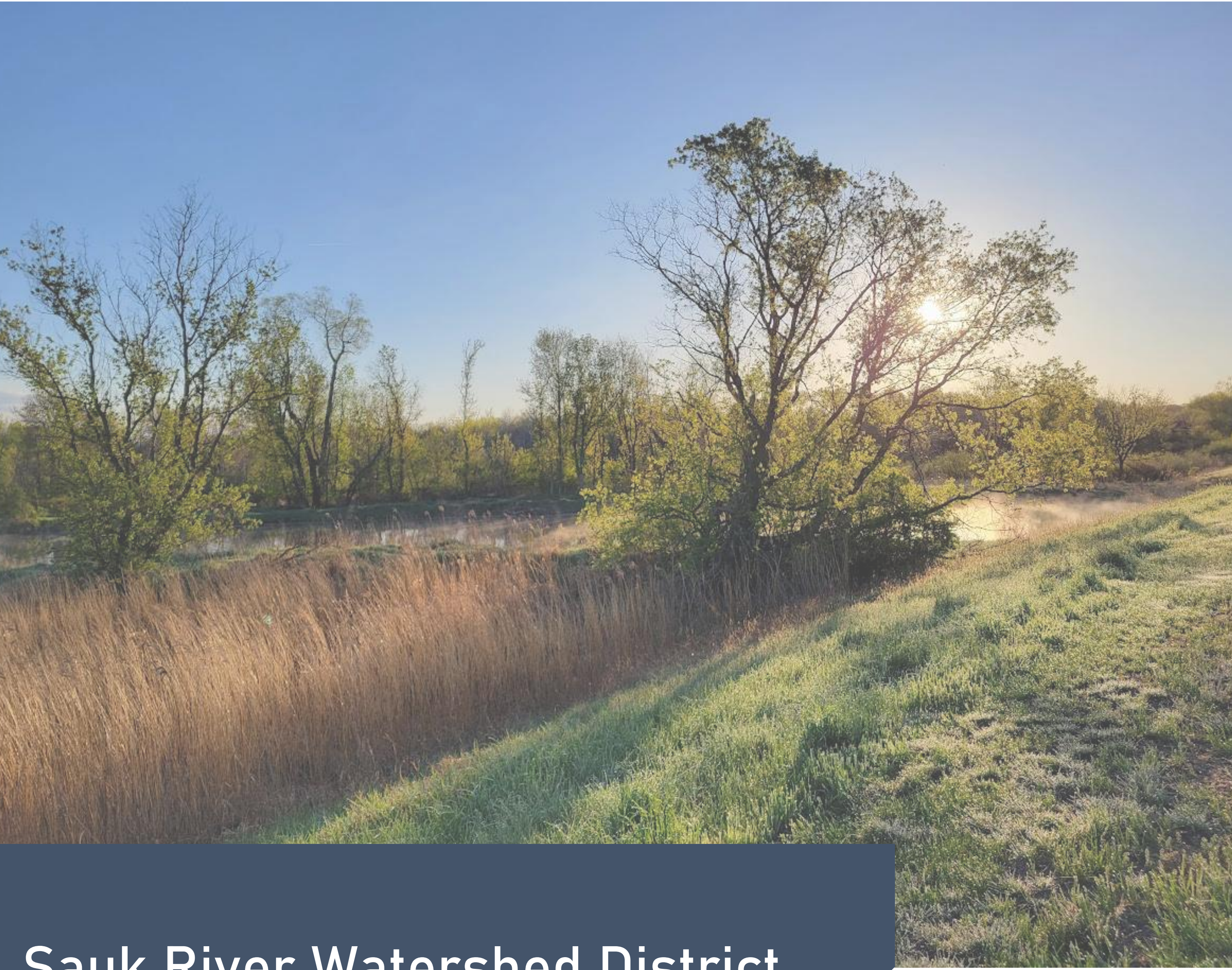

Sauk River Watershed District

2024 River & Streams Report

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Sauk River Watershed District

TABLE OF CONTENTS

Acronyms and Abbreviations

Table 1: Common Acronyms or Abbreviations

Acronym/Abbreviation	Explanation
µg/L	Micrograms per Liter
AIS	Aquatic Invasive Species
BMP	Best Management Practice
BOD	Biological Oxygen Demand
CWMP	Comprehensive Watershed Management Plan
DNR	Minnesota Department of Natural Resources; AKA, MN DNR
DO	Dissolved Oxygen
E. coli	*Escherichia coliform*
EPA	Environmental Protection Agency
FC	Fecal Coliform
FIBI	Fish Index of Biotic Integrity
Fish Bio	Fish Biological Assessment
ft	Foot/Feet
GPS	Global Positioning System
Hg-F	Mercury in fish tissue
Invert Bio	Invertebrate Biological Assessment
LID	Lake Improvement District
m	Meter
mg	Milligram
MIBI	Macroinvertebrate Index of Biotic Integrity
mL	Milliliter
MPCA	Minnesota Pollution Control Agency
MPN	Most Probable Number
MU	Management Unit (aka: WMU or Water Management Unit)
NCHF	North Central Hardwood Forest
NLCD	National Land Cover Database
$NO_3 + NO_2$	Nitrate + Nitrite (inorganic nitrogen)
OP	Ortho-phosphate
PCB-F	Polychlorinated biphenyls in fish tissue
SO_4	Sulfate
SRWD	Sauk River Watershed District
SWCD	Soil and Water Conservation District
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
TSS	Total Suspended Solids
WMD	Water Management District
WPLMN	Water Pollutant Load Monitoring Network
WQS	Water Quality Standard

MONITORING PROGRAM BACKGROUND

Located in Central Minnesota encompassing dairy country and straddling the Deciduous Forest and Prairie Grassland biomes, the Sauk River watershed drains about 1,041 square miles of land to the Mississippi River. The watershed spans into five counties, accounting for 64% of Stearns County, 22% of Todd County, 9% of Douglas County, 4% of Pope County, and 1% of Meeker County. The watershed as a whole is approximately 75 miles long and 30 miles at its widest. Lake Osakis is considered the headwaters for the Sauk River, which travels 126 miles southeast from the outlet of Osakis to its confluence with the Mississippi River near the city of Sauk Rapids. Within the watershed boundary are over 250 lakes greater than 10 acres in size, 366 miles of perennial rivers and streams, and 190 miles of extensive public drainage channels and ditches. The river drops roughly 340 feet between Lake Osakis and the Mississippi River, which is an average drop of around 2.5 feet per mile. The river has been dammed at the cities of Sauk Centre, Melrose, and Cold Spring, creating flowage lakes that affect the river's flow. The flow rate is greatly reduced in these flowage lakes, and water passes through much slower than in the free-flowing portions of the Sauk River.

The Sauk River Watershed District (SRWD) resides entirely in the North Central Minnesota Hardwood Forest (NCHF) ecoregion. The NCHF is a transitional region in the state between the forested land to the north and the agricultural lands to the south. Common features on this landscape are till plains, lake basins, outwash plains, and rolling to hilly moraines. Many of these features were formed during the last glacial maximum, approximately 10,000 years ago.

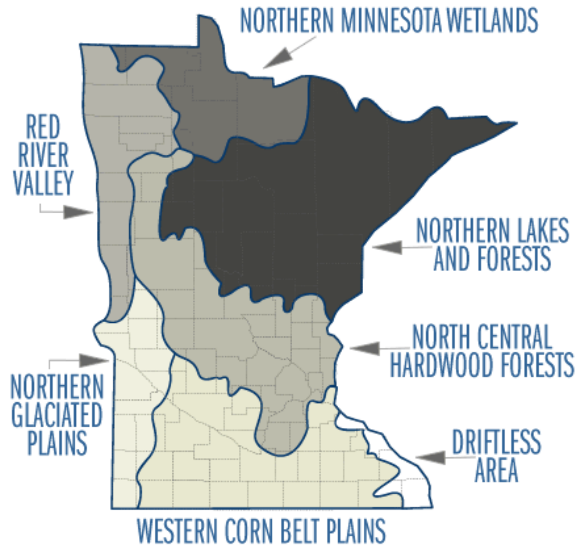
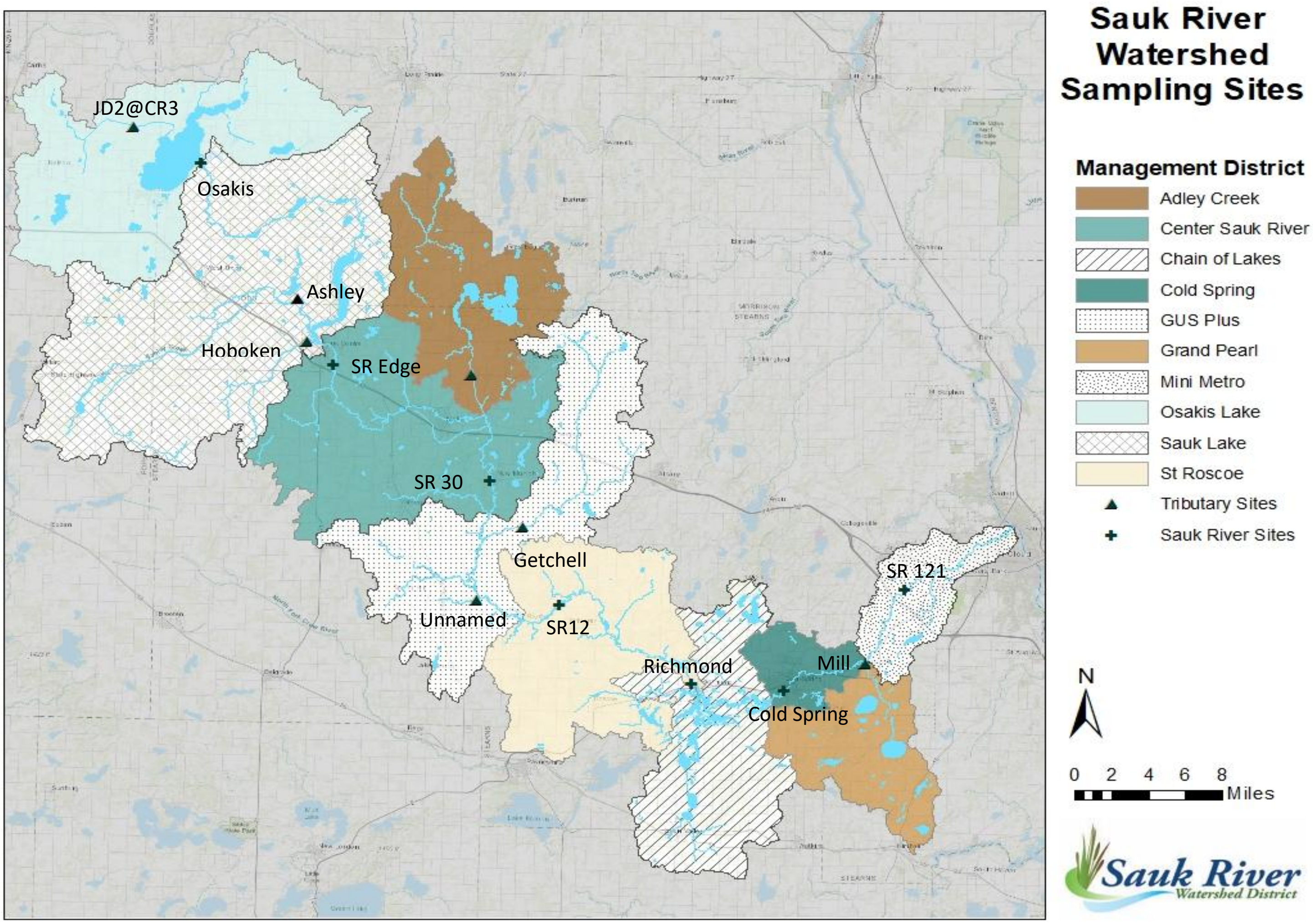


Figure 1: Minnesota Ecoregions

The SRWD has further subdivided the watershed into ten sub-watersheds called Water Management Districts (WMD; see Map 1). These WMD boundaries are used to determine areas of beneficial use for water quality improvement projects and to create a regional fee structure to fund projects. The SRWD maintains multiple monitoring sites located at the pour point, or outlet, of each management district, or as close to it as possible. Water quality monitoring samples and flow measurements are gathered at these locations to evaluate the water quality within each of the subwatersheds. Over time, some monitoring sites have been moved due to unforeseen challenges including bridge/culvert construction, backwater influence from lakes, theft, site and equipment safety, and data interference.

Monitoring all tributaries within the SRWD is not possible due to limited personnel, time, and funding. To bolster data collection, partnerships have been made with the Minnesota Pollution Control Agency (MPCA), Minnesota Department of Natural Resources (MN DNR), St. Cloud State University (SCSU), multiple local lake associations, and citizen volunteers to allow the SRWD to collect considerably more water quality samples each year than would be feasible with such few staff. Water quality data has been collected at many of the sampling sites for numerous years, and this allows the SRWD and our partners to analyze the data for long-term trends and track water quality changes over time.



Map 1: Sauk River Watershed Management Districts (WMDs)

Water Quality & Pollutants

A water quality pollutant commonly refers to a chemical or nutrient that can contaminate a waterbody and negatively affects the water use and aquatic environment. Sources of water quality pollutants are highly variable and depend on the surrounding landscape, land use practices, soil types, topography, climate, and more. Water quality standards (WQS) are numeric pollutant concentrations that, when met, describe the desired condition of a waterbody. WQS are critical regulatory tools to protect aquatic resources from the impacts of pollution. The Sauk River is considered a **Class 2** waterway, meaning the primary designated use is for aquatic habitat and recreation. The WQS in the Sauk River watershed are in line with protecting recreation and aquatic life in Central Minnesota. The federal Clean Water Act (CWA) and Minnesota Rules do provide some flexibility to the WQS in waterbodies where unique circumstances alter the typical relationship between a pollutant and the water's beneficial use. There are several waterbodies in the SRWD with alternative/site-specific rules and WQS.

Figure 2: Water cycle and sources of pollution (Source: Environmental Protection Agency)

Precipitation amounts, flow rates, and pollution concentrations vary widely, so consistent monitoring over time is key to reducing outliers in the data collection process. Short-duration, high-intensity rainstorms are common in the spring and early summer months, and these localized storms generate significant flows from runoff. This causes pollutant concentrations to reach extremes during these events.

To account for the variability in precipitation, climate, and agricultural activities, surface water monitoring sites are sampled once every two weeks from ice-out in the spring until the end of September and is done over multiple years. Flow measurements are also taken by SRWD staff to estimate a rating curve for the stream system. The rating curve allows us to calculate the pollutant load of a waterway. When water quality samples are taken, they are analyzed for pollutant concentrations in milligrams per liter (mg/L) or micrograms per liter (µg/L). Flow measurements are taken using specialized equipment that can measure the water's velocity while gathering information on the channel's cross-sectional height and depth. Flow rates are reported in cubic feet per second (cfs). One cubic foot can hold 28.3 liters of water, and so a pollutant load calculation computes as follows:

(Flow Rate in cubic feet per second) x (28.3 liters per 1 cubic foot) x (concentration of pollutant per liter) = pollutant load in milligrams per second

This pollutant load calculation can then be scaled up using water quality sample results and the channels' predicted flow (using a rating curve) to calculate pounds per month and pounds per year. These pollutant load calculations are used to estimate the amount of a pollutant present in a waterbody annually, and how much of a pollutant load reduction is needed to improve the waterbody enough to meet its WQS. These calculations and models are used to create a Total Maximum Daily Load (TMDL) report. A TMDL is a regulatory tool for federal and state agencies to address water pollution through data analysis and watershed-based implementation strategies. The implementation strategies concentrate on adaptive management processes for achieving water quality standards and restoring beneficial uses. Strategies include agricultural best management practices (BMPs), buffers and streambank stabilization, urban BMPs, septic system improvements, restoration of altered hydrology, drainage system management, and lakeshore buffers. The time period for the Sauk River Watershed TMDL study released by the MPCA in 2023 was from 2010 through 2019.

