

# **The Lakes of Maple Grove**

## **Lake Water Quality Report for 2017**

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**Maple Grove Lake Quality Commission**

**Prepared March 2018  
by Steve McComas, Blue Water Science**

# **The Lakes of Maple Grove Status Report - 2017**

**Prepared for the Maple Grove Lake Quality Commission.**

## **Commission Members - 2017**

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Prepared by Steve McComas, Blue Water Science

March 2018

# The Lakes of Maple Grove Status Report - 2017

## Introduction and Background

The City of Maple Grove has numerous lakes and smaller water bodies within the City limits. In 2017, a total of 12 lakes were monitored. Blue Water Science monitored 7 lakes over the summer months, including Cedar Island, Cook, Edward, Norwood, and the three Arbor Lakes. Three Rivers Park District sampled Eagle, Fish, Pike, Rice, and Weaver Lakes. This report summarizes the summer sampling data from May-September for all 12 lakes. A summary of general lake characteristics is shown in Table 1.

**Table 1. General lake characteristics of Maple Grove Lakes. Watershed acreage is from the 1996 Stormwater Management Plan.**

Lake	State ID Number	Watershed District	Size (acres)	Maximum Depth (feet)	Mean Depth (feet)	Total Watershed Size (ac)	Lake Classification (shallow or deep)	Lake Water Retention Time (years)
Cedar Island	27-119	Shingle Creek	86	7.0*	4.3	389	shallow	1.8
Cook	27-0120	Elm Creek	16.5	20	8	196	shallow	2.3
Eagle	27-111	Shingle Creek	285	37	10.5	1,838	deep	3.1
Edward	27-121	Elm Creek	33	9.5	5.5	102	shallow	
Fish	27-118	Elm Creek	239	48*	17.7	860	deep	9.1
Pike	27-111-02	Shingle Creek	75	25	4.9	746	shallow	1.0
Rice	27-116	Elm Creek	333	11	6.6	13,400	shallow	0.3
Weaver	27-117	Elm Creek	165	57*	21*	320	deep	20

\* from Hennepin Conservation District

\*\*from Met Council

## Guide to Interpreting Water Quality Information

SD = Secchi disc - a black and white disc lowered into the water until it can't be seen from the surface. This is the Secchi disc transparency reading.

TP = Total phosphorus - the fertilizing nutrient most responsible for causing excess algae to grow.

Chl a = Chlorophyll a - the green pigment in algae that is analyzed in the laboratory. It is correlated to the amount of algae in a lake.

ppb = parts per billion - concentrations of phosphorus and chlorophyll are often reported in ppb.

## Lake Goals (based on eutrophication criteria for North Central Hardwood Forest Ecoregion)

- Secchi disc: 5-7 feet of transparency as a summer average.
- Total phosphorus: try to keep phosphorus concentrations below 40 ppb as a summer average for deep lakes and less than 60 ppb for shallow lakes.
- Chlorophyll a: try to keep chlorophyll concentrations below 14 ppb as a summer average for deep lakes and less than 20 ppb for shallow lakes.

## 2017 Summer Sampling Results - Status Report

The objectives of the 2017 water quality sampling program were to check the health of the lakes in the City of Maple Grove and to see if they were improving, degrading, or staying the same. Water quality parameters monitored included Secchi disc (measure of water clarity), total phosphorus (measure of the primary nutrient that stimulates algal growth), and chlorophyll (measure of the amount of algae in the water).

Water quality was checked from May through September and results are shown in Table 2. North Arbor Lake had the best transparency and Cedar Island had the lowest transparency in 2017 (Tables 2 and 3).

**Table 2. Water chemistry summer averages for Maple Grove Lakes in 2017 (source: Three Rivers Park District collected data for Fish, Rice, and Weaver Lakes. Other data collected by Blue Water Science).**

	May - Sept Averages, 2017		
	Secchi Disc (ft)	Total Phosphorus (ppb)	Chl a (ppb)
Cedar Island	1.4	111	35
Cook	4.8	33	4
Eagle*	8.6	37	17
Edward	5.9	41	7
Fish*	7.0	50	18
Pike*	5.3	82	40
Rice*	3.0	162	56
Weaver*	7.7	33	14
North Arbor	15.2	15	3
South Arbor	13	19	3
West Arbor	7	33	13
Norwood	17	14	2

\*sampled by Three Rivers Park District

**Table 3. Maple Grove water quality data 2017. Results for secchi disc (SD) are in feet, total phosphorus (TP) are in ppb, chlorophyll *a* (chl) are in ppb, chlorides (chlor) are in ppb, and conductivity (cond) are in  $\mu$ S. Data for Fish, Rice, and Weaver are from Three Rivers Park District. Numbers in parentheses are bottom samples.**

Lakes	Cedar Island				Cook				Eagle			Edward				Fish			Pike			Rice			Weaver		
	SD	TP	Chl	Chlor	SD	TP	Chl	Chlor	SD	TP	Chl	SD	TP	Chl	Chlor	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl
<b>May</b>																											
week 1*									12.7	35	4.2					8.1	64	18.1	5.1	54	14.9	3.2	115	22.1	10.0	48	5.1
week 2																											
week 3									14.1	18	3.5					2.8	72	36.0	8.2	34	10.4	4.7	39	11.6	12.1	32	7.5
week 4	1.2	144	43.4	74	5.1	33	3.6	31	11.6	15	5.0	6.5	51	3.6	36.7	11.2	55	9.8	8.9	53	14.6	3.6	108	35.7	11.8	28	
<b>June</b>																											
week 1																											
week 2									12.8	27	7.3					9.2	46	11.6	8.4	70.9	27.1	4.4	90	34.7	7.2	26	12.0
week 3																											
week 4	1.3	157	52.9	75	5.2	37	4.3	30.1	8.2	30	9.0	4.3	61	27.1	35.7	7.8	45	16.5	4.9	143	52.5	4.3	131	48.2	9.4	32	10.7
<b>July</b>																											
week 1																											
week 2									10.3	33	7.0					6.9	50	10.7	2.6	113	111.6	2.7	210	118.4	4.8	32	17.1
week 3																											
week 4	1.4	124	45.3	79	4.1	42	6.4	31.0	7.8	32	12	6.8	35	2.1	37.7	6.9	42	11.3	4.3	76	41.9	1.5	243	123.4	4.4	55	22.8
<b>August</b>																											
week 1									5.2	36	28.0					4.1	32	18.6	4.7	76	39.0	1.3	286	92.4	6.6	29	9.9
week 2																											
week 3									4.4	47	32.7					4.3	37	22.5	5.0	74	23.0	2.1	230	49.1	5.1	28	21.7
week 4	1.4	77	12.8	65	5.1	26	2.1	29.1				5.7	34	1.1	31.9												
<b>September</b>																											
week 1									4.3	59	33.8					11.5	52	9.7	3.3	91	37.0	2.8	189	38.1	6.8	30	16.1
week 2																											
week 3									3.7	75	46.8					4.2	58	37.3	3.2	116	72.1	2.6	136	40.5	6.9	26	14.5
week 4	1.6	54	19.2	69	4.3	26	2.1	30.7				6.1	22	<1	35.8												
<b>May-September Average</b>																											
	1.4	111	35	73	4.8	33	4	30.4	8.6	37	17	5.9	41	7	35.6	7.0	50	18	5.3	82	40	3.0	162	56	7.7	33	14

