# Blue Lake
# Monitoring Report 2017

**What:** LID volunteers collected Total Phosphorus (TP), Chlorophyll-a, and transparency information every two weeks from May through October in both Upper and Lower Blue Lake (see map). SWCD Staff collected Dissolved Oxygen and Temperature information throughout the water column, once a month, from May to October in both lakes. SWCD staff provided training, equipment and coordinated lab testing.

**Why:** The lake has not been monitored with any regularity prior to 2013. Prior to 2013 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. This is the third consecutive year of monitoring done by the Isanti SWCD and the BLID. The data being gathered provides us with an understanding of the lake's health and water quality trends; furthermore, the data helps us diagnose areas of concern and provides evidence for the need to implement lake improvement projects (great for grant applications). In fact, monitoring data from 2015 and 2016 was used to obtain over $250,00 of grant funding to implement water quality improvement projects around the lake.

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: **No** |
| (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: **NO** |
| | Secchi Transparency: **YES** |

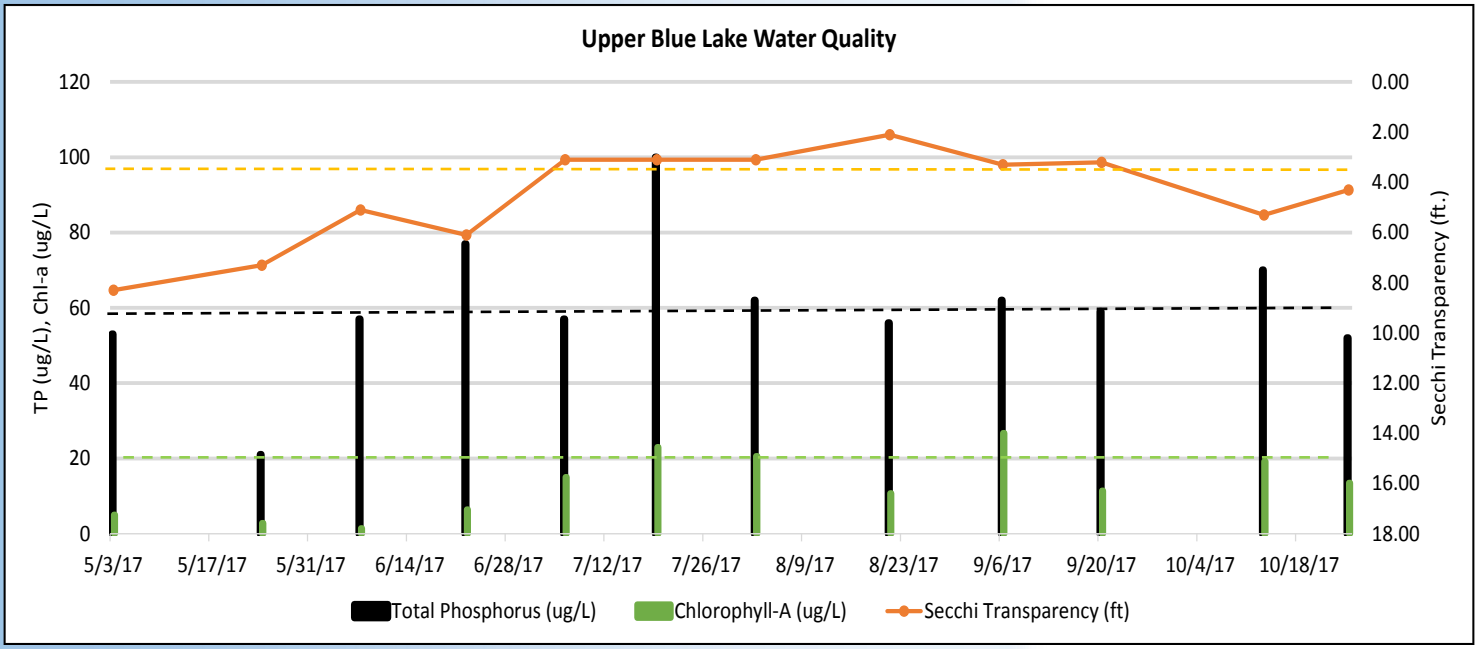
# Upper (Little) Blue Lake Monitoring Results 2017

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

**MN Clean Water Goals for Shallow Lakes**

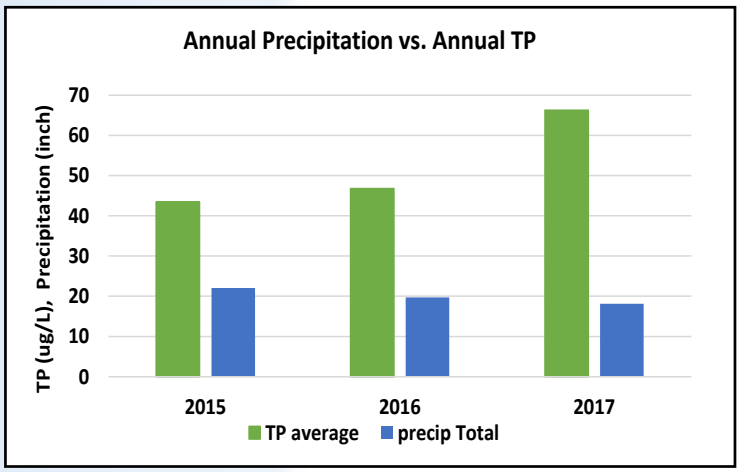
Total Phosphorus (TP): ≤ 60 ug/L  Chlorophyll-a: ≤ 20 mg/L  Secchi Depth: ≥ 3.28 feet

| | | | |
|---|---|---|---|
| Growing season average (June-September) | 66.50 ug/L (TP) | 14.40 mg/L (Chl-a) | 3.64 ft. (Secchi) |




## Data Analysis and Hypothesis:

- Maximum lake depth of 10 ft.= shallow lake.
- Monitoring results are compared to shallow lake state water quality goals.
- TP is higher (worse) than water quality goals— this is the first time this happened.
- Water clarity hovers near the goal for most of the season. Reduced clarity is due to algae.
- Increased TP and Chl-a in July may be a result of internal re-cycling due to boat traffic, low precipitation, and/or wind.
- Nutrient concentrations stay consistent for most of the year. This is similar to 2016; however, this year the concentrations were higher.
- Annual precipitation was lower than previous years but average TP was higher. This could point to a persistent source of TP such as internal recycling or SSTS.




