Kinderhook Lake Corporation
Aquatic Plant Management Plan

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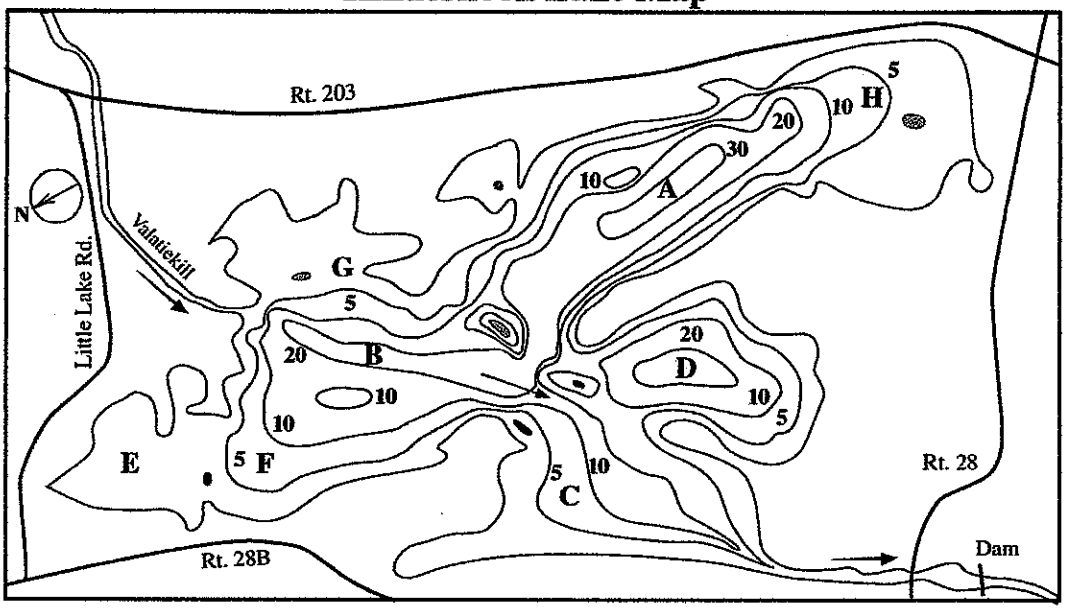
Kinderhook Lake Map



Identification of Aquatic Plants

Coontail, Bushy Pondweed, Sago Pondweed and Leafy Pondweed are the major native species of aquatic plants in Kinderhook Lake. **Curly-leafed Pond Weed, Eurasian Milfoil and Water Chestnut** are the major invasive species. Excess phosphorus pollutant in the bottom of the lake, which was introduced primarily by surface silt runoff from farms upstream on the Valatie Kill for about two hundred years, have fed excessive algae growth in the summer, particularly blue-green algae. Plant and algae identifications were done as a part of the CSLAP program in 1996; no endangered species were found. Microscopic analyses, performed weekly in the summer over the past eleven years have identified ***Anabaena circinalis*** and ***Lyngbya contorta*** as the two most abundant and troublesome forms of algae; ***Gomphisphaeria wichurae***, ***Anacystis cyanea*** and others are seen at lower levels. Blooms of Diatoms and Dinoflagellates, particularly ***Ceratium hirundinella***, occur in the spring and early summer and significant levels of green algae, ***Spirogyra porticalis*** and ***Ankistrodesmus falcatus***, have also been observed. In 2008, a new form of algae, with about the same basic morphology as ***Anabaena circinalis*** but about 1/20th the size, reproduced rapidly in August 2008. It was not seen in 2009 but reappeared in July, 2010. A sample was sent to Mr. Scott Kishbaum in 2008, but was not identified.

