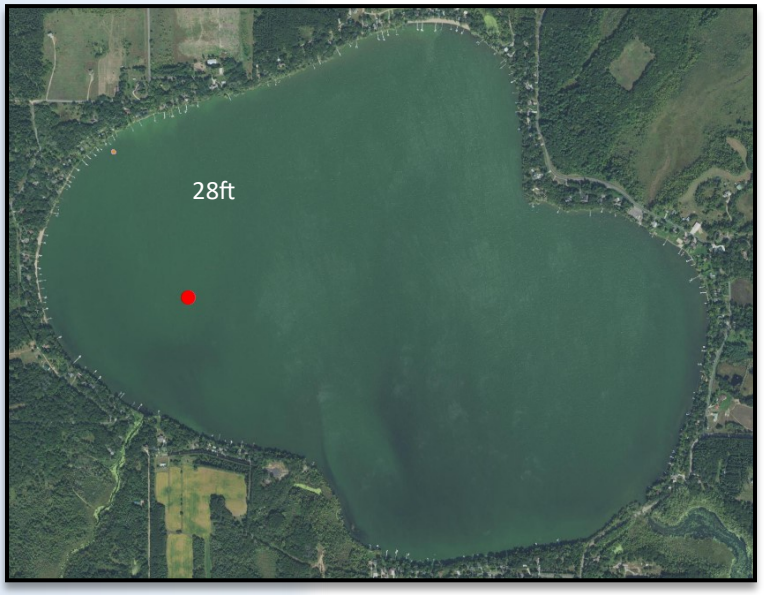
Green Lake Monitoring Report 2018

2018 was the third consecutive year that the Green Lake Improvement District (GLID) and the Isanti Soil and Water Conservation District (ISWCD) partnered to monitor the health of Green Lake.

What: GLID volunteers collected Total Phosphorus (TP), Chlorophyll-a (Chl-a) and Transparency information every two weeks from May through September in the deepest part of the lake (see map). SWCD staff collected dissolved oxygen, pH, conductivity and temperature information throughout the water column once a month from June through September. SWCD Staff provided training, equipment and coordinated lab testing.



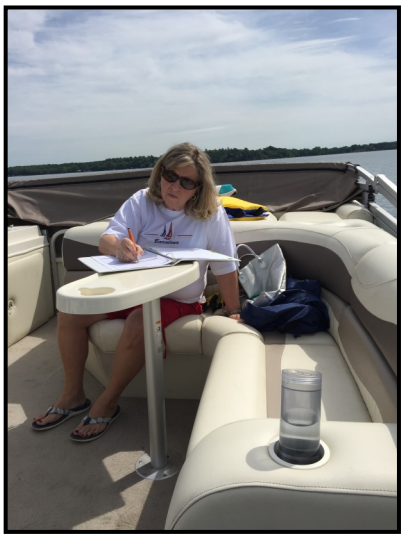
Lake Data for Green Lake	
Township	Wyanett
MN Lake ID	30013600
# of Public Boat Access	1
Aquatic Invasive Species	CLPW & EWM
Surface Area	822 acres
Maximum Depth	28ft
Lake Meets Clean Water Goals	Total Phosphorus: **Yes**
	Chlorophyll-a: **Yes**
	Transparency: **Yes**

Why: Green Lake was added to the MN impaired waters list in 2008 for having high nutrients (too much phosphorus). The listing triggered the completion of a Total Maximum Daily Load (TMDL) study. TMDL's quantify the phosphorus reduction necessary in order to make the lake healthy again. The study identified the need for a 39% phosphorus reduction.

The monitoring data collected in 2018 helps us get a better understanding of the factors driving high phosphorus levels. Additionally, we can use the data to track trends over time and track the effectiveness of projects that are meant to improve lake health (i.e. raingardens, lakeshore restorations, ag practices).

Green Lake samples are summarized in this report.

Green Lake Monitoring Report 2018



Volunteer Lake Monitors: Ken Murry, Barb Prince, Jim Haubenschild

2018 Rainfall Summary

While the total seasonal rainfall was similar to 2017, the majority of rainfall events occurred during the growing season (vegetation was growing and available to take up water) and nearly all events were under two inches. As a result, less sediment and phosphorus made its way into surface waters and water levels were lower than usual across the county.

Although precipitation did increase in the fall individual events were still quite "normal" (no events greater than 2+ inches) and they did not appear to have a large negative effect on water health.

General Definitions

Phosphorus (TP): an essential plant nutrient which can cause algal blooms in excess, measures all usable forms.

