I. INTRODUCTION: CSLAP DATA AND YOUR LAKE

Lakes are dynamic and complex ecosystems. They contain a variety of aquatic plants and animals that interact with each other and the environment. As water quality changes, so too will the plants and animals that live there and these changes in the food web also may additionally 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** a lake's water quality. 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.

Understanding Trophic States

All lakes and ponds undergo **eutrophication,** an aging process, which involves stages of succession in biological productivity and water quality (see Figure 1). **Limnologists** (scientists who study fresh water 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 with 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. Eutrophication is a natural process, and is not necessarily indicative of man-made pollution.

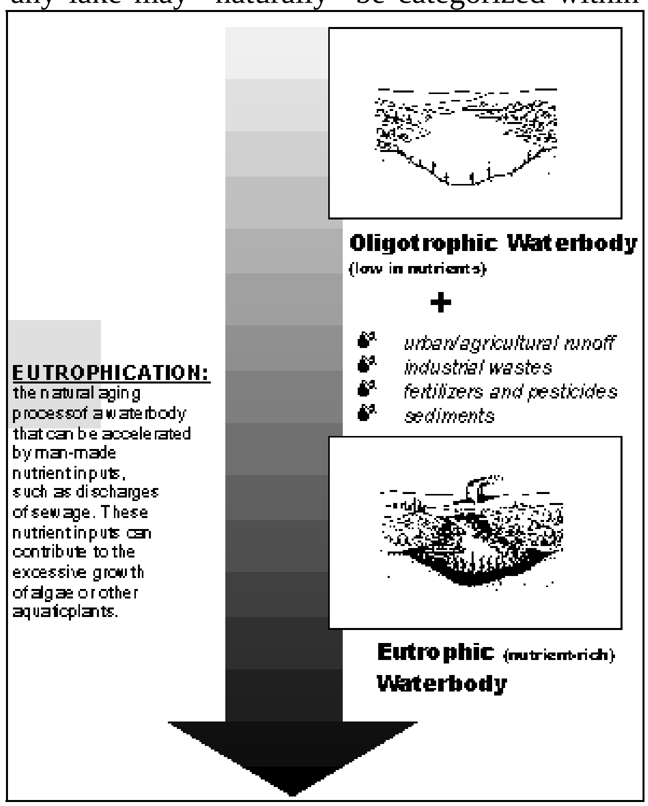

Figure 1. Trophic States

In fact, some lakes are thought to be "naturally" productive. It is important to understand that trophic classifications are not interchangeable with assessments of water quality. One person's opinion of degradation may be viewed by others as harmless or even beneficial. 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. Overall, 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 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, caused by shoreline erosion, agricultural and urban runoff, wastewater discharges or septic seepage, and other nonpoint source pollution sources are examples of activities that greatly accelerate the natural aging process of lakes, and significantly impair the water quality and value of a lake. These changes can cause succession changes in the plant and animal life within the lake, shoreline and surrounding watershed. 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 of time.

II. CSLAP PARAMETERS

CSLAP monitors several parameters related to the trophic state of a lake. Three parameters are the most important measures of eutrophication in most New York lakes: **total phosphorus, chlorophyll *a*** (measuring algal standing crop), 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. Additional CSLAP parameters are chosen to optimize the need to characterize lakes while balancing fiscal and logistic necessities. In addition, CSLAP also uses **Field Observation Forms** to gauge 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, volunteers collect and use data to assess both seasonal and yearly fluctuations in these parameters, and to evaluate the water quality in their lake. By comparing a specific year's data to historical water quality information, lake managers can pinpoint trends and determine if water quality is improving, degrading or are 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 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 indicate 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. Many lake management plans are centered around phosphorus controls.
Nitrogen (nitrate, 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. For much of the sampling season, many CSLAP lakes have very low or undetectable (<0.02 mg/l) levels.
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

Ranges for Parameters Assessing Trophic Status

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

Figure 3. Trophic Status Indicators

Parameter	Eutrophic	Mesotrophic	Oligotrophic	Moon Lake
Phosphorus (mg/l)	> 0.020	0.010 - 0.020	< 0.010	**0.027**
Chlorophyll a (µg/l)	> 8	2- 8	< 2	**21.1**
Secchi Disk Clarity (m)	2	2- 5	> 5	**1.7**

These classifications are valid for clear-water lakes only (waters with less than 30 platinum color units). Some humic or "tea color" lakes, for example, naturally have dissolved organic material with greater than 30 color units. This will cause the water transparency to be unexpectedly poor relative to low phosphorus and chlorophyll *a* levels. Water transparency can also be surprisingly lower than expected in shallow lakes, due to influences from the 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 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 the trophic standards described above, **Moon Lake** would be considered to be a **eutrophic** lake.

Aquatic Vegetation

Although the greatest portion of aquatic vegetation consists of the microscopic algae referred to as phytoplankton, and the other algal types listed below, "aquatic vegetation" usually refers to the larger rooted plants called **macrophytes.**

Figure 4. Types of Algae

Phytoplankton	Free-floating algae
Periphyton	Algae attached to surfaces
Charaphytes	Larger branched alga

Aquatic plants should be recognized for their contributions to lake beauty as well as 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. Macrophytes 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.

Of particular concern to many lakefront residents and recreational users are the exotic, or non-native macrophytes that can frequently dominate a native aquatic plant community and crowd out more beneficial species. The 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, interfering with recreational activities such as fishing, swimming or water-skiing. Some species can reduce water flow in lakes and canals. **Eurasian watermilfoil** *(Myriophyllum spicatum)* is the most common non-native species found in New York State. Other non-native species found in NYS lakes are **Curly-leaf pondweed** *(Potamogeton crispus),* **Eurasian water chestnut** *(Trapa natans),* and **Fanwort** *(Cabomba caroliniana).* These species need to be properly identified for lake associations to effectively manage their lake. 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 the macrophyte species 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 monitoring program. Volunteers collect plant specimen 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.

The following aquatic plant species have been identified in Moon Lake (summary information for non-native species found in Appendix D):

Non-Native Species	Year First ID	Perceived Abundance
Myriophyllum spicatum (Eurasian watermilfoil)	1992	scarce-moderate
Native Species		Perceived Abundance
Myriophyllum verticillatum (whorled watermilfoil)		scarce-moderate
Nymphaea ordata (white water lily)		scarce-moderate
Potamogeton nodosus (unnamed pondweed)		scarce-moderate
Potamogeton spp. (pondweed, unidentified species)		scarce-moderate
Scirpus spp. (water bulrush)		scarce-moderate
Vallisneria americanum (eelgrass, tapegrass, wild celery)		scarce-moderate

III. UNDERSTANDING YOUR LAKE DATA

CSLAP is intended to help lake associations understand their lake's conditions and foster sound lake protection and pollution prevention decisions supported by a strong database. This individual lake summary for 1996 contains two forms of information. These **raw data** and **graphs** present a snapshot or glimpse of water quality conditions at each lake. They are based on (at most) eight 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 participating in CSLAP for only one year will not have information about annual trends.

