Grand Lake

1999
Preliminary
Water Quality Study

Conducted and Submitted by:
Sauk River Watershed District

Funded by:
The Grand Lake Association

Grand Lake Water Quality Report

Grand Lake is located 2 miles south of Rockville, MN and is a developed recreational lake. The drainage area of Grand Lake is located in the Upper Mississippi- Sauk River drainage basin. The Grand Lake watershed is 8.8 sq. miles and is part of the Stearns County Pearl Lake Subwatershed unit that is 50.3 sq. miles. Within the Grand Lake watershed, the largest source of incoming water is from groundwater (Knutson 1980). However, nearly 100% of the surface watershed drains from four subwatershed units located west and southwest of the lake. Of the 5,679-acre watershed 51% drains from Ploofs Creek and 49% from three intermittent streams (Knutson 1980). Grand Lake has one outlet, which flows out the north end to join Mill Creek and the Sauk River at Rockville.

Morphological Data for Grand Lake

Parameters	Units
Surface Area	651 Acres
Volume	12,453 Acre-Feet
Littoral Zone	235 Acres
Maximum Depth	34 Feet
Shoreline Length	19, 540 Feet
Watershed Area	5,679 Acres
Ecoregion	North Central Hardwood Forest
Public Access	1

Since 1979, Grand Lake has undergone four lake studies. In 1979 Dr. Keith Knutson completed a water quality study at the request of the Grand Lake Owners Association. At the same time, Biocentric, Inc completed a study for Stearns County. The results of these studies were similar. In 1988 Wenck Associates, Inc. began a diagnostic study on Grand Lake. Due to lack of precipitation the study was not completed. However, the existing data is used in this report for comparison purposes. In 1995, the Minnesota Pollution Control Agencies conducted a Lake Assessment Project on Pearl Lake with Grand Lake as part of the Study. In 1998 the local area residents expressed concern for the water quality of Grand Lake. The area lake association contacted the Sauk River Watershed District (SRWD) to conduct a preliminary surface water study using their Lake Association funds. The results of these studies are summarized in the remainder of this report.

Grand Lake Summary

Lakes of the North Central Hardwood Forest ecoregion typically have Total Phosphorus concentrations ranging from 23 to 50 ug/L (micrograms per liter). Criteria developed by Heiskary and Wilson (MPCA1990) indicates that full support of recreation opportunities and aesthetics translated into a summer average value of less than 40 ug/L Total Phosphorus, with a maintained summer Secchi transparencies greater than 6.6ft (2m).

In 1999, Grand Lake averaged about 35 ug/L of Total Phosphorus. The four previous lake studies conducted (as mentioned above) reported Total Phosphorus levels of 48ug/L (1979 data, 2 reports), 42.8 ug/L (1988 data) and 38ug/L (1995 MPCA data). The summer average transparency data reported 4 feet, 3.1 feet and 8.8 feet respectively. The 1999 average transparency was 9.5 feet.

