	13	
2010	16	4.3	3.7	13	
2011	15	3.8	2.8	17	
2012	12	4.3	3.4	13	

2012 Summary

Parameter	Days	Min	Mean	Max
Secchi (m)	12	2.9	4.3	6.5
Chl-a (ug/l)	12	2.2	3.4	5.8
Summer TP (ug/l	12	9.5	13	19



THE GUT

Lake Champlain Station #15

Lay Monitor: Hadley Clark

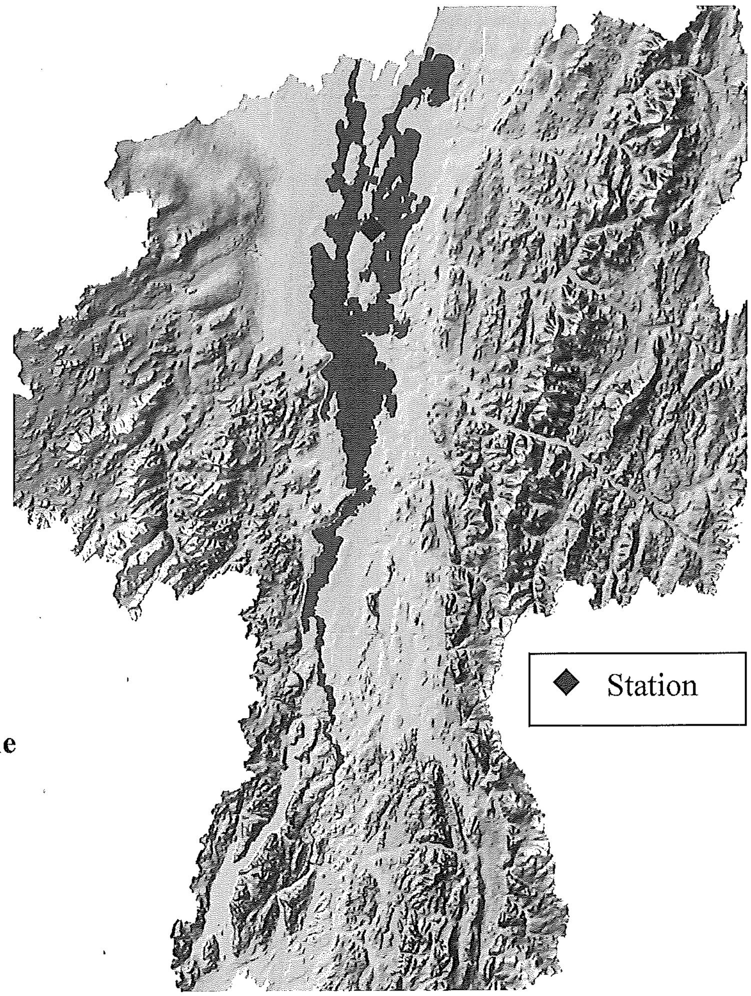
Former Lay Monitors:
Emily and Dan Clark
Eileen Brady
Roger Landry
Robert Martin

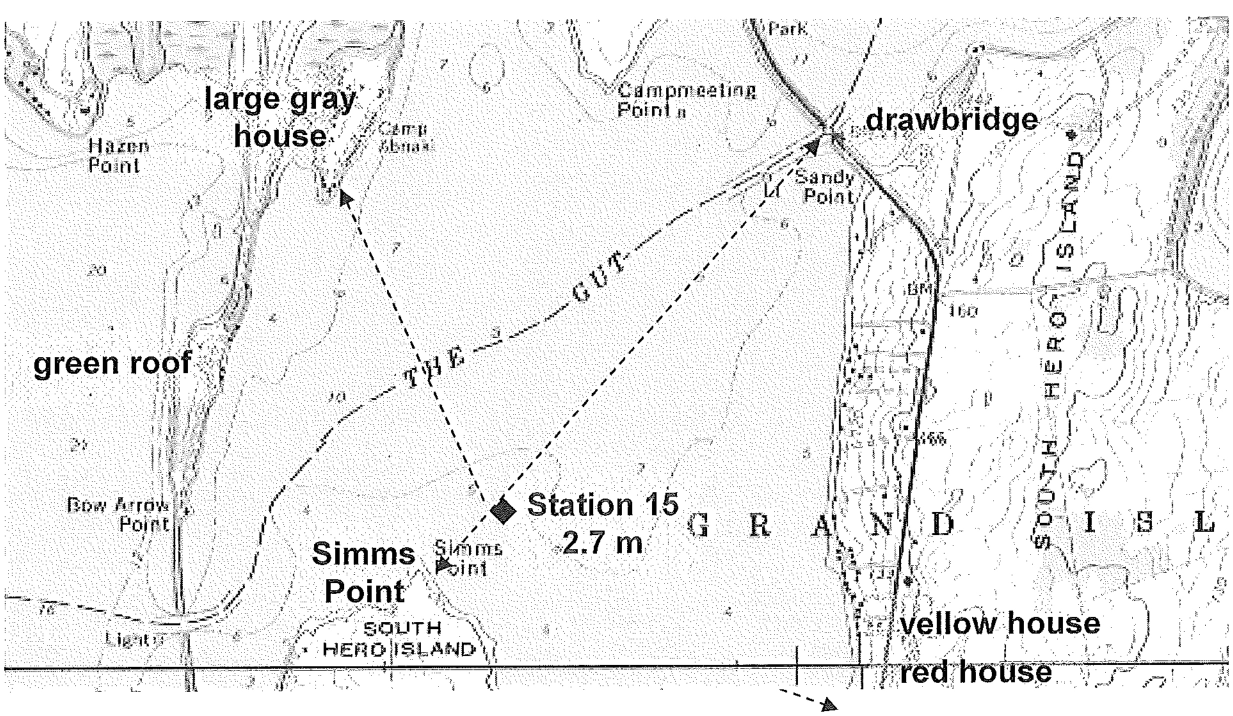
Location: station #15 is located in the Gut in the Northeast Arm section, beside Red Nun Buoy #6 in 15 ft. (4.5 m) of water.

Coordinates: 44°45.30' N
73°18.67' W

Compared to other lake stations, the long-term summer means indicate:

Water clarity – moderate
Algal population density – low
Nutrient enrichment – high





The Gut

Annual Data

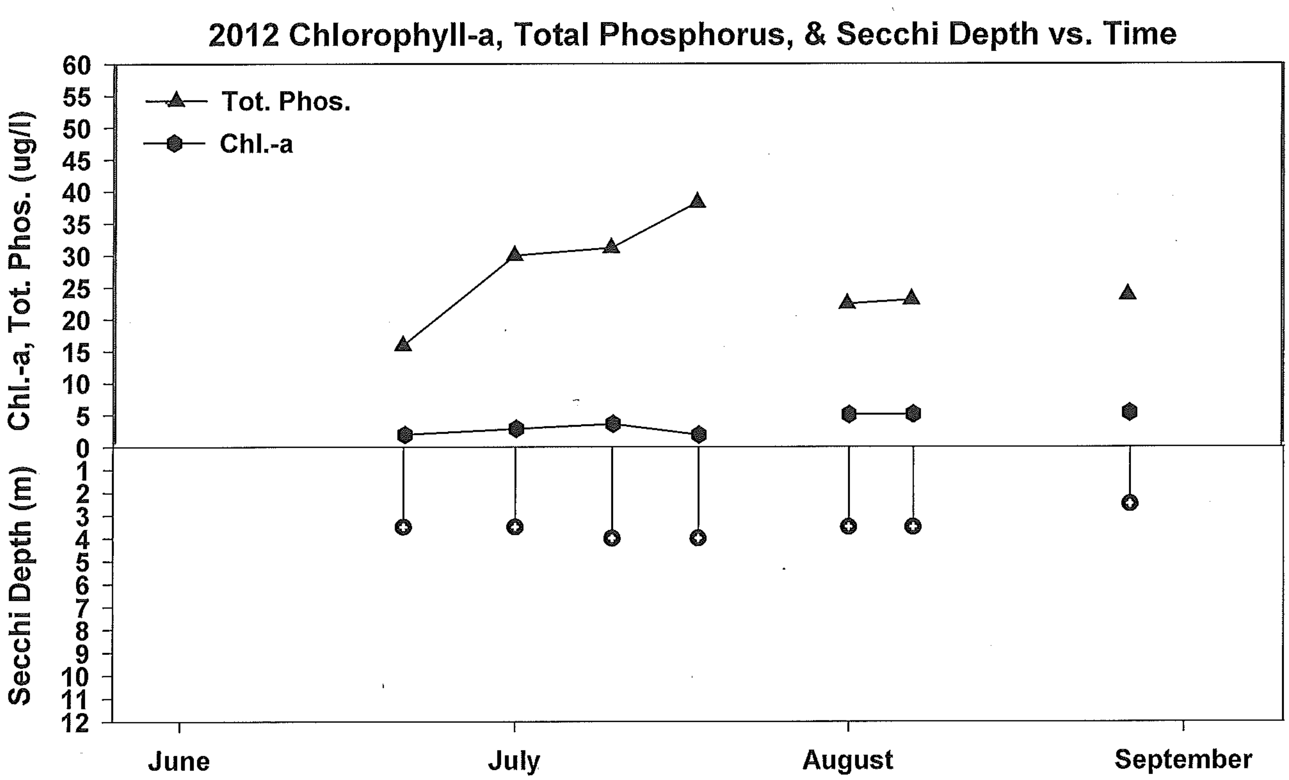
Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
1979	11	3.3			
1980	14	3.3			
1981	12				
1982	11		2.7	23	
1983	13		3.2	25	
1984	12	4.2	4.4	20	
1985	12		3.0	22	
1986	10	4.2		25	
1987	12		2.7	22	
1988	11		2.9	24	
1989	12		3.6	23	
1990	12		3.7	18	
1991	12		2.8	21	
1992	12		2.5	15	
1993	10	3.7	2.6	16	
1994	8		2.5	24	
1995	9		1.5	15	

Annual Data

Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
2006	9	2.9	6.0	21	
2007	10		4.3	19	
2008	12	3.3	2.7	19	
2009	12		3.7	21	
2010	10		2.1	16	
2011	9	2.9	2.5	22	
2012	7				

2012 Summary

Parameter	Days	Min	Mean	Max
Secchi (m)	7	2.5	3.5	4.0
Chl-a (ug/l)	7	1.2	3.1	4.8
Summer TP (ug/l	7	16	26	38

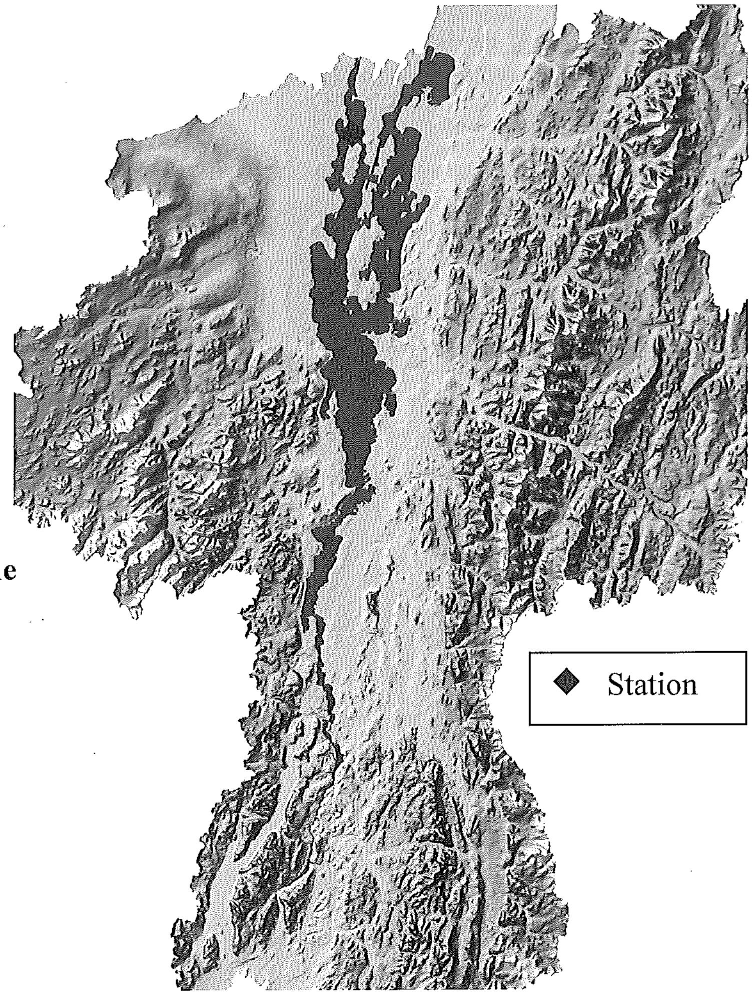


POINT AU FER

Lake Champlain Station #19

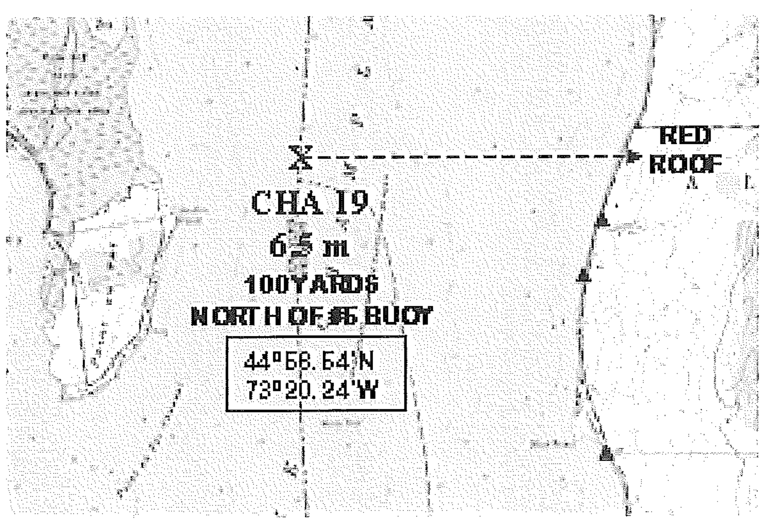
Lay Monitors: Joe Southwick

Location: station #19 is located in in the Main Lake section northeast of Point Au Fer. The station depth is 6 meters
Coordinates: 44°47.12' N
73°09.73' W



Compared to other lake stations, the long-term summer means indicate:

Water clarity – moderate
Algal population density – moderate
Nutrient enrichment – high



