VADNAIS LAKE AREA WATER MANAGEMENT ORGANIZATION

2013 WATER QUALITY MONITORING PROGRAM REPORT

Prepared by

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VLAWMO would like to thank the volunteers for their vital role in the Citizens Lake Monitoring Program. The volunteers for 2013 were: Ron Auger & Jim Grisim (Birch Lake), Paul Peterson (Amelia), Sue Fox (Gilfillan Lake), Kurt Carpenter (Goose Lake West & East) and Shannon Stewart (Tamarack Lake)

VLAWMO would also like to acknowledge and thank the following agencies for their assistance with assuring the quality of water within the watershed: St. Paul Regional Water Service, the Citizen's Lake Monitoring Program at the Minnesota Pollution Control Agency, the Lake Level Program at the Minnesota Department of Natural Resources, the Ramsey County Limnology Lab and Braun Intertec.

Definitions & Abbreviations

Ammonia (NH3) – an inorganic form of nitrogen that is contained in fertilizers, septic system effluent, and animal wastes. It is also a product of bacterial decomposition of organic matter. NH3 becomes a concern if high levels of the un-ionized form are present. In this form NH3 can be toxic to aquatic organisms. The presence of un-ionized ammonia is a function of the NH3 concentration, pH, and temperature. Conversion of NH3 to NO2 by nitrification requires large quantities of oxygen which can kill aquatic organisms due to the lowered dissolved oxygen concentrations in water.

Aquatic Invasive Species (AIS) – non-native species such as zebra mussels and Eurasian watermilfoil

Birch Lake Improvement District (BLID) – Homeowner/lakeshore owners on Birch Lake in White Bear Lake MN

Chlorophyll-a (Chl A) - Chl A is a green pigment in algae. Measuring Chl A concentration gives an indication of how abundant algae are in a waterbody.

Colony Forming Units (CFU) – unit used in measuring the level of E. coli in a water sample.

Conductivity (mS/cm) - Conductivity is a good measure of salinity in water. The measurement detects chloride ions from the salt. Salinity affects the potential dissolved oxygen levels in the water. The greater the salinity, the lower the saturation point. Measurement in millisiemens per cm. 1 mS/cm = 1000 uS/cm.

Dissolved Oxygen (DO) - The concentration of molecular oxygen (O2) dissolved in water. The DO level represents one of the most important measurements of water quality and is a critical indicator of a water body's ability to support healthy ecosystems. Levels above 5 mg/L are considered optimal, and most fish cannot survive for prolonged periods at levels below 3 mg/L. Microbial communities in water use oxygen to breakdown organic materials, such as animal waste products and decomposing algae and other vegetation. Low levels of dissolved oxygen can be a sign that too much organic material is in a water body.

Ecoli – Criteria for E. coli set forth in Minn.R. 7050.0222 creek must not exceed 126 organisms per 100 ml as a geometric mean of not less than 5 samples in any calendar month, nor shall more than ten percent of all samples taken during any calendar month individually exceed 1,260 organisms per 100 ml

EQuIS - a repository for water quality, biological, and physical data and is used by state environmental agencies, EPA and other federal agencies, universities, private citizens, and many others. The MPCA uses the information entered into the database to determine the quality of the state's water bodies. If water quality standards are not met, the water body will designated as impaired and will need to have a TMDL study conducted.

Eutrophic – a water body that is high in nutrients and low oxygen content. A eutrophic lake is usually shallow, green, with limited oxygen in the bottom layer of water.

Eutrophication – The aging process by which lakes are fertilized with nutrients. Natural eutrophication will gradually change the character of a lake. Human activities can accelerate the process.

Hypereutrophic – A very nutrient-rich lake with murky water, frequent algal blooms and fish kills, foul odor, and rough fish

Impaired Waters – The Clean Water Act requires states to publish, every two years, a list of streams and lakes that are not meeting their designated uses because of excess pollutants. The list, known as the 303(d) list, is based on violations of water quality standards.

Mesotrophic – the classification between eutrophic and oligotrophic lakes. These lakes have moderately clear water, late-summer algal blooms, moderate macrophyte populations, and occasional fish kills.

Nitrate (NO3) – High NO3 levels are often caused by over application of fertilizers that leach into waterbodies. Nitrate loading from water bodies in Minnesota has national implications as it is the primary chemical contributing to the hypoxia (low oxygen) zone at the mouth of the Mississippi River in the Gulf of Mexico. The Environmental Protection Agency (EPA) has a standard for nitrates in drinking water of 10ppb, infants and children are especially at risk.

Nitrite (NO2) – The second stage of the nitrogen cycle. Nitrite is poisonous to fish. Levels over 75 ug/L can cause stress in fish and greater than 500 ug/L can be toxic

Nitrogen (N) – Nitrogen is second only to phosphorus as an important nutrient for plant and algae growth. The amount of nitrogen in a water body strongly correlates to land use. Nitrogen comes from fertilizers, animal waste, sewage treatment plants and septic systems through surface runoff or groundwater sources. Nitrogen does not occur naturally in soil minerals but is a major component of all organic matter.

Nitrogen Cycle - the process of nitrogen breakdown in water. The first stage is the production of NH3. The second stage is the oxidation of NH3 into NO2 which is very poisonous to fish. The final stage is conversion of NO3 which

aquatic plants use. Once the plants have used their share of NO3, bacteria change it back into a gaseous form and release it back to the atmosphere. The Nitrogen Cycle is dependent on oxygen. If a water body has low DO, organic decay of nitrogen is slower and the water will have increased interim levels of toxic products (NH3 and NO2). The cycle also moves quicker in warmer water.

Oligotrophic – a water body that is generally clear, deep, and free of weeds or large algae blooms.

Particulate Phosphorus – a form of phosphorus that is attached to sediment particles and in plant and animal fragments suspended in the water and may not be immediately available to support algae growth. Some of this phosphorus is readily available but the amount can vary.

Phosphorus (P) - Phosphorus is the primary cause of excessive plant and algae growth in lake systems. Phosphorus originates from a variety of sources, many of which are human related. Major sources include human and animal wastes, soil erosion, detergents, septic systems and runoff from farmland, yards, and streets.

Secchi Disk – a round, white, metal disk that is used to determine water clarity. It is lowered into the water until it is not visible. The depth is recorded, and then the disk is raised until it is visible. The mean value of the two readings gives the clarity.

Secchi Disk Transparency (SDT) - the term used in describing the results of a secchi reading expressed in feet or meters.

Soluble Reactive Phosphorus (SRP) – a form of phosphorus that dissolves in water and is readily available (bio-available) to algae and has an immediate effect on algae growth and DO depletion. Its concentration varies widely over short periods of time as plants take it up and release it.

St. Paul Regional Water Service (SPRWS) – Agency which assists VLAWMO with water quality testing and controls the Vadnais chain of lakes, which supplies drinking water to the city of St. Paul.

Surface Water Assessment Grant (SWAG) - Grant awarded by the PCA to help fund surface water monitoring

Total Kjehldahl Nitrogen (TKN) – The sum of NO2, NO3, and NH3 in a water body. High measurements of TKN typically results from sewage and manure discharges to water bodies.

Total Maximum Daily Load (TMDL) – Calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards and an allocation of that amount to the pollutant's source.

Total Nitrate and Nitrite Nitrogen - Nitrate (NO3) plus nitrite (NO2) as nitrogen. In lakes, most nitrate/nitrogen is in NO3 form.

Total Phosphorus (TP) – A nutrient essential to the growth of organisms, and is commonly the limiting factor in the primary productivity of surface water bodies. Total phosphorus includes the amount of phosphorus in solution (reactive) and in particle form. Agricultural drainage, wastewater, and certain industrial discharges are typical sources of phosphorus, and can contribute to the eutrophication of surface water bodies.

Total Suspended Solids (TSS) – Very small particles remaining dispersed in a liquid due to turbulent mixing that can create turbid or cloudy conditions. A measure of the material suspended in water in mg/l. Total suspended solids (TSS) cause: a) interference with light penetration, b) buildup of sediment and c) potential reduction in aquatic habitat. Solids also carry nutrients that cause algal blooms and other toxic pollutants that are harmful to fish. Clay, silt, and sand from soils, phytoplankton (suspended algae), bits of decaying vegetation, industrial wastes, and sewage are common suspended solids.

Trophic Status Indicator (TSI) – TSI is an indicator of water quality. Lakes can be divided into three categories based on trophic state – oligotrophic, mesotrophic and eutrophic. A natural aging process occurs in lakes which cause them to change from oligotrophic to eutrophic over time and eventually fill in. Humans can accelerate this process by allowing nutrients from agriculture, lawn fertilizers, streets, septic systems, and urban storm drains to enter lakes. Trophic status is determined through TP, Chl A, and SDT measurements.

Turbidity – a water quality parameter that refers to how clear the water is. It is an indicator of the concentration of suspended solids in the water. Excessive sedimentation in streams and rivers is considered

to be the major source of surface water pollution in the United States. Polluted waters are commonly turbid. Turbidity is expressed in NTU (Nephelometric Turbidity Units).

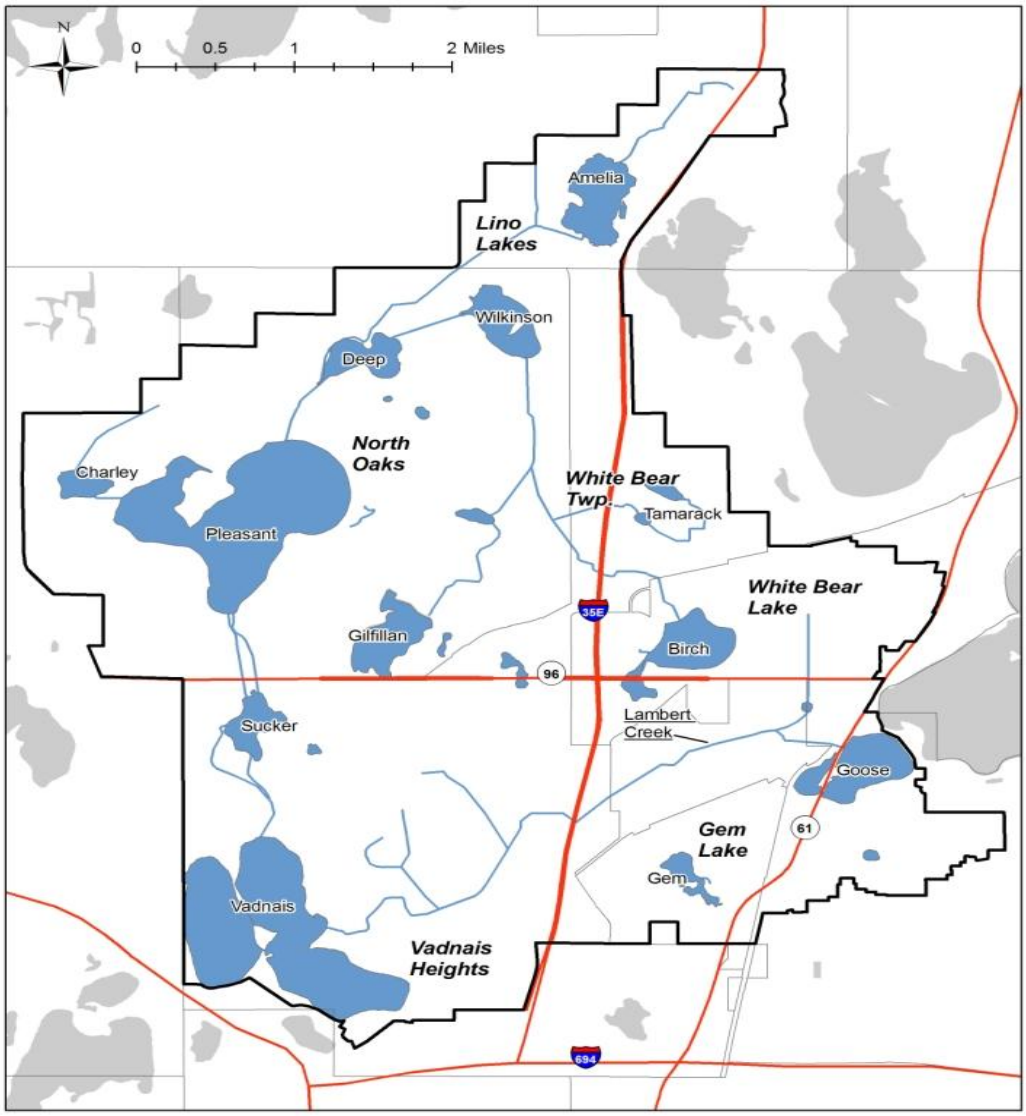
Volatile Suspended Solids (VSS) – a measure of the organic matter in suspended particles. When measured in conjunction with TSS, the proportions of organic versus mineral content of the particles can be determined.

Introduction

The Vadnais Lake Area Water Management Organization (VLAWMO) covers approximately 25 square miles in the northeast metropolitan area. The watershed encompasses the City of North Oaks and portions of the Cities of White Bear Lake, Gem Lake, Vadnais Heights, Lino Lakes, and White Bear Township. The watershed is 96% urbanized; agricultural land exists in the northern end of the boundaries. New land development is occurring near Gem Lake and Wilkinson Lake. Data collected through this program tracks changes in water quality in conjunction with the change in land use around these water bodies.

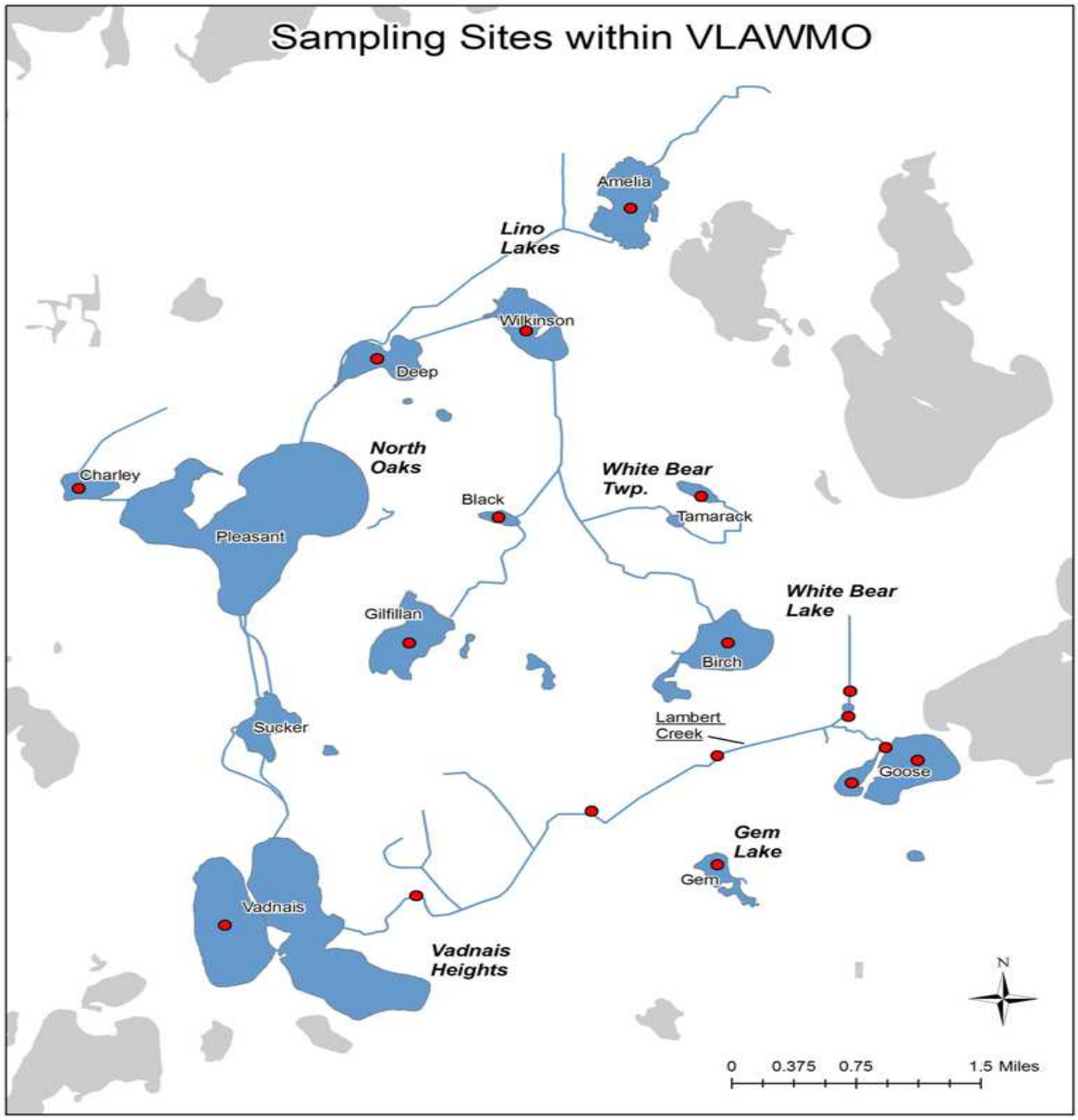
VLAWMO works in conjunction with the St. Paul Regional Water Service (SPRWS) on water quality monitoring. The SPRWS monitors the direct surface water flow into Vadnais Lake to assure high quality drinking water for over 400,000 consumers. The SPRWS monitors the main chain of lakes (Charley Lake, Pleasant Lake, Sucker Lake and Vadnais Lake) and while VLAWMO monitors Lambert Creek which flows directly into Vadnais Lake.

Figure 1: Map of VLAWMO



VLAWMO began the Citizens Lake Monitoring Program (CLMP) in 1997 to monitor several lakes and ponds within the watershed that were identified as having local significance. CLMP volunteers have helped collect samples from 12 water bodies: Amelia Lake, Birch Lake, Black Lake, Charlie Lake, Deep Lake, Gem Lake, Gilfillan Lake, Goose Lake East, Goose Lake West, Tamarack Lake, West Vadnais Lake and Wilkinson Lake. These lakes are all shallow with average depths no greater than 9 feet. Six areas along Lambert Creek are also sampled as part of the Organization's mission to protect and improve the water-related environment. The data received from the monitoring is used by VLAWMO and the Minnesota Pollution Control Agency (MPCA) to determine the health of the state's waters.

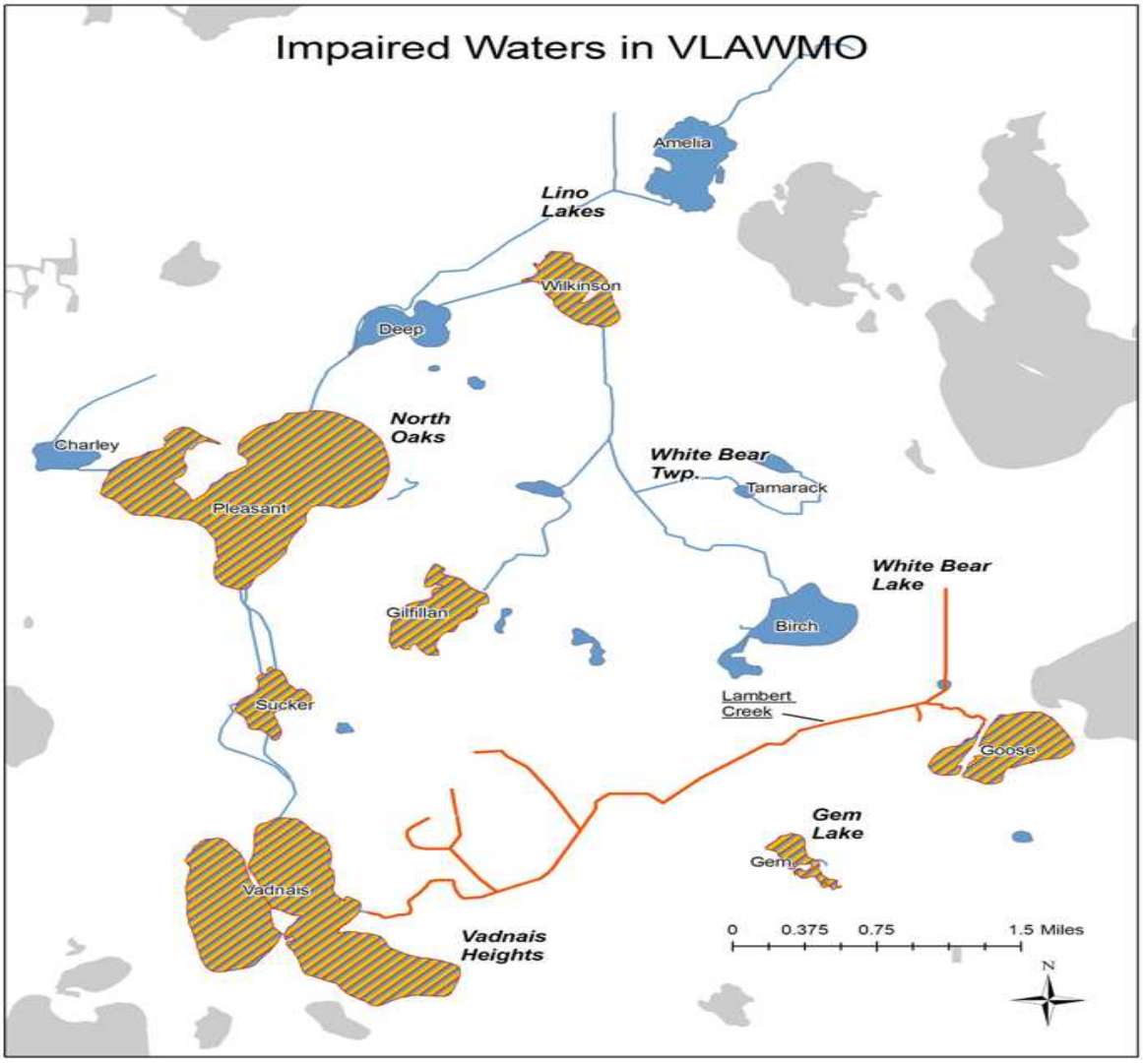
Figure 2: Sites Monitored by VLAWMO



Impaired Water Designations

The watershed has had several water bodies listed on the MPCA 303(d) list for Impaired Waters. The SPRWS Chain of Lakes (Pleasant, Sucker and Vadnais Lakes) have all been listed for nutrient pollution, specifically mercury. These lakes have been infested with zebra mussels, an aquatic invasive species, though this is not a condition of the Impaired Waters listing. This chain of lakes is fed by the Mississippi River through a pump in Fridley, MN. Lambert Creek (including Goose Lake and Whitaker Pond) has been added to the impaired list for bacteria, specifically fecal coliform or E. coli. Gem Lake, Gilfillan Lake, Goose Lake and Wilkinson Lake, impaired for nutrients, have also been added to the study due to the PCA's new "watershed wide' approach for TMDL's to make them more efficient. These water bodies are now scheduled for a TMDL study to determine the extent of pollution and if possible, where the pollutant is coming from. VLAWMO will initiate the study for Lambert Creek, Gilfillan, Wilkinson, Goose and Gem; while SPRWS will manage the study for Pleasant, Sucker, and Vadnais. Study began fall of 2010, still in review stage.