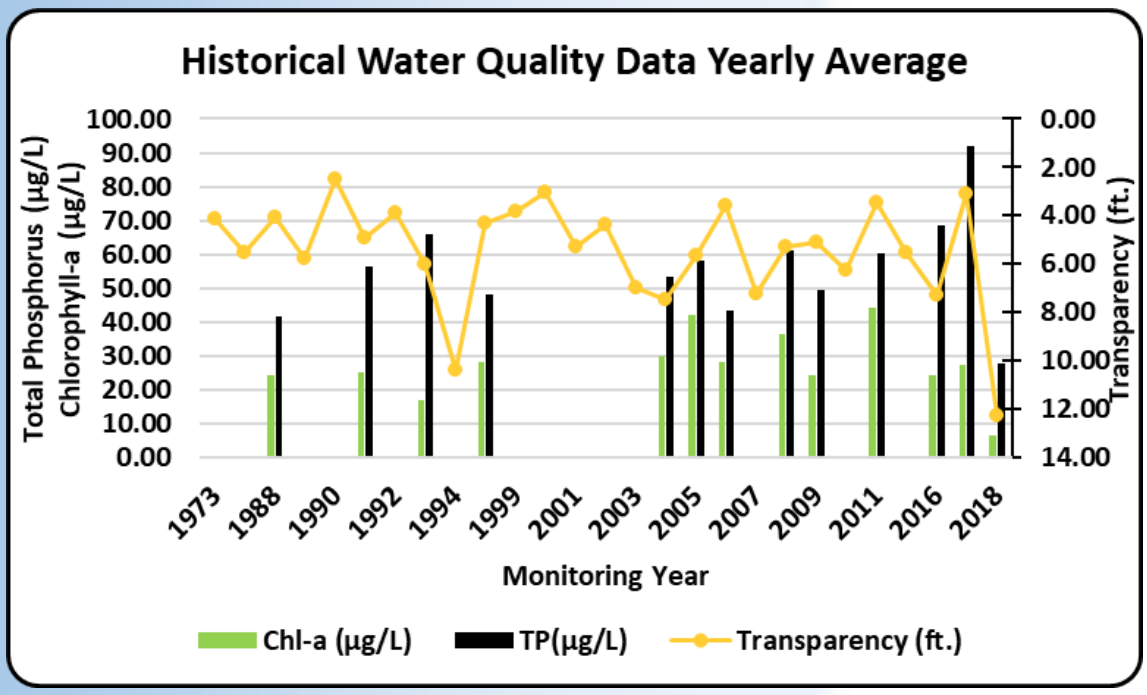
Chlorophyll-a (Chl-a): a pigment found in green plants, used to estimate amounts of algae in a lake.

Secchi Transparency: a measure of light penetration in water, which helps estimate algae concentration.

Green Lake Historical Water Quality Data

MN Clean Water Goals for Deep Lakes:		
Total Phosphorus (TP): ≤ 40 µg/L	Chlorophyll-a: ≤ 14mg/m3	Secchi Depth: ≥ 4.59 feet

In order to get an idea of lake health trends over time, we compiled historic TP, Chl-a and Secchi transparency data from the Minnesota Pollution Control (MPCA) website. While the data is beneficial for tracking general trends, it is important to note that there was a minimal amount of TP and Chl-a data available for each year prior to 2016 (i.e. 3 or fewer samples per year)— this has a tendency to skew annual averages. The data set for Secchi transparency is much more extensive and dates back to 1973.



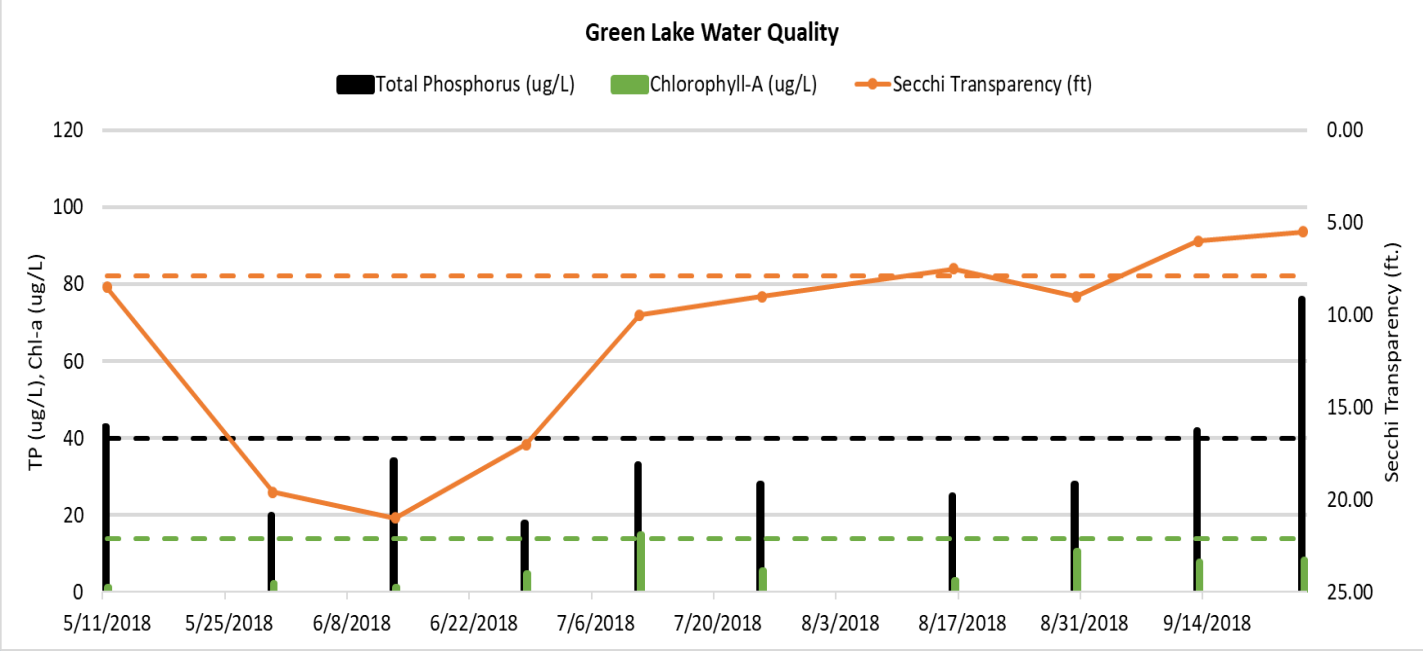
- There is a slight trend towards improving water clarity and Chl-a over time. The improvement may reflect aquatic vegetation shifts.
- Conversely, there is a slight trend towards increasing TP over time.
- 2016- 2018 water monitoring included more samples than previous years and sampling into September. Late season samples tend to have high TP due to lake turnover and result in higher averages (with the exception of 2018).
- The graph above illustrates the that TP and Chl-a averages exceed state standards for every year monitored— except 2018.
- Good lake health in 2018 was likely due to the timing and amounts of rainfall.

