

Michigan Department of Environmental Quality
Surface Water Quality Division
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Total Maximum Daily Load (TMDL) for Phosphorus in Kent Lake

Location: Kent Lake is a 1,000 acre (405 ha) impoundment of the Huron River located in Oakland County (Figure 1). This lake is entirely public-owned and receives over two million visitors annually, making it one of the most intensively used recreational lakes in the state.

Pollutant: Total Phosphorus.

Phosphorus Data and Goal:

Year	Total Phosphorus Concentration (mg/L)	Total Load to lake (pounds/year)	Actual Point Source contribution (pounds/year)	Nonpoint Source contribution (pounds/year)	
1978	0.044	12,400	7,400	5,000	
1994	0.030	7,600	1,100	6,500	
1997	0.023	5,800	1,400	4,400	
1998	0.030	7,600	1,300	6,300	
1999	0.025	7,000	1,400	5,600	
Average 1994-99	0.027	7,000	1,300	5,700	
	Total Phosphorus Concentration (mg/L)	Loading Capacity (pounds/year)	Waste Load Allocation (pounds/year)	Load Allocation (pounds/year)	Margin of Safety (pounds/year)
TMDL Goal	0.030	7,600	2,700	4,700	200

Bold numbers indicate actual measured values.

Background: In the late 1970's, Kent Lake was classified as a highly eutrophic to hypereutrophic lake with periodic fish kills and frequent nuisance algae blooms (Wandell and Jackson, 1979). Phosphorus was identified as the limiting nutrient for algae growth in this lake. In 1978, the in-lake phosphorus concentrations averaged 0.044 mg/L with a range of 0.027 mg/L to 0.09 mg/L and a total load of 12,400 pounds/year to Kent Lake (Wandell and Jackson, 1979). Of the 12,400 pounds of phosphorus, approximately 60 percent were from point source contributions and 40 percent were from nonpoint source contributions. In 1980, a point source phosphorus allocation of 2,700 pounds/year was approved by the Water Resource Commission for Kent Lake, which included Ford Motor Company-Wixom, Milford Publicly Owned Treatment Works (POTW), and Wixom POTW. In August 1991, the Ford Motor Company-Wixom diverted its effluent from the Huron River to the Wixom POTW.

Subsequent to the implementation of the 1980 allocation, overall water quality in Kent Lake has improved (Alexander, 1999). This improved water quality can be attributed to significant reductions in total phosphorus loading to Kent Lake. No reported nuisance algae blooms or fish kills have been reported within the past few years. In 1994, the spring turnover phosphorus concentration was 0.030 mg/L (Kosek, 1996). Using the Walker Model (Reckhow, 1978), total phosphorus loading in 1994 was estimated to be 7,600 pounds/year. Of the total loading for

1994, 15 percent was from point source contributions and 85 percent was from nonpoint source contributions. In 1997, spring turnover phosphorus concentration was 0.023 mg/L (Alexander, 1998). Using the Walker Model, total phosphorus loading in 1997 was estimated to be 5,800 pounds/year with point source contributions making up 24 percent of the total and nonpoint source contributing 76 percent. Also, in 1998, the spring turnover phosphorus concentration was 0.030 mg/L (Alexander, 1999). Using the Walker Model, total phosphorus loading in 1998 was estimated to be 7,600 pounds/year with a point source contribution of 17 percent and nonpoint contributions making up the remaining 83 percent.

Kent Lake was listed as a threatened waterbody on Michigan's 1998 Section 303(d) list (Creal and Wuycheck, 1998) of waterbodies needing TMDLs. The primary issue identified as threatening Kent Lake was nutrient enrichment (phosphorus).