Figure 3: Waterbodies listed on the MPCA 303(d) Impaired Waters List



Typical Measurements for Lakes and Streams

VLAWMO's watershed falls within the North Central Hardwood Forest (CHF) ecoregion. This ecoregion is an area of transition between the forested areas to the north and east and the agricultural areas to the south and west. The terrain varies from rolling hills to smaller plains. Non-urbanized upland areas are forested by hardwoods and conifers. Plains include livestock pastures, hay fields and row crops such as potatoes, beans, peas and corn.

The ecoregion contains many lakes, and water clarity and nutrient levels are moderate. Land surrounding many of these lakes has been developed for housing and recreation, and the densely populated metropolitan area dominates the eastern portion of this region. Water quality problems that face many of the water bodies in the area are associated with contaminated runoff from paved surfaces and lawns.

Below are typical measurements one might find for lakes and streams in the CHF ecoregion:

Lakes							
Field pH	TSS (mg/L)	NO_X (µg/L)	TP (µg/L)	Turb (NTU)	SDT (m)	Chl-a (µg/L)	TKN (µg /L)
8.6 – 8.8	2 – 6	<100	23 – 50	1 – 2	1.5 – 3.2	5 – 22	600 - 1200
Streams							
Field pH	TSS (mg/L)	NO_X (µg/L)	TP (µg/L)	Turb (NTU)	Fecal Coliform (cfu/100 ml)	Temp (°C)	BOD (in mg/L)
7.9 – 8.3	4.8 – 16	4 - 26	6 – 15	3 – 8.5	40 – 360	2 – 21	1.5 – 3.2

The MPCA has water quality standards based on a designated use for the water body. VLAWMO's water is classified as "2B". The SPRWS chain of lakes has a stricter designation of "2Bd" due to it being the drinking water source for St. Paul. The quality of Class 2B water must be suitable for aquatic recreation of all kinds as well as to support fish and aquatic plant life. In 2008, the MPCA approved new standards which will separate deep from shallow lakes. All of the lakes VLAWMO monitors are considered shallow and therefore those standards will apply. For those parameters which the MPCA does not have standards, the federal Environmental Protection Agency (EPA) has maximum contaminant level standards. VLAWMO's goal is to have its waterbodies within these standards.

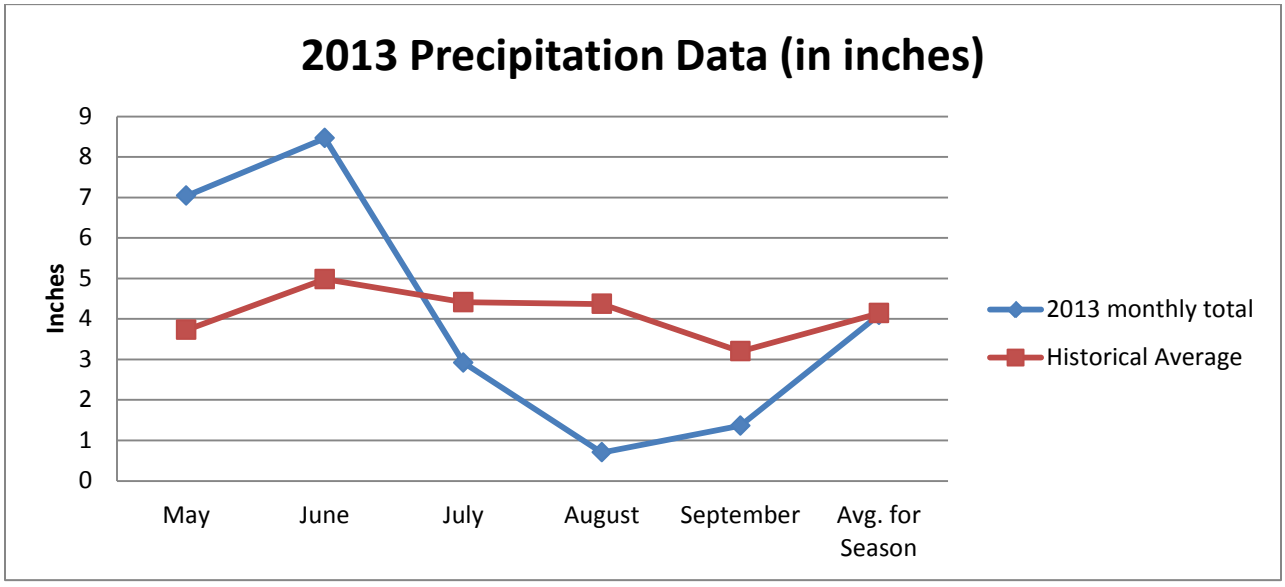
MPCA Standards Lakes					**EPA Standards**	
TP (µg/L)	Chl A (µg/L)	SDT (m)	Turb (NTU)	TSS (mg/L)	TKN (µg/L)	NO_2 (µg/L)
< 60	< 20	> 1	< 25	< 100	< 1000	< 100
MPCA Standards – Rivers and Streams					**EPA Standards**	
Fecal Coliform daily maximum (cfu/100 ml)	Chloride (Cl) chronic (mg/L)	Turb (NTU)	TSS (mg/L)	Un-ionized Ammonia (µg/L)	TKN (µg/L)	NO_2 (µg/L)
< 1260	< 230	< 25	< 100	<40	< 1000	< 100

Precipitation in 2013

Major factors influence water quality including the amount of precipitation, timing of precipitation events, and land use practices in the watershed. Long-term monitoring is necessary to characterize the impacts of various land use practices on surface water runoff within VLAWMO.

The 2013 monitoring season precipitation was very similar to 2012's season, early high rain amounts in spring and early summer with very little to no rain middle of the season with average rainfall end of season. The sampling season was 0.05" below average (May through September), compared to 0.28" below average in 2012. Precipitation moves contaminants resting on lawns, roofs, streets, and parking lots into nearby water bodies or into storm sewers that outlet into water bodies. Typically, the more precipitation that occurs, the more runoff there will be in the watershed. However, the timing and intensity of the precipitation, as well as soil types, land slopes, land uses, and other factors can influence the amount of runoff that reaches the water bodies. Lack of rain can also have an effect on the concentration of nutrients and chemicals in our water bodies. With a smaller volume of water in our water bodies, the more concentrated the nutrients and chemicals can become.

2013 Precipitation Data (in inches) White Bear Lake Rain Gauge, White Bear Lake, MN			
	2013 monthly total	Historical Average	Deviation
May	7.04	3.73	3.31
June	8.46	4.98	3.48
July	2.92	4.41	-1.49
August	0.7	4.37	-3.67
September	1.36	3.2	-1.84
Avg. for Season	4.09	4.14	-0.05



- Rain gauge used for data is located at Vadnais Heights city hall

Preliminary Analysis of Lake Data

VLAWMO staff worked with volunteers to collect samples from the lakes at two-week intervals from May through September. VLAWMO staff collected all creek samples. At the time of collection, volunteers measure water transparency with a Secchi disk (SDT), evaluate the physical and recreational conditions of the water, and if available, take a lake level reading. Samples are brought to Braun Intertec by VLAWMO staff within 24 hours for chemical analysis. Parameters measured at the lab include Phosphorus (TP &SRP), Chlorophyll-a (Chl A), total Kjeldahl Nitrogen, nitrate, ammonia and Total Suspended Solids (TSS). The data from these tests aid in the determination of the state of the water quality in a particular lake or stream and allow for monitoring of the long term health of the water body. Standards for water quality are set by the US Environmental Protection Agency (EPA) and enforced through the MPCA.

A measure of the lake health and lake age is Carlson's Trophic State Index (TSI), which measures the productivity level of a lake or degree of eutrophication. As a lake ages, it becomes more eutrophic, however human impact speeds up the process. High TSI values can relate to poorer water quality but not always. Trophic state is an absolute scale that describes the biological condition of a water body. Water quality, on the other hand, is a term used to describe the condition of a water body in relation to human needs or values

Water quality grades are given to each lake based on standards established by the Metropolitan Council. The standards give a range to each letter grade for the June – September averages of TP concentration, Chl A concentration, and SDT. The overall lake water quality grade is the average of the grades for each parameter. Other indicators of lake condition, such as aquatic plant growth or invasive species are not factored into the grades. As of 2013, the letter grades assigned to VLAWMO water bodies are as listed below:

VLAWMO Lake Grades

Lake	Grade	TSI Status
Amelia	B-	Eutrophic
Birch	B+	Mesotrophic
Black	B+	Mesotrophic
Charlie	C	Eutrophic
Deep	C	Eutrophic
Gem	B	Mesotrophic
Gilffilan	C+	Eutrophic
E. Goose	D-	Eutrophic - Hypereutrophic
W. Goose	C-	Eutrophic
Tamarack	D	Eutrophic - Hypereutrophic
Wilkinson	C	Eutrophic

Below is the raw data and chart explaining the TSI Status

2013 Data	avg SDT (m)	Tsi (SDT)	avg CHL (ug)	Tsi (CHL)	avg TP (ug)	Tsi(TP)
Amelia	1.1	59	19	59	39	57
Birch	2	50	3	41	30	53
Black	2	50	6	48	32	54
Charlie	1	60	11	54	57	62
Deep	1	60	21	60	121	73
Gem	2	50	17	58	35	55
Gilfillan	1	60	15	57	38	57
Goose East	0.5	70	112	77	265	85
Goose West	1	60	32	65	104	71
Tamarack	0.5	70	50	69	119	73
West Vadnais	0.4	73	59	71	79	67
Wilkinson	0.9	62	27	63	159	77

A list of possible changes that might be expected in a north temperate lake as the amount of algae changes along the trophic state gradient.

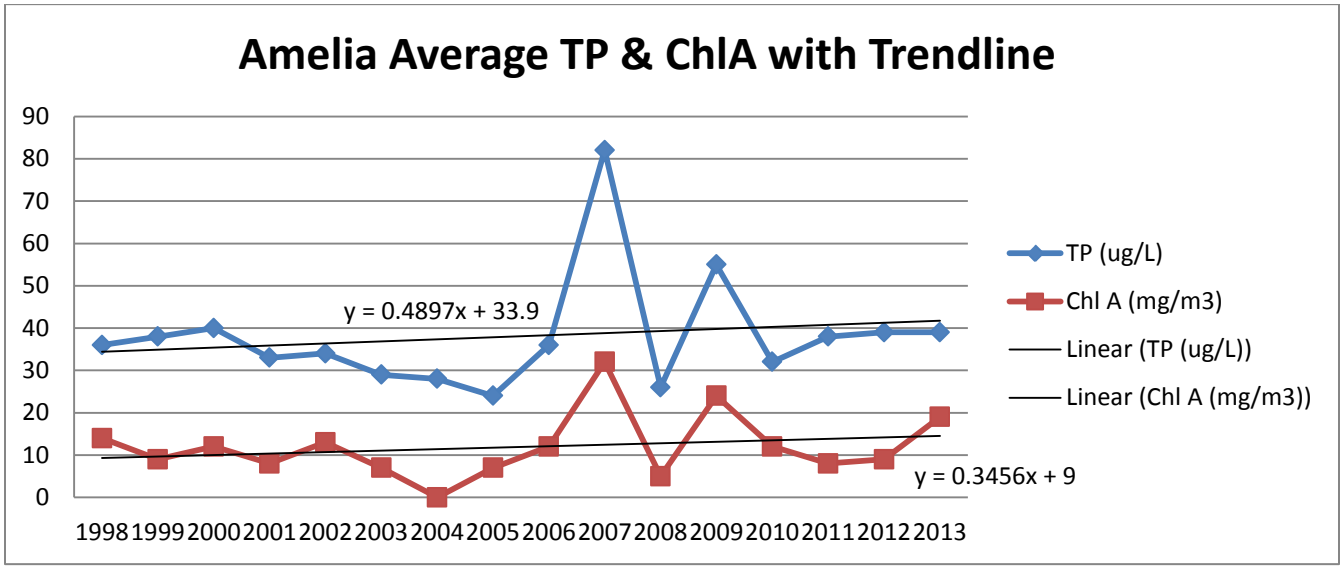
TSI	Chl (ug/L)	SD (m)	TP (ug/L)	Attributes	Water Supply	Fisheries & Recreation
<30	<0.95	>8	<6	**Oligotrophy:** Clear water, oxygen throughout the year in the hypolimnion	Water may be suitable for an unfiltered water supply.	Salmonid fisheries dominate
30-40	0.95-2.6	8-4	6-12	Hypolimnia of shallower lakes may become anoxic		Salmonid fisheries in deep lakes only
40-50	2.6-7.3	4-2	12-24	**Mesotrophy:** Water moderately clear; increasing probability of hypolimnetic anoxia during summer	Iron, manganese, taste, and odor problems worsen. Raw water turbidity requires filtration.	Hypolimnetic anoxia results in loss of salmonids. Walleye may predominate
50-60	7.3-20	2-1	24-48	**Eutrophy:** Anoxic hypolimnia, macrophyte problems possible		Warm-water fisheries only. Bass may dominate.
60-70	20-56	0.5-1	48-96	Blue-green algae dominate, algal scums and macrophyte problems	Episodes of severe taste and odor possible.	Nuisance macrophytes, algal scums, and low transparency may discourage swimming and boating.
70-80	56-155	0.25-0.5	96-192	**Hypereutrophy:** (light limited productivity). Dense algae and macrophytes		
>80	>155	<0.25	192-384	Algal scums, few macrophytes		Rough fish dominate; summer fish kills possible

VLAWMO's water resource technician completes the required data entry each year into the MPCA EQuIS program which makes the determination of impairment and opens opportunities for grants to help remedy the impairments.

2013 Monitoring Results

Amelia Lake

Amelia is located in Anoka County and is approximately 217 acres. Maximum depth for the lake is 3 feet. The majority of agricultural land left in the watershed is near Amelia Lake. VLAWMO staff was also collected all DO and YSI parameter readings on Amelia. VLAWMO has been monitoring Amelia since 1997. As you can see from the data below the trend for both TP and ChlA has been slightly upward over the last 15yrs. Overall Amelia is below the state standard of 60ug/L for TP and 25mg/m3 for ChlA over the last three years. Runoff and rain events are a big factor in these parameters for Amelia due to the amount of agricultural land surrounding the lake.



Amelia Lake Data

Amelia Lake Historical Avg TP/Chl A/SDT				Lake	Date	reading depth (ft)	Temp C	conductivity (mS/cm)	DO (mg/l)	pH
	TP (ug/L)	Chl A (mg/m3)	Secchi (m)	amelia	5/15/2013	b	13.65	0.54	7.15	7.6
1997	28	0	1.5	amelia		t	15.31	0.422	10.06	7.44
1998	36	14	1.1	amelia	6/11/2013	b	18.06	0.434	7.68	7.66
1999	38	9	1.2	amelia		t	19.02	0.411	10.3	7.55
2000	40	12	0.9	amelia	7/16/2013	b	21.83	0.463	2.54	7.47
2001	33	8	1.1	amelia		t	27.8	0.37	7.32	8
2002	34	13	1.4	amelia	8/22/2013	b	23.12	0.426	7	8
2003	29	7	1.5	amelia		t	24.4	0.423	8.6	7.89
2004	28	0	0							
2005	24	7	0							
2006	36	12	0							
2007	82	32	0.4							
2008	26	5	1.1							
2009	55	24	0.9							
2010	32	12	1.1							
2011	38	8	1.1							
2012	39	9	1.1							
2013	39	19	1.1							

- YSI parameters are good for Amelia Lake, no signs of concern. Red values indicate averages above state standard

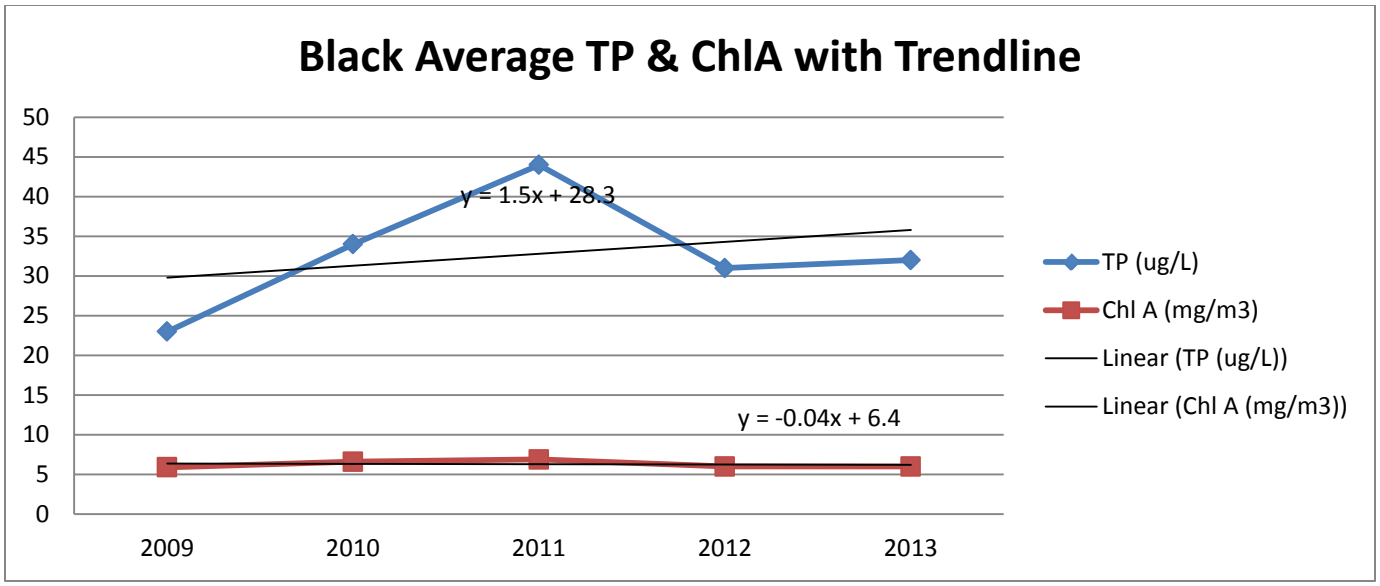
Amelia Lake 2013 Raw Data

SITE	DATE	Secchi (ft)	TP (mg/L)	ChlA (ug/l)	TKN (mg/L)	NH3 (mg/L)	NO3 mg/L	CL (mg/L)
amelia	5/7/2013							68
amelia	5/7/2013	4.5	0.039	8	2.3	0.046	0.083	
amelia	5/21/2013	3.25	0.048	15				
amelia	6/4/2013	3.25	0.043	8	2.5	0.052	0.018	
amelia	6/18/2013	3.75	0.049	2.7				
amelia	7/9/2013	3.25	0.03	23	0.58	0.016	ND	
amelia	7/23/2013	3.25	0.035	20				
amelia	8/13/2013	4	0.029	16	2	0.0056	ND	
amelia	8/27/2013	3.25	0.03	32				
amelia	9/10/2013	3.5	0.058	72	2.3	0.031	ND	
amelia	9/24/2013	4	0.025	1.3				

- Nitrogen and anemonia levels are well below state standards for Amelia Lake

Black Lake

Black Lake is located in North Oaks. There is very little developed land or roads around the lake. The lake is about 10 acres and has a maximum depth of 8 feet. VLAWMO began to monitor Black Lake in 2009. Black Lake is also one of, if not the only lake left within VLAWMO that has a significant population of wild rice. Access to the lake is minimal and the lake is surrounded by private property, is very isolated and has a wetland fringe. Black Lake is one of the healthiest lakes within VLAWMO with all lake nutrient parameters well below the state standards.