History of Invasive Weed Growth

There appears to be no record of the first appearance of **curly-leaf pond weed** in the lake but, in the 60's and 70's growth was so abundant in areas C, F, G and H that a cutter boat had to be used to carve paths through the beds to permit boats into the main lake. **Eurasian milfoil,** which appeared in the lake in the early 80's, essentially displaced curly leaf pondweed. By 1996 - 97 milfoil beds became so dense and floating fragments so abundant that fences had to be constructed on waterfronts to permit swimming. Attempts to control the weed by cutting were not successful and a proposal was submitted to DEC in 1997 to introduce sterile weed carp. The proposal was rejected by DEC and not pursued because, in 1998, the beds began to decrease in density and size. Since the beds appeared to die back in July, a search was initiated in 1999 to determine if the weevil (*Eurhryciopsos lecontei*) was present. Multiple specimens were found in weedbeds in areas F and C and positively identified at Cornell University. By 2002, curly-leaf pond weed began returning to the milfoil beds but both died back in early July so that neither weed was visible on the surface in July and August. From 2002 to 2004, both plants decreased in density. In 2005, 2006 and 2007 most curly-leaf pond weed and milfoil did not reach the surface. In 2008 and 2009, increased water clarity permitted both plants to spread to 11- to 12-ft. depths and increase substantially. In 2010, plants, once again, did not reach the surface and beds were not visible all summer.

Management History (Continued)

In 2008 and 2009, **Coontail** multiplied rapidly and, in 2009, was as much of a problem as curly-leaf pondweed and milfoil. A Permit request was obtained from DEC to treat coontail with Aquathol Super K in three bays in 2010 but growth was so minimal in that year, as well as in 2011 and 2012, that the herbicide was not used.

Water chestnut growth began in the early 1980s and, by 1991, completely filled bays E and G at the north end. 55-Gallon barrels of cutlets were collected from shorelines and swimming was not possible in some areas. Since cutting in the summer yielded impossible amounts of debris and water chestnut was recognized as an annual, the bar on the cutter-boat was adjusted to cut about 3 in. below the surface and leaflets were cut off as soon as they appeared in the Spring in 1992, 93 and 94. Early cutting dramatically reduced debris, cut sections decayed rapidly and the plants did not seed. By1995, the beds had been decreased in size by about 99%. In 2008, problems with the engine on the cutter boat prevented cutting. In 2009, the boat went over the dam in a flood and no cutting was done. Plants were removed from most of the lake by hand but the beds at the north end increased substantially. In 2010, the cutter-boat was repaired, a meeting was held with NYDEC to gain approval to use it to cut water chestnuts in June and July and cutting was resumed in 2010. Since the beds are in shallow water and mixed with lilly pads, a three-foot depth line was established for cutting and, since 2011, has confined the beds to a narrow area at the north end and prevented spreading to the rest of the lake.

Bushy Pondweed: Bushy pondweed was most likely a native plant in Kinderhook Lake but, normally, does not present aproblem. However, do to increased water clarity caused excessive growth along shorelines in June and July 2004 and 2007, it essentially filled all the muddy shorelines around the lake, making it difficult to use those shorelines for swimming. A Permit Application was submitted to DECK early 2008 to apply Aquathol K to selected areas where bushy pondweed had been a problem. The permit was granted but it was received only two weeks prior to its expiration - there was insufficient time to obtain the chemical and notify property owners so no herbicide was applied. In subsequent years, water clarity decreased and growth was not excessive.

Blue-green Algae has been a major problem for at least eighty years. Treatment with copper sulfate was begun by private landowners in the early 50's and then by Kinderhook Lake Corporation in the late 50's. In 1998 and 1999, blue-green algae growth became so dense, DEC indicated that, unless phosphorus levels were reduced in the lake in the Summer, there was a risk of having a serious fish-kill. In 1999, blue-green algae levels became so high that several 1,000# applications of copper sulfate did not reduce the levels and, for several weeks, the water was unfit for bathing.