\* Weeks: days 1-7 = week 1; days 8-14 = week 2; days 15-21 = week 3; days 22+ = week 4

Lakes	North Arbor					South Arbor					West Arbor					Norwood				
	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	Chlor	Cond
<b>May</b>																				
week 1*																				
week 2																				
week 3																				
week 4	9.6	19	6.4	238		9.2	26	6.4	238		11.7	18	3.6	37.6		16.1	16	2.1	61.4	
<b>June</b>																				
week 1																				
week 2																				
week 3																				
week 4	11.1	17 (30)	4.3	234		13.5	15 (52)	2.8	236		7.9	20 (23)	5.0	37.7		12.1	21 (25)	2.8	57.5	
<b>July</b>																				
week 1																				
week 2																				
week 3																				
week 4	20.2	13	1.4	235		13.4	16	2.1	236		10.8	20	5.0	38.3		12.8	13	3.4	64.5	
<b>August</b>																				
week 1																				
week 2																				
week 3																				
week 4	14.8	16	2.1	213		12.2	16	2.8	224		3.8	54	24.6	37.2		23.8	9	2.1	59.4	
<b>September</b>																				
week 1																				
week 2																				
week 3																				
week 4	20.1	9	<1	224	800	14.2	20	2.8	243	900	2.2	53	27.1	39.8	350	21.8	9	<1	61.7	325
<b>May-September Average</b>																				
	15.2	15	3	229	800	13	19	3	235	900	7	33	13	38	350	17	14	2	61	325

\* Weeks: days 1-7 = week 1; days 8-14 = week 2; days 15-21 = week 3; days 22+ = week 4

## Eurasian Watermilfoil (EWM) Monitoring Summary

Eurasian watermilfoil (EWM) has been found in 8 lakes in Maple Grove -- Fish, Eagle, Pike, Rice, Weaver, and all three Arbor Lakes. EWM in all eight lakes is past the point of eradication, but typically nuisance growth is limited to several shoreline areas. Eagle Lake has a small infestation and little nuisance growth. Rice Lake had a new infestation in 1996 but milfoil was not found in 1997, 1998, or after 2007. Overall observations are summarized in Table 4.

**Table 4. Summary of Eurasian watermilfoil observations for Maple Grove Lakes in 2017.**

	2017 Summer
Arbor - North	Eurasian watermilfoil found in 2003
Arbor - South	Eurasian watermilfoil found in 2004
Arbor - West	Eurasian watermilfoil found in 2002
Cedar Island Lake	No Eurasian watermilfoil found
Cook	No Eurasian watermilfoil found
Eagle Lake	Scattered Eurasian watermilfoil, found in 1992
Lake Edward	No Eurasian watermilfoil found
Fish Lake	Scattered Eurasian watermilfoil, found in 1993
Norwood Lake	No Eurasian watermilfoil found
Pike Lake	Scattered Eurasian watermilfoil, found in 1992
Rice Lake	Scattered Eurasian watermilfoil, found in 1996
Weaver Lake	Eurasian watermilfoil found in 2012

# Water Quality Summaries

## Secchi Disc, Phosphorus, and Chlorophyll a

A twenty year summary of water quality results for Maple Grove Lakes is shown in Table 5. City lakes have been stable in regard to water quality except for Lake Edward and Rice Lake. Fluctuating clarity in Lake Edward may be influenced by fish kills that occurred in 1995, 2000, and 2013. Rice Lake may be impacted by the drawdown on 1997-1998. Rice and Cedar Island Lakes have the highest phosphorus concentrations in town and Cook and Eagle have the lowest.

**Table 5. Growing season (May - September) averages for the Maple Grove Lakes [SD = secchi disc (ft), TP = total phosphorus (ppb), Chl a = chlorophyll a (ppb)].**

	Cedar Island			Cook			Eagle			Edward			Fish			Pike			Rice			Weaver		
	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl
1995	2.0	106	73	--	--	--	5.8	51	7	5.0	61	16	6.4	51	16	3.9	78	20	2.2	233	44	7.8	40	18
1996	1.8	--	--	--	--	--	5.9	33	9	8.1	104	2	7.0	55	9	3.4	66	23	2.9	453	37	6.5	35	6
1997	1.5	117	40	--	--	--	5.4	31	11	5.8	47	4	5.4	50	17	3.6	76	24	2.3	316	39	6.6	32	10
1998	1.4	102	44	--	--	--	5.9	29	11	4.1	46	11	5.9	46	13	3.3	70	31	3.3	469	20	6.6	40	14
1999	1.1	203	66	--	--	--	5.9	53	23	4.5	43	13	4.8	45	19	3.9	74	35	3.5	248	35	6.4	42	21
2000	--	--	--	--	--	--	9.5	36	5	5.5	45	6	4.6	53	19	4.3	65	30	5.2	175	23	6.6	43	15
2001	2.1	78	47	--	--	--	11	34	18	7.1	26	4	5.4	38	17	4.9	83	30	4.5	339	22	5.5	42	38
2002	1.8	90	55	--	--	--	3.3	42	67	6.7	48	13	3.6	51	26	--	--	--	4.2	152	18	8.3	43	20
2003	1.1	163	116	--	--	--	7.0	44	31	3.2	118	102	4.5	55	37	3.5	80	60	3.2	185	35	6.6	46	31
2004	1.0	147	133	6.2	26	4	6.8	45	28	2.2	77	47	7.9	47	29	3.5	97	65	3.9	207	36	8.9	51	40
2005	1.1	123	134	6.6	51	2	8.8	18	20	2.4	104	61	5.4	40	25	3.5	95	54	4.6	214	44	16.5	23	4
2006	0.7	161	173	7.5	22	33	5.8	47	36	1.9	95	55	3.9	49	29	4.3	89	47	3.0	187	50	14.4	25	7
2007	0.8	240	194	7.8	19	6	--	--	--	1.6	115	62	4.1	51	31	--	--	--	2.2	206	48	9.0	35	7
2008	0.7	455	226	8.0	20	2	--	--	--	3.2	105	67	2.7	47	17	--	--	--	2.6	436	51	8.0	30	8
2009	0.6	330	147	10.6	23	3	5.7	44	30	2.2	149	82	4.6	57.9	17	3.5	80.6	20	3.5	395	151	9.2	30.8	5
2010	0.7	143	67	7.4	18	3	5.9	50	21	3.6	88	58	4.9	48	14	3.9	89	29	3.4	227	57	13.1	31	5
2011	1.8	94	61	5.7	32	3	5.4	38	25	2.5	94	40	6.2	50	19	3.6	52	14	3.7	153	36	7.9	30	8
2012	0.9	130	58	5.0	34	3	5.7	42	25	3.4	72	41	5.5	42	26	3.5	34.8	15	2.5	256	53	7.6	31	11
2013	1.0	138	49	5.6	31	2	5.7	30	6	3.2	97	50	4.9	53	33	3.9	66	14	2.5	326	114	7.2	37	17
2014	1.7	88	27	6.1	36	2	6.2	34	7	4.7	43	7	7.1	40	22	4.5	48	8	4.2	232	60	6.9	37	21
2015	1.0	133	65	5.6	33	3.1	4.7	41	10	4.8	56	7.7	6.1	44	25	4.3	67	14	2.2	236	88	6.7	37	15
2016	1.3	153	68	5.0	45	2.2	6.7	47	11	6.1	67	13.1	6.6	42	21	4.8	63	9	2.4	168	50	10.9	30	8
2017	1.4	111	35	4.7	33	4	8.6	37	17	6.3	41	7	7.0	50	18	5.3	82	40	3	162	56	7.7	33	14

Cedar Island Lake data: Met Council - 1995; MPCA - 1996; and Blue Water Science - 1997 through 2017.