Black Lake Data

Black Lake Historical Avg TP/Chl A/SDT				Lake	Date	reading depth (ft)	Temp C	conductivity (mS/cm)	DO (mg/l)	pH
	TP (ug/L)	Chl A (mg/m3)	Secchi (m)	black	5/15/2013	b	14.62	0.314	6.18	7.02
2009	23	5.9	2	black		m	15.16	0.245	10.24	6.81
2010	34	6.6	2.1	black		t	15.58	0.245	11.01	7.32
2011	44	6.9	2.3	black	6/11/2013	b	16.54	0.229	11.78	7.8
2012	31	6	2.4	black		t	19.18	0.227	12.15	7.71
2013	32	6	2	black	8/22/2013	b	21.23	0.263	2.09	6.98
				black		t	24.13	0.241	5.78	7.62

- Black Lake YSI parameters are very good for this type of lake. Black Lake is around 8 ft deep and does show some signs of stratification

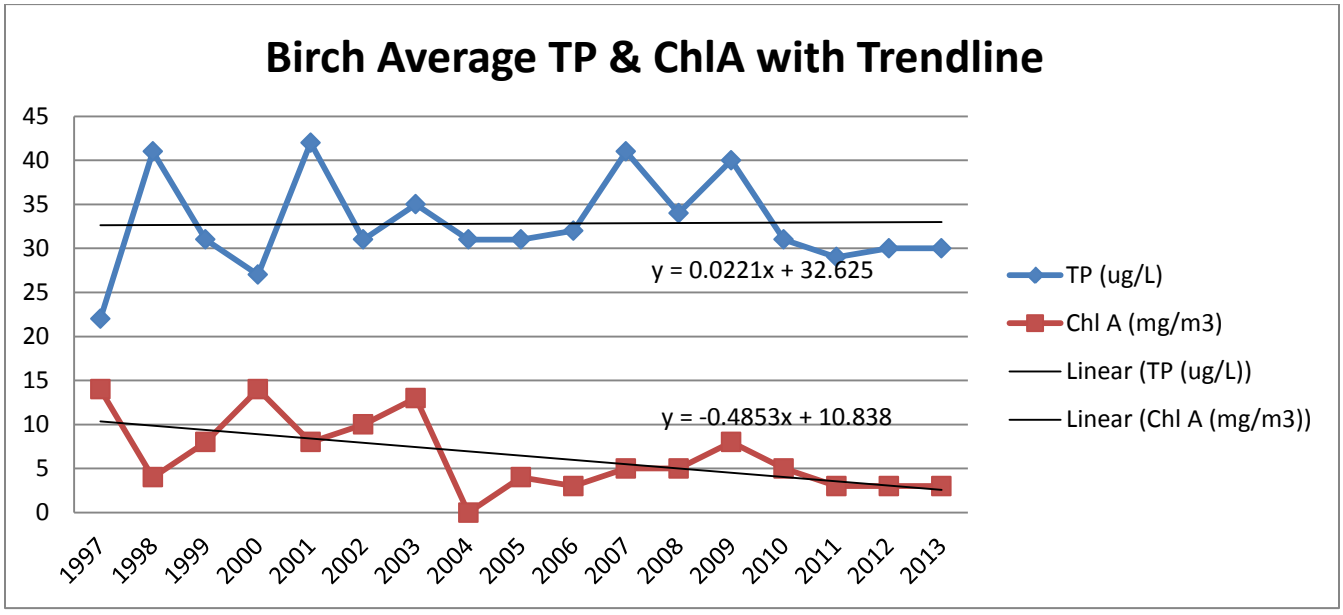
Black Lake Raw Data

SITE	DATE	Secchi (ft)	TP (mg/L)	ChlA (ug/l)	TKN (mg/L)	NH3 (mg/L)	NO3 mg/L	CL (mg/L)
black	5/7/2013							5
black	5/7/2013	6	0.032	6.7	0.97	0.24	0.081	
black	5/21/2013	4	0.029	6.7				
black	6/4/2013	5.5	0.021	5.3	0.73	0.051	ND	
black	6/18/2013	6.5	0.027	ND				
black	7/23/2013	6	0.019	5.3				
black	8/13/2013	5.5	0.02	5.3	0.81	0.028	ND	
black	8/27/2013	5	0.022	2.7				
black	9/10/2013	5	0.012	11	0.87	ND	ND	

- Nitrogen and anemonia levels are well below state standards for Black Lake

Birch Lake

Birch Lake is located within the City of White Bear Lake and is 127 acres with a maximum depth of 6 feet. Land is completely developed around Birch Lake and there are 4 storm sewer inlets around the lake. Birch Lake is a rare find in the metropolitan area because of its clarity and water quality. Results of Chl A and TP are very low for such an urbanized water body. TP has had a slight up trend over the last 16 years while ChlA has had a slight down trend during that same time period. This is somewhat unusual because TP and ChlA usually go up and down together.



Birch Lake Data

Birch Lake Historical Avg TP/Chl A/SDT				Lake	Date	reading depth (ft)	Temp C	conductivity (mS/cm)	DO (mg/l)	pH
	TP (ug/L)	Chl A (mg/m3)	Secchi (m)	birch	5/15/2013	b	15	0.383	9.83	8
1997	22	14	2.4	birch		t	15.49	0.382	10.16	7.95
1998	41	4	2.4	birch	6/11/2013	b	18.31	0.378	10.61	8.01
1999	31	8	2.4	birch		t	18.46	0.379	10.17	8.07
2000	27	14	2.4	birch	7/16/2013	b	26.5	0.363	7.55	8.15
2001	42	8	2.4	birch		t	27.68	0.362	8.49	8.17
2002	31	10	2.4	birch	8/22/2013	b	24.94	0.385	8.4	8.24
2003	35	13	2.4	birch		t	24.92	0.389	8.23	7.85
2004	31	0	2.4							
2005	31	4	2.4							
2006	32	3	2.4							
2007	41	5	2.4							
2008	34	5	1.2							
2009	40	8	1.1							
2010	31	5	1							
2011	29	3	2							
2012	30	3	2							
2013	30	3	2							

- YSI parameters are very good for Birch Lake. Conductivity is on the high side but not unusual for a metro lake. This is most likely due to the amount of raod runoff that enters Birch Lake

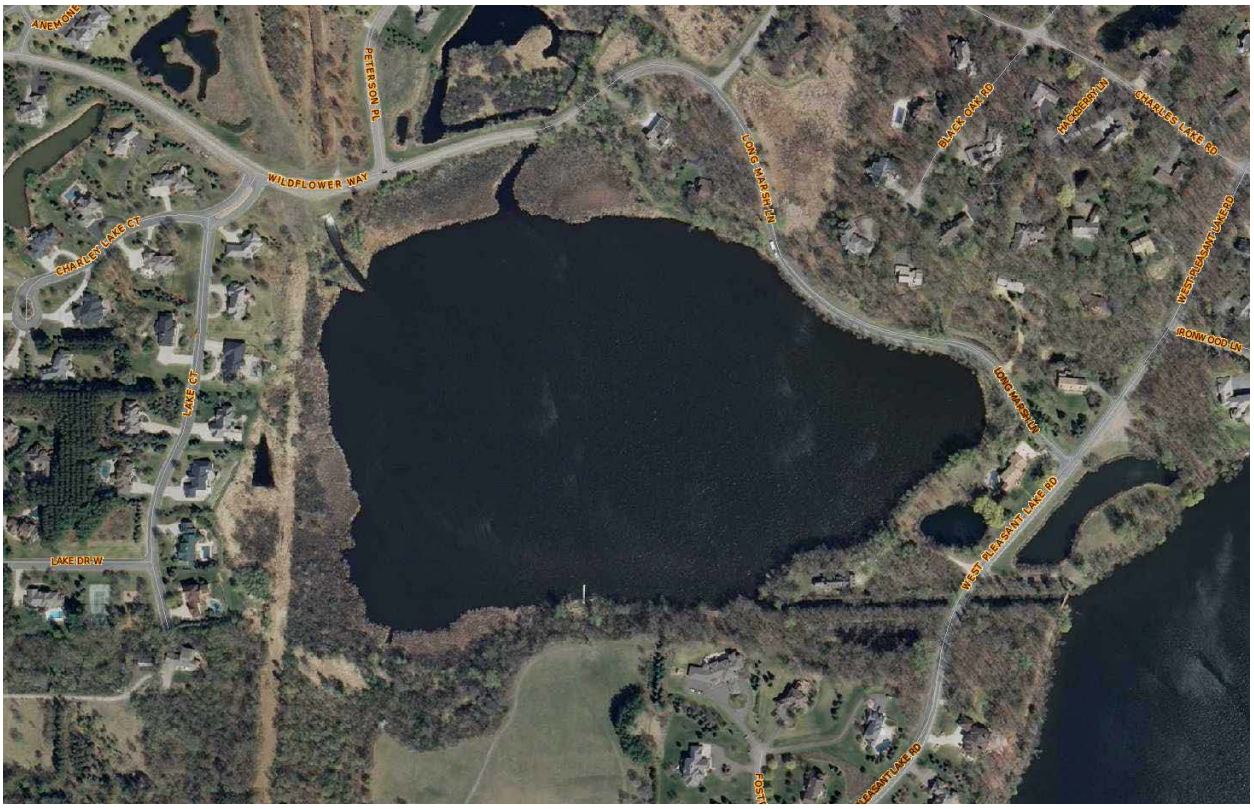
Birch Lake Raw Data

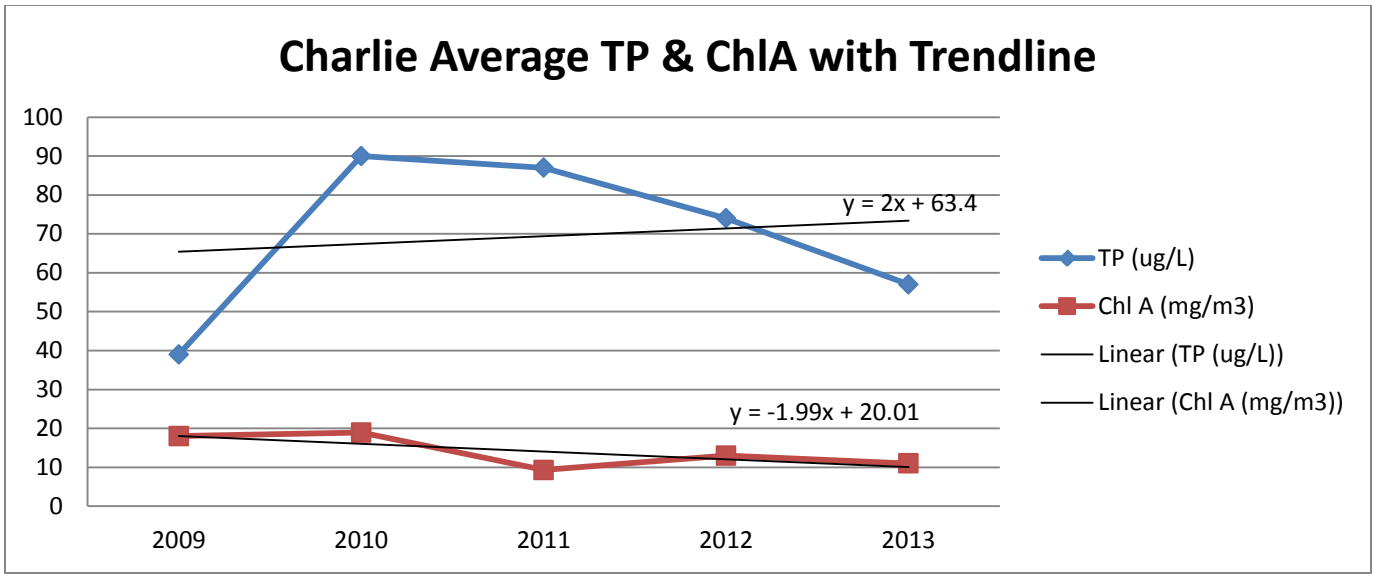
SITE	DATE	Secchi (ft)	TP (mg/L)	ChlA (ug/l)	TKN (mg/L)	NH3 (mg/L)	NO3 mg/L	CL (mg/L)
birch	5/7/2013							89
birch	5/7/2013	4.5	0.027	2.7	0.55	0.083	ND	
birch	5/21/2013	5	0.042	6.7				
birch	6/4/2013	>4	0.032	1.3	0.81	0.078	0.016	
birch	6/18/2013	5	0.038	2.7				
birch	7/9/2013	4.5	0.034	1.3	0.84	0.0098	ND	
birch	7/23/2013	4.5	0.029	1.3				
birch	8/13/2013	5.5	0.032	5.3	0.66	0.042	ND	
birch	8/27/2013	2.5	0.03	2.7				
birch	9/10/2013	4.5	0.0069	4	0.61	0.0044	ND	
birch	9/24/2013	5	0.032	2.7				

- Nitrogen and anemonia levels are well below state standards for Birch Lake

Charlie Lake

Water is pumped from the Mississippi River to Charlie Lake via a 60 inch 8 mile long pipe from a pumping station in Fridley. An average of 32 million gallons of water is pumped into Charley Lake each day. Charley Lake is the start of the chain of lakes controlled by the St. Paul Water Utility. This chain of lakes supplies drinking water for more than 400,000 customers. Most of the drinking water is coming from the Mississippi River, while some comes from wells to help cool the water and reduce treatment costs. VLAWMO began sampling Charlie in 2009.





Charlie Lake Data

Charlie Lake Historical Avg TP/Chl A/SDT				Lake	Date	reading depth (ft)	Temp C	conductivity (mS/cm)	DO (mg/l)	pH
	TP (ug/L)	Chl A (mg/m3)	Secchi (m)	charlie	5/15/2013	b	13.5	0.272	10.8	7.21
2009	39	18	1	charlie		t	14.59	0.27	11.65	7.44
2010	90	18.9	1	charlie	6/11/2013	b	18.38	0.311	12.33	7.85
2011	87	9.3	1.1	charlie		t	16.41	0.316	8.5	7.36
2012	74	13	1	charlie	7/16/2013	b	24.64	0.375	5.5	7.79
2013	57	11	1	charlie		t	26.31	0.36	7.95	7.93
				charlie	8/22/2013	b	25.54	0.421	7.15	8.01
				charlie		t	25.62	0.421	7.2	7.67

- Charlie Lake YSI parameters are good. There is a constant flow of millions of gallons of river water through Charlie lake year round and with that these parameters seem consistent with normal metro lakes

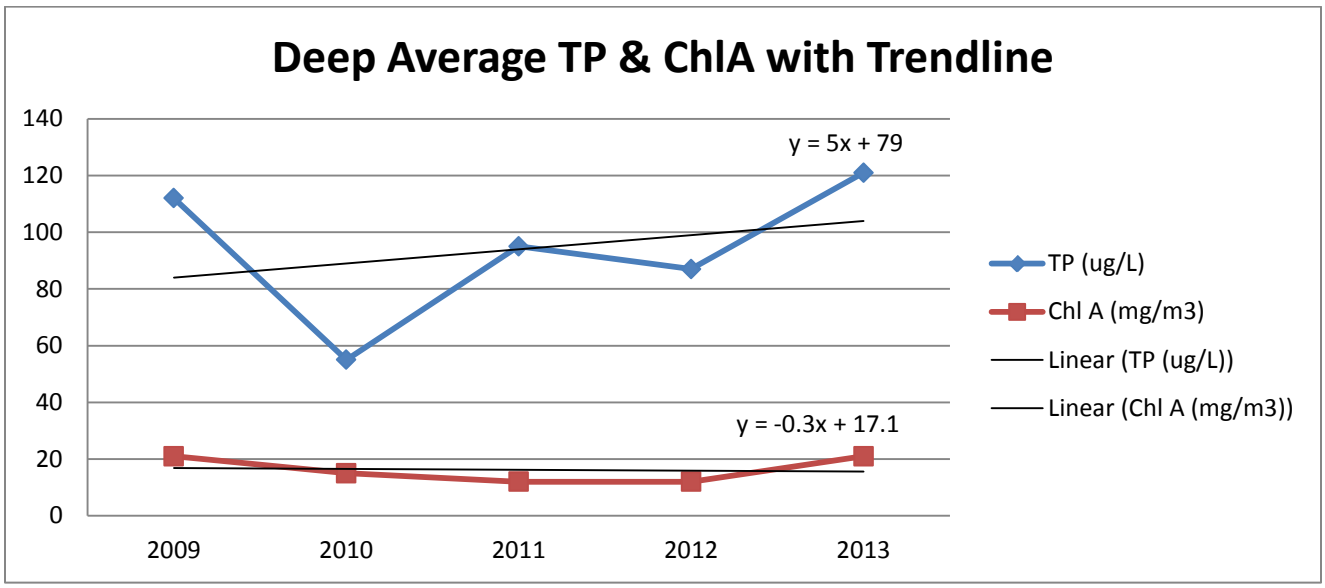
Charlie Lake Raw Data

SITE	DATE	Secchi (ft)	TP (mg/L)	ChlA (ug/l)	TKN (mg/L)	NH3 (mg/L)	NO3 mg/L	CL (mg/L)
charley	5/7/2013							30
charley	5/7/2013	4	0.064	27	1.3	0.081	0.017	
charley	5/21/2013	3	0.052	12				
charley	6/4/2013	3	0.065	20	1.2	0.086	0.12	
charley	6/18/2013	3	0.058	5.3				
charley	7/9/2013	3	0.11	11	0.87	0.16	0.23	
charley	7/23/2013	3	0.068	9.3				
charley	8/13/2013	4.5	0.036	13	0.53	0.039	0.097	
charley	8/27/2013	4	0.041	8				
charley	9/10/2013	3	0.028	8	0.44	0.038	0.26	
charley	9/24/2013	3.5	0.047	2.7				

- Nitrogen and anemonia levels are below state standards for Charlie Lake. NO3 levels are higher in Charlie compared to the rest of VLAWMO lake and is most likely due to the Mississippi water that is pumped through the lake

Deep Lake

Deep lake is a little over 80 acres and sits between and is hydro logically connected to Wilkinson Lake to the north and Pleasant Lake to the south. A canal connects the three lakes. A Deep Lake Preservation Committee was formed in 2009 by the residents living around Deep Lake to help maintain and improve the quality of the lake. A lake level gauge is also installed by VLAWMO on the lake each spring. All VLAWMO lakes are tested for nitrogen's and ammonia and Deep lake year over year tends to have the highest concentrations, although they are still below the standards. TP and ChlA have been trending downward since sampling began in 2009. By mid to late summer Deep Lake is very weedy and this has been a concern for residents.



Deep Lake Data

Deep Lake Historical Avg TP/Chl A/SDT				Lake	Date	reading depth (ft)	Temp C	conductivity (mS/cm)	DO (mg/l)	pH
	TP (ug/L)	Chl A (mg/m3)	Secchi (m)	deep	5/15/2013	b	15.54	0.398	11.95	7.54
2009	112	21	1	deep		t	16.24	0.398	11.81	8.09
2010	55	15	0.9	deep	6/11/2013	b	17.44	0.464	4.62	7.65
2011	95	12	1.2	deep		t	19	0.453	13.81	7.79
2012	87	12	1	deep	7/16/2013	b	22.21	0.574	1.5	7.36
2013	121	21	1	deep		t	24.22	0.497	4.55	7.38
				deep	8/22/2013	b	22.75	0.4	3.7	7.97
				deep		t	24.58	0.374	7.35	7.47

- Deep Lake YSI data is similar to that of Charlie Lake. Conductivity is on the high side

Deep Lake Raw Data

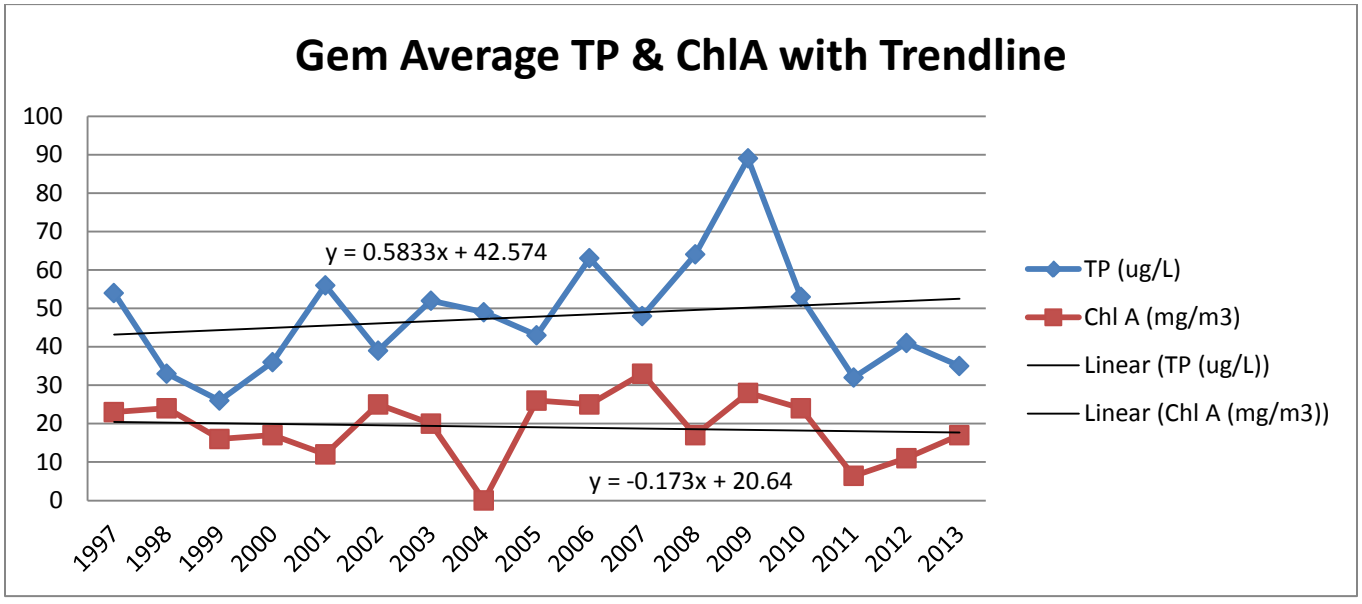
SITE	DATE	Secchi (ft)	TP (mg/L)	ChlA (ug/l)	TKN (mg/L)	NH3 (mg/L)	NO3 mg/L	CL (mg/L)
deep	5/7/2013							44
deep	5/7/2013	4	0.072	16	1	0.091	ND	
deep	5/21/2013	3	0.11	24				
deep	6/4/2013	3.5	0.068	5.3	1.3	0.15	0.02	
deep	6/18/2013	3.5	0.11	2.7				
deep	7/9/2013	4	0.1	9.3	1.1	0.021	ND	
deep	7/23/2013	3.5	1.9	170				
deep	8/13/2013	4	0.12	13	1.7	0.069	ND	
deep	8/27/2013	3.5	0.33	91				
deep	9/10/2013	3	0.68	170	15	0.16	ND	
deep	9/24/2013	3	0.062	5.3				

- Nitrogen and anemonia levels are below state standards for Deep Lake.