Green Lake Monitoring Results 2018

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

MN Clean Water Goals for Deep Lakes:		
Total Phosphorus (TP): ≤ 40 µg/L	Chlorophyll-a: ≤ 14mg/m3	Secchi Depth: ≥ 4.59 feet

2018 Growing season average (June-September)	27.7 µg/L	6.68 µg/L	12.25 ft

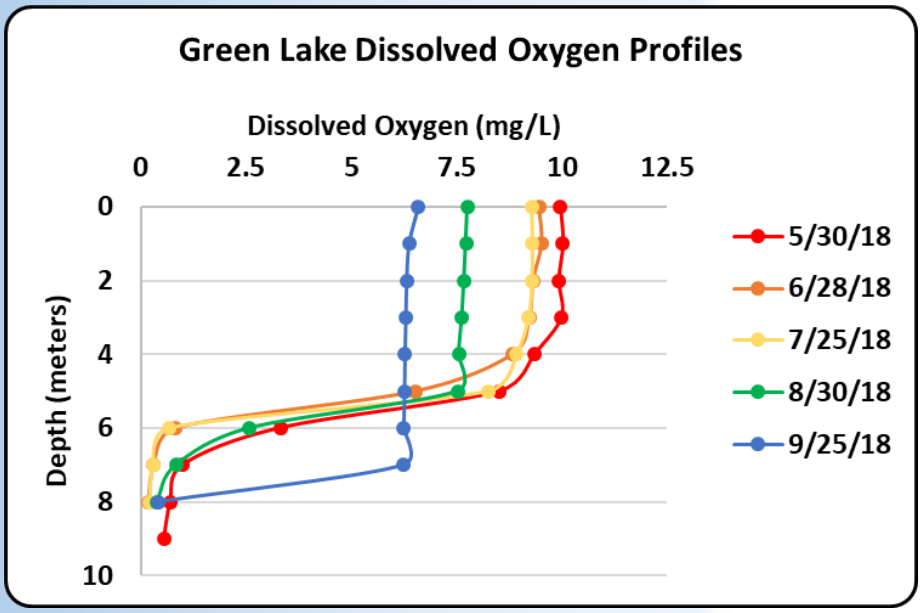


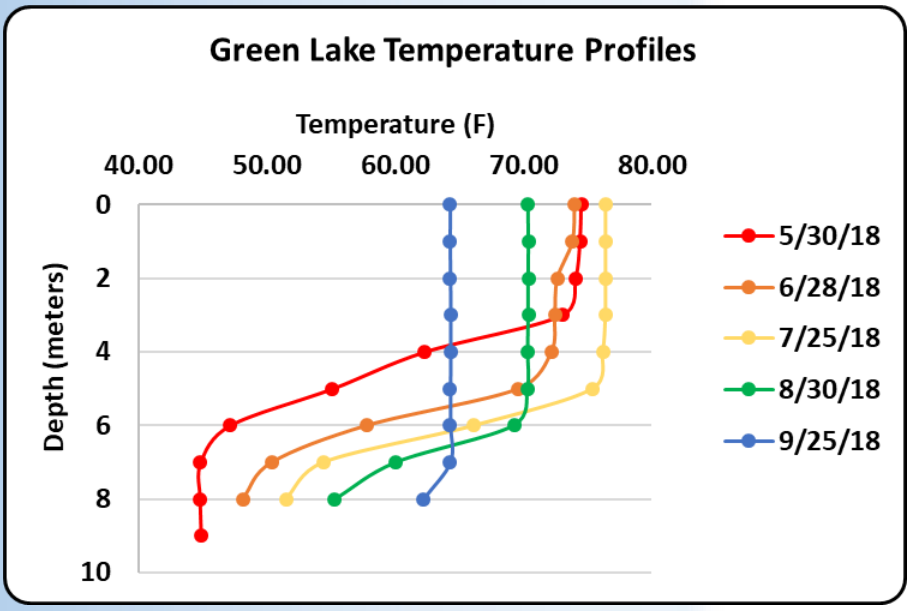
2018 Data Summary:

- The lake has a maximum depth of 28 feet and is categorized as a deep water lake.
- Monitoring results are compared to state water quality goals for deep lakes.
- Overall lake water quality was very good in 2018.
- Low TP through late August corresponds with low monthly rain and water temperature column stratification. (see temperature profiles on preceding page).
- TP, similar to previous years, increased late in the season. This suggests nutrients from the bottom of the lake are being mixed into the water column as the lake turns over (internal loading).
- Chl-a increased (more algae) mid-July. This corresponds with curlyleaf pondweed die off and is similar to previous years.
- 2018 was largely devoid of heavy rainfalls that would have contributed to pollutants in rainwater runoff. This undoubtedly influenced lake conditions for the year.

2018 Lake Stratification

In 2018 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.





Temperature was consistent throughout the water column late in the year and formed layers of water with different temperatures from 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 can result in the release of phosphorus from the lake sediments. Phosphorus can also be released from the sediments during fall turnover (we think this happens on Green Lake) or other mixing events such as heavy rains or winds. This can result in algae blooms.

2018 Monitoring Program Review

The data collected thus far gives us valuable insight into lake health and how the lake responds to variables over time. At this time we feel that it is important to continue to reduce the amount of nutrients making their way into the lake from the land.

How?

Residential Properties: lakeshore restorations, rain gardens, pervious pavers, rain barrels, etc. The lakeshore restoration program that the LID is initiating this year will play a critical role in reducing TP from residential properties.

