



Picture: Sylvan/Halfbreed Lake, May 16, 2009

COMFORT LAKE-FOREST LAKE WATERSHED DISTRICT 2014 WATER MONITORING REPORT

Prepared for:
Comfort Lake-Forest Lake Watershed District

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Washington Conservation District

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2014 STREAM MONITORING REPORT

I. EXECUTIVE SUMMARY

This portion of the report focuses on the summary and comparison of the stream water quality data collected by the Washington Conservation District (WCD) from January 1 – December 31, 2014, as well as historical data. In 2014, at the request of the Comfort Lake-Forest Lake Watershed District (CLFLWD) the WCD conducted continuous discharge and stream water quality monitoring at the following sites: Tributary to Bone Lake at Bone Lake North Inlet, Tributary to Sunrise River at Bone Lake Outlet, Tributary to Sunrise River at Little Comfort Lake Inlet, Sunrise River at Forest Lake Outlet, Tributary to Sunrise River at Heims Lake Drainage, Sunrise River at Comfort Lake Inlet, and Sunrise River at Comfort Lake Outlet (Figure 2). Automated storm composite, manual base and storm grab, and *E. coli* samples were collected at each site, with the exception of Sunrise River at Forest Lake Outlet and Tributary to Sunrise River at Bone Lake Outlet where no samples were collected. Site locations and monitoring types can be found in Table 3. This report and the accompanying data will also be provided in an electronic format. Please contact the Washington Conservation District at (651) 330-8220 to obtain historical data.

Each of the stream monitoring sites showed an increase in total discharge in 2014 as compared to 2013. The cause of the overall increase in discharge could be attributed to the large amount of snow observed in the winter of 2013/2014 and the above average precipitation from April through June of 2014. Both April and June had precipitation well above the average amount; 7.28 inches and 10.55 inches, respectively. Average monthly precipitation totals were derived from historic 30-year (1981-2010) averages for this region. The total precipitation for 2014, according to the State Climatology Office, was 37.57 inches while the average annual precipitation is 30.61 inches; it was an above average year for precipitation (Figure 1). Tributary to Bone Lake at Bone Lake North Inlet, Tributary to Sunrise River at Bone Lake Outlet, Tributary to Sunrise River at Little Comfort Lake Inlet, and Sunrise River at Comfort Lake Inlet all showed an increase in total phosphorus (TP) loads in 2014 as compared to 2013. Tributary to Sunrise River at Heims Lake Drainage and Sunrise River at Comfort Lake Outlet showed a decrease in TP loads. The total phosphorus load for the Sunrise River and entire Comfort Lake-Forest Lake Watershed District was estimated at 0.085 lbs./ac (2,099 lbs.) as determined by the Sunrise River at Comfort Lake Outlet site (Table 19), a slight decrease from 2013. Table 1 provides the 2014 discharge, loading, and rainfall summary for each stream monitoring station. It should be noted that the Sunrise River at Forest Lake Outlet site is excluded from these analyses and comparisons due to insufficient data for 2014 monitoring season.

While stream monitoring has been taking place on CLFLWD streams since 2004 it should be noted that the sampling technique has changed at almost all sites. When monitoring began the automated composite sampling technique was used at most sites. This involves multiple water samples collected at various flow points by an automated device, typically during storm events. Composite samples generally capture more of the rising limb and peak of a storm event where most nutrient loading is likely to occur. Between the years of 2005 and 2009 the sampling technique changed at several sites to grab samples, which is a manually collected discrete water sample. The issue with manual grab samples is the timing of the sample collection; it is very easy to miss the rising limb or peak of a storm event. Grab samples capture data at just one point in time during the storm event whereas a composite sample collects many samples during different points in the storm event. Composite samples can produce a more accurate loading number. When comparing loading numbers at sites where the sampling technique has changed it appears as though at some point there is a significant decrease in TP load. This apparent decrease correlates with the year in which the sampling technique was changed from composite to grab samples. When looking at the loading numbers it may lead to an unrealistic conclusion that phosphorus loads are decreasing. The switch in sampling techniques must be taken into consideration when comparing loading numbers. The 2012 monitoring season brought a slight change in sampling technique for all monitored

sites yet again. Grab sampling was still the technique used however; the samples were collected using the automated sampler versus a manual grab. The reasoning was that the timing of the grab sample would be more accurate when automatically collected, during the rising limb or at the peak of the storm event. In 2013 it was decided to go back to collecting automated storm composite samples in order to achieve more accurate loading numbers from sites where samples are collected. Composite samples were once again collected in 2014.

The Sunrise River at Forest Lake Outlet, Sunrise River at Comfort Lake Outlet, and Tributary to Sunrise River at Bone Lake Outlet sites have each utilized three different sampling techniques. All three sites started with the automated composite sampling technique, then switched to manual grab samples, and finally switched to using in-lake TP concentrations to estimate load. At Forest Lake Outlet composite sampling was used for the 2003, 2004, and 2005 monitoring seasons and switched to manual grab samples in 2006. Sampling ceased at the site in 2007 and all TP loads since then have been estimated using in-lake sample concentrations collected in the West Basin of Forest Lake. At Comfort Lake Outlet composite sampling was used for the 2003, 2004, and 2005 monitoring seasons and switched to manual grab samples in 2006. Grab samples were also collected in 2008 by the Army Corps of Engineers. In-lake TP concentrations were used to estimate load for the 2009 and 2010 monitoring seasons. In 2011 manual grab samples were once again collected at this site and in 2012 automated grab samples were collected. In 2013 and 2014 automated storm composite samples were once again collected. At Bone Lake Outlet automated composite sampling was used in 2003, 2004, and 2005 and switched to manual grab samples in 2006. Monitoring was discontinued at this site from 2007 through 2012. Monitoring resumed in 2013 using in-lake TP concentrations collected in Bone Lake to estimate load, as was the method used in 2014. As with grab samples, using in-lake total phosphorus concentrations may lead to artificially low loading numbers. This is due to the difference in sampling technique and location (in-lake versus in-stream). More accurate loading numbers can be estimated by collecting samples at the monitoring site. Once again, the changes in sampling techniques must be taken into consideration when comparing loading numbers.

Table 1. CLFLWD 2014 Stream Discharge, Loading, and Rainfall Summary

Site	Subwatershed (acres)	Yearly Discharge (cf)	Yearly Discharge (ac-ft.)	Peak Discharge (cfs)	Yearly Total Phosphorus Load (lbs.)	Yearly Total Suspended Solids Load (lbs.)	Monitored Rainfall (in.)
Bone Lake North Inlet	2,479	49,356,921	1,134	15.296	917	32,910	19.76
Bone Lake Outlet	5,495	108,435,210	2,491	20.731	271	NA	NA
Little Comfort Lake Inlet	10,513	132,674,265	3,047	17.331	354	42,545	15.19
Forest Lake Outlet	8,719	NA	NA	NA	NA	NA	NA
Heims Lake Drainage	667	32,336,273	743	15.632	374	106,692	NA
Comfort Lake Inlet	13,732	423,401,380	9,725	98.839	2,006	253,252	26.60
Comfort Lake Outlet	24,558	856,945,895	19,683	96.697	2,099	468,449	27.23

The WCD and citizen volunteers also conducted monitoring on eleven lakes for CLFLWD in 2014. A map of the locations of the monitoring sites can be found in Figure 2 and a table of the locations and monitoring types can be found in Table 3. The monitored lakes were as follows: Bone Lake, Comfort Lake, Forest Lake (West, Middle, and East Basins), Fourth, Heims, Lendt, Little Comfort Lake, Moody Lake, Shields Lake, Sylvan/Halfbreed Lake, and Third Lake. Lake results are discussed in the Lake Monitoring portion of this report.

II. INTRODUCTION AND METHODS

This portion of the report focuses on the summary and comparison of the stream water quality data collected by the Washington Conservation District (WCD) from January 1 – December 31, 2014, as well as historical data. In 2014, the WCD conducted continuous discharge and stream water quality monitoring at seven sites: Tributary to Bone Lake at Bone Lake North Inlet, Tributary to Sunrise River at Bone Lake Outlet, Tributary to Sunrise River at Little Comfort Lake Inlet, Sunrise River at Forest Lake Outlet, Tributary to Sunrise River at Heims Lake Drainage, Sunrise River at Comfort Lake Inlet, and Sunrise River at Comfort Lake Outlet (Figure 2). Automated storm composite, manual base and storm grab, and *E. coli* samples were collected at each site, with the exception of Sunrise River at Forest Lake Outlet and Tributary to Sunrise River at Bone Lake Outlet where no samples were collected. Site locations and monitoring types can be found in Table 3. Multiple water quality parameters were monitored and analyzed at each stream site. The purpose of this monitoring was to assess and document the current water quality conditions of the streams, identify problem resources or areas, and to continue a long-term baseline monitoring program which will enable the Comfort Lake-Forest Lake Watershed District (CLFLWD) to identify trends associated with land use changes in the watershed.

Continuous stage, velocity, and discharge measurements were recorded every 15 minutes at the Tributary to Bone Lake at Bone Lake North Inlet from April 21-November 4, 2014, Tributary to Sunrise River at Bone Lake Outlet from April 10-October 23, 2014, Tributary to Sunrise River at Little Comfort Lake Inlet from June 10-November 4, 2014, Sunrise River at Forest Lake Outlet from April 10-November 4, 2014, Tributary to Sunrise River at Heims Lake Drainage from April 29-November 4, 2014, Sunrise River at Comfort Lake Inlet from April 16-October 23, 2014, and Sunrise River at Comfort Lake Outlet from April 10-November 4, 2014. Precipitation data was also continuously collected at Tributary to Bone Lake at Bone Lake North Inlet, Tributary to Sunrise River at Little Comfort Lake Inlet, Sunrise River at Comfort Lake Inlet, and Sunrise River at Comfort Lake Outlet.

Staff gages were installed and read at each site. Field stage measurements were taken in the stream channels by measuring the area/velocity sensor (probe) depth. Temperature, dissolved oxygen, specific conductivity, pH, and transparency tube measurements were also taken. Stage-discharge relationships were developed at four stream sites and an area-velocity relationship was used at three sites (Bone Lake North Inlet, Little Comfort Lake Inlet, and Comfort Lake Inlet) to determine discharge. Automated storm composite and manual storm and base flow grab samples were collected at all continuous stream monitoring sites, with the exception of Sunrise River at Forest Lake Outlet and Tributary to Sunrise River at Bone Lake Outlet where no samples were collected. *E. coli* grab samples were also collected at all sampled monitoring sites. Duplicate base and/or storm samples were collected at most monitored sites per WCD standard operating procedures. The purpose of duplicate samples is to obtain information on the magnitude of errors owing to contamination, random and systematic errors, and any other variabilities that are introduced from the time of sampling until the samples arrive at the lab, therefore the duplicate results are not incorporated into the report. The Metropolitan Council Environmental Services Laboratory in St. Paul analyzed all samples. A complete list of detailed Washington Conservation District water monitoring methods and standard operating procedures can be found at <http://www.mnwcd.org/water-quality-water-monitoring/>.

CLFLWD streams are considered to be Class 2B Waters, according to the Minnesota Pollution Control Agency (MPCA). These types of streams are described as cool- and warm-water fisheries (not protected for drinking water) and are held to certain water quality standards as set by the MPCA (<https://www.revisor.mn.gov/rules/?id=7050.0222>). The state standards can be found in Table 2. According to

the MPCA, water quality standards are used to: “define maximum allowable levels of pollutants to protect beneficial uses, ascertain the quality of the state’s water resources by comparing the standards to monitoring data, identify waters that are polluted, help establish priorities for the allocation of treatment resources and cleanup efforts, set effluent limits and treatment requirements for dischargers in some situations, and assess risks to surface water from ground water contamination sites and help define cleanup goals.” More water quality standard information can be found here: <http://www.pca.state.mn.us/index.php/water/water-monitoring-and-reporting/water-quality-and-pollutants/water-quality-standards.html>.

It is important to track these water quality standards at each site to determine if the waters are meeting state goals and whether or not they are impaired. The MPCA is working on developing new standards for altered stream systems as part of the Tiered Aquatic Life Uses (TALU) framework (<http://www.pca.state.mn.us/index.php/water/water-permits-and-rules/water-rulemaking/tiered-aquatic-life-use-talu-framework.html>).

Table 2. MPCA Class 2B Water Quality Standards

Parameter	Water Quality Standard
Chloride (Chronic)	< 230 mg/L
Low DO	> 5 mg/L as daily minimum
pH	> 6.5 or < 8.5
Turbidity	< 25 NTU
Turbidity (TSS values)	< 100 mg/L
Turbidity (Transparency values)	> 20 cm
<i>E. coli</i>	< 126 mpn/100mL

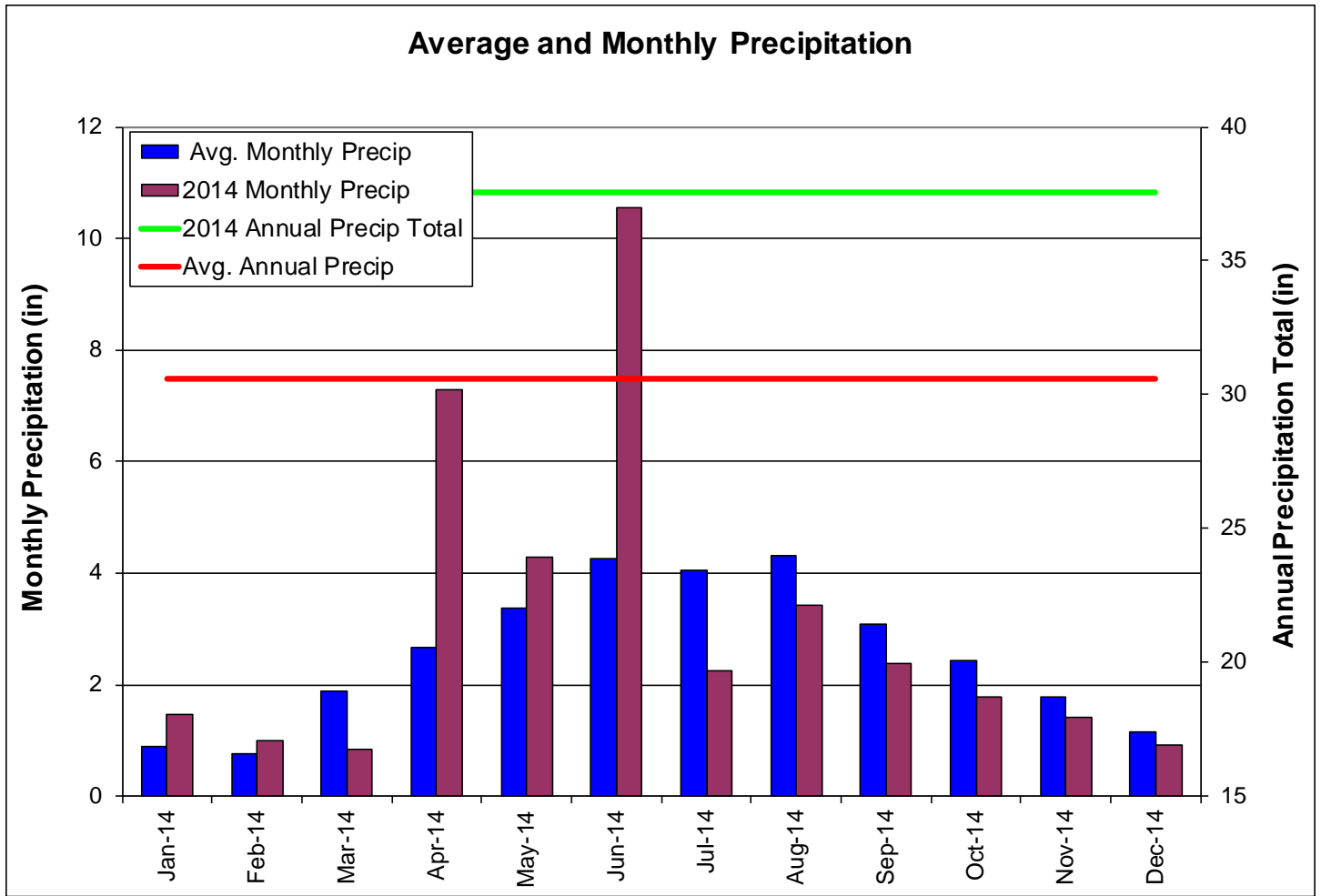


Figure 1. 2014 Monthly Precipitation and Historic 30-Year Average Monthly Precipitation

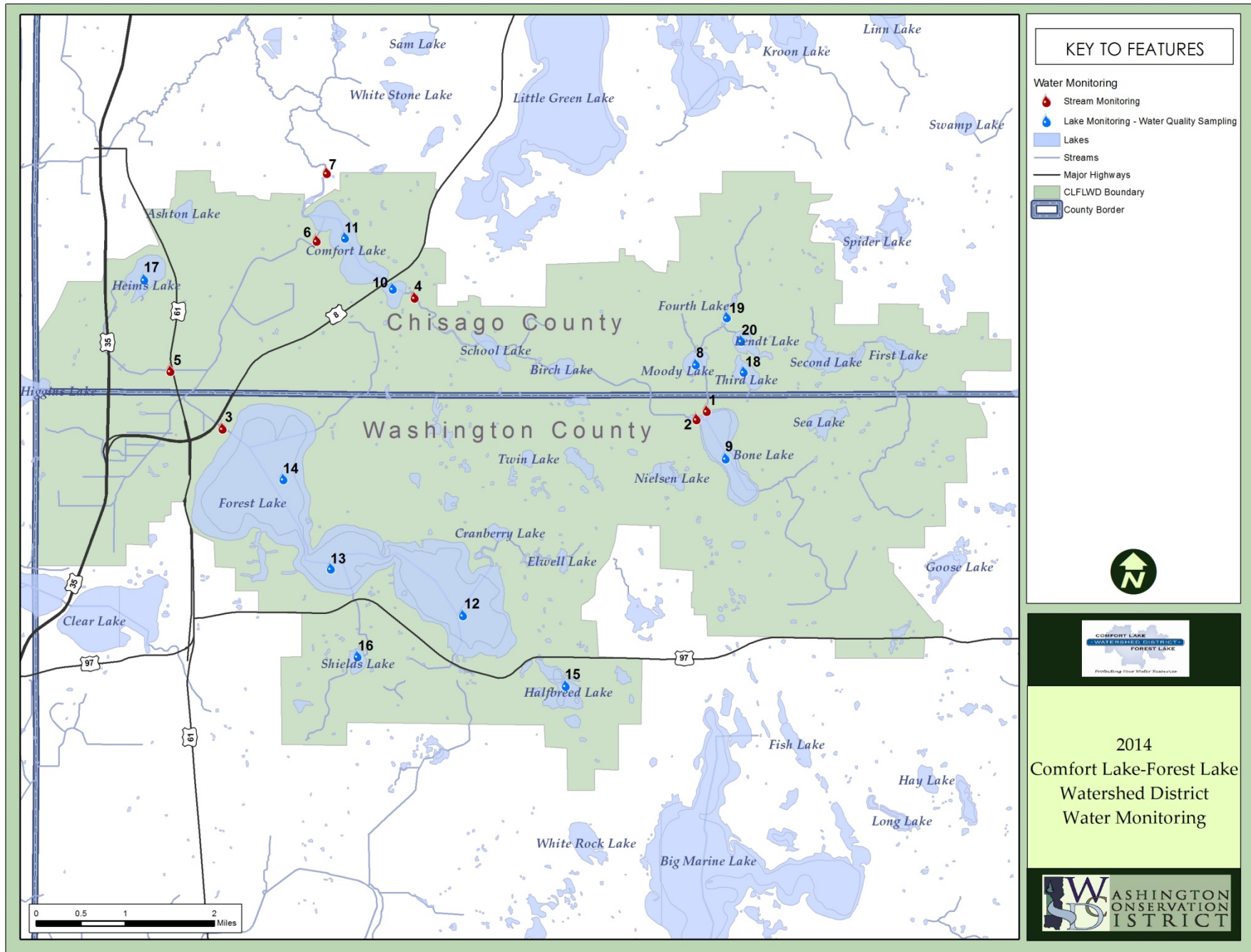


Figure 2. CLFLWD Monitoring Locations

Table 3. Monitoring Site Location and Description Summary

Site Description	Map Site ID#	Full Site Name	Summarized Site Name	General Site Location	Monitoring Site Description	Monitored Parameters
Stream Monitoring	1	Tributary to Bone Lake at Bone Lake North Inlet	Bone Lake North	238 th Street North	Flow Monitoring Through Culvert	Discharge and Automated Water Quality Grab Samples*
Stream Monitoring	2	Tributary to Sunrise River at Bone Lake Outlet	Bone Lake Outlet	Lofton Avenue North	Flow Monitoring Through Culvert	Discharge Only
Stream Monitoring	3	Tributary to Sunrise River at Forest Lake Outlet	Forest Lake Outlet	North Shore Drive	Flow Monitoring in Natural Cross-Section	Discharge Only
Stream Monitoring	4	Tributary to Sunrise River at Little Comfort Lake Inlet	Little Comfort Lake Inlet	Itasca Avenue	Flow Monitoring Through Culvert	Discharge and Automated Water Quality Grab Samples*
Stream Monitoring	5	Tributary to Sunrise River at Heims Lake Drainage	Heims Lake Drainage	Hwy 61	Flow Monitoring in Natural Cross-Section	Discharge and Automated Water Quality Grab Samples*
Stream Monitoring	6	Sunrise River at Comfort Lake Inlet	Comfort Lake Inlet	West Comfort Drive	Flow Monitoring Through Culvert	Discharge and Automated Water Quality Grab Samples*
Stream Monitoring	7	Sunrise River at Comfort Lake Outlet	Comfort Lake Outlet	Wyoming Trail	Flow Monitoring in Natural Cross-Section	Discharge and Automated Water Quality Grab Samples*
Lake Monitoring	8	Moody Lake	---	Chisago Lakes Township	---	Surface Water Quality Samples, Elevation**
Lake Monitoring	9	Bone Lake	---	City of Scandia	---	Surface Water Quality Samples, Elevation**
Lake Monitoring	10	Little Comfort Lake	---	Chisago City	---	Surface Water Quality Samples**
Lake Monitoring	11	Comfort Lake	---	City of Wyoming	---	Surface Water Quality Samples, Elevation**
Lake Monitoring	12	Forest Lake – East Basin (3)	---	City of Forest Lake	---	Surface Water Quality Samples**
Lake Monitoring	13	Forest Lake – Middle Basin (2)	---	City of Forest Lake	---	Surface Water Quality Samples, Elevation**
Lake Monitoring	14	Forest Lake – West Basin (1)	---	City of Forest Lake	---	Surface Water Quality Samples**
Lake Monitoring	15	Sylvan/Halfbreed Lake	---	City of Forest Lake	---	Surface Water Quality Samples, Elevation**
Lake Monitoring	16	Shields Lake	---	City of Forest Lake	---	Surface Water Quality Samples, Elevation**
Lake Monitoring	17	Heims Lake	---	City of Wyoming	---	Surface Water Quality Samples, Elevation**
Lake Monitoring	18	Third Lake	---	Chisago Lakes Township	---	Surface Water Quality Samples, Elevation**
Lake Monitoring	19	Fourth Lake	---	Chisago Lakes Township	---	Surface Water Quality Samples, Elevation**
Lake Monitoring	20	Lendt Lake	---	Chisago Lakes Township	---	Surface Water Quality Samples, Elevation**

*Stream Monitoring Water Quality Sample Parameters Include: Total Phosphorus, Dissolved Phosphorus, Total Kjeldahl Nitrogen, Nitrate, Nitrite, Ammonia Nitrogen, Total Suspended Solids, Volatile Suspended Solids, Total Chlorides, *E. coli* Bacteria

**Lake Monitoring Water Quality Sample Parameters Include: Total Kjeldahl Nitrogen, Total Phosphorus, Chlorophyll-a, Secchi Disk Transparency

III. BONE LAKE SUBWATERSHED

Bone Lake North Inlet

The station at the Bone Lake North Inlet recorded stage, velocity, and rainfall from April 21-November 4, 2014 (Figure 3). Total discharge during this period was 37,577,451 cf or 863 acre-ft. Total yearly discharge was 49,356,921 cf or 1,134 acre-ft. Total rainfall recorded during the monitoring season was 19.76 inches. Peak discharge of 15.296 cfs was recorded on May 3rd.

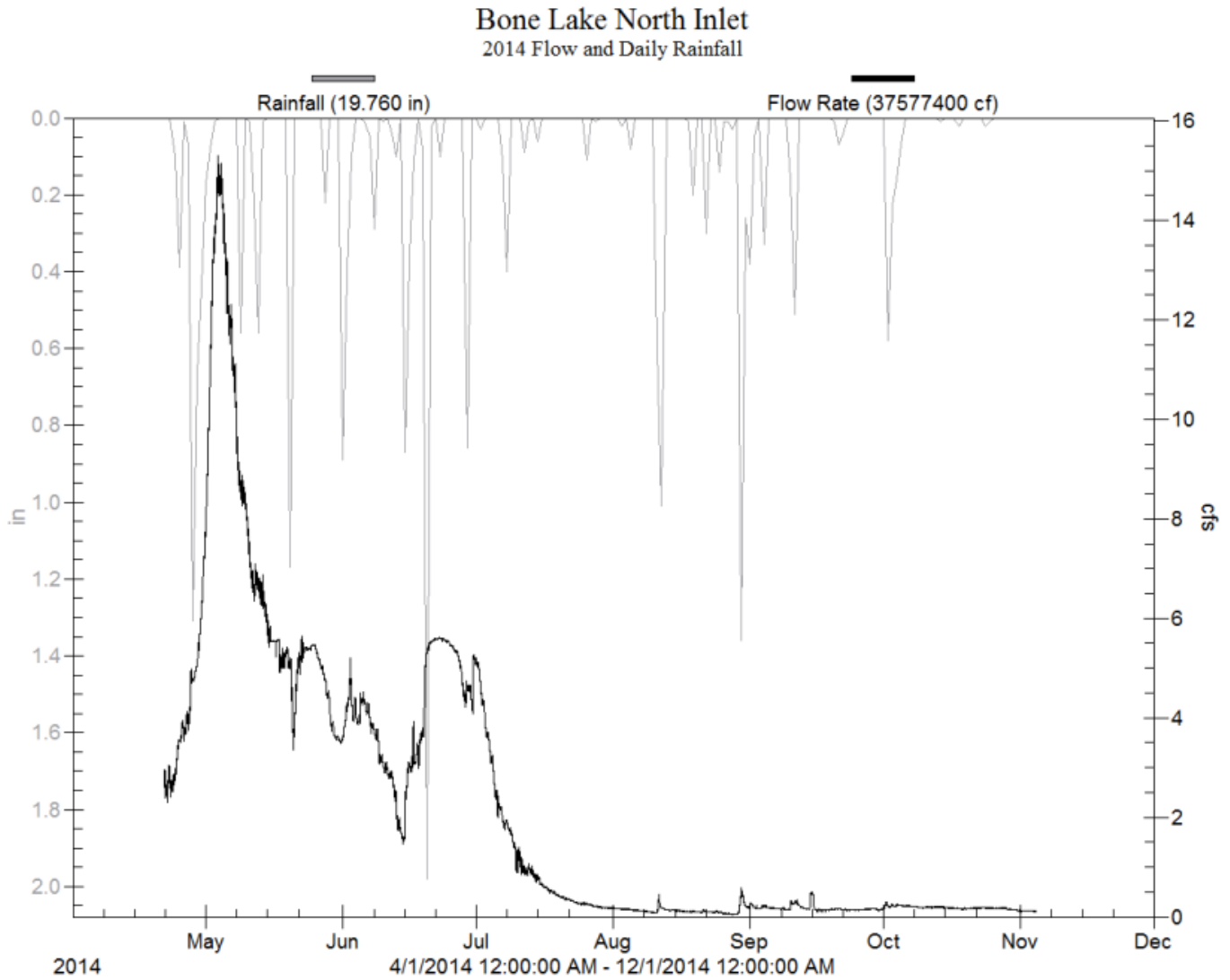


Figure 3. Bone Lake North Inlet 2014 Flow and Daily Rainfall

The total suspended solids (TSS), volatile suspended solids (VSS), total Kjeldahl nitrogen (TKN), total phosphorus (TP), dissolved phosphorus, chloride, nitrite, nitrate, ammonia nitrogen, and *E. coli* results from all collected samples are listed in Table 4 and field water quality measurements are listed in Table 5. The highest TKN result of 2.5 mg/L, the highest TP result of 0.558 mg/L, and the highest TSS result of 23 mg/L all came from a base grab collected on May 28th.

Table 4. Bone Lake North Inlet 2014 Sample Chemistry Results

Sample Type	Start	End	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	Dissolved TP (mg/L)	Chloride (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)	Ammonia Nitrogen (mg/L)	<i>E. coli</i> (mpn/100ml)	Un-ionized Ammonia (mg/L)
Storm Composite	4/27/2014 11:17	4/28/2014 8:17	-2	-2	1.2	0.063	0.062	10.4	<0.03	0.08	0.09		
Storm Grab	4/29/2014 11:03	4/29/2014 11:03	3	-2	1.3	0.074	-0.033	11.4	<0.03	0.05	0.15		
Storm Composite	6/19/2014 9:19	6/20/2014 9:58	4	-2	1.2	0.183	0.081	8.6	<0.03	0.05	-0.03		
Base Grab	4/21/2014 12:32	4/21/2014 12:32	5	3	1.3	0.078	-0.040	11.8	<0.03	0.06	0.07		0.000306
Base Grab	5/28/2014 9:40	5/28/2014 9:40	23	15	2.5	0.558	0.126	12.2	<0.03	<0.05	<0.02	133	0.000093
Base Grab	6/3/2014 9:56	6/3/2014 9:56	14	8	1.8	0.431	0.291	10.4	<0.03	<0.05	-0.05		0.000258
Base Grab	8/12/2014 10:51	8/12/2014 10:51	8	6	2.4	0.372	0.158	8.4	<0.03	<0.05	0.69	770	0.002913
Base Grab	10/27/2014 11:17	10/27/2014 11:17	-1	-1	0.9	-0.031	-0.030	9.7	<0.03	<0.05	0.21	8	0.004183
<i>E. coli</i> Grab	7/9/2014 9:05	7/9/2014 9:05										41	

Table 5. Bone Lake North Inlet 2014 Field Water Quality Measurements

Date/Time	Transparency (cm)	Water Temperature (C)	Dissolved Oxygen (mg/L)	Conductivity (umhos/cm)	pH
4/21/2014 12:32	>100	7.0	6.33	136	7.5
5/28/2014 9:40	52	16.8	0.06	202	7.2
6/3/2014 9:56	60	18.2	0.07	162	7.2
8/12/2014 10:51	60	18.7	0.61	224	7.1
10/27/2014 11:17	>100	9.1	2.28	253	8.1

Exceeds Water Quality Standard

Table 6. Bone Lake North Inlet 2014 Total Suspended Solids and Total Phosphorus Loading

Sample Type	Sample Collection Time				Loading Interval		Interval Volume (cf)	Interval Volume (ac-ft)	Interval TSS (lb)	Interval TP (lb)
	Start	End	TSS (mg/L)	TP (mg/L)	Start	End				
Base*			10	0.294	1/1/14 0:00	4/1/14 12:00	7,819,200	179.60	4978.8	143.51
Base Grab*	4/21/2014 12:32	4/21/2014 12:32	5	0.078	4/1/14 12:00	4/21/14 13:00	3,463,200	79.55	1081.0	16.86
Base			10	0.294	4/21/14 13:00	4/27/14 11:00	1,669,520	38.35	1063.1	30.64
Storm Composite	4/27/2014 11:17	4/28/2014 8:17	2	0.063	4/27/14 11:00	4/28/14 1:00	238,706	5.48	29.8	0.94
Storm Grab	4/29/2014 11:03	4/29/2014 11:03	3	0.074	4/28/14 1:00	4/29/14 12:00	631,633	14.51	118.3	2.92
Base			10	0.294	4/29/14 12:00	5/8/14 16:00	8,879,300	203.95	5653.9	162.96
Storm			3	0.107	5/8/14 16:00	5/8/14 19:00	95,448	2.19	17.9	0.64
Base			10	0.294	5/8/14 19:00	5/11/14 23:00	2,118,630	48.66	1349.0	38.88
Storm			3	0.107	5/11/14 23:00	5/12/14 4:00	119,745	2.75	22.4	0.80
Base			10	0.294	5/12/14 4:00	5/19/14 13:00	3,701,350	85.02	2356.8	67.93
Storm			3	0.107	5/19/14 13:00	5/21/14 3:00	613,084	14.08	114.8	4.08
Base Grab	5/28/2014 9:40	5/28/2014 9:40	23	0.558	5/21/14 3:00	5/31/14 22:00	4,406,080	101.20	6326.3	153.48
Storm			3	0.107	5/31/14 22:00	6/1/14 22:00	335,077	7.70	62.8	2.23
Base			10	0.294	6/1/14 22:00	6/2/14 10:00	186,505	4.28	118.8	3.42
Storm			3	0.107	6/2/14 10:00	6/2/14 21:00	187,848	4.31	35.2	1.25
Base Grab	6/3/2014 9:56	6/3/2014 9:56	14	0.431	6/2/14 21:00	6/14/14 22:00	3,427,970	78.74	2995.9	92.23
Storm			3	0.107	6/14/14 22:00	6/15/14 23:00	236,477	5.43	44.3	1.57
Base			10	0.294	6/15/14 23:00	6/19/14 4:00	914,594	21.01	582.4	16.79
Storm Composite	6/19/2014 9:19	6/20/2014 9:58	4	0.183	6/19/14 4:00	6/20/14 14:00	617,987	14.19	154.3	7.06
Base			10	0.294	6/20/14 14:00	6/28/14 17:00	3,761,050	86.39	2394.8	69.03
Storm			3	0.107	6/28/14 17:00	6/28/14 21:00	65,538	1.51	12.3	0.44
Base			10	0.294	6/28/14 21:00	8/10/14 20:00	4,147,840	95.27	2641.1	76.13
Storm			3	0.107	8/10/14 20:00	8/11/14 10:00	11,892	0.27	2.2	0.08
Base Grab	8/12/2014 10:51	8/12/2014 10:51	8	0.372	8/11/14 10:00	8/29/14 11:00	165,979	3.81	82.9	3.85
Storm			3	0.107	8/29/14 11:00	8/29/14 18:00	5,513	0.13	1.0	0.04
Storm			3	0.107	8/29/14 18:00	8/30/14 0:00	10,593	0.24	2.0	0.07
Storm			3	0.107	8/30/14 0:00	8/30/14 6:00	10,158	0.23	1.9	0.07
Base			10	0.294	8/30/14 6:00	8/31/14 22:00	33,340	0.77	21.2	0.61
Storm			3	0.107	8/31/14 22:00	9/1/14 6:00	7,339	0.17	1.4	0.05
Base			10	0.294	9/1/14 6:00	9/9/14 23:00	132,382	3.04	84.3	2.43
Storm			3	0.107	9/9/14 23:00	9/10/14 6:00	6,144	0.14	1.2	0.04
Base			10	0.294	9/10/14 6:00	9/14/14 8:00	76,744	1.76	48.9	1.41
Storm			3	0.107	9/14/14 8:00	9/15/14 5:00	32,387	0.74	6.1	0.22
Base			10	0.294	9/15/14 5:00	10/1/14 6:00	206,599	4.75	131.6	3.79
Storm			3	0.107	10/1/14 6:00	10/1/14 18:00	10,913	0.25	2.0	0.07
Base			10	0.294	10/1/14 18:00	10/2/14 14:00	15,415	0.35	9.8	0.28
Storm			3	0.107	10/2/14 14:00	10/3/14 0:00	8,260	0.19	1.5	0.06
Base			10	0.294	10/3/14 0:00	10/3/14 22:00	17,456	0.40	11.1	0.32
Storm			3	0.107	10/3/14 22:00	10/4/14 6:00	7,033	0.16	1.3	0.05
Base Grab	10/27/2014 11:17	10/27/2014 11:17	1	0.031	10/4/14 6:00	11/4/14 11:15	464,922	10.68	29.0	0.90
Base*			10	0.294	11/4/14 11:15	1/1/15 0:00	497,070	11.42	316.5	9.12
Base Average			10	0.294						
Storm Average			3	0.107						
All Average			8	0.224						
Total							49,356,921	1,134	32,910	917
CLFLWD Major Subwatershed Total Acres							2,479			
Total Load									13.28	0.37

Italics indicate estimated concentrations based on average base and storm flow concentrations.

*Interval volumes from 1/1/2014 to 4/1/2014, 4/1/2014 to 4/21/2014, and 11/4/2014 to 1/1/2015 were estimated using similar flow conditions.

Total phosphorus loading at the Bone Lake North Inlet site for 2014 was estimated at 0.37 lbs/ac or 917 lbs. (Table 6). Monitoring should continue at this site in an effort to attain a total phosphorus loading trend entering Bone Lake.

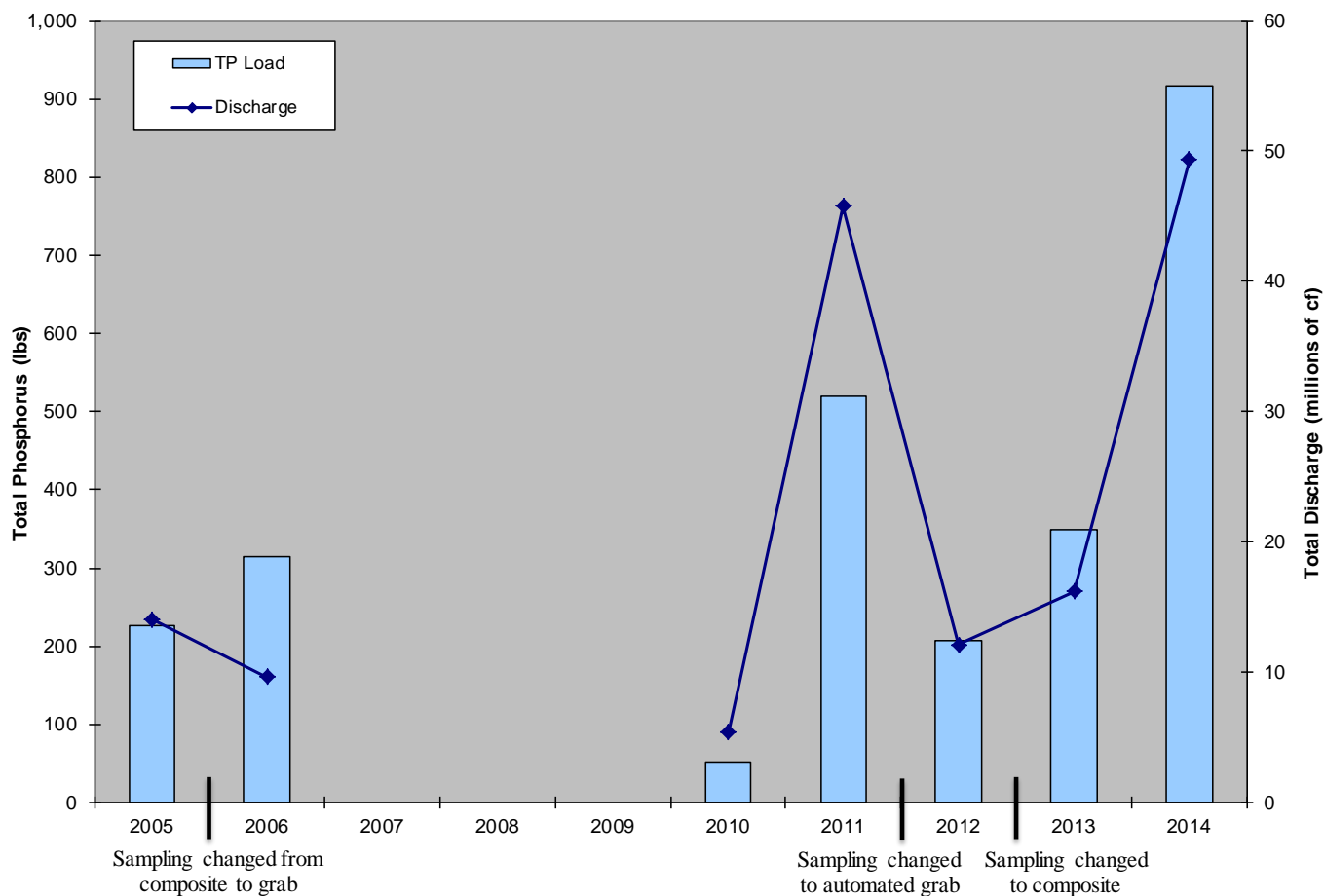


Figure 4. Bone Lake North Inlet Historic Annual Discharge and Total Phosphorus Load

Flow and water chemistry data has been collected at the Bone Lake North Inlet site since 2003, excluding the years 2004 and 2007-2009. Total estimated annual discharge and phosphorus loads can be found in Figure 4. When comparing year-to-year loading numbers it should be noted that the sampling technique changed between 2005 and 2006, 2011 and 2012, and 2012 and 2013. In 2005, water chemistry data was collected using automated composite samples. Since 2006, excluding the years 2007-2009, this data was collected by manual grab samples. The sampling technique changed again slightly in 2012. Automated storm grabs were collected utilizing the sampling equipment at the site. This allowed for improved timing of the storm grabs, more were collected during the rising limb and near the peak of storm events. For the monitoring season of 2013 the sampling technique changed again and automated storm composite samples were collected once again. Composite samples were again collected for the 2014 monitoring season. 2012 saw a dramatic decrease in discharge and TP load from 2011. This decrease could be misleading due to the fact that the site was removed prior to the end of the monitoring season. It was removed at the beginning of August in preparation for the fish barrier project on Bone Lake. There was an increase in discharge and TP load from 2012 to 2013 which again could be misleading due to the fact that the site was removed early in 2012. In order to make a better comparison for the years 2011 through 2014, similar time periods could be compared: 1/1/2011-8/8/2011, 1/1/2012-

8/9/2012, 1/1/2013-8/12/2013, and 1/1/2014-8/10/2014. When comparing the discharge and total phosphorus load estimates for these time periods there is still a decrease for both parameters from the years 2011 to 2012 and an increase for both parameters from the years 2012 to 2013 and 2013 to 2014. The increase in TP from 2013 to 2014 may also be somewhat misleading. There was a lack of samples collected during the 2013 monitoring season which made it unrealistic to characterize storm and base periods, therefore storm and base results were averaged to estimate TP numbers. The increase in discharge however, is accurate. There was a large amount of snow during the winter of 2013/2014 followed by a wet spring, leading to a significant increase in discharge. Approximately three times the volume of water passed through the site when compared to 2013. Due to the installation of the fish barrier, the site will continue to be monitored in a pipe instead of a natural stream channel.

Bone Lake Outlet

The station at the Bone Lake Outlet recorded stage and velocity from April 10-October 23, 2014 (Figure 5). Rainfall was not recorded at this station. Total discharge during this period was 85,759,980 cf or 1,970 acre-ft. Total yearly discharge was 108,435,210 cf or 2,491 acre-ft. Peak discharge of 20.731 cfs was recorded on June 28th.

