Blue Lake
Monitoring Report 2015

What: LID volunteers collected Total Phosphorus (TP), Chlorophyll-a, and transparency information every two weeks from May through September in both upper and lower blue lake (see map). SWCD Staff provided training, equipment and coordinated lab testing.

Why: The lake has not been monitored with any regularity in the past. In the last 24 years there have been only scattered transparency readings. More detailed monitoring was done in 2013 and 2014 by the MN Pollution Control Agency (lower Blue only) but they do not plan to return to the lake until 2023. With this limited information it is difficult to detect any lake health trends.

Additionally, there are water quality concerns for Blue Lake. In 2013 and 2014 the lake's algae levels (green water) were higher than clean water goals set by the state. Most algal blooms are harmless (they are more of a nuisance) but under the right conditions certain types of algae can pose health risks.

Upper and lower Blue Lake samples are summarized in this report individually.

Lake Data for Upper (Little) Blue Lake	
Township	Spencer Brook
MN Lake ID	30010701
# of Public Boat Access	0
Aquatic Invasive Species	Curly Leaf Pondweed
Surface Area	43 acres
Maximum Depth	10ft
Lake Meets Clean Water Goals	Total Phosphorus: **YES**
(When compared to shallow lake goals)	Chlorophyll-a: **YES**
	Secchi Transparency: **YES**

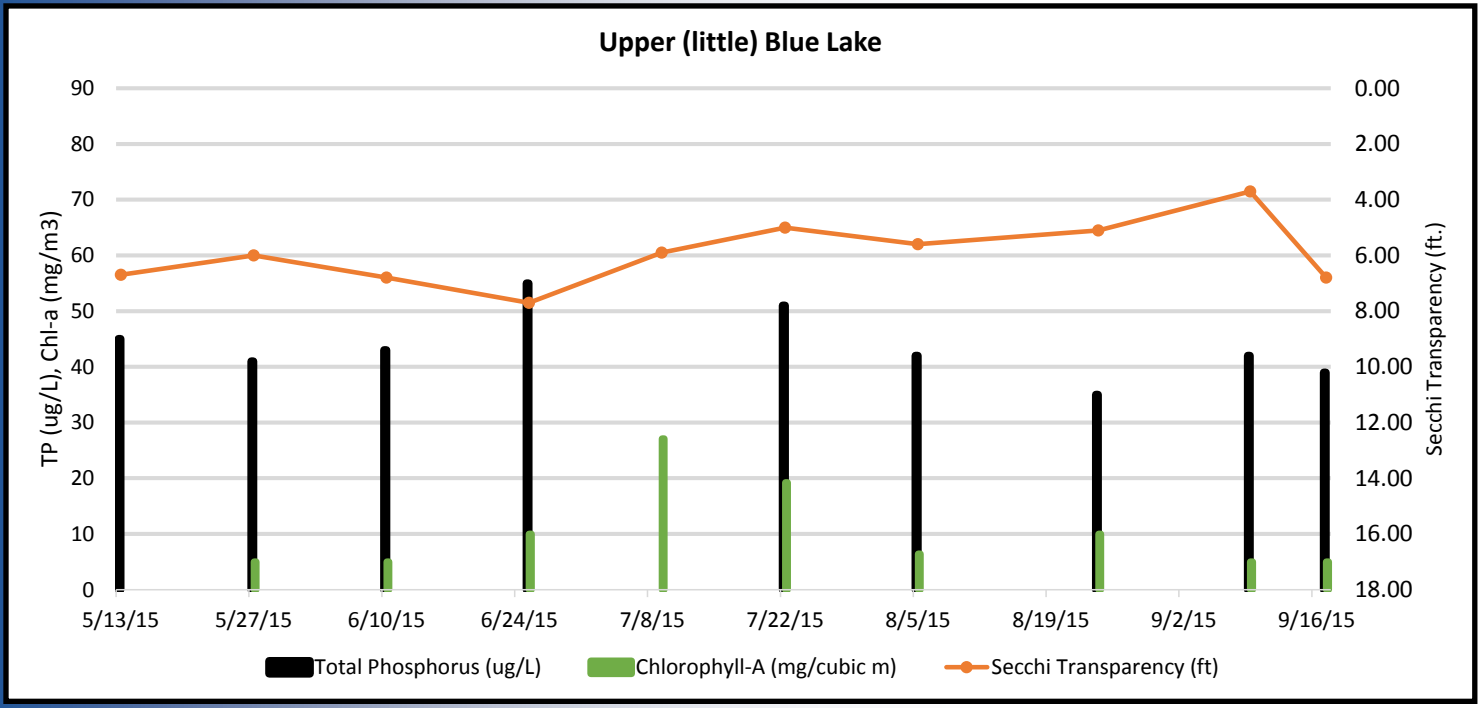
Lake Data for Lower (Big) Blue Lake	
Township	Spencer Brook/Stanford
MN Lake ID	30010702
# of Public Boat Access	2
Aquatic Invasive Species	Curly Leaf Pondweed
Surface Area	241 acres
Maximum Depth	30ft
Lake Meets Clean Water Goals	Total Phosphorus: **NO**
(When compared to deep lake goals)	Chlorophyll-a: **YES**
	Secchi Transparency: **YES**

Upper (Little) Blue Lake Monitoring Results 2015

Total Phosphorus (TP), Chlorophyll-a (Chl-a) and Secchi Transparency

MN Clean Water Goals for Shallow Lakes

Total Phosphorus (TP): ≤ 60 ug/L Chlorophyll-a: ≤ 20 mg/m3 Secchi Depth: ≥ 3.28 feet



Upper/Little Blue Lake has a maximum depth of about 10ft which means that this part of the lake may have the characteristics of a shallow lake. Shallow lakes tend to occur in one of two conditions: one is a clear water condition with abundant rooted aquatic vegetation (high fish and wildlife habitat value) and the other is a turbid condition with few aquatic plants (low fish and wildlife habitat value). Shallow lakes naturally have higher levels of nutrients. The monitoring results for Upper Blue Lake are compared to the States goals for shallow lakes in this area.

When compared to shallow lake water quality goals, Upper Blue Lake meets all goals. TP, Chlorophyll-a and Transparency varied slightly throughout the sample season; these small changes may be due to wind-mixing, precipitation or human activity such as boating. The increase in TP and corresponding increase in chlorophyll-a (algae) and decrease in clarity which occurred in late June may be due to the die-off of curly-leaf pondweed. When this plant dies it releases nutrients which feed algae; however, we do not yet have enough information to verify this. The TP concentration was not recorded in the month of July due to incorrect lab data. Chl-a was not recorded for May 15 because lab results were less than the detectable limit.

