Chippewa River Watershed Monitoring Summary 2003

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Chippewa River Watershed

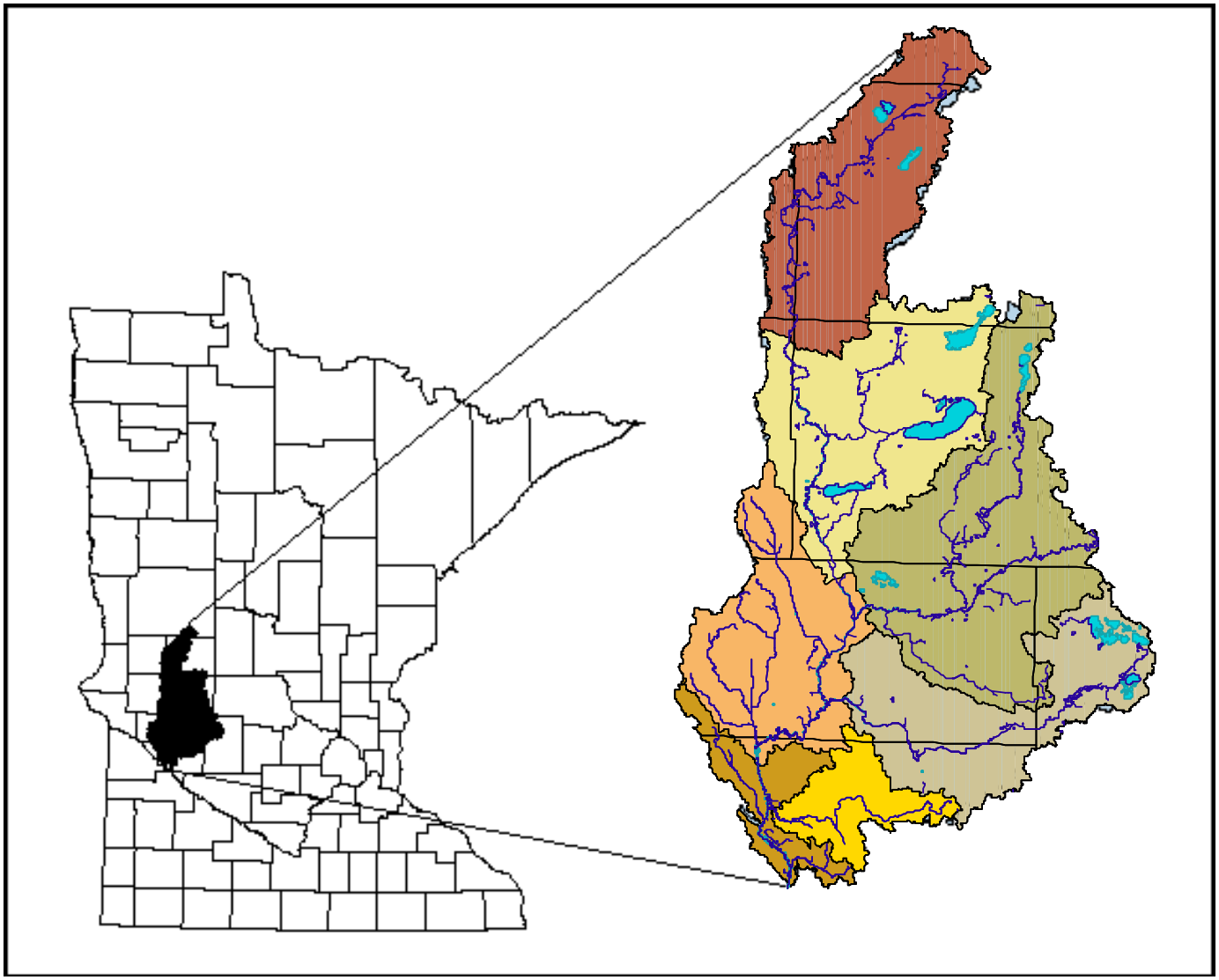


Table of Contents:

Chippewa River Watershed Project
Overall Goal

"The Chippewa River Watershed Project seeks to improve water quality and flooding problems within the Chippewa River watershed while promoting a healthy agricultural, industrial, and recreation-based economy for the region."

Ten-Year Goals

- To achieve the highest level of water quality attainable for ecoregion streams
- To increase the number of watershed residents taking an active role in enhancing and protecting the Chippewa River
- To continue to have the watershed community of agencies and organization bonded together as a group working toward the common goal of improved water quality
- To develop the Chippewa River as a major recreational resource within the Minnesota River Basin

Overview 2003 was an interesting year for the Chippewa River. The spring melt season got off to an early start in mid March but did not raise the river level higher that the long term average. Spring rainstorms in the lower two thirds of the watershed brought the river stage up through July. In particular, a three inch rainfall in the upper parts of the watershed resulted in the Chippewa River's 2003 high water event in mid July. From this point on the absence of significant rainfall led to low river stage levels through August and September. As a result of the dry conditions a three inch rainfall in the lower third of the watershed in late September was barely noted in the river as most of the water ended up replenishing ground water.

