Northeast Lakeshore Volunteer Monitoring Program

Northeast Lakeshore TMDL

2024 Annual Report

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Project Summary

Project Location

The Northeast Lakeshore (NEL) Volunteer Monitoring Program supports the Northeast Lakeshore Total Maximum Daily Load (TMDL), which was approved on October 30, 2023. The program started in 2023 with 12 surface water monitoring sites, seven sites were added for a total of 19 sites in 2024. The rivers and streams monitored in the program reflect the health of the respective watersheds, rivers, and streams themselves and contribute nutrients and sediment to Lake Michigan. The NEL is approximately 2,000 square miles and covers eight counties (Brown, Calumet, Door, Fond du lac, Kewaunee, Manitowoc, Ozaukee, and Sheboygan). There are three major river basins within the NEL: Kewaunee, Manitowoc, and Sheboygan basins.

The volunteer monitoring program relies on citizen volunteers to collect surface water samples from 19 monitoring sites, the monitoring sites are spread throughout the three basins: Kewaunee, Manitowoc, and Sheboygan. The monitoring sites are displayed in Figure 1 and more detailed location information can be found in Appendix A.

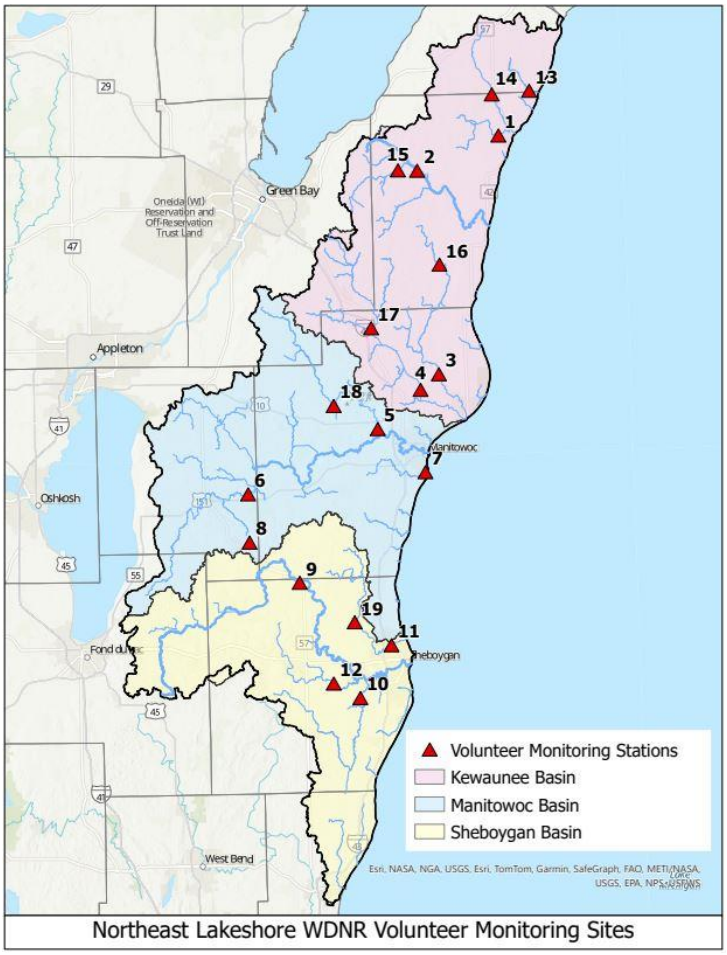


Figure 1: Map of volunteer monitoring sites in Northeast Lakeshore.

Project Background

The Northeast Lakeshore TMDL was approved by the EPA in October of 2023. The TMDL provides a framework to address total phosphorus (TP) and total suspended solids (TSS) reductions with the goal of achieving water quality standards. The TMDL sets goals for total TP and TSS concentrations in surface waters across the NEL. Loading capacities are defined, which is the maximum amount of a pollutant a waterbody can safely contain while still meeting the water quality standards set in the TMDL. As TMDL implementation progresses, one objective is to evaluate long-term water quality trends across the NEL.

The NEL Volunteer Monitoring Program began in 2023 to achieve some of the monitoring objectives resulting from the TMDL. Because this program started six months prior to the TMDL approval this sampling will also gather baseline data before implementation happens due to the TMDL. The volunteer monitoring program samples 19 sites across 17 different streams, the sites are distributed across the three basins within the NEL. The sites were chosen because they are good representations of water quality in the surrounding watershed, they were monitored during the development phase of the TMDL, and there is historical data to compare to.

Given the time commitment and spatial location of the monitoring sites, the assistance of volunteers is vital to the success of the program. Volunteers serve the essential role of data collectors, as they collect monthly (May – October) surface water samples at 19 monitoring sites. Volunteers are trained on the proper sampling protocol before the sampling season by Wisconsin Department of Natural Resources (WDNR) staff to ensure reliable and accurate results are collected each month.

Problem Statement

Surface waters in the NEL are impaired due to excessive phosphorus and sediment loading. TMDL implementation focuses on restoring waters impaired by excessive sediment and/or high phosphorus concentrations. Phosphorus and sediment cause numerous impairments to waterways, including oxygen depletion, degraded habitat, and nuisance algae growth. These impairments adversely impact fish and aquatic life, water quality, and recreation.

Every two years, Sections 303(d) and 305(b) of the Clean Water Act (CWA) requires states to publish a list of all waters not meeting water quality standards and an overall report on surface water quality status of all waters in the state. All 17 of the streams sampled in the program are on the 2024 303(d) Impaired Waters List, 16 of which are impaired by TP. Appendix B includes more information about the impaired monitoring streams.

Within the Northeast Lakeshore there is one Area of Concern (AOC), the Sheboygan River, which includes the lower 14 miles of the river and the Sheboygan harbor. This is an AOC primarily due to contamination from industrial waste, including polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs). There were originally nine beneficial use impairments (BUIs) listed, but four have been removed due to ongoing work in the area. One of the BUIs removed was for eutrophication or undesirable algae, which causes reduced oxygen in the water, altered food web dynamics, and reduced water quality in general. The BUI was listed in 1987 and was removed in 2015. There are still water quality improvements needed, which is

what the NEL TMDL discusses and why the volunteer monitoring program is important. Monitoring current and future conditions of the water and documenting improvements over time due to implementation is important.

Project Goals

There are two main goals for this project: (1) increase public awareness and involvement of water quality issues by engaging the public in citizen science and (2) the collection of reliable surface water quality data to assess long-term water quality trends. This program aims to increase community awareness on local water quality issues and the impact of land use decisions in the watershed. The focus is to raise awareness through building a volunteer base and increasing community involvement and engagement.

Through citizen science the program goal is to collect reliable data to characterize TP, dissolved reactive phosphorus (DRP), TSS, and total nitrogen (TN) during the primary algae and aquatic plant "growing season" of May through October. The monitoring data brings focus to which streams are affected by elevated phosphorus and sediment concentrations.

Additional goals of this project include:

1. Evaluate nutrient and sediment concentrations in the rivers, streams, and tributaries in the Northeast Lakeshore region.
2. Monitor the health of the watershed over time at a regional scale.
3. Evaluate the long-term effectiveness of implementation of the Northeast Lakeshore TMDL.

Proposed Work and Sampling Procedure

2024 was the second year for the NEL Volunteer Monitoring program. Implementation of volunteer monitoring efforts were coordinated by WDNR staff. Specifically, the WDNR:

- Continues to develop a well-trained volunteer base through various means of recruitment and community engagement:
    - Volunteers are trained to follow Water Action Volunteer (WAV) (https://wateractionvolunteers.org/) monitoring protocol to ensure consistency is being met in each sample.
    - Volunteers collect and ship surface water samples in iced coolers to the Wisconsin State Lab of Hygiene (WSLH) for analysis of TP, DRP, TSS, and TN.
    - Volunteers collect streamflow and transparency data at the time of surface water sample collection (if able).
    - One to two duplicate samples are collected at randomly selected sites throughout the sampling season (Appendix G). Duplicates are collected on the same day and at the same time as the regular sample.
- Continues to provide support to volunteers as needed:
    - Ensures safe access and suitability at each monitoring site.
    - Orders, prepares, and maintains supplies for volunteers to successfully carry out monitoring activities and shipment of samples.

    - Fosters an open line of communication with volunteers to ensure that all sites are being monitored at the frequency outlined in the project QAPP.
- Confirms that all 19 monitoring locations are monitored monthly from May to October for a total of six monitoring events annually.
- Compiles monthly sampling data results to share with volunteers and stakeholders:
    - Records data into tables and graphs for analysis.
    - Develops an annual report complete with data and figures to share with stakeholders to assess annual water quality.

2024 Sampling Season

Summary

2024 was the second year for the NEL volunteer monitoring program. Recruitment started and supply orders were sent to the WSLH in March, while sampling started in May. All the supplies and lab slips were put together by the WDNR coordinator, the supplies were either dropped off or mailed to returning volunteers. There were seven returning volunteers from the first season and 10 new volunteers. For the new volunteers, the supplies were given to them during their training.

Sample collection completeness for the season was 100%. One of the sites, School Creek, had six samples taken throughout the season, but the May sample was taken at a different location on the same stream. The May sample was taken at the original site location (School Creek at Christoff Lane, Station ID 313122), but after taking the May sample the coordinator and volunteer decided the site was too difficult to access long term. The site was moved about a mile upstream to the Rendezvous Road crossing, Station ID 10020829. The May sample results will not be used to calculate medians or confidence intervals. Sample completeness for each monitoring site can be found in Table 1.

In 2024 the shipping courier changed to UPS. US Postal Service (USPS) Priority Mail was used to ship samples in 2023, but there were issues including packages arriving late and being lost for multiple weeks. Because of the issues with USPS, UPS was chosen as the courier for its dependability and fast shipping times. There were no issues with UPS and it will be used as the courier for future seasons. All shipping labels were printed and provided to volunteers at the start of the season.

Sample Collection Completeness (%) Out of 114 samples per year (6 samples/site)		
Monitoring Site	2023	2024
Ahnapee River	-	100%
Branch River (CTH J)	-	100%
Branch River (N Union Rd)	100%	100%
Devils River	-	100%
East Twin River (CTH J)	-	100%
East Twin River (Steiners Corners Rd)	100%	100%
Fisher Creek	-	100%
Kewaunee River	100%	100%
Mullet River	100%	100%
Onion River	100%	100%
Pigeon River	67%	100%
Pine Creek	100%	100%
School Creek	-	100%*
Sheboygan River	67%	100%
Silver Creek (CTH LS)	100%	100%
Silver Creek (Willow Rd)	100%	100%
South Branch Manitowoc River	100%	100%
Stony Creek	-	100%
West Twin River	100%	100%
Combined Percentage	94%	100%

*Table 1: Sample collection completeness by monitoring site. *The first sample for this site was taken at a different location on the same stream.*

In 2024, a total of 31 DRP samples, or 27% of the DRP samples collected, were flagged due to samples exceeding the 48-hour hold time for DRP analysis. This number is less than 2023, where 47 samples, or 68%, were flagged for exceeding the hold time. The shipping courier changed from USPS to UPS, this is a large reason there were less samples flagged. There were no lost packages, and most of the samples showed up to the lab the day after collection. Even though most of the samples arrived the day after collection, some of these samples were still flagged because they were analyzed by the lab later than 48 hours after collection. The lab receives a high volume of samples during the summer months due to the increase in water sampling across the state, and these months had the highest number of samples flagged. The coordinator will bring this issue up to lab staff to hopefully prevent this in future seasons. Although these samples are flagged by the lab for exceeding the analysis holding time, they are still able to be processed and the data is usable. Volunteers are trained to ship samples immediately after collection or as early as possible the next day. They are also instructed to sample at the beginning of the week; volunteers should avoid sampling Thursday-Sunday because the samples have a low likelihood of making it to the lab within the 48-hour hold time. Getting samples to the lab and analyzed within 48 hours will still be an area for improvement next season.