	TP (ug/L)	Chl-a (mg/m3)	Secchi (ft.)
Growing Season Average	43.86	10.96	5.83

General Definitions

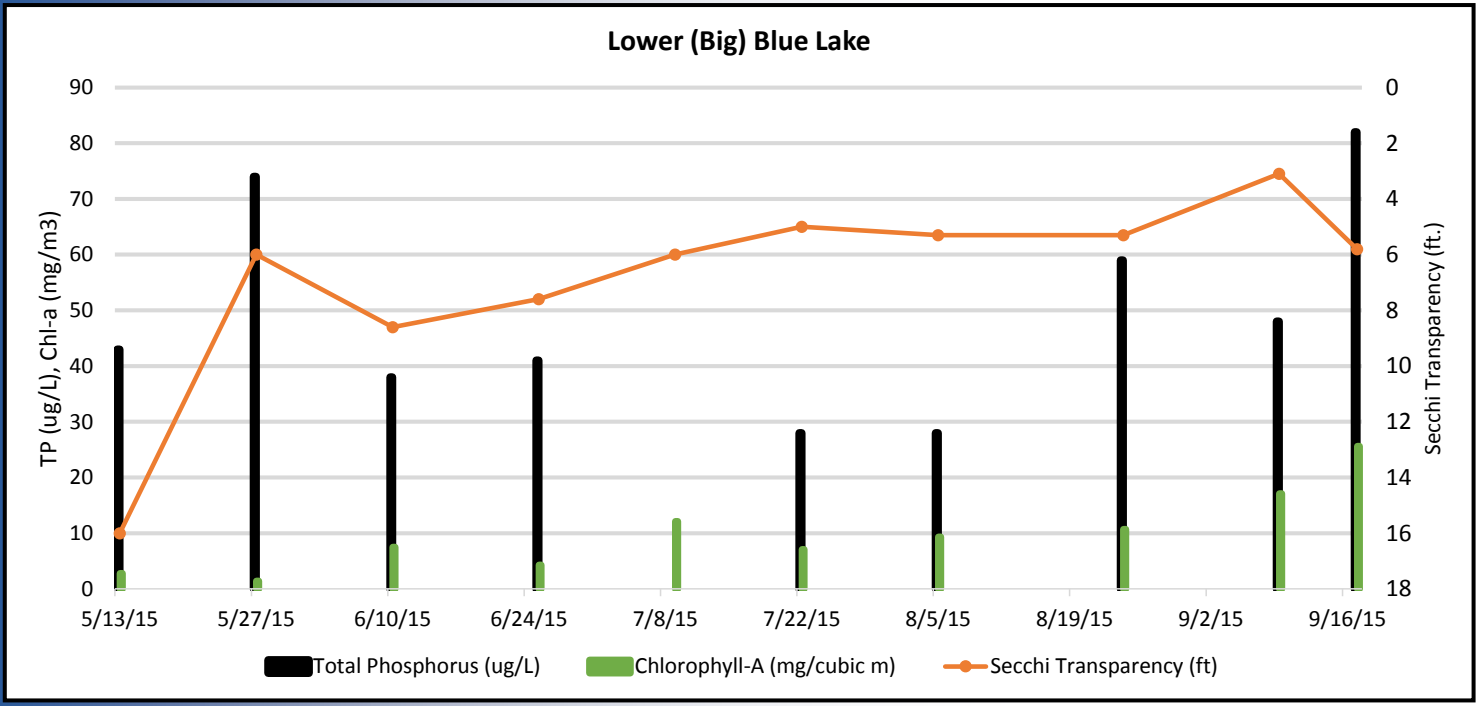
Phosphorus (TP): an essential plant nutrient in which an excess can cause severe algal blooms, measures all usable forms.
Chlorophyll-a (Chl-a): a pigment found in green plants, used to estimate amounts of algae in a lake.
Secchi Transparency: a measure of light penetration in water, an indication to the amount of algae in the water.

Lower (Big) Blue Lake Monitoring Results 2015

Total Phosphorus (TP), Chlorophyll-a (Chl-a) and Secchi Transparency

MN Clean Water Goals for Deep Lakes:

Total Phosphorus (TP): ≤ 40 ug/L Chlorophyll-a: ≤ 14mg/m3 Secchi Depth: ≥ 4.59 feet



Lower/Big Blue Lake has a maximum depth around 30ft and the majority of the lake is greater than 15 feet deep which means this part of the lake should have characteristics of a deep lake. Deep lakes tend to stratify or form layers, especially during summer, because the density of water changes as its temperature changes. The layers mix in the spring and fall. When the layers mix, nutrients trapped on the bottom of the lake can get released into the water column. The monitoring results for Lower Blue Lake are compared to the States goals for deep lakes in this area.

When compared to deep lake water quality goals, Big Blue Lake meets the goals for transparency and chlorophyll-a but does not meet the goal for phosphorus. Phosphorus was the highest early and late in the season. This result corresponds to the periods of time when the lake water column mixes. When the water mixes phosphorus trapped in the bottom of the lake gets released. This phenomenon is termed "internal loading"; however, at this time we do not have enough information to verify the theory. Chlorophyll-a appears to increase and transparency to decrease over the season– note that both of these parameters are meeting the water quality goals.

TP concentration was not recorded in the month of July due to incorrect lab data.