**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.

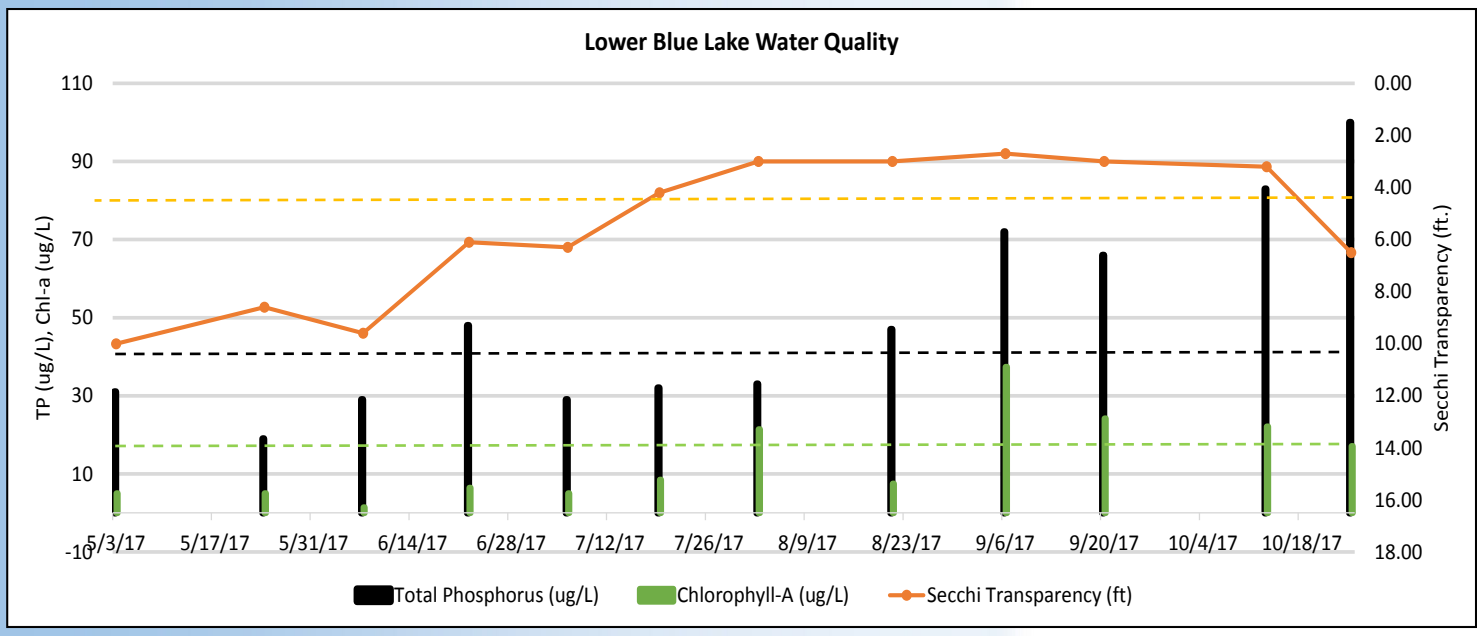
# Lower (Big) Blue Lake Monitoring Results 2017

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

**MN Clean Water Goals for Deep Lakes:**

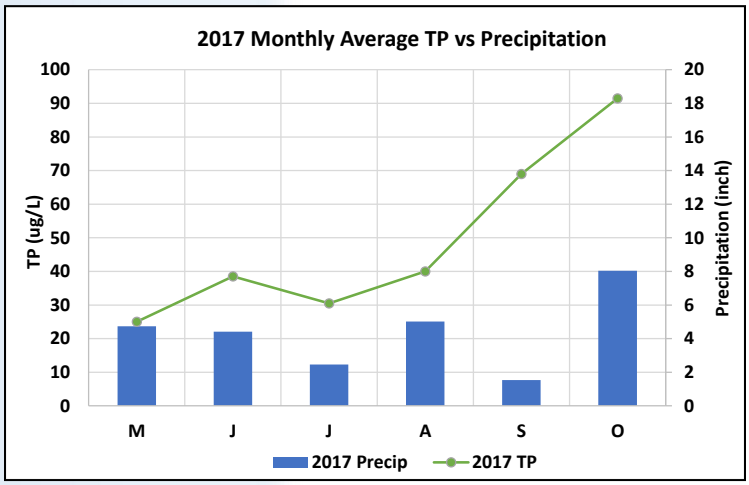
Total Phosphorus (TP): ≤ 40 ug/L  Chlorophyll-a: ≤ 14mg/L  Secchi Depth: ≥ 4.59 feet

| | | | |
|---|---|---|---|
| Growing season average (June-September) | 44.50 ug/L (TP) | 18.43 mg/L (Chl-a) | 5.45 ft. (Secchi) |




## Data Analysis and Hypothesis:

- Maximum Lake depth of 30ft.= deep water lake.
- The water column stratifies (forms layers) during summer months because it is deep.
- Monitoring results are compared to deep lake state water quality goals.
- Lake exceeds TP and Chl-a water quality goals. This means it can be classified as impaired! :(
- Average water clarity is better than the water quality goal threshold; however individual readings are worse later in the summer (because of increased algae).
- Low TP and Chl-a in July relate to thermal stratification. The heavy, cold water holds nutrients at the bottom of the lake.
- High TP and chl-a in late summer reflect water column mixing (September) and runoff from high rainfall (October).



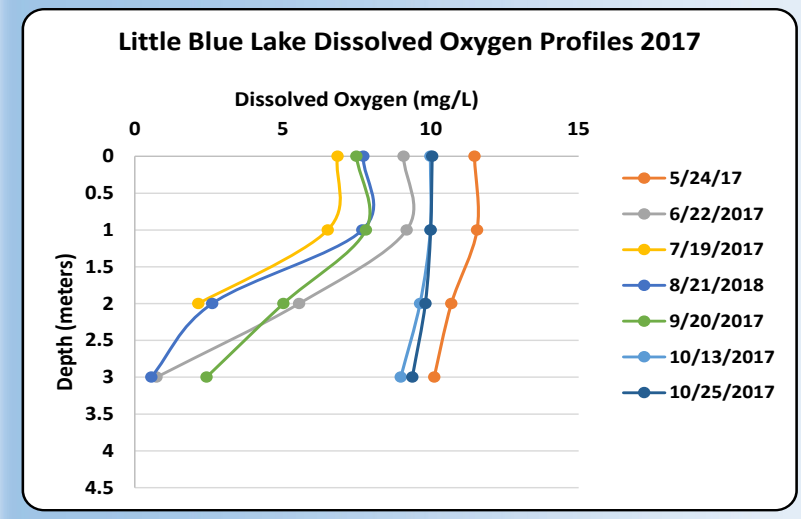

**General Definitions**

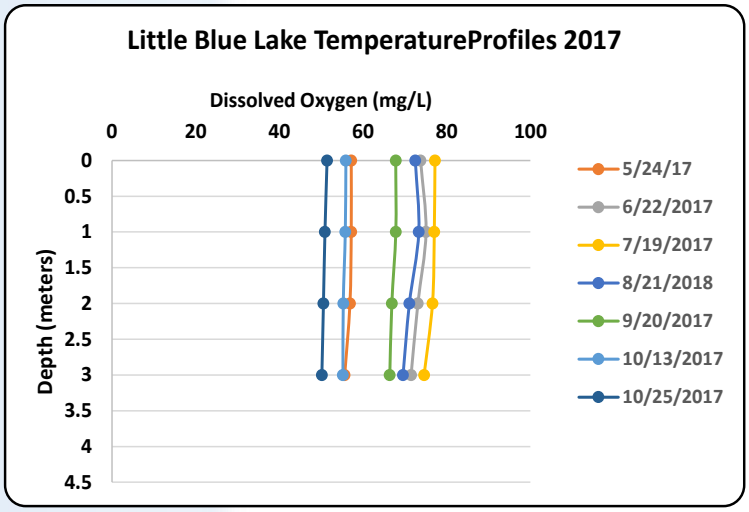
Phosphorus (TP): an essential plant nutrient in which an excess can cause severe algal blooms, measures all usable forms.
Chlorophyll-a (Chl-a): a pigment found in green plants, used to estimate amounts of algae in a lake.
Secchi Transparency: a measure of light penetration in water, an indication to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