The 19 sites were monitored by 17 volunteers, seven of the volunteers returned from 2023. The new volunteers were trained in May by taking the May sample with the WDNR coordinator. This style of training works well because it ensures the volunteer is sampling at the right location and saves them an extra trip to their site in May.

Outreach

Because there were seven new sites added to the program in 2024, new volunteer recruitment and outreach was important. Volunteer recruitment was done by sharing the NEL Volunteer Monitoring Fact Sheet (Appendix I) with WDNR contacts, county land and water departments, and local environmental groups. There was also a DNR press release published on March 4th, 2024 to promote the program and recruit volunteers (Appendix J). The press release was successful, multiple new volunteers heard about the program because of the press release.

The volunteer coordinator has attended multiple outreach events for the program, including a presentation to an outdoor enthusiast group and a YMCA naturalist class. It is important to spread the word about this program and participate in future events like these to recruit volunteers and make the community aware of the work the WDNR is doing in their area.

Water Quality Data

Wisconsin Listing Methodology

To evaluate stream water quality and TP concentration reductions, the WDNR follows a standard assessment procedure which accounts for sample methods, timing, variability, sample size and statistical confidence to more confidently determine whether a stream meets water quality criteria. The NEL TP sampling data is compared to Wisconsin's TP water quality criteria (WQC) for streams (0.075 mg/L) and rivers (0.100 mg/L) by calculating a 90% confidence limit around the Growing Season Median (GSM) of the TP sample dataset. A stream is considered impaired for TP if the lower confidence limit (LCL) of the GSM (May – October) TP concentration exceeds the TP WQC. The LCL is used to ensure a stream exceeds the criteria with a predetermined level of confidence before it is listed. A stream that is impaired for TP will be de-listed if the upper confidence limit (UCL) of the GSM TP subsequently drops below, or clearly attains, the criteria.[1] See Figure 2.

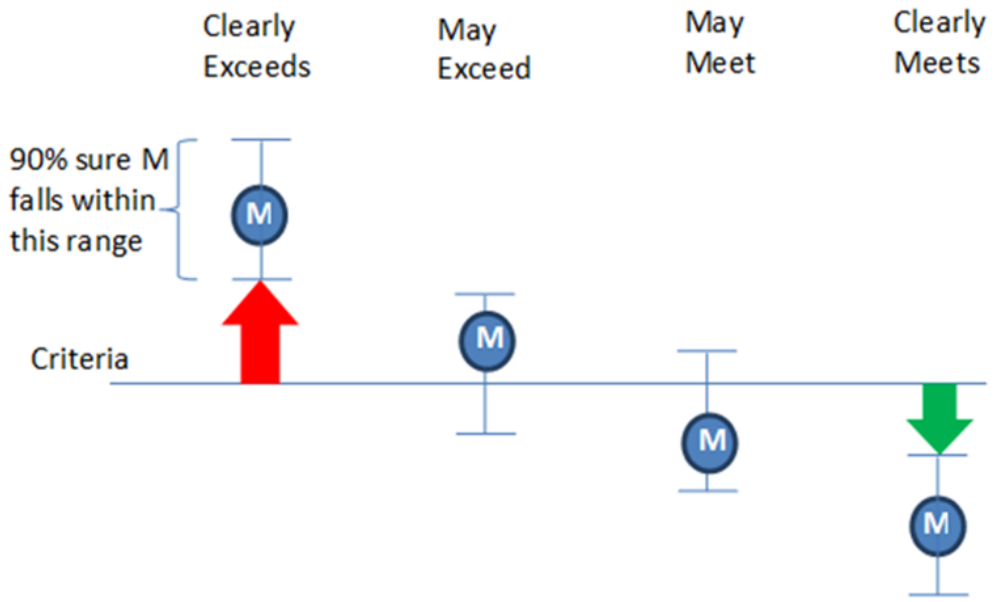


Figure 2: Wisconsin TP criteria confidence table. Criteria line indicates the 0.075 mg/L water quality criteria limit and M represents the Median value.

90% confidence limits are calculated for each monitoring location each year of data collection. A minimum of six samples, one per month from May – October, are needed to calculate the confidence limits. In years with less than six data points at a location, a data point from the same month from the most recent year of a full dataset is used instead; this is the first year of sampling for seven of the sites, there is not a previous dataset to use for missing data points.

[1] WDNR 2020. Guidelines for Monitoring for Watershed Restoration Effectiveness. Wisconsin Department of Natural Resources, Bureau of Water Quality. Madison, Wisconsin. EGAD#3200-2020-26

There was one site with a missing data point in 2024, School Creek. Six samples were taken, but the May sample was taken at a different station than the rest of the samples, that data point will not be used to calculate the confidence limit. The confidence limit will still be calculated only using five data points as there is no data from last season for this site. This confidence limit cannot be used for listing purposes and the results are flagged due to missing data. There were two sites that had a confidence limit calculated this way in 2023. A confidence limit table for each monitoring site is provided in Appendix E.

In 2024 there was one sampling stream with water quality that "Clearly Meets" the State TP WQC, this was the Ahnapee River, this is less than 2023 where five of the streams met the TP WQC. Two of the sites "May Meet" the State TP WQC, East Twin River (CTH J) and Silver Creek (Willow Drive), and seven of the sites "May Exceed", Branch River (N Union Road), Devils River, East Twin River (Steiners Corners), Kewaunee River, Mullet River, Stony Creek, and West Twin River. The remaining nine streams "Clearly Exceeds" the State TP WQC, meaning the LCL for these streams is above the TP WQC. The TP WQC for 16 of the monitoring streams is 0.075 mg/L, the Sheboygan River is the only monitoring site with a TP WQC of 0.100 mg/L according to the NEL TMDL.

It is important to continue to monitor these sites and calculate confidence limits for many years, determining water quality from only two seasons is difficult due to variable factors, including weather. The first year of sampling for 12 of the sites, 2023, was drier than average, but 2024 had higher than average precipitation throughout the season. Sampling these sites across multiple seasons is important for calculating medians that are true to the actual water quality. Implementation across the NEL will increase due to the TMDL, additional sampling data will be useful for detecting changes in water quality.

Total Phosphorus Analysis

TP median values were calculated from only the samples collected during the sampling year, which was six samples for all the sites except School Creek. The May sample for School Creek was taken at a different station than the rest of the season, this data was not used to calculate the median. Table 2 breaks down the median TP value for each monitoring site. Red values indicate years with less than 100% sample collection, these values may not be a proper representation of the median TP value at that stream location for the specific year due to the missing data points. The median is calculated instead of the mean according to Wisconsin Consolidated Assessment and Listing Methodology (WisCALM) protocol. Median is used for datasets with high variability to ensure results are not skewed by one extremely high or low value; streams and rivers tend to have higher variability in concentrations compared to lakes where the mean is used.

Median TP (mg/L)		
Monitoring Site	2023	2024
Ahnapee River	-	0.0596
Branch River (CTH J)	-	0.1325
Branch River (N Union Rd)	0.0522	0.0937
Devils River	-	0.1056
East Twin River (CTH J)	-	0.0569
East Twin River (Steiners Corners Rd)	0.0458	0.0863
Fisher Creek	-	0.2170
Kewaunee River	0.1510	0.1105
Mullet River	0.0568	0.0924
Onion River	0.1995	0.2020
Pigeon River	0.1615	0.2260
Pine Creek	0.1770	0.1535
School Creek	-	0.7110*
Sheboygan River	0.1265	0.1550
Silver Creek (CTH LS)	0.1240	0.1565
Silver Creek (Willow Rd)	0.0566	0.0565
South Branch Manitowoc River	0.2235	0.2780
Stony Creek	-	0.1060
West Twin River	0.0524	0.1081

*Table 2: NEL median TP by monitoring site. Red values indicate at least one sample was missed that year. *The first sample for this site was taken at a different location on the same stream.*

In 2024 three of the sites had a yearly median value below the State WQC of 0.075 mg/L, which is less than 2023 which had five sites below the WQC. The Sheboygan River has a TP WQC of 0.100 mg/L because it is a large river, the 2024 median TP result was above this criteria. Appendix D contains a graph displaying the yearly median TP concentration by monitoring site compared to the TP WQC. All monitoring data for 2023 and 2024 can be found in Appendix C.

Total phosphorus is a key indicator of water quality. It is an essential nutrient for plant growth however, when excess amounts are introduced to a waterbody, water quality can decrease and lead to harmful algal blooms. In 2024, 29 of 107 (27%) TP samples met the WQC for streams, which is 0.075 mg/L. This is less than 2023, where 41% of the samples met the TP WQC. The individual TP results for the Sheboygan River were not included in this count because the WQC for this river is 0.100 mg/L. Two of the six TP samples taken for the Sheboygan River were below 0.100 mg/L.

Table 3 compares the number of TP samples meeting and not meeting the stream WQC, Sheboygan River samples were not included. As monitoring continues in the years to come, Table 3 will be useful for assessing water quality improvements.

TP Samples Below 0.075 mg/L	2023	2024
# Monitoring Sites	11	18
# Samples Collected	64	107
# Above 0.075 mg/L	38	78
# Below 0.075 mg/L	26	29
% Below 0.075 mg/L	**41%**	**27%**

Table 3: TP Samples compared to TP WQC for 18 of the monitoring sites, Sheboygan River samples not included.

Dissolved Reactive Phosphorus Analysis

While TP is a key indicator of water quality, DRP also plays an important role in water quality. DRP is the soluble form of phosphorus and is readily available for plant and algae growth. DRP concentrations can vary widely over short time periods due to plants taking it up and releasing it. Excessive amounts of DRP can also lead to harmful algal blooms and cause poor water quality. It is important to monitor how much of the TP concentrations are made up of DRP concentrations across all monitoring sites. Appendix F compares each sampling event's TP and DRP concentrations.

Table 4 breaks down the DRP percentage ranges. The DRP percentage range with the most samples in 2024 was 60 – 80% (63 of 113 samples), meaning just over half of the TP samples had that percentage made up of DRP. Another 27% (29 of 113 samples) have 40 – 60% of their TP concentrations coming from DRP. This data shows the DRP percentage ranges are high, meaning harmful algae blooms have more of an opportunity to form. These algae blooms decrease water quality, which is why it's important to monitor DRP concentrations over time. As sampling continues, this data will be useful for evaluating implementation progress and effectiveness.