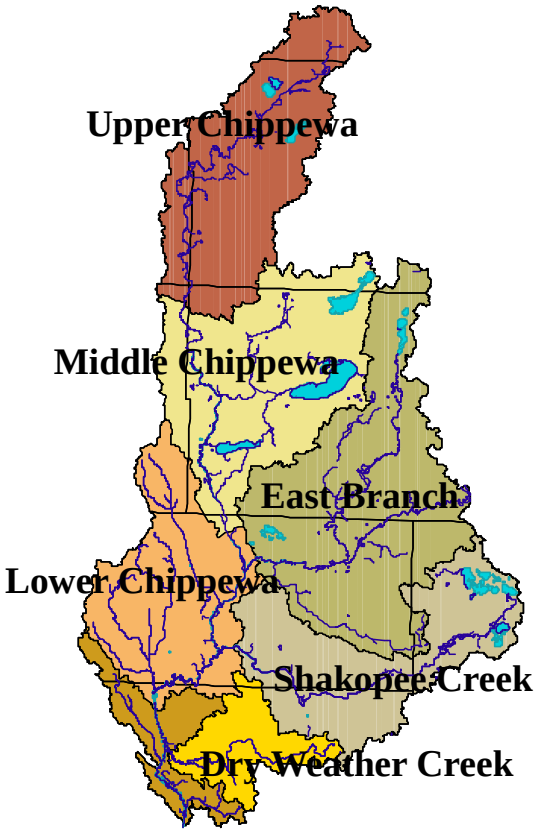
Pollution levels fluctuated between tributary basins but were generally lower than the last several years. The upper Chippewa proved to be the exception to the rule with a higher than average concentration of Nitrates, Total Suspended Solids and Phosphorous. Fecal Coliform levels were fairly normal with high levels seen as the river water warmed in July. High readings were observed both in high flows and in low flows suggesting a variety of sources.

Concentration (Flow Weighted Mean)

A Flow Weighted Mean is a statistical way of expressing a monitoring seasons overall pollution concentration. It is expressed in milligrams per liter (mg/L). It statistically represents the concentration of pollutants in the water that one would measure if one was able to catch all the water that flows out of the river in a tank, mix it up and then take a sample from this tank.

A flow weighted mean is a useful way to compare pollution from one year to another because it removes some of the variation caused by weather differences from year to year.

All concentration values represented in this report are flow weighted means.



Chippewa Watershed Land Use Classification

Land use	*Acres*	*Percent of total*
Agriculture	980,021	73.50%
Grassland	148,575	11.14%
Forest	71,798	5.38%
Water	71,668	5.37%
Wetlands	37,042	2.78%
Urban or Residential	23,565	1.77%
Gravel pits or exposed	724	0.05%
Unclassified	47	0.00%
Total	1,333,440	100.00%

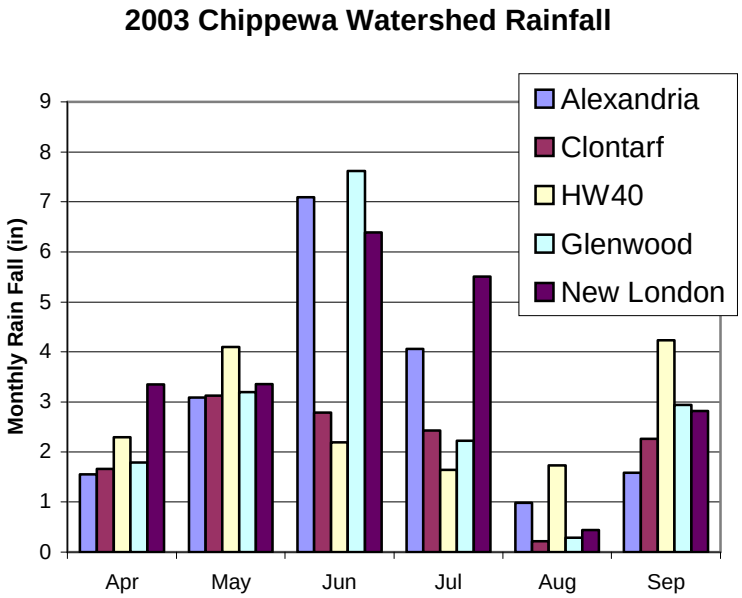
Chippewa River Tributaries / Sub-basins

Name	*Acres*	*Percent of whole*
1. East Branch	323,767	24.28%
2. Middle Chippewa River	257,712	19.33%
3. Upper Chippewa River	227,383	17.05%
4. Shakopee Creek	197,111	14.78%
5. Lower Chippewa River	195,443	14.66%
6. Dry Weather Creek	67,759	5.08%
7. Lower Unmonitored Region	64,300	4.82%
Chippewa River	**1,333,476**	**100.00%**