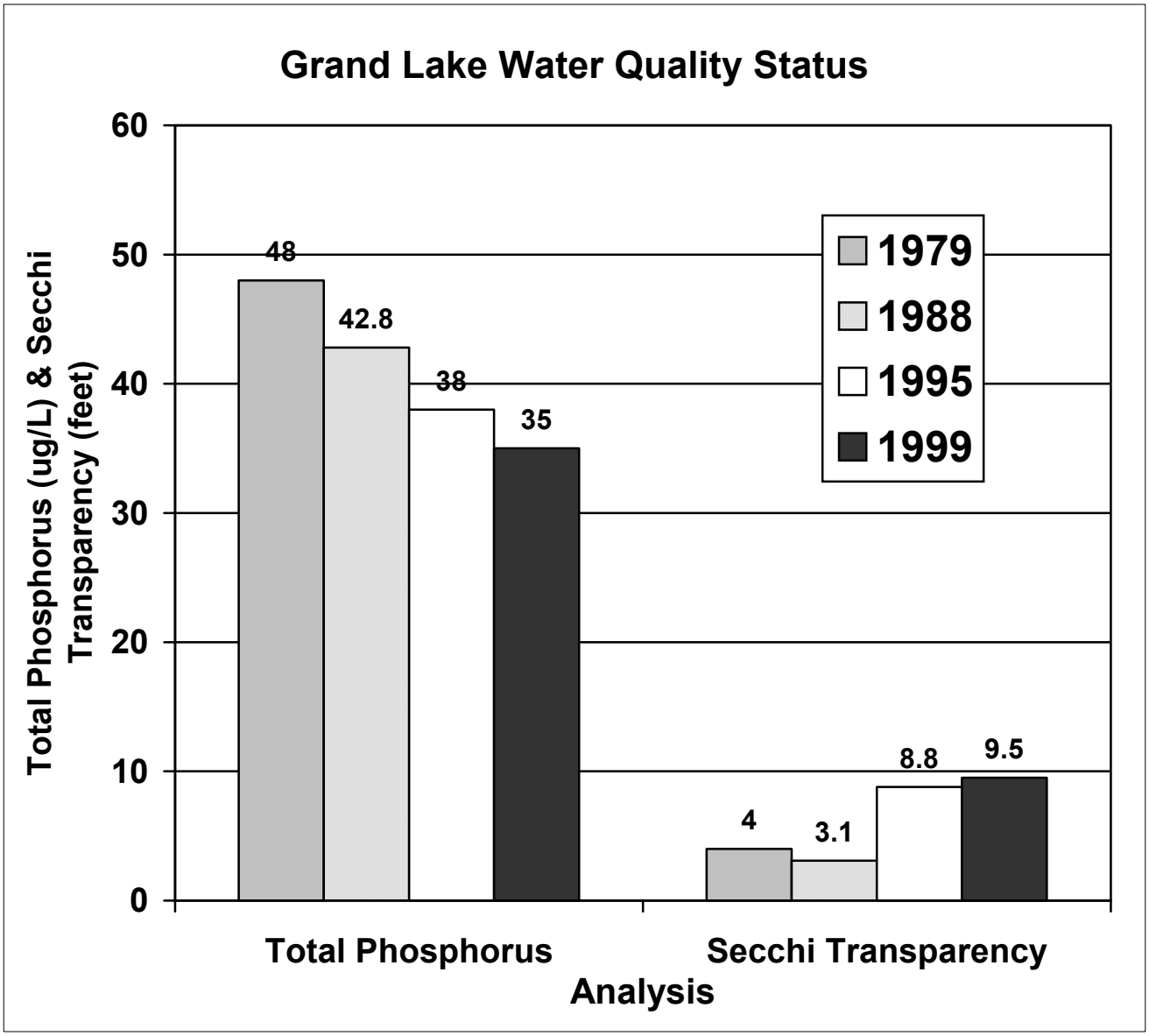
To maintain the in-lake ecoregion goal of less than 40ug/L of whole-lake average Total Phosphorus concentration, it is necessary to sustain or reduce the phosphorus loading to Grand Lake. This translates into annual flow-weighted mean Total Phosphorus concentrations in the inflow streams of about 100 - 160 ug/L. This Phosphorus target level is necessary to achieve improvement of in-lake conditions.

1999 Study

The Sauk River Watershed District staff began sampling in March 1999. Continuous flow monitoring equipment was installed along Ploofs Creek to collect any runoff event via an automatic sampler and flowmeter. In-lake monitoring occurred at 3 sites. Field analysis was conducted by the SRWD with assistance from local volunteers and members of the Grand Lake Association

The parameters analyzed and the sampling frequencies allowed quantification of the eutrophication parameters needed for modeling and quantification assessments (e.g. BATHTUB and Canfield and Bachmann). Summer measurements of transparency, pH, conductivity, temperature, and dissolved oxygen were measured with field equipment. SRWD staff collected Secchi transparency. Total phosphorus and chlorophyll A, Chloride, and all Nitrates were collected by SRWD staff and analyized by SRWD's contract laboratory. Measurements were accomplished 4-times at each lake sites, 11 times at Ploofs Creek and 6 times at the outlet of Grand Lake. Sampling was limited at the outlet due to dry conditions.