DRP Percentage of TP Ranges								
Year	# Sites	# Samples Collected	< 20% DRP	20 - 40% DRP	40 - 60% DRP	60 - 80% DRP	80 - 100% DRP	> 100% DRP
2023	12	67	3	12	21	27	3	1
2024	19	113	10	4	29	63	7	0
Percent of Total			**7%**	**9%**	**28%**	**50%**	**6%**	**1%**

Table 4: DRP Percentage of TP (DRP >100% due to sample variance).

Total Suspended Solids Analysis

Although there is not a statewide TSS WQC, the NEL TMDL defines a TSS target concentration of 12mg/L. High TSS levels are associated with degraded habitat in streams because excess TSS reduces light penetration, which affects plant growth, and it can interfere with fish feeding patterns. The TSS target of 12mg/L will help reduce the negative effects of excess TSS across the NEL.

The median TSS concentrations for the monitoring sites and the NEL TSS target are shown in Figure 3. The 2024 median concentration for 17 of the 19 sites was below the TSS target of 12mg/L. The only two sites with medians above the TSS target were the South Branch Manitowoc River and West Twin River. In 2023 and 2024 the South Branch Manitowoc River median TSS concentration was much higher than the other monitoring sites, this could be due to surrounding land use, sampling timing (if samples were taken directly after rain events), or how large the drainage basin for the river is compared to the other monitoring sites. For seven of the original 12 monitoring sites, the 2024 median was higher than the 2023 median. It will be important to monitor how TSS concentrations change over time and if there are patterns noted across the monitoring sites.

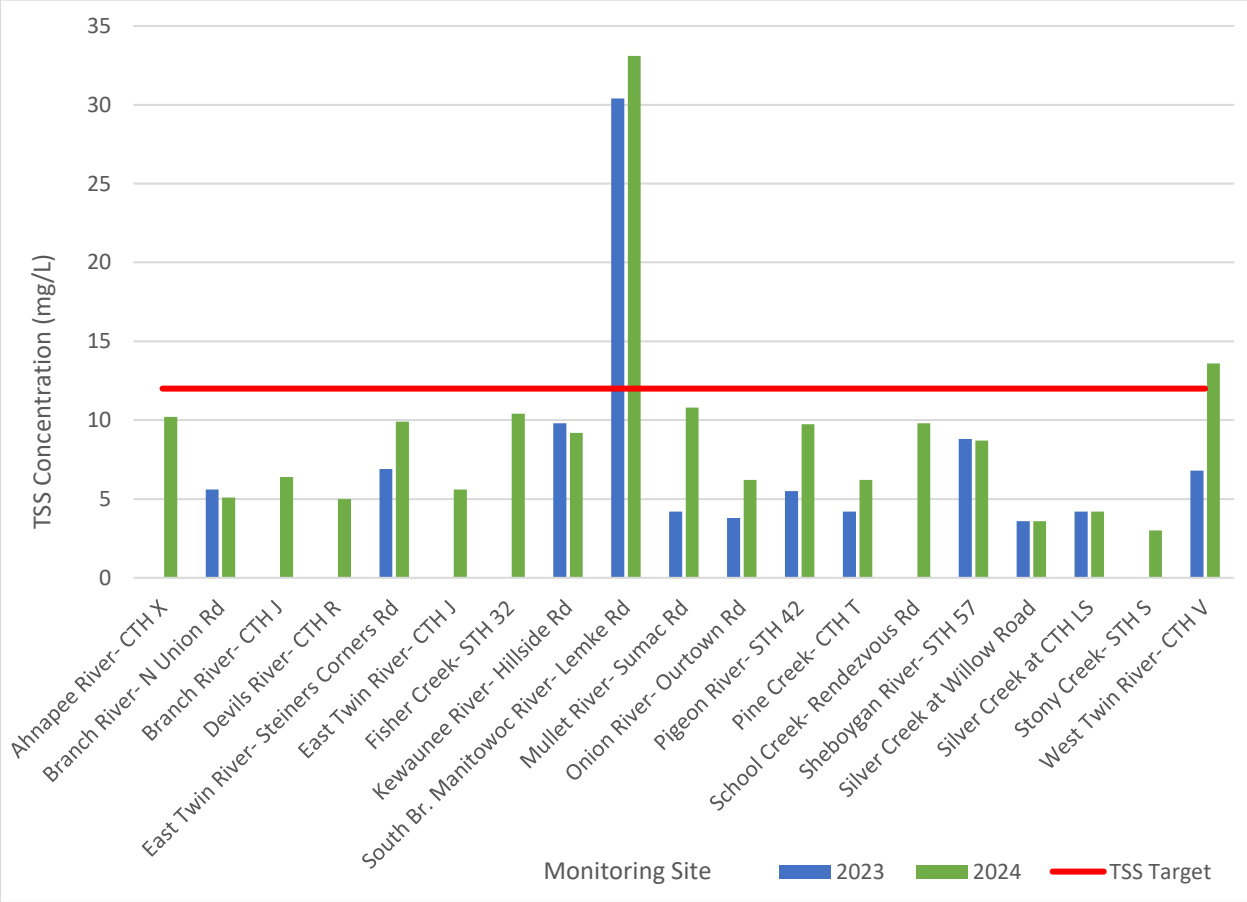


Figure 3: Yearly TSS median concentrations by monitoring site compared to the TSS target of 12mg/L.

Total Nitrogen Analysis

There is no WQC for nitrogen in Wisconsin and TMDLs are not developed for nitrogen, but it's still important to monitor TN trends over time. With only two years of data for 12 of the sites, and one year of data for seven sites, it's hard to note any trends. For 10 of the original 12 sites, TN was higher in 2024 than in 2023, the two sites with lower concentrations in 2024 were Mullet River and Sheboygan River.

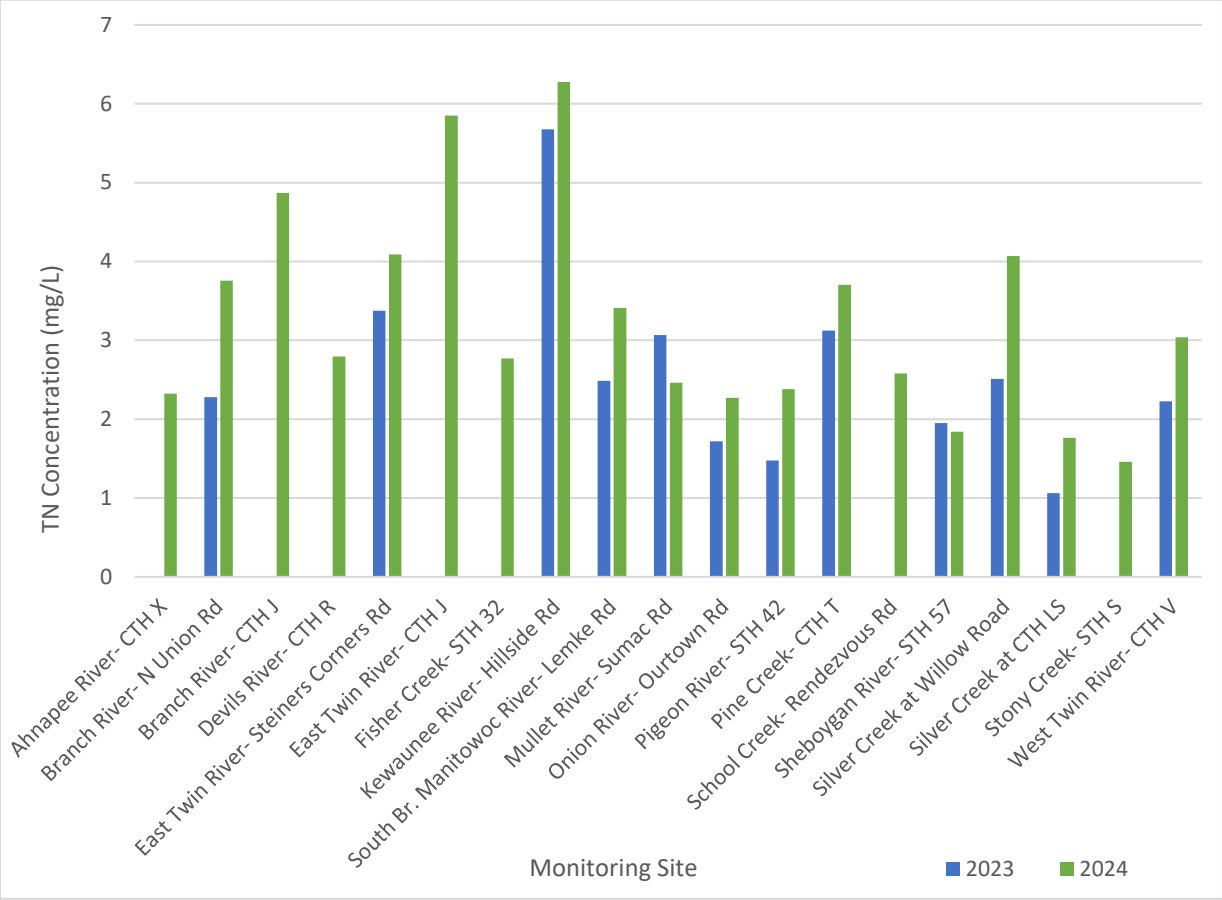


Figure 4: Yearly TN median concentrations by monitoring site.

Field Quality Assurance/Quality Control Duplicate Samples

To document the accuracy and precision of the field data collected by volunteers, quality assurance/quality control (QA/QC) samples are taken during the season. In 2023 one duplicate sample was taken, and in 2024 two were scheduled but only one was taken. For future seasons, the coordinator will be clearer with volunteers who are scheduled to take duplicate samples to ensure they aren't missed. The samples are randomly selected from the list of sites that are monitored. These QA/QC tests document the accuracy and precision of the data collected and look at natural variability and sampling error.

Duplicate samples are collected on the same day and time as the regular samples. The duplicate sample is an additional sample for each parameter, it is sampled using the same protocol and shipped to the lab with the regular sample. Duplicate sample results were compared to the regular sample result and an absolute difference was calculated. The absolute difference between the two sets of samples is compared to each test's Level of Quantification (LOQ) and is considered good data quality if the value falls below the LOQ. Relative percent difference between the regular and duplicate samples was also calculated, the results are flagged if the percentage is greater than 30% as this indicates a variance between the two sample results. The absolute difference for each parameter in 2024 was below the relative LOQ, meaning the data is good quality. The relative percent difference for each parameter was below 30%, meaning there is no variance between the sample results. Duplicate sample results are in Appendix G.

Stream Flow and Transparency

In addition to collecting water chemistry samples (TP, DRP, TSS, TN) each month, volunteers measure stream flow and water transparency. Streamflow can only be measured when there is at least two volunteers sampling, the stream has 20 ft. section of stream that is straight and accessible, and the stream is wadable. Many of the monitoring streams in the NEL don't meet these criteria, in 2024 there was no streamflow data collected.