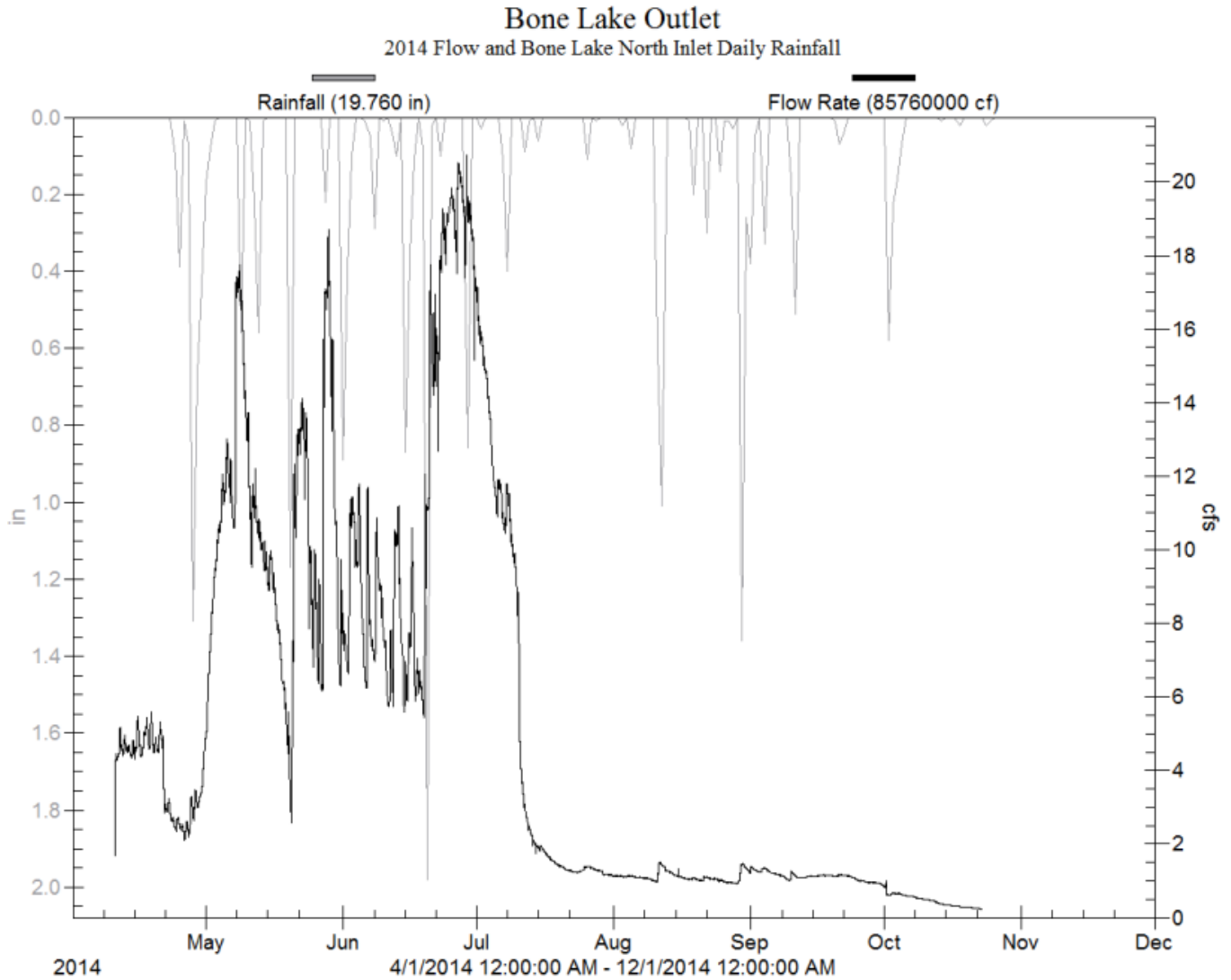


Figure 5. Bone Lake Outlet 2014 Flow and Bone Lake North Inlet Daily Rainfall

Table 7. Bone Lake Outlet 2014 Total Suspended Solids and Total Phosphorus Loading

Sample Type	Sample Collection Time				Loading Interval		Interval Volume (cf)	Interval Volume (ac-ft)	Interval TSS (lb)	Interval TP (lb)
	Start	End	TSS (mg/L)	TP (mg/L)	Start	End				
Base*			N/A	0.040	1/1/14 0:00	4/10/14 9:45	21,471,750	493.18	N/A	53.07
Base			N/A	0.040	4/10/14 9:45	4/29/14 12:45	6,404,550	147.11	N/A	15.83
Storm			N/A	0.040	4/29/14 12:45	5/2/14 11:45	1,362,140	31.29	N/A	3.37
Base			N/A	0.040	5/2/14 11:45	5/3/14 11:45	799,677	18.37	N/A	1.98
In-Lake Sample	5/4/2014 21:00	5/4/2014 21:00	N/A	0.034	5/3/14 11:45	5/5/14 11:45	1,908,740	43.84	N/A	4.05
Base			N/A	0.040	5/5/14 11:45	5/7/14 14:45	2,153,850	49.47	N/A	5.32
Storm			N/A	0.040	5/7/14 14:45	5/7/14 22:45	464,064	10.66	N/A	1.15
Base			N/A	0.040	5/7/14 22:45	5/11/14 22:45	4,869,350	111.84	N/A	12.03
Storm			N/A	0.040	5/11/14 22:45	5/12/14 3:45	209,919	4.82	N/A	0.52
Base			N/A	0.040	5/12/14 3:45	5/14/14 12:45	2,112,730	48.53	N/A	5.22
In-Lake Sample	5/15/2014 13:10	5/15/2014 13:10	N/A	0.034	5/14/14 12:45	5/16/14 12:45	1,612,230	37.03	N/A	3.42
Base			N/A	0.040	5/16/14 12:45	5/20/14 8:45	2,057,550	47.26	N/A	5.09
Storm			N/A	0.040	5/20/14 8:45	5/20/14 17:45	194,892	4.48	N/A	0.48
Storm			N/A	0.040	5/20/14 17:45	5/20/14 23:45	228,152	5.24	N/A	0.56
Base			N/A	0.040	5/20/14 23:45	5/25/14 12:45	4,497,950	103.31	N/A	11.12
In-Lake Sample	5/26/2014 13:45	5/26/2014 13:45	N/A	0.014	5/25/14 12:45	5/27/14 12:45	1,369,860	31.46	N/A	1.20
In-Lake Sample	5/28/2014 15:04	5/28/2014 15:04	N/A	0.017	5/27/14 12:45	5/29/14 12:45	2,842,580	65.29	N/A	3.02
Base			N/A	0.040	5/29/14 12:45	5/31/14 7:45	1,593,570	36.60	N/A	3.94
Storm			N/A	0.040	5/31/14 7:45	5/31/14 12:45	159,451	3.66	N/A	0.39
Base			N/A	0.040	5/31/14 12:45	6/2/14 6:45	1,128,100	25.91	N/A	2.79
Storm			N/A	0.040	6/2/14 6:45	6/2/14 15:45	336,169	7.72	N/A	0.83
Base			N/A	0.040	6/2/14 15:45	6/6/14 7:45	2,969,820	68.21	N/A	7.34
Storm			N/A	0.040	6/6/14 7:45	6/6/14 14:45	269,597	6.19	N/A	0.67
Base			N/A	0.040	6/6/14 14:45	6/8/14 6:45	1,116,640	25.65	N/A	2.76
Storm			N/A	0.040	6/8/14 6:45	6/8/14 16:45	360,203	8.27	N/A	0.89
In-Lake Sample	6/9/2014 16:00	6/9/2014 16:00	N/A	0.035	6/8/14 16:45	6/10/14 16:45	1,442,820	33.14	N/A	3.15
In-Lake Sample	6/12/2014 10:25	6/12/2014 10:25	N/A	0.024	6/10/14 16:45	6/12/14 16:45	1,193,730	27.42	N/A	1.79
Base			N/A	0.040	6/12/14 16:45	6/14/14 20:45	1,608,700	36.95	N/A	3.98
Storm			N/A	0.040	6/14/14 20:45	6/15/14 2:45	141,585	3.25	N/A	0.35
Base			N/A	0.040	6/15/14 2:45	6/15/14 14:45	266,118	6.11	N/A	0.66
Storm			N/A	0.040	6/15/14 14:45	6/15/14 22:45	212,489	4.88	N/A	0.53
Base			N/A	0.040	6/15/14 22:45	6/16/14 7:45	239,969	5.51	N/A	0.59
Storm			N/A	0.040	6/16/14 7:45	6/16/14 14:45	247,578	5.69	N/A	0.61
Base			N/A	0.040	6/16/14 14:45	6/19/14 9:45	1,604,560	36.85	N/A	3.97
Storm			N/A	0.040	6/19/14 9:45	6/19/14 12:45	117,624	2.70	N/A	0.29
In-Lake Sample	6/20/2014 18:00	6/20/2014 18:00	N/A	0.035	6/19/14 12:45	6/21/14 12:45	2,362,720	54.27	N/A	5.16
In-Lake Sample	6/23/2014 14:34	6/23/2014 14:34	N/A	0.046	6/21/14 12:45	6/23/14 21:45	3,475,640	79.83	N/A	9.98
Base			N/A	0.040	6/23/14 21:45	6/28/14 12:45	7,703,640	176.94	N/A	19.04
In-Lake Sample	6/29/2014 12:00	6/29/2014 12:00	N/A	0.043	6/28/14 12:45	6/30/14 12:45	3,274,970	75.22	N/A	8.79
Base			N/A	0.040	6/30/14 12:45	7/7/14 12:45	8,275,570	190.08	N/A	20.45
In-Lake Sample	7/8/2014 13:48	7/8/2014 13:48	N/A	0.130	7/7/14 12:45	7/9/14 12:45	1,865,390	42.85	N/A	15.14
Base			N/A	0.040	7/9/14 12:45	7/11/14 12:45	1,210,950	27.81	N/A	2.99
In-Lake Sample	7/12/2014 18:45	7/12/2014 18:45	N/A	0.034	7/11/14 12:45	7/13/14 12:45	464,776	10.68	N/A	0.99
Base			N/A	0.040	7/13/14 12:45	7/15/14 12:45	341,214	7.84	N/A	0.84
In-Lake Sample	7/16/2014 18:30	7/16/2014 18:30	N/A	0.031	7/15/14 12:45	7/17/14 12:45	307,227	7.06	N/A	0.59
Base			N/A	0.040	7/17/14 12:45	7/21/14 16:45	517,733	11.89	N/A	1.28
In-Lake Sample	7/23/2014 14:33	7/23/2014 14:33	N/A	0.103	7/21/14 16:45	7/23/14 16:45	217,920	5.01	N/A	1.40
In-Lake Sample	7/23/2014 18:00	7/23/2014 18:00	N/A	0.039	7/23/14 16:45	7/25/14 16:45	221,875	5.10	N/A	0.54
Base			N/A	0.040	7/25/14 16:45	7/31/14 12:45	640,174	14.70	N/A	1.58
In-Lake Sample	8/1/2014 20:00	8/1/2014 20:00	N/A	0.026	7/31/14 12:45	8/2/14 12:45	195,374	4.49	N/A	0.32
Base			N/A	0.040	8/2/14 12:45	8/6/14 12:45	385,031	8.84	N/A	0.95
In-Lake Sample	8/7/2014 13:41	8/7/2014 13:41	N/A	0.034	8/6/14 12:45	8/8/14 12:45	188,173	4.32	N/A	0.40
Base			N/A	0.040	8/8/14 12:45	8/10/14 18:45	199,025	4.57	N/A	0.49
Storm			N/A	0.040	8/10/14 18:45	8/11/14 14:45	96,046	2.21	N/A	0.24
Base			N/A	0.040	8/11/14 14:45	8/13/14 12:45	221,812	5.09	N/A	0.55
In-Lake Sample	8/14/2014 20:30	8/14/2014 20:30	N/A	0.014	8/13/14 12:45	8/15/14 12:45	203,876	4.68	N/A	0.18
Base			N/A	0.040	8/15/14 12:45	8/19/14 12:45	371,873	8.54	N/A	0.92
In-Lake Sample	8/20/2014 13:43	8/20/2014 13:43	N/A	0.025	8/19/14 12:45	8/21/14 12:45	177,921	4.09	N/A	0.28
Base			N/A	0.040	8/21/14 12:45	8/29/14 10:45	687,985	15.80	N/A	1.70
Storm			N/A	0.040	8/29/14 10:45	8/30/14 8:45	107,663	2.47	N/A	0.27
Base			N/A	0.040	8/30/14 8:45	9/3/14 12:45	467,200	10.73	N/A	1.15
In-Lake Sample	9/4/2014 12:52	9/4/2014 12:52	N/A	0.031	9/3/14 12:45	9/5/14 12:45	224,780	5.16	N/A	0.43
Base			N/A	0.040	9/5/14 12:45	9/9/14 22:45	431,373	9.91	N/A	1.07
Storm			N/A	0.040	9/9/14 22:45	9/10/14 4:45	25,203	0.58	N/A	0.06
Base			N/A	0.040	9/10/14 4:45	9/16/14 12:45	611,292	14.04	N/A	1.51
In-Lake Sample	9/17/2014 13:01	9/17/2014 13:01	N/A	0.048	9/16/14 12:45	9/18/14 12:45	198,864	4.57	N/A	0.60
Base			N/A	0.040	9/18/14 12:45	9/30/14 12:45	1,088,060	24.99	N/A	2.69
In-Lake Sample	10/1/2014 12:54	10/1/2014 12:54	N/A	0.025	9/30/14 12:45	10/2/14 12:45	128,498	2.95	N/A	0.20
Base			N/A	0.040	10/2/14 12:45	10/12/14 12:45	485,530	11.15	N/A	1.20
In-Lake Sample	10/13/2014 12:57	10/13/2014 12:57	N/A	0.049	10/12/14 12:45	10/14/14 12:45	66,877	1.54	N/A	0.20
Base			N/A	0.040	10/14/14 12:45	10/23/14 8:30	220,718	5.07	N/A	0.55
Base*			N/A	0.040	10/23/14 8:30	1/1/15 0:00	1,203,480	27.64	N/A	2.97
In-Lake/Base Average			N/A	0.040						
Storm Average			N/A	NA						
All Average			N/A	0.040						
Total							108,435,210	2,491	N/A	271
CLFLWD Major Subwatershed Total Acres							5,495			
Total Load										
Total TSS/TP (lbs/ac/yr)									N/A	0.049

Italics indicate estimated concentrations based on average base and storm flow concentrations.

*Interval volumes from 1/1/2014 to 4/10/2014 and 10/23/2014 to 1/1/2015 were estimated using similar flow conditions.

Although no samples were collected at the Bone Lake Outlet site in 2014, the WCD used in-lake concentrations from samples collected in Bone Lake to estimate a total phosphorus load at this location. Total phosphorus loading at the Bone Lake Outlet site for 2014 was estimated at 0.049 lbs/ac or 271 lbs. (Table 7).

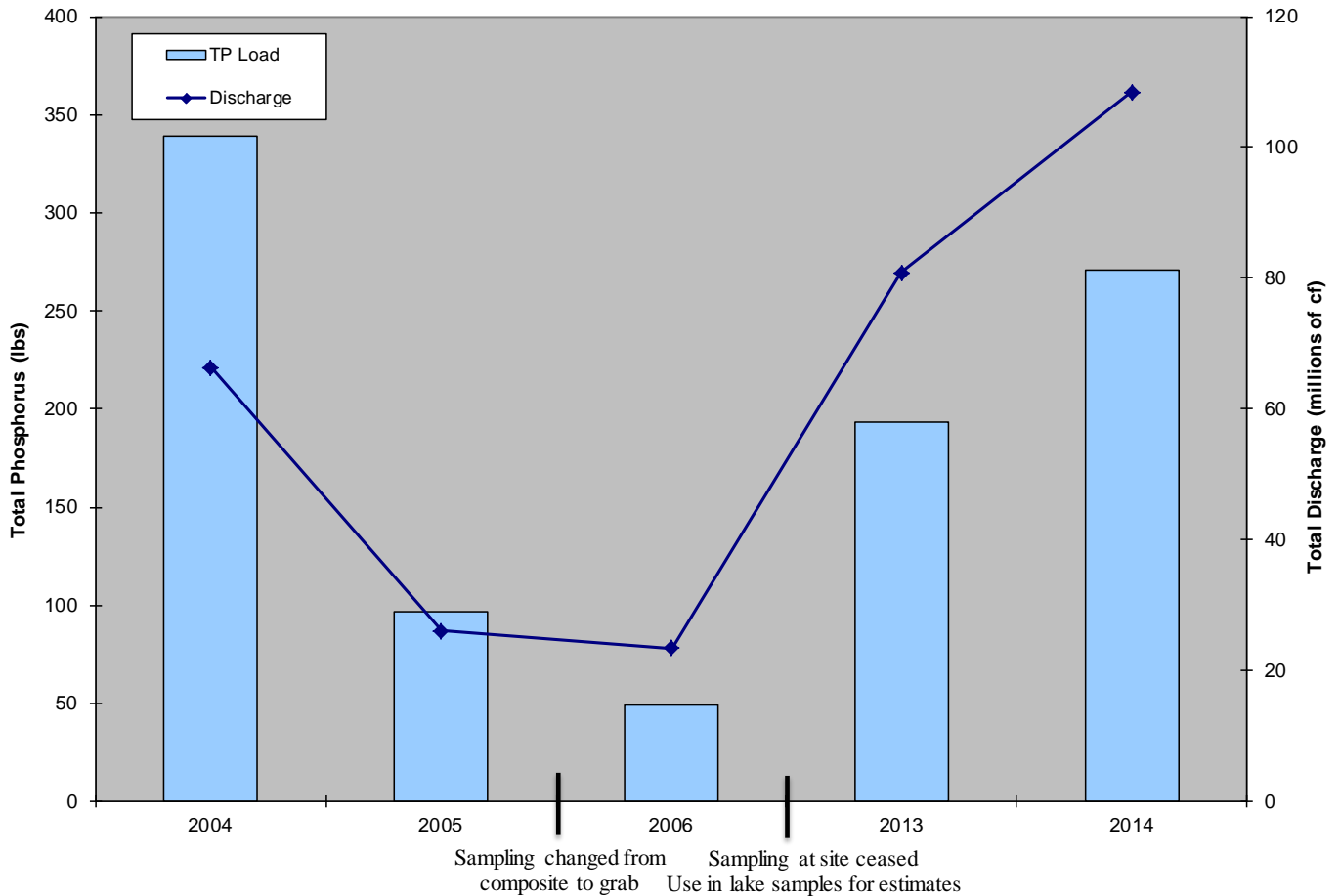


Figure 6. Bone Lake Outlet Historic Annual Discharge and Total Phosphorus Load

Flow and water chemistry data was collected at the Bone Lake Outlet from 2003 through 2006 and not again until 2013. Total estimated annual phosphorus loading and discharge can be found in Figure 6. It should be noted that when comparing year to year loading estimates, the sampling technique utilized at this site has changed. Automated composite sampling was used during the 2004-2005 monitoring seasons, and was switched to manual grab sampling for the 2006 season. Monitoring at the site ceased in 2007 but was resumed in 2013 when the sampling technique changed again. Load estimates for 2013 were made using in-lake sample concentrations, as was the case for 2014 as well. There was an increase in both discharge and TP load from 2013 to 2014.

IV. LITTLE COMFORT LAKE SUBWATERSHED

Little Comfort Lake Inlet

Stage, velocity, and rainfall were recorded at the Little Comfort Lake Inlet site from June 10-November 4, 2014 (Figure 7). The site was installed in June due to unfavorable conditions prior to that time; ice and high water levels prevented installation. Total discharge during this period was 56,375,145 cf or 1,295 acre-ft. Total yearly discharge was 132,674,265 cf or 3,047 acre-ft. Total rainfall recorded during the monitoring season was 15.19 inches. Peak discharge of 17.331 cfs occurred on June 30th.

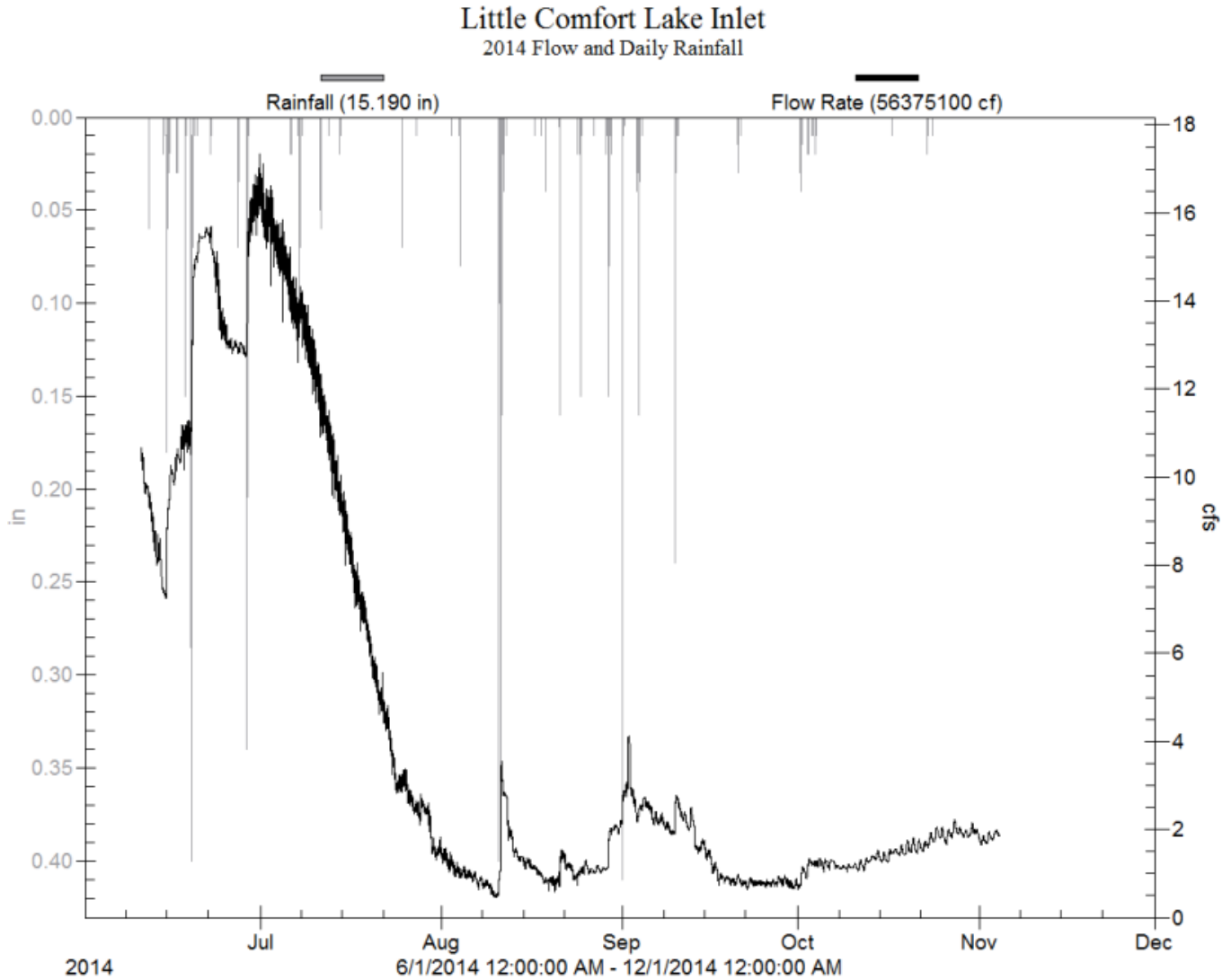


Figure 7. Little Comfort Lake Inlet 2014 Flow and Daily Rainfall

Automated storm composite and manual base and storm grab samples were collected at the Little Comfort Lake Inlet site in 2014. The TSS, VSS, TKN, TP, dissolved phosphorus, chloride, nitrite, nitrate, ammonia nitrogen, and *E. coli* results from all collected samples are listed in Table 8 and field water quality measurements are listed in Table 9. The highest concentrations of TKN and TP were 3.20 mg/L and 0.229 mg/L, respectively, from a storm composite collected from August 31st-September 3rd. The highest TSS concentration was 150 mg/L from a storm composite collected from August 11th-August 12th. This TSS result exceeded the turbidity water quality standard of >100 mg/L, along with a TSS result from another composite sample.

Table 8. Little Comfort Lake Inlet 2014 Sample Chemistry Results

Sample Type	Start	End	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	Dissolved TP (mg/L)	Chloride (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)	Ammonia Nitrogen (mg/L)	<i>E. coli</i> (mpn/100ml)	Un-ionized Ammonia (mg/L)
Storm Grab	4/29/2014 10:51	4/29/2014 10:51	11	6	1.30	0.078	<0.020	14.6	<0.03	0.17	0.19		
Storm Grab	6/3/2014 10:21	6/3/2014 10:21	5	3	1.10	0.063	-0.047	15.4	<0.03	0.05	-0.04		0.000750
Storm Composite	6/19/2014 8:55	6/20/2014 9:32	9	6	1.10	0.094	<0.020	13.4	<0.03	<0.05	-0.02		
Storm Composite	8/11/2014 3:54	8/12/2014 7:08	150	64	2.70	0.205	<0.020	10.9	<0.03	0.13	<0.02		
Storm Composite	8/31/2014 22:58	9/3/2014 5:51	133	66	3.20	0.229	<0.020	13.4	<0.03	<0.05	<0.02		
Base Grab	4/21/2014 11:37	4/21/2014 11:37	6	4	0.96	0.065	<0.020	15.8	<0.03	0.18	0.11		0.001804
Base Grab	5/28/2014 9:55	5/28/2014 9:55	8	-5	1.00	0.060	<0.020	18.9	<0.03	<0.05	<0.02	14	0.000364
Base Grab	8/12/2014 10:28	8/12/2014 10:28	-2	-1	0.95	-0.041	-0.024	12.6	<0.03	0.11	0.06	378	0.000888
Base Grab	9/16/2014 9:30	9/16/2014 9:30	-1	-1	0.81	-0.022	<0.020	14.6	<0.03	0.07	-0.03	201	0.000674
Base Grab	10/27/2014 10:53	10/27/2014 10:53	-1	-1	0.67	<0.020	-0.024	14.8	<0.03	<0.05	<0.02	62	0.000575
<i>E. coli</i> Grab	7/9/2014 9:44	7/9/2014 9:44										11	
Exceeds Water Quality Standard													

Table 9. Little Comfort Lake Inlet 2014 Field Water Quality Measurements

Date/Time	Transparency (cm)	Water Temperature (C)	Dissolved Oxygen (mg/L)	Conductivity (umhos/cm)	pH
4/21/2014 11:37	82	12.6	10.62	336	7.9
5/28/2014 9:55	>100	20.1	5.48	288	7.7
6/3/2014 10:21	>100	20.5	5.16	288	7.7
8/12/2014 10:28	>100	20.4	4.55	311	7.6
9/16/2014 9:30	>100	10.8	7.09	334	8.1
10/27/2014 10:53	>100	8.2	9.20	379	8.3
Exceeds Water Quality Standard					

Table 10. Little Comfort Lake Inlet 2014 Total Suspended Solids and Total Phosphorus Loading

Sample Type	Sample Collection Time		TSS (mg/L)	TP (mg/L)	Loading Interval		Interval Volume (cf)	Interval Volume (ac-ft)	Interval TSS (lb)	Interval TP (lb)
	Start	End			Start	End				
Base*			4	0.040	1/1/14 0:00	4/15/2014 12:30	36,122,400	829.69	8,117.9	89.30
Base Grab*	4/21/2014 11:37	4/21/2014 11:37	6	0.065	4/15/14 12:30	4/22/2014 12:30	3,628,800	83.35	1,359.2	14.72
Base*			4	0.040	4/22/14 12:30	4/29/14 4:30	3,744,000	86.00	841.4	9.26
Storm Grab*	4/29/2014 10:51	4/29/2014 10:51	11	0.078	4/29/14 4:30	4/29/14 12:30	259,200	5.95	178.0	1.26
Base*			4	0.040	4/29/14 12:30	5/26/14 12:30	16,796,160	385.79	3,774.7	41.52
Base Grab*	5/28/2014 9:55	5/28/2014 9:55	8	0.060	5/26/14 12:30	5/29/14 12:30	2,021,760	46.44	1,009.7	7.57
Base*			4	0.040	5/29/14 12:30	6/3/14 6:30	3,283,200	75.41	737.8	8.12
Storm Grab*	6/3/2014 10:21	6/3/2014 10:21	5	0.063	6/3/14 6:30	6/3/14 12:30	237,600	5.46	74.2	0.93
Base*			4	0.040	6/3/14 12:30	6/10/14 15:30	5,232,600	120.19	1,175.9	12.94
Base			4	0.040	6/10/14 15:30	6/14/14 21:30	3,231,930	74.23	726.3	7.99
Storm			62	0.134	6/14/14 21:30	6/15/14 5:30	249,821	5.74	960.7	2.09
Base			4	0.040	6/15/14 5:30	6/19/14 3:30	3,560,950	81.79	800.3	8.80
Storm Composite	6/19/2014 8:55	6/20/2014 9:32	9	0.094	6/19/14 3:30	6/20/14 10:30	1,598,740	36.72	898.2	9.38
Base			4	0.040	6/20/14 10:30	6/28/14 15:30	9,932,320	228.13	2,232.1	24.55
Storm			62	0.134	6/28/14 15:30	6/28/14 21:30	307,347	7.06	1,181.9	2.57
Base			4	0.040	6/28/14 21:30	8/10/14 19:30	26,483,900	608.30	5,951.8	65.47
Storm Composite	8/11/2014 3:54	8/12/2014 7:08	150	0.205	8/10/14 19:30	8/12/14 7:30	319,470	7.34	2,991.5	4.09
Base Grab	8/12/2014 10:28	8/12/2014 10:28	2	0.041	8/12/14 7:30	8/29/14 10:30	1,704,900	39.16	212.9	4.36
Storm			62	0.134	8/29/14 10:30	8/30/14 3:30	110,408	2.54	424.6	0.92
Base			4	0.040	8/30/14 3:30	8/31/14 21:30	309,698	7.11	69.6	0.77
Storm Composite	8/31/2014 22:58	9/3/2014 5:51	133	0.229	8/31/14 21:30	9/3/14 6:30	616,447	14.16	5,118.2	8.81
Base			4	0.040	9/3/14 6:30	9/3/14 19:30	106,436	2.44	23.9	0.26
Storm			62	0.134	9/3/14 19:30	9/4/14 22:30	250,962	5.76	965.1	2.10
Base			4	0.040	9/4/14 22:30	9/9/14 21:30	947,081	21.75	212.8	2.34
Storm			62	0.134	9/9/14 21:30	9/10/14 10:30	122,875	2.82	472.5	1.03
Base Grab	9/16/2014 9:30	9/16/2014 9:30	1	0.022	9/10/14 10:30	9/20/14 12:30	1,298,180	29.82	81.0	1.78
Base			4	0.040	9/20/14 12:30	10/22/14 12:30	3,135,480	72.02	704.6	7.75
Base Grab	10/27/2014 10:53	10/27/2014 10:53	1	0.010	10/22/14 12:30	11/4/14 10:30	2,088,200	47.96	130.4	1.30
Base*			4	0.040	11/4/14 10:30	1/1/15 0:00	4,973,400	114.23	1,117.7	12.29
Base Average			4	0.040						
Storm Average			62	0.134						
All Average			33	0.087						
Total							132,674,265	3,047	42,545	354
CLFLWD Major Subwatershed Total Acres							10,513			
Total Load										
Total TSS/TP (lbs/ac/yr)									4.05	0.03

Italics indicate estimated concentrations based on average base and storm flow concentrations.

*Interval volumes from 1/1/2014 to 4/15/2014, 4/15/2013 to 4/22/2014, 4/22/2014 to 4/29/2014, 4/29/2014 to 5/26/2014, 5/26/2014 to 5/29/2014, 5/29/2014 to 6/3/2014, 6/3/2014 to 6/10/2014, and 11/4/2014 to 1/1/2015 were estimated using similar flow conditions.

Total phosphorus loading at Little Comfort Lake Inlet for 2014 was estimated at 0.03 lbs/ac or 354 lbs. (Table 10). Monitoring should continue at this site in an effort to attain a total phosphorus loading trend entering Little Comfort Lake.

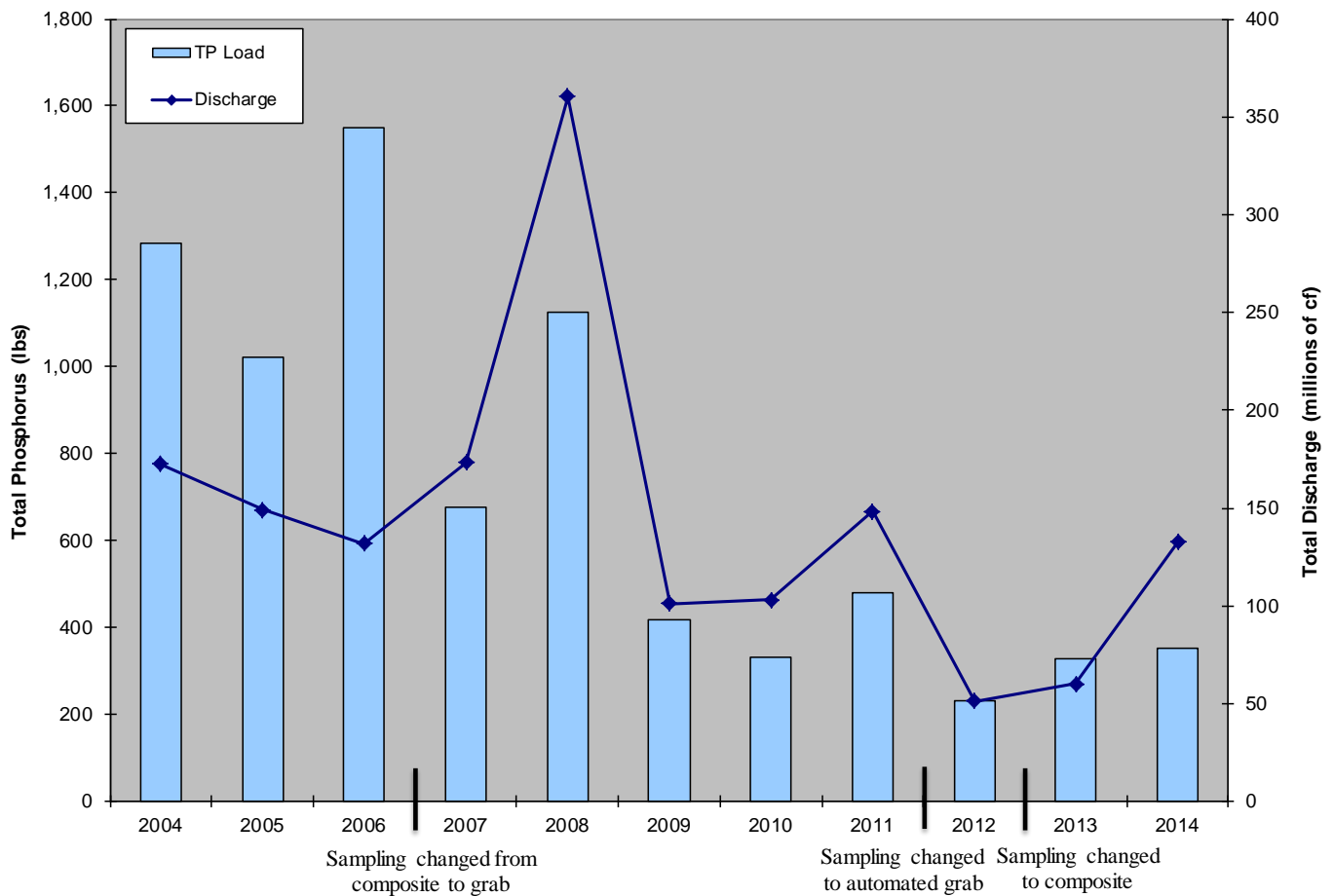


Figure 8. Little Comfort Lake Inlet Historic Annual Discharge and Total Phosphorus Load

Flow and water chemistry data has been collected at the Little Comfort Lake Inlet site since 2004. Total estimated annual discharge and phosphorus loads can be found in Figure 8. When comparing year-to-year loading numbers it should be noted that the sampling technique changed between 2006 and 2007, 2011 and 2012, and 2012 and 2013. From 2004 through 2006 water chemistry data was collected using automated composite samples. Starting in 2007 this data was collected by manual grab samples. The drop in total phosphorus export between 2006 and 2007 may be due to the change in sampling techniques. The sampling technique changed again slightly in 2012. Automated storm grabs were collected utilizing the sampling equipment at the site. The 2013 monitoring season once again saw a change in sampling technique, back to collecting automated storm composites. Automated composite samples were once again collected in 2014. There was an increase in both discharge and TP load from 2013 to 2014. Due to the late installation of this site the difference in discharge and TP is most likely not as dramatic as it would have been if the site had been installed in April or May; discharge numbers had to be estimated up until the point of installation. The abundant amount of snowfall during the winter of 2013/2014 followed by a wet spring caused the discharge numbers to increase (double) as compared to 2013.

V. FOREST LAKE SUBWATERSHED

Forest Lake Outlet

The station at the Forest Lake Outlet site recorded stage and velocity from April 16-November 4, 2014 (Figure 9). However, due to equipment issues, battery failures and area/velocity sensor fouling, only data through May 27th could be utilized. Due to the lack of data, discharge and loading estimates were not able to be determined for 2014.

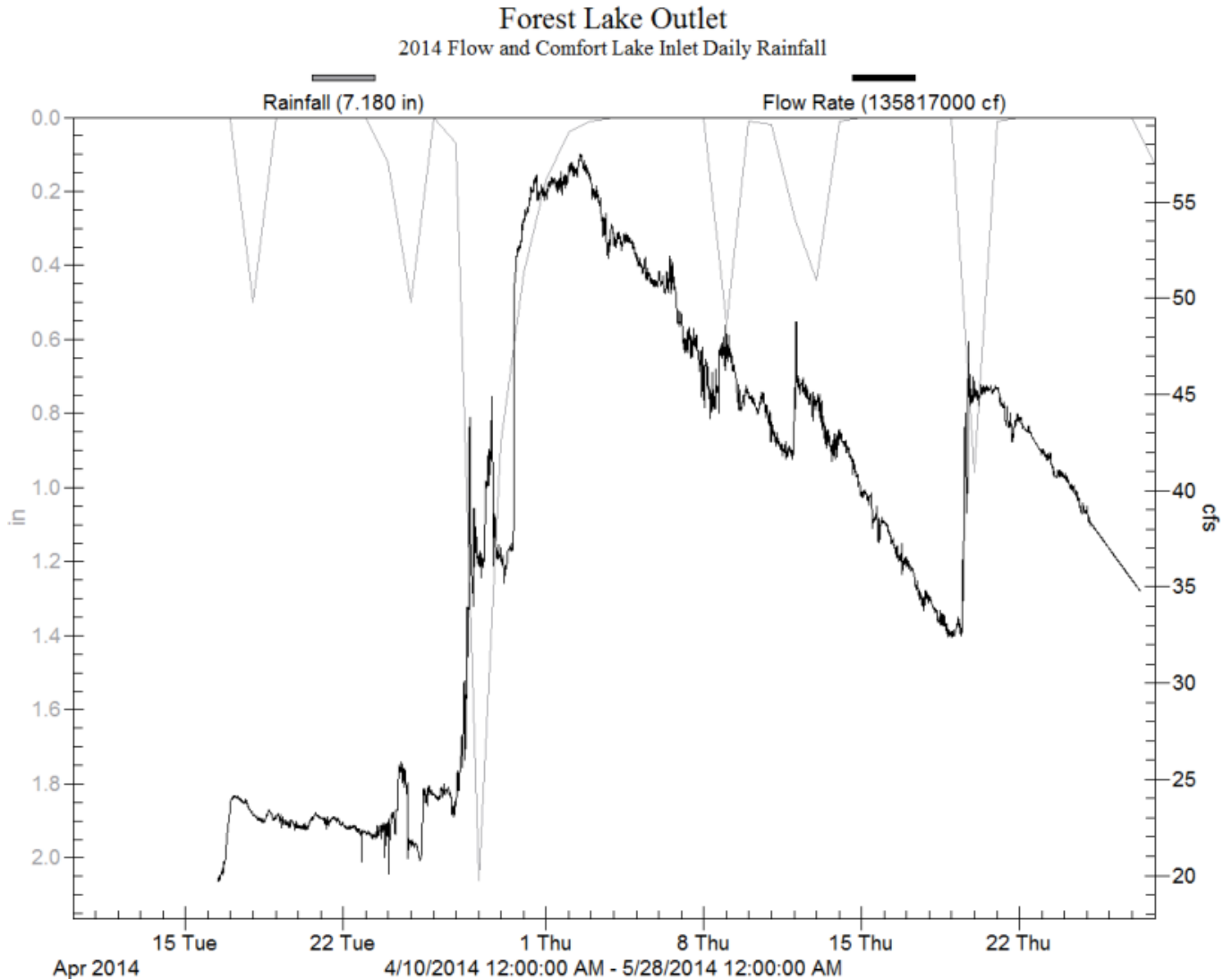


Figure 9. Forest Lake Outlet 2014 Flow and Comfort Lake Inlet Daily Rainfall

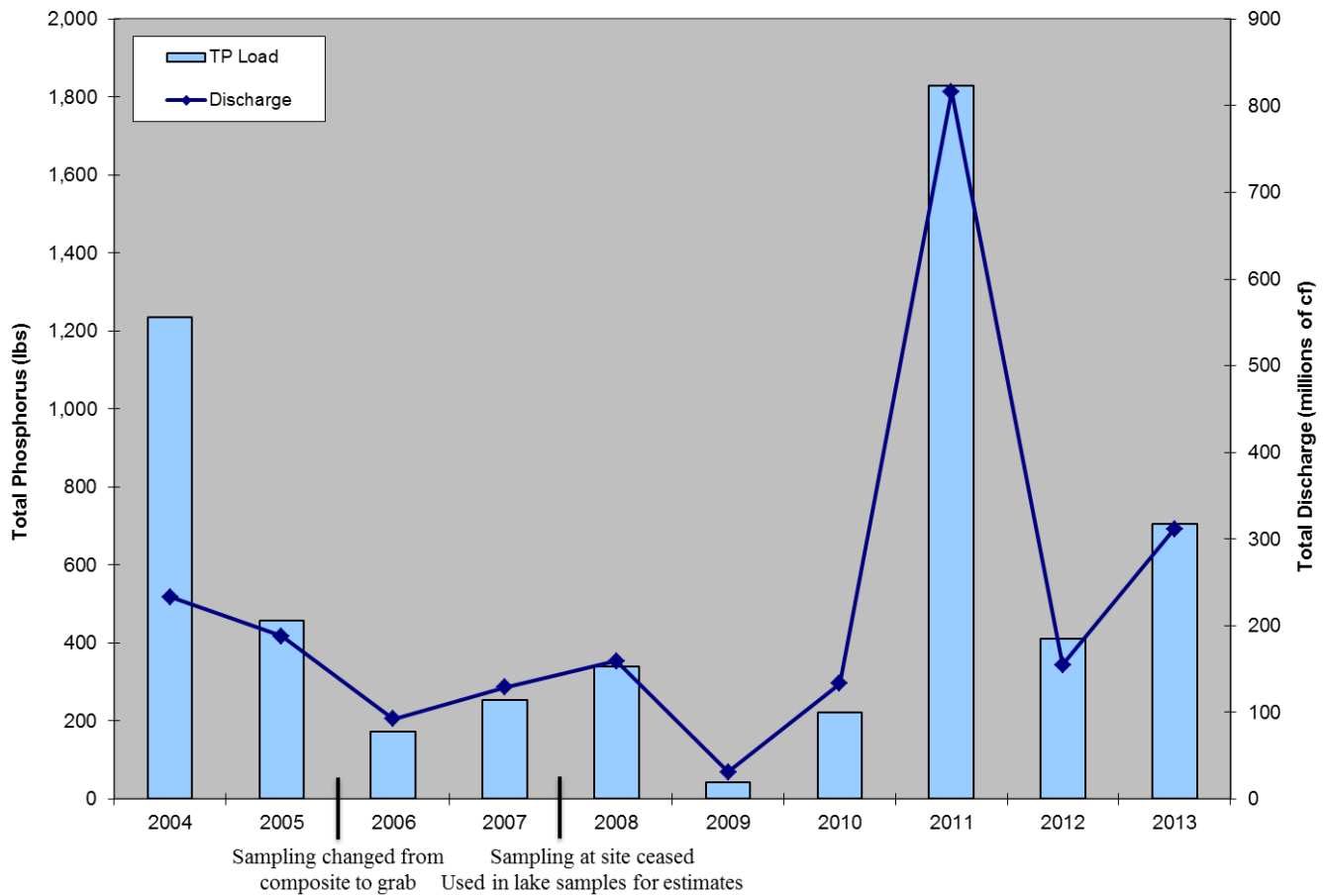


Figure 10. Forest Lake Outlet Historic Annual Discharge and Total Phosphorus Load

Flow and water chemistry data has been collected at the Forest Lake Outlet site since 2003. Total estimated annual phosphorus loading and discharge can be found in Figure 10, excluding 2014. It should be noted that when comparing year to year loading estimates, the sampling technique utilized at this site has changed a number of times. Automated composite sampling was used in the 2003-2005 monitoring seasons and was switched to manual grab sampling for the 2006 season. Sampling at the site ceased in 2007, and all loading estimates since then have been made using in-lake sample concentrations. These changes partially explain the reduction in load versus discharge, due to the refinement level of each technique.

VI. COMFORT LAKE SUBWATERSHED

Heims Lake Drainage

The Heims Lake Drainage site recorded stage and velocity from April 29-November 4, 2014 (Figure 11). 2014 is the third year that monitoring has taken place at this location. The primary purpose of this site is to quantify the discharge and load contributions coming from Heims Lake and other small tributaries. Total discharge for the monitoring season was 21,210,113 cf, or 487 acre-feet. Total yearly discharge was 32,336,273 cf or 743 acre-ft. No automated rain gage was installed at this site to record daily rainfall. A peak discharge of 15.632 cfs occurred on June 1st.

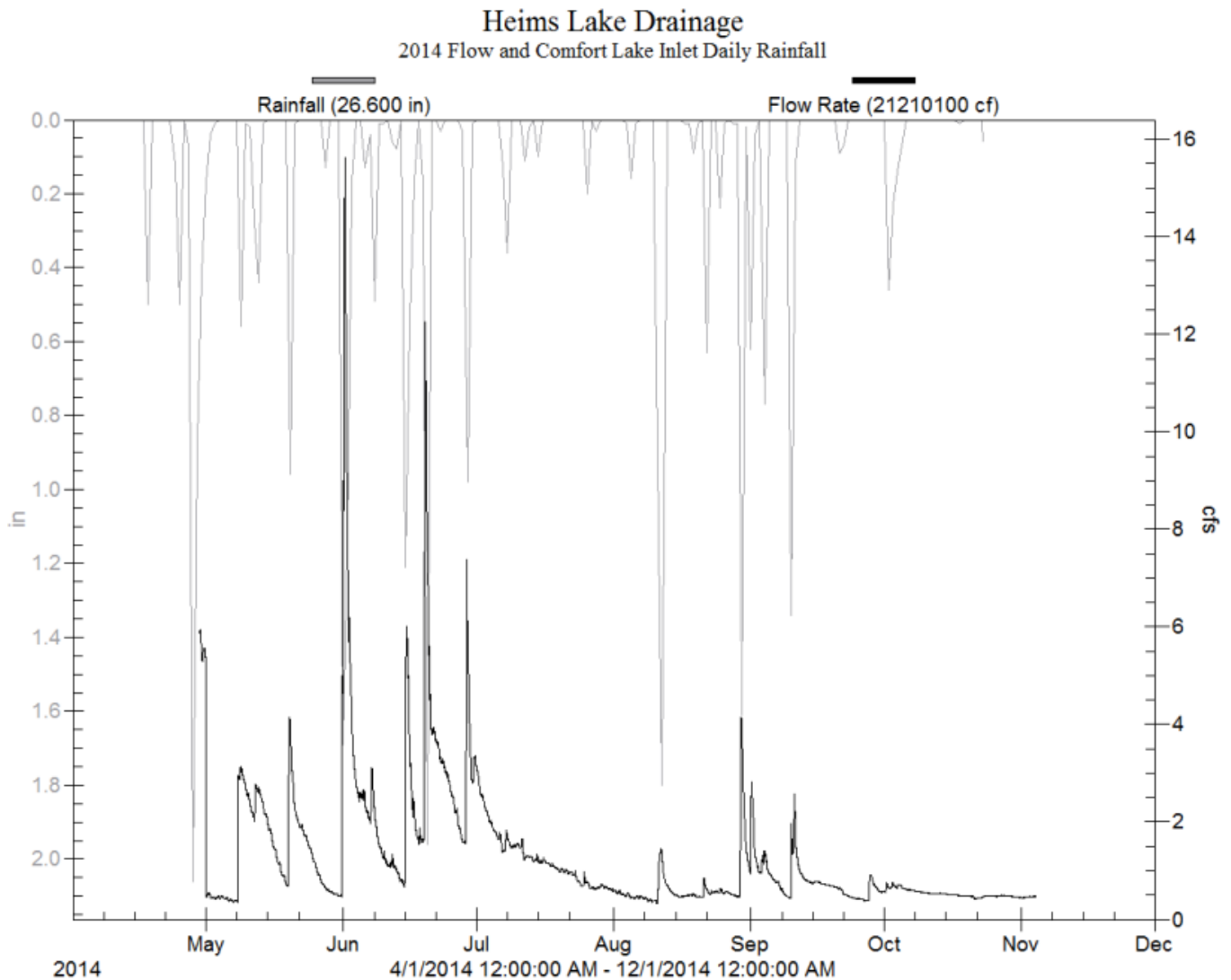


Figure 11. Heims Lake Drainage 2014 Flow and Comfort Lake Inlet Daily Rainfall

Automated storm composite and manual base and storm grab samples were collected at the Heims Lake site in 2014. The TSS, VSS, TKN, TP, dissolved phosphorus, chloride, nitrite, nitrate, ammonia nitrogen, and *E. coli* results from all collected samples are listed in Table 11 and field water quality measurements are listed in Table 12. The highest TSS, TKN, and TP concentrations of 3,970 mg/L, 35 mg/L, and 5.340 mg/L, respectively, were observed from a storm composite sample collected from September 10-September 11th. Two of the TSS results exceeded the turbidity water quality standard of >100 mg/L.