Agricultural Properties: cover crops, filter strips, water and sediment control basins, etc.

In an effort to help pin-point additional projects that would trap large amounts of TP regionally (such as wetland restorations), the SWCD has secured funding (to be matched by the GLID) to complete a phosphorus diagnostic study using the data collected by the SWCD. This work will also determine the need to address internal nutrient loading in the future.

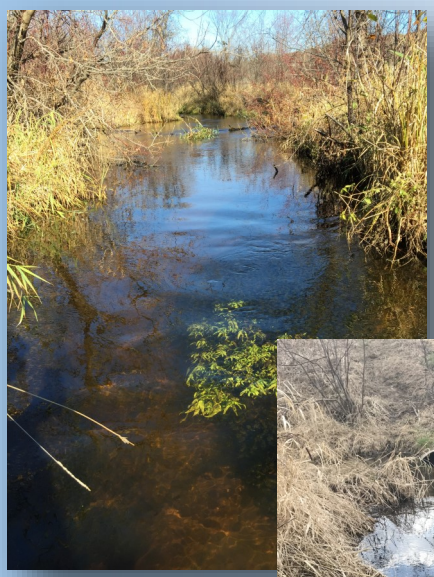
Below are key points and recommendations for lake monitoring in 2019:

- No monitoring is scheduled for 2019. In the future we recommend sampling every other year OR three years on and three years off.
- Continue bi-weekly volunteer Secchi transparency readings.

For more information contact: Isanti SWCD 763-689-3271
Thomas Zimmermann, Conservation Tech tzimmermann@isantiswcd.org
Tiffany Determan, District Mgr tdeterman@isantiswcd.org

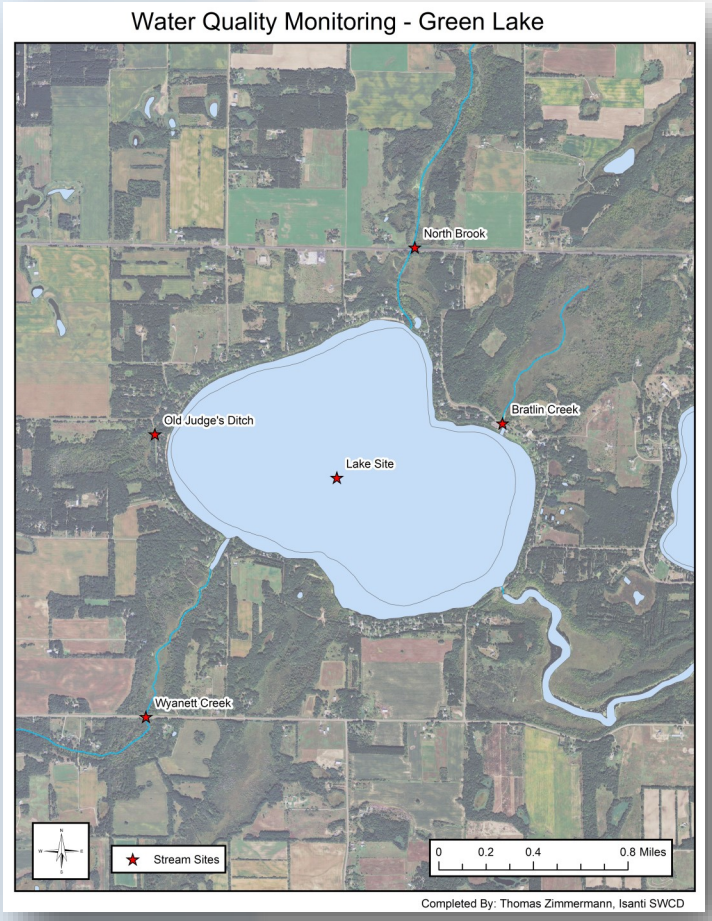
Thanks to the GLID members who have assisted with lake monitoring.

Green Lake Tributary Monitoring 2018



North Brook

Wyanett Creek



2018 was the third year the Green Lake Improvement District (GLID) partnered with the Isanti Soil and Water Conservation District (SWCD) to monitor the health of inlets that empty into Green Lake:

- North Brook at highway 95
- Wyanett Creek at 325th Ave.
- Bratlin Creek
- Old Judge's Creek

This report describes the results of monitoring that occurred in 2018 as well as comparisons to previous years.

General Definitions:

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.

2018 Area Conditions

2018 Rainfall Summary

The area was largely missed by heavy rains throughout the year. The majority of rain events occurred during the growing season (vegetation was growing and available to take up water) and nearly all events were under two inches. As a result, less sediment and phosphorus made its way into surface waters and water levels and flow were lower than usual across the county. Consistent (though still small) rain events and cooler than average temperatures in the fall led to a sight rebound in stream levels late in the season.

Water Health Comparisons:

- TP measurements for this ecoregion typically range between 60 and 150 µg/L.
- TSS measurements for this area typically range between 4.8 and 16 mg/L.
- The State goal or standard for TP in streams is 100 µg/L (i.e. we would like to see TP stay below this number).

Tributary Monitoring

What: In 2018 eight sampling events were targeted at four inlets. We targeted four samples during rain events and four during base flow. The samples were tested for total phosphorus (TP), total suspended solids (TSS) and transparency. Dissolved oxygen, temperature, conductivity, pH and water flow were also measured in the field.