Gem Lake

Gem Lake is within the City of Gem Lake and has no public access. It is 25 acres in size and is 17 feet deep. There has been development along portions of the lake in recent years. In 2000, volunteers noticed a distinct algae bloom and noted that water clarity was getting poorer. Over the 16 years of monitoring data there is a slight up trend in TP levels with a slight down trend in ChlA levels.

Gem Lake has also been included on the Lambert Creek TMDL study for nutrient impairment. Recent years of monitoring data are suggesting that the trend may be heading down for nutrient levels in Gem Lake and hopefully in the near future it will be removed from the state impaired waters list. The City of Gem Lake, VLAWMO and stakeholders will be working together to implement the TMDL strategies as soon as they are approved by the EPA and MNPCA, winter 2014.



Gem Lake Data

Gem Lake Historical Avg TP/Chl A/SDT				Lake	Date	reading depth (ft)	Temp C	conductivity (mS/cm)	DO (mg/l)	pH
	TP (ug/L)	Chl A (mg/m3)	Secchi (m)	gem	5/15/2013	b	7.07	0.262	1.56	7.59
1997	54	23	1.2	gem		m	12.86	0.198	11.52	7.21
1998	33	24		gem		t	14	0.196	11.46	7.72
1999	26	16	1.2	gem	6/11/2013	b	10.02	0.24	1.28	6.61
2000	36	17	1.1	gem		m	16.29	0.2	7.49	6.99
2001	56	12	1.8	gem		t	18.65	0.199	10.17	8.29
2002	39	25	1.3	gem	7/16/2013	b	20.17	0.21	6.63	7.95
2003	52	20	1.4	gem		m	12.75	0.282	2.54	6.43
2004	49	0	1.5	gem		t	26.95	0.195	7.38	8.4
2005	43	26	0	gem	8/22/2013	b	17.4	0.243	1.76	8.27
2006	63	25	0	gem		m	23.68	0.204	7.5	8.03
2007	48	33	1.1	gem		t	24.75	0.207	8.37	8.56
2008	64	17	1.5							
2009	89	28	1.3							
2010	53	24	1.4							
2011	32	6.4	2.1							
2012	41	11	2							
2013	35	17	2							

- Gem Lake YSI data is similar to that of other metro lakes. Conductivity is pretty low which is good and usually Gem Lake shows signs of stratification. At 17ft, Gem is the deepest lake VLAWMO monitors.

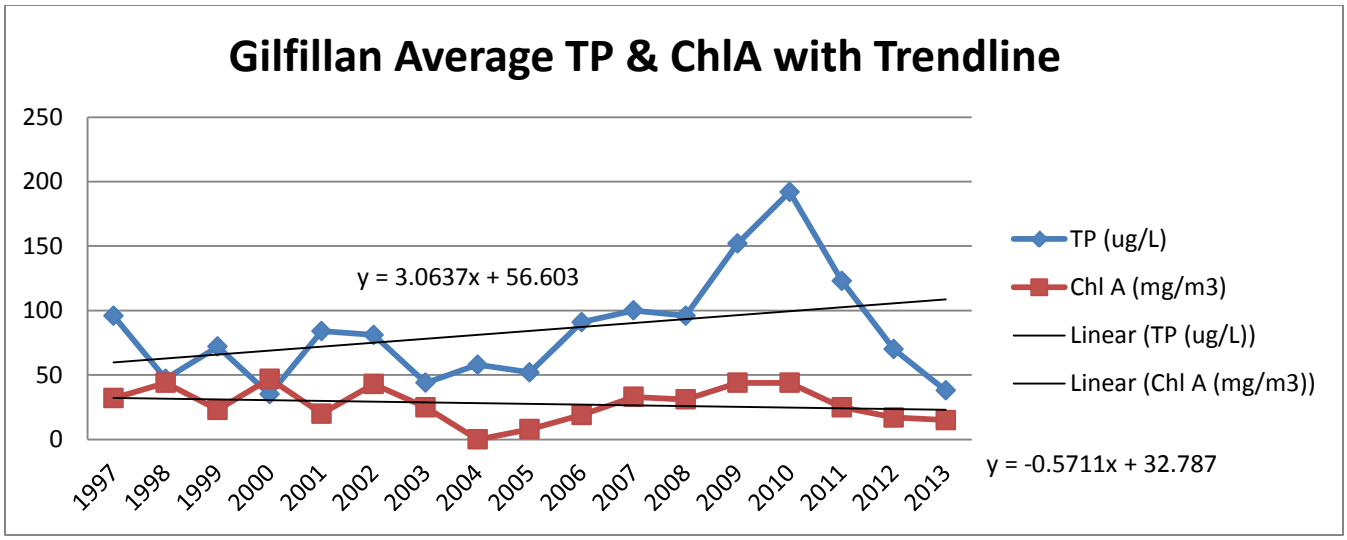
Gem Lake Raw Data

SITE	DATE	Secchi (ft)	TP (mg/L)	ChlA (ug/l)	TKN (mg/L)	NH3 (mg/L)	NO3 mg/L	CL (mg/L)
gem	5/7/2013							45
gem	5/7/2013	5.5	0.048	15	0.93	0.056	ND	
gem	5/21/2013	8	0.033	6.7				
gem	6/4/2013	7	0.029	4	0.59	0.059	ND	
gem	6/18/2013	8	0.03	1.3				
gem	7/9/2013	6	0.033	5.3	0.5	0.034	ND	
gem	7/23/2013	6	0.033	8				
gem	8/13/2013	1.5	0.044	84	1.4	0.032	ND	
gem	8/27/2013	6.5	0.031	5.3				
gem	9/10/2013	4	0.018	24	0.95	0.021	ND	
gem	9/24/2013	2.5	0.054	21				

- Nitrogen and anemonia levels are below state standards for Gem Lake.

Gilfillan Lake

Gilfillan Lake is located within the City of North Oaks and is surrounded by homes. It is 110 acres with a maximum depth of 6 feet. The Minnesota Department of Natural Resources has used the lake for walleye stocking nursery in the past. According to available information, there has not been any fish stocking activity for a few years other than homeowners socking minnows. Gilfillan is one of four VLAWMO lakes that are part of the TMDL study due to nutrient impairment. The study began fall of 2010 and should be approved by EPA and MNPCA fall of 2013 The City of North Oaks and the SPRWS have agreed to begin pumping water from Pleasant Lake to Gilfillan Lake to increase water levels. The pump, filter and piping were installed fall of 2011, pumping began spring of 2012. The increased water level (about 2.5ft) has significantly reduced nutrient levels in the lake, although they are still above state standards. The pumps were turned on in the spring of 2013 to make sure everything was working properly and were then shut off for the season. Water level stayed close to the max elevation of 910ft for the summer.



Gilfillan Lake Data

Gilfillan Lake Historical Avg TP/Chl A/SDT				Lake	Date	reading depth (ft)	Temp C	conductivity (mS/cm)	DO (mg/l)	pH
	TP (ug/L)	Chl A (mg/m3)	Secchi (m)	gilfillan	5/15/2013	b	14.19	0.319	10.01	7.07
1997	96	32	0.5	gilfillan		m	14.44	0.31	11.99	6.55
1998	47	44	0.5	gilfillan		t	15.05	0.309	12.34	7.58
1999	72	23	0	gilfillan	6/11/2013	b	17.36	0.312	7.12	7.33
2000	35	47	0	gilfillan		t	19.05	0.311	10.25	7.56
2001	84	20	0	gilfillan	7/16/2013	b	23.72	0.368	2.85	7.69
2002	81	43	0.4	gilfillan		t	27.25	0.297	8.65	7.91
2003	44	25	1.4	gilfillan	8/22/2013	b	25.07	0.352	8.3	7.89
2004	58	0	0	gilfillan		t	25.25	0.316	8.41	7.32
2005	52	8	0	site	date	Tp (ug/l)				
2006	91	19	0	Inlet Gilfillan	7/10/2012	0.034				
2007	100	33	0.7	Inlet Gilfillan	7/24/2012	0.049				
2008	96	31	0.5	Inlet Gilfillan	8/7/2012	0.033				
2009	152	44	0.4							
2010	192	44	0.4							
2011	123	25	0.4							
2012	70	17	0.8							
2013	38	15	1							

- Gilfillan Lake YSI data is similar to that of other metro lakes. Conductivity is pretty low and is consistent with other lakes that don't receive much or any road runoff. Inlet data is from 2012, shows below state standard Tp levels being pumped into main lake.

Gilfillan Lake Raw Data

SITE	DATE	Secchi (ft)	TP (mg/L)	ChlA (ug/l)	TKN (mg/L)	NH3 (mg/L)	NO3 mg/L	CL (mg/L)
gilfillan	5/7/2013							26
gilfillan	5/7/2013	5.5	0.034	11	0.99	0.077	0.021	
gilfillan	5/21/2013	3	0.025	11				
gilfillan	6/4/2013	4.5	0.031	9.3	1	0.028	ND	
gilfillan	6/18/2013	4	0.035	4				
gilfillan	7/9/2013	2	0.05	17	1.1	0.017	ND	
gilfillan	7/23/2013	2.5	0.046	19				
gilfillan	8/13/2013	2.9	0.033	17	1.1	0.018	ND	
gilfillan	8/27/2013	3.5	0.037	17				
gilfillan	9/10/2013	2	0.041	32	1.9	0.0037	ND	
gilfillan	9/24/2013	2	0.054	21				

- Nitrogen and anemonia levels are below state standards for Gilfillan Lake.

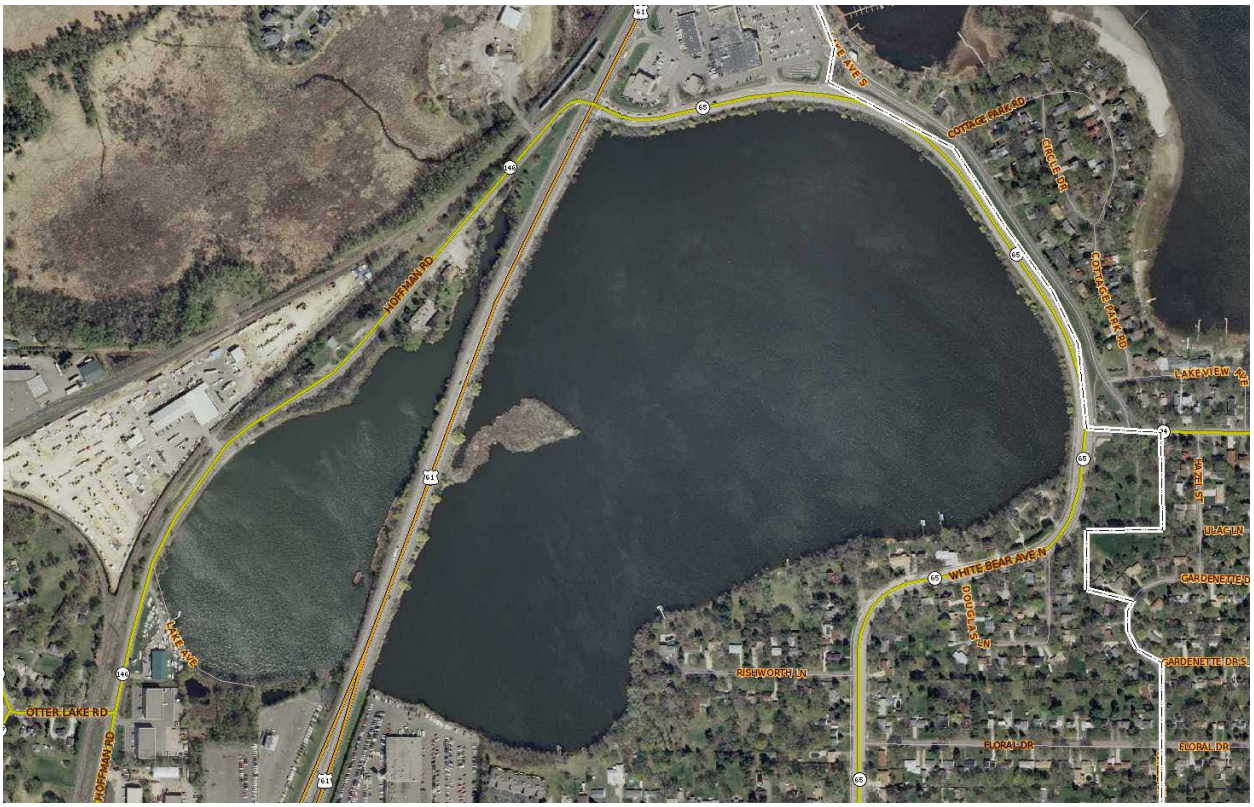
Goose Lake

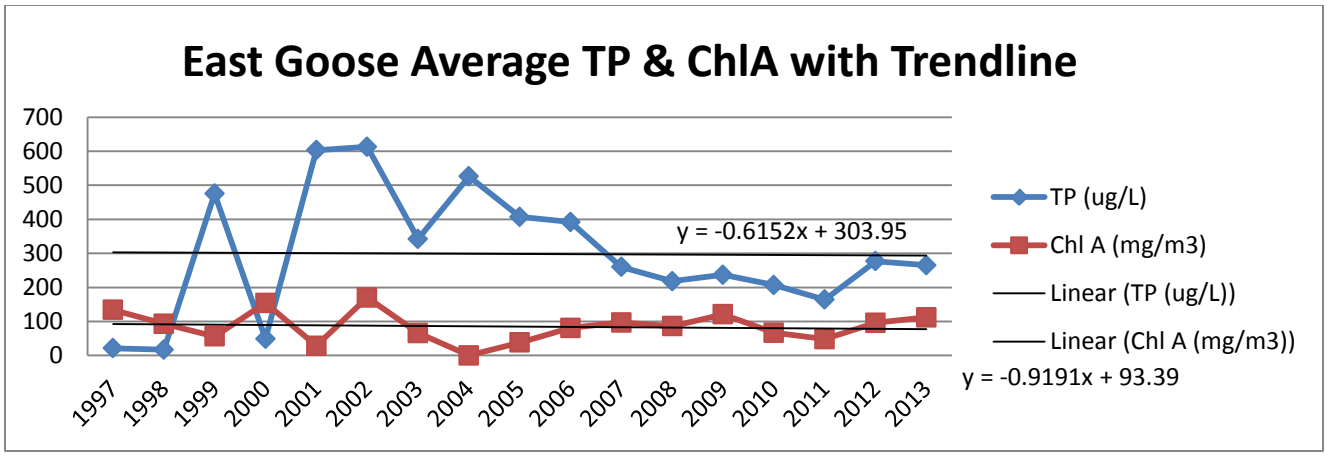
Goose Lake is located in White Bear Lake and is 145 acres with a maximum depth of 7 feet. The land use is largely residential and industrial around the lake and Highway 61 cuts through the lake. The old White Bear Lake sewage treatment plant discharged to Goose Lake for almost 50 years. A sediment study conducted in 1989 found that there was PCB contamination as well as high levels of cadmium, lead, and zinc. Another sediment study should be conducted to look for any changes in the last 20 years.

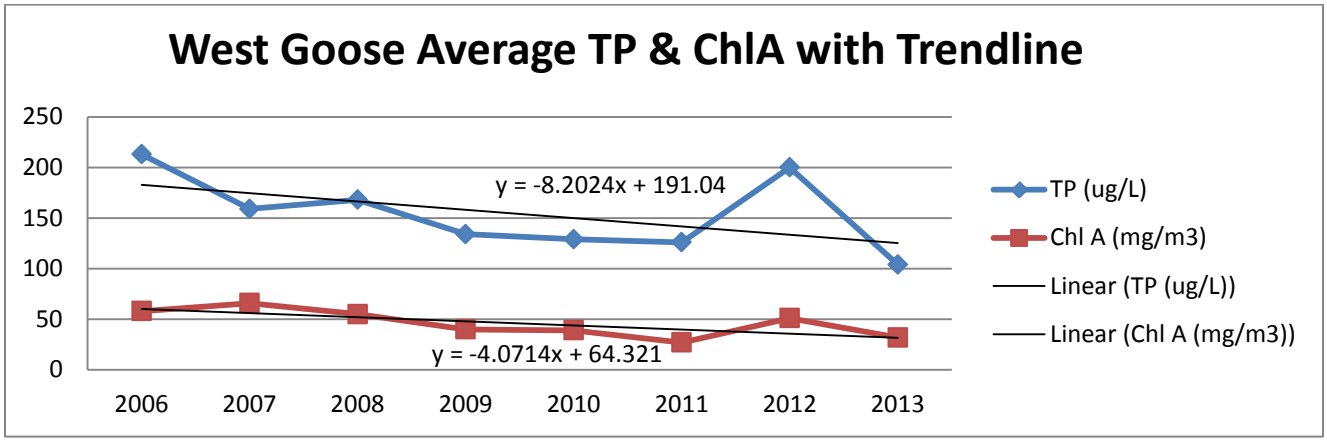
Though the lake is connected via culverts under the highway, VLAWMO began to assess the lake on each side of the road to track any differences between the two water bodies. In years past, only the east side of the lake was monitored. In 2006, VLAWMO began to collect samples from the west side. Both East and West Goose Lake are included in the Lambert Creek TMDL for nutrient impairment.

Groundwater used to cool equipment at the Kohler Mix Company is continuously discharging into the south end of West Goose Lake year round at a rate of 500 gallons/minute. This seems to be "flushing" the west side of the lake and could be a major reason the west side of the lake has consistently had better water quality compared to the east side over the years. The north end of West Goose discharges through a weir into Lambert Creek which flows into East Vadnais Lake, the drinking water reservoir for the SPRWS.

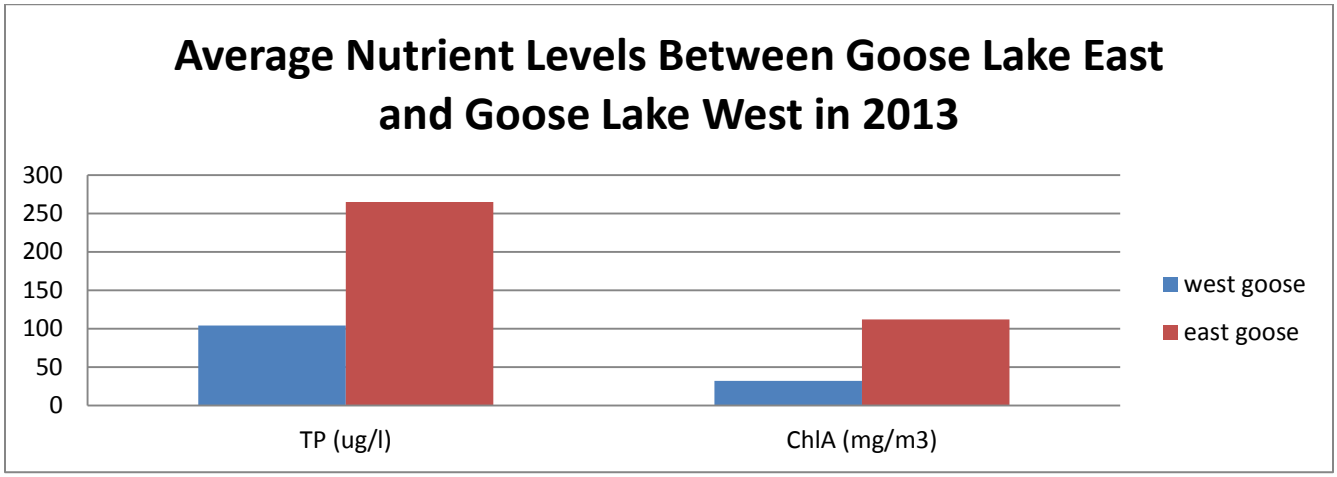
Approximately 16,000lbs of bullhead were removed out of both basins in 2013. The main source of nutrient issues in Goose Lake is from internal loading. Rough fish (bullhead, carp, sucker) suspend nutrients in the water column while foraging for food. We hope to see a decrease in nutrient levels over the next few years due to the rough fish removal.