Table 11. Heims Lake Drainage 2014 Sample Chemistry Results

Sample Type	Start	End	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	Dissolved TP (mg/L)	Chloride (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)	Ammonia Nitrogen (mg/L)	<i>E. coli</i> (mpn/100ml)	Un-ionized Ammonia (mg/L)
Storm Grab	4/29/2014 9:32	4/29/2014 9:32	4	-2	1.3	0.072	-0.036	23.9	<0.03	0.20	<0.02		
Storm Composite	5/31/2014 17:29	6/1/2014 10:28	24	15	1.9	0.139	0.070	17.2	<0.03	<0.05	-0.05		
Storm Composite	6/14/2014 23:56	6/17/2014 1:18	43	24	2.5	0.357	0.095	29.7	<0.03	<0.05	<0.02		
Storm Composite	6/19/2014 5:19	6/19/2014 17:53	22	14	2.3	0.330	0.129	16.9	<0.03	<0.05	-0.04		
Storm Composite (Duplicate)	6/19/2014 5:19	6/19/2014 17:53	19	12	2.2	0.316	0.145	16.0	<0.03	<0.05	-0.03		
Storm Composite	6/28/2014 18:39	6/29/2014 5:08	89	51	2.4	0.448	0.186	20.6	<0.03	<0.05	-0.03		
Storm Composite	8/29/2014 14:15	9/2/2014 22:02	644	374	5.6	1.160	0.084	27.6	<0.03	<0.05	<0.02		
Storm Composite	9/10/2014 0:28	9/11/2014 8:17	3,970	2,280	35.0	5.340	0.102	23.9	<0.03	<0.05	<0.02		
Base Grab	4/21/2014 10:04	4/21/2014 10:04	-1	-2	1.4	0.069	-0.042	25.4	<0.03	0.58	0.09		0.001633
Base Grab	5/28/2014 10:55	5/28/2014 10:55	6	-4	2.1	0.107	-0.034	57.1	<0.03	<0.05	-0.05	20	0.000556
Base Grab	8/12/2014 8:52	8/12/2014 8:52	13	8	1.4	0.166	0.065	49.2	<0.03	<0.05	-0.05	579	0.000354
Base Grab	9/16/2014 8:25	9/16/2014 8:25	15	12	1.4	0.124	-0.048	21.6	<0.03	<0.05	-0.04	82	0.000502
Base Grab	10/27/2014 9:36	10/27/2014 9:36	6	-3	1.2	0.086	-0.043	56.7	<0.03	<0.05	-0.06	10	0.000629
<i>E. coli</i> Grab	7/9/2014 10:51	7/9/2014 10:51										120	
Exceeds Water Quality Standard													

Table 12. Heims Lake Drainage 2014 Field Water Quality Measurements

Date/Time	Transparency (cm)	Water Temperature (C)	Dissolved Oxygen (mg/L)	Conductivity (umhos/cm)	pH
4/21/2014 10:04	>120	5.0	7.54	235	8.2
5/28/2014 10:55	55	16.6	6.34	395	7.6
8/12/2014 8:52	61	16.6	4.73	350	7.4
9/16/2014 8:25	46	8.9	6.41	205	7.9
10/27/2014 9:36	>100	6.9	7.08	394	7.9
Exceeds Water Quality Standard					

Table 13. Heims Lake Drainage 2014 Total Suspended Solids and Total Phosphorus Loading

Sample Type	Sample Collection Time		Loading Interval		Interval Volume (cf)	Interval Volume (ac-ft)	Interval TSS (lb)	Interval TP (lb)		
	Start	End	TSS (mg/L)	TP (mg/L)					Start	End
Base*			8	0.110	1/1/14 0:00	4/15/14 12:15	8,126,730	186.66	4,160.0	56.01
Base Grab*	4/21/2014 10:04	4/21/2014 10:04	1	0.069	4/15/14 12:15	4/24/14 12:15	855,360	19.65	53.4	3.68
Base*			8	0.110	4/24/14 12:15	4/28/14 22:15	534,240	12.27	273.5	3.68
Storm Grab*	4/29/2014 9:32	4/29/2014 9:32	4	0.072	4/28/14 22:15	4/29/14 11:15	93,600	2.15	23.4	0.42
Base*			8	0.110	4/29/14 11:15	4/29/14 15:15	24,480	0.56	12.5	0.17
Base			8	0.110	4/29/14 15:15	5/11/14 23:15	1,825,980	41.94	934.7	12.58
Storm			138	0.418	5/11/14 23:15	5/12/14 8:15	82,882	1.90	712.3	2.16
Base			8	0.110	5/12/14 8:15	5/19/14 11:15	1,034,610	23.76	529.6	7.13
Storm			138	0.418	5/19/14 11:15	5/20/14 2:15	167,793	3.85	1,442.0	4.37
Base Grab	5/28/2014 10:55	5/28/2014 10:55	6	0.107	5/20/14 2:15	5/31/14 15:15	1,260,020	28.94	471.9	8.42
Storm Composite	5/31/2014 17:29	6/1/2014 10:28	24	0.139	5/31/14 15:15	6/1/14 11:15	631,709	14.51	946.4	5.48
Base			8	0.110	6/1/14 11:15	6/7/14 4:15	1,878,730	43.15	961.7	12.95
Storm			138	0.418	6/7/14 4:15	6/7/14 13:15	84,667	1.94	727.6	2.21
Base			8	0.110	6/7/14 13:15	6/14/14 21:15	818,629	18.80	419.1	5.64
Storm Composite	6/14/2014 23:56	6/17/2014 1:18	43	0.357	6/14/14 21:15	6/17/14 2:15	693,155	15.92	1,860.7	15.45
Base			8	0.110	6/17/14 2:15	6/19/14 4:15	308,172	7.08	157.8	2.12
Storm Composite	6/19/2014 5:19	6/19/2014 17:53	22	0.330	6/19/14 4:15	6/19/14 19:15	476,357	10.94	654.2	9.81
Base			8	0.110	6/19/14 19:15	6/28/14 16:15	2,390,390	54.90	1,223.6	16.47
Storm Composite	6/28/2014 18:39	6/29/2014 5:08	89	0.448	6/28/14 16:15	6/29/14 6:15	281,957	6.48	1,566.5	7.89
Base			8	0.110	6/29/14 6:15	8/10/14 20:15	4,260,580	97.86	2,181.0	29.36
Storm			138	0.418	8/10/14 20:15	8/11/14 22:15	103,253	2.37	887.4	2.69
Base Grab	8/12/2014 8:52	8/12/2014 8:52	13	0.166	8/11/14 22:15	8/21/14 5:15	440,693	10.12	357.6	4.57
Storm			138	0.418	8/21/14 5:15	8/21/14 12:15	17,849	0.41	153.4	0.47
Base			8	0.110	8/21/14 12:15	8/29/14 11:15	377,467	8.67	193.2	2.60
Storm Composite	8/29/2014 14:15	9/2/2014 22:02	644	1.160	8/29/14 11:15	9/2/14 22:15	709,239	16.29	28,513.1	51.36
Base			8	0.110	9/2/14 22:15	9/3/14 10:15	41,675	0.96	21.3	0.29
Storm			138	0.418	9/3/14 10:15	9/4/14 2:15	72,944	1.68	626.9	1.90
Base			8	0.110	9/4/14 2:15	9/9/14 22:15	375,421	8.62	192.2	2.59
Storm Composite**	9/10/2014 0:28	9/11/2014 8:17	3,970	5.340	9/9/14 22:15	9/11/14 9:15	214,615	4.93	53,188.4	71.54
Base Grab	9/16/2014 8:25	9/16/2014 8:25	15	0.124	9/11/14 9:15	9/27/14 11:15	898,150	20.63	841.0	6.95
Storm			138	0.418	9/27/14 11:15	9/28/14 8:15	60,564	1.39	520.5	1.58
Base			8	0.110	9/28/14 8:15	10/1/14 8:15	161,405	3.71	82.6	1.11
Storm			138	0.418	10/1/14 8:15	10/1/14 16:15	19,378	0.45	166.5	0.51
Base			8	0.110	10/1/14 16:15	10/2/14 14:15	51,894	1.19	26.6	0.36
Storm			138	0.418	10/2/14 14:15	10/2/14 22:15	20,300	0.47	174.5	0.53
Base			8	0.110	10/2/14 22:15	10/3/14 21:15	56,658	1.30	29.0	0.39
Storm			138	0.418	10/3/14 21:15	10/4/14 3:15	14,688	0.34	126.2	0.38
Base Grab	10/27/2014 9:36	10/27/2014 9:36	6	0.086	10/4/14 3:15	11/4/14 10:45	1,378,290	31.66	516.2	7.40
Base*			8	0.110	11/4/14 10:45	1/1/15 0:00	1,491,750	34.26	763.6	10.28
Base Average			8	0.110						
Storm Average			138	0.418						
All Average			79	0.278						
Total							32,336,273	743	106,692	374
CLFLWD Major Subwatershed Total Acres							667			
Total Load									159.96	0.560

Italics indicate estimated concentrations based on average base and storm flow concentrations.

*Interval volumes from 1/1/2014 to 4/15/2014, 4/15/2014 to 4/24/2014, 4/24/2014 to 4/28/2014, 4/28/2014 to 4/29/2014, and 11/4/2014 to 1/1/2015 were estimated using similar flow conditions.

**Storm composite results were left out of storm and all average calculations for both TSS and TP.

Total phosphorus loading at the Heims Lake Drainage site for 2014 was estimated at 0.560 lbs/ac or 374 lbs. (Table 13). Monitoring at this location will help quantify discharge and loads coming from Heims Lake into the Sunrise River.

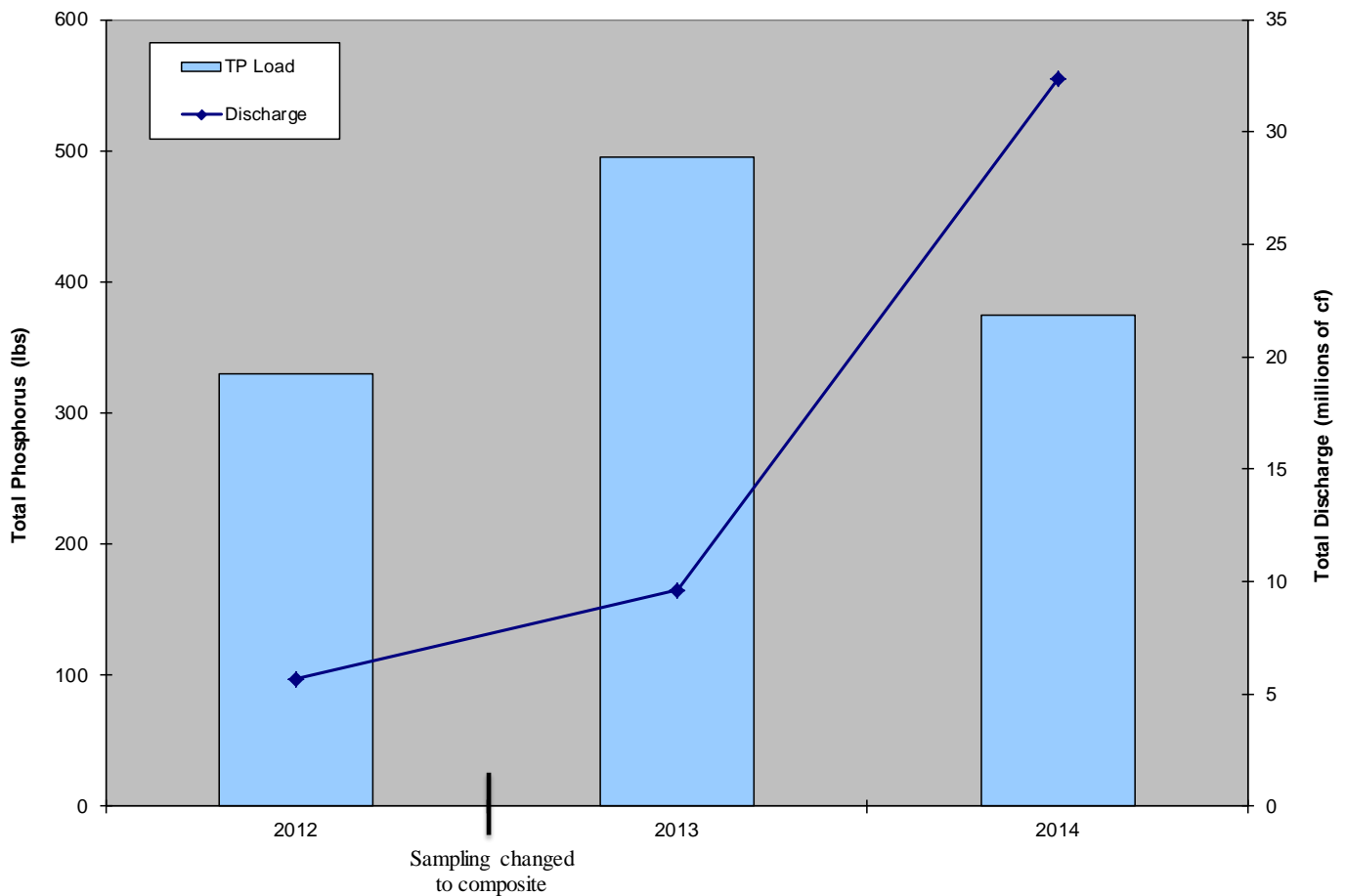


Figure 12. Heims Lake Drainage Historic Annual Discharge and Total Phosphorus Load

2014 is the third year that flow and water chemistry data has been collected at the Heims Lake Drainage site. Estimated annual total discharge and phosphorus export can be seen in Figure 12. There was an increase in discharge and a decrease in TP load from 2013 to 2014. The increase in discharge could be due to the fact that the winter of 2013/2014 had above average amounts of snowfall followed by a wet spring. Approximately three times the volume of water passed through the site as compared to 2013. Another factor to consider is the change in sampling technique from 2012 (automated grab samples) to 2013 (automated composite samples). Automated composite samples were once again collected in 2014. An interesting note for 2014 is that while the TP load decreased the TSS load showed a significant increase; from 24,224 lbs. in 2013 to 106,692 lbs. in 2014. Further monitoring is needed to assess and understand the loading trend present at this site and its effects downstream.

Comfort Lake Inlet

The station at Comfort Lake Inlet recorded stage, velocity, and rainfall from April 16-October 23, 2014 (Figure 13). Total discharge for the monitoring season was 284,876,980 cf or 6,543 acre-ft. Total yearly discharge was 423,401,380 cf or 9,725 acre-ft. Total rainfall for the monitoring season was 26.60 inches. A peak flow of 98.839 cfs occurred on May 3rd.

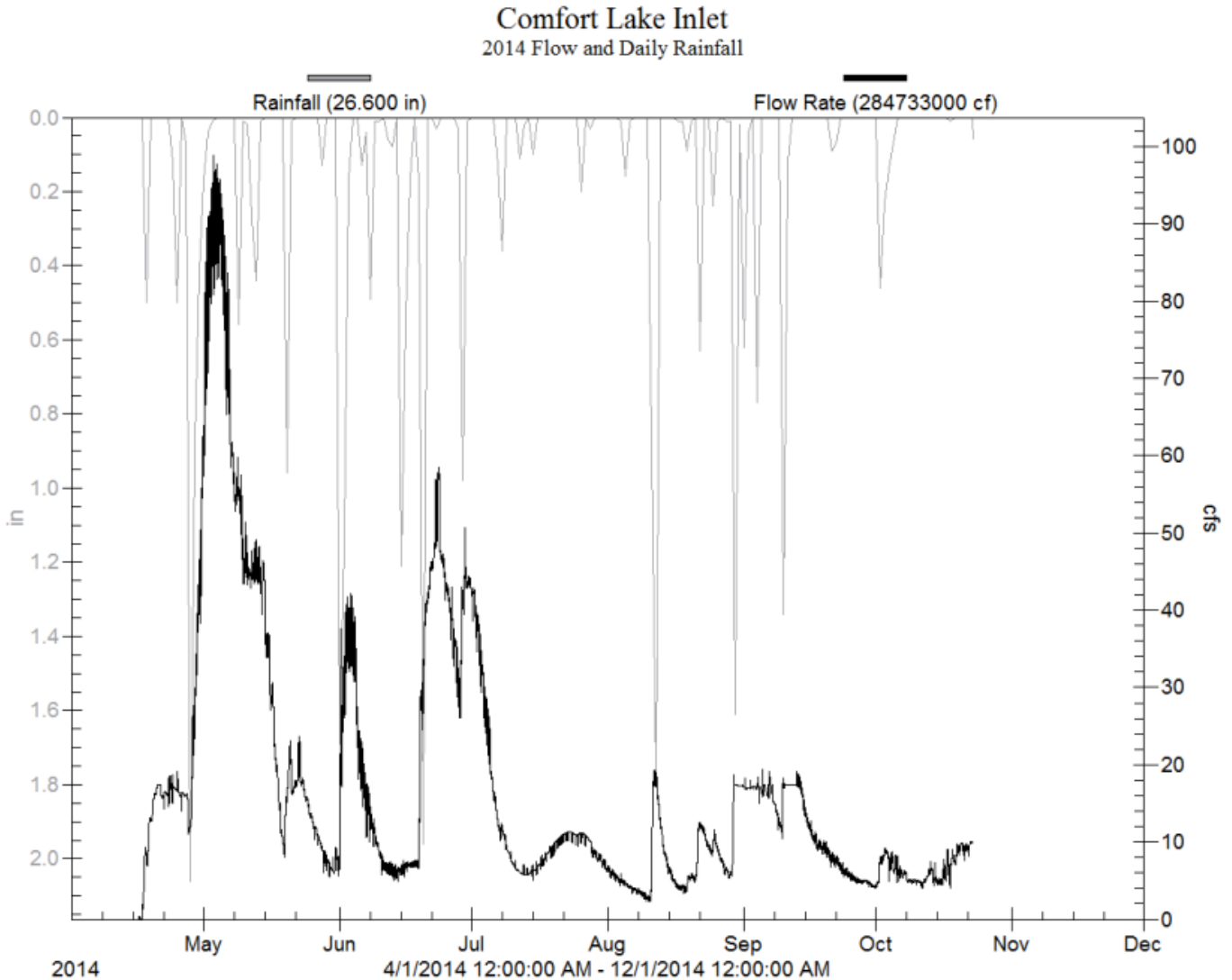


Figure 13. Comfort Lake Inlet 2014 Flow and Daily Rainfall

Automated storm composite and manual base and storm grab samples were collected at the Comfort Lake Inlet site in 2014. The TSS, VSS, TKN, TP, dissolved phosphorus, chloride, nitrite, nitrate, ammonia nitrogen, and *E. coli* results from all collected samples are listed in Table 14 and field water quality measurements are listed in Table 15. The highest TSS concentration observed was 71 mg/L from a storm composite sample collected from August 11th-August 14th. The highest TKN and TP concentrations observed were 2.30 mg/L and 0.188 mg/L, respectively, both from a storm composite sample collected from August 29th-August 31st.

Table 14. Comfort Lake Inlet 2014 Sample Chemistry Results

Sample Type	Start	End	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	Dissolved TP (mg/L)	Chloride (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)	Ammonia Nitrogen (mg/L)	<i>E. coli</i> (mpn/100ml)	Un-ionized Ammonia (mg/L)
Storm Composite	4/20/2014 14:14	4/20/2014 16:57	~2	~2	1.2	-0.033	<0.020	90.0	<0.03	0.81	0.06		
Storm Composite	4/27/2014 14:08	4/27/2014 19:45	12	4	1.3	0.071	<0.020	54.4	<0.03	0.72	-0.04		
Storm Grab	4/29/2014 9:46	4/29/2014 9:46	5	~2	1.0	0.064	0.061	51.3	<0.03	0.68	<0.02		
Storm Composite	8/11/2014 5:15	8/14/2014 3:37	71	23	2.0	0.157	<0.020	76.9	<0.03	0.31	<0.02		
Storm Composite	8/21/2014 15:57	8/23/2014 6:05	41	~16	1.4	0.086	-0.026	78.2	<0.03	<0.05	<0.02		
Storm Composite	8/29/2014 21:31	8/31/2014 16:46	53	19	2.3	0.188	<0.020	58.6	<0.03	<0.05	<0.02		
Base Grab	5/28/2014 10:30	5/28/2014 10:30	22	7	1.3	0.074	<0.020	50.1	<0.03	<0.05	-0.03	119	0.000576
Base Grab	6/3/2014 10:49	6/3/2014 10:49	6	3	1.4	0.075	0.054	48.5	<0.03	<0.05	-0.03		0.000492
Base Grab	6/17/2014 9:39	6/17/2014 9:39	20	9	1.5	0.089	-0.025	53.5	<0.03	0.08	<0.02		
Base Grab	6/20/2014 13:14	6/20/2014 13:14	6	~4	1.6	0.114	-0.038	39.0	<0.03	<0.05	<0.02		
Base Grab	8/20/2014 11:36	8/20/2014 11:36	~2	~2	1.4	0.084	0.052	102.3	0.04	0.46	0.09		0.000979
Base Grab	9/16/2014 8:45	9/16/2014 8:45	~2	~2	1.1	-0.044	-0.044	59.5	<0.03	0.11	<0.02	156	0.000394
Base Grab	10/27/2014 10:18	10/27/2014 10:18	~2	~1	1.2	-0.025	-0.023	99.0	<0.03	0.66	0.06	72	0.000548
<i>E. coli</i> Grab	7/9/2014 10:04	7/9/2014 10:04										75	
<i>E. coli</i> Grab	8/12/2014 9:48	8/12/2014 9:48										1,300	

Table 15. Comfort Lake Inlet 2014 Field Water Quality Measurements

Date/Time	Transparency (cm)	Water Temperature (C)	Dissolved Oxygen (mg/L)	Conductivity (umhos/cm)	pH
4/21/2014 10:44	>120	7.1	9.96	479	8.3
5/28/2014 10:30	65	17.9	3.94	429	7.8
6/3/2014 10:49	>100	18.8	2.03	398	7.7
8/12/2014 9:48	>100	18.4	3.46	553	7.6
8/20/2014 11:36	>100	19.7	4.71	646	7.5
9/16/2014 8:45	>100	12.2	6.55	458	8.0
10/27/2014 10:18	>100	8.4	3.52	753	7.8
Exceeds Water Quality Standard					

Table 16. Comfort Lake Inlet 2014 Total Suspended Solids and Total Phosphorus Loading

Sample Type	Sample Collection Time		Loading Interval		Interval Volume (cf)	Interval Volume (ac-ft)	Interval TSS (lb)	Interval TP (lb)		
	Start	End	TSS (mg/L)	TP (mg/L)					Start	End
Base*			9	0.072	1/1/14 0:00	4/16/14 9:45	118,392,300	2,719.33	63,349.5	533.19
Base			9	0.072	4/16/14 9:45	4/17/14 11:45	73,177	1.68	39.2	0.33
Storm			31	0.100	4/17/14 11:45	4/17/14 22:45	292,631	6.72	560.2	1.82
Base			9	0.072	4/17/14 22:45	4/20/14 10:45	2,736,620	62.86	1,464.3	12.32
Storm Composite	4/20/2014 14:14	4/20/2014 16:57	2	0.033	4/20/14 10:45	4/20/14 22:45	748,041	17.18	93.4	1.54
Base			9	0.072	4/20/14 22:45	4/27/14 10:45	9,257,190	212.63	4,953.3	41.69
Storm Composite	4/27/2014 14:08	4/27/2014 19:45	12	0.071	4/27/14 10:45	4/27/14 20:45	439,937	10.10	329.6	1.95
Base			9	0.072	4/27/14 20:45	4/28/14 9:45	588,327	13.51	314.8	2.65
Storm			31	0.100	4/28/14 9:45	4/28/14 16:45	523,250	12.02	1,001.7	3.26
Storm Grab	4/29/2014 9:46	4/29/2014 9:46	5	0.064	4/28/14 16:45	4/30/14 9:45	5,232,920	120.19	1,633.4	20.91
Base			9	0.072	4/30/14 9:45	5/19/14 10:45	88,833,500	2,040.40	47,533.1	400.07
Storm			31	0.100	5/19/14 10:45	5/20/14 0:45	650,201	14.93	1,244.7	4.05
Base Grab	5/28/2014 10:30	5/28/2014 10:30	22	0.074	5/20/14 0:45	5/31/14 14:45	13,065,100	300.09	17,943.3	60.35
Storm			31	0.100	5/31/14 14:45	5/31/14 20:45	147,821	3.40	283.0	0.92
Storm			31	0.100	5/31/14 20:45	6/1/14 4:45	215,229	4.94	412.0	1.34
Storm			31	0.100	6/1/14 4:45	6/1/14 7:45	277,677	6.38	531.6	1.73
Base Grab	6/3/2014 10:49	6/3/2014 10:49	6	0.075	6/1/14 7:45	6/14/14 21:45	19,641,900	451.15	7,357.0	91.96
Storm			31	0.100	6/14/14 21:45	6/15/14 1:45	87,235	2.00	167.0	0.54
Base Grab	6/17/2014 9:39	6/17/2014 9:39	20	0.089	6/15/14 1:45	6/19/14 3:45	2,383,000	54.73	2,975.2	13.24
Storm			31	0.100	6/19/14 3:45	6/19/14 7:45	159,668	3.67	305.7	1.00
Storm			31	0.100	6/19/14 7:45	6/19/14 13:45	478,418	10.99	915.9	2.98
Base Grab	6/20/2014 13:14	6/20/2014 13:14	6	0.114	6/19/14 13:45	6/28/14 16:45	32,684,100	750.72	12,242.1	232.60
Storm			31	0.100	6/28/14 16:45	6/28/14 19:45	395,125	9.08	756.4	2.46
Base			9	0.072	6/28/14 19:45	8/10/14 19:45	46,101,400	1,058.90	24,668.0	207.62
Storm Composite	8/11/2014 5:15	8/14/2014 3:37	71	0.157	8/10/14 19:45	8/14/14 4:45	3,787,940	87.00	16,789.1	37.13
Base Grab	8/20/2014 11:36	8/20/2014 11:36	2	0.084	8/14/14 4:45	8/21/14 6:45	3,170,430	72.82	395.8	16.63
Storm Composite	8/21/2014 15:57	8/23/2014 6:05	41	0.086	8/21/14 6:45	8/23/14 6:45	1,897,820	43.59	4,857.4	10.19
Base			9	0.072	8/23/14 6:45	8/25/14 1:45	1,449,330	33.29	775.5	6.53
Storm			31	0.100	8/25/14 1:45	8/25/14 12:45	405,522	9.31	776.3	2.53
Base			9	0.072	8/25/14 12:45	8/29/14 10:45	2,462,570	56.56	1,317.7	11.09
Storm Composite	8/29/2014 21:31	8/31/2014 16:46	53	0.188	8/29/14 10:45	8/31/14 21:45	3,505,990	80.53	11,599.9	41.15
Storm			31	0.100	8/31/14 21:45	9/1/14 1:45	247,510	5.69	473.8	1.54
Base			9	0.072	9/1/14 1:45	9/4/14 0:15	4,321,340	99.26	2,312.3	19.46
Base*			9	0.072	9/4/14 0:15	9/4/14 11:30	688,500	15.81	368.4	3.10
Base			9	0.072	9/4/14 11:30	9/4/14 19:00	459,178	10.55	245.7	2.07
Base*			9	0.072	9/4/14 19:00	9/5/14 10:15	933,300	21.44	499.4	4.20
Base			9	0.072	9/5/14 10:15	9/5/14 23:00	798,521	18.34	427.3	3.60
Base*			9	0.072	9/5/14 23:00	9/6/14 13:15	872,100	20.03	466.6	3.93
Base			9	0.072	9/6/14 13:15	9/6/14 14:15	61,241	1.41	32.8	0.28
Base*			9	0.072	9/6/14 14:15	9/6/14 18:15	252,000	5.79	134.8	1.13
Base			9	0.072	9/6/14 18:15	9/6/14 18:45	32,901	0.76	17.6	0.15
Base*			9	0.072	9/6/14 18:45	9/7/14 13:15	1,132,200	26.01	605.8	5.10
Base			9	0.072	9/7/14 13:15	9/7/14 14:15	60,071	1.38	32.1	0.27
Base*			9	0.072	9/7/14 14:15	9/7/14 18:15	230,400	5.29	123.3	1.04
Base			9	0.072	9/7/14 18:15	9/7/14 18:45	27,269	0.63	14.6	0.12
Base*			9	0.072	9/7/14 18:45	9/8/14 9:00	692,550	15.91	370.6	3.12
Base			9	0.072	9/8/14 9:00	9/9/14 21:45	1,686,840	38.74	902.6	7.60
Storm			31	0.100	9/9/14 21:45	9/10/14 1:45	228,819	5.26	438.1	1.43
Base Grab	9/16/2014 8:45	9/16/2014 8:45	2	0.044	9/10/14 1:45	10/1/14 9:45	17,740,300	407.47	2,214.9	48.73
Storm			31	0.100	10/1/14 9:45	10/2/14 4:45	397,270	9.12	760.5	2.48
Base			9	0.072	10/2/14 4:45	10/23/14 9:15	12,322,600	283.04	6,593.6	55.50
Base Grab*	10/27/2014 10:18	10/27/2014 10:18	2	0.025	10/23/14 9:15	11/4/14 11:15	5,220,000	119.90	651.7	8.15
Base*			9	0.072	11/4/14 11:15	1/1/15 0:00	14,912,100	342.51	7,979.2	67.16
Base Average			9	0.072						
Storm Average			31	0.100						
All Average			19	0.085						
Total							423,401,380	9,725	253,252	2,006
CLFLWD Major Subwatershed Total Acres							13,732			
Total Load										
Total TSS/TP (lbs/ac/yr)									18.44	0.146

Italics indicate estimated concentrations based on average base and storm flow concentrations.

*Interval volumes from 1/1/2014 to 4/16/2014, 9/4/2014 to 9/8/2014, 10/23/2014 to 11/4/2014, and 11/4/2014 to 1/1/2015 were estimated using similar flow conditions.

Total phosphorus loading at Comfort Lake Inlet for 2014 was estimated at 0.146 lbs/ac or 2,006 lbs. (Table 16).

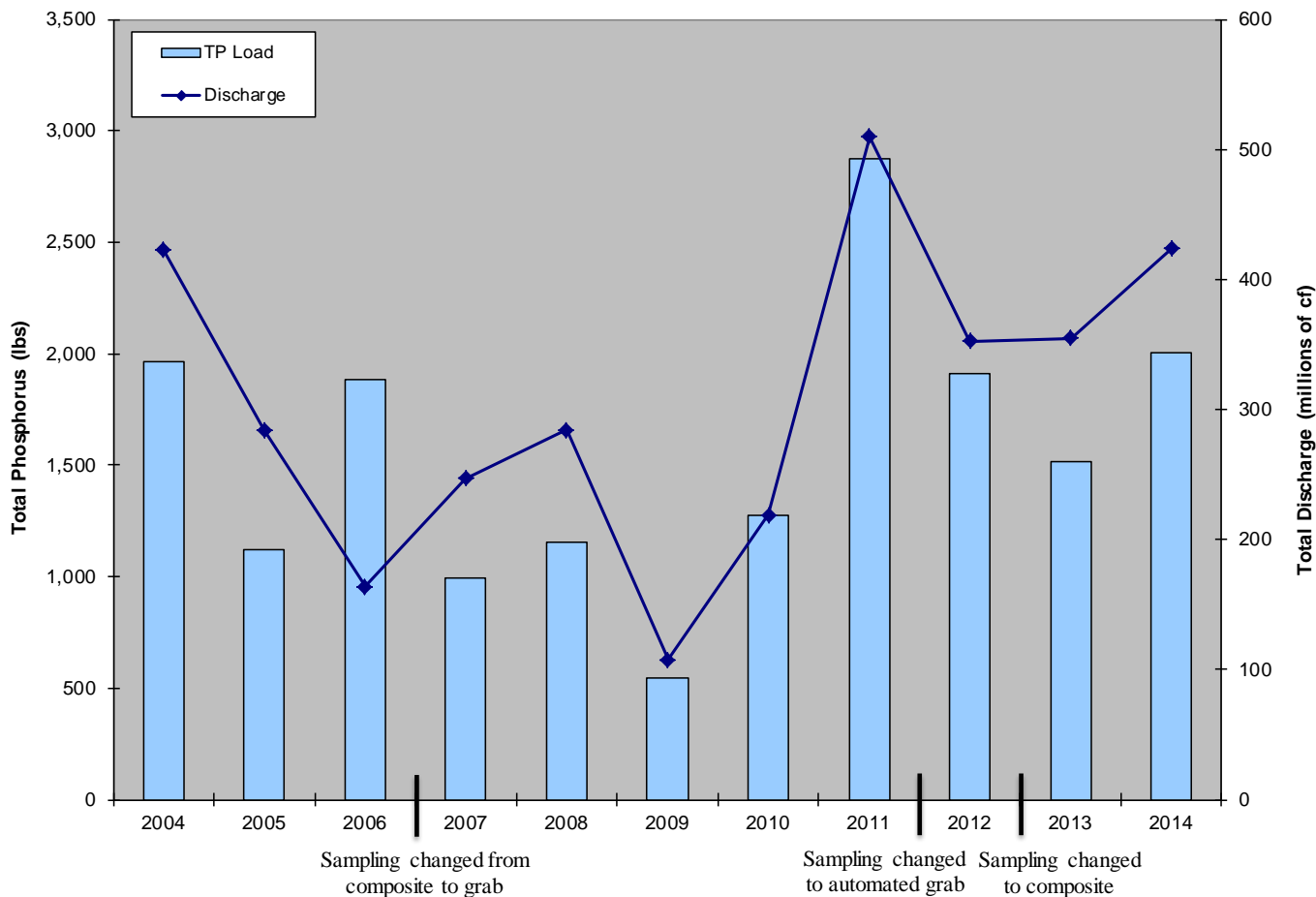


Figure 14. Comfort Lake Inlet Historic Annual Discharge and Total Phosphorus Load

Flow and water chemistry data has been collected at the Comfort Lake Inlet site since 2004. Estimated total annual phosphorus export and discharge can be seen in Figure 14. When making year-to-year comparisons of load estimates, it should be noted that the sampling technique changed from automated composite sampling to manual grab sampling in 2007. 2012 brought a slight change to the sampling technique again. Grab samples were collected using the automatic sampler that was already at the site collecting data. There was another sampling technique change for the 2013 monitoring season back to composite sampling. Composite samples were once again collected in 2014. Unlike the other sites with historic information available, there does not seem to be as great of an impact on the overall load estimation when switching between the two sampling methods. One potential cause of this could be that the Shallow Pond wetland complex upstream of the site may be acting as a sink for nutrients; settling them out before they reach this site. Both the TP load and discharge increased from 2013 to 2014.

It should be noted that the Comfort Inlet culvert was replaced in early spring of 2011. The previous culvert was a corrugated round pipe that was 8 feet in diameter. The current culvert is a concrete box culvert that measures 7 feet by 7 feet. Discharge numbers for the years prior to 2011 may have been slightly altered due to the condition of the previous culvert. The bottom and sides of the culvert were

rusted and deteriorating in areas which could have possibly caused some of the discharge to be missed. Discharge will be more accurately measured within this new culvert.

Comfort Lake Outlet

The station at the Comfort Lake Outlet site recorded stage, velocity, and rainfall from April 10-November 4, 2014 (Figure 15). Total discharge for this period was 670,176,995 cf or 15,393 acre-ft. Total yearly discharge was 856,945,895 cf and 19,683 acre-ft. Total rainfall for the monitoring season was 27.23 inches. The highest flow was recorded at 96.697 cfs on July 30th.

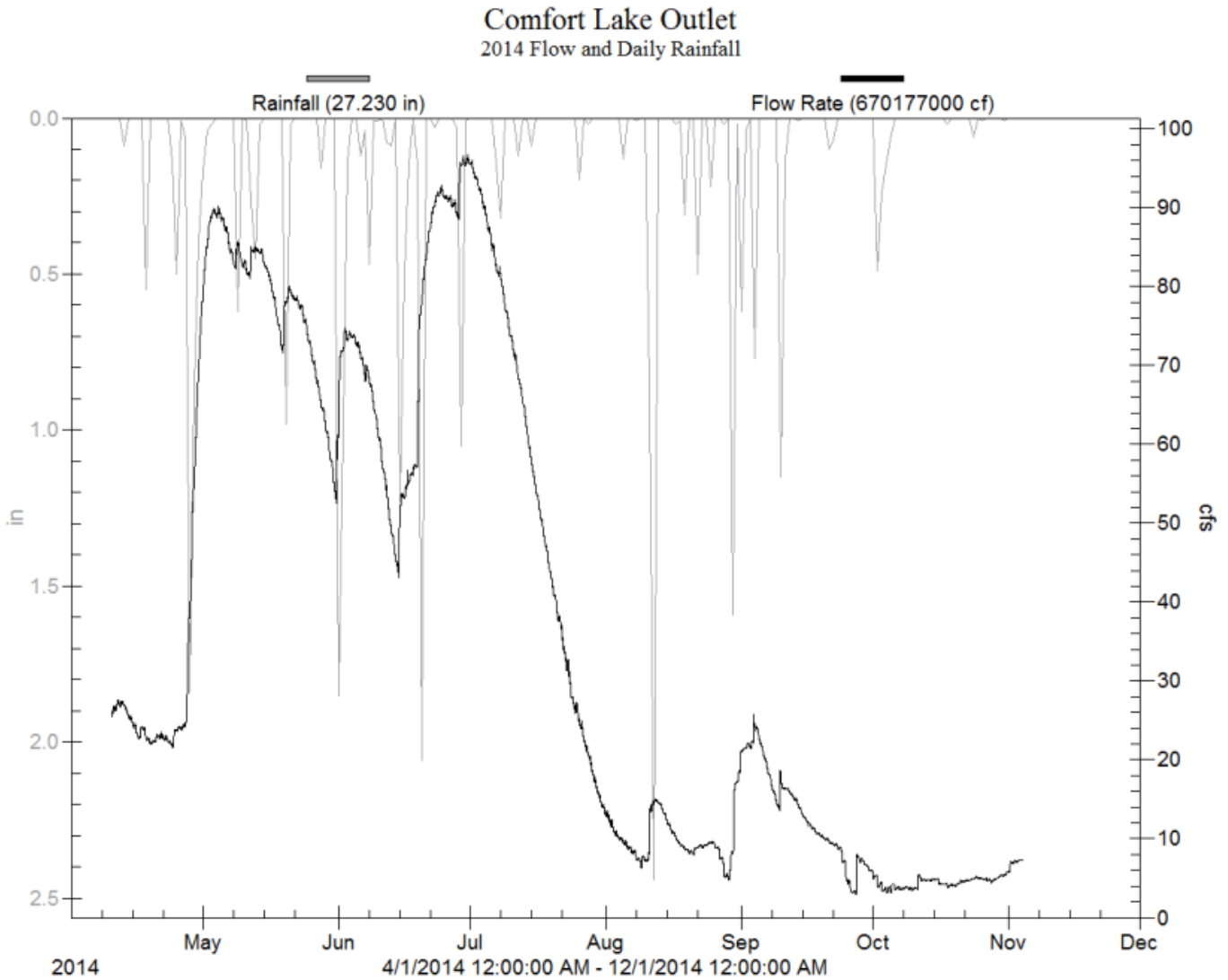


Figure 15. Comfort Lake Outlet 2014 Flow and Daily Rainfall

2014 is the fourth year since 2006 that samples were collected by the WCD at the Comfort Lake Outlet site. Grab samples were collected by the Army Corps of Engineers in 2008. Automated storm composite and manual base and storm grab samples were collected in 2014. The TSS, VSS, TKN, TP, dissolved phosphorus, chloride, nitrite, nitrate, ammonia nitrogen, and *E. coli* results from all collected samples are listed in Table 17 and field water quality measurements are listed in Table 18. The highest TSS concentration collected was 92 mg/L from a May 5th storm grab sample. The highest TKN and TP concentrations were 2.6 mg/L and 0.168 mg/L, respectively, from a storm composite sample collected from August 11th-August 12th.

Table 17. Comfort Lake Outlet 2014 Sample Chemistry Results

Sample Type	Start	End	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	Dissolved TP (mg/L)	Chloride (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)	Ammonia Nitrogen (mg/L)	<i>E. coli</i> (mpn/100ml)	Un-ionized Ammonia (mg/L)
Storm Composite	4/27/2014 18:49	4/28/2014 7:16	5	-2	1.20	0.050	-0.040	51.1	<0.03	0.47	0.13		
Storm Grab	4/29/2014 10:24	4/29/2014 10:24	4	-2	1.20	0.053	-0.039	40.2	<0.03	0.53	0.18		
Storm Grab	5/5/2014 11:38	5/5/2014 11:38	92	-12	1.30	0.050	<0.020	50.0	<0.03	0.45	0.16		
Storm Composite	6/19/2014 5:48	6/20/2014 11:02	12	-8	1.30	0.096	<0.020	38.7	<0.03	<0.05	<0.02		
Storm Composite	8/11/2014 17:49	8/12/2014 7:53	68	30	2.60	0.168	<0.020	30.7	<0.03	<0.05	<0.02		
Storm Composite	8/30/2014 11:45	9/4/2014 8:21	31	15	1.50	-0.045	<0.020	37.0	<0.03	<0.05	<0.02		
Base Grab	4/21/2014 11:12	4/21/2014 11:12	-2	-2	0.92	-0.041	-0.041	58.1	<0.03	0.56	-0.03		0.000404
Base Grab	5/28/2014 10:15	5/28/2014 10:15	-2	-2	1.00	-0.038	-0.032	44.0	<0.03	<0.05	<0.02	43	0.002032
Base Grab	6/3/2014 10:34	6/3/2014 10:34	6	-4	1.10	-0.041	<0.020	39.4	<0.03	<0.05	-0.04		0.002837
Base Grab	6/17/2014 9:58	6/17/2014 9:58	5	4	1.10	-0.043	<0.020	39.5	<0.03	0.05	<0.02		
Base Grab	8/20/2014 11:20	8/20/2014 11:20	-2	-2	1.10	-0.035	-0.024	34.8	<0.03	<0.05	<0.02		0.000228
Base Grab	9/16/2014 9:10	9/16/2014 9:10	-1	-1	0.96	-0.020	<0.020	42.4	<0.03	<0.05	-0.04	39	0.001734
Base Grab	10/27/2014 9:57	10/27/2014 9:57	-1	-1	0.94	-0.033	-0.026	42.5	<0.03	<0.05	-0.03	16	0.000884
<i>E. coli</i> Grab	7/9/2014 10:23	7/9/2014 10:23										16	
<i>E. coli</i> Grab	8/12/2014 9:23	8/12/2014 9:23										120	

Table 18. Comfort Lake Outlet 2014 Field Water Quality Measurements

Date/Time	Transparency (cm)	Water Temperature (C)	Dissolved Oxygen (mg/L)	Conductivity (umhos/cm)	pH
4/21/2014 11:12	>120	7.2	12.32	419	8.0
5/28/2014 10:15	>100	19.8	8.82	403	8.5
6/3/2014 10:34	>100	20.7	7.70	383	8.3
8/12/2014 9:23	>100	21.4	3.07	408	7.7
8/20/2014 11:20	>100	23.2	4.98	378	7.4
9/16/2014 9:10	>100	13.7	5.30	388	8.3
10/27/2014 9:57	>100	10.4	10.65	433	8.2
Exceeds Water Quality Standard					

Table 19. Comfort Lake Outlet 2014 Total Suspended Solids and Total Phosphorus Loading

Sample Type	Sample Collection Time		Loading Interval		Interval Volume (cf)	Interval Volume (ac-ft)	Interval TSS (lb)	Interval TP (lb)		
	Start	End	TSS (mg/L)	TP (mg/L)					Start	End
Base*			3	0.036	1/1/14 0:00	4/10/14 10:45	171,846,000	3,947.10	29,118.0	384.66
Base			3	0.036	4/10/14 10:45	4/16/14 18:45	14,054,000	322.80	2,381.3	31.46
Storm			35	0.077	4/16/14 18:45	4/17/14 19:45	2,153,970	49.47	4,751.1	10.35
Base Grab	4/21/2014 11:12	4/21/2014 11:12	2	0.041	4/17/14 19:45	4/27/14 6:45	18,799,200	431.80	2,347.1	48.12
Storm Composite	4/27/2014 18:49	4/28/2014 7:16	5	0.050	4/27/14 6:45	4/28/14 9:45	3,407,540	78.27	1,063.6	10.64
Storm Grab	4/29/2014 10:24	4/29/2014 10:24	4	0.053	4/28/14 9:45	4/29/14 11:45	5,010,480	115.08	1,251.1	16.58
Storm Grab	5/5/2014 11:38	5/5/2014 11:38	92	0.050	4/29/14 11:45	5/5/14 12:45	43,360,100	995.93	249,026.0	135.34
Base			3	0.036	5/5/14 12:45	5/8/14 15:45	23,084,300	530.22	3,911.5	51.67
Storm			35	0.077	5/8/14 15:45	5/9/14 6:45	4,586,190	105.34	10,115.9	22.04
Base			3	0.036	5/9/14 6:45	5/11/14 22:45	19,058,400	437.75	3,229.3	42.66
Storm			35	0.077	5/11/14 22:45	5/12/14 3:45	1,499,970	34.45	3,308.5	7.21
Base			3	0.036	5/12/14 3:45	5/19/14 10:45	50,864,500	1,168.30	8,618.6	113.86
Storm			35	0.077	5/19/14 10:45	5/19/14 16:45	1,619,340	37.19	3,571.8	7.78
Base Grab	5/28/2014 10:15	5/28/2014 10:15	2	0.038	5/19/14 16:45	5/31/14 14:45	72,451,400	1,664.13	9,045.7	171.87
Storm			35	0.077	5/31/14 14:45	5/31/14 20:45	1,244,940	28.59	2,746.0	5.98
Storm			35	0.077	5/31/14 20:45	6/1/14 17:45	5,045,720	115.89	11,129.5	24.25
Base Grab	6/3/2014 10:34	6/3/2014 10:34	6	0.041	6/1/14 17:45	6/7/14 7:45	34,958,200	802.95	13,093.8	89.47
Storm			35	0.077	6/7/14 7:45	6/7/14 12:45	1,252,590	28.77	2,762.9	6.02
Base			3	0.036	6/7/14 12:45	6/14/14 21:45	36,319,500	834.22	6,154.1	81.30
Storm			35	0.077	6/14/14 21:45	6/15/14 14:45	3,160,860	72.60	6,972.0	15.19
Base Grab	6/17/2014 9:58	6/17/2014 9:58	5	0.043	6/15/14 14:45	6/19/14 3:45	17,011,900	390.74	5,309.9	45.67
Storm Composite	6/19/2014 5:48	6/20/2014 11:02	12	0.096	6/19/14 3:45	6/20/14 13:45	9,249,320	212.45	6,928.8	55.43
Base			3	0.036	6/20/14 13:45	6/28/14 15:45	62,589,700	1,437.61	10,605.3	140.10
Storm			35	0.077	6/28/14 15:45	6/28/14 22:45	2,366,600	54.36	5,220.1	11.38
Base			3	0.036	6/28/14 22:45	8/11/14 1:45	170,238,000	3,910.17	28,845.5	381.06
Storm			35	0.077	8/11/14 1:45	8/11/14 11:45	460,722	10.58	1,016.2	2.21
Storm Composite	8/11/2014 17:49	8/12/2014 7:53	68	0.168	8/11/14 11:45	8/12/14 20:45	1,735,780	39.87	7,368.3	18.20
Base Grab	8/20/2014 11:20	8/20/2014 11:20	2	0.035	8/12/14 20:45	8/29/14 10:45	13,629,900	313.06	1,701.7	29.78
Storm			35	0.077	8/29/14 10:45	8/30/14 9:45	659,362	15.14	1,454.4	3.17
Storm Composite	8/30/2014 11:45	9/4/2014 8:21	31	0.045	8/30/14 9:45	9/4/14 14:45	9,355,700	214.89	18,105.2	26.28
Base			3	0.036	9/4/14 14:45	9/9/14 21:45	8,467,040	194.48	1,434.7	18.95
Storm			35	0.077	9/9/14 21:45	9/10/14 1:45	251,121	5.77	553.9	1.21
Base			3	0.036	9/10/14 1:45	9/15/14 12:45	7,160,850	164.48	1,213.4	16.03
Base Grab	9/16/2014 9:10	9/16/2014 9:10	1	0.020	9/15/14 12:45	10/12/14 12:45	15,061,900	345.95	940.3	18.81
Base Grab	10/27/2014 9:57	10/27/2014 9:57	1	0.033	10/12/14 12:45	11/4/14 10:15	10,007,900	229.87	624.8	20.62
Base*			3	0.036	11/4/14 10:15	1/1/15 0:00	14,922,900	342.76	2,528.6	33.40
Base Average			3	0.036						
Storm Average			35	0.077						
All Average			18	0.055						
Total							856,945,895	19,683	468,449	2,099
CLFLWD Major Subwatershed Total Acres							24,558			
Total Load										
Total TSS/TP (lbs/ac/yr)									19.08	0.085

Italics indicate estimated concentrations based on average base and storm flow concentrations.

*Interval volumes from 1/1/2014 to 4/10/2014 and 11/4/2014 to 1/1/2015 were estimated using similar flow conditions.

Total phosphorus loading at the Comfort Lake Outlet site and the entire Comfort Lake-Forest Lake Watershed for 2014 was estimated at 0.085 lbs/ac or 2,099 lbs. (Table 19). TP load decreased slightly from 2013 to 2014 while discharge doubled. The increase in discharge can be attributed to the large amount of snow during the winter of 2013/2014 followed by a wet spring; the river at this station was out of its banks until mid-July. The TSS load at this site showed more of an increase than the TP load for 2014.

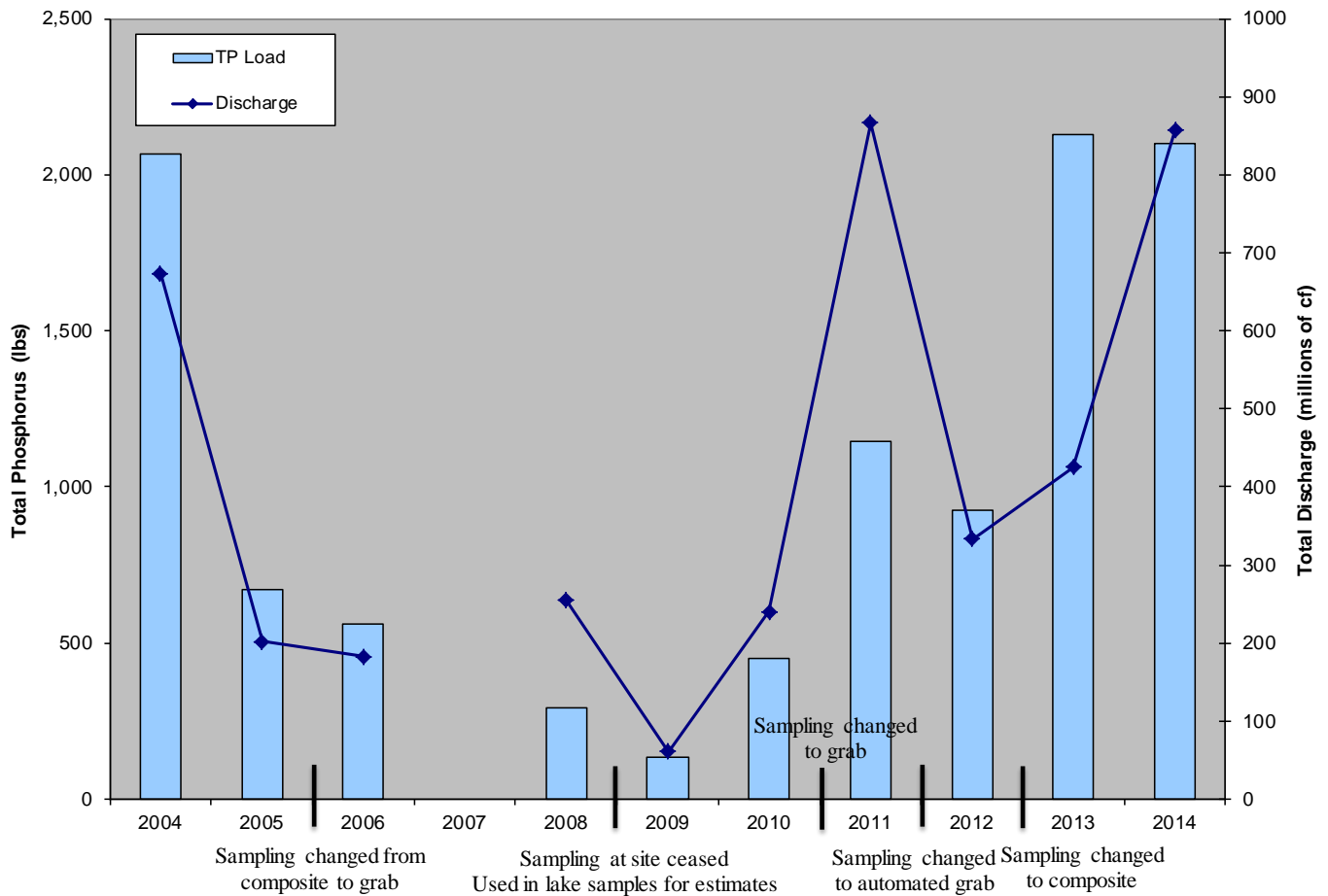


Figure 16. Comfort Lake Outlet Historic Annual Discharge and Total Phosphorus Load

Flow and water chemistry data has been collected at the Comfort Lake Outlet site since 2003. The equipment was installed but damaged in 2007, making load and discharge data unavailable from that year. Estimated total annual phosphorus load and discharge can be seen in Figure 16. When making year-to-year load comparisons, it should be noted that three different sampling methods have been employed at this site. Automated composite sampling was used in 2004-2005, and manual grab sampling occurred in 2006. Grab samples were taken in 2008 by the Army Corps of Engineers, where sampling was on a set schedule and was not event based. In-lake nutrient concentrations were used to develop an estimate of total phosphorus loads in 2009-2010. The sampling methods used in 2008-2010 do not necessarily characterize the full export accurately, as they do not represent the concentrations present during storm flow conditions. In 2011 and 2012 event grab samples were collected at the monitoring site and in 2013 the sampling technique was switched back to composite. Automated composite samples were once again collected in 2014. It is recommended that event based sampling continue at this site to better understand the load that is leaving the Comfort Lake-Forest Lake Watershed.

