Results of the Ten Year Plan: A Proposal for Alum Treatment of Lake Mohegan

By

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Summary and Overview

In 1990, the Mohegan Lake District adopted a Ten Year Plan, for the management of the lake during the years 1990-2000. Researched and written entirely by local volunteer David Wright, the 54 page report provided a framework for management efforts during the past ten years. That report summarized 60 years of data and sampling reports from a variety of sources, applied basic limnological principles, and suggested a number of tactics to try to preserve what was recognized to be a very sick lake.

Thanks to a good group of volunteers and supportive town administrations, much of what we sought to accomplish, was accomplished. In 1991, power boats (over 5 hp.) were banned from the lake; a new wetlands law was adopted, "lake-friendly" fertilizer was located and promoted. The lake was stocked several times with Walleye, to try to correct the fish biomass dislocation. A new and improved aeration system was installed. The old weed harvester was overhauled, and weed removal was now measured in the tens of tons per year. We stopped using copper sulfate, an algicide which merely served as a band-aid and appeared to do more harm than good. We located and stocked the lake with *Daphnia pulex* zooplankton. We mapped and started work on remediating road catch basins and actually got one catch basin moved. Many of our members carried petitions and worked to get sewers under construction.

Clarity of the water improved from the late 1980s. We experienced some of the best water clarity ever recorded at the lake, during 1995 and 1996. However, the past three years have seen the quality fall back to being "poor" at best. Although this is largely the result of three mild winters, the District is not satisfied with the water quality, and has sought another tool.

Since 1992, the District has studied the possible use of aluminum sulfate, or "alum." Briefly, alum is not an algicide, and is not toxic to anything. It works by (1) attaching itself to phosphorus in the water and precipitating it to the bottom of the lake, and (2) then sealing the bottom of the lake, preventing the release of further phosphorus from the bottom sediments for a period of time. Without phosphorus, the algae cannot grow, and the water is clear.

The cost is high. Probably $25,000 for the first year, and $20,000 a year thereafter. This is well within the scope of the District's annual $47,000 budget, and it is proposed to reduce the dedicated Dredging Capital Fund (with almost $100,000), to re-dedicate it to this project.

Background: The Ten Year Plan

In the late 1980s, the Lake District became re-invigorated, as the water quality in the lake declined from "poor" to "miserable." The water smelled bad, and was constantly covered with green slime. Weed growth was also out of control. The primary management technique was, several times each summer, to treat the lake with toxic copper sulfate.

This author sat down and reviewed all the data and scientific reports which had been prepared. These consisted primarily of the 1972 and 1977 reports from Carpenter Environmental, a 1982 K-V Associates report and 1983 Alfred Crew sewers study. In addition, the lake district had conducted monitoring through several contractors over the years.

The good news was, the healthfulness of the water was generally excellent. Bacteria levels were very low, and may have had wildlife as the source rather than failing septic tanks. Unfortunately, the clarity of the water was poor. Although there is no formal rule, the accepted national standard for swimming is 4 feet of sight depth.[1] For most of the summer in the late 1980s, this standard was not met.

During May and June, Green Algae would grow, but usually the lake was moderately clear; then in July and August Blue Green Algae would overtake the lake and reduce water clarity to "poor."

The conclusion of every study was that Lake Mohegan was "eutrophic" oir "hypereutrophic," meaning there was much more biological activity than would be expected in a healthy lake. The lake was sick.

The causes were clear. There was too much phosphorus and nitrogen in the lake's water. Like any other weed, algae thrives on these elements. Studies concluded that we should address phosphorus, which is the "limiting" agent – if phosphorus can be reduced, algae growth can be reduced.

The first source of phosphorus was the watershed. Most of the phosphorus (60%) comes from road runoff and catch basins, which in turn collect all the excess lawn fertilizer applied by local property owners. The second largest source (30%) was septic tanks; even if they function properly, they eventually give off large quantities of phosphorus and nitrogen.

The second source of phosphorus is the lake's sediments, which are rich in phosphorus and nitrogen. In this shallow lake (average depth 8.3 feet), the surface waters can easily mix with bottom water and replenish the phosphorus supply. The sediments themselves are at least 20 to 30 feet thick, an ooze comprised of leaves, grass clippings, weeds and dead algae.

The Ten Year Plan proposed a number of tactics to address the problem:

1. Stop the use of copper sulfate. It was discovered that this chemical more effectively kills the zooplankton which feed on the algae, so a very temporary improvement in clarity came at a price of destroying the algae's natural predator, the zooplankton. We stopped using copper in 1991.

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[1] "Sight depth" is the distance one can see down into the water. It is measured by use of a Secchi disk, a black-and-white circular disk in common use throughout the world.