Point Au Fer

Annual Data

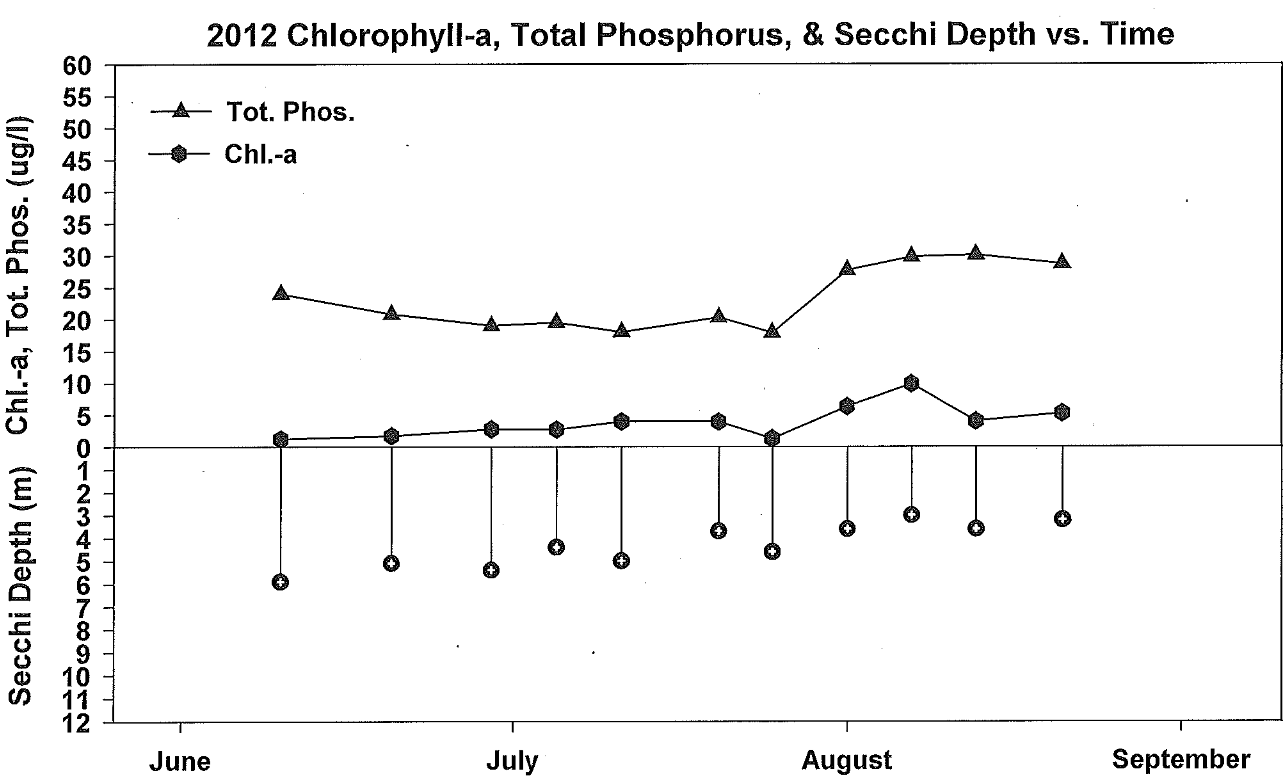
Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
1979	12		2.6		
1980	11		2.9	17	
1981	13		3.1	19	
1982	11		2.9	18	
1983	12		3.7	20	
1984	8	3.7	3.9		
1985	10	4.1	4.4	25	
1986	11		4.0	22	
1987	11		2.8	20	
1990	10	4.2	5.0	18	
1991	10		4.1	20	
1992	9		2.8	17	
1993	8	4.9	3.7	19	
1994	5				
1995	8		3.5	18	
1996	7				
1997	10		2.3	14	
1998	9	3.7	3.7	18	
1999	12		3.3	21	

Annual Data

Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
2000	4				
2001	11		3.0	18	
2002	10		2.2	25	
2003	8	4.4	4.3	22	
2004	8		2.0		
2006	10		4.0	21	
2007	10		5.0	18	
2009	12	5.2	2.4	22	
2010	11	4.5	5.3	26	
2012	11	4.3	4.5	23	

2012 Summary

Parameter	Days	Min	Mean	Max
Secchi (m)	11	3.0	4.3	5.9
Chl-a (ug/l)	11	1.8	4.5	10
Summer TP (ug/l	11	18	23	30



OUTER MISSISQUOI BAY

Lake Champlain Station #20

Lay Monitors: Paul Hansen

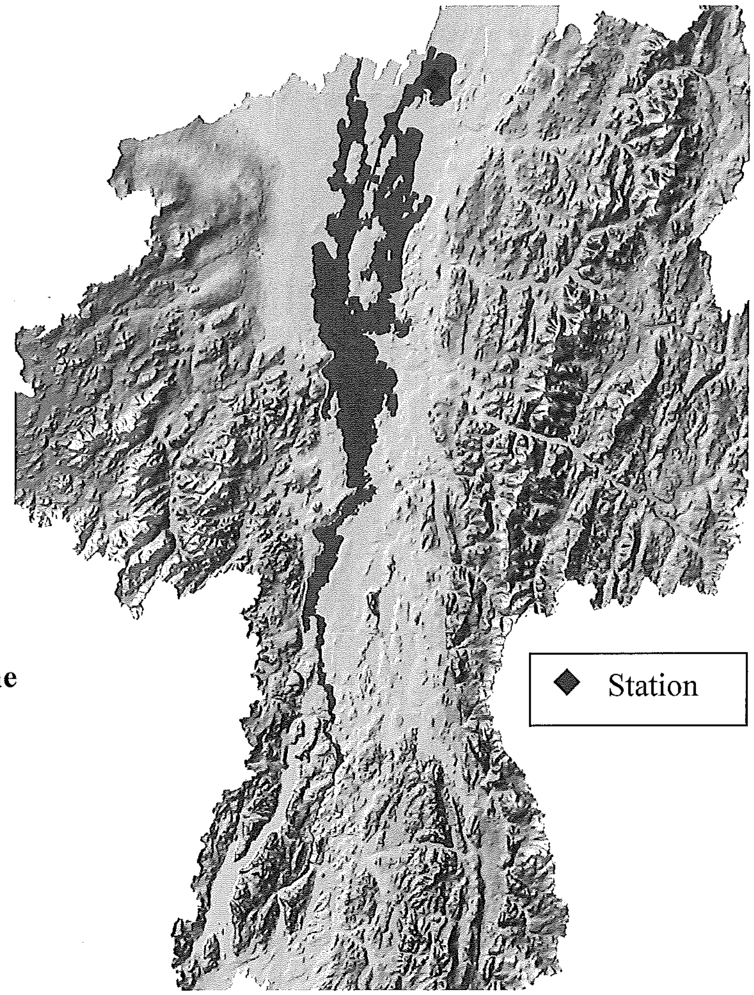
Former Lay Monitors:
Terry O'Brien
Betty and Ken Hagedorn
Bill and Barbara Duval

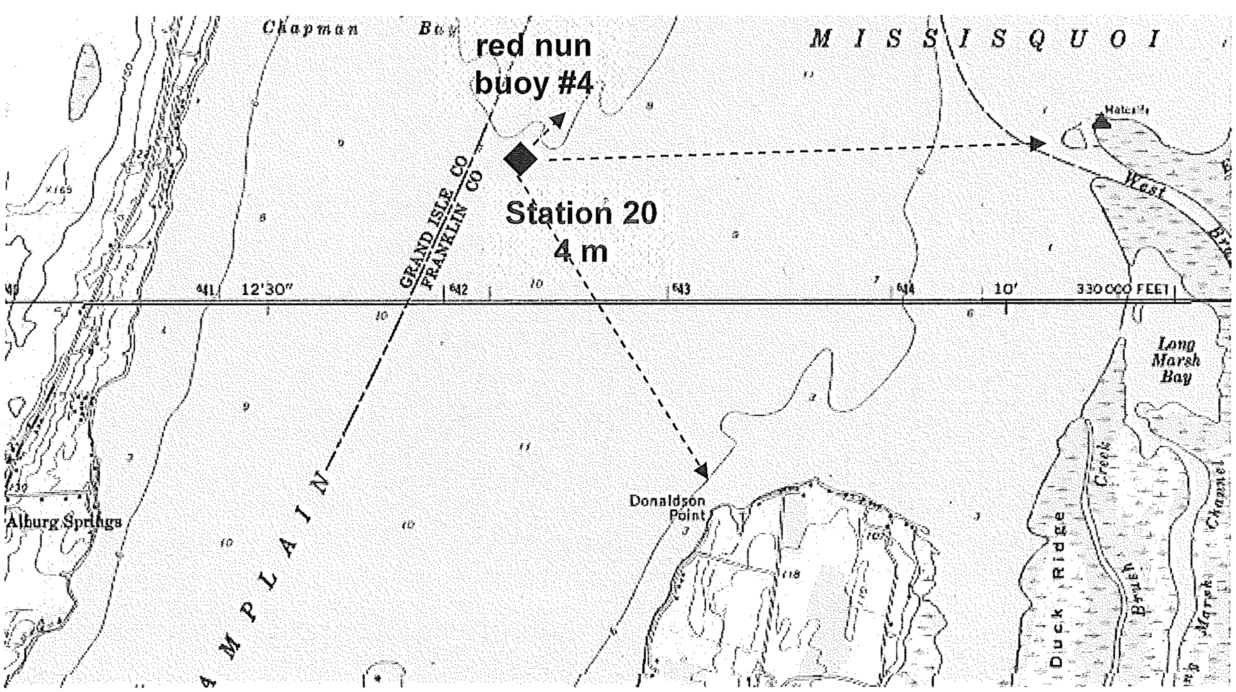
Location: station #20 is located in the outer section of Missisquoi Bay south of Red Buoy #4 in approximately 13 ft. (4 m) of water.

Coordinates: 45°00.29' N
73°10.43' W

Compared to other lake stations, the long-term summer means indicate:

Water clarity – low
Algal population density – high
Nutrient enrichment – high





Outer Mississquoi Bay

Annual Data

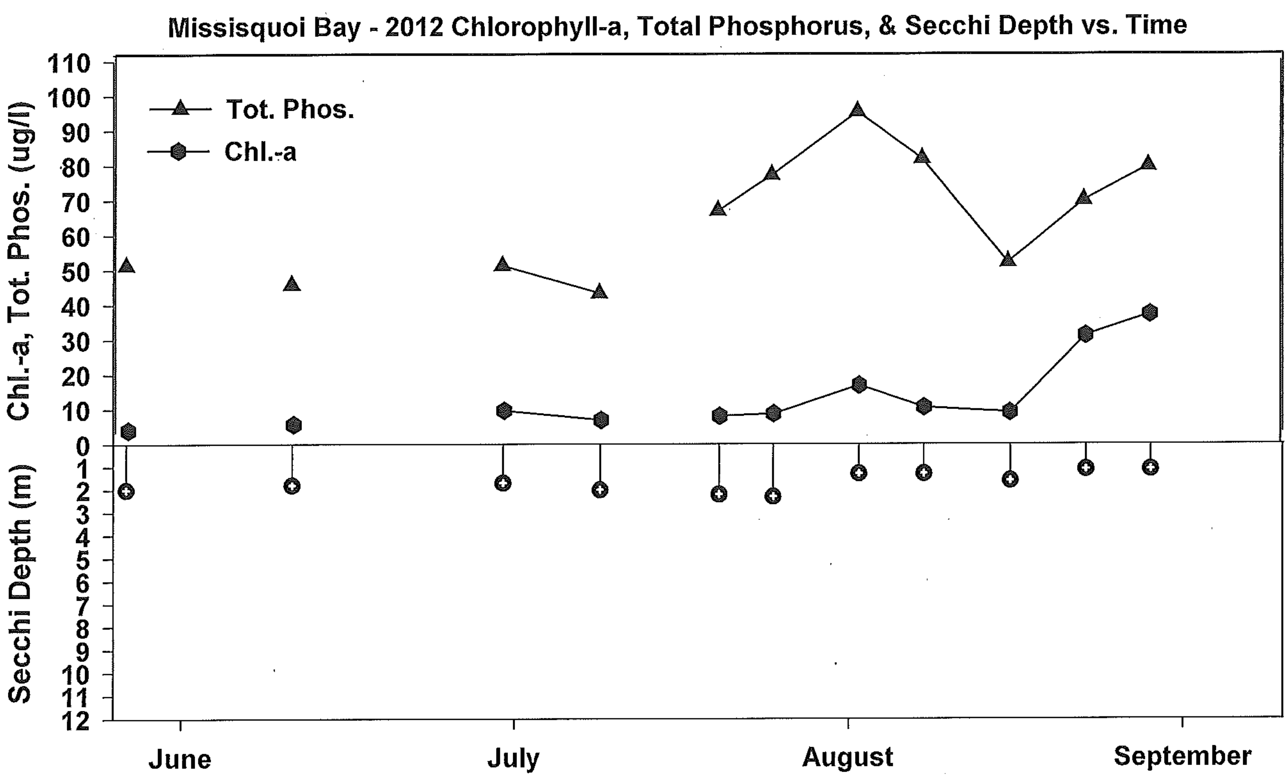
Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
1979	9			16	
1981	10		7.5	53	
1983	8		6.9		
1984	11		10	37	
1985	7				
1987	12	2.1	5.4	37	
1988	10	2.2	5.1	35	
1989	11		10	31	
1990	11		9.0	26	
1991	9		11	43	
1992	12		6.0	38	
1993	10	1.7	16	50	
1994	11		8.6	38	
1995	12		14	47	
1996	9	1.9	17	44	
1997	11	1.6	16	50	
1998	10	1.6	10	35	
1999	9	1.1	85	76	

Annual Data

Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
2000	9		7.6	30	
2001	10	2.3	21	57	
2002	9	1.5	24	37	
2003	9	1.4	25	48	
2004	11	1.5	38	58	
2005	10	1.6	19	52	
2006	9	1.7	18	44	
2008	10	1.5	20	54	
2009	5				
2010	7				
2011	9	1.9		68	
2012	11	1.7	10	65	

2012 Summary

Parameter	Days	Min	Mean	Max
Secchi (m)	11	1.1	1.7	2.3
Chl-a (ug/l)	11	0.5	10	34
Summer TP (ug/l	11	43	65	95



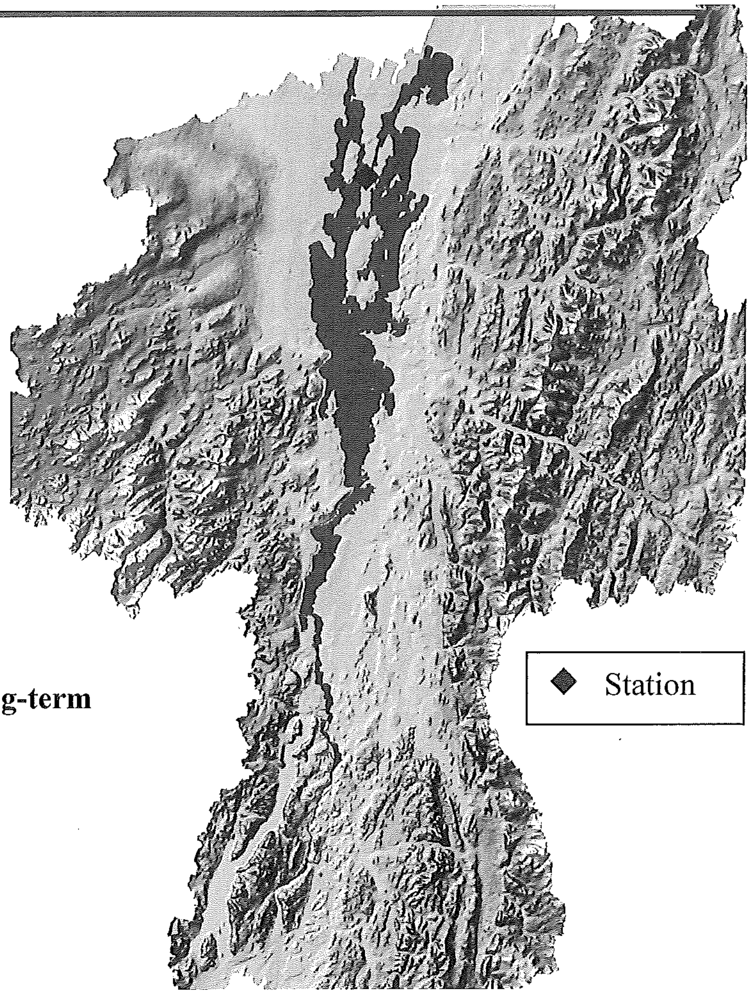
Inner Carry Bay

Lake Champlain Station #29

Lay Monitor: Don and Bobbi Weaver
Former Lay Monitors:
Ken Basset
Chuck Balchiunas
Larry Dupont
Mary Jane Healy

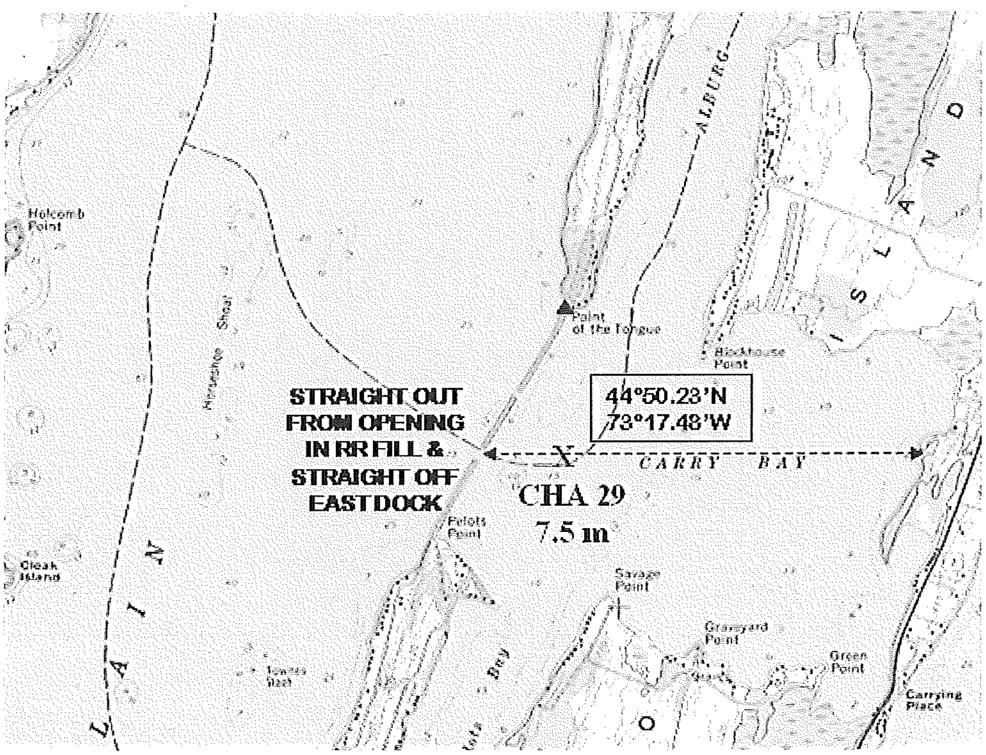
Location: In the western side of Carry Bay, North Hero, just off the cut in the railroad fill in approximately 25 feet (7.5 m) of water.