VII. WATERSHED PHOSPHORUS FLOW CHART

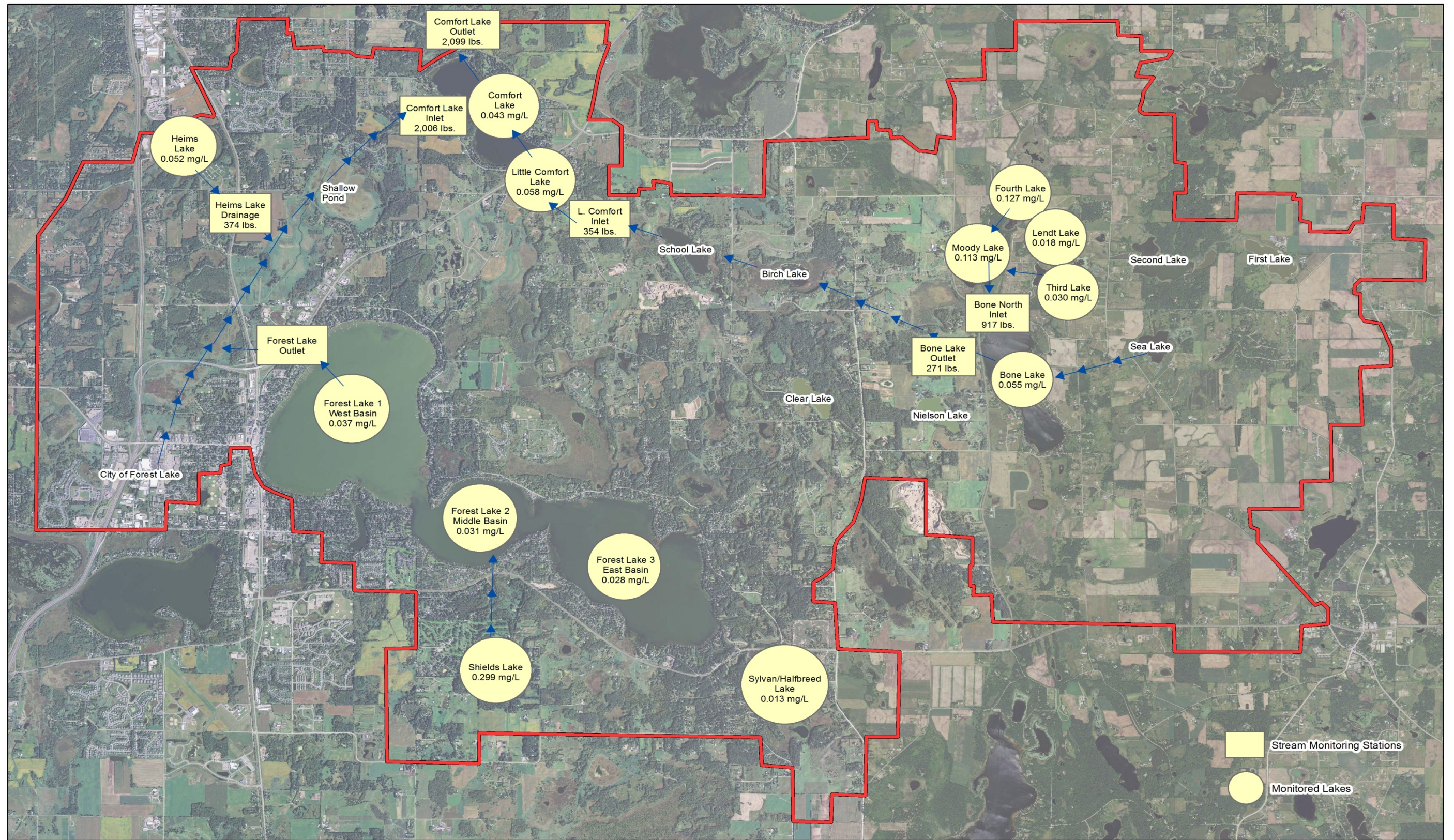


Figure 17. 2014 Watershed Summer Average Lake Phosphorus Concentrations and Total Phosphorus Load Water Quality Flow Chart

VIII. HISTORICAL STREAM LOADING, DISCHARGE, AND *E. coli* SUMMARY

Table 20. CLFLWD Historical Stream Loading, Discharge, and Rainfall Summary

Site	Year	Monitoring Season	Growing Season (June 1-Sept 30) Discharge*		Yearly Estimated Discharge		Growing Season (June 1-Sept 30) Load*		Total Yearly Estimated Load		Monitored Rainfall (inches)
			Cubic Feet	Acre Feet	Cubic Feet	Acre Feet	TP (lbs.)	TSS (lbs.)	TP (lbs.)	TSS (lbs.)	
Tributary to Sunrise River at Bone Lake North Inlet	2003	5/27/03-10/30/03	23,012,779	528	NA	NA	654	129,443	NA	NA	12.73
Tributary to Sunrise River at Bone Lake North Inlet	2005	3/29/05-11/1/05	3,370,684	77	14,075,577	323	89	14,745	226	24,817	20.73
Tributary to Sunrise River at Bone Lake North Inlet	2006	5/1/06-10/25/06	1,892,891	43	9,625,678	221	74	1,085	315	5,225	15.67
Tributary to Sunrise River at Bone Lake North Inlet	2007										
Tributary to Sunrise River at Bone Lake North Inlet	2008										
Tributary to Sunrise River at Bone Lake North Inlet	2009										
Tributary to Sunrise River at Bone Lake North Inlet	2010	4/5/10-11/1/10	1,519,181	35	5,475,569	126	17	742	53	2,588	19.33
Tributary to Sunrise River at Bone Lake North Inlet	2011	4/7/11-10/31/11	9,840,224	226	45,744,150	1,051	106	2,048	519	9,390	14.87
Tributary to Sunrise River at Bone Lake North Inlet	2012	3/23/12-8/9/12	NA	NA	12,133,284	279	NA	NA	207	17,310	19.13
Tributary to Sunrise River at Bone Lake North Inlet	2013	5/13/13-11/4/13	8,995,972	207	16,205,989	372	194	8,096	349	14,512	14.96
Tributary to Sunrise River at Bone Lake North Inlet	2014	4/21/14-11/4/2014	14,579,955	335	49,356,921	1,134	283	9,426	917	32,910	19.76
Tributary to Sunrise River at Bone Lake Outlet	2003	5/27/03-10/30/03	45,627,921	1,047	NA	NA	297	66,763	NA	NA	12.35
Tributary to Sunrise River at Bone Lake Outlet	2004	3/24/04-11/2/04	27,081,226	622	66,316,511	1,522	146	14,138	339	35,283	18.03
Tributary to Sunrise River at Bone Lake Outlet	2005	3/29/05-11/1/05	7,753,089	178	26,115,815	600	36	30,343	97	38,776	18.27
Tributary to Sunrise River at Bone Lake Outlet	2006	5/1/06-10/30/06	6,821,497	157	23,460,532	539	14	1,018	49	3,158	14.08
Tributary to Sunrise River at Bone Lake Outlet	2013	4/24/13-11/4/13	37,604,427	864	80,882,661	1,858	90	80,882,661	194	NA	No Data Available at Site
Tributary to Sunrise River at Bone Lake Outlet	2014	4/10/14-10/23/14	50,145,600	1,152	108,435,210	2,491	134	NA	271	NA	No Data Available at Site
Tributary to Sunrise River at Bone Lake South Inlet	2005	4/5/05-11/1/05	4,581,651	105	23,004,776	528	117	34,695	231	41,383	No Data Available at Site
Tributary to Sunrise River at Bone Lake South Inlet	2006	5/1/06-10/30/06	2,278,834	52	15,794,923	363	71	4,734	229	14,324	No Data Available at Site
Tributary to Sunrise River at Shields Outlet/Forest Inlet	2005	4/20/05-11/1/05	11,446,896	263	27,638,328	634	237	19,188	420	79,186	19.63
Tributary to Sunrise River at Shields Outlet/Forest Inlet	2006	5/2/06-10/30/06	4,119,142	95	17,784,049	408	92	3,372	332	8,620	13.18
Tributary to Sunrise River at Forest Lake Outlet	2003	5/29/03-10/11/03	134,712,756	3,093	NA	NA	551	209,614	NA	NA	No Data Available at Site
Tributary to Sunrise River at Forest Lake Outlet	2004	3/31/04-11/2/04	93,716,849	2,151	233,100,967	5,351	598	107,761	1,235	167,533	No Data Available at Site
Tributary to Sunrise River at Forest Lake Outlet	2005	3/24/05-11/2/05	59,097,451	1,357	187,748,294	4,310	141	27,981	457	83,383	No Data Available at Site
Tributary to Sunrise River at Forest Lake Outlet	2006	5/2/06-10/25/06	21,006,901	482	92,349,949	2,120	41	5,738	173	24,263	No Data Available at Site
Tributary to Sunrise River at Forest Lake Outlet	2007	3/26/07-10/29/07	5,378,189	123	128,950,817	2,960	8	NA	253	NA	No Data Available at Site
Tributary to Sunrise River at Forest Lake Outlet	2008	4/3/08-11/3/08	41,809,187	960	159,233,702	3,656	81	NA	341	NA	No Data Available at Site
Tributary to Sunrise River at Forest Lake Outlet	2009	4/9/09-11/2/09	373,155	9	31,187,212	716	1	NA	43	NA	No Data Available at Site
Tributary to Sunrise River at Forest Lake Outlet	2010	3/30/10-11/2/10	65,644,741	1,507	133,406,543	3,063	117	NA	221	NA	No Data Available at Site
Tributary to Sunrise River at Forest Lake Outlet	2011	4/5/11-10/31/11	106,740,354	2,452	816,052,697	18,744	234	NA	1,828	NA	No Data Available at Site
Tributary to Sunrise River at Forest Lake Outlet	2012	3/23/12-11/5/12	77,082,238	1,770	155,054,646	3,561	204	NA	411	NA	No Data Available at Site
Tributary to Sunrise River at Forest Lake Outlet	2013	4/9/13-11/3/13	77,476,102	1,780	311,584,377	7,157	175	NA	706	NA	No Data Available at Site
Tributary to Sunrise River at Forest Lake Outlet	2014	4/16/14-11/4/14	NA	NA	NA	NA	NA	NA	NA	NA	No Data Available at Site
Tributary to Sunrise River at Bixby Park	2009	5/7/09-10/20/09	11,602,336	266	22,103,528	507	103	5,212	179	9,317	No Data Available at Site
Tributary to Sunrise River at Bixby Park	2010	3/30/10-11/1/10	15,997,632	367	21,072,618	484	121	7,639	158	9,737	No Data Available at Site
Tributary to Sunrise River at Bixby Park	2011	4/13/11-10/31/11	15,314,122	352	30,679,839	705	148	11,821	285	22,316	No Data Available at Site
Tributary to Sunrise River at Bixby Park	2012	3/30/12-11/5/12	23,932,555	550	50,118,632	1,151	293	123,763	973	1,152,008	No Data Available at Site
Sunrise River at County Line Ditch	2007	3/27/07-10/29/07	13,265,950	305	168,125,270	3,860	420	35,317	1,212	109,981	20.65
Sunrise River at County Line Ditch	2008	4/3/08-11/4/08	46,128,347	1,059	167,318,507	3,841	216	67,304	650	144,481	16.85
Sunrise River at County Line Ditch	2009	4/3/09-11/3/09	15,225,062	350	71,188,173	1,634	45	2,364	85	5,403	17.52
Sunrise River at County Line Ditch	2010	3/31/10-11/1/10	104,422,088	2,397	182,196,709	4,183	524	41,009	811	69,760	23.86
Sunrise River at County Line Ditch	2011	5/16/11-10/31/11	174,130,314	4,000	376,243,391	8,642	858	90,682	1,792	193,402	12.28
Sunrise River at County Line Ditch	2012	3/30/12-11/5/12	72,141,600	1,657	158,144,746	3,632	344	163,389	930	609,889	22.07
Tributary to Sunrise River at Heims Lake Drainage/Hwy 61	2012	4/2/12-11/5/12	1,309,476	30	5,667,458	130	40	2,172	330	51,715	No Data Available at Site
Tributary to Sunrise River at Heims Lake Drainage/Hwy 61	2013	4/9/13-11/4/13	2,814,191	65	9,605,584	221	150	9,577	495	24,224	No Data Available at Site
Tributary to Sunrise River at Heims Lake Drainage/Hwy 61	2014	4/29/14-11/4/14	15,297,621	351	32,336,273	743	255	96,276	374	106,692	No Data Available at Site
Sunrise River at Greenway Avenue	2008	4/14/08-11/4/08	64,476,470	1,480	231,516,014	5,315	499	233,541	1,505	696,004	No Data Available at Site
Sunrise River at Greenway Avenue	2009										
Sunrise River at Greenway Avenue	2010										
Sunrise River at Greenway Avenue	2011	5/26/11-10/31/11	155,958,904	3,582	442,205,000	10,157	1,358	76,702	3,722	218,922	No Data Available at Site
Sunrise River at Greenway Avenue	2012	4/2/12-11/5/12	87,412,116	2,008	262,400,771	6,027	888	750,188	6,370	7,183,660	No Data Available at Site
Sunrise River at Greenway Avenue	2013	5/15/13-11/4/13	121,486,726	2,790	326,439,257	7,498	778	54,590	2,071	129,646	No Data Available at Site
Tributary to Sunrise River at Manning Trail	2008	4/21/08-11/3/08	7,613,182	175	63,196,487	1,451	41	1,232	508	7,421	No Data Available at Site
Tributary to Sunrise River at Manning Trail	2009	4/2/09-11/2/09	759,696	17	11,231,268	258	7	265	104	3,718	No Data Available at Site
Tributary to Sunrise River at July Avenue	2008	4/17/08-11/3/08	22,886,998	525	80,937,662	1,858	146	5,316	431	14,137	17.25
Tributary to Sunrise River at July Avenue	2009	4/2/09-11/2/09	3,759,027	86	27,127,126	623	23	1,295	151	9,112	17.92
Tributary to Sunrise River at Little Comfort Lake Inlet	2004	5/4/04-11/2/04	79,549,516	1,826	172,272,256	3,955	584	474,947	1,283	1,220,397	19.59
Tributary to Sunrise River at Little Comfort Lake Inlet	2005	3/29/05-11/2/05	56,782,372	1,304	149,011,733	3,421	461	211,373	1,023	697,890	21.99
Tributary to Sunrise River at Little Comfort Lake Inlet	2006	5/4/06-10/30/06	42,677,774	980	131,946,491	3,029	834	411,398	1,551	643,540	16.89
Tributary to Sunrise River at Little Comfort Lake Inlet	2007	4/26/07-10/30/07	54,709,030	1,256	173,218,653	3,977	202	13,620	676	43,113	23.65
Tributary to Sunrise River at Little Comfort Lake Inlet	2008	4/22/08-11/3/08	93,791,250	2,153	360,171,837	8,268	256	23,369	1,127	94,344	16.35
Tributary to Sunrise River at Little Comfort Lake Inlet	2009	4/9/09-11/2/09	26,119,773	600	101,219,564	2,324	119	12,439	418	34,444	17.34
Tributary to Sunrise River at Little Comfort Lake Inlet	2010	3/30/10-11/15/10	56,666,594	1,301	103,234,147	2,370	188	9,260	331	18,146	23.58
Tributary to Sunrise River at Little Comfort Lake Inlet	2011	4/21/11-10/31/11	65,595,117	1,507	148,136,193	3,403	223	12,635	481	29,758	19.14
Tributary to Sunrise River at Little Comfort Lake Inlet	2012	3/30/12-10/30/12	20,666,292	475	51,169,672	1,175	78	5,065	230	37,392	23.20
Tributary to Sunrise River at Little Comfort Lake Inlet	2013	5/13/13-11/4/13	39,736,345	913	60,039,577	1,379	225	43,960	330	50,187	13.89
Tributary to Sunrise River at Little Comfort Lake Inlet	2014	6/10/14-11/4/14	59,904,865	1,376	132,674,265	3,047	169	25,311	354	42,545	15.19
Sunrise River at Comfort Lake Inlet	2004	4/5/04-11/2/04	147,834,005	3,394	422,272,825	9,694	899	255,626	1,963	403,759	20.97
Sunrise River at Comfort Lake Inlet	2005	3/29/05-11/2/05	93,498,873	2,146	284,332,944	6,527	392	33,117	1,119	125,039	22.48
Sunrise River at Comfort Lake Inlet	2006	5/2/06-10/30/06	40,363,884	927	163,858,477	3,762	913	52,781	1,887	175,089	18.27
Sunrise River at Comfort Lake Inlet	2007	3/26/07-10/30/07	39,591,680	909	247,038,494	5,671	242	15,064	997	63,755	22.42
Sunrise River at Comfort Lake Inlet	2008	4/3/08-9/24/08	109,097,724	2,505	284,321,095	6,527	482	85,171	1,153	196,267	18.24
Sunrise River at Comfort Lake Inlet	2009	4/3/09-11/2/09	33,167,079	761	107,548,295	2,469	155	7,325	547	21,691	17.80
Sunrise River at Comfort Lake Inlet	2010	3/30/10-10/30/10	113,660,642	2,609	218,947,013	5,026	874	39,921	1,278	60,721	22.68
Sunrise River at Comfort Lake Inlet	2011	5/4/11-11/2/11	245,003,912	5,628	509,788,473	11,709	1,506	111,184	2,876	215,478	13.93
Sunrise River at Comfort Lake Inlet	2012	4/5/12-11/7/12	126,038,503	2,895	352,448,988	8,095	717	46,916	1,914	150,817	21.14
Sunrise River at Comfort Lake Inlet	2013	5/13/13-11/4/13	126,233,743	2,899	355,022,452	8,154	545	36,696	1,519	99,754	15.68
Sunrise River at Comfort Lake Inlet	2014	4/16/14-10/23/14	149,568,395	3,435	423,401,380	9,725	790	97,284	2,006	253,252	26.60
Sunrise River at Comfort Lake Outlet	2003	5/29/03-11/3/03	361,495,072	8,299	NA	NA	1,308	285,063	NA	NA	13.09
Sunrise River at Comfort Lake Outlet	2004	3/22/04-11/2/04	249,741,973	5,733	673,985,011	15,473	1,076	401,584	2,065	566,195	21.68
Sunrise River at Comfort Lake Outlet	2005	3/24/05-11/2/05	85,981,864	1,974	201,840,954	4,634	326	153,936	670	251,622	22.32
Sunrise River at Comfort Lake Outlet	2006	5/2/06-10/30/06	51,812,383	1,189	183,293,248	4,208	122	16,097	563	60,519	18.32
Sunrise River at Comfort Lake Outlet	2007	3/26/07-7/12/07	NA	NA	NA	NA	NA	NA	NA	NA	21.42
Sunrise River at Comfort Lake Outlet	2008	5/1/08-11/3/08	73,273,609	1,682	254,442,469	5,841	99	21,762	291	62,469	16.53
Sunrise River at Comfort Lake Outlet	2009	4/22/09-11/2/09	17,619,711	404	61,039,355	1,401	34	NA	134	NA	No Data Available at Site
Sunrise River at Comfort Lake Outlet	2010	4/5/10-11/2/10	144,901,319	3,326	240,198,442	5,514	273	NA	450	NA	22.97
Sunrise River at Comfort Lake Outlet	2011	4/18/11-10/31/11	433,531,324	9,958	866,127,458	19,894	566	136,863	1,146	267,379	18.57

E. coli

The Minnesota Pollution Control Agency has set water quality standards for Class 2 Waters of the State for aquatic life and recreation (<https://www.revisor.mn.gov/rules/?id=7050.0222>). The following is the description for the *Escherichia (E.) coli* standard:

“Not to exceed 126 organisms per 100 milliliters as a geometric mean of not less than five samples representative of conditions within any calendar month, nor shall more than ten percent of all samples taken during any calendar month individually exceed 1,260 organisms per 100 milliliters. The standard applies only between April 1 and October 31.”

Monthly Geometric Means for *E. coli* (#/100 mL)

Site	April	May	June	July	August	September	October
Bone Lake North Inlet	Insufficient Data	Insufficient Data	110	126	Insufficient Data	Insufficient Data	Insufficient Data
Bone Lake South Inlet	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Bone Lake Outlet	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Shields Outlet/Forest Inlet	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Forest Lake Outlet	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Bixby Park	Insufficient Data	Insufficient Data	Insufficient Data	815	Insufficient Data	Insufficient Data	Insufficient Data
County Line Ditch	Insufficient Data	Insufficient Data	88	161	187	Insufficient Data	Insufficient Data
Heims Lake	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Greenway Avenue	Insufficient Data	Insufficient Data	121	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Manning Trail	Insufficient Data	Insufficient Data	99	152	415	Insufficient Data	Insufficient Data
July Avenue	Insufficient Data	Insufficient Data	21	56	208	Insufficient Data	Insufficient Data
Little Comfort Inlet	Insufficient Data	40	60	117	180	208	127
Comfort Lake Inlet	Insufficient Data	70	175	140	237	152	Insufficient Data
Comfort Lake Outlet	Insufficient Data	Insufficient Data	36	16	26	36	18
	Exceeds geometric mean of 126 #/100mL from not less than 5 samples in a calendar month						
	10% of samples taken in the last 10 years exceed 1,260 #/100mL (Doesn't necessarily exceed geometric mean standard)						

Site	Date	E. coli (#/100ml)
Greenway Avenue	6/5/2008 9:50	31
	6/26/2008 10:00	126
	7/17/2008 7:38	147
	8/7/2008 8:45	326
	8/27/2008 9:40	104
	6/9/2011 9:30	156
	7/7/2011 9:18	66
	8/11/2011 9:59	50
	5/31/2012 10:23	30
	6/26/2012 10:00	326
	7/24/2012 12:27	182
	6/27/2013 8:52	132
	7/29/2013 9:20	127
10/10/2013 9:36	207	
Shields Outlet/Forest Inlet	5/5/2005 8:15	27
	7/13/2005 9:15	120
	10/19/2005 9:30	14
	6/14/2006 9:15	66
	10/10/2006 9:00	59
	7/22/2003 10:25	13
Forest Lake Outlet	6/8/2004 8:45	3
	7/15/2004 8:45	18
	5/5/2005 8:30	59
	7/13/2005 9:30	126
	10/19/2005 9:45	19
	6/14/2006 9:30	10
Bone Lake South Inlet	8/10/2006 9:15	44
	9/6/2006 9:30	13
	5/5/2005 8:30	13
	7/13/2005 10:45	567
	10/19/2005 10:45	95
	6/14/2006 10:30	345
Bone Lake North Inlet	8/10/2006 8:30	96
	9/6/2006 8:15	250
	10/10/2006 10:00	115
	7/22/2003 9:20	<1
	9/11/2003 8:55	265
	6/8/2004 10:00	3
Bone Lake Outlet	7/15/2004 10:00	2
	8/12/2004 9:15	139
	5/5/2005 8:15	1
	7/13/2005 10:30	<1
	10/19/2005 11:00	2
	6/14/2006 10:25	1
Forest Lake Outlet	7/24/2006 10:30	727
	8/10/2006 8:50	26
	9/6/2006 8:30	33
	7/22/2003 9:20	<1
	9/11/2003 8:55	265
	6/8/2004 10:00	3
Shields Outlet/Forest Inlet	7/15/2004 10:00	2
	8/12/2004 9:15	139
	5/5/2005 8:15	1
	7/13/2005 10:30	<1
	10/19/2005 11:00	2
	6/14/2006 10:25	1
Greenway Avenue	7/24/2006 10:30	727
	8/10/2006 8:50	26
	9/6/2006 8:30	33
	7/22/2003 9:20	<1
	9/11/2003 8:55	265
	6/8/2004 10:00	3
Bone Lake Outlet	7/15/2004 10:00	2
	8/12/2004 9:15	139
	5/5/2005 8:15	1
	7/13/2005 10:30	<1
	10/19/2005 11:00	2
	6/14/2006 10:25	1
Forest Lake Outlet	7/24/2006 10:30	727
	8/10/2006 8:50	26
	9/6/2006 8:30	33
	7/22/2003 9:20	<1
	9/11/2003 8:55	265
	6/8/2004 10:00	3
Shields Outlet/Forest Inlet	7/15/2004 10:00	2
	8/12/2004 9:15	139
	5/5/2005 8:15	1
	7/13/2005 10:30	<1
	10/19/2005 11:00	2
	6/14/2006 10:25	1
Greenway Avenue	7/24/2006 10:30	727
	8/10/2006 8:50	26
	9/6/2006 8:30	33
	7/22/2003 9:20	<1
	9/11/2003 8:55	265
	6/8/2004 10:00	3
Bone Lake Outlet	7/15/2004 10:00	2
	8/12/2004 9:15	139
	5/5/2005 8:15	1
	7/13/2005 10:30	<1
	10/19/2005 11:00	2
	6/14/2006 10:25	1
Forest Lake Outlet	7/24/2006 10:30	727
	8/10/2006 8:50	26
	9/6/2006 8:30	33
	7/22/2003 9:20	<1
	9/11/2003 8:55	265
	6/8/2004 10:00	3
Shields Outlet/Forest Inlet	7/15/2004 10:00	2
	8/12/2004 9:15	139
	5/5/2005 8:15	1
	7/13/2005 10:30	<1
	10/19/2005 11:00	2
	6/14/2006 10:25	1
Greenway Avenue	7/24/2006 10:30	727
	8/10/2006 8:50	26
	9/6/2006 8:30	33
	7/22/2003 9:20	<1
	9/11/2003 8:55	265
	6/8/2004 10:00	3
Bone Lake Outlet	7/15/2004 10:00	2
	8/12/2004 9:15	139
	5/5/2005 8:15	1
	7/13/2005 10:30	<1
	10/19/2005 11:00	2
	6/14/2006 10:25	1
Forest Lake Outlet	7/24/2006 10:30	727
	8/10/2006 8:50	26
	9/6/2006 8:30	33
	7/22/2003 9:20	<1
	9/11/2003 8:55	265
	6/8/2004 10:00	3
Shields Outlet/Forest Inlet	7/15/2004 10:00	2
	8/12/2004 9:15	139
	5/5/2005 8:15	1
	7/13/2005 10:30	<1
	10/19/2005 11:00	2
	6/14/2006 10:25	1
Greenway Avenue	7/24/2006 10:30	727
	8/10/2006 8:50	26
	9/6/2006 8:30	33
	7/22/2003 9:20	<1
	9/11/2003 8:55	265
	6/8/2004 10:00	3
Bone Lake Outlet	7/15/2004 10:00	2
	8/12/2004 9:15	139
	5/5/2005 8:15	1
	7/13/2005 10:30	<1
	10/19/2005 11:00	2
	6/14/2006 10:25	1
Forest Lake Outlet	7/24/2006 10:30	727
	8/10/2006 8:50	26
	9/6/2006 8:30	33
	7/22/2003 9:20	<1
	9/11/2003 8:55	265
	6/8/2004 10:00	3
Shields Outlet/Forest Inlet	7/15/2004 10:00	2
	8/12/2004 9:15	139
	5/5/2005 8:15	1
	7/13/2005 10:30	<1
	10/19/2005 11:00	2
	6/14/2006 10:25	1
Greenway Avenue	7/24/2006 10:30	727
	8/10/2006 8:50	26
	9/6/2006 8:30	33
	7/22/2003 9:20	<1
	9/11/2003 8:55	265
	6/8/2004 10:00	3
Bone Lake Outlet	7/15/2004 10:00	2
	8/12/2004 9:15	139
	5/5/2005 8:15	1
	7/13/2005 10:30	<1
	10/19/2005 11:00	2
	6/14/2006 10:25	1
Forest Lake Outlet	7/24/2006 10:30	727
	8/10/2006 8:50	26
	9/6/2006 8:30	33
	7/22/2003 9:20	<1
	9/11/2003 8:55	265
	6/8/2004 10:00	3
Shields Outlet/Forest Inlet	7/15/2004 10:00	2
	8/12/2004 9:15	139
	5/5/2005 8:15	1
	7/13/2005 10:30	<1
	10/19/2005 11:00	2
	6/14/2006 10:25	1
Greenway Avenue	7/24/2006 10:30	727
	8/10/2006 8:50	26
	9/6/2006 8:30	33
	7/22/2003 9:20	<1
	9/11/2003 8:55	265
	6/8/2004 10:00	3
Bone Lake Outlet	7/15/2004 10:00	2
	8/12/2004 9:15	139
	5/5/2005 8:15	1
	7/13/2005 10:30	<1
	10/19/2005 11:00	2
	6/14/2006 10:25	1
Forest Lake Outlet	7/24/2006 10:30	727
	8/10/2006 8:50	26
	9/6/2006 8:30	33
	7/22/2003 9:20	<1
	9/11/2003 8:55	265
	6/8/2004 10:00	3
Shields Outlet/Forest Inlet	7/15/2004 10:00	2
	8/12/2004 9:15	139
	5/5/2005 8:15	1
	7/13/2005 10:30	<1
	10/19/2005 11:00	2
	6/14/2006 10:25	1
Greenway Avenue	7/24/2006 10:30	727
	8/10/2006 8:50	26
	9/6/2006 8:30	33
	7/22/2003 9:20	<1
	9/11/2003 8:55	265
	6/8/2004 10:00	3
Bone Lake Outlet	7/15/2004 10:00	2
	8/12/2004 9:15	139
	5/5/2005 8:15	1
	7/13/2005 10:30	<1
	10/19/2005 11:00	2
	6/14/2006 10:25	1
Forest Lake Outlet	7/24/2006 10:30	727
	8/10/2006 8:50	26
	9/6/2006 8:30	33
	7/22/2003 9:20	<1
	9/11/2003 8:55	265
	6/8/2004 10:00	3
Shields Outlet/Forest Inlet	7/15/2004 10:00	2
	8/12/2004 9:15	139
	5/5/2005 8:15	1
	7/13/2005 10:30	<1
	10/19/2005 11:00	2
	6/14/2006 10:25	1
Greenway Avenue	7/24/2006 10:30	727
	8/10/2006 8:50	26
	9/6/2006 8:30	33
	7/22/2003 9:20	<1
	9/11/2003 8:55	265
	6/8/2004 10:00	3
Bone Lake Outlet	7/15/2004 10:00	2
	8/12/2004 9:15	139
	5/5/2005 8:15	1
	7/13/2005 10:30	<1
	10/19/2005 11:00	2
	6/14/2006 10:25	1
Forest Lake Outlet	7/24/2006 10:30	727
	8/10/2006 8:50	26
	9/6/2006 8:30	33
	7/22/2003 9:20	<1
	9/11/2003 8:55	265
	6/8/2004 10:00	3
Shields Outlet/Forest Inlet	7/15/2004 10:00	2
	8/12/2004 9:15	139
	5/5/2005 8:15	1
	7/13/2005 10:30	<1
	10/19/2005 11:00	2
	6/14/2006 10:25	1
Greenway Avenue	7/24/2006 10:30	727
	8/10/2006 8:50	26
	9/6/2006 8:30	33
	7/22/2003 9:20	<1
	9/11/2003 8:55	265
	6/8/2004 10:00	3
Bone Lake Outlet	7/15/2004 10:00	2
	8/12/2004 9:15	139
	5/5/2005 8:15	1
	7/13/2005 10:30	<1
	10/19/2005 11:00	2
	6/14/2006 10:25	1
Forest Lake Outlet	7/24/2006 10:30	727
	8/10/2006 8:50	26
	9/6/2006 8:30	33
	7/22/2003 9:20	<1
	9/11/2003 8:55	265
	6/8/2004 10:00	3
Shields Outlet/Forest Inlet	7/15/2004 10:00	2
	8/12/2004 9:15	139
	5/5/2005 8:15	1
	7/13/2005 10:30	<1
	10/19/2005 11:00	2
	6/14/2006 10:25	1
Greenway Avenue	7/24/2006 10:30	727
	8/10/2006 8:50	26
	9/6/2006 8:30	33
	7/22/2003 9:20	<1
	9/11/2003 8:55	265
	6/8/2004 10:00	3
Bone Lake Outlet	7/15/2004 10:00	2
	8/12/2004 9:15	139
	5/5/2005 8:15	1
	7/13/2005 10:30	<1
	10/19/2005 11:00	2
	6/14/2006 10:25	

Site	Date	E. coli (#/100ml)
Comfort Lake Inlet	6/8/2004 9:00	19
	7/15/2004 9:15	50
	8/12/2004 8:30	176
	9/27/2004 9:30	22
	5/5/2005 8:45	302
	7/13/2005 9:45	158
	8/25/2005 8:45	435
	10/19/2005 10:00	32
	6/14/2006 9:45	128
	7/24/2006 9:45	387
	8/10/2006 9:00	291
	9/6/2006 10:00	261
	5/2/2007 11:00	31
	6/13/2007 9:43	115
	7/16/2007 10:23	127
	10/18/2007 9:48	649
	6/5/2008 10:35	86
	6/12/2008 9:07	365
	6/19/2008 9:00	150
	6/26/2008 9:45	249
	6/30/2008 9:28	206
	7/7/2009 9:30	115
	7/14/2008 10:00	160
	7/17/2008 7:50	238
	7/24/2008 8:40	172
	7/31/2008 9:30	167
	8/7/2008 9:00	649
	8/11/2008 9:30	179
	8/14/2008 9:08	387
	8/21/2008 9:10	150
	8/27/2008 9:25	326
	5/28/2009 9:15	41
	6/25/2009 9:00	>2,420
	7/29/2009 8:54	118
	8/27/2009 10:25	84
	9/30/2009 9:13	152
	5/25/2010 8:45	84
	6/24/2010 8:55	206
	7/28/2010 10:43	261
	8/26/2010 8:43	161
	9/30/2010 8:51	77
	6/9/2011 9:20	54
	7/7/2011 9:29	118
	8/11/2011 10:10	46
	9/8/2011 9:04	387
	5/31/2012 10:06	30
	6/26/2012 9:45	192
	7/24/2012 12:18	214
	8/30/2012 8:52	192
	6/27/2013 9:04	407
	7/29/2013 9:50	53
	9/24/2013 10:11	461
	10/10/2013 10:02	179
	5/28/2014 10:30	119
	7/9/2014 10:04	75
	8/12/2014 9:48	1,300
	9/16/2014 8:45	156
	10/27/2014 10:18	72
Comfort Lake Outlet	7/22/2003 10:00	3
	9/11/2003 8:25	34
	10/7/2003 10:00	13
	10/28/2003 8:10	3
	6/8/2004 9:15	6
	7/15/2004 9:30	6
	8/12/2004 8:45	32
	9/27/2004 9:45	14
	5/5/2005 8:45	3
	7/13/2005 10:00	14
	10/19/2005 10:15	6
	6/14/2006 9:55	42
	7/24/2006 10:00	111
	8/10/2006 9:00	17
	9/6/2006 9:15	18
	10/10/2006 9:20	10
	6/9/2011 9:10	26
	7/7/2011 9:39	16
	8/11/2011 10:23	18
	9/8/2011 9:16	64
	10/5/2011 9:58	276
	5/31/2012 9:50	19
	6/26/2012 9:35	19
	7/24/2012 12:11	22
	6/27/2013 9:13	435
	7/29/2013 9:35	28
	8/15/2013 10:08	10
	9/24/2013 9:55	99
	10/10/2013 9:43	76
	5/28/2014 10:15	43
	7/9/2014 10:23	16
	8/12/2014 9:23	120
	9/16/2014 9:10	39
	10/27/2014 9:57	16

Site	Date	E. coli (#/100ml)
County Line Ditch	5/2/2007 10:45	22
	6/13/2007 10:02	186
	7/16/2007 10:37	>2,420
	10/18/2007 10:23	328
	6/5/2008 9:55	20
	6/12/2008 8:46	1,300
	6/19/2008 8:50	28
	6/26/2008 10:15	18
	6/30/2008 9:07	34
	7/7/2008 9:45	66
	7/14/2008 9:45	45
	7/17/2008 7:22	162
	7/24/2008 8:25	140
	7/31/2008 10:00	129
	8/4/2008 9:20	131
	8/7/2008 8:30	142
	8/14/2008 8:43	218
	8/21/2008 9:25	210
	8/27/2008 9:50	>2,420
	5/28/2009 9:30	1120
	6/25/2009 8:30	>2,420
	7/29/2009 8:37	29
	8/27/2009 10:15	68
	9/30/2009 8:56	44
	5/25/2010 8:32	93
	6/24/2010 8:41	31
	7/28/2010 10:18	461
	8/26/2010 9:00	135
	9/30/2010 8:34	64
	6/9/2011 9:45	44
	7/7/2011 9:09	185
	8/11/2011 9:47	79
	9/8/2011 8:40	201
	10/5/2011 9:20	111
	5/31/2012 10:49	16
	6/26/2012 10:15	105
	7/24/2012 12:38	219
Manning Trail	6/5/2008 9:15	249
	6/12/2008 9:52	417
	6/19/2008 9:35	71
	6/26/2008 9:15	41
	6/30/2008 10:08	26
	7/7/2008 8:50	102
	7/14/2008 10:03	118
	7/17/2008 8:21	214
	7/24/2008 9:16	115
	7/31/2008 8:30	272
	8/4/2008 8:30	88
	8/7/2008 9:30	195
	8/14/2008 9:47	205
	8/21/2008 8:30	248
	8/27/2008 8:50	>2,420
	5/28/2009 8:45	58
	6/10/2009 8:10	119
	8/26/2009 8:00	>2,420
July Avenue	6/5/2008 9:18	23
	6/12/2008 9:37	52
	6/19/2008 9:25	10
	6/26/2008 9:20	15
	6/30/2008 9:56	12
	7/7/2008 9:05	11
	7/14/2008 9:10	19
	7/17/2008 8:12	125
	7/24/2008 9:04	56
	7/31/2008 9:00	38
	8/4/2008 8:45	46
	8/7/2008 9:20	88
	8/14/2008 9:36	144
	8/21/2008 8:45	411
	8/27/2008 9:00	980
	5/28/2009 9:00	126
	6/10/2009 8:20	37
	7/28/2009 8:00	579
	8/26/2009 8:11	345

Site	Date	<i>E. coli</i> (#/100ml)
Little Comfort Inlet	6/8/2004 9:45	16
	7/15/2004 9:45	16
	8/12/2004 9:00	195
	9/27/2004 10:00	126
	5/5/2005 9:00	4
	7/13/2005 10:00	69
	10/19/2005 10:30	21
	6/14/2006 10:05	108
	7/24/2006 10:15	214
	8/10/2006 8:45	461
	9/6/2006 9:00	166
	10/10/2006 9:40	101
	5/2/2007 11:10	30
	6/13/2007 9:28	109
	7/16/2007 10:10	147
	10/18/2007 9:32	41
	6/5/2008 9:30	38
	6/12/2008 9:27	148
	6/19/2008 9:15	31
	6/26/2008 9:35	63
	6/30/2008 9:45	23
	7/7/2008 9:20	72
	7/14/2008 9:20	225
	7/17/2008 8:01	1,733
	7/24/2008 8:53	365
	7/31/2008 9:15	145
	8/4/2008 9:00	261
	8/7/2008 9:10	687
	8/14/2008 9:22	172
	8/21/2008 9:00	56
	8/27/2008 9:15	261
	6/10/2009 8:30	548
	7/28/2009 8:10	201
	5/25/2010 8:59	866
	6/24/2010 9:08	121
	7/28/2010 11:01	210
	8/26/2010 8:30	91
	9/30/2010 9:05	201
	6/9/2011 9:00	20
	7/7/2011 9:52	83
	8/11/2011 10:39	37
	9/8/2011 9:28	365
	10/5/2011 10:07	2,420
	5/31/2012 9:34	61
	6/26/2012 9:25	135
	7/24/2012 11:59	111
	8/30/2012 8:38	345
	6/27/2013 9:24	67
	7/29/2013 10:10	45
	8/15/2013 10:37	63
	9/24/2013 9:45	266
	10/10/2013 10:21	326
	5/28/2014 9:55	14
	7/9/2014 9:44	11
	8/12/2014 10:28	378
	9/16/2014 9:30	201
	10/27/2014 10:53	62

Site	Date	<i>E. coli</i> (#/100ml)
Bixy Park	6/16/2009 9:15	7
	6/23/2009 8:15	30
	6/30/2009 9:09	63
	7/15/2009 8:54	>2420
	7/21/2009 8:45	>2420
	7/28/2009 8:00	579
	8/11/2009 8:30	43
	8/18/2009 8:30	41
	8/26/2009 8:34	192
	5/25/2010 8:17	125
	7/28/2010 10:04	1,300
	7/7/2011 8:57	68
	8/11/2011 9:29	91
	7/24/2012 12:49	980
Heims Lake	5/31/2012 10:36	91
	6/26/2012 10:30	82
	7/24/2012 12:40	222
	6/27/2013 8:41	135
	5/28/2014 10:55	20
	7/9/2014 10:51	120
	8/12/2014 8:52	579
	9/16/2014 8:25	82
	10/27/2014 9:36	10

Note: When fecal coliform samples were collected, results were converted to equivalent *E. coli* values.

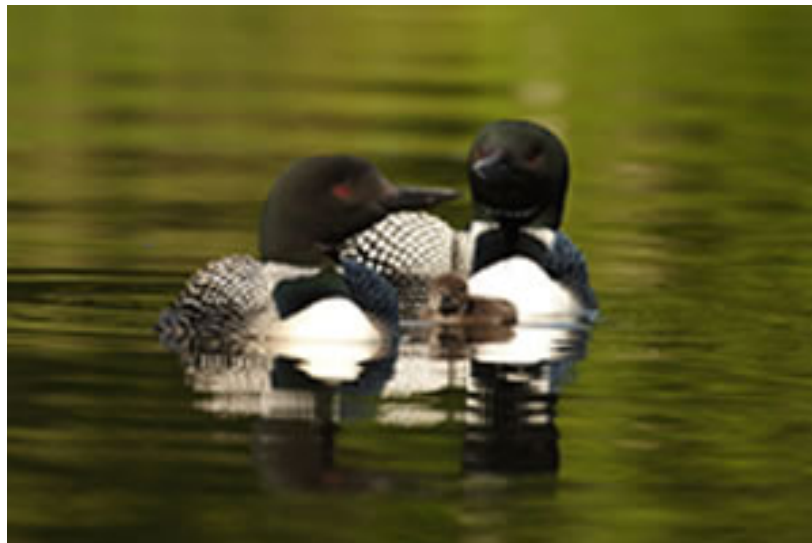
2014 LAKE MONITORING REPORT

I. EXECUTIVE SUMMARY

Monitoring of resources within the Comfort Lake-Forest Lake Watershed District has been a priority since the District was formed in 1999. However, some level of water quality monitoring has been conducted in the District going back to the late 1970's. Starting in the 1990's a more comprehensive approach to the monitoring of its lakes was adopted. In 2014 a total of eleven lakes (Bone, Comfort, Forest (3 basins), Fourth, Heims, Lendt, Little Comfort, Moody, Shields, Sylvan/Halfbreed, and Third) were monitored by the Washington Conservation District and citizen volunteers. These data are being used to monitor long-term water quality trends, calibrate water quality models, prioritize management actions, and assess past improvement projects.

The data tell different stories on each lake. Sylvan Lake continues to earn top marks with its very low phosphorus and chlorophyll concentrations and excellent water clarity and in 2014 even showed a statistically significant ($p < 0.01$) improving trend for both Secchi disk transparency and total phosphorus concentrations. Other lakes like Forest Lake, Comfort Lake, and Bone Lake can be described as having average water quality but during the months of June, July, and August can exhibit algae blooms and reduced water clarity that exceed state water quality standards for phosphorus and clarity. Some lakes like Moody Lake and Shields Lake continue to have very poor water quality and greatly exceed state water quality standards. The data for most lakes indicate a neutral trend, neither improving nor declining over the period of time that monitoring has been conducted. Only three lakes, Shields Lake, Comfort Lake, and Forest Lake (West Basin) showed a statistically significant declining trend after the 2014 monitoring season, all for Secchi disk transparency. Four lakes, Comfort Lake, Bone Lake, Moody Lake, and Sylvan/Halfbreed Lake showed a statistically significant ($p < 0.01$) improving trend for total phosphorus (TP). Lake grades and trends can be found in Figure 20 and Table 22.

The purpose of this document is to summarize water quality trends and current conditions in the Districts' main recreational lakes. The information provided here is used regularly by the Comfort Lake-Forest Lake Watershed District to guide water resource management decisions. This information is also intended be useful to the Districts' member cities and citizens alike.



II. INTRODUCTION AND METHODS

There are 19 named lakes in the Comfort Lake Forest-Lake Watershed. These lakes have significant aesthetic and recreational value. They also serve as a home to a wide variety of plants, fish, mammals, reptiles, and migratory waterfowl. The quality of water in these lakes is a key variable in how the lake is used, both by humans and animals. Poor water quality can result in decreased use for recreation and loss of habitat for plants and animals. More specifically, poor water quality can lead to nuisance algae blooms, odor problems, fish kills, and shifts in fish populations toward less desirable species such as carp and bullhead. Improving and protecting lake water quality is a high priority for the Comfort Lake-Forest Lake Watershed District.

The culprit for poor water quality is often high nutrient levels, specifically phosphorus. Phosphorus is a nutrient that is required by algae to grow. In Minnesota lakes, phosphorus is often the “limiting” nutrient, meaning that the main factor limiting algae growth would be not enough phosphorus. Therefore, the addition of phosphorus translates directly into more algae. Although phosphorus is found naturally in all lakes, the addition of phosphorus through human activities is common in urban and agricultural areas. Among other sources, phosphorus is added to lakes by urban stormwater, agricultural runoff, lakeshore erosion, and non-native plants and fish.

Regularly assessing water quality allows resource managers to compare lakes to one another, measure change over time, and prioritize management actions. Monitoring of lake water quality has been conducted in the Comfort Lake-Forest Lake Watershed District as far back as the 1970’s. Water quality data over the years has been collected by a number of organizations including the Comfort Lake Forest-Lake Watershed District, the Washington Conservation District, Metropolitan Council, the MN Department of Natural Resources, the MN Pollution Control Agency, and citizen volunteers.

LAKE CLASSIFICATION AND GOALS

The Comfort Lake-Forest Lake Watershed District’s *Watershed Management Plan* (2011) assigns numerical water quality goals for in lake phosphorous for each of its ten major recreational lakes; Bone, Birch, Comfort, Forest, Heims, Little Comfort, Moody, School, Shields, and Sylvan/Halfbreed. These standards correspond to current state water quality standards adopted in Minnesota by the MN Pollution Control Agency. The numeric goals for phosphorus are listed in Table 21.