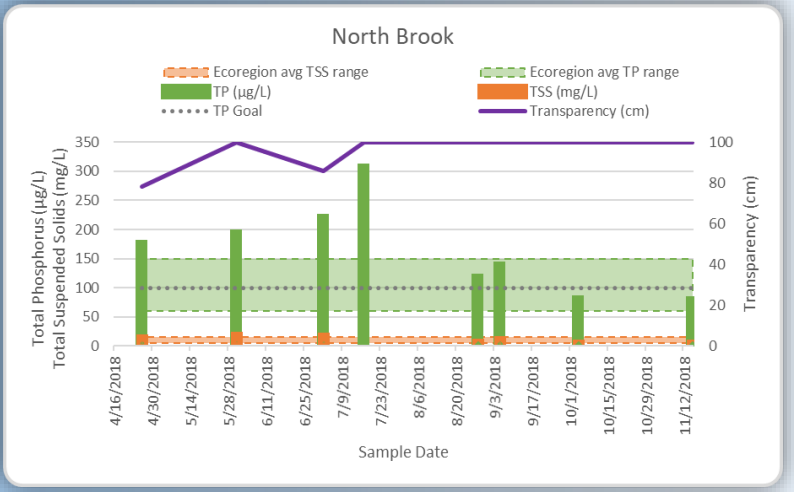
In addition to water quality, water levels were continually tracked using in-stream data loggers at North Brook and Wyanett Creek. The water levels were recorded every four hours from early May through early November.

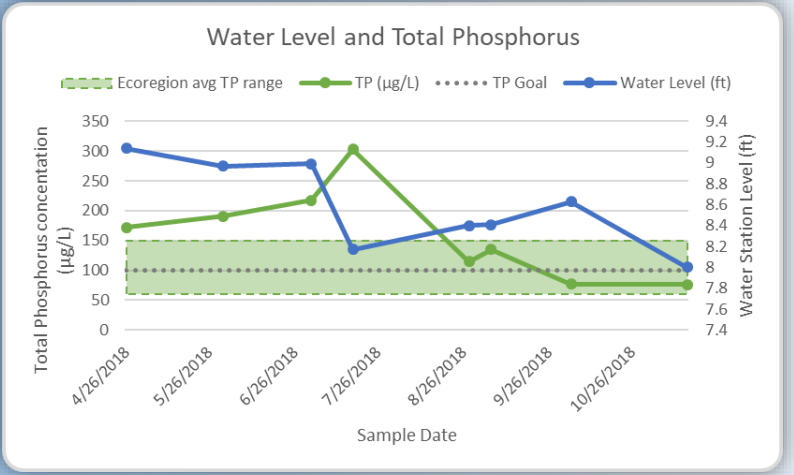
Why: The information collected is used in conjunction with the Subwatershed Assessment for North Brook and Wyanett Creek completed in 2017. The data helps us determine which tributary should be a higher priority for water quality projects. In theory, the stream that delivers the most nutrients to the lake would be the highest priority. Additionally, the information collected can be used to track trends and to determine how well water quality improvement projects are working.

2018 Tributary Monitoring Results

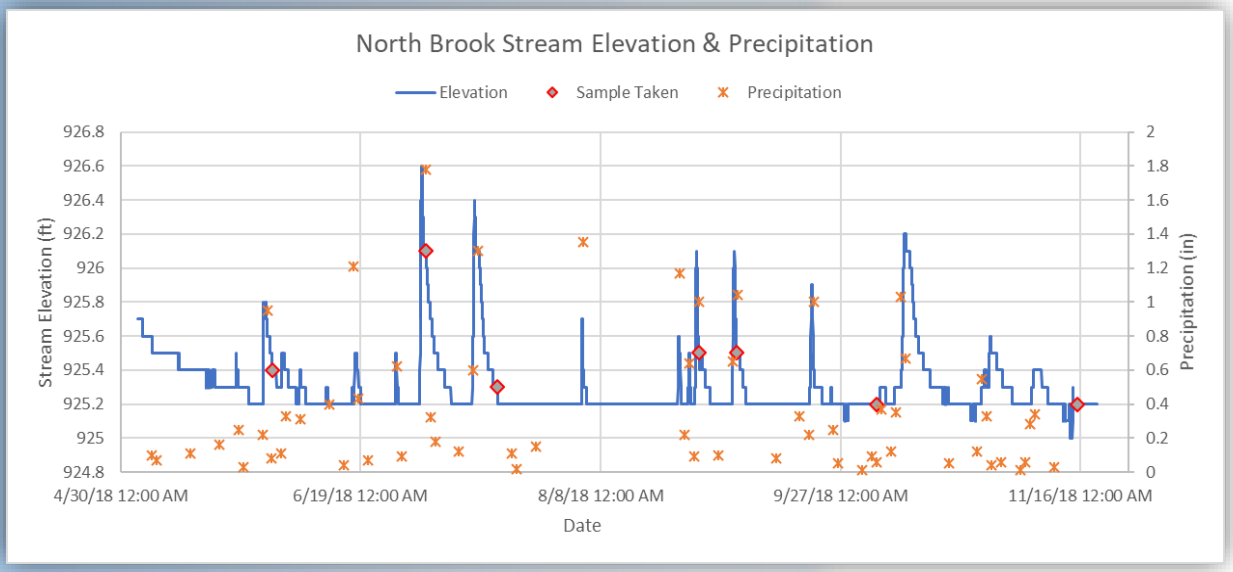
Total Suspended Solids (TSS), Total Phosphorus (TP) and Transparency Tube