Coordinates: 44°50.23’ N
73°17.43’ W



Compared to other lake stations, the long-term summer means indicate:

Water clarity – moderate
Algal population density – high
Nutrient enrichment – high



Carry Bay

Annual Data

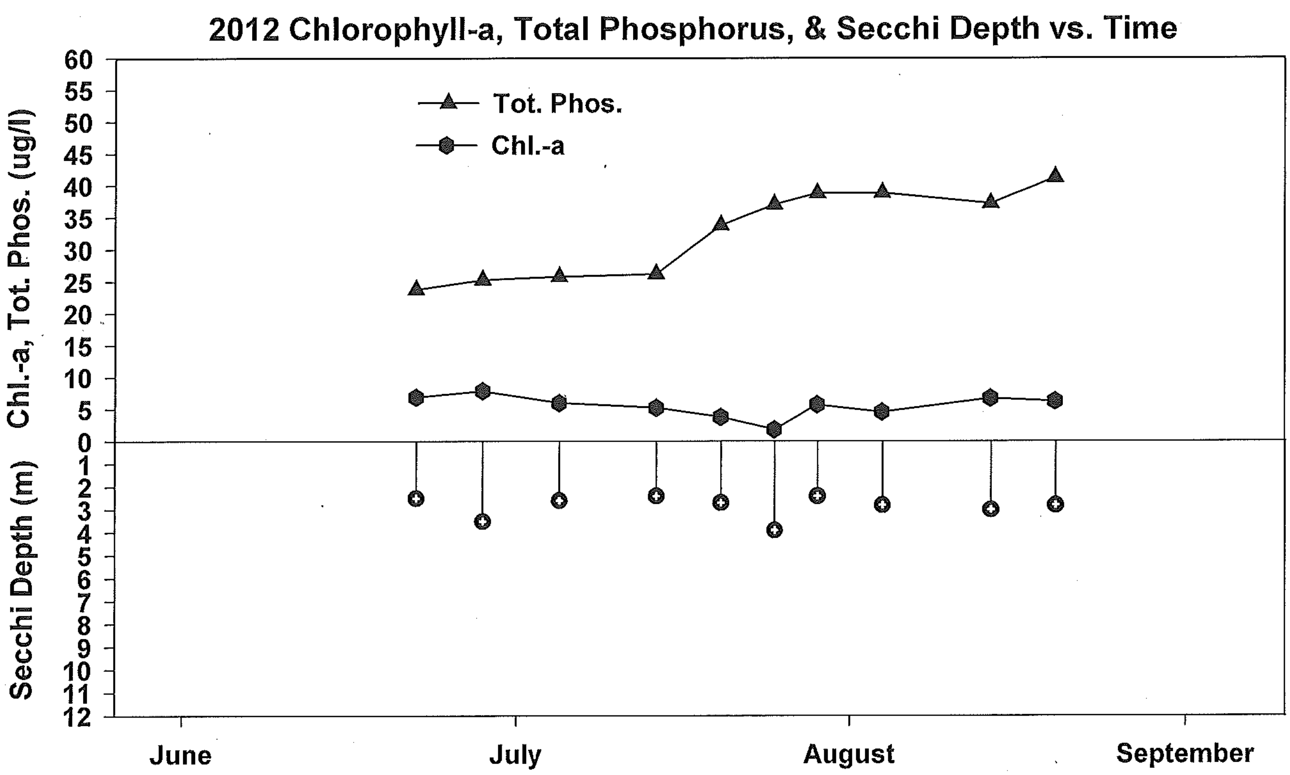
Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
1982	10	2.7	3.8	30	
1983	8		3.7		
1985	10	2.2	6.4	28	
1986	10	3.7	4.8	19	
1987	13	4.3	4.0	23	
1988	11		5.0	26	
1989	8	4.0	8.4	25	
1990	9	4.3	7.4	21	
1991	6				
1993	8	3.6	8.8	30	
1994	9	2.9		28	

Annual Data

Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
2003	8	2.9	12	36	
2004	9		19	63	
2007	8	3.6	5.2	24	
2009	12		5.9	28	
2010	11	2.4	11	36	
2011	9	1.9		38	
2012	10	2.9	5.7	33	

2012 Summary

Parameter	Days	Min	Mean	Max
Secchi (m)	10	2.4	2.9	3.9
Chl-a (ug/l)	10	2.1	5.7	8.1
Summer TP (ug/l	10	24	33	41

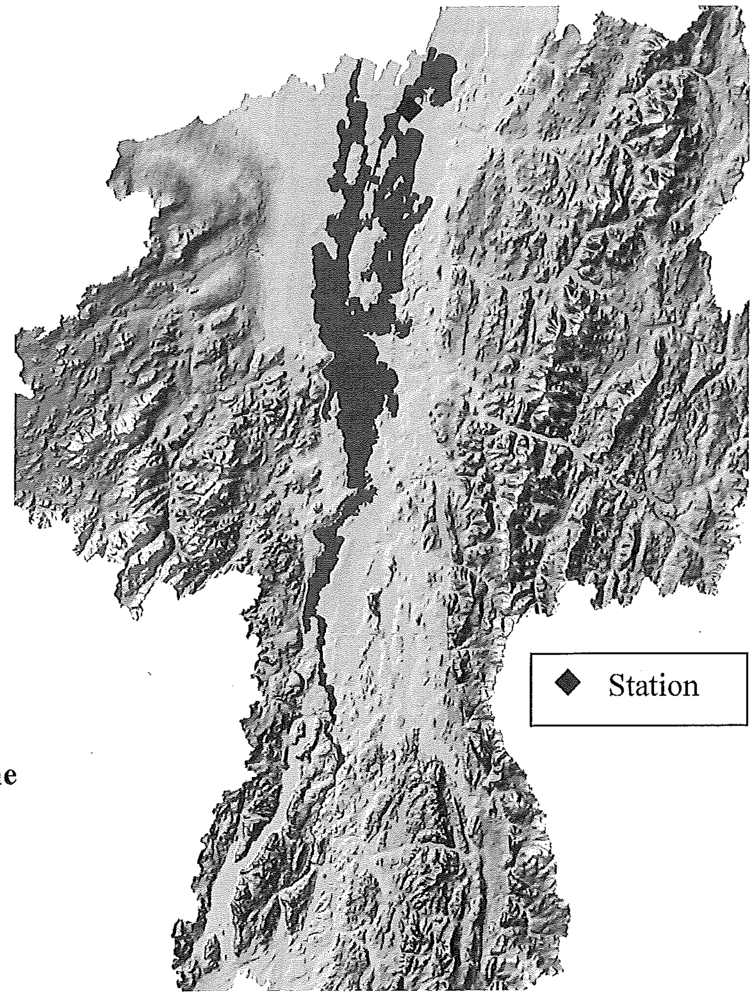


ALBURG BRIDGE

Lake Champlain Station #30

Lay Monitors: Paul Hansen

Former Lay Monitors:
Betty and Ken Hagedorn
Bill and Barbara Duval

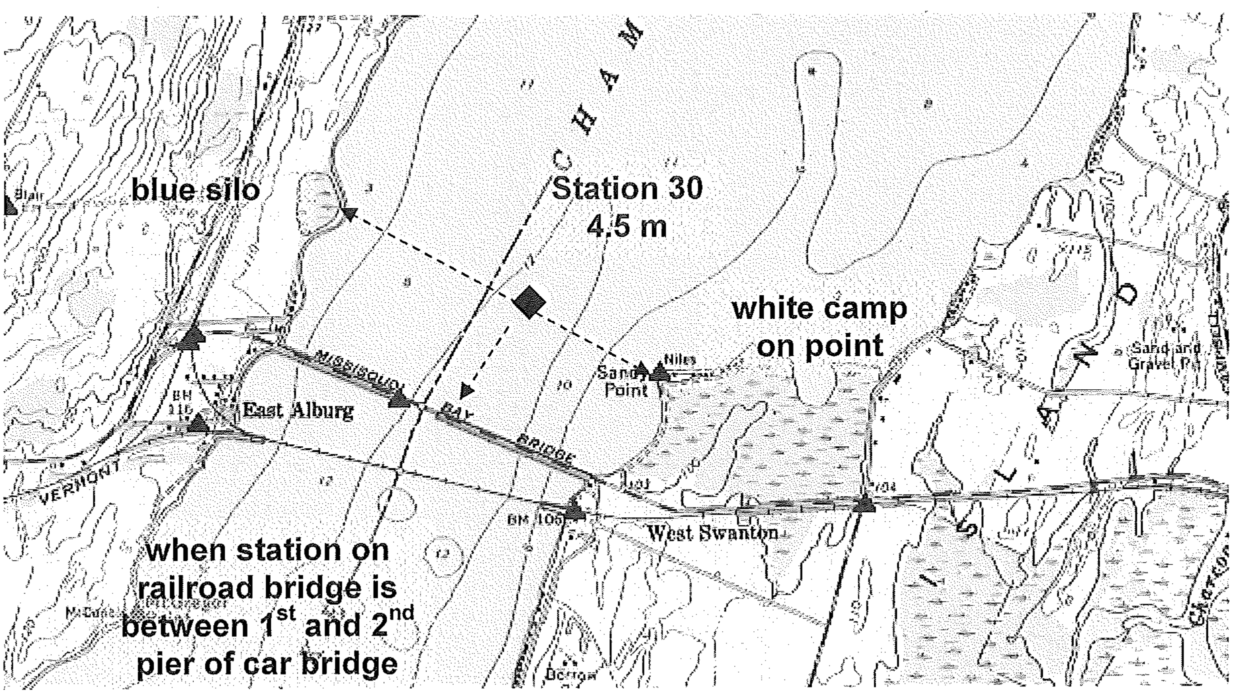


Location: station #30 is located in the "outlet" area of Missisquoi Bay, just north of the Route 78 Alburg – West Swanton bridge in approximately 15 ft. (4.5 m) of water.

Coordinates: 44°58.55' N
73°12.90' W

Compared to other lake stations, the long-term summer means indicate:

Water clarity – low
Algal population density – high
Nutrient enrichment – high



Alburg Bridge

Annual Data

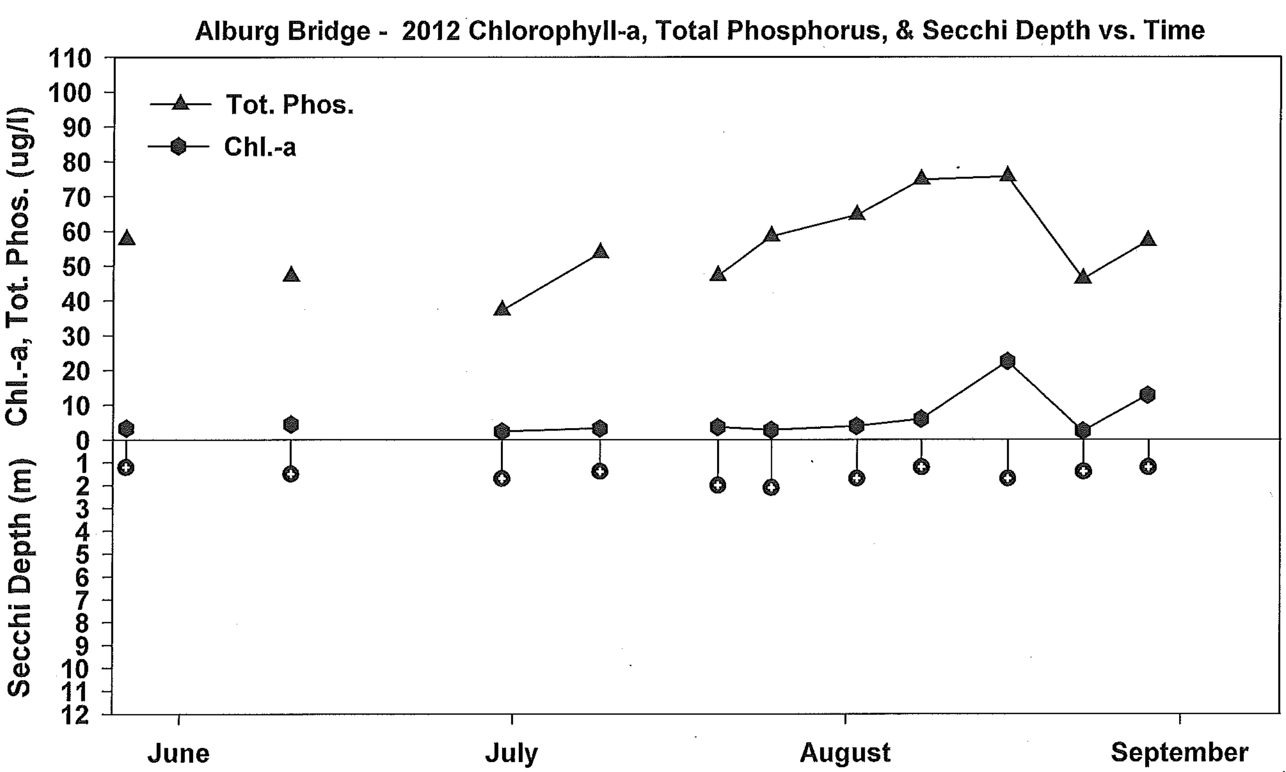
Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
1983	9	2.7	4.9		
1984	11	2.0	13	44	
1985	6				
1986	9	2.5	6.6	32	
1987	12	2.4	4.7	34	
1988	10	2.4	7.3	34	
1989	11		9.7	27	
1990	11	2.8	9.7	26	
1991	9	1.8	15	39	
1992	12	2.3	8.0	38	
1993	10	2.0	12	39	
1994	11	2.1	12	42	
1995	12	1.8	17	46	
1996	10	2.1	15	31	
1997	11	1.6	11	43	
1998	10	1.7	7.9	31	
1999	9	1.2	57	64	