Table 21. In-lake Water Quality Goals for Summer Average Total Phosphorus Concentrations

Lake	10-year In-Lake Total Phosphorus Goal (µg/L)	20-year In-Lake Total Phosphorus Goal (µg/L)	Long Term In-Lake Total Phosphorus Goal (µg/L)
Bone	40	40	30
Birch	60	60	60
Comfort	40	40	30
Forest	<40	<40	30
Heims	40	40	40
Little Comfort	40	40	30
Moody	60	40	40
School	50	40	40
Shields	100	60	60
Sylvan/Halfbreed	20	20	20

WATER QUALITY PARAMETERS

This report presents data for three key water quality parameters: phosphorus (measured as total phosphorus, TP), Chlorophyll-*a* (Chl-*a*), and Secchi depth. Phosphorus is a plant nutrient that is the primary driver for algal growth. Chlorophyll-*a* is found in all photosynthesizing plant cells, including algae. By measuring the amount of chlorophyll-*a* in a lake, you are measuring the amount of algae. Secchi depth is a measure of water clarity and is measured by lowering a Secchi disk over the side of a boat. The deepest depth at which the Secchi disk is visible is the Secchi depth. Since phosphorus drives algae growth, and algae affects water clarity, these parameters are often coupled – i.e. more phosphorus = more algae (chl-*a*) = reduced water clarity. This relationship is illustrated in Figure 18. Secchi depth data is not always available for all lakes. In very shallow lakes, or in lakes with dense plant growth, a Secchi disk is not a practical tool for evaluating water clarity but at this time is the best tool available.

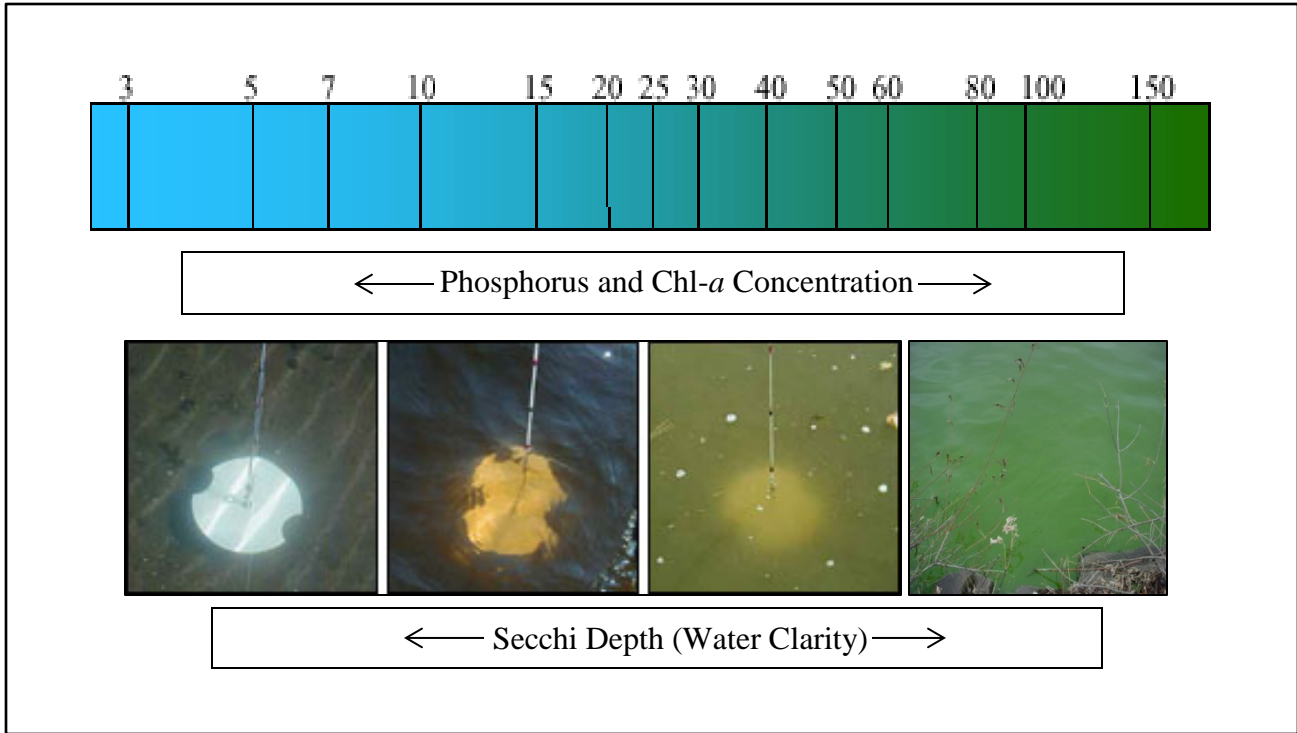


Figure 18. Relationship Between Phosphorus, Chlorophyll-*a*, and Secchi Depth

Although these parameters are usually coupled, complex biological processes can lead to a decoupling of phosphorus, chlorophyll-*a*, and clarity. When this occurs more detailed analysis is often needed to understand why the relationship has broken down.

Water quality presented in this report is compiled from several sources, including CLFLWD databases, the state water quality database ‘EQuIS’, Washington Conservation District, DNR’s Lake Finder, and the Metropolitan Council’s lake database. The values presented are summer averages; summer months of June through September. This is the same seasonal period used by the Metropolitan Council to establish lake grades as part of its regional Citizen-Assisted Monitoring Program (CAMP).

INTERPRETING WATER QUALITY GRAPHS – EXAMPLES

The example set of graphs can be used as a guide for interpreting the water quality graphs presented in this report (Figure 19).

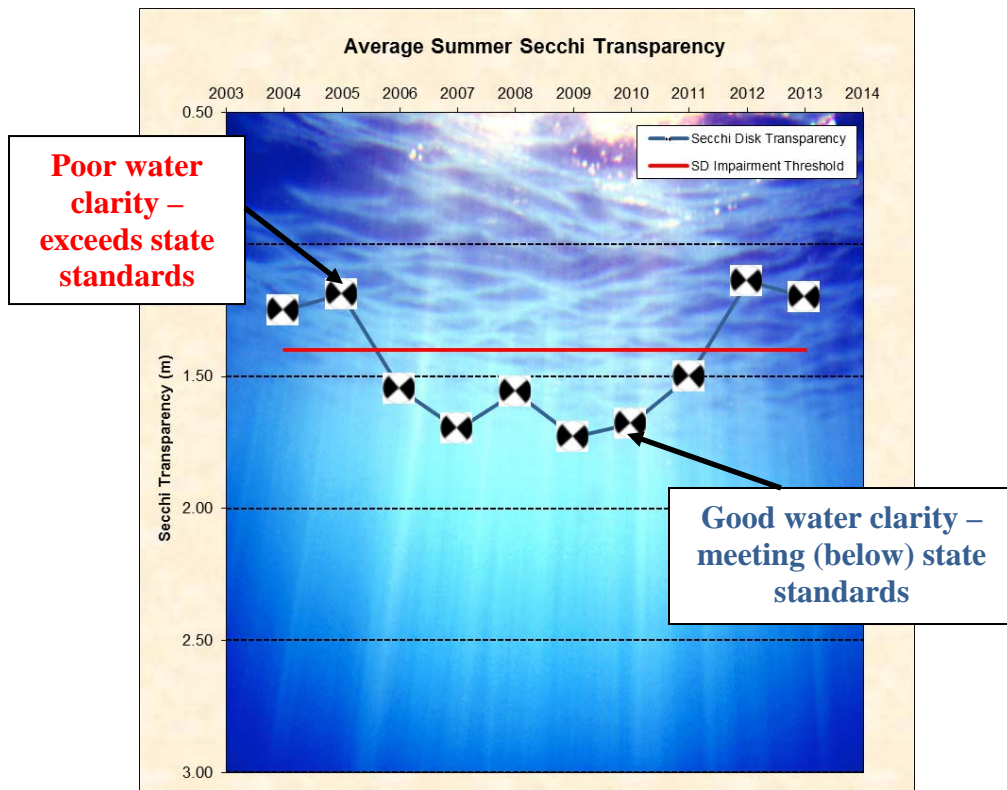
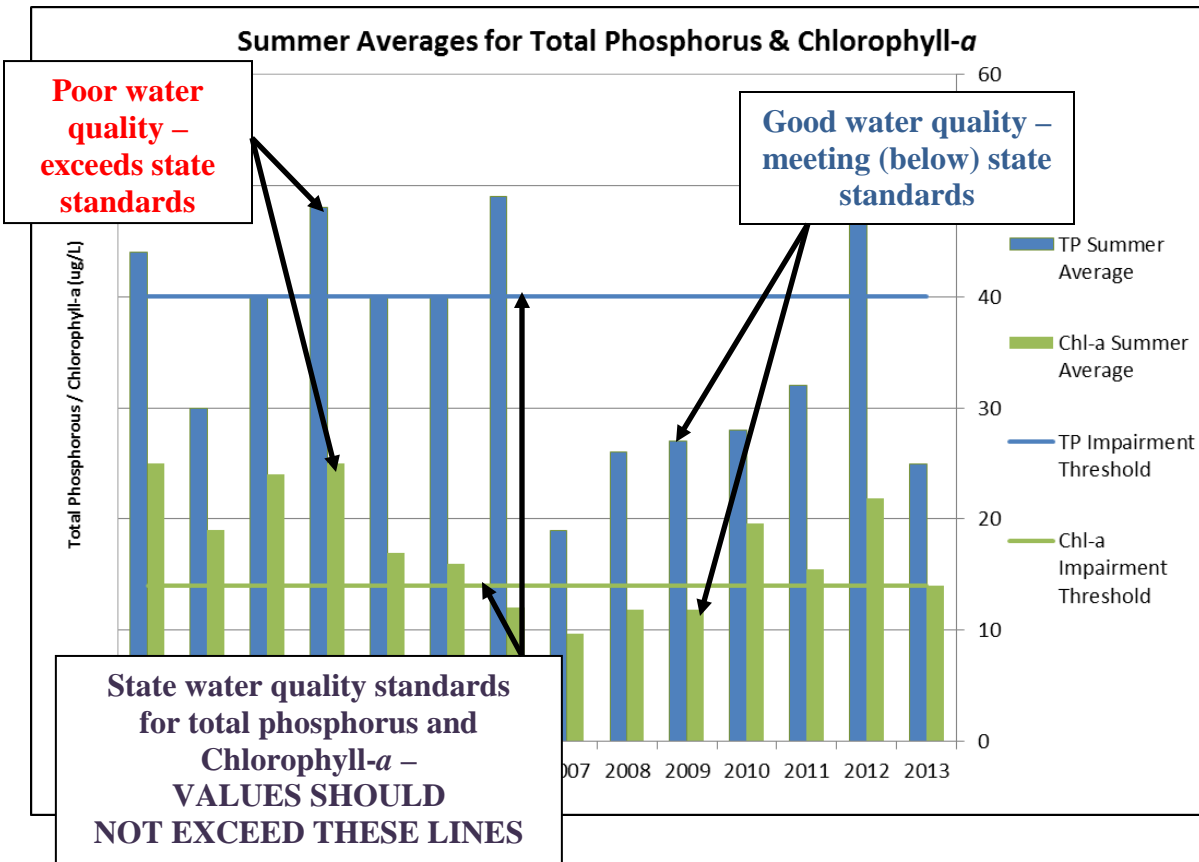


Figure 19. Example Water Quality Graphs

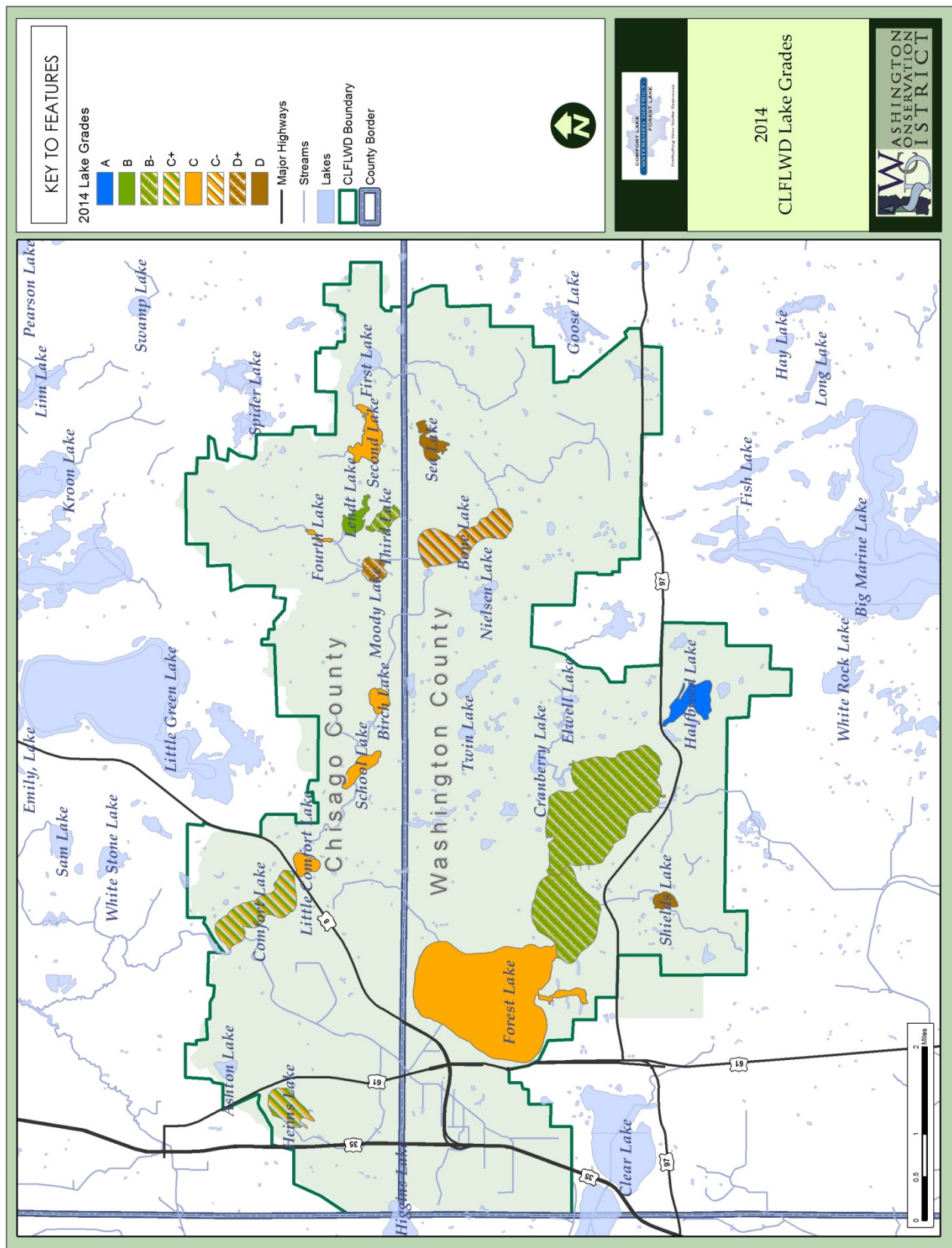


Figure 20. Lake Water Quality Grades

Table 22. Comfort Lake-Forest Lake Watershed District Lake Water Quality Summary

Lake	Acres	DNR ID	Most Recent Phosphorous Average (µg/L)	Most Recent Year of Data	Grade	Listed by MPCA as Impaired for Phosphorous	Secchi Disk Water Quality Trend	Total Phosphorus Water Quality Trend
Bone	221	82005400	55	2014	C-	X	No Trend	Improving
Birch	33	13004200	60	2007	C		NA	NA
Comfort	218	13005300	43	2014	C+	X	Declining	Improving
Forest (West)	1086	82015600	37	2014	C		Declining	No Trend
Forest (Middle)	364	82015600	31	2014	B-		No Trend	No Trend
Forest (East)	790	82015600	28	2014	B-		No Trend	No Trend
Fourth Lake	8	13002200	127	2014	C		NA	NA
Heims	90	13005600	52	2014	C+		NA	NA
Lendt Lake	42	13010300	18	2014	B		NA	NA
Little Comfort	36	13005400	58	2014	C	X	No Trend	No Trend
Moody	45	13002300	113	2014	D+	X	No Trend	Improving
Second	75	13002500	54	2008	C	X	NA	NA
School	47	13005700	47	2009	C	X	NA	NA
Sea	50	82005300	122	2009	D		NA	NA
Shields	30	82016200	299	2014	D	X	Declining	No Trend
Sylvan/Halfbreed	75	82008000	13	2014	A		Improving	Improving
Third Lake	42	13002400	30	2014	B-		NA	NA

Grade

Grade is determined by averaging the three most recent individual grades for total phosphorus, chlorophyll-*a*, and Secchi depth. The scale used to assign grades is the same used by Metropolitan Council.

Impaired for Phosphorus

X'ed lakes are listed as impaired by the State of Minnesota for exceeding phosphorous standards. TMDL studies are required on these lakes.

Water Quality Trend

Trend was assigned by reviewing total phosphorus and Secchi depth averages where a 10 year record of monitoring exists.

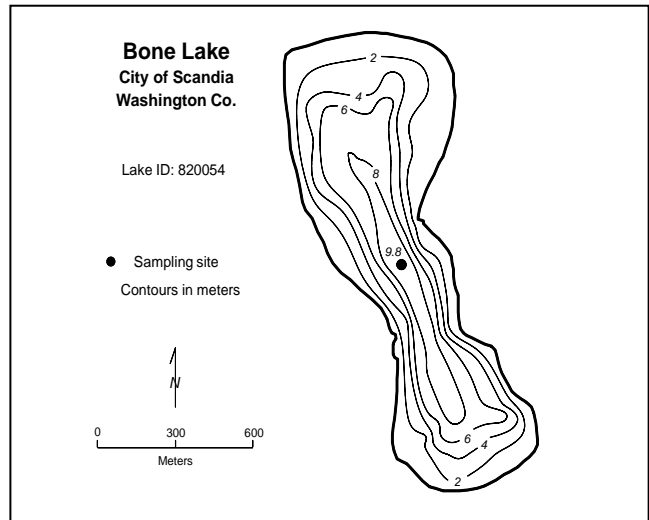
III. INDIVIDUAL LAKE WATER QUALITY SUMMARIES



Bone Lake

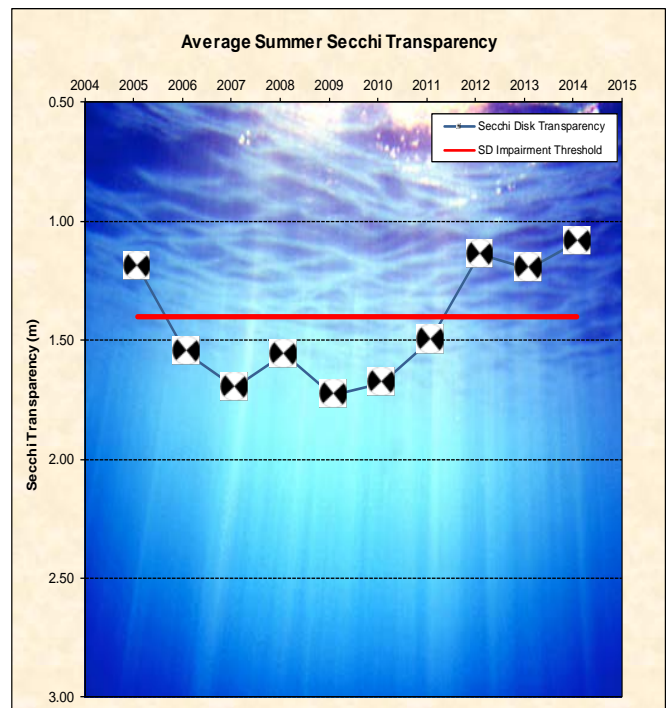
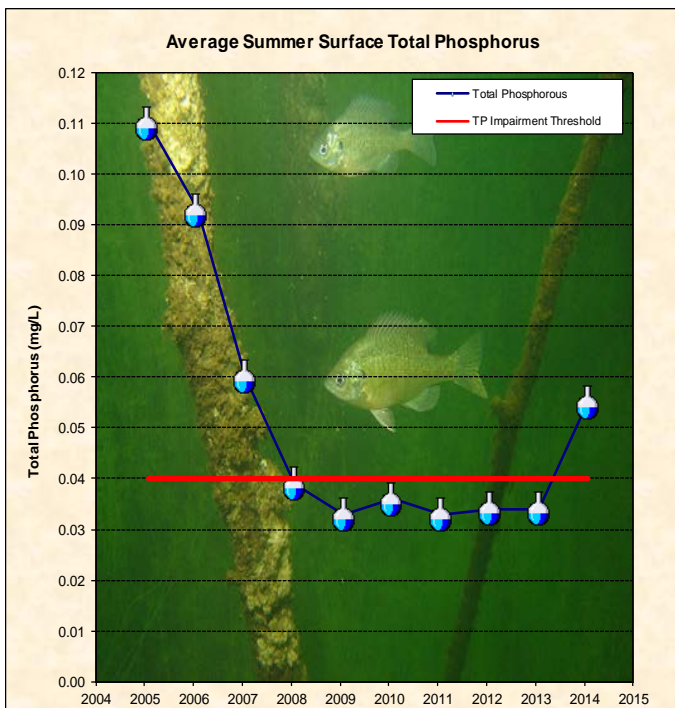
2014 Lake Grade: C-

- DNR ID #: 82005400
- Municipality: City of Scandia
- Location: Section 5 T32N-R20W
- Lake Size: 221.45 acres
- Maximum Depth (2014): 32 ft.
- Ordinary High Water Mark: 909.1 ft.
- 56% Littoral
Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



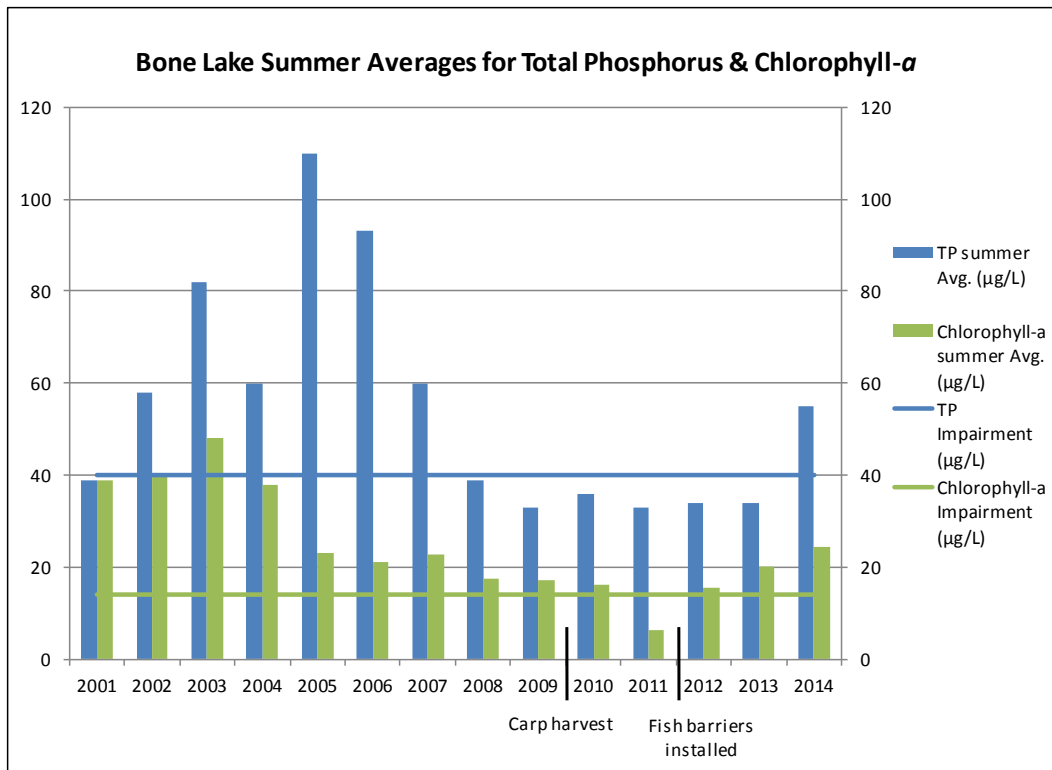
Summary Points

- Based on the chlorophyll-*a* results Bone Lake was considered eutrophic in 2014, according to the Carlson Trophic State Index.
- Using the Kendall Tau correlation test ($p < 0.01$) there is a statistically significant **improving** trend for the average total phosphorus and no trend for the average Secchi transparency at this time.
- The major land use is rural/agricultural.
- The lake stratified in 2014 with the thermocline varying between 5 and 6 meters.
- Bone Lake is listed as impaired for nutrients on the Minnesota Pollution Control Agency's Impaired Waters List.
- Eurasian watermilfoil and Curly-leaf pondweed (invasive aquatic plants) are extensive in this lake.
- Carp removal was performed in the winter of 2010.
- Low velocity fish barriers were installed at Bone Lake north inlet and Bone Lake outlet in the fall of 2012.



Date	Total Phosphorus (mg/L)	Chlorophyll-a (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
5/15/14	0.034	26.0	1.20	1.80	11.5	11.31
5/28/14	0.017	2.5	1.00	1.60	22.5	9.55
6/12/14	0.024	22.0	1.10	1.30	21.8	10.74
6/23/14	0.046	31.0	1.20	1.40	24.3	13.26
7/8/14	0.130	26.0	1.20	1.20	23.2	8.20
7/23/14	0.103	26.0	1.30	1.00	26.2	9.12
8/7/14	0.034	26.0	1.20	0.90	26.5	10.64
8/20/14	0.025	13.0	1.40	0.80	25.5	8.46
9/4/14	0.031	23.0	1.20	1.00	22.2	8.91
9/17/14	0.048	27.0	1.60	1.10	18.9	7.57
10/1/14	0.025	31.0	1.50	1.60	16.6	9.33
10/13/14	0.049	42.0	1.70	1.10	12.1	10.78
2014 Average	0.047	24.6	1.30	1.23	20.9	9.82
2014 Summer Average	0.055	24.3	1.28	1.09	23.6	9.61
Volunteer Data						
5/4/14	0.034	12.0	1.20	1.30	9.7	NA
5/26/14	0.014	2.2	0.85	3.10	21.0	NA
6/9/14	0.035	22.0	1.20	1.70	24.3	NA
6/20/14	0.035	23.0	1.30	1.00	25.0	NA
6/29/14	0.043	32.0	1.30	0.90	24.4	NA
7/12/14	0.034	34.0	1.30	0.70	25.6	NA
7/16/14	0.031	28.0	1.10	0.90	25.2	NA
7/23/14	0.039	17.0	1.30	0.90	27.5	NA
8/1/14	0.026	22.0	1.10	1.00	31.0	NA
8/14/14	0.014	13.0	1.10	1.10	25.6	NA
2014 Average	0.031	20.5	1.18	1.26	23.9	NA
2014 Summer Average	0.031	20.5	1.18	1.26	23.9	NA
Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*						
Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*						
2014 Elevation (ft)	High	High Date	Low	Low Date	Average	
	910.43	5/20/2014	908.23	10/23/2014	909.07	

*MPCA description of Impaired Lake's Listing criteria: "At a minimum, a decision that a given lake is impaired for the 303(d) list due to excessive nutrients will be supported by data for both causal and response factors. Data requirements for 303(d) listing consist of 12 or more TP measurements collected from June through September over the most recent 10-year period. Ideally this should represent 12 separate visits to the lake over the course of two summers; however it might also reflect four monthly samples over the course of three years (a typical sampling regimen for many lake monitoring programs). In addition to exceeding the TP guideline thresholds, lakes to be considered for 303(d) listing should have at least 12 Secchi measurements and 12 chlorophyll-a measurements. This amount of data will allow for at least one season (preferably more) for paired TP, chlorophyll-a, and Secchi disk data and provide a basis for evaluating their interrelationships and hence the trophic status of the lake."



Lake Water Quality Summary										
	Lake Grades									
	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005
Total Phosphorus (mg/L)	C	C	C	C	C	C	C	C	C	C
Chlorophyll-a (µg/L)	C	C	B	A	B	B	B	B	B	C+
Secchi depth (ft)	D	C	D	C	C	C	C	C	C	C
Overall	C-	C	C	C+	C+	C+	C+	C+	C+	C

Bone Lake Water Surface Elevation Statistics

Outlet Elevation (culvert): 907.3 ft.

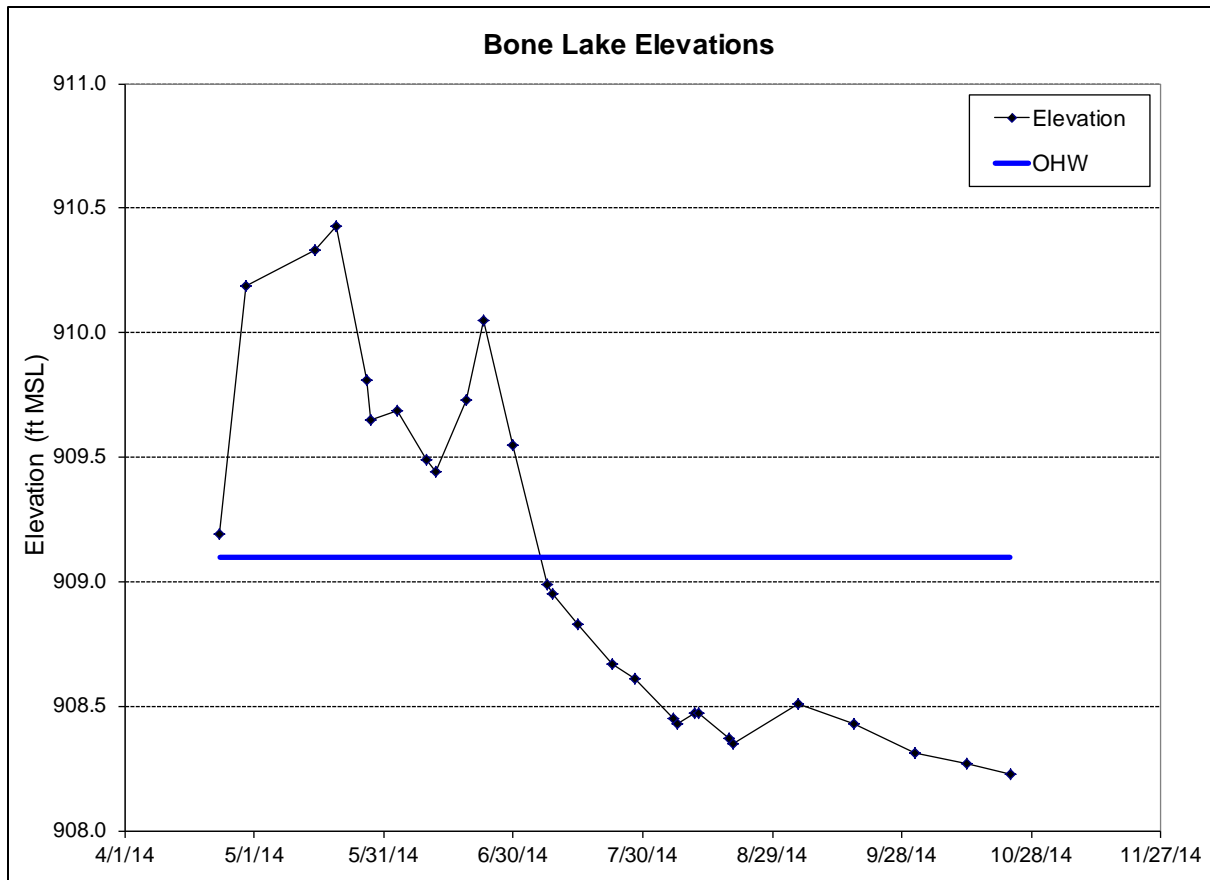
Ordinary High Water Level (OHW) Elevation: 909.1 ft.

100 Year Flood Elevation (CLFLWD): 910.6 ft.

Highest Recorded Elevation: 910.97 ft. (07/07/1975)

Lowest Recorded Elevation: 906.7 ft. (11/07/1966)

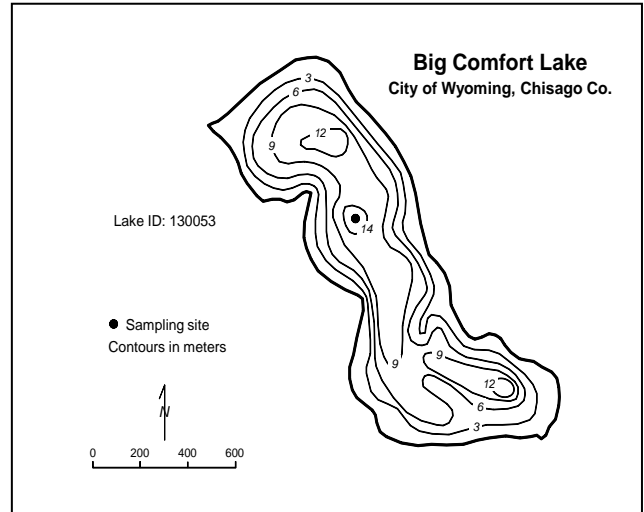
Datum: NGVD 29 (ft.)



Comfort Lake

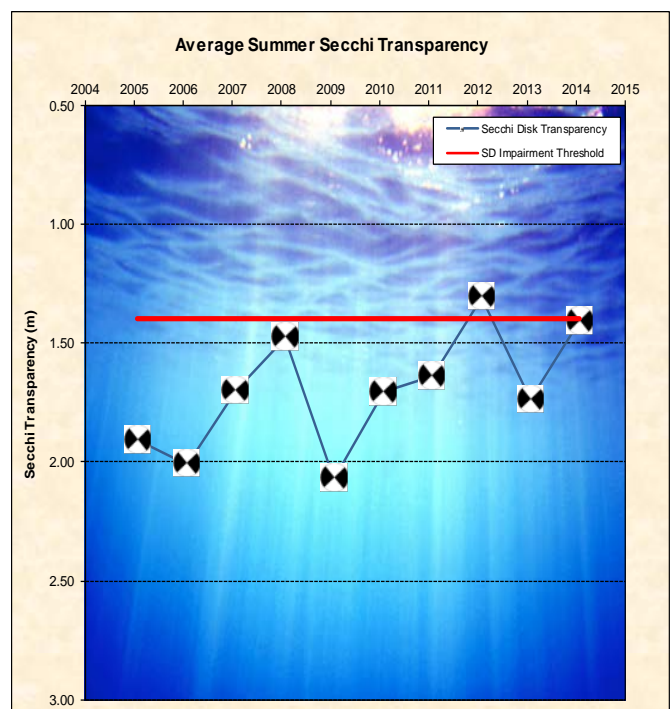
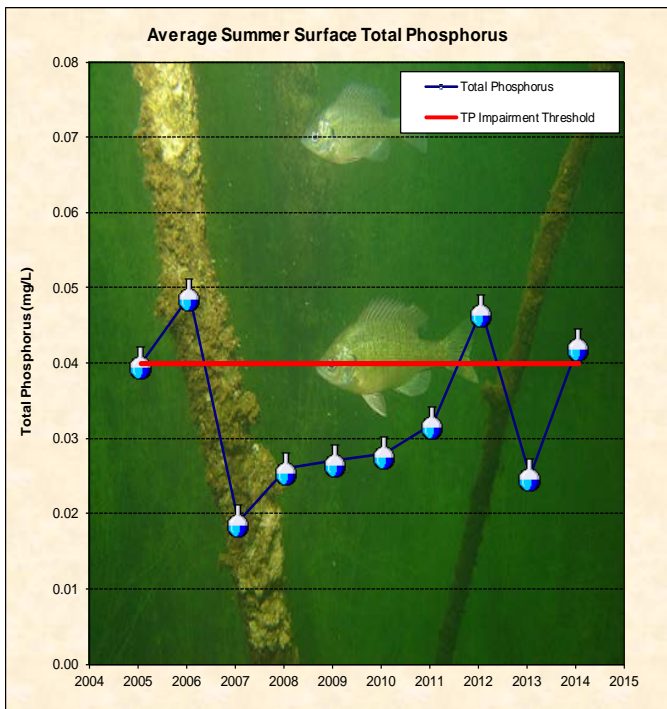
2014 Lake Grade: C+

- DNR ID #: 13005300
 - Municipality: City of Wyoming
 - Location: Section 27 T33N-R21W
 - Lake Size: 217.82 acres
 - Maximum Depth (2014): 45 ft.
 - Ordinary High Water Mark: 887.2 ft.
 - 41% Littoral
- Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



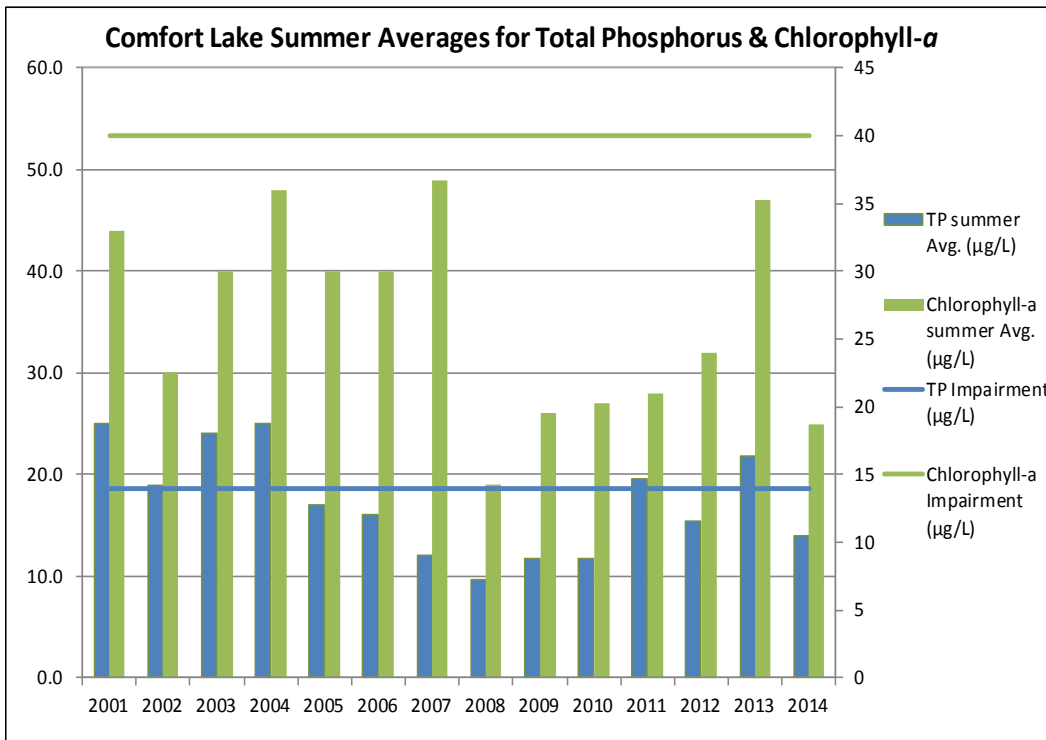
Summary Points

- Based on the chlorophyll-*a* results Comfort Lake was considered eutrophic in 2014, according to the Carlson Trophic State Index.
- Using the Kendall Tau correlation test ($p < 0.01$) there is a statistically significant **improving** trend for the average total phosphorus and a statistically significant **declining** trend for the average Secchi transparency.
- The major land use is a mix of semi-urban, rural, and agricultural.
- The lake stratified in 2014 with the thermocline varying between 4 and 6 meters.
- Comfort Lake is listed as impaired for nutrients on the Minnesota Pollution Control Agency's Impaired Waters List.
- Eurasian watermilfoil and Curly-leaf pondweed (invasive aquatic plants) are extensive in this lake.



Date	Total Phosphorus (mg/L)	Chlorophyll-a (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
5/15/14	0.030	11.0	0.98	1.98	11.3	10.43
5/28/14	0.021	3.7	1.30	2.74	23.8	9.33
6/12/14	0.045	6.3	1.10	1.83	21.1	7.43
6/23/14	0.061	28.0	1.30	1.22	25.0	10.31
7/8/14	0.085	16.0	1.30	1.07	23.3	7.24
7/23/14	0.045	24.0	1.30	1.22	25.6	9.42
8/7/14	0.017	16.0	1.10	1.37	26.2	9.19
8/20/14	0.016	7.0	1.20	1.83	25.1	7.59
9/4/14	0.041	16.0	1.30	1.37	21.8	8.46
9/17/14	0.030	26.0	1.50	1.37	18.2	8.44
10/1/14	0.040	20.0	1.60	1.37	16.6	8.69
10/13/14	0.053	17.0	1.50	1.52	12.1	6.74
2014 Average	0.040	15.9	1.29	1.57	20.8	8.61
2014 Summer Average	0.043	17.4	1.26	1.41	23.3	8.51
Volunteer Data						
6/23/14	0.046	16.0	1.30	1.30	25.9	NA
7/3/14	0.037	21.0	1.50	1.15	24.6	NA
7/19/14	0.027	17.0	1.30	1.20	22.9	NA
8/6/14	0.026	19.0	1.30	1.25	26.0	NA
8/14/14	0.018	5.5	1.10	1.45	25.0	NA
9/7/14	0.020	15.0	1.10	NA	NA	NA
9/13/14	0.022	17.0	1.30	NA	NA	NA
9/29/14	0.007	24.0	1.40	NA	NA	NA
10/10/14	0.043	12.0	1.50	NA	NA	NA
10/23/14	0.031	8.5	1.10	NA	NA	NA
2014 Average	0.028	15.5	1.29	1.27	24.9	NA
2014 Summer Average	0.025	16.8	1.29	1.27	24.9	NA
Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*						
Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*						
2014 Elevation (ft)	High	High Date	Low	Low Date	Average	
	887.63	6/23/2014	885.79	10/1/2014	886.59	

*MPCA description of Impaired Lake's Listing criteria: "At a minimum, a decision that a given lake is impaired for the 303(d) list due to excessive nutrients will be supported by data for both causal and response factors. Data requirements for 303(d) listing consist of 12 or more TP measurements collected from June through September over the most recent 10-year period. Ideally this should represent 12 separate visits to the lake over the course of two summers; however it might also reflect four monthly samples over the course of three years (a typical sampling regimen for many lake monitoring programs). In addition to exceeding the TP guideline thresholds, lakes to be considered for 303(d) listing should have at least 12 Secchi measurements and 12 chlorophyll-a measurements. This amount of data will allow for at least one season (preferably more) for paired TP, chlorophyll-a, and Secchi disk data and provide a basis for evaluating their interrelationships and hence the trophic status of the lake."



Lake Water Quality Summary										
	Lake Grades									
	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005
Total Phosphorus (mg/L)	C	B	C	B	B	B	B	A	C	C
Chlorophyll-a (µg/L)	B	B	C	B	B-	B	A	A	B	B
Secchi depth (ft)	C	C	C	C	C	C	C	C	C	C
Overall	C+	B-	C	B-	B-	B	B	B+	C+	C+

Comfort Lake Water Surface Elevation Statistics

Outlet Elevation (rock weir): 885.4 ft.

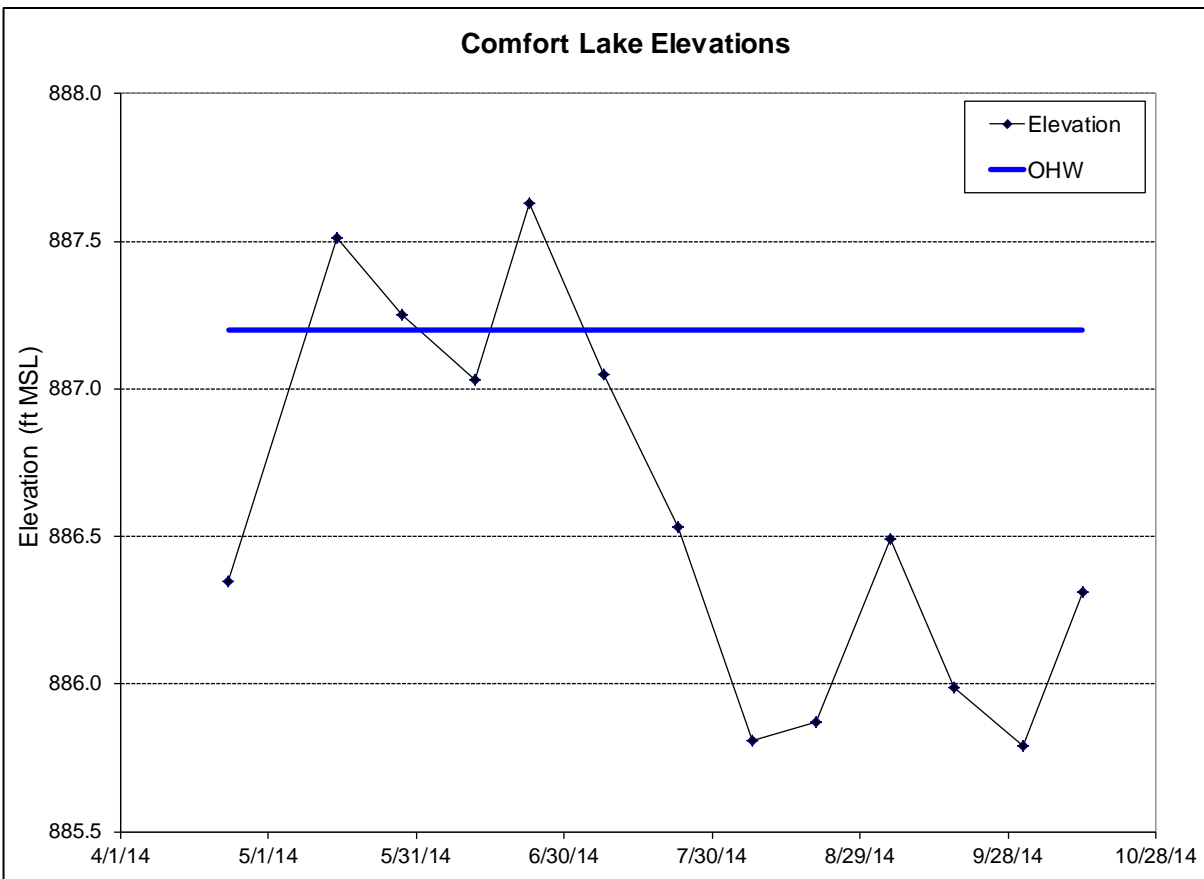
Ordinary High Water Level (OHW) Elevation: 887.2 ft.

100 Year Flood Elevation (CLFLWD): 889.5 ft.

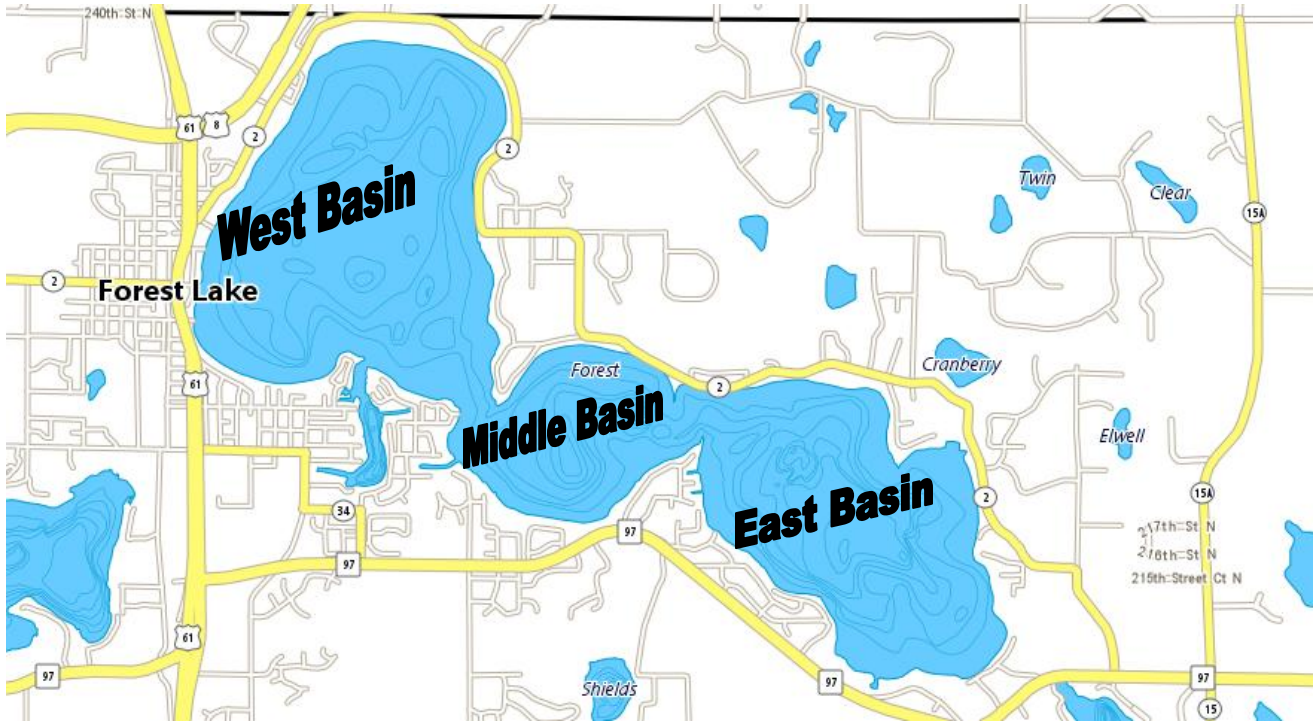
Highest Recorded Elevation: 888.32 ft. (07/02/1975)

Lowest Recorded Elevation: 884.8 ft. (10/08/1969)

Datum: NGVD 29 (ft.)