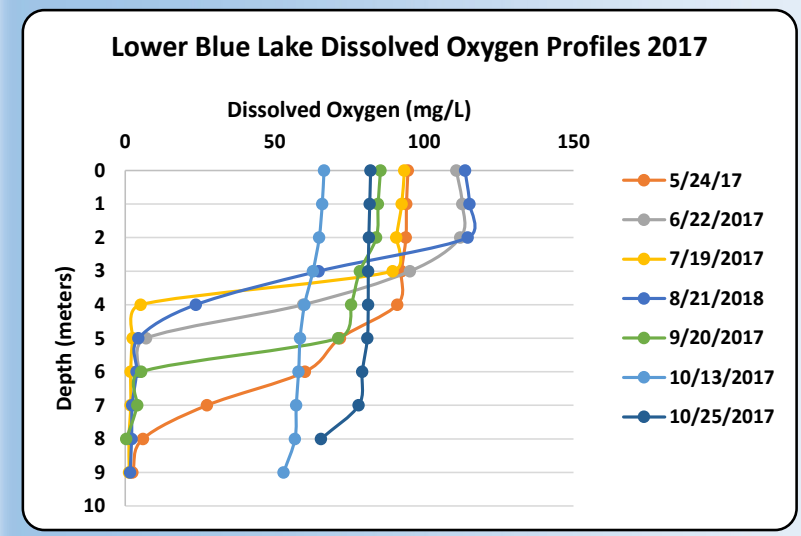
# 2017 Lake Stratification

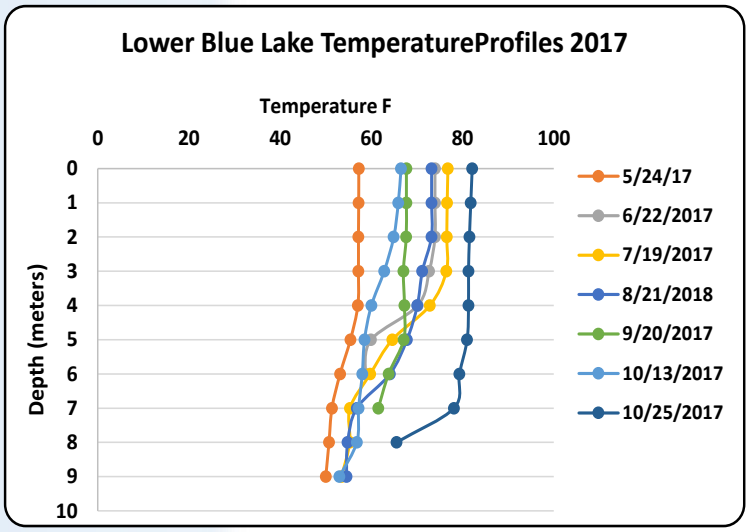
In 2017 we measured temperature and dissolved oxygen profiles starting at the surface of the water and then at one meter increments to the bottom of the lake. This information adds to the story when we analyze lake water quality data. The graphs below are representations of the data collected.

**Little Blue Lake:** Temperature remains consistent from top to bottom throughout the entire summer season. This indicates that the water column is continually mixing (as expected). As such, nutrients that are sitting in the sediments can continually mix into the lake (internal loading). Adding to this, dissolved oxygen periodically decreases to near zero at the bottom. Phosphorus becomes more soluble and can be released from the bottom sediments when this occurs. The decreases in dissolved oxygen may be a result of the decay of excess organic matter such as curly leaf pondweed.



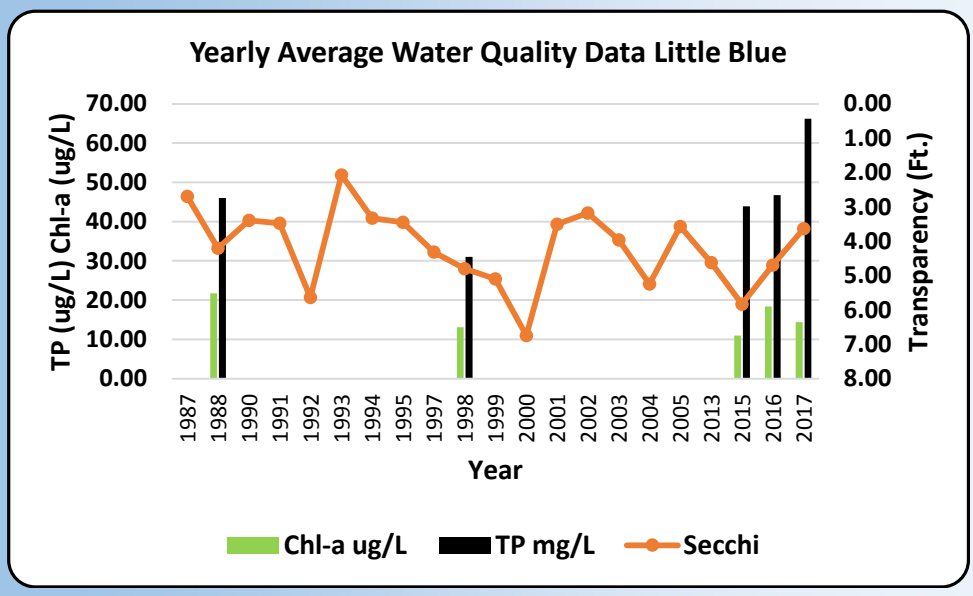




**Big Blue Lake**: Temperature is consistent throughout the water column early and late in the year and forms layers of water with different temperatures from late May to late August. This process is called thermal stratification and is expected in a deep lake. The cool water acts as a barrier between the lake bottom and the warm waters above. Dissolved oxygen periodically decreases to near zero at the lake bottom. This phenomenon is typical in deep, nutrient rich lakes and occurs as the supply of oxygen is consumed by bacteria and decaying matter over the summer months. When the lake mixes (during fall turnover or because of other events such as heavy rains or winds) the nutrients are allowed to escape into the surface water and can stimulate an algal bloom.