Annual Data

Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
2000	9	2.1	7.8	35	
2001	10	2.3	8.0	36	
2002	9	1.7	19	54	
2003	8			42	
2004	11	1.5	35	56	
2005	10	1.6	20	45	
2006	9	1.6	20	47	
2008	10	1.4	21	58	
2009	11	1.9	8.5	47	
2010	7				
2011	9	2.0		62	
2012	11	1.6	6.6	56	

2012 Summary

Parameter	Days	Min	Mean	Max
Secchi (m)	11	1.2	1.6	2.1
Chl-a (ug/l)	11	2.9	6.6	23
Summer TP (ug/l	11	37	56	76



BURLINGTON BAY

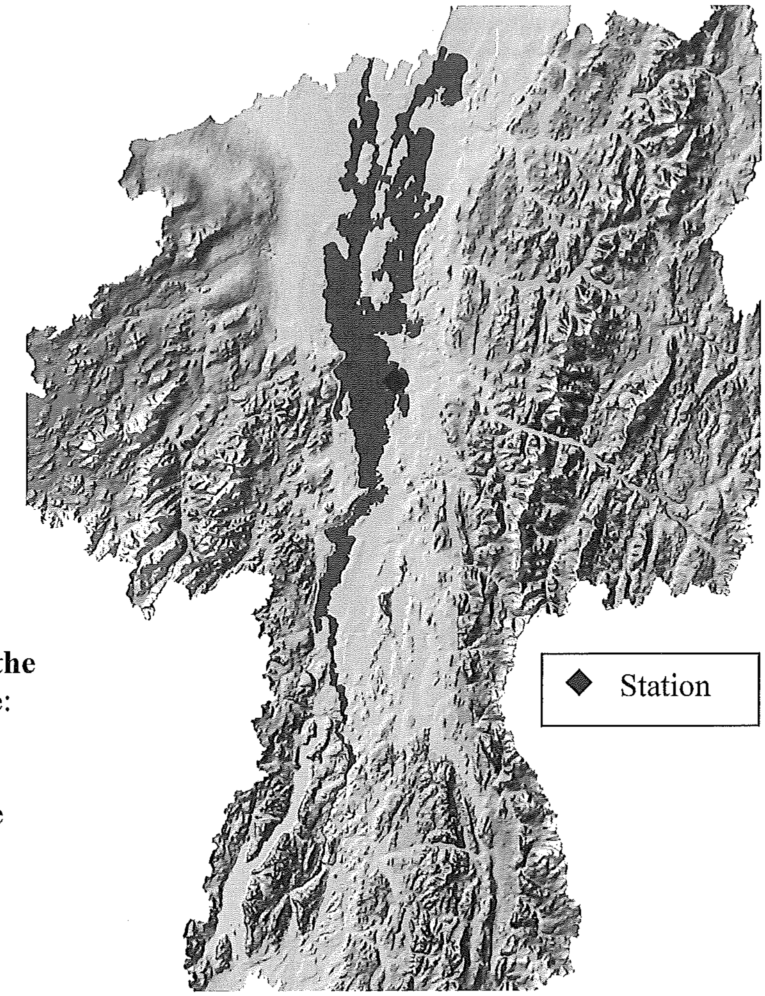
Lake Champlain Station #33

Lay Monitor: Jonathan Eddy

Former Lay Monitors:
Don Bailey

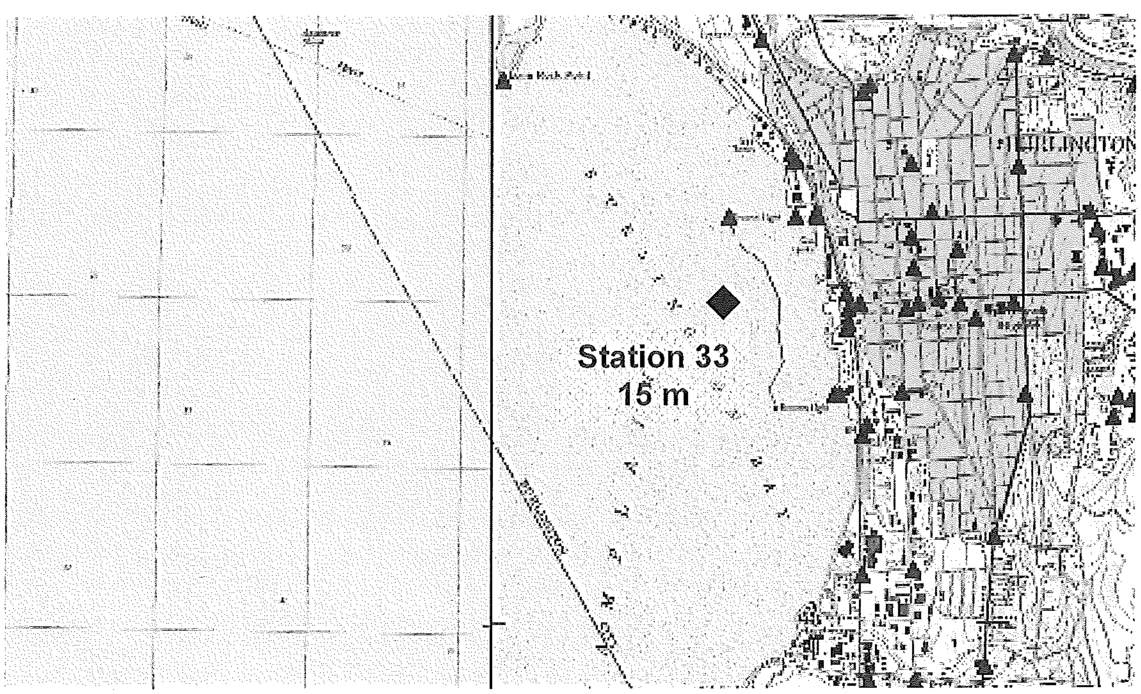
Location: station #33 is located across from the Burlington waterfront in the middle of Burlington Bay in approximately 49 ft. (15 m) of water.

Coordinates: 44°28.49' N
73°13.90' W



Compared to other lake stations, the long-term summer means indicate:

Water clarity – moderate
Algal population density – moderate
Nutrient enrichment – high



Burlington Bay

Annual Data

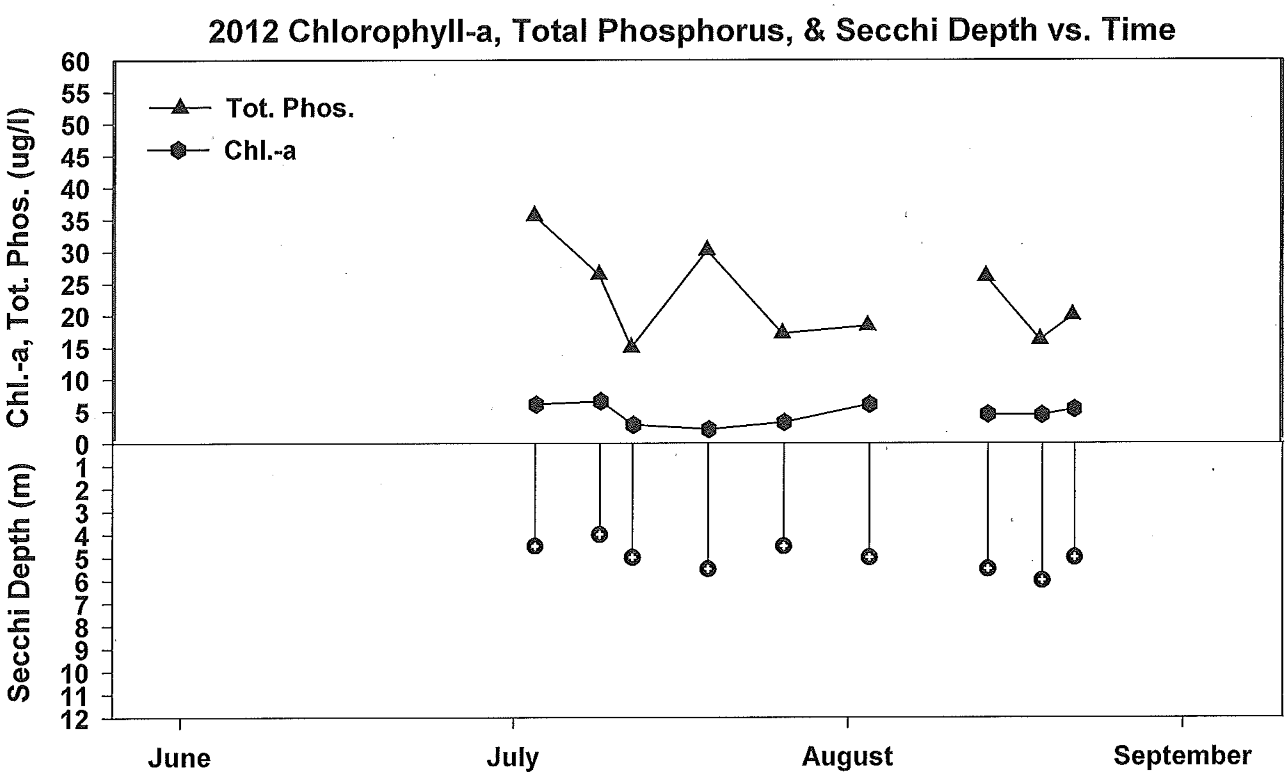
Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
1992	13	5.1	3.8	15	
1993	13	4.4	4.9	18	
1994	6				
1995	8	5.9	2.5	12	
1996	8	4.2	4.2	17	
1997	7				
1998	8	3.6	4.0	22	
1999	8	5.6	6.3	14	

Annual Data

Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
2000	8	5.2	5.7	20	
2001	9	5.3	2.9	15	
2002	8	5.6	0.9	13	
2003	8	5.9	2.1	17	
2004	10	5.8	3.1	16	
2005	9	5.0	5.0	19	
2006	9	4.7	4.7	20	
2007	8	5.2	2.4	13	
2008	10	4.6	3.3	22	
2009	9	5.2	5.1	25	
2010	9	5.2	3.6	16	
2011	9	3.6		23	
2012	9	5.0	4.0	23	

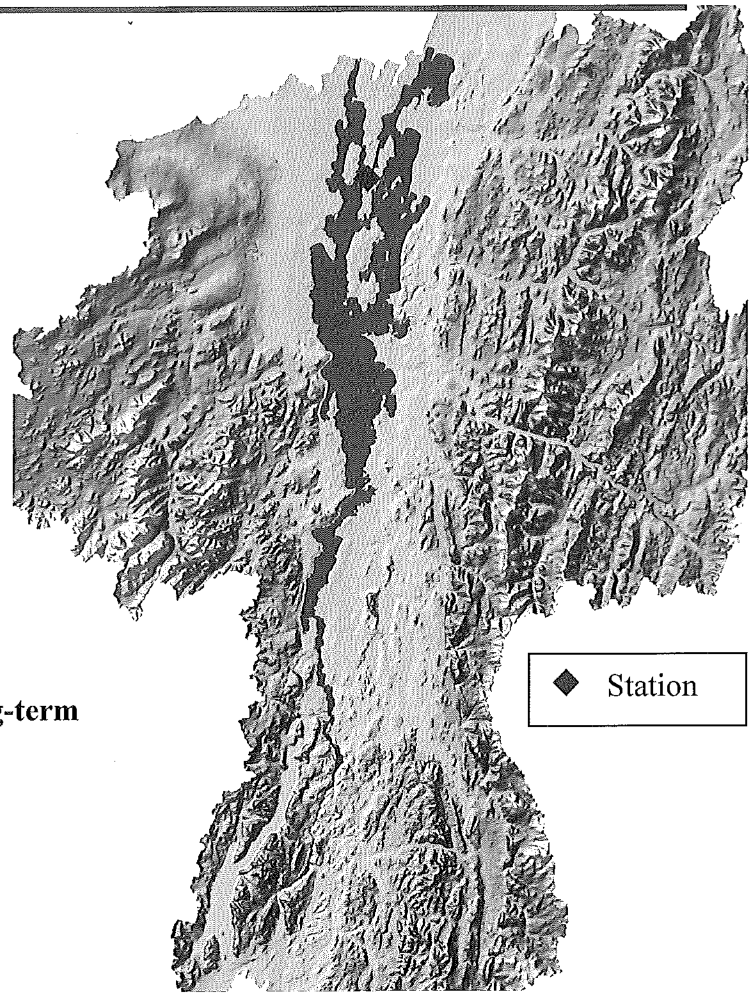
2012 Summary

Parameter	Days	Min	Mean	Max
Secchi (m)	9	4.0	5.0	6.0
Chl-a (ug/l)	9	1.5	4.0	6.0
Summer TP (ug/l	9	15	23	36



Outer Carry Bay

Lake Champlain Station #37



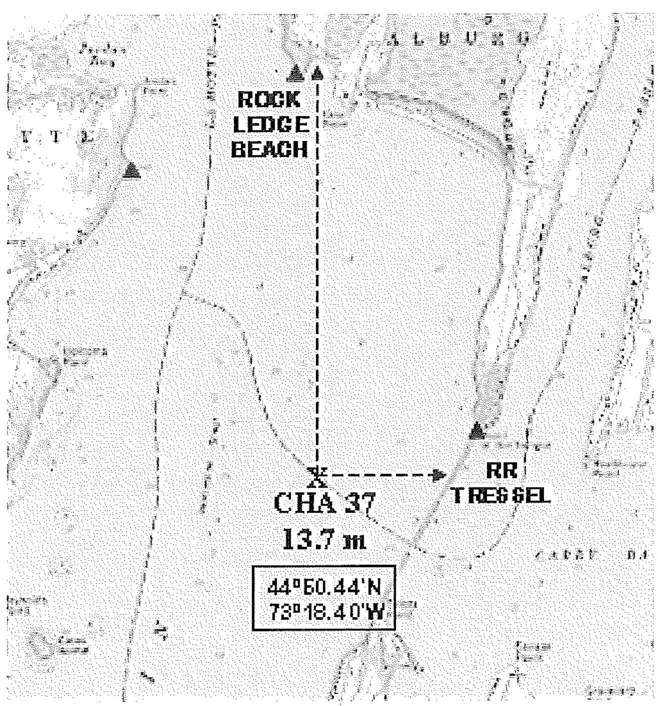
Lay Monitor: Don and Bobbi Weaver
Former Lay Monitors:
Ken Basset
Chuck Balchiunas

Location: In the open water, straight outside of Carry Bay, North Hero, through the cut in the railroad fill in approximately 45 feet of water.