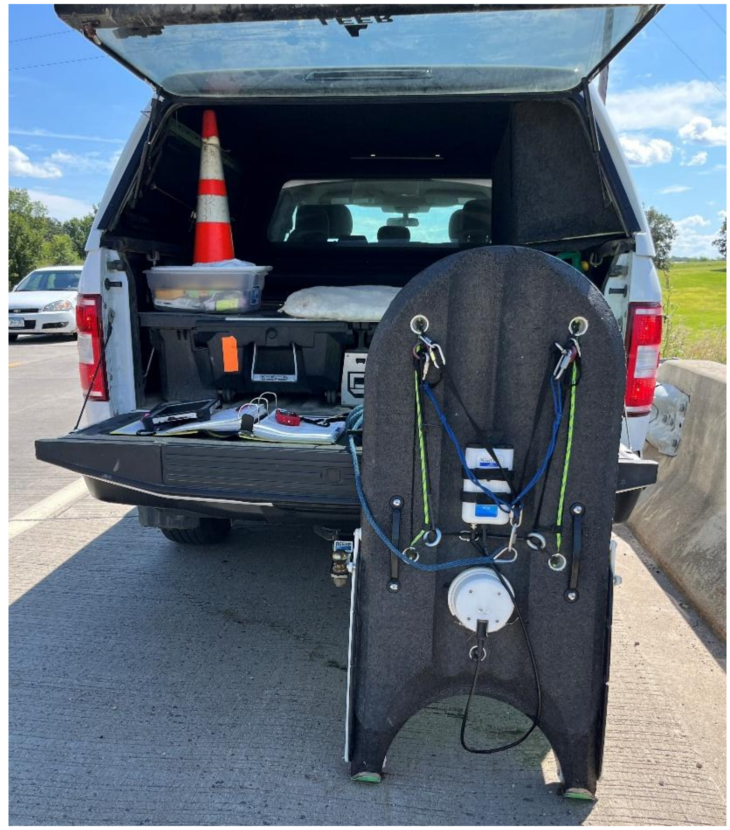


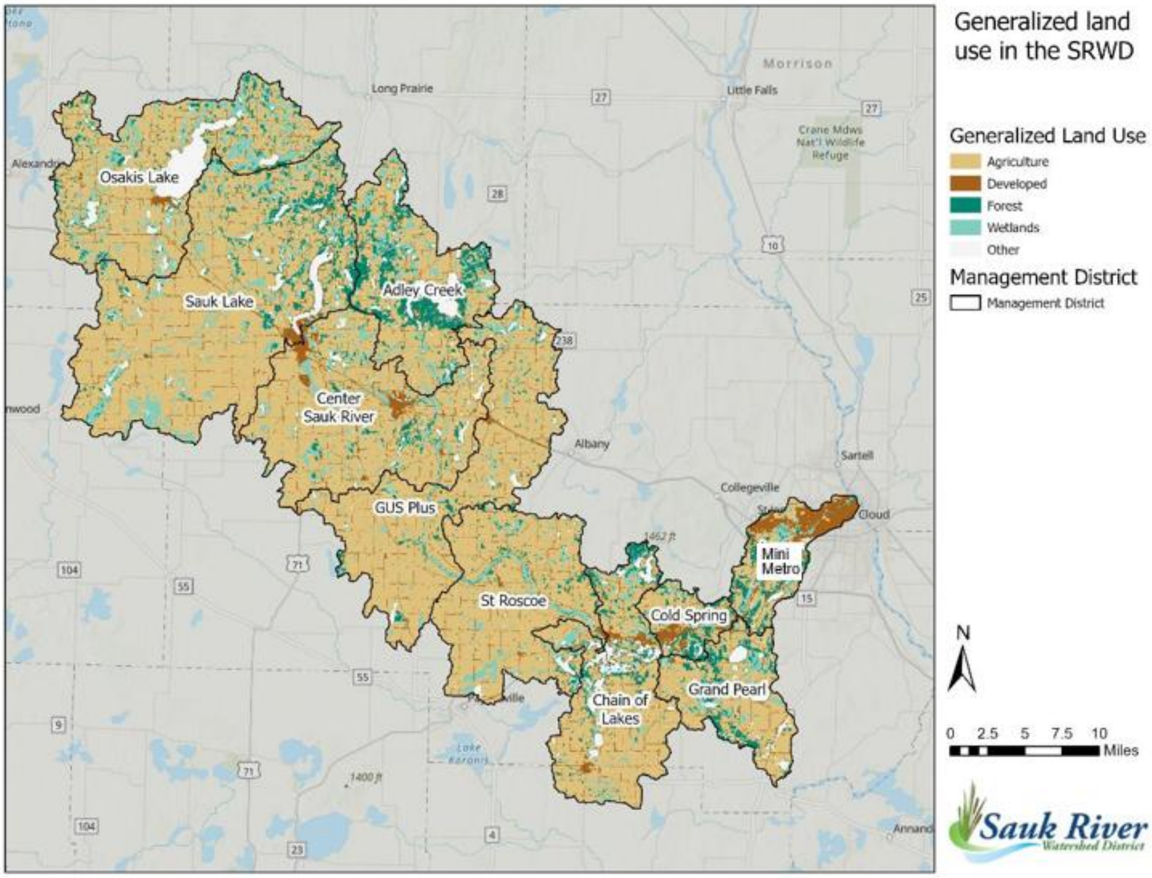
Image 1: M9 flow measurement device

WATERSHED IMPAIRMENTS

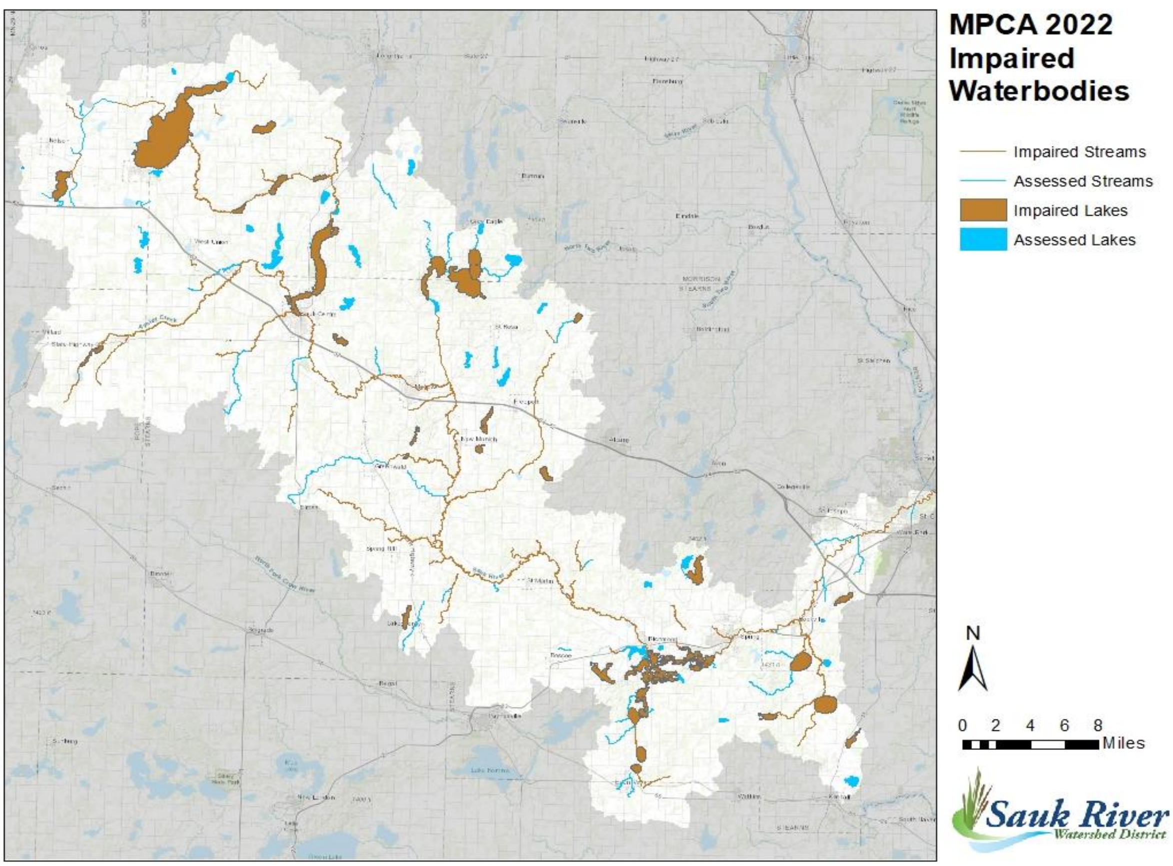
Around 50 percent of the assessed rivers and streams in the SRWD are impaired. The most common impairments are:

- Excessive nutrients (nitrogen and phosphorus)
- Low dissolved oxygen concentrations (daily flux of more than 3.5 mg/L)
- Excessive *E. coli* levels (>126/MPN)
- Poor-quality habitat for fish and aquatic insects (FIBI and MIBI studies)
- Excessive suspended solids (>30 mg/L)

The types of pollutants present on a landscape are mainly tied to the land-use designation. Land use type in the Sauk River watershed is heavily agricultural with a large percentage in row crops and pastureland (70%), further broken down into wetlands (10%), forests (8%), developed land (7%), and open water or shrubland (5%). Only a portion of identified impairments have an associated TMDL written at this time. See more on each impairment type below.



Map 2: Sauk River Watershed District generalized land use



Map 3: Sauk River Watershed impaired waterbodies

E. coli: The primary source of this bacteria in the Sauk River Watershed is from nonpoint sources. These nonpoint sources are features like pastureland and farmland runoff, direct livestock access to waterbodies, septic systems, and unauthorized pipes, ditches, and other manmade structures that connect to a drainage system. Additionally, there are approximately 1,200 feedlots within the drainage area of waterways with *E. coli* impairments, 33 of them being larger confined animal feeding operations (CAFOs).

Excessive Nutrients (phosphorus and nitrogen): Potential primary sources in the watershed includes runoff from agricultural fields, pastureland, and developed areas, along with permitted wastewater discharges, septic system releases, and phosphorus excreted by bacteria from lake sediments. Nutrients can also come from lawns care products, grass clippings, road surface particles, organic debris, eroded soil particles, pet and wildlife waste, and some atmospheric deposition. It is worth noting that the nutrient-impaired streams and lakes in the SRWD all have drainage areas that are at least 50 percent or more row crops.

Excessive Suspended Solids: The sources of suspended solids are mainly localized in each impaired region or reach. Stressor identification reporting indicates that streambank failures in impaired reaches are caused by frequent high flows, creating shear stress on the streambanks, and upstream dams that starve the channel of larger-sized rocks, gravels, and boulders. Additionally, localized regions are undergoing active erosion caused by cattle trampling the banks when allowed to directly access the waterway.

Low Dissolved Oxygen (DO): The river WQS for DO is a daily flux of no more than 3.5 mg/L and a concentration above 2 mg/L. High flux rates in the impaired reaches suggest there are high rates of photosynthesis occurring in the waterbody by aquatic plants and algae. Phosphorus is the main contributor to algae growth and can cause a negative effect on DO in streams when algae growth takes off.

Poor Quality Habitat for Fish/Aquatic Insects: Poor habitat conditions vary widely by the specific location in the watershed. The MPCA has performed studies on macroinvertebrate indices of biotic integrity (MIBI) and fish indices of biotic integrity (FIBI) in the SRWD to assess the health of these aquatic communities. Each Water Management District except Mini Metro has at least one impairment for each. Poor quality habitat can come from various sources such as perched culverts obstructing fish passage, low dissolved oxygen content, bedded sediment covering spawning and feeding areas, excessive runoff leading to hazardous flow velocities, lack of woody material for shelter and feeding, excessive nutrients, and harmful algal blooms.

Note that Table 2 on the following page includes impairments for the entire watershed, not solely the systems we currently monitor. It also does not include lake impairments.

Table 2: Impairment count by water management district (WMD)

WMD	Impaired Reach Segments	MIBI	FIBI	DO	Nutrients	TSS	*E. coli*/Fecal Coliform	Total Impairments
Osakis Lake	5	3	4	1	1	1	1	10
Sauk Lake	8	5	8	2			1	16
Adley Creek	1		1				1	2
Centre Sauk	7	5	7				1	13
GUS Plus	10	6	5	3		2	7	23
St. Roscoe	5	3	3				1	7
Chain of Lakes	6	2	2	3			2	9
Cold Spring	4	1	1		1		2	5
Grand Pearl	3	1	1				3	5
Mini Metro	1				1			1
Total	**50**	**26**	**32**	**9**	**3**	**3**	**19**	**90**

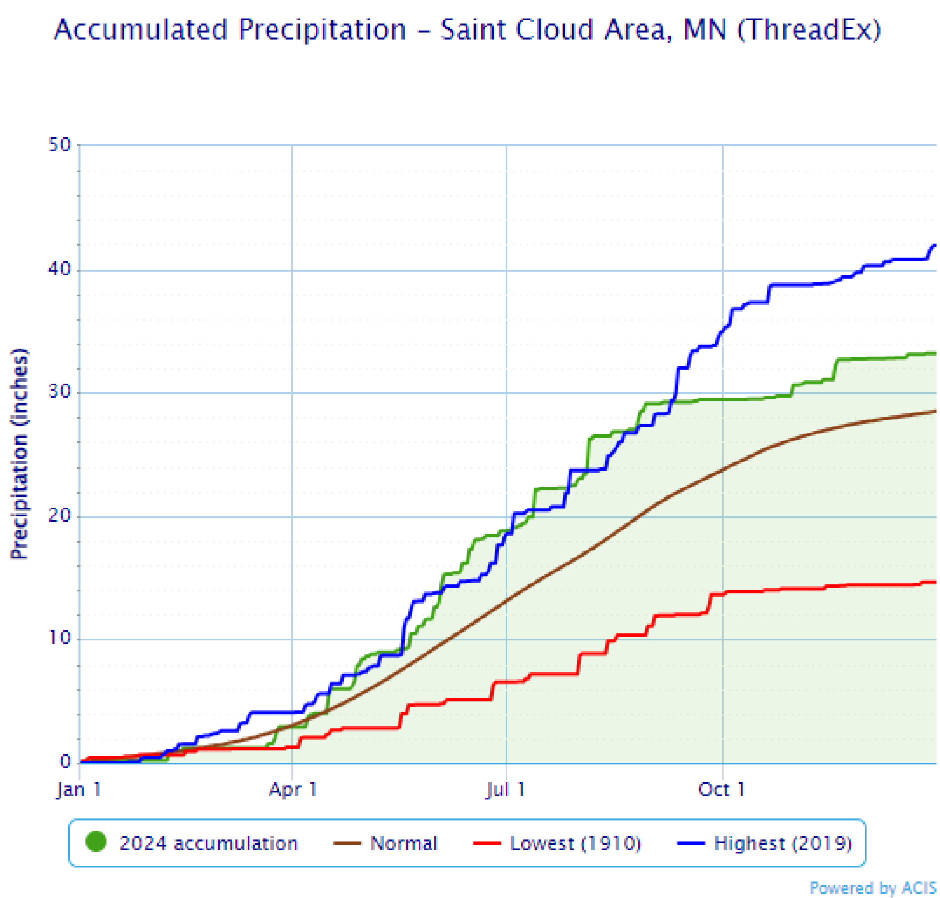
Table 3: Impairment types for 2024 river and tributary monitoring sites (Sauk River mainstem sites bolded)

Location Name	EQuIS Site ID	Management District	Impairment(s)
JD2 @CR3	S006-568	Osakis Lake	TSS, Fish Bio, Invert Bio, DO, Nutrients, *E. coli*
Osakis Outlet (Headwaters to Guernsey Lk)	S002-649	Sauk Lake	Mercury in fish tissue
Hoboken Creek	S014-892	Sauk Lake	Fish Bio
Ashely 11	S004-625	Sauk Lake	Fish Bio, Invert Bio, *E. coli*, DO
Sauk River's Edge (Sauk Lk to Melrose Dam)	S000-373	Centre Sauk	Fish Bio, Invert Bio, Mercury in fish tissue
SR 30 (Sauk River; Adley Cr to Getchell Cr)	S000-366	Centre Sauk	Fish Bio, Invert Bio, Mercury in fish tissue, *E. coli*
Getchell Creek	S003-289	GUS Plus	Fish Bio, Invert Bio, DO, *E. coli*
Unnamed Creek	S000-950	GUS Plus	TSS, *E. coli*
SR 12 (Sauk River; Getchell Cr to State Hwy 23)	S000-702	St. Roscoe	Mercury in fish tissue, *E. coli*
Richmond (Sauk River; Getchell Cr to State Hwy 23)	S000-517	St. Roscoe	Mercury in fish tissue, *E. coli*
Cold Spring (Sauk River; Knaus Lk to Cold Spring Dam)	S003-286	Cold Spring	Mercury in fish tissue, Nutrients
Mill Creek	S000-444	Grand Pearl	Fish Bio, Invert Bio, E. coli, Fecal coliform
SR 121 (Sauk River; Mill Cr to Mississippi R)	S000-360	Mini Metro	Mercury in fish tissue, Nutrients, PCB-F

2024 WEATHER & PRECIPITATION

The 2024 monitoring year was one of highs and lows. We were coming out of prolonged drought conditions and a winter that was not really a winter at all. The Minnesota State Climatology Office dubbed it "The Lost Winter of '23-'24." Winter was marked with warmth and a lack of snow and ice coverage on lakes. The December – February meteorological winter became the warmest on record at all historical stations except Duluth, and the warmest on a statewide-average basis, shattering the previous record from 1997-98 by 2.2 °F. A proper snowstorm finally came at the end of March and doubled some seasonal snowfall totals, since most areas in the state had experienced less than 50 percent of their normal snowfall up to February. 2024 was also hit with heavy rainfall amounts. According to the St. Cloud Regional Airport daily precipitation monitoring site, the total accumulated precipitation in 2024 was *4.7 inches higher* than the daily accumulated normal for that site. Then, making a complete 180 with warmer-than-average fall temperatures and little rainfall in September and October, drought conditions returned in fall of 2024.

Summarized in the graph below is accumulated precipitation for 2024 (green line) compared to the "normal"/expected amount for the region (brown line). The year started off below "normal," but quickly began to surpass these amounts once spring rains came and continued throughout the summer.



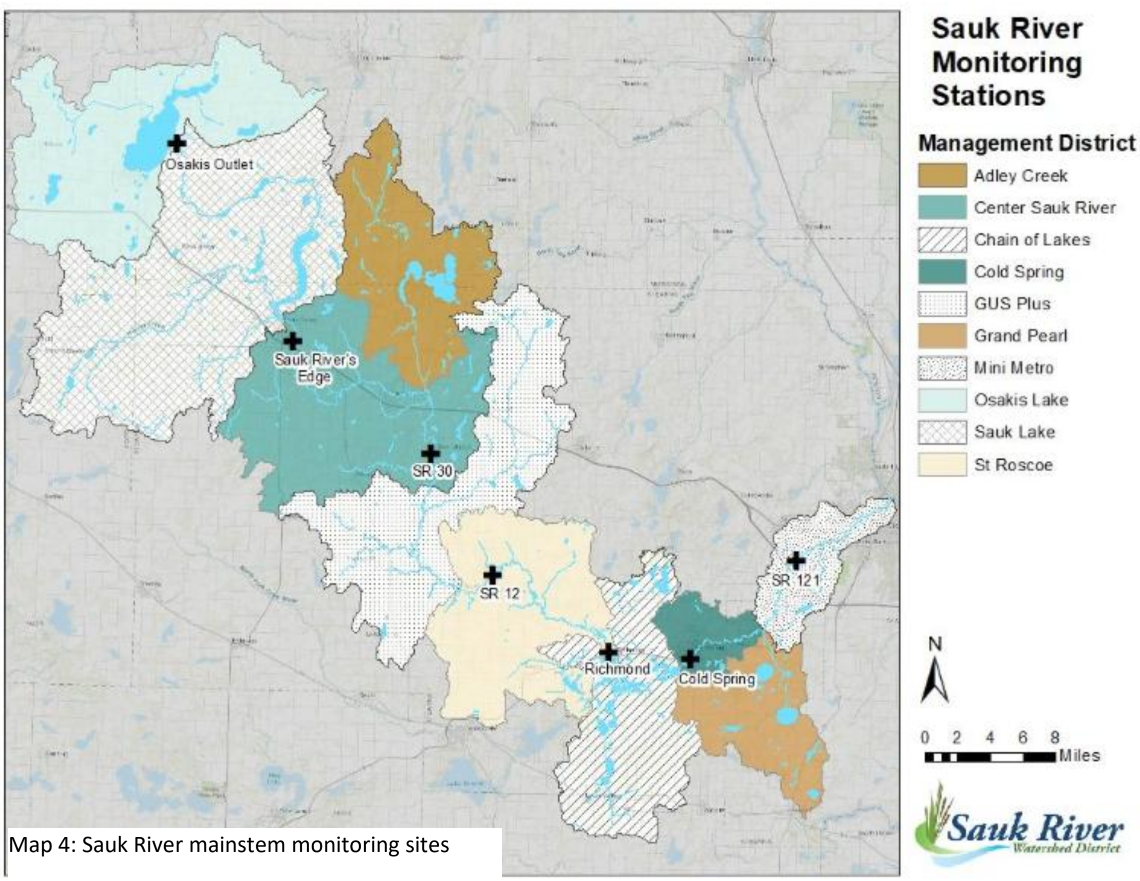
Graph 1: Annual accumulated precipitation at St. Cloud Regional Airport (Source: National Oceanic and Atmospheric Administration)

SAUK RIVER MAINSTEM

River sampling sites are broken up into mainstem and tributary sites. The SRWD monitors and samples seven mainstem sites once every two weeks. Additional monitoring activities include taking flow, also known as discharge, measurements about once a month. This is the case for all sites except for SR 12, which is a joint site with the MPCA and DNR, who take care of all flow data collection and management. The seven sites are listed below:

Osakis Outlet (Osakis — *headwaters*)
Sauk River's Edge (Sauk Centre, CR 186)
SR 30 (New Munich, CR 30)
SR 12 (St. Martin, CR 12)
Richmond (CR 111)
Cold Spring (CR 2/Red River Road)
SR 121 (St. Joseph, CR 121)

These names will be used throughout this report to refer to these specific sampling locations in the watershed. The map below shows the mainstem monitoring sites along with the 10 management districts designated by the SRWD. These management districts are used to determine benefit and priority areas for water quality improvement projects. Tributary monitoring will be discussed in a later section.



Map 4: Sauk River mainstem monitoring sites

The table below contains the annual average concentrations for each 2024 mainstem monitoring site, along with the flow count and number of sample visits. Values that are underlined and bolded indicate averages that exceed the state WQS. In 2024, as in most years, total phosphorus (TP) concentrations exceeded or were close to exceeding the WQS at many of the SRWD monitoring sites. For reference, a table of water quality parameters and the associated WQS set by the MPCA is also included. An explanation of each sampling parameter and what it indicates can be found in the glossary.