In 2007, Cutrine Plus liquid, rather than copper sulfate was applied to the surface with the view that it would provide more effective algae control. Cutrine is more expensive than copper sulfate but is claimed to be more effective and less toxic. However, Cutrine in solution weighs considerably more than the equivalent amount of copper sulfate salt. The KLC treatment boat carries only 1,500#, thus multiple runs were required for a single application. Since copper sulfate is considerably less expensive, weighs less as a solid salt and is easier for KLC to apply, copper sulfate has been used since 2007. When applied as soon as the blue-green algaelevels begin to rise, it has provided adequate control.

Phosphorus and Sulfur Pollution

Based on data generated in the CSLAP Program in 1998, approximately 1/2 of summer phosphate was coming from deep bottom sediments and 1/2 from the Valatie Kill, surface runoff and septic systems. After reviewing alternative approaches with NYDEC to reduce phosphate, **a program was initiated in 2001 to apply alum to the Lake to irreversibly bind phosphorus in deep sediments as aluminum phosphate.** As a consequence of that program, phosphorus release from the main lake was essentially blocked by 2004 but two other deep regions, identified as B and D on the lake map, continued to release phosphorus and were treated with alum until 2010. A review of the Kinderhook Lake alum program was included on p. 181 of the ***Diet for a Small Lake*** published in 2009.

In 2012, three years after the last alum applications to the lake, an important observation was made regarding deep phosphorus levels. On July 25th, phosphorus levels at 20-ft. depth were 0.04 ppm in all three deep regions. This was a surprise because levels at that time of year in the inlet and south bay have always been signifcantly higher, even when large amounts of alum were added to provide control. Surface and Valatie Kill phosphorus levels have been 0.04 ppm for many years but, prior to alum applications, deep levels were ten-times that in mid-summer. After three years of alum applications, the level in the deep region of the main lake had been reduced to 0.04 ppm and it has remained there since 2004 with no further addition of alum. However, levels remained high in the other two regions even though additional alum was added until 2010.

In 2012, it was so hot and dry that the flow of water into the lake was exremely low. A sample of water taken at 21 ft. in the south bay, which contained suspended fine sediment, had a total phosphorus level of 0.15 ppm, 4 times that of the level one foot higher. Since under-water video taken of the lake in 2003 revealed a relatively heavy flow of particles through the flow region, it is likely that alum additions to the deep regions of all three areas effectively bound phosphate and reduced release but the flow of water into those areas from Valatie Kill continued to bring new bound phosphate into the two areas effected by the flow. If phosphate contaminated sediment is, indeed, being added to those two areas, 20-ft. depth samples should continue to be taken to monitor phophorus levels to determine if more alum should be added.

Management Objectives

An updated "**Lake Management Plan,**" submitted Oct. 1, 2012, covers programs outlined above. Thus far, Kinderhook Lake Corporation has been responsible for all the improvement programs using volunteers - no commercial firms have been used to support the programs. Grants were received from Hudson City Bank and Niagara Mohawk to support the 2001-02 alum-treatment programs. Local town officials and riparian owners have been kept informed of the programs by KLC Newsletters.

Since Kinderhook Lake is relatively small, a policy of **Whole Lake Management** has been adopted. An annual drawdown of about 4 ft. is performed in the Winter to reduce shoreline growth of aquatic plants and prevent ice and water damage to shorelines during the Spring melt. Thus, the Corporation has adopted a **Year-Round Management Plan. Curly-leaf Pond Weed and Milfoil** are accepted as an integral part of the plant population, and, although growth increased in 2008 and 2009, it has leveled off in subsequent years. **Coontail** increased in 2009 and 2010 but has leveled off and is a part of the milfoil beds. **Sago Pondweed** is increasing at the north and south ends of the lake but is in shallow water and presents no problem to boating. In 2012, water clarity was low so weed growth presented no problem to boating or swimming - the beds appear to be thin but healthy. Thus, we will continue our program of **Selective Control.**

We plan to continue the confinement of **Water Chestnuts to the North end. Bushy Pondweed, Leafy Pondweed** and **Coontail** will continue to be monitored along shorelines.

