New York State Department of Environmental Conservation

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New York
Citizens Statewide Lake Assessment Program
(CSLAP)

2006 Annual Report- Oquaga Lake

December, 2007

New York State Department of Environmental Conservation

2006 INTERPRETIVE SUMMARY

NEW YORK
CITIZENS STATEWIDE
LAKE ASSESSMENT PROGRAM
(CSLAP)

OQUAGA LAKE

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NYS Department of Environmental Conservation
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BACKGROUND AND ACKNOWLEDGMENT

The Citizens Statewide Lake Assessment Program (CSLAP) is a volunteer lake monitoring program conducted by the NYS Department of Environmental Conservation (NYSDEC) and the NYS Federation of Lake Associations (FOLA). Founded in 1986 with 25 pilot lakes, the program has involved more than 200 lakes, ponds, and reservoirs and 1000 volunteers from eastern Long Island to the northern Adirondacks to the western-most lake in New York, and from 10-acre ponds to several Finger Lakes, Lake Ontario, Lake George, and lakes within state parks. In this program, lay volunteers trained by the NYSDEC and FOLA collect water samples, observations, and perception data every other week in a 15 week interval between May and October. Water samples are analyzed by certified laboratories. Analytical results are interpreted by the NYSDEC and FOLA and utilized for a variety of purposes by the State of New York, local governments, researchers, and, most importantly, participating lake associations. This report summarizes the 2006 sampling results for **Oquaga Lake**.

Oquaga Lake is a 134 acre, class AA lake found in the Town of Deposit in Broome County in the Southern Tier region of New York State. It was first sampled as part of CSLAP in 1987. The following volunteers have participated in CSLAP, and deserve most of the credit for the success of this program at **Oquaga Lake**: **Kathy Greenman, Barbara and Fred Fenning, Joan, Ross, James and Carole Peduto, and Mark and Andrew Millspaugh.**

In addition, the authors wish to acknowledge the following individuals, without whom this project and report would never have been completed:

From the Department of Environmental Conservation, N.G. Kaul, Sal Pagano, Dan Barolo, Italo Carcich, Phil DeGaetano, Dick Draper, and Jeff Myers for supporting CSLAP for the past 20 years; Jay Bloomfield and James Sutherland, for their work in developing and implementing the program, and the technical staff from the Lake Services Section, for continued technical review of program design.

From the Federation of Lake Associations, Anne Saltman, Dr. John Colgan, Don Keppel, Bob Rosati, Don Cook, Nancy Mueller and the Board of Directors, for their continued strong support of CSLAP.

The New York State Department of Health (prior to 2002), particularly Jean White and Upstate Freshwater Institute (since 2002), particularly Steve Effler and Jennifer Aicher, provided laboratory materials and all analytical services, reviewed the raw data, and implemented the quality assurance/quality control program.

Finally, but most importantly, the authors would like to thank the more than 1,000 volunteers who have made CSLAP a model for lay monitoring programs throughout the country and the recipient of a national environmental achievement award. Their time and effort have served to greatly expand the efforts of the state and the public to protect and enhance the magnificent water resources of New York State.

OQUAGA LAKE
FINDINGS AND EXECUTIVE SUMMARY

Oquaga Lake was sampled as part of the New York Citizens Statewide Lake Assessment Program in 2006. For all program waters, water-quality conditions and public perception of the lake each year and historically have been evaluated within annual reports issued after each sampling season. This report attempts to summarize both the 2006 CSLAP data and an historical comparison of the data collected within the 2006 sampling season and data collected at Oquaga Lake prior to 2006.

The majority of the short- and long-term analyses of the water quality conditions in Oquaga Lake are summarized in Table 2, divided into assessments of eutrophication indicators, other water quality indicators, and lake perception indicators. Oquaga Lake continues to be highly unproductive, with very high water transparency, very low algae levels, and moderately low phosphorus readings. The lake has been much less productive—higher water clarity and lower chlorophyll *a* readings—in the last five years than in the period from 1987 to 1992. Although water clarity dropped in previous years after heavy rainfall, the high rains from Hurricane Ernesto in August of 2007 triggered a significant rise in water transparency. Lake productivity does not change significantly as the summer progresses; this is coincident with deepwater nutrient levels that are similar to those at the lake surface. The nitrogen to phosphorus ratios indicate that phosphorus limits algae levels in Oquaga Lake, and thus it is likely that phosphorus loading to the lake must be minimized to maintain the existing water clarity in the lake. Phosphorus levels in the lake have been consistently below the state phosphorus guidance value in Oquaga Lake, resulting in water transparency readings that easily exceed the minimum recommended water clarity for swimming beaches. In short, Oquaga Lake has been less productive in recent years, including 2006, perhaps indicative of "permanently" clearer conditions.

The lake is weakly colored (low levels of dissolved organic matter) and it is likely that these readings reflect the soil and vegetation characteristics of the watershed (i.e. "natural" conditions at the lake, based on readings from nearby lakes). Color readings may at times limit water transparency, although the high water clarity is more due to low algae levels than occasionally low color. It is likely that higher color comes from heavy rainfall. The lake has soft water, circumneutral (near neutral) pH readings, and mostly undetectable nitrate and low ammonia readings. Conductivity readings have increased since 1987, although it is not known if this has otherwise affected the lake. These readings continue to be indicative of soft water lakes. pH readings usually fall within state water quality standards, and should support most aquatic organisms. Nitrate and ammonia levels do not appear to warrant a threat to the lake; although nitrate levels have risen slightly in recent years. Calcium levels are not high enough support zebra mussel populations, and these organisms have not been found in the lake.

The recreational suitability of Oquaga Lake continues to be described as "could not be nicer" for most uses—this overall assessment of the lake is consistent with the measured water quality conditions in the lake, and is found in other "crystal clear" lakes. Aquatic plants are only rarely visible from the lake surface, although aquatic plant coverage may have increased slightly in recent years. These assessments are stable during the summer, coincident with seasonally stable water quality conditions and weed densities or coverage. Recreational use impacts appear to be limited to poor weather.

The 1996 NYSDEC Priority Waterbody Listings (PWL) for the Delaware River basin do not include Oquaga Lake. The CSLAP datasets suggest that no listings appear to be warranted. The next PWL review for this basin will likely occur in 2008.

General Comments and Questions:

- ***What is the condition of Oquaga Lake?***

Water quality conditions in Oquaga Lake continue to be best characterized as moderately to highly unproductive, with low nutrient and algae levels and high water clarity, particularly in the last five years. Recreational assessments of the lake have consistently been highly favorable during the summer, as expected given the water quality conditions in the lake, although this also reflects the lack of invasive weed problems in the lake.

- ***What about the dark and murky bottom waters of the lake?***

The bottom waters of Oquaga Lake have nutrient (phosphorus) levels similar to those measured at the lake surface, and this suggests that deepwater oxygen levels are probably not depressed (as is the case in many NYS lakes deeper than 20-30 feet). Bottom oxygen levels were fairly high in the 1935 survey, and it is likely that readings today would be similar. Deepwater nitrate and ammonia levels also appear to be similar to those measured at the lake surface.

- ***How does this condition change from spring showers thru changing of the leaves?***

The productivity of Oquaga Lake does not change in any predictable way during the summer and into the fall, due in part to bottom waters that have nutrient levels similar to those at the lake surface. Not coincidentally, recreational assessments and perceptions of lake conditions (how the lake looks) are also fairly stable (and highly favorable) during the summer.

- ***How has the condition changed since CSLAP sampling began on the lake and/or relative to historical values?***

Conductivity readings have generally increased since CSLAP began in 1987, and lake productivity has been lower (higher water clarity, lower phosphorus and chlorophyll *a* readings) since 2002 than in the period from 1987 to 1992, suggesting a stable long-term change toward lower productivity. Recreational assessments continued to be stable and highly favorable.

- ***How does Oquaga Lake compare to other similar lakes (nearby lakes,….)?***

Oquaga Lake appears to be less productive (re: higher clarity, and lower nutrient and algae levels) than other nearby (Delaware River basin) lakes, other lakes used for potable water intake (Class AA lakes), and other NYS lakes. Recreational assessments have been more favorable than in the typical lake in each of these classes of waterbodies, as expected given the excellent water quality and lack of invasive weed problems.

- ***Based on these data, what should be done to improve or maintain Oquaga Lake?***

Water quality conditions and recreational assessments in Oquaga Lake appear to be highly favorable, so lake management activities should focus on preventing the introduction of exotic plants and animals to the lakes via education, surveillance of boat launch sites (public and private), and boat inspections. This is particularly important since invasive exotic weeds have been found in many lakes within the Delaware River basin and throughout New York State. The lake does not appear to be a candidate for zebra mussel infestation, at least given the existing calcium readings in the lake.

Context and Qualifiers

The NY Citizens Statewide Lake Assessment Program (CSLAP) is intended to be a long-term, standardized, trophic-based, water-quality monitoring program to facilitate comparison of water-quality data from season to season, year to year, and from lake to lake. The data and information collected through CSLAP can be utilized to identify water-quality problems, detect seasonal and long-term patterns, and educate sampling volunteers and lake residents about water-quality conditions and stressors at their lakes. It is particularly useful in evaluating the over-enrichment of aquatic plant (algae and rooted plant) communities in a lake, and the response of the lake to these trophic stressors.

Shorefront residents, lake managers, and government agencies are increasingly tasked to better assess and evaluate water-quality conditions and lake uses in NYS lakes, including those sampled through CSLAP, whether to address localized problems, meet water-quality standards, satisfy state and federal environmental reporting requirements, or enhance and balance a suite of lake uses. CSLAP data should be a part of this process, but only a part. For some lakes, particularly small lakes and ponds with limited public access by those who don't reside on the lake shore, CSLAP may be the sole source of data used to assess lake conditions. In addition, studies conducted through CSLAP find strong similarities between sampling sites in many, but not all, large lakes, and generally find a strong convergence of perceptions about lake and recreational use conditions within most lakes, based on a local familiarity with "normal" conditions and factors that might affect lake use. For the purpose of broad water-quality evaluations and understanding the connection between measured water-quality indicators and the support of broadly based recreational uses of the lake, CSLAP can be a singularly effective tool for standardizing the lake-assessment process. CSLAP volunteers, lake associations, and others engaged in lake assessment and management should continue to utilize CSLAP in this context.

However, for large, multi-use lakes, or those lakes that are threatened by pollutants not captured in eutrophication-based monitoring programs, CSLAP becomes a less effective primary tool for assessing lake condition and use impairments. For example, CSLAP data have only limited utility in evaluating the following:

(a) contamination from bacteria or other biological toxins, particularly related to the safety of water use for potable intake or swimming
(b) contamination from inorganic (e.g., metals) and organic (e.g., PCBs, DDT) compounds
(c) portions of a lake not well mixed with the "open water" or otherwise distant from the primary sampling site(s), including the shoreline, bottom sediment and isolated coves
(d) rooted aquatic plant impacts in areas of the lake not evaluated by the sampling volunteers
(e) diverging perceptions of recreational-use impacts, particularly in lakes with shorelines or isolated coves exhibiting conditions very different from those sampled or evaluated by the sampling volunteers
(f) impacts to fish or other fauna due to factors unrelated to eutrophication
(g) PWL or 303(d) listings for other pollutants or portions of the lake not sampled through CSLAP

For these waterbodies, CSLAP can and should continue to be part of an extensive database used to comprehensively evaluate the entirety of the lake and its uses, but absent a more complete dataset, CSLAP data should be used with caution as a sole means for evaluating the lake. Water-quality evaluations, recommended PWL listings, and other extrapolations of the data and analyses should be utilized in this context and by no means should be considered "the last word" on the lake.

I. INTRODUCTION: CSLAP DATA AND YOUR LAKE

Lakes are dynamic and complex ecosystems. They contain a variety of aquatic plants and animals that interact and live with each other in their aquatic setting. As water-quality changes, so too will the plants and animals that live there, and these changes in the food web also may affect water-quality. Water-quality monitoring provides a window into the numerous and complex interactions of lakes. Even the most extensive and expensive monitoring program **cannot completely assess** the water-quality of a lake. However, by looking at some basic chemical, physical, and biological properties, it is possible to gain a greater understanding of the general condition of lakes. CSLAP monitoring is a basic step in overall water-quality monitoring.

Understanding Trophic States

All lakes and ponds undergo **eutrophication,** an aging process, that involves stages of succession in biological productivity and water-quality (see Figure 1). **Limnologists** (scientists who study freshwater systems) divide these stages into **trophic** states. Each trophic state can represent a wide range of biological, physical, and chemical characteristics and any lake may "naturally" be categorized within any of these trophic states. In general, the increase in productivity and decrease in clarity corresponds to an enrichment of nutrients, plant and animal life. Lakes with low biological productivity and high clarity are considered **oligotrophic**. Highly productive lakes with low clarity are considered **eutrophic**. Lakes that are **mesotrophic** have intermediate or moderate productivity and clarity. It is important to remember that eutrophication is a natural process and is not necessarily indicative of man-made pollution.

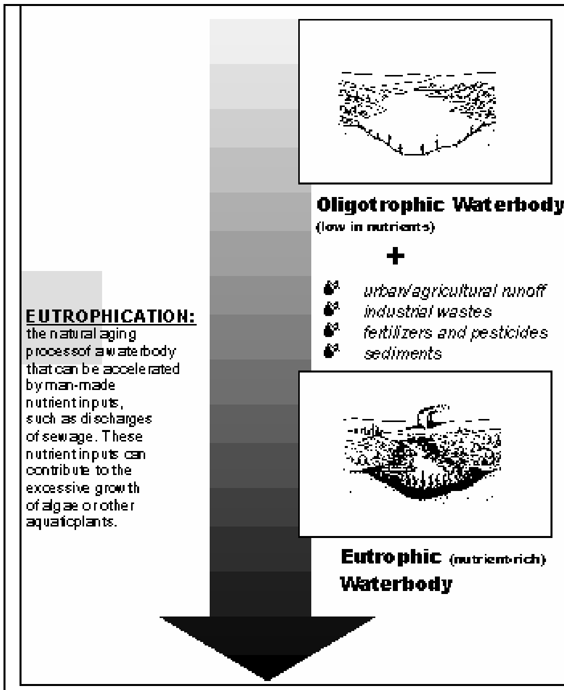


Figure 1. Trophic States

In fact, some lakes are thought to be "naturally" productive. Trophic classifications are not interchangeable with assessments of water-quality. Water-quality degradation from the perspective of one user may contrast with the perception of favorable conditions by a different lake user. For example, a eutrophic lake may support an excellent warm-water fishery because it is nutrient rich, but a swimmer may describe that same lake as polluted. A lake's trophic state is still important because it provides lake managers with a reference point to view changes in a lake's water-quality and they begin to understand how these changes may cause **use impairments** (threaten the use of a lake or swimming, drinking water or fishing)**.**

When human activities accelerate lake eutrophication, it is referred to as **cultural eutrophication**. Cultural eutrophication may result from shoreline erosion, agricultural and urban runoff, wastewater discharges or septic seepage, and other non-point source pollution sources. These can greatly accelerate the natural aging process of lakes, cause successional changes in the plant and animal life within the lake, shoreline and surrounding watershed, and impair the water-quality and value of a lake. They may ultimately extend aquatic plants and emergent vegetation throughout the lake, resulting in the transformation of the lake into a marsh, prairie, and forest. The extent of cultural eutrophication and the corresponding pollution problems can be signaled by significant changes in the trophic state over a short period.

Why is this important? New York State lakes can be affected by a variety of stressors, from acid rain to zebra mussels and almost everything in between. In any given part of the state, some of these stressors are more important than others. For example, there are probably more lakes affected by acid rain than any other pollutant, but these impacts are typically associated with a particular region (the Adirondacks and Catskills) and particular type of lake (small, high-elevation lakes in basins with thin soils and little buffering capacity). But for most lakes in New York, cultural eutrophication represents the most significant source of pollutants and threat to water-quality. As a result, water-quality indicators related to eutrophication comprise the foundation of most water-quality monitoring programs.

II. CSLAP SAMPLING PARAMETERS

CSLAP monitors several parameters related to the trophic state of a lake, including the clarity of the water, the amount of nutrients in the water, and the amount of algae resulting from those nutrients. Three parameters are the most important measures of eutrophication in most New York lakes: **total phosphorus, chlorophyll *a*** (estimating the amount of algae), and **Secchi disk transparency**. Because these parameters are closely linked to the growth of weeds and algae, they provide insight into “how the lake looks” and its suitability for recreation and aesthetics. Other CSLAP parameters help characterize water-quality at the lake. Each of these sampling parameters is outlined in Figure 2. In addition, CSLAP also uses the responses on the Field Observation Forms to gauge volunteer perceptions of lake water-quality. Most water-quality “problems” arise from impairment of accepted or desired lake uses, or the perception that such uses are somehow degraded. As such, any water-quality monitoring program should attempt to understand the link between perception and measurable quality.

The parameters analyzed in CSLAP provide valuable information for characterizing lakes. By adhering to a consistent sampling protocol provided in the CSLAP Sampling Protocol sampling volunteers collect and use data to assess both seasonal and yearly fluctuations in these parameters and to evaluate the water-quality conditions in their lake. By comparing a specific year's data to historical water-quality information, lake managers can pinpoint trends and determine whether water-quality is improving, degrading or remaining stable. Such a determination answers a first critical question posed in the lake-management process.

Figure 2. CSLAP Parameters

PARAMETER	SIGNIFICANCE
Water Temperature (°C)	Water temperature affects many lake activities, including the rate of biological growth and the amount of dissolved oxygen. It also affects the length of the recreational season.
Secchi Disk Transparency (m)	Determined by measuring the depth at which a black and white disk disappears from sight, the Secchi disk transparency estimates the clarity of the water. In lakes with low color and rooted macrophyte ("weed") levels, it is related to algal productivity.
Conductivity (µmho/cm)	Specific conductance measures the electrical current that passes through water, and is used to estimate the number of ions (charged particles). It is somewhat related to both the hardness and alkalinity (acid-buffering capacity) of the water and may influence the degree to which nutrients remain in the water. Generally, lakes with conductivity of less than 100 µmho/cm are considered softwater, while conductivity readings above 300 µmho/cm are found in hardwater lakes.
pH	pH is a measure of the (free) hydrogen ion concentration in solution. Most clearwater lakes must maintain a pH between 6 and 9 to support most types of plant and animal life. Low pH waters (<7) are acidic, while high pH waters (>7) are basic.
Color (true) (platinum color units)	The color of dissolved materials in water usually consists of organic matter, such as decaying macrophytes or other vegetation. It is not necessarily indicative of water-quality but may significantly influence water transparency or algae growth. Color in excess of 30 ptu indicates sufficient quantities of dissolved organic matter to affect clarity by imparting a tannic color to the water.
Phosphorus (total, mg/l)	Phosphorus is one of the major nutrients needed for plant growth. It is often considered the "limiting" nutrient in NYS lakes, for biological productivity is often limited if phosphorus inputs are limited. Nitrogen-to-phosphorus ratios of >25 generally indicate phosphorus limitation. Many lake management plans are centered on phosphorus controls. Phosphorus is reported as total phosphorus (TP)
Nitrogen (nitrate, ammonia, and total (dissolved), mg/l)	Nitrogen is another nutrient necessary for plant growth and can act as a limiting nutrient in some lakes, particularly in the spring and early summer. Nitrogen to phosphorus ratios <10 generally indicate nitrogen limitation (for algae growth). For much of the sampling season, many CSLAP lakes have very low or undetectable levels of one or more forms of nitrogen. It is measured in CSLAP in three forms_ nitrate/nitrite (NO_x) ammonia ($NH_{3/4}$), and total nitrogen (TN or TDN).
Chlorophyll *a* (µg/l)	The measurement of chlorophyll *a*, the primary photosynthetic pigment found in green plants, provides an estimate of phytoplankton (algal) productivity, which may be strongly influenced by phosphorus.
Calcium (mg/l)	Calcium is a required nutrient for most aquatic fauna and is required for the shell growth for zebra mussels (at least 8-10 mg/l) and other aquatic organisms. It is naturally contributed to lakes from limestone deposits and is often strongly correlated with lake buffering capacity and conductivity.

Ranges for Parameters Assessing Trophic Status and Oquaga Lake

The relationship between phosphorus, chlorophyll *a*, and Secchi disk transparency has been explored by many researchers, to assess the trophic status (the degree of eutrophication) of lakes. Figure 3 shows the ranges for phosphorus, chlorophyll a, and Secchi disk transparency (summer median) that are representative for the major trophic classifications:

Figure 3. Trophic Status Indicators

Parameter	Eutrophic	Mesotrophic	Oligotrophic	Oquaga Lake
Phosphorus (mg/l)	> 0.020	0.010 - 0.020	< 0.010	**0.007**
Chlorophyll a (µg/l)	> 8	2- 8	< 2	**2.8**
Secchi Disk Clarity (m)	< 2	2- 5	> 5	**6.4**

These classifications are valid for clear-water lakes only (with less than 30 platinum color units). Some humic or "tea color" lakes, for example, naturally have high levels of dissolved organic material, resulting in color readings that exceed 30 color units. This will cause the water transparency to be lower than expected, given low phosphorus and chlorophyll *a* levels in the lake. Water transparency can also be unexpectedly lower in shallow lakes due to influences from the bottom (or the inability to measure the maximum water clarity due to the visibility of the Secchi disk on the lake bottom). Even shallow lakes with high water clarity, low nutrient concentrations, and little algal growth may also have significant weed growth due to shallow water conditions. While such a lake may be considered unproductive by most water-quality standards, that same lake may experience severe aesthetic problems and recreational impairment related to weeds, not trophic state. Generally, however, the trophic relationships described above can be used as an accurate "first" gauge of productivity and overall water-quality.

By each of the trophic standards described above, the lake would be considered **oligotrophic, or unproductive.** This has been a consistent assessment for the last several years, as chlorophyll *a* readings have dropped, and water clarity and nutrient readings have been typical of oligotrophic (unproductive) lakes for nine of the eleven CSLAP sampling seasons at the lake. Water quality conditions in 1991 and 1992 were more typical of mesotrophic, or moderately productive, lakes. The trophic condition of Oquaga Lake will be discussed in greater detail later in this report.

III. CSLAP LAKES

CSLAP sampling began in 1986 on 25 lakes generally distributed throughout the state, and in the following 20 years has expanded to more than 200 lakes. The program was developed primarily to identify water-quality problems, develop long-term databases, and educate lakefront property owners on small lakes with little historical information and few other contemporary studies. However, the program has been utilized by lake residents, lake associations and managers, municipalities, state and federal government and environmental organizations to gain insights about small ponds, large high-profile lakes and multi-use reservoirs from eastern Long Island to the northern Adirondacks, to the western border of New York State. A map showing each of the lakes sampled through CSLAP since 1986 is shown in Figure 4. The distribution of lakes roughly matches the distribution of lake associations in the state (or at least those affiliated with the NY Federation of Lake Associations, the largest lake association organization in the state). The relative paucity of CSLAP lakes in the Finger Lakes region reflects the small number of lakes in a region dominated by very large lakes, while the small number of lakes sampled in the Catskills, Long Island, and western NY reflects the shortage of organized lake associations in those areas.

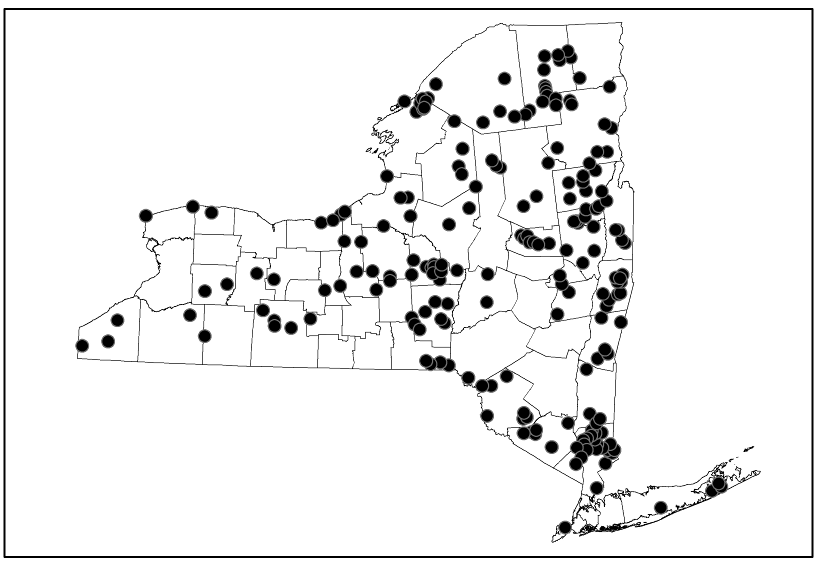


Figure 4: CSLAP Sampling Sites

CSLAP lakes have ranged from the very small (five acre Cranberry Lake in the downstate region) to the great (two state park beaches on Lake Ontario). It has included perhaps the clearest lake in New York State (Skaneateles Lake, one of the Finger Lakes, with as high as 50 feet of water transparency) and several lakes with clarity as low as one foot. There are a large number of lakes used for potable water, as well as those classified only for fishing and non-contact recreation. Some lakes (those on Long Island) sit just above sea level, while others are perched high in the clouds, including

Summit Lake in central NY and Twitchell Lake in the Adirondacks, more than 2,000 feet above sea level.

Figures 5a through 5d summarize the variety of lakes sampled through CSLAP. In short, these lakes constitute a reprehensive cross-section of the lake conditions, uses, and settings encountered in New York State.

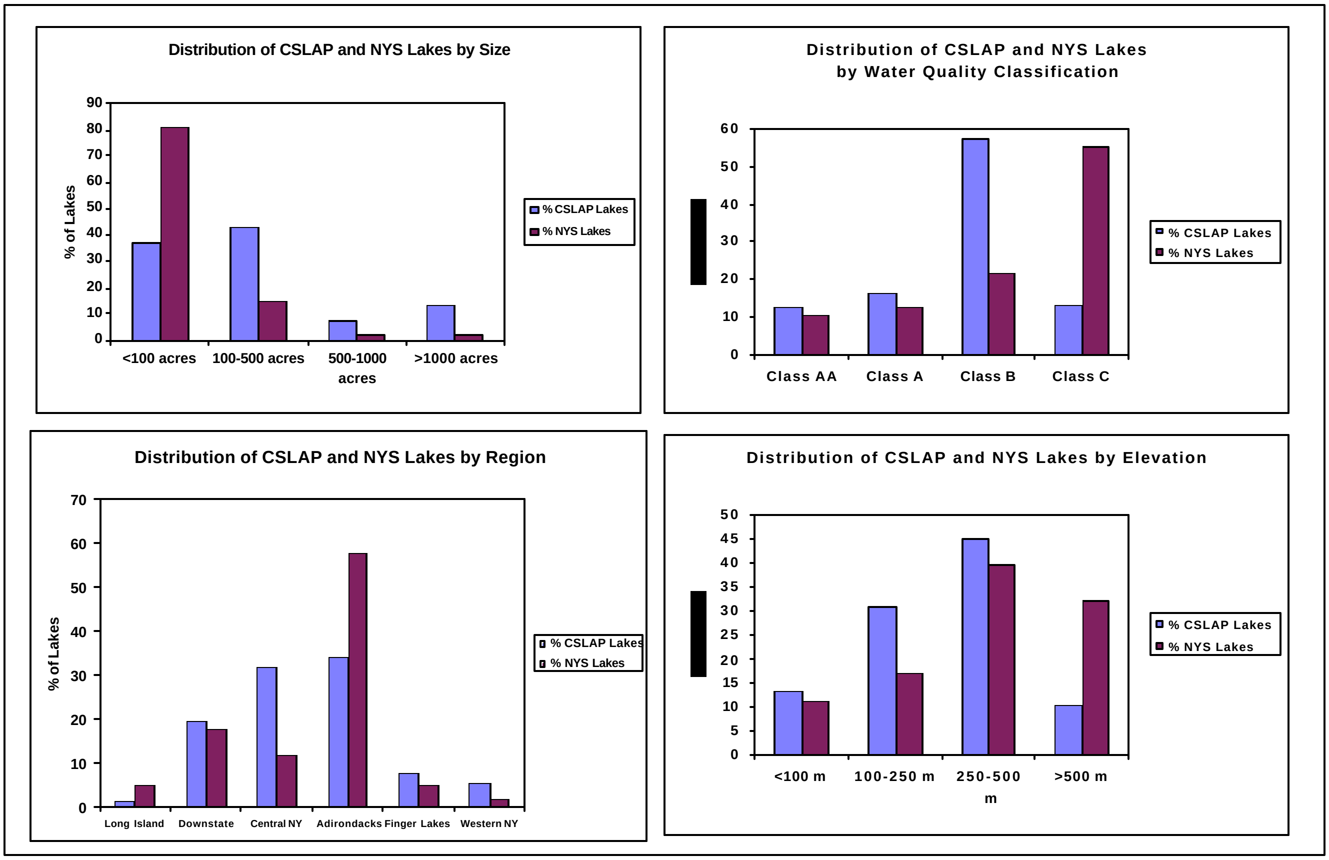


Figure 5- Comparison of CSLAP and New York State Lakes

The typical CSLAP lake is slightly larger than the typical New York State lake and is more likely to be found in central New York (between the Adirondacks, downstate and Finger Lakes regions). However, this profile, as well as the preponderance toward "mid-elevation" regions, is probably more typical of the "lake community" regions of the state. This corresponds to those regions in which large numbers of lakes are heavily populated, which in turn represents lower elevation waterbodies that support siting septic systems and have close proximity to roads and other non-lake communities (comprised of visitors and seasonal lake residents). The relatively higher percentage of Class B lakes in CSLAP and Class C lakes in the rest of the state reflects the large number of uninhabited Class C lakes in the Adirondacks. These lakes have been classified as Class C lakes, often by default, due in part to the lack of information about historical or contemporary lake uses and water-quality conditions.

The distribution of lakes in these categories does suggest that CSLAP lakes are mostly comparable to other New York State lakes, and that an evaluation of CSLAP data may serve as a reasonable surrogate for statewide water-quality evaluations, particularly since CSLAP serves as the primary long-term database maintained and supported by New York State.

IV: OQUAGA LAKE- BACKGROUND INFORMATION

Oquaga Lake is a 134 acre, class AA lake found in the Town of Deposit in Broome County in the Southern Tier region of New York State. It was first sampled as part of CSLAP in 1987. Figure 6 shows the location of Oquaga Lake. It is one of 4 CSLAP lakes among the >25 lakes found in Broome County, and one of 12 CSLAP lakes among the >240 lakes and ponds in the Delaware River drainage basin. Oquaga Lake is a Class AA lake; this means that the best intended use for the lake is for potable water—drinking—, contact recreation—swimming and bathing—and for non-contact recreation—boating and aesthetics. These "categories" will be used to evaluate water-quality conditions later in the report.

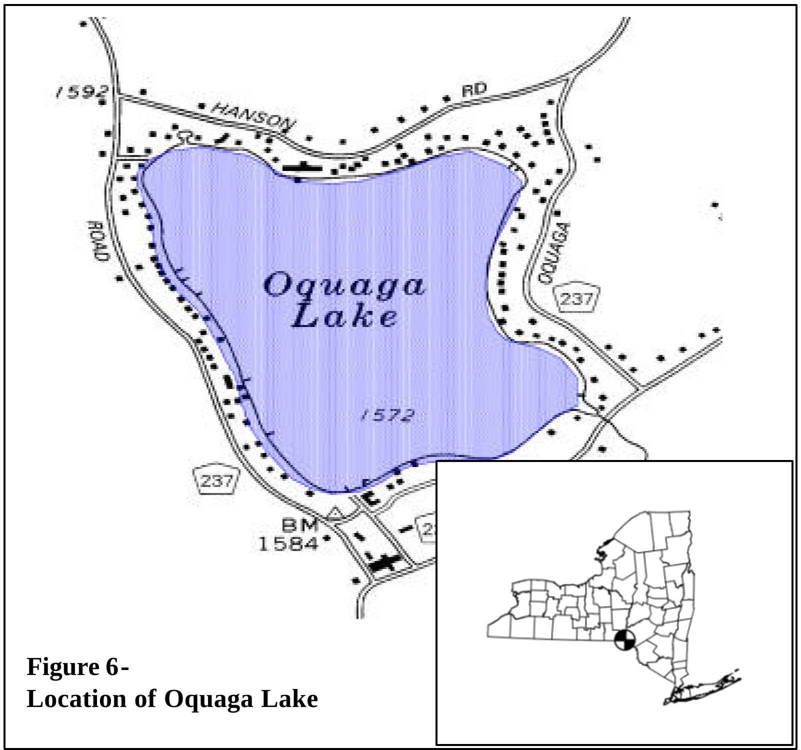


Figure 6 -
Location of Oquaga Lake

CSLAP samples have been collected from the deepest part of the lake, corresponding to a depth of about 108 feet (32 meters). Most lakes with a maximum depth of > 20 feet are thermally stratified, so bottom samples have been collected through CSLAP at the lake.

Historical Water-Quality Information for Oquaga Lake

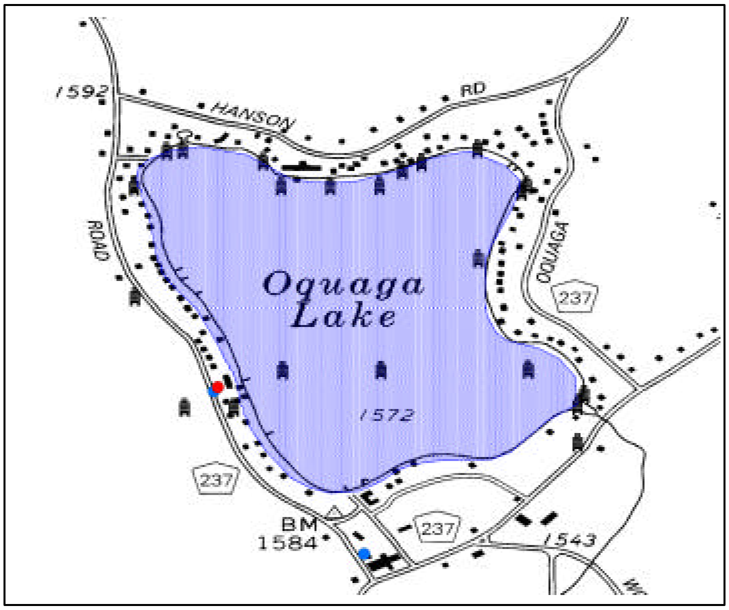
Oquaga Lake was sampled by the Conservation Department (the predecessor to the NYSDEC) on August 8th, 1935 as part of the Biological Survey of the Delaware River basin. The temperature and oxygen surveys from this study show dissolved oxygen reductions only near the lake bottom (close to 111 feet), and exceeding critical levels for all fish at all depths. Most of the parameters sampled in CSLAP were not analyzed as part of this survey. The results from the "shared" parameters are included in Table 1. The results from this survey suggest water quality conditions in 1935 were similar to those measured in 2004.