	TP (ug/L)	Chl-a (mg/m3)	Secchi (ft.)
Growing season average	46.29	11.71	5.84

General Definitions

Phosphorus (TP): an essential plant nutrient in which an excess can cause severe algal blooms, measures all usable forms.
Chlorophyll-a (Chl-a): a pigment found in green plants, used to estimate amounts of algae in a lake.
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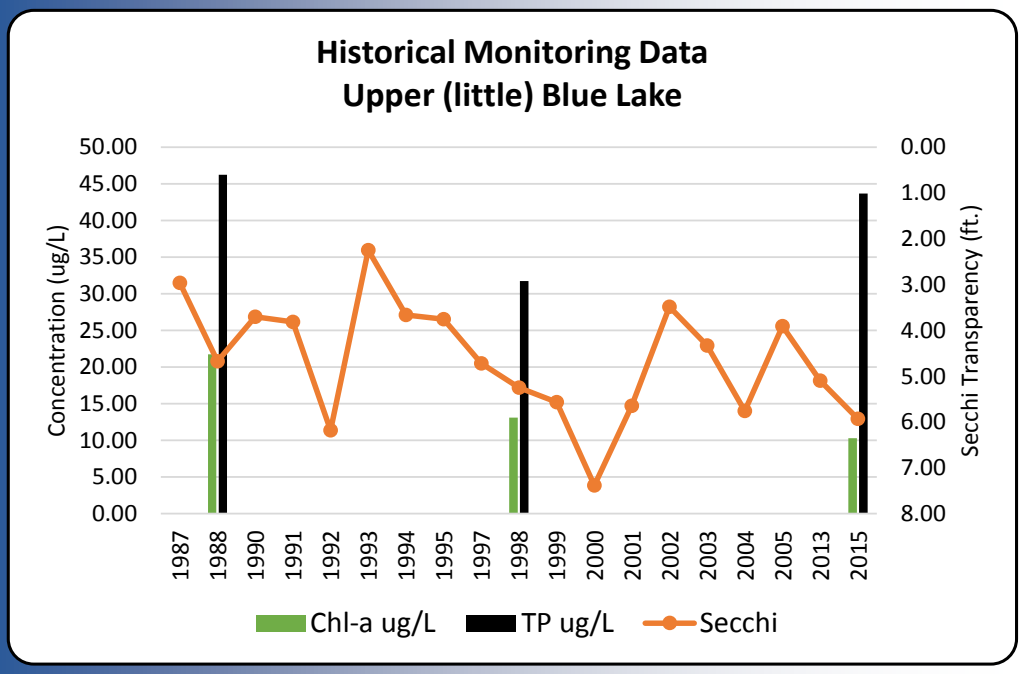
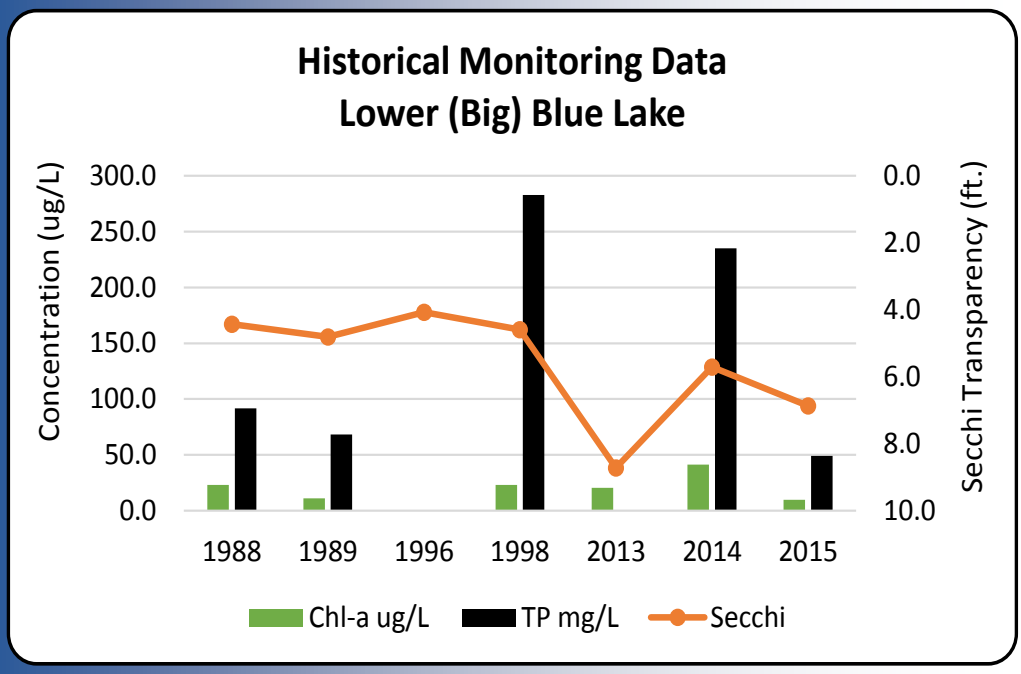
Historical Monitoring Data

Total Phosphorus (TP), Chlorophyll-a (Chl-a) and Secchi Transparency



Source: Minnesota Pollution Control Agency

Little (Upper) Blue Lake has the most historical transparency monitoring data, reporting observations almost every year from 2005 back to 1987. From 2013 to 2015 the average transparency has increased .83 feet. The most recent chlorophyll -a and total phosphorus monitoring was done seventeen years ago, which is not enough information to detect any water quality trends.



Source: Minnesota Pollution Control Agency

Lower (Big) Blue Lake has 2014 and 2013 monitoring data for TP, Chl-a and transparency. There was a drastic drop in all three parameters from 2014 to 2015. More years of data are needed to explain this occurrence. Currently the Chl-a average is the lowest in three years and transparency observations have improved by almost 1 foot since 2014.

2015 Monitoring Recommendations

It is difficult to draw any conclusions from the limited monitoring data available. The data collected in 2015 did give us valuable insight into water health and how the lake responds over the season. We recommend the LID to continue lake and stream monitoring as planned. Additionally, the LID should work with the SWCD to identify ways to minimize runoff from the lake tributaries and lake shore properties prior to investigating any in-lake activities.

Below are key points and recommendations for lake monitoring in 2016 :

- Continue monitoring as planned.
- Collecting temperature and dissolved oxygen profiles during each sample event at each site would give additional insight in to lake mixing and its effects on water quality. The SWCD may be able to assist with this.
- Make note periods of heavy boat traffic on the lake.

For more information contact: IsantiSWCD 763-689-3271

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Todd Kulaf, Conservation Tech todd.kulaf@mn.nacdnet.net

Thanks to the BLID members who have assisted with lake and stream monitoring, especially Jim LeFebvre and Dave Bebeau!