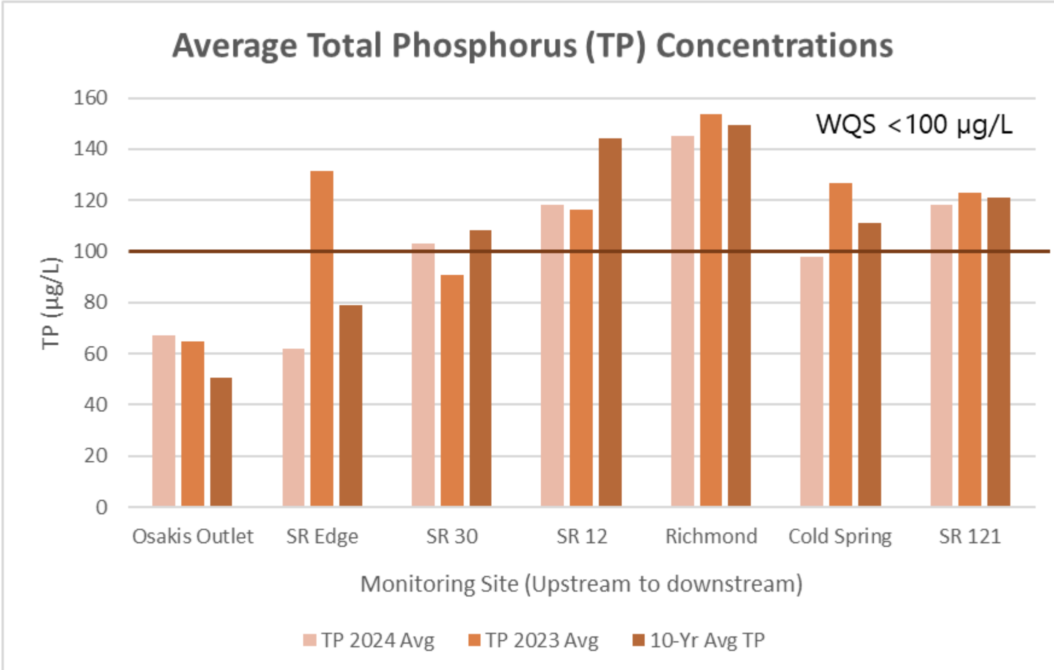
Table 4: Annual averages for 2024 mainstem monitoring sites

2024 Monitoring Sites	Total Phosphorus (µg/L)	Ortho-phophate (µg/L)	% OP:TP	Total Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Total Suspended Solids (mg/L)	Specific Conductivity (µS/cm)	Chloride (mg/L)	Hardness (CaCO3)	Transparency Tube (cm)	DO (mg/L)	Temp (°F)	Flow Count	Sample Visits
Osakis Outlet	67	34	*51*	1.008	0.417	7.7	391.0	16.9	177	94.38	10.46	60.4	4	13
SR Edge	62	20	*32*	1.074	1.925	8.0	533.2	18.0	239	82.23	9.37	64.8	7	14
SR 30	**<u>103</u>**	62	*60*	0.990	2.007	7.1	572.6	42.2	274	92	8.63	62.7	7	14
SR 12	**<u>142</u>**	98	*69*	1.695	3.038	8.7	600.8	28.8	286	76.14	8.26	62.5	N/A	14
Richmond	**<u>145</u>**	108	*74*	1.050	2.761	4.5	623.8	30.8	314	92.93	7.08	62.2	9	14
Cold Spring	98	70	*71*	1.045	1.501	3.2	572.7	28.8	264	96.21	9.04	65.0	8	14
SR 121	**<u>118</u>**	78	*66*	0.927	1.421	5.2	586.3	33.0	268	99.71	7.54	64.9	9	14

Eutrophication standards for class 2B rivers and streams.

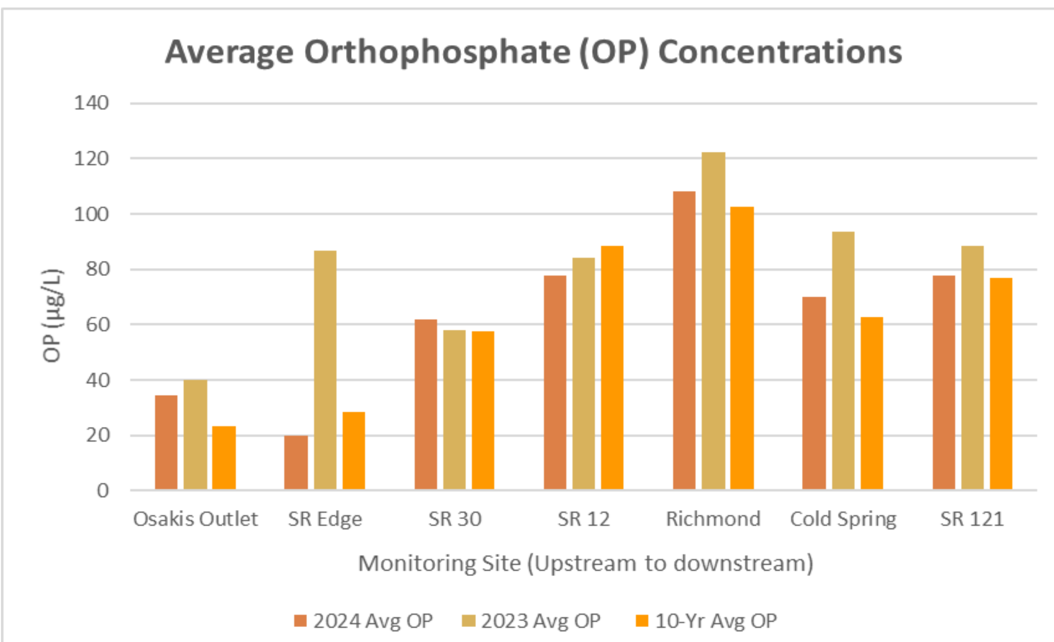
Substance	Units	Chronic Standard
Total Suspended Solids	mg/L	less than or equal to 30
Phosphorus, total	µg/L	less than or equal to 100
Chlorophyll-a (seston)	µg/L	less than or equal to 18
Diel dissolved oxygen flux	mg/L	less than or equal to 3.5
Biochemical oxygen demand (BOD5)	mg/L	less than or equal to 2.0
T-tube	cm	greater than or equal to 20.
pH	unit-less	Range of 6 to 9
Temperature	C	30 C as a daily maximum
Dissolved Oxygen	mg/L	7.0 mg/L as a daily minimum.

The following graphs break down the annual average concentrations of specific parameters for each mainstem site, listed left to right in order of upstream to downstream. 2024 averages are compared to 2023 averages and the 10-year average. The sites are ordered this way because average nutrient concentrations typically increase as you travel further downstream, but significantly decrease once reaching the Cold Spring site. This is especially apparent for TP and ortho-phosphate (OP) concentrations. There are three dams along the Sauk River, one of them being in Cold Spring which helped to form the Sauk River Chain of Lakes system. The other two dams are located in Melrose (upstream of the SR 30 site) and Sauk Centre (upstream of the SR Edge site). When flowing water reaches a reservoir that is backed up by a dam, it slows down significantly, and debris and nutrients in the flow will sink down to the bottom sediment. This helps to explain the drop in concentrations once water reaches the Cold Spring site. See the graphs and discussion on the next page for annual average concentrations for TP and OP.



Graph 2: Mainstem TP annual averages

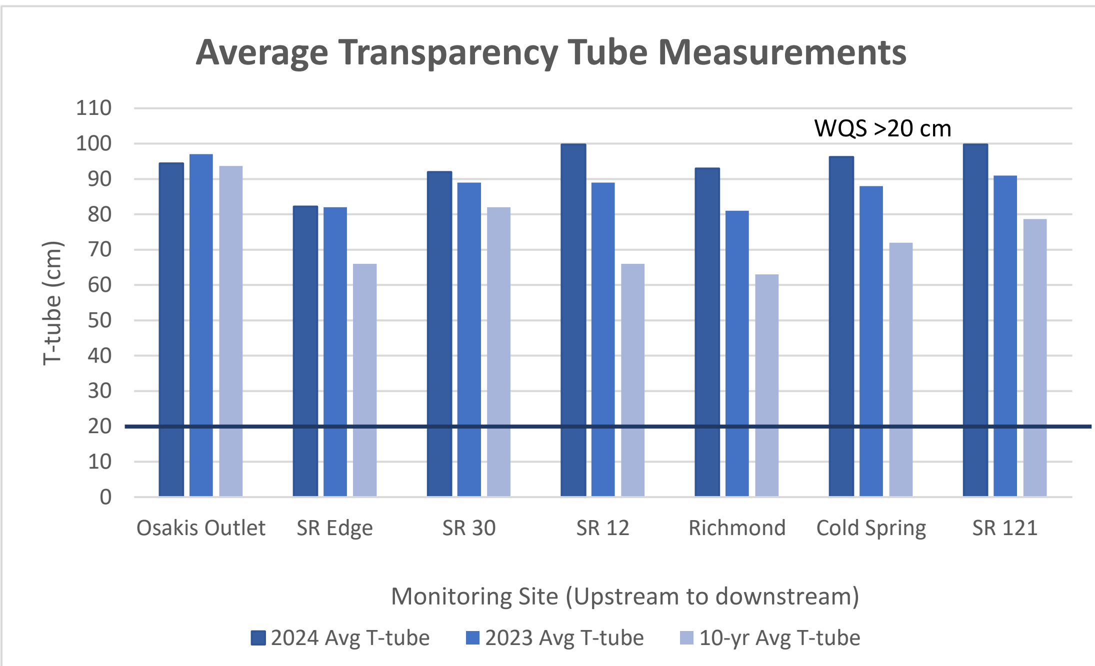
Annual TP concentrations in 2024 were all below the 10-year average, except for Osakis Outlet, and were below the 2023 average for 4 sites. However, 2024 averages were above the WQS of <100 µg/L for 4 sites (SR30, SR12, Richmond, and SR121). There was a significant drop from the 2023 average at SR Edge.



Graph 3: Mainstem OP annual averages

For OP, 2024 averages were slightly higher than the 10-year average for 5 sites. All 2024 averages were below the 2023 average except for SR30. Again, there was a notable drop from the 2023 average at SR Edge. There is no state WQS for OP. The decrease in averages is in line with what was reported in the **"Watershed Assessment and Trends Update**," published by the MPCA in 2021. This report offers a data assessment to help direct future watershed funding and on-the-ground work. Once every 10 years, the MPCA works with local partners such as watershed districts and the Minnesota DNR to conduct intensive monitoring on the lakes and streams in a watershed on a rotational basis. This intensive monitoring includes fish and macroinvertebrate studies, along with water chemistry, to evaluate water quality. The MPCA was in the Sauk River watershed to do intensive monitoring in 2008 and 2018. Overall, data analysis found that MIBI scores improved, there was improving clarity in 14 lakes, phosphorus levels have *decreased* significantly over the past 20 years, and nitrate levels have *increased* significantly over the past 20 years. Continued problems include higher than desired phosphorus (despite some improvement), bacteria levels, and low dissolved oxygen levels.

Transparency Tube (Water Clarity)

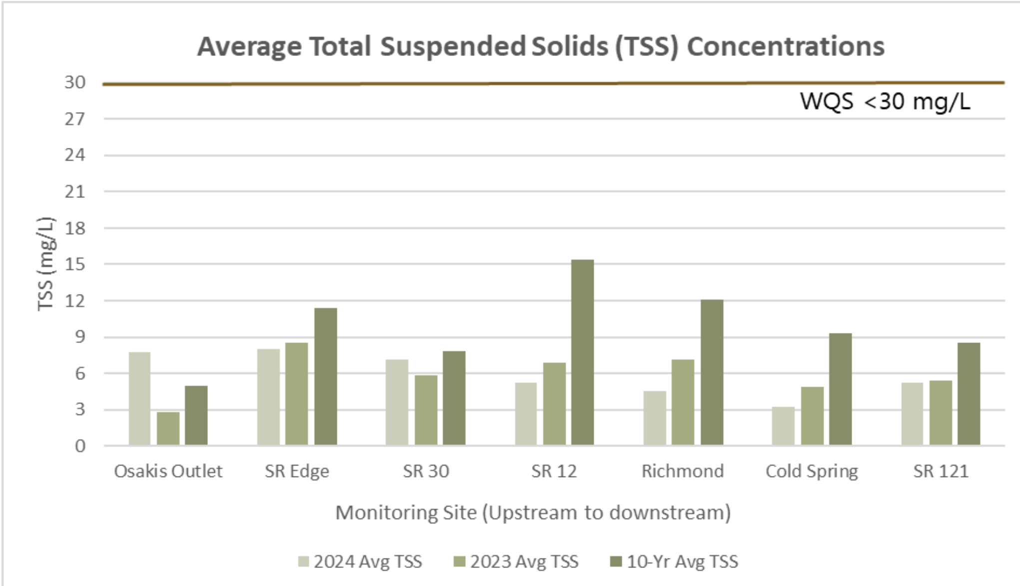


Graph 4: Mainstem transparency tube annual averages

A transparency measurement represents stream water clarity, or how cloudy the water is, and acts as a basic indicator of water quality. This is done by using a transparency tube (T-tube), which is a clear, plastic 1-meter tube that is filled with water from the waterbody to create a vertical column of water. The person taking the measurement then looks down through the T-tube from above to determine the depth/distance at which the smaller Secchi disk attached to a string can be seen. They slowly pull up on the string until the Secchi disk can be seen, then take note of the depth at which the Secchi disk lies.

Graph 4 above reveals that all 2024 averages were above 2023 averages except for Osakis Outlet. 2024 averages are also above the 10-year average. Keep in mind that higher numbers are desirable for this parameter since a higher result means the water clarity is better. All averages are also well above the WQS of >20 cm. The Sauk River mainstem continues to have encouraging transparency measurements.

Total Suspended Solids (TSS)



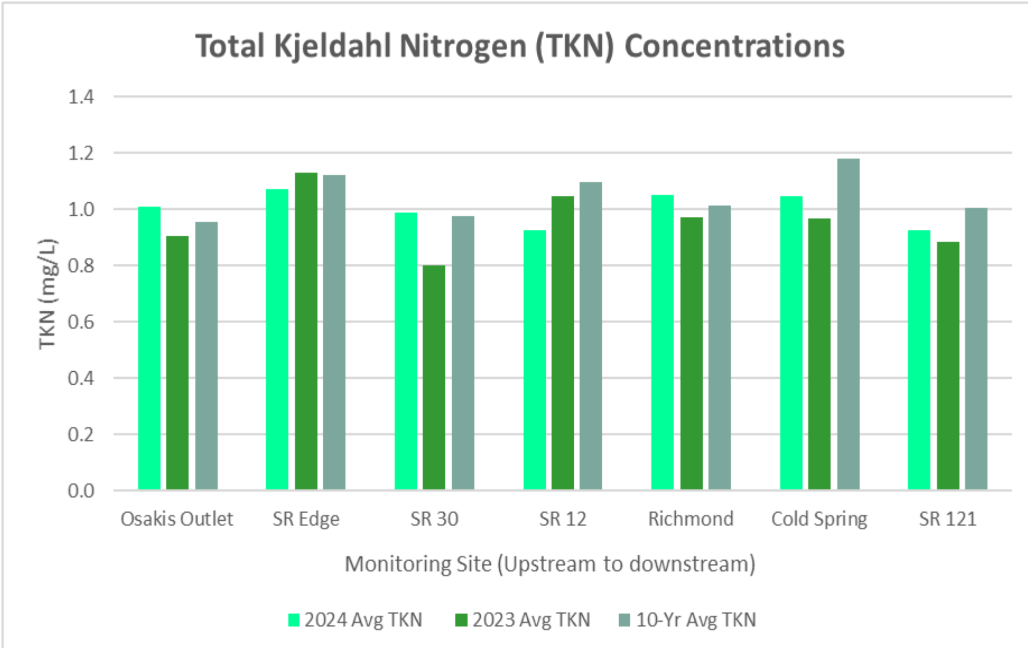
Graph 5: Mainstem TSS annual averages

For TSS, all 2024 averages were below the 10-year average except for Osakis Outlet. The majority of sites were also below the 2023 averages. The most significant change was the increase experienced at Osakis Outlet. This is most likely because both 2022 and 2023 were low-flow years, and not much runoff entered Lake Osakis. TSS remained below 8 mg/L for all of 2023, and flow coming over the weir structure at the outlet was down to a trickle by the beginning of September. In contrast, 2024 was a wet summer, so more runoff was entering the system. An outlier TSS result of 64.8 mg/L was collected in April, which greatly skewed the average to be much higher.

Overall, each average along the mainstem is well below the WQS of <30 mg/L. Exceedances of the standard are rare and mostly found during spring runoff samples or after a rainfall event of more than 2 inches. However, even if TSS data suggests that the watershed is generally meeting the WQS, MIBI and FIBI studies reveal that suspended sediment is still impacting aquatic life in the river. Larger boulders and cobbles are necessary for many fish and macroinvertebrate species for nesting and resting. These larger substrates are typically missing downstream of dams. Bank failure is also more common downstream of dams due to incised channels that confine flow, along with increased water depth and shear force. The sediment created by bank downcutting may not be suspended long enough to trigger a TSS impairment, but it still degrades the habitat quality.

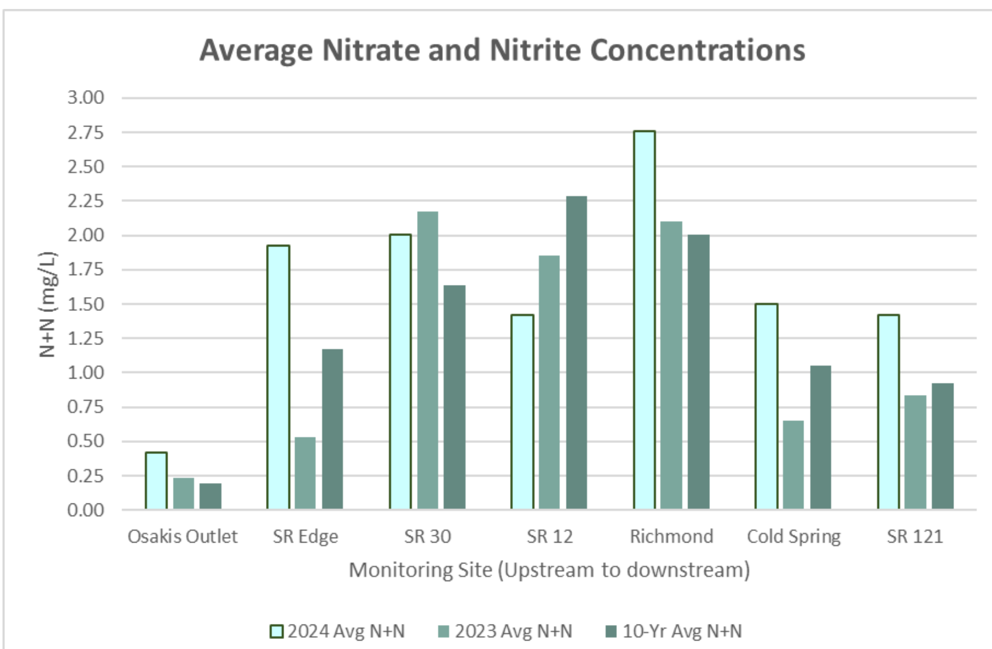
Total Kjeldahl Nitrogen (TKN)

Nitrogen levels in the watershed are evaluated by sampling two forms of nitrogen, total Kjeldahl nitrogen (TKN) and nitrate + nitrite (N+N). TKN is made up of organic nitrogen and ammonia. High levels of TKN often indicate the presence of animal waste and can lead to abundant plant growth. This in turn can have adverse effects on aquatic ecosystems, plants, invertebrates, fish, and humans. N+N are inorganic forms of nitrogen, with nitrates in particular being an essential plant nutrient. Sources of nitrates include wastewater plants, runoff from fertilized lawns and cropland, failing septic systems, runoff from manure storage areas, and industrial discharges that contain corrosion inhibitors. Excessive nitrates can become toxic to warm-blooded animals at concentrations around 10 mg/L. The natural level of nitrogen in surface water is typically less than 1 mg/L.



Graph 6: Mainstem TKN annual averages

Unlike with TP and OP, there is no clear pattern that emerges for TKN concentrations in the mainstem. Average results in 2024 were generally close to the 10-year average, but slightly higher than 2023 averages for most sites. Even so, each average falls below 1.2 mg/L. This is relevant because the average TKN concentration for the NCHF ecoregion is 0.6-1.2 mg/L.