The field notes from this survey indicate the following:

"Oquaga Lake is a deep body of water (max. 111ft) with excellent chemical conditions on the bottom. Lake trout are present but those caught average small in size. Lake herring are recommended for stocking. The latter should supply a much needed deep-water forage fish for the lake trout. This species taken by the survey party had been feeding on small perch which are not plentiful judging from the gill-net collection. Rock bass dominate the shallow water. Sunfish are scarce along the shores. Only moderate numbers of large small-mouthed bass are recommended for planting since there is too little shallow water which produces bass food. Furthermore, rooted aquatic plants are scarce and recreational uses have caused the removal of other shelter.

Vegetation is scant."

The lake may also have been sampled as part of a local monitoring effort and/or in support of fisheries management activities on the lake.



Historical Fisheries Information for Oquaga Lake

It is not known by the report authors if private stocking occurs in Oquaga Lake.

General statewide fishing regulations are applicable in Oquaga Lake. In addition, the open season on trout lasts from April 1st through October 15th, with no size limits and a daily take limit of 5, with no more than 2 >12" and 5 brook trout under 8".

Permitted Facilities Associated with Oquaga Lake

There appears to be several facilities or activities on Oquaga Lake that requires permits or is otherwise regulated by the NYSDEC; the map to the left shows the activities on or near the lake (represented by "milk bottle" symbols). These correspond to a well (associated with Chestnut Inn) and multiple private residents (mostly associated with shorefront improvement projects).

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V. NEW YORK STATE, CSLAP AND OQUAGA LAKE WATER-QUALITY DATA: 1986-2005

Overall Summary:

Although water-quality conditions at each CSLAP lake have varied each year since 1986, and although detailed statistical analyses of the entire CSLAP dataset has not yet been conducted, general water-quality trends can be evaluated after 5-20 years' worth of CSLAP data from these lakes. Overall (regional and statewide) water-quality conditions and trends can be evaluated by a variety of different means. Each of the tested parameters ("analytes") can be evaluated by looking at how the analyte varies from year to year from the long-term average ("normal") condition for each lake, and by comparing these parameters across a variety of categories, such as across regions of the state, across seasons (or months within a few seasons), and across designated best uses for these lakes. Such evaluations are provided in the second part of this summary, via figures 7 through 17. The annual variability is expressed as the difference in the annual average (mean) from both the long-term average and the normal variability expected from this long-term average. The latter can be presented as the "standard error" (SE, calculated here within the 95% confidence interval)--one standard error away from the long-term average can be considered a "moderate" change from "normal," with a deviation of two or more standard errors considered to be a "significant" change. For each of these parameters, the percentage of lakes with annual data falling within one standard error from the long-term average are considered to exhibit "no change," with the percentage of lakes demonstrating moderate to significant changes also displayed on these graphs (figures 7a through 17a). Annual changes in these lakes can also be evaluated by standard linear regressions- annual means over time, with moderate correlation defined as $R^2 > 0.33$, and significant correlation defined as $R^2 > 0.5$. These methods are described in greater detail in Appendix D. Assessments of weather patterns--whether a given year was wetter or drier than usual--accounts for broad statewide patterns, not weather conditions at any particular CSLAP lake. As such, weather may have very different impacts at some (but not most) CSLAP lakes in some of these years.

Long-term trends can also be evaluated by looking at the summary findings of individual lakes and attempting to extrapolate consistent findings to the rest of the lakes. Given the (non-Gaussian) distribution of many of the water-quality parameters evaluated in this report, non-parametric tools may be the most effective means for assessing the presence of a water-quality trend. However, these tools do not indicate the magnitude of the trend. As such, a combination of parametric and non-parametric tools are employed here to evaluate trends. The Kendall tau ranking coefficient has been utilized by several researchers and state water-quality agencies to evaluate water-quality trends via non-parametric analyses and is utilized here. For parametric analyses, best-fit analysis of summer (June 15 through September 15) averages for each of the eutrophication indicators can be evaluated, with trends attributable to instances in which deviations in annual means exceed the deviations found in the calculation of any single annual mean. "Moderate" change is defined as $t > 0.33$, and "significant" change is defined as $t > 0.5$. It has been demonstrated in many of these programs that long-term trend analyses cannot be utilized to evaluate lake datasets until at least five years' worth of data have been collected.

As of 2006, there were 112 CSLAP lakes sampled in the last five years that have been sampled for at least five years. The change in these lakes is demonstrated in figures 7 and 8; figures 7a through 7j indicate "moderate" long-term change, while figures 8a through 8j indicate "significant" long-term change. When these lakes are analyzed by this combination of parametric and non-parametric analyses, these data suggest that while most NYS lakes have not demonstrated a significant change (either t or R^2 >0.5) or even a moderate changes (t or R^2 >0.33).

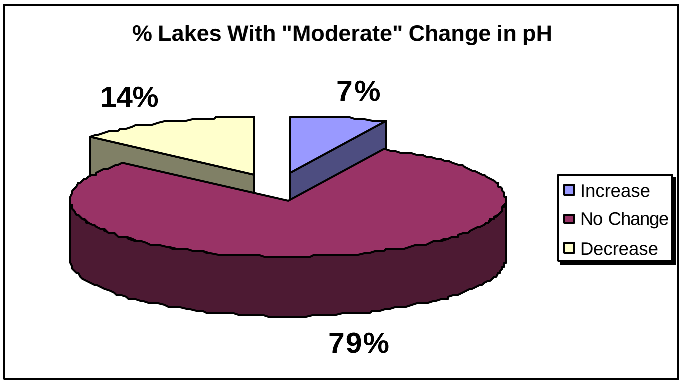


Figure 7a. %CSLAP Lakes Exhibiting Moderate Long-Term Change in pH

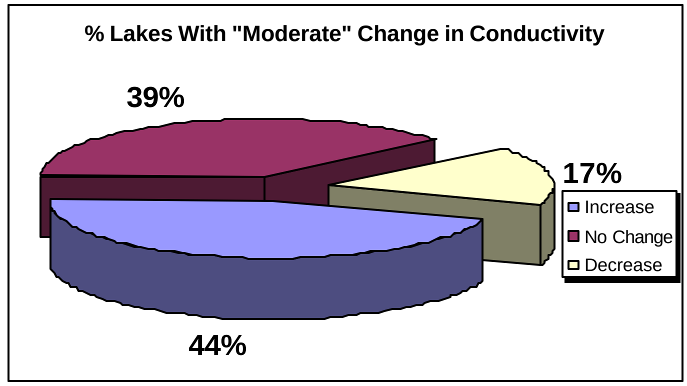


Figure 7b. %CSLAP Lakes Exhibiting Moderate Long-Term Change in Conductivity

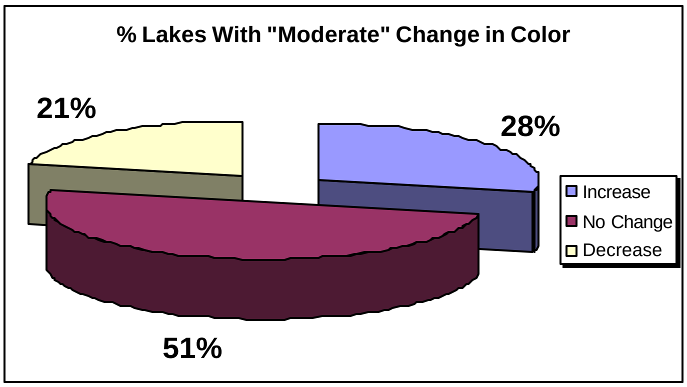


Figure 7c. %CSLAP Lakes Exhibiting Moderate Long-Term Change in Color

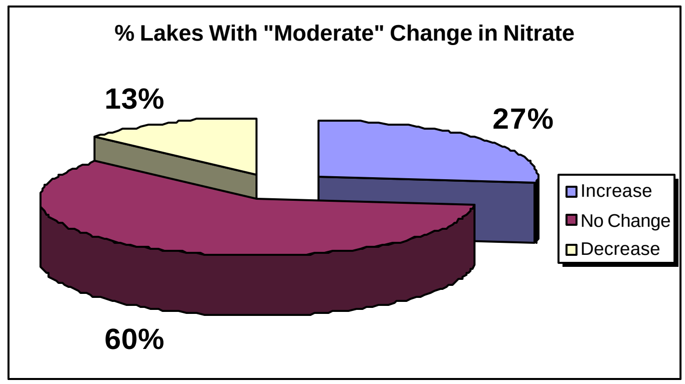


Figure 7d. %CSLAP Lakes Exhibiting Moderate Long-Term Change in Nitrate

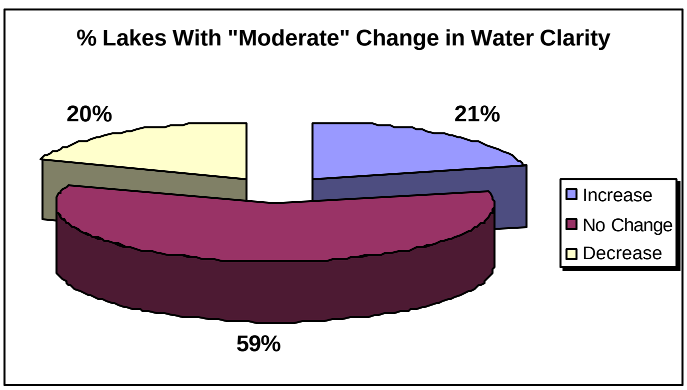


Figure 7e. %CSLAP Lakes Exhibiting Moderate Long-Term Change in Water Clarity

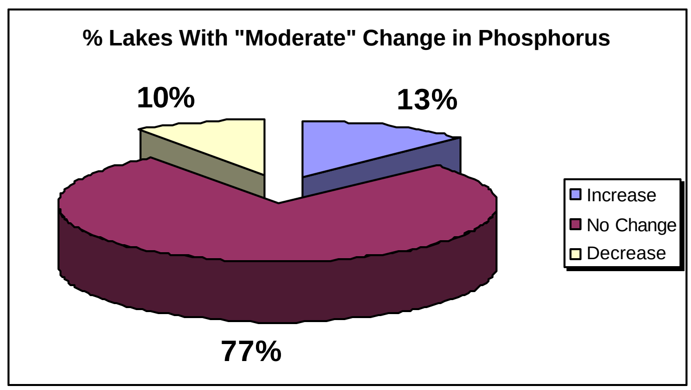


Figure 7f. %CSLAP Lakes Exhibiting Moderate Long-Term Changes in Phosphorus

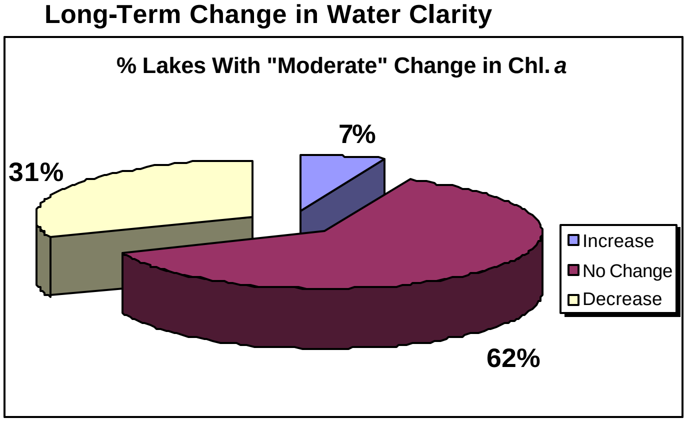


Figure 7g. %CSLAP Lakes Exhibiting Moderate Long-Term Change in Chlorophyll *a*

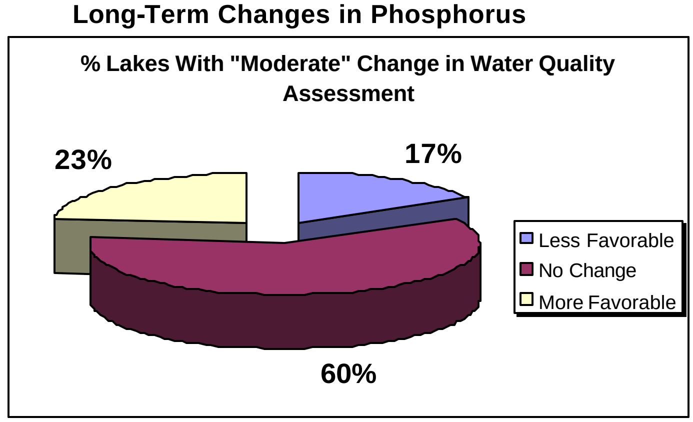


Figure 7h. %CSLAP Lakes Exhibiting Moderate Long-Term Change in Water-quality Assessment

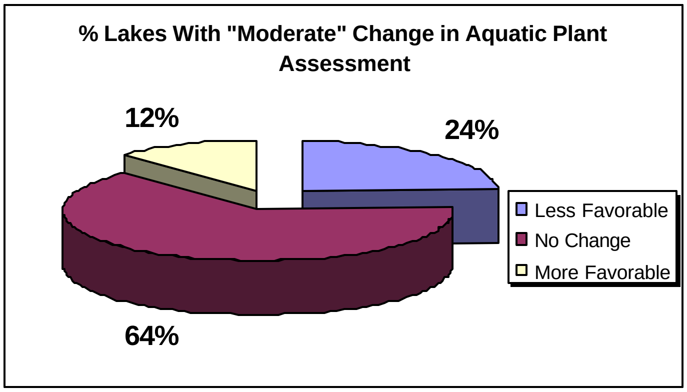


Figure 7i. %CSLAP Lakes Exhibiting Moderate Long-Term Change in Aquatic Plant Assessment

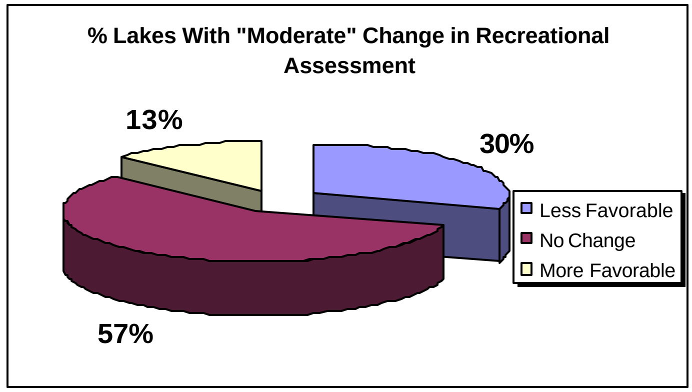


Figure 7j. %CSLAP Lakes Exhibiting Moderate Long-Term Change in Recreational Assessment

Some of the lakes sampling through CSLAP have demonstrated a moderate change since CSLAP sampling began in 1986, at least for some of the sampling parameters measured through CSLAP. In general, between 50% and 65% of the CSLAP lakes have not exhibited even moderate changes. Some of the parameters that have exhibited moderate changes may not reflect actual water-quality change. For example, it appears that the increase in color (Figure 7c) and decrease in nitrate (Figure 7d) and chlorophyll *a* (Figure 7g) is probably due to the shift in laboratories, even though the analytical methods are comparable. The increase in conductivity (Figure 7b) and decrease in pH (Figure 7a) are probably real phenomena--both changes were evident to some degree prior to the shift in laboratories, and both are largely predictable. The difference between the increase and decrease in the other sampling parameter (or between more favorable and less favorable conditions) does not appear to be important and probably indicates random variability.

Figures 8a through 8j indicate that, not surprisingly, "substantial" change is less common. Substantial change follows the same patterns as discussed above with the evaluation of "moderate" change in CSLAP lakes, except that the percentage of CSLAP lakes not exhibiting significant change is much higher, rising to about 65-80% of these lakes. For those CSLAP lakes exhibiting substantial change, it is most apparent in the same parameters described above. About 25% of the CSLAP lakes have exhibited a substantial increase in conductivity, consistent with a broad (and expected) successional pattern, in which lakes generally concentrate materials washed in from the surrounding watershed (and as the runoff itself concentrates materials as these watersheds move from forested to more urbanized, whether via residential development or other uses. The comparison between figures 8b and 8e through 8g indicate that this has not (yet) translated into higher nutrient loading into lakes.

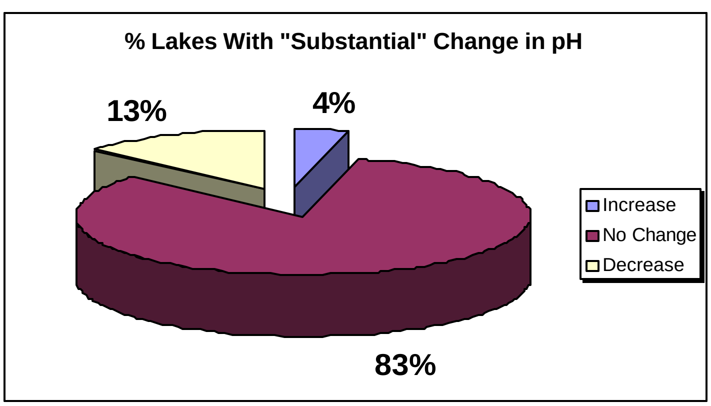


Figure 8a. %CSLAP Lakes Exhibiting Substantial Long-Term Change in pH

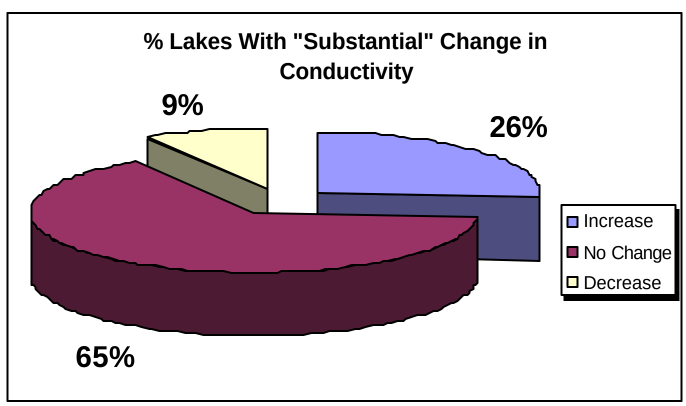


Figure 8b. %CSLAP Lakes Exhibiting Substantial Long-Term Change in Conductivity

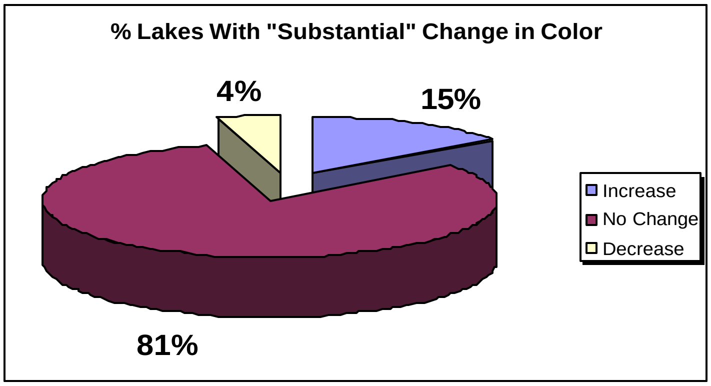


Figure 8c. %CSLAP Lakes Exhibiting Substantial Long-Term Change in Color

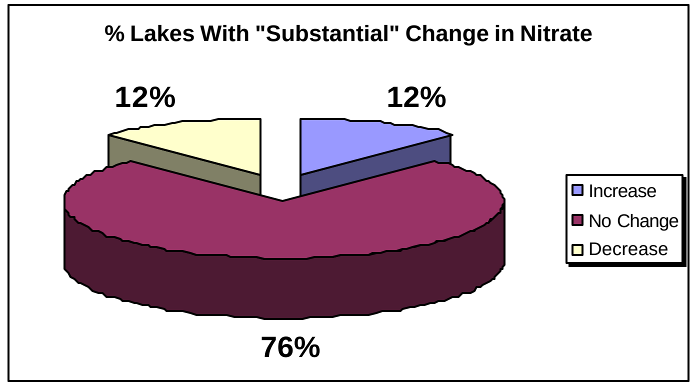


Figure 8d. %CSLAP Lakes Exhibiting Substantial Long-Term Change in Nitrate

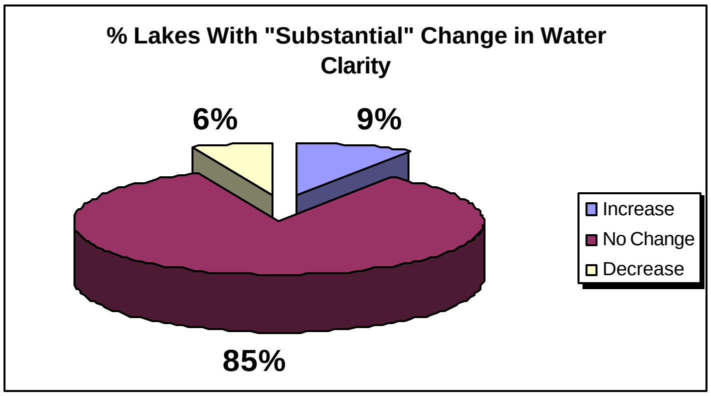


Figure 8e. %CSLAP Lakes Exhibiting Substantial Long-Term Change in Water Clarity

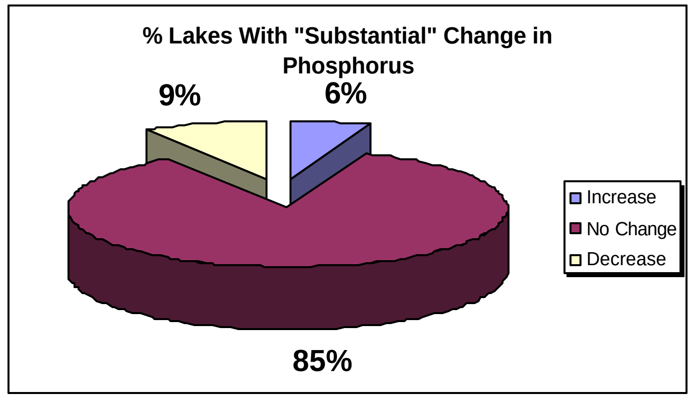


Figure 8f. %CSLAP Lakes Exhibiting Substantial Long-Term Change in Phosphorus

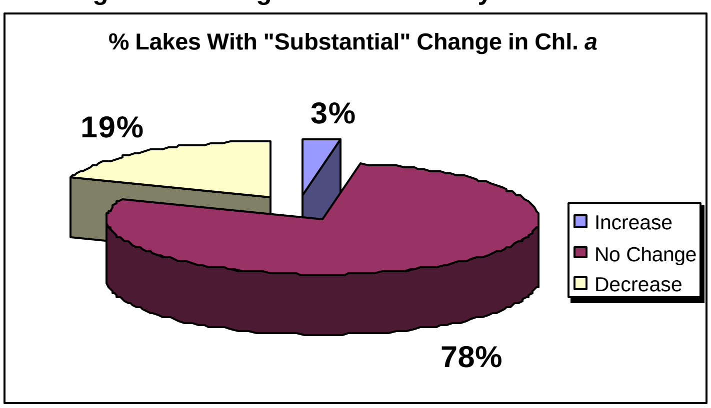


Figure 8g. %CSLAP Lakes Exhibiting Substantial Long-Term Change in Chlorophyll *a*

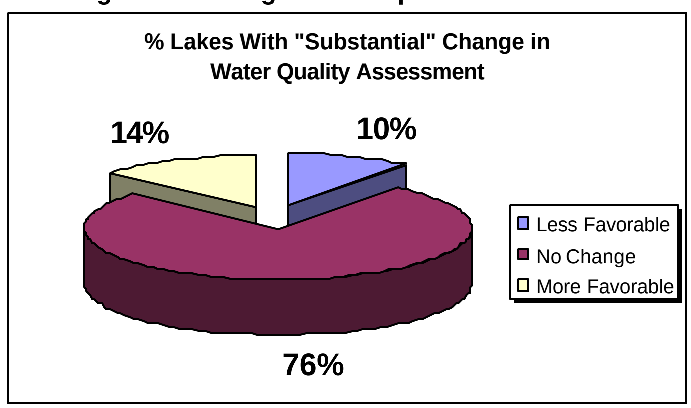


Figure 8h. %CSLAP Lakes Exhibiting Substantial Long-Term Changes in Water-quality Assessment

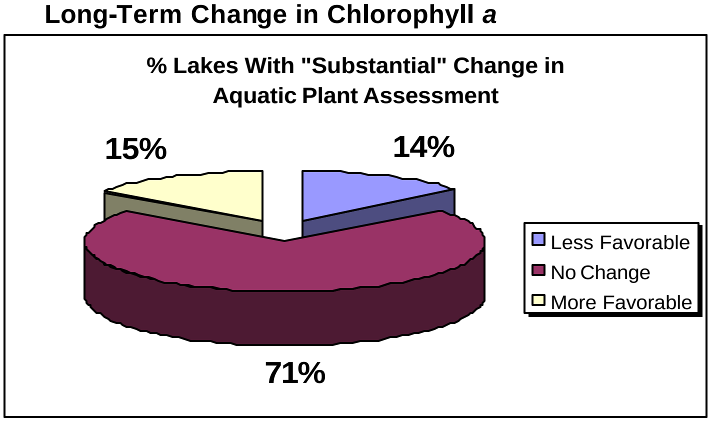


Figure 8i. %CSLAP Lakes Exhibiting Substantial Long-Term Change in Aquatic Plant Assessment

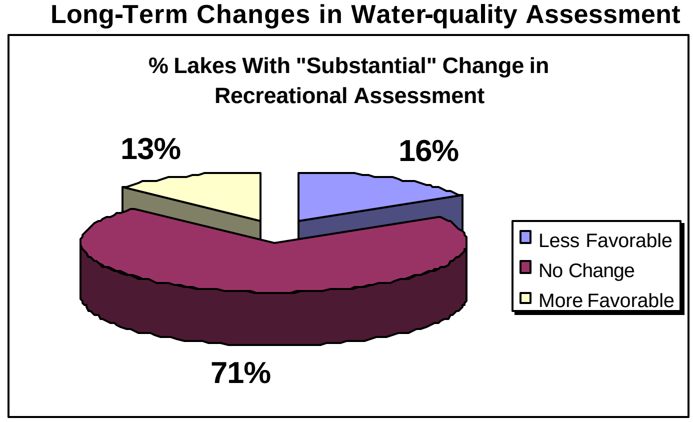


Figure 8j. %CSLAP Lakes Exhibiting Substantial Long-Term Change in Recreational Assessment

As noted above, there does not appear to be any clear pattern between weather and water-quality changes, although some connection between changes in precipitation and changes in some water-quality indicators is at least alluded to in some cases. However, all of these lakes may be the long-term beneficiaries of the ban on phosphorus in detergents in the early 1970s, which, with other local circumstances (perhaps locally more "favorable" weather, local stormwater or septic management, etc.), has resulted in less productive conditions. Without these circumstances, water-quality conditions in many of these lakes might otherwise be more productive in the creeping march toward aging, eutrophication, and succession (as suggested from the steady rise in conductivity). In other words, the higher materials loading into these lakes may be largely balanced by a reduction in nutrients within the corresponding runoff.

The drop in pH in NYS lakes has been studied at length within the Adirondacks and may continue to be attributable on a statewide basis to acid rain, which continues to fall throughout the state. The CSLAP dataset is not adequate to evaluate any ecological changes associated with higher lake acidity, and it is certainly worth noting that the slight drop in pH in most CSLAP lakes does not bring these lakes into an acidic status (these lakes have, at worse, become slightly less basic). In addition, for lakes most susceptible to acidification, laboratory pH is only an approximation of actual pH. Fully accurate pH readings require field measurements using very specialized equipment, although for most lakes with even modest buffering capacity, laboratory pH is a good estimate of *in situ* pH readings. So while the decrease in pH in some CSLAP lakes should continue to be watched, it does not appear to be a cause for concern, at least relative to the low pH in small, undeveloped, high-elevation lakes within the Adirondack Park.

Lake perception has changed more significantly than water-quality (except conductivity), due in part to the shorter timeframe for evaluation and thus a lower statistical hurdle for quantifying change (15 years versus up to 20 years for some lakes), one perhaps due to the multiple influences of these phenomena. None of these indicators--water-quality perception, weeds perception, or recreational perception--have varied in a consistent manner, although variability is more common in each of these indicators. The largest change is in recreational assessments, with about one third of all lakes exhibiting substantial change and nearly half demonstrating moderate change. A more detailed analysis of these assessments (not presented here) indicates that the Adirondacks have demonstrated more "positive" change than other regions of the state, due to the perception that aquatic weed densities have not increased as significantly (and water-quality conditions have improved in some cases). However, the rapid spread of *Myriophyllum spicatum* into the interior Adirondacks will likely reverse this "trend" in coming years, and it is not clear if these "findings" can be extrapolated to other lakes within the Adirondack Park.

Larger trends and observations about each of the CSLAP sampling parameters are presented below in figures 8 through 18. As noted in the nitrate discussion, there is still an insufficient database for ammonia or total nitrogen to evaluate annual, geographic, seasonal, or lake-use variability in these sampling parameters. However, these parameters are discussed in the specific discussions for Oquaga Lake later in this document.

pH

Annual Variability:

The pH of most CSLAP lakes has consistently been well within acceptable ranges for most aquatic organisms during each sampling season. The average pH has not varied significantly from one sampling season to the next. There does not appear to be a strong connection between pH and weather; some of the years with the relatively highest pH--1988 and 1992--and the lowest pH--1987--correspond to dry (1988), wet (1992), and normal (1987) years, although some of the other years with relatively low pH corresponded to wetter years (1996, 2000, and 2004). There do not appear to be any significant annual pH trends in the CSLAP dataset. 90% of all samples had pH between 6.5 and 8.5 (the state water-quality standards); 6% of samples have pH > 8.5, and 4% have pH < 6.5.

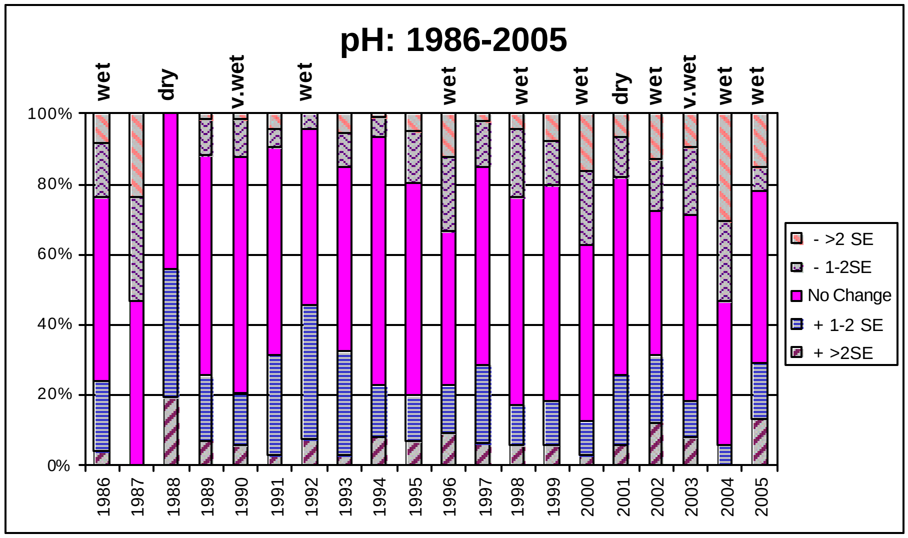


Figure 9a. *Annual Change from "Normal" pH in CSLAP Lakes (SE = Standard Error)*

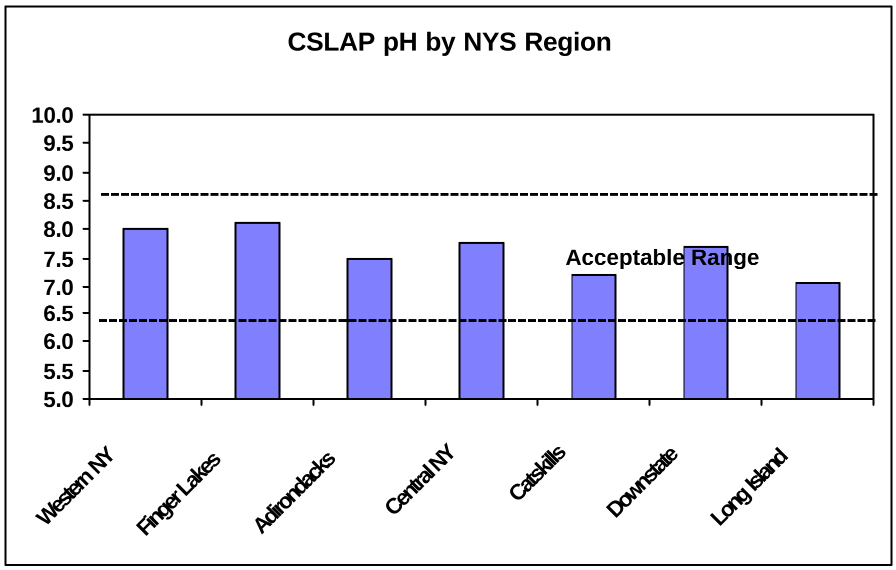


Figure 9b. *pH in CSLAP Lakes by NYS Region*

What Was Expected in 2006?

2006 was a relatively wet year, at least in most of the state during much of the summer sampling season. While there is not a strong correlation between weather and pH during most of the CSLAP sampling seasons, pH readings have generally been lower during wet years, most likely due to the input of acidic rain. Therefore, it is anticipated that pH readings may be slightly lower than usual, at least in some CSLAP lakes.

What Happened at Oquaga Lake in 2006?

pH readings in Oquaga Lake in the last two years were slightly higher than normal, but nearly all readings continue to be well within the state water quality standards.