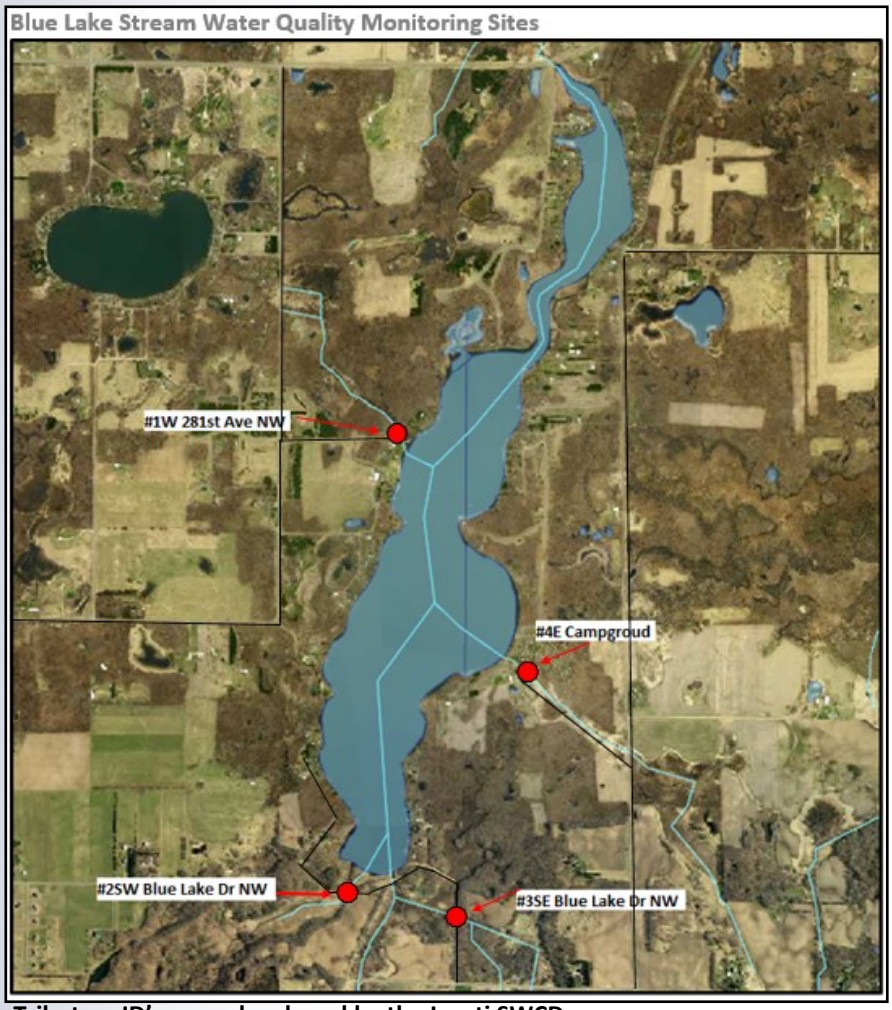
Blue Lake
Tributary Monitoring

Introduction

In 2015 the Blue Lake Improvement District (BLID) partnered with the Isanti Soil and Water Conservation District (SWCD) to monitor four tributaries that empty into Blue Lake:

- #1 West 281st Ave. NW Dead End Site
- #2 Southwest Blue Lake Dr. NW Site
- #3 Southeast Blue Lake Dr. NW Site
- #4 East Campground Site

Site #4E Campground



Tributary ID's were developed by the Isanti SWCD

Tributary Monitoring

What: In 2015 eight samples were collected at each of the four tributaries targeting four samples during rain events and four during base flow. The samples were tested for total phosphorus (TP), total suspended solids (TSS) and transparency. Water level was also recorded during each sample event. Blue LID volunteers collected the samples and the Isanti SWCD staff provided training, equipment, coordinated lab testing and gathered water samples when volunteers could not (weather dependent sampling).

In addition to water quality, water levels were continually tracked using in-stream data loggers. Water level readings, when paired with flow, will help us understand how much water and nutrients are being carried from the tributaries and into the lake. The water levels were recorded every 4 hours from mid-March through early November.

Why: This information will help us focus future lake water quality improvement projects at the best places on the landscape. In other words, near the streams that deliver the most nutrients to the lake. The lake's tributaries have not been monitored in the past.

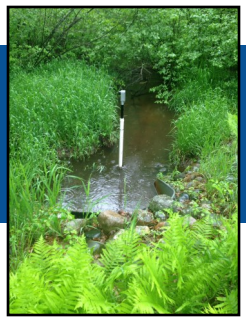
Total Phosphorus: an essential plant nutrient in which an excess can cause severe algal blooms.

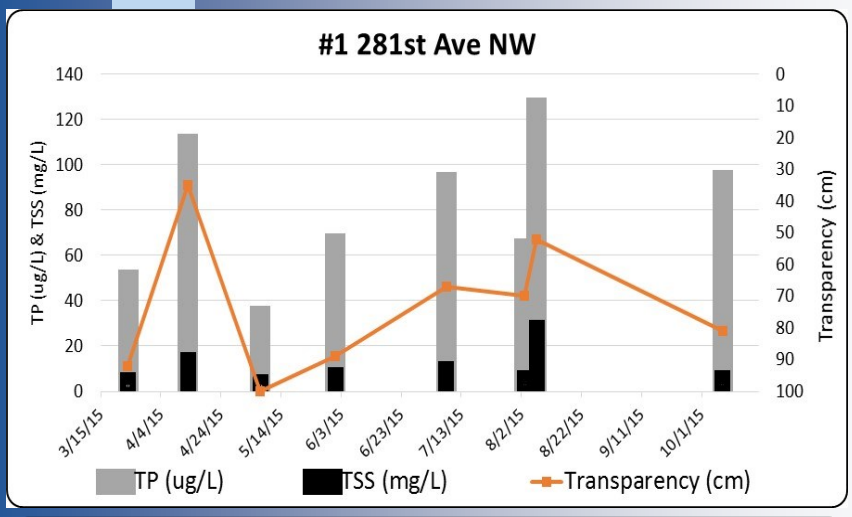
Total Suspended Solids: tiny particles of soil and other matter that remain suspended in water making it cloudy. Particles include sediment and organic matter.

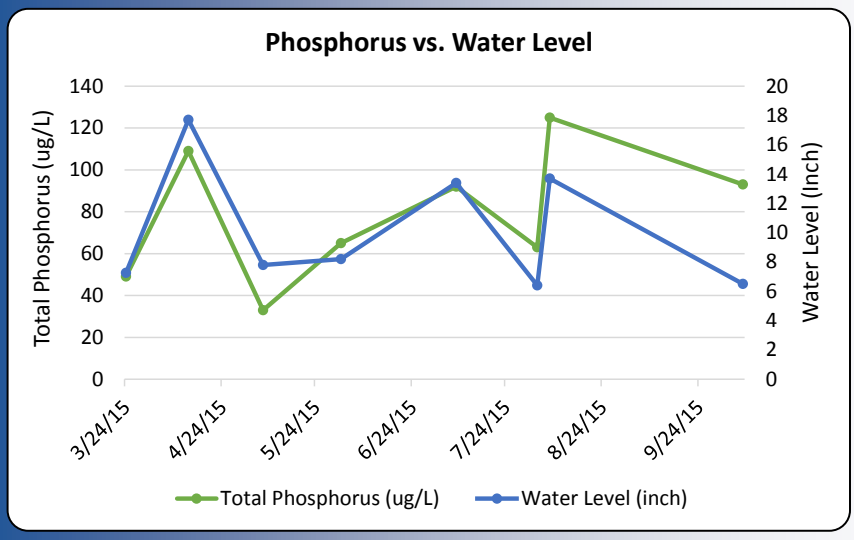
Transparency: an indirect measure of suspended and dissolved materials (soil particles and tea color caused by organic materials) in the water.