Site: North Brook





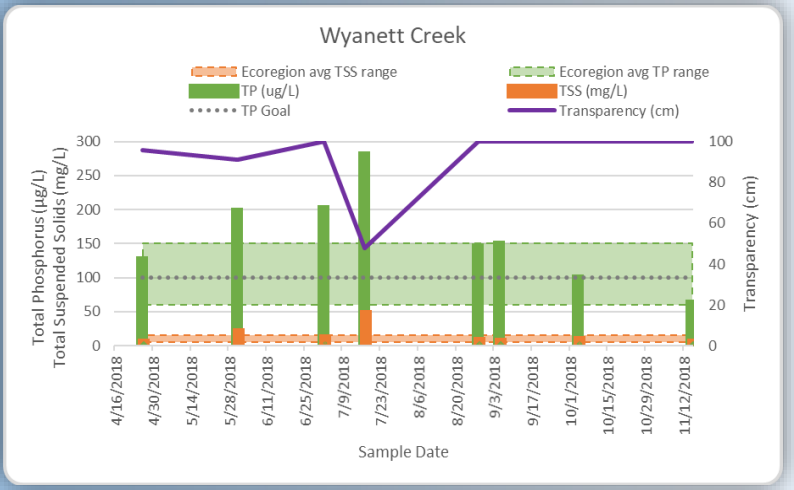
- 2018 average TP was 173 µg/L. The average TP range from 2016-2017 was 169-181µg/L.
- This tributary had the highest TP of all four tributaries monitored in 2018. Elevated TP in July corresponds with rain events.
- TP concentrations were relatively lower than previous years. The timing of rainfall as described at the beginning of the report likely has something to do with this (less nutrients being flushed from the land in 2018).
- 2018 average TSS was 9 mg/L. The average TSS range from 2016-2017 was 10-21 mg/L.
- 2018 average transparency was 96 cm. The average transparency range from 2016-2017 was 86-93 cm.
- TP levels appear to have an inverse relationship with water level.
- In 2018, based on paired flow and sample information, North Brook contributed more nutrients to the lake than Wyanett Creek. The reverse was true in 2016 and 2017.

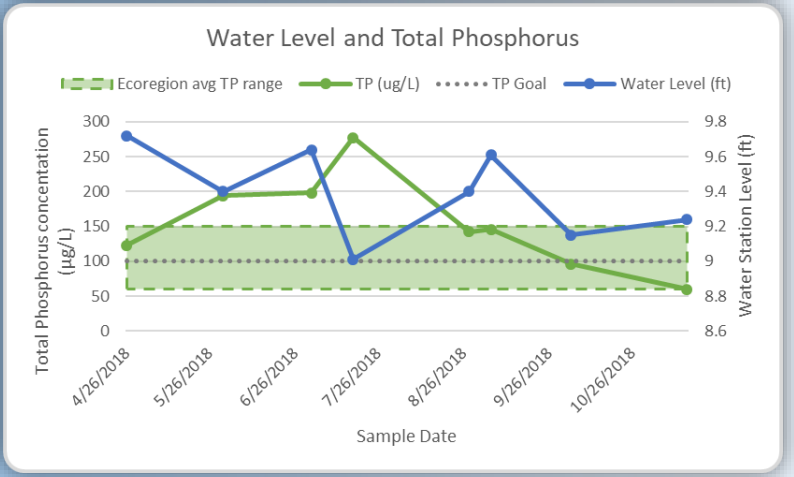


2018 Tributary Monitoring Results

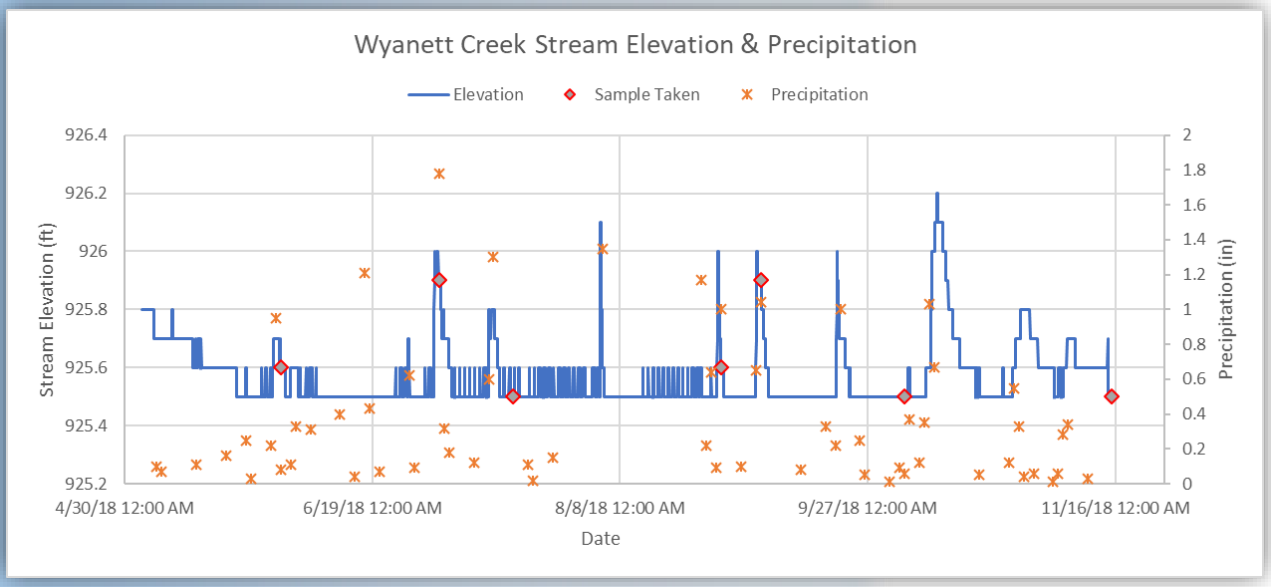
Total Suspended Solids (TSS), Total Phosphorus (TP) and Transparency Tube