Statewide Variability:

As expected, pH readings are lowest in the high-elevation regions (Adirondacks and Catskills) or Long Island, which has primarily shallow and slightly colored lakes, and the highest in regions with relatively high conductivity (western NY and the Finger Lakes region). All of these readings are consistently within the acceptable range for most aquatic organisms. However, the CSLAP dataset does not reflect the low pH found in many high elevation NYS lakes overlying granite and poorly buffered soils, because the typical CSLAP lake resides in geological settings (primarily limestone) that allow for residential development. In other words, pH is one of the few CSLAP sampling parameters that does not yield comparable results when comparing CSLAP results to overall NYS results, because CSLAP lakes are not really representative of the typical NYS lake as related to pH.

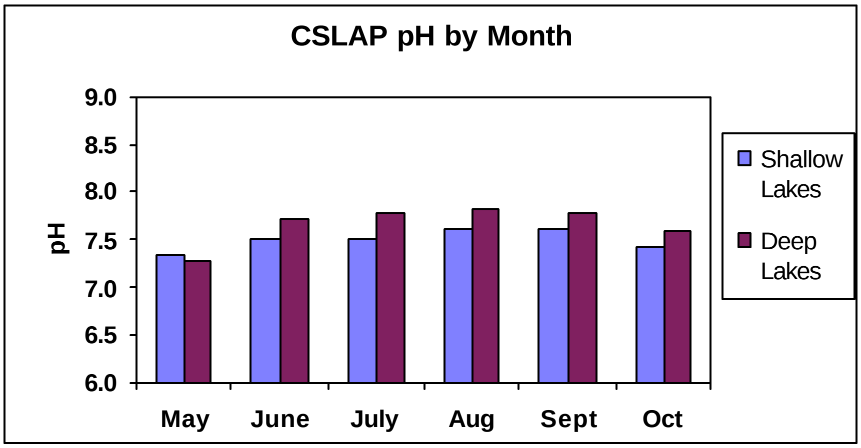


Figure 9c. *pH in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

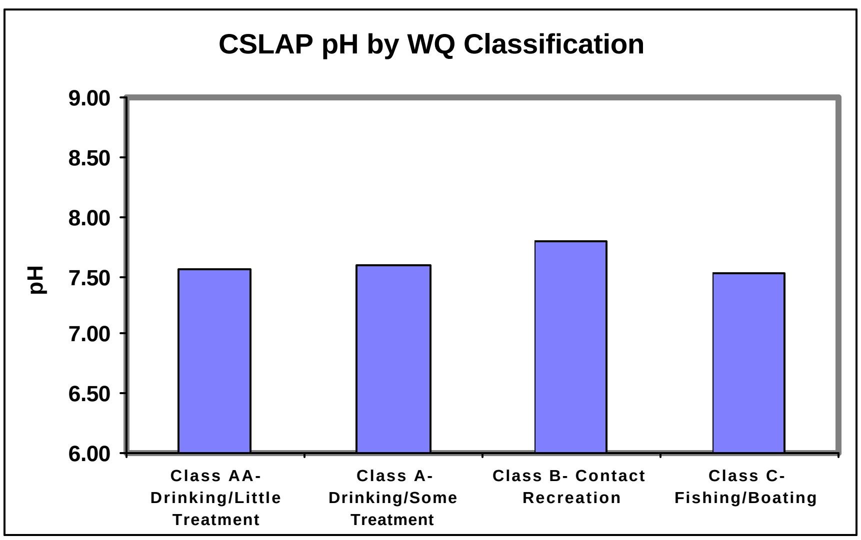


Figure 9d. *pH in CSLAP Lakes by Lake Use*

Seasonal Variability:

pH readings tend to increase slightly during the course of the summer, due largely to increasing algal photosynthesis (which consumes CO_2 and drives pH upward), although these seasonal changes are probably not significant. Low pH depressions are most common early in the sampling season (due to lingering effects from snowpack runoff), and high pH spikes occur mostly in mid- to late summer.

Lake-Use Variability:

pH does not vary significantly from one lake use to another, although in general, pH readings are slightly higher for lakes used primarily for contact recreation (Class B). However, this is probably more reflective of geographical differences (there are relatively more Class B CSLAP lakes in higher pH regions, and more Class A lakes in lower pH regions) than any inherent link between pH and lake usage.

Conductivity

Annual Variability:

The conductivity of most CSLAP lakes has varied somewhat from year to year and has been (slightly) increasing overall and in specific lakes since 1986. This is apparent from Figure 10a, which shows that more lakes have exhibited higher readings in recent years than in the first several years of CSLAP sampling at the lake (although lower conductivity was apparent in 2004). There does not appear to be a correlation between weather and conductivity, although the overall annual trend appears to be stronger than weather-impacted changes.

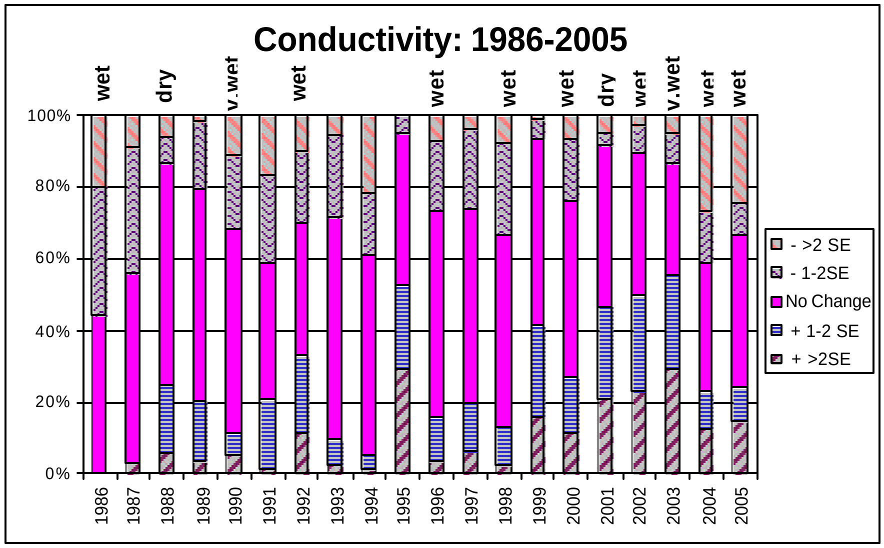


Figure 10a. *Annual Change from "Normal" Conductivity in CSLAP Lakes (SE = Standard Error)*

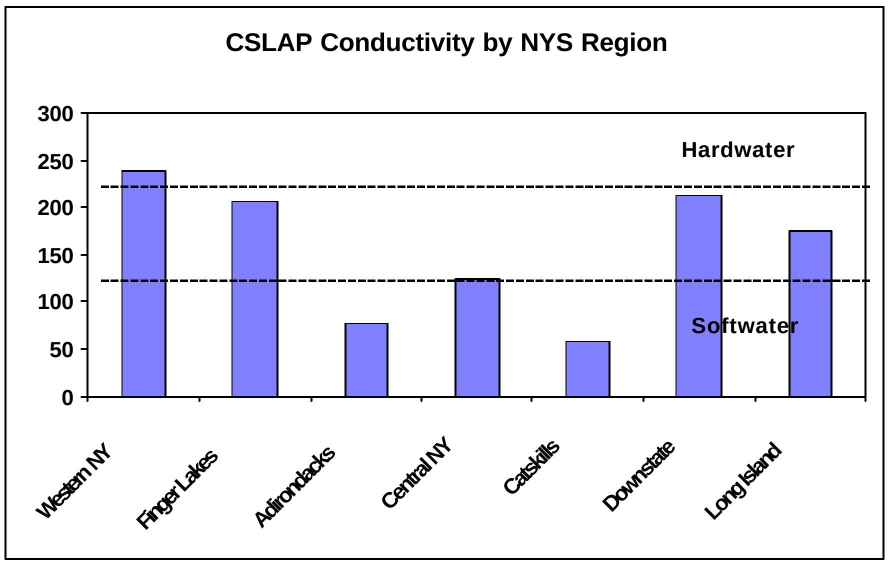


Figure 10b. *Conductivity in CSLAP Lakes by NYS Region*

What Was Expected in 2006?

2006 was a relatively wet year, at least in most of the state during much of the summer sampling season. Conductivity readings have generally not been correlated with weather, and any weak weather patterns appear to be dwarfed with a significant trend toward increasing conductivity readings over time. Therefore, it is anticipated that conductivity readings may be within the normal range for most CSLAP lakes, although higher conductivity readings may be more likely than lower conductivity.

What Happened at Oquaga Lake in 2006?

Conductivity readings in Oquaga Lake have generally increased in recent years, and these readings were higher in 2006 than in most previous CSLAP sampling seasons. While the peak readings in the first sample corresponded to the heavy early season rainfall, but heavy rains in late summer and in response to Hurricane Ernesto led to lower than normal readings.

Statewide Variability:

Although "hardwater" and "softwater" are not consistently defined by conductivity, in general lakes in the Adirondacks and Catskills have lower conductivity (softer water), and lakes downstate, in western NY, and in the Finger Lakes region have higher conductivity (harder water). These regional differences are due primarily to surficial geology and "natural" conditions in these areas. However, within each of these broad geographical areas, there are usually some lakes with higher conductivity and some lakes with lower conductivity readings.

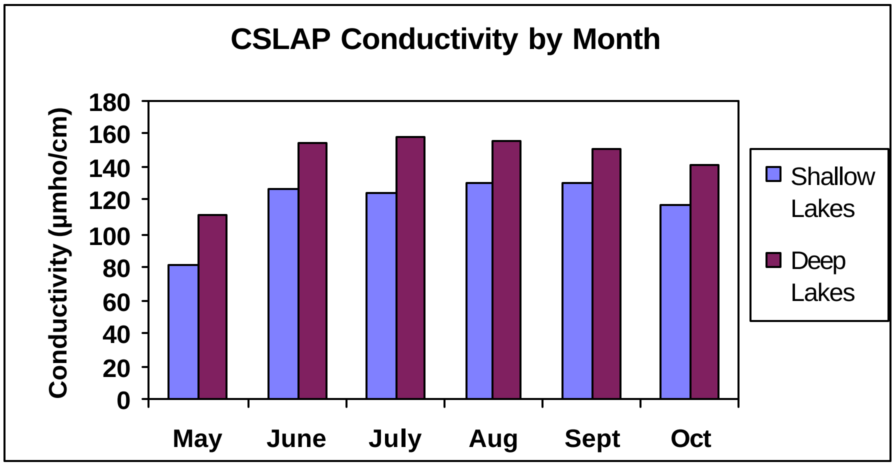


Figure 10c. *Conductivity in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

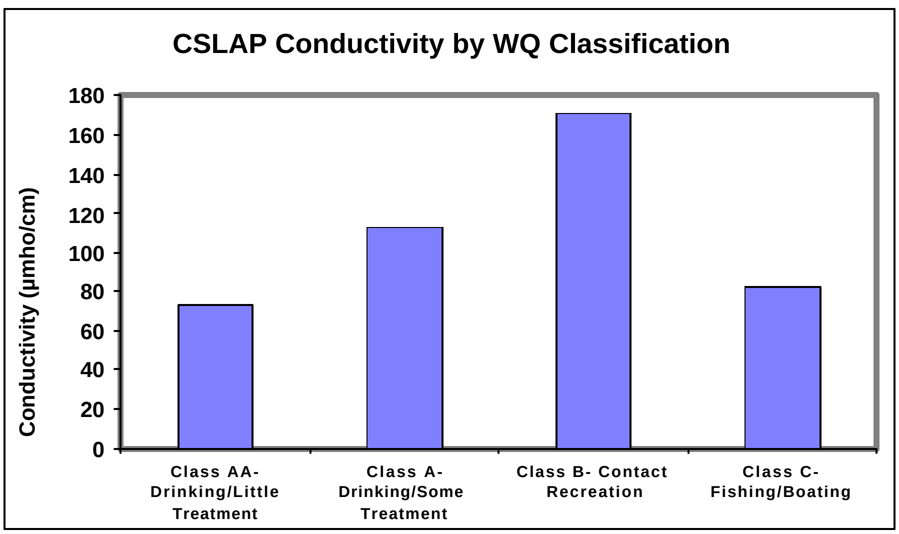


Figure 10d. *Conductivity in CSLAP Lakes by Lake Use*

Seasonal Variability:

Conductivity readings are much higher in the summer than in the late spring in many CSLAP lakes. These readings decreased in deep lakes in the summer and fall but remained fairly steady in shallow lakes during this period (actual readings within specific lakes, however, may often vary significantly from week to week). Although lake destratification (turnover) brings bottom waters with higher conductivity to the lake surface in deeper lakes, conductivity readings dropped in the fall. It is possible that fully mixed conditions may be missed in some NYS lakes by discontinuing sampling after the end of October. Conductivity readings overall were higher in deep lakes, although this may be an artifact of the sampling set (there are more CSLAP deep lakes in areas that "naturally" have harder water).

Lake-Use Variability:

Conductivity readings are substantially higher for lakes used primarily for contact recreation (Class B) and are somewhat higher for lakes used for drinking water with some treatment (Class A). However, this is probably more reflective of geographical differences (there are relatively more softwater CSLAP lakes in the Adirondacks, which tend to have more Class A or Class AA lakes, at least in CSLAP, and more Class B lakes are found in hardwater regions) than any *de facto* connection between conductivity and lake usage.

Color

Annual Variability:

The color of most CSLAP lakes has varied from year to year. The years with the lowest color readings, 1993 and 1995, had "normal" levels of precipitation, although four of the years with the highest color readings (1992 and 2002 through 2005) were wet, and the least-colored waters generally occurred during dry conditions. Most lake samples (92%) correspond to water-color readings too low (< 30 ptu) to significantly influence water clarity. Color readings were much higher in 2004 than in any other CSLAP sampling season. Given that color readings were also higher in 2002 and 2003, the increase in color may be attributable in part to the shift in laboratories, which occurred prior to the 2003 sampling season.

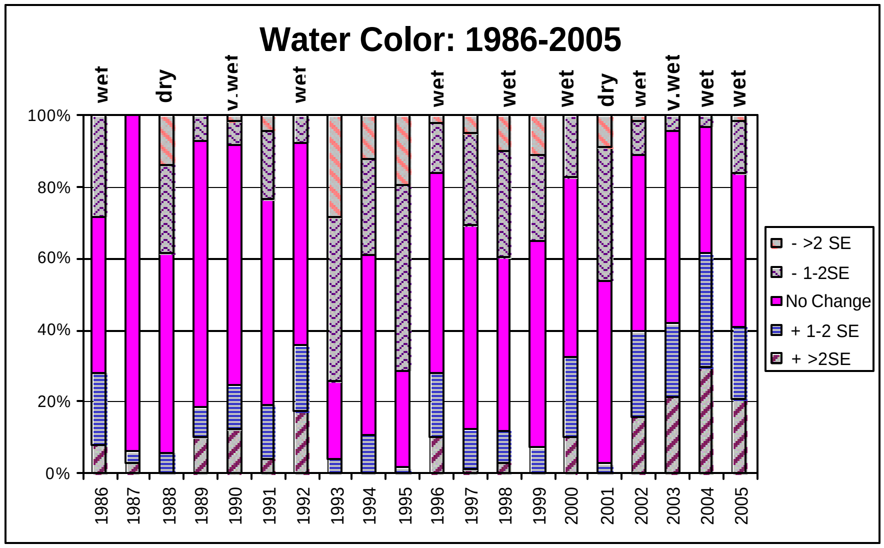


Figure 11a. *Annual Change from "Normal" Color in CSLAP Lakes (SE = Standard Error)*

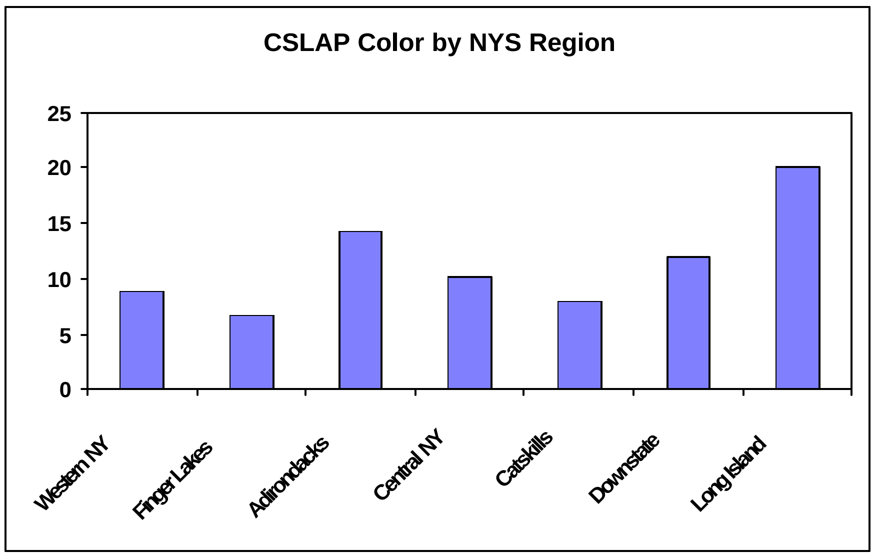


Figure 11b. *Color in CSLAP Lakes by NYS Region*

What Was Expected in 2006?

As noted above, color readings have generally been higher during wet years, and readings have been higher in the last three years, perhaps due to slightly different analytical methodology. Since 2006 generally corresponded to a wet year, it is likely that color readings in 2006 will at least be higher than the long-term average, although readings may not be higher than in 2004, which was also generally a wet year.

What Happened at Oquaga Lake in 2006?

Water color readings were higher than normal in 2006, particularly early in the sampling season. As with conductivity, the heaviest rainfall corresponded to the peak color readings in early summer and the lowest readings later in the year.

Statewide Variability:

Water color is highest in Long Island and the Adirondacks, and lowest in the Finger Lakes, Catskill and western NY regions. This is mostly coincident with the statewide conductivity distribution (with softwater lakes more likely to be colored). The CSLAP dataset may be a representative cross-section of NYS lakes as related to color.

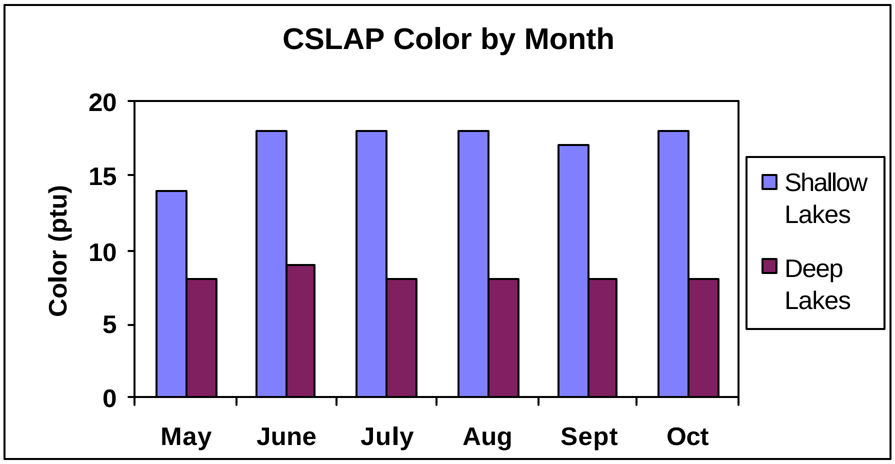


Figure 11c. *Color in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

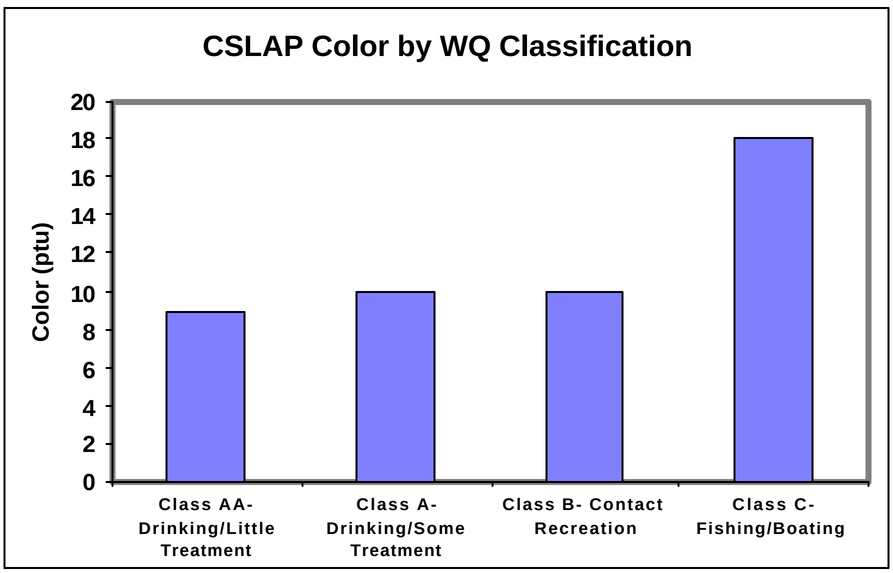


Figure 11d. *Color in CSLAP Lakes by Lake Use*

Seasonal Variability:

Color readings are significantly higher in shallow lakes than in deepwater lakes; these readings increase from spring to summer in these shallower lakes (perhaps due to dissolution of organic material, including algae, and wind-induced mixing during the summer) and then drop off again in late summer into the fall. Color generally follows the opposite trend in deeper lakes, with slightly decreasing color readings perhaps due to more particle setting in the summer and remixing in the fall, although the seasonal trend in the deeper lakes is not as pronounced as in shallow lakes.

Lake-Use Variability:

Color readings are substantially higher for lakes used primarily for non-contact recreation (Class C), but this is probably more reflective of morphometric differences, for Class C lakes tend to be shallow lakes (mean depth = 4 meters), while the other classes tend to be deeper lakes (mean depth = 9 meters). However, the elevated color readings correspond to elevated levels of dissolved organic matter and may also reflect impediments (via economically viable water treatment, aesthetics, and potential formation of hazardous compounds during chlorination) to the use of these waters for drinking.

Nitrate

Annual Variability:

Evaluating nitrate in CSLAP lakes is confounded by the relative lack of nitrate data for many sampling seasons (it was analyzed in water samples at a lower frequency, or not at all, for many years), the high number of undetectable nitrate readings, and some changes in detection levels. The limited data indicated that nitrate was highest in 1986 and 1989, two early CSLAP years in which nitrate was analyzed more frequently (including a relatively large number of early season samples), and in 2004 and 2005, which corresponded to the use of a new analytical tool. Readings were lowest in 1995, 2002 and 2003. Although nitrate levels are probably closely related to winter and spring precipitation levels (due to the higher nitrate readings in snowpacks), this is not apparent from Figure 12a. No readings have approached the state water-quality standard (= 10 mg/l) in any CSLAP sample.

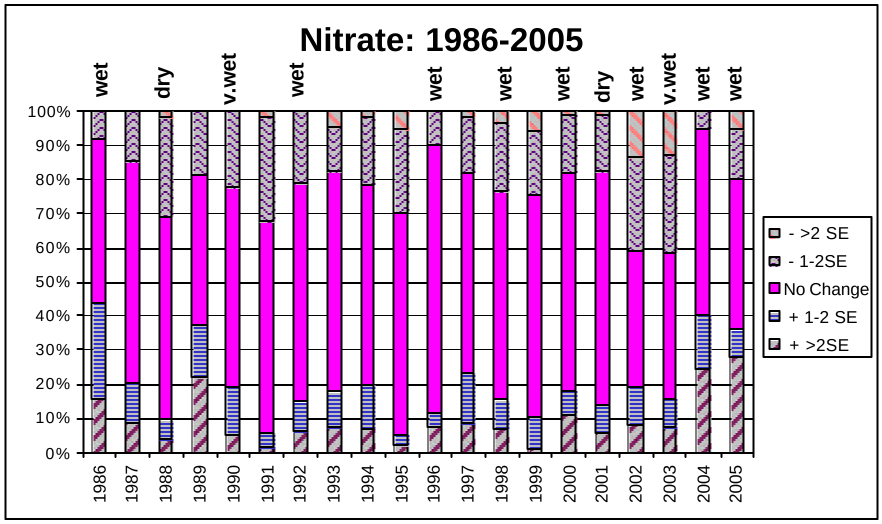


Figure 12a. *Annual Change from "Normal" Nitrate in CSLAP Lakes (SE = Standard Error)*

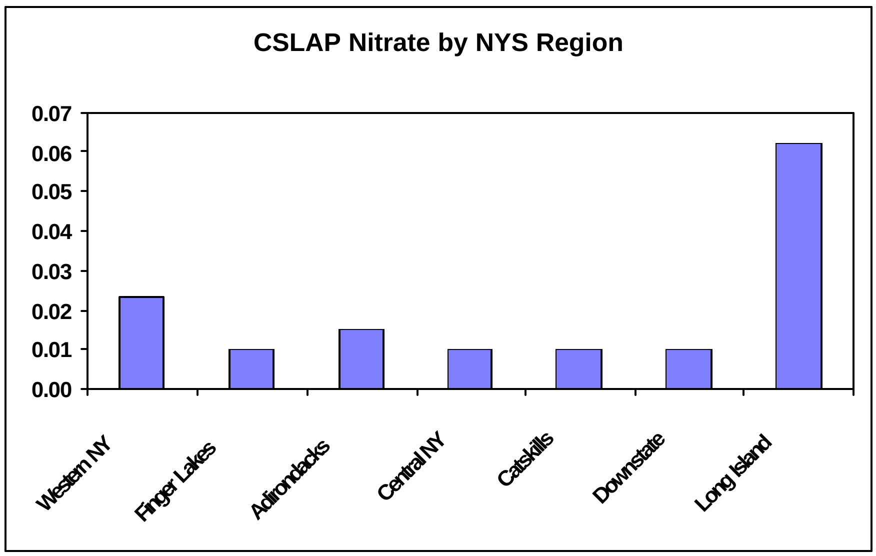


Figure 12b. *Nitrate in CSLAP Lakes by NYS Region*

What Was Expected in 2006?

Nitrate readings have been very unpredictable, although at nearly all times, all nitrate readings are small. Given the higher readings found in 2004, it is presumed that nitrate readings may also be slightly higher in 2006.

What Happened at Oquaga Lake in 2006?

Nitrate readings in Oquaga Lake have been consistently low and are close to the analytical detection limit, although these readings have increased slightly in recent years.

Statewide Variability:

Nitrate levels are highest in Long Island, western NY, and the Adirondacks, and lowest in the other NYS regions. However, none of these regions demonstrate readings that are particularly high. Readings from individual lakes in Long Island, Madison County, and the Adirondacks (spring only) are often elevated, although still well below water-quality standards.

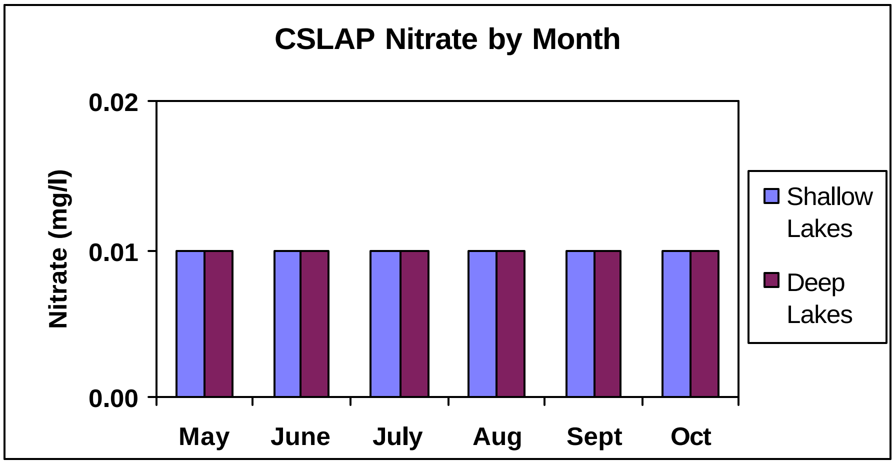


Figure 12c. *Nitrate in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

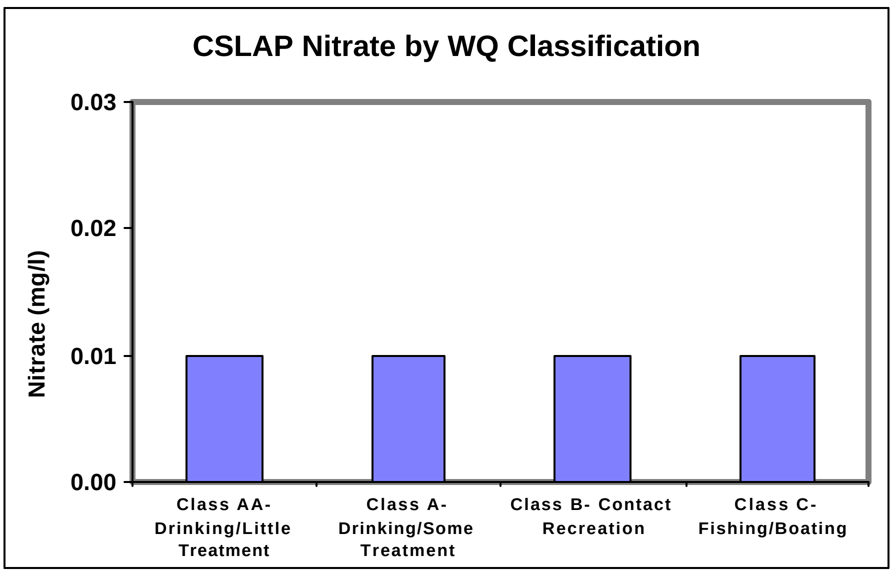


Figure 12d. *Nitrate in CSLAP Lakes by Lake Use*

Seasonal Variability:

Nitrate readings are not seasonally variable on a program-wide basis, as indicated in Figure 12c. However, in some individual lakes, in the regions listed above, nitrate is often detectable until early summer and then undetectable through the rest of the sampling season (the large number of lakes with undetectable nitrate levels throughout the year overwhelm the statistics in Figure 12c).

Lake-Use Variability:

Nitrate readings appeared to be identical for all classes of lake uses, as indicated in Figure 12d. Higher early-season nitrate readings are found in some lakes influenced by the melting of large winter snowpacks, such as some Class AA and A lakes in the Adirondacks, but these statistics cannot be easily teased from datasets strongly influenced by the large number of lakes with undetectable nitrate readings.

Trophic Indicators: Water Clarity

Annual Variability:

Water clarity (transparency) has varied annually in most CSLAP lakes. There does not appears to be much of a correlation between clarity and precipitation--the highest clarity occurred in 1995, 1997, and 1999, which corresponded to normal precipitation (statewide), although the lowest clarity occurred during two wet years (1996 and 2000). There are no significant broad statewide water clarity trends, although (as described in other portions of this report), clear trends do exist on some lakes. The majority of water clarity readings in CSLAP lakes (56%) correspond to *mesotrophic* conditions (clarity between 2 and 5 meters), with 27% corresponding to *eutrophic* conditions (Zsd < 2) and 17% corresponding to *oligotrophic* conditions (Zsd > 5).

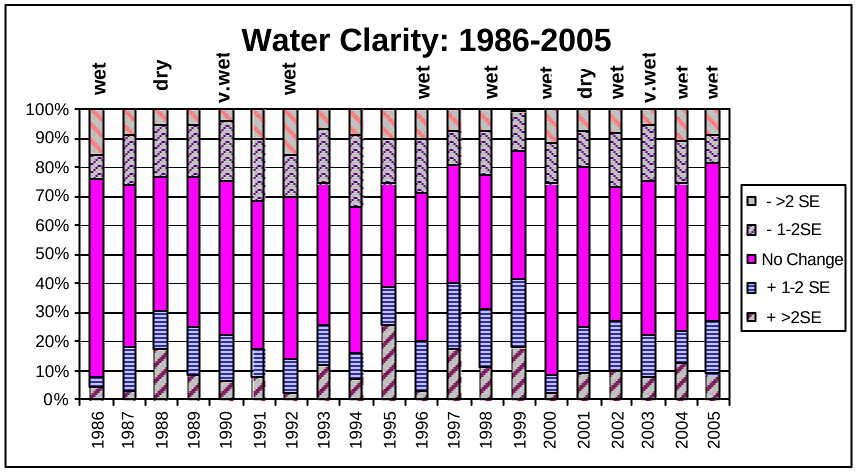


Figure 13a. *Change from "Normal" Water Clarity in CSLAP Lakes (SE = Standard Error)*

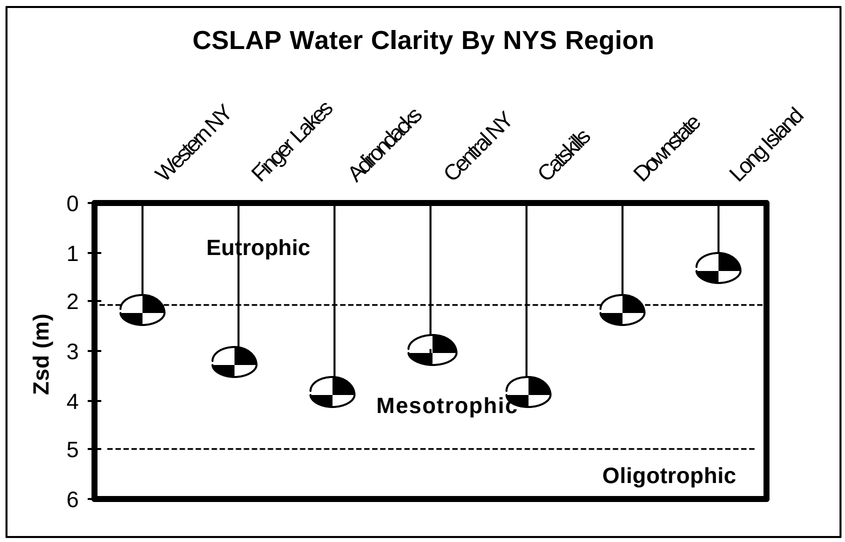


Figure 13b. *Water Clarity in CSLAP Lakes by NYS Region*

What Was Expected in 2006?

Since there is not a strong correlation between weather and water transparency readings, it is difficult to identify expected conditions. However, since water clarity seems to be lowest during wet years, it is likely that more lakes would exhibit slightly lower water transparency readings in 2006.

What Happened at Oquaga Lake in 2006?