Eagle, Fish, Pike, and Weaver Lake data collected by Three Rivers Park District.

Rice Lake data: Met Council and by Three Rivers Park District

## Report Card

Water quality data have been converted to grades based on a Met Council grading scale. Grades are shown in Table 6.

**Table 6. Lake grades for Maple Grove Lakes.**

	Cedar Island			Cook			Eagle			Edward			Fish			Pike			Rice			Weaver		
	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl
1995	F	D	D	--	--	--	C	C	A	C	C	B	C	C	B	C	D	B	F	F	C	B	C	B
1996	F	--	--	--	--	--	C	B	A	B	D	A	C	C	A	D	D	C	D	F	C	C	C	A
1997	F	D	C	--	--	--	C	B	B	C	C	A	C	C	B	D	D	C	D	F	C	C	B	B
1998	F	D	D	--	--	--	C	B	B	C	C	B	C	C	B	D	D	C	D	F	D	C	C	B
1999	F	F	D	--	--	--	C	C	C	C	C	B	C	C	B	C	D	C	D	F	C	C	C	C
2000	--	--	--	--	--	--	B	C	A	C	C	A	C	C	B	C	C	C	C	F	C	C	C	B
2001	F	D	C	--	--	--	A	C	B	C	B	A	C	C	B	C	D	C	C	F	C	C	C	C
2002	F	D	D	--	--	--	D	C	D	C	C	B	D	C	C	--	--	--	C	D	B	B	C	B
2003	F	F	F	--	--	--	C	C	C	D	D	F	C	C	C	D	D	D	D	F	C	C	C	C
2004	F	D	F	C	B	A	B	C	C	F	D	C	B	C	C	D	D	D	D	F	C	B	C	C
2005	F	D	F	C	C	A	B	A	B	D	D	D	C	C	C	D	D	D	C	F	C	A	B	A
2006	F	F	F	B	A	C	C	C	C	F	D	D	C	C	C	C	D	C	D	F	D	A	B	A
2007	F	F	F	B	A	A	--	--	--	F	D	D	C	C	C	--	--	--	F	F	C	B	C	A
2008	F	F	F	B	A	A	--	--	--	D	D	D	D	C	B	--	--	--	D	F	D	B	B	A
2009	F	F	F	A	A	A	C	C	C	F	D	F	C	C	B	D	D	C	D	F	F	B	B	A
2010	F	D	D	B	A	A	C	C	C	D	D	C	C	C	B	C	D	C	D	F	D	A	B	A
2011	F	D	D	C	B	A	A	C	C	D	D	C	C	C	B	D	C	B	D	F	C	B	B	A
2012	F	D	D	C	C	A	C	C	C	D	D	C	C	C	C	D	C	B	D	F	D	B	B	B
2013	F	F	D	C	B	A	C	B	A	D	D	D	C	C	C	D	C	B	D	F	F	B	C	B
2014	F	D	C	C	C	A	C	C	A	C	C	A	C	C	C	C	C	A	C	F	D	C	C	C
2015	F	D	D	C	C	A	C	C	B	C	C	A	C	C	C	C	C	B	F	F	F	C	C	B
2016	F	F	D	C	C	A	C	C	B	C	C	B	C	C	C	C	C	A	D	F	D	A	B	A
2017	F	D	C	C	C	A	B	C	B	C	C	A	C	C	B	C	D	C	D	F	D	B	C	B



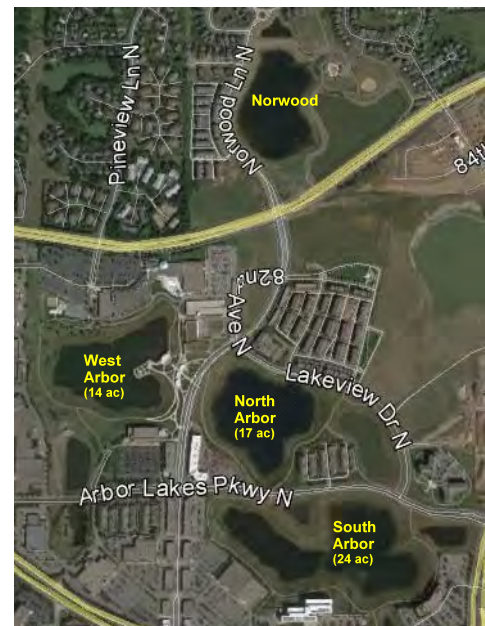
**Arbor and Norwood Lakes:** Results from sampling three Arbor Lakes and Norwood Lake are summarized in Tables 7 and 8 and Figure 1. All four have good water quality and relatively low phosphorus concentrations.

**Table 7. Growing season averages for the Arbor Lakes and Norwood Lake.**

	West Arbor			North Arbor			South Arbor			Norwood		
	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl
<b>May-September Average</b>												
1999 (1 date - Aug)	3.1	18	11	6.7	20	<1	5.4	13	<1	--	--	--
2001 (1 date - Sept)	5.3	--	--	16.0	--	--	8.2	--	--	--	--	--
2002 (3 dates)	9.0	16	1	8.9	11	2	13.0	12	1	--	--	--
2003 (5 dates)	7.0	19	4	12.3	9	3	11.7	10	3	--	--	--
2004 (5 dates)	9.6	18	5	11.5	12	2	12.4	12	2	--	--	--
2005 (5 dates)	10.7	28	2.4	13.2	17	3	10.7	17	2	--	--	--
2006 (5 dates)	9.7	23	2	13.8	13	2	7.9	29	17	--	--	--
2007 (5 dates)	9.4	19	2.6	12.1	9	2.2	11.3	15	5	--	--	--
2008 (5 dates)	8.4	24	7.0	14.3	12	3.7	10.2	16	4.4	--	--	--
2009 (5 dates)	9.6	28	5.3	13.9	14	1.1	13.9	17	2.0	--	--	--
2010 (5 dates)	7.9	36	11	13.8	9	1.7	13.4	14	1.7	--	--	--
2011 (5 dates)	7.1	27	12	12.7	12	4.4	12.4	14	2.6	--	--	--
2012 (5 dates)	6.6	28	12	14.5	11	6.1	13.0	15	5.3	--	--	--
2013 (5 dates)	7.6	24	5.7	15.3	11	1.5	12.2	18	2.7	--	--	--
2014 (5 dates)	9.1	24	6.7	18.1	8	1.1	12.9	11	2.4	14.9	13	2.2
2015 (5 dates)	5.0	57	14	15.0	12	1.7	12.0	18	3.2	16.4	14	2.1
2016 (5 dates)	7.7	40	10	14.8	15	2.8	10.7	20	3.3	11.1	28	6.3
2017 (5 dates)	7.0	33	13	16.2	15	3.0	12.0	19	3.0	19.0	14	2.0