Graph 7: Mainstem N+N annual averages

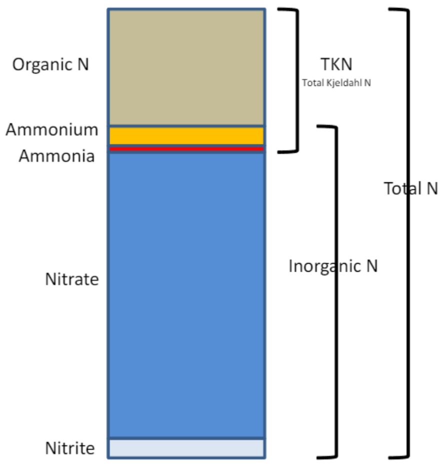


Figure 3: breakdown of forms of nitrogen

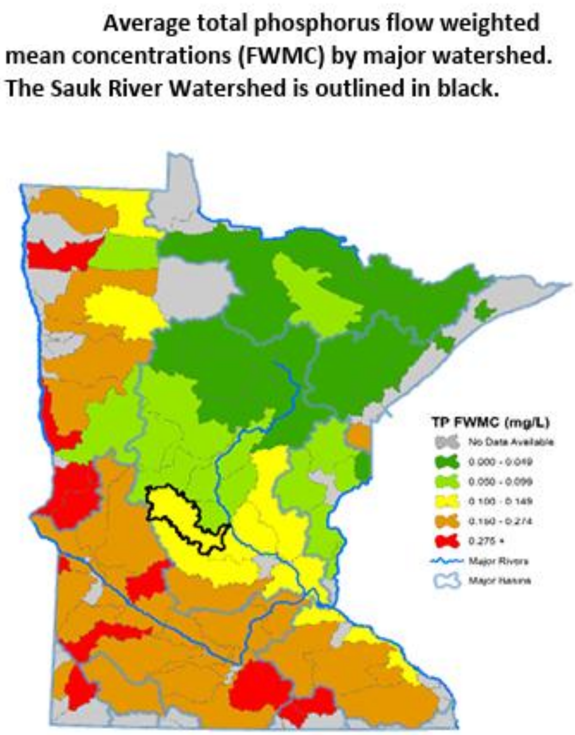
N+N concentrations in 2024 did jump significantly at many sites, with the highest average being observed at the Richmond site, coming in at 2.76 mg/L. Each site's 2024 average was higher than the 10-year average except for SR12. To give some context, there is no state WQS that applies to surface waters for TKN and N+N, but there is an Environmental Protection Agency (EPA) drinking water standard of<10 mg/L. While all 2024 samples from the mainstem were well below this threshold, this is a parameter we will continue to closely monitor since there appears to be an increasing trend in nitrogen levels throughout the watershed. This will be discussed further in the tributaries section of this report. The trend of increasing N+N levels is common across MN watersheds.

To help explain why many 2024 averages were considerably higher than in previous years, annual weather conditions must be considered. Nitrates can enter surface waters either from overland runoff or groundwater flow feeding surface waters. Due to intense drought conditions experienced regionally in 2022 and 2023, there were low flows and very little runoff across the watershed, which led to depleted groundwater levels. Nitrates that had been applied to the soil during the drought years stayed locked within the root zone and did not have a chance to migrate and leach into groundwater. In other words, they remained in the upper soil layer. Since the nitrogen did not have as much opportunity to reach the river, concentrations remained low. Then came the rain in 2024. The excessive rainfall saturated the ground, increased groundwater levels, and restored groundwater flow, which allowed the nitrates that had accumulated in the upper soil layers to begin migrating. The accumulation of nitrogen in the soil from the past two growing seasons, at least, was able to begin moving in groundwater flow again. This increased surface water runoff and groundwater connectivity, allowing the nutrients to once again reach the river. This phenomenon is reflected in the observed 2024 N+N concentrations in the Sauk River. The tributaries to the Sauk River showed even higher levels of N+N, as will be explained later in this report.

Flow-Weighted Mean Concentration (FWMC)

While concentrations of sampled parameters averaged over a full year does offer an acceptable analysis of waterbody conditions, there are more comprehensive methods that paint a more accurate picture. One of those methods is calculating the flow-weighted mean concentration (FWMC) of a certain parameter for a monitoring site. The FWMC for a site is a calculation that best summarizes the overall quality of all the water passing one point on a river over a certain period of time. It is computed by dividing the pollutant load by volume of water that has flowed past the monitoring location over the calculation period. This allows for a consistent comparison of water quality by taking both the pollutant loads and volume of water into account, making it more practical to compare wet years to dry years.

Also included in the "2021 Watershed Assessment and Trends Update" report are the figures on the following page that compare FWMC levels for the Sauk River watershed to the rest of the major watersheds in the state (Figure 4). This data is provided by the Watershed Pollutant Load Monitoring Network (WPLMN) through the MPCA. The WPLMN has two monitoring locations in the Sauk River watershed, the first located north of St. Martin where the SRWD's SR 12 site is, meaning it is a joint site between the District and the MPCA. The downstream location is near Sauk Rapids at the confluence (outlet) with the Mississippi River and has been operating each year since 2007. Water quality samples are collected at the St. Martin site by WPLMN staff from snowmelt through October 31 annually, and at the outlet location throughout the year.



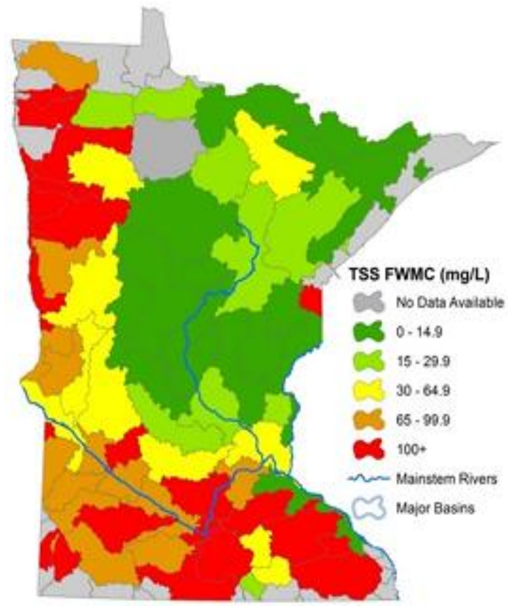


Figure 4: Statewide average FWMC for TP and TSS

The graphic on the left displays the FWMC for total phosphorus by major watersheds in Minnesota. The Sauk River watershed falls in the yellow range for TP, which is a concentration of 0.1 – 0.149 mg/L on average. The graphic on the right shows total suspended solids FWMC averages for the state, with the watershed falling in the dark green category, or ranging from 0 – 14.9 mg/L. According to the watershed assessment and trends report, TSS and TP concentrations in the watershed often become elevated immediately following heavy rain events, but those conditions are short-lived and rapidly decrease.

TRIBUTARIES

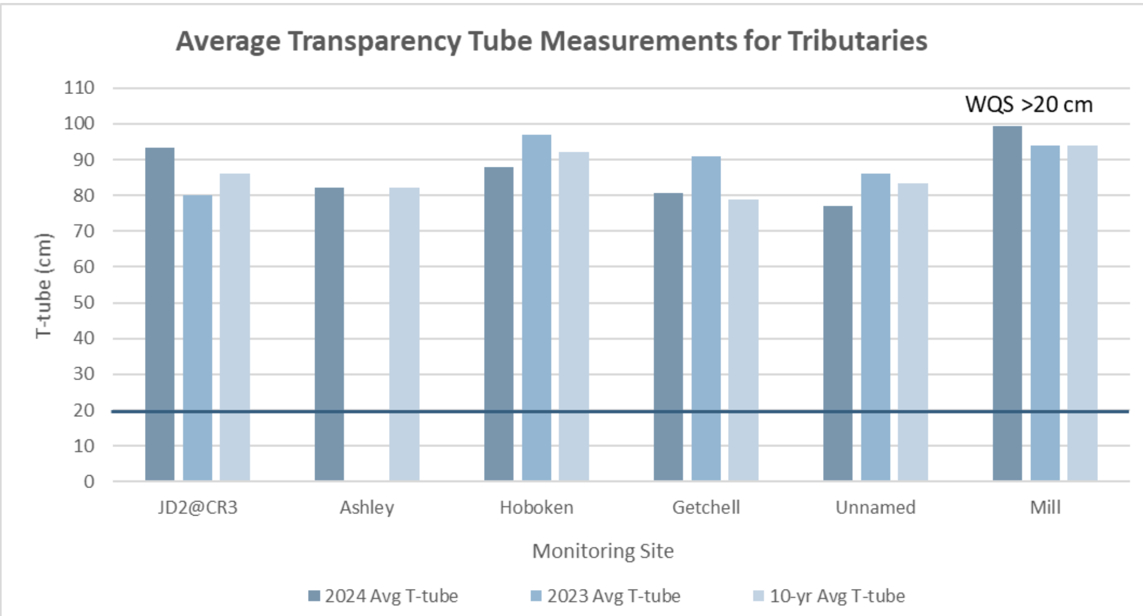
Routine monitoring is done on six tributaries to the Sauk River. With some exceptions due to limited staff time and high flows, samples were collected once every two weeks, and flow measurements were completed regularly with a target of at least once per month. The six sites are listed below:

Judicial Ditch #2 (also called Crooked Lake Ditch, outlets into Lake Osakis)
Ashley Creek (north of Sauk Centre)
Hoboken Creek (Sauk Centre)
Getchell Creek/CD #26 (south of New Munich)
Unnamed Creek (east of Spring Hill)
Mill Creek (Rockville)

Table 5 on the following page summarizes the annual average concentrations for the tributary sites in 2024. Values that are underlined and bolded indicate that the average exceeds the state WQS. The red cells indicate a concerning average concentration, but not an exceedance because there is no WQS for nitrates.

Table 5: Annual averages for 2024 tributary monitoring sites

2024 Monitoring Sites	Total Phosphorus (µg/L)	Ortho-phophate (µg/L)	% OP:TP	Total Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Total Suspended Solids (mg/L)	Specific Conductivity (µS/cm)	Chloride (mg/L)	Hardness (CaCO3)	Transparency Tube (cm)	DO (mg/L)	Temp (°F)	Flow Count	Sample Visits
JD2@CR3	**115**	78	*68*	1.424	1.471	4.7	615.1	12.9	336	93.44	8.11	57.2	17	17
Ashley Creek	**123**	81	*66*	1.140	3.418	11.4	641.8	21.1	359	82.25	8.32	57.0	4	14
Hoboken Creek	**114**	93	*82*	0.821	12.720	5.9	817.1	33.1	411	88	10.28	55.9	6	14
Getchell Creek	**277**	217	*78*	1.698	3.316	7.6	676.2	21.6	325	80.5	8.42	61.8	6	14
Unnamed Creek	**202**	144	*71*	0.862	10.143	16.7	763.4	21.2	423	77.13	9.18	61.0	5	8
Mill Creek	51	31	*60*	0.670	0.400	3.6	463.8	21.5	257	99.43	9.06	59.5	7	14

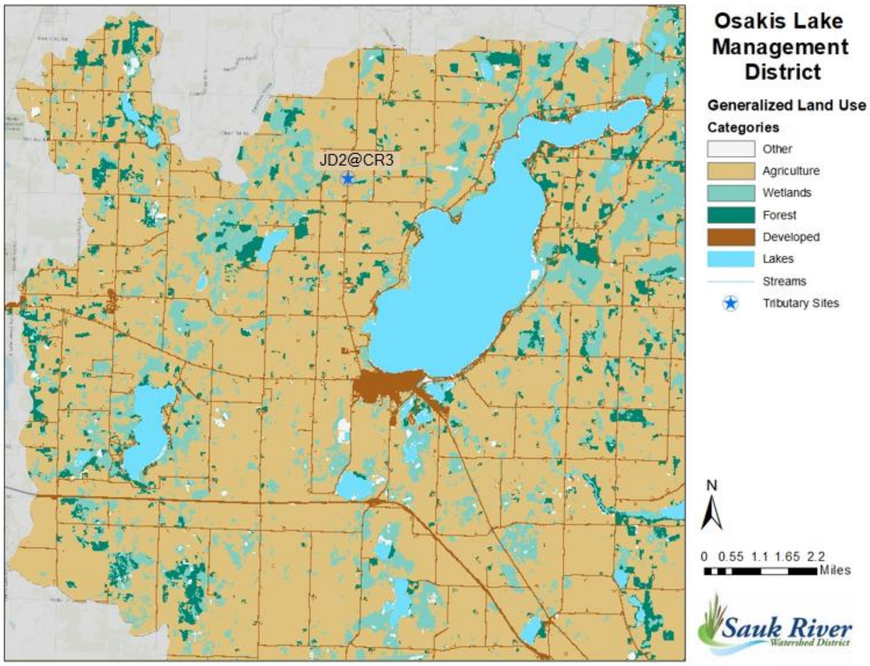


Graph 8: Tributary transparency tube annual averages (note: Ashley 11 was not monitored in 2023)

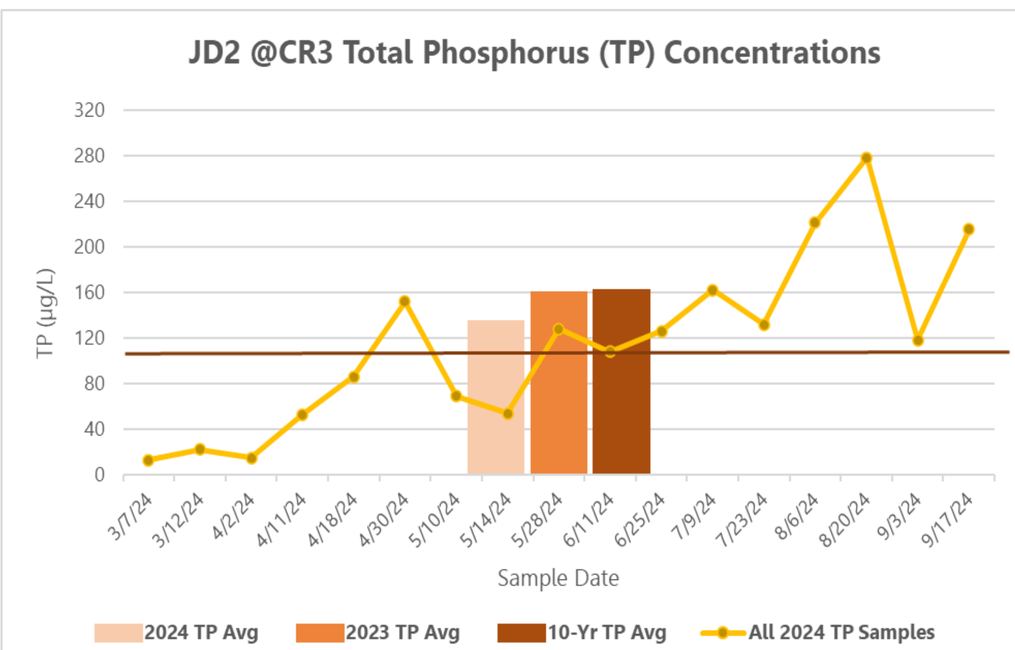
Judicial Ditch #2 (JD2 @CR3)

Image 2: JD2 @CR3 on 6.5.2024

Routine water quality monitoring for JD2 takes place at the ditch crossing of County Road 3 near Osakis. This monitoring site was originally established to collect water quality data within the Crooked Lake Basin area and help create a capital improvement project in the area. The SRWD now continuously monitors the site since the JD2 drainage area (~38,000 acres) makes up 47 percent of Lake Osakis's entire watershed. The monitoring site is the most northern site in the watershed, and the drainage area is dominated by agricultural land (74 percent). JD2 @CR3 is roughly three stream-miles upstream from Lake Osakis and two stream-miles upstream from the SRWD sediment retention pond project. This monitoring site captures the majority of the ditch's drainage area before the landscape becomes too flat and marshy for quality flow measurements to be taken. Since taking accurate flow measurements here has proven difficult due to dense vegetation and its flashy nature, SRWD staff took flow measurements at JD2 on a weekly basis in 2024 once plant growth in the channel began, which evidently was present most of the year.

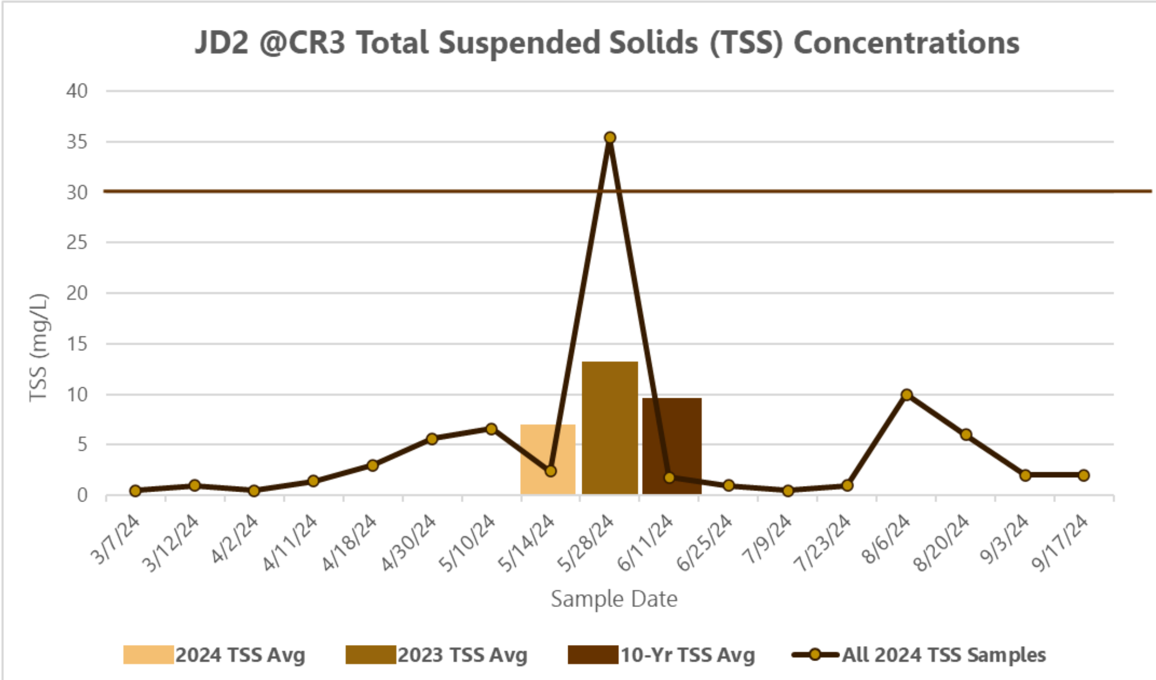


Map 5: Osakis Lake WMD land use and JD2 monitoring site



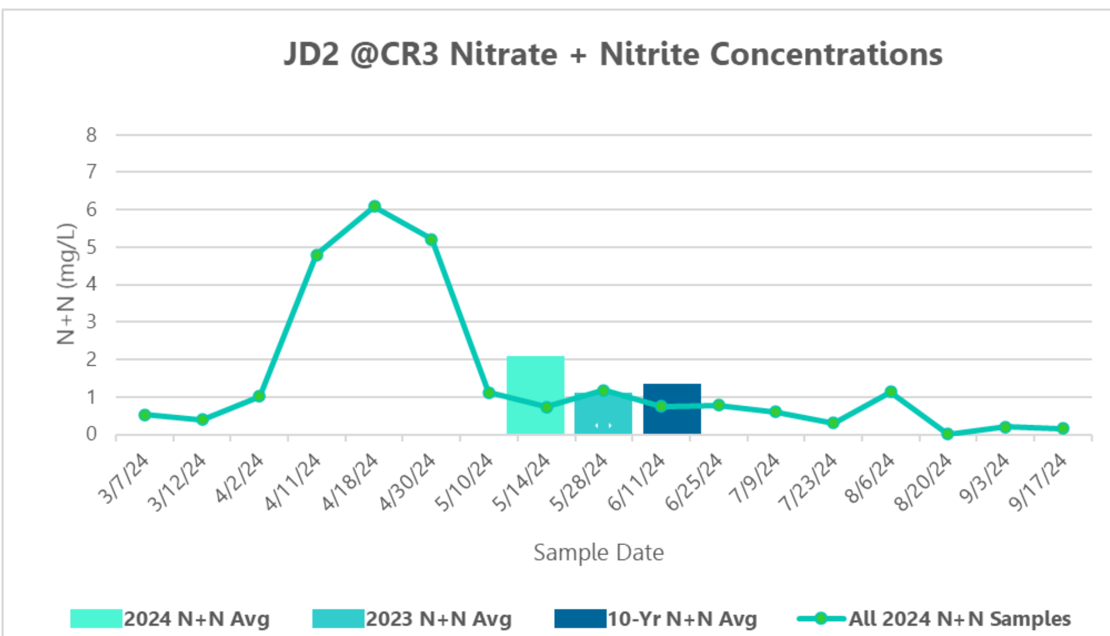
Graph 9: JD2 TP annual averages

The graph to the left compares annual average TP results at JD2 for 2024, 2023, and the 10-year average, which is displayed by the vertical bar graphs. It also includes each individual sample result taken in 2024, indicated by the yellow line graph. The dates along the bottom only correlate with the line graph. The annual average for TP in 2024 came in at 115 µg/L, only slightly above the WQS of <100 µg/L. That concentration is a drop from the 2023 and 10-year average. The peaks in sampling concentrations correlate with heavy rain events, meaning more runoff was entering the system.