Water transparency readings in 2006 were among the highest recorded at Oquaga Lake, although water clarity readings have been high in recent even years (2002, 2004, and 2006). These higher water clarity levels corresponded to lower than normal phosphorus and chlorophyll *a* readings. Water clarity rose substantially after the heavy storm events in late summer.

Statewide Variability:

As expected, water clarity is highest in the Adirondacks, Catskills, and Finger Lakes regions, and lowest in Long Island, downstate, and western NY. The differences are more pronounced (at least for the Adirondacks) when "naturally" colored lakes are not considered. However, except for Long Island (for which water clarity is at least partially limited by the shallow water depth), the "typical" lake in each of these regions would be classified as *mesotrophic*.

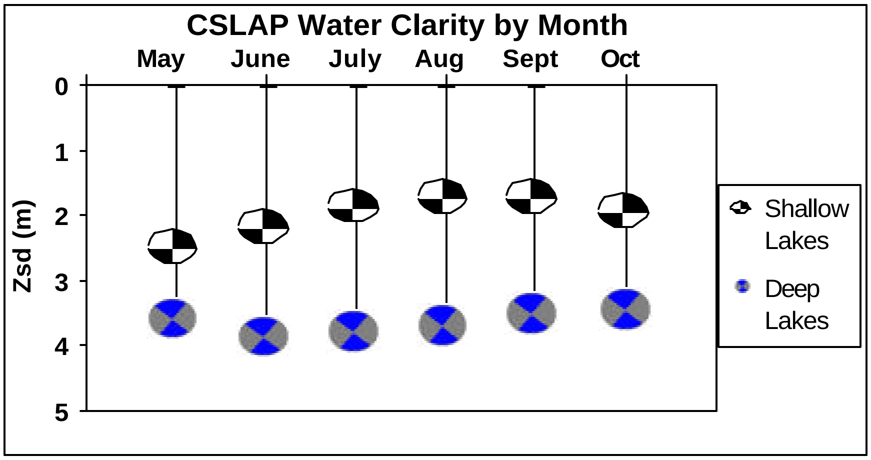


Figure 13c. *Water Clarity in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

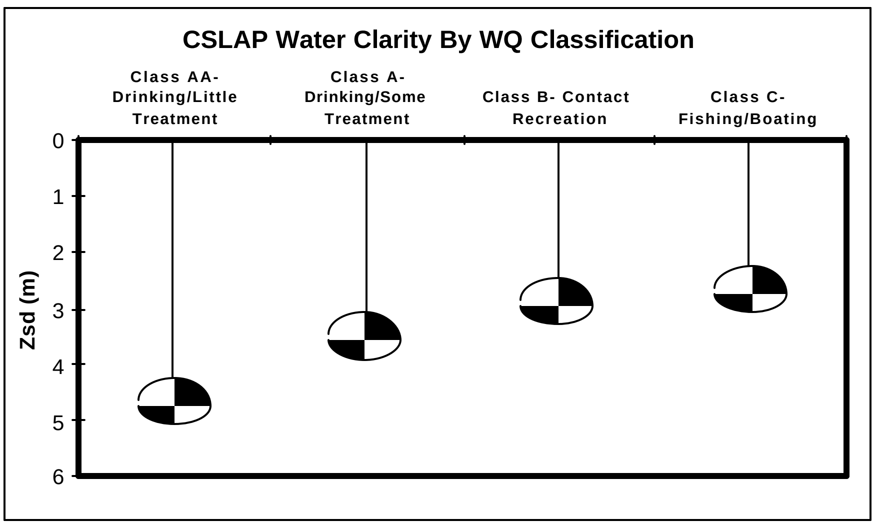


Figure 13d. *Water Clarity in CSLAP Lakes by Lake Use*

Seasonal Variability:

Water clarity readings are lower, as expected, in shallow lakes, even when water depth does not physically limit a water clarity measurement. Transparency decreases in both shallow and deep lakes during the course of the sampling season (the drop in clarity in shallower lakes is somewhat more significant), although clarity readings increase from spring to early summer in deeper CSLAP lakes. Water transparency rebounds slightly in shallower lakes in the fall, probably due to a drop in nutrient levels. The lack of "rebound" in deeper lakes may be due to occasional fall algal blooms in response to surface nutrient enrichment after lake turnover (see below).

Lake-Use Variability:

Water transparency decreases as the "sensitivity" of the lake use decreases, with higher clarity found in lakes used for potable water (Class AA), and lower clarity found in lakes used primarily for contact and non-contact (fishing and boating) recreation. As with many of the other water-quality indicators, this is due to both geographical and morphometric (depth) differences, although the original designation of these uses may also reflect these measurable and visually apparent water-quality differences.

Trophic Indicators: Phosphorus (TP)

Annual Variability:

Total phosphorus (TP) has varied annually in most CSLAP lakes. The highest phosphorus readings occurred during 1991, 1996, 1998, 2000, and 2003, the latter four of which corresponded to wet years. However, the lowest readings, from 1989, 1997, and 2002, did not correspond to unusually dry years, and 2004 was a fairly wet year. The majority of phosphorus readings in CSLAP lakes (39%) correspond to *mesotrophic* conditions (clarity of 2 to 5m), with 27% corresponding to *eutrophic* conditions (< 2m clarity) and 34% corresponding to *oligotrophic* conditions (> 5m clarity); the latter is a much higher percentage than the trophic designation for water clarity.

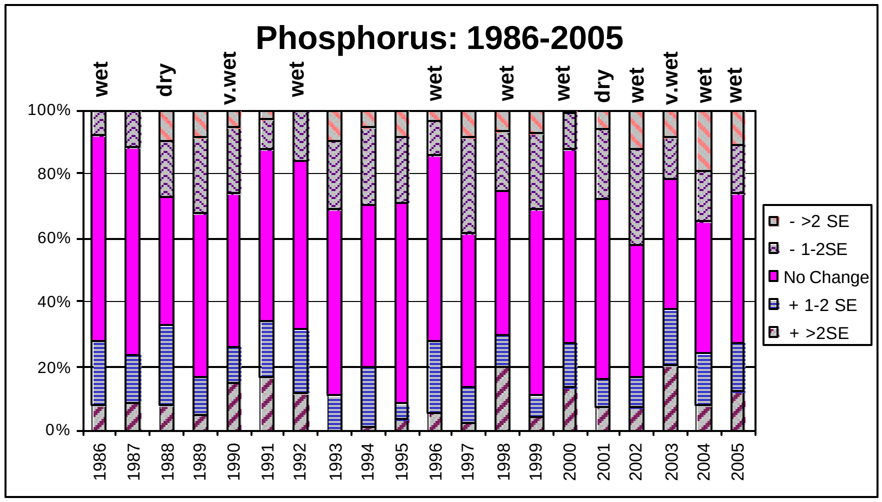


Figure 14a. *Annual Change from "Normal" TP in CSLAP Lakes (SE = Standard Error)*

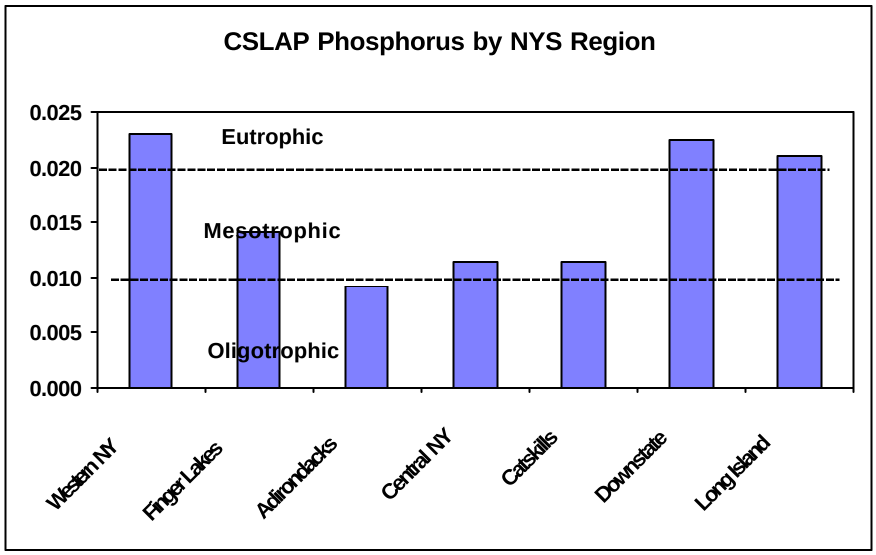


Figure 14b. *TP in CSLAP Lakes by NYS Region*

What Was Expected in 2006?

As noted above, there is not a strong correlation between weather and total phosphorus, and there does not appear to be a consistent long-term pattern in the total phosphorus data. The data also does not appear to be significantly laboratory-dependent, at least as apparent in Figure 14a. As such, it is difficult to predict whether phosphorus levels might be expected to be higher or lower in most CSLAP lakes in 2006.

What Happened at Oquaga Lake in 2006?

Phosphorus readings in Oquaga Lake were lower in 2006 than in the typical previous sampling season, resulting in the lower algae levels. Deepwater phosphorus readings were slightly higher than normal, but continued to be close to those measured at the lake surface.

Statewide Variability:

As expected, nutrient levels are lowest in the Adirondacks, Catskills, and Central New York (where clarity is highest) and highest in Long Island, downstate, and western NY, where clarity is lowest. In the latter three regions, the "typical" lake in each of these regions would be classified as *eutrophic*, while only in the Adirondacks could most lakes be described as *oligotrophic*, based on nutrients.

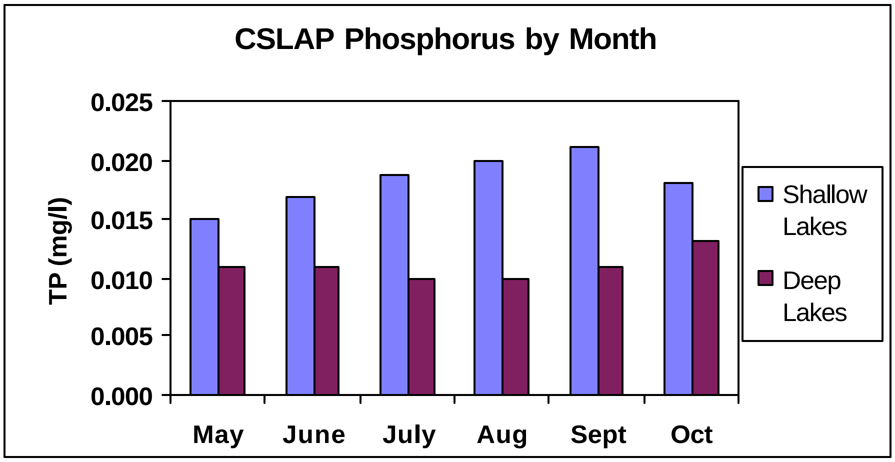


Figure 15c. *TP in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

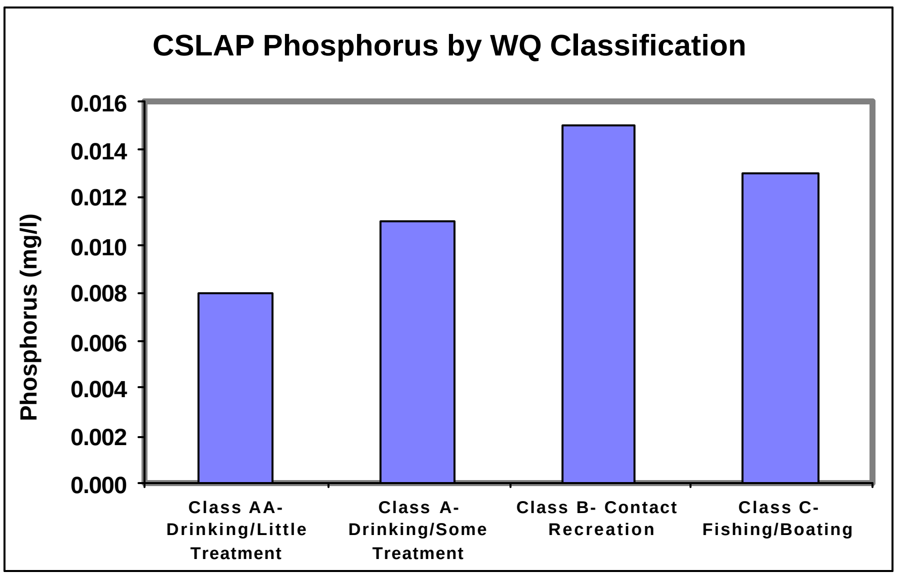


Figure 15d. *TP in CSLAP Lakes by Lake Use*

Seasonal Variability:

Nutrient levels are higher, as expected, in shallow lakes, and phosphorus levels increase in shallow lakes during the course of the sampling season, until dropping in the fall. However, phosphorus levels in deeper lakes are lower and decrease slightly through July, then increase into the fall. The latter phenomenon is due to surface nutrient enrichment after lake turnover (high nutrient water from the lake bottom, due to release of nutrients from poorly oxygenated lake sediments in the summer, migrates to the lake surface when the lake destratifies).

Lake-Use Variability

Phosphorus readings are lower in lakes used for minimally treated potable water intakes (Class AA) and are higher for other lake uses. Although Class B waters are utilized for a "higher" lake use than Class C lakes (contact recreation versus non-contact recreation), these lakes actually have higher nutrient levels, perhaps reflecting the influence of deepwater nutrient enrichments (these lakes are typically deeper) and the "unofficial" use of Class C waters for bathing and contact recreation.

Trophic Indicators: Chlorophyll *a* (Chl.a)

Annual Variability:

Chlorophyll *a* (Chl.a) has varied in most CSLAP lakes more significantly than the other trophic indicators, as is typical of biological indicators (which tend to grow “patchy”). With the exception of the very high readings in 1987 (probably due to a lab “problem”), the highest chlorophyll *a* levels occurred during 1990, 1991, 1996, and 2000, corresponding to wet years. However, the lowest readings, from 1989, 1997, and 2001 through 2005 also corresponded to normal to wet conditions in most of these years. The consistently lower chlorophyll readings in the last four years may also correspond to the shift in laboratories, although both labs use the same analytical methodology. The near majority of chlorophyll readings in CSLAP lakes (49%) correspond to *mesotrophic* conditions (clarity between 2 and 5 meters), with 33% corresponding to *eutrophic* conditions (Zsd < 2) and 18% corresponding to *oligotrophic* conditions (Zsd > 5); these percentages are more like those for water clarity rather than those for phosphorus.

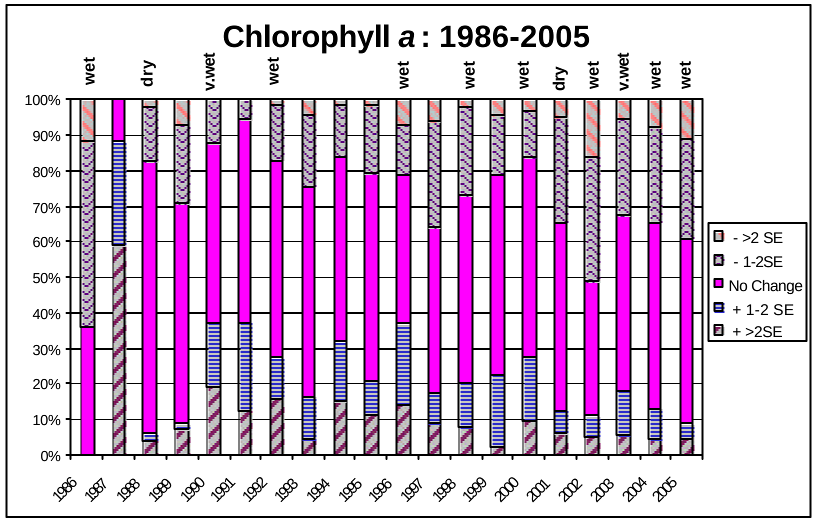


Figure 16a. *Annual Change from “Normal” Chlorophyll a in CSLAP Lakes (SE = Standard Error)*

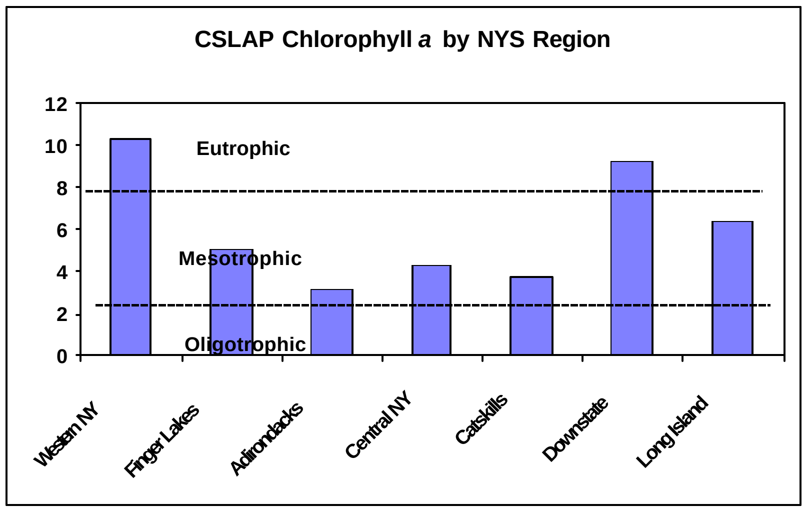


Figure 16b. *Chlorophyll a in CSLAP Lakes by NYS Region*

What Was Expected in 2006?

It is likely that chlorophyll readings would be lower than the long-term average for most CSLAP lakes in 2006, due to consistently lower readings coming from the same laboratory in the last several years. Because 2006 was also generally a hotter and “stickier” year than is typical at most NYS lakes, it would not be surprising to see higher-than-usual chlorophyll readings, at least relative to the last several years. However, this did not consistently occur in previously hot/humid years.

What Happened at Oquaga Lake in 2006?

Chlorophyll *a* readings since 2002 have been lower than in the first six years of CSLAP sampling (which ended in 1992). This corresponded to a significant shift in water transparency readings.

Statewide Variability:

As with phosphorus, chlorophyll levels are lowest in the Adirondacks, Central New York, and the Catskills (where clarity is highest) and highest in Long Island, downstate, and western NY, where clarity is lowest. In the latter two regions, the "typical" lake in each of these regions would be classified as *eutrophic,* while lakes in the other regions would be described as *mesotrophic*.

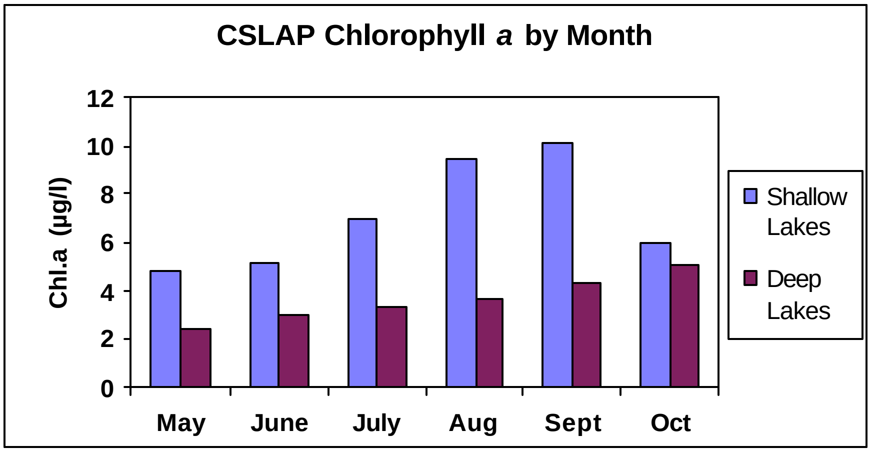


Figure 16c. *Chlorophyll a in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

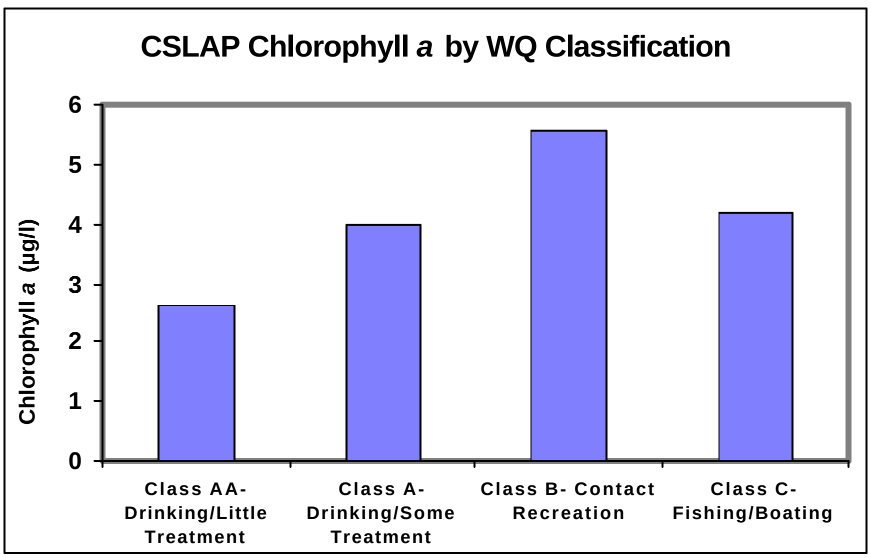


Figure 16d. *Chlorophyll a in CSLAP Lakes by Lake Use*

Seasonal Variability:

Chlorophyll levels are higher, as expected, in shallow lakes, and increase in both shallow and deep lakes during the course of the sampling season, with chlorophyll readings dropping in shallow lakes in the fall. The steady increase in chlorophyll in both shallow and (to a lesser extent) deep lakes is consistent with the change in phosphorus over the same period, due to steady migration of nutrients released from poorly oxygenated lake sediments during the summer and especially in the fall (as well as drier weather, increased lake use, and other factors).

Lake-Use Variability:

Chlorophyll readings are lower in lakes used for minimally treated potable water intakes (Class AA) and are higher for other lake uses. Although Class B waters are utilized for a "higher" lake use than Class C lakes (contact recreation versus non-contact recreation), these lakes actually have similar levels, perhaps reflecting the influence of deepwater nutrient enrichments (these lakes are typically deeper) and the "unofficial" use of Class C waters for bathing and contact recreation. This is similar to the use pattern for phosphorus.

Water-quality Assessment (QA on the Perception Form)

Annual Variability

Water-quality assessments (the perceived physical condition of the lake or QA on the use-impairment surveys) were least favorable in the very wet (2000) and very dry (1995) years, suggesting the lack of correlation between weather and perceived water-quality (although 1995 was also the year with the most "improved" conditions). The general perception of CSLAP lakes in 2005 indicated no strong changes in perceived water-quality, whether favorable or unfavorable. Although there is a strong connection between measured and perceived water clarity in most CSLAP lakes, this is not closely reflected in the comparison of Figures 14a and 17a.

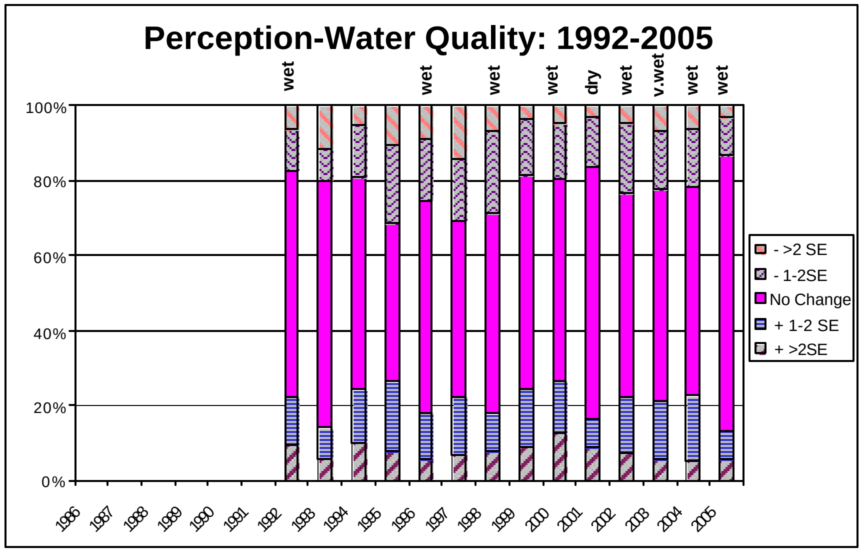


Figure 17a. *Annual Change from "Normal" Water-Quality Assessment in CSLAP Lakes (SE = Standard Error)*

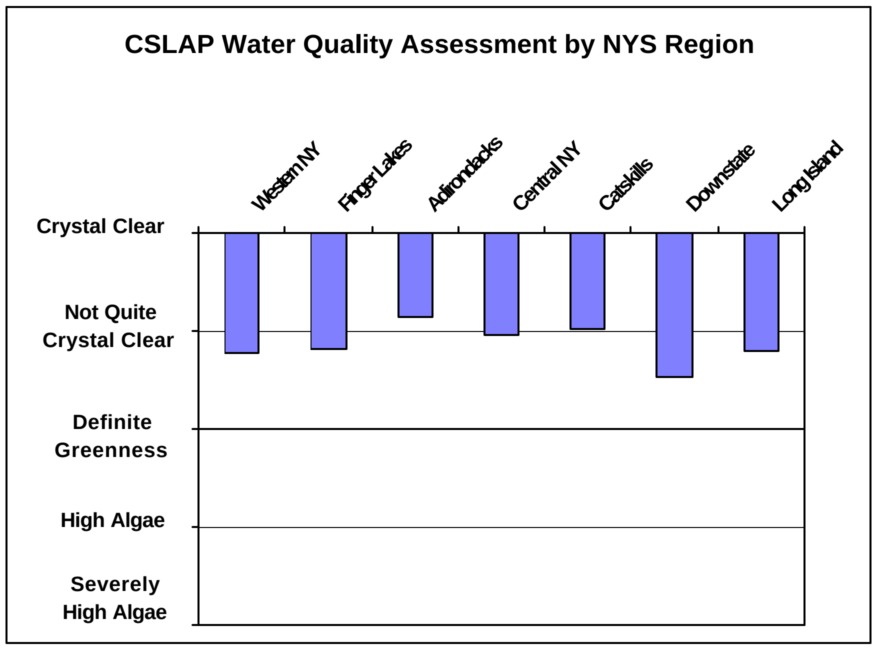


Figure 17b. *Water-Quality Assessment in CSLAP Lakes by NYS Region*

What Was Expected in 2006?

There was not a strong connection between precipitation (within mostly normal weather patterns) and perceived water-quality, or even between measured and perceived water-quality conditions. As such, it is difficult to identify expected conditions in 2006, although because water clarity readings were mostly within normal ranges, it is reasonable to expect that perceived water-quality conditions would also largely be unchanged.

What Happened at Oquaga Lake in 2006?

Water-quality assessments were less favorable in 2006 than in previous years, despite very high water transparency readings. These assessments did increase with the substantial rise in water clarity after the heavy late summer storm events.

Statewide Variability:

The most favorable water-quality assessments (at least in support of contact recreation) occurred in the Adirondacks, Catskills, and central New York, as expected, and water-quality assessments were slightly less favorable downstate, western NY, and on Long Island. This is mostly consistent with the water clarity readings in these regions. However, since the difference between the most favorable (Adirondacks) and least favorable (downstate) assessments is smaller that the measured water transparency differences, this suggests that the relatively low water clarity in the latter regions may be considered "normal" by lake residents.

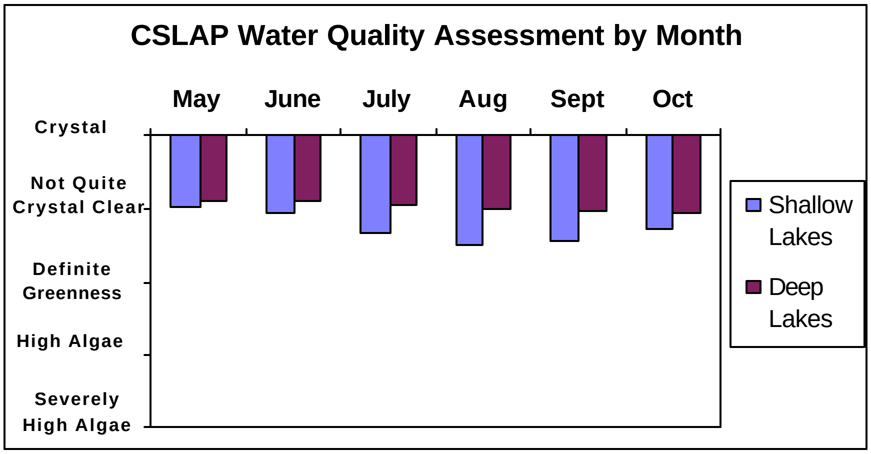


Figure 17c. *Water-Quality Assessment in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

Seasonal Variability:

Water-quality assessments become less favorable as the summer progresses in both deep and (especially) shallow lakes, coincident with similar patterns for the trophic indicators. However, the seasonal changes in these assessments are not very large. These assessments become slightly more favorable in shallow lakes in the fall, consistent with the improved (measured) water clarity, although overall water-quality assessments are less favorable all year in shallow lakes.

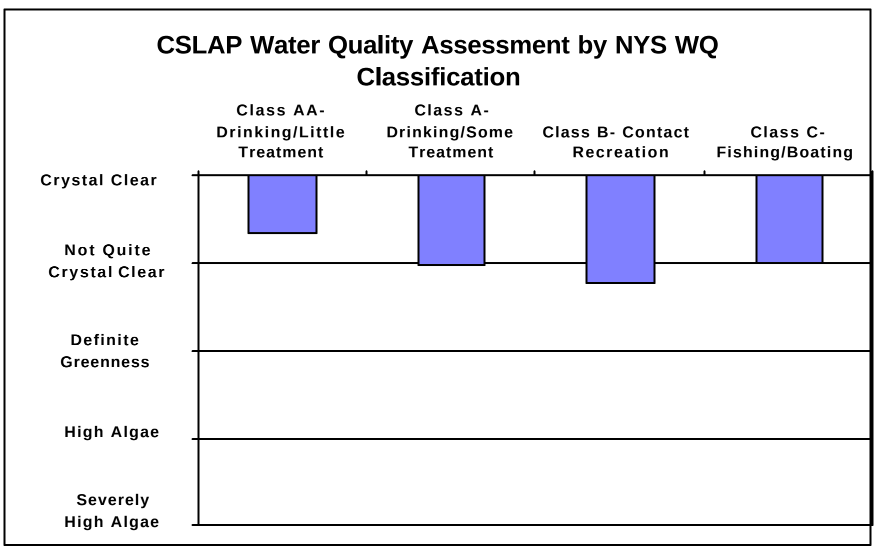


Figure 17d. *Water-Quality Assessment in CSLAP Lakes by Lake Use*

Lake Use Variability:

Water-quality assessments are more favorable in lakes used for potable water intakes (Class AA and Class A) and less favorable for other lake uses. Although Class B waters are utilized for a "higher" lake use than Class C lakes (contact recreation versus non-contact recreation), these lakes actually have similar water-quality assessments, perhaps reflecting the influence of deepwater nutrient enrichments (these lakes are typically deeper) and the "unofficial" use of Class C waters for bathing and contact recreation. This is similar to the pattern seen for the trophic indicators.

Aquatic Plant (Weed) Assessment (QB)

Annual Variability:

Aquatic-plant assessments (the perceived extent of weed growth in the lake or QB on the use impairment surveys) indicated that weeds grew most significantly in 1995 (normal conditions) and 2000 (wet conditions), and weed growth was less extensive in 1994 and 1999, suggesting the lack of correlation between weather and weed densities. The highest weed growth occurred when the perceived physical condition (clarity) of the lake was also least favorable--these conditions may offer a selective advantage to invasive or exotic weeds (such as *Myriophyllum spicatum*).

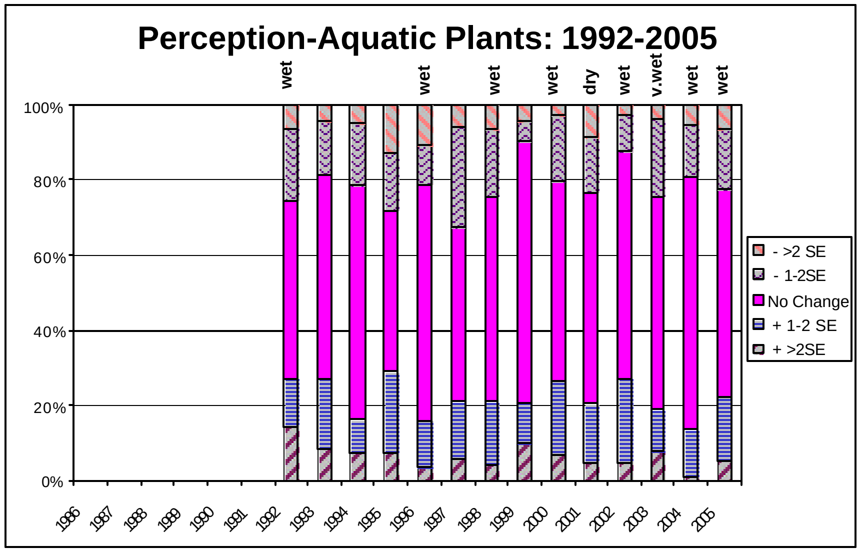


Figure 18a. *Annual Change from "Normal" Weed Assessment in CSLAP Lakes (SE = Standard Error)*

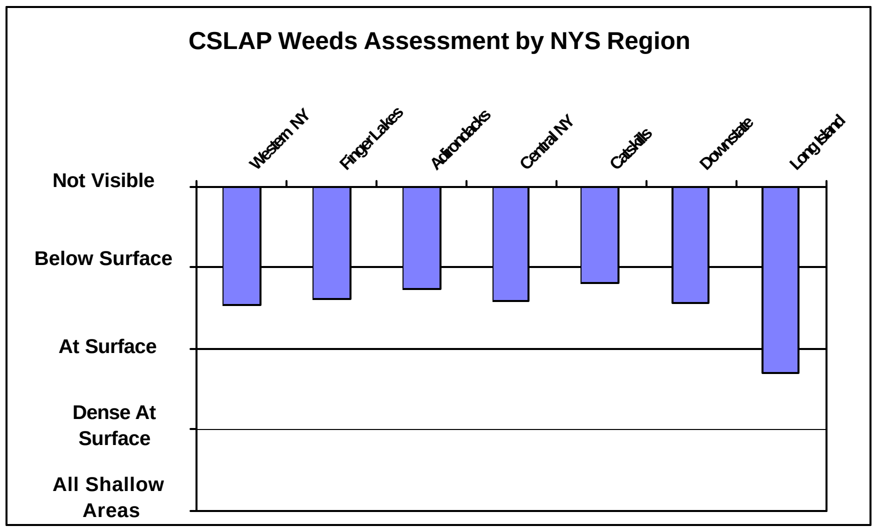


Figure 18d. *Weed Assessment in CSLAP Lakes by NYS Region*

What Was Expected in 2006?