# Historic Monitoring Data Comparison

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

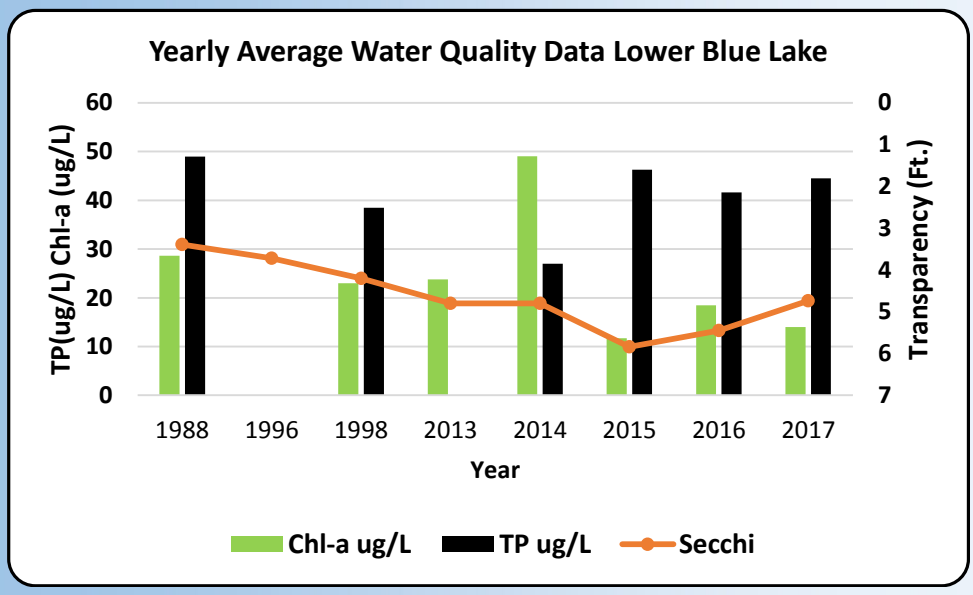



Source: MPCA and Isanti SWCD

Little (Upper) Blue Lake has the most historical transparency monitoring data, reporting observations almost every year from 2005 back to 1987.

Over the most recent 10 years (2015-2017) it appears that water quality is declining.

Interestingly, it does appear that transparency has improved slightly since 1988.




Source: MPCA and Isanti SWCD

Lower (Big) Blue Lake has four years of recent monitoring data for TP, Chl-a and transparency.

Over the most recent 10 years (2014-2017) it appears that water quality is declining.

Interestingly, it does appear that transparency has improved since 1988.

2017 is the second consecutive year that TP and Chl-a exceeded state water quality goals (were worse).

**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.

# 2018 Monitoring Recommendations

The data collected in 2017 give us valuable insight into water health and how the lake responds over the season and from year-to-year. We recommend the LID to continue lake and stream monitoring as planned. Additionally, the LID should continue to work with the SWCD to identify ways to minimize runoff from the lake tributaries and lake shore properties (we will do this with the grant!) AND start discussions on how to quantify and minimize internal recycling of nutrients.

Below are key points and recommendations for lake monitoring in 2018:

- Continue monitoring as planned.
- Continue Collecting temperature and dissolved oxygen profiles during every other sample event.
- Make note periods of heavy boat traffic on the lake.
- Make note when CLPW begins to decay.
- Discuss internal loading monitoring options.

For more information contact: **IsantiSWCD** 763-689-3271
Tiffany Determann, District Mgr tdeterman@isantiswcd.org
Todd Kulaf, Conservation Tech tkulaf@isantiswcd.org

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

# Blue Lake
# Tributary Monitoring 2017

## Introduction

2017 was the third year that the Blue Lake Improvement District (BLID) partnered with the Isanti Soil and Water Conservation District (SWCD) to monitor the health of the four tributaries that empty into Blue Lake:

- #1 281st Ave. NW
- #2 Blue Lake Dr. NW –SW inlet
- #3 Blue Lake Dr. —SE inlet
- #4 Tiger Street SE Inlet
- #5 Upstream SE Inlet

Site #2

**Blue Lake Inlet Monitoring Map**

Map completed by: Isanti SWCD

## Tributary Monitoring

**Tributary ID's were developed by the Isanti SWCD**

What: In 2017 eight sample events were conducted at four tributaries. We targeted four samples during rain events and four during base/low flow. Site #5 was sampled four times. Samples were tested for total phosphorus (TP), total suspended solids (TSS) transparency and Ortho Phosphorus (OP)—OP site #4 only. Dissolved oxygen, temperature, conductivity, pH and water flow were measured in the field.

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

Why: The information collected helps 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. Additionally, this information will be used to track trends and to determine how well water quality improvement projects are working.

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

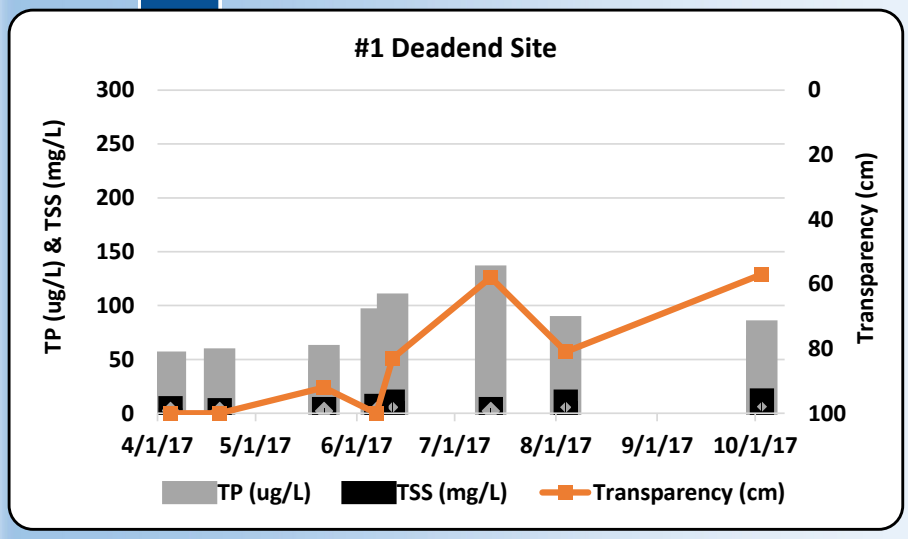
**Orthophosphate:** the amount of phosphorus that is immediately available for algae and plant growth.