2015 Tributary Monitoring Results

Total Suspended Solids, Total Phosphorus and Transparency Tube



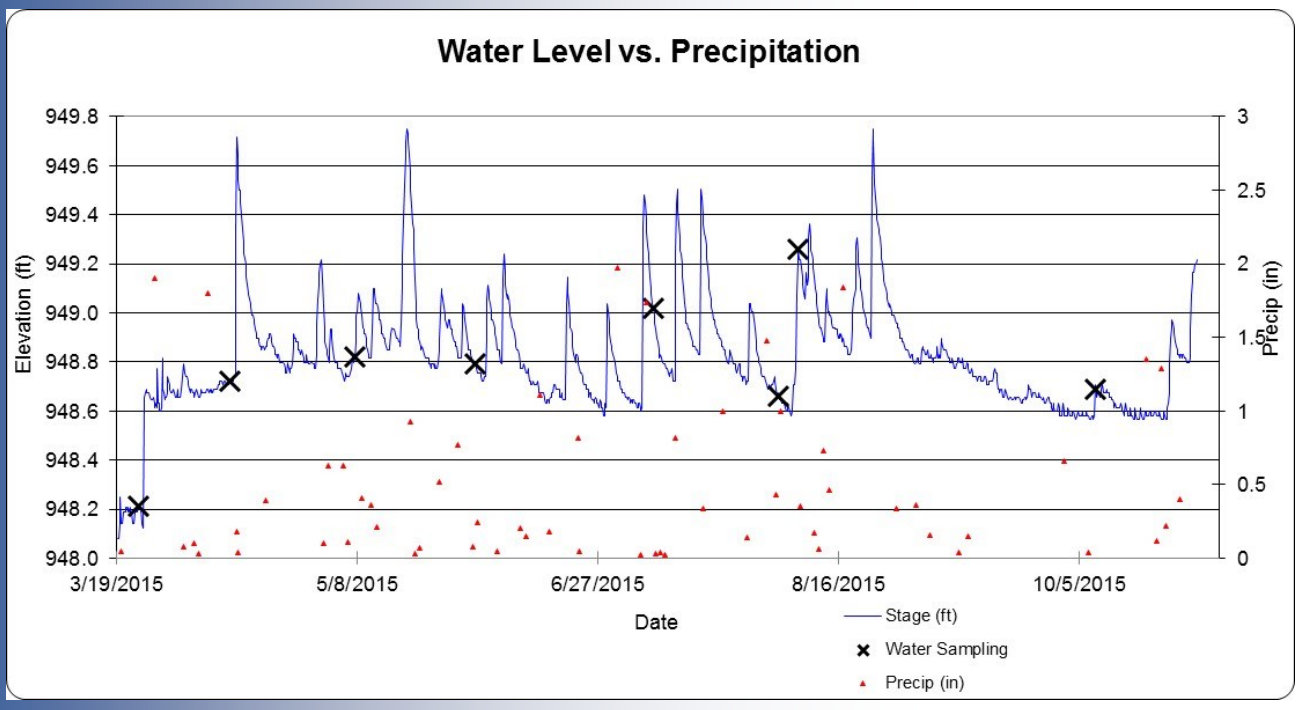




Site:

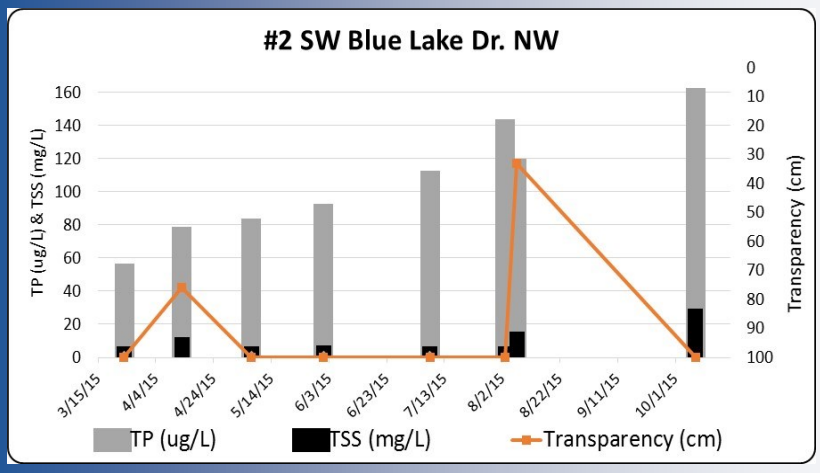
#1 281st Ave NW

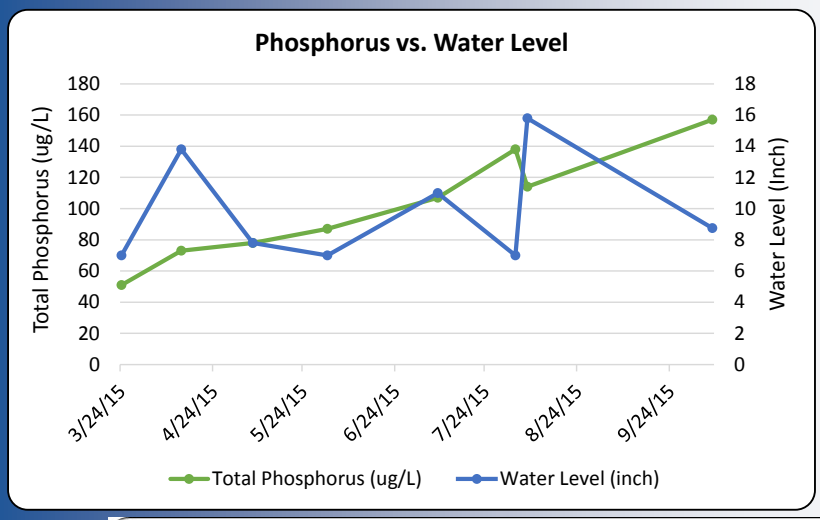
- The average concentration of TP at this location was 78.63 µg/L; the lowest concentration measured among all four tributaries. The concentration is 115.47% lower than the campground site (169.43 µg/L).
- Typical TP measurements for this ecoregion range between 60 and 150 µg/L. The average concentration at this location is at the low end of the range.
- Typical TSS measurements for this ecoregion range between 4.8 and 16 mg/L. The average concentration of TSS detected at this location was 10.00 mg/L which is average in this ecoregion.
- Transparency readings averaged 73.25 cm (Transparency tubes only measure to 100 cm) this means the water is typically quite clear.
- It appears that water quality measurements fluctuate in relation to water level (precipitation). Runoff from land use appears to play a factor in nutrient concentrations.