**Table 8. Lake grades for the Arbor Lakes and Norwood Lake.**

	West Arbor			North Arbor			South Arbor			Norwood		
	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl
1999	D	A	B	C	A	A	C	A	A	--	--	--
2001	C	--	--	A	--	--	B	--	--	--	--	--
2002	B	A	A	B	A	A	A	A	A	--	--	--
2003	C	A	A	A	A	A	A	A	A	--	--	--
2004	A	A	A	A	A	A	A	A	A	--	--	--
2005	A	B	A	A	A	A	A	A	A	--	--	--
2006	B	B	A	A	A	A	B	B	B	--	--	--
2007	B	A	A	A	A	A	A	A	A	--	--	--
2008	B	B	A	A	A	A	A	A	A	--	--	--
2009	B	B	A	A	A	A	A	A	A	--	--	--
2010	B	C	B	A	A	A	A	A	A	--	--	--
2011	B	B	B	A	A	A	A	A	A	--	--	--
2012	C	B	B	A	A	A	A	A	A	--	--	--
2013	B	B	A	A	A	A	A	A	A	--	--	--
2014	B	B	A	A	A	A	A	A	A	A	A	A
2015	C	C	B	A	A	A	A	A	A	A	A	A
2016	B	C	B	A	A	A	A	A	A	A	B	A
2017	B	C	B	A	A	A	A	A	A	A	A	A



**Location map of lakes.**

## Arbor Lakes Secchi Disc and Total Phosphorus Data

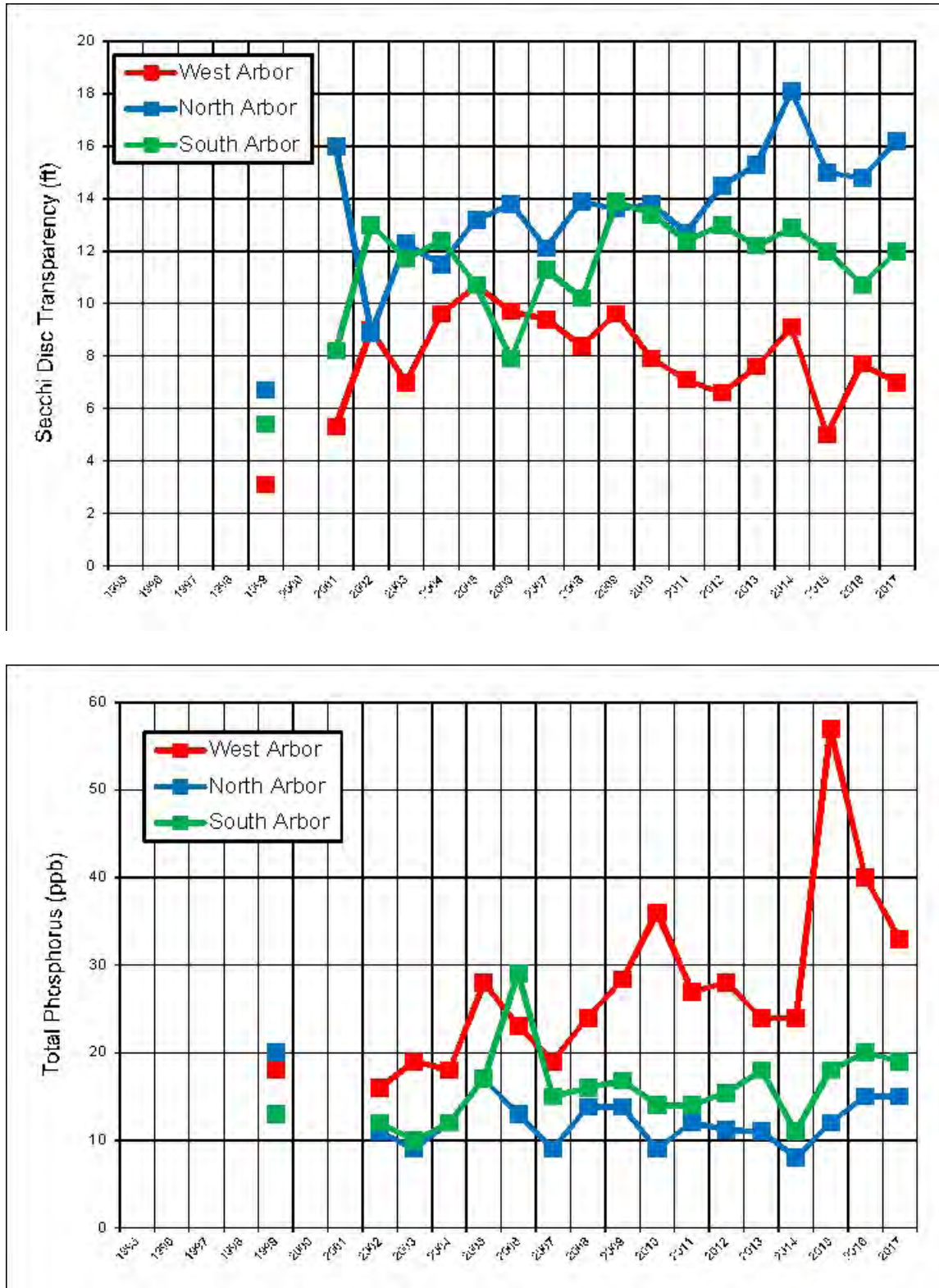


Figure 1. Secchi disc transparency (top) and total phosphorus concentrations (bottom) for the Arbor Lakes from 1999 - 2017.