Raw Data

Two **"data sets"** are provided in **Table 1** and **Appendix A.** The data presented in **Table 1** show the entire CSLAP sampling history of your lake, including the minimum, maximum, average, and number of samples for each sampling year and parameter. This data may be useful for comparing a certain data point perhaps for the current sampling year with historical data information. This table also includes data from other sources for which sufficient quality assurance/quality control documentation is available for assessing the validity of the results. **Appendix A** contains the "raw" data collected during all sampling seasons and years in which the lake was sampled as part of CSLAP. You may find these data useful in an overall context of water quality.

TABLE 1 CSLAP Data Summary for Moon Lake

Year	Min	Avg	Max	N	Parameter
1992-96	**0.90**	**1.74**	**4.75**	**37**	**CSLAP Zsd**
1996	1.30	1.72	2.60	8	CSLAP Zsd
1995	1.00	1.29	2.00	7	CSLAP Zsd
1994	0.90	1.96	4.75	8	CSLAP Zsd
1993	0.98	1.59	3.15	6	CSLAP Zsd
1992	1.00	2.05	4.05	8	CSLAP Zsd
1979	1.00	1.00	1.00	1	DEC
Year	**Min**	**Avg**	**Max**	**N**	**Parameter**
1992-96	**0.013**	**0.027**	**0.041**	**38**	**CSLAP Tot.P**
1996	0.013	0.025	0.032	8	CSLAP Tot.P
1995	0.022	0.028	0.034	8	CSLAP Tot.P
1994	0.024	0.029	0.036	8	CSLAP Tot.P
1993	0.023	0.032	0.041	6	CSLAP Tot.P
1992	0.017	0.025	0.030	8	CSLAP Tot.P
1979	0.063	0.063	0.063	1	DEC
Year	**Min**	**Avg**	**Max**	**N**	**Parameter**
1992-96	**0.01**	**0.01**	**0.02**	**34**	**CSLAP NO3**
1996	0.01	0.01	0.01	8	CSLAP NO3
1995	0.01	0.01	0.01	8	CSLAP NO3
1994	0.01	0.01	0.01	6	CSLAP NO3
1993	0.01	0.01	0.02	4	CSLAP NO3
1992	0.01	0.01	0.01	8	CSLAP NO3
Year	**Min**	**Avg**	**Max**	**N**	**Parameter**
1992-96	**5**	**11**	**20**	**36**	**TColor**
1996	5	13	20	8	TColor
1995	5	8	10	6	TColor
1994	7	11	16	8	TColor
1993	7	11	17	6	TColor
1992	12	15	18	8	TColor
Year	**Min**	**Avg**	**Max**	**N**	**Parameter**
1992-96	**5.34**	**8.12**	**9.32**	**36**	**CSLAP pH**
1996	7.89	8.49	9.19	8	CSLAP pH
1995	8.06	8.38	9.32	6	CSLAP pH
1994	7.64	7.91	8.11	8	CSLAP pH
1993	5.34	7.62	8.35	6	CSLAP pH
1992	7.98	8.13	8.26	8	CSLAP pH
1979	8.50	8.50	8.50	1	DEC

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:

L Name	Lake name
Date	Date of sampling
Zbot	Depth of the lake at the sampling site, meters
Zsd	Secchi disk transparency, meters
Zsp	Depth of the sample, meters
TAir	Temp of Air, °C
TH2O	Temp of Water Sample, °C
TotP	Total Phosphorus, in mg/l
NO3	Nitrate nitrogen as N, 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) other

Table 1 continued					
Year	**Min**	**Avg**	**Max**	**N**	**Parameter**
1992-96	**127**	**134**	**143**	**35**	**CSLAP Cond25**
1996	127	131	135	8	CSLAP Cond25
1995	133	136	143	6	CSLAP Cond25
1994	128	132	136	8	CSLAP Cond25
1993	129	134	138	6	CSLAP Cond25
1992	134	137	141	7	CSLAP Cond25
1979	133	133	133	1	DEC
Year	**Min**	**Avg**	**Max**	**N**	**Parameter**
1992-96	**3.53**	**21.11**	**62.80**	**38**	**CSLAP Chl.a**
1996	6.10	17.28	34.50	8	CSLAP Chl.a
1995	13.60	26.30	62.80	8	CSLAP Chl.a
1994	4.44	21.92	52.90	8	CSLAP Chl.a
1993	3.53	22.79	37.40	6	CSLAP Chl.a
1992	5.95	17.69	49.10	8	CSLAP Chl.a
1979	55.50	55.50	55.50	1	DEC
Year	**Min**	**Avg**	**Max**	**N**	**Parameter**
1992-96	**2.0**	**3.0**	**4.0**	**33**	**QA**
1996	3.0	3.4	4.0	7	QA
1995	2.0	2.7	4.0	7	QA
1994	2.0	3.1	4.0	7	QA
1993	3.0	3.0	3.0	5	QA
1992	2.0	2.8	3.0	6	QA
Year	**Min**	**Avg**	**Max**	**N**	**Parameter**
1992-96	**2.0**	**3.2**	**4.0**	**33**	**QB**
1996	3.0	3.8	4.0	7	QB
1995	3.0	3.3	4.0	7	QB
1994	3.0	3.0	3.0	7	QB
1993	2.0	2.8	3.0	5	QB
1992	3.0	3.2	4.0	6	QB
Year	**Min**	**Avg**	**Max**	**N**	**Parameter**
1992-96	**2.0**	**3.2**	**4.0**	**33**	**QC**
1996	3.0	3.1	4.0	7	QC
1995	2.0	3.3	4.0	7	QC
1994	2.0	2.9	4.0	7	QC
1993	3.0	3.2	4.0	5	QC
1992	3.0	3.7	4.0	6	QC

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 may 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 while trying to draw conclusions about annual trends.

There are certain factors not accounted for in this report that lake managers should consider. These include:

- **Local weather conditions** (high or low temperatures, rainfall, droughts or hurricanes). Weather data summaries from the nearest NOAA station are provided below for 1996 to provide some context for understanding measured water quality conditions in the lake; however, for many lakes, the closest NOAA station is too far away for assessing truly local conditions.

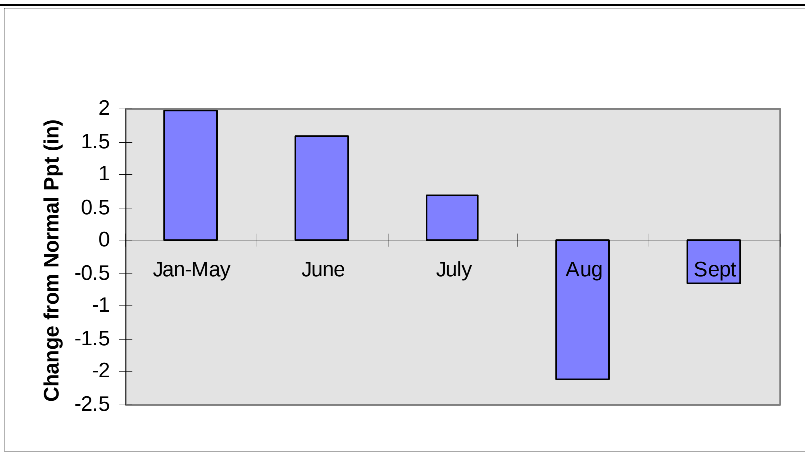

Figure 5. 1996 Precipitation Data for the Gouverneur NOAA Station

This plot shows that the winter and spring of 1996 was slightly wet compared to the typical year, while the early summer of 1996 was extremely wet and the late summer was extremely dry. Lakes that obtain most of their hydrological input from either runoff from the watershed or direct precipitation may behave differently under these precipitation conditions than a lake where groundwater inputs are more significant. Some or all of the variability in the lake data reported in 1996 may be attributable to these precipitation patterns, although specific local weather conditions are not known.