Water clarity and overall esthetics of the lake, including phytoplankton growth, have improved over the past eleven years. Alum application to the **Valatie Kill** was not very successful in 2006, but may be attempted again using more appropriate equipment and larger quantities of alum. One of our goals has been to completely eliminate the use of copper sulfate and toxic herbicides to control plant species but, until the Valatie Kill, septic and surface runoff inputs can be reduced, it may be necessary to continue the use. In 2009, four 1,000# applications provided acceptable control of blue-green algae with little or no floating blue-green or gray algae before or after treatments. In 2010, water clarity dropped to 4 ft. in July due to a very thin, filamentous algae but very little floating blue-green scum was observed until the middle of September when copper sulfate applications were discontinued. The same observations were made in 2011 and 2012 when five 1,000# applications proved effetive.

Management Alternatives

Since the present **Integrated Methods** appear to be accomplishing the long-range objectives of improving water quality and controlling invasive plants, no methods, other than those mentioned above, are planned.

Pre-, During- and Post-Treatment Actions Planned

Monitoring-

Aquatic Plants - Populations are monitored in June and August by KLC personnel and detailed Annual Reports have been submitted to DEC since 1997, using maps to identify locations and data to record density.

Water Quality - Beginning June1st each year since 2000, algae levels have been monitored microscopically weekly and phosphorus levels biweekly. A quantitative, grid-method is used to record levels of diatom, blue-green, ceratium and green algae forms and a semiquantitative method is used to evaluate relative levels of ten forms of algae and zooplankton. Secchi disk readings are taken weekly. Accurate records are kept for each copper sulfate treatment and detailed reports of the results have been submitted to DEC each Fall. All treatments, monitoring and report preparation and submissions are performed by Kinderhook Lake Corporation volunteers.

Early Response-

Curly-leaf Pondweed and Milfoil are controlled by the methods covered above; no cutting or harvesting is performed to permit the milfoil weevil to continue to infect the growing tips of the milfoil and provide control. Water Chestnut removal is begun as soon as leaflets reach the surface and are deposited on shore-lines to dry. Hand harvesting of the leaflets and nutlets is continued throughout the Summer by residents and volunteers. Whenever possible, nutlets are burned. Reparian owners are reminded repeatedly in the Newsletter, to remove plants from the lake whenever they are seen. Signs are posted at the Public and Corporation Launch Site to avoid the introduction of exotic plants and zebra mussels into the lake. Boat-cleaning methods, to avoid introduction of zebra mussels, were included in the Newsletter. Thus far, no mussels have been detected but calcium levels in the water are high enough to support growth.

Source Management

By addition of alum to the Valatie Kill upstream from the lake in 2006, we had hoped to reduce the input of phosphorus and it may be attempted again. Analyses indicate that nitrogen levels are within acceptable range for plant growth and are not the the source of excessive algae growth. Riparian owners who live on the lake are encouraged to clean septic tanks annually, summer residents biannually. They are requested to discontinue the use of phosphate-containing fertilizers and to provide a border of nutrient absorbing plants along their shorelines. Huge boulders and rocks have been placed at the edges of the Valatie Kill upstream from the lake to reduce erosion and movement of silt into the lake. However, sometimes the flow is so violent (80 million gallons per day following extremely heavy rains) that it has been very difficult to prevent erosion. Attempts will continue to provide better control.

Evaluation of Efficacy

As mentioned above, the techniques presently employed appear to be improving the quality of water and the level of plant-life in the lake. Weed beds are important to the fishery and the strategy of attempting to shift the population from invasive to native species appears to be working. A resident survey performed in 2003 indicated that residents were aware of the programs in progress and wanted them continued. Voluntary membership and contributions to Kinderhook Lake Corporation have continued to provide support for programs.