

FINDINGS OF THE TECHNICAL REVIEW COMMITTEE

October 2009

INTRODUCTION

The LMCD expects to receive increasing requests for new surface structures in shallow areas of the lake. An environmental committee was formed to evaluate the existing ordinances as to their ability to protect these shallow from any possible irreparable damage. It was concluded that any recommendations should be based upon both environmental concerns and public input. A Technical Advisory Committee (TAC) was formed to determine the environmental concerns. The TAC consisted of:

David Gross, Committee Chair and LMCD Board
Lisa Whalen, LMCD Board
Jack Gleason, Minnesota Department of Natural Resources (MN DNR)
John Barten, Three Rivers Park District (TRPD)
Tim Latterner, Dock and Lift Service
Dr. David Biesboer, University of Minnesota (U of M)
Tony Brough, Hennepin County Environmental Services
Dr. Udai Singh, MCWD

TECHNICAL ADVISORY COMMITTEE

The first concern of the TAC was to base its recommendations on generally accepted scientific principles. The scientific literature was surveyed to determine what research had been performed in the cognizant areas. Several Technical papers and memoranda were identified as being relevant to the mission of the TAC. A task was assigned to review these papers and memoranda then summarize and document content as to applicability to the protection of Lake Minnetonka from Docks and Motor Boat traffic in shallow water. From this information conclusions would be drawn and recommendations made.

The following papers and memoranda were submitted for review

- 1 Effects of Pier Shading on Littoral Zone Habitat and Communities in Lakes Ripley and Rock, Jefferson County, Wisconsin
[http://files.dnr.state.mn.us/waters/watermgmt/section/shoreland/PUB-SS-1006 Piers.pdf](http://files.dnr.state.mn.us/waters/watermgmt/section/shoreland/PUB-SS-1006%20Piers.pdf)
- 2 The Effects of Motorized Watercraft on Aquatic Systems, Timothy Asplundh. [http://files.dnr.state.mn.us/waters/watermqmt/section/shoreland/lakes watercraft.pdf](http://files.dnr.state.mn.us/waters/watermqmt/section/shoreland/lakes%20watercraft.pdf)
- 3 Changes in Phosphorus Concentrations due to Mixing by Motorboats in Shallow Lakes , Yousuf,McLellon and Zebuth
- 4 Management of Small Docks and Piers- Best Management Practices

- <http://coastalmanagement.noaa.gov/initiatives/media/bmp.pdf>
- 5 Living on the Water
<http://www.bocc.citms.fl.us/devseivices/commdev/envrig/livingwater.pdf>
- 6 Lake Ripley Water Census & Recreational Carrying Capacity Analysis <http://www.lakeripley.org/>
- 7 Shallow Areas, the Near Shore Zone and Human Impacts, Fact Sheet #10 of the Shoreland Management and Lake Classification Series
<http://www.uwsp.edu/cnr/uwexlakes/factsheets/fs.JQ.pdf>
- 8 Comprehensive Study Looks at Pier Impacts on Fish and Aquatic Life
<http://dnr.wi.gov/fish/documents/effectsofpier shading on fish.pdf>
- 9 Alternatives for Coastal Development: One Site, Three Scenarios (Docks Indicator Information)
<http://www.csc.noaa.gov/alternatives/docks.html>
- 10 Coastal Connections Newsletter (October/November 2003)
<http://www.csc.noaa.gov/newsletter/2003/issueQ>
- 11 Can no-wake zones effectively protect littoral zone habitat from boating disturbance Aspund and Cook
- 12 Effects of Motor Boats on Submerged Aquatic Macrophytes Aspund and Cook
- 13 A simple model for evaluating the costs and benefits of aquatic macrophytes. Van Nes, E., van den Berg, M., Clayton, J.S., Coops, H. Scheffer, M., and van Ierland, E. 1999. *Hydrobiologia* 415: 335-339
- 14 Effects of pleasure-boat traffic on macrophyte growth in canals. Murphy, K.J. and Eaton, J.W. 1983. *Journal of Applied Ecology* 20: 713-729.

ANALYSIS

The following analysis is presented:

1.0 Effects of Pier Shading on Littoral Zone Habitat and Communities in Lakes Ripley and Rock, Jefferson County, Wisconsin

This paper is from the Wisconsin DNR.

The direct and indirect ecological effects of pier shading were evaluated on two calcareous lakes in southeast Wisconsin. Sunlight availability and the response of macrophytes, macroinvertebrates, and both juvenile and small non-game fishes were evaluated under piers and within nearby control sites. All measurements were taken in water depths of 1.5 to 5ft.