- **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 conditions. 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.
- **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. Where appropriate, some statistical summaries have been provided and are documented in Appendix B of this report.

Are there any seasonal trends in the data?

Seasonal Comparison of Eutrophication Parameters–1996 and in the typical CSLAP Sampling Season

Figure 5 and Figure 6 compare data for the measured eutrophication parameters for Moon Lake.
Figure 5 plots the data points for the current summer season. Figure 6 plots the monthly average of the data points for all the CSLAP sampling seasons at the lake. The second may give a more complete illustration of the seasonal conditions at your lake.

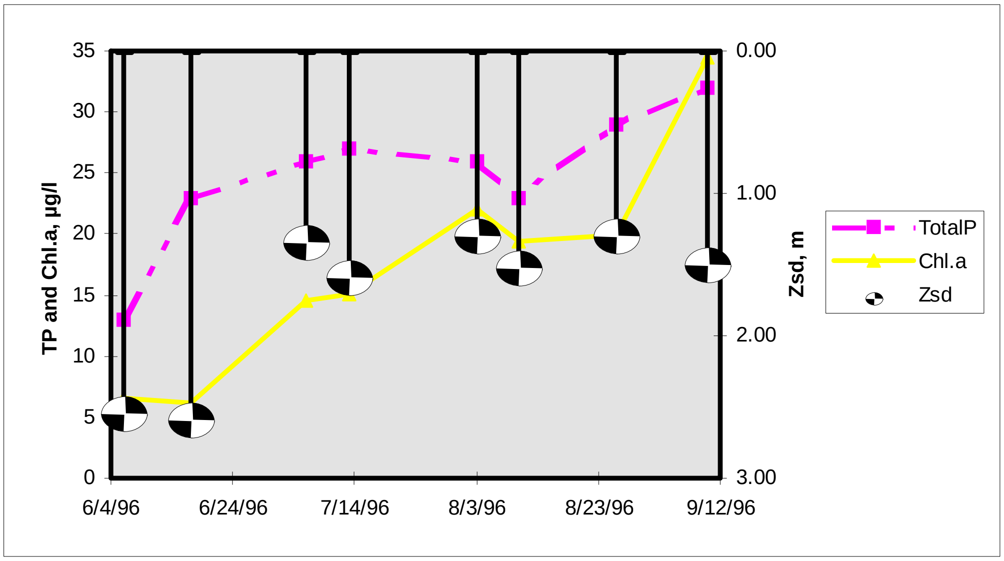

Figure 5. 1996 Eutrophication Data for Moon Lake
This graph illustrates the most recent condition of the lake.

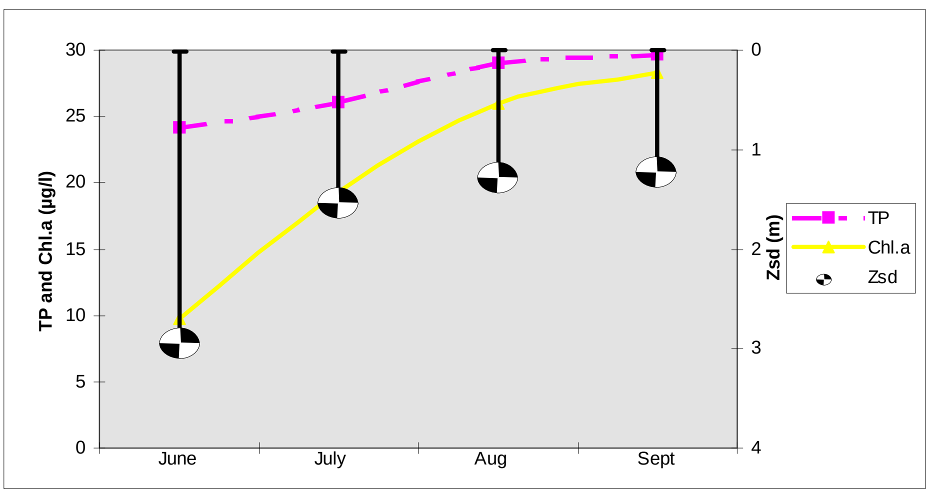

Figure 6. Typical Monthly Averages for Moon Lake
This graph shows monthly averages compiled from all sampling seasons at the lake.

These two graphs provide evidence for the following conclusions about seasonal trends:

a) Water clarity shows a significant[1] decrease over the course of a typical summer, at a rate equal to or greater than the variability found during any sampling season. Total phosphorus and chlorophyll *a* demonstrate seasonal tendencies (both increase) over the summer, but at a rate that is not statistically significant.

b) There does not appear to be a strong seasonal correlation[1] between nutrients and algae at Moon Lake, although it is likely that algae growth is most frequently limited by phosphorus concentrations.

c) There does not appear to be a strong seasonal correlation[1] between algae and water clarity at Moon Lake, although it is likely that water clarity is most frequently controlled by algae levels.

d) There does not appear to be a strong seasonal correlation[1] between water color and clarity at Moon Lake, nor does it appear that water color significantly influences water transparency in Moon Lake.

[1] the definition of "significant" and "strong seasonal correlation", as defined here, are found in Appendix B

How has the lake changed since CSLAP began in 1992?