Epilimnetic (surface) samples were analyzed from 2-meter composite samples. Samples requiring preservation were preserved in the field and transported to the laboratory on ice. Laboratory analysis was conducted by a MDH certified laboratory under contract with the SRWD. Further information regarding laboratory results can be found in the attachments.



The 1999 data shows that the summer average total phosphorus concentrations from Ploofs Creek was 89.8 ug/L, which is below the ecoregion averages (100 -160 ug/L) for streams is this area. However, 1999 was a dry year, therefore additional monitoring would be necessary to further determine how Ploofs Creeks reacts during a wetter year.

The previous studies state that the majority of the incoming phosphorus loading is from Ploofs Creek (28%), septic systems/groundwater (28%), and from direct precipitation (28%). This determination correlates with the volume of flow from each source. Without a full diagnostic study it is difficult to further quantify these percentages in greater detail.

Conclusions

Reviewing the historic data and the 1999 data it is apparent that the land use in the 4 subwatersheds and lakeshore have changed to some degree. The in-lake Total Phosphorus summer averages and Secchi transparencies have improved in the past 20 years based on data available (see attachments). However, using Carlson's Trophic Status Index, the Minnesota Pollution Control Agency classifies Grand Lake as Eutrophic. With a trophic status of 53, Grand Lake falls on the low end of the Eutrophic status (see attachments). A lake with a Eutrophic status is said to have a high rate of nutrient cycling and, thus, a high level of biological productivity (MPCA Water Collection Manual 1994).

Watershed residents should work with local, state and federal officials to maintain or improve water quality in Grand Lake. The actions to accomplish this range along a continuum from taking no action to working to develop an integrated watershed plan with water quality as the main goal of this plan. Should watershed residents decide to actively protect water quality in Grand Lake, a first step might be to adopt a Non-degradation goal. It would be used to help establish water quality goals for such that would maintain full support of recreational opportunities and aesthetics within Grand Lake**.** The following recommendations have been given to help attain this goal.

1. Continue to monitor water transparency by participation in the Citizen Lakes Monitoring Program (CLMP). This monitoring serves as an adequate substitute for collection and analysis of water chemistry.
2. Groundwater and/or septic systems contributes a substantial amount of the inflow volume to Grand lake (28% according to the 1988 study). Lakeshore residents should ensure that septic systems are constructed and operating properly, with adequate sized tanks and drainfields, as well as correct separation distance from the bottom of the disposal trench to groundwater.

   Septic system performance should be examined in an attempt to better understand this potential bacterial and nutrient source to the lake. It is extremely difficult and expensive to technically quantify the precise losses of **any one** system to the lake. However, over the past ten years methods have been defined to approximate nutrient losses from septic systems. More information regarding these methods can be found at the Stearns County Environmental Services or at the Minnesota Pollution Control Agency.

   According to the 1980 study approximately 28% of the phosphorus loading was from septic systems. A couple of cautions should be employed when thinking of this 28% for the following reasons:

   - Septic tanks generate soluble forms of phosphorus to lakes, which is much more readily useable by algae (than the particulate forms) and hence, is more bioavailable.
   - Septic tank sources of phosphorus may likely increase over time due to more lakeshore dwellers, more overloaded systems, switching from seasonal to full-time residency, and systems that have exceeded their useful "lifetimes" of approximately 25 years or so.
   - As the watershed sources of phosphorus are reduced, the relative magnitude of the septic tanks Phosphorus income to the lake will increase proportionally. In this manner, if septic tank sources of Phosphorus remained constant, after watershed best management practices were implemented, then septics would likely account for a higher percentage.

3. Overland flow and nutrient transport from developed lakeshore can be reduced by the installation of naturalized shoreland buffer strips. This has the added benefits of increasing wildlife and habitat and reducing shoreland erosion.

4. Lakeshore residents and other landowners within the watershed should work together to maximize opportunities for wetland restorations and other activities that will enhance water storage and provide adequate settling time for nutrients and sediments
5. Landowners within the watershed should implement Best Management Practices that protect water quality by reducing the transport of excess nutrients and sediments to permanent and ephemeral streams that discharge to the lake.