Findings revealed significant shading under piers with a corresponding reduction in aquatic plant abundance, as well as a shift in community composition to one dominated by shade-tolerant species. The median biomass under the piers was 5 grams compared with 107 grams in the control sites. The resulting loss of macrophyte habitat under piers translated into a reduction in macroinvertebrate numbers. The median number of macroinvertebrates under the piers was 23 compared with 61 in the control sites. Juvenile Centrarchid fishes showed preference for abundant macrophyte cover found in control areas. Mean fish catch rates under piers (11.2) were statistically lower than catch rates within plant beds (38.7).

Results suggest that the proliferation of piers and other near-shore structures are contributing to the degradation of littoral zone habitat and biological diversity.

2.0 The Effects of Motorized Watercraft on Aquatic Systems

This paper is from the Wisconsin DNR

This paper is a survey of other work. The Paper is divided into determining the effects in 7 different areas. They are Water Clarity (Turbidity, nutrients, algae), Water Clarity (Metals, Hydrocarbons), Shoreline Erosion, Macrophytes, Fish, Wildlife and Human Enjoyment. The first four are most applicable to Docks and boat traffic in shallow water. The following conclusions are drawn:

While the effects of boats on aquatic systems are complex and depend on a number of factors, a few general observations can be made.

First, the physical effects of propeller, waves, and turbulence appear to be more of an issue than engine fuel discharge. Water clarity, aquatic plant disturbance, and shoreline erosion all are serious issues that can be exacerbated by boat traffic. Second, most of the impacts of boats are felt most directly in shallow waters (less than 10 feet deep) and along the shoreline of lakes and rivers not exposed to high winds (less than 1000 feet of open water). Third, these effects can have repercussions for other features of the aquatic ecosystem, including the fish community, wildlife use, and nutrient status.

These observations all emphasize that the most important area of a lake or river to protect is the shallow-water, near-shore habitat known as the littoral zone. Boats that operate in deep waters with large surface areas are not likely to be impacting the aquatic ecosystem.

3.0 Changes in Phosphorus Concentrations due to Mixing by Motorboats in Shallow Lakes

This paper is from the University of Central Florida

Changes in water quality due to mixing by motor-boats were studied in shallow lakes of Central Florida, namely Lakes Claire, Mizell and Jessup. The lakes differ in average

water depth, sediment characteristics and trophic state. The lakes vary in average depth from 7 to 12 feet.

The results showed significant increase in turbidity and ortho- and total phosphorus concentrations in water samples collected after mixing by motorboats in Lakes Claire and Jessup. The results obtained from Lake Mizell were not as conclusive. Lake Mizell was substantially deeper, had a sandy bottom sediment in the shallower depths and it was frequently used for recreation activities which made it difficult to maintain a valid control. The increase in the orthophosphorus content for Lakes Claire, Mizell and Jessup averaged 43, 16 and 73% which corresponded to an average of 46, 24 and 105 mg-P of orthophosphorus resuspended per square meter of the bottom sediments, respectively. Similarly, the increase in the total phosphorus content for Lakes Claire, Mizell and Jessup averaged 39, 28 and 55%, which corresponded to an average of 84, 58 and 249 mg-P, respectively.

Positive correlations existed between turbidities and the phosphorus content in the water column and the calculated correlation coefficients were greater than those required for a 1% level of significance. The rate of increase in the phosphorus content with mixing time is much higher than the rate of decline after cessation of mixing.

Data indicate substantial water quality effects are possible due to recreational boating on shallow lakes. These effects are significant and should be considered in water resource studies. Whether physical control of boating sizes and/or horsepower is required for these type lakes is not determined. However, the study provides a base for regulatory control to prevent degradation of water quality due to mixing and for consideration in waste load allocation modeling.

4.0 Management of Small Docks and Piers- Best Management Practices

This memorandum was funded by NOAA, NCCOS and OCRM

This memorandum describes the Best Management Practices to minimize shade under docks installed in shallow water.