Annual Trends in Eutrophication Parameters and Recreational Assessment

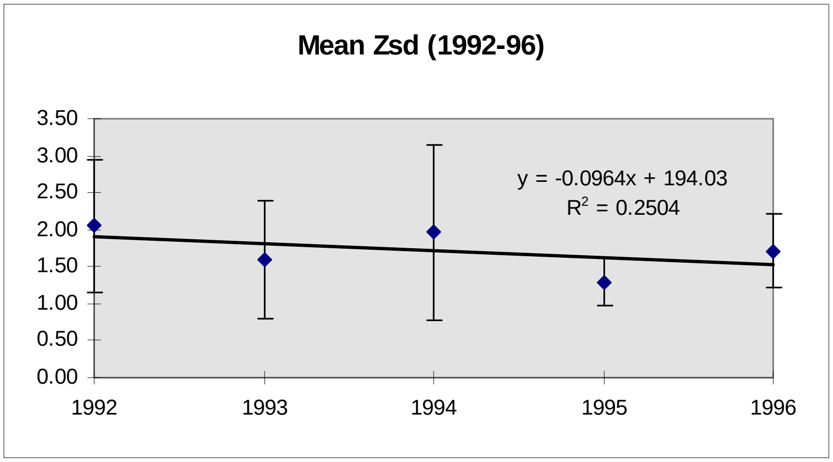

Figure 7
Mean Zsd (Water Clarity), 1992-1996

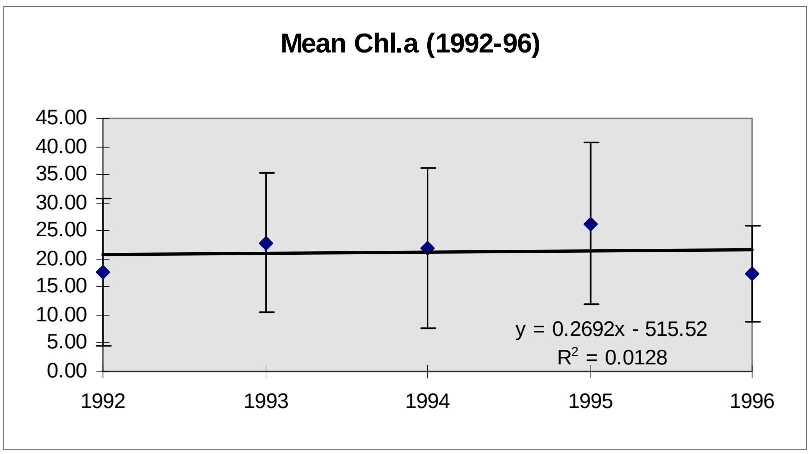

Figure 8
Mean Chl.a, 1992-1996

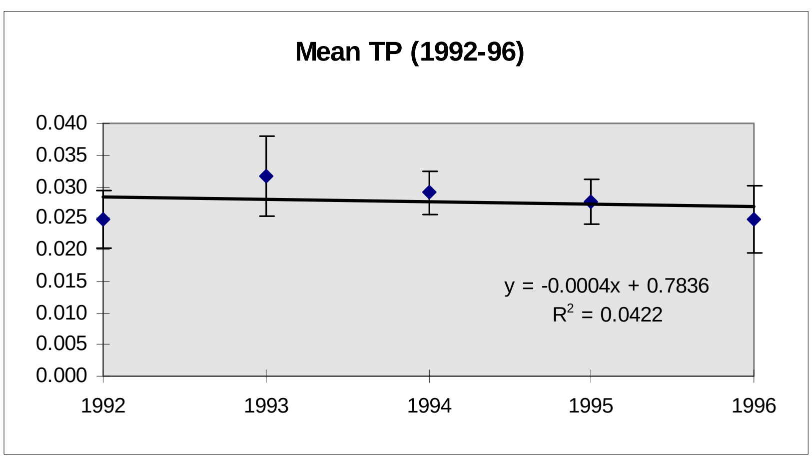

Figure 9
Mean TP, 1992-1996

Figure 7-9 graphs compare the annual averages for each of the sampled eutrophication parameters, and provide information about the variability in each years' data and the best-fit lines for describing annual trends. Based on these three graphs, the following conclusions can be made:

a) None of the measured eutrophication parameters have demonstrated significant change since CSLAP sampling began on the lake, although conductivity has shown a regular and significant decrease since 1992.

b) There is no (statistically significant) annual water clarity trend, although water clarity measurements have, on average, decreased slightly since 1992

c) There is no (statistically significant) annual chlorophyll *a* trend, and chlorophyll *a* readings have, on average, not changed since 1992

d) There is no (statistically significant) annual phosphorus trend, although total phosphorus readings have decreased slightly since 1992, somewhat inconsistent with the decrease in water clarity over the same period and further indicative that the annual changes at Moon Lake have been within the normal variability found in the lake.

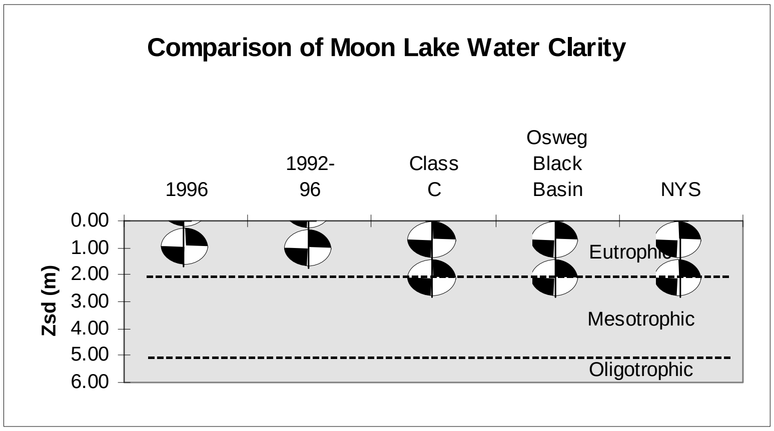

Figure 10. *Comparison of 1996 Secchi Disk Transparency to Previous Years at the Lake, Lakes With the Same Water Quality Classification, Neighboring Lakes, and Other NYS Lakes*

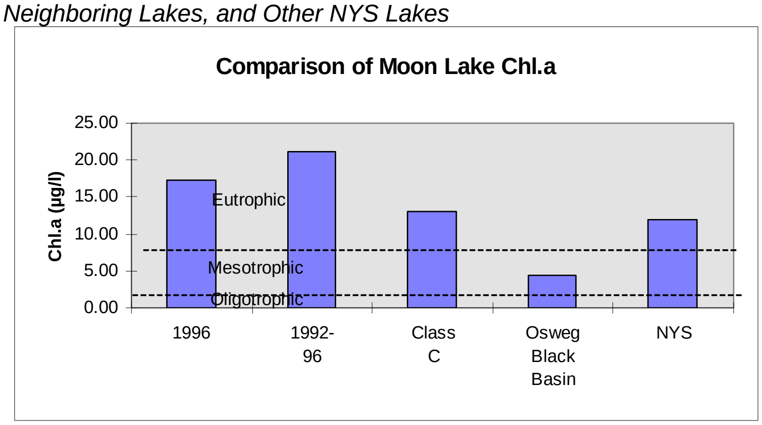

Figure 11. *Comparison of 1996 Chlorophyll a to Previous Years at the Lake, Lakes With the Same Water Quality Classification, Neighboring Lakes, and Other NYS Lakes*

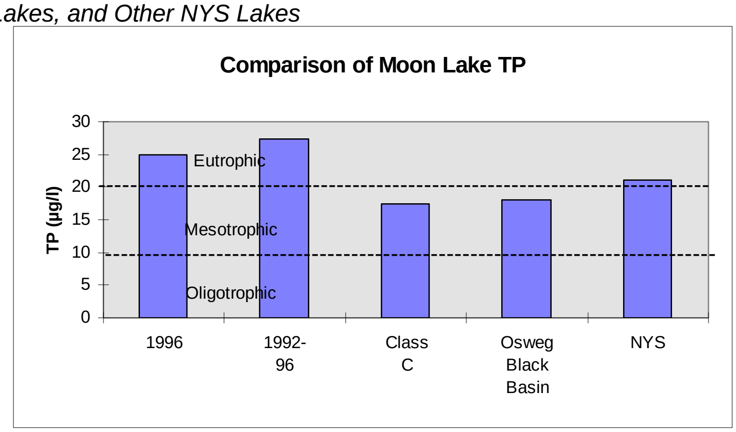

Figure 12. *Comparison of 1996 Total Phosphorus to Previous Years at the Lake, Lakes With the Same Water Quality Classification, Neighboring Lakes, and Other NYS Lakes*