2015 Tributary Monitoring Results

Total Suspended Solids, Total Phosphorus and Transparency Tube

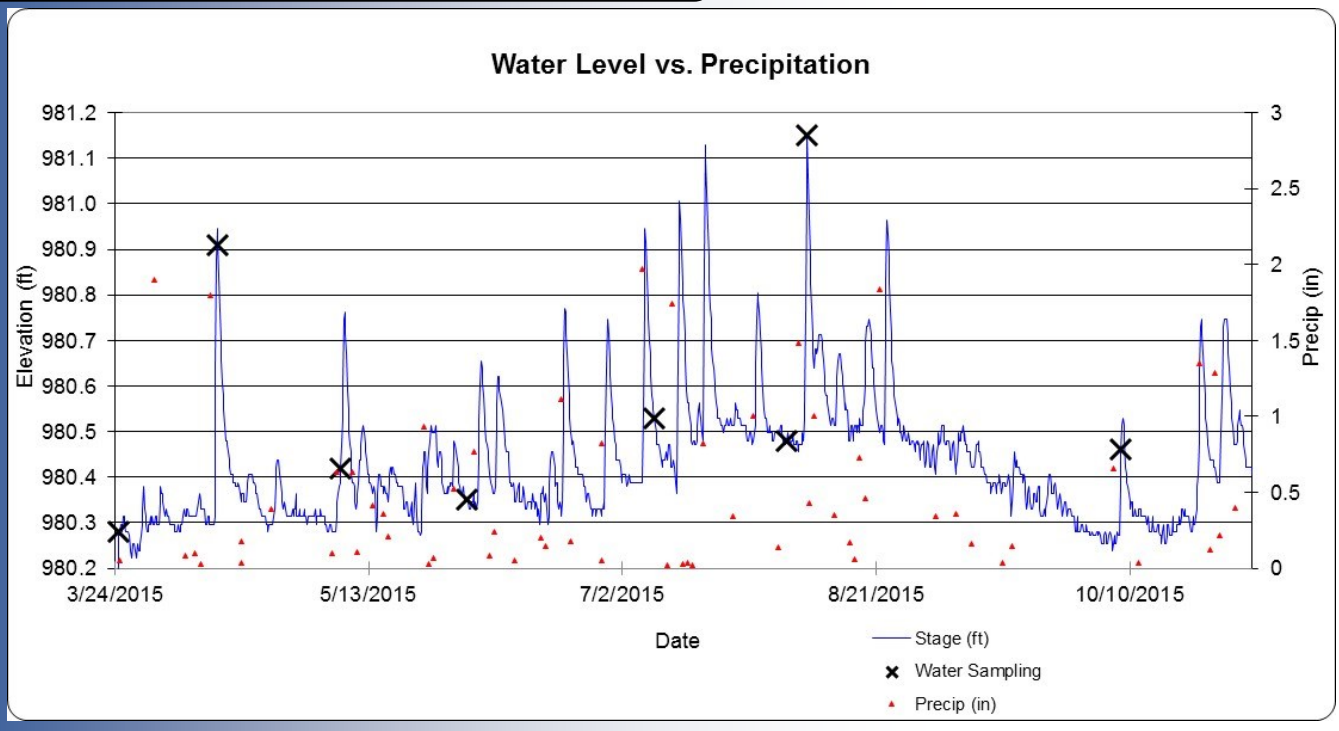




Site:

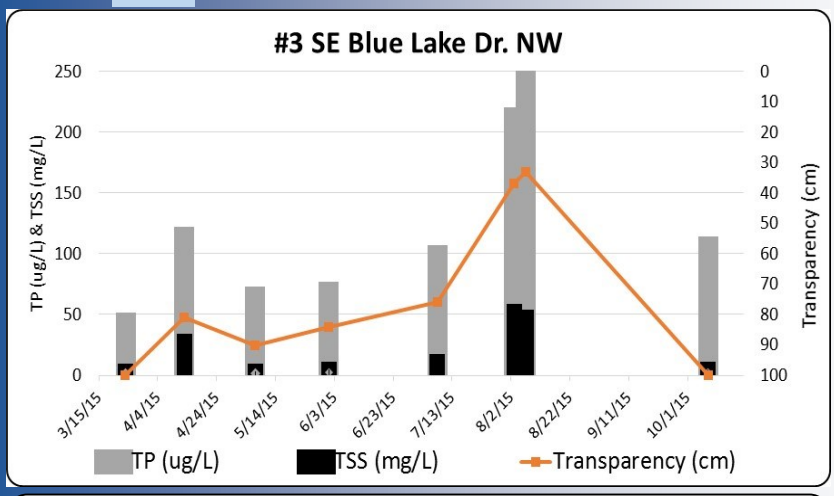
#2SW Blue Lake Dr. NW

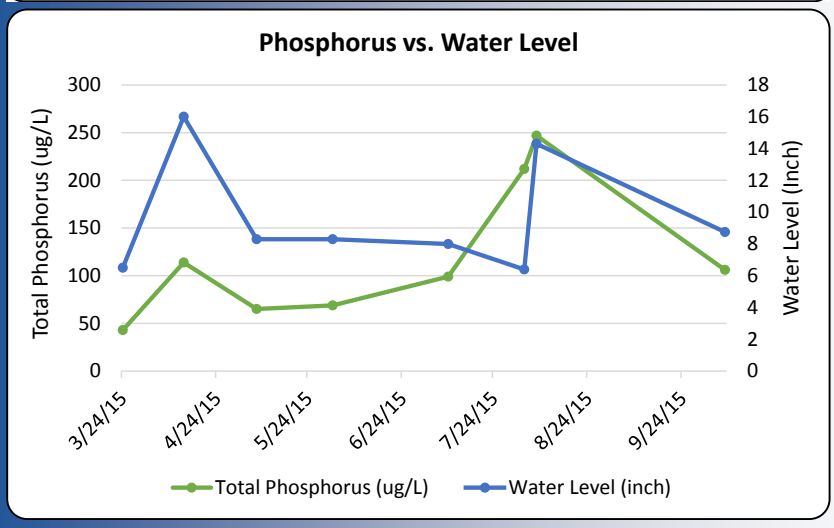
- The average concentration of TP at this location was 100.63 µg/L, the third highest concentration measured among the four tributaries.
- Typical TP measurements for this ecoregion range between 60 and 150 µg/L. The average concentration at this location falls near the middle of this range.
- Typical TSS measurements for this ecoregion range between 4.8 and 16 mg/L. The average concentration of TSS detected at this locations was 6.88 mg/L- better than average for this ecoregion.
- The TSS measurements correspond with the average transparency tube reading of 88.63 cm, the highest among all four Blue Lake tributaries.
- TP levels increased throughout the monitoring season regardless of precipitation; however, when samples were taken at the peak of water level, both TP and transparency were at their worst.