- Both the East and West side are showing long term downward trends for both TP & ChlA. This is a good sign but both these water bodies are still well above state standards.



- Comparison of water quality between the two basins above shows that Goose Lake West has much better average TP and Chla levels compared to Goose Lake East, however both basins are still above PCA standards. TMDL will focus on strategies to move these two basins closer to state standards

Goose Lake Data

East Goose

East Goose Lake Historical Avg TP/Chl A/SDT				Lake	Date	reading depth (ft)	Temp C	conductivity (mS/cm)	DO (mg/l)	pH
	TP (ug/L)	Chl A (mg/m3)	Secchi (m)	east goose	5/15/2013	b	14.38	0.426	11.95	8
1997	21	134	0.4	east goose		t	14.41	0.426	11.93	7.95
1998	17	93	0.2	east goose	6/11/2013	b	17.92	0.409	9.53	8.04
1999	475	56	0.3	east goose		t	18.43	0.407	10.35	8.09
2000	49	154	0.3	east goose	7/16/2013	b	25.43	0.377	6.15	8.1
2001	603	28	0.3	east goose		t	26.78	0.379	10.24	8.2
2002	613	170	0.2	east goose	8/22/2013	b	24.73	0.389	9.21	8.32
2003	342	66	0.3	east goose		t	24.94	0.41	12.35	7.89
2004	526	0	0							
2005	407	38	0							
2006	392	81	0							
2007	260	97	0							
2008	218	86	0.3							
2009	237	121	0.3							
2010	207	67	0.3							
2011	164	48	0.3							
2012	277	96	0.2							
2013	265	112	0.5							

- East Goose Lake YSI data is similar to that of other metro lakes. There were sections of the lake with very low DO's. This was noticed during the fish survey when one of the 4 nets had a large number of fish kill while the other 3 nets had very little on both days of the survey

West Goose

West Goose Lake Historical Avg TP/Chl A/SDT				Lake	Date	reading depth (ft)	Temp C	conductivity (mS/cm)	DO (mg/l)	pH
	TP (ug/L)	Chl A (mg/m3)	Secchi (m)	west goose	5/15/2013	b	15.52	0.396	10.22	8.04
2006	213	58		west goose		t	15.67	0.396	10.17	8.12
2007	159	66		west goose	6/11/2013	b	18.77	0.409	9.05	8.16
2008	168	55	0.3	west goose		t	18.87	0.409	8.8	8.16
2009	134	40	0.5	west goose	7/16/2013	b	27.22	0.36	8	8.19
2010	129	39	0.5	west goose		t	27.39	0.359	8.2	8.06
2011	126	27	0.8	west goose	8/22/2013	b	24.5	0.344	8.59	7.82
2012	200	51	0.7	west goose		t	24.55	0.344	8.78	8.22
2013	104	32	1							

- West Goose Lake YSI data is similar to that of East Goose Lake. DO levels are lower on the west side. Algae levels on the West side are much less and therefore oxygen production during the day on the West side from the algae is less. DO levels are still good.

Goose Lake Raw Data

East Goose

SITE	DATE	Secchi (ft)	TP (mg/L)	ChlA (ug/l)	TKN (mg/L)	NH3 (mg/L)	NO3 mg/L	CL (mg/L)
east goose	5/7/2013							83
east goose	5/7/2013	3.5	0.12	5.3	1.4	0.09	ND	
east goose	5/21/2013	3	0.098	13				
east goose	6/4/2013	1.5	0.11	17	1.6	0.27	0.067	
east goose	6/18/2013	1.5	0.18	4				
east goose	7/9/2013	3.5	0.16	11	0.48	0.04	ND	
east goose	7/23/2013	2	0.18	71				
east goose	8/13/2013	0.5	0.6	510	5.5	0.06	ND	
east goose	8/27/2013	0.5	0.49	200				
east goose	9/10/2013	0.5	0.41	210	5.8	0.031	ND	
east goose	9/24/2013	0.5	0.31	85				

- Nitrogen and anemonia levels are well below state standards for East Goose Lake

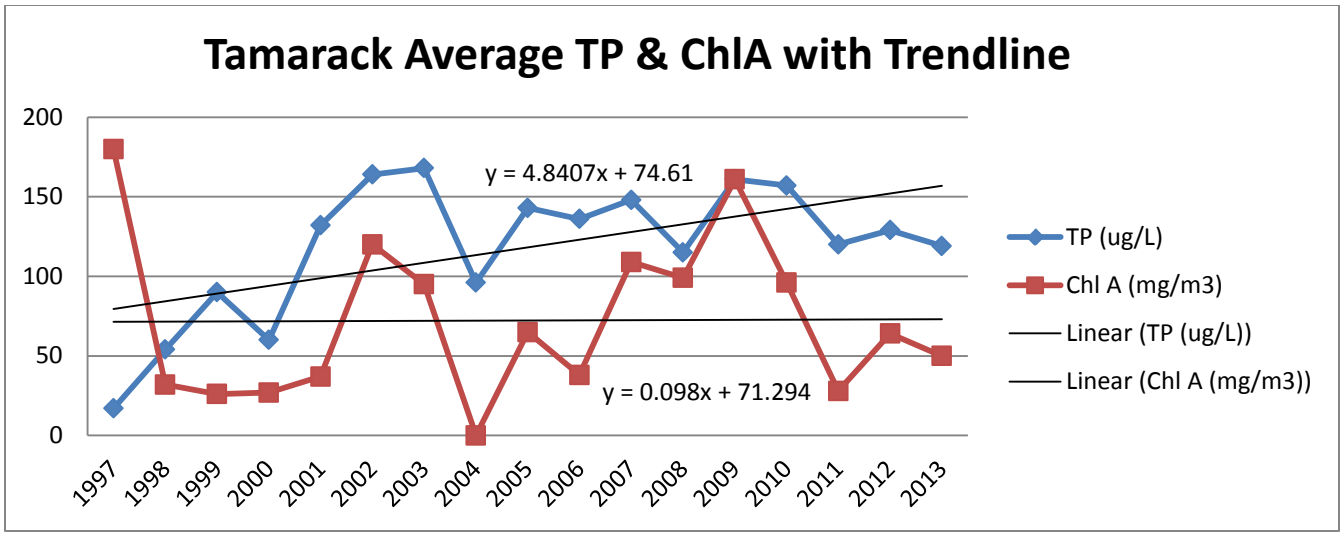
West Goose

SITE	DATE	Secchi (ft)	TP (mg/L)	ChlA (ug/l)	TKN (mg/L)	NH3 (mg/L)	NO3 mg/L	CL (mg/L)
west goose	5/7/2013							53
west goose	5/7/2013	5	0.089	1.3	1	0.18	0.029	
west goose	5/21/2013	4	0.063	11				
west goose	6/4/2013	2.50	0.064	13	1.3	0.39	0.057	
west goose	6/18/2013	2	0.083	1.3				
west goose	7/9/2013	4.75	0.066	13	0.62	0.051	ND	
west goose	7/23/2013	3.5	0.13	31				
west goose	8/13/2013	2.75	0.11	41	1.4	0.038	ND	
west goose	8/27/2013	1.5	0.15	69				
west goose	9/10/2013	2	0.17	110	3.3	0.06	ND	
west goose	9/24/2013	1.75	0.12	32				

- Nitrogen and anemonia levels are well below state standards for West Goose Lake. West side levels are slightly lower than the East side levels, overall they are pretty similar considering the big differenceses between the two basins even though they are connected.

Tamarack Lake

Tamarack Lake is part of the Tamarack Nature Center. It is 86 acres with a maximum depth of 10 feet. As there is no boat access, samples are taken from the observation dock on the southeast side of the lake. Ramsey County restored a large ditched wetland downstream of Tamarack and upstream of Fish Lake, as part of a wetland-banking project in 1997. Tamarack Lake is one of 4 lakes listed as impaired for nutrients on the 2010 Lambert Creek TMDL study. Internal loading is the major reason for the impairment. This is a very isolated lake with a large natural buffer, runoff from Hwy 35E will make its way to Tamarack on the west side after going through a large wetland. Historically Tamarack was surrounded by farmland. TP & ChlA levels are extremely high and show little sign of lowering. In the summer of 2013 VLAWMO installed a floating island on the lake. The island was planted with native vegetation. The root systems that develop below the island create a large surface area for highly beneficial microbes allowing for increased nutrient uptake and reduction in overall nutrient levels in the lake.



Tamarack Lake Data

Tamarack Lake Historical Avg TP/Chl A/SDT				Lake	Date	reading depth (ft)	Temp C	conductivity (mS/cm)	DO (mg/l)	pH
	TP (ug/L)	Chl A (mg/m3)	Secchi (m)	tamarack	5/15/2013	b	14.8	0.372	12.72	7.89
1997	17	180	0.2	tamarack		t	15.01	0.371	12.65	7.97
1998	54	32	0.5	tamarack	6/11/2013	b	17.84	0.386	7.23	7.82
1999	90	26	0.4	tamarack		t	19.04	0.379	10.62	7.76
2000	60	27	0.4	tamarack	7/16/2013	b	25.94	0.391	6.3	8.3
2001	132	37	0.4	tamarack		t	28.51	0.367	10.2	8.19
2002	164	120	0.4	tamarack	8/22/2013	b	24.56	0.366	4.12	8.13
2003	168	95	0.3	tamarack		t	24.65	0.353	5.88	7.96
2004	96	0	0.8							
2005	143	65	0							
2006	136	38	0							
2007	148	109	0.5							
2008	115	99	0.3							
2009	161	161	0.2							
2010	157	96	0.2							
2011	120	28	0.6							
2012	129	64	0.4							
2013	119	50	0.5							

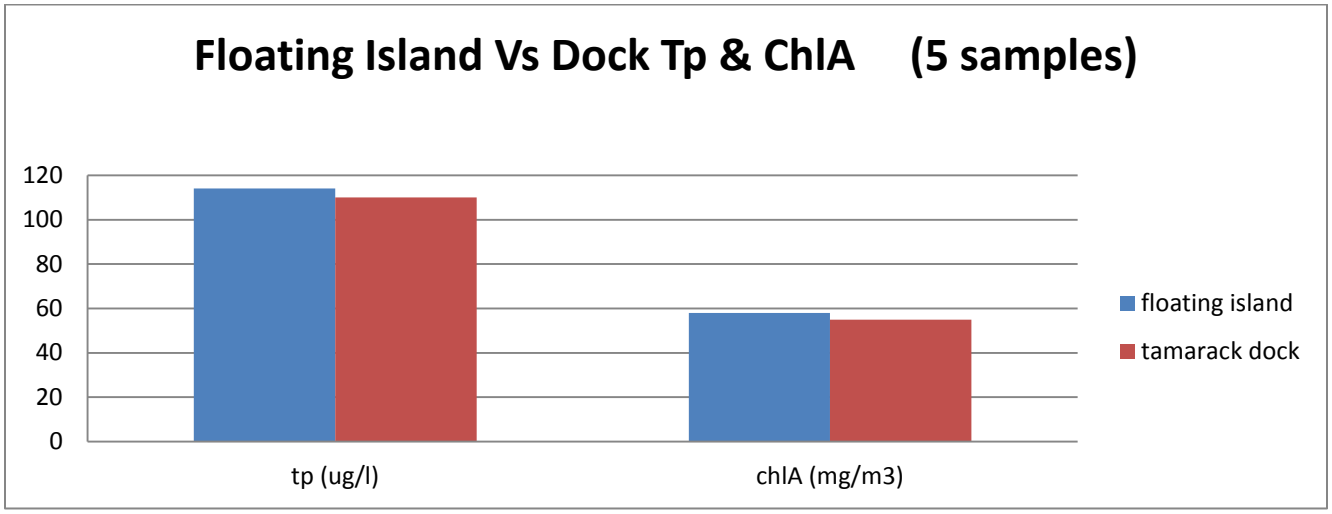
- Tamarack Lake YSI data is similar to that of similar metro lakes, nutrient levels are very high especially for an isolated lake with significant buffers. Internal loading is most likely the cause of these high levels

Tamarack Lake Raw Data

SITE	DATE	Secchi (ft)	TP (mg/L)	ChlA (ug/l)	TKN (mg/L)	NH3 (mg/L)	NO3 mg/L	CL (mg/L)
tamarack	5/7/2013							35
tamarack	5/7/2013	2.5	0.076	12	2.3	0.66	0.062	
tamarack	5/21/2013	3	0.091	8				
tamarack	6/4/2013	2	0.083	13	1.8	0.082	0.015	
tamarack	6/18/2013	2.5	0.077	9.3				
tamarack	6/25/2013		0.086	19	1.6	0.032	ND	
tamarack	7/9/2013	2	0.12	47	1.4	0.031	ND	
tamarack	7/23/2013	1	0.16	69				
tamarack	8/13/2013	1	0.15	110	2.8	0.025	ND	
tamarack	8/27/2013	1	0.16	59				
tamarack	9/10/2013	1	0.12	91	3.5	0.0049	ND	
tamarack	9/24/2013	1	0.19	120				

- Nitrogen and anemonia levels are below state standards for Tamarack Lake and similar to the rest of the VLAWMO lakes

Floating Island Data



- A floating island was installed July 2013 to reduce nutrient levels in Tamarack. Island is located in the middle of the lake and will most likely take a few years to become established and show reductions. A sample will be taken at both the island and the dock each sample run to monitor changes between both sits. Below is the potential effect the island could have on nutrient levels

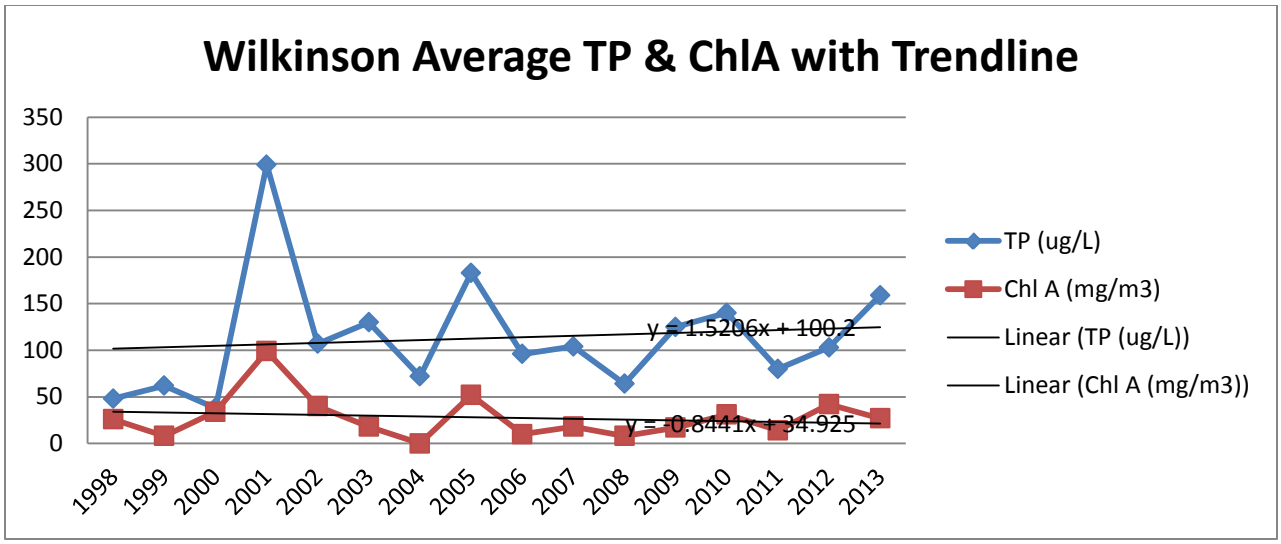
Reductions based on 2012 avg TP of 129 ug/L			
reductions	result (ug/L)	reductions	result (ug/L)
10%	116.1	25%	96.75
15%	109.65	50%	64.5

Tamarack VS Floating Island Raw Data

SITE	DATE	Secchi (ft)	TP (mg/L)	ChlA (ug/l)	TKN (mg/L)	NH3 (mg/L)	NO3 mg/L
floating island	6/18/2013	2.5	0.082	16	1.8	0.038	ND
floating island	6/25/2013		0.1	12	1.7	0.046	ND
floating island	7/9/2013	2	0.12	33	1.4	0.016	ND
floating island	8/13/2013	1.5	0.15	81	2.6	0.037	ND
floating island	9/10/2013	1	0.12	150	3.5	0.095	ND
	average	*1.75*	*0.1144*	*58.4*	*2.2*	*0.0464*	
tamarack	6/18/2013	2.5	0.077	9.3			
tamarack	6/25/2013		0.086	19	1.6	0.032	ND
tamarack	7/9/2013	2	0.12	47	1.4	0.031	ND
tamarack	8/13/2013	1	0.15	110	2.8	0.025	ND
tamarack	9/10/2013	1	0.12	91	3.5	0.0049	ND
	average	*1.625*	*0.1106*	*55.26*	*2.325*	*0.02323*	

Wilkinson Lake

Wilkinson Lake was part of the James J. Hill experimental farm and is now part of the Minnesota Land Trust, which preserves the land in a natural condition. The City of North Oaks required 150-foot buffer between the lake edge and any structures. The property on the north west side of the lake is currently being developed. The North Oaks Company has spent considerable time and effort over the years to restore the lake including the installation of a fish barrier to attempt to keep the rough fish from destroying the natural vegetation and waterfowl habitat and to improve water quality. The lake has also had two drawdowns to kill the carp. Wilkinson is the fourth lake within VLAWMO to be on the 2010 impaired waters list for nutrients and is part of the on-going Lambert Creek TMDL study. Farmland runoff and internal loading seem to be the main factors to the poor water quality. Water quality has not changed much over the last 15 years of monitoring, but a noticeable spike in average TP levels has occurred the last two years. TP levels are still within the 15 year monitoring range.



Wilkinson Lake Data

Wilkinson Lake Historical Avg TP/Chl A/SDT				Lake	Date	reading depth (ft)	Temp C	conductivity (mS/cm)	DO (mg/l)	pH
	TP (ug/L)	Chl A (mg/m3)	Secchi (m)	wilkinson	5/15/2013	b	14.36	0.505	10.25	7.69
1998	48	26	1.1	wilkinson		t	15.4	0.505	10.72	7.58
1999	62	8	0	wilkinson	6/11/2013	b	17.37	0.517	2.34	7.48
2000	38	34	0	wilkinson		t	17.84	0.519	3.2	7.08
2001	299	99	0.2	wilkinson	8/22/2013	b	22.61	0.476	3.6	7.87
2002	107	40	0	wilkinson		t	23.22	0.479	3.11	7.84
2003	130	18	0							
2004	72	0	0							
2005	183	52	0							
2006	96	10	0							
2007	104	18	0.9							
2008	64	8	0.3							
2009	125	17	1							
2010	140	31	0.8							
2011	80	14	1							
2012	103	42	0.9							
2013	159	27	0.9							

- Wilkinson Lake YSI data is similar to that of similar metro lakes, DO's are slightly lower on average than the rest of VLAWMO lakes, Conductivity is on the high side for VLAWMO lakes.