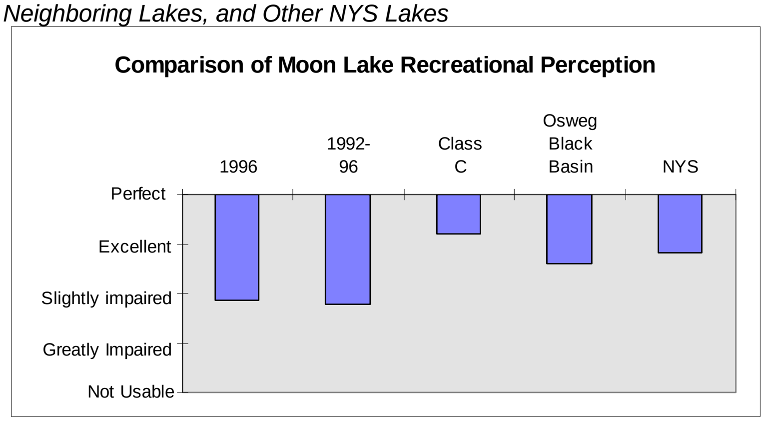

Figure 13. *Comparison of 1996 Recreational Perception*

How does this lake compare to other lakes?

Annual Comparison of Eutrophication Parameters and Recreational Assessment For Moon Lake—1996, the Typical CSLAP Sampling Season for this lake, Neighboring Lakes, Lakes with the Same Lake Classification, and Other NYS Lakes

The graphs to the left illustrate comparisons of each eutrophication parameter and recreational perception at Moon Lake-in 1996, relative to Moon Lake in previous CSLAP sampling seasons, other lakes in the same drainage basin, lakes with the same water quality classification (each classification is summarized in Appendix C), and all of New York State. Please keep in mind 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 data base for some regions of the state preclude a comprehensive comparison to neighboring lakes.

Based on these graphs, the following conclusions can be made:

a) Using water clarity as an indicator, Moon Lake is more productive than other lakes with the same water quality classification (Class C)., and other lakes in the Oswegatchie-Black Rivers basin and rest of the state.

b) Using chlorophyll *a* as an indicator, Moon Lake is more productive than other lakes in the Oswegatchie-Black Rivers basin, other Class C lakes, and NYS lakes.

c) Using total phosphorus concentrations as an indicator, Moon Lake is more productive than other Class C lakes, and other lakes in the Oswegatchie-Black Rivers basin and rest of the state.

d) Using QC on the field observations form as an indicator, Moon Lake is less suitable for recreation than other lakes in the Oswegatchie-Black Rivers basin, rest of the state, and other Class C lakes.

Discussion:
The less favorable assessment of recreational usability of Moon Lake occurs due to the relatively high productivity and weed growth in the lake, and is consistent with other lakes with comparable water quality and biological conditions.

IV. CONSIDERATIONS FOR LAKE MANAGEMENT

CSLAP is intended to be used as a means for collecting information required for comprehensive lake management (although the program is utilized for other purposes, and it is not capable of collecting all the necessary information for lake management). An extensive summary and interpretation of all the water quality, survey, perception, and background information collected for each lake was to be compiled for the now-mythical Five Year Summary Reports. The most important piece of these Five Year Summary reports, according to the few readers at NYS lakes lucky enough to be duly summarized, is the recommendation section, which is a summary of the most pressing lake problems (as identified by CSLAP), a compendium of strategies most frequently employed to address these problems, and an identification of the strategies most likely to work at the lake, given the various ecological, logistic, economic, and/or philosophical considerations for each strategy.

While the staff limitations that precluded the development of more than a few Five Year Summary reports still exist, the report authors have attempted to include a broad summary of the major lake problems and "considerations" for lake management as defined within the even narrower context of the physical condition (i.e. algae and water clarity), aquatic plant coverage (i.e. 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 any given program lake, but in the overall context of lake management in New York State represent the most common and germane issues within the broad universe of lake management. If these summaries look like a compendium of Diet for a Small Lake, then (congratulations!) you have been doing your reading. Each summarized management strategy is more extensively outlined in Diet, and this joint NYSDEC-NYSFLA publication should be consulted for more details and for a broader context of in-lake or watershed management techniques within the overall sphere of lake management. These "considerations" should not be construed as "recommendations", since there is insufficient information available through CSLAP to assess even if, not to mention how, a lake should be managed. Rather, these are more akin to "tips" should a lake association decide to undertake managing problems defined (via water quality data) or articulated (via perception data) through CSLAP.

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

Problem	Probable cause	Probable source
Poor water clarity	Excessive algae	**Excessive phosphorus loading** from septics, watershed runoff (stormwater, construction sites, agriculture, ...)

Discussion:
The water sampling results indicate that recreational impairments in this lake are related to lower-than-desired water transparency. Water clarity in this lake appears to be strongly related to algae, which is linked to nutrient concentrations. As such, improving water clarity involves reducing algae levels, which is linked to the need to reduce nutrient concentrations in the lake and ultimately within the surrounding watershed. It is not known if water clarity improvement is a continuing lake management goal at Moon Lake. As such, and as noted above, these considerations do not consititute recommendations, but rather attempt to discuss management alternatives most likely to be successful at addressing these problems.

In-lake controls (listed in order of frequency of use and likelihood of success in the "typical" NYS lake)*: copper sulfate, precipitation/inactivation, hypolimnetic withdrawal, aeration, dilution/flushing, artificial circulation, food web manipulation*

Discussion:
The strategies outlined below primarily address the cause, but not the ultimate source, of problems related to poor water clarity. As such, their effectiveness is necessarily short-term, but perhaps more immediately realized, relative to strategies that control the source of the problem. **The problems may continue or worsen if the source of the problem is not addressed, using strategies such as those described under "Watershed controls" below.**

-*Copper sulfate* is an algacide that is frequently used to control nuisance levels of planktonic algae (dots of algae throughout the water column) or filamentous algae (mats of algae on the lake surface, weeds, or rocks) throughout the lake. It is usually applied 1-3x per summer in granular or liquid form, usually by a licensed applicator. Many people feel that it is effective at reducing algae levels to below nuisance conditions, others feel it only "flattens the peak" of the worst blooms, and still others think it is merely a placebo. There are concerns about the long-term affect of copper on the macroinvertebrate communities that live on the lake bottom, and in some lakes, the affect of copper on the zooplankton (microscopic animals that feed on algae) cause a "bounce-back" algae bloom that is worse than the original bloom.

-*Precipitation/Inactivation* involves adding a chemical binding agent, usually alum, to bind and precipitate phosphorus, removing it from the water column, and to seal bound phosphorus in the sediment, rendering it inactive for release to the overlying water (as often occurs in stratified lakes with low oxygen levels). It has a mixed rate of success in NYS, although when successful it usually provides long-term control of nutrient release from bottom sediments (it is only a short-term method for removing existing phosphorus from the water column). It is not recommended for lakes with low pH or buffering capacity (like most small NYS lakes at high elevation), for at low pH, aluminum can be toxic to fish.