Site: Wyanett Creek





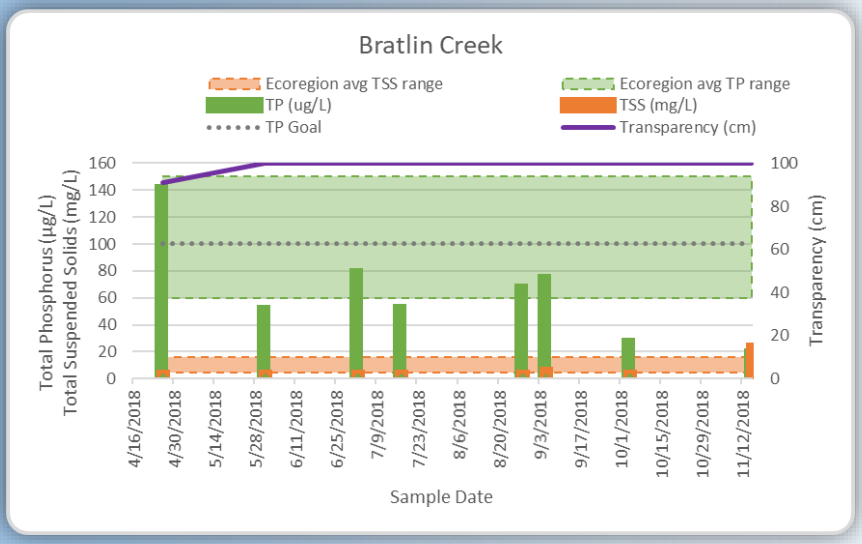
- 2018 average TP was 154 µg/L. The average TP range from 2016-2017 was 220-247 µg/L.
- This site had the second highest TP of the four sites monitored.
- TP concentrations were relatively lower than previous years. The timing of rainfall as described at the beginning of the report likely has something to do with this (less nutrients being flushed from the land in 2018).
- 2018 average TSS was 11 mg/L. The average TSS range from 2016-2017 was 18-24 mg/L.
- 2018 average transparency was 92 cm. The average transparency range from 2016-2017 was 79-84 cm.
- TP levels appear to have an inverse relationship with water level.
- In 2018, based on paired flow and sample information, North Brook contributed more nutrients to the lake than Wyanett Creek. The reverse was true in 2016 and 2017.

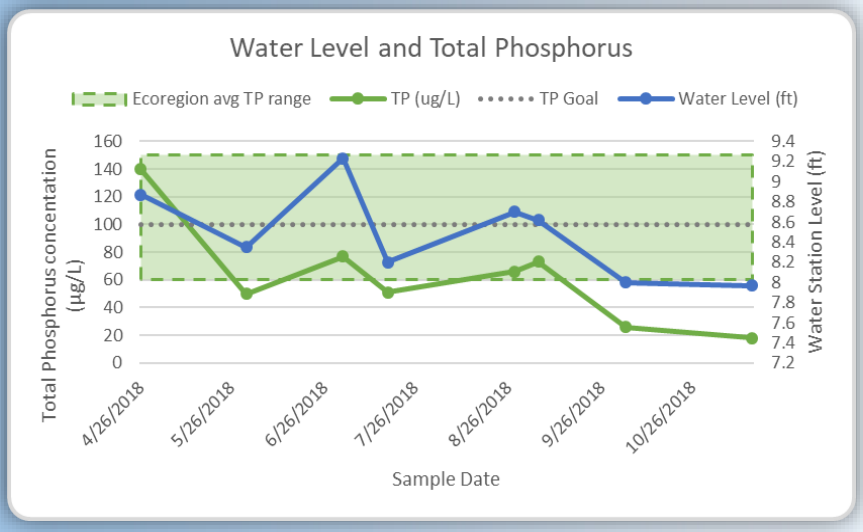


2018 Tributary Monitoring Results

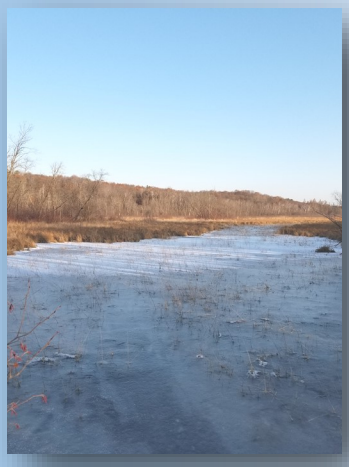
Total Suspended Solids (TSS), Total Phosphorus (TP) and Transparency Tube