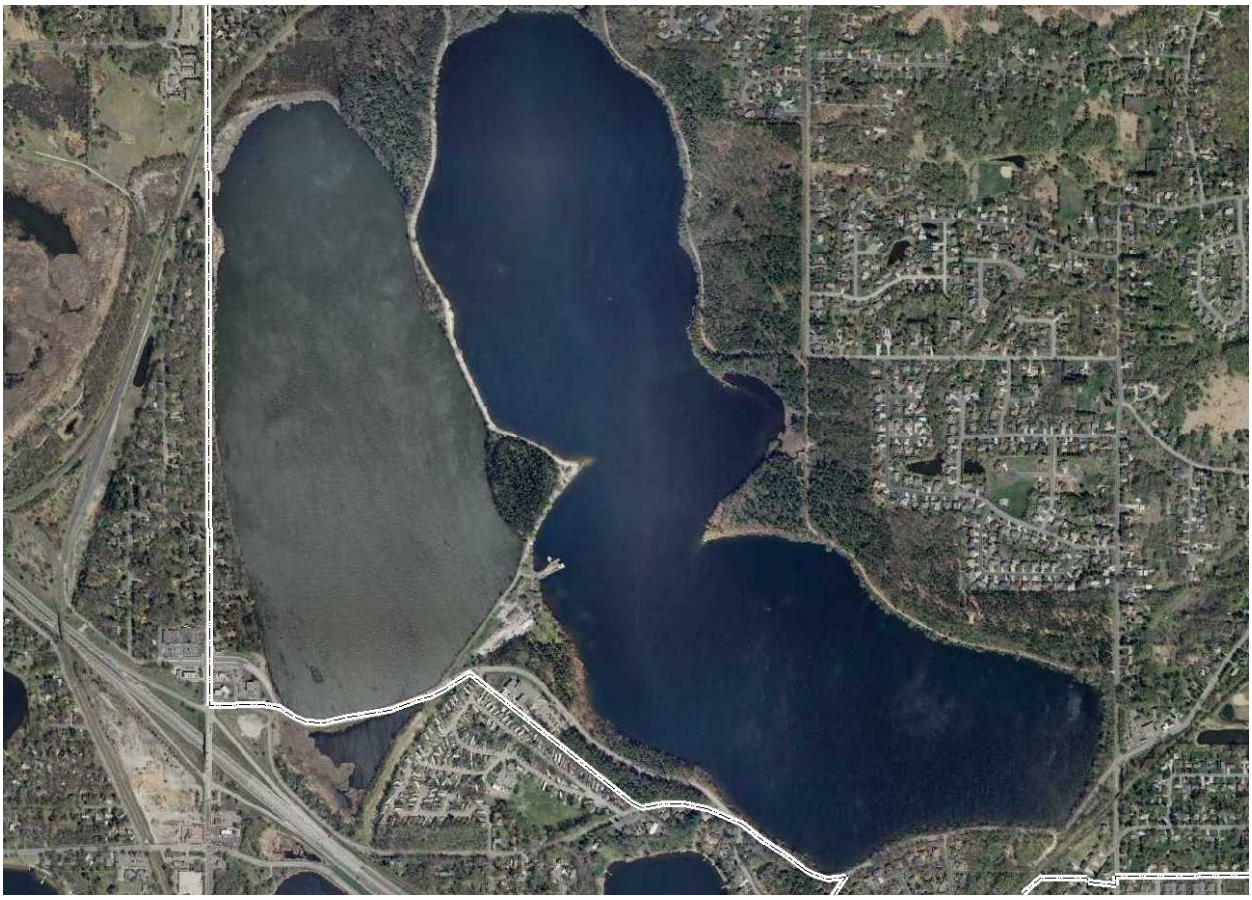
Wilkinson Lake Raw Data

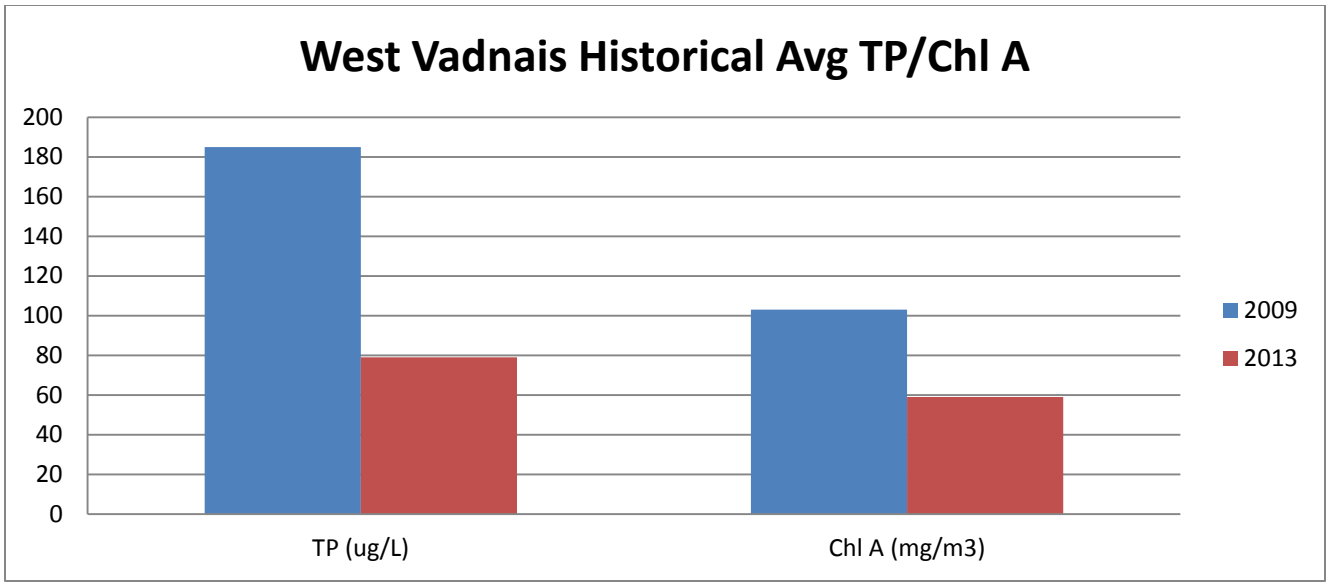
SITE	DATE	Secchi (ft)	TP (mg/L)	ChlA (ug/l)	TKN (mg/L)	NH3 (mg/L)	NO3 mg/L	CL (mg/L)
wilkinson	5/7/2013							66
wilkinson	5/7/2013	3.5	0.19	33	2.3	0.53	0.16	
wilkinson	5/21/2013	2.5	0.13	27				
wilkinson	6/4/2013	4.5	0.11	1.3	1.3	0.29	0.032	
wilkinson	6/18/2013	4	0.19	ND				
wilkinson	7/9/2013	3	0.2	60	1.2	0.056	ND	
wilkinson	7/23/2013	3	0.31	4				
wilkinson	8/13/2013	2	0.23	91	2.6	0.046	ND	
wilkinson	8/27/2013	2.5	0.057	12				
wilkinson	9/10/2013	3	0.056	9.3	1.6	0.045	ND	
wilkinson	9/24/2013	2	0.12	4				

- Nitrogen and anemonia levels are below state standards for Wilkinson Lake and similar to the rest of the VLAWMO lakes. TP levels have increased dramatically over the last two years but are still within the 15 year monitoring range

West Vadnais Lake

West Vadnais Lake is located in the southwest corner of the watershed. Its neighbor, East Vadnais Lake, receives in lake treatment by the Saint Paul Water Authority (SPRWS) as a measure to protect the drinking water supply. Even though these lakes are right next to each other they are not connected and have drastically different water quality. The SPRWS monitors East Vadnais Lake. VLAWMO monitored West Vadnais for part of 2009 and began full monitoring this year. West Vadnais is on the 2014 impaired waters list for nutrients.





West Vadnais Lake Data

West Vadnais Historical Avg TP/Chl A/SDT				Lake	Date	reading depth (ft)	Temp C	conductivity (mS/cm)	DO (mg/l)	pH
	TP (ug/L)	Chl A (mg/m3)	Secchi (m)	vadnais west	5/15/2013	b	14.14	0.518	10.6	7.8
2009	185	103	0.4	vadnais west		t	15.06	0.498	11.92	8.17
2013	79	59	0.4	vadnais west	6/11/2013	b	16.43	0.471	6.22	8.39
				vadnais west		t	18.13	0.432	14.05	8.22
				vadnais west	7/16/2013	b	23.77	0.56	2.24	8.11
				vadnais west		t	26.22	0.429	9.61	8.42
				vadnais west	8/22/2013	b	24.23	0.511	7.09	8.54
				vadnais west		t	24.74	0.464	9.3	8.69

- Wilkinson Lake YSI data is similar to that of similar other metro lakes, conductivity is on the high side for VLAWMO lakes.

West Vadnais Lake Raw Data

SITE	DATE	Secchi (ft)	TP (mg/L)	ChlA (ug/l)	TKN (mg/L)	NH3 (mg/L)	NO3 mg/L	CL (mg/L)
west vadnais	5/7/2013							90
west vadnais	5/7/2013	2.5	0.044	27	2.4	0.7	0.034	
west vadnais	5/21/2013	1.5	0.089	73				
west vadnais	6/4/2013	1.5	0.078	36	2.2	0.054	0.015	
west vadnais	6/18/2013	1	0.091	24				
west vadnais	7/9/2013	1.5	0.096	52	2.2	0.00078	ND	
west vadnais	7/23/2013	1.5	0.079	31				
west vadnais	8/13/2013	1	0.064	67	2.3	0.0026	ND	
west vadnais	8/27/2013	1	0.091	64				
west vadnais	9/10/2013	1	0.059	130	3.4	0.01	ND	
2009 Data								
west vadnais	7/21/2009	1	0.139	73.3	3.9	0.016	0.286	
west vadnais	8/4/2009	0.5	0.216	144.5	4.8	0.02	0.05	
west vadnais	8/18/2009	0.5	0.315	174.3	3.0	0.01	0.05	
west vadnais	9/1/2009	1	0.144	69.2	4.7	0.01	0.05	
west vadnais	9/15/2009	1.5	0.112	53.9	2.9	0.01	0.05	

- Nitrogen and anemonia levels are below state standards for West Vadnais Lake and similar to the rest of the VLAWMO lakes. Only five samples were taken in 2009. TP and ChlA were much higher than in 2013. Future sampling will begin to draw a picture of what the lake is doing and which of these years more acuately describes the lake water quality.

VLAWMO 2013 Lake Chloride Levels

Chloride Standards:

Chronic Exposure Standard;

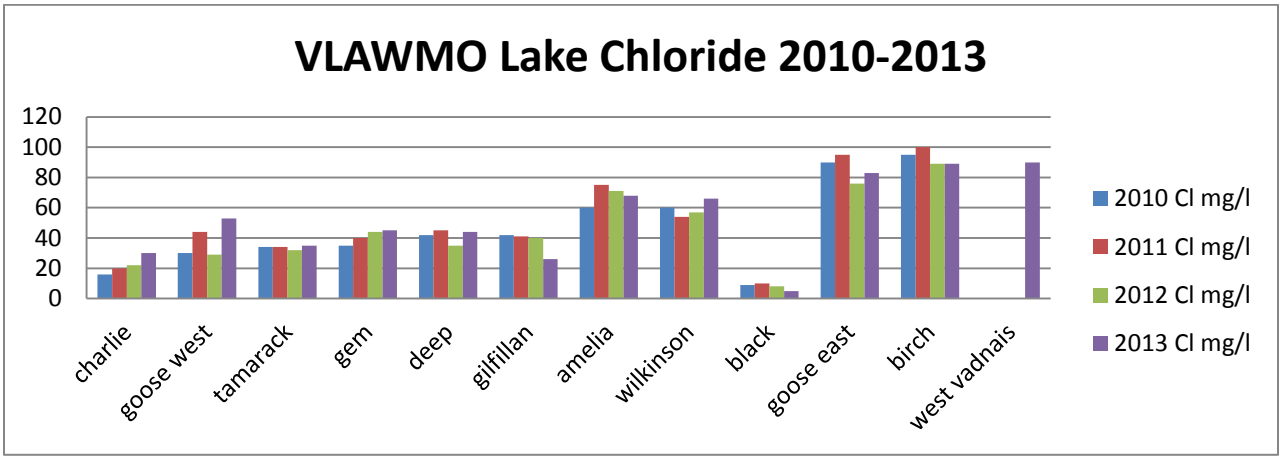
- 4 day average >230 mg/l

Acute Exposure Standard;

- One hour >860 mg/l

Impairment Threshold;

- Two or more exceedances in a three year period having at least five data points



- VLAWMO staff takes Lake Chloride readings in the spring right after ice-off. The samples are taken from the middle of the lake. 2013 was the fourth year of VLAWMO's chloride program. The lakes with the highest chloride levels are typically the lakes that receive the most street/storm water runoff. Most of our cities have gone to an all salt mix for winter ice control and future monitoring will be interesting to see how that will affect the chloride levels in VLAWMO lakes. Gem and Charlie lakes are the only lakes to have an increase in chloride levels each of the last four years of monitoring.

	2010 Cl mg/l	2011 Cl mg/l	2012 Cl mg/l	2013 Cl mg/l
charlie	16	20	22	30
goose west	30	44	29	53
tamarack	34	34	32	35
gem	35	40	44	45
deep	42	45	35	44
gilfillan	42	41	40	26
amelia	60	75	71	68
wilkinson	60	54	57	66
black	9	10	8	5
goose east	90	95	76	83
birch	95	100	89	89
west vadnais				90

Lake Level Data

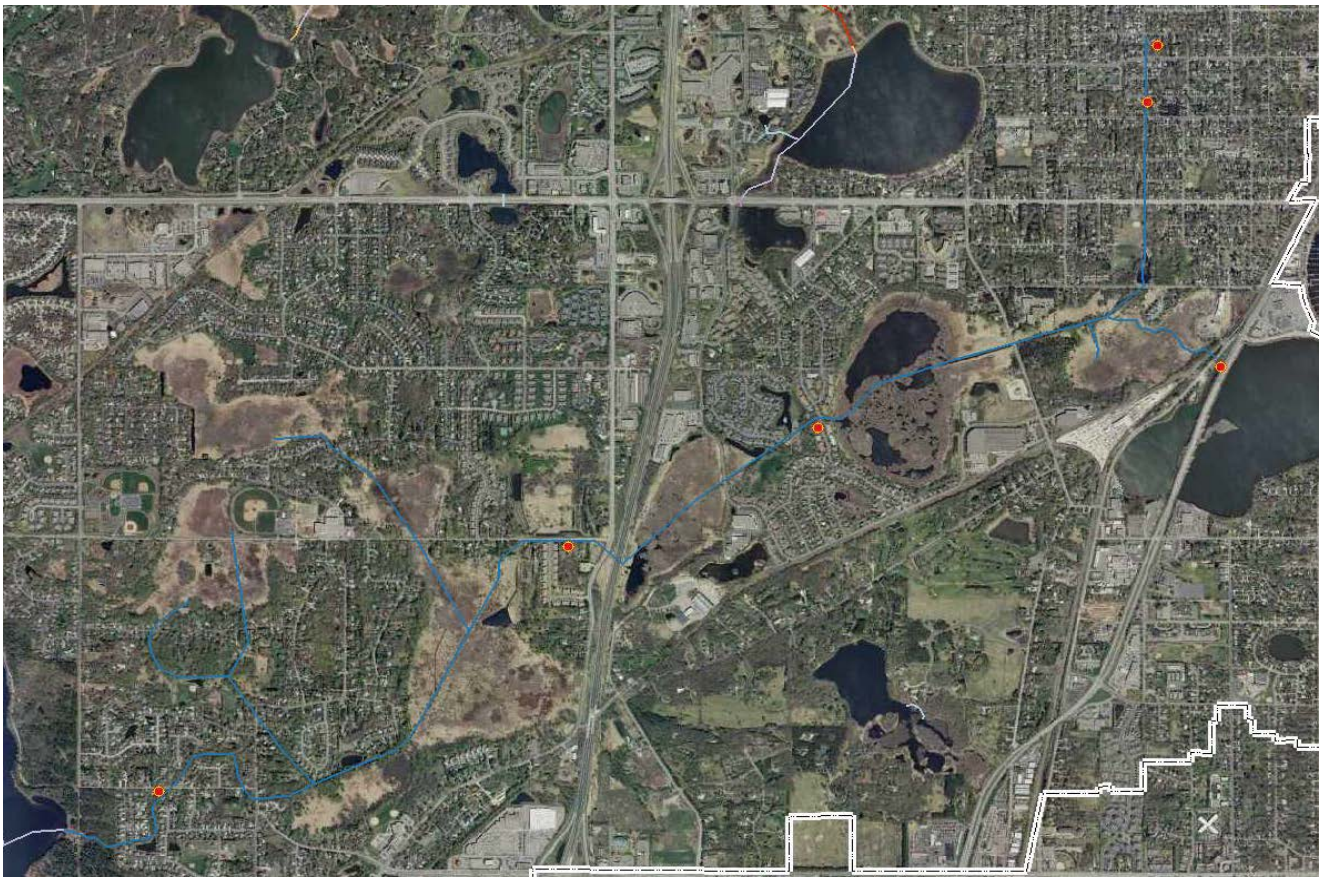
	Lake Elevations 2013 (ft)			
	Gilfillan	**Birch**	**Gem**	**Goose**
gauge reading start	0.81	1.39	8.5	7.39
lake level start 5/10/2013	910.31	919.05	946.91	924.34
0.00 out	909.5	917.66	938.41	916.95
5/21/2013	910.65	919.31	947.24	924.62
6/4/2013	910.5	919,56	947.25	924.4
6/18/2013	910.59	919.76	947.37	924.44
7/9/2013	910.71	920.26	947.75	924.45
7/23/2013	910.54	920.06	947.51	924.35
8/13/2013	910.26	919.66	947.27	924.05
8/27/2013	910.05		946.9	924.05
9/10/2013	909.8	919.55	946.66	
9/24/2013	909.7			
yearly increase/decrease	0.61	0.5	0.25	0.29

2013 Lambert Creek Monitoring Results

Lambert Creek Monitoring Details

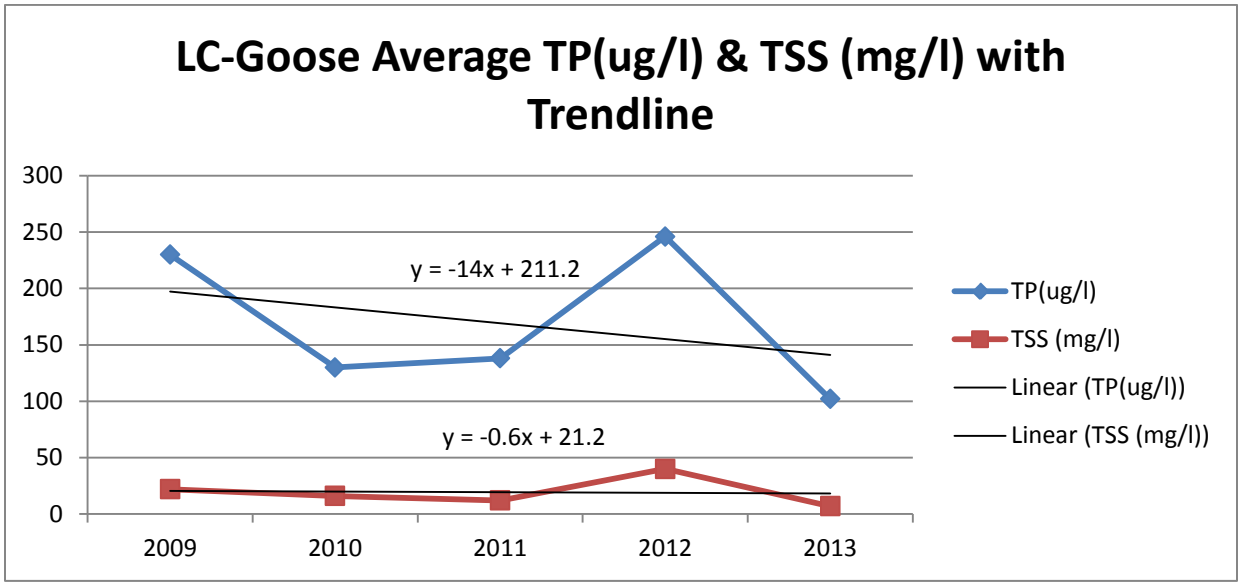
Samples are collected by VLAWMO staff at six sites along Lambert Creek on a bi-weekly basis May through September as well as after significant storm events (at least 0.5 inches). The six sites noted in charts and graphs are: Goose Lake, WBL storm sewer, Whitaker Pond, Oakmede, County Rd F, and Kohler Rd. The samples are analyzed by Braun Intertec for TP, SRP, TKN, NH3, N03, TSS. VLAWMO analyzes turbidity. VLAWMO staff collects pH, conductivity, DO and temperature readings at the three flume locations. Creek flow is also collected at the flumes. This information will also help with the TMDL process and allows us to set baselines to compare with future monitoring data.

VLAWMO has collected samples at five of the six sites to test for E. coli. Samples were analyzed at the SPRWS lab. Lambert Creek is on the impaired waters list for its high levels of E. coli. Water contaminated with bacteria from human or animal fecal material can cause illness in humans if ingested. The maximum daily level allowed is 1260 cfu/100ml. The maximum 30 day mean level is 126 cfu/100ml. Standards are designed to protect swimmers who might ingest small quantities of water from getting sick. VLAWMO stopped the E. coli sampling in 2013 and will begin targeted sampling in 2014 to try to target the source of contamination.



- Red dots mark the creek sampling locations. From left to right Koehler, Oakmede, Cty Rd F, Whitaker, WBLSS, and Goose.