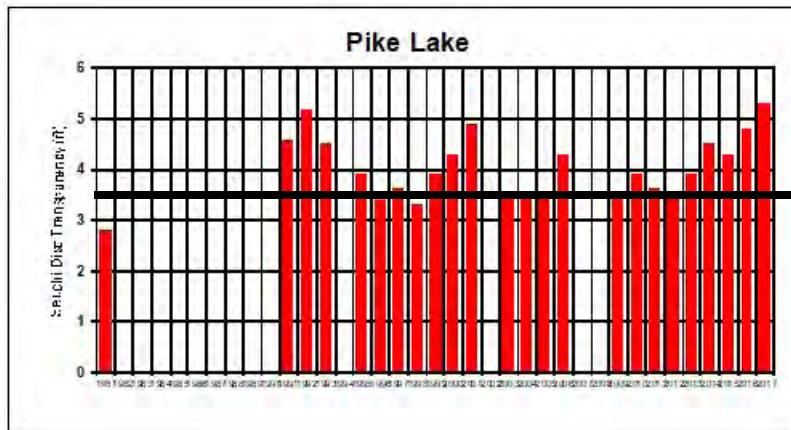
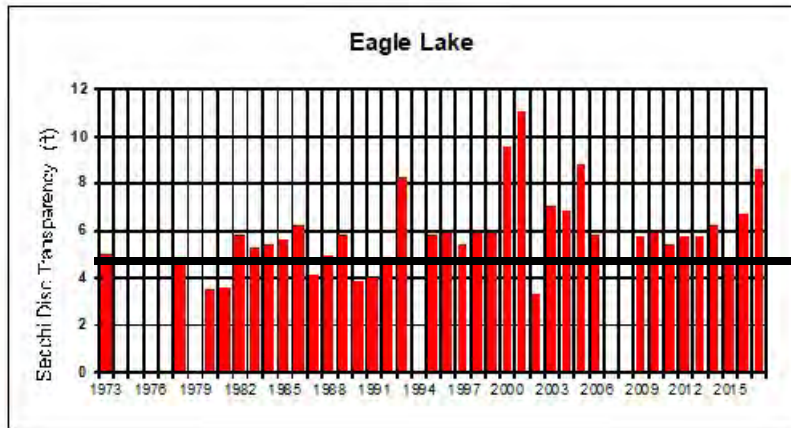
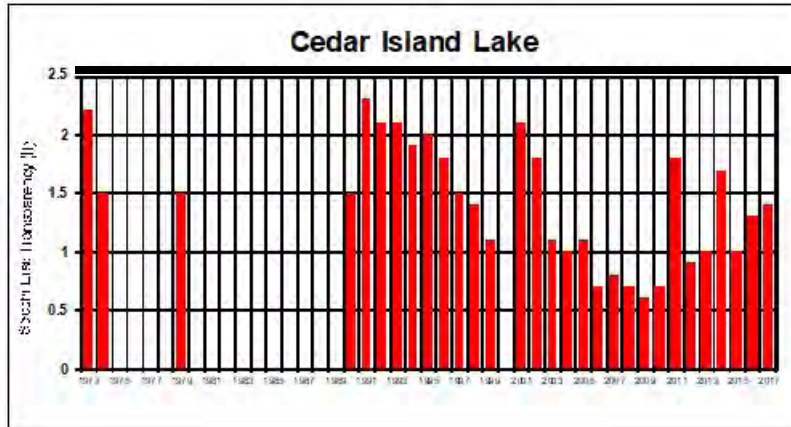
### **Secchi Disc Transparency Graphs for Maple Grove Lakes**

Graphs of average summer water transparency over the years for each of the major Maple Grove lakes are displayed on the next two pages. Eagle, Fish, and Weaver Lakes have summer water clarity averages generally over five feet. Cedar Island Lake generally has a summer average less than two feet. Pike and Rice Lakes averages are right around 3 to 5 feet. Transparency goals for all lakes should average 5 to 7 feet over the summer.

### **Total Phosphorus Graphs for Maple Grove Lakes**

Graphs of average summer water total phosphorus for the major Maple Grove Lakes (not including the Arbor Lakes) are shown after the Secchi disc graphs. Cook Lake had the lowest summer phosphorus concentration of the lakes (although the Arbor Lakes also have low phosphorus concentrations). Rice Lake and Cedar Island Lake had the highest total phosphorus in 2016.

# Shingle Creek Watershed District - Secchi Disc Data



**Secchi Disc Results**  
 Cedar Island Lake has the lowest Secchi disc transparency in Maple Grove. Transparency fluctuates in the remaining Maple Grove lakes. Aquatic plants could grow to twice the average seasonal Secchi disc transparency. Aquatic plants are beneficial for lakes and help to maintain or improve water clarity.

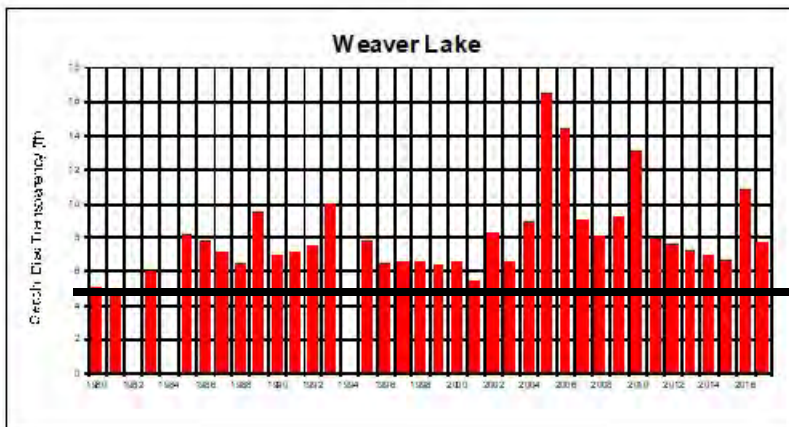
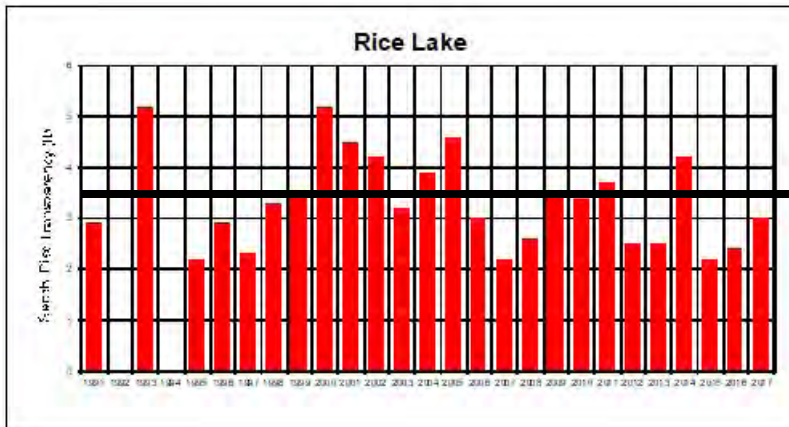
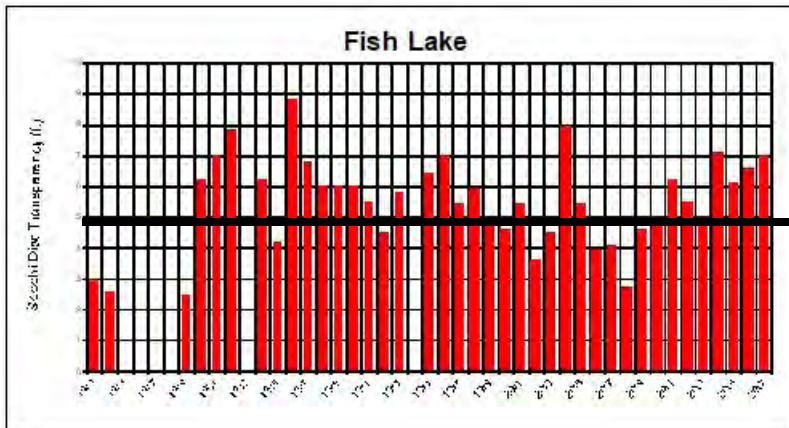
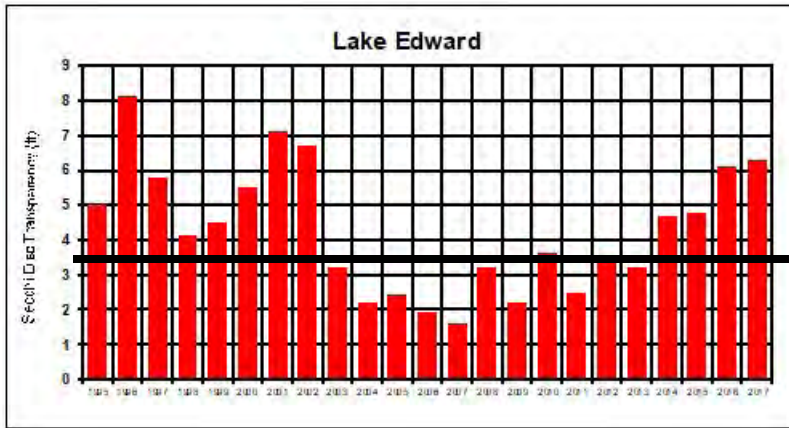
**Legend: Secchi Disc Clarity Criteria**  
 (shown with line in above graphs)