**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.

# 2017 Tributary Monitoring Results

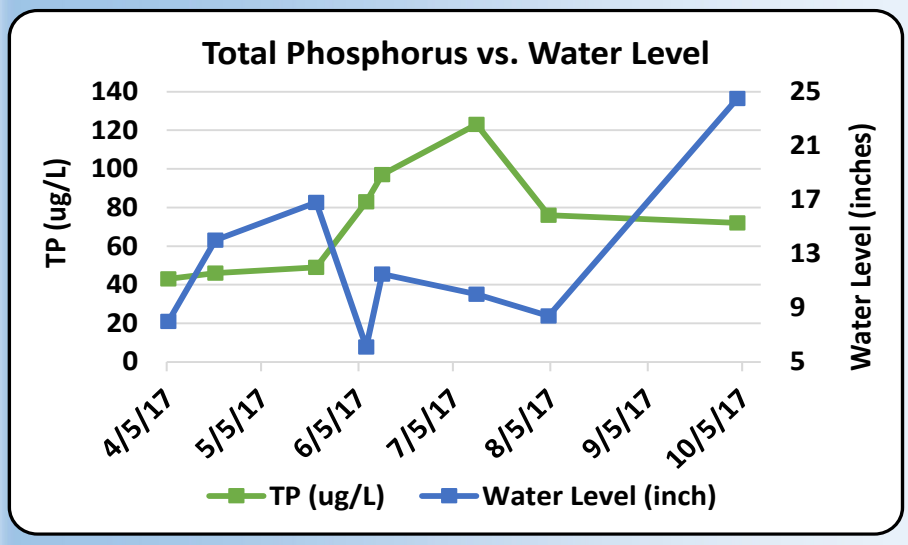
Total Suspended Solids, Total Phosphorus and Transparency Tube

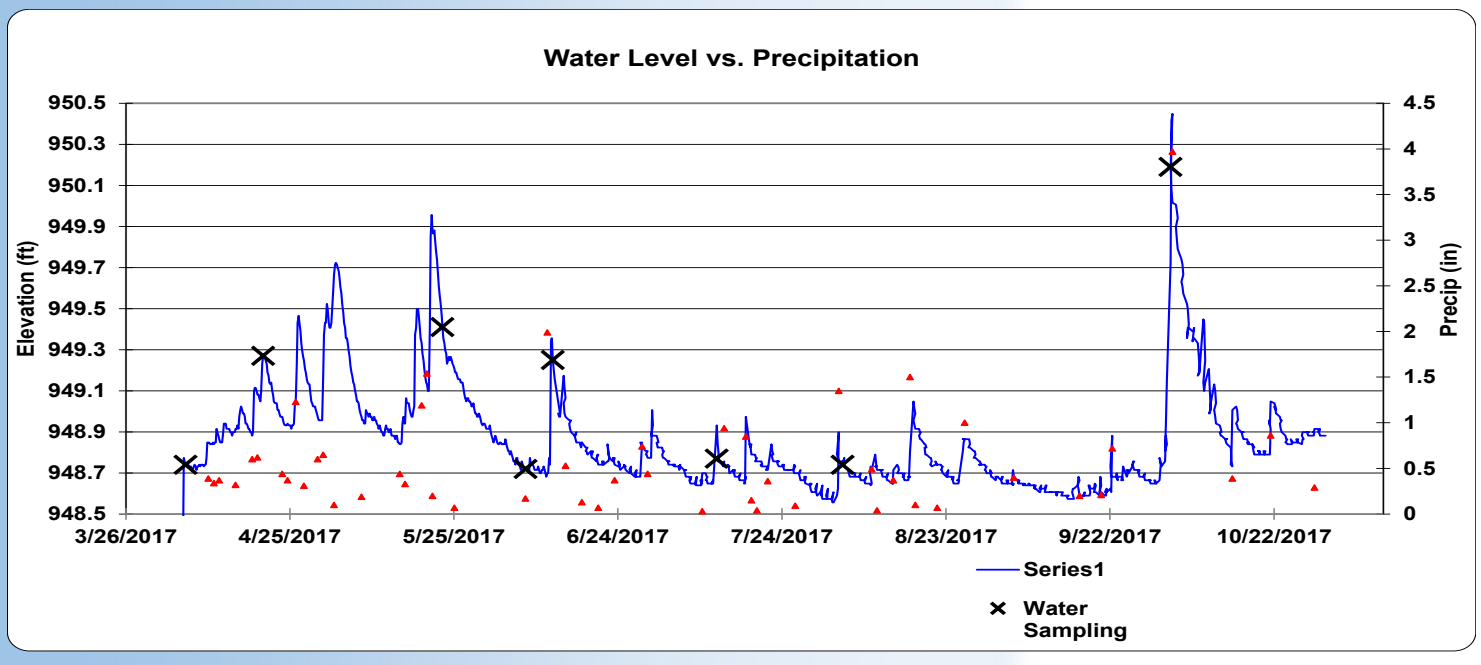



## Site:

## #1 281st Ave NW

- The average concentration of TP at this location in 2017 was 73.62 µg/L; the lowest concentration measured among all four tributaries. Concentrations have been the lowest here for three consecutive years.
- The highest TP concentration was observed after a 2" rain in July.
- TP measurements for this area typically range between 60 and 150 µg/L.
- Flow was highest at this location.
- TSS measurements for this area typically range between 4.8 and 16 mg/L. The average concentration of TSS detected at this location was 7.12 mg/L.
- Transparency readings averaged 83.87 cm (Transparency tubes only measure to 100 cm) this means the water is typically quite clear. The 2016 average was 73.88.
- Stream levels overall were low in 2017.