Coordinates: 44°50.44' N
73°18.40' W

Compared to other lake stations, the long-term summer means indicate:

Water clarity – moderate
Algal population density – moderate
Nutrient enrichment – high



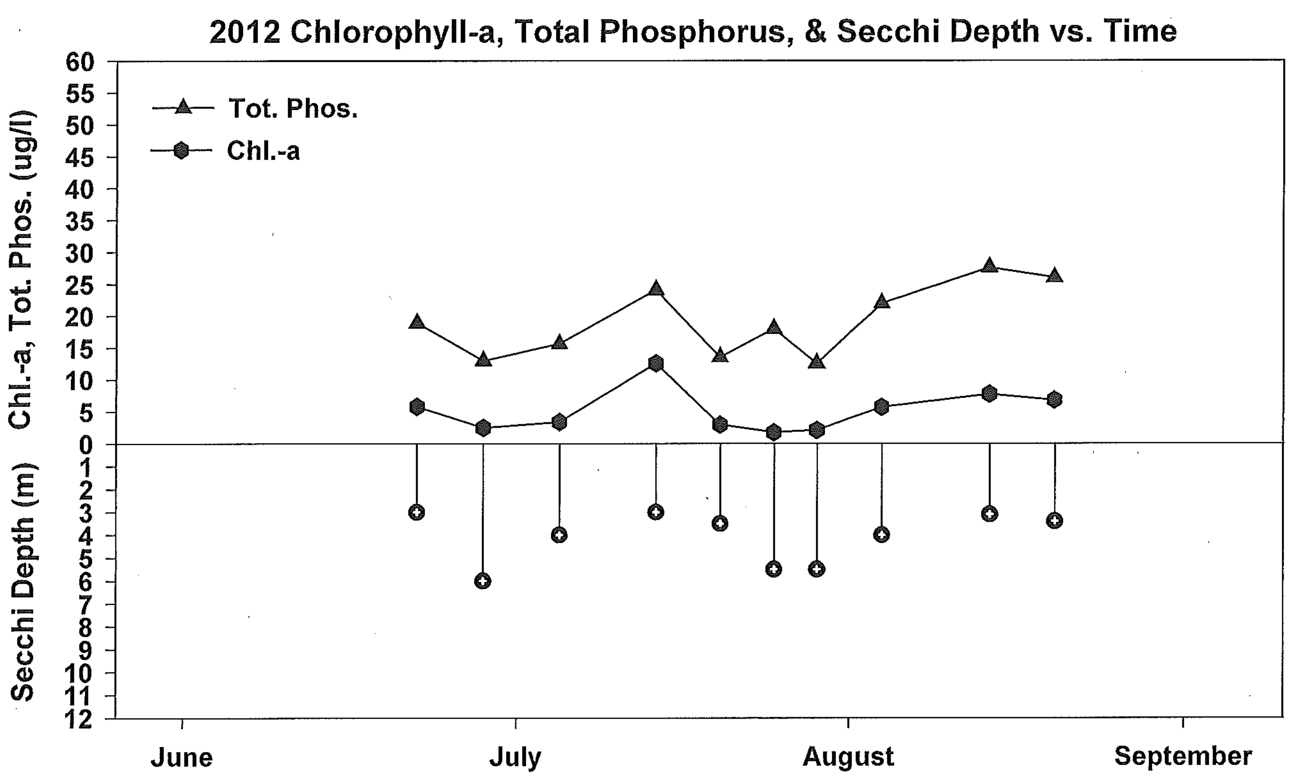
Outer Carry Bay

Annual Data

Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
2003	8	4.2	4.7	20	
2004	9	2.9	10.0	28	
2007	8	5.6	4.4	17	
2009	12	5.3	4.3	17	
2010	11	3.4	6.8	20	
2011	9	3.2		19	
2012	10	4.1	5.1	19	

2012 Summary

Parameter	Days	Min	Mean	Max
Secchi (m)	10	3.0	4.1	6.0
Chl-a (ug/l)	10	1.7	5.1	13
Summer TP (ug/l	10	13	19	28



TOWN FARM BAY

Lake Champlain Station #38

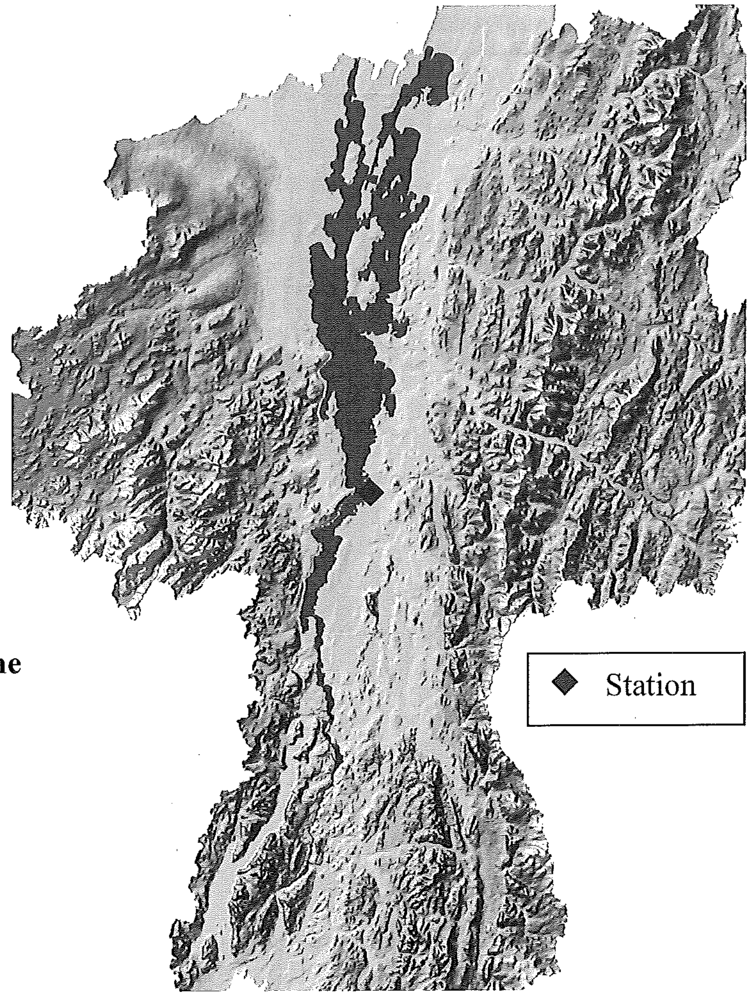
Lay Monitors: Carol Hanley
Richard Bernstein

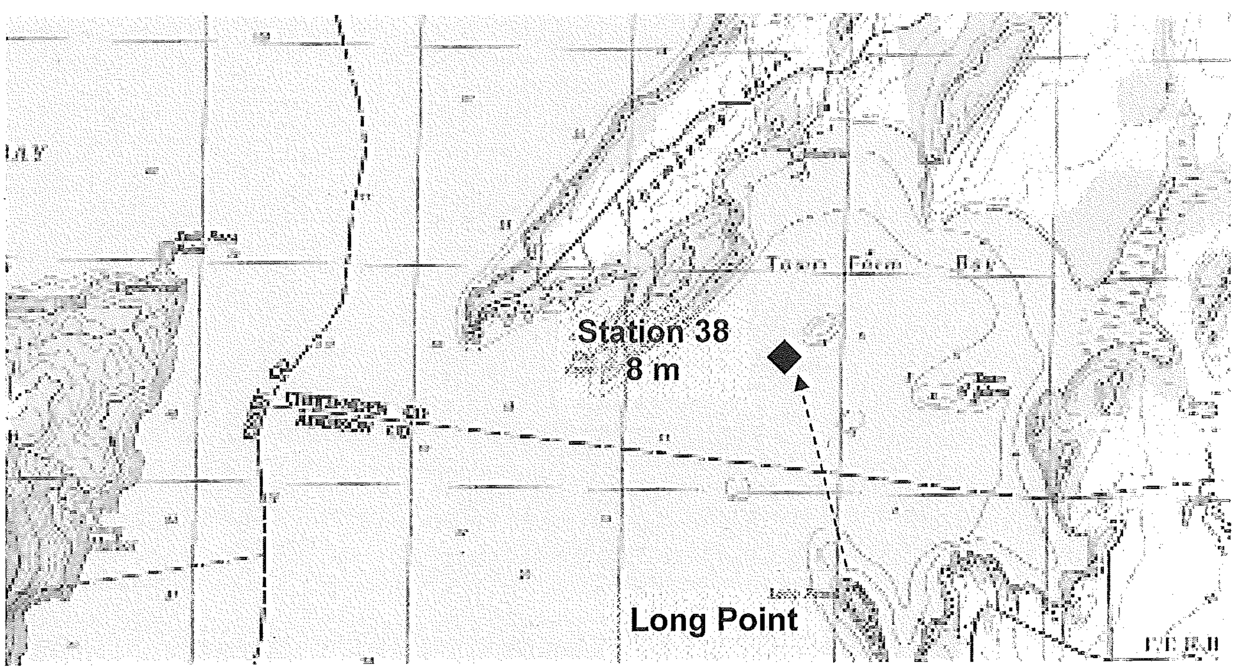
Location: station #38 is located in Town Farm Bay north of Long Point in approximately 27 ft. (8 m) of water.

Coordinates: 44°15.78' N
73°17.22' W

Compared to other lake stations, the long-term summer means indicate:

Water clarity – low
Algal population density – high
Nutrient enrichment – high





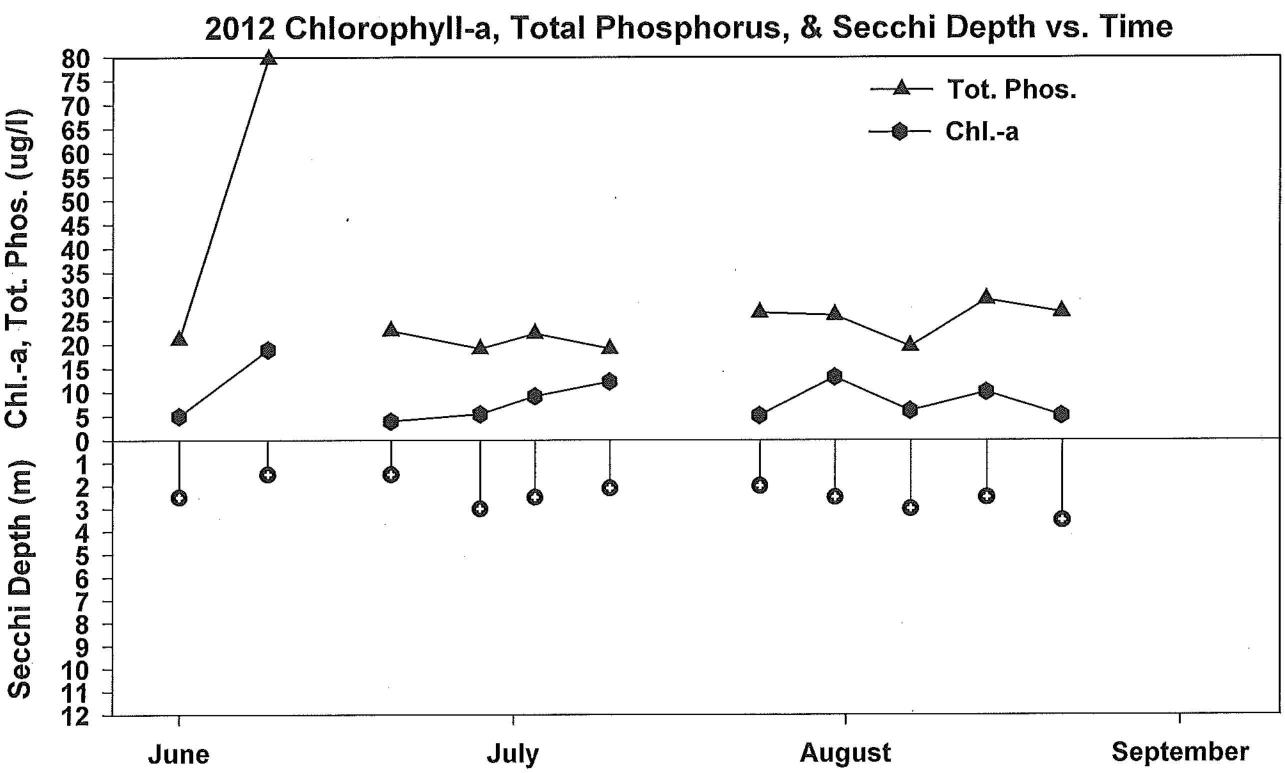
Town Farm Bay

Annual Data

Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
2008	12	2.6	10	30	
2009	13	2.9	6.9	24	
2010	13	3.6	4.9	19	
2011	14	2.0	11	28	
2012	11	2.4	7.0	28	

2012 Summary

Parameter	Days	Min	Mean	Max
Secchi (m)	11	1.5	2.4	3.5
Chl-a (ug/l)	11	3.5	7.0	15
Summer TP (ug/l	11	19	28	80



NORTH BEACH

Lake Champlain Station #40

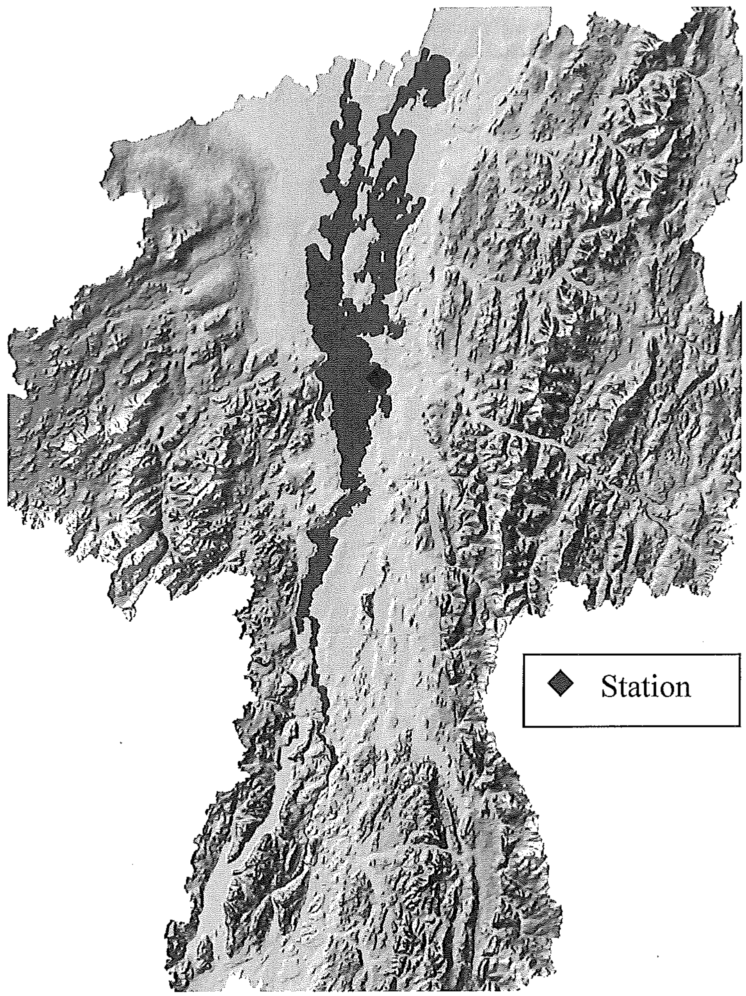
Lay Monitors: Jen Guimaras, Grace Ballou and the Burlington Community Sailing Center

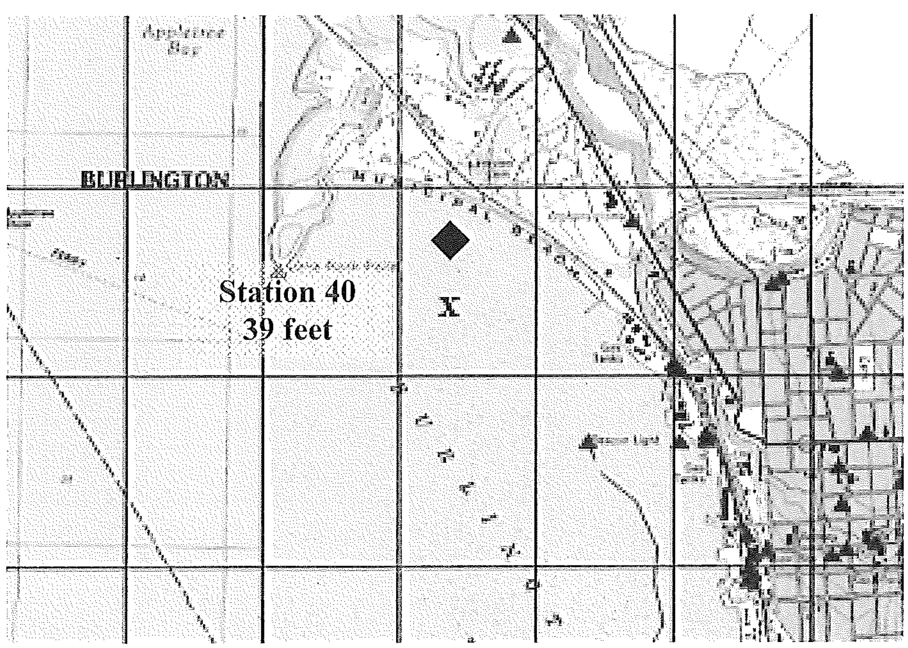
Location: station #40 is located straight off North Beach in Burlington in approximately 39 ft. (12 m) of water.