Stream flow is affected by the amount of water within a watershed and increases with rainstorms or snowmelt and decreases during dry periods. Flow defines the shape, size, and course of the stream. Volunteers measure streamflow using a velocity-area approach. A 20 ft. length of stream is assessed followed by measuring the width and the water depth at numerous locations across the width. Water velocity is determined by measuring the time it takes for a tennis ball to float along the stream length. Streamflow data can be found in Appendix H.

Water transparency is collected each month with a 120 cm transparency tube. Water clarity is affected by suspended sediment, dissolved material, and algae. When there is more dissolved material in the water, transparency numbers decrease. The highest transparency reading is 120cm, this means the water is clear and there is minimal dissolved material. Six of the monitoring sites had a median transparency reading of 120cm in 2024. Transparency data can be found in Appendix H.

Key Takeaways for 2023-2024

- In 2024, three sites had median TP concentrations below the State TP WQC for streams of 0.075mg/L. This number is lower than 2023, where five of the sites had medians below the TP WQC.
    - The TP median for the Sheboygan River continues to stay above the TP river criteria of 0.100 mg/L.
- DRP concentrations continue to make up a large part of TP concentrations, 56% of the TP samples in 2024 had 60-80% of their concentration coming from DRP. DRP contributes to excess algae growth and potentially harmful algal blooms, it will be important to monitor DRP concentrations as implementation increases across the NEL.
- The median TSS concentration for all monitoring sites, except South Branch Manitowoc River and West Twin River, continue to stay below the TSS target of 12mg/L.
- TN results varied by monitoring site and there is not a defined TN WQC or target.
    - TN results were higher in 2024 than 2023 for 10 of the original 12 monitoring sites.
- In 2024, School Creek was monitored from May-October, but the May sample was taken at a different site than the other five months. The May sample was taken at the original sampling location at the road crossing of Christoff Lane (Station ID 13122), but the site was hard to access. The coordinator moved the site to the next road crossing upstream at Rendezvous Road (Station ID 10020829).
    - The May data was not used when calculating the confidence limit and medians, but the data can be found in Appendix C.
- It is important to note weather conditions throughout the season. In 2024, May-August had two to four more inches of rain than average across the NEL basin, this is the opposite of 2023 which had less precipitation than average.
    - More precipitation has an effect on all parameters as more runoff can increase the amount of nutrients in waterbodies.

Data Conclusions

2024 was the second year of monitoring for the NEL volunteer monitoring program. The program started with 12 sites and seven were added in 2024 for a total of 19 sites. The NEL TMDL was approved in October 2023, meaning implementation and best management practices will increase across the NEL in future years. The future data collected may evaluate water quality changes over time in respect to changes in implementation, climate, and land use.

Raw data may suggest that variations in weather patterns, temperature, and time of year may have an impact on the TP, DRP, TSS, and TN concentrations. 2024 was a wetter year than average and when there is more precipitation there is more runoff going into the waterbodies, this may cause concentrations of TP, DRP, TSS, and TN to be higher than average. It is important to note extreme weather conditions each season and to keep these conditions in mind when analyzing the data. The NEL volunteer program should continue so water quality trends can be monitored over time, conclusions cannot be made after one year of data.

In 2024, 16 of the monitoring sites had median TP concentrations over the State TP WQC of 0.075 mg/L, nine of these sites had a confidence limit that "Clearly Exceeds" the TP WQC while the others "May Exceed". The Sheboygan River is included in the sites that "Clearly Exceeds" as the median TP concentration was above the TP WQC for rivers, which is 0.100 mg/L. These streams are impaired by total phosphorus and demonstrate the need for best management practices and implementation in the NEL. There was only one site with a confidence limit that "Clearly Meets" the TP WQC, Ahnapee River, and the two sites that "May Meet" were East Twin River (CTH J) and Silver Creek (Willow Road).

DRP made up a large portion of total phosphorus concentrations across the monitoring streams. Appendix F provides a table of the percentage of DRP making up each TP sample and Table 4 categorizes the values into percentage categories. In 2024, 63 of the 113 samples had a DRP percentage range of 60 – 80%, which is 56% of the samples, and 29 samples, or 26%, were in the 40-60% range. This means most of the TP samples in 2024 were made up of more than 40% DRP. The dissolved form of phosphorus is readily available for plant uptake and contributes to harmful algal blooms, when there is a high percentage of DRP algal blooms can form more easily. It will be important to monitor how DRP concentrations change over time as implementation increases due to the NEL TMDL.

There were 10 TSS samples that reported no detect (ND) throughout the season, these samples mostly occurred in the Autumn months, September and October. The median TSS result for 17 of the monitoring sites was below the TSS target of 12mg/L defined by the NEL TMDL. The two sites that were above the TSS target were the South Branch Manitowoc River and the West Twin River. The South Branch Manitowoc River median continues to be much higher than the other sites, this could be due to surrounding land use, timing of sampling, and size of the watershed.

There is not a State WQC for TN and TMDLs are not developed for nitrogen. The TN results for the monitoring sites were variable, for 10 of the original 12 sites the 2024 median was higher than 2023. As more TN data is collected, the relationship between TN and other parameters will be evaluated because it is hard to draw conclusions from one year of data. It is important to continue to test for TN because nitrogen is often found in agricultural settings and there is high agricultural activity in the NEL region.

Program Conclusions

One of the main goals of the NEL Volunteer Monitoring Program is the engagement of the public and increasing their awareness on water quality issues. There were about twenty volunteers between 2023 and 2024, but multiple volunteers were part of larger organizations, possibly making the volunteer contribution much higher. With the knowledge the volunteers possess, they can teach others and be an extension of the program. The volunteers can talk about their experiences with others, which allows the information to be carried out to even more individuals in the basin.

Volunteer recruitment was carried out in several ways, including reaching out to county land and water departments and local environmental groups, and publishing a press release. Presentations were also given during the sampling season to gain interest from future volunteers and to spread awareness about water quality issues in the area. These presentations garnered interest from individuals who were unsure how they could participate when it came to improving water quality. These outreach events were successful and there will be more in the future.

Communication proves to be the most important aspect of the WDNR coordinators position. This was the second year for the NEL volunteer program, there were returning volunteers but since seven sites were added to the program there was still trainings to coordinate and new volunteers to manage. The volunteers were grateful for the high level of communication and appreciated the WDNR coordinator was available for questions and help with sampling when needed.

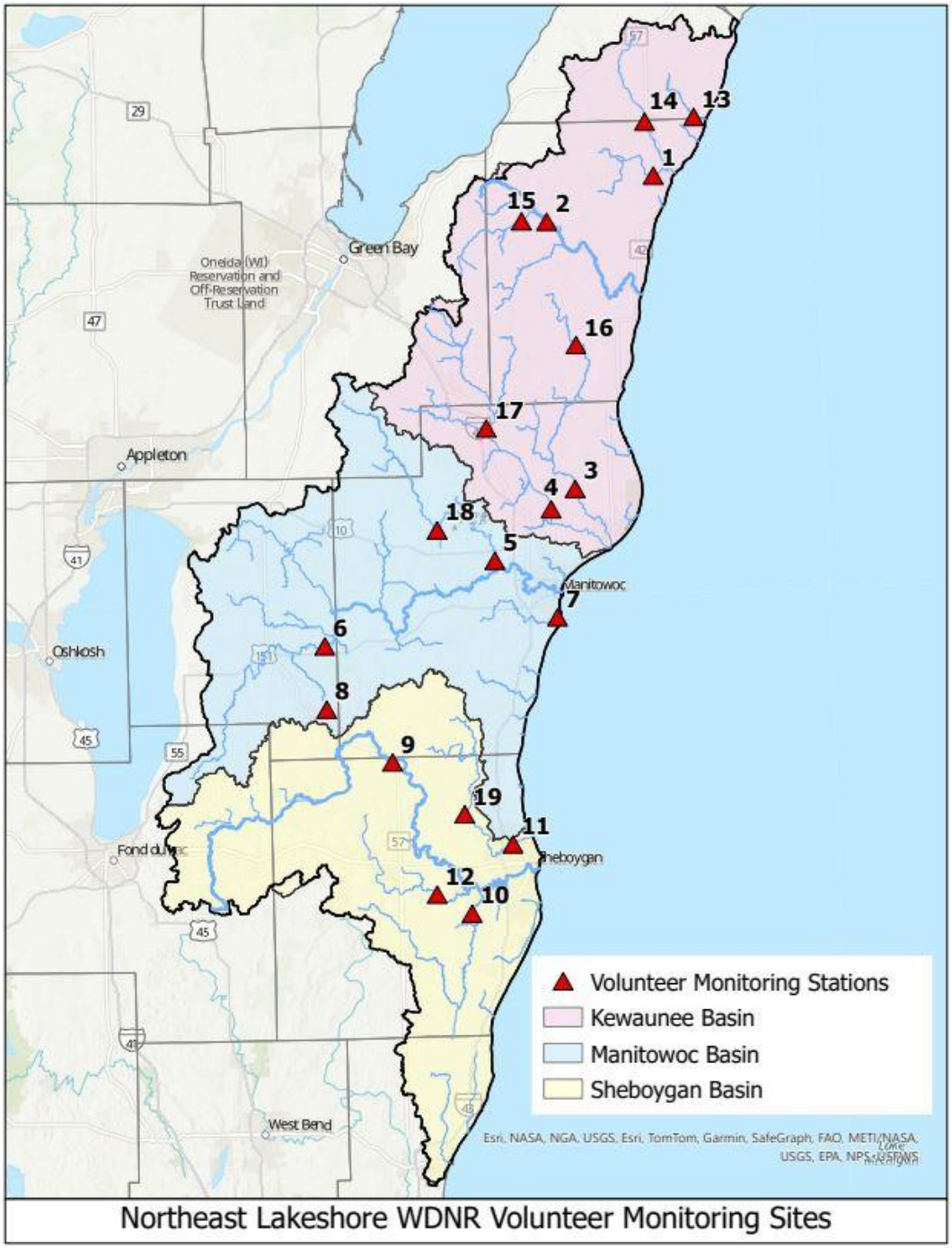
This water quality monitoring data is also important in measuring implementation progress. There are six active 9 Key Element Plans within the NEL TMDL area. These plans assess the causes and sources of pollution and prioritize restoration and protection strategies to address water quality problems. Watersheds with active 9 Key Element Plans include CalMan Lakes (2018), Pine Creek (2019), North Branch of the Manitowoc River (2019), Ahnapee River (2020), Upper Ahnapee River (2020), and Pigeon River (2023). The active 9 Key Element watershed plans focus on non-point source agricultural implementation, while the NEL TMDL will focus on implementation across all sources of pollution in the watershed. As implementation of these plans continue, monitoring data can be utilized to help track implementation progress and assist in determining where additional data and information is needed to track progress.

Acknowledgements

Thank you to all the volunteers who made the 2024 monitoring season in the Northeast Lakeshore possible. Thank you to the WDNR and the WAV program for funding and support. The WAV program manages a nutrient data database, where results can be viewed for monitoring sites across the state (WAV Data Dashboard (wisc.edu)).