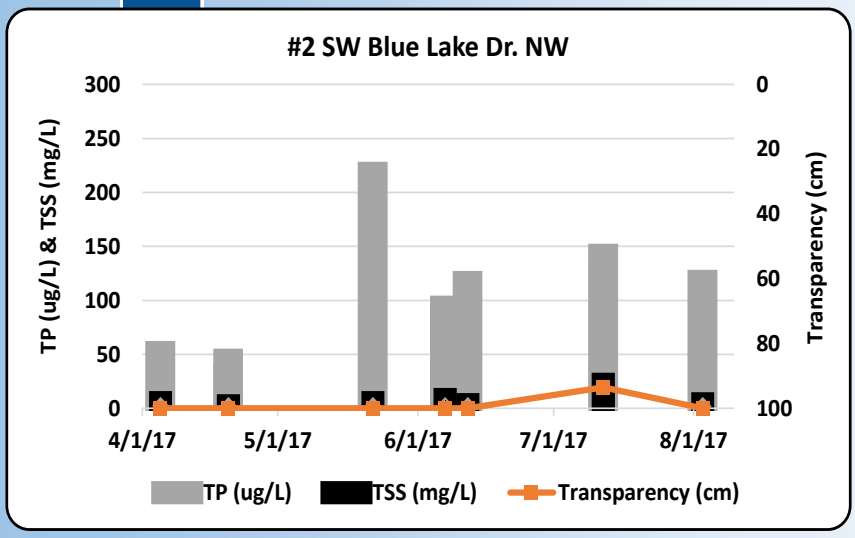



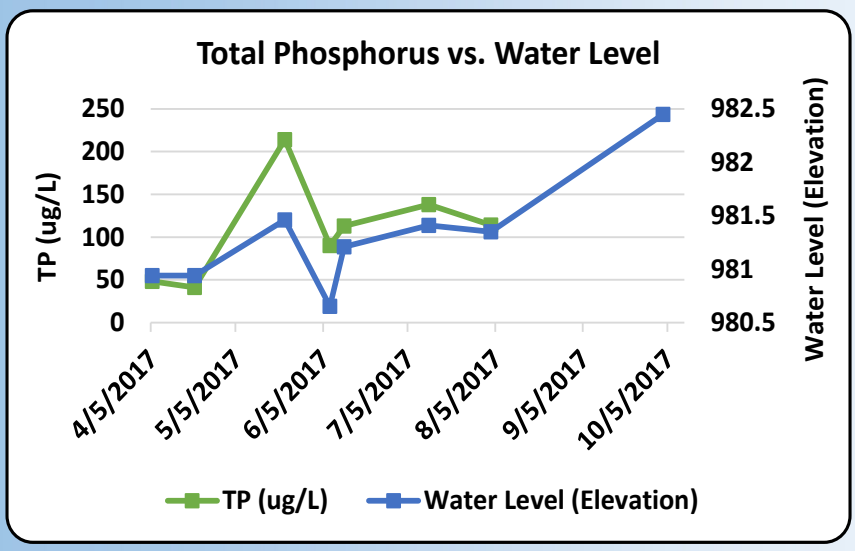
# 2017 Tributary Monitoring Results

Total Suspended Solids, Total Phosphorus and Transparency Tube

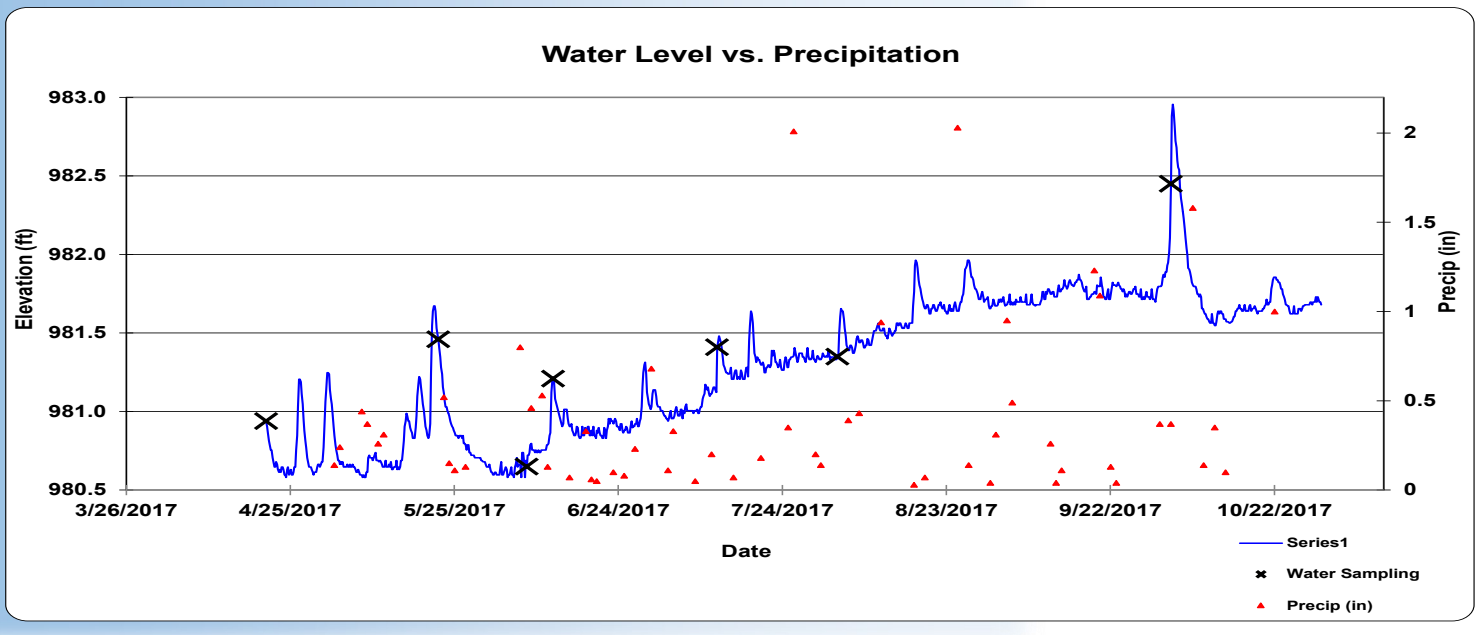
## Site:

## #2 Blue Lake Dr. NW –SW inlet



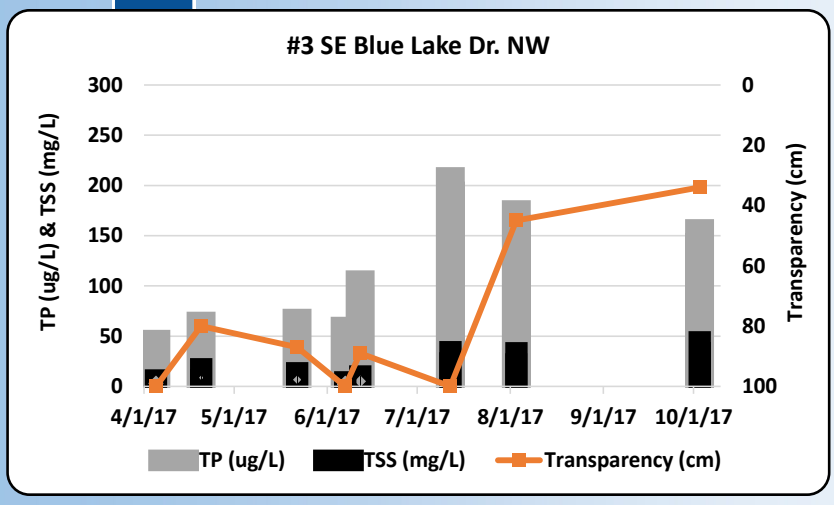



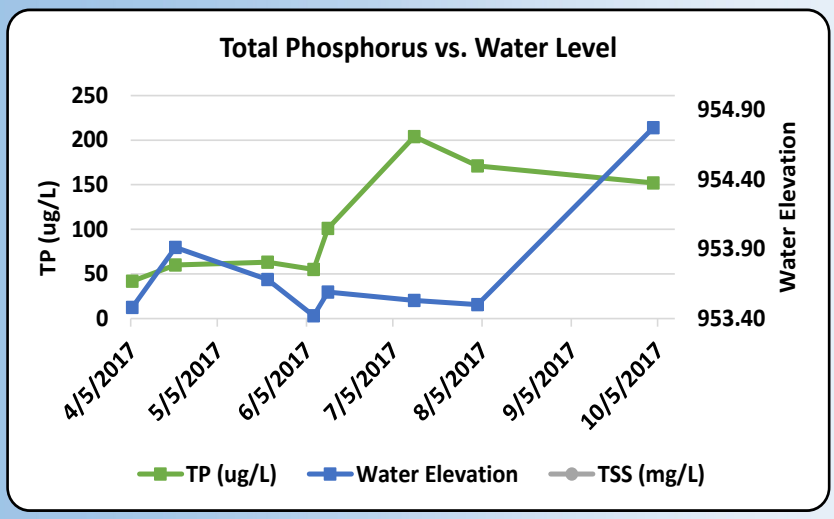

- A beaver dam built down stream between June and July significantly impacted stream flow and water level in 2017. The altered conditions should be taken into consideration when viewing results.
- The average concentration of TP at this location was 108.28 µg/L, the second highest concentration measured among the four tributaries. In 2016 the average was 173.25 µg/L.
- TP measurements for this area typically range between 60 and 150 µg/L.
- Flow was not measured here because of the dam.
- TSS measurements for this area typically range between 4.8 and 16 mg/L. The average concentration of TSS detected at this locations in 2017 was 7 mg/L. The 2016 average was 10.63
- Transparency readings averaged 99 cm (Transparency tubes only measure to 100 cm) this means the water is quite clear. The 2016 average was 73.
- This is the second consecutive year the site has been manipulated by beavers. We recommend discontinuing monitoring here.
- Stream levels overall were low in 2017.