2015 Tributary Monitoring Results

Total Suspended Solids, Total Phosphorus and Transparency Tube

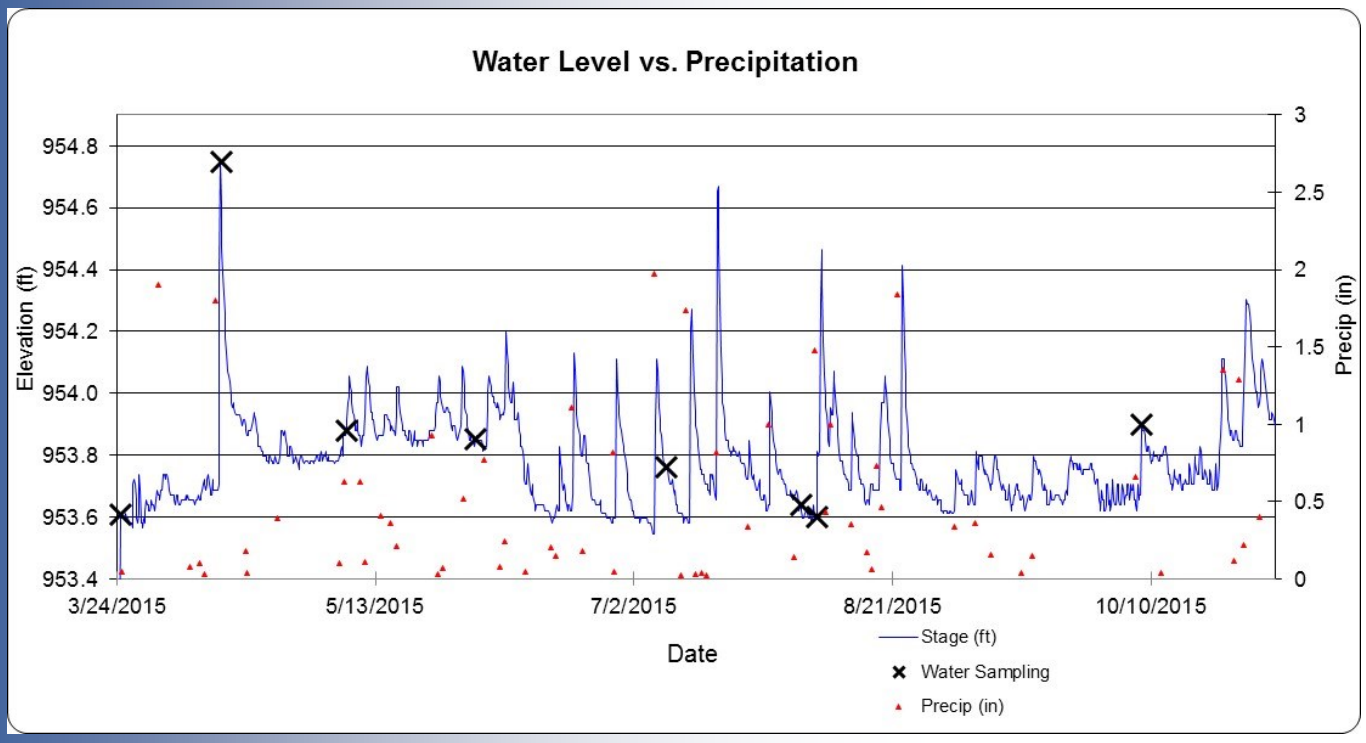




Site:

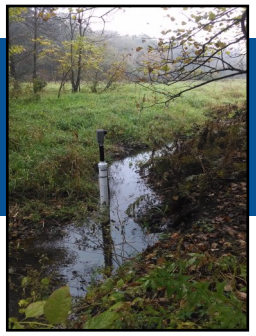
#3SE Blue Lake Dr. NW

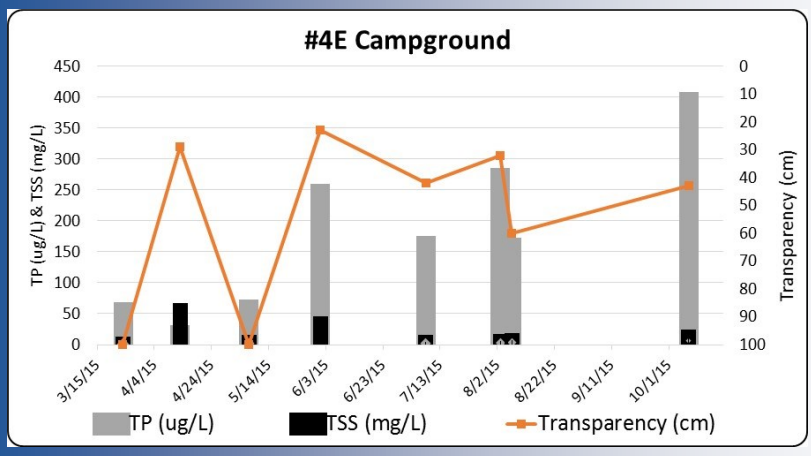
- The average concentration of TP at this location was 119.38 µg/L.; the second highest of all four sites
- Typical TP measurements for this ecoregion range between 60 and 150 µg/L. The average concentration at this location is near the high end of the range.
- Typical TSS measurements for this ecoregion range between 4.8 and 16 mg/L. The average concentration at this location was 19.38 mg/L, this exceeds the "normal" range of conditions by 21.12%.
- Transparency readings averaged 75.13 cm (transparency tubes only measure to 100cm). While it seems that the water is typically quite clear the high water event in August resulted in a rather drastic reduction in water clarity (30 cm).
- It appears that water quality fluctuates in response to water level (precipitation). Runoff from land use appears to play a factor in nutrient concentrations. The highest concentration of TP was measured during the August event (247 µg/L).