Among the recommendations are:

- 4.1 Elevate Docks
- 4.2 Keep Docks as narrow as possible
- 4.3 Orient docks North/South
- 4.4 Avoid covering docks with structures
- 4.5 Increase light transmission through Docks

And most relevant to our mission

Maintaining a minimum distance between structures (this might involve requiring communal or shared docks rather than a one-dock-per-lot situation)

5.0 Living on the Water

This memorandum is of unknown origin

This memorandum states generally accepted facts without justification. The most relevant recommendations are:

- 5.1 Establish a zone of native plants between your lawn and the shoreline, and leave natural vegetated shorelines when possible.
- 5.2 If erosion is a problem, consider installing rip rap (native limestone boulders) instead of flat concrete walls. The irregular shape and cavities provides food and shelter to fish and wildlife.
- 5.3 If you already have a seawall, consider softening it by planting native plants or installing rip rap waterside of the wall.
- 5.4 Consider dock designs that reduce shading of sea grasses or submerged vegetation. Often board spacing or cover design can be adjusted to allow better light penetration.
- 5.5 Design your dock to avoid prop dredging or bottom damage to submerged vegetation. If you own a large boat in a shallow water body, consider an alternative or off-site storage.

6.0 Lake Ripley Water Census & Recreational Carrying Capacity Analysis

This report is was produced by the Lake Ripley Management District

This report is a detailed analysis of the carrying capacity of Lake Ripley. While it is interesting reading and they struggle with many of same density problems as does the LMCD, there in no relevant data regarding the Docks and Motor Boat traffic in shallow water.

7.0 Shallow Areas, the Near Shore Zone and Human Impacts

This pamphlet is produced by the Wisconsin Lakes Partnership
This pamphlet contains recommendations to Cities to enact ordinances for Docks and Surface use based upon the work of Aspund and Cook. It is non specific and contains no new information.

8.0 Comprehensive Study Looks at Pier Impacts on Fish and Aquatic Life

This pamphlet is of unknown origin

This pamphlet contains recommendations to homeowners on the sitting of docks based upon the work of Aspund and Cook. It is non specific and contains no new information

9.0 Alternatives for Coastal Development: One Site, Three Scenarios (Docks Indicator Information)

This pamphlet is produced by NOAA

This pamphlet contains recommendations to the public on dock construction standards. It states that you should avoid shading but contains no new information

10.0 Coastal Connections Newsletter (October/November 2003)

This pamphlet is produced by NOAA

This pamphlet contains recommendations to the public on dock construction standards. It states that you should avoid shading and pollution but contains no new information

11.0 Can no-wake zones effectively protect littoral zone habitat from boating disturbance

This is another paper from Aspund and Cook at the Wisconsin DNR

Long Lake Wisconsin was studied to determine the effect of High Speed boats on the vegetation of the Littoral zone. The lake is used for water skiing and has long areas of the littoral zone exposed to high speed boat traffic. Scoured areas were observed showing the tracks of high speed boats. The study determined the effect of placing No-wake buoys to protect the study areas.

Data were collected in 1995 prior to No wake buoy placement, and the bottom was resurveyed in 1997 after the placement of buoys. As can be seen in the results the no wake buoys resulted in Chara growing in the previously Scoured areas

Table 1. Percentage of experimental plots covered by Chara, Milfoil, and Scour as determined by digital image analysis of aerial photographs taken in 1995 (prior to buoy placement) and 1997. Numbers are averages of replicate plots and do not necessarily sum to 100 percent.

	1995			1997		
	% Chara	% Milfoil	%	%	% Milfoil	%
No-	47.8	19.7	29.7	75.9	16.5	1.5
No-Wake	57.4	20.0	17.4	69.9	21.5	2.0
Open	64.1	18.4	12.0	65.6	21.8	2.2

12.0 Effects of Motor Boats on Submerged Aquatic Macrophytes

This is another paper from Aspund and Cook at the Wisconsin DNR

Lakes across the country are increasingly threatened by overuse, particularly involving more and larger motor boats. In recent years, Lake Ripley, located in Jefferson County in southern Wisconsin, that exhibited a decline in macrophyte abundance along with increased motor boat activity.

To examine the possible connections between these two events, a study on the effects of motor boats on submerged aquatic macrophytes was conducted during the summer of 1995. Four enclosures, two of solid plastic and two of mesh fencing, were built in each of two areas in about 1 m of water adjacent to high boat traffic areas. These enclosures were intended to exclude motor boat access and, in the solid-walled enclosures, to block the turbidity generated by boat-induced sediment resuspension.

Weekly water samples were collected for turbidity, suspended solids, dissolved oxygen, and temperature. At the end of the study, plant biomass, height and percent cover were measured inside the enclosures and in control plots. Our hypothesis was that Motor Boats limit macrophyte growth either directly by physical disturbance or more indirectly by generating turbidity which decreases light availability and therefore limits production and biomass.

Results indicated that motor boats reduced plant biomass quite dramatically, primarily through scouring of the sediment substrate and direct cutting, but not through turbidity generation. Excluding motor boats from small experimental plot in a lake with heavy boat traffic significantly increased macrophyte biomass, coverage, and shoot height compared to impacted area.