Precipitation and Flow

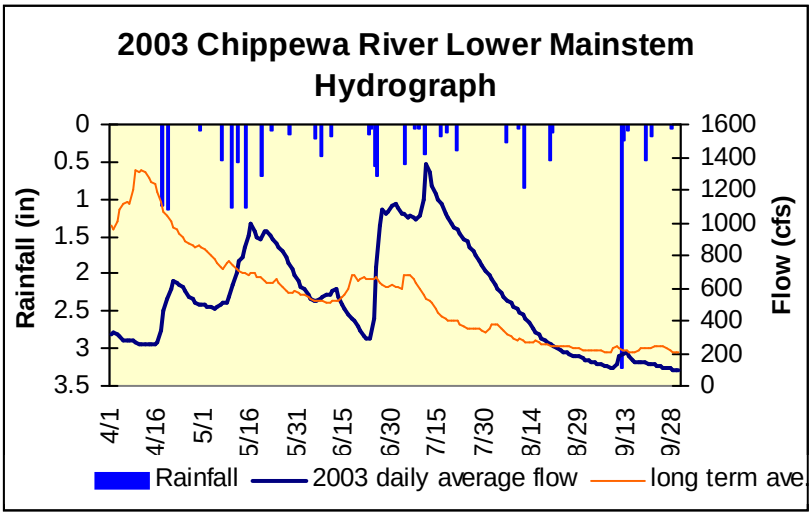
Precipitation

Precipitation varied across the watershed. June and July saw the most variation from one end of the watershed to the other. The chart to the right illustrates some of the variation in rainfall seen in communities in and around the Chippewa River Watershed. Note how little rainfall came in August. September numbers are higher due to one rain event that came lat and dropped one to six inches over the landscape. Rainfall in April, May and June tends to cause the most runoff due to the limited amount of canopy cover in agricultural fields and the saturation of the soil from the spring melt.

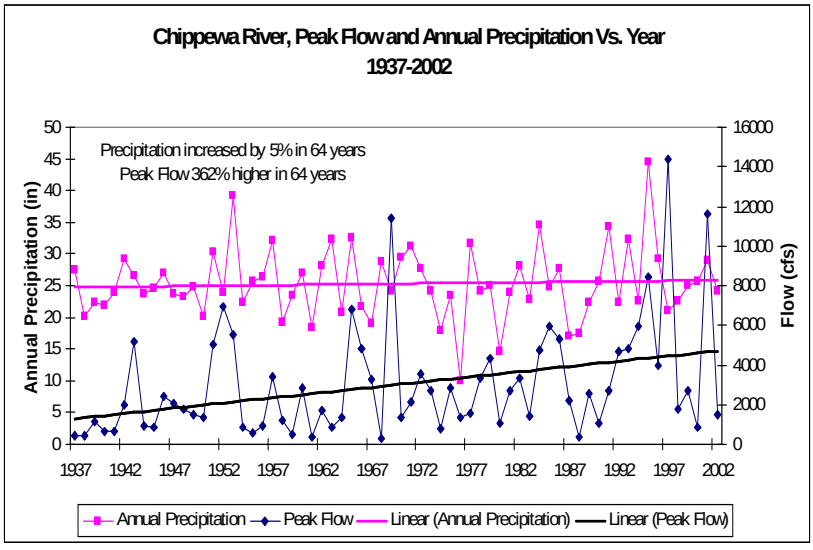


Flow

CRWP monitors flow as a matter of course in monitoring pollution concentrations. The example hydrograph for the Lower Mainstem (right) describes conditions observed. The Lower Mainstem is monitored at CRWP's Hwy 40 site. Hwy 40 is CRWP's most downstream site and therefore is considered the "outlet site". Note the unusually low spring melt and then the high water in late June and July. Also note how a three inch rain in September caused almost no change in flow while two months earlier a series of small rainstorms caused a three fold increase in flow.



At the Hwy 40 Chippewa River Mainstem site the USGS has been conducting the flow monitoring for 64 years. In this time they have documented a 350% increase in the annual high water level. The University of Minnesota Climatology Working Group has documented a 5 % increase in Rainfall over the same time. This suggests that there are other factors driving the increase in Peak flood events on the Chippewa River. Most likely human changes on the hydrology of the River have brought about the change. These include but are not limited to stream straightening , improvement of drainage, opening and drainage of previously closed systems, increased areas with impervious surfaces, removal of woodlands and grasslands.



Flow and pollution are directly related. The highest levels of pollution are observed during high water events. The higher the water the worse the pollution. This is a result of higher rates of upland erosion during the rainstorms that cause the high water and increased levels of bank erosion that results when rising river waters destabilize the river banks.

Total Suspended Solids

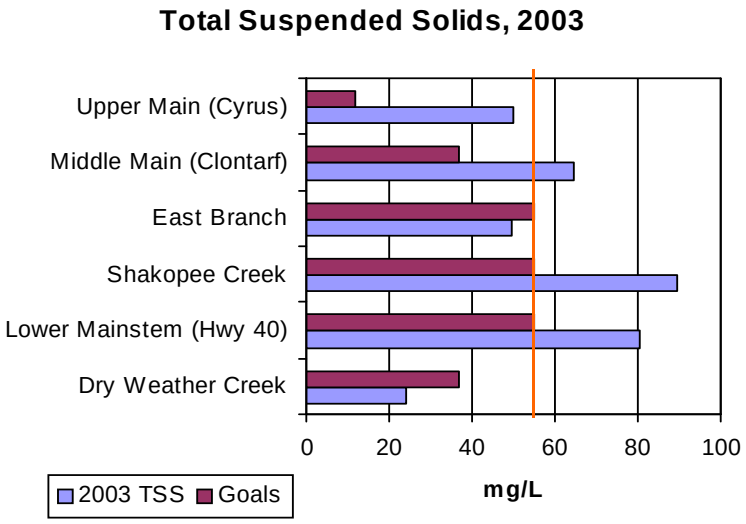
Total Suspended Solids (TSS)