Coordinates: 44 29 11.62° N
73 14 22.33° W

Compared to other lake stations, the long-term summer means indicate:

Water clarity – moderate
Algal population density – moderate
Nutrient enrichment – high





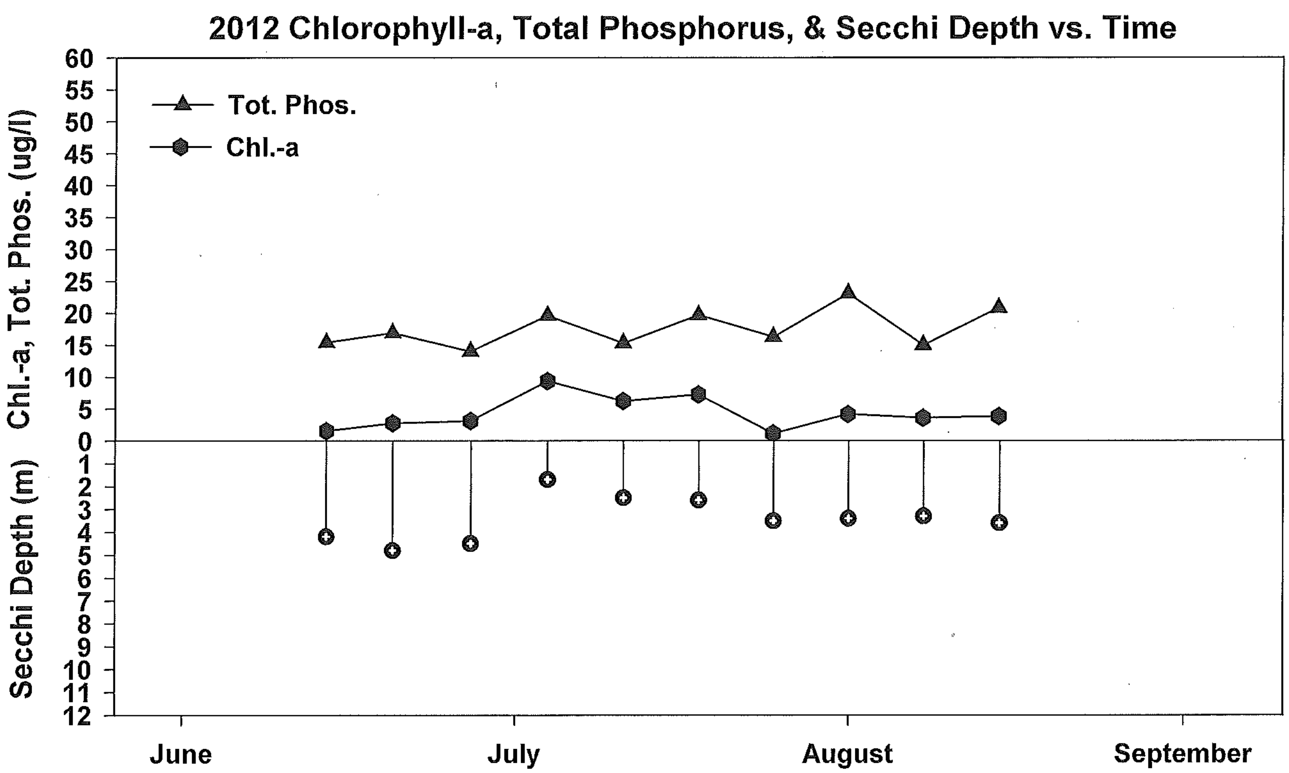
North Beach

Annual Data

Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
2009	9	5.0	7.0	18	
2010	8	5.1	3.1	16	
2011	11	3.8	5.8	18	
2012	10	3.4	5.1	18	

2012 Summary

Parameter	Days	Min	Mean	Max
Secchi (m)	10	1.7	3.4	4.8
Chl-a (ug/l)	10	2.0	5.1	10
Summer TP (ug/l	10	14	18	23



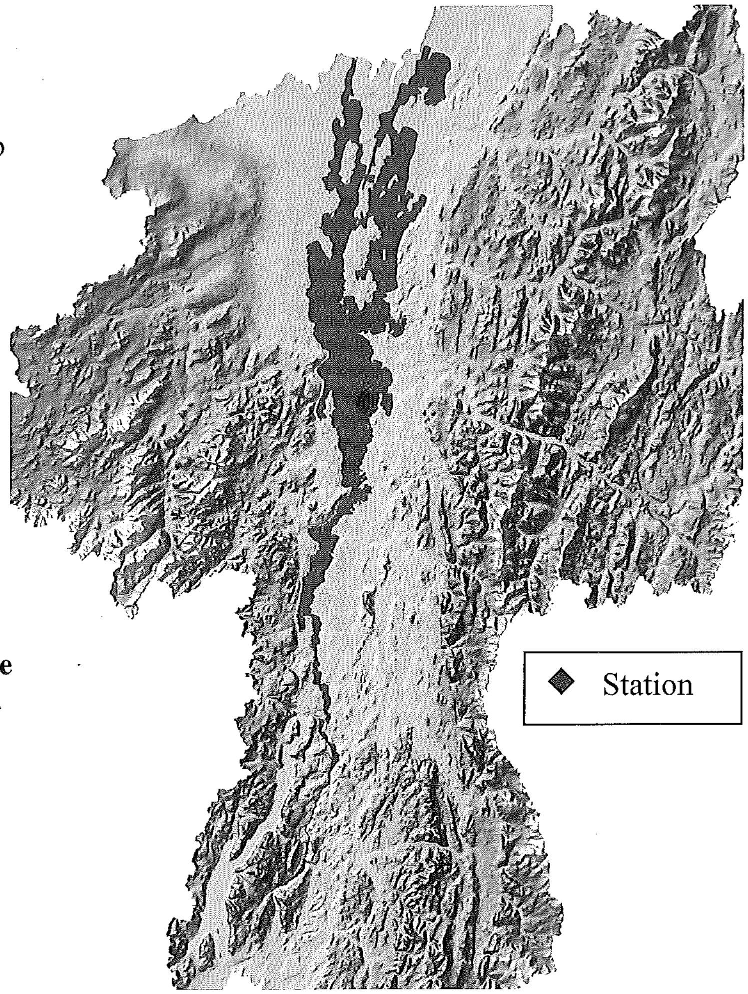
QUENESKA ISLAND

Lake Champlain Station #41

Lay Monitor: Kate & Marshall Webb

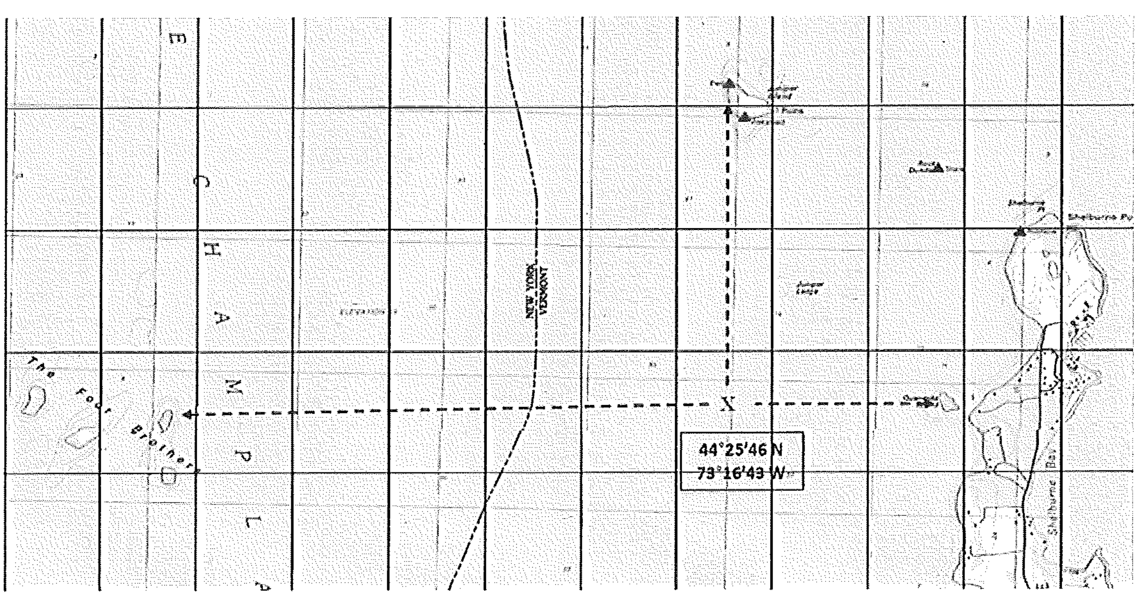
Location: station #41 is located off west Queneska Island, west of Shelburne Point.

Coordinates: 44°25'46 N
73°16'43 W



Compared to other lake stations, the long-term summer means indicate:

Water clarity – moderate
Algal population density – moderate
Nutrient enrichment – high



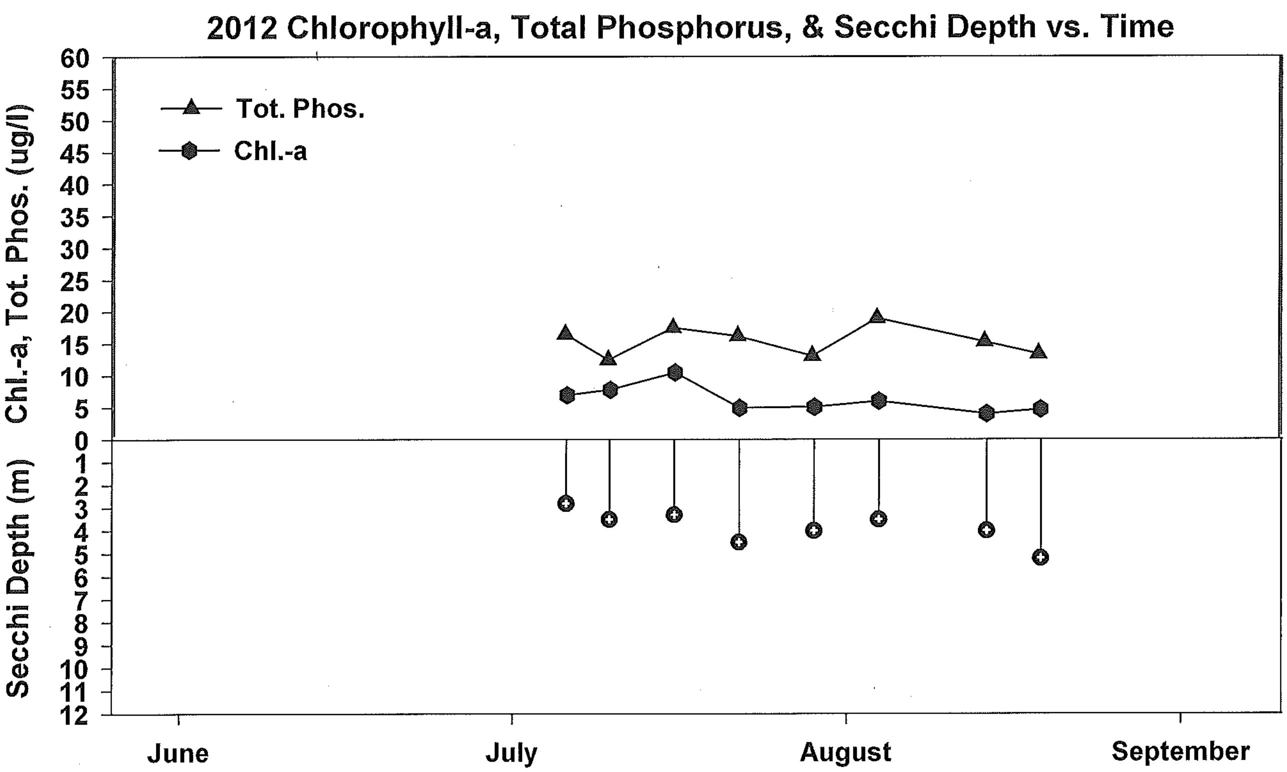
Queneska Island

Annual Data

Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
2011	10	3.7		17	
2012	8	3.9	5.6	15	

2012 Summary

Parameter	Days	Min	Mean	Max
Secchi (m)	8	2.8	3.9	5.2
Chl-a (ug/l)	8	3.4	5.6	9.9
Summer TP (ug/l	8	13	15	19

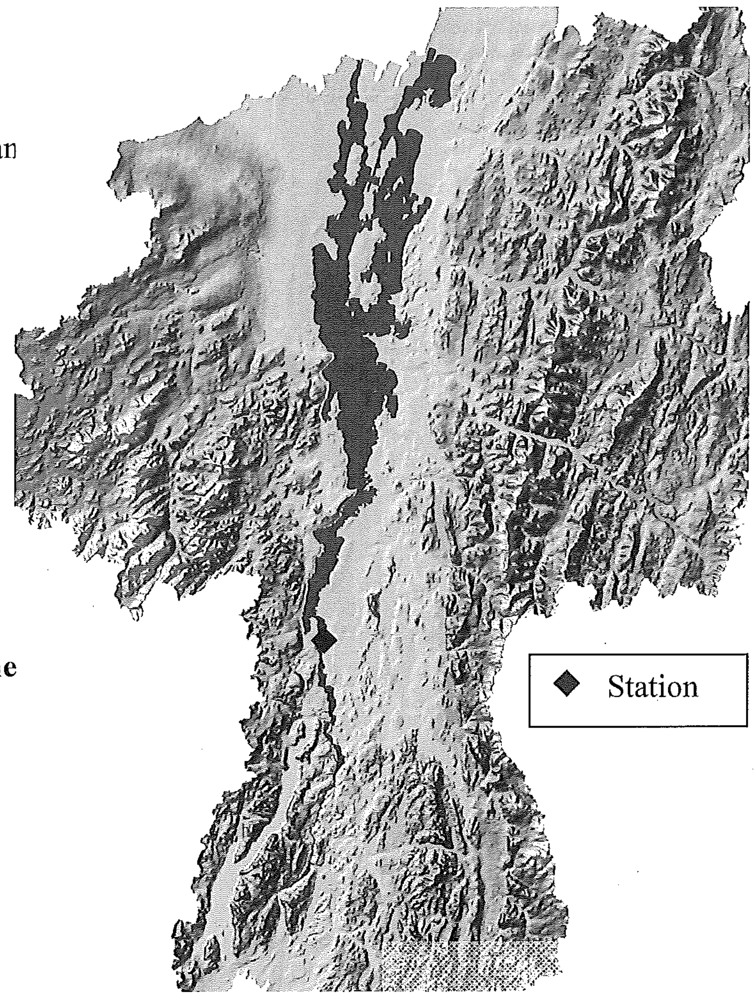


CHAMPLAIN BRIDGE

Lake Champlain Station #42

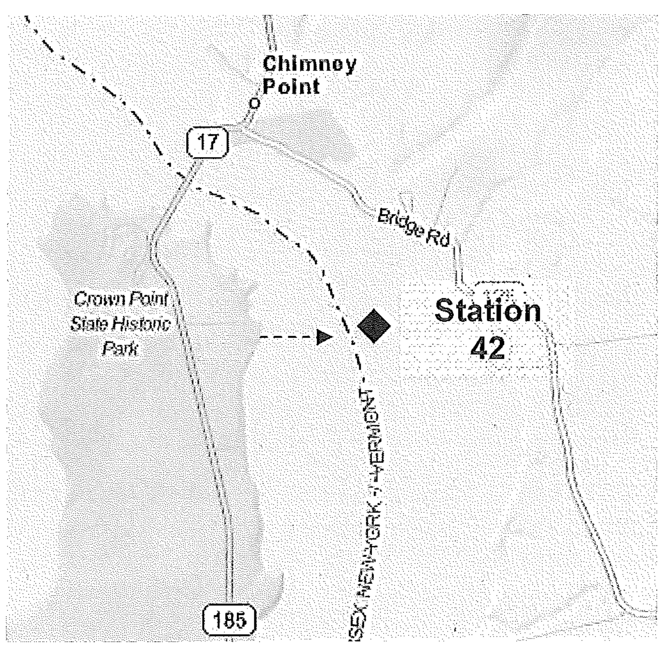
Lay Monitor: Chip and Cathy Morgan

Location: station #42 is located just south of the new Champlain Bridge.