Appendices

Appendix A: Northeast Lakeshore Volunteer Monitoring Sites and TMDL Basin Boundaries



Northeast Lakeshore WDNR Volunteer Monitoring Sites

	Stream Name	WBIC	SWIMS ID	SWIMS Station Name	Latitude	Longitude	Impairment
1	Silver Creek	94900	10020779	Silver Creek at Willow Rd	44.60788	-87.47114	TP
2	Kewaunee River	90700	10029954	Kewaunee River at Hillside Rd	44.55438	-87.65939	TP
3	East Twin River	84000	10008207	East Twin River at Steiners Corners Rd	44.22131	-87.62302	TP
4	West Twin River	87000	10029482	West Twin River at CTH V	44.19678	-87.66578	TP
5	Branch River	71300	363299	Branch River at N Union Rd	44.13479	-87.76542	TP
6	South Branch Manitowoc River	77900	363375	South Branch Manitowoc River at Lemke Rd	44.03367	-88.06298	TP
7	Silver Creek	67300	363228	Silver Creek at CTH LS	44.06227	-87.65994	TP
8	Pine Creek	79900	10020831	Pine Creek at CTH T	43.9548	-88.06231	TP
9	Sheboygan River	50700	10021359	Sheboygan River at STH 57	43.8873	-87.95099	TP
10	Onion River	51200	603480	Onion River at Ourtown Rd	43.69669	-87.82086	TP
11	Pigeon River	62300	603294	Pigeon River at STH 42	43.78144	-87.74747	TP
12	Mullet River	53400	10049358	Mullet River at Sumac Rd	43.72143	-87.88	TP
13	Stony Creek	96100	10051616	Stony Creek at CTH S (C)	44.67920	-87.39765	TP and TSS
14	Ahnapee River	94800	153029	Ahnapee River at CTH X Nr Forestville	44.67525	-87.48349	Unknown Pollutant
15	School Creek	92200	10020829	School Creek-100 Feet Below Bridge Off Rendezvous Road	44.54725	-87.72383	TP
16	East Twin River	84000	10008204	East Twin River at CTH J	44.40007	-87.61436	TP
17	Devils River	89900	10039193	Devils River at CTH R	44.29954	-87.77419	TP
18	Branch River	71300	10016958	Branch River at CTH J	44.17371	-87.86216	TP
19	Fisher Creek	62500	10033781	Fisher Creek- Upstream of STH 32	43.82052	-87.82895	TP

*SWIMS – Surface Water Integrated Monitoring System; a Wisconsin DNR information system that holds chemistry (water, sediment), physical, and biological (macroinvertebrate, aquatic invasive species) surface water data.

Appendix B: Impaired Monitoring Streams

Local Waterbody Name	Waters ID	WBIC	County	Total Size	Cycle Listed	TMDL Priority	Source Category	Pollutant	Impairment	Listing Condition Category
Ahnapee River	18073	94800	Door, Kewaunee	7.9	2022	Low	PS/NPS	Unknown Pollutant	Degraded Biological Community	TMDL approved by EPA in 2023 (4A)
Branch River	9899	71300	Manitowoc	12.4	2020	High	PS/NPS	Total Phosphorus	Impairment Unknown	TMDL approved by EPA in 2023 (4A)
	482183			7.7			NPS	Total Phosphorus	Impairment Unknown	
Devil's River	10138	89900	Manitowoc	6	2020	High	NPS	Total Phosphorus	Impairment Unknown	TMDL approved by EPA in 2023 (4A)
East Twin River	10205	84000	Kewaunee	7.8	2014	High	NPS	Total Phosphorus	Impairment Unknown	TMDL approved by EPA in 2023 (4A)
	10206			6.7				Total Phosphorus	Degraded Biological Community	
	18071			10.5	2018			Total Phosphorus	Impairment Unknown	
	4700226		Kewaunee, Manitowoc	15.9				Total Phosphorus	Impairment Unknown	

Fisher Creek	18021	62500	Sheboygan	4.4	2016	High	NPS	Total Phosphorus	Degraded Biological Community	TMDL approved by EPA in 2023 (4A)
Kewaunee River	18061	90700	Kewaunee	10.9	2020	High	NPS	Total Phosphorus	Impairment Unknown	TMDL approved by EPA in 2023 (4A)
	482871		Brown, Kewaunee	11.53			PS/NPS	Total Phosphorus	High Phosphorus Levels	TMDL approved by EPA in 2023 (4A)
Manitowoc River (South Branch)	9924	77900	Calumet, Manitowoc	12.6	2012	High	PS/NPS	Total Phosphorus	High Phosphorus Levels	TMDL approved by EPA in 2023 (4A)
					2016	Low	PS/NPS	Unknown Pollutant	Elevated Water Temperature	TMDL Needed (5A)
	3990110		Calumet, Fond du Lac	23.9		High	NPS	Total Phosphorus	Degraded Biological Community	TMDL approved by EPA in 2023 (4A)
Mullet River	9839	53400	Sheboygan	17.8	2012	High	PS/NPS	Total Phosphorus	Impairment Unknown	TMDL approved by EPA in 2023 (4A)
	9842			5.9	2020			Total Phosphorus	Impairment Unknown	

Onion River	3987353	51200	Sheboygan	31.8	2012	High	PS/NPS	Total Phosphorus	Degraded Biological Community	TMDL approved by EPA in 2023 (4A)
Pigeon River	1496062	62300	Manitowoc, Sheboygan	18.1	2012	High	PS/NPS	Total Phosphorus	High Phosphorus Levels	TMDL approved by EPA in 2023 (4A)
Pine Creek	9931	79900	Calumet	5.5	2020	High	NPS	Total Phosphorus	Impairment Unknown	TMDL approved by EPA in 2023 (4A)
	9932			3.6	2016			Total Phosphorus	High Phosphorus Levels	
School Creek	10184	92200	Brown, Kewaunee	5.6	2018	High	NPS	Total Phosphorus	High Phosphorus Levels	TMDL approved by EPA in 2023 (4A)
Sheboygan River	11354	50700	Sheboygan	13.6	2014	High	PS/NPS	Total Phosphorus	Impairment Unknown	TMDL approved by EPA in 2023 (4A)
	11356		Calumet, Manitowoc, Sheboygan	20.2	2020			Total Phosphorus	Degraded Biological Community	
	5753343		Sheboygan, Fond du Lac	20.8				Total Phosphorus	High Phosphorus Levels	
Silver Creek (Havel Creek)	10212	94900	Kewaunee	5.5	2018	High	NPS	Total Phosphorus	Impairment Unknown	TMDL approved by EPA in 2023 (4A)

Silver Creek	9872	67300	Manitowoc	8.4	2014	High	NPS	Total Phosphorus	Impairment Unknown	TMDL approved by EPA in 2023 (4A)
	8106635			9.3			PS/NPS			
Stony Creek	10219	96100	Door, Kewaunee	8.3	2024	High	NPS	Total Phosphorus	Impairment Unknown	TMDL approved by EPA in 2023 (4A)
					1998			Total Suspended Solids	Degraded Habitat	
	10220		Door	7.8	2018			Total Phosphorus	Impairment Unknown	
West Twin River	9948	87000	Manitowoc	9.5	1998	High	NPS	Total Phosphorus	Low DO	TMDL approved by EPA in 2023 (4A)
	9949			0.4						
	9950			1.4						
	18050			5.9	2016		PS/NPS	Unknown Pollutant	Elevated Water Temperature	
					1998		NPS	Total Phosphorus	Low DO	
	18051			1.3	2016			Unknown Pollutant	Elevated Water Temperature	

Appendix C: Sampling Data

		TP (mg/L)		DRP (mg/L)		TSS (mg/L)		TN (mg/L)	
Monitoring Site	Month	2023	2024	2023	2024	2023	2024	2023	2024
Ahnapee River	May	-	0.112	-	0.0109	-	38.2	-	2.87
	June	-	0.0571	-	0.00855	-	17.2	-	2.75
	July	-	0.081	-	0.00756	-	9.4	-	2.69
	August	-	0.0492	-	0.00593	-	5.6	-	1.45
	September	-	0.062	-	ND	-	11	-	1.25
	October	-	0.0546	-	0.00651	-	7.8	-	1.96
Branch River (CTH J)	May	-	0.115	-	0.0821	-	5	-	3.4
	June	-	0.15	-	0.101	-	18	-	4.72
	July	-	0.205	-	0.141	-	16.8	-	4.78
	August	-	0.159	-	0.12	-	7.8	-	4.96
	September	-	0.0665	-	0.0435	-	4.6	-	5.32
	October	-	0.0422	-	0.0292	-	3.2	-	6.06
Branch River (N Union Rd)	May	0.0554	0.0613	0.0204	0.0337	5.2	4.2	3.71	2.33
	June	0.0496	0.126	0.0252	0.0857	5.6	12.6	2.98	3.71
	July	0.0566	0.191	0.016	0.134	5.6	15.2	1.59	3.8
	August	0.0547	0.2	0.027	0.163	7	6	1.82	3.55
	September	0.0284	0.0499	0.00998	0.0217	4.4	3.4	2.18	3.92
	October	0.0235	0.0276	0.00656	0.0119	ND	2.4	2.38	4.06
Devils River	May	-	0.203	-	0.157	-	10.6	-	2.02
	June	-	0.116	-	0.087	-	5	-	2.76
	July	-	0.0952	-	0.0794	-	2.8	-	3.18
	August	-	0.158	-	0.112	-	7	-	2.29
	September	-	0.0718	-	0.0546	-	2.2	-	2.83
	October	-	0.0315	-	0.0238	-	ND	-	3.07
East Twin River (CTH J)	May	-	0.119	-	0.0902	-	7.8	-	6.6
	June	-	0.0868	-	0.0657	-	5.2	-	8.95
	July	-	0.0467	-	0.033	-	2.4	-	12
	August	-	0.0671	-	0.0335	-	6	-	1.57
	September	-	0.0368	-	0.023	-	6.8	-	4.85
	October	-	0.0215	-	0.0184	-	5	-	5.1
East Twin River (Steiners Corners Rd)	May	0.0398	0.0813	0.0132	0.0512	3.5	5.8	3.59	3.29
	June	0.0518	0.0913	0.0231	0.0564	4	11.2	3.71	4.17
	July	0.111	0.19	0.0688	0.118	11.6	27	2.27	3.41
	August	0.0921	0.24	0.0493	0.148	9.8	28.2	2.69	4.01
	September	0.0373	0.0456	0.0169	0.0209	17.8	4.4	3.16	5.95
	October	0.0321	0.0468	0.0138	0.0241	3.6	8.6	4.25	4.7
	May	-	0.403	-	0.172	-	80	-	8.01