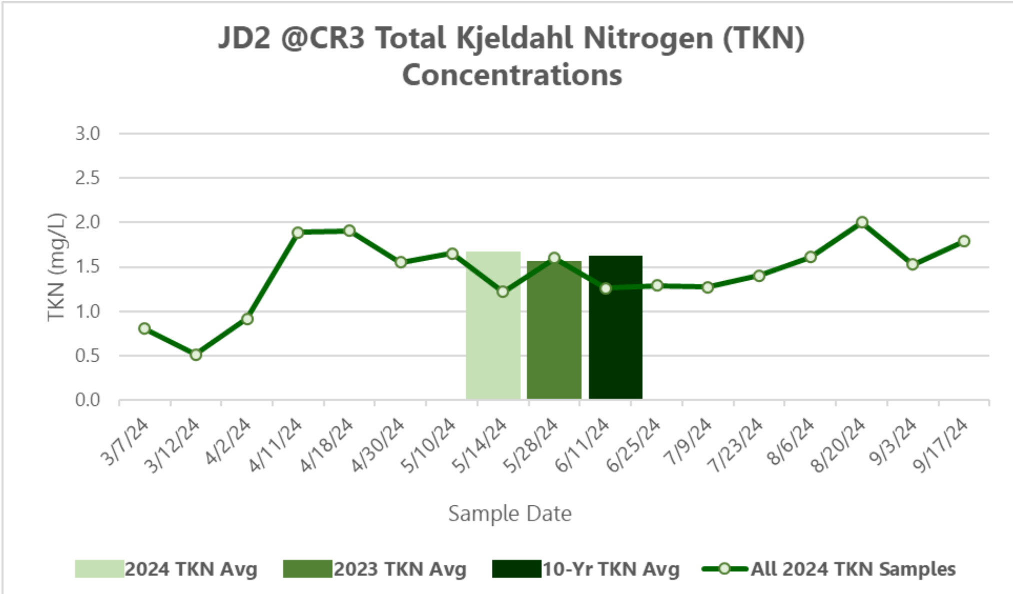
Graph 10: JD2 TSS annual averages

As with the results for the mainstem, TSS concentrations at JD2 remained low with only one sample exceeding the WQS of <30 mg/L. The 2024 average was below the 2023 and 10-year averages. JD2 experienced the second-lowest annual average for TSS at 4.7 mg/L.



Graph 11: JD2 N+N annual averages

Nitrate + Nitrite results for 2024 had a few samples with higher concentrations, which all correlate with spring runoff. The annual average was slightly higher than the 2023 and 10-year averages. In Central Minnesota, the background level of N+N is around 3 mg/L, so the 2024 average is not a concern.



Graph 12: JD2 TKN annual averages

TKN concentrations at JD2 remained relatively consistent throughout the monitoring season. The 2024 average is tracking with the 2023 and 10-year averages, coming in only slightly higher. Since the average TKN concentration for the NCHF ecoregion is 0.6-1.2 mg/L, these concentrations are not a concern as they are only slightly higher than this range.

Ashley Creek (Ashley at CR11)

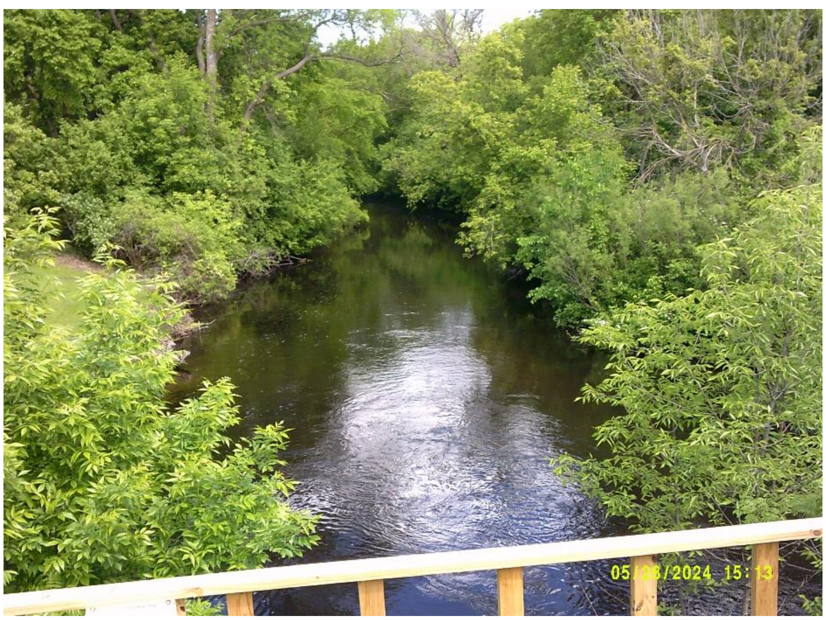
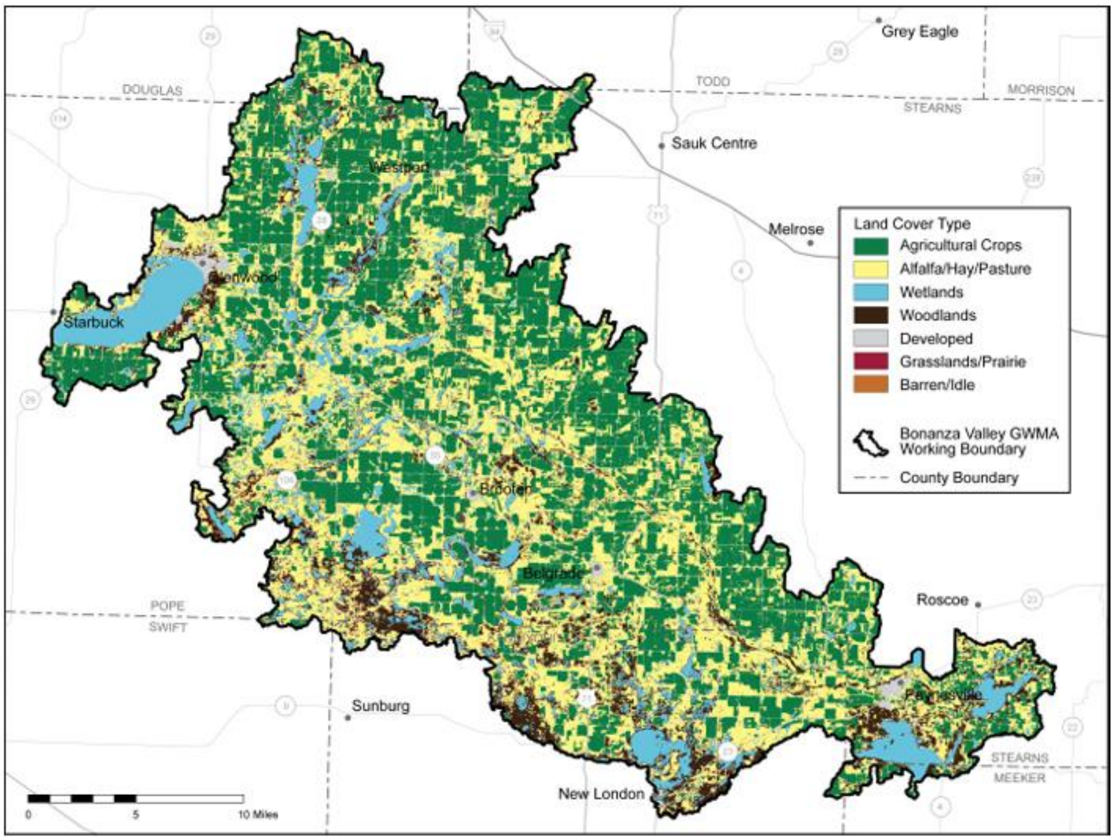


Image 3: Ashley 11 on 5.28.2024

Both Ashley Creek and Hoboken Creek are within the Sauk Lake Management District. The Ashley 11 site was originally established in 2006, but was decommissioned in May of 2021 due to structural instability of the monitoring platform used to access the site. A new site was installed downstream on 415th Ave. in October 2021. Monitoring at the new site resumed from March to May of the 2022 monitoring season, but equipment theft and damage rendered the site inoperable for the rest of the year. The Ashley 11 site was re-established at CR 11 at the end of 2023, and monitoring resumed there for all of the 2024 season. This is why the graphs displaying the average concentrations will compare 2024 data to 2020 data.

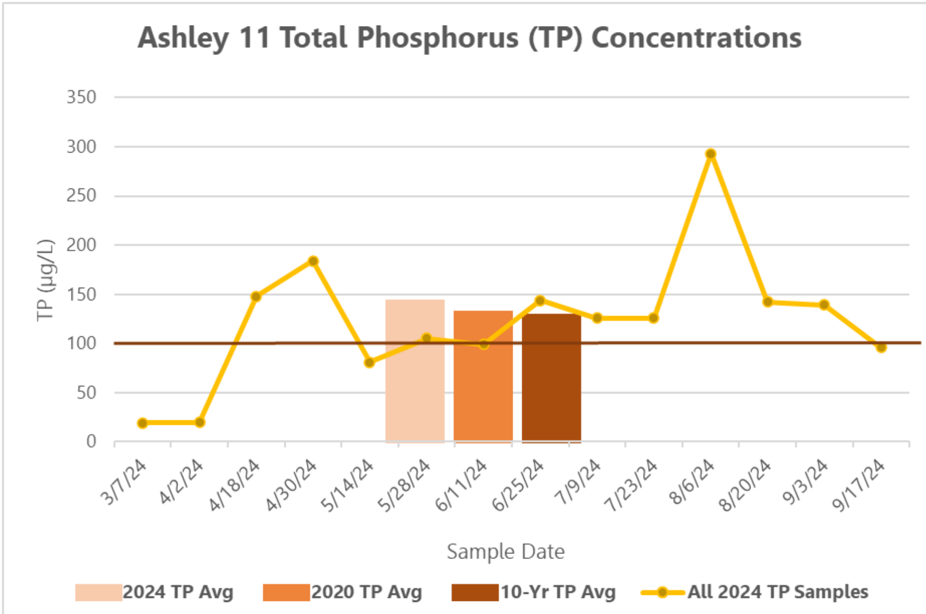
A large portion of Ashley Creek's watershed is also a part of the **Bonanza Valley**, which is a sandy plain and former glacial river bed that stretches from Alexandria down to Paynesville. This unique region that falls within our watershed and beyond encompasses areas in Stearns, Pope, Douglas, and Kandiyohi Counties. It is one of three areas in the state for which growing demands for water is a high concern, and where the Minnesota DNR is actively monitoring to better manage its groundwater use. The area is heavily agricultural, with around 68 percent of the land cover type being in row crops or hay/pasture (see Map 6 below). With farmers using the groundwater to irrigate their fields, groundwater use here over the past 25 years has increased about 5 times faster than the state average.



Map 6: Land cover types in the Bonanza Valley GWMA

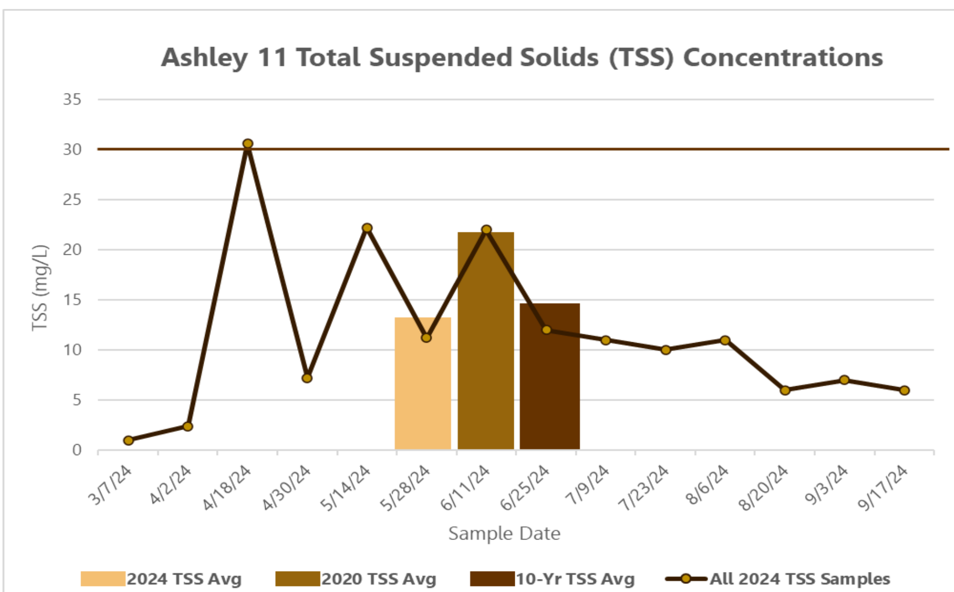
The DNR characterized this region as the Bonanza Valley Groundwater Management Area (GWMA) in 2016 and has since increased monitoring, studied impacts on local surface waters, and established a groundwater management plan. To assess groundwater flow and the hydrologic cycle of the area, they have 72 observation wells that include electronic loggers that send updates of water levels every hour. The DNR has also installed solar-powered stainless-steel boxes at about 15 locations with equipment that monitors water volume, temperature, precipitation, and other components. The sites are visited year-round every four to six weeks to check measurements. Anyone pumping more than 10,000 gallons of water a day in the Bonanza Valley GWMA needs to get a permit from the DNR. To help ensure the sustainable supply of water, farmers have taken steps such as planting cover crops and using technology to adjust irrigation systems based on weather.

Knowing the context of a stream's watershed helps us to understand what the monitoring results are conveying. The following graphs are set up the same way as the JD2 graphs, but compare 2024 averages to 2020 averages.



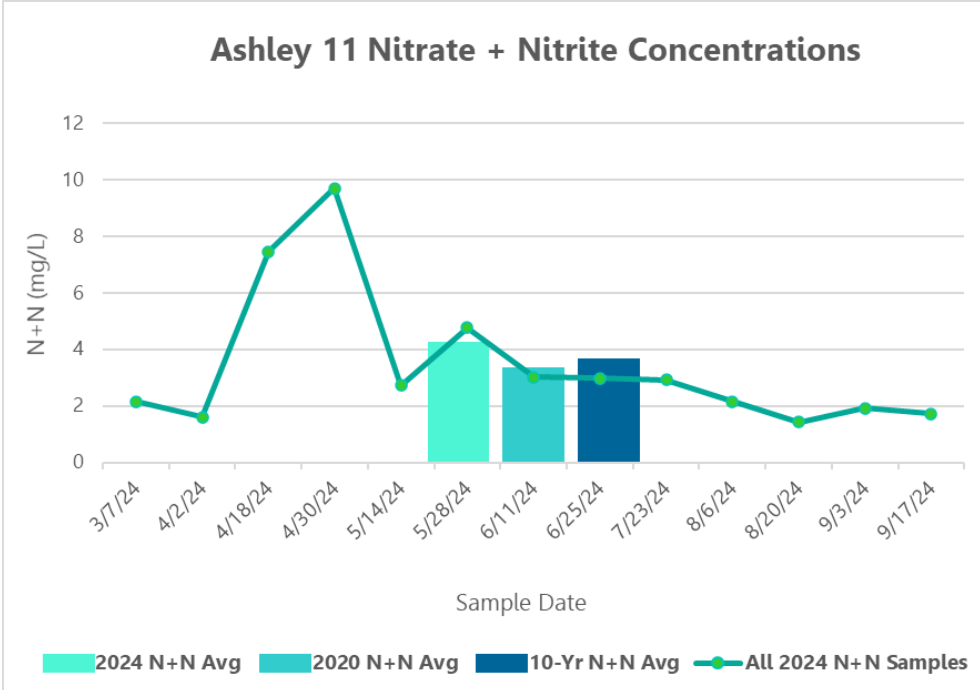
Graph 13: Ashley 11 TP annual averages

For 2024 TP concentrations at Ashley 11, the annual average is slightly higher than the 2020 and 10-year average. The 2024 average came out to be 123 µg/L, which is above the WQS (as displayed by the horizontal brown line). Peaks in concentration levels correspond with heavy rain events.



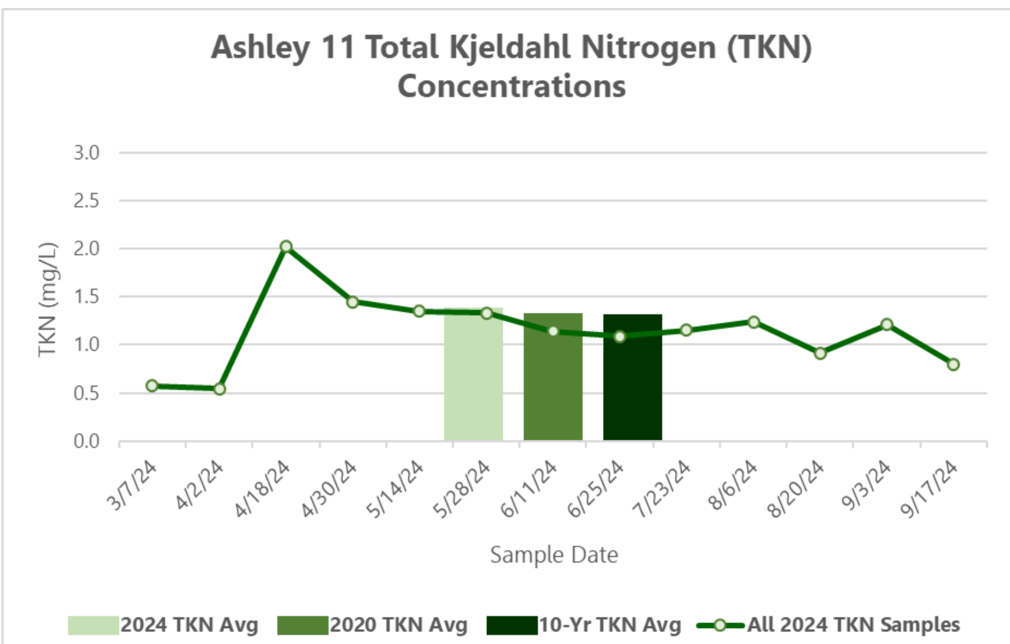
Graph 14: Ashley 11 TSS annual averages

TSS concentrations at Ashley 11 remained relatively low in 2024 with an annual average of 11.4 mg/L. This is lower than the 10-year average and significantly lower than the 2020 average. Only one sample exceeded the WQS of <30 mg/L.



Graph 15: Ashley 11 N+N annual averages

The 2024 average N+N concentration is slightly higher than the Central Minnesota background level of around 3 mg/L. This average is higher than both the 2020 and 10-year average. One sample on 4/30 had a result of 9.69 mg/L. As a reminder, there is no state WQS for nitrates, but the EPA drinking water standard is <10 mg/L.



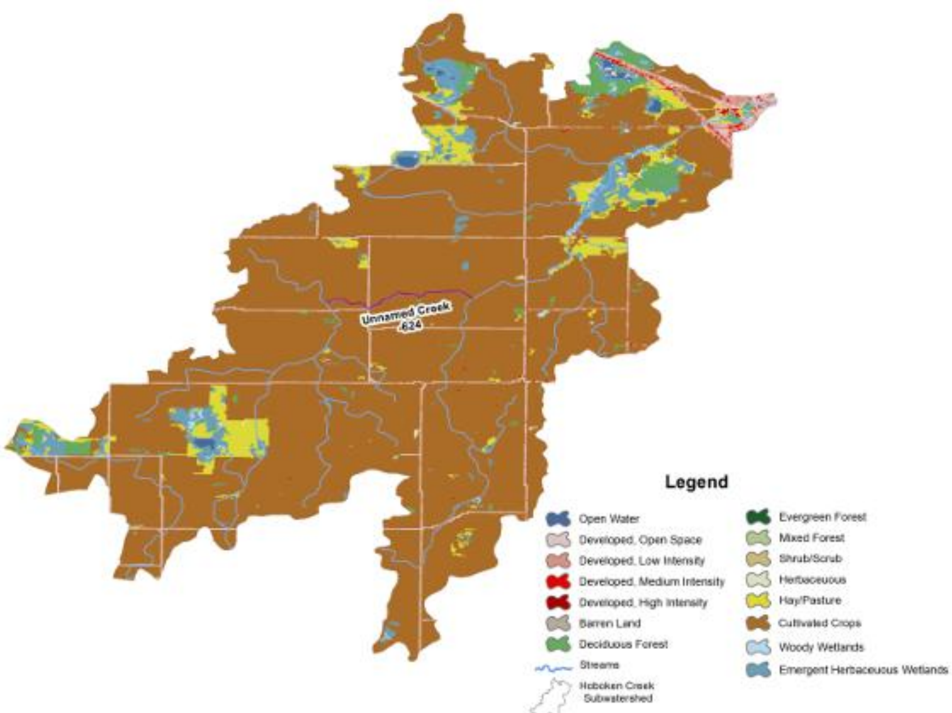
Graph 16: Ashley 11 TKN annual averages

As will be the case for many other tributaries, TKN concentrations remained low at Ashley 11. Only one sample had a result above 2 mg/L. The 2024 average was 1.14 mg/L.