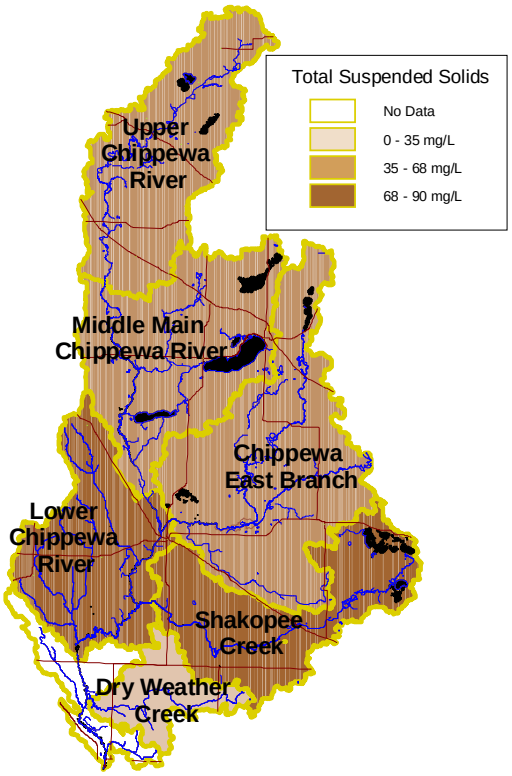
Flow weighted mean concentrations for 2003 were fairly close to 2002 concentrations. Overall we observed a continuation of the decreasing trend that has been observed over the last 4 years. One exception was observed to this trend. The Upper Mainstem, monitored at Site 2, Cyrus, over the past two years has exhibited much higher concentrations of TSS than in previous years.

While the decreasing TSS trend in 2003 is positive, most of the Chippewa sub-basins did not achieve their limited target goals that CRWP partners set for them in 1999. Shakopee Creek, the Upper Mainstem and the Middle Mainstem were the main contributors to the TSS being 47% over the target goal at Hwy 40. These concentrations will be hard to improve without cutting the upstream tributary concentrations and curbing peak flood events.

According to the Minnesota Pollution Control Agency, TSS concentrations of 58 through 66 mg/L can be used to list a river as impaired (red line on chart). The Lower Mainstem, Middle Mainstem and Shakopee Creek all had Flow Weighted mean concentrations exceeding this level.

Two basins deserve praise in 2003. The East Branch and Dry Weather Creek met their goal levels for TSS. This is the second year that they have achieved their goals.





What are Total Suspended Solids? <Taken From "State of The Minnesota River 2002 Executive Summary>
The transport of sediment is a natural function of rivers. Modification of the landscape has accelerated the rate of soil into waterways. Increased runoff has resulted in stream bank erosion. Elevated sediment (suspended soil particles) has many impacts It makes rivers look muddy, affecting aesthetics and swimming. Sediment carries nutrients, pesticides, and other chemicals into the river that may impact fish and wildlife species. Sedimentation can restrict the areas where fish spawn, limit biological diversity, and keep river water cloudy, reducing the potential for growth of beneficial plant species.

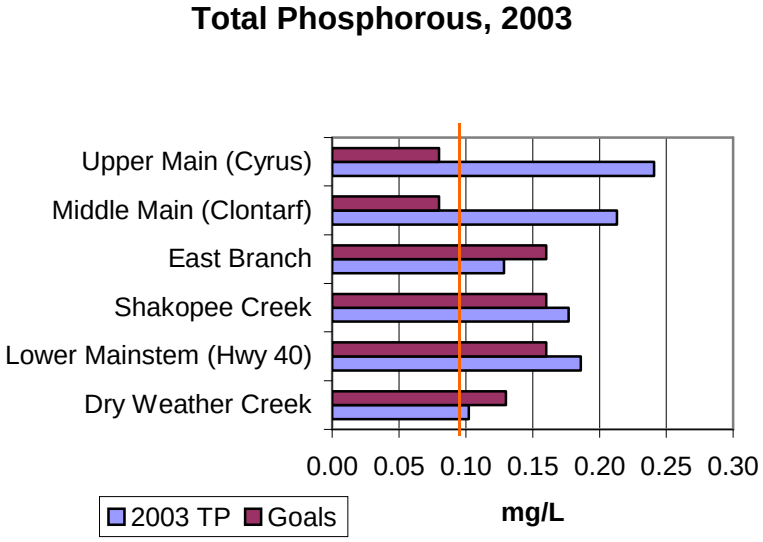
Total Phosphorous

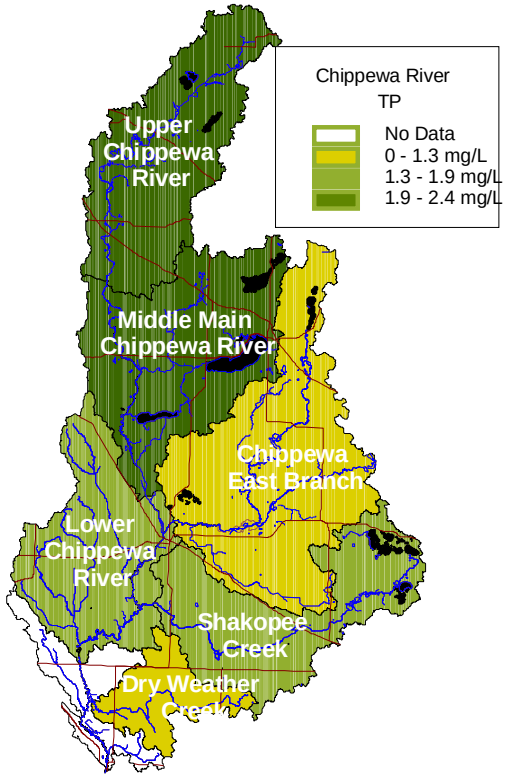
Total Phosphorous (TP)

Total phosphorous concentrations varied widely across the watershed (see chart at right). Two sub-basins, the East Branch and Dry Weather Creek achieved the goals that CRWP partners set for them in 1999. Furthermore, Dry Weather Creek almost achieved the 0.1 mg/L desired goal set by the Environmental Protection Agency for prevention of nuisance algal growth.