Forest Lake 2014 Water Quality Summaries

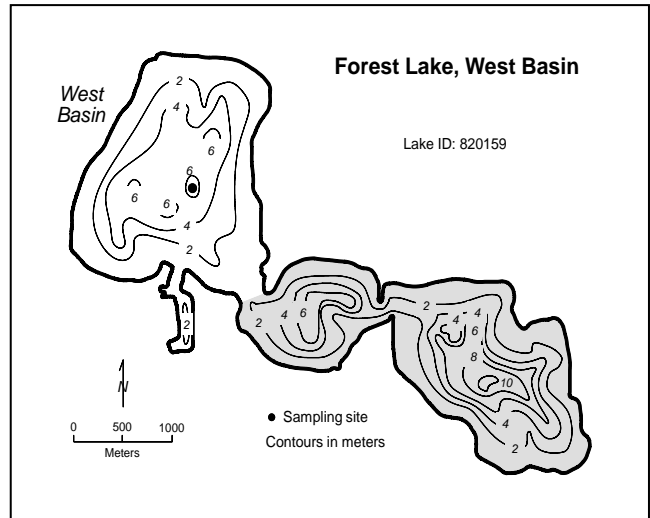


Water quality sampling for Forest Lake is conducted on each of the three basins shown above. The following pages include a summary for each of the three basins and one page on lake level statistics.

Forest Lake (West Basin)

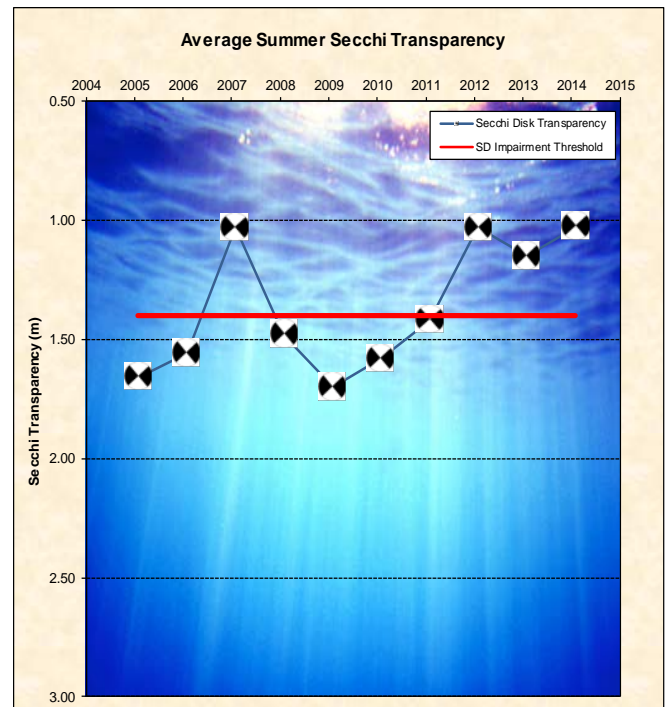
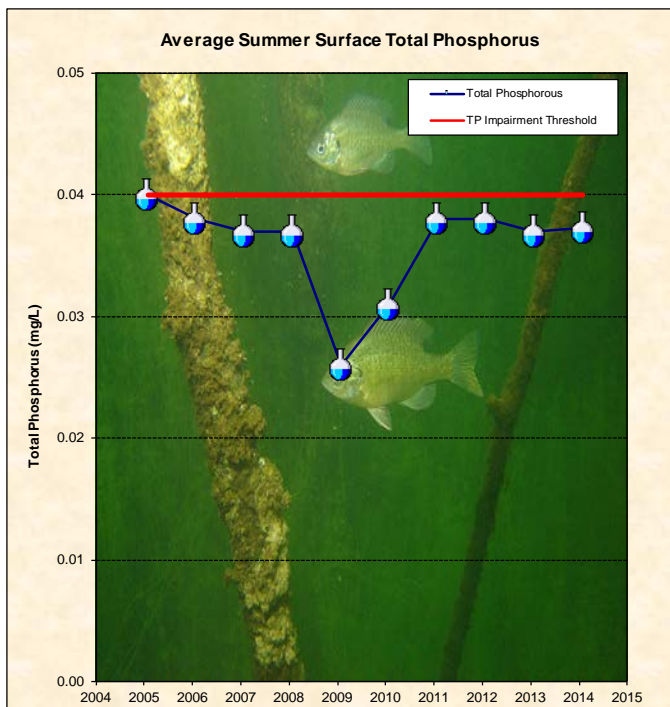
2014 Lake Grade: C

- DNR ID #: 82015900
- Municipality: City of Forest Lake
- Location: Section 9 T32N-R21W
- Lake Size: 1,086.08 acres
- Maximum Depth (2014): 21 ft.
- Ordinary High Water Mark: 901.8 ft.
- 67% Littoral
Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.

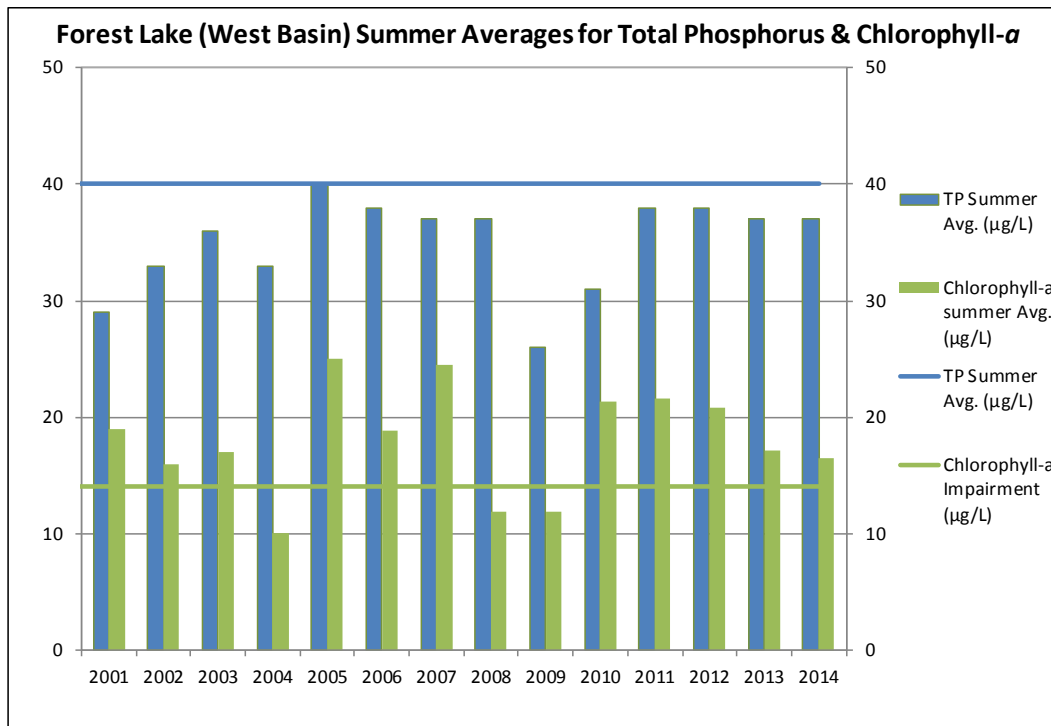


Summary Points

- Based on the chlorophyll-*a* results Forest Lake (West Basin) was considered eutrophic in 2014, according to the Carlson Trophic State Index.
- Using the Kendall Tau correlation test ($p < 0.01$) there is no trend for the average total phosphorus at this time and a statistically significant **declining** trend for the average Secchi transparency.
- The major land use is urban.
- The lake did not stratify in 2014.
- Flowering rush and Curly-leaf pondweed (invasive aquatic plants) are present in this lake.



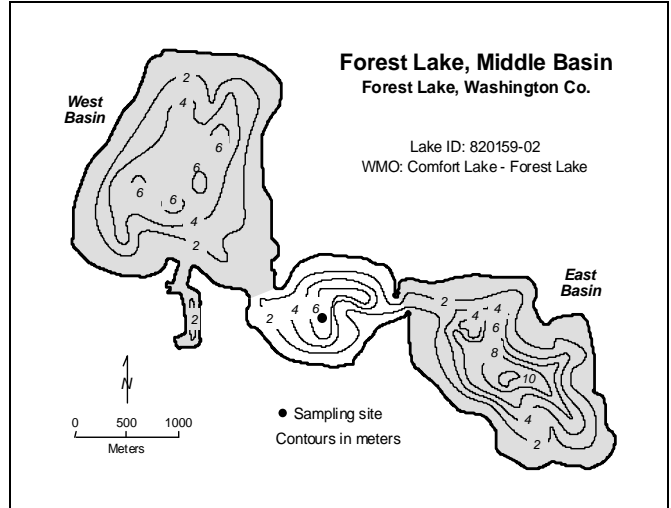
Date	Total Phosphorus (mg/L)	Chlorophyll-a (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
5/15/14	0.026	11.0	1.10	1.83	12.1	10.32
5/28/14	0.013	2.1	0.82	2.29	21.0	9.29
6/13/14	0.034	6.7	0.88	1.52	20.4	9.05
6/23/14	0.030	6.4	0.77	1.22	25.2	10.16
7/8/14	0.024	14.0	0.84	0.91	23.1	8.54
7/23/14	0.049	16.0	0.98	0.76	25.2	8.97
8/7/14	0.025	12.0	0.75	1.07	25.2	9.54
8/20/14	0.039	19.0	1.00	1.22	24.0	9.14
9/4/14	0.054	36.0	1.00	0.76	21.6	8.73
9/17/14	0.040	22.0	1.10	0.76	16.7	9.43
10/1/14	0.035	17.0	1.10	0.91	16.4	8.43
10/13/14	0.019	10.0	0.91	1.37	11.0	9.68
2014 Average	0.032	14.4	0.94	1.22	20.2	9.27
2014 Summer Average	0.037	16.5	0.92	1.03	22.7	9.20
Volunteer Data						
4/28/14	0.016	6.4	0.74	1.80	2.4	NA
5/11/14	0.017	10.0	0.81	1.70	8.4	NA
5/19/14	0.011	6.8	0.64	1.80	13.3	NA
6/6/14	0.014	3.6	0.68	NA	NA	NA
6/20/14	0.034	17.0	0.86	1.00	21.8	NA
7/6/14	0.020	10.0	0.87	0.90	24.1	NA
7/17/14	0.025	7.2	0.73	NA	NA	NA
7/31/14	0.029	10.0	0.87	0.70	24.9	NA
8/17/14	0.031	22.0	0.94	0.90	25.0	NA
8/30/14	0.040	24.0	1.00	0.70	22.3	NA
9/13/14	0.045	21.0	1.10	0.70	17.4	NA
9/24/14	0.027	13.0	0.96	1.00	17.9	NA
10/11/14	0.022	6.2	0.85	1.30	11.1	NA
10/24/14	0.021	5.4	0.83	2.00	11.1	NA
2014 Average	0.025	11.6	0.85	1.21	16.6	NA
2014 Summer Average	0.029	14.2	0.89	0.84	21.9	NA
Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*						
Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*						
	High	High Date	Low	Low Date	Average	
2014 Elevation (ft)	902.23	5/2/2014	901.07	10/1/2014	901.56	
*MPCA description of Impaired Lake's Listing criteria: "At a minimum, a decision that a given lake is impaired for the 303(d) list due to excessive nutrients will be supported by data for both causal and response factors. Data requirements for 303(d) listing consist of 12 or more TP measurements collected from June through September over the most recent 10-year period. Ideally this should represent 12 separate visits to the lake over the course of two summers; however it might also reflect four monthly samples over the course of three years (a typical sampling regimen for many lake monitoring programs). In addition to exceeding the TP guideline thresholds, lakes to be considered for 303(d) listing should have at least 12 Secchi measurements and 12 chlorophyll-a measurements. This amount of data will allow for at least one season (preferably more) for paired TP, chlorophyll-a, and Secchi disk data and provide a basis for evaluating their interrelationships and hence the trophic status of the lake."						



Lake Water Quality Summary										
	Lake Grades									
	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005
Total Phosphorus (mg/L)	C	C	C	C	B-	B	C	C	C	C
Chlorophyll-a (µg/L)	B	B	C	C	C+	B+	B	C	B	C+
Secchi depth (ft)	D	D	D	B	C	C	C	C	C	C
Overall	C	C	C-	C	C+	B	C+	C	C+	C

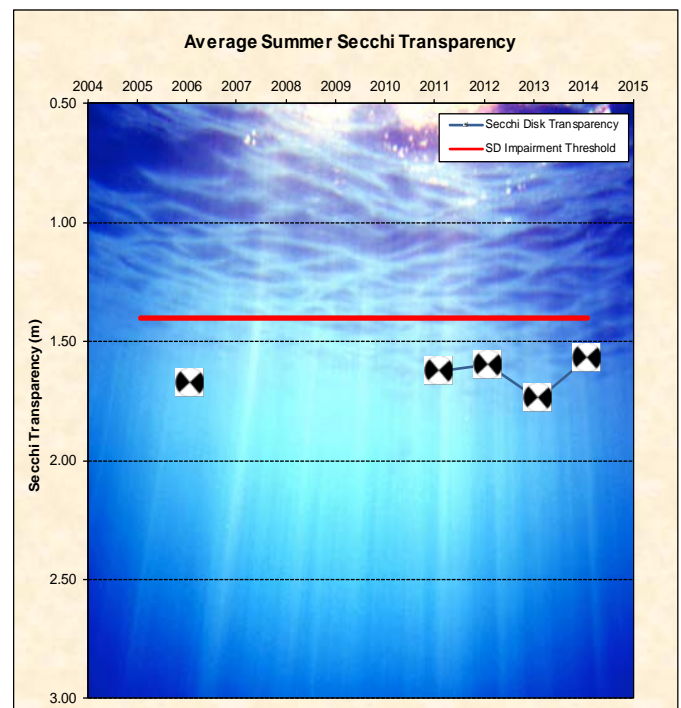
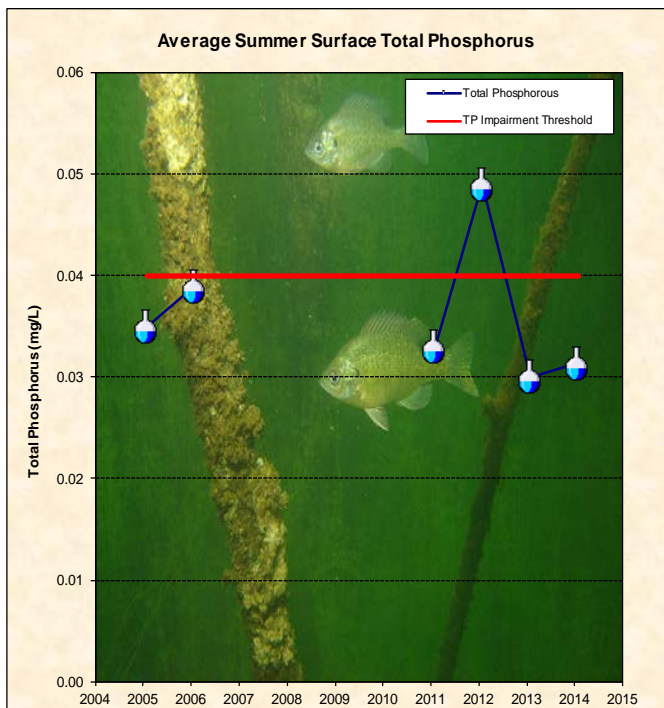
Forest Lake (Middle Basin) 2014 Lake Grade: B-

- DNR ID #: 82015900
- Municipality: City of Forest Lake
- Location: Section 9 T32N-R21W
- Lake Size: 363.80 acres
- Maximum Depth (2014): 33 ft.
- Ordinary High Water Mark: 901.8 ft.
- 67% Littoral
Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



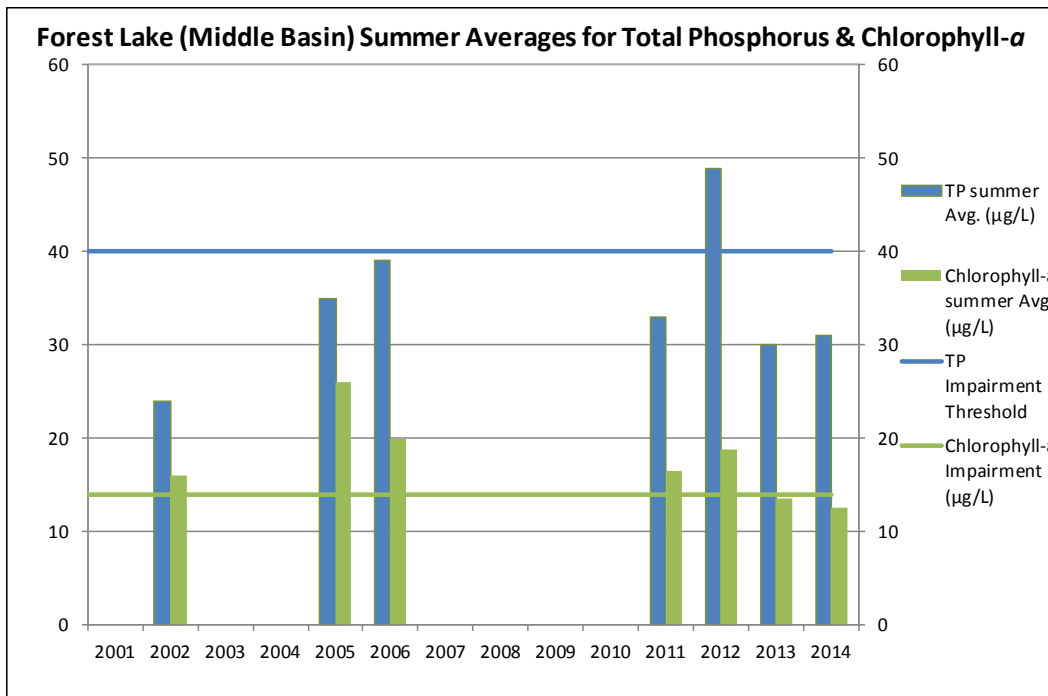
Summary Points

- Based on the chlorophyll-*a* results Forest Lake (Middle Basin) was considered eutrophic in 2014, according to the Carlson Trophic State Index.
- Using the Kendall Tau correlation test ($p < 0.01$) there is no trend for the average total phosphorus and for the average Secchi transparency at this time.
- The major land use is urban and rural/agricultural.
- The lake stratified in 2014 with the thermocline varying between 6 and 7 meters.
- Flowering rush and Curly-leaf pondweed (invasive aquatic plants) are present in this lake.



Date	Total Phosphorus (mg/L)	Chlorophyll-a (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
5/15/14	0.024	11.0	0.83	2.13	12.0	10.28
5/28/14	0.018	4.0	0.91	2.29	21.1	9.30
6/13/14	0.038	5.2	1.00	2.44	20.0	8.76
6/23/14	0.020	8.0	0.88	1.98	24.6	10.72
7/8/14	0.045	11.0	0.97	1.52	23.0	8.13
7/23/14	0.033	12.0	0.83	1.52	25.5	8.77
8/7/14	0.020	10.0	0.92	1.22	25.3	9.86
8/20/14	0.024	10.0	1.00	1.58	24.0	8.30
9/4/14	0.032	18.0	0.88	1.22	21.7	8.49
9/17/14	0.039	27.0	1.10	1.07	16.9	9.27
10/1/14	0.032	19.0	0.96	1.22	16.6	8.72
10/13/14	0.033	12.0	1.00	1.83	11.3	9.93
2014 Average	0.030	12.3	0.94	1.67	20.2	9.21
2014 Summer Average	0.031	12.7	0.95	1.57	22.6	9.04
Volunteer Data						
5/10/14	0.022	6.9	0.68	2.00	13.4	NA
5/23/14	0.013	2.6	0.63	2.00	19.3	NA
6/8/14	0.022	2.7	0.75	3.00	21.8	NA
6/20/14	0.015	16.0	0.38	2.00	23.7	NA
7/3/14	0.017	7.2	0.80	1.70	23.6	NA
7/17/14	0.019	8.4	0.84	1.80	23.6	NA
7/29/14	0.024	8.9	0.82	1.60	24.2	NA
8/17/14	0.018	11.0	0.87	1.70	24.0	NA
8/30/14	0.022	15.0	0.80	1.80	23.1	NA
9/14/14	0.037	19.0	0.90	1.40	17.3	NA
9/27/14	0.043	22.0	0.83	1.50	20.0	NA
10/12/14	0.024	13.0	0.86	2.00	10.9	NA
10/20/14	0.022	10.0	0.79	2.10	10.2	NA
2014 Average	0.023	11.0	0.77	1.89	19.6	NA
2014 Summer Average	0.024	12.2	0.78	1.83	22.4	NA
Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*						
Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*						
	High	High Date	Low	Low Date	Average	
2014 Elevation (ft)	902.23	5/2/2014	901.07	10/1/2014	901.56	

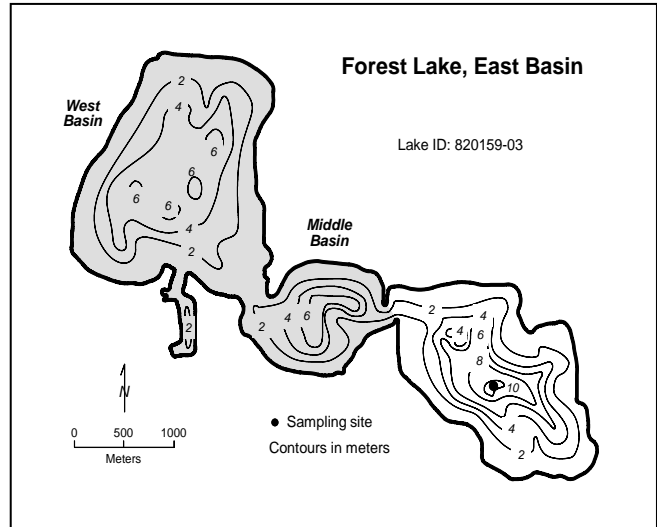
*MPCA description of Impaired Lake's Listing criteria: "At a minimum, a decision that a given lake is impaired for the 303(d) list due to excessive nutrients will be supported by data for both causal and response factors. Data requirements for 303(d) listing consist of 12 or more TP measurements collected from June through September over the most recent 10-year period. Ideally this should represent 12 separate visits to the lake over the course of two summers; however it might also reflect four monthly samples over the course of three years (a typical sampling regimen for many lake monitoring programs). In addition to exceeding the TP guideline thresholds, lakes to be considered for 303(d) listing should have at least 12 Secchi measurements and 12 chlorophyll-a measurements. This amount of data will allow for at least one season (preferably more) for paired TP, chlorophyll-a, and Secchi disk data and provide a basis for evaluating their interrelationships and hence the trophic status of the lake."



Lake Water Quality Summary										
	Lake Grades									
	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005
Total Phosphorus (mg/L)	B	B	C	C	NA	NA	NA	NA	C	C
Chlorophyll-a (µg/L)	B	B	B	B	NA	NA	NA	NA	B	C
Secchi depth (ft)	C	C	C	C	NA	NA	NA	NA	C	NA
Overall	B-	B-	C+	C+	NA	NA	NA	NA	C+	NA

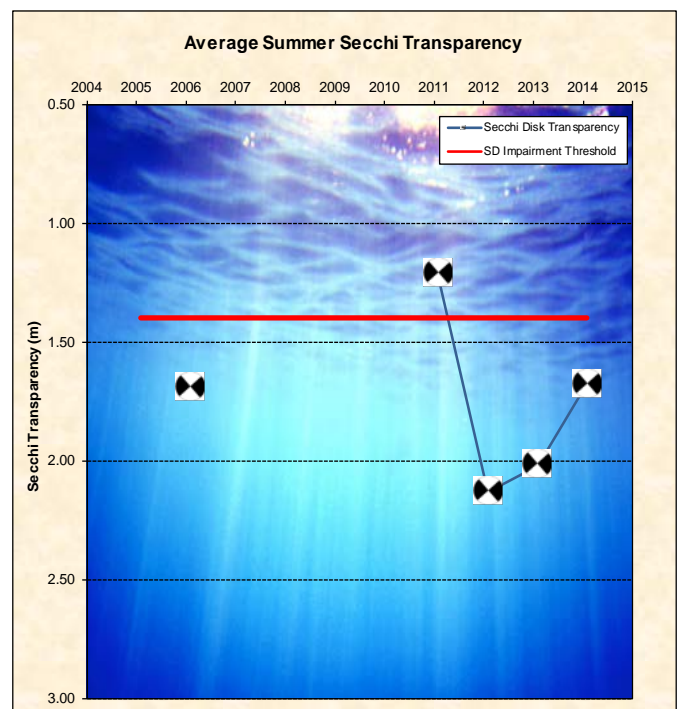
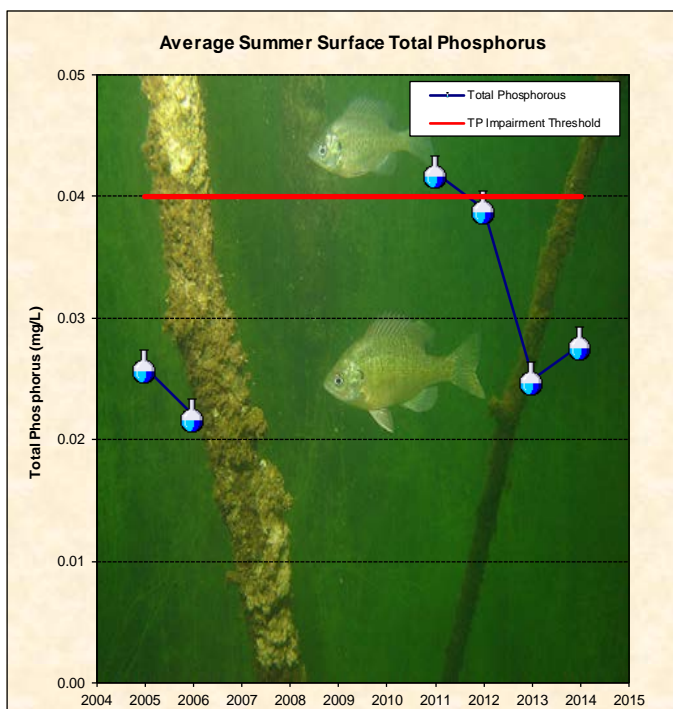
Forest Lake (East Basin) 2014 Lake Grade: B-

- DNR ID #: 82015900
- Municipality: City of Forest Lake
- Location: Section 9 T32N-R21W
- Lake Size: 789.58 acres
- Maximum Depth (2014): 33 ft.
- Ordinary High Water Mark: 901.8 ft.
- 67% Littoral
Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



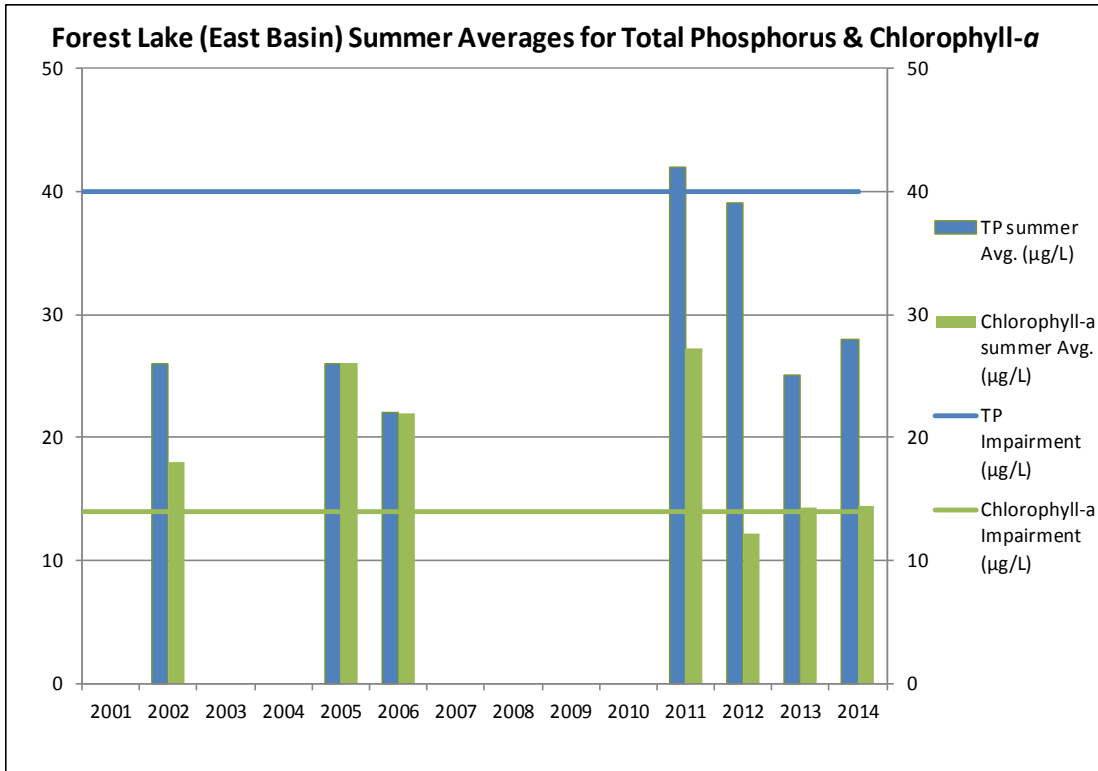
Summary Points

- Based on the chlorophyll-*a* results Forest Lake (East Basin) was considered eutrophic in 2014, according to the Carlson Trophic State Index.
- Using the Kendall Tau correlation test ($p < 0.01$) there is no trend for the average total phosphorus and for the average Secchi transparency at this time.
- The major land use is semi-urban and rural/agricultural.
- The lake stratified in 2014 with the thermocline varying between 6 and 8 meters.
- Flowering rush and Curly-leaf pondweed (invasive aquatic plants) are present in this lake.



Date	Total Phosphorus (mg/L)	Chlorophyll-a (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
5/15/14	0.029	9.1	0.95	2.44	11.9	10.15
5/28/14	0.016	3.0	0.79	2.44	20.0	9.97
6/12/14	0.020	4.3	0.72	2.13	21.4	8.92
6/23/14	0.028	12.0	0.93	1.98	24.3	11.04
7/8/14	0.022	7.5	0.74	1.98	22.9	7.88
7/23/14	0.036	7.6	0.75	1.98	24.9	8.59
8/7/14	0.023	16.0	0.98	1.22	25.6	9.81
8/20/14	0.027	12.0	1.00	1.52	24.0	7.96
9/4/14	0.029	28.0	0.91	1.37	21.7	8.68
9/17/14	0.038	28.0	1.50	1.22	17.0	8.68
10/1/14	0.027	15.0	0.96	1.83	16.7	8.64
10/13/14	0.023	11.0	0.90	2.74	11.5	9.54
2014 Average	0.027	12.8	0.93	1.91	20.2	9.16
2014 Summer Average	0.028	14.4	0.94	1.68	22.7	8.95
Volunteer Data						
5/11/14	0.024	14.0	0.70	1.60	13.3	NA
5/24/14	0.022	2.8	0.61	2.00	17.6	NA
6/8/14	0.022	1.4	0.59	2.00	22.4	NA
6/20/14	0.023	6.0	0.72	1.00	24.6	NA
7/3/14	0.018	5.1	0.72	1.60	23.2	NA
7/18/14	0.016	4.2	0.68	1.70	22.6	NA
8/2/14	0.020	9.6	0.58	1.30	25.1	NA
8/19/14	0.019	10.0	0.59	1.40	24.5	NA
8/30/14	0.022	9.3	0.82	1.40	23.1	NA
9/16/14	0.024	2.0	0.99	1.40	17.6	NA
9/25/14	0.030	16.0	0.90	1.60	20.3	NA
10/11/14	0.023	6.1	0.69	3.00	12.2	NA
2014 Average	0.022	7.2	0.72	1.67	20.5	NA
2014 Summer Average	0.022	7.1	0.73	1.49	22.6	NA
Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*						
Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*						
	High	High Date	Low	Low Date	Average	
2014 Elevation (ft)	902.23	5/2/2014	901.07	10/1/2014	901.56	

*MPCA description of Impaired Lake's Listing criteria: "At a minimum, a decision that a given lake is impaired for the 303(d) list due to excessive nutrients will be supported by data for both causal and response factors. Data requirements for 303(d) listing consist of 12 or more TP measurements collected from June through September over the most recent 10-year period. Ideally this should represent 12 separate visits to the lake over the course of two summers; however it might also reflect four monthly samples over the course of three years (a typical sampling regimen for many lake monitoring programs). In addition to exceeding the TP guideline thresholds, lakes to be considered for 303(d) listing should have at least 12 Secchi measurements and 12 chlorophyll-a measurements. This amount of data will allow for at least one season (preferably more) for paired TP, chlorophyll-a, and Secchi disk data and provide a basis for evaluating their interrelationships and hence the trophic status of the lake."



Lake Water Quality Summary										
	Lake Grades									
	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005
Total Phosphorus (mg/L)	B	B	C	C	NA	NA	NA	NA	A	B
Chlorophyll-a (µg/L)	B	B	B	C	NA	NA	NA	NA	C	C
Secchi depth (ft)	C	C	C	C	NA	NA	NA	NA	C	NA
Overall	B-	B-	C+	C	NA	NA	NA	NA	B-	NA

Forest Lake Water Surface Elevation Statistics

Outlet Elevation (dam): 901.4 ft.

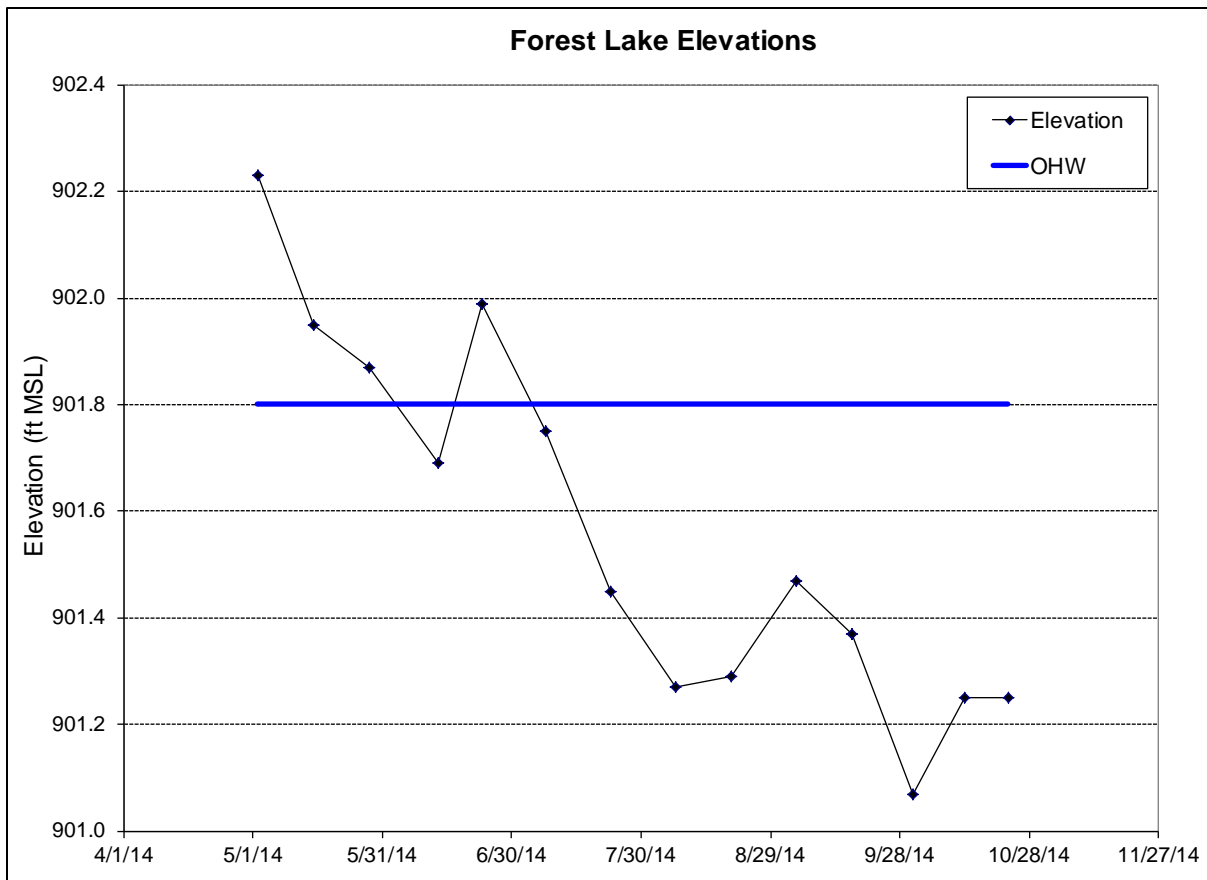
Ordinary High Water Level (OHW) Elevation: 901.8 ft.

100 Year Flood Elevation (CLFLWD): 902.4 ft.

Highest Recorded Elevation: 902.23 ft. (06/24/1993 and 05/02/2014)

Lowest Recorded Elevation: 899.45 ft. (10/07/1969)

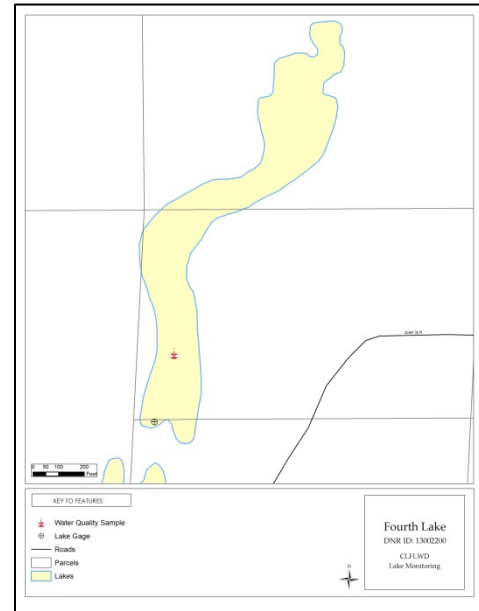
Datum: NGVD 29 (ft.)



Fourth Lake

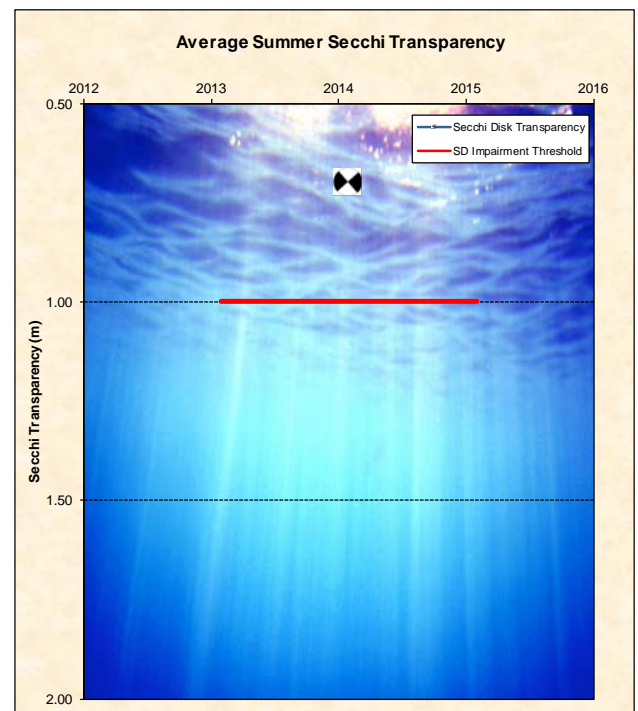
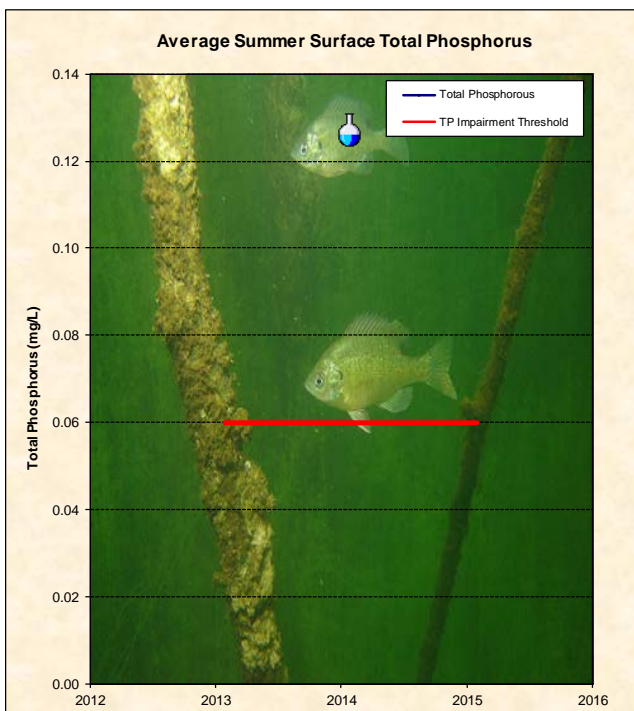
2014 Lake Grade: C

- DNR ID #: 13002200
- Municipality: Chisago Lake Twp.
- Location: Section 32 T33N-R20W
- Lake Size: 8 acres
- Maximum Depth (2014): 6 ft.
- Ordinary High Water Mark: N/A
- 100% Littoral
 Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.

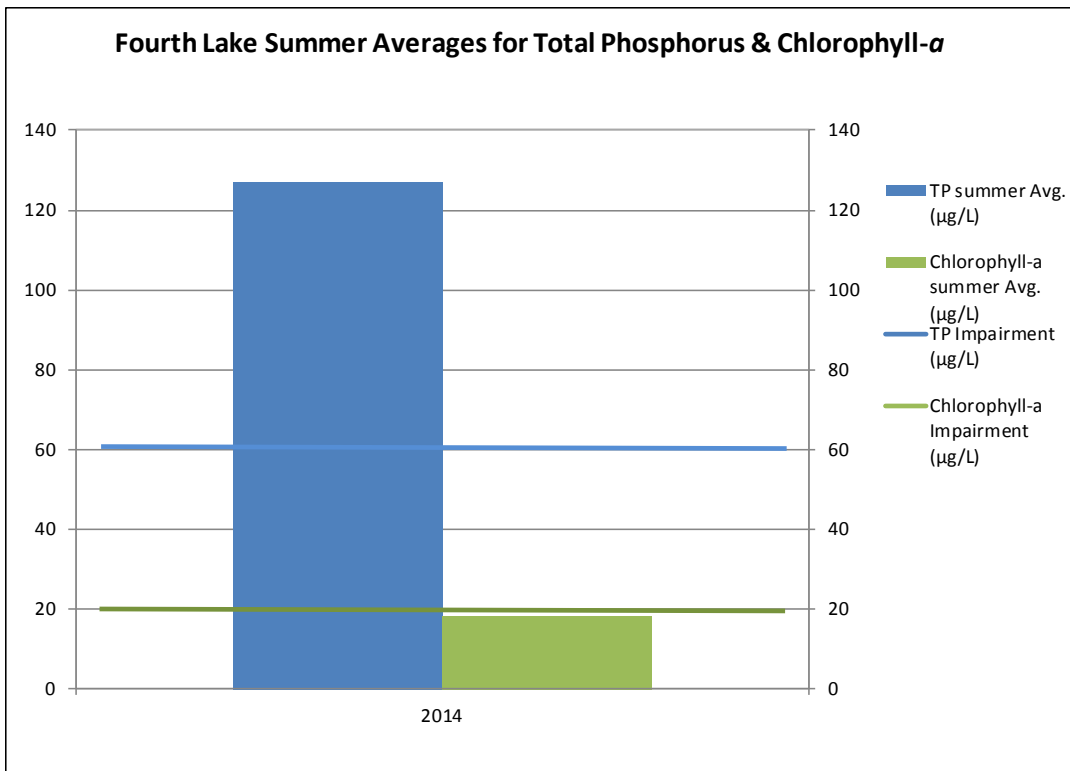


Summary Points

- Based on the chlorophyll-*a* results Fourth Lake was considered eutrophic in 2014, according to the Carlson Trophic State Index.
- There are an insufficient number of years of data to determine long term water quality trends at this time.
- The major land use is rural/agricultural.
- The lake did not stratify in 2014.
- 2014 is the first year that water quality monitoring has been conducted on this lake.



Date	Total Phosphorus (mg/L)	Chlorophyll-a (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
5/14/14	0.067	11.0	1.50	0.76	12.8	6.38
5/29/14	0.155	10.0	2.20	0.91	26.8	6.05
6/12/14	0.135	11.0	1.90	0.76	21.2	5.18
6/26/14	0.322	11.0	1.40	0.61	26.7	7.84
7/10/14	0.080	6.1	1.10	1.22	21.9	3.90
7/22/14	0.144	17.0	1.80	0.91	25.8	6.47
8/5/14	0.158	60.0	2.50	0.15	23.6	11.20
8/21/14	0.029	9.7	1.50	0.30	21.7	11.50
9/30/14	0.021	14.0	0.93	0.91	16.5	5.16
10/16/14	0.061	53.0	1.60	1.07	11.5	7.72
2014 Average	0.117	20.3	1.64	0.76	20.9	7.14
2014 Summer Average	0.127	18.4	1.59	0.70	22.5	7.32
Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*						
Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*						
	High	High Date	Low	Low Date	Average	
2014 Elevation (ft)	913.92	10/16/2014	913.30	8/5/2014	913.61	
*MPCA description of Impaired Lake's Listing criteria: "At a minimum, a decision that a given lake is impaired for the 303(d) list due to excessive nutrients will be supported by data for both causal and response factors. Data requirements for 303(d) listing consist of 12 or more TP measurements collected from June through September over the most recent 10-year period. Ideally this should represent 12 separate visits to the lake over the course of two summers; however it might also reflect four monthly samples over the course of three years (a typical sampling regimen for many lake monitoring programs). In addition to exceeding the TP guideline thresholds, lakes to be considered for 303(d) listing should have at least 12 Secchi measurements and 12 chlorophyll-a measurements. This amount of data will allow for at least one season (preferably more) for paired TP, chlorophyll-a, and Secchi disk data and provide a basis for evaluating their interrelationships and hence the trophic status of the lake."						