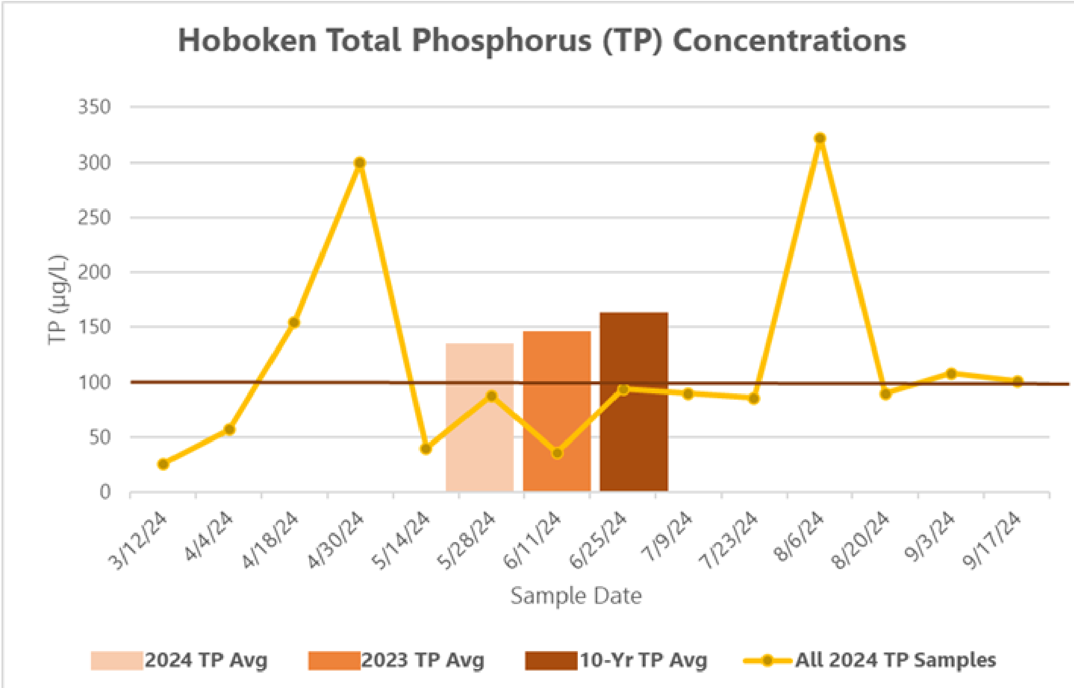
Hoboken Creek (Hoboken at Fairy Lake Rd.)

Image 4: Hoboken Creek on 5.14.2024

This tributary is around 11 miles long with a drainage area of 28 square miles. It begins south of Sauk Centre and flows north until it outlets into Big Sauk Lake on the southeast side. One of the drainage systems managed by the SRWD Drainage Authority, County Ditch #51, outlets into Hoboken. Hoboken Creek flows through a predominately agricultural landscape before passing through Sauk Centre. Two alternate locations along the creek have previously been monitored with limited success. A previous monitoring location for Hoboken on Hickman Drive had to be taken down due to its close proximity to Big Sauk Lake. Review of the data at the Hickman Drive site found that Big Sauk Lake was altering the creek's flow during high water events. The present monitoring location for Hoboken Creek has been in place since 2017.

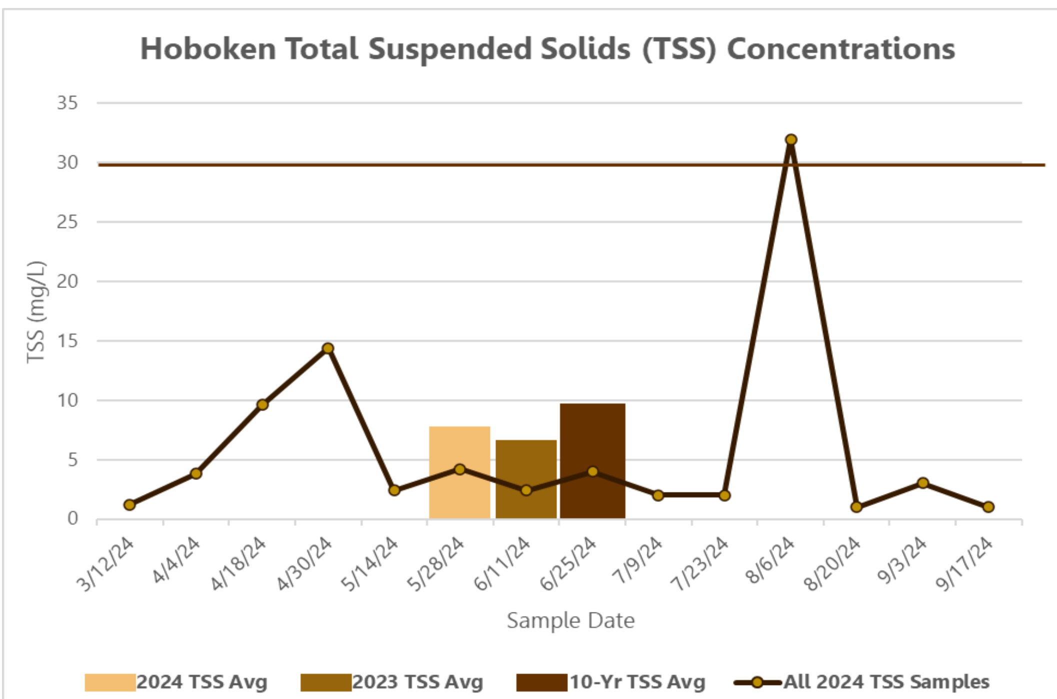


Map 7: Land use type in the watershed of Hoboken Creek



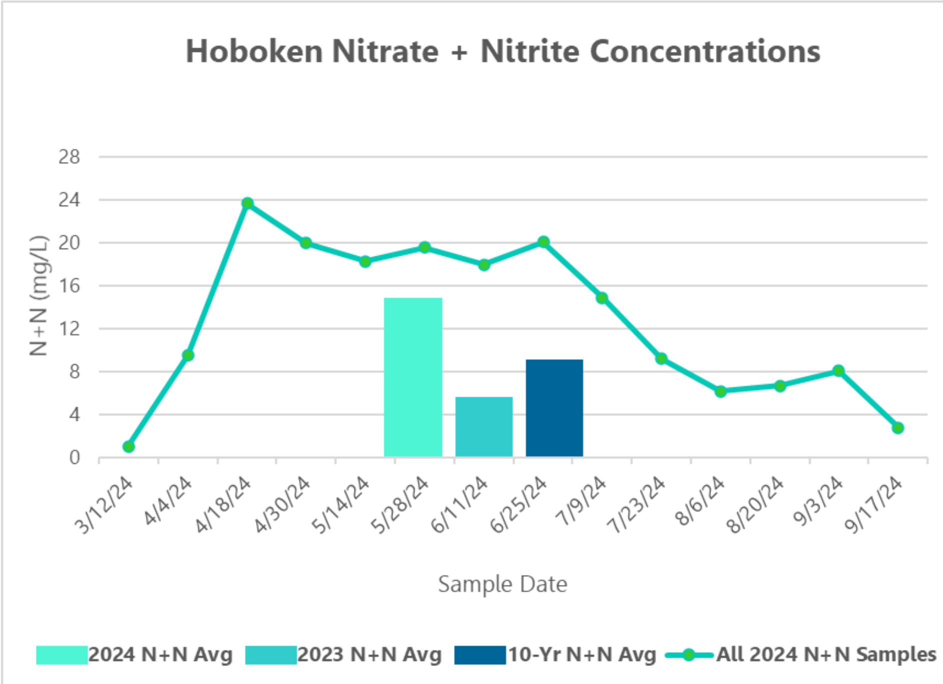
Graph 17: Hoboken TP annual averages

Even though the 2024 average TP concentration was above the WQS of <100 µg/L, it is lower than the 2023 and 10-year averages. Its 2024 annual average of 114 µg/L puts Hoboken at the second-lowest for TP out of the monitored tributaries. The two large spikes reflect high runoff levels that entered the creek due to rain events, demonstrating the flashy nature of the system.



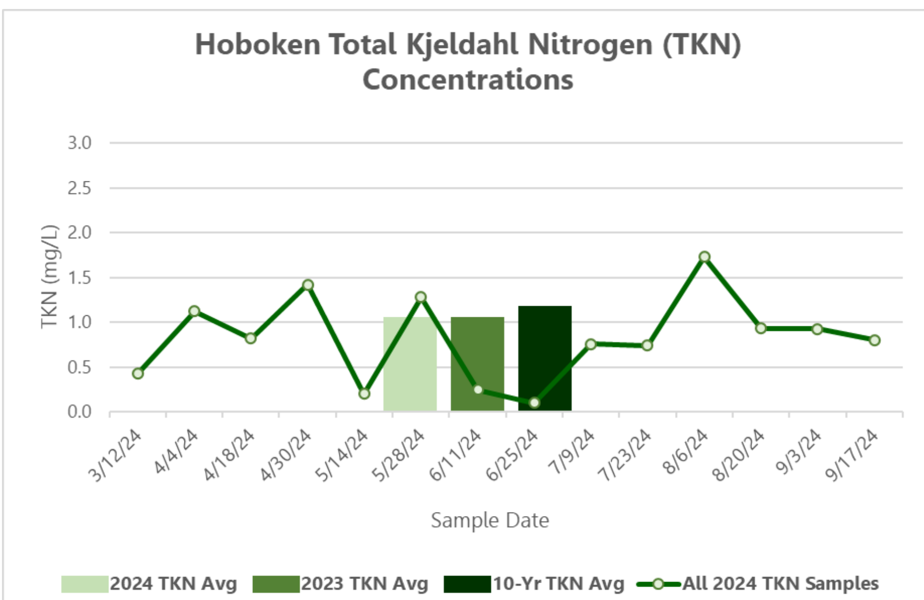
Graph 18: Hoboken TSS annual averages

The 2024 TSS average was lower than the 10-year average, but slightly higher than the 2023 average. It is still well below the WQS of <30 mg/L with only one sample result exceeding this concentration.



Graph 19: Hoboken N+N annual averages

More of a concern for this system is the unusually high annual average for N+N, which came in at 12.72 mg/L in 2024. This is notably higher than 2023 concentrations and is the highest N+N average of all the monitoring sites in the watershed. As discussed earlier in this report in reference to the mainstem nitrate levels, we are seeing a jump in 2024 concentrations, especially for flashy systems. This is likely due to the build-up of nitrates in the upper soil layer from the previous two summers, which were drought years. The highest N+N result at Hoboken in 2024 was 23.7 mg/L, more than double the EPA drinking water standard of <10 mg/L.



Graph 20: Hoboken TKN annual averages

The 2024 annual average for TKN was almost exactly the same as the 2023 average and slightly lower than the 10-year average. All samples remained below a concentration of 2 mg/L, so TKN is not currently a concern for this site.

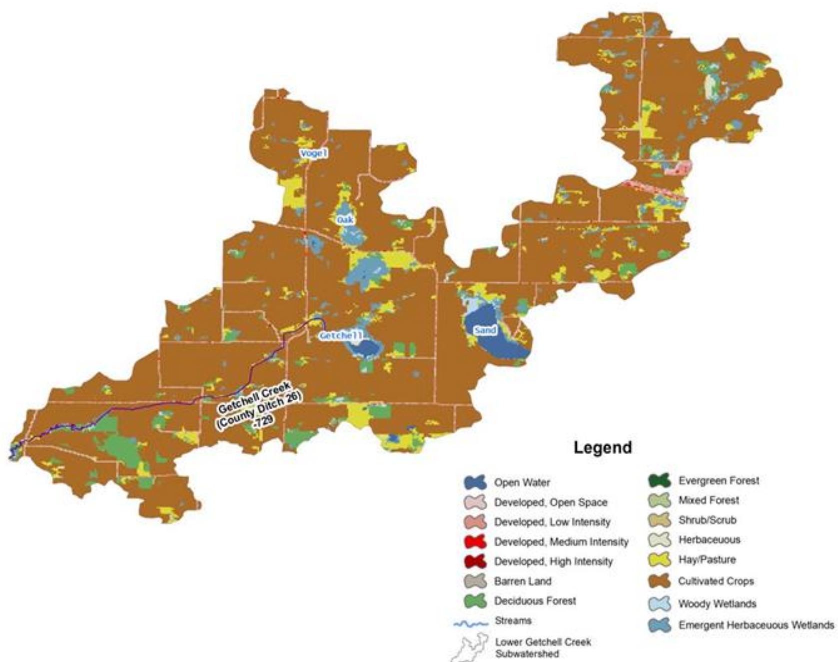
Getchell Creek/CD #26 (Getchell at CR156)


Image 5: Getchell Creek on 6.14.2024

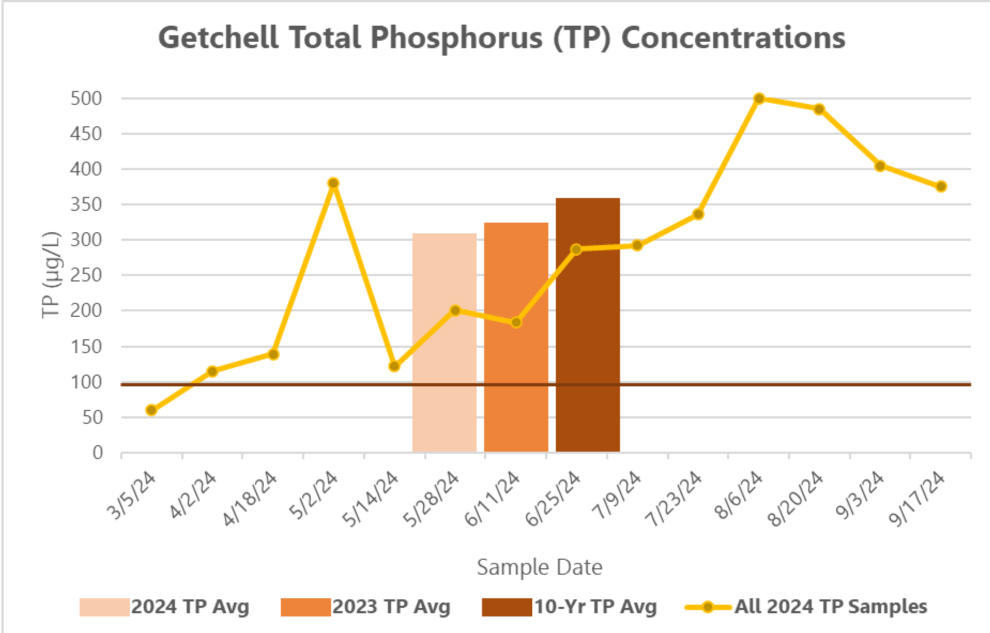
Getchell Creek is one of the larger tributaries in the watershed. It begins in St. Anna Lake and flows south, passes under I-94 near Freeport, then outlets into the Sauk River south of New Munich. It is about 18 miles long and drains an area of 67 square miles. This creek is unique because, for a stretch of the waterway, it is designated as a public drainage system (County Ditch #26). Just south of where County Ditch #15 enters Getchell/CD #26, Getchell flows through Getchell Lake. The system then travels about 6 miles SW until reaching the Sauk. The Getchell monitoring site is at the CR 176 crossing, which is a section that is also on the CD #26 drainage system.

This tributary is within the GUS Plus WMD, which is ranked second in importance for targeting implementation actions for reducing downstream impacts in our watershed's Comprehensive Watershed Management Plan (CWMP). GUS stands for Getchell, Unnamed, and Stony Creeks, the major tributaries in this WMD. Getchell is the largest of the three creeks and has the highest rate of sediment and phosphorus loading to the Sauk River. It is listed as impaired for *E. coli*, low dissolved oxygen, and poor fish/macroinvertebrate habitat. Land use in the lower subwatershed of Getchell is dominated by cropland (79.2 percent), followed by barren land (6.5 percent) then wetlands (4.8 percent). Around 87 percent of the streams in this subwatershed have been channelized, including most of Getchell Creek itself.

The SRWD has recently been awarded a $1.19 million Lessard Sams Outdoor Heritage Fund grant to implement streambank restoration projects and re-meandered channels in the lower section of the subwatershed, downstream of Getchell Lake. This work will help stabilize the channel by reducing shear stress on the banks and allow the creek to access its floodplain. It will also bolster the benefits of the floodplain benches that are currently in place right below the 330th Street crossing downstream of Getchell Creek, which were constructed in 2021.

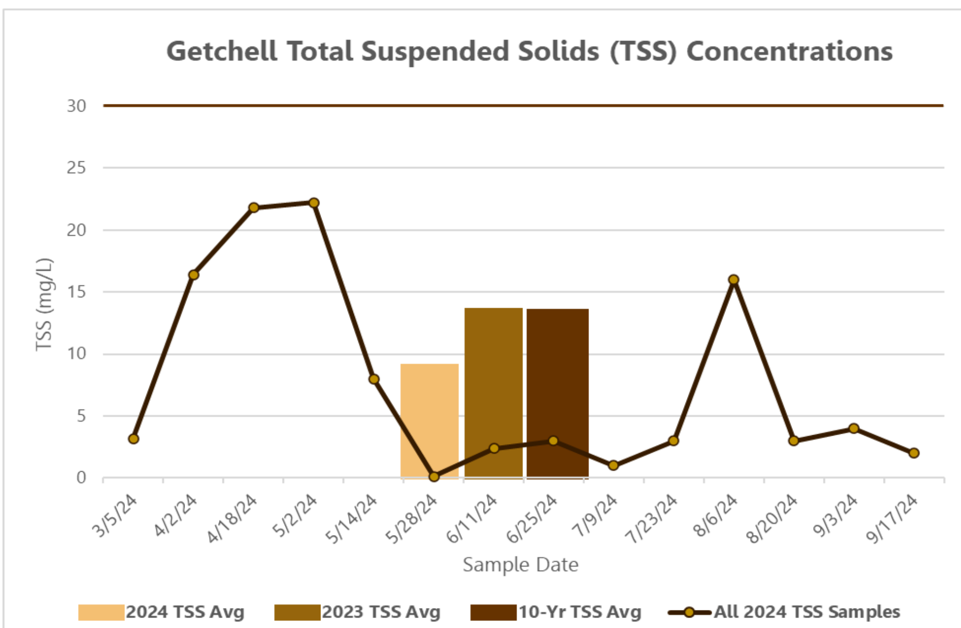


Map 8: Land use type in the lower subwatershed of Getchell Creek



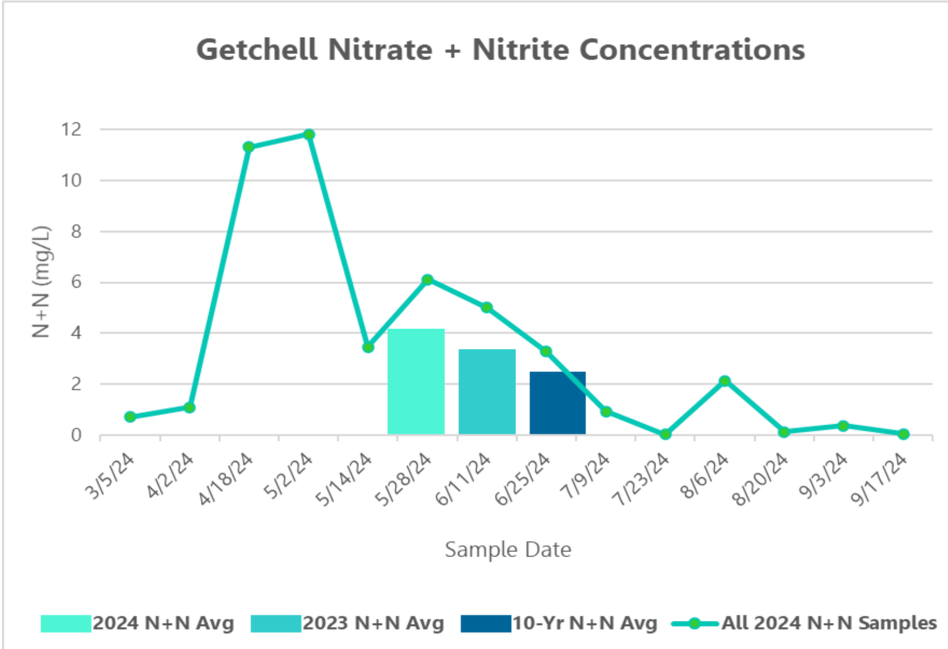
Graph 21: Getchell TP annual averages

Getchell Creek has the highest TP concentration of all the tributaries the SRWD monitors, with the 2024 annual average being 277 µg/L. This is a decrease from the 2023 and 10-year averages, but significantly higher than the WQS. Only one sample was below 100 µg/L. These high concentrations can be attributed to agricultural overland runoff and tile outlets along the creek since this natural stream also functions as a public drainage system.