The Lower Mainstem and Shakopee Creek were both close to their goal concentrations. The Lower Mainstem was up 5% a statistically insignificant change. Shakopee Creek was down 27% over 2002 concentrations. This drop for Shakopee Creek is quite a jump

The Upper Main and Middle Main 2003 concentrations were the highest observed in 2003. They were also more than double their goal concentrations. The 2002 upper main flow weighted mean was 24% higher than 2002 and The 2003 Middle Main was 39% higher than 2002. This trend in the Chippewa River headwaters region is a growing concern and threatens to destabilize downstream efforts to bring phosphorous concentrations down





What is Phosphorus? <Taken From "State of The Minnesota River 2002 Executive Summary>

Phosphorus is an important nutrient for plant growth. Total Phosphorous is the measure of the total concentration of phosphorous present in a water sample. Excess phosphorus in the river is a concern because it can stimulate the growth of algae. Excessive algae growth, death, and decay can severely deplete oxygen supply in the river, endangering fish and other forms of aquatic life. Low dissolved oxygen rates are of particular concern during low flow times or in slow moving areas such as reservoirs and the lower reaches of the river.

Point-source Phosphorous comes mainly from municipal and industrial discharges to surface waters. Non-point-source phosphorous comes from runoff from urban areas, construction sites, agricultural lands, manure transported in from feedlots and agricultural lands and human waste from noncompliant septic systems.

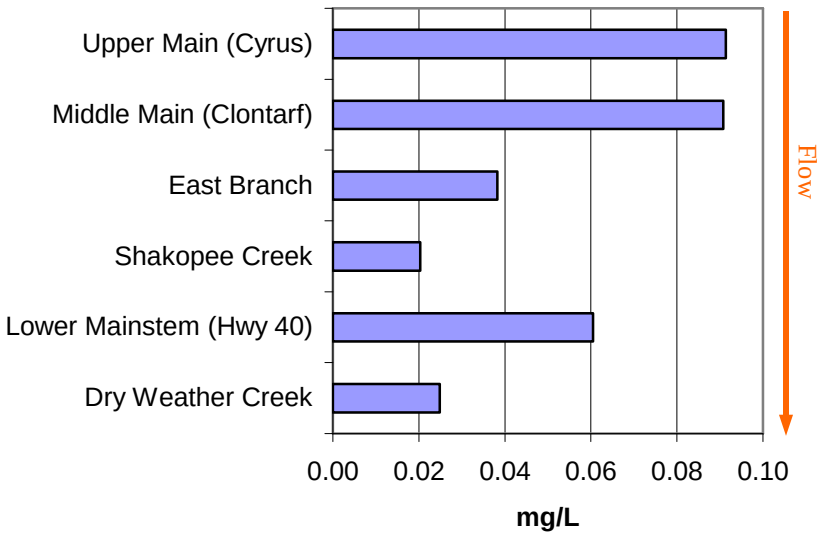
Orthophosphorous

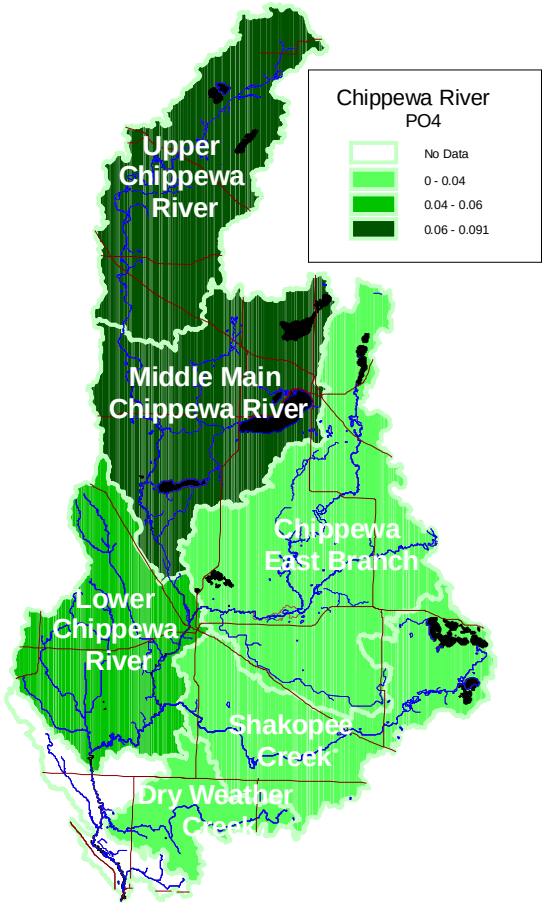
Orthophosphorous (OP)

Orthophosphorous concentrations varied widely across the watershed (see chart at right). Concentrations did appear to follow a logical pattern as water flowed downstream and tributaries contributed waters with different concentrations.