Site: Bratlin Creek





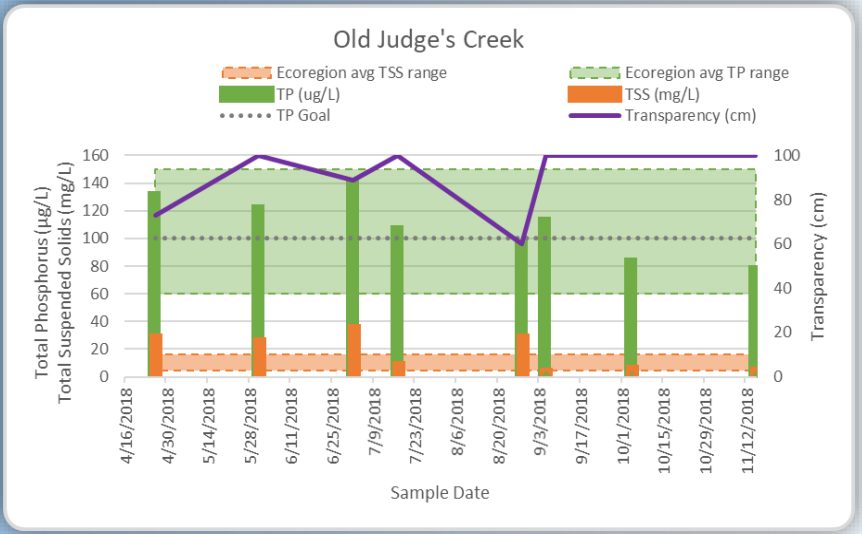
- 2018 average TP was 63 µg/L. The average TP in 2017 was 102µg/L.
- This site had the lowest TP of all four tributaries monitored.
- This site has relatively low TP throughout the season; however, early season high TP occurred in both 2017 and 2018.
- TP concentrations were relatively lower than previous years. The timing of rainfall as described at the beginning of the report likely has something to do with this (less nutrients being flushed from the land in 2018).
- 2018 average TSS was 2 mg/L. The average TSS in 2017 was 6 mg/L.
- 2018 average transparency was 99 cm. The average transparency in 2017 was 100 cm.
- TP levels correspond with water level fluctuations.
- Based on paired flow and TP measurements, Bratlin Creek contributed the second lowest amount of TP to the lake in 2018.

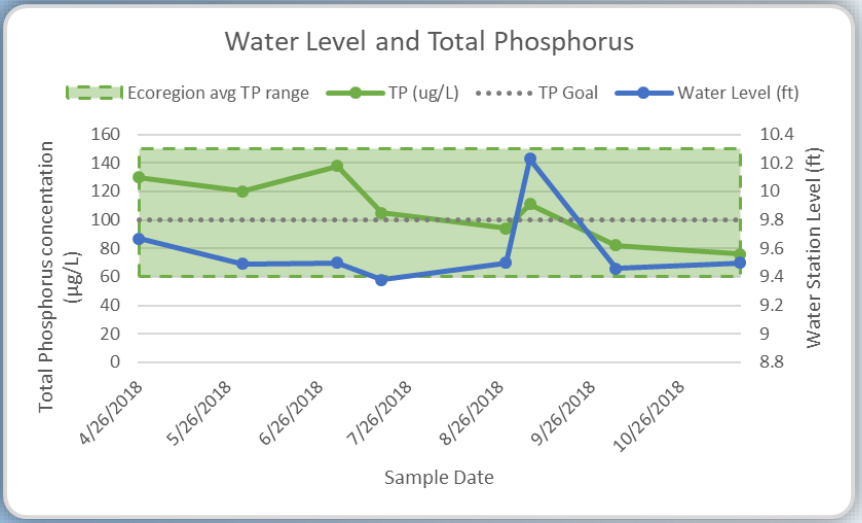


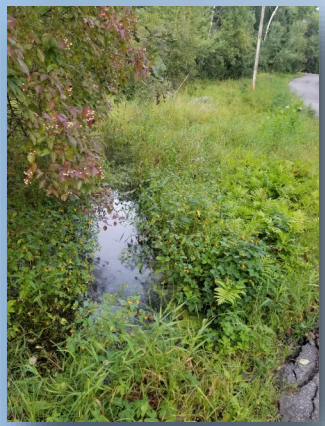
2018 Tributary Monitoring Results

Total Suspended Solids (TSS), Total Phosphorus (TP) and Transparency Tube

Site: Old Judge's Creek







- 2018 average TP was 107 µg/L. The average TP in 2017 was 102µg/L.
- TP concentrations were relatively lower than previous years. The timing of rainfall as described at the beginning of the report likely has something to do with this (less nutrients being flushed from the land in 2018).
- 2018 average TSS was 16 mg/L. The average TSS in 2017 was 6 mg/L.
- 2018 average transparency was 90cm. The average transparency in 2017 was 100cm.
- Stream flow is typically blocked by a man-made dam (log) in the culvert.
- TP levels correspond with water level fluctuations.
- Based on paired flow and TP measurements, Old Judge's Creek contributed the lowest amount of TP to the lake in 2018.

2018 Results and Recommendations

2018 summary:

North Brook: While TP levels were lower than previous years, there is plenty of opportunity for improvement. This watershed should be a priority location for restoration projects such as cover crops, filter strips, buffers, and/or a wetland restoration. More investigation would be necessary before moving forward with a wetland restoration. Isanti County is currently in the process of initiating a county ditch maintenance program– North Brook is planned to be the first ditch to go though the process. The County will work closely with the SWCD to identify restoration opportunities during the process.

Wyanett Creek: While TP levels were lower than previous years, there is plenty of opportunity for improvement. This watershed should be a priority location for restoration projects such as cover crops, filter strips, buffers, and/or a wetland restoration. More investigation would be necessary before moving forward with a wetland restoration.

Bratlin Creek: This location typically has good water health (with the exception of the early season). While there may be restoration opportunities here– time and effort may be best focused at North Brook and Wyanett Creek to start. However, if the opportunity arises, the protection of existing natural areas (wetland, forest, grassland) in this watershed would be beneficial (i.e. land easements or purchases and/or increased building set-backs from the creek and wetland boundaries).

Old Judge's Creek: Water flow at this location is the lowest of all sites; thus, this site contributes the least TP to the lake. Nonetheless, if opportunities for restoration projects arise in this watershed they should be investigated– time and effort may be best focused at North Brook and Wyanett Creek to start.

Future Monitoring

- No monitoring is scheduled for 2019. The SWCD recommends sampling every other year OR three years on and three years off. Cost estimates will be provided to the LID for both scenarios prior to the July Annual meeting.

For more information contact: Isanti SWCD 763-689-3271
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Thanks to the GLID members who have assisted with lake and stream monitoring, notably Ken and Barb Murray.