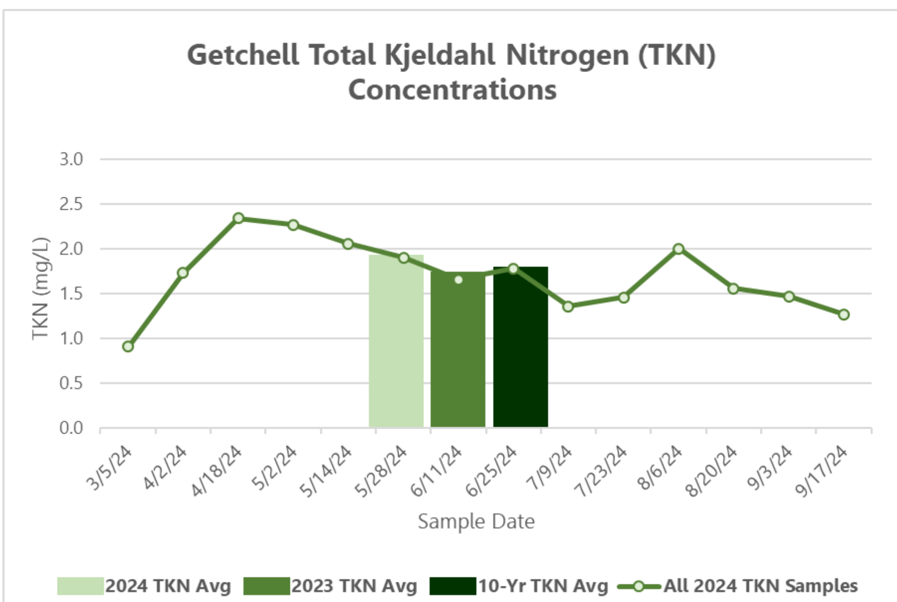
Graph 22: Getchell TSS annual averages

There were some higher TSS results at the beginning of the year thanks to snowmelt runoff, but concentrations remained relatively low throughout the rest of the season. No samples exceeded the WQS of <30 mg/L. There was even a significant drop from the 2023 average. The 2024 average was 7.6 mg/L.



Graph 23: Getchell N+N annual averages

The 2024 average for N+N is higher than the 2023 and 10-year averages. While not at a concerning level yet, the SRWD will continue closely monitoring nitrate levels since we have been seeing increases from the 10-year average across the board. The 2024 average for Getchell was 3.32 mg/L, slightly above the Central Minnesota average of 3 mg/L.



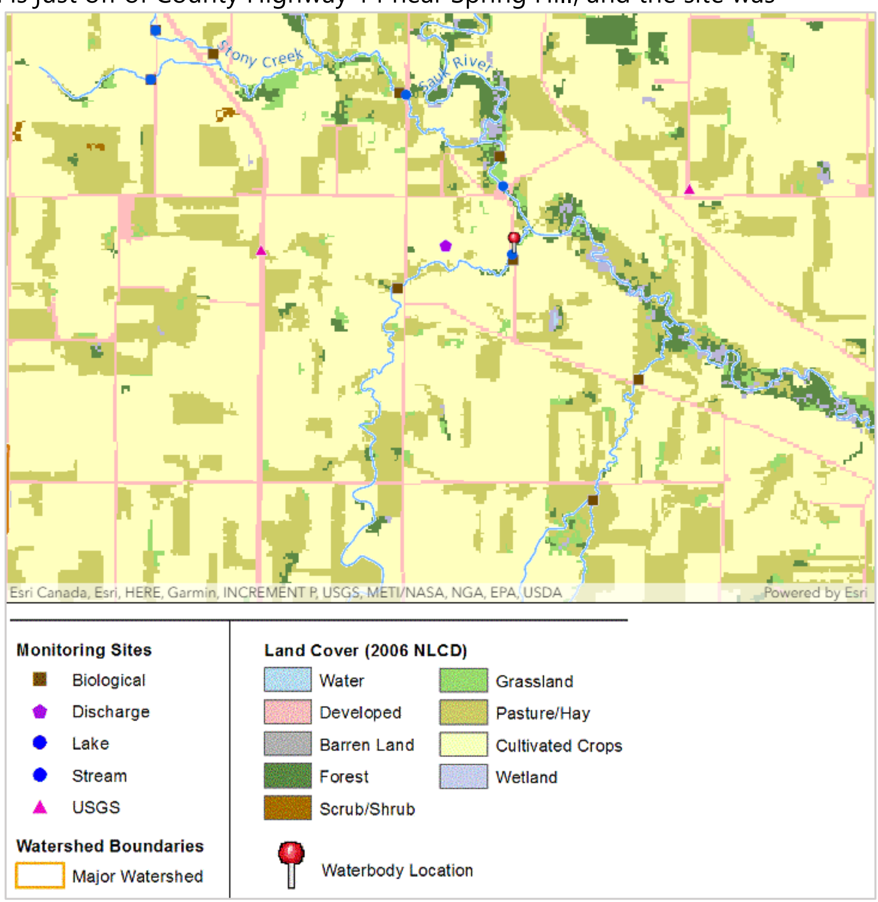
Graph 24: Getchell TKN annual averages

Getchell experienced the highest 2024 annual average for TKN of all the monitored tributaries with an average of 1.7 mg/L. This is a slight increase from the 2023 and 10-year averages. It is also above the average TKN level for the NCHF ecoregion of 0.6-1.2 mg/L. High TKN measurements usually result from sewage and manure discharges to waterbodies; in the case of Getchell, manure can enter the system from overland runoff picking up applied manure from agricultural fields.

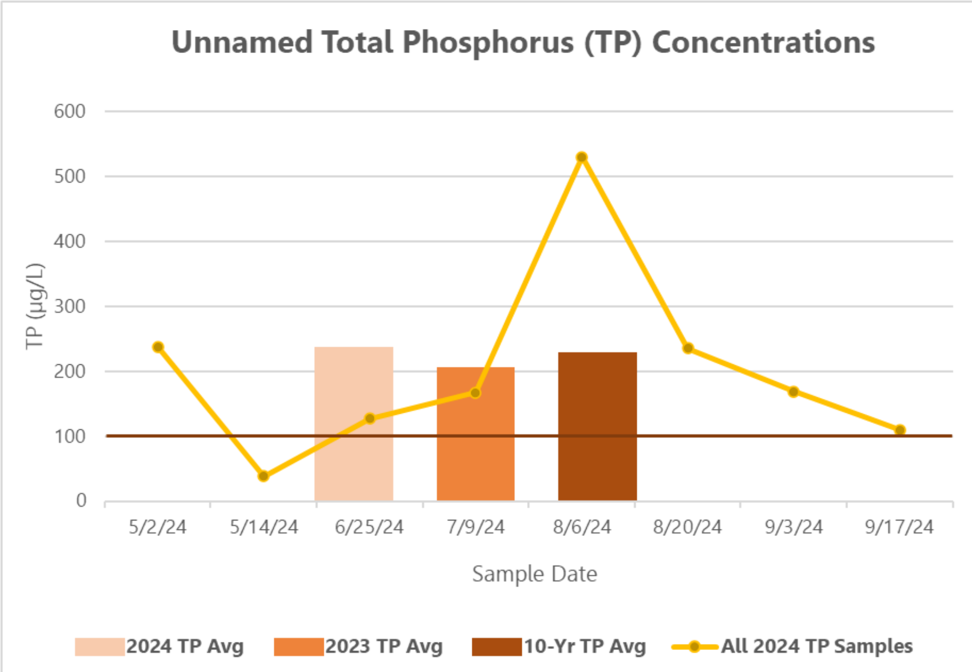
Unnamed Creek (Unnamed at 318th Ave.)

Image 6: Unnamed Creek on 10.9.2023

This unnamed tributary to the Sauk River is the “U” in the GUS Plus WMD. It is around 9 miles long and drains an area of 17 square miles. The monitoring location is just off of County Highway 14 near Spring Hill, and the site was established in 2018. The last 0.6 miles of Unnamed Creek is listed as impaired for *E. coli*, due in large part to manure runoff and cattle access to the stream. In 2008, it was listed as impaired for high turbidity, which is the only listing of its kind in the Sauk River watershed. However, after recent review by the MPCA of data that the SRWD has collected, they have found that turbidity levels (measured by TSS) on average are falling below the WQS of <30 mg/L, meaning it is not consistently reaching impairment levels. Therefore, the MPCA is considering removing the turbidity listing for Unnamed Creek. The MPCA has also mentioned that previous fish community studies imply a low probability of that section being impaired for turbidity. However, *E. coli* continues to be a problem.

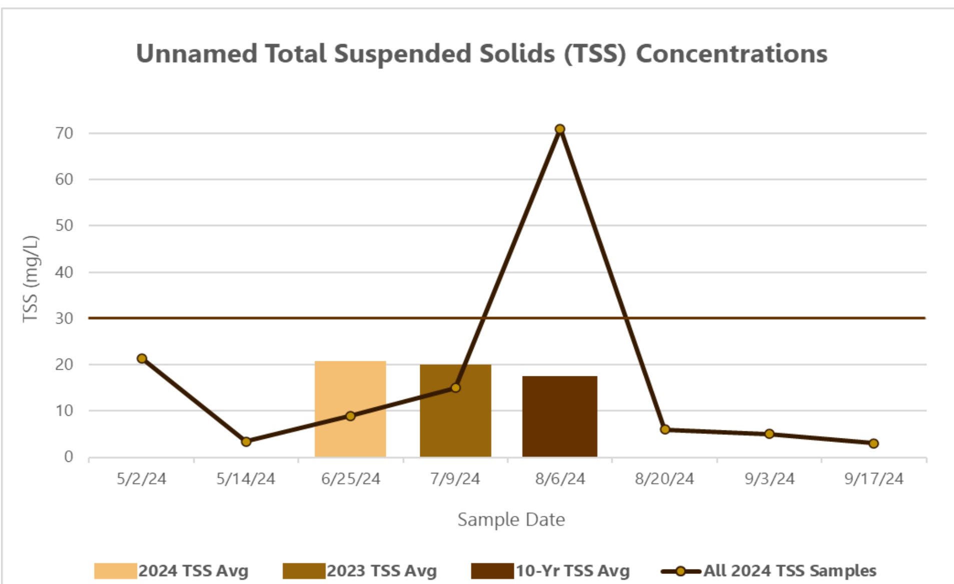


Map 9: Land use type in the lower section of Unnamed Creek



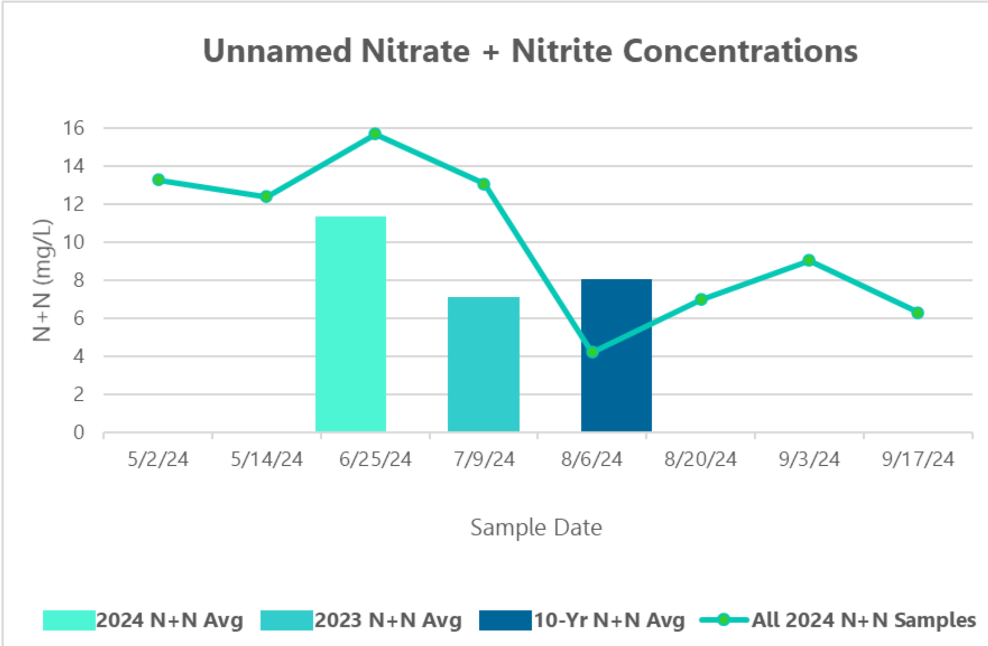
Graph 25: Unnamed TP annual averages

Unnamed Creek had the second highest average TP concentration in 2024 out of the monitored tributaries. The 2024 average was 202 µg/L, which is slightly higher than both the 2023 and 10-year averages. Only one sample fell below the WQS of <100 µg/L, and the highest concentration reached 530 µg/L after a heavy rain event.



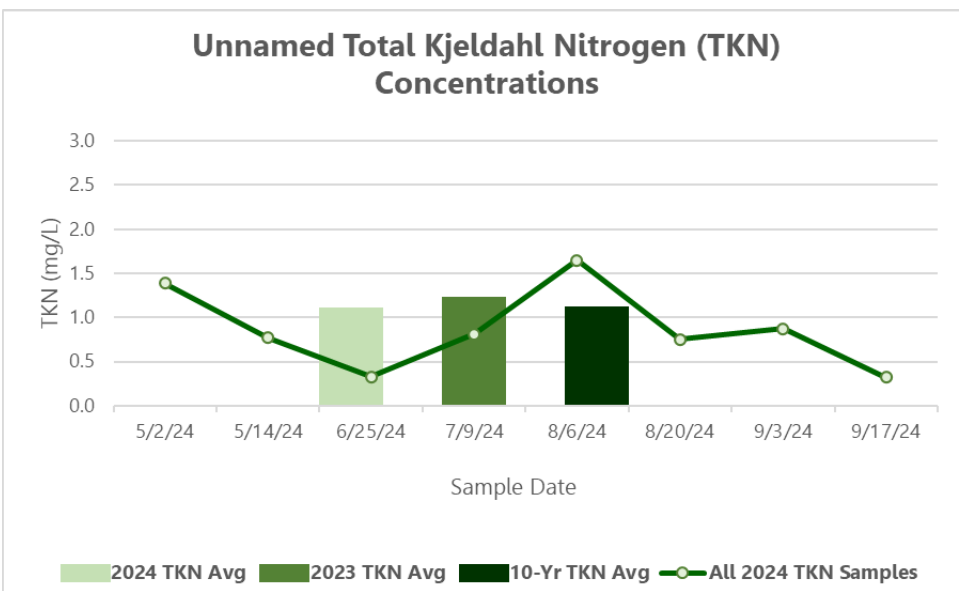
Graph 26: Unnamed TSS annual averages

Even with the potential to remove the turbidity listing (which is connected to TSS) from Unnamed Creek, it is notable that Unnamed had the highest TSS average in 2024 out of all the monitoring sites in the watershed. The 2024 average does remain below the WQS, but it is higher than the 2023 and 10-year average. Spring flooding and large precipitation events can result in short bursts of elevated TSS levels. Unnamed is an extremely flashy system with water levels sometimes increasing by many feet within just a few hours. These circumstances have greatly eroded and widened the stream banks, resulting in spikes of TSS concentrations.



Graph 27: Unnamed N+N annual averages

Unnamed was one of the two monitored tributaries that had a N+N annual average above 10 mg/L in 2024. The annual average was 10.14 mg/L, which is a jump from the 2023 average. As previously mentioned, this is most likely due to the build-up on nitrates in the upper soil layer from the previous two summers, which were drought years. This is plausible because during late summer and early fall, the creek is primarily fed by groundwater sources.



Graph 28: Unnamed TKN annual averages

TKN levels at Unnamed Creek remained low throughout 2024, and concentrations never surpassed 1.7 mg/L. The 2024 average was below the 2023 and 10-year averages.

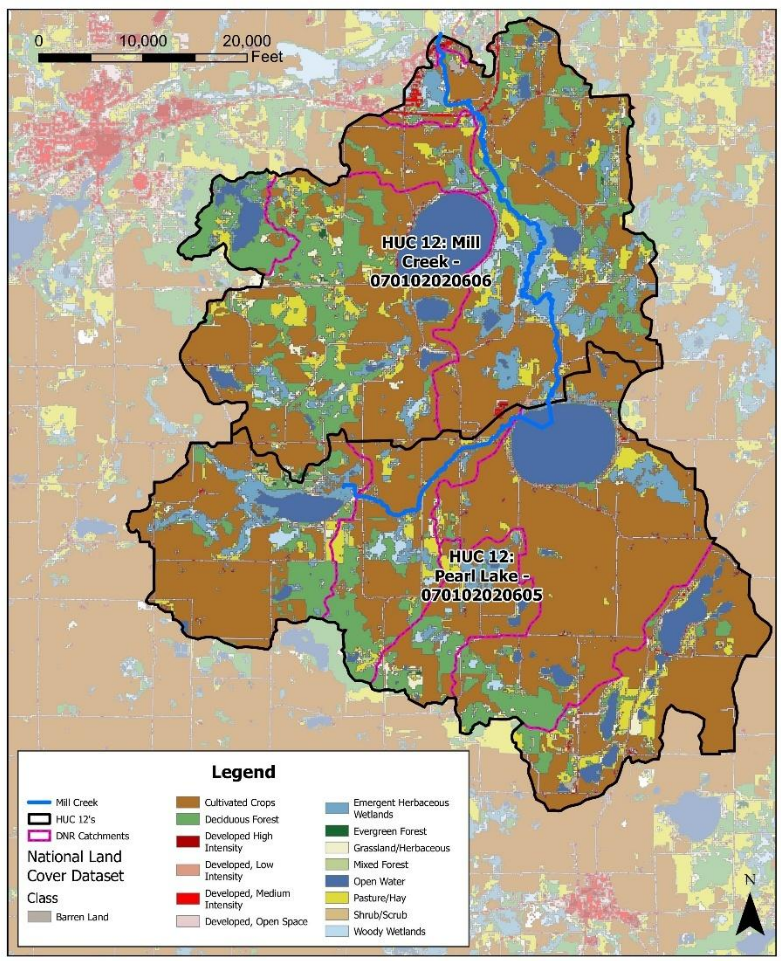
Mill Creek (Mill at Broadway St.)