-*Hypolimnetic withdrawal* takes deoxygenated, high nutrient water from the lake bottom and discharges the water downstream from the lake. This strategy is sort of a hybrid of aeration and dilution/flushing, and is usually limited to lakes in which control structure (such as a dam) exists where the release valve is located below the thermocline. It has been quite successful and usually inexpensive when applied properly, but must only be employed when downstream waterbodies will not be adversely impacted by the pulse of low oxygen water (which may include elevated levels of hydrogen sulfide, ammonia, and iron).

-*Aeration* involves pumping or lifting water from the lake bottom (hypolimnion) for exposure to the atmosphere, with the oxygenated waters returning to the lake bottom. The airlift device is usually quite expensive, and operating costs can be quite high. There is also a risk of breaking down the thermocline, which can result in an increase in algae levels and loss of fish habitat for many cold-water species. However, most of the limited number of aeration projects have been quite successful. *Artificial circulation* is the process by which air is injected into the hypolimnion to eliminate thermal stratification- it is aeration by circulation.

-*Dilution/flushing* involves using high quality dilution water to reduce the concentration of limiting nutrients and increase the rate at which these nutrients are flushed through the lake. This strategy requires the availability of high quality dilution water and work best when the lake is small, eutrophic, and no downstream waterbodies that may be affected by the pulse of nutrients leaving the lake (and for these lakes, high quality dilution water is probably not available from the surrounding watershed, because such an input would already be flushing the lake).

-*Food web manipulation* involves altering the population of one component within the food web, most frequently algae, by altering the populations of other components in the same web. For algae control, this would most frequently involve stocking the lake with herbivorous (algae-eating) fish, but this may be at the expense of other native fish. While this procedure has worked in some situations, it is inherently risky, and not recommended at lakes in which the native fisheries serve as a valuable local resource.

Watershed controls*: monitoring, nutrient control, land use controls to limit urban runoff, limit use of lawn fertilizers, reduce waterfowl feeding*

Discussion:

These strategies are effective at controlling the source of the problem, and thus afford more long-term relief, although the implementation of these strategies usually take much longer than in-lake controls.

Monitoring may be necessary to quantify the problem and pin-point the source of pollutants. This may be quantitative (water quality data in tributaries or near-shore areas), semi-quantitative (use of biological indicators to determine stressed stream segments), or qualitative (windshield surveys and stream walks to identify suspect areas).

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 (by replacing the 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 increased loading to the system (through camp expansion or conversion to year-round residency). Replacing leach fields 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.

- 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 Reducing the Impacts of Stormwater Runoff to provide more detailed information about developing a stormwater management plan.
- There are nearly an infinite number of agriculture management practices to reduce nutrient export or retain particles lost from agricultural fields, related to fertilizer controls, soil erosion practices, and control of animal wastes. 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 Controlling Agricultural Nonpoint Source Water Pollution in New York State.
- 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* such as restricting development, via zoning, floodplain management, and clustering restrictions, to less environmentally critical areas along the lake shore and within the watershed, deeded or contractual access to the lake, and cutting restrictions have been used to, among other things, reduce pollutant loading to lakes. This voluntary approach varies greatly from one community to the next (state law affords local government great latitude in developing land use plans), and frequently involves balancing lake use protection with land use restrictions.

-*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, or, even better, eliminating lawn fertilizers or using lake water as a "fertilizer" at shoreline properties, fewer nutrients may enter the lake.

-*Waterfowl* introduce nutrients (and bacteria) to the lake water through their feces. Encouraging the congregation of waterfowl by feeding will concentrate this nutrient source, contributing to a higher local nutrient load and increasing the overall nutrient concentrations in the lake.

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

Problem	Probable cause	Probable source
Excessive weed growth	**Excessive nutrients, enriched bottom sediments, ...**	**Excessive pollutant loading** from watershed runoff **and sediment** (stormwater, construction sites, agriculture, ...), septics, bottom disturbance,...

Discussion:
Perception data indicate that aquatic weed growth is perceived to inhibit recreational use of this lake. Nuisance weed growth in lakes is caused by a variety of factors- water clarity, sediment consistency, wave action, competition between individual plant species, sediment nutrient levels, etc. In most cases, excessive weed growth is associated with the presence (and dominance) of exotic (non-native) submergent plant species such as Eurasian watermilfoil (*Myriophyllum spicatum*), although some lakes are inhibited by dense growth of native species. Some of these cannot be controlled by lake associations, while others can only be addressed peripherally (for example, sediment consistency can be influenced by the loading to the lake). Given the potential side effects associated with most aquatic plant management strategies, the cost and controversy associated with many strategies, and the benefits

of diverse, healthy aquatic plant communities, aquatic plant management should only be undertaken when lake use conditions (recreational, municipal, economic, etc.) are significantly and regularly threatened or impaired. Aquatic plant management most efficiently involves a mix of immediate, in-lake controls, and long-term measures to address the causes and sources of this excessive weed growth.

Although it was not identified as a dominant plant species in Moon Lake, *Myriophyllum spicatum* (Eurasian water milfoil) is likely to be, and is assumed below as, the focus of any plant management efforts directed toward improving recreational conditions in the lake.

In-lake controls*: physical/mechanical plant management techniques, chemical plant management techniques, biological plant management techniques*

Discussion:

The strategies outlined below primarily address the cause, but not the ultimate source, of problems related to nuisance aquatic plant growth. As such, their effectiveness is necessarily short-term, but perhaps more immediately realized, relative to strategies that control the source of the problem.

-Physical/mechanical control techniques utilize several modes of operation to remove or reduce the growth of nuisance plants. The most commonly employed procedures are the following:

- *mechanical harvesters* physically remove rooted aquatic plants by using a mechanical machine to cut and transport plants to the shore for proper storage. Mechanical harvesters are probably the most common "formal" plant management strategy in New York State. While it is essentially akin to "mowing the (lake) lawn", it usually provides access to the lake surface and may remove some lake nutrients if the cut plants are disposed out of the watershed. However, if some shallow areas of the lake are not infested with weeds, they will likely become infested after mechanical harvesting, since fragments frequently wander from cut areas to barren sediment and colonize new plant communities. Harvesters are very expensive, but can be rented or leased. *Rotovators* are rotovating mechanical harvesters, dislodging and removing plants and roots. *Mechanical cutters* cut, but don't remove, vegetation or fragments. Box springs, sickles, cutting bars, boat props, and anchors often serve as mechanical cutters.
- *hand harvesting* is the fancy term for lake weeding- pulling out weeds and (hopefully) the root structure by hand. It is very labor intensive, but very plant selective (pull the "weeds", leave the "plants"); it is limited to small near-shore areas. *Diver dredging* is like hand-harvesting with a vacuum cleaner- in this strategy, scuba divers hand-pull plants and place them into a suction hose for removal into a basket in a floating barge. It is also labor intensive and can be quite expensive, but it can be used in water deeper than about 5ft (the rough limit for hand harvesting). It works best where plant beds are dense.
- *water level manipulation* is the same thing as *drawdown*, in which the lake surface is lowered, usually over the winter, to expose vegetation and sediments to freezing and drying conditions. Over time this affects the growing characteristics of the plants, and in many cases selectively eliminates susceptible plants. This is obviously limited to lakes that have a mechanism (dam structure, controlled culvert, etc.) for manipulating water level. It is usually very inexpensive, but doesn't work on all plants and there is a risk of insufficient lake refill the following spring.
- *bottom barriers* are screens or mats that are placed directly on the lake bottom to prevent the growth of weeds by eliminating sunlight needed for plant survival. The mats are held in place by anchors or stakes, and must be periodically cleaned or removed to detach any surface sediment that may serve as a medium for new growth. The mats, if installed properly, are almost always effective, with relatively few environmental side-effects, but are

expensive and do not select for plant control under the mats. It is best used when plant communities are dense but small in area.