The Upper Mainstem and Middle Mainstem maintained fairly equal concentrations. It appears that the lower levels in the East Branch and Shakopee Creek worked to lower the final concentration observed at the Lower Mainstem monitoring site.

The Upper Main and Middle Main 2003 concentrations were the highest observed in 2003. They were also more than double that of any other contributing Chippewa tributary. Algae growth was noted at the Middle Mainstem monitoring site. Also, a minor fish kill which corresponded to low dissolved oxygen levels was observed downstream of the Upper Mainstem monitoring site.





What is Orthophosphorous? <Taken From "State of The Minnesota River 2002 Executive Summary>

Ortho phosphorus is soluble reactive phosphorous and is readily available for biological uptake. A particular concern with Orthophosphorous is that it is readily available to algae and under certain conditions can stimulate excess algae growth leading to subsequent depletion of dissolved oxygen. Primary sources of Orthophosphorous are wastewater treatment plants, feedlot runoff, and failing septic systems.

Nitrate Nitrite Nitrogen

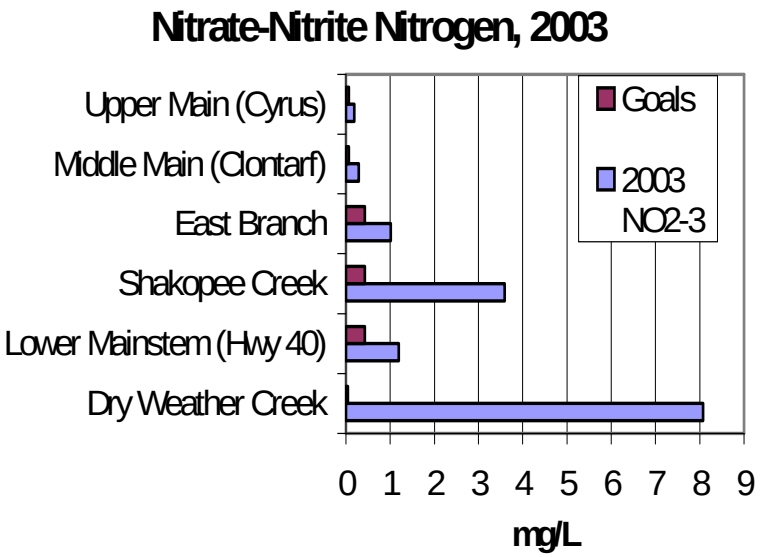
Nitrate Nitrite Nitrogen (NO2-3)

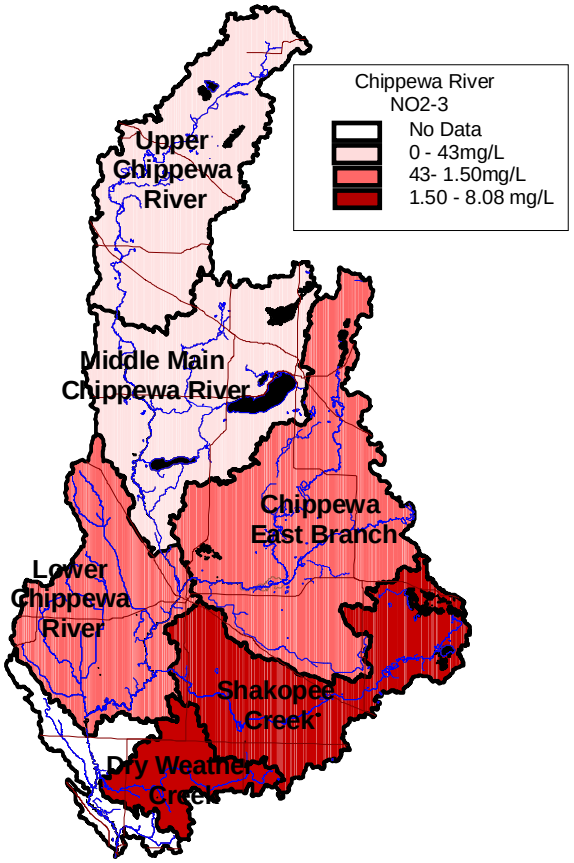
Nitrate Nitrite Nitrogen concentrations varied widely across the watershed (see chart at right). Concentrations appeared to follow a increasing pattern as water flowed downstream and tributaries contributed waters with more and more Nitrogen.

The Upper Mainstem Middle Mainstem and East Branch maintained fairly low concentrations. These low concentrations managed to stay relatively low even against the relative mountain of nitrogen coming out of Shakopee Creek and Lower Mainstem streams.

Dry Weather Creek saw the highest flow weighted mean of the sites monitored. Shakopee Creek, Dry weather Creek and the Lower Mainstem have the highest portion of their land under agricultural production and have very few land use types that typically retain or remove nitrogen from the landscape (wetlands, grasslands, forests).

No Chippewa sub-basin achieved the goals set for them by CRWP partners in 1999.





What are Nitrates? <Taken From "State of The Minnesota River 2002 Executive Summary>

Nitrogen exists in the environment in many forms. In recent decades, there has been a substantial increase in nitrogen fertilizer use. Elevated nitrate-N in the Chippewa River can pollute aquifers it recharges. Therefore nitrogen can affect drinking water. At high enough concentrations, nitrate-N can cause infants who drink the water to become sick and die (methemoglbinemia). Downstream, nitrate-N from the Chippewa River contributes to hypoxia (low levels of dissolved oxygen) in the Gulf of Mexico by stimulating the growth of algae which, through death and decay, consume large amounts of dissolved oxygen and thereby threaten aquatic life.