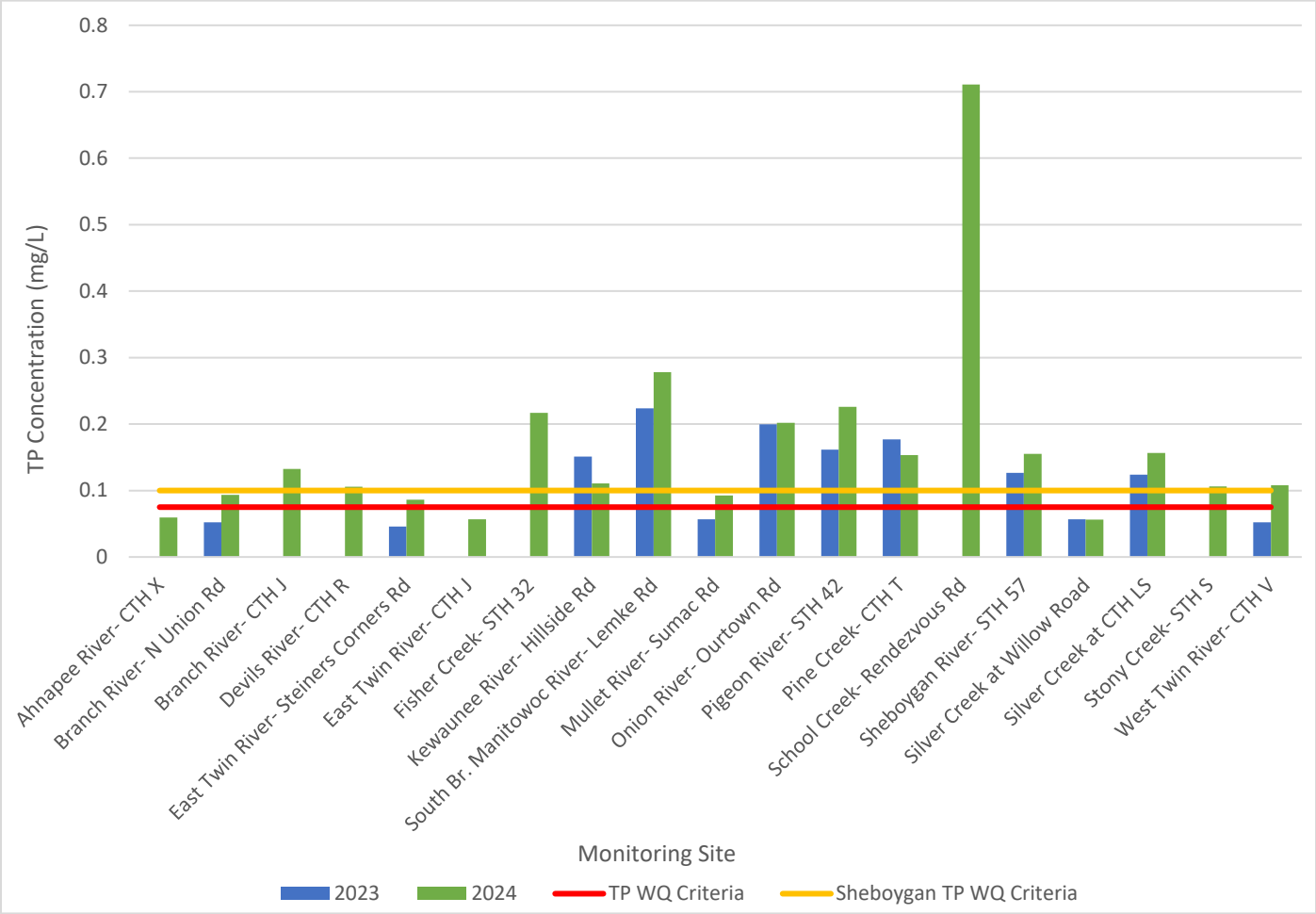
Fisher Creek	June	-	0.21	-	0.13	-	8.2	-	2.76
	July	-	0.224	-	0.156	-	12.6	-	2.78
	August	-	0.129	-	0.0923	-	ND	-	3.19
	September	-	0.0849	-	0.0609	-	2	-	1.08
	October	-	0.382	-	0.331	-	ND	-	0.841
Kewaunee River	May	0.157	0.116	0.0967	0.0785	7.4	10	6.62	5.94
	June	0.131	0.976	0.0824	0.26	3.75	491	9.42	6.61
	July	0.159	0.101	0.104	0.0697	16.6	3.4	6.02	0.613
	August	0.385	0.12	0.3	0.0822	14.4	6.4	5.33	7.19
	September	0.145	0.105	0.0902	0.0554	11.6	12	4.37	7.37
	October	0.0998	0.0879	0.0544	0.0552	8	8.4	3.43	5.47
Mullet River	May	0.0608	0.0748	0.0216	0.0397	10	9.4	2.63	2.2
	June	0.0601	0.116	0.0291	0.0624	4.2	13.5	2.93	2.45
	July	0.056	0.17	0.0367	0.0988	3	17.8	4.57	1.95
	August	0.0575	0.11	0.0459	0.0652	ND	12.2	3.04	2.47
	September	0.0401	0.0732	0.0147	0.0533	ND	3.8	3.8	3.08
	October	0.00964	0.0315	0.0242	0.0182	ND	2.2	3.09	3.48
Onion River	May	0.103	0.132	0.0634	0.0964	4.25	2.8	1.92	2.39
	June	0.281	0.216	0.223	0.166	ND	6.75	0.84	3.31
	July	0.249	0.246	0.201	0.186	2.8	15	2.33	2.57
	August	0.231	0.292	0.189	0.234	3.6	6.2	1.52	2.15
	September	0.134	0.188	0.0993	0.146	ND	4.4	0.76	1.62
	October	0.168	0.0439	0.113	0.0282	4	ND	2.37	1.01
Pigeon River	May	0.105	0.351	0.0713	0.189	4.4	60	1.66	8.07
	June	0.272	0.138	0.218	0.0979	9	7	0.868	2.81
	July	0.218	0.35	0.158	0.213	6.6	18.2	1.29	2.28
	August	-	0.191	-	0.138	-	9.75	-	2.48
	September	-	0.261	-	0.231	-	2.6	-	0.904
	October	0.101	0.0437	0.0599	0.0266	3.4	ND	4.47	0.974
Pine Creek	May	0.0925	0.13	0.0588	0.0744	3.6	6	2.61	2.51
	June	0.16	0.164	0.119	0.11	4.8	6.4	3.62	3.33
	July	0.194	0.399	0.155	0.117	4.4	13.8	4.71	2.85
	August	0.252	0.143	0.194	0.102	3.4	4	2.63	4.28
	September	0.293	0.169	0.0646	0.104	4	8.4	5.06	4.08
	October	0.144	0.0954	0.0884	0.0548	6.8	3.6	1.92	4.34
School Creek	May	-	0.191*	-	0.157*	-	3.4*	-	7.05*
	June	-	0.553	-	0.442	-	18.5	-	4.67
	July	-	0.521	-	0.396	-	9.8	-	2.58
	August	-	0.813	-	0.654	-	28	-	3.64
	September	-	0.711	-	0.492	-	9	-	1.3

	October	-	0.737	-	0.539	-	3.4	-	0.943
Sheboygan River	May	0.124	0.145	0.0557	0.0134	7.8	24.8	1.94	1.81
	June	0.129	0.165	0.0255	0.0117	9.8	21.8	1.96	2.05
	July	0.164	0.294	0.0257	0.218	17	9	1.5	1.68
	August	-	0.177	-	0.113	-	7.33	-	1.89
	September	-	0.0836	-	0.0278	-	8.4	-	1.72
	October	0.0874	0.0753	0.0593	0.039	3	4.6	2.15	1.87
Silver Creek (CTH LS)	May	0.141	0.161	0.111	0.0965	6.4	14.2	2.34	2.14
	June	0.107	0.152	0.0671	0.114	2.6	4.2	1.04	2.65
	July	0.214	0.195	0.136	0.152	5.4	6	1.34	2.24
	August	0.191	0.204	0.123	0.158	16.2	3.2	1.08	1.39
	September	0.101	0.0793	0.0636	0.0486	3	ND	0.988	1.04
	October	0.103	0.0704	0.0613	0.0383	2	2.6	1.04	1.08
Silver Creek (Willow Road)	May	0.0801	0.0667	0.0496	0.0365	3.6	3.4	2.61	3.93
	June	0.0586	0.0958	0.0277	0.0638	3.25	3.6	5.55	4.45
	July	0.075	0.0462	0.0417	0.0288	5	4.4	2.41	5.47
	August	0.0545	0.0402	0.0229	0.0164	4.8	2.4	2.08	4.21
	September	0.0409	0.0258	0.0174	0.00713	3.2	ND	2.63	2.42
	October	0.0298	0.115	0.00947	0.0226	ND	51.6	2.33	2.49
South Branch Manitowoc River	May	0.289	0.316	0.173	0.0176	48.6	67.6	3.02	1.94
	June	0.19	0.349	0.0877	0.225	24.6	36	2.86	3.34
	July	0.252	0.501	0.149	0.367	29.2	8.6	1.78	1.84
	August	0.26	0.24	0.146	0.134	31.6	43	2.17	3.48
	September	0.195	0.16	0.0757	0.0954	51.8	30.2	2.53	3.56
	October	0.121	0.0806	0.0706	0.0508	5.8	5.2	2.44	4.54
Stony Creek	May	-	0.086	-	0.0527	-	4.4	-	1.41
	June	-	0.592	-	0.35	-	72	-	5.07
	July	-	0.184	-	0.125	-	3	-	1.61
	August	-	0.107	-	0.0708	-	ND	-	1.32
	September	-	0.105	-	0.0721	-	2.2	-	1.51
	October	-	0.102	-	0.046	-	2.8	-	1.39
West Twin River	May	0.0557	0.0861	0.0106	0.0499	8.75	4.8	2.31	2.6
	June	0.049	0.13	0.0165	0.0857	2.2	13.6	2.4	3.35
	July	0.0802	0.237	0.05	0.13	9.4	38.4	1.82	3.83
	August	0.0672	0.266	0.0329	0.197	6.8	13.6	2.14	3.68
	September	0.0191	0.0415	0.00593	0.0229	2.2	ND	2.07	2.73
	October	0.024	0.038	-	0.0215	ND	ND	2.41	2.57

ND indcates sample concentration was not detected.

****Sample was taken at a different station. The samples were taken at School Creek at Christoff Lane, Station ID 313122.***

Appendix D: Median Total Phosphorus Concentration by Monitoring Site



TP WQC is 0.075 mg/l for all sites except Sheboygan River, Sheboygan River TP WQC is 0.100 mg/L.