- *sediment removal*, also referred to as dredging, controls aquatic plants by physically removing vegetation and by increasing the depth of the lake so that plant growth is limited by light availability. Dredging projects are usually very successful at increasing depth and controlling vegetation, but it is very expensive, may result in significant side effects (turbidity, algal blooms, potential suspension of toxic materials), and may require significant area for disposal.

-*Chemical control techniques* involve the use of aquatic herbicides to kill undesired aquatic vegetation and prevent future nuisance weed growth. These herbicides come in granular or liquid formulations, and can be applied in spot- or whole-lake treatments. Some herbicides provide plant control by disrupting part of the plants life cycle or ability to produce food, while others have more toxicological effects. Aquatic herbicides are usually effective at controlling plants, with longevity, efficiency, and target plant selectivity variable depending on dosage rate, extent of non-target (usually native) plant growth, flushing rate, and other factors, but the use of herbicides is often a highly controversial matter highly conditional with personal philosophies about introducing chemicals to lakes. Some of the more recently registered herbicides appear to be more selective and have fewer side effects than some of the previously utilized chemicals. Chemical control of nuisance plants can be quite expensive.

-*Biological control techniques* presently involve the stocking of sterile grass carp, which are herbivorous plants that feed exclusively on macrophytes (and macroalgae). Grass carp, when stocked at the appropriate rate, have been effective at controlling nuisance weeds in many southern states, although their track record in NYS is relatively short. These carp may not prefer the nuisance plant species desired for control, and they are quite efficient at converting macrophyte biomass into nutrients that become available for algae growth. This is, however, one of the less expensive means of plant control. Native species of a*quatic weevils and moths* have been naturally controlling nuisance plants in the Finger Lakes and throughout the Northeast, although they have long existed in many lakes with no apparent proficiency for lake-wide control. These are still considered experimental in regards to controlled plant management.

Watershed controls*: monitoring, sediment control, land use controls to limit urban runoff, cleaning boat props, discouraging the feeding of waterfowl, "weed watcher" signs*

Discussion:

The primary watershed "pollutant" contributing to nuisance aquatic weed growth is probably sediment and silt, particularly since these particles frequently carry nutrients that are necessary for aquatic plant growth. These strategies are effective at controlling the source of the problem, and thus afford more long-term relief, although the implementation of these strategies usually take much longer than in-lake controls.

-*Monitoring* may be necessary to quantify the problem and pin-point the source of pollutants. This may be quantitative (water quality data in tributaries or near-shore areas), semi-quantitative (use of biological indicators to determine stressed stream segments), or qualitative (windshield surveys and stream walks to identify suspect areas).

-*Sediment controls* can take several forms, depending on the original source of the nutrients:

- 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 Reducing the Impacts of Stormwater Runoff to provide more detailed information about developing a stormwater management plan.

- There are nearly an infinite number of agriculture management practices to reduce soil loss from agricultural fields, related primarily to soil erosion. 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 Controlling Agricultural Nonpoint Source Water Pollution in New York State.
- 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* such as restricting development, via zoning, floodplain management, and clustering restrictions, to less environmentally critical areas along the lake shore and within the watershed, deeded or contractual access to the lake, and cutting restrictions have been used to, among other things, reduce pollutant loading to lakes. This voluntary approach varies greatly from one community to the next (state law affords local government great latitude in developing land use plans), and frequently involves balancing lake use protection with land use restrictions.

-*Boat propellers* frequently get entangled by weeds and weed fragments. Propellers not cleaned after leaving an "infected" lake or before entering an "uncontaminated" lake may introduce plant fragments to the lake. This is a particular problem for those species, such as many nuisance plants, that reproduce actively through fragmentation.

-*Waterfowl* may introduce to lakes plant fragments, particular nuisance weeds like Eurasian watermilfoil that easily fragment. Encouraging the congregation of waterfowl by feeding will increase the likelihood that these fragments can be introduced to a previously uncolonized lake.

-*Weed watcher* ("...look out for this plant..") signs have been successful in reducing the spread of nuisance aquatic plants. They are usually placed near high traffic areas, such as boat launch sites, marinas, and inlets and outlets.

CSLAP DATA KEY:

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

L Name	Lake name
Date	Date of sampling
Zbot	depth of the bottom at the sampling site, meters
Zsd	average Secchi disk reading, meters
Zsp	depth of the sample, meters
TAir	Temp of Air, °C
TH2O	Temp of Water Sample, °C
TotP	Total Phosphorus, in mg/l
NO3	Nitrate nitrogen as N, 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) other

Appendix A. CSLAP Data for Moon Lake (refer to CSLAP Data Keys on previous page)