# 2017 Tributary Monitoring Results

## Total Suspended Solids, Total Phosphorus and Transparency Tube

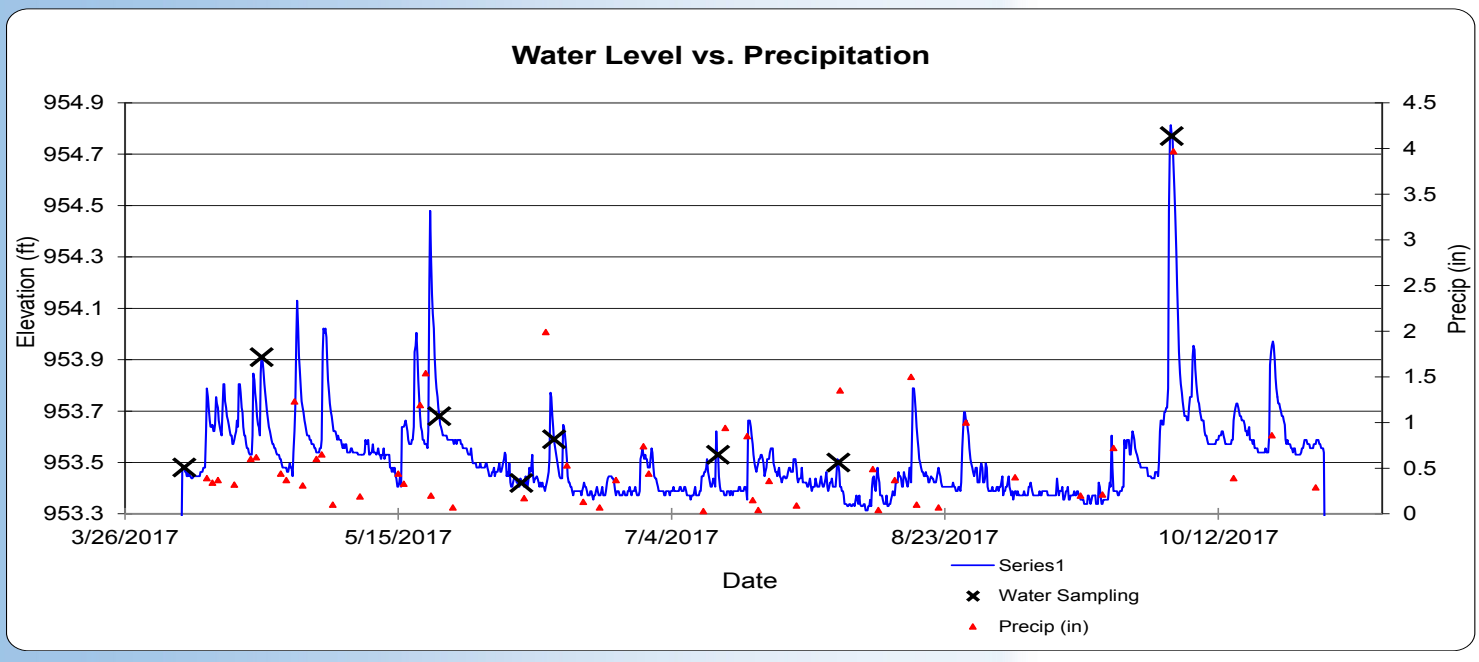



## Site:

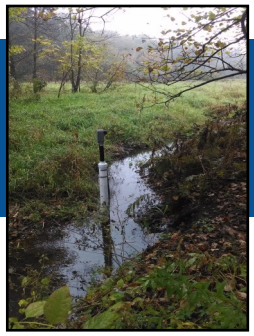
## #3 Blue Lake Dr. —SE inlet

- The average concentration of TP at this location was 105.75 µg/L.; the second lowest of all four sites. In 2016 the average was 121.88 µg/L.
- TP measurements for this ecoregion typically range between 60 and 150 µg/L.
- Flow was the second highest at this location
- TSS measurements for this ecoregion range between 4.8 and 16 mg/L. The average concentration at this location was 21.13 mg/L. The 2016 average was 15.88 .
- Transparency readings averaged 79.37 cm (transparency tubes only measure to 100cm). While the water is typically quite clear the storm event in early July resulted in a rather drastic reduction in water clarity (25 cm). In 2016 the average was 75.63 .
- Stream levels overall were low in 2017.