Appendix E: 2023-2024 Confidence Interval Table

Monitoring Site	TP Calculation	2023	2024
Ahnapee River	**U90% (mg/L)**	-	0.0740
	Median (mg/L)	-	0.060
	L90% (mg/L)	-	0.0451
	Relation to Criteria	-	Clearly Meets
Branch River (CTH J)	**U90% (mg/L)**	-	0.1698
	Median (mg/L)	-	0.1325
	L90% (mg/L)	-	0.0952
	Relation to Criteria	-	Clearly Exceeds
Branch River (N Union Rd)	**U90% (mg/L)**	0.0612	0.1393
	Median (mg/L)	0.05215	0.0937
	L90% (mg/L)	0.0431	0.0480
	Relation to Criteria	Clearly Meets	May Exceed
Devils River	**U90% (mg/L)**	-	0.1432
	Median (mg/L)	-	0.1056
	L90% (mg/L)	-	0.0680
	Relation to Criteria	-	May Exceed
East Twin River (CTH J)	**U90% (mg/L)**	-	0.0788
	Median (mg/L)	-	0.0569
	L90% (mg/L)	-	0.0350
	Relation to Criteria	-	May Meet
East Twin River (Steiners Corners Rd)	**U90% (mg/L)**	0.0659	0.1357
	Median (mg/L)	0.0458	0.0863
	L90% (mg/L)	0.0257	0.0369
	Relation to Criteria	Clearly Meets	May Exceed
Fisher Creek	**U90% (mg/L)**	-	0.2966
	Median (mg/L)	-	0.2170
	L90% (mg/L)	-	0.1374
	Relation to Criteria	-	Clearly Exceeds
Kewaunee River	**U90% (mg/L)**	0.2141	0.3284
	Median (mg/L)	0.151	0.1105
	L90% (mg/L)	0.0879	-0.1074
	Relation to Criteria	Clearly Exceeds	May Exceed

Mullet River	**U90% (mg/L)**	0.0690	0.1214
	Median (mg/L)	0.05675	0.0924
	L90% (mg/L)	0.0445	0.0634
	Relation to Criteria	Clearly Meets	May Exceed
Onion River	**U90% (mg/L)**	0.2424	0.2560
	Median (mg/L)	0.1995	0.2020
	L90% (mg/L)	0.1566	0.1480
	Relation to Criteria	Clearly Exceeds	Clearly Exceeds
Pigeon River	**U90% (mg/L)**	**0.2220**	0.3008
	Median (mg/L)	**0.1615**	0.2260
	L90% (mg/L)	**0.1010**	0.1512
	Relation to Criteria	Clearly Exceeds	Clearly Exceeds
Pine Creek	**U90% (mg/L)**	0.2220	0.2203
	Median (mg/L)	0.177	0.1535
	L90% (mg/L)	0.1320	0.0867
	Relation to Criteria	Clearly Exceeds	Clearly Exceeds
School Creek	**U90% (mg/L)**	-	**0.7932**
	Median (mg/L)	-	**0.7110**
	L90% (mg/L)	-	**0.6288**
	Relation to Criteria	-	Clearly Exceeds
Sheboygan River	**U90% (mg/L)**	**0.1488**	0.2036
	Median (mg/L)	**0.1265**	0.1550
	L90% (mg/L)	**0.1042**	0.1064
	Relation to Criteria	Clearly Exceeds	Clearly Exceeds
Silver Creek (CTH LS)	**U90% (mg/L)**	0.1540	0.1913
	Median (mg/L)	0.124	0.1565
	L90% (mg/L)	0.0940	0.1217
	Relation to Criteria	Clearly Exceeds	Clearly Exceeds
Silver Creek (Willow Road)	**U90% (mg/L)**	0.0684	0.0776
	Median (mg/L)	0.05655	0.0565
	L90% (mg/L)	0.0447	0.0353
	Relation to Criteria	Clearly Meets	May Meet

South Branch Manitowoc River	**U90% (mg/L)**	0.2610	0.3691
	Median (mg/L)	0.2235	0.2780
	L90% (mg/L)	0.1860	0.1869
	Relation to Criteria	Clearly Exceeds	Clearly Exceeds
Stony Creek	**U90% (mg/L)**	-	0.2268
	Median (mg/L)	-	0.1060
	L90% (mg/L)	-	-0.0148
	Relation to Criteria	-	May Exceed
West Twin River	**U90% (mg/L)**	0.0670	0.1682
	Median (mg/L)	0.05235	0.1081
	L90% (mg/L)	0.0377	0.0479
	Relation to Criteria	Clearly Meets	May Exceed

Red numbers indicate less than six samples were taken over the sampling season, relation to criteria is an estimate.

Appendix F: Percentage of Total Phosphorus Concentrations from Dissolved Reactive Phosphorus

DRP % of TP			
Monitoring Site	Month	2023	2024
Ahnapee River	May	-	***10%***
	June	-	15%
	July	-	9%
	August	-	12%
	September	-	0%
	October	-	12%
Branch River (CTH J)	May	-	***71%***
	June	-	***67%***
	July	-	***69%***
	August	-	***75%***
	September	-	65%
	October	-	69%
Branch River (N Union Rd)	May	37%	55%
	June	51%	***68%***
	July	28%	***70%***
	August	49%	***82%***
	September	35%	43%
	October	28%	43%
Devils River	May	-	***77%***
	June	-	***75%***
	July	-	***83%***
	August	-	***71%***
	September	-	76%
	October	-	76%
East Twin River (CTH J)	May	-	***76%***
	June	-	76%
	July	-	71%
	August	-	50%
	September	-	63%
	October	-	86%
East Twin River (Steiners Corners Rd)	May	33%	63%
	June	45%	62%
	July	62%	***62%***
	August	54%	***62%***
	September	45%	46%
	October	43%	51%
	May	-	***43%***

Fisher Creek	June	-	***62%***
	July	-	***70%***
	August	-	***72%***
	September	-	72%
	October	-	***87%***
Kewaunee River	May	***62%***	***68%***
	June	***63%***	***27%***
	July	***65%***	69%
	August	***78%***	***69%***
	September	***62%***	53%
	October	55%	63%
Mullet River	May	36%	53%
	June	48%	54%
	July	66%	***58%***
	August	80%	59%
	September	37%	73%
	October	251%	58%
Onion River	May	62%	***73%***
	June	***79%***	***77%***
	July	***81%***	***76%***
	August	***82%***	***80%***
	September	***74%***	***78%***
	October	***67%***	64%
Pigeon River	May	68%	***54%***
	June	***80%***	***71%***
	July	***72%***	***61%***
	August	-	***72%***
	September	-	***89%***
	October	59%	61%
Pine Creek	May	64%	57%
	June	***74%***	***67%***
	July	***80%***	***29%***
	August	***77%***	***71%***
	September	22%	***62%***
	October	***61%***	57%
School Creek	May	-	***82%****
	June	-	***80%***
	July	-	***76%***
	August	-	***80%***
	September	-	***69%***

	October	-	***73%***
Sheboygan River	May	45%	9%
	June	20%	7%
	July	16%	***74%***
	August	-	***64%***
	September	-	33%
	October	68%	52%
Silver Creek (CTH LS)	May	***79%***	***60%***
	June	63%	***75%***
	July	***64%***	***78%***
	August	***64%***	***77%***
	September	63%	61%
	October	60%	54%
Silver Creek (Willow Road)	May	62%	55%
	June	47%	67%
	July	56%	62%
	August	42%	41%
	September	43%	28%
	October	32%	20%
South Branch Manitowoc River	May	***60%***	6%
	June	***46%***	***64%***
	July	***59%***	***73%***
	August	***56%***	***56%***
	September	***39%***	***60%***
	October	58%	63%
Stony Creek	May	-	61%
	June	-	***59%***
	July	-	***68%***
	August	-	66%
	September	-	69%
	October	-	45%
West Twin River	May	19%	58%
	June	34%	***66%***
	July	62%	***55%***
	August	49%	***74%***
	September	31%	55%
	October	-	57%

Red percentages indicate the DRP concentration exceeded the TP concentration (DRP >100%).

Italicized and bold percentages indicate the DRP sample concentration was above the 0.075 mg/L TP criteria. TP criteria is 0.100 mg/L for Sheboygan River.

****The sample was taken at a different station. The samples were taken at School Creek at Christoff Lane, Station ID 313122.***

Appendix G: Duplicate Sample Data

Site Name	Date	Parameter	Duplicate Sample	Regular Sample	Absolute Difference		Relative Percent Difference
Mullet River-Sumac Rd	8/9/2023	RESIDUE TOTAL NFLT (TOTAL SUSPENDED SOLIDS)	ND	ND	-	MG/L	-
	8/9/2023	PHOSPHORUS TOTAL	0.0561	0.0575	0.0014	MG/L	2.46
	8/9/2023	PHOSPHATE ORTHO AS PO4 DISS	0.0403	0.0459	0.0056	MG/L	12.99
	8/9/2023	NITROGEN TOTAL	3.04	3.04	0	MG/L	0.00
Mullet River-Sumac Rd	8/7/2024	RESIDUE TOTAL NFLT (TOTAL SUSPENDED SOLIDS)	11.9	12.2	0.3	MG/L	2.49
	8/7/2024	PHOSPHORUS TOTAL	0.106	0.11	0.004	MG/L	3.70
	8/7/2024	PHOSPHATE ORTHO AS PO4 DISS	0.0622	0.0652	0.003	MG/L	4.71
	8/7/2024	NITROGEN TOTAL	2.45	2.47	0.02	MG/L	0.81

	Level of Detection (LOD) mg/L	Level of Quantification (LOQ) mg/L
TP	0.00900	0.0300
DRP	0.00400	0.0130
TSS	2.0	2.0
TN	0.058	0.192

Appendix H: Stream Flow and Transparency Data

		Streamflow (CFS)		Transparency (CM)	
Monitoring Site	Month	2023	2024	2023	2024
Ahnapee River	May	-	-	-	27
	June	-	-	-	43
	July	-	-	-	50
	August	-	-	-	94
	September	-	-	-	40
	October	-	-	-	60
Branch River (CTH J)	May	-	-	-	120
	June	-	-	-	47
	July	-	-	-	48
	August	-	-	-	75.4
	September	-	-	-	87
	October	-	-	-	97
Branch River (N Union Rd)	May	-	-	120	120
	June	-	-	120	80
	July	-	-	120	60
	August	-	-	120	120
	September	-	-	120	120
	October	-	-	120	120
Devils River	May	-	-	-	100
	June	-	-	-	-
	July	-	-	-	105.7
	August	-	-	-	62
	September	-	-	-	120
	October	-	-	-	120
East Twin River (CTH J)	May	-	-	-	120
	June	-	-	-	95
	July	-	-	-	120
	August	-	-	-	120
	September	-	-	-	102
	October	-	-	-	120
East Twin River (Steiners Corners Rd)	May	-	-	120	120
	June	-	-	120	90
	July	-	-	107.5	60
	August	-	-	90	37
	September	-	-	85	120
	October	-	-	120	-
	May	-	-	-	8