Lambert Creek-Goose Lake Data



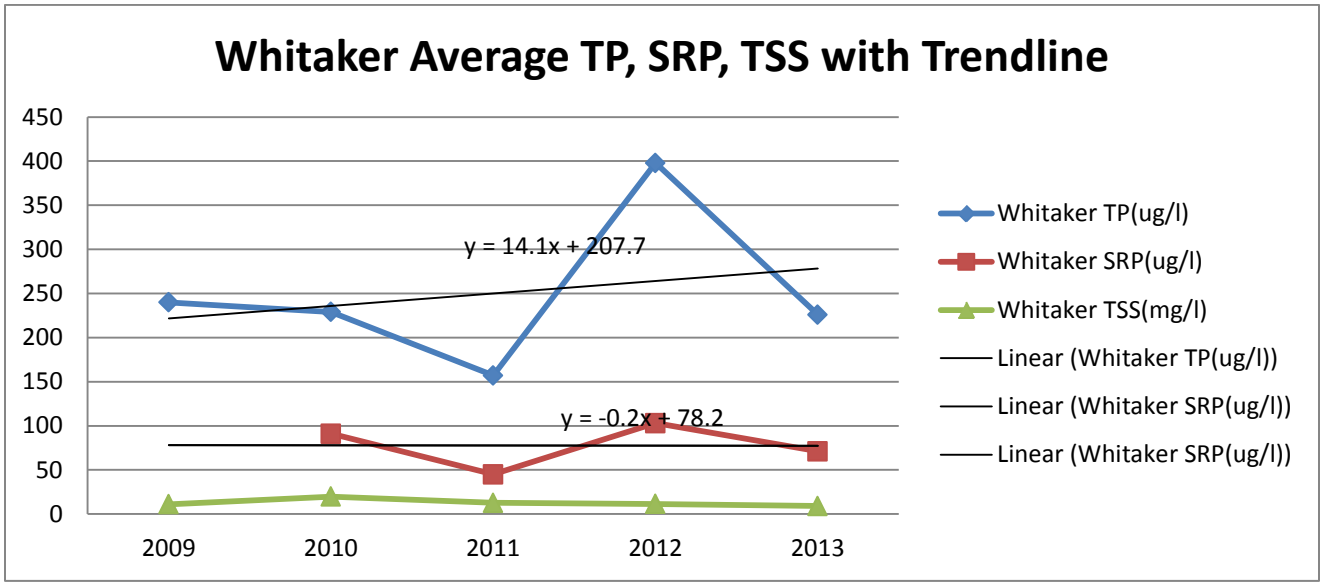
- LC-Goose Lake was close to the state standards for TP and the lowest average over the last 5 years. An official state standard should be out in 2014 and it has been suggested to be between 100 and 150 ug/l. State standard for TSS is 14mg/l. LC-Goose TSS has been pretty constant over the last 5 years.

	Goose-LC		Reading Location	Date	Temp C	Conductivity	DO (mg/l)	pH
	TP(ug/l)	TSS (mg/l)	**Goose-lc**	5/8/2013	17.23	0.403	7.72	8
2009	230	22	**Goose-lc**	6/13/2013	19.39	0.416	8.1	8.55
2010	130	16	**Goose-lc**	7/18/2013	27.72	0.371	2.04	8.04
2011	138	12	**Goose-lc**	8/23/2013	21.03	0.344	2.56	8.03
2012	246	40	**Goose-lc**	10/1/2013	dry	dry	dry	dry
2013	102	7						

Goose – LC Raw Data

SITE	DATE	TP (mg/L)	TKN (mg/L)	NH3 (mg/L)	NO3 mg/L	TSS (mg/L)	CL (mg/L)
Goose - lc	4/8/2013						30
Goose - lc	4/25/2013						51
Goose - lc	5/8/2013	0.064	1.3	0.21	0.032	6	
Goose - lc	5/22/2013	0.08				6.5	
Goose - lc	6/5/2013	0.078	1.5	0.37	0.091	7.5	
Goose - lc	6/19/2013	0.076				13	
Goose - lc	7/10/2013	0.094	0.93	0.17	0.016	3	
Goose - lc	7/24/2013	0.14				6	
Goose - lc	8/14/2013	0.088	0.93	0.2	0.046	5	
Goose - lc	8/28/2013	0.2				14	
Goose - lc	9/11/2013	Dry	Dry	Dry	Dry	Dry	

Lambert Creek-Whitaker Pond Data



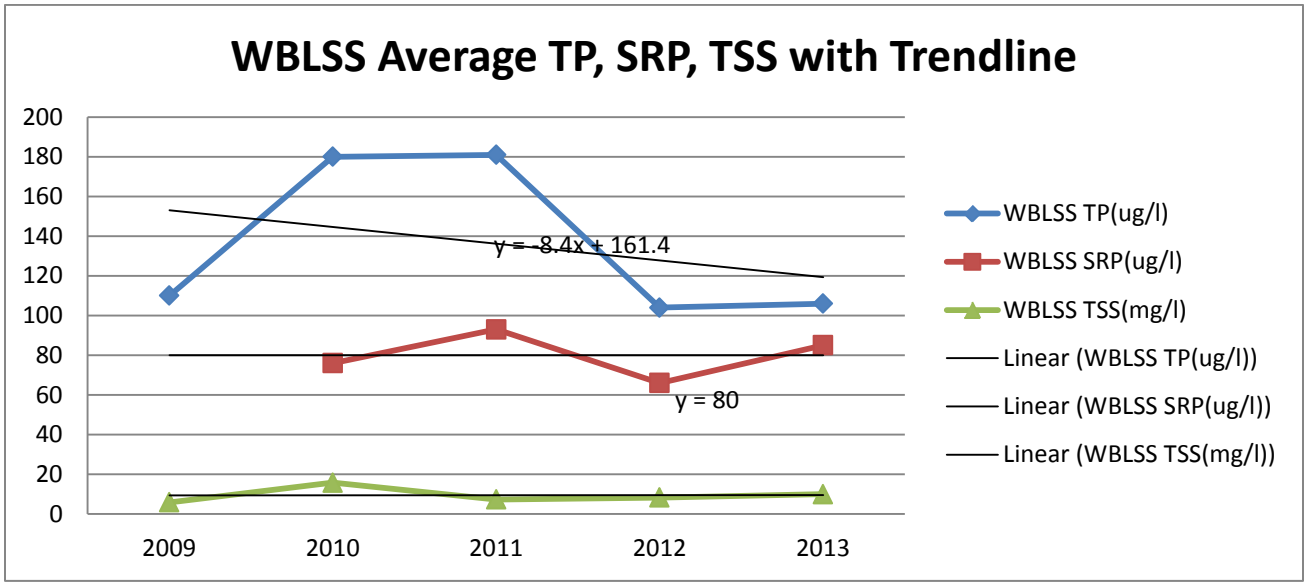
- Whitaker Pond on average for the last 5 years is above state standards for TP. An official state standard should be out in 2014 and it has been suggested to be between 100 and 150 ug/l. State standard for TSS is 14mg/l. Whitaker Pond has been slightly above state standard for TSS. SRP is also tested at this site. Both SRP and TSS have been pretty consistent over the last 5 years, TP levels have shown a slight uptrend over the last 5 years.

	Whitaker			Reading Location	Date	Temp C	Conductivity	DO (mg/l)	pH
	TP(ug/l)	SRP(ug/l)	TSS(mg/l)	whitaker	5/8/2013	16.15	0.474	9.96	8.16
2009	240		11	whitaker	6/13/2013	17.88	0.258	3.12	8.27
2010	229	91	19.7	whitaker	7/18/2013	26.91	0.511	3.7	8
2011	157	45	12.7	whitaker	8/23/2013	18.53	0.798	3.2	7.84
2012	398	103	11.5	whitaker	10/1/2013	15.56	0.562	3.05	7.27
2013	226	71	9						

Whitaker Raw Data

SITE	DATE	TP (mg/L)	SRP (mg/L)	TKN (mg/L)	NH3 (mg/L)	NO3 mg/L	TSS (mg/L)	CL (mg/L)
whitaker	4/8/2013							35
whitaker	4/25/2013							69
whitaker	5/8/2013	0.094	0.025	0.91	0.14	1.1	3	
whitaker	5/22/2013	0.14	0.059				8.5	
whitaker	6/5/2013	0.16	0.033	1.2	0.41	0.22	5.5	
whitaker	6/19/2013	0.44	0.2				31	
whitaker	7/10/2013	0.26		0.98	0.87	0.17	2	
whitaker	7/24/2013	0.31	0.14				8	
whitaker	8/14/2013	0.24	0.025	0.71	0.51	ND	9.5	
whitaker	8/28/2013	0.26	0.058				14	
whitaker	9/11/2013	0.22	0.048	2	0.48	0.087	120	
whitaker	9/25/2013	0.14	0.05				3	

Lambert Creek-White Bear Lake Storm Sewer (WBLSS) Data



- WBLSS on average for the last 5 years is above state standards for TP. An official state standard should be out in 2014 and it has been suggested to be between 100 and 150 ug/l. State standard for TSS is 14mg/l, WBLSS has been slightly above state standard. SRP is also tested at this site. Both TP and TSS are showing a downtrend, SRP levels have been fairly consistent since monitoring began in 2010.

	WBLSS		
	TP(ug/l)	SRP(ug/l)	TSS(mg/l)
2009	110		5.9
2010	180	76	15.8
2011	181	93	7.3
2012	104	66	8.3
2013	106	85	10

Whitaker Pond Weir Data

In 2010 VLAWMO worked with Ramsey County, White Bear Lake, White Bear Township and the SPRWS to improve the Whitaker Pond site. The WBLSS drains about 640 acres into Whitaker Pond, which eventually flows into East Vadnais Lake, the drinking water reservoir for the SPRWS. A forebay was installed before the pond to help settle out TSs. The weir was rebuilt and sand/iron filing bags were installed to help reduce TP and SRP levels. Monitoring over the last three years since the project was complete has not shown the reductions VLAWMO was hoping for.

- Did not show improvements for TP reduction
- Did not show improvement for TSS reduction
- Did show an improvement in SRP reduction

The following graphs will show the TP, TSS and SRP levels entering Whitaker Pond through the WBLSS and leaving Whitaker Pond on the downstream side of the weir. Monitoring data still suggests the pond is not improving water quality, average levels of TP, SRP and TSS are higher downstream of the weir than they are entering the pond at the WBLSS. Only TSS is below state standards, both TP and SRP are close to or above state standards when leaving Whitaker Pond.

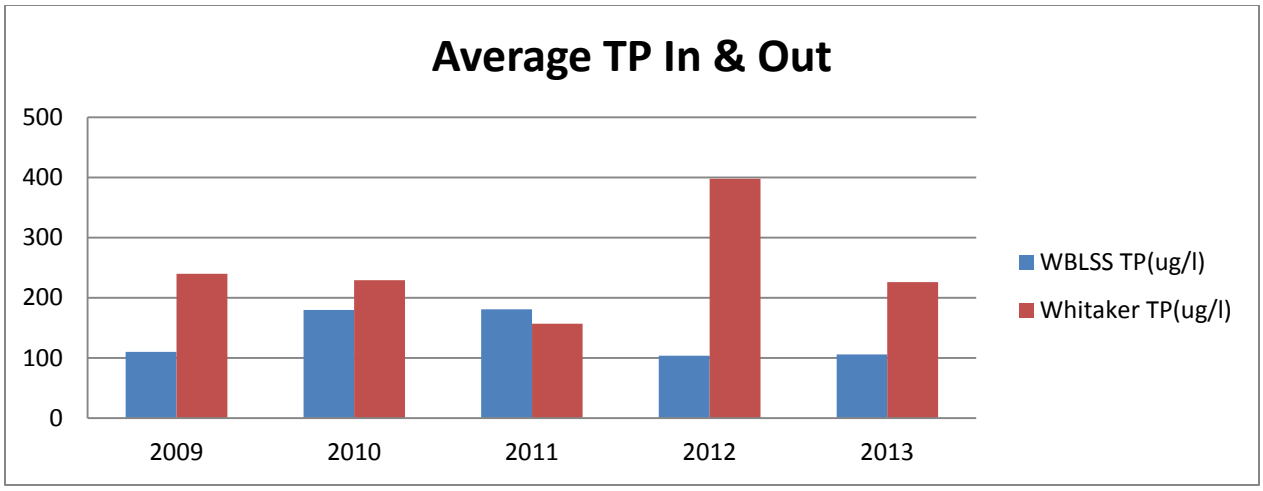
WBLSS Raw Data

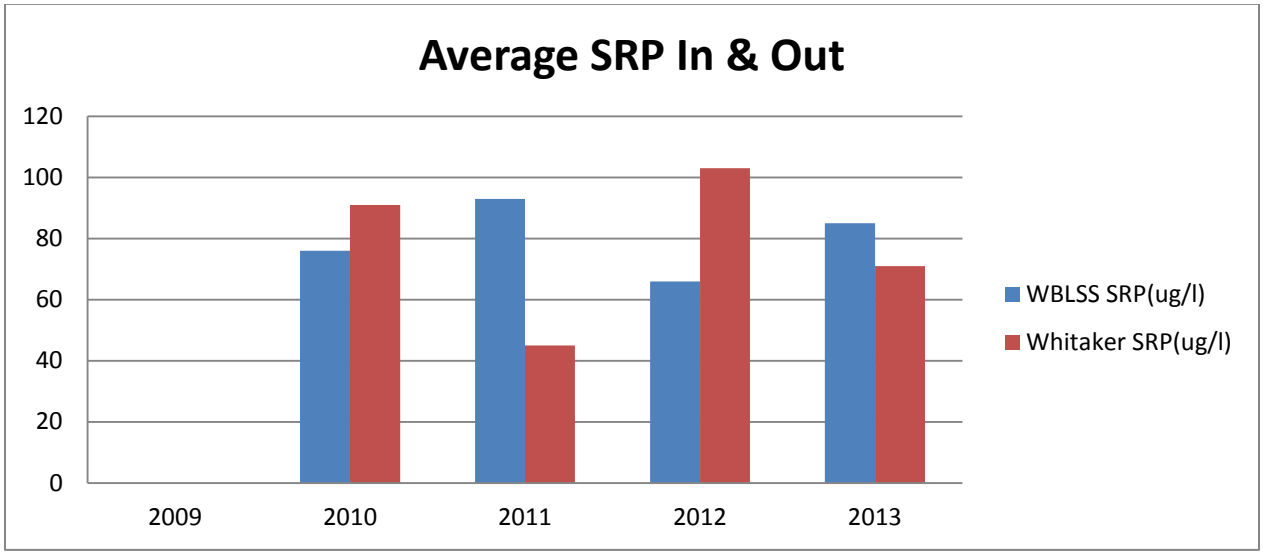
SITE	DATE	TP (mg/L)	SRP (mg/L)	TKN (mg/L)	NH3 (mg/L)	NO3 mg/L	TSS (mg/L)	CL (mg/L)
wblss	4/8/2013							51
wblss	4/25/2013							101
wblss	5/8/2013	0.078	0.068	0.43	0.047	4.9	ND	
wblss	5/22/2013	0.09	0.013				37	
wblss	6/5/2013	0.16	0.095	0.94	0.1	4.6	11	
wblss	6/19/2013	0.092	0.081				4.5	
wblss	7/10/2013	0.097		ND	0.017	5.4	1.5	
wblss	7/24/2013	0.095	0.089				ND	
wblss	8/14/2013	0.1	0.093	ND	0.036	4.2	1.5	
wblss	8/28/2013	0.12	0.11				12	
wblss	9/11/2013	0.12	0.12	ND	0.01	3.9	ND	
wblss	9/25/2013	0.11	0.093				2	

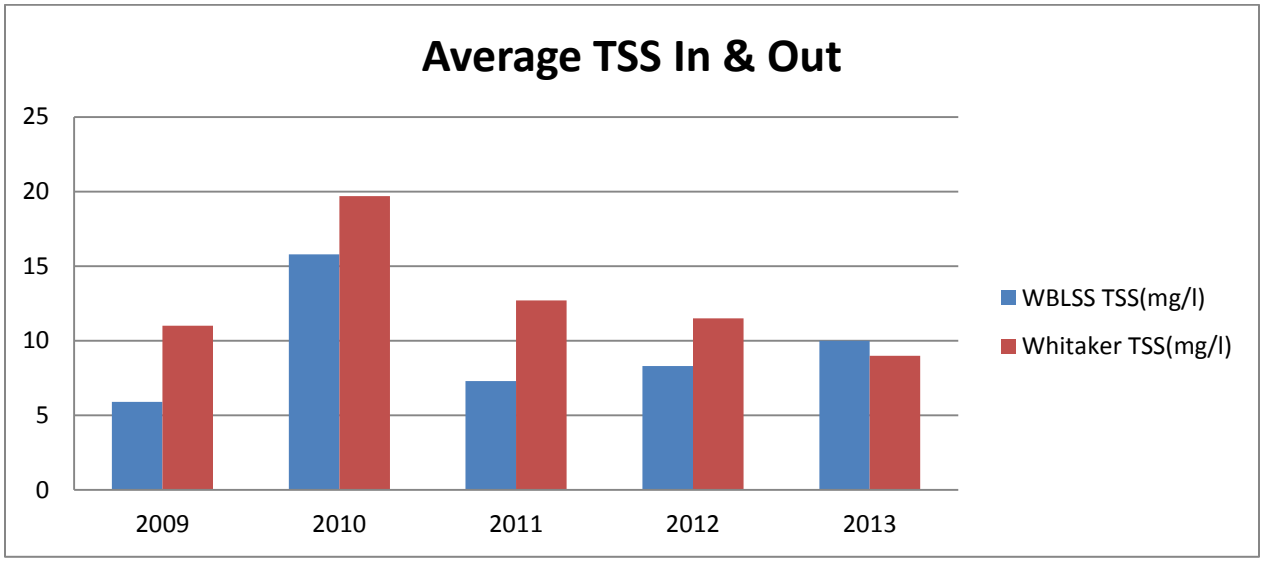
- VLAWMO takes TP, SRP and TSS samples twice a month. Nitrogen samples are taken once a month

	WBLSS	**Whitaker**		WBLSS	Whitaker		WBLSS	Whitaker
	TP(ug/l)	**TP(ug/l)**		SRP(ug/l)	SRP(ug/l)		TSS(mg/l)	TSS(mg/l)
2009	110	240	**2009**			**2009**	5.9	11
2010	180	229	**2010**	76	91	**2010**	15.8	19.7
2011	181	157	**2011**	93	45	**2011**	7.3	12.7
2012	104	398	**2012**	66	103	**2012**	8.3	11.5
2013	106	226	**2013**	85	71	**2013**	10	9

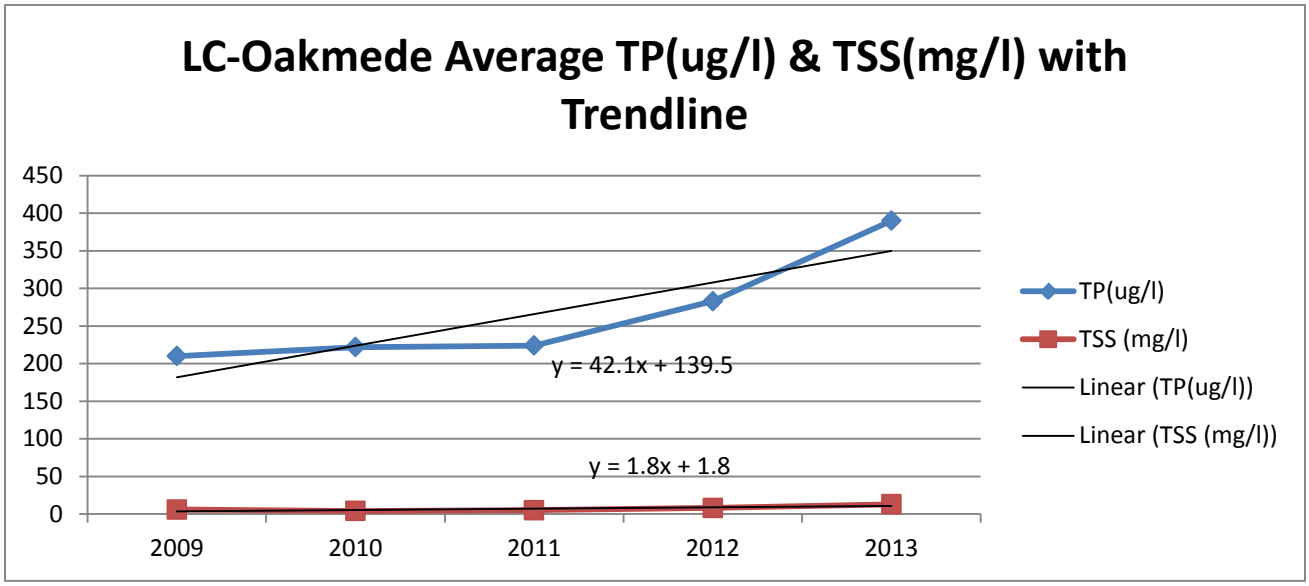
- The above tables are the average year to year comparisons of nutrient levels entering Whitaker Pond from the WBLSS and leaving Whitaker Pond. Below shows graphs of the same data.