In April 1998, a 12-month phosphorus loading analysis was begun to confirm the appropriateness of the Walker Model as a phosphorus predictive tool for Kent Lake (Alexander, 1999). This phosphorus analysis showed a total phosphorus load to Kent Lake of 6,700 pounds from April 1998 to March 1999. The April 1999 spring turnover phosphorus concentration was 0.025 mg/L and the predicted in-lake phosphorus concentration using the Walker Model was 0.026 mg/L. Based on comparison of the actual in-lake phosphorus concentration and the predicted, the Walker Model was determined to be a good predictor for phosphorus, for both loading and in-lake concentration.

The goal for phosphorus concentration in Kent Lake is 0.030 mg/L. This concentration is generally accepted in the majority of available literature as the cutoff point between eutrophic and hypereutrophic. This goal was recommended in the draft TMDL for phosphorus in Kent Lake, which was public noticed from January 18, 1999 to February 19, 1999, in which no public comments opposing this goal were received. Additionally, this goal will meet the requirements of the Water Quality Standards R 323.1060(2) for plant nutrients. This rule states "nutrients shall be limited to the extent necessary to prevent stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi or bacteria which are or may become injurious to the designated uses of the waters of the state."

Waste Load Allocation: The waste load allocation was established at 2,700 pounds/year, using current National Pollutant Discharge Elimination System permit limits for the Milford POTW and the Wixom POTW (Table 1). Phosphorus loading from the two point source discharges averaged 1,300 pounds/year during 1994, 1997, 1998, and 1999 (Table 2), significantly less than the 7,400 pounds/year in 1978.

Load Allocation: The estimated total nonpoint source contribution during 1994, 1997, 1998, and 1999 averaged 5,600 pounds/year with a range of 4,400 pounds/year to 6,500 pounds/year, slightly more than the 5,000 pounds/year in 1979. Based on this information, it can be assumed that there is some variability in nonpoint source contributions and that there may be some increases in nonpoint source loading since 1978. Therefore, a load allocation of 4,700 pounds/year of phosphorus was established for nonpoint source contributions to Kent Lake. This load allocation equates to an average phosphorus reduction of 16 percent (900 pounds/year) in nonpoint source contributions. This will likely occur over the time period that point sources are increasing. Therefore, it is anticipated that Kent Lake will meet the goal of 0.030 mg/L during this period. The total nonpoint source phosphorus load includes contributions from atmospheric deposition, ground water contribution, and immediate drainage area runoff (Alexander, 1999).

Margin of Safety: There are 200 pounds/year of phosphorus loading allocated to a margin of safety. This equates to about 3 percent of the loading capacity of this lake. This is appropriate due to the good predictions found with the model used in the TMDL development process.

Summary: The TMDL for Kent Lake allocates 4,700 pounds of phosphorus to nonpoint source loads, 2,700 pounds of phosphorus to point source loads, and 200 pounds/year to a margin of safety. These loads are established on an annual basis to meet the goal of 7,600 pounds per year and an in-lake total phosphorus concentration of 0.030 mg/L.

References:

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Prepared by: Michael Alexander, Aquatic Biologist
Great Lakes and Environmental Assessment Section
Surface Water Quality Division
Michigan Department of Environmental Quality

Table 1. Current permit limits and waste load allocation recommendations for facilities discharging upstream of Kent Lake.

Facility	Current Limits (pounds/year)	Waste Load Allocation (pounds/year)
Milford POTW	900	900
Wixom POTW	1,800	1,800

Table 2. Phosphorus loading data for facilities discharging upstream of Kent Lake.