**Shallow Lakes:** Secchi disc transparency greater than 3.3 feet is considered to be unimpaired.

**Deep Lakes:** Secchi disc transparency greater than 4.6 feet is considered to be unimpaired.



# Elm Creek Watershed District - Secchi Disc Data

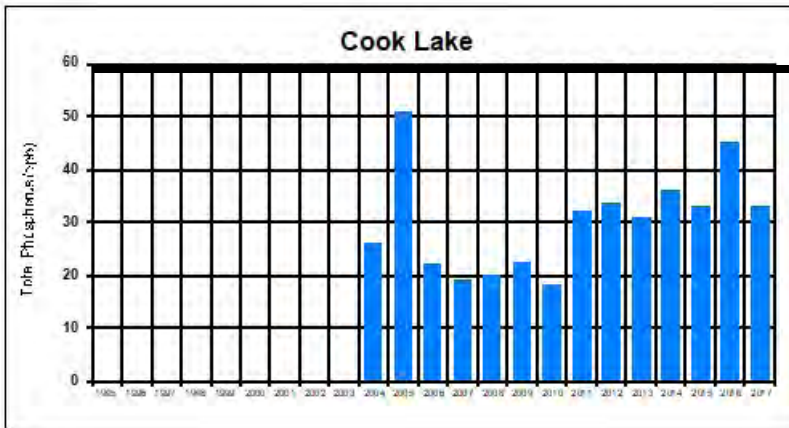
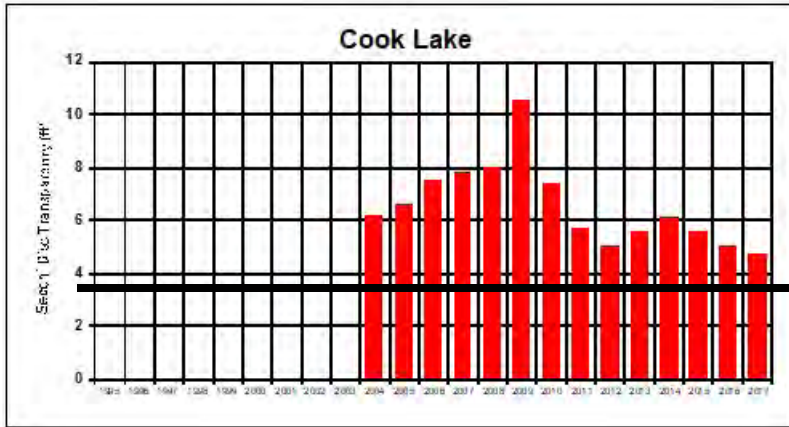


**Legend: Secchi Disc Clarity Criteria**  
 (shown with line in above graphs)

**Shallow Lakes:** Secchi disc transparency greater than 3.3 feet is considered to be unimpaired.

**Deep Lakes:** Secchi disc transparency greater than 4.6 feet is considered to be unimpaired.

# Cook Lake Data



**Legend: Secchi Disc Clarity Criteria**  
(shown with line in above graphs)

**Shallow Lakes:** Secchi disc transparency greater than 3.3 feet is considered to be unimpaired.

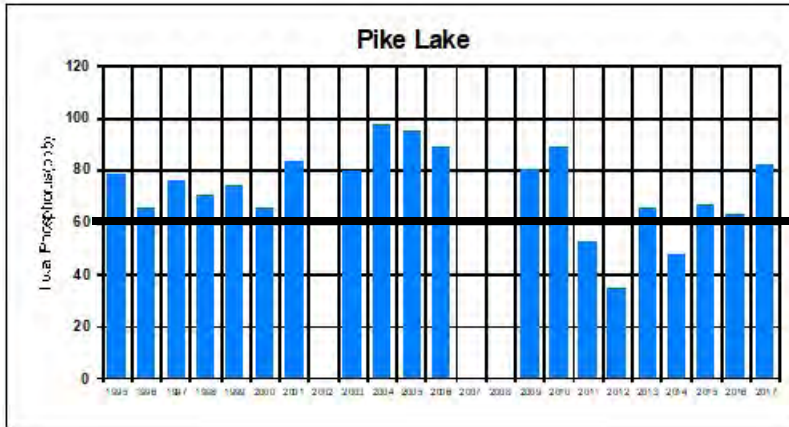
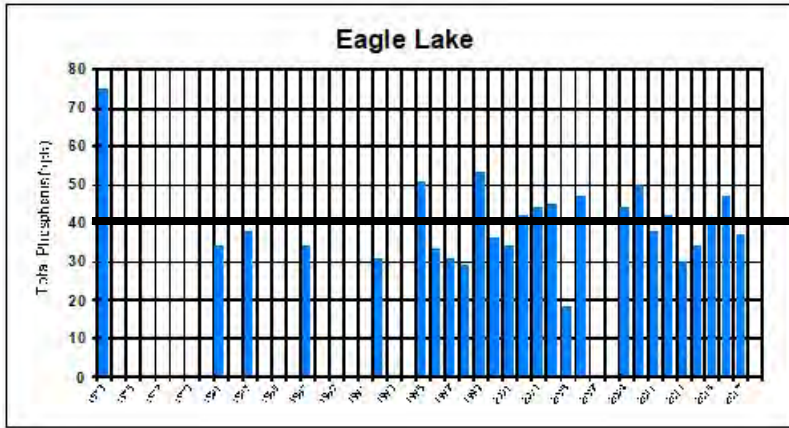
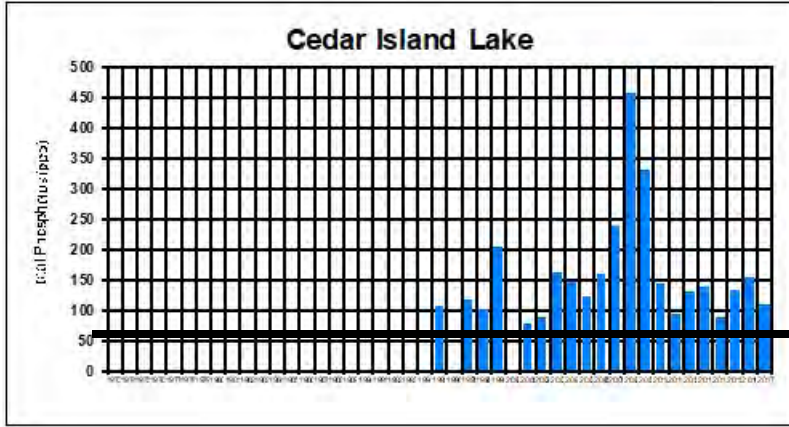
**Deep Lakes:** Secchi disc transparency greater than 4.6 feet is considered to be unimpaired.