Image 7: Mill Creek on 5.30.2024

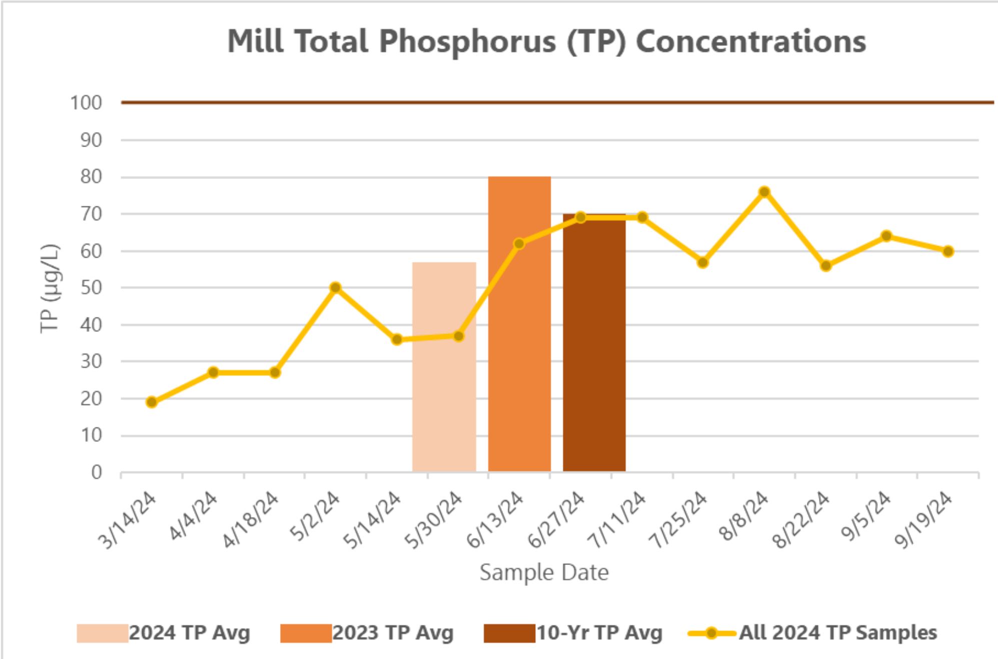
Mill Creek is the furthest downstream tributary that the SRWD monitors. It falls within the Grand Pearl WMD, named after the large lakes in the subwatershed. The system is about 11 miles long and begins south of Rockville at the outlet of Goodners Lake, flows through Pearl Lake, then continues north, eventually flowing into the Sauk River in Rockville. Mill Creek's watershed is 48 square miles in size. The Grand Pearl WMD is ranked second highest priority in the watershed (behind the Sauk Lake WMD) for groundwater availability and groundwater quality concerns. Mill Creek is also a priority stream due to its potential to impact St. Cloud's drinking water; the city sources their drinking water from the Mississippi River just downstream of where the Sauk River enters the Mississippi. The entire length of Mill Creek is impaired for aquatic recreation and *E. coli*.

Mill Creek consistently has one of the lowest averages for each monitored parameter, especially phosphorus. That is likely because this management district has one of the highest percentages of forested land use remaining in the watershed. According to the 2021 NLCD land use data, 15.2 percent of the subwatershed is forested area, 8.8 percent is considered wetlands, and 59.2 percent is row crops and pastureland. In the segment between Pearl and Grand Lake, the creek runs through several large wetlands and forests that provide buffering/protection from direct runoff from cropland and developed areas. In this section, there are few residences or farms near the creek.

Mill Creek Watershed
Landuse - NLCD 2021

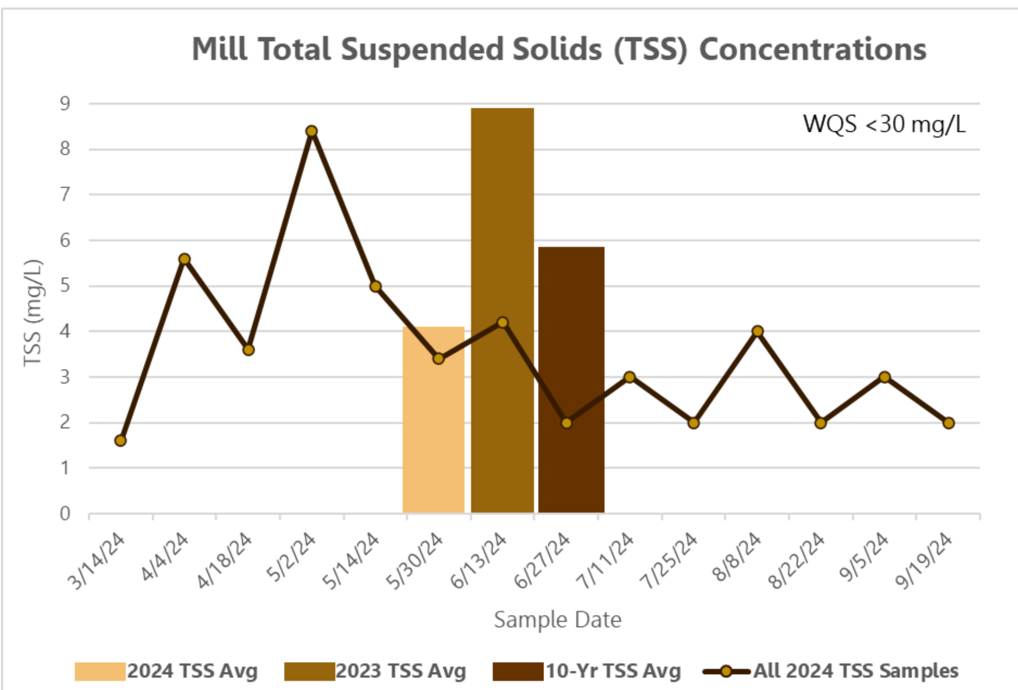


Map 10: Land use type in Mill Creek watershed



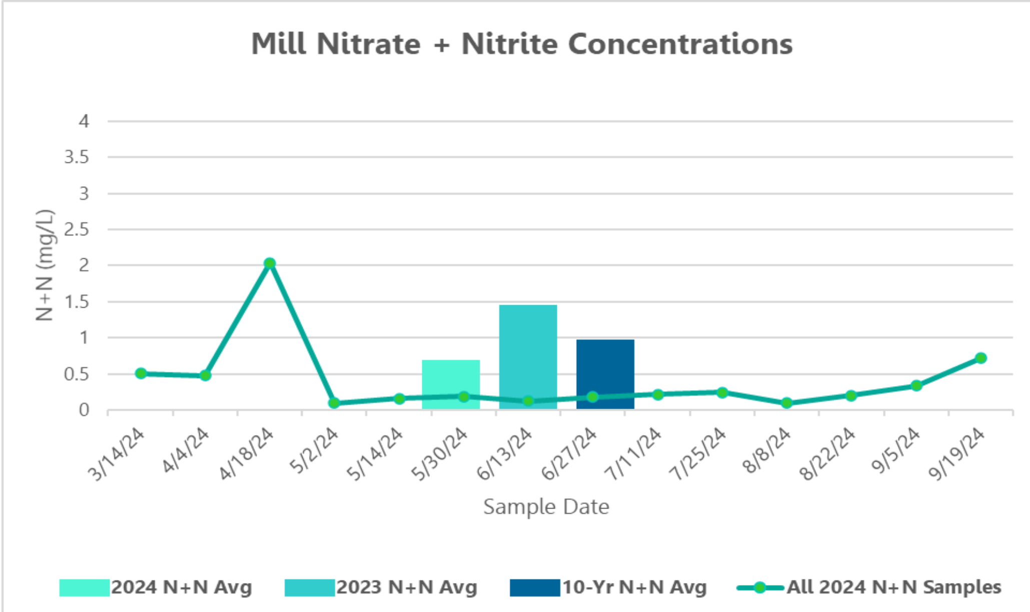
Graph 29: Mill TP annual averages

Mill Creek was the only tributary in 2024 with a TP average below the WQS of <100 µg/L. There were no sample results that exceeded the WQS. The annual average fell below both the 2023 and 10-year averages, and it was a significant drop from the 2023 average.



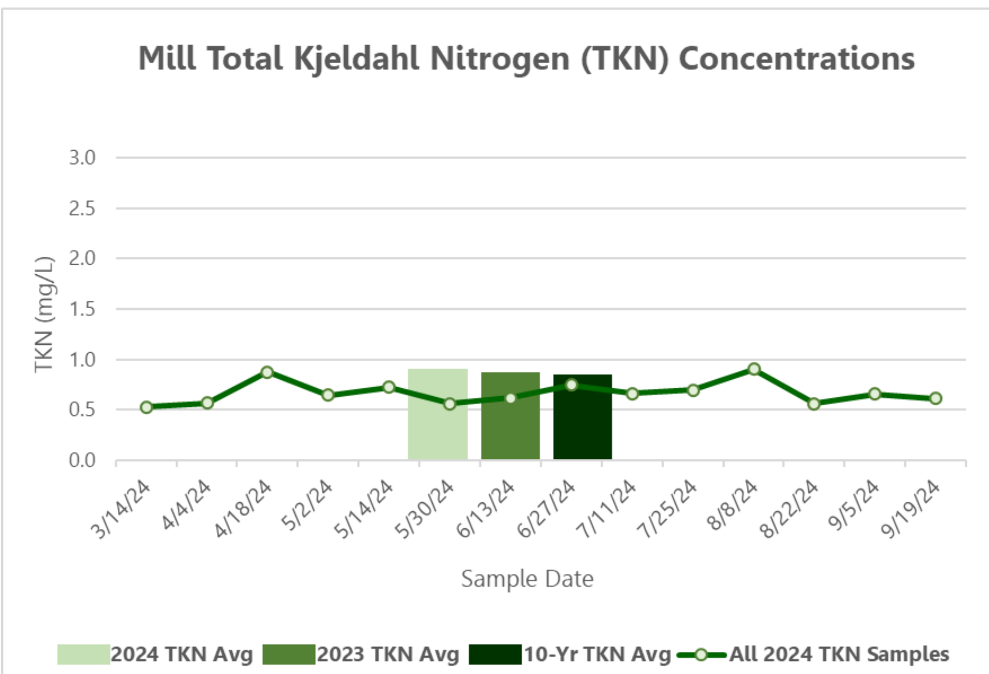
Graph 30: Mill TSS annual averages

TSS concentrations at Mill remained low and never even exceeded 10 mg/L. The 2024 average came out to be 3.6 mg/L. This is also a significant drop from the 2023 average, as indicated in the graph above.



Graph 31: Mill N+N annual averages

By far the lowest concentration in the watershed, Mill Creek had an average N+N result of 0.4 mg/L in 2024. There was only one sample that exceeded 1 mg/L. With nitrate concentrations on the rise in many areas of the watershed, it is encouraging to see these low results, especially in a subwatershed with such a high priority for groundwater quality concerns.



Graph 32: Mill TKN annual averages

Lastly, TKN concentrations at Mill Creek also remained low with an average of 0.67 mg/L. This average is slightly higher than the N+N average, with Mill being the only site at which this was the case. This implies that hardly any inorganic nitrogen (nitrate and nitrite) is entering the system since concentration levels remained below the average background level of 3 mg/L.

2024 SAUK RIVER AND TRIBUTARIES SUMMARY

Throughout 6-7 months of monitoring and collecting data, there is a lot of information to sift through, and 2024 was no exception. There was no shortage of precipitation during the open water season, which kept the monitoring department busy. An examination of the data shows some positive and some negative results. The Sauk River and its tributaries continue to have favorable water clarity, as demonstrated by the TSS and turbidity tube results. For all 13 monitoring sites on both the mainstem and its tributaries, transparency tube averages were well above the WQS of >20 cm., indicating good water clarity.

On the Sauk River mainstem, phosphorus levels are still a concern, but there does appear to be a declining trend in phosphorus concentrations especially when compared to the 10-year averages. Although phosphorus levels are indicating improving conditions, nitrogen data in the Sauk River, and across Minnesota, have been increasing. For example, each monitoring site's 2024 annual average for N+N was higher than the 10-year average (except for SR12). These substantial jumps can be explained by the reality of weather patterns and climate conditions. The summers of 2022 and 2023 were extremely dry, and the winter of 2023 had snow accumulation well below average, which allowed for applied nitrates on the landscape to accumulate in the upper soil layer. When above-average precipitation came in the summer of 2024, groundwater connectivity was restored, and the built-up nitrates began leaching into groundwater sources. This is reflected in the higher levels of N+N sampled from our waterbodies.

As for the six tributary sites, phosphorus levels were consistently above the WQS except for Mill Creek, but most of the sites had phosphorus averages below the 2023 and 10-year averages. Nitrate levels were higher than previous years, again with the exception of Mill Creek. This is due in part to the flashy nature of both Hoboken and Unnamed Creek. The 2024 averages for Unnamed and Hoboken were both above the EPA drinking water standard of <10 mg/L (12.72 mg/L and 10.14 mg/L, respectively). TSS concentrations remained low across the watershed, with significant drops from the 2023 average at both Getchell and Mill Creek.

It is extremely valuable to be able to utilize over 20 years of data collection and monitoring activities in the Sauk River Watershed to paint a picture of water conditions each year and to draw conclusions about the conditions of our watershed over time. In order to track the changes in water quality as land use and regional climate in the watershed evolve, it is crucial to continue building the long-term data in our watershed. This data will help us identify where progress has been made and where change is needed. This effort is greatly aided by the work of volunteer water monitors, county and city partnerships, lake associations, and collaboration with state and non-profit organizations. The SRWD is able to convey a comprehensive, up-to-date picture of the state of our water resources and is actively working to protect them for future generations

GLOSSARY

Average – This monitoring summary uses the arithmetic averages for all annual data displayed. The arithmetic mean is commonly referred to as the average, or simply the mean, of a set of values. It is calculated by adding all the values together and then dividing them by the number of values (n) that were added. This is commonly used to consolidate many measurements into one representative measurement.

Chloride (Cl^-) – Regularly analyzed in water quality monitoring to evaluate salinity levels. The use of road salt (sodium chloride) for deicing is a major manmade source of chloride to surface water and groundwater. Application of road salt in the United States has tripled since the 1970s. Elevated concentrations of chloride in streams can be toxic to aquatic life. The WQS for Class 2 waters is 230 mg/L for chronic levels and 860 mg/L for acute levels.

Comprehensive Watershed Management Plan (CWMP) – Synonymous with the One Watershed, One Plan (1W1P), which is a planning program run through the Board of Water and Soil Resources (BWSR) to work at a watershed level to improve water quality. The purpose of a CWMP is as follows:
- Align local water planning purposes and procedures
- Acknowledge and build off existing local government structure, water plan services, and local capacity
- Solicit input and engage experts from agencies, citizens, and stakeholder groups
- Focus on implementation of prioritized and targeted actions capable of measurable progress.

Ecoregion – A region defined by distinctive geography, plant and animal communities, land uses, soil profiles, and sun and moisture patterns. Ecoregions are used by the Environmental Protection Agency (EPA) and Minnesota Pollution Control Agency (MPCA) to characterize regional differences in the state and their effects on water quality. The Minnesota ecoregion the Sauk River Watershed resides in is the **North Central Hardwood Forest** (NCHF). The NCHF ecoregion is a transitional zone between the predominantly forested northern lakes region and the corn belt plains in southern Minnesota.

Fish Index of Biotic Integrity (FIBI) – An index to measure aquatic vertebrate communities and the surrounding conditions using fish species as indicators. Overall, there are 12 fish community variables that can be broken down into three main categories: species richness and composition, trophic composition, and fish abundance and condition. By assessing the variables within these parameters, scientists can compare a sampled site with a relatively undisturbed site with similar geographical and climatic conditions.

Macroinvertebrate Index of Biotic Integrity (MIBI) – In 2003 and 2004, IBIs based on macroinvertebrate communities were developed for streams in specific major basins of Minnesota and used to conduct Aquatic Life Use assessments. Development of the MIBI utilized a standardized protocol developed by researchers from the Environmental Protection Agency (EPA) and elsewhere. The stream classification system and macroinvertebrate-based Indices of Biological Integrity document have been utilized (in concert with other indicators) since 2010 to annually assess the condition of aquatic life in Minnesota’s rivers and streams.

Nitrate + Nitrite (N+N) – A water quality parameter that is often sourced from fertilizers, animal/human waste, industrial waste, or decaying organic matter. These are inorganic forms of nitrogen, with nitrates in particular being an essential plant nutrient since plants can only take up inorganic nitrogen. Excessive nitrates can become toxic to warm-blooded animals at concentrations around 10 mg/L.

Ortho-phosphate (OP) – A dissolved, inorganic form of phosphorus that is easily taken up by plants and bacteria. Ortho-phosphate is a portion of the forms of phosphorus found in the environment, and high levels of OP have been correlated with poor water quality, algae blooms, and reduced viability of certain aquatic species.

Point Source and Nonpoint Source – These terms are used when referring to how a pollutant enters a waterbody. **Point sources** are single and identifiable locations, such as the end of a pipe, and are regulated by state and federal agencies. **Nonpoint sources** can be rain and snow runoff, which accumulates pollutants as water flows across the landscape. Places like parking lots, farmland, construction sites, and eroding streambanks are considered nonpoint sources of pollution and are harder to track, control and, regulate.

Pollutant Load – The amount or mass of a substance that passes a particular point of a river (such as a monitoring station) in a specified amount of time (e.g., daily, annually).

Rating Curve – A rating curve represents the relationship between river stage/level and streamflow or discharge. Each channel is different and, because the stage-discharge relation is a function of the stream geometry and bed material, each rating curve will be unique to a site for a particular period of time. Existing rating curves should be validated every year by collecting additional data at least every 4-5 weeks throughout the monitoring season and a range of high and low flows.

Specific Conductance (SpC) – Also referred to as specific conductivity or just conductivity, SpC is a measure of the ability of water to conduct an electrical current. It is an important water quality measurement because it gives a good idea of the amount of dissolved material in the water. High SpC indicates high dissolved-solids concentration, which can affect the suitability of water for domestic, industrial, and agricultural uses. A normal conductivity value is roughly twice the total hardness in unsoftened water samples.

Total Kjeldahl Nitrogen (TKN) – A method for measuring organic nitrogen plus ammonia in a water sample. Nitrate and ammonia are the major forms of dissolved inorganic nitrogen and are the only forms that are available for algal and plant uptake.

Total Maximum Daily Loads (TDML) – The amount of a pollutant that can be present and still have a waterbody meet water quality standards. A TMDL allocates pollutant loading to four separate metrics:
TMDL = Waste load allocation (WLA) + Load Allocation (LA) + Margin of Safety (MOS) + Reserve Capacity (RC)
WLA includes pollutant loading from permitted sources (point sources), LA includes sources not covered by a permit (nonpoint sources), MOS accounts for uncertainty in these estimates, and RC allows for future growth.

Total Phosphorus (TP) – A measure of all forms of phosphorus, both the organic and inorganic. Organic phosphorus is not commonly found in suspension in the water column and is not as chemically available as food for plants and animals. Inorganic phosphorus, referred to as ortho-phosphate (OP), is commonly dissolved in water and is readily available to plants and animals. Phosphorus is an essential nutrient for growth, but is only necessary in small concentrations to sustain life. Phosphorus can also be found in the water column and embedded in water bottom materials. Point sources of phosphorus include wastewater and industrial releases, and nonpoint sources from agricultural fertilizers and contaminated groundwater.

Water Management District (WMD) – Closely tied to hydrologic boundaries, district boundaries may additionally consider ecological, economic, social, geopolitical, and land use factors for boundary purposes. In Minnesota, watershed districts have the authority to create WMDs and develop a fee structure to fund WQ improvement projects based on a specific pollution problem or water resource issue in the region. For example, the fee can be based on land contribution to runoff volume if there is a flooding or water storage issue. Alternatively, if nutrients and phosphorus are the water quality issue, land use and impervious surface area would be factored into how the fee is developed. Defining WMDs is the optional mechanism for funding specific watershed projects.

Watershed Pollutant Load Monitoring Network (WPLMN) – The purpose of this monitoring program is to maintain water quality data collection, build on local partnerships, and develop a better of understanding of impacts to the rivers located in central Minnesota. The network also tracks pollutant trend information and provides educational materials for Minnesota residents. WPLMN has two monitoring locations in the Sauk River watershed.

Water Quality Standards (WQS) – Numeric or narrative pollutant standards that, when met, describe the desired condition of a waterbody. Water quality standards are critical regulatory tools for protecting aquatic resources from adverse pollutant impacts. Commonly, WQS are set to protect human and aquatic life health. WQS form a legal basis for controlling pollutants entering the waters of the United States and are legally enforceable. The Clean Water Act and Minnesota Rules provide the flexibility to tailor WQS to waterbodies where unique circumstances alter the typical or expected relationship between a pollutant and the protected beneficial use.