PName	Date	Zbot	Zsd	Zsamp	Tot.P	NO3	TColor	pH	Cond25	Chl.a	QA	QB	QC	QD
Moon L	6/6/92	5.0	4.05	1.5	0.029	0.01	18	7.98	140	5.95	3	3	3	26
Moon L	6/23/92	5.2	2.55	1.5	0.028	0.01	15	8.10	141	12.60				
Moon L	7/6/92	5.0	1.85	1.5	0.021	0.01	14	8.23	140	21.90				
Moon L	7/20/92	5.2	2.30	1.5	0.017	0.01	14	8.26	136	8.47	3	3	3	2
Moon L	8/2/92	4.8	1.35	1.5	0.023	0.01	14	8.11	136	8.16	3	3	4	12
Moon L	8/17/92	5.1	1.95	1.5	0.021	0.01	12	8.20	135	13.60	3	3	4	25
Moon L	9/1/92	5.1	1.35	1.5	0.029	0.01	16	8.07	134	21.70	2	4	4	25
Moon L	9/13/92	5.1	1.00	1.5	0.030	0.01	17	8.08		49.10	3	3	4	12
Moon L	6/14/93	5.2	3.15	1.5	0.024		12	5.34	138	3.53	3	3	3	2
Moon L	6/29/93	5.2	2.10	1.5	0.023	0.02	17	8.35	133	10.40	3	2	3	12
Moon L	7/25/93	5.1	1.04	1.5	0.035	0.01	7	8.18	129	37.40	3	3	3	2
Moon L	8/10/93	4.8	1.05	1.5	0.041		10	7.94	135	34.80	3	3	3	12
Moon L	8/23/93	4.9	1.20	1.5	0.034	0.01	9	7.93	136	21.70				
Moon L	9/7/93	4.9	0.98	1.5	0.033		8	7.99	135	28.90	3	3	4	25
Moon L	6/15/94		2.85	1.5	0.026	0.01	13	7.94	136	5.53	3	3	3	13
Moon L	6/28/94	5.0	4.75	1.5	0.028	0.01	11	7.89	135	18.40	3	3	4	15
Moon L	7/10/94	5.1	1.70	1.5	0.024	0.01	8	8.11	132	19.80	3	3	2	1
Moon L	7/25/94	5.0	1.50	1.0	0.031	0.01	7	7.77	134	21.50	2	3	2	
Moon L	8/10/94	5.7	1.00	1.5	0.036		11	7.64	132	4.44	4	3	3	14
Moon L	8/22/94	5.1	0.90	1.0	0.031		16	8.02	131	52.90				
Moon L	9/5/94	5.1	1.45	1.5	0.029		10	7.80	131	27.90	4	3	4	1234
Moon L	9/19/94	5.4	1.55	1.5	0.027	0.01	8	8.08	128	24.90	3	3	2	1
Moon L	6/26/95	5.2	2.00	1	0.024	0.01	10	8.06	143	19.10	2	3	2	2
Moon L	7/10/95	5.5	1.38	1.5	0.027	0.01	10	8.28	136	13.60	3	3	3	15
Moon L	7/25/95	5.5	1.10	1.5	0.027	0.01				20.90	2	4	4	2
Moon L	8/7/95	5.4	1.40	1.5	0.034	0.01				25.80	2	3	3	2
Moon L	8/20/95	4.7	1.10	1.5	0.022	0.01	5	9.32	133	62.80	4	3	4	1234
Moon L	9/5/95	4.8	1.00	1.5	0.027	0.01	10	8.46	135	28.50	3	3	3	1256
Moon L	9/17/95	4.6	1.05	1.5	0.032	0.01	5	8.10	135	20.90	3	4	4	1245
Moon L	9/30/95	4.6			0.028	0.01	5	8.07	135	18.80				
Moon L	6/6/96	4.65	2.55	1.5	0.013	0.01	15	7.89	134	6.6	3	3	3	125
Moon L	6/17/96	5.5	2.60	1.5	0.023	0.01	10	8.6	135	6.1	3	4	3	124
Moon L	7/6/96	5.5	1.35	1.5	0.026	0.01	15	8.44	132	14.6	3	4	4	124
Moon L	7/13/96	4.8	1.60	1.5	0.027	0.01	15	8.93	130	15.1	4	4	3	1235
Moon L	8/3/96	4.9	1.30	1.5	0.026	0.01	10	8.41	128	22	3	4	3	124
Moon L	8/10/96	4.95	1.53	1.5	0.023	0.01	10	9.19	127	19.4	4	4	3	124
Moon L	8/26/96	4.9	1.30	1.5	0.029	0.01	5	8.37	130	19.9	4	4	3	125
Moon L	9/10/96	4.75	1.50	1.5	0.032	0.01	20	8.11	128	34.5	3	3	3	2

Appendix B: Summary of Statistical Methods Used in this Report

A variety of statistical methods have been used to present, analyze, and interpret data collected through CSLAP. Some of these methods are commonly used procedures (and have been used previous in Annual Reports), while others have been modified for use on this dataset. The following is a summary of the methods used, or the terms used to summarize a method:

A brief word about including all data points. Occasionally, a sample result indicates that a laboratory, transport, processing, or collection error has occurred; for example, a pH reading of 2.2 (a not-so-weak acid) or a conductivity reading of 4 (distilled water). These results are not included in the dataset. All other data points are retained unless there is strong evidence that the result is erroneous.

Mean- the statistical "average" of all samples in a particular dataset. Mean is determined by adding all of the data values within the dataset, and dividing by the number of samples in the dataset.

(Mean pH- since pH is not a direct analytical measure, but rather is a mathematical construct from a direct measure (it is the negative logarithm of the hydrogen ion concentration of the water), mean pH is determined by taking the negative logarithm of the mean hydrogen ion concentration)

(Mean NO_3- since nitrate is not detectable, an absolute reading for that sample is not obtainable. This becomes problematic when computing an average, or mean, for a set of samples that include undetectable values. For the purposes of calculating means, undetectable nitrate readings (reported as less than 0.02 mg/l) are assumed to be = 0.01 mg/l. Likewise, all other parameters reporting undetectable values are assumed to be 1/2 of the detection limit)

Standard Deviation is a measure of the variability of data points around the calculated mean. A large standard deviation indicates a wide variability in the data (and thus a lower assurance that the mean is representative of the dataset), while a small standard deviation indicates little variability in the data. The standard deviation presented here (the "brackets" on each data point in the **How the Lake Has Changed..** section) corresponds to a *true population* standard deviation (☞).

Linear Regression is a statistical method for finding a straight line that best fits a set of two or more data points, in the form y = mx + b, with m the slope of the line, and b the value for y when the line crosses the x axis (when x = 0). **R^2-** R is a correlation coefficient used to measure linear association. R shows the strength of the relationship between the regressed parameters—the closer the value of R to 1 or -1, the stronger the linear association (R ranges from -1 to +1. When R = 1, the data fall exactly on a straight line with a positive slope, while at R = -1, the data fall exactly on a straight line with a negative slope. This value is squared (R^2) in most statistical analyses, in large part so R values < 0 can be compared to R values > 0).

The "significance" of the data reported in linear regressions, standard deviations, and other more rigorous statistical data analyses have been long debated among statisticians. For this report, we hope to provide some rudimentary statistical basis for evaluating the data collected at each lake, and to evaluate larger questions about each dataset, such as water quality trends ("has the lake changed"). In this report, "significant" is defined as the range of the best-fit line exceeding the first standard deviation of each monthly average, and "strong correlation" is defined as a correlation coefficient (R^2) for the best fit line describing the parameters exceeding 0.5.

This definition of "significant" may appear to be too, well, wordy, but the justification for it is as follows. If the amount that a measure such as water clarity changes over time, as determined by a best-fit line, is less than it changes in any given year, than it is likely that this change is not statistically valid. As an example, if a persons weight fluctuates by 6 pounds (say from 144 to 150) any given day, a reported weight loss of 2 pounds (from 149 to 147) should be considered within the normal range of variability. If you are that person, then you may think you lost weight, and may have according to the scale, but, at least statistically, you didn’t. The justification for “strong correlation” is not as easy to explain, but may be more verifiable- it appears to be a definition consistent with that used to compare other datasets.

Appendix C. New York State Water Clarity Classifications

Class N:	Enjoyment of water in its natural condition and where compatible, as 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
Class $AA_{special}$:	Lake Champlain and Upper Hudson River Drainage Basins. Any usage except usage except for disposal of sewage, industrial wastes or other wastes
Class AA:	Source of water supply for drinking, culinary, or food processing purposes and any other usages. 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 and any other usages. 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:	Primary contact recreation and any other uses except as a source of water supply for drinking, culinary or food processing purposes
Class C:	Suitable for fishing and all other uses except as a water supply for drinking, culinary or food processing purposes and primary contact recreation
Class D:	These waters are suitable for secondary contact recreation, but 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 the propagation of fish. The waters must be suitable for fish survival
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