**Legend: Total Phosphorus Criteria**  
(shown with line in above graphs)

**Shallow Lakes:** Total phosphorus concentrations less than 60 ppb are considered to be unimpaired.

**Deep Lakes:** Total phosphorus concentrations less than 40 ppb is considered to be unimpaired.

# Shingle Creek Watershed District - Total Phosphorus Data



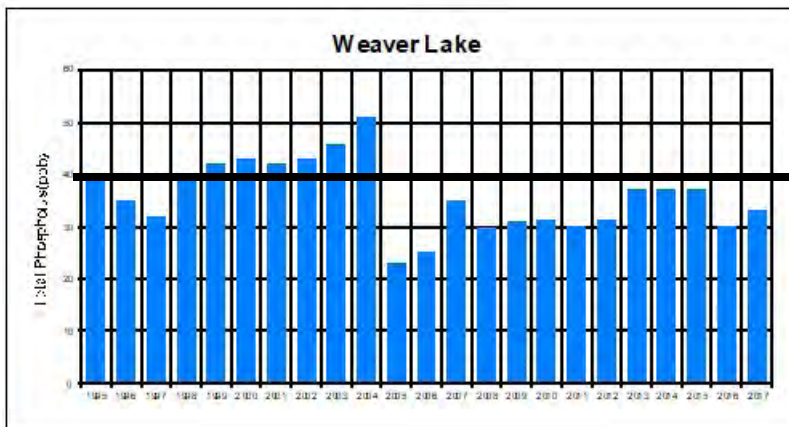
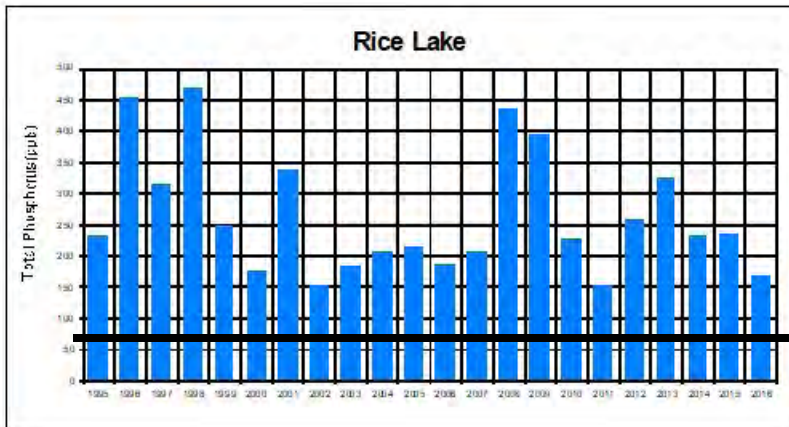
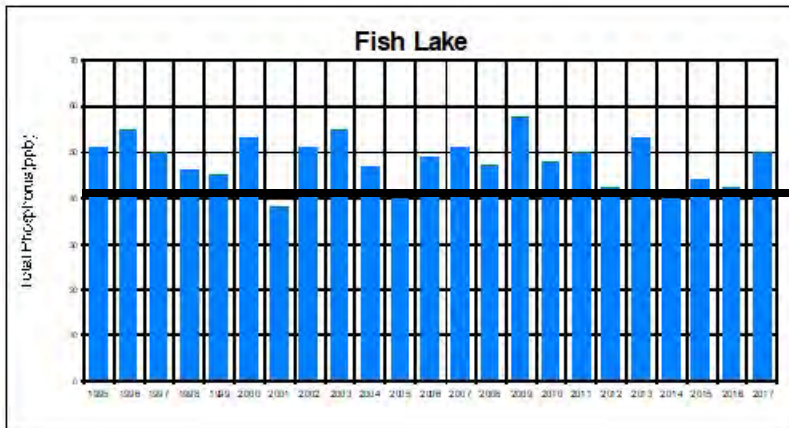
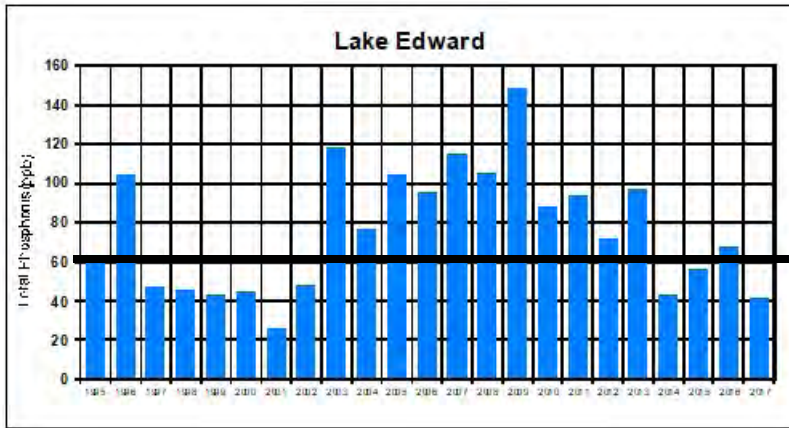
**Legend: Total Phosphorus Criteria**  
(shown with line in above graphs)

**Shallow Lakes:** Total phosphorus concentrations less than 60 ppb are considered to be unimpaired.

**Deep Lakes:** Total phosphorus concentrations less than 40 ppb is considered to be unimpaired.



# Elm Creek Watershed District - Total Phosphorus Data



**Legend: Total Phosphorus Criteria**  
 (shown with line in above graphs)

**Shallow Lakes:** Total phosphorus concentrations less than 60 ppb are considered to be unimpaired.

**Deep Lakes:** Total phosphorus concentrations less than 40 ppb is considered to be unimpaired.







2013 Data

Lakes	North Arbor			South Arbor			West Arbor			Cedar Island			Cook			Eagle			Edward			Fish			Pike			Rice			Weaver							
	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl					
<b>May</b>																																						
week 1*																																						
week 2																																						
week 3	5.4	18	2.0	6.7	42	2.9	4.9	21	1.9	1.2	119	28.4	6.0	13	2.5	5.6	31	2.9	3.1	89	45.7	4.3	66	22	3.6	38	12.0	3.1	102	22	6.9	53	<5					
week 4																																						
<b>June</b>																																						
week 1																																						
week 2																																						
week 3																																						
week 4	16.9	12	1.2	13.6	13	1.4	11.1	19	3.7	1.3	149	24.7	4.5	52	4.1	9.2	35	2.2	3.8	73	23.3				3.0	117	20.1											
<b>July</b>																																						
week 1																																						
week 2																																						
week 3	14.2	10	1.8	14.8	10	1.9	7.4	18	4.2	0.8	153	63.5	6.4	28	2.7	5.3	24	10.8	4.2	78	36.2	4.3	45	26	4.0	54	19.1	1.3	410	309	4.3	38	24					
week 4																																						
<b>August</b>																																						
week 1																																						
week 2																																						
week 3																																						
week 4	16.4	7	1.3	17.2	7	>1	5.4	25	6.1	0.7	160	75.3	5.4	44	<1	4.2	24	8.6	2.9	70	37.6	1.8	39	40	3.7	73	8.7	1.1	572	203	5.9	37	10					
<b>September</b>																																						
week 1																																						
week 2																																						
week 3																																						
week 4	23.6	8	<1	8.9	17	6.1	9.2	36	12.7	0.9	108	52.2	5.5	20	<1	4.2	34	7.7	2.1	173	108	2.2	39	43	5.1	46	7.7	1.8	584	47	4.9	32	17					
<b>May-September Average</b>																																						
	15.3	11	1.5	12.2	18	2.7	7.6	24	5.7	1.0	138	48.8	5.6	31	2.3	5.7	30	6.4	3.2	97	50.2	4.9	53	32.6	3.9	66	13.5	2.5	326	114	7.2	37	16.5					