There was not a strong connection between precipitation and extent of weed growth, at least as measurable through CSLAP. This makes it difficult to identify expected conditions in 2006. As is always the case, it is likely that the extent of weed growth in any particular CSLAP lake in 2006 is unrelated to the extent of weed growth in most other NYS lakes and is not readily predictable given historical patterns of aquatic-plant growth in that lake.

And What Happened at Oquaga Lake in 2006?

Aquatic plant coverage was slightly higher than usual in 2006, although aquatic plants still did not grow to the lake surface. This may have been in response to higher water clarity, although plant coverage was consistent throughout the summer despite some significant seasonal variability in water transparency.

Statewide Variability:

Aquatic plant growth was most significant in Long Island (and to a lesser extent Downstate and in western NY) and least significant in the Catskills and Adirondacks. The former may have a larger concentration of shallow lakes (Long Island) or preponderance of exotic weeds (downstate and western NY), while the latter may correspond to deeper lakes or fewer instances of these invasive weeds, although it is also likely that invasive-weed growth may be increasing in many lakes within these "less impacted" areas.

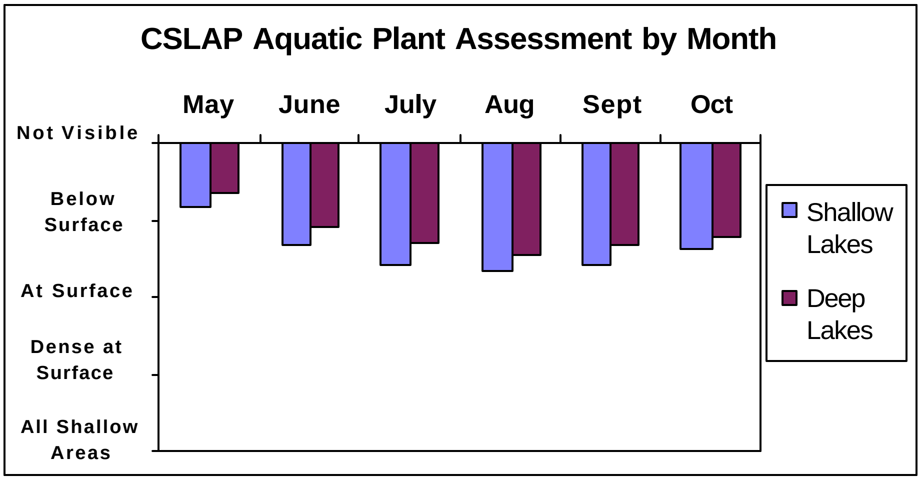


Figure 18c. *Weed Assessment in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

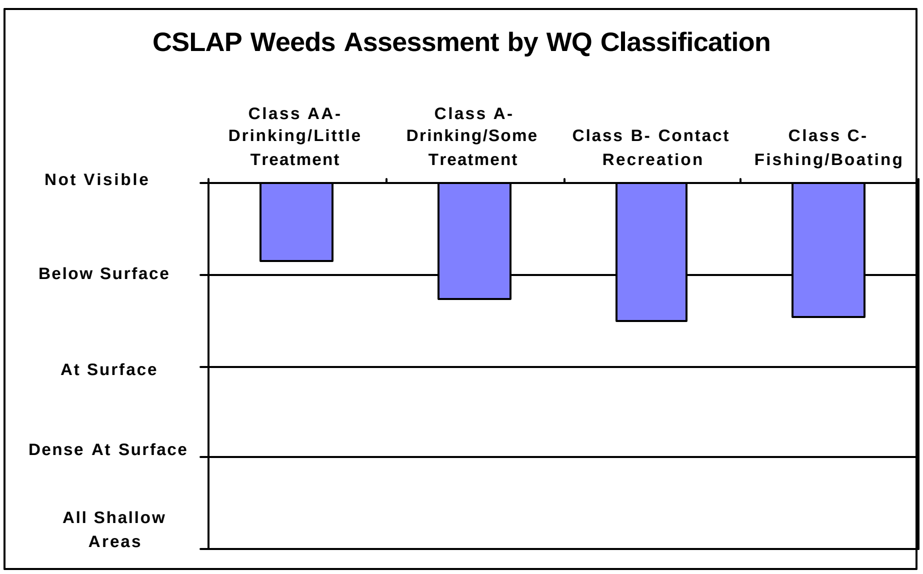


Figure 18d. *Weed Assessment in CSLAP Lakes by Lake Use*

Seasonal Variability:

As expected, aquatic-plant densities and coverage increase seasonally (through late summer) in both shallow and deep lakes, with greater aquatic-plant coverage and densities found in shallow lakes. Peak aquatic-plant densities tend to occur in late summer. The variability from one lake to another (from very little growth to dense growth at the lake surface) is more pronounced later in the summer. Despite higher clarity in shallow lakes in the fall, aquatic-plant coverage decreases, while the drop in fall plant coverage in deeper lakes is less pronounced.

Lake Use Variability:

Aquatic-plant coverage was more significant in Class B and Class C lakes than in other lakes, but this (again) is probably a greater reflection of geography or lake size and depth (Class B lakes tend to be found outside the high elevation areas in the Catskills and Adirondacks, and Class C lakes tend to be shallower than Class AA or Class A lakes).

Recreational Assessment (QC)

Annual Variability:

Recreational assessments (the perceived recreational suitability of the lake or QC on the use-impairment surveys) have varied from year to year, with no clear long-term pattern. The most favorable assessments were in 1997, corresponding to the year with the lowest aquatic-plant (weed) coverage. This was also among the years with the most favorable water-quality assessments. The years with the most favorable water-quality assessments (1995 and 1998) were among the years with the most favorable recreational assessments, despite higher than usual weed densities. This suggests that recreational assessments are influenced by both water-quality conditions and aquatic plant densities. The extent of "normal" conditions (the middle bar in Figure 19a) has generally not changed significantly since perception surveys were first conducted in 1992.

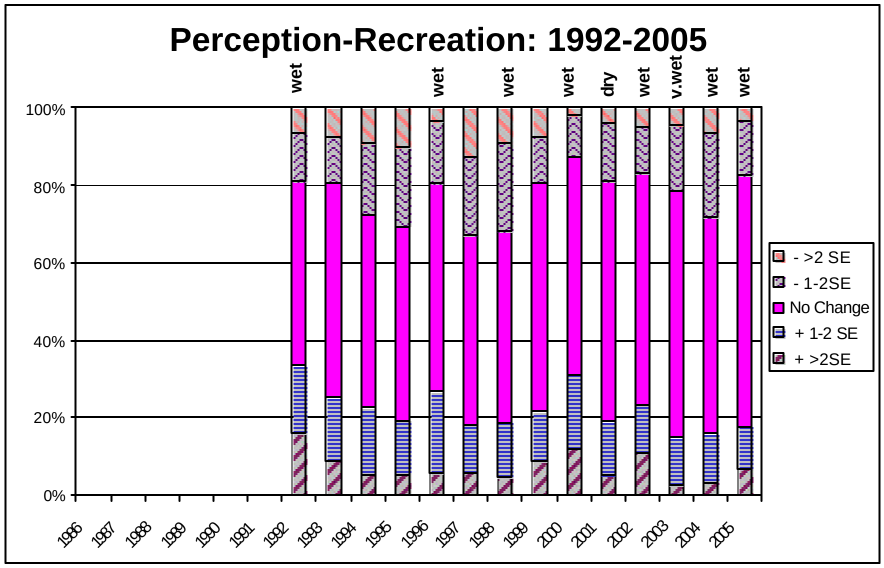


Figure 19a. *Annual Change from "Normal" Recreational Assessment in CSLAP Lakes (SE = Standard Error)*

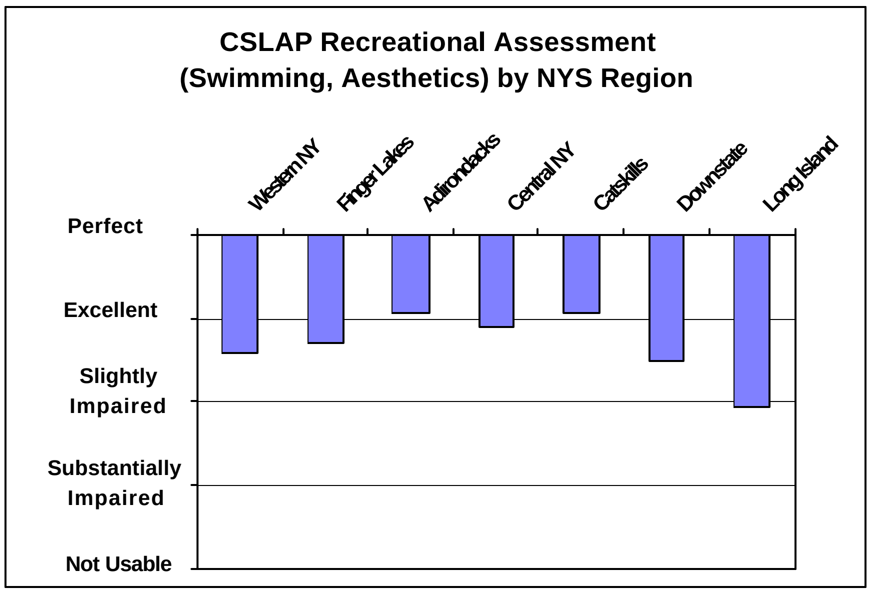


Figure 19b. *Recreational Assessment in CSLAP Lakes by NYS Region*

What Was Expected in 2006?

There was not a strong connection between precipitation (within mostly normal weather patterns) and perceived water-quality, or even between measured and perceived water-quality conditions. As such, it is difficult to identify expected conditions in 2006, although since water clarity readings were mostly within normal ranges, it is reasonable to expect that perceived water-quality conditions would also largely be unchanged.

What Happened at Oquaga Lake in 2006?

Recreational assessments were similar in 2006 to those reported in previous years, and were highly favorable throughout the summer.

Statewide Variability:

Recreational assessments are most favorable in the Adirondacks and Catskills, and less favorable in Long Island and (to a lesser extent) downstate and in western New York. This appears to be in response to less favorable assessments of water-quality and aquatic plant growth, respectively. Except for (the assessments in the small number of CSLAP lakes in) Long Island, overall recreational assessments in all regions are, in general, highly favorable.

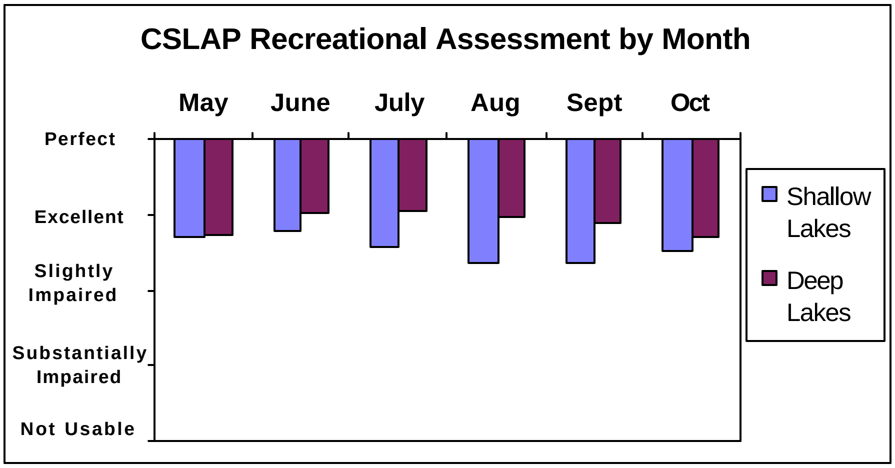


Figure 19c. *Recreational Assessment in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

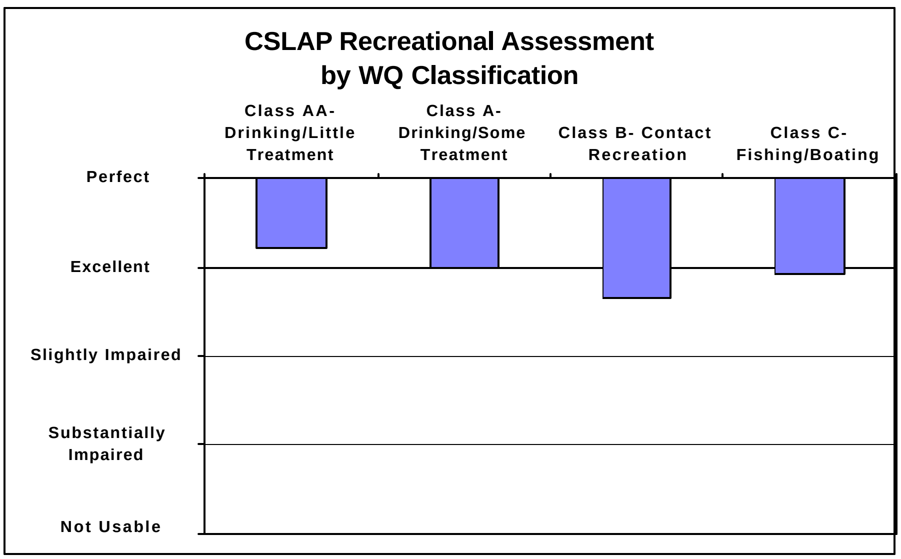


Figure 19d. *Recreational Assessment in CSLAP Lakes by Lake Use*

Seasonal Variability:

Recreational assessment in both shallow and deep lakes tends to improve from spring to early summer and then degrade through the summer, improving in shallow lakes in the fall. As expected, this generally corresponds to seasonal increases in aquatic plant coverage in deep lakes and also to seasonally degrading water-quality in shallow lakes. Overall recreational assessments are more favorable in deep lakes every month of the sampling season, although the differences are less pronounced in late spring and early fall (and winter, when every lake looks nice!).

Lake Use Variability:

Recreational assessment becomes less favorable as the designated lake use becomes less sensitive (drinking water to contact recreation), although recreational assessments of Class C lakes are only slightly less favorable than in Class AA and A lakes. This may be considered a validation of these classifications (recognizing, again, that many Class C lakes continue to fully support contact recreation and perhaps even potable-water use).

VI. DETAILED OQUAGA LAKE WATER-QUALITY SUMMARY

CSLAP is intended to provide a database to help lake associations understand lake conditions and foster sound lake protection and pollution prevention decisions. This individual lake summary for 2006 contains two forms of information. The raw data and graphs present a snapshot or glimpse of water-quality conditions at each lake. They are based on (at most) eight or nine sampling events during the summer. As lakes are sampled through CSLAP for a number of years, the database for each lake will expand, and assessments of lake conditions and water-quality data become more accurate. For this reason, lakes new to CSLAP for only one year will not have information about annual trends.

Raw Data

Two **"**data sets**"** are provided below. The data presented in Table 1 include an annual summary of the minimum, maximum, and average for each of the CSLAP sampling parameters, including data from other sources for which sufficient quality-assurance/quality-control documentation is available for assessing the validity of the results. This data may be useful for comparing a particular data point for the current sampling year with historical data or information. Table 2 includes more detailed summaries of the 2006 and historical data sets, including some evaluation of water-quality trends, comparison against existing water-quality standards, and whether 2006 represented a typical year.

Graphs

The second form of data analysis for your lake is presented in the form of graphs. These graphs are based on the raw data sets to represent a snapshot of water-quality conditions at your lake. The more sampling that has been done on a particular lake, the more information that can be presented on the graph, and the more information you have to identify annual trends for your lake. For example, a lake that has been doing CSLAP monitoring consistently for five years will have a graph depicting five years' worth of data, whereas a lake that has been doing CSLAP sampling for only one year will only have one. Therefore, it is important to consider the number of sampling years of information in addition to where the data points fall on a graph when trying to draw conclusions about annual trends. There are certain factors not accounted for in this report that lake managers should consider:

- **Local weather conditions** (high or low temperatures, rainfall, droughts or hurricanes). Due to delays in receiving meteorological data from NOAA stations within NYS, weather data from individual weather stations or the present sampling season are not included in these reports. Some of the variability reported below can be attributed more to weather patterns than to a "real" water trend or change. However, it is presumed that much of the sampling "noise" associated with weather is dampened over multiple years of data collection and thus should not significantly influence the limited trend analyses provided for CSLAP lakes with longer and larger databases.

- **Sampling season and parameter limitations**. Because sampling is generally confined to June-September, this report does not look at CSLAP parameters during the winter and other seasons. Winter conditions can impact the usability and water-quality of a lake. In addition, there are other sampling parameters (fecal coliform, dissolved oxygen, etc.) that may be responsible for chemical and biological processes and changes in physical measurements (such as water clarity) and the perceived conditions in the lake. *The 2006 CSLAP report attempts to standardize some comparisons by limiting the evaluation to the summer recreational season and the most common sampling periods (mid-June through mid-September), in the event that samples are collected at other times of the year (such as May or October) during only some sampling seasons.*

TABLE 1: CSLAP Data Summary for Oquaga Lake

Year	Min	Avg	Max	N	Parameter
1987-06	**1.75**	**6.36**	**12.30**	**87**	**CSLAP Zsd**
2006	5.60	8.46	11.65	7	CSLAP Zsd
2005	4.73	6.12	6.80	7	CSLAP Zsd
2004	6.10	8.85	11.30	8	CSLAP Zsd
2003	5.05	7.67	9.70	8	CSLAP Zsd
2002	5.45	8.49	12.30	9	CSLAP Zsd
1992	3.50	4.57	5.75	3	CSLAP Zsd
1991	1.75	4.58	6.50	6	CSLAP Zsd
1990	4.25	5.64	6.50	7	CSLAP Zsd
1989	4.25	4.88	5.63	7	CSLAP Zsd
1988	4.75	5.65	6.50	10	CSLAP Zsd
1987	2.75	4.73	6.00	15	CSLAP Zsd
Year	Min	Avg	Max	N	Parameter
1987-06	**0.002**	**0.007**	**0.014**	**87**	**CSLAP Tot.P**
2006	0.004	0.006	0.007	8	CSLAP Tot.P
2006	0.006	0.009	0.014	8	CSLAP Hyp TP
2005	0.004	0.006	0.009	8	CSLAP Tot.P
2005	0.005	0.008	0.012	8	CSLAP Hyp TP
2004	0.002	0.004	0.007	8	CSLAP Tot.P
2004	0.003	0.007	0.013	8	CSLAP Hyp TP
2003	0.003	0.006	0.011	8	CSLAP Tot.P
2003	0.005	0.008	0.016	8	CSLAP Hyp TP
2002	0.003	0.005	0.007	8	CSLAP Tot.P
2002	0.006	0.009	0.017	6	CSLAP Hyp TP
1992	0.008	0.011	0.014	3	CSLAP Tot.P
1991	0.007	0.009	0.012	6	CSLAP Tot.P
1990	0.004	0.008	0.012	7	CSLAP Tot.P
1989	0.005	0.008	0.013	7	CSLAP Tot.P
1988	0.005	0.007	0.011	10	CSLAP Tot.P
1987	0.003	0.007	0.012	14	CSLAP Tot.P
Year	Min	Avg	Max	N	Parameter
1987-06	**0.00**	**0.02**	**0.18**	**71**	**CSLAP NO3**
2006	0.01	0.02	0.03	7	CSLAP NO3
2005	0.01	0.03	0.09	8	CSLAP NO3
2004	0.01	0.02	0.02	8	CSLAP NO3
2004	0.01	0.02	0.05	8	CSLAP HyNO3
2003	0.00	0.01	0.03	8	CSLAP NO3
2003	0.00	0.00	0.01	8	CSLAP HyNO3
2002	0.00	0.01	0.01	9	CSLAP NO3
2002	0.00	0.01	0.02	9	CSLAP HyNO3
1992	0.01	0.01	0.01	1	CSLAP NO3
1991	0.01	0.01	0.01	3	CSLAP NO3
1990	0.01	0.01	0.01	4	CSLAP NO3
1989	0.01	0.01	0.01	3	CSLAP NO3
1988	0.01	0.01	0.01	6	CSLAP NO3
1987	0.01	0.02	0.18	14	CSLAP NO3

DATA SOURCE KEY

CSLAP New York Citizens Statewide Lake Assessment Program

LCI the NYSDEC Lake Classification and Inventory Survey conducted during the 1980s and again beginning in 1996 on select sets of lakes, typically 1 to 4x per year

DEC other water-quality data collected by the NYSDEC Divisions of Water and Fish and Wildlife, typically 1 to 2x in any give year

ALSC the NYSDEC (and other partners) Adirondack Lake Survey Corporation study of more than 1500 Adirondack and Catskill lakes during the mid 1980s, typically 1 to 2x

ELS USEPA's Eastern Lakes Survey, conducted in the fall of 1982, 1x

NES USEPA's National Eutrophication Survey, conducted in 1972, 2 to 10x

EMAP USEPA and US Dept. of Interior's Environmental Monitoring and Assessment Program conducted from 1990 to present, 1 to 2x in four year cycles

Additional data source codes are provided in the individual lake reports

CSLAP DATA KEY:

The following key defines column headings and parameter results for each sampling season:

Min Minimum reading for the parameter

Avg Geometric average (mean) reading for the parameter

Max Maximum reading for the parameter

N Number of samples collected

Zsd Secchi disk transparency, meters

Tot.P Total Phosphorus as P, in mg/l (Hypo = bottom sample)

NO3 Nitrate + Nitrite nitrogen as N, in mg/l

NH_4 Ammonia as N, in mg/l

TDN Total Dissolved Nitrogen as N, in mg/l

TN Total Nitrogen as N, in mg/l

TP/TN Phosphorus/Nitrogen ratios, unitless (calculated from TDN prior to 2006)

Ca Calcium, in mg/l

Tcolor True color, as platinum color units

pH (negative logarithm of hydrogen ion concentration), standard pH

Cond25 Specific conductance corrected to 25°C, in µmho/cm

Chl.a Chlorophyll *a*, in µg/l

QA Survey question re: physical condition of lake: (1) crystal clear; (2) not quite crystal clear; (3) definite algae greenness; (4) high algae levels; and (5) severely high algae levels

QB Survey question re: aquatic plant populations of lake: (1) none visible; (2) visible underwater; (3) visible at lake surface; (4) dense growth at lake surface; (5) dense growth completely covering the nearshore lake surface

QC Survey question re: recreational suitability of lake: (1) couldn't be nicer; (2) very minor aesthetic problems but excellent for overall use; (3) slightly impaired; (4) substantially impaired, although lake can be used; (5) recreation impossible

QD Survey question re: factors affecting answer QC: (1) poor water clarity; (2) excessive weeds; (3) too much algae/odor; (4) lake looks bad; (5) poor weather; (6) litter, surface debris, beached/floating material; (7) too many lake users (boats, PWCs, etc); (8) other

TABLE 1: CSLAP Data Summary for Oquaga Lake (cont)

Year	Min	Avg	Max	N	Parameter
2002-06	**0.00**	**0.02**	**0.06**	**40**	**CSLAP NH4**
2006	0.01	0.02	0.05	7	CSLAP NH4
2005	0.01	0.01	0.01	8	CSLAP NH4
2004	0.01	0.01	0.02	8	CSLAP NH4
2004	0.01	0.02	0.03	8	CSLAP HyNH4
2003	0.00	0.01	0.01	8	CSLAP NH4
2003	0.00	0.01	0.04	8	CSLAP HyNH4
2002	0.01	0.04	0.06	9	CSLAP NH4
2002	0.01	0.04	0.08	9	CSLAP HyNH4
Year	Min	Avg	Max	N	Parameter
2002-06	**0.01**	**0.29**	**0.64**	**40**	**CSLAP TDN**
2006	0.26	0.44	0.64	8	CSLAP TDN
2005	0.01	0.10	0.19	8	CSLAP TDN
2004	0.27	0.35	0.48	7	CSLAP TDN
2004	0.01	0.16	0.27	6	CSLAP HyTDN
2003	0.03	0.18	0.23	8	CSLAP TDN
2003	0.03	0.13	0.19	8	CSLAP HyTDN
2002	0.26	0.37	0.53	9	CSLAP TDN
2002	0.29	0.38	0.48	9	CSLAP HyTDN
Year	Min	Avg	Max	N	Parameter
2002-06	**2.55**	**136.91**	**435.94**	**39**	**CSLAP TN/TP**
2006	100.93	186.42	354.55	8	CSLAP TN/TP
2005	2.55	39.83	66.14	8	CSLAP TN/TP
2004	123.59	228.80	435.94	7	CSLAP TN/TP
2004	1.35	75.19	216.33	6	CSLAP HyTN/TP
2003	5.18	78.04	152.52	8	CSLAP TN/TP
2003	3.39	46.95	74.05	8	CSLAP HyTN/TP
2002	94.33	162.94	239.90	8	CSLAP TN/TP
2002	63.16	104.30	143.93	6	CSLAP HyTN/TP
Year	Min	Avg	Max	N	Parameter
1987-06	**1**	**6**	**45**	**83**	**CSLAP TColor**
2006	5	14	27	7	CSLAP TColor
2005	1	4	9	8	CSLAP TColor
2004	1	6	16	7	CSLAP TColor
2003	6	8	11	6	CSLAP TColor
2002	2	5	9	8	CSLAP TColor
1992	2	4	5	3	CSLAP TColor
1991	2	10	45	6	CSLAP TColor
1990	1	2	5	7	CSLAP TColor
1989	2	2	4	7	CSLAP TColor
1987	3	5	8	10	CSLAP TColor
1987	2	5	9	14	CSLAP TColor

TABLE 1: CSLAP Data Summary for Oquaga Lake (cont)

Year	**Min**	**Avg**	**Max**	**N**	**Parameter**
1987-06	**5.78**	**7.30**	**8.28**	**84**	**CSLAP pH**
2006	6.68	7.49	8.28	8	CSLAP pH
2005	6.80	7.48	7.86	8	CSLAP pH
2004	5.78	6.87	7.95	8	CSLAP pH
2003	6.41	7.00	7.20	8	CSLAP pH
2002	6.90	7.31	7.52	7	CSLAP pH
1992	7.68	7.71	7.75	3	CSLAP pH
1991	6.95	7.43	7.63	6	CSLAP pH
1990	6.60	7.29	7.89	7	CSLAP pH
1989	7.36	7.62	7.89	7	CSLAP pH
1987	6.33	7.48	8.06	8	CSLAP pH
1987	6.85	7.11	7.49	14	CSLAP pH
Year	Min	Avg	Max	N	Parameter
1987-06	**22**	**63**	**127**	**83**	**CSLAP Cond25**
2006	54	72	127	8	CSLAP Cond25
2005	22	55	78	8	CSLAP Cond25
2004	50	72	84	8	CSLAP Cond25
2003	69	72	78	8	CSLAP Cond25
2002	72	73	74	7	CSLAP Cond25
1992	59	60	60	3	CSLAP Cond25
1991	57	58	59	6	CSLAP Cond25
1990	56	61	79	7	CSLAP Cond25
1989	55	57	58	6	CSLAP Cond25
1987	56	59	66	8	CSLAP Cond25
1987	53	55	63	14	CSLAP Cond25
Year	Min	Avg	Max	N	Parameter
2002-06	**4.96**	**5.93**	**7.00**	**7**	**CSLAP Ca**
2006	5.75	5.79	5.82	2	CSLAP Ca
2005	5.68	6.34	7.00	2	CSLAP Ca
2004	4.96	4.96	4.96	1	CSLAP Ca
2003	6.10	6.15	6.20	2	CSLAP Ca
2002				0	CSLAP Ca
Year	Min	Avg	Max	N	Parameter
1987-06	**0.05**	**2.76**	**23.80**	**82**	**CSLAP Chl.a**
2006	0.24	0.72	1.62	8	CSLAP Chl.a
2005	0.05	0.62	1.39	8	CSLAP Chl.a
2004	0.10	1.13	3.22	8	CSLAP Chl.a
2003	0.13	0.92	1.72	7	CSLAP Chl.a
2002	0.41	0.80	1.25	8	CSLAP Chl.a
1992	1.98	4.48	6.97	3	CSLAP Chl.a
1991	1.26	8.44	23.80	6	CSLAP Chl.a
1990	0.63	2.06	3.01	7	CSLAP Chl.a
1989	0.43	2.22	4.11	6	CSLAP Chl.a
1988	1.06	2.41	4.66	10	CSLAP Chl.a
1987	1.20	7.06	19.20	11	CSLAP Chl.a

TABLE 1: CSLAP Data Summary for Oquaga Lake (cont)

Year	Min	Avg	Max	N	Parameter
1992-06	**1**	**1.2**	**2**	**40**	**QA**
2006	1	1.6	2	7	QA
2005	1	1.1	2	7	QA
2004	1	1.1	2	8	QA
2003	1	1.1	2	8	QA
2002	1	1.1	2	8	QA
1992	1	1.0	1	2	QA
Year	Min	Avg	Max	N	Parameter
1992-06	**1**	**1.7**	**3**	**40**	**QB**
2006	2	2.0	2	7	QB
2005	1	1.7	2	7	QB
2004	2	2.1	3	8	QB
2003	1	1.1	2	8	QB
2002	1	1.5	2	8	QB
1992	1	1.0	1	2	QB
Year	Min	Avg	Max	N	Parameter
1992-06	**1**	**1.2**	**3**	**40**	**QC**
2006	1	1.1	2	7	QC
2005	1	1.3	2	7	QC
2004	1	1.0	1	8	QC
2003	1	1.5	3	8	QC
2002	1	1.1	2	8	QC
1992	1	1.0	1	2	QC

- **Statistical analyses**. True assessments of water-quality trends and comparison to other lakes involve rigid statistical analyses. Such analyses are generally beyond the scope of this program, in part due to limitations on the time available to summarize data from nearly 100 lakes in the five months from data receipt to the next sampling season. This may be due in part to the inevitable inter-lake inconsistencies in sampling dates from year to year and in part to the limited scope of monitoring. Where appropriate, some statistical summaries, utilizing both parametric and non-parametric statistics, have been provided within the report (primarily in Table 2).

- **Mean versus Median.** Much of the water-quality summary data presented in this report is reported as the mean, or the average of all of the readings in the period in question (summer, annual, year to year). However, while mean remains one of the most useful, and often most powerful, ways to estimate the most typical reading for many of the measured water-quality indicators, it is a less useful and perhaps misleading estimate when the data are not "normally" distributed (most common readings in the middle of the range of all readings, with readings less common toward the end of the range).

  In particular, comparisons of one lake to another, such as comparisons within a particular basin, can be greatly affected by the spread of the data across the range of all readings. For example, the average phosphorus level of nine lakes with very low readings (say 10 µg/l) and one lake with very high readings (say 110 µg/l) could be much higher (in this case, 20 µg/l) than in the “typical lake” in this set of lakes (much closer to 10 µg/l). In this case, median, or the middle reading in the range, is probably the most accurate representation of “typical”.

This report will include the use of both mean and median to evaluate “central tendency,” or the most typical reading, for the indicator in question. In most cases, “mean” is used most often to estimate central tendency. However, where noted, “median” may also be used.

TABLE 2- Current and Historical Data Summaries for Oquaga Lake
Eutrophication Indicators

Parameter	Year	Minimum	Average	Maximum
Zsd	2006	5.60	8.46	11.65
(meters)	All Years	1.75	6.36	12.30
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Phosphorus	2006	0.004	0.006	0.007
(mg/l)	All Years	0.002	0.007	0.014
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Chl.a	2006	0.24	0.72	1.62
(µg/l)	All Years	0.05	2.75	23.80

Parameter	Year	Was 2006 Clarity the Highest or Lowest on Record?	Was 2006 a Typical Year?	Trophic Category	Zsd Changing?	% Samples Violating DOH Beach Std?+
Zsd	2006	Within Normal Range	Yes	Oligotrophic	Increasing?	0
(meters)	All Years			Oligotrophic		0
Parameter	**Year**	**Was 2006 TP the Highest or Lowest on Record?**	**Was 2006 a Typical Year?**	**Trophic Category**	**TP Changing?**	**% Samples Exceeding TP Guidance Value**
Phosphorus	2006	Within Normal Range	Yes	Oligotrophic	Decreasing?	0
(mg/l)	All Years			Oligotrophic		0
Parameter	**Year**	**Was 2006 Algae the Highest or Lowest on Record?**	**Was 2006 a Typical Year?**	**Trophic Category**	**Chl.a Changing?**	
Chl.a	2006	Within Normal Range	Yes	Oligotrophic	Decreasing?	
(µg/l)	All Years			Mesotrophic		

Minimum allowable water clarity for siting a new NYS swimming beach = 1.2 meters
NYS Total Phosphorus Guidance Value for Class B and Higher Lakes = 0.020 mg/l

The CSLAP dataset usually indicates that Oquaga Lake is an *oligotrophic*, or highly unproductive lake, based on phosphorus, chlorophyll *a* and Secchi disk readings. Despite the normally low productivity, Oquaga Lake was even less productive than usual in 2006, based on higher water transparency readings and lower phosphorus and algae levels. The lower lake productivity was influenced by heavy rainfall associated with Hurricane Ernesto in early August and early in the summer, with the most significant rise in water clarity associated with the Ernesto rainfall. The lake has been less productive in the last five years than in the first six (1987-1992) years of CSLAP sampling, although in recent years productivity has varied somewhat from year to year. There is a moderately strong correlation between changes in water clarity and algae, but a lesser correlation between changes in algae and phosphorus, although it is likely that maintaining the high water transparency of Oquaga Lake will require keeping algae levels in check. This in turn will necessitate continued control of phosphorus loading to the lake. Phosphorus levels in Oquaga Lake, even those measured near the lake bottom, are usually well below the state guidance value for lakes used for contact recreation (swimming). Secchi disk transparency readings at all times greatly exceed the minimum recommended water clarity for swimming beaches (= 1.2 meters). In short, the productivity of Oquaga Lake was probably much lower in 2006 than in the period from 1987 to 1992—water clarity readings were much higher, due to lower chlorophyll *a* and phosphorus readings—continuing a trend first observed when CSLAP sampling on the lake resumed in 2002.