Compared to other lake stations, the long-term summer means indicate:

Water clarity – low
Algal population density – high
Nutrient enrichment – high



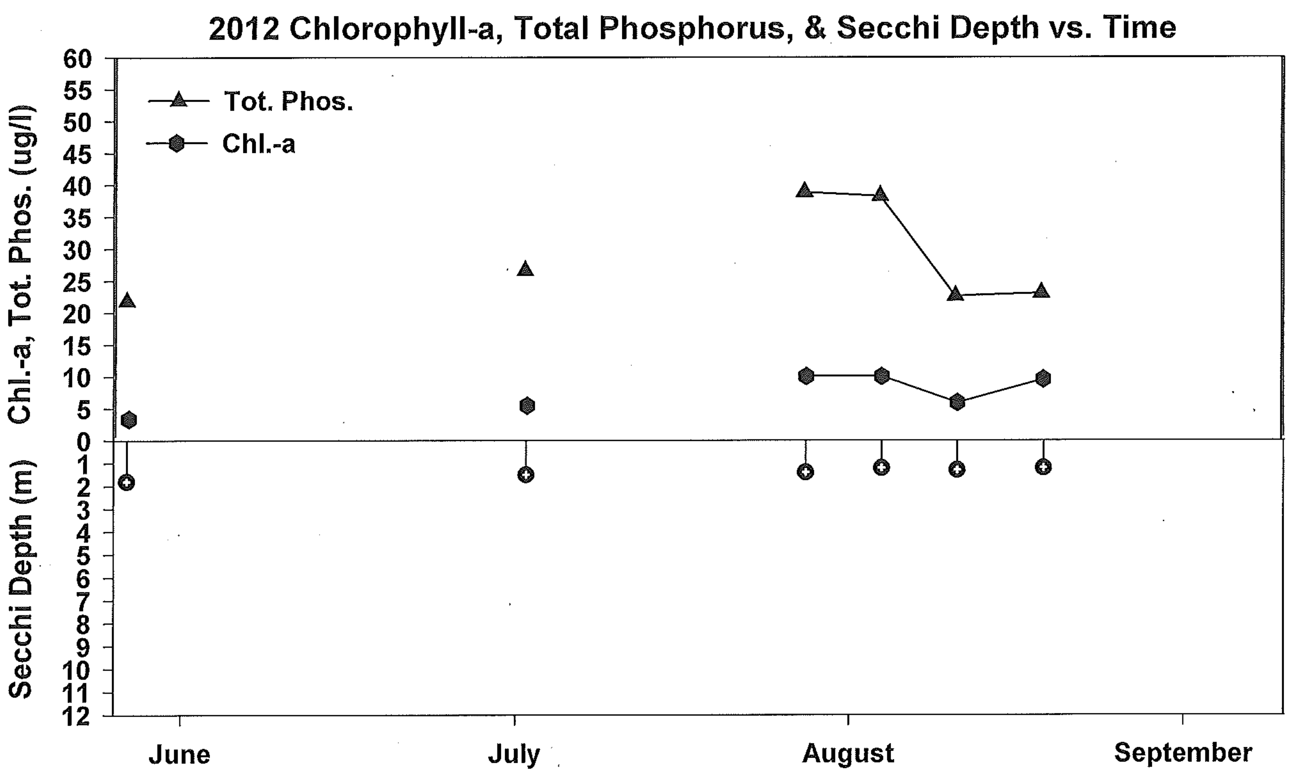
Champlain Bridge

Annual Data

Year	Days Sampled	Secchi (m)	Chloro-a (ug/l)	Summer TP (ug/l)	Spring TP (ug/l)
2011	11	1.4	10	37	
2012	6				

2012 Summary

Parameter	Days	Min	Mean	Max
Secchi (m)	6	1.2	1.4	1.8
Chl-a (ug/l)	6	2.7	6.8	9.5
Summer TP (ug/l	6	22	29	39



Appendix 1 - Participation, 1979 - 2012
Inland Lakes

Lake	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Arrowhead Mountain	-	S	S	S	S	S	S	S	S	S	S	-	-	-	-	-	-	-	-	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beebe	S	S	S	S	S	S	B	B	BP	B	BP	BP	BP	B	B	S	B	B	B	BP	B	B	B	B	B	B	B	B	B	BP	B	B	B	S
Bliss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	B	B	S	S	S	S	S	S	-	-	-	-	-	-	-	-
Bomoseen	S	S	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	S
Buck	-	-	-	-	-	-	-	-	-	-	-	S	S	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Burr	BP	B	B	B	S	S	S	S	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carmi	S	S	S	SP	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Caspian	BP	S	S	S	S	S	S	S	-	-	-	-	B	B	B	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Cedar (Monkton)	-	-	-	-	-	-	-	-	-	-	-	S	SP	S	S	SP	SP	BP	-	BP	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chipman	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	B	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Colchester	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	S	SP	-	-	-	-	-	-	-	-	-
Cole	-	S	S	S	S	-	S	-	-	S	S	S	S	B	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Coles	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	S	S	S	S	S	S
Crystal	-	-	-	-	S	S	S	S	S	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Curtis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	S	S	B	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Danby	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	-	S	S	S
Derby	-	-	-	S	S	S	S	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dunmore	B	B	-	S	-	S	S	S	S	-	-	-	-	-	B	B	B	B	S	S	S	S	S	S	S	S	S	S	S	S	S	S	SP	S
East Long	-	-	-	-	-	-	-	-	-	-	-	S	S	S	S	S	S	B	B	B	B	-	-	-	-	-	-	-	-	-	-	-	-	-
Echo (Charleston)	B	S	S	B	S	S	S	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	B	S	S	S	S	S	S	S	S
Echo	-	-	-	-	-	-	-	-	-	-	S	S	BP	BP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eden	-	-	-	-	-	-	-	-	-	-	S	SP	S	S	S	S	S	S	S	SP	B	B	B	B	-	B	B	S	S	S	S	S	S	S
Elfin	-	-	-	-	B	S	S	S	S	S	B	BP	B	B	B	B	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Elligo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SP	S	S	S	-	-	-	-	-	-	-	-	-	-	-	-
Elmore	S	S	SP	S	S	S	S	B	B	-	-	-	-	-	-	-	S	S	S	-	-	-	-	-	-	-	-	-	-	-	-	-	S	SP
Fairfield	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	B	B	B	S	S	S	SP	S	S	-	-	S	S	S	S	S	-	S
Fairlee	S	S	S	S	S	S	S	B	B	B	B	B	B	B	B	B	B	B	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Fern	-	-	-	BP	S	-	-	-	-	-	-	-	SP	B	B	B	B	B	B	B	B	B	B	B	B	-	B	-	-	-	-	-	-	-
Forest (Nelson)	BP	BP	-	-	-	-	-	-	-	-	-	S	SP	S	-	-	-	-	-	-	-	S	S	S	S	S	S	S	S	S	S	S	S	S
Fosters	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	B	S	S	S	S	S	S	S
Glen	-	-	-	B	B	BP	B	B	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Great Averill	B	B	B	-	-	-	-	-	-	-	S	S	SP	B	S	S	S	S	-	BP	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Great Hosmer	-	-	-	-	-	S	S	S	S	S	B	B	B	B	BP	B	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Green River	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Greenwood	B	-	-	-	-	-	-	-	-	-	-	S	SP	SP	SP	SP	-	-	-	-	-	-	-	-	-	-	-	-	S	S	S	S	-	-
Groton	BP	B	B	S	SP	S	S	S	S	S	-	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	S	S	S	S	-	S	S	S
Halls	B	S	S	S	S	S	S	B	S	S	S	S	S	B	B	B	B	B	B	B	B	B	S	S	S	S	S	S	S	S	S	S	S	S
Harvey's	S	S	S	S	S	S	SP	S	SP	-	-	-	B	B	B	B	B	B	S	S	S	S	SP	S	S	S	S	S	S	S	S	S	S	S

B = basic monitoring, Secchi water clarity only
S = supplemental monitoring - Secchi water clarity, total phosphorus and chlorophyll-a
P = partial data

Appendix 1 - Participation, 1979 - 2012
Inland Lakes

Lake	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Hortonia	S	S	S	S	S	S	B	-	B	B	B	B	BP	B	B	B	B	B	B	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indian Brook Reservoir	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	-	S
Iroquois	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	B	B	B	B	B	B	B	B	B	B	-	B	S	S	S	S	S
Island Pond	BP	S	S	S	S	S	S	B	B	B	B	B	-	B	B	B	B	B	-	-	-	BP	B	B	B	B	B	B	B	B	B	B	B	B
Joes	B	BP	SP	B	SP	S	S	S	S	S	BP	-	-	-	B	B	B	-	-	-	-	B	B	B	B	S	S	S	S	S	S	S	S	S
Little																																S	S	S
Long	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	B	B	B	-	-	-	-	-	-	-	-	-
Lowell	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	S	S	S	S	S	S	SP	SP	-	-	-	-	-	-	-	-	-
Lower	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	S	S	-	-
Lyford	-	-	-	-	S	S	S	S	S	-	-	-	-	-	-	-	-	-	-	B	B	S	S	S	S	S	-	S	-	-	-	-	-	-
Maidstone	B	B	B	-	-	-	-	-	-	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Martins	-	SP	S	S	S	SP	S	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Memphremagog	-	-	-	-	-	-	S	S	S	S	S	S	S	-	S	S	S	S	S	-	-	-	-	-	-	S	S	S	S	S	S	S	S	S
Memphremagog South Bay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	SP	S	S	-	-	-	-
Metcalf	-	-	S	S	S	S	S	S	-	-	-	-	-	-	-	S	S	S	-	S	S	S	S	-	-	-	-	-	-	-	-	-	-	-
Miles	-	-	-	-	-	-	S	S	S	S	SP	SP	SP	BP	B	-	-	-	-	-	-	-	-	-	-	-	-	-	S	SP	S	S	S	S
Mirror	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	B	S	-	-	-	-	-	-	S
Morey	S	S	S	S	SP	S	S	S	S	S	S	S	S	SP	S	S	S	B	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Newark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	-	-	-	-	-	-	-	-	-	-	S
Nichols	-	-	-	-	-	-	-	-	-	-	-	S	S	-	S	S	S	-	B	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Ninevah	-	-	S	SP	SP	S	S	S	S	B	BP	B	B	B	-	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
North Montpelier	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	S	S	S	S	-	-	-	S	S	S	S	S	S	S	S
Paran	-	S	SP	S	SP	SP	SP	SP	S	S	S	-	B	B	B	B	-	-	-	-	-	-	-	-	-	S	SP	S	-	-	-	-	-	-
Parker	S	S	S	S	S	S	S	S	S	S	S	S	S	B	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Peacham	-	-	-	-	B	S	S	S	S	S	-	-	-	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	-	S	S	S	S	S
Pensioner	-	-	-	-	-	-	-	-	-	-	-	-	S	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Perch	-	-	-	-	B	BP	-	S	S	S	S	-	-	-	-	-	-	-	-	B	B	B	-	-	B	B	B	-	-	-	B	B	B	-
Pinneo	-	-	-	SP	S	S	S	S	S	SP	B	B	BP	B	B	B	B	BP	B	BP	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Raponda	-	S	S	S	S	S	-	-	-	-	-	-	B	-	-	-	-	-	-	-	-	-	-	S	S	S	S	S	S	S	S	S	S	S
Rescue	B	BP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	B	S	S	S	S	S	S	S
Runnemede	-	-	-	-	-	-	-	-	-	-	-	-	S	-	-	-	-	-	-	SP	-	S	S	S	S	S	S	S	S	S	S	S	S	S
St. Catherine	S	S	S	S	S	S	S	S	B	-	-	-	-	-	B	B	B	S	SP	S	S	S	S	S	S	S	B	S	S	S	S	S	S	S
Salem	B	B	-	-	-	-	S	S	S	S	S	S	B	B	-	-	-	-	-	-	B	S	S	S	S	S	S	S	S	S	S	S	S	S
Seymour	S	S	S	S	S	S	S	B	B	B	B	B	B	B	B	S	S	S	B	B	B	S	S	S	S	S	S	S	S	S	S	S	S	S
Shadow	S	S	S	S	S	S	-	-	-	-	-	-	-	-	BP	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Shelburne	-	-	-	-	-	-	-	S	S	S	S	S	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Silver	-	-	-	-	B	S	S	S	S	S	S	S	SP	-	B	BP	-	-	B	B	BP	BP	B	B	B	B	B	B	B	B	B	-	B	B
South	-	-	-	-	-	-	-	-	-	-	-	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S

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P = partial data

Appendix 1 - Participation, 1979 - 2012
Inland Lakes

Lake	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Spring	-	-	-	-	-	-	-	S	S	S	S	S	S	B	B	B	S	S	S	S	S	S	-	-	-	-	-	-	-	-	-	-	-	-
Star	S	SP	-	-	-	-	-	S	S	S	SP	-	-	-	BP	-	-	-	-	-	B	-	-	-	-	-	-	-	-	-	-	-	-	-
Stratton	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	S	S	S	-	S	S	S	S	-	-	-	-	-	-
Sunset (Benson)	S	S	S	S	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	B	-	B	B	B	S	S
Sunset (Brookfield)	-	-	-	-	-	-	-	S	S	S	S	S	S	SP	B	B	B	B	BP	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Ticklenaked	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	SP	S	S	S	S	S	S	S	S	S	S	S	S
Valley	-	S	S	S	S	S	B	B	BP	B	B	-	SP	-	-	-	-	-	-	BP	B	-	-	-	-	-	-	-	-	-	-	-	-	-
Wapanacki	-	-	-	-	S	S	S	S	S	S	B	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Willoughby	-	S	S	-	S	S	S	S	B	BP	-	B	B	B	S	B	B	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Winona	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	-	-	-	-
Woodbury	S	S	S	S	S	S	BP	BP	S	BP	SP	S	B	B	B	B	B	B	-	B	-	B	B	B	B	B	B	B	B	B	B	B	B	B
Woodford/Big Pond	-	-	S	S	S	-	-	S	-	-	-	-	-	-	S	SP	S	SP	B	-	-	-	-	-	-	-	-	-	-	S	-	S	S	S
Woodward	-	-	S	SP	S	S	S	S	B	BP	BP	-	BP	-	B	BP	-	BP	-	-	B	B	-	-	-	-	-	-	-	-	-	-	-	-

B = basic monitoring, Secchi water clarity only
S = supplemental monitoring - Secchi water clarity, total phosphorus and chlorophyll-a
P = partial data