2. Ban power boats, whose huge engines and props, stirred up the sediments from the bottom of the lake like a giant egg beater. The Town banned power boats over 5 hp. In 1991.

3. Improve the aeration system to oxygenate the water, allowing fish to live, increasing the habitat for zooplankton to grow and restore themselves, and allowing rust to precipitate and partially seal the bottom sediments. Aerated water also allows for more beneficial bacteria to grow and consume some of the bottom sludge, and inhibits the release of phosphorus bonded in bottom sediment. In fits and spurts, the aeration system was improved, though it is still far short of the goal of 130 cubic feet per minute.

4. Increase watershed protection to 200 feet around the lake. Prohibit the removal of buffer vegetation whose roots could take up nutrients otherwise entering the lake. Prohibit the use of commercial fertilizers within the same area. The Town passed these laws in 1991; however, most people still use commercial lawn fertilizers, even though zero-phosphorus fertilizer is now available at Home Depot.

5. Dredge the lake. This is probably the only long-term solution to saving the lake. At 100 acres and 8 feet deep, it is a management nightmare, almost an impossibility to save. If 20 to 40 feet of sediment can be removed, the lake can be restored. This would be several million cubic yards of material. This will cause several good things to happen. First, there will be more water, creating a thermal cushion when summer comes; now the water heats up like a giant Petri dish, accelerating algae growth. A deeper cooler lake will slow this process. Unfortunately, over 10 years, almost no progress was made on this aspect. In 1998, we finally got a bid for Aquadredge (Charles Pound, Armonk, NY) to do the sampling work as a precursor to dredging 10 acres for about 15,000 cubic yards. Just the sampling was to cost over $100,000, and with no clear prospect for getting a permit, and without any idea of the final cost of the dredging itself.

6. Biomanipulation. It was recommended to survey the biomass of fish in the lake, and stock certain predator fish to restore the food chain. Ken Wagner of Fugro McClellan did the survey and confirmed there is a lack of predator fish and an abundance of small panfish, sunnies and bluegill. We therefore stocked some 2,000 walleye pike, a voracious predator fish. Good news is, people said it wouldn't survive in Lake Mohegan, but the walleye didn't agree. We should stock another 2,000 and more bass. All reports indicate the fishing in Lake Mohegan is the best it's ever been.

7. Sewers. We advocated the installation of sewers around the lake. Both East and West are now under construction, which will sewer some 600 homes. Unfortunately, this may reduce the water level of the lake, and the District has gotten quotes and entered into contract with a well driller to drill a deep test well to explore the possibility of bringing deep aquifer water into the lake. It is planned to present the first well results to a hydrologist for further study.

8. Aluminum Sulfate. It was proposed to study the use to heavy dosage and low dosage aluminum sulfate. Heavy dosage is the conventional application, which seals the bottom.

We wanted to explore a low dosage, which might be sufficient to precipitate the phosphorus from the water, yet not be so heavy as to seal the bottom. This would be like a non-toxic substitute for copper sulfate. The contractor who did the testing was not enthused – he wanted to just do a heavy dose – so the test results were defective. To this day, we don't know if a low dose of alum will serve to precipitate phosphorus from the water. As to the heavy sealing dose, we hesitated for two reasons. First, some of us felt it would be silly to dump tons of chemicals into the lake one year, if we were going to dredge them out the next year. As it turns out, however, dredging is not economically feasible. Second, there was a feeling that the results would be ephemeral – with 10 times as much phosphorus in the lake, and more coming in every time it rains, we questioned the longevity of the treatment. We felt it would only last a year (if that), and be very expensive.

The Proposed Alum Treatment

Based on all of this, I have come down to recommending the heavy dose alum treatment, as the only realistic management option. Of course, we must continue aeration, weed removal, fish stocking and watershed protection. But this is the only viable means of achieving significant improvement in water clarity.

I propose we dedicate the dredging capital fund to an alum capital fund. This will fund a five year plan as follows:

Year 1 (2000) – Full heavy dose treatment, approximate cost $25,000.
Year 1 - 5 – Maintenance follow-up doses as necessary, approximate cost $18,000 per year

Two case studies, Mountain Lakes, New Jersey and Lake Wallenpaupack, Penn., are very similar to Lake Mohegan. In each case, the lakes experienced very high nutrient loading, they were shallow, and water quality was poor. In each case, the contractor adopted a multi-year plan: apply a heavy sealing dose the first year, and apply lesser maintenance doses in succeeding years. The results were great water quality, and it was also discovered the alum did not adversely impact on anything and eventually disappeared into the sediments.

I am attaching with this report some articles and data on alum application.

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