Fecal Coliform

Fecal Coliform

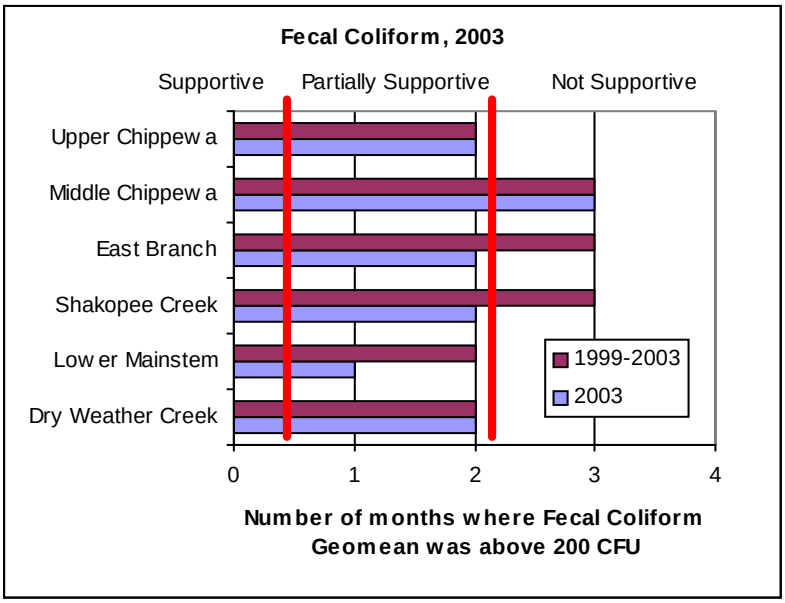
2003 Fecal Coliform levels were high during the months that residents of the Chippewa Watershed use the river for swimming. In the months of June through September 33 of 78 tests were above the 200 Colony Forming Units (CFU) per 100 ml standard acceptable for human skin contact.

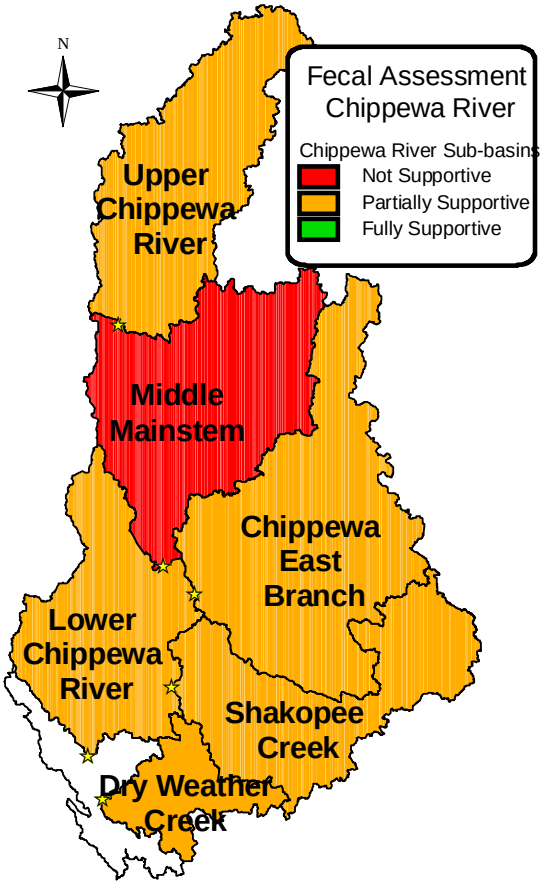
While some of the higher incidents of fecal coliform were after rain events indicating a field runoff event, many were during low flows suggesting that failed human septic systems are also a source.

Considering the evidence **swimming is not recommend from June through August**. in the Chippewa River.

Three Sites saw a slight improvement in 2003 over the last 5 years. The East Branch and Shakopee Creek were ranked as Partially Supportive as opposed to Not Supportive. The Lower Mainstem was ranked as Partially Supportive but with only one month where the fecal coliform were the geomean was above 200 CFU as opposed to two months.

The total number of events above 200 CFU was down in 2003. 26% of all tests came in above 200 CFU for 2003. That is less than the 34% for 1999-2002.





What is Fecal Coliform?

Fecal coliform are a broad group of bacteria found in the feces of warm-blood animals. They are easy to test for and are therefore a useful indicator of biological contamination. The presence of fecal coliform bacteria in aquatic environments indicates that the water has been recently (hours to a few days) contaminated by the feces. This fecal matter may be contaminated by pathogens, disease producing bacteria or viruses. The presence of fecal contamination is an indicator that a potential health risk exists for individuals exposed to this water. Fecal coliform bacteria may occur in ambient water as a result of the overflow of domestic sewage or nonpoint sources of human and animal waste.