Appendix 1 - Participation, 1979 - 2012
Lay Monitoring Lake Champlain Stations

Lake Champlain Stations	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
#1 - Whitehall	S	S	S	S	-	-	-	-	SP	SP	S	-	S	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
#2 - Larrabee's Point	S	S	S	S	S	S	S	S	S	S	S	SP	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	S	S	S	SP	SP
#3 - Crown Point	S	S	S	S	S	S	-	-	-	S	S	-	S	SP	SP	S	S	S	S	S	-	-	-	-	-	-	-	S	S	S	S	S	SP	-
#4 - Button Bay-Broad Lake	-	S	-	-	S	SP	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	SP	S	S	S	S
#5 - Thompson's Point	S	S	S	S	S	S	SP	-	SP	S	-	-	S	S	-	-	S	S	S	SP	S	S	S	S	S	SP	S	S	S	S	S	S	S	S
#6 - Shelburne Bay	S	S	S	S	-	-	S	S	SP	S	S	S	S	S	S	S	S	S	S	S	-	S	S	S	S	S	S	S	S	S	S	S	S	S
#7 - Burlington-Broad Lake	S	S	S	S	-	S	SP	-	S	S	-	SP	S	S	-	S	S	SP	S	S	-	SP	S	S	-	S	S	S	S	S	S	S	S	S
#8 - Willsboro Point	S	S	S	S	S	SP	S	S	S	S	S	S	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
#9 - Colchester Shoals	SP	-	S	-	SP	-	S	-	-	SP	-	-	-	S	-	-	SP	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
#10 - Outer Malletts Bay	S	S	S	-	-	S	S	-	SP	-	SP	SP	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
#11 - Inner Malletts Bay	S	S	S	-	S	S	S	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
#12 - Fish Bladder Island	B	B	-	-	S	SP	SP	-	SP	-	-	S	S	S	S	S	S	-	-	S	S	S	S	S	S	S	S	SP	S	SP	S	S	S	-
#13 - Cumberland Bay	-	SP	-	SP	-	S	S	S	SP	SP	-	-	-	-	SP	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
#14 - Treadwell Bay-Broad Lake	S	S	S	S	S	S	S	-	SP	SP	-	-	-	-	S	S	S	S	-	-	-	S	-	-	-	-	-	-	-	-	-	-	-	-
#15 - The Gut	B	B	B	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	-	-	-	-	-	-	-	-	-	S	S	S	S	S	S	SP
#16 - Ball Island	BP	S	S	-	S	S	S	S	SP	-	-	SP	SP	SP	SP	-	SP	-	-	-	-	SP	S	SP	SP	SP	SP	S	-	S	S	S	S	-
#17 - St. Albans Bay	S	S	S	S	S	S	S	S	S	S	S	S	S	SP	S	S	S	S	S	S	-	S	S	S	S	SP	SP	-	-	S	S	S	S	-
#18 - Butler Island	S	S	S	S	S	S	S	S	S	S	-	S	S	S	S	S	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	-
#19 - Point Au Fer	S	S	S	S	S	S	S	S	S	-	-	S	S	S	S	SP	S	SP	S	S	S	SP	S	S	S	S	-	S	S	-	S	S	-	S
#20 - Missisquoi Bay	S	-	S	-	S	S	SP	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	S	S	SP	S	S
#21 - Keeler Bay	B	B	BP	B	B	B	S	S	S	S	S	S	SP	S	S	S	-	S	S	S	SP	-	-	-	-	-	-	-	-	-	-	-	-	-
#22 - Maquam Bay	-	-	B	B	BP	BP	BP	-	BP	BP	-	SP	S	SP	S	S	S	S	S	S	S	S	S	S	-	-	-	-	-	S	S	S	S	-
#23 - Alburg Passage	-	-	-	BP	-	-	S	S	S	S	S	S	S	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
#24 - Inner Missisquoi Bay	-	-	-	S	SP	SP	S	S	-	-	-	-	SP	S	S	-	S	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
#25 - Pelots Point	-	-	-	S	SP	-	S	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
#26 - Kellogg Bay	-	-	-	S	S	S	SP	-	S	-	S	SP	S	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
#29 - Carry Bay	-	-	-	S	S	-	S	S	S	S	S	S	SP	-	S	S	-	-	-	-	-	-	-	-	S	S	-	-	S	-	S	S	S	S
#30 - Alburg Bridge	-	-	-	-	S	S	SP	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	SP	S	S	S	-	S	S	SP	S	S
#31 - Sandbar	-	-	-	-	-	-	-	-	-	-	-	S	S	S	S	S	S	-	-	S	S	S	SP	S	S	S	S	SP	S	SP	-	S	S	-
#32 - Valcour Island	-	-	-	-	-	-	-	-	-	-	-	-	-	S	S	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
#33 - Burlington Bay	-	-	-	-	-	-	-	-	-	-	-	-	-	S	S	SP	S	S	SP	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
#34 - Potash Point	-	-	-	-	-	-	-	-	-	-	-	-	-	S	-	-	-	-	-	-	-	-	SP	SP	-	-	-	-	-	-	-	-	-	-

B = basic monitoring, Secchi water clarity only
S = supplemental monitoring - Secchi water clarity, total phosphorus and chlorophyll-a
P = partial data

Appendix 1 - Participation, 1979 - 2012
Lay Monitoring Lake Champlain Stations

Lake Champlain Stations	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
#36 - West Haven	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	S	S	-	S	S	-	-	-	-	S	-	-	-	-	-	S	-	-	-
#37 – Outer Carry Bay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	S	-	-	S	S	S	S	S	S
#38 – Town Farm Bay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	S	S	S	S
#39 – Inner Thompson point	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	-	-	-	-
#40 - North Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	S	S	S
#41 - Queneska Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S
#42 - Champlain Bridge	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S

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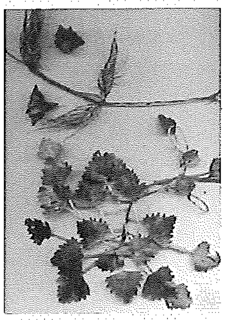
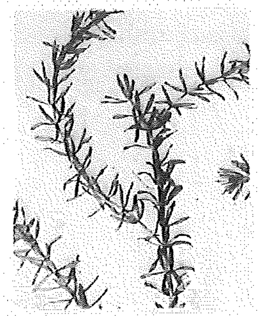
P = partial data

Appendix 2
Nuisance Exotic Species

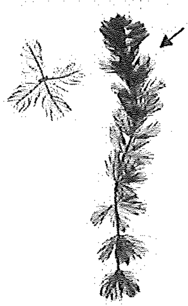
Vermont Invasive Species!



Water chestnut
Trapa natans
This is a glossy, green, triangular-leaved plant that can easily choke the waterbodies it invades, out-compete native plants, and reduce oxygen levels which can increase the potential for fish kills. Dense, nearly impenetrable water chestnut growth can make fishing, hunting, swimming, boating, and other recreational activities nearly impossible

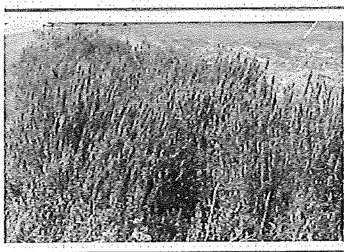


Hydrilla
Hydrilla verticillatat
This is a submersed rooted perennial, and highly adaptable to a wide range of environmental conditions. Hydrilla has leaves in whorls of 3 to 8 joined directly to the stem, visible toothed leaf margins and small potato-like tubers at the end of the underground stems. This species is considered one of the most problematic aquatic plant invaders. Preventing its introduction into Vermont waters is imperative.

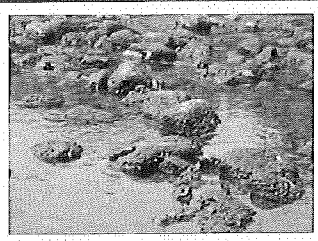


Eurasian watermilfoil
Myriophyllum spicatum
This is a stringy, submerged plant that quickly proliferates. It is known for its delicate, feathery appearance and has whorls of leaves around the stem, 4 are common, but often 3 to 6 can be found. The leaves are divided into pairs of thread like segments, typically 12 or more. Sometimes tops of the plant exhibit a reddish color.

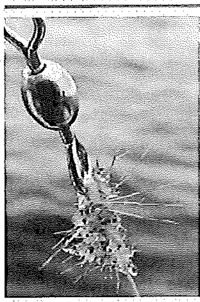
Variable-leaved watermilfoil
(Myriophyllum heterophyllum)
This is a rooted, submerged perennial species, first confirmed in a Vermont water in 2008. It has densely packed whorls of 4 to 6 underwater leaves around the stem, each underwater leaf has 7 to 11 pairs of segments, thick, robust, reddish stems and mature plants show blade-like leaves above water surface with serrated edges.



Purple loosestrife
Lythrum salicaria
A wetland perennial plant that is highly successful and able to out-compete native vegetation due to it's high germination rate, and its abundant and easily transported seed. Dense growth can eliminate food and shelter for wildlife including shallow water fish spawning grounds.

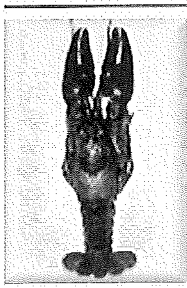


Didymo
(Didymosphenia geminata) A non-native algae (diatom) species capable of forming thick nuisance mats on river and stream bottoms with potentially significant impacts to fisheries and other habitat.

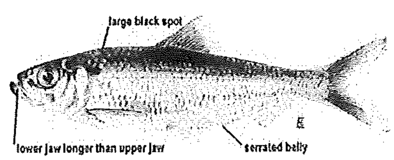


Spiny waterflea
Bythotrephes longimanus
The spiny waterflea is a small (5-15 mm) predaceous crustacean that threatens aquatic ecosystems by competing with native fish for food. Anglers often discover new infestations. The flea collects on fishing lines and cables in gelatin like clumps. They can spread to other lakes when fishing gear is contaminated. Females die out of water, but eggs can remain viable and can establish a new population. Eradicating established infestations is impossible.

Zebra mussel
Dreissena polymorpha
Zebra mussels are small barnacle-like mollusks. They have caused some very serious economic and environmental problems in many areas. They are highly prolific and able to form dense colonies out-competing native species. Zebra mussels feed by filtering plankton out of the water which impacts water clarity and alters the food web.



Rusty crayfish
Orconectes rusticus
Rusty crayfish can be identified by their robust claws with black bands on the tips, and dark, rusty spots on each side of their carapace (body). They can out-compete native species, forcing native crayfish from daytime hiding areas and destroying aquatic plant beds. They have likely been spread into numerous waterbodies in Vermont by anglers using them for bait.



Alewife
Alosa pseudoharengus
Alewife is a marine fish from the herring family capable of surviving in freshwater. They reproduce quickly and can soon become the most dominant fish species in a lake. They are very efficient feeders and consume huge quantities of zooplankton which enable them to out-compete other species.

Appendix 3
Glossary

ALGAE - Simple aquatic plants which are usually microscopic in size. Algae can grow suspended in the water or attached to plants or the lake bottom. Algae do not have true roots, flowers, and leaves.

ANAEROBIC - (also **anoxic**) - Environment in which oxygen is absent.

BACTERIA - Microscopic single cell organisms that are similar to plants but lacking in chlorophyll.

BLOOM - A very large algal population that may cause a green coloration of the water or form large floating mats. Such a large population may be stimulated by high nutrient levels, warm-water temperatures and long periods of sunlight. Seasonal spring and fall algal blooms usually are part of the normal cycle of a productive lake.

CHLOROPHYLL - The photosynthetic, green pigment contained in all green plants.

CULTURAL EUTROPHICATION - The acceleration by human activities of the natural aging process in a lake evidenced by increasing nutrient concentrations.

DRAINAGE BASIN - (also **watershed**) - The land area draining into a body of water. The surface area of the lake is included in the calculation of the drainage basin surface area.

ECOLOGY - The study of the relationships between organisms and their environment.

EROSION - The loosening and subsequent transport of soil away from its native site. In Vermont, erosion typically results from the removal of vegetation, which is a soil stabilizer.

EUTROPHIC - A general classification of lakes which have a high level of nutrients. Eutrophic lakes are often shallow, warm, seasonally deficient in oxygen in the lower depths of the lake, and supportive of large algal and/or aquatic plant populations.

EUPHOTIC ZONE - The layer of lake water where light penetrates through the water and is useable by plants and algae.

EUTROPHICATION - The natural aging process of a lake whereby nutrients and sediments increase in the lake over time, increasing its productivity and eventually turning it into a marsh. If the process is accelerated by human-made influences, it is referred to as "cultural eutrophication."

FECAL COLIFORM BACTERIA - Bacteria found in the feces of warm-blooded animals. Fecal coliform bacteria are used as indicators of recent sewage contamination. Fecal coliform bacteria are not harmful themselves, rather they indicate the potential presence of other disease-causing organisms.

GROUNDWATER - Water that lies beneath the earth's surface in water-filled layers of sand, gravel, clay or cracked rock.

LAKE BASIN - A depression in the surface of the land that forms a lake when full of water. Lakes may be composed of more than one basin.

LIMITING NUTRIENT - The nutrient whose demand exceeds its supply such that growth is restricted until more is available.

LIMNOLOGY - The study of the physical, biological, and chemical aspects of inland ponds (generally freshwater), lakes, and streams.

MACROPHYTES - Rooted aquatic plants which grow in or on the water. They have true roots, flowers, and leaves.

MEAN - (also **average**) - Calculated by adding the values of all the data points and dividing this sum by the number of data points.

MESOTROPHIC - A general classification of lakes between the levels of oligotrophic and eutrophic. Mesotrophic lakes have a moderate level of nutrients and are somewhat productive (supportive of moderate growths of algae and aquatic plants).

METER - A measure of length in the metric system, approximately equivalent to 3.25 feet. One meter (m) equals 39.37 inches or 1.0936 yards.

MICROGRAM - (□g) - The unit of measurement used to express one part per million (ppm).

NON-POINT SOURCE POLLUTION - Pollution that comes from a diffuse area, as opposed to a discharge pipe, and that enters lakes or streams via runoff, groundwater, or tributary streams. Examples are soil erosion, septic system pollution, and manure runoff.

NUTRIENT - A chemical required for growth, development or maintenance by a plant or animal. Examples are nitrogen and phosphorus.

OLIGOTROPHIC - A general classification of lakes which have a low level of nutrients. Oligotrophic lakes are usually deep and cold. They usually have a sufficient amount of oxygen at all depths and they support little algal and aquatic plant growth.

ORGANIC COMPOUND - A chemical compound containing carbon as the base element. Some kinds of organic compounds can be toxic to plant and animal life.

OVERTURN - The thorough mixing of the water in a lake during the spring and during the fall when the water is uniform in temperature and density.

PHOSPHORUS - A nutrient required by plants, including algae, for growth. In lakes, phosphorus is usually the nutrient in shortest supply relative to other nutrients. The addition of phosphorus to a lake will stimulate plant and algal growth.

PHOTOSYNTHESIS - Production of organic compounds using light by chlorophyll-containing cells.

PHOTIC ZONE - The lighted region of a lake where photosynthesis takes place.

PHYTOPLANKTON - Small plants, usually microscopic, suspended in the water, that drift in the water with waves or currents.

POINT SOURCE POLLUTION - Pollution from discharge pipes or outfalls from sources, such as wastewater treatment plants or industrial facilities.

RIPARIAN - A term used to describe the shoreland area of lakes, ponds and streams.

SECCHI DISK - A white and black disk 8 inches (20 cm) in diameter used to measure transparency of water.

SEDIMENT - Bottom material in a lake that has been deposited after the formation of a lake basin. Sediment results from the accumulation of decomposing remains of aquatic organisms, chemical precipitation of dissolved minerals, and erosion of surrounding lands. Sediment particles may also be suspended in the water.

SEDIMENTATION - The sinking of silt, algae, and other particles through the lake water column and their deposition on the lake bottom (where they form sediment). Sedimentation is an important process in the life of a lake, transferring nutrients throughout the lake's layers and providing a critical link between surface plankton and bottom-dwelling organisms.

STRATIFICATION - The formation of thermal zones in deep lakes during the summer. These zones are referred to as the epilimnion (warm upper region), hypolimnion (cold lower region), and metalimnion (thin boundary between the other two layers).

TROPHIC LEVEL - A relative level of productivity. Three trophic levels of Vermont lakes are eutrophic, mesotrophic and oligotrophic.

TURBIDITY - A measurement of water clarity. High turbidity (low water clarity) is caused by suspended particles such as silt, soil or algae which reduce light penetration.

WATER TABLE - The upper surface of groundwater below which the soil is saturated with water.

WATERSHED - (also **drainage basin**) - The land area draining into a body of water. The surface area of the lake is included in the calculation of the drainage basin surface area.

WETLAND - An area that is inundated by surface or ground water with a frequency sufficient to support significant vegetation or aquatic life dependent on saturated or seasonally saturated soil conditions for growth and reproduction.

ZOOPLANKTON - Small aquatic animals, often microscopic in size and capable of mobility.