\* Weeks: days 1-7 = week 1; days 8-14 = week 2; days 15-21 = week 3; days 22+ = week 4

Arbor Lakes profile data for temp, diss oxygen, pH, conductivity, oxidation/reduction potential (ORP) for 2013.

South Arbor Lake

Depth (m)	June 24					July 18					August 29					September 24				
	Temp (C)	DO (mg/l)	pH	Cond (µs)	ORP (mV)	Temp (C)	DO (mg/l)	pH	Cond (µs)	ORP (mV)	Temp (C)	DO (mg/l)	pH	Cond (µs)	ORP (mV)	Temp (C)	DO (mg/l)	pH	Cond (µs)	ORP (mV)
0	24.4	9.6	8.7	0.99	366	27.5	9.2	9.5	0.92	341	27.1	8.3	9.6	0.95	309	18.6	8.6	9.3	1.03	349
1	23.7	9.1	8.8	0.99	365	27.4	9.2	9.5	0.92	338	27	8.2	9.7	0.95	307	18.5	8.6	9.3	1.03	354
2	23.4	8.9	8.8	0.99	364	26.3	9.5	9.5	0.92	339	27	8.1	9.7	0.95	306	18.4	8.6	9.3	1.03	358
3	21.5	9	8.8	1.06	366	25.2	8.5	9.3	0.93	341	25	8.3	9.7	0.95	304	18.2	8.6	9.3	1.03	362
4	16.45	9	8.5	1.13	377	21.4	8.5	8.7	1.12	355	23.6	7	8.9	1.01	289	18.1	8.6	9.3	1.04	368
5	12.3	6.2	8.2	1.22	388	15.4	8.2	8.4	1.21	369	22.1	5.1	8.6	1.09	226	18	7.8	9.1	1.04	375
6	9.5	5	8	1.29	393	11.8	5.8	8.1	1.29	376	20.3	4.2	8.5	1.1	208	16.8	3.1	8.5	1.28	398
7	7.9	2.2	7.9	1.35	352	10.2	4.6	8.1	1.33	365						13.9	0.8	8.3	1.36	177

North Arbor Lake

Depth (m)	June 24					July 18					August 29					September 24				
	Temp (C)	DO (mg/l)	pH	Cond (µs)	ORP (mV)	Temp (C)	DO (mg/l)	pH	Cond (µs)	ORP (mV)	Temp (C)	DO (mg/l)	pH	Cond (µs)	ORP (mV)	Temp (C)	DO (mg/l)	pH	Cond (µs)	ORP (mV)
0	23.8	9	8.7	1.035	372	27.1	8.2	9.1	0.989	380	26.9	8.1	9.2	1.03	290	18.7	8.9	9.3	1.1	284
1	23.5	8.7	8.8	1.048	371	27	8.1	9	0.99	374	26.7	8.1	9.2	1.03	291	18.5	9	9.3	1.1	291
2	23.4	8.5	8.77	1.05	370	26.2	8.2	9.1	0.995	372	26.7	8	9.2	1.02	291	18.4	9	9.3	1.1	299
3	22	8.6	8.7	1.086	372	25.3	8.5	9.1	1	369	25.8	8.3	9.2	1.04	292	18.4	9	9.3	1.1	305
4	18.4	8.8	8.6	1.165	375	23.9	8.5	9	1.05	369	25	8.6	9.2	1.04	294	18.4	9	9.3	1.1	309
5	13.89	10.7	8.5	1.2	381	18.6	12.6	8.9	1.178	376	22.5	9.8	9	1.12	302	18.3	8.9	9.3	1.1	314
6	10.2	12.43	8.4	1.256	385	12.8	15.9	8.8	1.26	382	16.8	15	8.8	1.275	313	18.3	9	9.3	1.1	316
7	7.72	12.7	8.3	1.29	391	9.4	14.2	8.5	1.3	389	12.4	12.5	8.6	1.31	323	14.8	9.5	8.7	1.3	335
8	6.3	8.2	8.1	1.317	396	7.4	9	8.3	1.32	396	9.5	6.5	8.5	1.35	308	11.3	5.9	8.5	1.35	342
9	5.6	4	7.9	1.343	399	6.4	5.2	8.1	1.35	399	8.3	3.6	8.3	1.35	289	9.6	3.2	8.4	1.35	344
10	5.4	1	7.9	1.368	298	6	1.4	8	1.35	389						8.4	1.8	8.4	1.34	345
11																7.3	0.7	8.3	1.35	95

West Arbor Lake

Depth (m)	June 24					July 18					August 29					September 24				
	Temp (C)	DO (mg/l)	pH	Cond (µs)	ORP (mV)	Temp (C)	DO (mg/l)	pH	Cond (µs)	ORP (mV)	Temp (C)	DO (mg/l)	pH	Cond (µs)	ORP (mV)	Temp (C)	DO (mg/l)	pH	Cond (µs)	ORP (mV)
0	24.8	9.3	9.1	0.347	377	28	8.7	9.5	0.334	354	28	9	9.6	0.367	312	19.7	8.8	9.4	0.39	261
1	24	9.1	9.2	0.347	374	27.9	8.6	9.5	0.334	351	27.7	8.3	9.6	0.367	310	19.6	8	9.4	0.39	268
2	23.4	8.8	9.1	0.347	373	26.4	8.8	9.5	0.334	350	26.9	8.2	9.6	0.362	309	19.2	8	9.4	0.39	272
3	19.5	8.5	8.8	0.408	381	25.5	8.7	9.5	0.337	351	25.8	6.3	9.4	0.38	313	19	7.7	9.3	0.39	276
4	16	8.3	8.6	0.434	390	21.7	8.6	8.9	0.458	365	24.9	3.2	8.8	0.94	324	18.9	7.6	9.3	0.39	279
5	13.8	4.3	8.3	0.492	399	19	5.3	8.5	0.495	376	23.7	1	8.5	0.413	101	18.8	7.3	9.3	0.39	281
6	12.7	2	8.1	0.51	357	16.3	1.3	8.3	0.499	338	21.6	0.3	8.2	0.475	26	18.8	7.3	9.3	0.39	284
7						12.5	0.4	8	0.55	64						18.7	7	9.2	0.39	176