TABLE 2- Current and Historical Data Summaries for Oquaga Lake (cont.)
Other Water-Quality Indicators

Parameter	Year	Minimum	Average	Maximum
Nitrate	2006	0.01	0.02	0.03
(mg/l)	All Years	0.00	0.02	0.18
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
NH4	2006	0.01	0.02	0.05
(mg/l)	All Years	0.00	0.02	0.06
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
TDN	2006	0.26	0.44	0.64
(mg/l)	All Years	0.01	0.29	0.64
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
True Color	2006	5	14	27
(ptu)	All Years	1	6	45
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
pH	2006	6.68	7.49	8.28
(std units)	All Years	5.78	7.30	8.28
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Conductivity	2006	54	72	127
(µmho/cm)	All Years	22	63	127
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Calcium	2006	5.8	5.8	5.8
(mg/l)	All Years	5.0	5.9	7.0

These data indicate Oquaga Lake is a weakly colored, circumneutral (near neutral pH) lake with low nitrate and ammonia levels and soft water. Water transparency readings may be influenced by water color—the highest color readings (in early 2006) corresponded to the lowest water clarity readings. However, the very high water clarity is more strongly influenced by very low algae levels than by (usually) low water color. While the higher color readings in early 2006 occurred after heavy rain events, water color decreased after the heavy rains from Hurricane Ernesto. Nitrate and ammonia do not appear to represent a threat to water-quality, and deepwater ammonia and nitrate readings are close to those at the lake surface. Nitrate readings have risen slightly in recent years, but both nitrate and ammonia levels are close to the analytical detection limit. pH readings are almost always between the lower and upper state water-quality standards (=6.5 to 8.5). It is likely that these readings are adequate to support most aquatic organisms. Most conductivity readings have been typical of soft water lakes, although they have risen slightly since 1987. Calcium levels are below the threshold found to support zebra mussels, and it is not believed that these exotic animals have been found in Oquaga Lake.

TABLE 2- Current and Historical Data Summaries for Oquaga Lake (cont.)
Other Water-Quality Indicators (cont)

Parameter	Year	Was 2006 Nitrate the Highest or Lowest on Record?	Was 2006 a Typical Year?	Nitrate High?	Nitrate Changing?	% Samples Exceeding NO3 Standard	
Nitrate	2006	Within Normal Range	Yes	No	No	0	
(mg/l)	All Years			No		0	
Parameter	**Year**	**Was 2006 NH4 the Highest or Lowest on Record?**	**Was 2006 a Typical Year?**	**NH4 High?**	**NH4 Changing?**	**% Samples Exceeding NH4 Standard**	
NH4	2006	Within Normal Range	Yes	No	No	0	
(mg/l)	All Years			No		0	
Parameter	**Year**	**Was 2006 TDN the Highest or Lowest on Record?**	**Was 2006 a Typical Year?**	**TDN High?**	**TDN Changing?**	**Ratios of TN/TP Indicate P or N Limitation?**	
TDN	2006	Highest at Times	Higher than Normal	No	No	P Limitation	
(mg/l)	All Years			No		P Limitation	
Parameter	**Year**	**Was 2006 Color the Highest or Lowest on Record?**	**Was 2006 a Typical Year?**	**Colored Lake?**	**Color Changing?**		
True Color	2006	Within Normal Range	Higher than Normal	No	No		
(ptu)	All Years			No			
Parameter	**Year**	**Was 2006 pH the Highest or Lowest on Record?**	**Was 2006 a Typical Year?**	**Acceptable Range?**	**pH Changing?**	**% Samples > Upper pH Standard**	**% Samples < Lower pH Standard**
pH	2006	Highest at Times	Yes	Yes	No	0	0
(std units)	All Years			Yes		0	4
Parameter	**Year**	**Was 2006 Conductivity Highest or Lowest on Record?**	**Was 2006 a Typical Year?**		**Conductivity Changing?**		
Conductivity	2006	Highest at Times	Higher than Normal		No		
(µmho/cm)	All Years						
Parameter	**Year**	**Was 2006 Calcium Highest or Lowest on Record?**	**Was 2006 a Typical Year?**	**Support Zebra Mussels?**	**Calcium Changing?**		
Calcium	2006	Within Normal Range	Yes	No	No		
(mg/l)	All Years			No			

NYS Nitrate standard = 10 mg/l
NYS Ammonia standard = 2 mg/l (as NH_3-NH_4)
NYS pH standard - 6.5 < acceptable pH < 8.5

TABLE 2- Current and Historical Data Summaries for Oquaga Lake

Lake Perception Indicators (1= most favorable, 5= least favorable)

Parameter	Year	Minimum	Average	Maximum
QA	2006	1	1.6	2
(Clarity)	All Years	1	1.2	2
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
QB	2006	2	2.0	2
(Plants)	All Years	1	1.7	3
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
QC	2006	1	1.1	2
(Recreation)	All Years	1	1.2	3

Parameter	Year	Was 2006 Clarity the Highest or Lowest on Record?	Was 2006 a Typical Year?	Clarity Changed?	%Frequency 'Definite Algae Greenness'	%Frequency 'Severe Algae Levels'	%Frequency 'Slightly Impaired' Due to Algae	%Frequency 'Substantially Impaired' Due to Algae
QA	2006	Highest and Lowest	Yes	Yes	0	0	0	0
(Clarity)	All Years				0	0	0	0
Parameter	**Year**	**Was 2006 Weed Growth the Heaviest on Record?**	**Was 2006 a Typical Year?**	**Weeds Changed?**	**%Frequency Surface Weeds**	**%Frequency Dense Weeds**	**%Frequency 'Slightly Impaired' Due to Weeds**	**%Frequency 'Substantially Impaired' Due to Weeds**
QB	2006	Within Normal Range	Yes	Yes	0	0	0	0
(Plants)	All Years				3	0	0	0
Parameter	**Year**	**Was 2006 Recreation the Best or Worst on Record?**	**Was 2006 a Typical Year?**	**Recreation Changed?**	**%Frequency Slightly Impaired**	**%Frequency Substantially Impaired**		
QC	2006	Best at Times	Yes	Yes	0	0		
(Recreation)	All Years				3	0		

Recreational and water-quality assessments in Oquaga Lake continue to be highly favorable. Oquaga Lake has most frequently been described as “crystal clear” to “not quite crystal clear,” an assessment slightly less favorable than in other lakes with similar water clarity readings. However, changes in these assessments do usually reflect changes in the water clarity of Oquaga Lake. Aquatic plants only rarely grow to the lake surface, and are rarely implicated in recreational use impacts. Oquaga Lake is usually reported as “could not be nicer” for recreational uses, an assessment comparable to that in other lakes with similar water quality characteristics and lack of invasive weed growth. Recreational assessments appear to be associated only with poor weather. These assessments are stable during the summer, as expected given the relative stability in water quality and aquatic plant coverage.

Oquaga Lake has been described by the CSLAP sampling volunteers as “slightly impaired” in 3% of the CSLAP sampling sessions, and has never been identified as “substantially” impaired. Slightly impaired conditions were never associated with excessive algae or poor water clarity, and were associated with excessive weeds during 3% of the CSLAP sampling sessions.

<u>**How Do the 2006 Data Compare to Historical Data from Oquaga Lake?**</u>

Seasonal Comparison of Eutrophication, Other Water-quality, and Lake-Perception Indicators–2006 Sampling Season and in the Typical or Previous Sampling Seasons at Oquaga Lake

Figures 20 and 21 compare data for the measured eutrophication parameters for Oquaga Lake in 2006 and since CSLAP sampling began at Oquaga Lake. Figures 22 and 23 compare nitrogen to phosphorus ratios, figures 24 through 31 compare other sampling indicators, and figures 32 and 33 compare volunteer perception responses during the same periods.

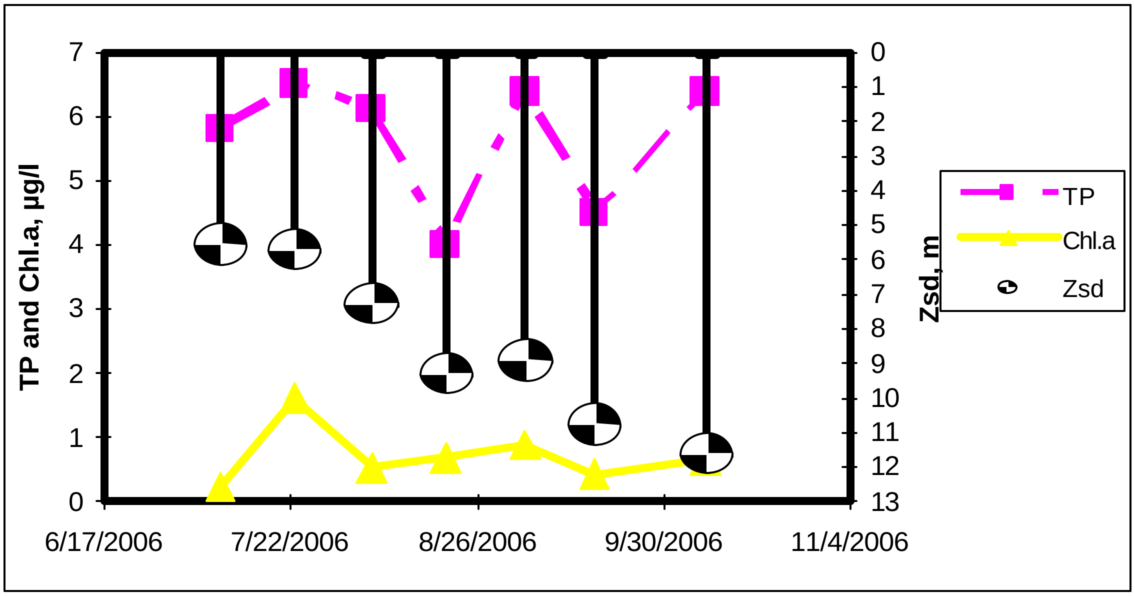


Figure 20. 2006 Eutrophication Data for Oquaga Lake

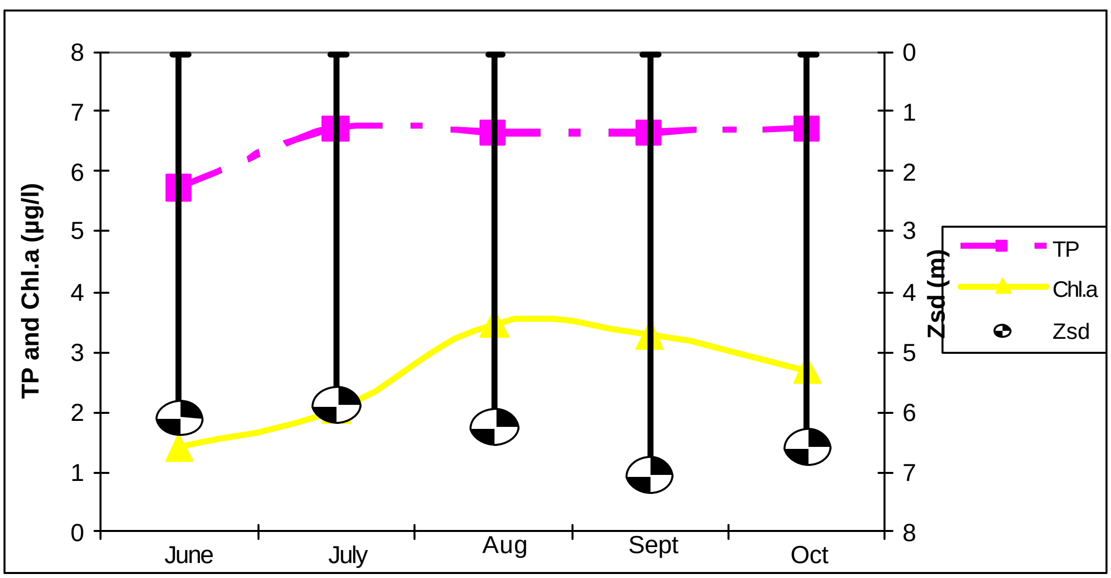


Figure 21- Eutrophication Data in a Typical (Monthly Mean) Year for Oquaga Lake

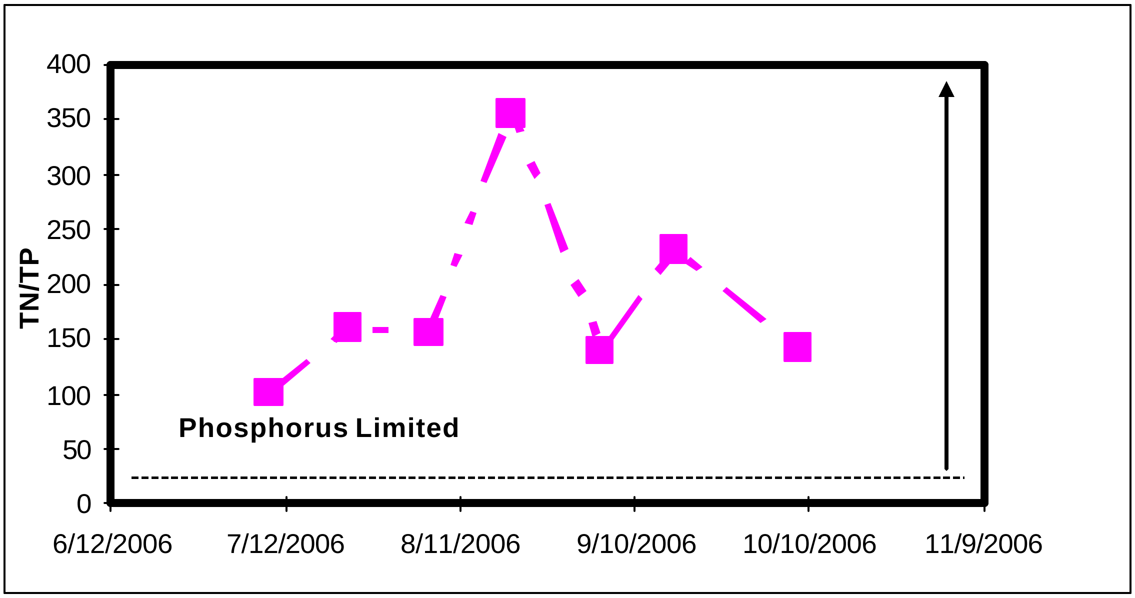


Figure 22. 2006 Nitrogen-to-Phosphorus Ratios for Oquaga Lake

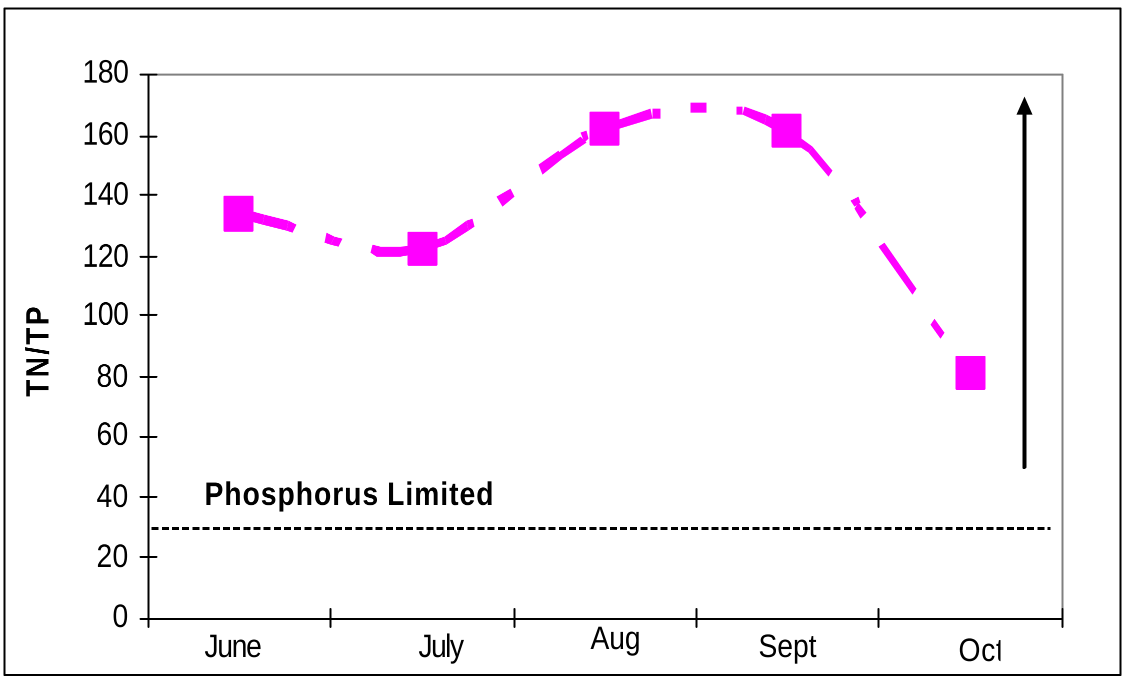


Figure 23- Nitrogen–to-Phosphorus Ratios in a Typical (Monthly Mean) Year for Oquaga Lake

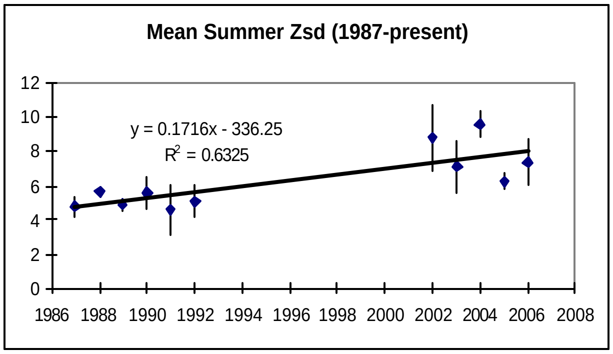


Figure 24. Annual Average Summer Water Clarity for Oquaga Lake

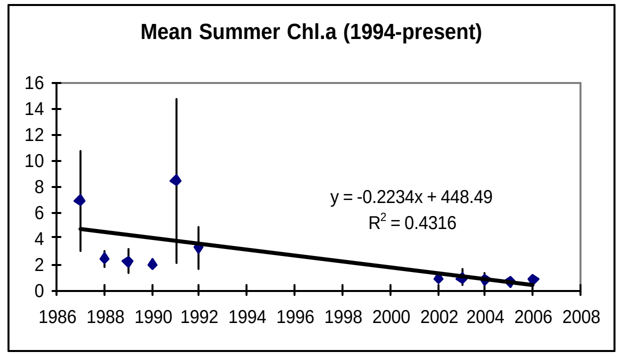


Figure 25. Annual Average Summer Chlorophyll a for Oquaga Lake

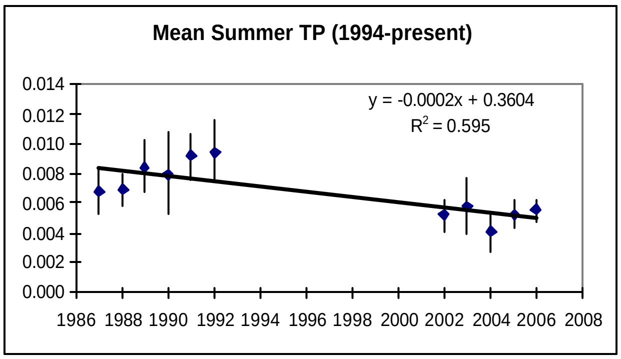


Figure 26. Annual Average Summer Total Phosphorus for Oquaga Lake

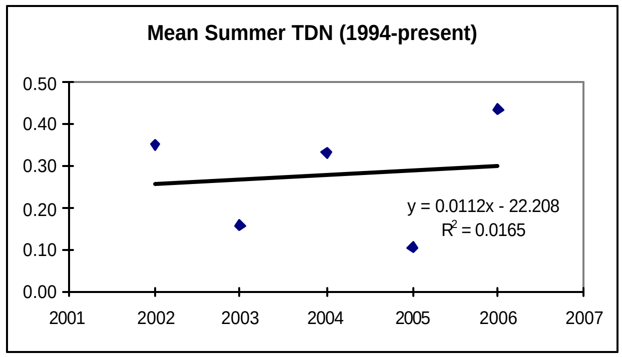


Figure 27. Annual Average Summer Total Nitrogen for Oquaga Lake

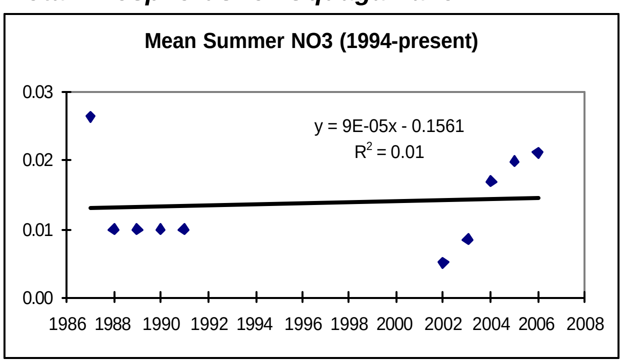


Figure 28. Annual Average Summer Nitrate for Oquaga Lake

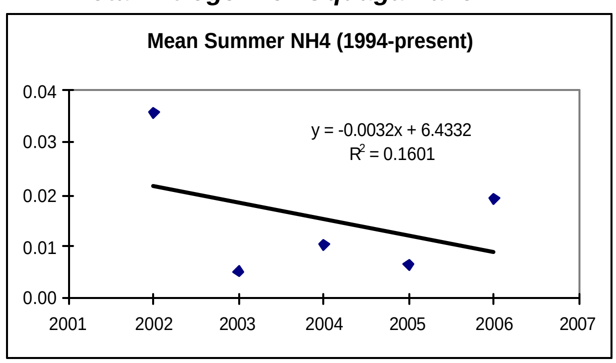


Figure 29. Annual Average Summer Ammonia for Oquaga Lake

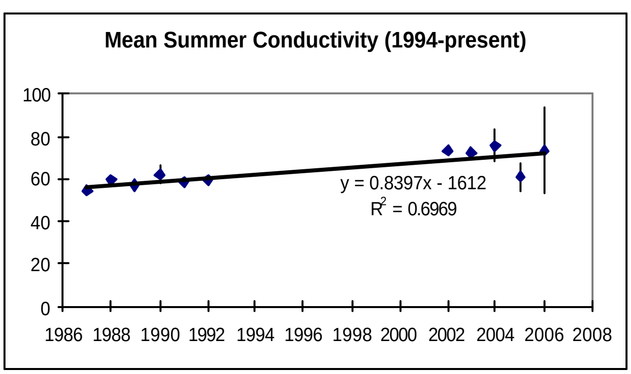


Figure 30. Annual Average Summer Conductivity for Oquaga Lake

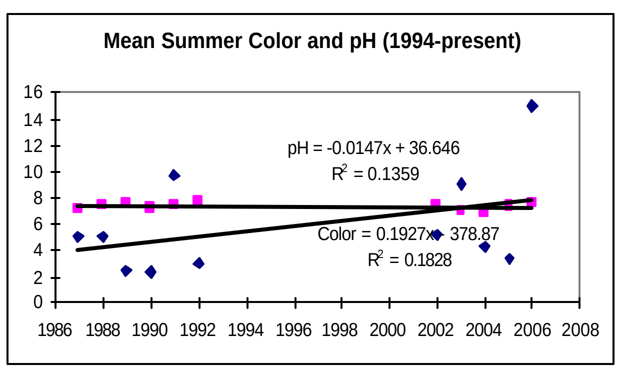


Figure 31. Annual Average Summer pH and Color for Oquaga Lake

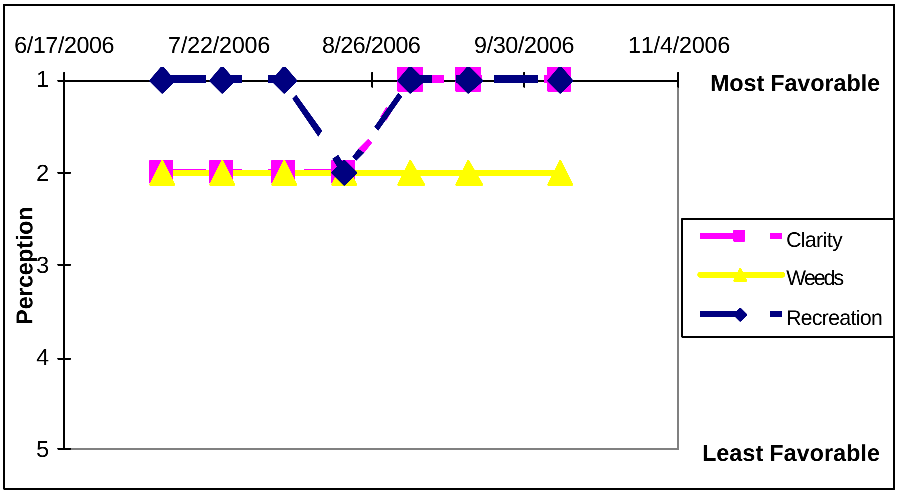


Figure 32. 2006 Lake Perception Data for Oquaga Lake

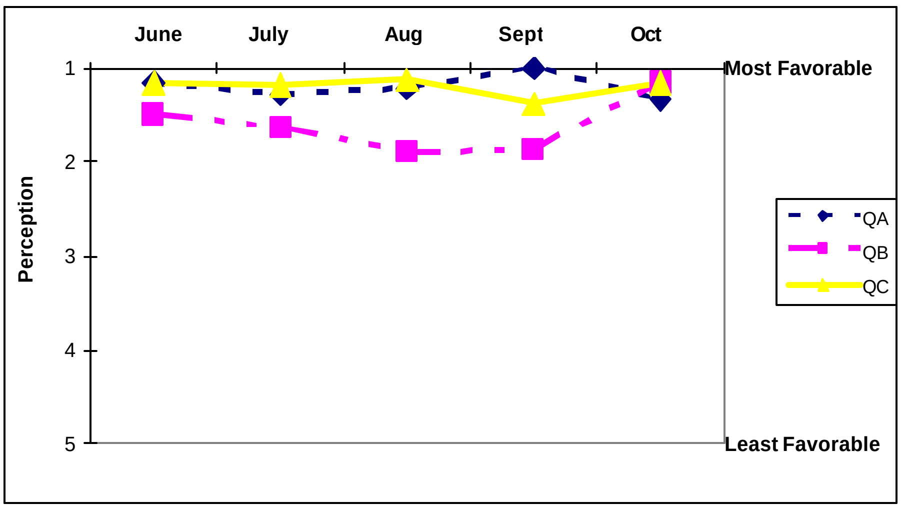


Figure 33- Lake Perception Data in a Typical (Monthly Mean) Year for Oquaga Lake

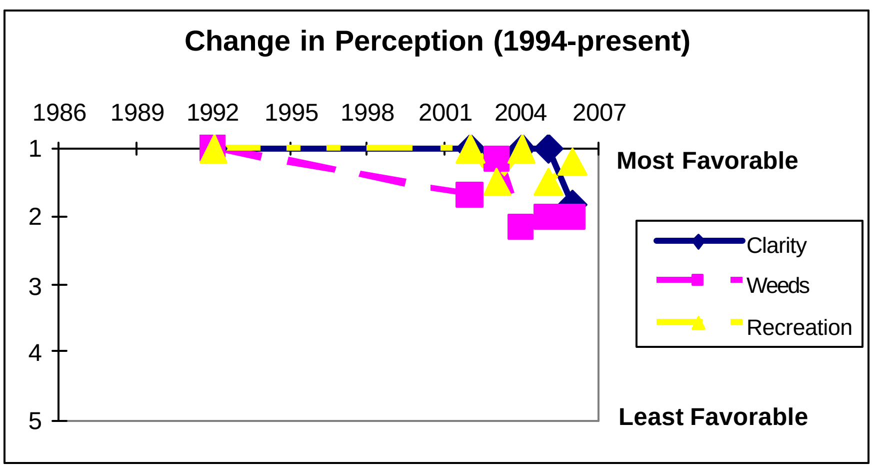


Figure 34- Annual Average Lake Assessments for Oquaga Lake

(QA = clarity, ranging from (1) crystal clear to (3) definite algae greenness to (5) severely high algae levels;
QB = weeds, ranging from (1) not visible to (3) growing to the surface to (5) dense growth covers lake;
QC = recreation, ranging from (1) could not be nicer to (3) slightly impaired to (5) lake not usable)

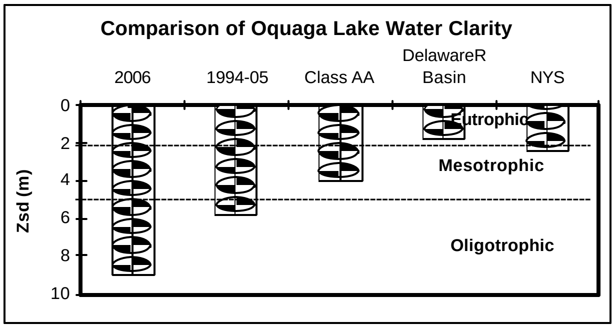


Figure 35. *Comparison of 2006 Secchi Disk Transparency to Lakes With the Same Water-Quality Classification, Neighboring Lakes, and Other CSLAP Lakes in 2006*

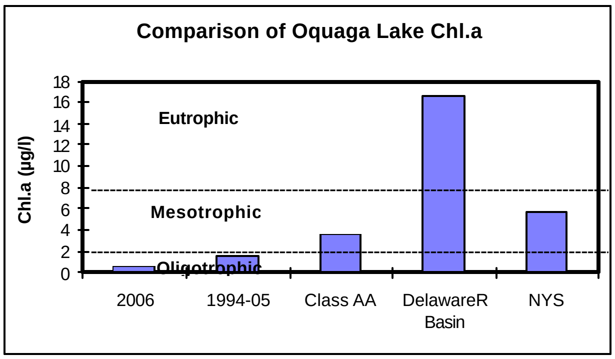


Figure 36. *Comparison of 2006 Chlorophyll a to Lakes with the Same Water-Quality Classification, Neighboring Lakes, and Other CSLAP Lakes in 2006*

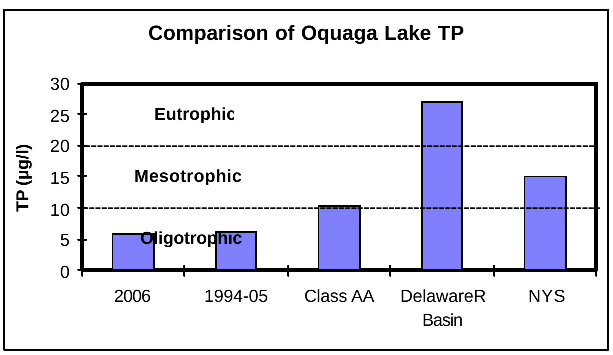


Figure 37. *Comparison of 2006 Total Phosphorus to Lakes With the Same Water-Quality Classification, Neighboring Lakes, and Other CSLAP Lakes in 2006*

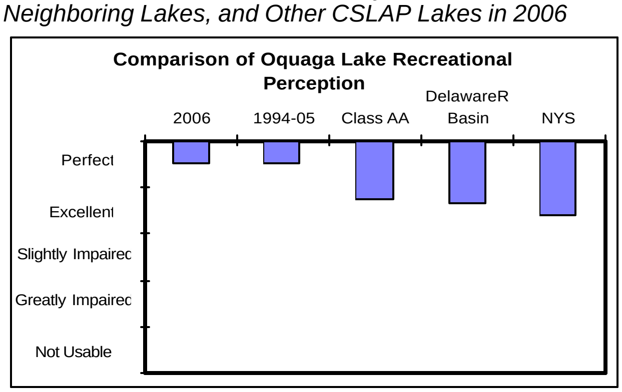


Figure 38. *Comparison of 2006 Recreational Perception to Lakes With the Same Water-Quality Classification, Neighboring Lakes, and Other CSLAP Lakes in 2006*

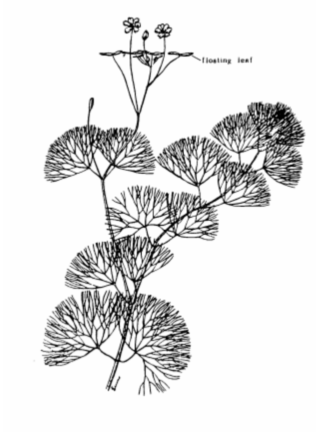
How does Oquaga Lake compare to other lakes?

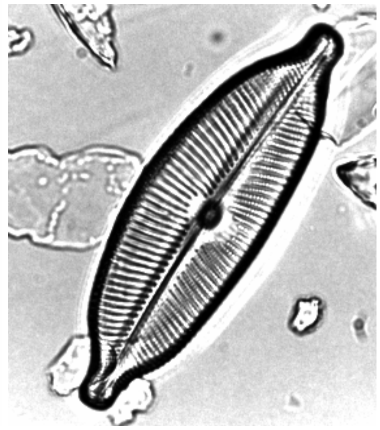
Annual Comparison of Median Readings for Eutrophication Parameters and Recreational Assessment For Oquaga Lake in 2006 to Historical Data for Oquaga Lake, Neighboring Lakes, Lakes with the Same Lake Classification, and Other CSLAP Lakes

The graphs to the left illustrate comparisons of each eutrophication parameter and recreational perception at Oquaga Lake—in 2006, other lakes in the same drainage basin, lakes with the same water-quality classification (each classification is summarized in Appendix B), and all of CSLAP. Readers should note that differences in watershed types, activities, lake history and other factors may result in differing water-quality conditions at your lake relative to other nearby lakes. In addition, the limited database for some regions of the state precludes a comprehensive comparison to neighboring lakes.

Based on these graphs, the following conclusions can be made about Oquaga Lake in 2006:

a) Using water clarity as an indicator, Oquaga Lake is less productive than other Class AA lakes, other Delaware River basin lakes, and other NYS lakes.
b) Using chlorophyll *a* concentrations as an indicator, Oquaga Lake is less productive than other Delaware River basin lakes, other Class AA and other NYS lakes.
c) Using total phosphorus concentrations as an indicator, Oquaga Lake is less productive than other Delaware River basin lakes, other Class AA lakes, and other NYS lakes.
d) Using QC on the field-observations form as an indicator, Oquaga Lake is more suitable for recreation than other Delaware River basin lakes, other Class AA lakes, and other NYS lakes.