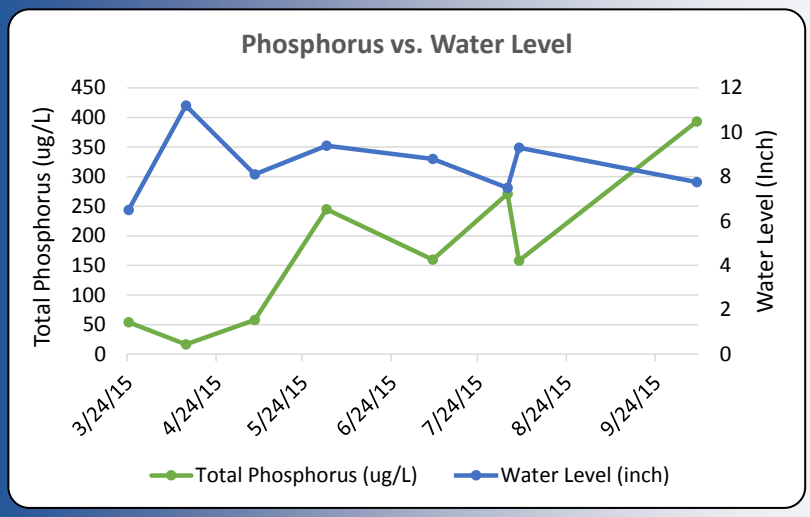


2015 Tributary Monitoring Results

Total Suspended Solids, Total Phosphorus and Transparency Tube



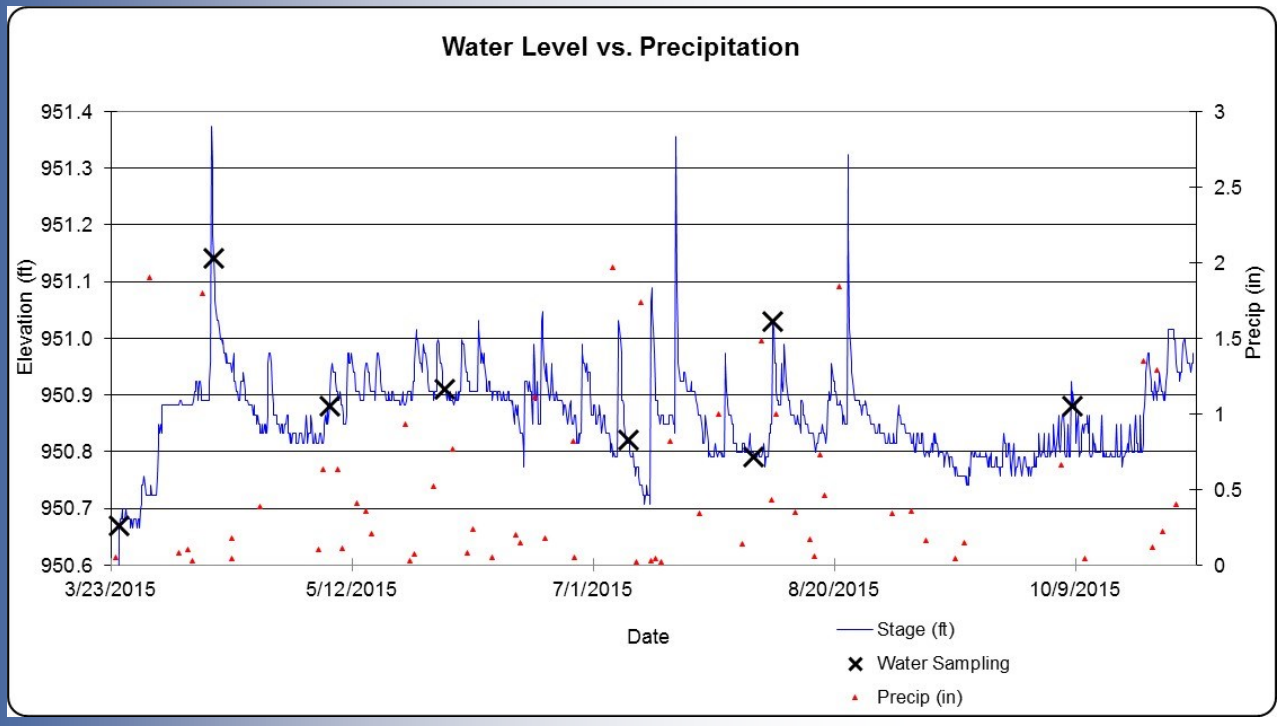




Site:

#4E Campground Site

- The average concentration of TP at this location was 169.3 µg/L; the highest concentration measured among all four tributaries (42% higher than site #3).
- Typical TP measurements for this ecoregion range between 60 and 150 µg/L. The average concentration at this location exceeds this range. TP was consistently high at this location.
- Typical TSS measurements for this ecoregion range between 4.8 and 16 mg/L. The average concentration of TSS detected at this location was 16.13 mg/L; slightly higher than the typical range.
- Corresponding with high TP and TSS, the transparency at this site was also much lower than all other sites. Transparency readings averaged 53.63 cm (transparency tubes only measure to 100 cm).
- Interestingly, TP appears to decrease with increased water level (precipitation). This result would suggest that the wetland is a source of nutrients to the lake.
- Water level here showed the least amount of fluctuation in comparison to the other sites.



2015 Results and Recommendations

2015 marked the first complete year of monitoring at the four tributary location's. To this point, tributaries 1-3 appear to have water quality that is driven by precipitation carrying nutrients off of the land and into the water. All tested parameters in sites 1-3 are, for the most part, close to or within typical ranges for this ecoregion; however, they may still contribute to lake pollution over time.

Tributary 4 appears to have the highest concentrations of nutrients (TP). The highest phosphorus levels, at least in 2015, occur during base flow conditions. This characteristic is often observed downstream of wetlands that become anoxic (low – no oxygen) during periods of low flow. Anoxic conditions cause phosphorus to release from sediments. This tributary could be a starting point in which to focus water quality improvement projects. If the wetland is in fact a source of pollution a wetland restoration may be key to lake protection.

Because weather conditions and other environmental factors can vary so drastically from year to year it is recommended to continue monitoring at each of the tributaries as planned. Continued monitoring will give us a better understanding of how the streams and lake respond to environmental conditions and therefore how we might best be able to work together to protect the quality of the lake.

Below are key points and recommendations for monitoring in 2016 at each of the four tributaries:

Tributaries 1-3:

- Focus on grabbing samples at the highest and lowest water levels (peak flow and low flow).
- Gauging flow during sample events would be helpful in determining the total load of nutrients moving in the stream. The SWCD would need to complete this task.

Tributary 4:

- Focus on grabbing samples at the highest and lowest water levels (peak flow and low flow).
- Gauging flow during sample events would be helpful in determining the total load of nutrients moving in the stream. The SWCD would need to complete this task.
- Consider adding ortho-phosphorus (OP) to the testing parameters for this location. By measuring OP, we can gain valuable insight into the sources of nutrients and potential solutions.
- Consider measuring dissolved oxygen at this location. A field instrument is needed for this task, the SWCD may be able to help.
- Investigate locations for adding a sample point upstream. We may be able to pin-point the area contributing to high nutrient levels.

For more information contact: IsantiSWCD 763-689-3271

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