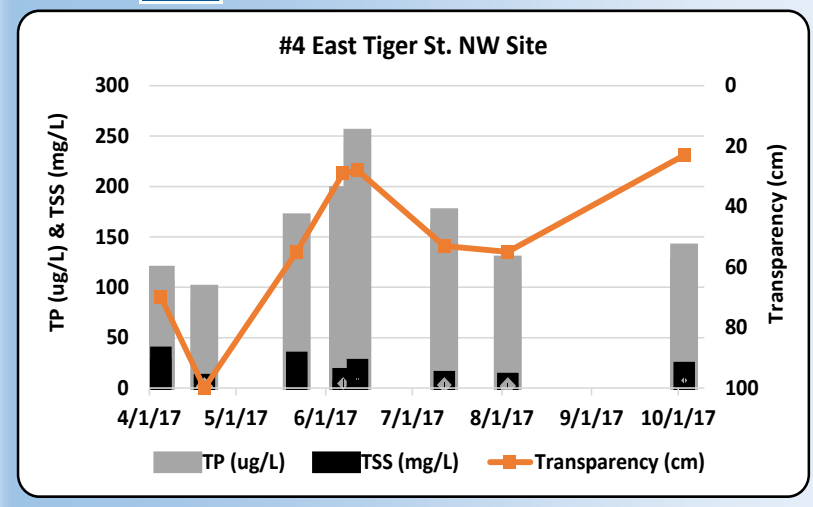
# 2017 Tributary Monitoring Results

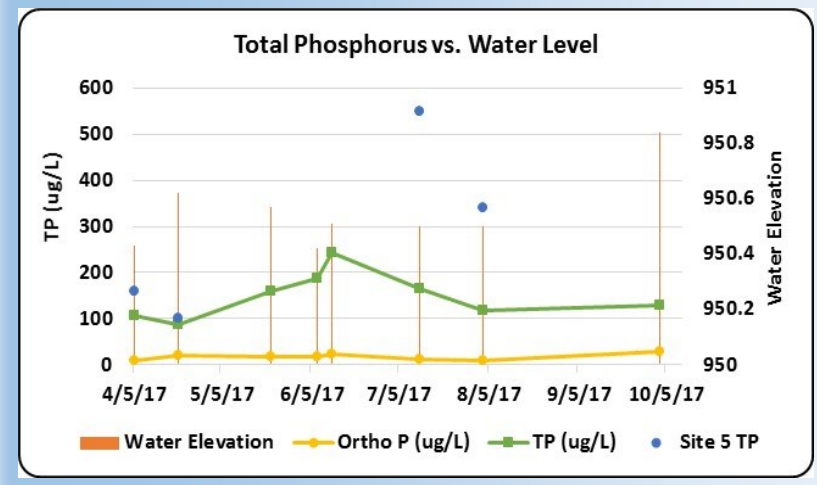
Total Suspended Solids, Total Phosphorus and Transparency Tube



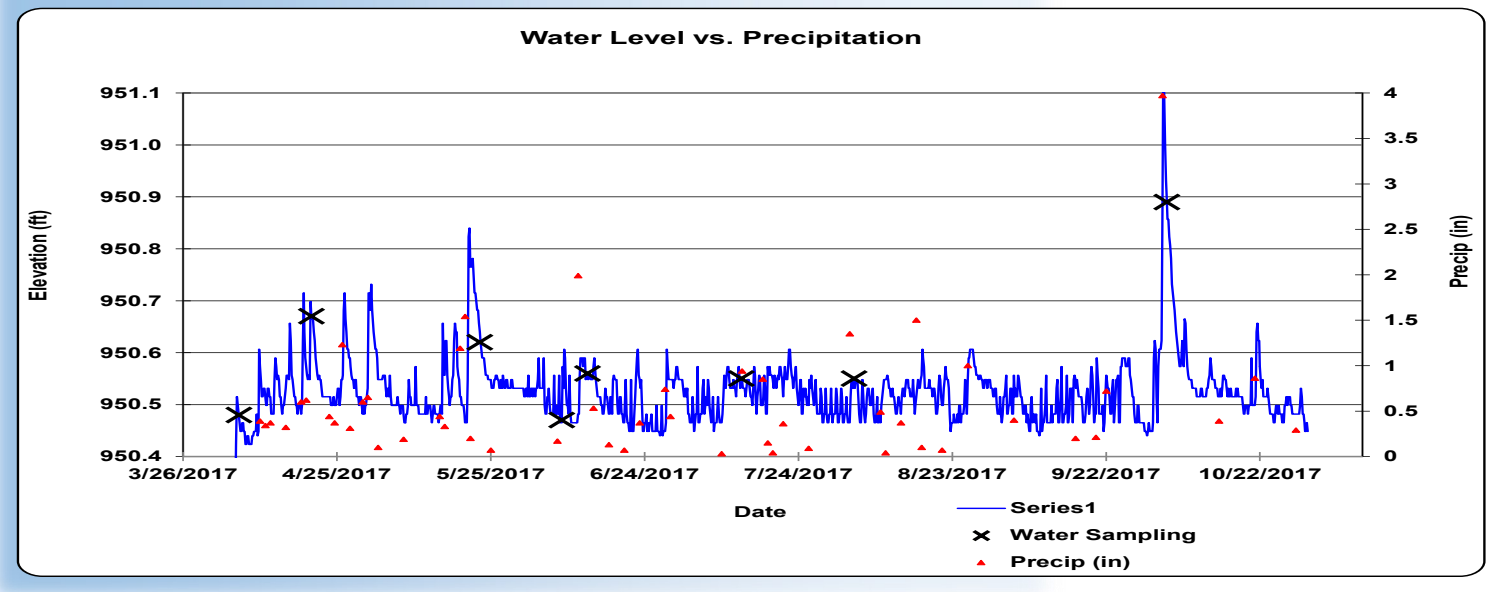
## Site:

## #4 E East Tiger St. NW




- The average concentration of TP at this location in 2017 was 149.13; the highest concentration measured among all four tributaries. The 2016 average was 224.63 µg/L, the highest then too.
- TP measurements for this area typically range between 60 and 150 µg/L.
- Site 5 TP was higher than the downstream site (blue dots in TP vs water level graph). Theoretically, the nutrients were soaked up by the semi-dry wetland.
- Flow was lower than previous years at this location.
- TSS measurements for this area range between 4.8 and 16 mg/L. The average concentration of TSS at this location was 13.75 mg/L. Levels increase during storm events which indicate that either material is being washed into the stream or decaying debris is being flushed from the wetland. The 2016 average was 26.88 mg/L.
- Transparency at this site was also much lower (worse) than all other sites. Transparency readings averaged 55.62 cm (transparency tubes only measure to 100 cm). In 2015 the average was 45.13.
- OP Levels were low.
- Stream levels overall were low in 2017.



# 2017 Results and Recommendations

CLEAN WATER LAND & LEGACY AMENDMENT

**Summary:**

For all sites, nutrient concentrations and water levels were the lowest observed out of the three years of monitoring.

Water levels at site #4 were three to four inches lower than 2015 and 2016. We suspect that when it did rain the dry wetland had more storage area and that resulted in less organic matter being flushed into the tributary. TP was collected at site #5 up-stream (at Tiger St.) to determine nutrient contributions from the upper drainage area. Concentrations were high but were likely soaked up by the wetland before getting to the lake. In a lower flow year like 2017, the proposed sand filter should treat most (if not all) of the water from this tributary.

Nutrient concentrations at sites #1 and #3 were within the typical range for the region but on the high end. Upland conservation will be focused in these tributaries.

For a second consecutive year beaver dams hindered monitoring efforts at site #2. Water level exceeded typical elevation by one to two feet and flow was greatly restricted.

<u>Below are key points and recommendations for monitoring in 2018 at each of the four tributaries:</u>

- Sample as planned (same as 2017): 8 grab samples at highest and lowest water levels (peak flow and low flow); water level measure-ments; flow; dissolved oxygen; temperature; pH.
- Discontinue sampling ortho-phosphorus (OP) at site #4. The infor-mation collected to date was used to determine the appropriate treatment (sand filter) at this location.
- Discontinue monitoring at Tributary #2.
- **NEW**: Based on conversations at LID meetings, consider sampling the inlet located on the west side of the lake at the end of Blue Lake Dr NW. Grab 4 samples during high flow.

**For more information contact: IsantiSWCD 763-689-3271**
**Tiffany Determann, District Mgr tdeterman@isantiswcd.org**
**Todd Kulaf, Conservation Tech tkulaf@isantiswcd.org**

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