Lake Water Quality Summary										
	Lake Grades									
	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005
Total Phosphorus (mg/L)	D	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorophyll-a (µg/L)	B	NA	NA	NA	NA	NA	NA	NA	NA	NA
Secchi depth (ft)	C*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Overall	C	NA	NA	NA	NA	NA	NA	NA	NA	NA

*Adjusted due to limiting factors

Fourth Lake Water Surface Elevation Statistics

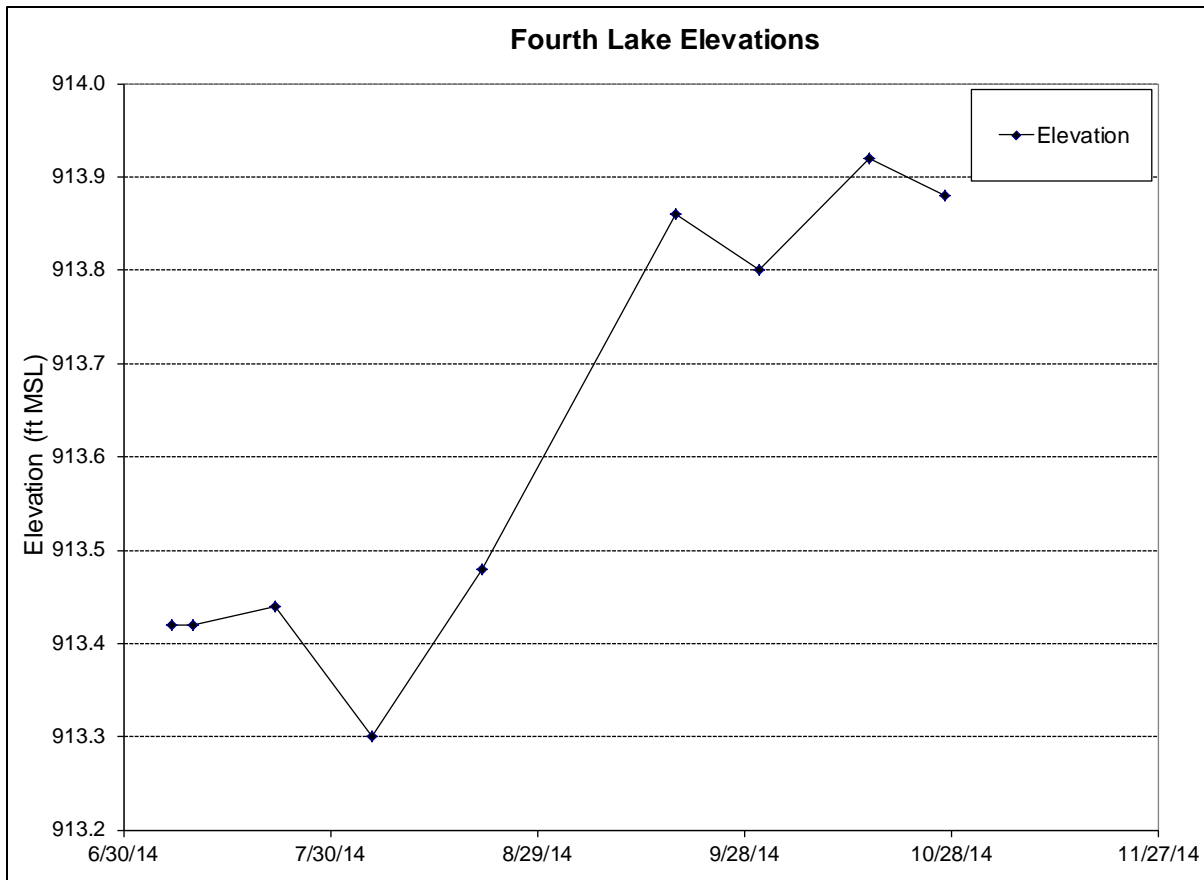
Outlet Elevation:

Ordinary High Water Level (OHW) Elevation: N/A

Highest Recorded Elevation: 913.92 ft. (10/16/2014)

Lowest Recorded Elevation: 913.30 ft. (08/05/2014)

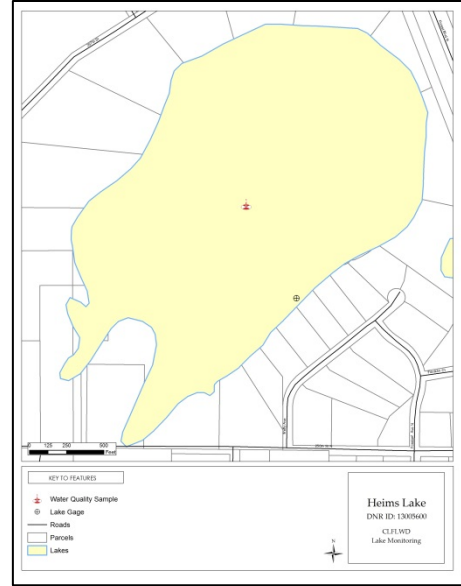
Datum: NGVD 29 (ft.)



Heims Lake

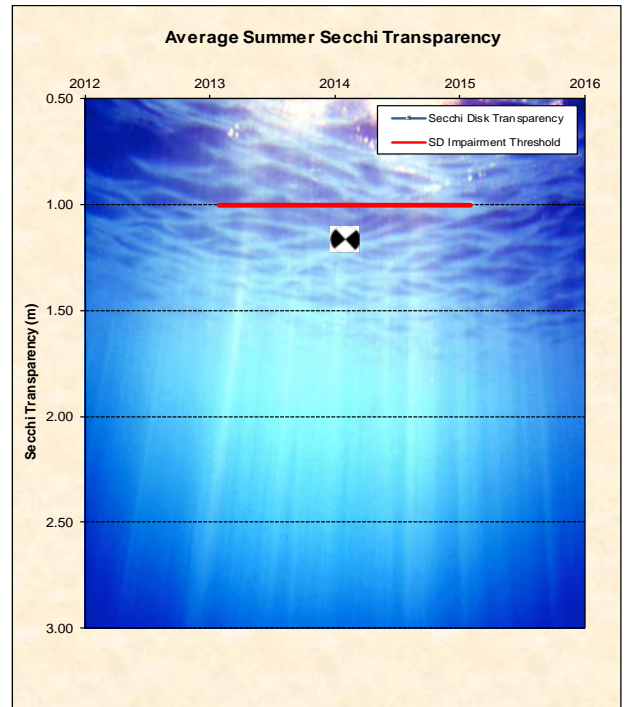
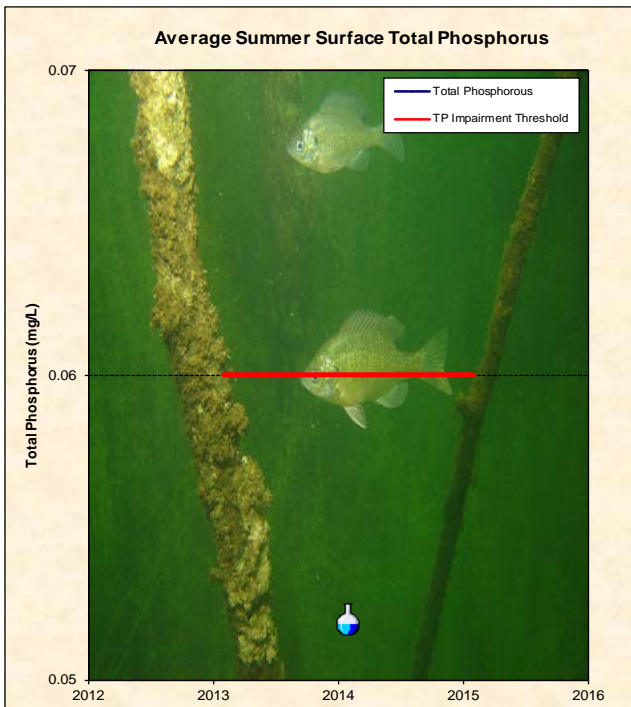
2014 Lake Grade: C+

- DNR ID #: 13005600
- Municipality: City of Wyoming
- Location: Section 29 T33N-R21W
- Lake Size: 90 acres
- Maximum Depth (2014): 5.5 ft.
- Ordinary High Water Mark: 898.6 ft.
- 100% Littoral
Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



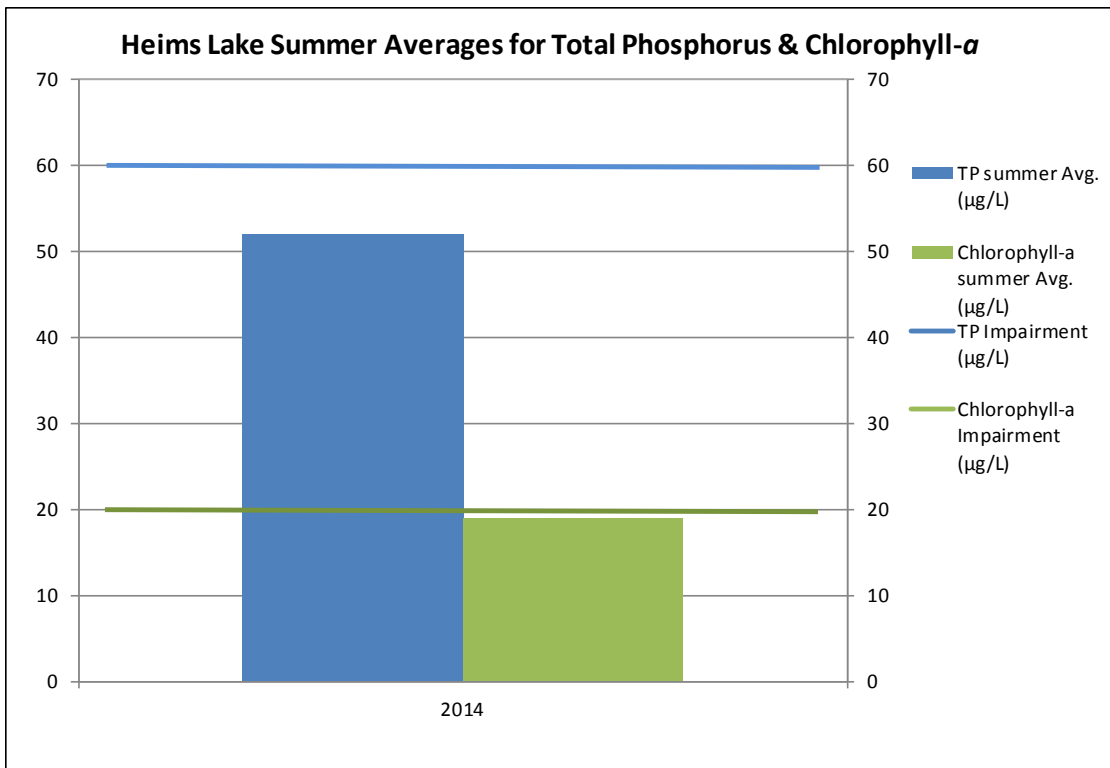
Summary Points

- Based on the chlorophyll-*a* results Heims Lake was considered eutrophic in 2014, according to the Carlson Trophic State Index.
- There are an insufficient number of years of data to determine long term water quality trends at this time.
- The major land use is semi-urban and rural/agricultural.
- The lake did not stratify in 2014.
- 2014 is the first year that water quality monitoring has been conducted on this lake.



Date	Total Phosphorus (mg/L)	Chlorophyll-a (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
5/14/14	0.021	3.6	0.81	1.22	13.3	7.98
5/27/14	0.021	2.5	0.80	0.91	23.7	6.03
6/12/14	0.027	7.2	1.10	1.07	21.3	5.27
6/25/14	0.030	17.0	0.84	1.07	22.7	6.27
7/7/14	0.074	60.0	1.20	1.07	23.1	7.20
7/22/14	0.040	18.0	1.20	1.07	23.9	0.42
8/5/14	0.043	13.0	1.30	0.91	23.8	2.87
8/21/14	0.067	18.0	1.40	1.22	23.0	3.10
9/3/14	0.150	26.0	1.30	1.37	20.5	10.86
9/16/14	0.019	5.0	1.10	1.37	15.7	3.48
9/30/14	0.018	6.6	1.00	1.37	15.4	2.94
10/10/14	0.022	3.8	0.88	1.52	9.2	6.74
2014 Average	0.044	15.1	1.08	1.18	19.6	5.26
2014 Summer Average	0.052	19.0	1.16	1.17	21.0	4.71
Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*						
Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*						
	High	High Date	Low	Low Date	Average	
2014 Elevation (ft)	899.36	9/3/2014	898.76	10/2/2014	899.13	

*MPCA description of Impaired Lake's Listing criteria: "At a minimum, a decision that a given lake is impaired for the 303(d) list due to excessive nutrients will be supported by data for both causal and response factors. Data requirements for 303(d) listing consist of 12 or more TP measurements collected from June through September over the most recent 10-year period. Ideally this should represent 12 separate visits to the lake over the course of two summers; however it might also reflect four monthly samples over the course of three years (a typical sampling regimen for many lake monitoring programs). In addition to exceeding the TP guideline thresholds, lakes to be considered for 303(d) listing should have at least 12 Secchi measurements and 12 chlorophyll-a measurements. This amount of data will allow for at least one season (preferably more) for paired TP, chlorophyll-a, and Secchi disk data and provide a basis for evaluating their interrelationships and hence the trophic status of the lake."



Lake Water Quality Summary										
	Lake Grades									
	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005
Total Phosphorus (mg/L)	C	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorophyll-a (µg/L)	B	NA	NA	NA	NA	NA	NA	NA	NA	NA
Secchi depth (ft)	C*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Overall	C	NA	NA	NA	NA	NA	NA	NA	NA	NA

*Adjusted due to limiting factors

Heims Lake Water Surface Elevation Statistics

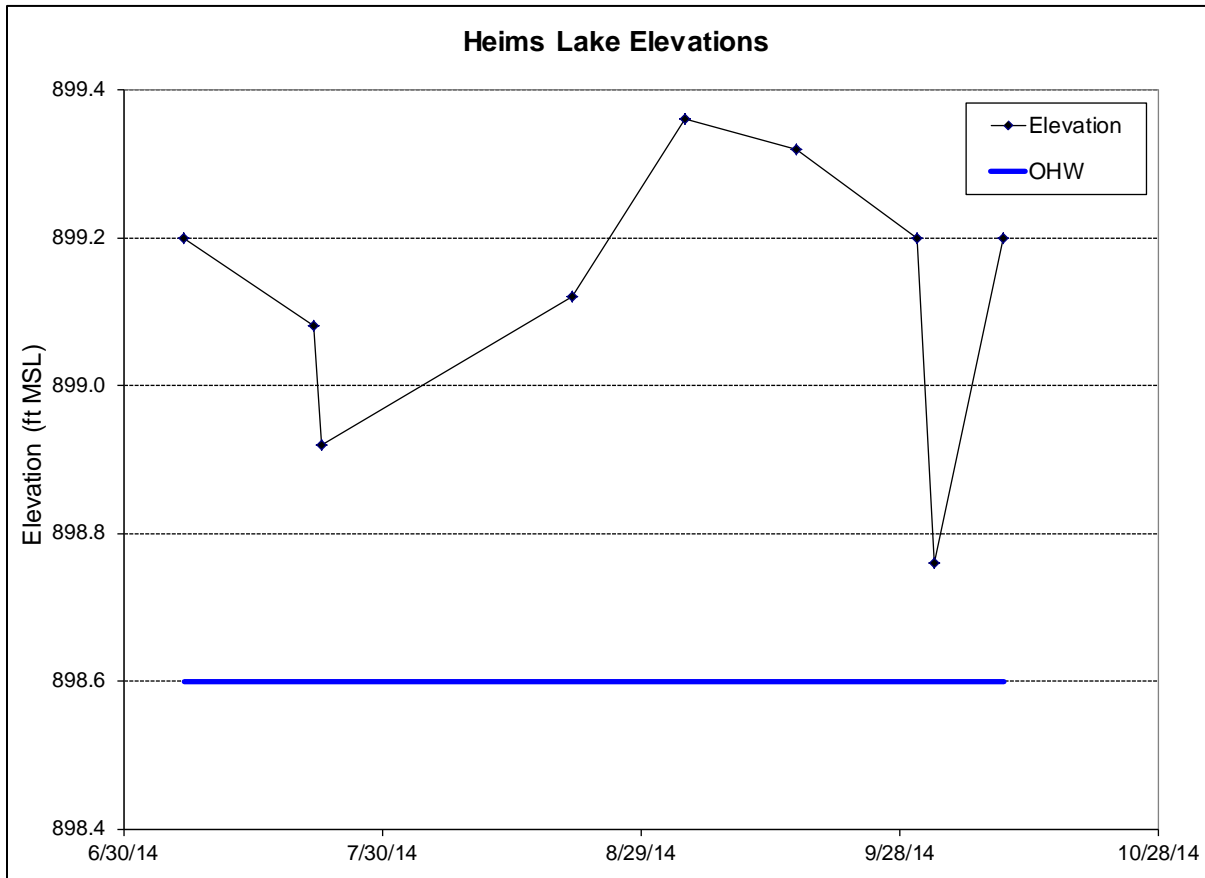
Outlet Elevation:

Ordinary High Water Level (OHW) Elevation: 898.6 ft.

Highest Recorded Elevation: 899.36 ft. (09/03/2014)

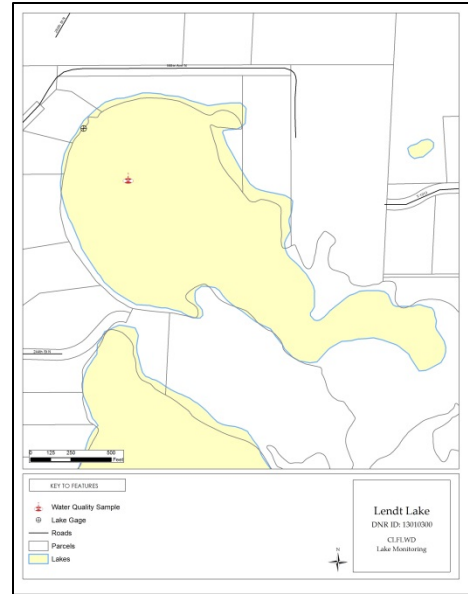
Lowest Recorded Elevation: 897.73 ft. (10/14/2004)

Datum: NGVD 29 (ft.)



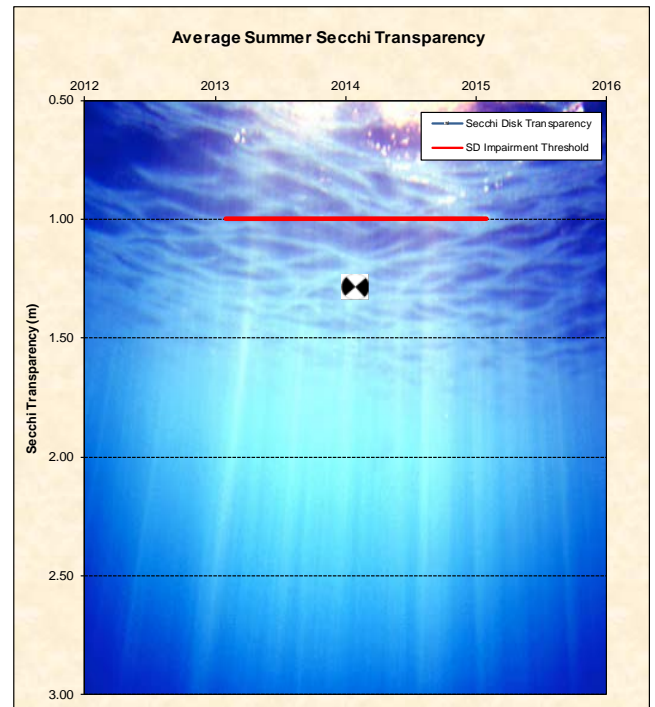
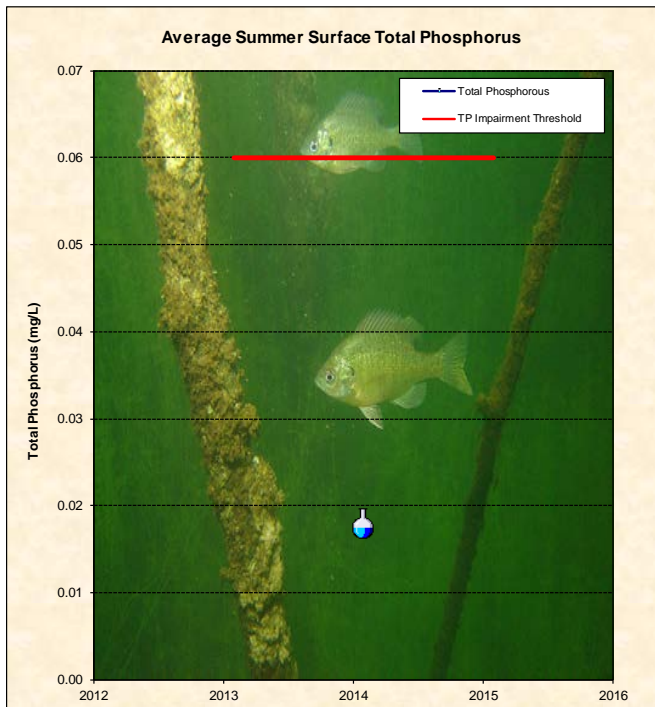
Lendt Lake 2014 Lake Grade: B

- DNR ID #: 13010300
- Municipality: Chisago Lake Twp.
- Location: Section 32 T33N-R20W
- Lake Size: 42 acres
- Maximum Depth (2014): 6.5 ft.
- Ordinary High Water Mark: N/A
- 100% Littoral
Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.

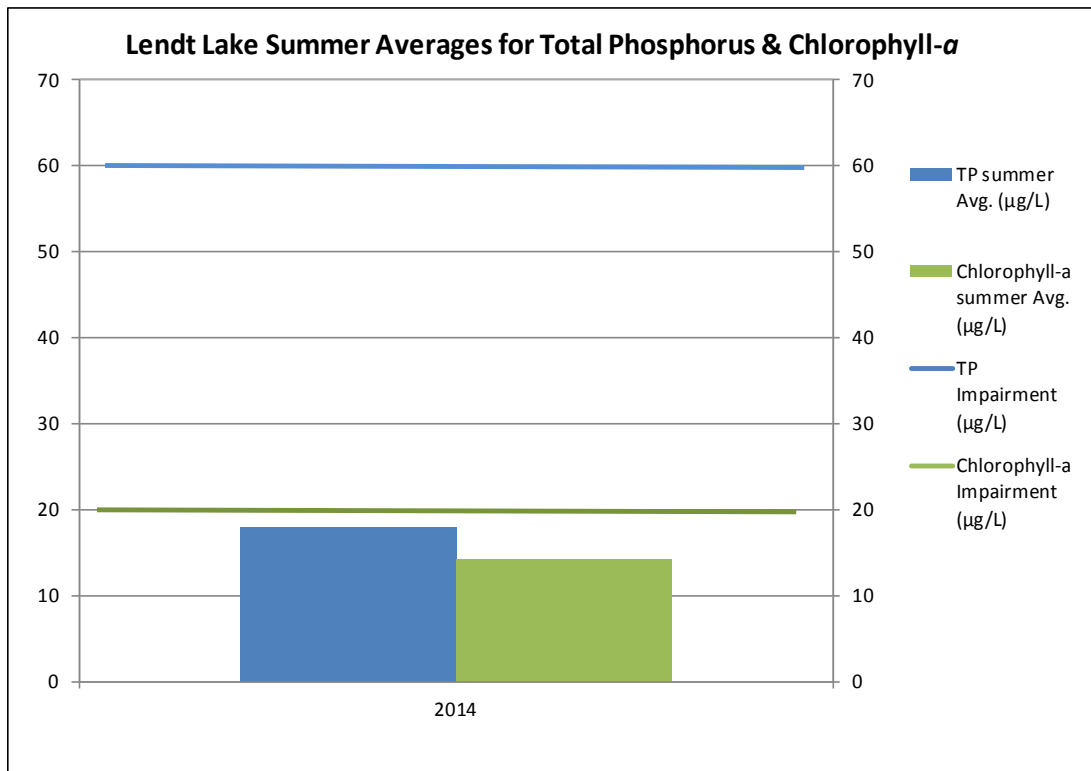


Summary Points

- Based on the chlorophyll-*a* results Fourth Lake was considered eutrophic in 2014, according to the Carlson Trophic State Index.
- There are an insufficient number of years of data to determine long term water quality trends at this time.
- The major land use is rural/agricultural.
- The lake did not stratify in 2014.
- 2014 is the first year that water quality monitoring has been conducted on this lake.



Date	Total Phosphorus (mg/L)	Chlorophyll-a (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
5/14/14	0.021	6.0	0.79	1.68	13.3	9.33
5/29/14	0.035	3.3	0.72	1.37	25.7	7.45
6/12/14	0.013	2.7	0.64	1.37	23.0	7.11
6/26/14	0.027	7.8	0.86	1.37	23.9	6.90
7/10/14	0.013	35.0	0.30	1.52	23.3	6.02
7/22/14	0.015	3.3	0.80	1.52	28.1	7.25
8/5/14	0.013	2.3	0.74	1.07	25.2	6.72
8/21/14	0.024	12.0	0.86	1.07	23.9	7.15
9/5/14	0.009	3.6	0.58	0.91	20.7	4.43
9/18/14	0.010	2.0	0.62	1.37	16.0	9.44
9/30/14	0.027	59.0	0.78	1.37	17.1	6.77
10/16/14	0.013	6.1	0.64	1.37	12.1	8.40
2014 Average	0.018	11.9	0.69	1.33	21.0	7.25
2014 Summer Average	0.017	14.2	0.69	1.29	22.4	6.87
Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*						
Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*						
	High	High Date	Low	Low Date	Average	
2014 Elevation (ft)	922.45	7/7/2014 & 7/10/2014	922.05	10/16/2014	922.20	
*MPCA description of Impaired Lake's Listing criteria: "At a minimum, a decision that a given lake is impaired for the 303(d) list due to excessive nutrients will be supported by data for both causal and response factors. Data requirements for 303(d) listing consist of 12 or more TP measurements collected from June through September over the most recent 10-year period. Ideally this should represent 12 separate visits to the lake over the course of two summers; however it might also reflect four monthly samples over the course of three years (a typical sampling regimen for many lake monitoring programs). In addition to exceeding the TP guideline thresholds, lakes to be considered for 303(d) listing should have at least 12 Secchi measurements and 12 chlorophyll-a measurements. This amount of data will allow for at least one season (preferably more) for paired TP, chlorophyll-a, and Secchi disk data and provide a basis for evaluating their interrelationships and hence the trophic status of the lake."						



Lake Water Quality Summary										
	Lake Grades									
	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005
Total Phosphorus (mg/L)	A	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorophyll-a (µg/L)	B	NA	NA	NA	NA	NA	NA	NA	NA	NA
Secchi depth (ft)	C	NA	NA	NA	NA	NA	NA	NA	NA	NA
Overall	B	NA	NA	NA	NA	NA	NA	NA	NA	NA

*Adjusted due to limiting factors

Lendt Lake Water Surface Elevation Statistics

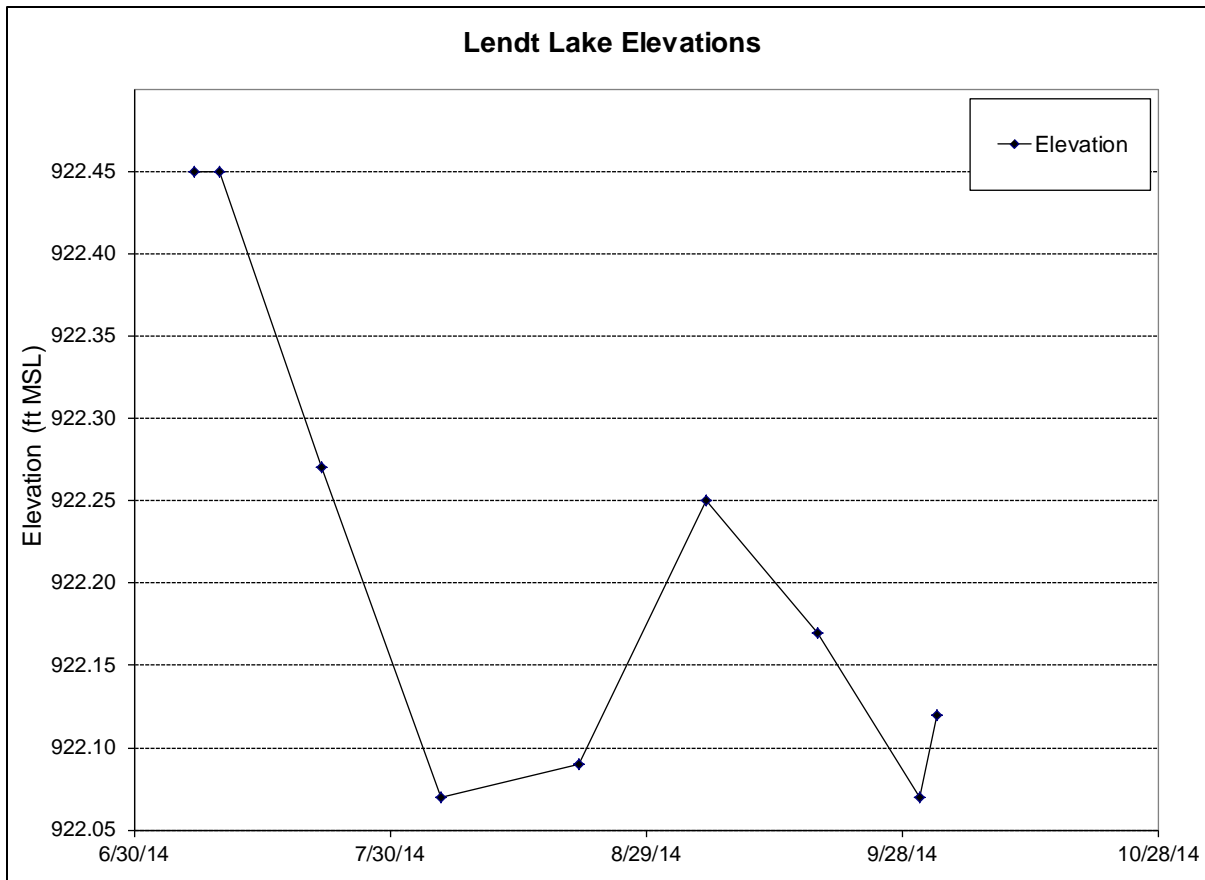
Outlet Elevation:

Ordinary High Water Level (OHW) Elevation: N/A

Highest Recorded Elevation: 922.45 ft. (07/07/2014)

Lowest Recorded Elevation: 922.05 ft. (10/16/2014)

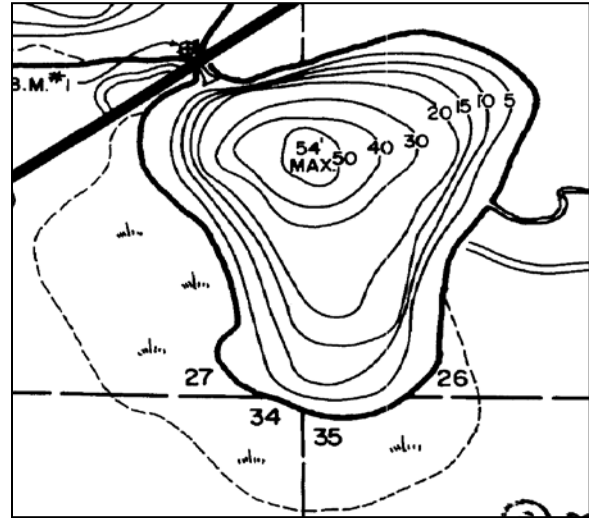
Datum: NGVD 29 (ft.)



Little Comfort Lake

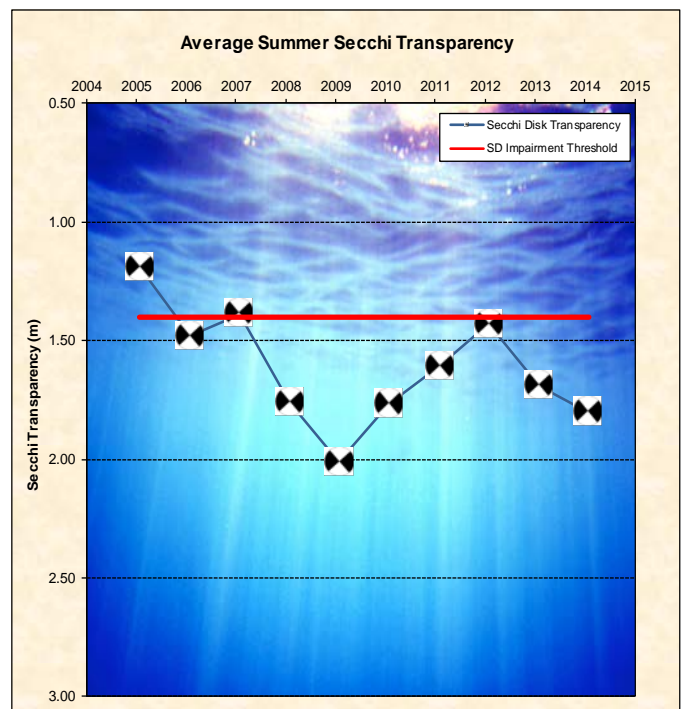
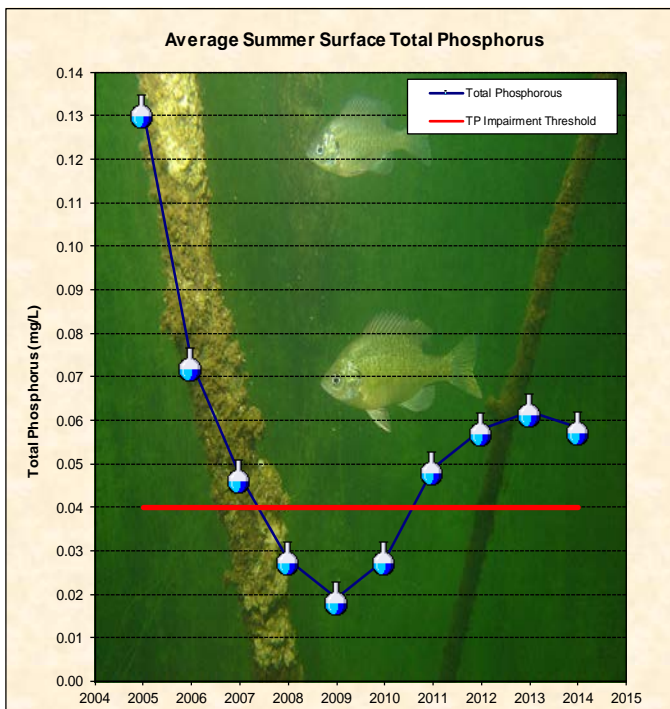
2014 Lake Grade: C

- DNR ID #: 13005400
- Municipality: Chisago City
- Location: Section 27 T33N-R21W
- Lake Size: 36 acres
- Maximum Depth (2014): 54 ft.
- Ordinary High Water Mark: 887.2 ft.
- 44% Littoral
Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



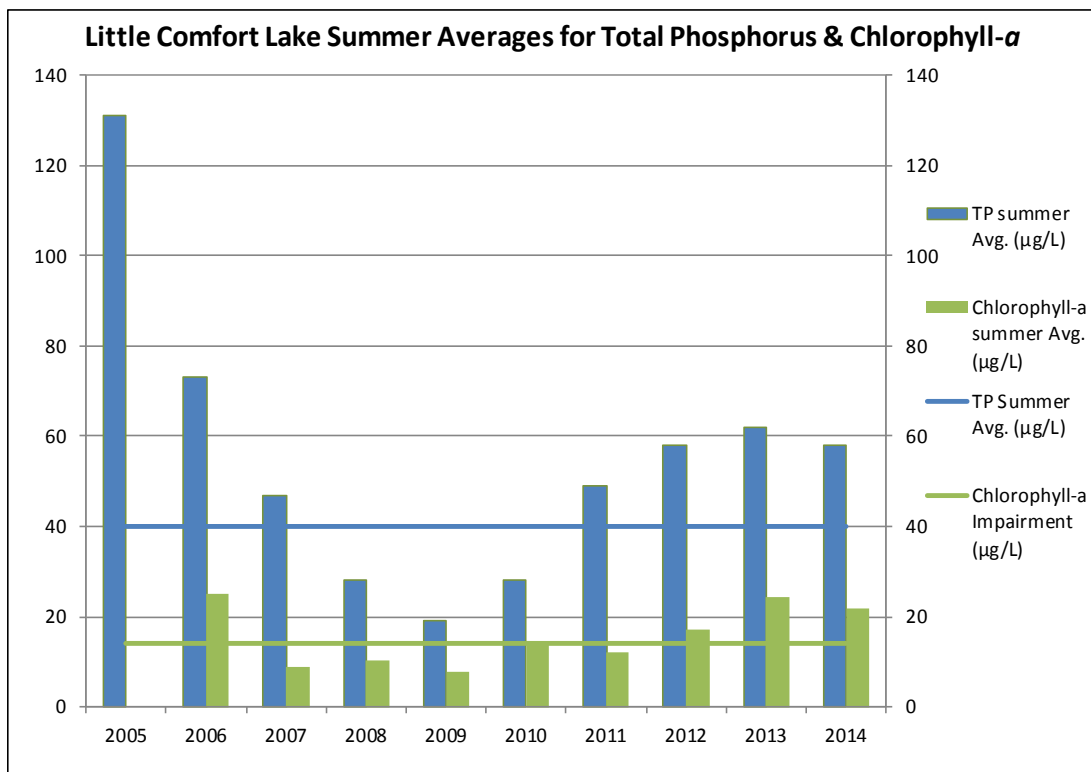
Summary Points

- Based on the chlorophyll-*a* results Little Comfort Lake was considered eutrophic in 2014, according to the Carlson Trophic State Index.
- Using the Kendall Tau correlation test ($p < 0.01$) there is no trend for the average total phosphorus and for the average Secchi transparency at this time.
- The major land use is rural/agricultural.
- The lake stratified in 2014 with the thermocline varying between 3 and 4 meters.
- Little Comfort Lake is listed as impaired for nutrients on the Minnesota Pollution Control Agency's Impaired Waters List.
- Curly-leaf pondweed (invasive aquatic plant) is extensive in this lake. A report has been made of the presence of Eurasian watermilfoil but that has yet to be verified.



Date	Total Phosphorus (mg/L)	Chlorophyll-a (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
5/12/14	0.052	21.0	1.50	1.68	14.5	10.27
5/27/14	0.044	10.0	1.00	1.37	22.4	7.57
6/13/14	0.063	13.0	1.60	1.83	20.0	5.57
6/25/14	0.093	24.0	1.20	1.07	23.1	6.62
7/7/14	0.097	30.0	1.20	1.14	24.1	7.98
7/22/14	0.050	16.0	1.30	1.68	25.8	6.75
8/5/14	0.040	12.0	1.30	2.59	25.1	6.71
8/21/14	0.044	27.0	1.20	1.68	24.3	8.92
9/3/14	0.072	37.0	1.40	1.52	21.9	7.54
9/16/14	0.025	16.0	1.10	2.29	16.4	8.94
9/30/14	0.040	26.0	1.20	2.44	17.3	8.14
10/10/14	0.032	11.0	1.20	2.74	11.0	7.65
2014 Average	0.054	20.3	1.27	1.84	20.5	7.72
2014 Summer Average	0.058	22.3	1.28	1.80	22.0	7.46
Volunteer Data						
7/16/14	0.019	3.9	1.00	1.80	25.2	NA
8/1/14	0.015	3.9	1.30	2.00	25.9	NA
8/17/14	0.025	6.1	1.10	2.40	21.2	NA
9/28/14	0.018	4.0	0.90	2.60	14.6	NA
10/9/14	0.019	3.5	0.88	2.70	12.7	NA
2014 Average	0.019	4.3	1.04	2.30	19.9	NA
2014 Summer Average	0.019	4.5	1.08	2.20	21.7	NA
Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*						
Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*						
	High	High Date	Low	Low Date	Average	
2014 Elevation (ft)	NA	NA	NA	NA	NA	

*MPCA description of Impaired Lake's Listing criteria: "At a minimum, a decision that a given lake is impaired for the 303(d) list due to excessive nutrients will be supported by data for both causal and response factors. Data requirements for 303(d) listing consist of 12 or more TP measurements collected from June through September over the most recent 10-year period. Ideally this should represent 12 separate visits to the lake over the course of two summers; however it might also reflect four monthly samples over the course of three years (a typical sampling regimen for many lake monitoring programs). In addition to exceeding the TP guideline thresholds, lakes to be considered for 303(d) listing should have at least 12 Secchi measurements and 12 chlorophyll-a measurements. This amount of data will allow for at least one season (preferably more) for paired TP, chlorophyll-a, and Secchi disk data and provide a basis for evaluating their interrelationships and hence the trophic status of the lake."



Lake Water Quality Summary										
	Lake Grades									
	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005
Total Phosphorus (mg/L)	C	C	C	C	B	A	B	C	D	D
Chlorophyll-a (µg/L)	C	C	B	B	B	A	C	A	C	NA
Secchi depth (ft)	C	C	C	C	C	C	C	C	C	D
Overall	C	C	C+	C+	B-	B+	B-	B-	C	NA

Little Comfort Lake Water Surface Elevation Statistics

Outlet Elevation: 885.7 ft.

Ordinary High Water Level (OHW) Elevation: 887.2 ft.

100 Year Flood Elevation (CLFLWD): 892.1 ft.

Highest Recorded Elevation: 887.81 ft. (05/08/2001)

Lowest Recorded Elevation: 885.41 ft. (09/05/2003)

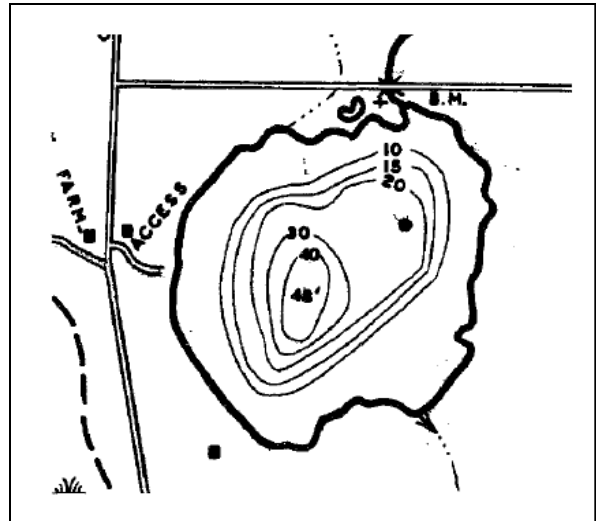
Datum: NGVD 29 (ft.)

*Elevation data has not been recorded on this lake since 2004.

Moody Lake

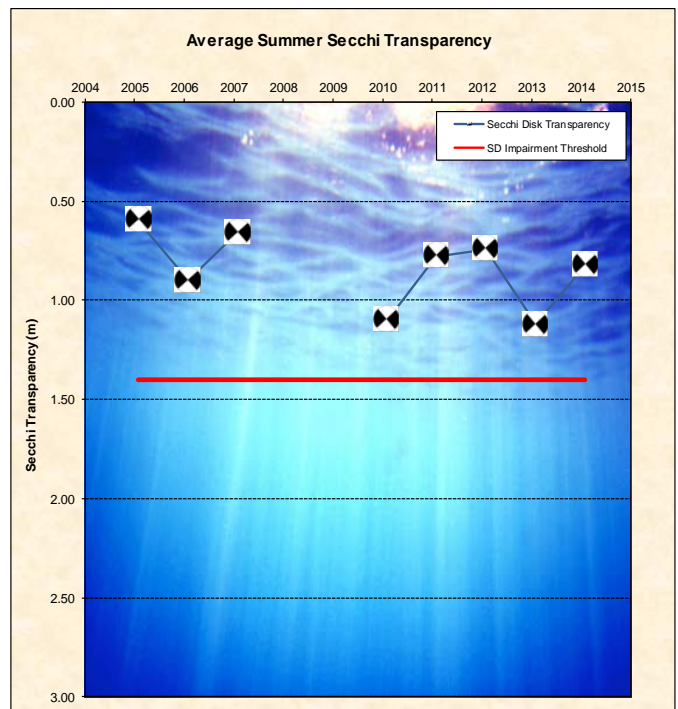
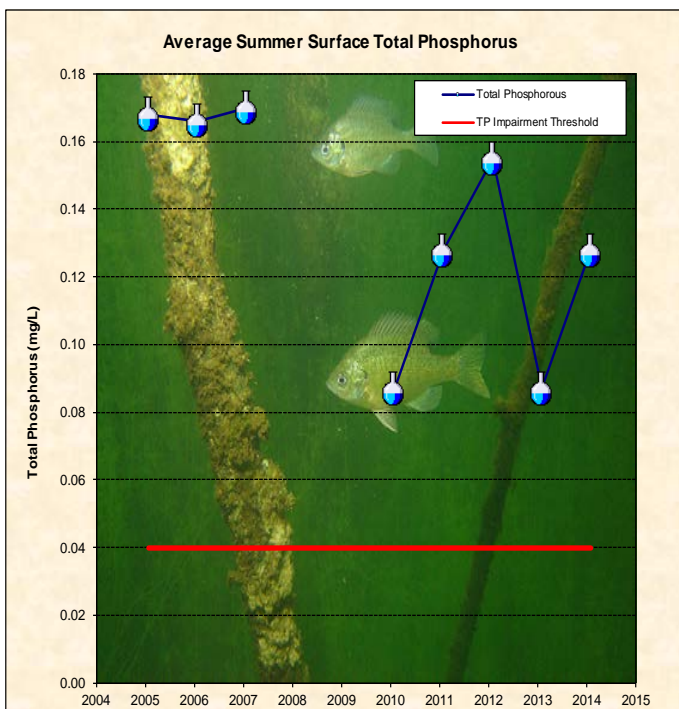
2014 Lake Grade: D+

- DNR ID #: 13002300
 - Municipality: Chisago Lakes Township
 - Location: SW^{1/4} Section 32 T33N-R20W
 - Lake Size: 45.33 acres
 - Maximum Depth (2014): 47 ft.
 - Ordinary High Water Mark: N/A
 - 49% Littoral
- Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



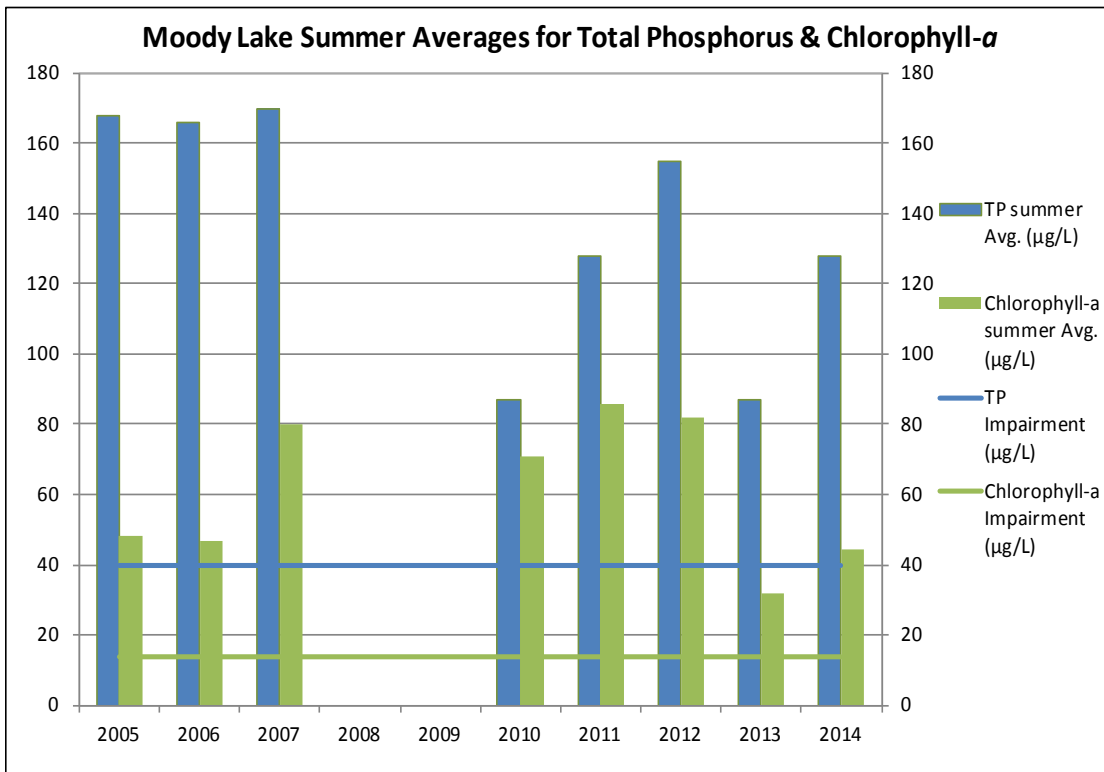
Summary Points

- Based on the chlorophyll-*a* results Moody Lake was considered eutrophic in 2014, according to the Carlson Trophic State Index.
- Using the Kendall Tau correlation test ($p < 0.01$) there is a statistically significant **improving** trend for the average total phosphorus and no trend for the average Secchi transparency at this time.
- The major land use is rural/agricultural.
- The lake stratified in 2014 with the thermocline varying between 2 and 4 meters.
- Moody Lake is listed as impaired for nutrients on the Minnesota Pollution Control Agency's Impaired Waters List.
- Curly-leaf pondweed (an invasive aquatic plant) is present in this lake.