Average TP In & Out
500
400
300
200
100
0
2009
2010
2011
2012
2013
WBLSS TP(ug/l)
Whitaker TP(ug/l)


Average SRP In & Out
120
100
80
60
40
20
0
2009
2010
2011
2012
2013
WBLSS SRP(ug/l)
Whitaker SRP(ug/l)


Average TSS In & Out
25
20
15
10
5
0
2009
2010
2011
2012
2013
WBLSS TSS(mg/l)
Whitaker TSS(mg/l)

Lambert Creek - Oakmede Data



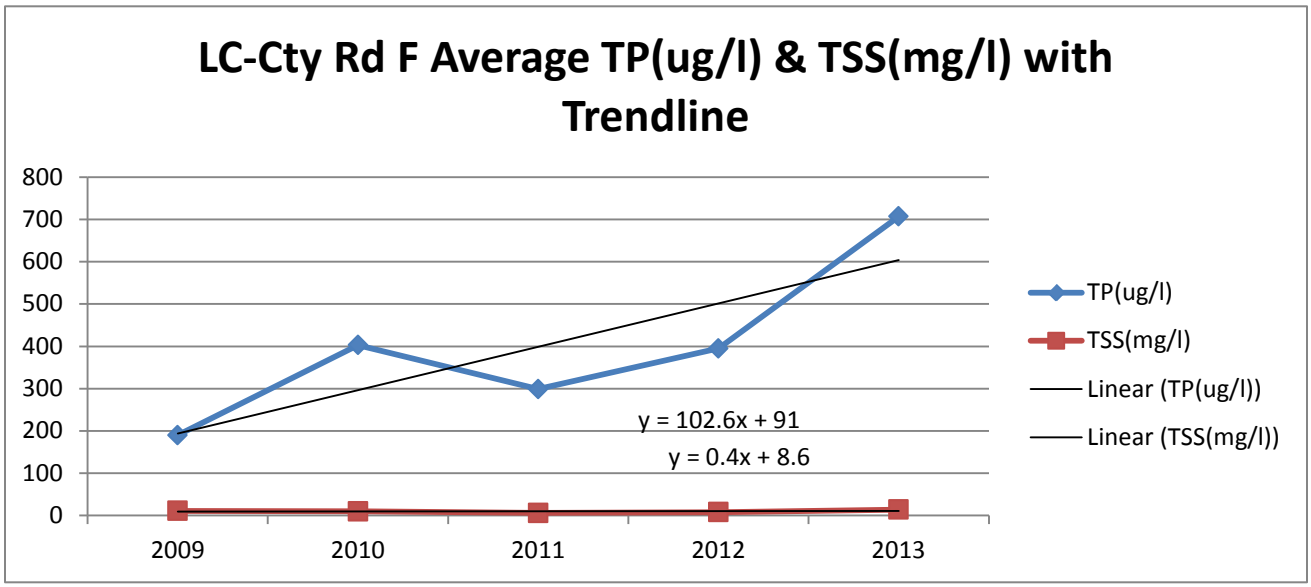
- LC-Oakmede has been well above state standards for TP over the last 5 years of monitoring. An official state standard should be out in 2014 and it has been suggested to be between 100 and 150 ug/l State standard for TSS is 14mg/l, LC-Oakmede is below state standard for the last 5 years. TP is showing a steady up trend and TSS has been flat over the last 5 years. Restoration has been taking place at the site for the last two years and the disturbance in the area may be a reason for the increased TP levels. Once everything establishes itself TP levels should begin to decrease.

	Oakmede		Reading Location	Date	Temp C	Conductivity	DO (mg/l)	pH
	TP(ug/l)	TSS (mg/l)	**oakmede**	5/8/2013	12.9	0.523	11.88	7.77
2009	210	6	**oakmede**	6/13/2013	18.88	0.464	5.1	8.11
2010	222	4	**oakmede**	7/18/2013	28.04	0.41	4.66	7.68
2011	224	5	**oakmede**	8/23/2013	18.81	0.483	4.6	7.69
2012	283	8	**oakmede**	10/1/2013	15.15	0.521	5.03	7.39
2013	390	13						

Oakmede Raw Data

SITE	DATE	TP (mg/L)	TKN (mg/L)	NH3 (mg/L)	NO3 mg/L	TSS (mg/L)	CL (mg/L)
Oakmede - Ic	4/8/2013						92
Oakmede - Ic	4/25/2013						79
Oakmede - Ic	5/8/2013	0.11	0.9	0.077	0.016	2	
Oakmede - Ic	5/22/2013	0.25				5	
Oakmede - Ic	6/5/2013	0.26	1.1	0.14	0.028	2.5	
Oakmede - Ic	6/19/2013	0.26				4.5	
Oakmede - Ic	7/10/2013	0.39	1.1	0.14	ND	4	
Oakmede - Ic	7/24/2013	0.36				3.5	
Oakmede - Ic	8/14/2013	0.58	1.1	0.37	0.018	13	
Oakmede - Ic	8/28/2013	0.68				65	
Oakmede - Ic	9/11/2013	0.6	1.5	0.38	0.021	28	
Oakmede - Ic	9/25/2013	0.41				7	

Lambert Creek - County Rd. F Data



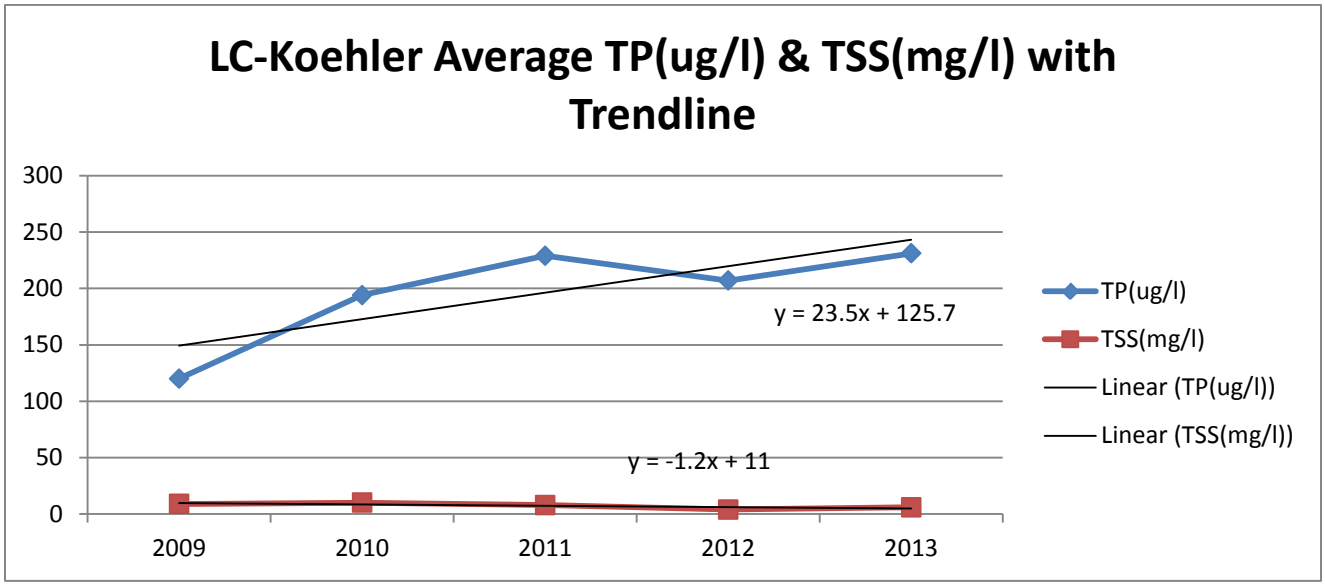
- LC-Cty Rd. F has been well above state standards for TP over the last 5 years of monitoring. This is the highest level of TP out of all six sampling sites on the creek. An official state standard should be out in 2014 and it has been suggested to be between 100 and 150 ug/l.. State standard for TSS is 14mg/l LC- Cty Rd. F is below state standard for the last 4 years. TP is showing a steady up trend and TSS has been flat over the last 5 years.

	Cty Rd F		Reading Location	Date	Temp C	Conductivity	DO (mg/l)	pH
	TP(ug/l)	TSS(mg/l)	cty rd f	5/8/2013	9.7	0.547	9.02	7.8
2009	190	11	cty rd f	6/13/2013	17.8	0.495	6.05	7.76
2010	403	10	cty rd f	7/18/2013	23.67	0.508	3.86	7.43
2011	299	6	cty rd f	8/23/2013	17.09	0.94	4.12	7.26
2012	395	8	cty rd f	10/1/2013	14.52	0.781	6.55	7.81
2013	707	14						

Cty Rd F Raw Data

SITE	DATE	TP (mg/L)	TKN (mg/L)	NH3 (mg/L)	NO3 mg/L	TSS (mg/L)	CL (mg/L)
Cty Rd F - lc	4/8/2013						100
Cty Rd F - lc	4/25/2013						81
Cty Rd F - lc	5/8/2013	0.094	0.92	0.11	0.08	ND	
Cty Rd F - lc	5/22/2013	0.43				5.5	
Cty Rd F - lc	6/5/2013	0.44	1.1	0.1	0.046	5	
Cty Rd F - lc	6/19/2013	0.55				6.5	
Cty Rd F - lc	7/10/2013	0.85	1.1	0.044	0.027	5	
Cty Rd F - lc	7/24/2013	0.77				4.5	
Cty Rd F - lc	8/14/2013	0.42	0.91	0.39	0.28	4	
Cty Rd F - lc	8/28/2013	1.8				26	
Cty Rd F - lc	9/11/2013	1.4	3.2	0.88	0.62	60	
Cty Rd F - lc	9/25/2013	0.32				14	

Lambert Creek - Koehler Rd. Data



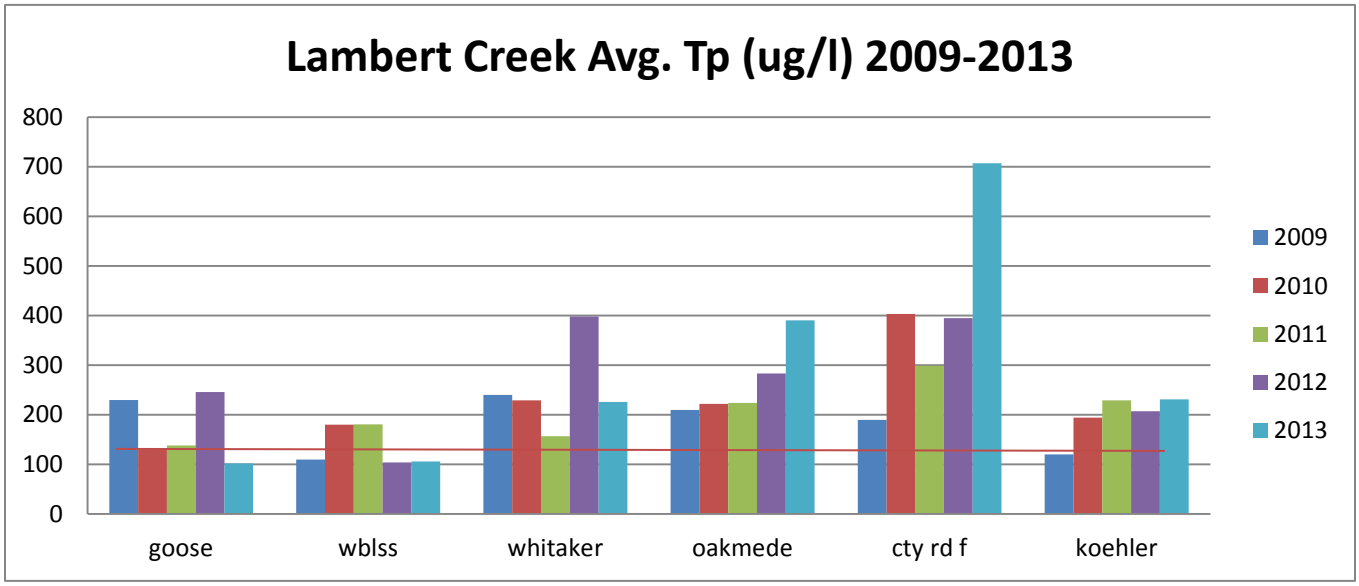
- Koehler has been well above state standards for TP over the last 5 years of monitoring. This is the highest level of TP out of all six sampling sites on the creek. An official state standard should be out in 2014 and it has been suggested to be between 100 and 150 ug/l.. State standard for TSS is 14mg/l Koehler is below state standard for the last 4 years. TP is showing a steady up trend and TSS has been flat over the last 5 years. Stream bank restoration was done in 2011 and little improvement has been seen so far.

	Koehler		Reading Location	Date	Temp C	Conductivity	DO (mg/l)	pH
	TP(ug/l)	TSS(mg/l)	koehler	5/8/2013	10.18	0.669	8.86	6.9
2009	120	9	koehler	6/13/2013	15.48	0.631	5.5	8.06
2010	194	10	koehler	7/18/2013	22.96	0.574	3.86	7.4
2011	229	8	koehler	8/23/2013	16.09	0.95	6.75	8.05
2012	207	4	koehler	10/1/2013	15.26	1.014	7.15	8.16
2013	231	6						

Koehler Raw Data

SITE	DATE	TP (mg/L)	TKN (mg/L)	NH3 (mg/L)	NO3 mg/L	TSS (mg/L)	CL (mg/L)
Koehler - lc	4/8/2013						105
Koehler - lc	4/25/2013						110
Koehler - lc	5/8/2013	0.078	1.5	0.16	0.3	ND	
Koehler - lc	5/22/2013	0.14				4	
Koehler - lc	6/5/2013	0.22	1.4	0.19	0.11	8.5	
Koehler - lc	6/19/2013	0.59				10	
Koehler - lc	7/10/2013	0.44	1.5	0.16	0.08	8	
Koehler - lc	7/24/2013	0.34				3	
Koehler - lc	8/14/2013	0.12	1.1	0.31	1.2	1.5	
Koehler - lc	8/28/2013	0.25				5	
Koehler - lc	9/11/2013	0.089	0.92	0.014	0.98	14	
Koehler - lc	9/25/2013	0.049				3	

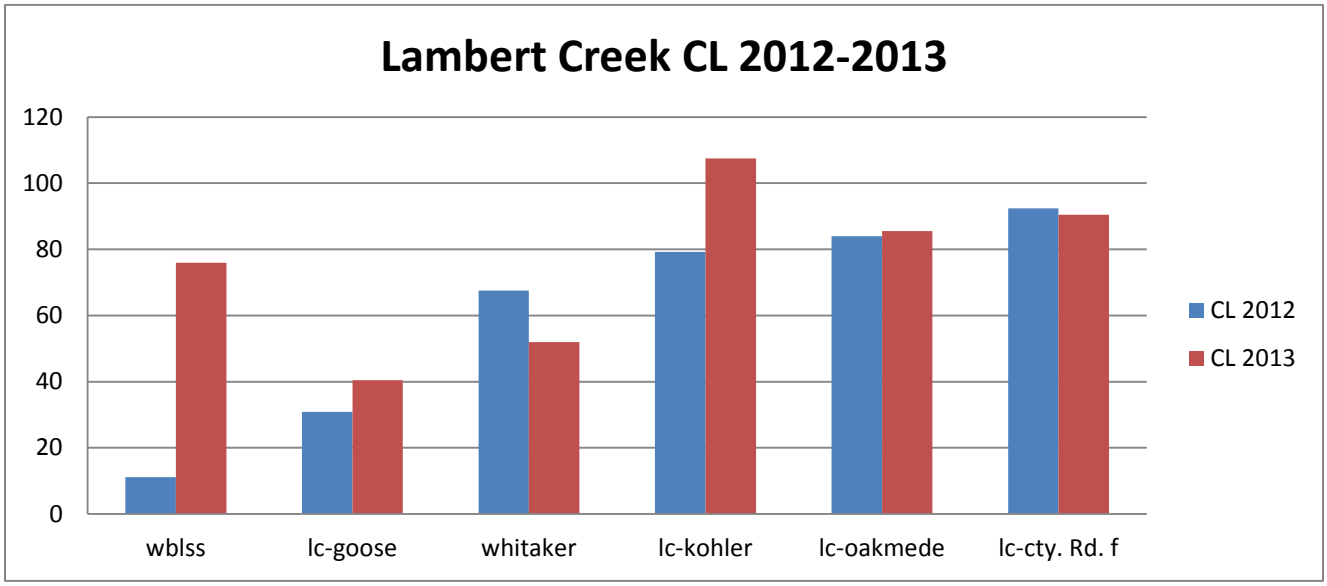
Lambert Creek Average Total Phosphorus



- Current state standard for stream Tp is 130 ug/l. All stream location have averaged over the state standard at least half of the time over the last 5 years with many of the locations over the state standard all five years. Red line indicates standard.

Lambert Creek Average yearly Tp (ug/l) 2009-2013					
	2009	**2010**	**2011**	**2012**	**2013**
goose	230	130	138	246	102
wblss	110	180	181	104	106
whitaker	240	229	157	398	226
oakmede	210	222	224	283	390
cty rd f	190	403	299	395	707
koehler	120	194	229	207	231

Lambert Creek Chloride Data



- Lambert Creek Cl levels are well below state standards. VLAWMO has been monitoring Cl levels since 2010

Chloride Standards:

Chronic Exposure Standard;

- 4 day average >230 mg/l

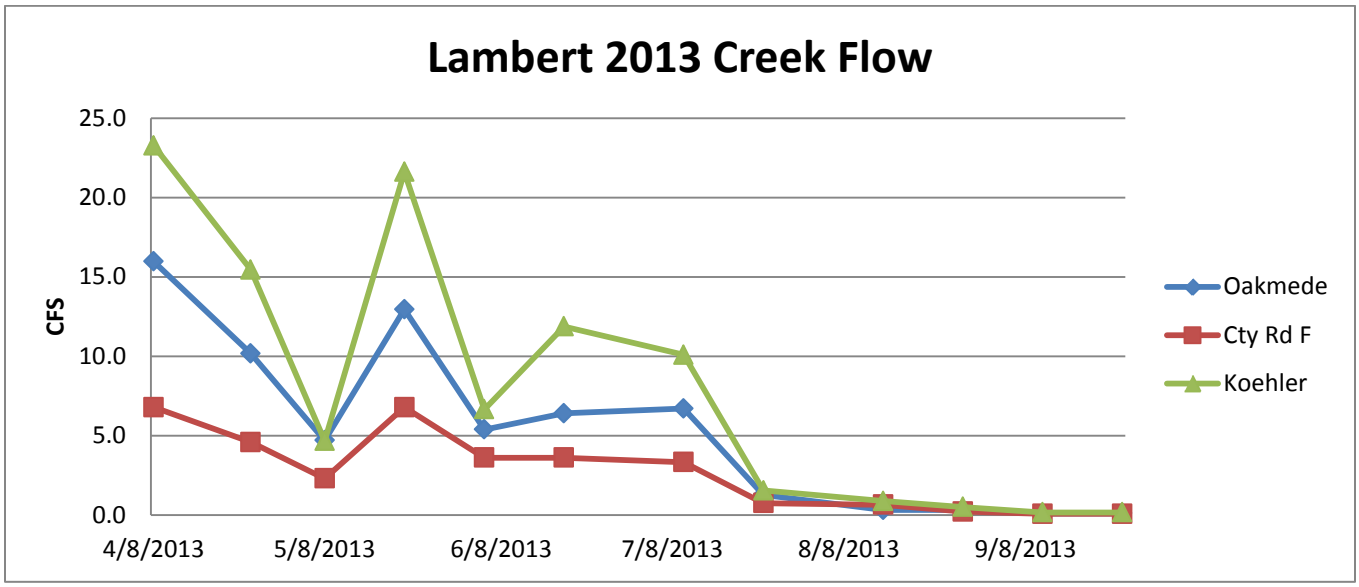
Acute Exposure Standard;

- One hour >860 mg/l

Impairment Threshold;

- Two or more exceedances in a three year period having at least five data points

Lambert Creek Flow



Lambert Creek YSI Data

Reading Location	Date	Temp C	Conductivity	DO (mg/l)	pH
cty rd f	5/8/2013	9.7	0.547	9.02	7.8
cty rd f	6/13/2013	17.8	0.495	6.05	7.76
cty rd f	7/18/2013	23.67	0.508	3.86	7.43
cty rd f	8/23/2013	17.09	0.94	4.12	7.26
cty rd f	10/1/2013	14.52	0.781	6.55	7.81
goose	5/8/2013	17.23	0.403	7.72	8
goose	6/13/2013	19.39	0.416	8.1	8.55
goose	7/18/2013	27.72	0.371	2.04	8.04
goose	8/23/2013	21.03	0.344	2.56	8.03
goose	10/1/2013	dry	dry	dry	dry
koehler	5/8/2013	10.18	0.669	8.86	6.9
koehler	6/13/2013	15.48	0.631	5.5	8.06
koehler	7/18/2013	22.96	0.574	3.86	7.4
koehler	8/23/2013	16.09	0.95	6.75	8.05
koehler	10/1/2013	15.26	1.014	7.15	8.16
oakmede	5/8/2013	12.9	0.523	11.88	7.77
oakmede	6/13/2013	18.88	0.464	5.1	8.11
oakmede	7/18/2013	28.04	0.41	4.66	7.68
oakmede	8/23/2013	18.81	0.483	4.6	7.69
oakmede	10/1/2013	15.15	0.521	5.03	7.39
whitaker	5/8/2013	16.15	0.474	9.96	8.16
whitaker	6/13/2013	17.88	0.258	3.12	8.27
whitaker	7/18/2013	26.91	0.511	3.7	8
whitaker	8/23/2013	18.53	0.798	3.2	7.84
whitaker	10/1/2013	15.56	0.562	3.05	7.27

- The YSI data for all creek sites above are within state standards. One thing to note is the high conductivity levels at the Koehler Rd. site and the midsummer conductivity jump from .258 to .798 at the Whitaker site.

VLAWMO Zebra Mussel Monitoring

VLAWMO placed zebra mussel traps in 4 lakes (Goose Lake, Birch Lake, Gilfillan Lake, Wilkinson Lake), as well as 1 location on Lambert Creek (just below the Koehler flume).

This was VLAWMO's second year of Zebra Mussel monitoring and nothing was found in the above lakes and stream location. VLAWMO does have Zebra Mussels in the North Oaks chain of lakes (Charley, Deep, Pleasant, Vadnais, and Sucker)