Facility	Year	Design Flow (MGD)	Avg. Flow (MGD)	Actual Total Load (pounds/year)
Milford POTW	1994	1.04	0.83	451
	1997		0.44	178
	1998		0.74	187
	1999		0.59	261
Wixom POTW	1994	2.8	2.13	665
	1997		2.34	1177
	1998		2.34	1132
	1999		2.41	1112

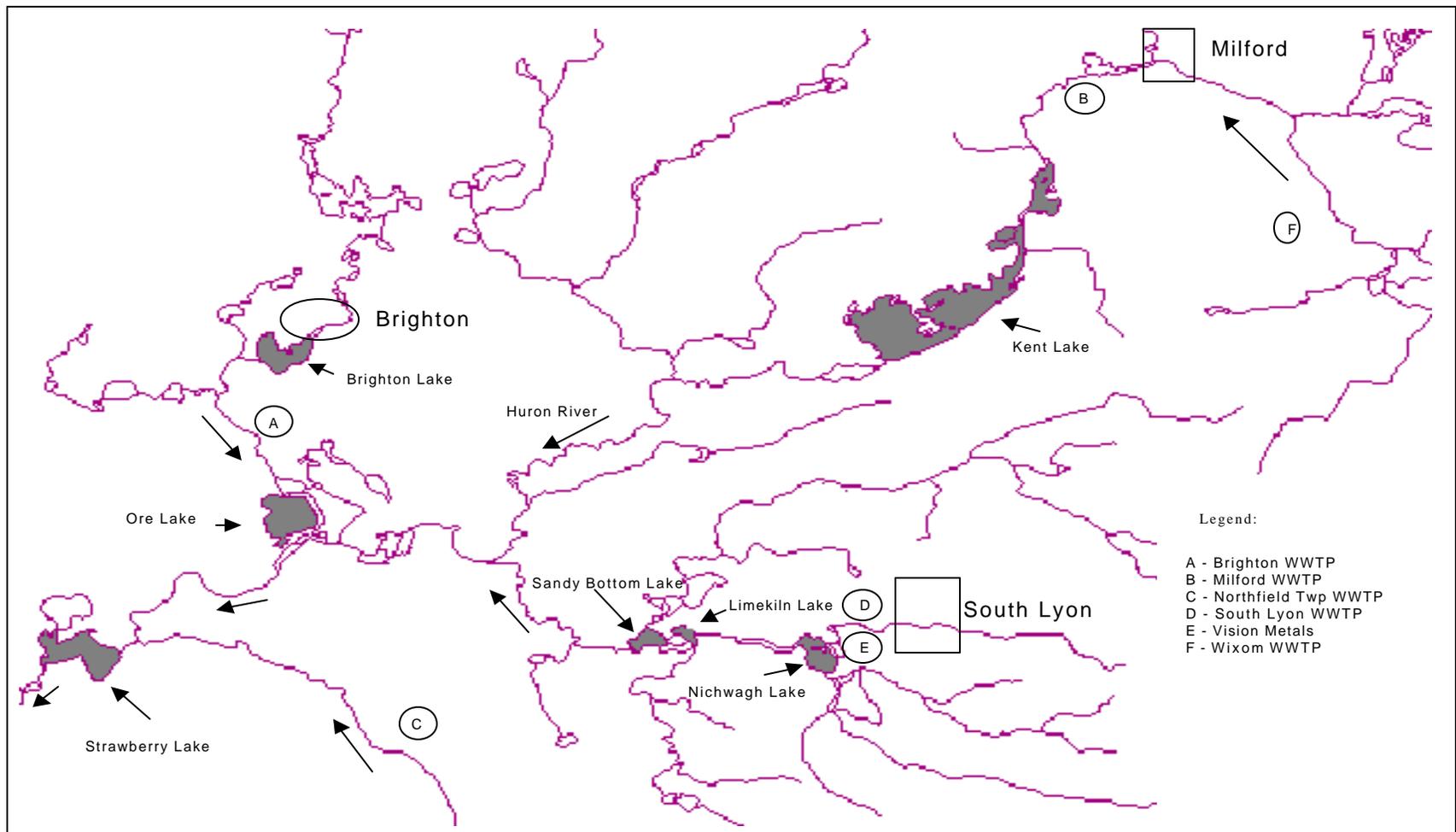


Figure 1. Upper Huron River and the Kent Lake watershed showing the current point source discharges.