VII. AQUATIC PLANTS

a. Macrophytes:

Aquatic plants should be recognized for their contributions to lake beauty as well as for providing food and shelter for other life in the lake. Emergent and floating plants such as water lilies floating on the lake surface may provide aesthetic appeal with their colorful flowers; sedges and cattails help to prevent shoreline erosion and may provide food and cover for birds. Submergent plants like pondweeds and leafy waterweed harbor insects, provide nurseries for amphibians and fish, and provide food for birds and other animals. Those who enjoy fishing at the lake appreciate a diverse plant population. Aquatic plants can be found throughout the *littoral zone*, the near-shore areas in which sufficient light reaches the lake bottom to promote photosynthesis. Plant growth in any particular part of the lake is a function of available light, nutrition and space, bottom substrate, wave action, and other factors, and extensive plant growth can occur in both “clean” and “polluted” lakes. A large portion of aquatic vegetation consists of the microscopic algae referred to as phytoplankton; the other portion consists of the larger rooted plants called macrophytes**.**

As invasive plants colonize and spread into a lake, native plant species can be threatened or even eliminated from aquatic plant communities. The most susceptible of these are those that reside in marginal regions, limited by water depth, sediment type, or inability to compete for space. As a result, many plants identified as *rare, threatened* or *endangered (RTE) species* are protected under New York State law. *The New York State Natural Heritage Program has not reported any RTE species in Oquaga Lake*.

Of particular concern to many lakefront residents and recreational users are the *non-indigenous macrophytes* that can frequently dominate native aquatic plants and crowd out more beneficial plant species. The invasive plant species may be introduced to a lake by waterfowl, but in most cases they are introduced by fragments or seedlings that remain on watercraft from already-infested lakes. Once introduced, these species have tenacious survival skills, crowding out, dominating and eventually aggressively overtaking the indigenous (native) plant communities in a variety of water-quality conditions. When this occurs, they interfere with recreational activities such as fishing, swimming or water skiing. These species need to be properly identified to be effectively managed.

Non-native Invasive Macrophyte Species

Examples of the common non-native invasive species found in New York are:

- **Eurasian watermilfoil** *(Myriophyllum spicatum)*
- **Curly-leaf pondweed** *(Potamogeton crispus)*
- **Eurasian water chestnut** *(Trapa natans)*
- **Fanwort** *(Cabomba caroliniana).*

If these plants are not present, efforts should be made to continue protecting the lake from the introduction of these species.

Whether the role of the lake manager is to better understand the lake ecosystem or better manage the aquatic plant community, knowledge of plant distribution is paramount to the management process. There are many procedures available for assessing and monitoring aquatic vegetation. The CSLAP Sampling Protocol contains procedures for a "semi-quantitative" plant-

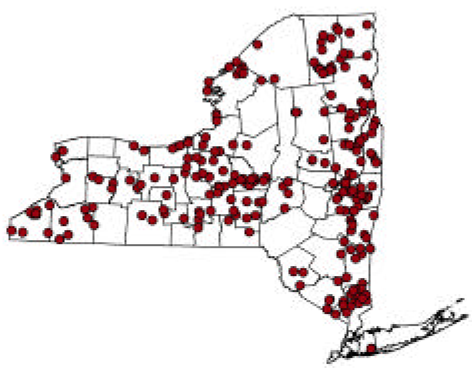


Figure 39a. Myriophyllum spicatum distribution in New York State

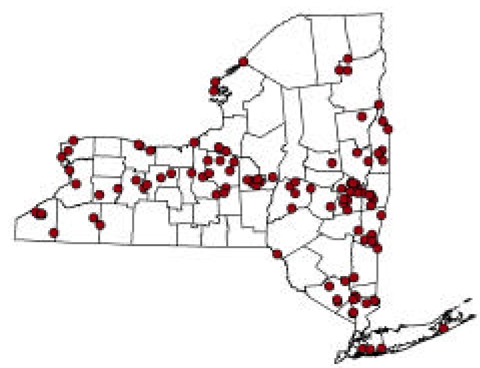


Figure 39b. Potamogeton crispus distribution in New York State

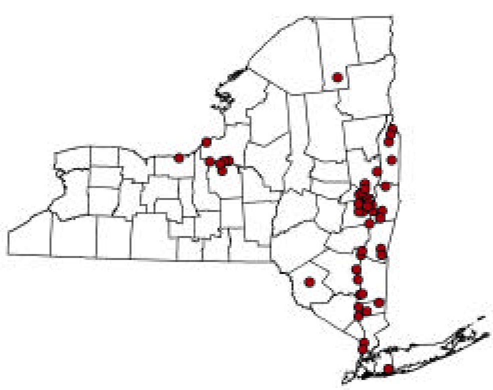


Figure 39c. Trapa natans distribution in New York State

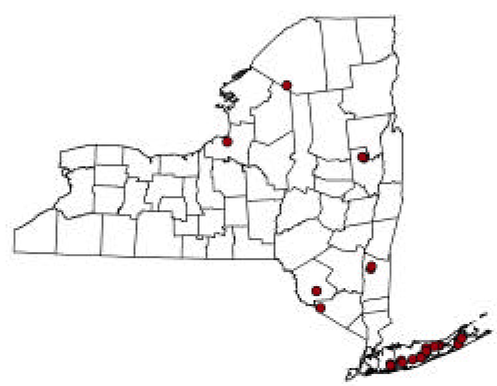


Figure 39d. Cabomba caroliniana distribution in New York State

monitoring program. Volunteers collect plant specimens and provide field information and qualitative abundance estimates for an assessment of the macrophyte communities within critical areas of the lake. While these techniques are no substitute for professional plant surveys, they can help provide better information for lake managers. Lake associations planning to devote significant time and expenditures toward a plant-management program are advised to pursue more extensive plant surveying activities.

Formal and informal survey work has been effective in developing statewide distribution maps of each of the major submergent exotic species, and CSLAP data has figured prominently in this process. As of 2006, the statewide distribution maps of confirmed identifications are shown on Figures 39a to 39d.

Aquatic plant surveys have not been conducted through CSLAP at Oquaga Lake.

b. Algae

Microscopic algae referred to as phytoplankton make up much of aquatic vegetation found in lakes. For this reason, and because phytoplankton are the primary producers of food (through photosynthesis) in lakes, they are the most important component of the complex food web that governs ecological interactions in lakes.

In a lake, phytoplankton communities are usually very diverse and are comprised of hundreds of species having different requirements for nutrients, temperature and light. In many lakes, including those of New York, diatom populations are greatest in the spring, due to a competitive advantage in cooler water and relatively high levels of silica. In most lakes, however, diatom densities rarely reach nuisance portions in the spring. By the summer, green algae take advantage of warmer temperatures and greater amounts of nutrients (particularly nitrogen) in the warm water and often increase in density. These alga often grow in higher densities than do diatoms or most other species, although they are often not the types of algae most frequently implicated in noxious algae blooms. Later in the summer and in the early fall, blue-green algae, which possess the ability to utilize atmospheric nitrogen to provide this required nutrient, increase in response to higher phosphorus concentrations. This often happens right before turnover or destratification in the fall. These alga are most often associated with taste and odor problems, bloom conditions, and the “spilled paint” slick that prompts the most complaints about algae. Each lake possesses a unique blend of algal communities, often varying in population size from year to year and with differing species proportional in the entire population. The most common types range from the mentioned diatoms, green, and blue-green algae, to golden-brown algae to dinoflagellates and many others, dominating each lake community.

So how can this be evaluated through CSLAP? CSLAP does assess algal biomass through the chlorophyll *a* measurement. While algal differentiation is important, many CSLAP lake associations are primarily interested in “how much?,” not “what kind?,” and this is assessed through the chlorophyll *a* measurement. Phytoplankton communities have not been regularly identified and monitored through CSLAP, in part due to the cost and difficulty in analyzing samples and in part due to the difficulty in using a one-time sample to assess long-term variability in lake conditions. A phytoplankton analysis may reflect a temporary, highly unstable and dynamic water-quality condition.

Prior to 1998, nearly all CSLAP lakes were sampled once for phytoplankton identification, but since then, phytoplankton sampling has not been a regular part of CSLAP. For these sampled lakes, a summary of the most abundant phytoplankton species is included below. Algal species frequently associated with taste and odor problems are specifically noted in this table, although it should be mentioned that these samples, like all other water samples collected through CSLAP, come from near the center of the lake, a location not usually near water intakes or swimming beaches. Since algal communities can also be spatially quite variable, even a preponderance of taste- and odor-causing species in the water samples might not necessarily translate to potable-water-intake or aesthetic impairments, although the threat of such an impairment might be duly noted in the "Considerations" section below.

Phytoplankton surveys conducted through CSLAP at Oquaga Lake have identified the following algae:

Date: 7/24/92 Most Abundant Species: Gymnodinium spp. (dinoflagellates)- 57%, Dinobryon sociale (golden brown algae)- 31%, Peridinium spp. (dinoflagellates)- 6%
Most Abundant Genera: Pyrrhophyta (dinoflagellates)- 63%, Chrysophyta (golden brown algae)- 33%, Cyanophyta (blue-green algae)- 3%

So What Does That Mean?

The algae species most common in the late July sample from 1992 are not associated with taste and odor or filtration problems, and the densities of these algae were very low, so it is unlikely that use impairment problems result from the presence of these algae.

VIII: PRIORITY WATERBODY LISTS AND IMPACTS TO LAKE USE

The Priority Waterbody List (PWL) is presently an inventory of all waters in New York State (lakes, ponds, reservoirs, rivers, streams, and estuaries) known to have designated water uses with some degree of impairment, or those threatened by potential impairment. However, the PWL is slowly evolving into an inventory of all waterbodies for which sufficient information is available to assess the condition and/or usability of the waterbody. PWL waterbodies are identified through a broad network of county and state agencies, with significant public outreach and input, and the list is maintained and compiled by the NYSDEC Division of Water. Monitoring data from a variety of sources, including CSLAP, have been utilized by state agencies to evaluate lakes for inclusion on the PWL, and the process for incorporating lakes data has become more standardized.

Specific numeric criteria have recently been developed to characterize sampled lakes in the available use-based PWL categories (*precluded*, *impaired*, *stressed*, or *threatened*). Evaluations utilize the NYS phosphorus guidance value, water-quality standards, criteria utilized by other states, and the trophic ranges described earlier to supplement the other more antidotal inputs to the listing. The procedures by which waterbodies are evaluated are known as the Consolidated Assessment and Listing Methodology (CALM) process. This process is undertaken on an annual rotating basin, with waterbodies in several drainage basins evaluated each year. Each of the 17 drainage basins in the state is assessed within every 5 years. In general, waterbodies that violate pertinent water-quality standards (such as those listed in Table 3) at a frequency of greater than 25% are identified as *impaired*, at a frequency of 10-25% are identified as *stressed*, and at a frequency of 0-10% are identified as *threatened*, although some evidence of use impairment (including through CSLAP lake-perception surveys) might also be required. Mean (average) phosphorus levels are evaluated against the state guidance value. Evidence of use prohibitions (via beach closures, etc.) is often required to identify a waterbody as *precluded*, while evidence of actual use restrictions or necessary management must accompany an *impaired* listing, at least for lakes evaluated in recent years.

Lakes that have been identified as *precluded* or *impaired* on the PWL are likely candidates for the federal 303(d) list, an "Impaired Waters" designation mandated by the federal Clean Water Act. Lakes on this list must be closely evaluated for the causes and sources of these problems. Remedial measures must be undertaken, under a defined schedule, to solve these water-quality problems. This entire evaluation and remediation process is known as the "TMDL" process, which refers to the Total Maximum Daily Load calculations necessary to determine how much (pollution that causes the water-quality problems) is too much.

Oquaga Lake is not presently among the lakes listed in the Delaware River drainage basin PWL.

TABLE 3- Water-Quality Standards Associated With Class B and Higher Lakes

Parameter	Acceptable Level	To Protect…..
Secchi Disk Transparency	> 1.2 meters*	Swimming
Total Phosphorus	< 0.020 mg/L and Narrative*	Swimming
Chlorophyll a	none	NA
Nitrate Nitrogen	< 10 mg/L and Narrative*	Drinking Water
Ammonia Nitrogen	2 mg/L*	Drinking Water
True Color	Narrative*	Swimming
pH	< 8.5 and > 6.5*	Aquatic Life
Conductivity	None	NA

Narrative Standards and Notes:
Secchi Disk Transparency: The 1.2 meter (4 feet) guidance is applied for safety reasons (to see submerged swimmers or bottom debris) and strictly applies only to citing new swimming beaches, but may be appropriate for all waterbodies used for contact recreation (swimming).
Phosphorus and Nitrogen: "None in amounts that will result in the growths of algae, weeds and slimes that will impair the waters for their best usages" (Class B= swimming)

-The 0.020 mg/l threshold for TP corresponds to a guidance value, not a standard; it strictly applies to Class B and higher waters but may be appropriate for other waterbodies used for contact recreation (swimming). NYS (and other states) is in the process of identifying numerical nutrient (phosphorus and perhaps Secchi disk transparency, chlorophyll *a*, and nitrogen) standards, but this is unlikely to be finalized within the next several years.

-The 10 mg/L Nitrate standard strictly applies to only Class A or higher waters, but is included here because some Class B lakes are informally used for potable-water intake.

-For the form of ammonia (NH_3+NH_4) analyzed, a 2 mg/l human health standard applies to Class A or higher waters. Lower un-ionized ammonia standards apply to all classes of NYS lakes, this form is not analyzed through CSLAP.

Color: "None in amounts that will adversely affect the color or impair the waters for their best usages" (for Class B waters, this is swimming).

pH: The standard applies to all classes of waterbodies

1. Water-quality Standards Evaluation on Oquaga Lake:

pH readings failed to reach the NYS water-quality standards (=6.5 to 8.5) during 4% of the CSLAP sampling sessions at Oquaga Lake. Phosphorus levels at Oquaga Lake have not exceeded the phosphorus guidance value for NYS lakes (=0.020 mg/l) during any of the CSLAP sampling sessions, and water transparency readings have exceeded the minimum recommended water clarity for swimming beaches (= 1.2 meters) during each of the CSLAP sampling sessions. It is not known whether any of the narrative water-quality standards listed in Table 3 have been violated at Oquaga Lake; none of the other numeric standards summarized in Table 3 have been violated.

2. Lake Uses:

Water-quality monitoring programs are devised to evaluate lake conditions as they relate to a variety of lake indicators, from water-quality standards to trophic conditions to invasive species to other measures of the physical, chemical, and biological integrity of these ecological systems. One of these indicators is intended to be lake uses--whether these lakes and ponds can be used for potable water, swimming and bathing, fishing and use of the water by aquatic life, and aesthetics. This is consistent with the broad goals of the 1972 federal Clean Water Act, the governing legislation for federal and state management of lakes and ponds, which states that a fundamental goal of environmental management was to make all waterbodies "fishable and swimmable" by 1983.

The "fishability" of a lake or pond is a function of water-quality (are there pollutants that will kill the fish or render them inedible?); substrate and habitat (is there enough cold water and high oxygen for coldwater fish?; is there enough food for the fish? is there enough cover from predators or structure for fishermen?); space (is there enough flowing water for survival or reproduction?; is there enough room to support all of the various fish species in the lake?), and even access (can anglers get to the areas where the fish can be found?).

Likewise, the "swimmability" of a lake or pond also depends on water-quality (will I get sick due to bacterial contamination from sewage, stormwater or waterfowl?); safety (can swimmers or bottom debris be seen in deeper water?); aesthetics (is the water too green, too weedy, or too cold?; is the bottom too mucky?); user conflicts (can I swim where people use PWCs?); the physical characteristics of the lake and shoreline (how quickly does the lake get too deep? is the shoreline flat enough for a beach?); legal considerations (will the threat of litigation prevent a lake community from establishing public beaches?), and also access (can swimmers from less hospitable parts of the lake or from the outside swim at a beach?).

Although other designated lake uses are not identified as primary goals of the Clean Water Act, they should be evaluated as part of the lake-assessment process. These include potable water, non-contact recreational uses such as boating, aquatic life support unrelated to fishing, and aesthetics. Similar questions could be posed about the suitability of a particular lake or pond for this use, although many of the concerns addressed in evaluating the fishability or swimmability of a waterbody are pertinent to evaluating drinking-water quality, the ability of a lake to support power boating or sailing, or the adequacy of the lake bottom for salamanders, frogs, and other valued biota.

CSLAP is not really designated to answer many of these questions, at least directly. Some of these issues relate to the physical characteristics of the entire shoreline and bottom of the lake or pond and cannot be easily evaluated in simple water-quality surveys. Other important water-quality indicators, such as bacteria, cannot be sampled at the frequency needed to compare lake conditions to existing water-quality standards or are limited by logistic considerations. Other indicators, such as sediment toxins, are too expensive to be included in standard water-quality monitoring programs. It is anticipated that future generations of CSLAP will look to better address some of these questions through expanded monitoring and partnerships with other monitoring agencies, academic institutions, lake residents, and other parties invested in the lake-assessment and management process. It is also anticipated that data from other sources will be more completely included in the lake- and pond-assessment process in the future. Until that time, however, it should again be stated that these assessments are both preliminary and incomplete, based on data presently collectable through the monitoring programs summarized in this report.

Oquaga Lake is a Class AA lake, which means it is designated for support of potable water (drinking), contact recreation (swimming and bathing), non-contact recreation (such as boating), aesthetics, and aquatic life (including fishing). As such, Oquaga Lake should be evaluated for its best intended uses—support of drinking water, swimming, aquatic life, non-contact recreation, and aesthetics.

a. Potable Water

Oquaga Lake is classified for potable water use, even though it not known by the report authors if the lake presently sustains this use.

CSLAP is not intended to evaluate the suitability of lakes or ponds for potable water use. Several of the water quality indicators measured through CSLAP provide little insight into potability, even when a water quality standard exists for that indicator. For example, while there is a potable water quality standard for nitrate, the 10 mg/l standard will not be exceeded in any lake or pond not dominated by wastewater influent. The highest lake nitrate readings measured through CSLAP- those from the Finger Lakes region or Long Island- do not exceed 3-4 mg/l. Likewise, ammonia readings in the surface waters of lakes rarely approach the 2 mg/l standard, although these numbers are within the range found in the bottom of some lakes with extreme deepwater anoxia (the absence of oxygen). This is not the case in Oquaga Lake, based on the limited deepwater ammonia readings. In addition, deepwater phosphorus readings are comparable to those measured at the lake surface, suggesting that deepwater anoxia does not occur. This also suggests that the lake is not susceptible to impacts from other oxygen-sensitive pollutants, such as arsenic, iron, and manganese, although these are not presently measured through CSLAP.

Nuisance algae can create some significant impacts to potable water use. Several algal species, especially blue green algae, are often associated with taste- and odor-producing compounds. Many of the same blue green algae produce toxins. The blue-green algae most frequently implicated in either taste and odor problems or the production of algal toxins include *Anabaena*, *Aphanizomena*, *Microcystis* (also known as Annie, Fannie, and Mike), and *Oscillatoria.* While *Anabaena* was found in the single 1992 algae sample, it is not likely that algae grow densely enough to produce these toxins, based on the chlorophyll *a* readings in the lake. While these toxins may also impact swimmers accidentally ingesting water, it is not likely that the presence of very low levels of *Anabaena* impacts the suitability of the lake water for contact recreation.

3. Overall Evaluation- Drinking Water

The CSLAP dataset at Oquaga Lake, including water chemistry data, physical measurements, and volunteer samplers' perception data, is too limited to evaluate use impairments associated with potable water. The limited data suggest that Oquaga Lake exhibits water quality characteristics of other lakes that fully support potable water use.

b. Swimming/Contact Recreation

It is presumed that Oquaga Lake is used for swimming, bathing, or other forms of contact recreation, although the frequency of and opportunities for swimming are not evaluated through CSLAP. As noted above, it is classified for bathing and swimming.

A number of water-quality indicators are measured in CSLAP that relate to the suitability of lake for swimming and contact recreation. Water clarity measurements can be used to evaluate the lake against the NYS Department of Health guidelines for siting new swimming beaches (= 4 feet). Public-perception data collected through CSLAP assess swimming conditions, and regional or statewide criteria connecting water transparency readings (or nutrient and algae levels) to recreational-use impacts will likely be developed in the near future. However, there remains a relatively strong correlation between contact recreational conditions and phosphorus readings, with recreational-use impacts generally corresponding to the state guidance value for phosphorus (= 20 parts per billion total phosphorus). Algae levels are measured as chlorophyll *a*, while rooted aquatic-plant populations are broadly quantified through CSLAP, and are linked to potential impacts on swimming and aesthetics. These water-quality-based and perception-based evaluations of swimming conditions are outlined below.

1. Water-quality Evaluation of Swimming/Contact Recreation

These data showed that none of the Oquaga Lake samples possessed total phosphorus readings exceeding 20 parts per billion (=µg/l), which corresponds to the state phosphorus guidance value. Water transparency readings were less than 2 meters during none of the CSLAP sampling sessions, due to the influence of dissolved color and the shallow maximum depth of the lake. This roughly corresponds to the distinction between *eutrophic* and *mesotrophic* lakes and a water clarity reading that would roughly be equivalent to the state phosphorus guidance value. Perhaps more importantly, this may correspond to the saddle point between high-quality and reduced-quality swimming, based on lake perception data (see below).

Although there is no state water-quality standard for chlorophyll *a*, readings exceeding 8 µg/l generally correspond to water clarity readings lower than 2 meters and total phosphorus readings in excess of 20 µg/l- each of these indicator thresholds marks the distinction between *mesotrophic* and *eutrophic* lake. 5% of the Oquaga Lake samples corresponded to chlorophyll *a* readings > 8 µg/l, although none since 1991.

Bacteria data have not been collected through CSLAP on Oquaga Lake or (if collected by the lake association or local community) have not been forwarded to the NYSDEC for evaluation.

2. Lake Perception Evaluation

Lake perception data from CSLAP provide insights into recreational (swimming) conditions, perceptions of water clarity, and the density and coverage of aquatic plants. Recreational assessments indicating “beautiful, could not be nicer” and “..excellent for swimming, boating, and overall enjoyment” conditions suggest no limits to recreational use. The frequency of “slightly” to “substantially” impaired conditions may be closely related to the need to implement lake-management actions. These surveys also assess the extent to which these impacts are influenced by excessive weed growth, nuisance algae or poor water clarity.

The evaluation of these survey results, and the extrapolation of these results to a lake-wide assessment, is restricted by the small sample size and the potential for responses that are not representative of the responses from the typical lake resident, whether due to the impact of local conditions or different goals for different lake users. However, these assessments may serve as an instructive starting point for evaluating impacts on lake uses.

The CSLAP volunteers described Oquaga Lake as “slightly” impaired during 3% of the CSLAP sampling sessions, but never “substantially” impaired. Slightly impaired conditions were never associated with excessive algae or poor water clarity, but were associated with excessive weeds during 3% of the CSLAP sampling sessions.

3. Overall Evaluation- Swimming and Contact Recreation

The CSLAP dataset at Oquaga Lake, including water chemistry data, physical measurements, and volunteer samplers’ perception data, suggests that swimming and contact recreation should be fully supported.

c. Aquatic Life/Non-Contact Recreation

Oquaga Lake supports fishing and other forms of non-contact recreation. Other forms of non-contact recreation, such as boating, may be a function of access points, whether the lake shoreline is inhabited, and water depth, but it is also presumed that Oquaga Lake may be used for boating.

While water-quality plays a role in evaluating non-contact recreation, particularly cold-water fisheries, the information needed to properly evaluate fishing quality, angler success, and boating enjoyment and viability are not collected in most routine monitoring programs. It is anticipated that future generations of the CSLAP report will include more comprehensive evaluations of non-contact recreational conditions in lakes and ponds, as databases containing this information become more readily available, but until that time, only ancillary measures can be evaluated.

The primary indicators from these monitoring programs used to evaluate fisheries, aquatic life, and non-contact recreation (boating, etc.) include lake perception surveys, aquatic plant densities (and the presence of invasive exotic plants), and water-quality indicators related to fish habitat and survival, such as pH and ammonia. While other water-quality indicators, such as other forms of nitrogen, can also be used to evaluate water-quality impacts to aquatic life, these indicators are generally found at low enough levels to minimize their utility in evaluating lake conditions. Dissolved oxygen can be very useful in evaluating habitat, but temperature and oxygen profiles are not collected through CSLAP. These datasets can provide at least some insights into the ability of lakes and ponds to support these uses.

1. Fisheries and Aquatic Life Evaluation

pH data are collected through CSLAP. Fish consumption advisories are issued by the NYS Department of Health, and fishing regulations are instituted by the NYSDEC. Lake recreational perception data related to non-contact recreation (fishing and boating) and aesthetics are also collected through CSLAP, and these can be used to evaluate fisheries and aquatic life impacts to Oquaga Lake.

These data indicate that pH readings in Oquaga Lake samples failed to reach the state water-quality standards (= 6.5 to 8.5) during 4% of the CSLAP sampling sessions. While laboratory pH is not as accurate as field pH for evaluating lake acidity, these data suggest that fisheries or aquatic life impacts do not occur as a result of depressed or elevated pH.

It is not known if fishing regulations result in any impact to the use of Oquaga Lake for fishing. The lake likely possesses coolwater or coldwater fish species susceptible to low oxygen levels in coldwater habitats (deepwater conditions during the summer, and throughout the water column during other times of the year), but it is unlikely that significant oxygen deficits occur in the lake, based on the deepwater phosphorus and ammonia data.

2. Boating (Recreation) and Aesthetics Evaluation

Impacts to non-contact recreation, such as boating and aesthetics, can only be peripherally evaluated through CSLAP. Sampling volunteers can report that the lake "looks bad," as a direct measure of impacts to lake aesthetics, while "poor water clarity," "excessive algae growth," and "excessive weed growth" may be indirect measures of these impacts.

The CSLAP volunteers never reported that Oquaga Lake "looks bad" during any of the CSLAP sampling sessions. Surface weed growth was reported during 3% of the CSLAP sampling sessions, but dense weed growth was never reported.

3. Overall Evaluation- Aquatic Life and Non-Contact Recreation

The CSLAP dataset on Oquaga Lake, including water chemistry data, physical measurements, and volunteer samplers' perception data, suggest that aquatic life and non-contact recreation should be fully supported.

IX: CONSIDERATIONS FOR LAKE MANAGEMENT

CSLAP is intended for a variety of uses, such as collecting needed information for comprehensive lake management, although it is not capable of collecting all the needed information. To this end, this section includes a broad summary of the major lake problems and "considerations" for lake management. These include only those lake problems that may have been defined by CSLAP sampling, such as physical condition (algae and water clarity), aquatic plant coverage (type and extent of weed populations), and recreational suitability of the lake, as related to contact recreation. These broad categories may not encompass the most pressing issue at a particular time at any given CSLAP lake, for example, local concerns about filamentous algae or concerns about other parameters not analyzed in the CSLAP sampling. While there is some opportunity for CLSAP-trained volunteers to report and assess some site-specific conditions or concerns on the CSLAP Field Observations Form, such as algae blooms or shoreline vegetation, this section is limited to the confines of this program. The categories represent the most common, broadest issues within the lake management as reported through CSLAP.

Each summarized management strategy is more extensively outlined in *Diet for a Small Lake*, and this joint NYSDEC-NYSFLA publication should be consulted for more details and for a broader context of in-lake- or watershed- management techniques. These "considerations" should not be construed as "recommendations," because there is insufficient information available through CSLAP to assess whether or how a lake should be managed. Issues associated with local environmental sensitivity, permits, and broad community-management objectives also cannot be addressed here. Rather, the following section should be considered as "tips" or a compilation of suggestions for a lake association to manage problems defined by CSLAP water-quality data or articulated by perception data. When appropriate, lake-specific management information, and other lake-specific or local "data" (such as the presence of a controllable outlet structure) is reported in ***bold*** in this "considerations" section.

The primary focus of CSLAP monitoring is to evaluate lake condition and impacts associated with lake eutrophication. Because lake eutrophication is often manifested in excessive plant growth, whether algae or aquatic macrophytes (weeds), it is likely that lake-management activities, whether promulgated to reduce algae or weed growth or to maintain water clarity and the existing makeup and density of aquatic plants in the lake, will need to address watershed inputs of nutrients and sediment to the lake, because both can contribute to either algal blooms or excessive weed growth. A core group of nutrient and sediment control activities will likely serve as the foundation for most comprehensive lake-management plans and activities and can be summarized below.

a. GENERAL CONSIDERATIONS FOR ALL CSLAP LAKES

Nutrient controls can take several forms, depending on the original source of the nutrients:

- Septic systems can be regularly pumped or upgraded to reduce the stress on the leach fields which can be replaced with new soil or moving the discharge from the septic tank to a new field). Pumpout programs are usually quite inexpensive, particularly when lakefront residents negotiate a bulk rate discount with local pumping companies. Upgrading systems can be expensive, but may be necessary to handle the increased loading from camp expansion or conversion to year-round residency. Replacing leach fields alone can be expensive and limited by local soil or slope conditions, but may be the only way to reduce actual nutrient loading from septic systems to the lake. It should be noted that upgrading or replacing the leach field may do little to change any bacterial loading to the lake, since bacteria are controlled primarily within the septic tank, not the leach field.
- Stormwater runoff control plans include street cleaning, artificial marshes, sedimentation basins, runoff conveyance systems, and other strategies aimed at minimizing or intercepting pollutant discharge from impervious surfaces. The NYSDEC has developed a guide called <u>Reducing the Impacts of Stormwater Runoff</u> to provide more detailed information about developing a stormwater management plan. This is a strategy that cannot generally be tackled by an individual homeowner, but rather requires the effort and cooperation of lake residents and municipal officials.
- There are numerous agriculture management practices such as fertilizer controls, soil erosion practices, and control of animal wastes, which either reduce nutrient export or retain particles lost from agricultural fields. These practices are frequently employed in cooperation with county Soil and Water Conservation District offices, and are described in greater detail in the NYSDEC's <u>Controlling Agricultural Nonpoint Source Water Pollution in New York State.</u> Like stormwater controls, these require the cooperation of many watershed partners, including farmers.
- Streambank erosion can be caused by increased flow due to poorly managed urban areas, agricultural fields, construction sites, and deforested areas, or it may simply come from repetitive flow over disturbed streambanks. Control strategies may involve streambank stabilization, detention basins, revegetation, and water diversion.

Land use restrictions development and zoning tools such as floodplain management, master planning to allow for development clusters in more tolerant areas in the watershed and protection of more sensitive areas, deed or contracts which limit access to the lake, and cutting restrictions can be used to reduce pollutant loading to lakes. This approach varies greatly from one community to the next and frequently involves balancing lake-use protection with land-use restrictions. State law gives great latitude to local government in developing land-use plans.

Lawn fertilizers frequently contain phosphorus, even though nitrogen is more likely to be the limiting nutrient for grasses and other terrestrial plants. By using lawn fertilizers with little or no phosphorus, eliminating lawn fertilizers or using lake water as a “fertilizer” on shoreline properties, fewer nutrients may enter the lake. Retaining the original flora as much as possible, or planting a buffer strip (trees, bushes, shrubs) along the shoreline, can reduce the nutrient load leaving a residential lawn.

Waterfowl introduce nutrients, plant fragments, and bacteria to the lake water through their feces. Feeding the waterfowl encourages congregation which in turn concentrates and increases this nutrient source and will increase the likelihood that plant fragments, particularly from Eurasian watermilfoil and other plants that easily fragment and reproduce through small fragments, can be introduced to a previously uncolonized lake..

Although not really a “watershed control strategy”, establishing **no-wake zones** can reduce shoreline erosion and local turbidity. Wave action, which can disturb flocculent bottom sediments and unconsolidated shoreline terrain is ultimately reduced, minimizing the spread of fertile soils to susceptible portions of the lake.

Do not discard or introduce plants from one water source to another or deliberately introduce a "new" species from a catalogue or vendor. For example, do not empty bilge or bait bucket water from another lake upon arrival at another lake, for this may contain traces of exotic plants or animals. Do not empty aquaria wastewater or plants in the lake.

Boat propellers are a major mode of transport to uncolonized lakes. Propellers, hitches, and trailers frequently get entangled by weeds and weed fragments. Boats not cleaned of fragments after leaving a colonized lake may introduce plant fragments to another location. New introductions of plants are often found near public access sites.

b. SPECIFIC CONSIDERATIONS FOR OQUAGA LAKE

Management Focus: **Water Clarity/Algae/Physical Condition/Recreational Condition**

Issue	Through	By?
Maintain water clarity	Maintaining or reducing algae levels	Maintaining or reducing nutrient Inputs to the lake

Discussion:

User perception and water quality data indicate that water clarity readings are sufficient to support most uses of the lake**.** This places the focus of water clarity management on maintaining present conditions. Although some increase in nutrient loading is inevitable, the lake association should devote efforts to minimize the input of nutrients to the lake, or change activities that otherwise influence water clarity.

Management Focus: **The Impact of Weeds on Recreational Condition**

Issue	Effect on Lake Use
Low weed growth	**No use impairments associated with weed growth**

Discussion:
Weed growth in this lake is not dense enough to have an impact on recreational or aesthetic quality of the lake For many lake associations, this is the ideal situation, although an ideal condition for swimmers, boaters and lakefront residents may not be ideal for a significant sports fishery. For lakes in this condition, lake management is largely a task of maintaining course, of keeping nuisance plants out of the lake.

-*If you have a small amount of nuisance plant growth you may want to consider the following (consult the DEC Region 7 office to determine if permits are required for either of these activities within your lake):*

-*Hand harvesting* is a very labor-intensive means for controlling weed populations. If only a very small number of nuisance plant stems exist, this may be the best means of control, removing the roots and stems of the entire plant, and disposing properly before they propagate into larger, uncontrollable beds that become the obnoxious neighbors of beneficial native plants**.**

-*Benthic barriers* are small opaque mats (usually constructed from plastic, burlap, or other materials) anchored down on top of plants to prevent sunlight from reaching the plants, thus eventually killing the plants. These are limited to only small areas, and the mats must be anchored and perforated to prevent gas bubbles from dislodging the mats.

c. SPECIFIC MONITORING CONSIDERATIONS FOR OQUAGA LAKE

Discussion:
Oquaga Lake has sampled through CSLAP since 1987. More extensive data will help to continue evaluating "normal" conditions on the lake, and to identify water quality or use problems at the lake. However, some additional parameters may be appropriate for evaluation at the lake:

1. *Bacteria*- Oquaga Lake is classified for use for contact recreation (swimming), and it is likely that at least some swimming occurs. The use of the lake for swimming and bathing can best be evaluated with bacteriological data. A comparison of sampling results to the state water quality standards requires at least five samples per month. These data cannot be collected through CSLAP.
2. *Algal toxins*- Algal toxins, usually associated with blue-green algae, may affect swimmers and others who ingest small amounts of water (as well as any lake residents who utilize Oquaga Lake as a potable water supply). These may be analyzed in standard water samples as part of CSLAP in coming years.
3. *Aquatic plants*- Aquatic plant surveys have not been conducted through CSLAP at Oquaga Lake. CSLAP samplers can collect and submit for identification any plant samples thought to be exotic or otherwise invasive, as well as any rare or unusual plants. Sampling protocols are also available to conduct systematic monitoring of

aquatic plants for the purpose of evaluating aquatic plant management actions utilized at the lake.