13.0 A simple model for evaluating the costs and benefits of aquatic macrophytes

This peer-reviewed paper is from the Netherlands.

Dense beds of macrophytes are a nuisance for boating, fishing, and swimming in freshwater lakes. In many lakes, lake managers are trying to restore native vegetation that has disappeared because of the invasion of exotics or loss of water quality. Establishing a stable littoral zone of vegetation reduces lake turbidity, increases water quality and increases diversity of plants and important benthic organisms in a lake.

This paper has some interesting points that apply to Lake Minnetonka. For boaters and swimmers, the obvious solution to having macrophyte populations on lakes is to entirely remove them. However algal blooms will replace the macrophytes and invariably cause as much of a nuisance as the macrophyte populations. Thus, benefit curves for both nature conservation and recreation will decline.

This study concludes with two important points: 1) From environmental economic analyses, the optimal strategy to balance recreation and conservation on a particular lake, would be to aim for an intermediate biomass level. However, in lakes such a Minnetonka that has been invaded by a large amount of aquatic biomass by an invasive species (Eurasian watermilfoil), it becomes difficult to develop a stable biological system. 2) More importantly, the most useful model presented by these authors would suggest that the best management strategy would be to keep some parts of lakes totally free of aquatic “weeds” (macrophytes, whether native or non-native) and allow other portions of the lake to be densely vegetated.

14.0 Effects of pleasure-boat traffic on macrophyte growth in canals.

This peer-reviewed paper is from the England.

These authors examined how the movement of pleasure boats damages aquatic macrophyte communities in the very large canal system found in a large part of central England. They note that both propellers and hulls cause physical damage and up-rooting, turbulence increases water turbidity that in turn decreases plant photosynthesis, and that engine emissions may be toxic to plants and animals in the ecosystem.

A summary of this paper shows the following important points:

1) Using a cluster analysis, these authors showed significant associations between community diversity, abundance of aquatic macrophytes, and pleasure boat traffic. An interesting point they observed was calculated as the following unit: boat movements/hectare/meter depth/year or as an abbreviation, **my** (movements per year or **my**). Evidence was found that in a critical traffic range in one meter of water (3 feet deep) that 2000 to 4000 **my** reduced macrophyte standing crop by maintaining high turbidity. Low **my** resulted in large amount of summer time macrophyte growth whereas values greater than 4000 **my** resulted in very significant losses of macrophytes in shallow water. It could be noted based on this information that counts of boat traffic in shallow water of about 3 feet or less in lake Minnetonka would indicate a need for boat control if **my** exceeds 4000 boats per year.

2) Boat traffic in the range of 1000-2000 **my** seems to create a satisfactory balance between ecological and recreational uses of a waterway. This range of boats moving through shallow areas will maintain an open waterway and allow for a good diversity of both submerged and emergent aquatic species.

SUMMARY

Together the papers expound two consistent conclusions.

One That docks in the littoral zone prevents light from reaching the surface water and inhibit growth of both aquatic fauna and flora (1,4,5)

And

Two That Motor Boats operated at speed in the Littoral zone scour and mechanically disturb the lake bottom, increase turbidity and inhibit growth of both aquatic fauna and flora.(2,3,5,11,12.13).

No Wake zones can significantly reduce these effects(11). Motor Boat traffic in greater than 10ft of water has little effect on the fauna and flora.

Counts of boat traffic in shallow water of about 3 feet or less in lake Minnetonka would indicate a need for boat control if movements/year exceeds 4000 boats per year. Boat traffic in the range of 1000-2000 movements/year seems to create a satisfactory balance between ecological and recreational uses of a waterway. This range of boats moving through shallow areas will maintain an open waterway and allow for a good diversity of both submerged and emergent aquatic species. (14)

CONCLUSIONS

In order to maintain the stability of the Lake in light of increasing development the Littoral zone must be protected from the negative effects of surface structures and motorboat traffic. Minimal shading, no wake zones and reduction of boat traffic in shallow areas can mitigate the problem. There is a conflict between recreational use of the lake and the overall health of the lake. Suitable compromises must be found

RECOMMENDATIONS

1. Review LMCD ordinances to facilitate minimization of surface area of docks and other surface structures
2. Increase the use of no wake zones in sensitive littoral areas
3. Avoid high density traffic in shallow areas
4. Attempt to protect sensitive areas while allowing unlimited use in others
5. Educate the public to understand the damage caused by shading and motorboat traffic to the Littoral zone