Native aquatic plants flourish in the shallow, nearshore areas of Muskellunge Lake (Figure 31). They can create some navigational nuisances. Channels could be created through the plants to facilitate boating access, but it is recommended that only the minimum amount of plants be removed to reduce nuisance conditions.

Figure 31. [top] In the nearshore areas a variety of submerged and floatingleaf plants are present. [bottom] One of the most common plants in Muskellunge Lake is the native plant, coontail. It is difficult to control.

A variety of options are available for the creating channels through dense aquatic plant growth. An example of a manual method is the weed puller shown in Figure 32. It can be used to create a channel and remove plants at the same time. Rakes can also be used.

Another option is harvesting a channel about 20 to 30 feet wide through the surface matted growth would allow unrestricted navigation and should not harm the lake. Mechanical harvesters pick-up most of the plants that are cut (Figure 32). Hiring a mechanical harvester to cut channels or clear cut areas in the northern bays would cost about $600 - $800 per acre.

Figure 32. A mechanical harvester is recommended for picking up coontail in the northern bays if plant management is considered.

Project 5. Fish Management Options

The aeration system appears to be meeting the objective of keeping fish alive over winter. This winter aeration program probably needs to continue indefinitely. However, it would be helpful to take winter dissolved oxygen readings to make sure the aeration system is sustaining fish. There does not appear to be any benefit to running the aerator during the summer as a water quality project, at this time. However, if the pH of the sediments was greater than 8.0, then aeration could be considered. Sediments will release phosphorus at high pHs and aeration can sometimes lower the pH.

A future project could involve a fish and aquatic plant manipulation in an attempt to improve water clarity. Increasing gamefish with stocking and removing panfish by netting could help to restructure the fish community. Then, maintaining channels through the aquatic vegetation would allow gamefish better access to panfish and aid in sustaining panfish control.

Figure 33. The Muskellunge Lake Association operates the winter aeration system on Muskellunge Lake.

Project 6. Sediment Alum Treatment for Water Clarity Improvement

The best chance at improving lake water quality is to address the groundwater and lake sediment phosphorus release. These two sources represent over 70% of the nutrient input into the water column. The use of an alum sediment treatment would address both phosphorus release from lake sediments and phosphorus associated with groundwater inflow.

A common technique to reduce sediment phosphorus release from lakes when lake bottom phosphorus is a significant phosphorus source is a sediment alum treatment. Using an alum dosing determination methodology of Rydin and Welch (1999), helps to estimate an alum dose required to reduce phosphorus release to 1 mg-P/m^2/day. At this time, a dose requirement has not been made. However, for this discussion it is estimated that about 1,000 gallons of alum per lake acre would be needed. A dose of this magnitude would probably be applied with three treatments of 333 gallon of alum/ac over 3 or 6 years.

Under existing conditions, it is estimated that groundwater and p-release account for 492 pounds of phosphorus per year, the equivalent to 2.5 mg-P/m^2/day for 100 days. If the alum treatment was effective in reducing the excessive phosphorus release from lake sediments down to 1 mg-P/m^2/day, the bottom loading would be reduced to 200 pounds per year. The new annual phosphorus budget for the lake would not be 380 pounds of phosphorus per year. It is predicted lake phosphorus concentrations would drop to 30 ppb or less in the lake and transparency would increase to 6.6 feet compared to the observed 4.3 feet as a seasonal average. However, there is no guarantee the effect would last longer than several years.

Figure 34. An alum application is generally applied from a barge. This was a lake sediment alum application on Lake Susan in Chanhassen.

If an alum treatment was to be considered, several steps are necessary to move forward with implementation.

Sequence of events

1. Collect top and bottom water samples, twice a month, May through September and once per month October through April.
2. Monitor pH of lake water, incoming groundwater, and lake sediments for one year. Monthly measurements are probably adequate.
3. Test Muskellunge Lake sediments to determine the alum dose required.
4. Pursue funds for financing an alum project from the Wisconsin DNR.
5. Because water will clear up, set aside funds for additional aquatic plant harvesting.

Cost Range: It is assumed that 80% of the lake surface would be treated with alum and this is about 220 acres. Until more information is acquired, an assumed cost is $1,100/ac. The total cost for the alum project would be approximately $242,000.

Project 7. Ongoing Education Program

Lake residents get an important amount of lake protection information from the lake newsletter. Each issue should offer tips on lake protection techniques. There is abundant material available. An example of an informational piece is shown below. Additional information on preventing the introduction of exotic plants and animals is found in the Appendix.

15 WAYS TO PROTECT WATER QUALITY

1 Pick up pet waste from your yard 2 Use only phosphorus-free fertilizer 3 Know the rules and permits required before you build, dig, or clear vegetation in shoreland areas 4 Restore and maintain your shore with a thirty-five-foot vegetative buffer 5 Learn the value of native aquatic plants and keep them in place 6 Keep roadside ditches clear of debris, grass clippings and leaves 7 Prevent sediments from reaching waterways 8 Control storm runoff by installing rain barrels, rain gardens, or splash blocks 9 Respect slow and no-wake zones when boating 10 Inspect and maintain your septic system regularly 11 Fire pit ashes contain phosphorus: prevent them from reaching the water 12 Remind visitors of water use and recreation regulations 13 Inform new neighbors of water quality issues 14 Be a good shoreland steward 15 Get involved!

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One reason why

Project 8. Watershed and Lake Monitoring Program

At this time, because of good runoff water quality, new watershed water quality monitoring is not proposed. A lake monitoring program is outlined in Table 16. It is designed to be flexible to accommodate the volunteer work force and a fluctuating budget.

Table 16. Muskellunge Lake Water Quality Monitoring Program.

Category	Level	Alternative	Labor Needed	Cost/Year
A. Dissolved oxygen and temperature profiles	1	Check dissolved oxygen in Muskellunge Lake every two weeks in January, February, and March depending on winter conditions.	Moderate	$0
	2	Check dissolved oxygen in Muskellunge Lake every one to two weeks in December, January, February, and March, depending on winter conditions and collect phosphorus samples.	Moderate	$0
	3	Check dissolved oxygen and temperatures once per month from May - September.		
B. Water clarity	1	Secchi disc taken at spring and fall turnover.	Low	$0
	2	Secchi disc monitoring once per month May - October.	Low-moderate	$0
	3	Secchi disc monitoring twice per month, May - October.	Moderate	$0
C. Water chemistry	1	Spring and fall turnover samples are collected and sent to UW-Stevens Point. Selected parameters for analysis include: TP and chlorophyll.	Low	$200
	2	Sample for phosphorus and chlorophyll once per month from May - September (surface water only) with the Self-Help Monitoring Program.	Low-moderate	$300
	3	Sample for phosphorus and chlorophyll twice per month from May - October.	Moderate	$600
	4	Sample for phosphorus, chlorophyll, Kjeldahl-N, nitrate-nitrite-N, and ammonia-N once per month (May-October)	Moderate	$960
	5	Sample for phosphorus, chlorophyll, Kjeldahl-N, nitrate-nitrite-N, and ammonia-N twice per month (May-October).	Moderate	$1,920
D. Special samples or surveys	1	Special monitoring: suspended solids, BOD, chloride, turbidity, sampling bottom water, and other parameters as appropriate. Aquatic plant surveys, etc.	--	$100-$3,000

A recommended monitoring program consists of Level A1, A3, B2, and C2 annually. An aquatic plant survey (Level D1) should be conducted every three years. Lake sediment pH could be checked as well. In addition, a zooplankton sampling program could be considered.

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