4. *Temperature and oxygen profiles*- the suitability of the lake for supporting sensitive fish, the susceptibility of the lake to nutrient release from bottom sediments and fall algal blooms, and the environment for aquatic plant growth can be evaluated through temperature and oxygen profiles. These can be created through the use of electronic meters or through chemical titrations conducted on site, but, at present, neither of these are collected through CSLAP at Oquaga Lake.

Appendix A. Raw Data for Oquaga Lake

LNum	PName	Date	Zbot	Zsd	Zsamp	Tot.P	NO3	TKN	TN	TN/TP	TColor	pH	Cond25	Ca	Chl.a
30	Oquaga L	6/13/1987	30.0	3.63	1.5	0.005	0.02				8	7.15	55		
30	Oquaga L	6/21/1987	30.0	5.75	1.5	0.007	0.02				9	7.16	54		1.20
30	Oquaga L	7/5/1987	30.0	5.25	1.5	0.009	0.01				5	7.08	54		2.70
30	Oquaga L	7/11/1987	30.0	5.75	1.5	0.006	0.01				2	7.04	54		
30	Oquaga L	7/19/1987	27.0	5.50	1.5	0.003	0.01				6	7.07	54		2.70
30	Oquaga L	7/26/1987	30.0	3.88	1.5	0.006	0.01				5	6.95	54		6.40
30	Oquaga L	8/3/1987	30.0	2.75	1.5	0.009	0.01				5	6.88	55		19.20
30	Oquaga L	8/10/1987	30.0	3.38	1.5	0.008	0.01				5	6.85	55		14.40
30	Oquaga L	8/17/1987	30.0	5.25	1.5	0.005	0.01				6	7.13	56		1.70
30	Oquaga L	8/23/1987	30.0	5.25	1.5	0.005	0.01				4	7.07	53		3.90
30	Oquaga L	8/30/1987	30.0	4.50	1.5	0.005	0.01				6	7.49	53		
30	Oquaga L	9/7/1987	30.0	5.25	1.5	0.012	0.18				3	7.16	56		9.90
30	Oquaga L	9/16/1987	30.0	6.00	1.5	0.005	0.02				2	7.39	63		5.00
30	Oquaga L	10/10/1987	30.0	4.25	1.5	0.007	0.01				6	7.11	54		10.60
30	Oquaga L	10/23/1987	30.0	4.63	1.5										
30	Oquaga L	7/1/1988	30.0	5.75	1.5	0.007	0.01				5	6.33	61		3.25
30	Oquaga L	7/13/1988	30.0	6.50	1.5	0.009					4	8.06	66		4.66
30	Oquaga L	7/21/1988	30.0	5.00	1.5	0.011	0.01				5	7.39	57		2.74
30	Oquaga L	7/28/1988	30.0	6.25	1.5	0.006					5	7.55	57		1.06
30	Oquaga L	8/4/1988	30.0	6.00	1.5	0.005	0.01				3	7.98	60		1.37
30	Oquaga L	8/11/1988	30.0	5.50	1.5	0.006					8				1.63
30	Oquaga L	8/18/1988	30.0	5.50	1.5	0.006	0.01				7	7.14	56		2.07
30	Oquaga L	8/25/1988	30.0	4.75	1.5	0.006					7				2.15
30	Oquaga L	9/2/1988	30.0	5.50	1.5	0.008	0.01				3	7.78	57		2.00
30	Oquaga L	9/15/1988	30.0	5.75	1.5	0.005	0.01				3	7.62	60		3.18
30	Oquaga L	7/10/1989	30.0	4.88	1.5	0.005	0.01				3	7.85	57		2.33
30	Oquaga L	8/2/1989	30.0	4.25	1.5	0.007					2	7.40	58		1.20
30	Oquaga L	8/9/1989	30.0	4.25	1.5	0.009					2	7.89	55		
30	Oquaga L	8/19/1989	30.0	5.25	1.5	0.010	0.01				4	7.83	56		0.43
30	Oquaga L	8/26/1989	30.0	5.13	1.5	0.013					2	7.44			2.22
30	Oquaga L	9/4/1989	30.0	4.75	1.5	0.008					2	7.36	56		4.11
30	Oquaga L	9/13/1989	30.0	5.63	1.5	0.007	0.01				2	7.54	58		3.05
30	Oquaga L	7/14/1990	30.0	4.25	1.5	0.011	0.01				5	7.23	64		3.01
30	Oquaga L	7/20/1990	30.0	5.25	1.5	0.007					3	7.54	57		0.63
30	Oquaga L	8/3/1990	30.0	5.25	1.5	0.008	0.01				1	7.89	56		2.08
30	Oquaga L	8/20/1990	30.0	5.75	1.5	0.006					3	7.29	79		2.43
30	Oquaga L	9/1/1990	30.0	6.25	1.5	0.004	0.01				2	6.60	57		1.34
30	Oquaga L	9/11/1990	30.0	6.50	1.5	0.012					1	6.75	57		2.21
30	Oquaga L	9/27/1990	30.0	6.25	1.5	0.008	0.01				3	7.74	57		2.75
30	Oquaga L	7/1/1991	30.0	6.50	1.5	0.008	0.01				2	7.61	59		1.26
30	Oquaga L	7/15/1991	30.0	6.25	1.5	0.007					3	7.52	59		2.41
30	Oquaga L	7/28/1991	30.0	5.75	1.5	0.007	0.01				2	7.63	57		2.90
30	Oquaga L	8/13/1991	30.0	4.50	1.5	0.010					2	7.29	58		6.88
30	Oquaga L	8/26/1991	30.0	2.75	1.5	0.011	0.01				4	6.95	58		13.40
30	Oquaga L	9/9/1991	30.0	1.75	1.5	0.012					45	7.60	59		23.80
30	Oquaga L	6/25/1992	30.0	5.75	1.5	0.008					2	7.69	60		1.98
30	Oquaga L	7/24/1992	30.0	4.45	1.5	0.011					4	7.75	59		4.48
30	Oquaga L	10/4/1992	30.0	3.50	1.5	0.014	0.01				5	7.68	60		6.97
30	Oquaga L	06/23/02	16.0	5.45	1.5	0.007	0.00	0.02	0.40	58.90	8	7.52	72		1.17
30	Oquaga L	07/07/02	30.0	6.45	1.5	0.003	0.00	0.05	0.26	75.25	9				0.95

LNum	PName	Date	Zbot	Zsd	Zsamp	Tot.P	NO3	TKN	TN	TN/TP	TColor	pH	Cond25	Ca	Chl.a
30	Oquaga L	07/21/02	30.0	8.15	1.5	0.007	0.01	0.05	0.29	42.60	6	7.47	73		0.56
30	Oquaga L	08/05/02	30.0	9.85	1.5	0.005	0.00	0.06	0.40	76.56	3	7.37	73		0.64
30	Oquaga L	08/18/02	30.0	10.20	1.5	0.005	0.01	0.03	0.40	74.42	3	6.90	74		0.97
30	Oquaga L	09/02/02	30.0	12.30	1.5	0.003	0.00	0.01	0.37	108.34	2	7.21	74		1.25
30	Oquaga L	09/25/02	26.0	9.58		0.006	0.00	0.02	0.53	94.04					
30	Oquaga L	10/06/02		6.85			0.01	0.03	0.26		7	7.46	73		0.48
30	Oquaga L	10/20/02	30.0	7.55		0.006	0.01	0.05	0.37	58.59	5	7.26	72		0.41
30	Oquaga L	6/30/2003	30.0	5.50	1.0	0.007	0.01	0.01	0.19	27.89	7	7.16	73	6.1	
30	Oquaga L	7/13/2003	30.0	5.05		0.006	0.00	0.00	0.16	27.50	10	7.20	72		1.72
30	Oquaga L	7/27/2003	30.0	5.90		0.011	0.00	0.00	0.03	2.34		7.08	70		1.19
30	Oquaga L	8/12/2003	30.0	9.70	1.5	0.004	0.01	0.00	0.18	45.65	11	6.41	78		1.58
30	Oquaga L	8/25/2003	30.0	9.50		0.003	0.03	0.01	0.23	68.88		7.14	72	6.2	0.23
30	Oquaga L	9/2/2003	30.0	6.90		0.005	0.00	0.00	0.18	37.97	8	7.15	72		0.13
30	Oquaga L	9/28/2003	30.0	9.45		0.006	0.00	0.01	0.23	38.77	7	6.68	69		0.50
30	Oquaga L	10/13/2003	30.0	9.35		0.007	0.00	0.00	0.22	32.95	6	7.18	74		1.12
30	Oquaga L	6/13/2004	30+	6.10	1.0	0.004	0.01	0.02			16	6.54	74		3.22
30	Oquaga L	6/29/2004	30+	10.20	1.0	0.003	0.01	0.01	0.27	97.48	9	5.78	80		0.10
30	Oquaga L	7/2/2004	30+	8.90	1.0										
30	Oquaga L	7/11/2004	30+	8.40	1.0	0.002	0.01	0.01	0.32		7	6.75	81		1.40
30	Oquaga L	7/25/2004				0.006	0.01	0.01	0.34	210.38	2	6.55	75		0.05
30	Oquaga L	8/10/2004	30+	9.40	1.0	0.007	0.02	0.02	0.36	64.47	2	6.80	76	5.0	1.80
30	Oquaga L	8/22/2004	30+	11.30	1.0	0.004	0.02	0.01	0.32	49.13	27	7.49	84		1.00
30	Oquaga L	9/6/2004		9.10		0.004	0.02	0.02	0.39	101.71	1	7.95	57		0.30
30	Oquaga L	9/26/2004	30+	7.40	1.5	0.003	0.02	0.01	0.48	114.35	2	7.08	50		0.70
30	Oquaga L	6/19/2005	30+	6.60	1.5	0.007	0.01	0.01	0.14	21.16	1	6.80	49	5.7	1.4
30	Oquaga L	7/9/2005	30+	5.50	1.5	0.004	0.07	0.01	0.10	24.94	1	7.40	68		0.7
30	Oquaga L	7/24/2005	30+	6.80	1.5	0.004	0.01	0.01	0.01	1.15	6	7.54	60		0.1
30	Oquaga L	8/9/2005	30+	6.10	1.5	0.005	0.01	0.01	0.11	22.06	1	7.42	70		0.8
30	Oquaga L	9/5/2005				0.006	0.01	0.01	0.19	29.87	9	7.86	56	7.0	0.3
30	Oquaga L	9/17/2005	30+	6.35		0.007	0.09	0.01	0.12	16.79	7	7.59	78		0.2
30	Oquaga L	10/9/2005	30+	6.75		0.005	0.01	0.01	0.10	20.52	4	7.82	35		0.2
30	Oquaga L	10/22/05	30+	4.73		0.009	0.01	0.01	0.06	7.41	6	7.37	22		1.2
30	Oquaga L	6/25/2006				0.004	0.03	0.02	0.42	211.35	27	8.07	127	5.8	0.67
30	Oquaga L	7/9/2006	30+	5.60	1.5	0.006	0.01	0.01	0.26	100.93	19	7.1	54		0.24
30	Oquaga L	7/23/2006	30+	5.70	1.5	0.007	0.03	0.02	0.47	158.60	18	7.52	66		1.62
30	Oquaga L	8/6/2006	30+	7.30	1.5	0.006	0.02	0.02	0.43	154.96		7.38	76		0.53
30	Oquaga L	8/20/2006	30+	9.25		0.004	0.02	0.03	0.64	354.55	5	8.28	55	5.8	0.69
30	Oquaga L	9/4/2006	30+	8.95		0.006			0.40	138.55	6	7.56	62		0.90
30	Oquaga L	9/17/2006	30+	10.80		0.005	0.02	0.05	0.47	231.13	10	6.68	66		0.44
30	Oquaga L	10/8/2006	30+	11.65	1.5	0.006	0.03	0.02	0.41	141.31	12	7.33	72		0.66
30	Oquaga L	06/23/02	16.0			0.008	0.01	0.02	0.39	46.14					
30	Oquaga L	07/07/02	30.0			0.006	0.00	0.04	0.29	48.10					
30	Oquaga L	07/21/02	30.0			0.017	0.01	0.08	0.48	28.53					
30	Oquaga L	08/05/02	30.0			0.008	0.00	0.04	0.39	48.65					2.58
30	Oquaga L	08/18/02	30.0			0.007	0.02	0.04	0.46	65.00					
30	Oquaga L	09/02/02	30.0	8.15			0.00	0.01	0.37						
30	Oquaga L	09/25/02	26.0	9.58	24.0	0.008	0.00	0.04	0.37	46.20					
30	Oquaga L	10/06/02		6.85	20.0		0.01	0.05	0.34						
30	Oquaga L	10/20/02	30.0	7.55	15.0		0.01	0.05	0.33						
30	Oquaga L	6/30/2003				0.006	0.01	0.02	0.16	24.91					
30	Oquaga L	7/13/2003				0.005	0.00	0.00	0.14	28.54					
30	Oquaga L	7/27/2003			13.0	0.016	0.00	0.00	0.03	1.53					

LNum	PName	Date	Zbot	Zsd	Zsamp	Tot.P	NO3	TKN	TN	TN/TP	TColor	pH	Cond25	Ca	Chl.a
30	Oquaga L	8/12/2003				0.010	0.00	0.00	0.19	19.31					
30	Oquaga L	8/25/2003			12.5	0.006	0.01	0.00	0.09	14.86					
30	Oquaga L	9/2/2003				0.005	0.01	0.04	0.16	30.09					
30	Oquaga L	9/28/2003				0.006	0.00	0.01	0.19	33.44					
30	Oquaga L	10/13/2003				0.006	0.00	0.00	0.11	16.95					
30	Oquaga L	6/13/2004				0.013	0.01	0.02							
30	Oquaga L	6/29/2004				0.007	0.01	0.01	0.27	41.04					
30	Oquaga L	7/2/2004													
30	Oquaga L	7/11/2004				0.003	0.01	0.01	0.25	97.70					
30	Oquaga L	7/25/2004				0.012	0.01	0.03	0.17	14.87					
30	Oquaga L	8/10/2004				0.005	0.01	0.02	0.13	26.07					
30	Oquaga L	8/22/2004				0.008	0.02	0.02	0.01	0.61					
30	Oquaga L	9/6/2004				0.007	0.02	0.03							
30	Oquaga L	6/19/2005				0.009									
30	Oquaga L	7/9/2005				0.007									
30	Oquaga L	7/24/2005				0.005									
30	Oquaga L	8/9/2005				0.005									
30	Oquaga L	9/5/2005				0.012									
30	Oquaga L	9/17/2005			13.0	0.011									
30	Oquaga L	10/9/2005			10.0	0.009									
30	Oquaga L	10/22/05				0.008									
30	Oquaga L	6/25/2006				0.007									
30	Oquaga L	7/9/2006	30+			0.009									
30	Oquaga L	7/23/2006	30+			0.010									
30	Oquaga L	8/6/2006	30+			0.014									
30	Oquaga L	8/20/2006	30+		15.0	0.008									
30	Oquaga L	9/4/2006	30+		20.0	0.006									
30	Oquaga L	9/17/2006	30+		12.0	0.006									
30	Oquaga L	10/8/2006	30+			0.008									

LNum	PName	Date	Zbot	Zsd	Zsamp	QaQc	TAir	TH20	QA	QB	QC	QD
30	Oquaga L	6/13/1987	30.0	3.63	1.5	1	23	19				
30	Oquaga L	6/21/1987	30.0	5.75	1.5	1	21	23				
30	Oquaga L	7/5/1987	30.0	5.25	1.5	1	24	23				
30	Oquaga L	7/11/1987	30.0	5.75	1.5	1	85	78				
30	Oquaga L	7/19/1987	27.0	5.50	1.5	1	29	25				
30	Oquaga L	7/26/1987	30.0	3.88	1.5	1	30	26				
30	Oquaga L	8/3/1987	30.0	2.75	1.5	1	25	24				
30	Oquaga L	8/10/1987	30.0	3.38	1.5	1	25	24				
30	Oquaga L	8/17/1987	30.0	5.25	1.5	1	29	26				
30	Oquaga L	8/23/1987	30.0	5.25	1.5	1	16	23				
30	Oquaga L	8/30/1987	30.0	4.50	1.5	1	26	19				
30	Oquaga L	9/7/1987	30.0	5.25	1.5	1	22	18				
30	Oquaga L	9/16/1987	30.0	6.00	1.5	1	22	19				
30	Oquaga L	10/10/1987	30.0	4.25	1.5	1	13	14				
30	Oquaga L	10/23/1987	30.0	4.63	1.5	1	17	12				
30	Oquaga L	7/1/1988	30.0	5.75	1.5	1	19	17				
30	Oquaga L	7/13/1988	30.0	6.50	1.5	1	28	24				
30	Oquaga L	7/21/1988	30.0	5.00	1.5	1	18	23				
30	Oquaga L	7/28/1988	30.0	6.25	1.5	1	26	24				
30	Oquaga L	8/4/1988	30.0	6.00	1.5	1	25	26				
30	Oquaga L	8/11/1988	30.0	5.50	1.5	1	27	25				
30	Oquaga L	8/18/1988	30.0	5.50	1.5	1	21	23				
30	Oquaga L	8/25/1988	30.0	4.75	1.5	1	20	21				

LNum	PName	Date	Zbot	Zsd	Zsamp	QaQc	TAir	TH20	QA	QB	QC	QD
30	Oquaga L	9/2/1988	30.0	5.50	1.5	1	23	21				
30	Oquaga L	9/15/1988	30.0	5.75	1.5	1	14	16				
30	Oquaga L	7/10/1989	30.0	4.88	1.5	1	20	22				
30	Oquaga L	8/2/1989	30.0	4.25	1.5	1	22	24				
30	Oquaga L	8/9/1989	30.0	4.25	1.5	1	20	20				
30	Oquaga L	8/19/1989	30.0	5.25	1.5	1	21	24				
30	Oquaga L	8/26/1989	30.0	5.13	1.5	1	21	21				
30	Oquaga L	9/4/1989	30.0	4.75	1.5	1	18	20				
30	Oquaga L	9/13/1989	30.0	5.63	1.5	1	21	21				
30	Oquaga L	7/14/1990	30.0	4.25	1.5	1						
30	Oquaga L	7/20/1990	30.0	5.25	1.5	1	30	25				
30	Oquaga L	8/3/1990	30.0	5.25	1.5	1	27	24				
30	Oquaga L	8/20/1990	30.0	5.75	1.5	1	15	21				
30	Oquaga L	9/1/1990	30.0	6.25	1.5	1	25	23				
30	Oquaga L	9/11/1990	30.0	6.50	1.5	1	20	21				
30	Oquaga L	9/27/1990	30.0	6.25	1.5	1	21	13				
30	Oquaga L	7/1/1991	30.0	6.50	1.5	1	18	26				
30	Oquaga L	7/15/1991	30.0	6.25	1.5	1	25	22				
30	Oquaga L	7/28/1991	30.0	5.75	1.5	1	23	24				
30	Oquaga L	8/13/1991	30.0	4.50	1.5	1	24	23				
30	Oquaga L	8/26/1991	30.0	2.75	1.5	1	18	23				
30	Oquaga L	9/9/1991	30.0	1.75	1.5	1	20	22				
30	Oquaga L	6/25/1992	30.0	5.75	1.5	1	23	19	1	1	1	
30	Oquaga L	7/24/1992	30.0	4.45	1.5	1	17	20	1	1	1	5
30	Oquaga L	10/4/1992	30.0	3.50	1.5	1	19	16				
30	Oquaga L	06/23/02	16.0	5.45	1.5	1	20	17	1	1	1	
30	Oquaga L	07/07/02	30.0	6.45	1.5	1	25	19	1	1	1	
30	Oquaga L	07/21/02	30.0	8.15	1.5	1	25	22	1	2	1	
30	Oquaga L	08/05/02	30.0	9.85	1.5	1	22	24	1	2	1	
30	Oquaga L	08/18/02	30.0	10.20	1.5	1	24		1	2	1	
30	Oquaga L	09/02/02	30.0	12.30	1.5	1	23	22	1	2	1	
30	Oquaga L	09/25/02	26.0	9.58		1	13					
30	Oquaga L	10/06/02		6.85		1	16		2	1	1	5
30	Oquaga L	10/20/02	30.0	7.55		1	10		1	1	2	5
30	Oquaga L	6/30/2003	30.0	5.50	1.0	1	21	22	1	1	1	
30	Oquaga L	7/13/2003	30.0	5.05		1	17	21	1	1	1	5
30	Oquaga L	7/27/2003	30.0	5.90		1	24		2	1	2	
30	Oquaga L	8/12/2003	30.0	9.70	1.5	1			1	1	1	
30	Oquaga L	8/25/2003	30.0	9.50		1	16	19	1	2	1	
30	Oquaga L	9/2/2003	30.0	6.90		1	16	17	1	1	3	5
30	Oquaga L	9/28/2003	30.0	9.45		1		16	1	1	2	5
30	Oquaga L	10/13/2003	30.0	9.35		1	16	12	1	1	1	
30	Oquaga L	6/13/2004	30+	6.10	1.0	1	21	19	2	2	1	5
30	Oquaga L	6/29/2004	30+	10.20	1.0	1	18	19	1	2	1	0
30	Oquaga L	7/2/2004	30+	8.90	1.0	1	19	20	1	2	1	0
30	Oquaga L	7/11/2004	30+	8.40	1.0	1	21	20	1	2	1	0
30	Oquaga L	7/25/2004				1						
30	Oquaga L	8/10/2004	30+	9.40	1.0	1	23	18	1	2	1	0
30	Oquaga L	8/22/2004	30+	11.30	1.0	1			1	2	1	0
30	Oquaga L	9/6/2004		9.10		1	18	17	1	3	1	5
30	Oquaga L	9/26/2004	30+	7.40	1.5	1	17	15	1	2	1	0
30	Oquaga L	6/19/2005	30+	6.60	1.5	1	16	15	1	2	2	5
30	Oquaga L	7/9/2005	30+	5.50	1.5	1	15	17	1	2	2	5
30	Oquaga L	7/24/2005	30+	6.80	1.5	1	20		1	2	1	0
30	Oquaga L	8/9/2005	30+	6.10	1.5	1	22	20	1	2	1	0
30	Oquaga L	9/5/2005				1						
30	Oquaga L	9/17/2005	30+	6.35		1	15	17	1	2	1	5
30	Oquaga L	10/9/2005	30+	6.75		1		11	1	1	1	5
30	Oquaga L	10/22/05	30+	4.73		1	7	8	2	1	1	158

LNum	PName	Date	Zbot	Zsd	Zsamp	QaQc	TAir	TH20	QA	QB	QC	QD
30	Oquaga L	6/25/2006				1						
30	Oquaga L	7/9/2006	30+	5.60	1.5	1	18		2	2	1	0
30	Oquaga L	7/23/2006	30+	5.70	1.5	1	17	19	2	2	1	5
30	Oquaga L	8/6/2006	30+	7.30	1.5	1	17	20	2	2	1	0
30	Oquaga L	8/20/2006	30+	9.25		1	18	17	2	2	2	8
30	Oquaga L	9/4/2006	30+	8.95		1	16	14	1	2	1	5
30	Oquaga L	9/17/2006	30+	10.80		1	18	15	1	2	1	0
30	Oquaga L	10/8/2006	30+	11.65	1.5	1	12	10	1	2	1	0
30	Oquaga L	06/23/02	16.0			2	20					
30	Oquaga L	07/07/02	30.0			2	25					
30	Oquaga L	07/21/02	30.0			2	25					
30	Oquaga L	08/05/02	30.0			2	22					
30	Oquaga L	08/18/02	30.0			2	24					
30	Oquaga L	09/02/02	30.0	8.15		2	23	10				
30	Oquaga L	09/25/02	26.0	9.58	24.0	2	13	14				
30	Oquaga L	10/06/02		6.85	20.0	2	16	9				
30	Oquaga L	10/20/02	30.0	7.55	15.0	2	10	55				
30	Oquaga L	6/30/2003				2						
30	Oquaga L	7/13/2003				2						
30	Oquaga L	7/27/2003			13.0	2						
30	Oquaga L	8/12/2003				2						
30	Oquaga L	8/25/2003			12.5	2						
30	Oquaga L	9/2/2003				2						
30	Oquaga L	9/28/2003				2						
30	Oquaga L	10/13/2003				2						
30	Oquaga L	6/13/2004				2						
30	Oquaga L	6/29/2004				2						
30	Oquaga L	7/2/2004				2						
30	Oquaga L	7/11/2004				2						
30	Oquaga L	7/25/2004				2						
30	Oquaga L	8/10/2004				2						
30	Oquaga L	8/22/2004				2						
30	Oquaga L	9/6/2004				2						
30	Oquaga L	9/26/2004				2						
30	Oquaga L	6/19/2005	30+			2						
30	Oquaga L	7/9/2005	30+			2						
30	Oquaga L	7/24/2005	30+			2						
30	Oquaga L	8/9/2005	30+			2						
30	Oquaga L	9/5/2005				2						
30	Oquaga L	9/17/2005	30+		13.0	2		6				
30	Oquaga L	10/9/2005	30+		10.0	2		4				
30	Oquaga L	10/22/05	30+			2		5				
30	Oquaga L	6/25/2006				2						
30	Oquaga L	7/9/2006	30+			2						
30	Oquaga L	7/23/2006	30+			2						
30	Oquaga L	8/6/2006	30+			2						
30	Oquaga L	8/20/2006	30+		15.0	2		4				
30	Oquaga L	9/4/2006	30+		20.0	2		4				
30	Oquaga L	9/17/2006	30+		12.0	2		6				
30	Oquaga L	10/8/2006	30+			2						

Appendix B. New York State Water-Quality Classifications

Class N: Enjoyment of water in its natural condition and where compatible, as a source of water for drinking or culinary purposes, bathing, fishing and fish propagation, recreation and any other usages except for the discharge of sewage, industrial wastes or other wastes or any sewage or waste effluent not having filtration resulting from at least 200 feet of lateral travel through unconsolidated earth. These waters should contain no deleterious substances, hydrocarbons or substances that would contribute to eutrophication, nor shall they receive surface runoff containing any such substance.

Class $AA_{special}$: Source of water supply for drinking, culinary or food-processing purposes; primary and secondary contact recreation, and fishing. These waters shall be suitable for fish propagation and survival and shall contain no floating solids, settleable solids, oils, sludge deposits, toxic wastes, deleterious substances, colored or other wastes or heated liquids attributable to sewage, industrial wastes or other wastes. There shall be no discharge or disposal of sewage, industrial wastes or other wastes into these waters. These waters shall contain no phosphorus and nitrogen in amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages.

Class $A_{special}$: Source of water supply for drinking, culinary or food-processing purposes; primary and secondary contact recreation; and fishing. These waters shall be suitable for fish propagation and survival. These international boundary waters, if subjected to approved treatment equal to coagulation, sedimentation, filtration and disinfection, with additional treatment if necessary to remove naturally present impurities, will meet New York State Department of Health drinking water standards and will be considered safe and satisfactory for drinking water purposes.

Class AA: Source of water supply for drinking, culinary or food processing purposes; primary and secondary contact recreation, and fishing. These waters shall be suitable for fish propagation and survival. These waters, if subjected to approved disinfection treatment, with additional treatment if necessary to remove naturally present impurities, will meet New York State Department of Health drinking-water standards and will be considered safe and satisfactory for drinking-water purposes.

Class A: Source of water supply for drinking, culinary or food-processing purposes; primary and secondary contact recreation, and fishing. These waters shall be suitable for fish propagation and survival. These waters, if subjected to approved treatment equal to coagulation, sedimentation, filtration and disinfection, with additional treatment if necessary to remove naturally present impurities, will meet New York State Department of Health drinking-water standards and will be considered safe and satisfactory for drinking-water purposes

Class B	Suitable for primary and secondary contact recreation and fishing. These waters shall be suitable for fish propagation and survival.
Class C:	Suitable for fishing and fish propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.
Class D:	Suitable for fishing. Due to such natural conditions as intermittency of flow, water conditions not conducive to propagation of game fishery, or stream bed conditions, the waters will not support fish propagation. These waters shall be suitable for fish survival. The water-quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.
Class (T):	Designated for trout survival, defined by the Environmental Conservation Law Article 11 (NYS, 1984b) as brook trout, brown trout, red throat trout, rainbow trout, and splake.

APPENDIX C:
SUMMARY OF STATISTICAL METHODS USED TO EVALUATE TRENDS

1. Non-Parametric Analyses

Kendall tau ranking orders paired observations by one of the variables (arranging water clarity readings by date). Starting with the left-hand (earliest date) pair, the number of times that the variable not ordered (clarity readings) is exceeded by the same variable in subsequent pairs is computed as P, and the number of times in which the unordered variable is not exceeded is computed as Q. This computation is completed for each ordered pair, with N= total number of pairs (samples), and the sum of the differences S = Σ(P-Q). The Kendall tau rank correlation coefficient **t** is computed as:

$$t = 2S/(N^*(N-1))$$

Values for t range from –1 (complete negative correlation) to +1 (complete positive correlation). As above, strong correlations (or simply "significance") may be associated with values for t greater than 0.5 (or less than –0.5), and moderate correlations may be associated with values for t between 0.3 and 0.5 (or between –0.3 and –0.5), but the "significance" of this correlation must be further computed. Standard charts for computing the probabilities for testing the significance of S are provided in most statistics text books, and for values of N greater than 10, a standard normal deviate D can be computed by calculating the quotient:

$$D= S\sqrt{18} / \sqrt{[(N(N-1)(2N+5)]}$$

and attributing the following significance:

$D > 3.29$ = 0.05% significance
$2.58 < D < 3.29$ = 0.5% significance
$1.96 < D < 2.58$ = 2.5% significance
$D < 1.96$ = > 2.5% significance

For the purpose of this exercise, 2.5% significance or less is necessary to assign validity (or, using the vernacular above, "significance") to the trend determined by the Kendall tau correlation. It should be noted again that this evaluation does not determine the magnitude of the trend but only whether a trend is likely to occur.

Parametric trends can be defined by standard best-fit linear regression lines, with the significance of these data customarily defined by the magnitude of the best-fit regression coefficient ® or R^2. This can be conducted using raw or individual data points, or seasonal summaries (using some indicator of central tendency, such as mean or median). Because the former can be adversely influenced by seasonal variability and/or imprecision in the length and breadth of the sampling season during any given year, seasonal summaries may provide more realistic measures for long-term trend analyses. However, because the summaries may not adequately reflect variability within any given sampling season, it may be appropriate to compare deviations from seasonal means or medians with the "modeled" change in the mean/median resulting from the regression analyses.

When similar parametric and non-parametric tools are utilized to evaluate long-term trends in NYS lakes, a few assumptions must be adopted:

- Using the non-parametric tools, trend “significance” (defined as no more than approx. 3% “likelihood” that a trend is calculated when none exists) can only be achieved with at least four years of averaged water-quality data. When looking at all summer data points (as opposed to data averaging), a minimum of 40 data points is required to achieve some confidence in data significance. This corresponds to at least five years of CSLAP data. The “lesson” in these assumptions is that data trends assigned to data sets collected over fewer than five years assume only marginal significance.

As noted above, summer data only are utilized (as in the previous analyses) to minimize seasonal effects and different sampling schedules around the fringes (primarily May and September) of the sampling season. This reduces the number of data points used to compile averages or whole data sets but is considered necessary to best evaluate the CSLAP datasets.

2. Parametric Analyses

Parametric analyses are conducted by comparing annual changes in summer mean values for each of the analyzed sampling parameters. Summer is defined as the period from June 15 thru September 15, and roughly corresponds to the window between the end of spring runoff (after ice out) and start of thermal stratification, and the onset of thermal destratification. This period also corresponds to the peak summer recreational season and (for most lakes) the most critical period for water-quality impacts. It also bounds the most frequent range of sampling dates for the majority of both the primarily seasonal volunteers and full-time residents of CSLAP lakes.

Trends in the parametric analyses are determined by the least squares method, in which “significance” requires both a high correlation coefficient ($R^2>0.5$) and intra-seasonal variance to be lower than the predicted change (trend) during the period of sampling (roughly corresponding to ?y). Changes in water-quality indicators are also evaluated by the two-sided t-test, in which the change (z statistic) in the mean summer value for each of the indicators by decade of sampling (1980s, 1990s, 2000s) is compared to the t statistic distribution within the 95% confidence interval, with the null hypothesis corresponding to no significant change.

APPENDIX D: BACKGROUND INFO FOR OQUAGA LAKE

CSLAP Number	30
Lake Name	Oquaga L
First CSLAP Year	1987
Sampled in 2005?	yes
Latitude	420111
Longitude	752714
Elevation (m)	479
Area (ha)	54.4
Volume Code	9
Volume Code Name	Delaware River
Pond Number	383
Qualifier	none
Water-quality Classification	AA
County	Broome
Town	Deposit
Watershed Area (ha)	630
Retention Time (years)	3.3
Mean Depth (m)	13.9
Runoff (m/yr)	0.363713324
Watershed Number	14
Watershed Name	Delaware River
NOAA Section	2
Closest NOAA Station	Deposit
Closest USGS Gaging Station-Number	1426500
Closest USGS Gaging Station-Name	West Branch Delaware River at Hale Eddy
CSLAP Lakes in Watershed	Anawanda L, Crystal L, Deer L, L Guymard, L Wanaksink, Oquaga L, Somerset L, Timber L, Weiden P, Wolf L