Date	Total Phosphorus (mg/L)	Chlorophyll-a (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
5/12/14	0.133	35.0	1.80	1.52	14.5	10.23
5/29/14	0.107	17.0	1.20	1.52	24.7	9.41
6/13/14	0.173	1.0	1.80	1.37	22.0	6.09
6/26/14	0.185	36.0	1.70	0.91	22.0	5.29
6/26/14	NA	NA	NA	0.91	23.4	6.19
7/10/14	0.220	110.0	2.00	0.46	23.3	9.68
7/22/14	0.102	61.0	1.80	0.76	25.9	7.58
7/22/14	NA	NA	NA	0.61	26.9	9.17
8/5/14	0.095	41.0	1.90	0.61	25.6	7.87
8/21/14	0.078	51.0	2.00	0.61	24.0	7.05
8/21/14	NA	NA	NA	0.76	24.3	8.61
9/5/14	0.062	45.0	2.00	0.91	21.2	6.42
9/18/14	0.054	33.0	1.90	0.91	16.4	9.66
9/30/14	0.044	23.0	1.70	1.07	17.4	7.64
10/16/14	0.118	21.0	1.90	1.68	11.9	7.32
2014 Average	0.114	39.5	1.81	0.98	21.6	7.88
2014 Summer Average	0.113	44.6	1.87	0.83	22.7	7.60
Volunteer Data						
5/25/14	0.057	14.0	1.20	1.50	21.8	NA
6/8/14	0.128	23.0	1.60	NA	NA	NA
6/22/14	0.164	32.0	1.50	0.90	24.5	NA
7/6/14	0.139	84.0	1.90	0.50	25.3	NA
7/20/14	0.079	65.0	1.70	0.70	24.5	NA
8/3/14	0.055	28.0	1.80	0.70	27.6	NA
8/17/14	0.065	58.0	1.80	0.70	24.7	NA
8/31/14	0.049	44.0	1.50	NA	NA	NA
9/14/14	0.042	27.0	1.50	NA	NA	NA
10/11/14	0.083	15.0	1.80	NA	NA	NA
10/26/14	0.076	19.0	1.70	NA	NA	NA
2014 Average	0.085	37.2	1.64	0.83	24.7	NA
2014 Summer Average	0.090	45.1	1.66	0.70	25.3	NA
Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*						
Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*						
2014 Elevation (ft)	High	High Date	Low	Low Date	Average	
	912.99	9/5/2014	912.51	8/5/14 & 8/21/14	912.76	

*MPCA description of Impaired Lake's Listing criteria: "At a minimum, a decision that a given lake is impaired for the 303(d) list due to excessive nutrients will be supported by data for both causal and response factors. Data requirements for 303(d) listing consist of 12 or more TP measurements collected from June through September over the most recent 10-year period. Ideally this should represent 12 separate visits to the lake over the course of two summers; however it might also reflect four monthly samples over the course of three years (a typical sampling regimen for many lake monitoring programs). In addition to exceeding the TP guideline thresholds, lakes to be considered for 303(d) listing should have at least 12 Secchi measurements and 12 chlorophyll-a measurements. This amount of data will allow for at least one season (preferably more) for paired TP, chlorophyll-a, and Secchi disk data and provide a basis for evaluating their interrelationships and hence the trophic status of the lake."



Lake Water Quality Summary										
	Lake Grades									
	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005
Total Phosphorus (mg/L)	D	D	F	D	D	NA	NA	F	F	F
Chlorophyll-a (µg/L)	C	C	F	F	D	NA	NA	F	D	D
Secchi depth (ft)	D	D	D	D	D	NA	NA	F	D	F
Overall	D+	D+	F+	D-	D	NA	NA	F	D-	F

Moody Lake Water Surface Elevation Statistics

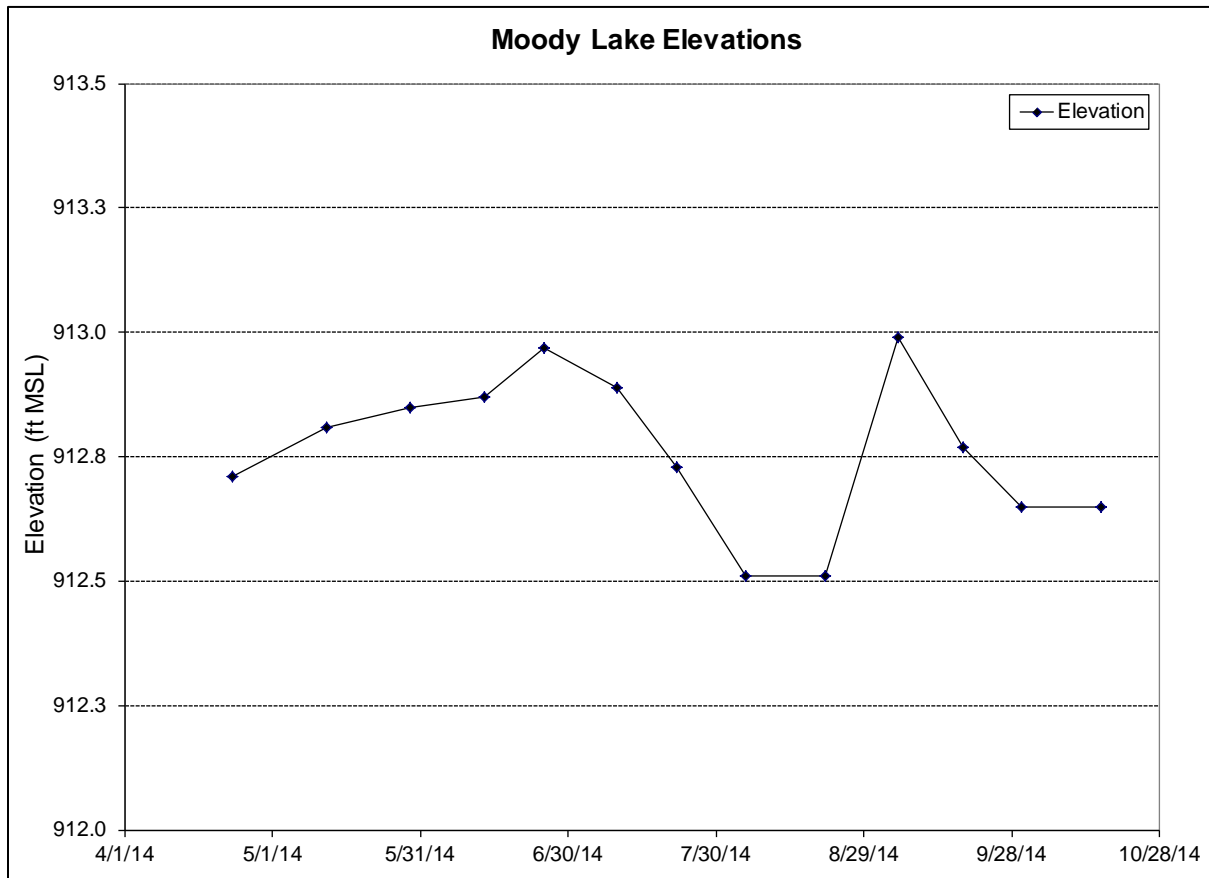
Ordinary High Water Level (OHW) Elevation: N/A

100 Year Flood Elevation (CLFLWD): 892.1 ft.

Highest Recorded Elevation: 912.99 ft. (09/05/2014)

Lowest Recorded Elevation: 911.78 ft. (10/10/2013)

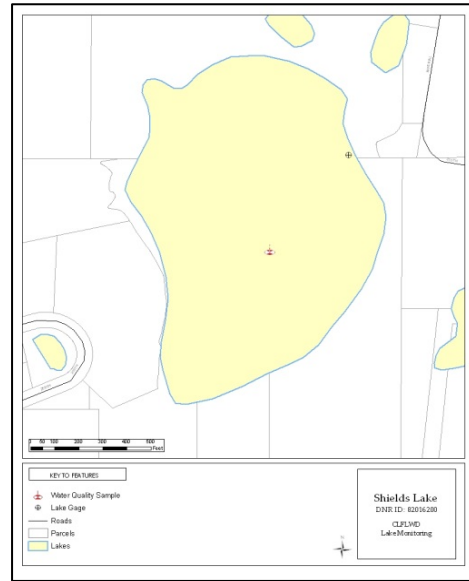
Datum: NGVD 29 (ft.)



Shields Lake

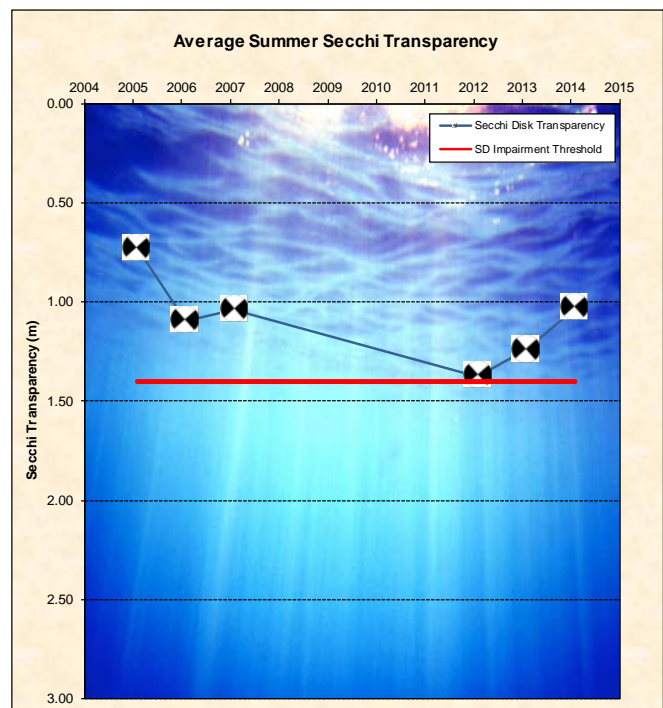
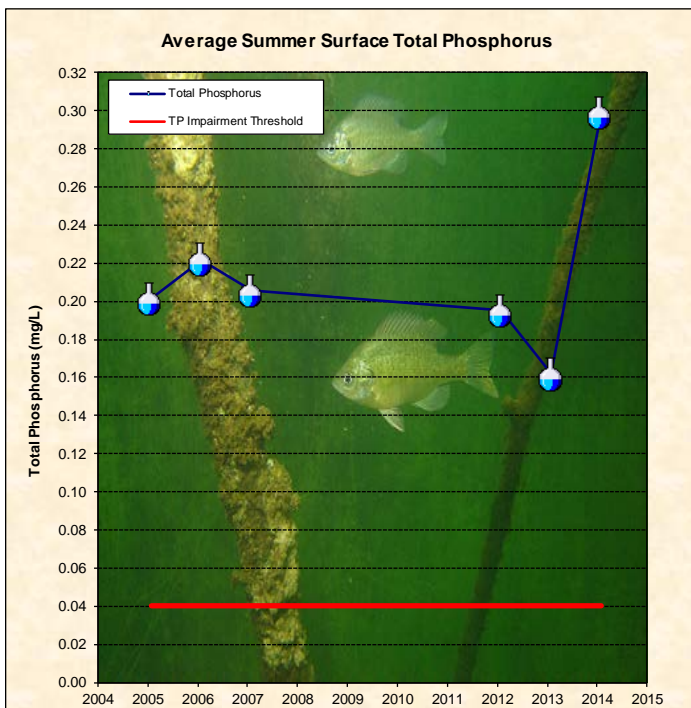
2014 Lake Grade: D

- DNR ID #: 82016200
 - Municipality: City of Forest Lake
 - Location: NE^{1/4} Section 22 T32N-R21W
 - Lake Size: 29.58 Acres
 - Maximum Depth (2014): 25.5 ft.
 - Ordinary High Water Mark: 902.5 ft.
 - 74% Littoral
- Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.

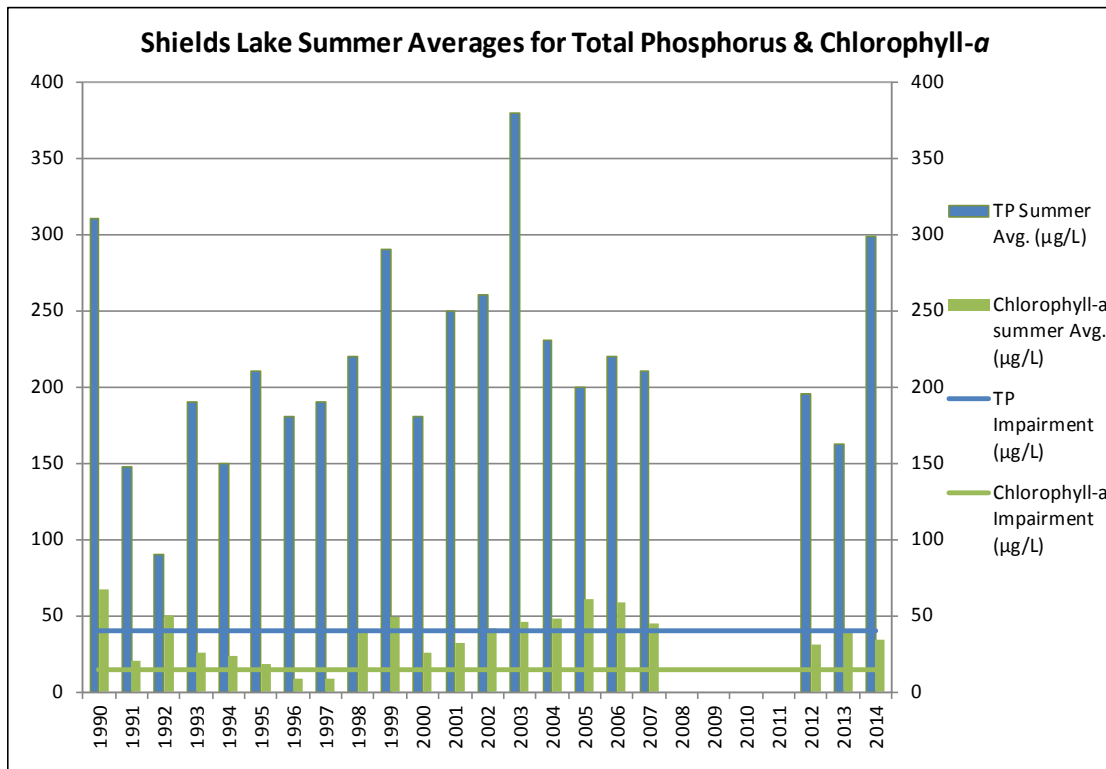


Summary Points

- Based on the chlorophyll-*a* results Shields Lake was considered eutrophic in 2014, according to the Carlson Trophic State Index.
- Using the Kendall Tau correlation test ($p < 0.01$) there is no trend for the average total phosphorus at this time and a statistically significant **declining** trend for the average Secchi transparency.
- The major land use is a mix of semi-urban and rural/agricultural.
- The lake stratified in 2014 with the thermocline varying between 2 and 3 meters.
- Shields Lake is listed as impaired for nutrients on the Minnesota Pollution Control Agency's Impaired Waters List.
- Curly-leaf pondweed (an invasive aquatic plant) is extensive in this lake.



Date	Total Phosphorus (mg/L)	Chlorophyll-a (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
5/12/14	0.073	58.0	1.90	1.37	15.7	11.78
5/27/14	0.070	6.0	1.40	1.98	22.7	10.06
6/13/14	0.218	7.2	1.60	1.83	20.2	5.99
6/25/14	0.255	11.0	1.40	1.52	23.2	4.33
7/7/14	0.326	44.0	1.80	1.07	25.2	9.43
7/22/14	0.291	33.0	1.80	0.91	26.7	8.81
8/5/14	0.356	39.0	2.70	0.76	24.6	9.20
8/21/14	0.299	28.0	2.60	0.61	24.4	8.82
9/3/14	0.327	37.0	2.00	0.76	22.6	5.13
9/16/14	0.332	59.0	2.40	1.07	16.5	11.85
9/30/14	0.288	47.0	2.40	0.76	17.1	7.55
10/10/14	0.450	28.0	2.90	1.07	10.7	4.78
2014 Average	0.274	33.1	2.08	1.14	20.8	8.14
2014 Summer Average	0.299	33.9	2.08	1.03	22.3	7.90
Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*						
Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*						
	High	High Date	Low	Low Date	Average	
2014 Elevation (ft)	901.76	6/25/2014	900.56	9/30/2014	901.25	
*MPCA description of Impaired Lake's Listing criteria: "At a minimum, a decision that a given lake is impaired for the 303(d) list due to excessive nutrients will be supported by data for both causal and response factors. Data requirements for 303(d) listing consist of 12 or more TP measurements collected from June through September over the most recent 10-year period. Ideally this should represent 12 separate visits to the lake over the course of two summers; however it might also reflect four monthly samples over the course of three years (a typical sampling regimen for many lake monitoring programs). In addition to exceeding the TP guideline thresholds, lakes to be considered for 303(d) listing should have at least 12 Secchi measurements and 12 chlorophyll-a measurements. This amount of data will allow for at least one season (preferably more) for paired TP, chlorophyll-a, and Secchi disk data and provide a basis for evaluating their interrelationships and hence the trophic status of the lake."						



Lake Water Quality Summary										
	Lake Grades									
	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005
Total Phosphorus (mg/L)	F	F	F	NA	NA	NA	NA	F	F	F
Chlorophyll-a (µg/L)	C	C	C	NA	NA	NA	NA	C	D	D+
Secchi depth (ft)	D	C	C	NA	NA	NA	NA	D	D	D+
Overall	D	D+	D+	NA	NA	NA	NA	D	D-	D-

Shields Lake Water Surface Elevation Statistics

Outlet Elevation (culvert): 900.0 ft.

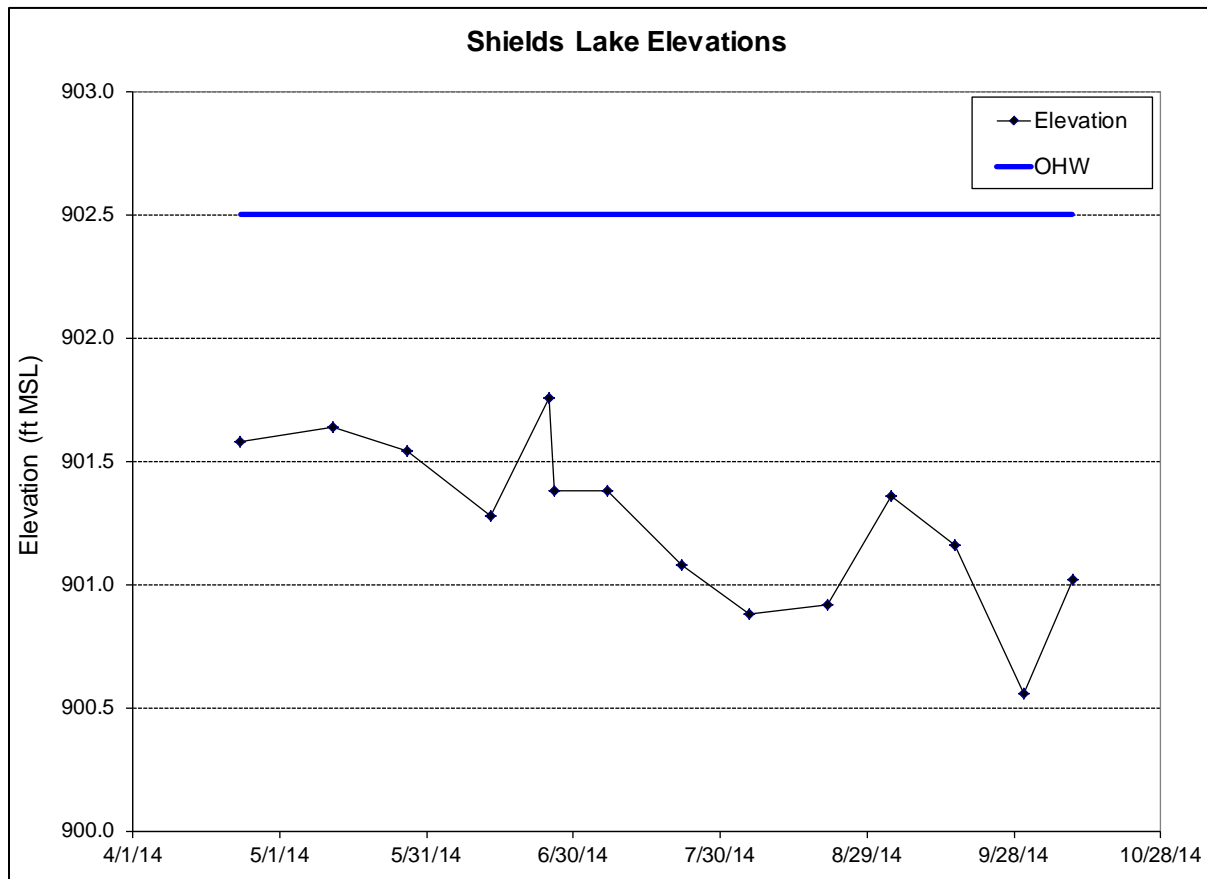
Ordinary High Water Level (OHW) Elevation: 902.5 ft.

100 Year Flood Elevation (FEMA): 904.5 ft.

Highest Recorded Elevation: 903.99 ft. (06/27/2003)

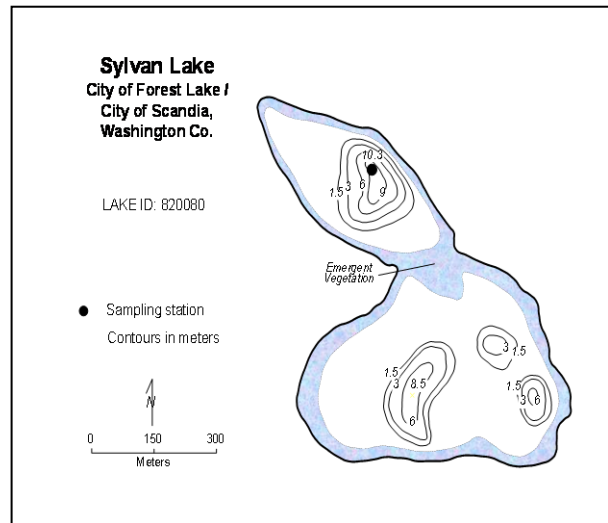
Lowest Recorded Elevation: 899.77 ft. (10/02/2006)

Datum: NGVD 29 (ft.)



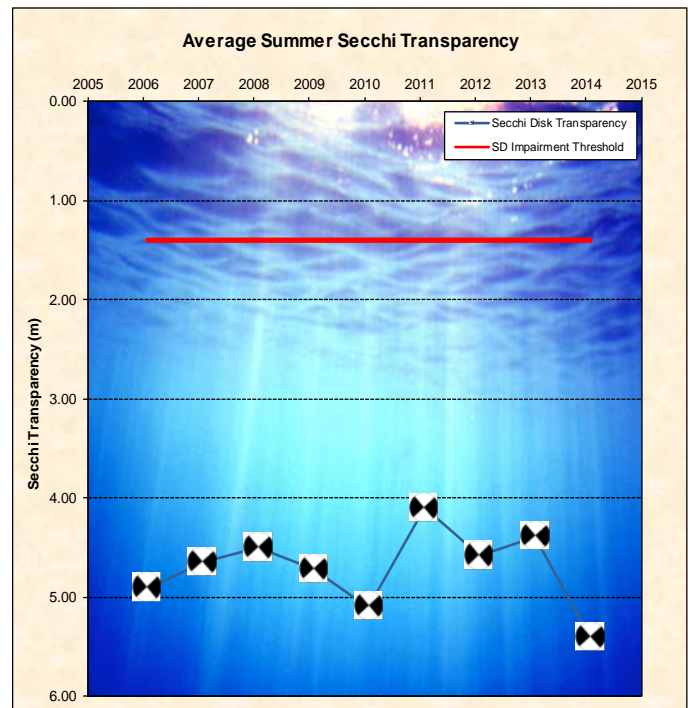
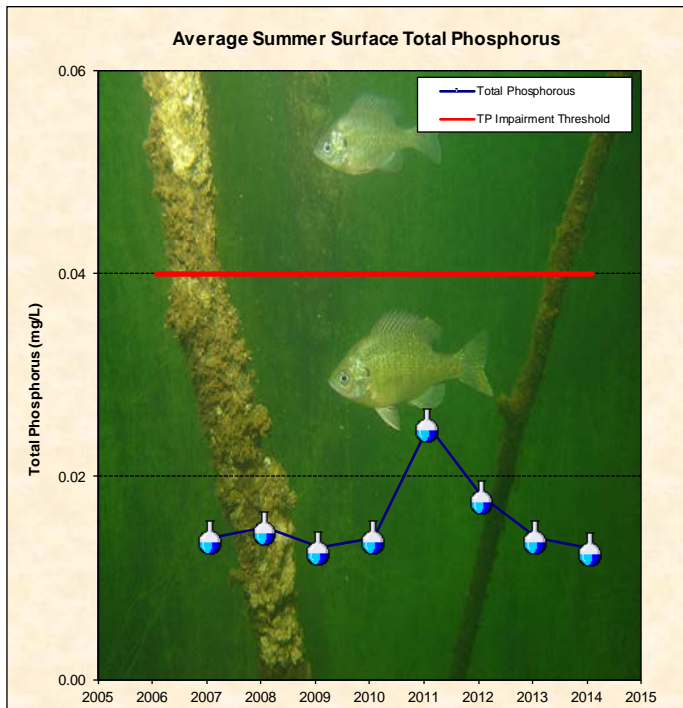
Sylvan/Halfbreed Lake 2014 Lake Grade: A

- DNR ID #: 82008000
- Municipality: City of Forest Lake
- Location: Section 24 T32N-R21W
- Lake Size: 74.50 acres
- Maximum Depth (2014): 40.5 ft.
- Ordinary High Water Mark: 937.1 ft.
- 90% Littoral
Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.

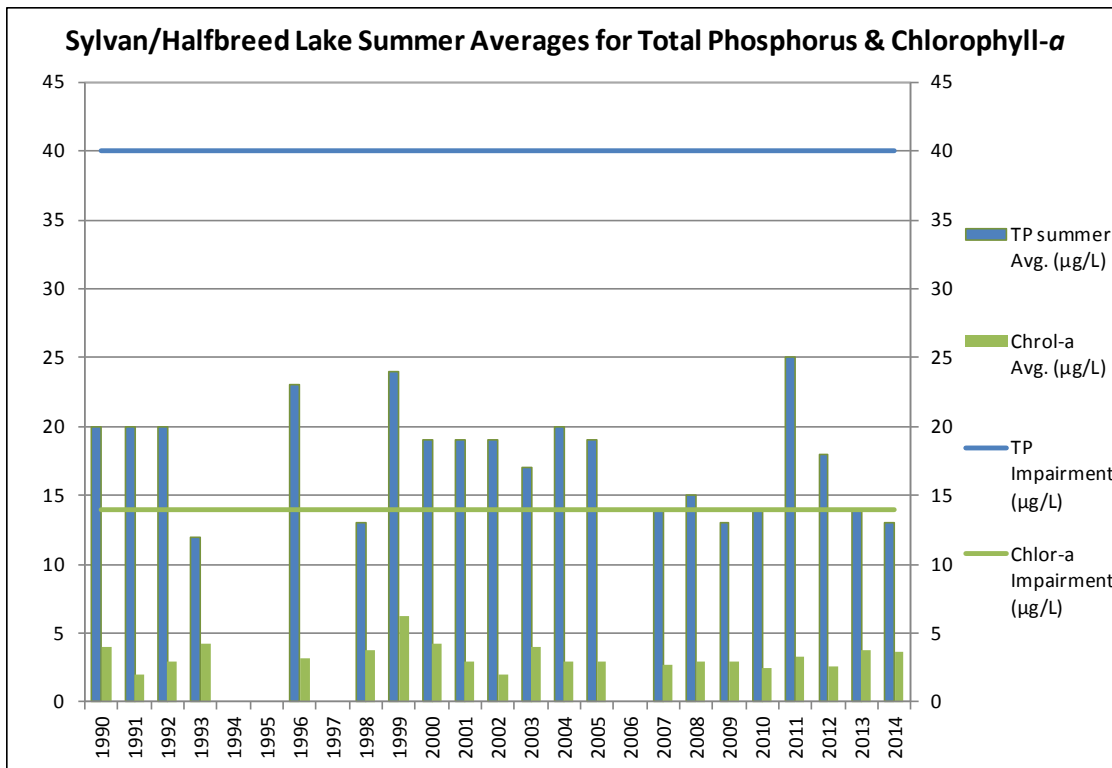


Summary Points

- Based on the chlorophyll-*a* results Sylvan/Halfbreed Lake was considered mesotrophic in 2014, according to the Carlson Trophic State Index.
- Using the Kendall Tau correlation test ($p < 0.01$) there is a statistically significant **improving** trend for the average total phosphorus and a statistically significant **improving** trend for the average Secchi transparency.
- The major land use is semi-urban and rural/agricultural.
- The lake stratified in 2014 with the thermocline varying between 6 and 8 meters.
- Curly-leaf pondweed (an invasive aquatic plant) is present in this lake.



Date	Total Phosphorus (mg/L)	Chlorophyll-a (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
5/12/14	0.016	3.8	0.71	3.51	15.0	9.65
5/27/14	0.005	2.7	0.50	5.79	22.5	9.86
6/13/14	0.009	5.8	0.69	8.23	21.6	7.11
6/25/14	0.019	3.9	0.67	3.81	24.3	8.61
7/7/14	0.019	1.9	0.64	4.88	24.8	8.81
7/22/14	0.009	2.0	0.51	4.88	25.6	8.12
8/5/14	0.014	3.6	0.73	7.01	25.2	9.26
8/21/14	0.016	3.7	0.74	4.57	24.3	7.80
9/3/14	0.011	3.4	0.65	4.88	22.5	7.64
9/15/14	0.010	3.9	0.65	5.49	17.1	8.82
9/30/14	0.009	5.1	0.67	4.88	17.9	8.73
10/10/14	0.009	4.1	0.58	4.88	11.5	8.88
2014 Average	0.012	3.7	0.65	5.23	21.0	8.61
2014 Summer Average	0.013	3.7	0.66	5.40	22.6	8.32
Volunteer Data						
5/17/14	0.008	1.9	0.42	5.30	12.4	NA
6/6/14	0.010	1.5	0.63	6.70	24.8	NA
6/18/14	0.009	5.8	0.69	NA	NA	NA
6/21/14	0.006	2.5	0.54	4.00	25.0	NA
7/8/14	0.009	1.7	0.54	4.80	23.7	NA
7/23/14	0.007	1.3	0.43	5.60	26.0	NA
8/12/14	0.005	3.3	0.57	5.00	24.1	NA
8/19/14	0.009	2.2	0.57	4.60	24.2	NA
9/20/14	0.011	6.3	0.61	NA	NA	NA
10/14/14	0.009	4.1	0.58	NA	NA	NA
2014 Average	0.008	3.1	0.56	5.14	22.9	NA
2014 Summer Average	0.008	3.1	0.57	5.12	24.6	NA
Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*						
Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*						
	High	High Date	Low	Low Date	Average	
2014 Elevation (ft)	937.52	7/8/2014	936.67	10/25/2014	937.09	
*MPCA description of Impaired Lake's Listing criteria: "At a minimum, a decision that a given lake is impaired for the 303(d) list due to excessive nutrients will be supported by data for both causal and response factors. Data requirements for 303(d) listing consist of 12 or more TP measurements collected from June through September over the most recent 10-year period. Ideally this should represent 12 separate visits to the lake over the course of two summers; however it might also reflect four monthly samples over the course of three years (a typical sampling regimen for many lake monitoring programs). In addition to exceeding the TP guideline thresholds, lakes to be considered for 303(d) listing should have at least 12 Secchi measurements and 12 chlorophyll-a measurements. This amount of data will allow for at least one season (preferably more) for paired TP, chlorophyll-a, and Secchi disk data and provide a basis for evaluating their interrelationships and hence the trophic status of the lake."						



Lake Water Quality Summary										
	Lake Grades									
	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005
Total Phosphorus (mg/L)	A	A	A	B	A	A	A	A	A	A
Chlorophyll-a (µg/L)	A	A	A	A	A	A	A	A	A	A
Secchi depth (ft)	A	A	A	A	A	A	A	A	A	A
Overall	A	A	A	A-	A	A	A	A	A	A

Sylvan/Halfbreed Lake Water Surface Elevation Statistics

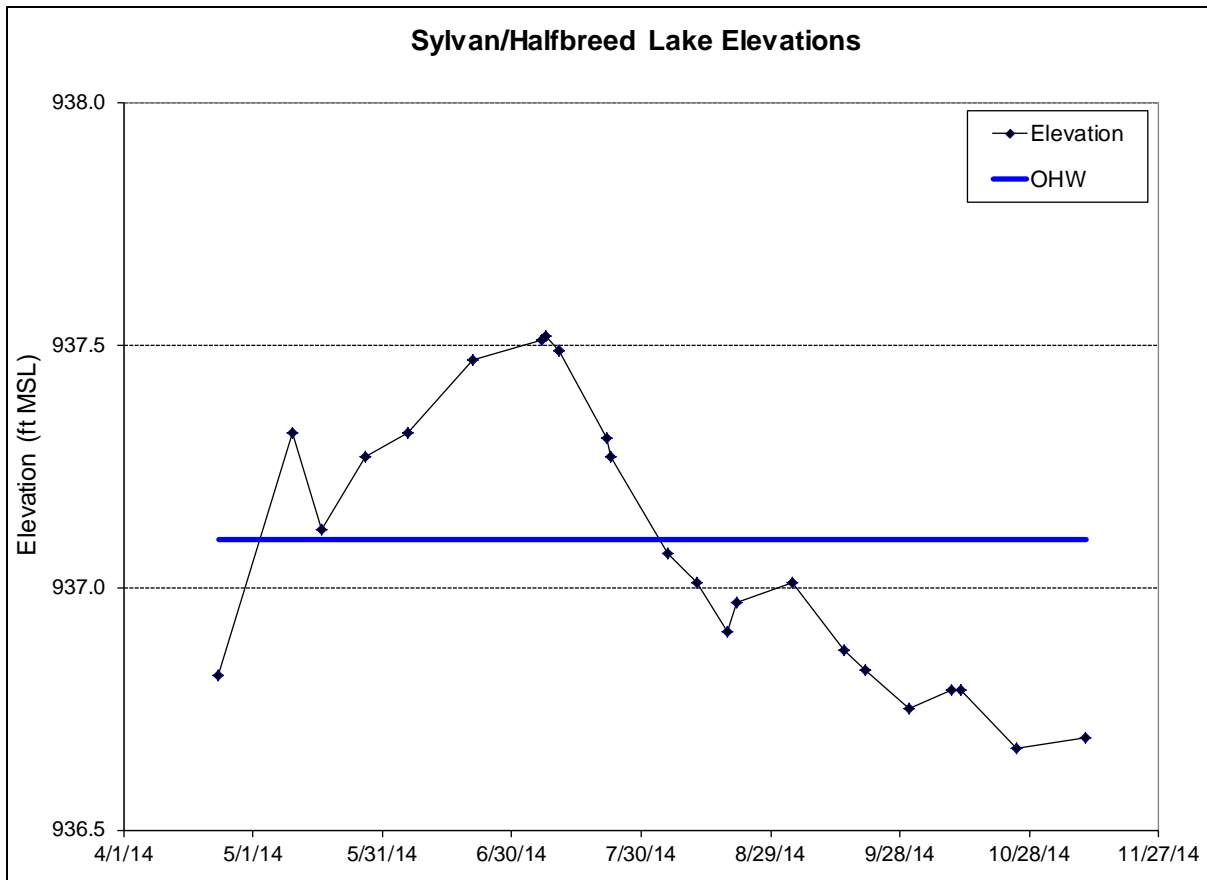
Outlet Elevation: N/A (landlocked)

Ordinary High Water Level (OHW) Elevation: 937.1 ft.

Highest Recorded Elevation: 938.00 ft. (07/03/2003)

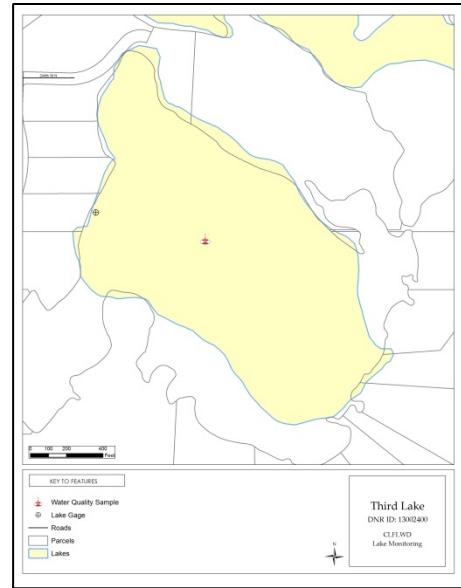
Lowest Recorded Elevation: 934.52 ft. (11/22/1990)

Datum: NGVD 29 (ft.)



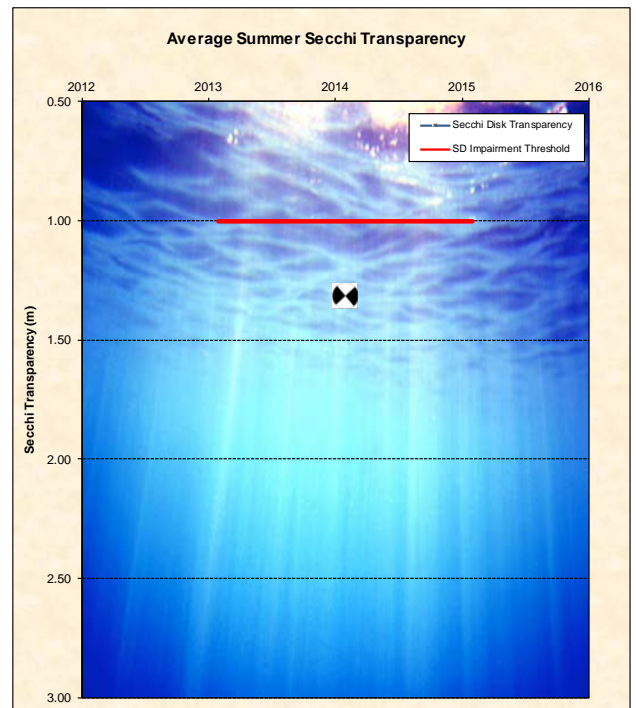
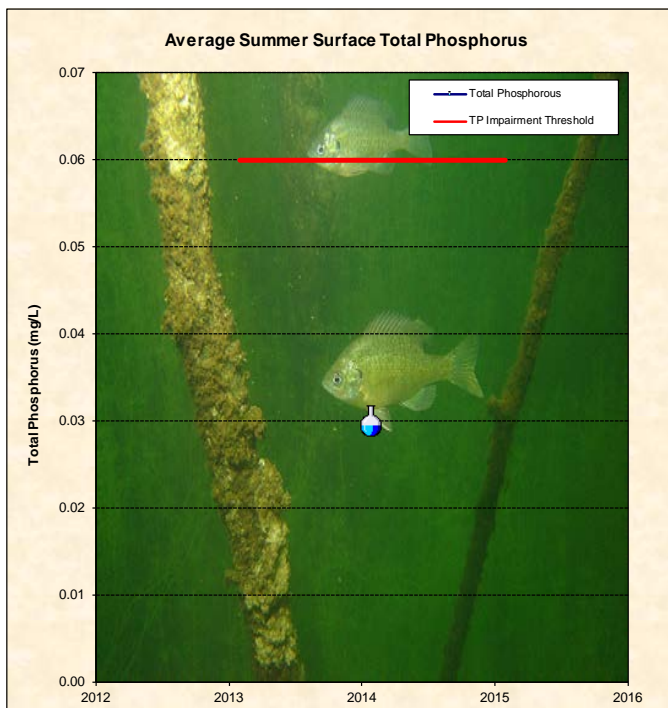
Third Lake 2014 Lake Grade: B-

- DNR ID #: 13002400
- Municipality: Chisago Lake Twp.
- Location: Section 32 T33N-R20W
- Lake Size: 42 acres
- Maximum Depth (2014): 5.5 ft.
- Ordinary High Water Mark: 923.6 ft.
- 100% Littoral
Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



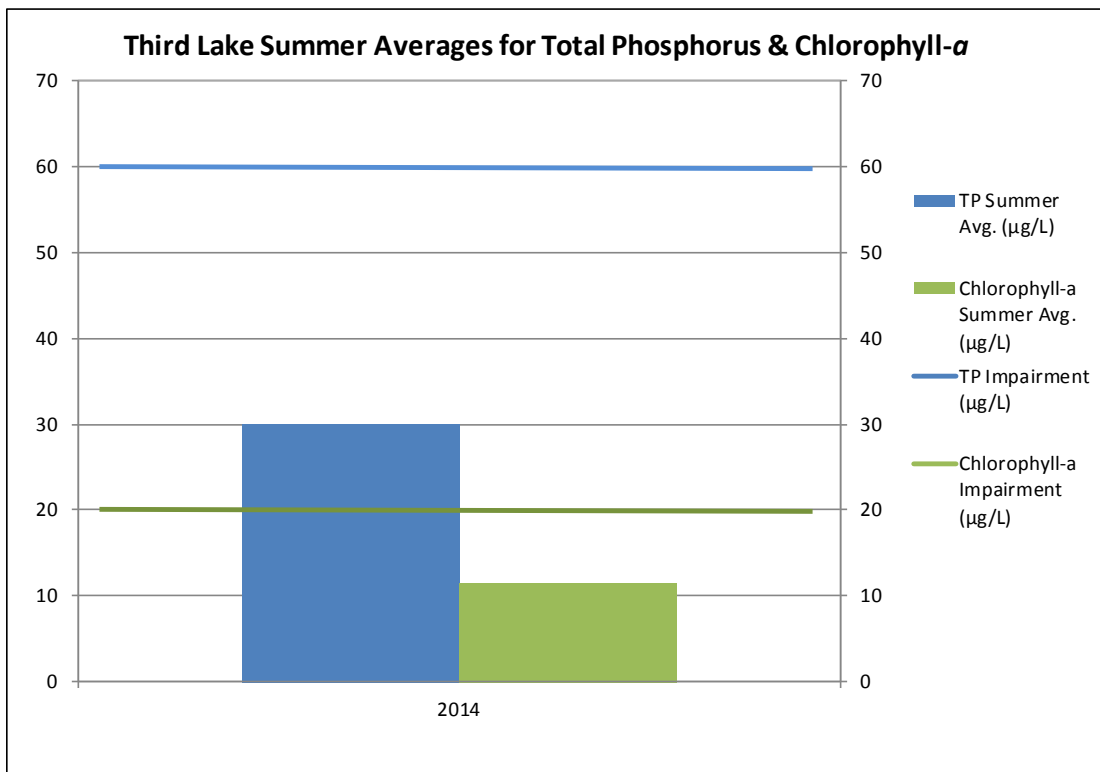
Summary Points

- Based on the chlorophyll-*a* results Third Lake was considered eutrophic in 2014, according to the Carlson Trophic State Index.
- There are an insufficient number of years of data to determine long term water quality trends at this time.
- The major land use is rural/agricultural.
- The lake did not stratify in 2014.
- 2014 is the first year that water quality monitoring has been conducted on this lake.



Date	Total Phosphorus (mg/L)	Chlorophyll-a (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
5/14/14	0.018	4.7	0.86	1.22	12.5	8.83
5/29/14	0.016	1.6	0.83	1.22	25.4	8.14
6/12/14	0.027	4.0	0.97	1.52	22.8	6.00
6/26/14	0.030	5.4	1.10	1.37	23.9	5.86
7/10/14	0.027	3.7	0.93	1.52	23.5	5.85
7/22/14	0.038	5.3	1.10	1.37	28.3	6.82
8/5/14	0.026	11.0	1.20	1.37	25.8	5.85
8/21/14	0.076	59.0	1.70	1.22	24.1	6.63
9/5/14	0.019	4.1	1.10	1.22	20.5	4.12
9/18/14	0.016	2.8	1.00	1.22	16.2	8.71
9/30/14	0.011	7.5	1.20	1.07	16.3	6.59
10/16/14	0.019	6.6	0.94	1.22	12.3	8.79
2014 Average	0.027	9.6	1.08	1.30	21.0	6.85
2014 Summer Average	0.030	11.4	1.14	1.32	22.4	6.27
Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*						
Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*						
	High	High Date	Low	Low Date	Average	
2014 Elevation (ft)	921.55	7/7/2014	921.01	10/16/2014	921.23	

*MPCA description of Impaired Lake's Listing criteria: "At a minimum, a decision that a given lake is impaired for the 303(d) list due to excessive nutrients will be supported by data for both causal and response factors. Data requirements for 303(d) listing consist of 12 or more TP measurements collected from June through September over the most recent 10-year period. Ideally this should represent 12 separate visits to the lake over the course of two summers; however it might also reflect four monthly samples over the course of three years (a typical sampling regimen for many lake monitoring programs). In addition to exceeding the TP guideline thresholds, lakes to be considered for 303(d) listing should have at least 12 Secchi measurements and 12 chlorophyll-a measurements. This amount of data will allow for at least one season (preferably more) for paired TP, chlorophyll-a, and Secchi disk data and provide a basis for evaluating their interrelationships and hence the trophic status of the lake."



Lake Water Quality Summary										
	Lake Grades									
	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005
Total Phosphorus (mg/L)	B	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorophyll-a (µg/L)	B	NA	NA	NA	NA	NA	NA	NA	NA	NA
Secchi depth (ft)	C	NA	NA	NA	NA	NA	NA	NA	NA	NA
Overall	B-	NA	NA	NA	NA	NA	NA	NA	NA	NA

*Adjusted due to limiting factors

Third Lake Water Surface Elevation Statistics

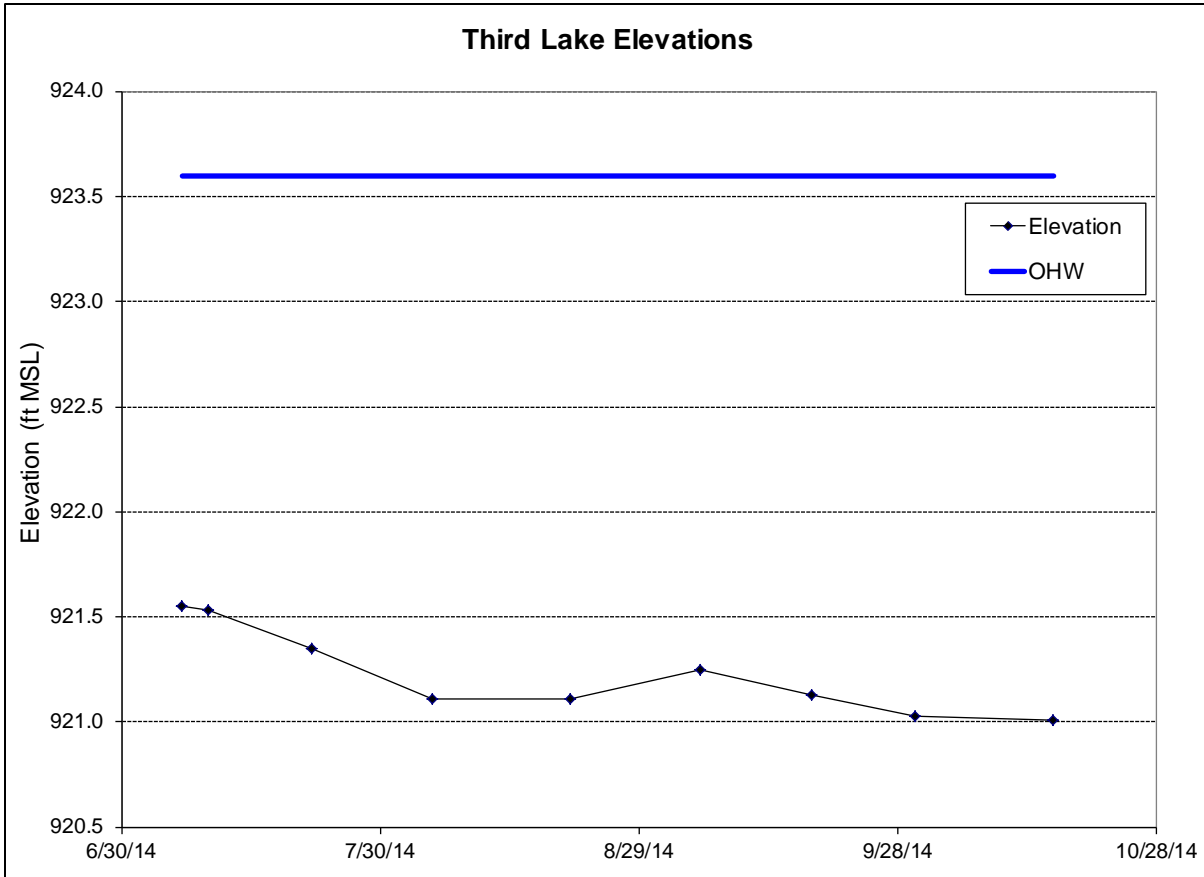
Outlet Elevation:

Ordinary High Water Level (OHW) Elevation: 923.6 ft.

Highest Recorded Elevation: 921.55 ft. (07/07/2014)

Lowest Recorded Elevation: 917.22 ft. (11/08/1963)

Datum: NGVD 29 (ft.)



APPENDIX A

ABBREVIATIONS, ACRONYMS, AND SYMBOLS

BMP	Best Management Practice
CAMP	Citizen-Assisted Monitoring Program
cfs	cubic feet per second
cf	cubic feet
Chl- <i>a</i>	Chlorophyll- <i>a</i>
CLFLWD	Comfort Lake-Forest Lake Watershed District
Composite Sample	Multiple water samples collected at various flow points by automated device
DO	Dissolved Oxygen
EQuIS	Environmental Quality Information System
Grab Sample	Manually collected discrete water sample
<i>E. coli</i>	<i>Escherichia coli</i>
mg/L	milligrams per liter
MPCA	Minnesota Pollution Control Agency
MPN	Most Probable Number
OHW	Ordinary High Water level
TALU	Tiered Aquatic Life Uses
TKN	Total Kjeldahl Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
µg/L	micrograms per liter
VSS	Volatile Suspended Solids
WCD	Washington Conservation District