Fisher Creek	June	-	-	-	-
	July	-	-	-	63.5
	August	-	-	-	120
	September	-	-	-	120
	October	-	-	-	120
Kewaunee River	May	-	-	-	70
	June	-	-	120	-
	July	-	-	58	-
	August	-	-	45	-
	September	-	-	75	-
	October	-	-	70	-
Mullet River	May	-	-	113.3	104
	June	-	-	120	57
	July	-	-	120	61
	August	-	-	120	49
	September	-	-	120	120
	October	-	-	120	120
Onion River	May	-	-	120	20
	June	-	-	120	80
	July	-	-	120	60
	August	-	-	120	90
	September	-	-	-	20
	October	-	-	110	120
Pigeon River	May	1.25	-	64.4	13
	June	-	-	51	-
	July	-	-	-	52.5
	August	-	-	-	79
	September	-	-	-	120
	October	-	-	-	120
Pine Creek	May	-	-	120	120
	June	-	-	120	101.2
	July	-	-	120	63.1
	August	-	-	120	113.4
	September	-	-	76	85.2
	October	-	-	120	119.5
School Creek	May	-	-	-	120*
	June	-	-	-	17.5
	July	-	-	-	95
	August	-	-	-	34
	September	-	-	-	40

	October	-	-	-	95
Sheboygan River	May	2.25	-	64.2	35
	June	-	-	54	-
	July	-	-	45	81.5
	August	-	-	-	87
	September	-	-	-	97.5
	October	-	-	-	120
Silver Creek (CTH LS)	May	-	-	120	-
	June	-	-	120	102
	July	-	-	-	120
	August	-	-	67	-
	September	-	-	120	120
	October	-	-	120	120
Silver Creek (Willow Road)	May	-	-	120	117
	June	-	-	120	82
	July	-	-	120	113
	August	-	-	120	120
	September	-	-	120	120
	October	-	-	-	120
South Branch Manitowoc River	May	-	-	27.25	17.1
	June	-	-	30	34.1
	July	-	-	28	68.55
	August	-	-	31	32.2
	September	-	-	19	34.5
	October	-	-	84	97.2
Stony Creek	May	-	-	-	120
	June	-	-	-	120
	July	-	-	-	120
	August	-	-	-	120
	September	-	-	-	120
	October	-	-	-	120
West Twin River	May	-	-	120	120
	June	-	-	120	-
	July	-	-	120	120
	August	-	-	120	120
	September	-	-	120	120
	October	-	-	120	120

The sample was taken at a different station. The samples were taken at School Creek at Christoff Lane, Station ID 313122.

Appendix I: Northeast Lakeshore Volunteer Monitoring Fact Sheet

Northeast Lakeshore Volunteer Monitoring Fact Sheet

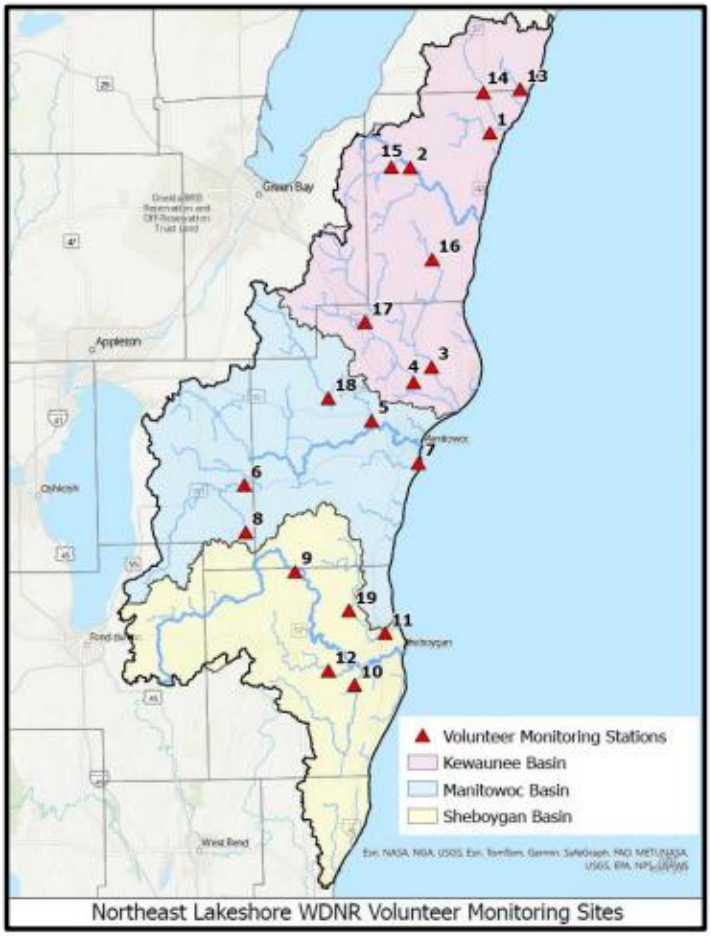
The Northeast Lakeshore Total Maximum Daily Load (TMDL) was approved on October 30, 2023. The TMDL identifies the need for pollutant reductions in waterbodies throughout the basin to meet water quality standards. There are 51 stream segments and 12 lakes in the Northeast Lakeshore region listed as impaired due to excess phosphorus and/or sediment loading.

Phosphorus is an essential nutrient for plant growth, but can have detrimental effects on lakes, rivers, and streams when excessive amounts are introduced to these systems. Common forms of pollutant delivery in these systems include surface runoff from urban and agricultural areas and discharges from wastewater treatment facilities, industrial businesses, and farms. Excess phosphorus in a river system can potentially create harmful algal blooms during the summer months which impact human, plant, and animal life.

The Northeast Lakeshore Volunteer Monitoring Program began in 2023 to help achieve the monitoring goals outlined in the TMDL. The program started with 12 stream monitoring sites. Seven sites were added in 2024, bringing the total to 19 sites across 17 rivers and streams. Volunteers are relied upon to collect surface water samples following WDNR protocol on a monthly basis between the months of May and October. Water samples are shipped to the State Lab of Hygiene in Madison and are analyzed for Total Phosphorus, Total Suspended Solids, and Total Nitrogen.

Northeast Lakeshore Facts:

- Watershed area: ~2,000 square miles
- Includes 8 counties (Brown, Calumet, Door, Fond du Lac, Kewaunee, Manitowoc, Ozaukee, and Sheboygan)
- 63 impaired waterbody segments
- 69 Concentrated Animal Feeding Operations (CAFOs)
- 10 MS4s*
- 49 Dischargers
  - 32 municipal
  - 17 industrial



Northeast Lakeshore WDNR Volunteer Monitoring Sites

Want to get involved or have questions? Contact:

Katherine Rynish
Water Resource Management Specialist
Natural Resource Program Coordinator
Phone: (920) 296-5126
Email: Katherine.Rynish@wisconsin.gov

See backside for exact sample locations.

*MS4s - municipal separate storm sewer system; municipalities with WPDES permits for stormwater management.

	Stream Name	WBIC	SWIMS ID	SWIMS Station Name	Latitude	Longitude	Impairment
1	Silver Creek	94900	10020779	Silver Creek at Willow Rd	44.60788	-87.47114	TP
2	Kewaunee River	90700	10029954	Kewaunee River at Hillside Rd	44.55438	-87.65939	TP
3	East Twin River	84000	10008207	East Twin River at Steiners Corners Rd	44.22131	-87.62302	TP
4	West Twin River	87000	10029482	West Twin River at CTH V	44.19678	-87.66578	TP
5	Branch River	71300	363299	Branch River at N Union Rd	44.13479	-87.76542	TP
6	South Branch Manitowoc River	77900	363375	South Branch Manitowoc River at Lemke Rd	44.03367	-88.06298	TP
7	Silver Creek	67300	363228	Silver Creek at CTH LS	44.06227	-87.65994	TP
8	Pine Creek	79900	10020831	Pine Creek at CTH T	43.9548	-88.06231	TP
9	Sheboygan River	50700	10021359	Sheboygan River at STH 57	43.8873	-87.95099	TP
10	Onion River	51200	603480	Onion River at Ourtown Rd	43.69669	-87.82086	TP
11	Pigeon River	62300	603294	Pigeon River at STH 42	43.78144	-87.74747	TP
12	Mullet River	53400	10049358	Mullet River at Sumac Rd	43.72143	-87.88	TP
13	Stony Creek	96100	10051616	Stony Creek at CTH S (C)	44.67920	-87.39765	TP and TSS
14	Ahnapee River	94800	153029	Ahnapee River at CTH X Nr Forestville	44.67525	-87.48349	Unknown Pollutant
15	School Creek	92200	10020829	School Creek-100 Feet Below Bridge Off Rendezvous Road	44.54725	-87.72383	TP
16	East Twin River	84000	10008204	East Twin River at CTH J	44.40007	-87.61436	TP
17	Devils River	89900	10039193	Devils River at CTH R	44.29954	-87.77419	TP
18	Branch River	71300	10016958	Branch River at CTH J	44.17371	-87.86216	TP
19	Fisher Creek	62500	10033781	Fisher Creek- Upstream of STH 32	43.82052	-87.82895	TP

*SWIMS – Surface Water Integrated Monitoring System; a Wisconsin DNR information system that holds chemistry (water, sediment), physical, and biological (macroinvertebrate, aquatic invasive species) surface water data.

More information can be found at:
https://dnr.wisconsin.gov/topic/TMDLs/NELakeshore/VolunteerMonitoring.html

Appendix J: 2024 WI DNR Press Release

DNR SEEKING VOLUNTEERS FOR STREAM MONITORING IN CENTRAL AND NORTHEASTERN WISCONSIN

Volunteers are needed to help sample streams and rivers in the Lower Fox, Upper Fox and Wolf River and Northeast Lakeshore basins.
Photo credit: Wisconsin DNR

MADISON, Wis. – The Wisconsin Department of Natural Resources (DNR) is seeking volunteers to help monitor streams and rivers in several river basins located in central and northeastern Wisconsin, specifically the Lower Fox, Upper Fox and Wolf River and Northeast Lakeshore basins. Sampling is essential for monitoring water quality improvements, assessing implementation activities and evaluating long-term land use changes.

There are multiple monitoring locations in each basin that need volunteers, and more than one volunteer can sample each site. Sampling occurs once a month from May through October, which is the prime algae growing season, making it easier to determine which streams are affected by

elevated nutrient and suspended sediment concentrations.

Monitoring locations are located at or near road crossings and are chosen for their ease of access. Volunteers should be comfortable wading into the water, but no previous water quality experience is needed. Volunteers will be trained on DNR protocol, and all equipment will be supplied except for boots/waders.

When sampling, each volunteer will need to fill three bottles with water from the stream and take up to two field measurements; the entire process takes about one hour each month. The samples then need to be packed on ice in the provided cooler and dropped off at the closest U.S. post office to be shipped to the State Laboratory of Hygiene in Madison for analysis.

The Lower Fox, Upper Fox and Wolf River and Northeast Lakeshore basins have total maximum daily loads, which identify a need for pollutant reductions to meet water quality standards and provide a framework to meet those standards. The volunteer programs help to fulfill monitoring goals.

Volunteers are crucial for these monitoring programs. The DNR would not be able to monitor as many waterbodies without volunteers' help. Water resources are important for many reasons, including recreation, habitat and health. This program is a great way for volunteers to learn about the water quality in their area and how they can become involved.

For more information about volunteering at these sites, contact Katherine Wendorf at Katherine.Wendorf@wisconsin.gov or 920-296-5126 or visit the DNR website:

- Lower Fox River Basin
- Upper Fox and Wolf River Basins
- Northeast Lakeshore Basin