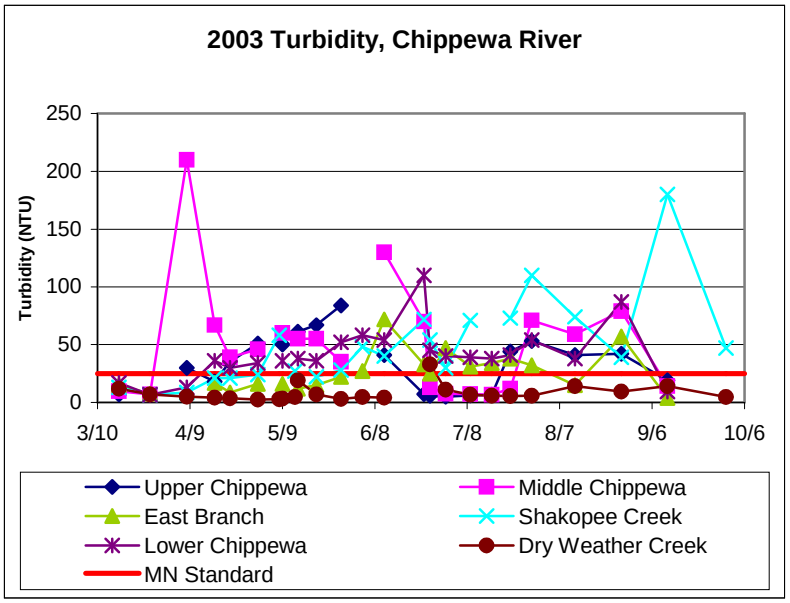
Turbidity

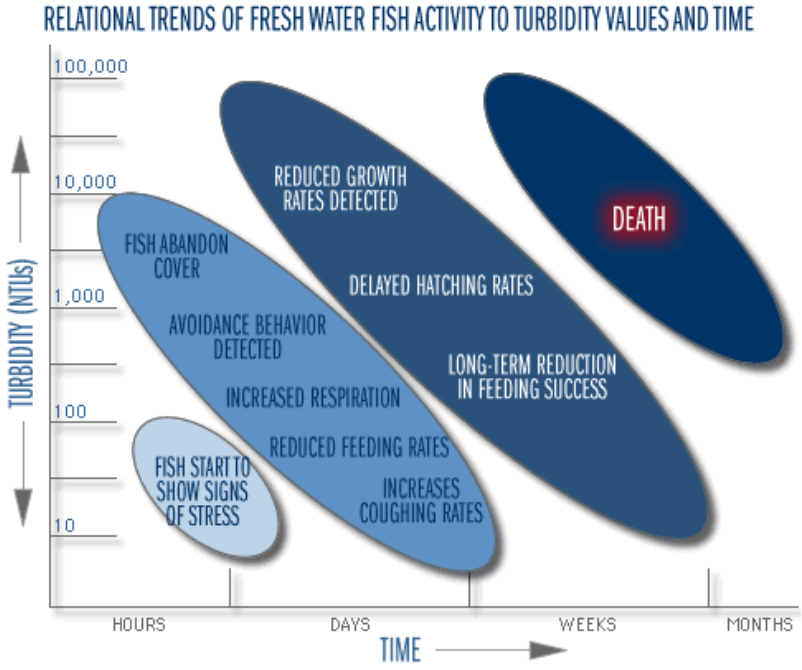
Turbidity

High turbidity was a prominent feature of most stretches of the Chippewa River in 2003. At all sites except Dry Weather Creek Turbidity levels regularly were observed above the MN State Standard of 25 NTUs (red line on chart to right).

High turbidity during high flows is expected and for the most part tolerable to aquatic species. The continuation of high turbidity for long periods of time including during low flow periods is concerning. The constant high turbidity levels suggest that aquatic habitat on the Chippewa is seriously degraded.

Currently, the lower 11 miles of the Chippewa are listed as impaired for turbidity. This data shows that the impairment goes all the way up the Chippewa River. It is a watershed wide problem that needs to be addressed throughout the watershed.





What is Turbidity?

Turbidity refers to how clear the water is. The greater the amount of total suspended solids (TSS) in the water, the murkier it appears and the higher the measured turbidity. Dredging operations, channelization, increased flow rates, floods, or even too many bottom-feeding fish (such as carp) may stir up bottom sediments and increase the cloudiness of the water.

High concentrations of particulate matter can modify light penetration, cause shallow lakes and bays to fill in faster, and smother benthic habitats - impacting both organisms and eggs. As particles of silt, clay, and other organic materials settle to the bottom, they can suffocate newly hatched larvae and fill in spaces between rocks which could have been used by aquatic organisms as habitat. Fine particulate material also can clog or damage sensitive gill structures, decrease their resistance to disease, prevent proper egg and larval development, and potentially interfere with particle feeding activities. If light penetration is reduced significantly, macrophyte growth may be decreased which would in turn impact the organisms dependent upon them for food and cover. Reduced photosynthesis can also result in a lower daytime release of oxygen into the water. Effects on phytoplankton growth are complex depending on too many factors to generalize.

Very high levels of turbidity for a short period of time may not be significant and may even be less of a problem than a lower level that persists longer. The figure above shows how aquatic organisms are generally affected.

<Taken from WOW. 2003. Water on the Web - Monitoring Minnesota Lakes on the Internet and Training Water Science Technicians for the Future - A National On-line Curriculum using Advanced Technologies and Real-Time Data .(http://wow.nrri.umn.edu). University of Minnesota-Duluth, Duluth, MN 55812.>

Conclusion

Conclusions

Overall, monitoring indicated that pollution continues to be an issue for the Chippewa River. Most sites did not achieve the goals set for them by project partners in 1999. Given this, many sites continued to support the decreasing pollution trend seen in the previous five years for many of the sites monitored. Sub-basins exemplifying this trend in some respects are Dry Weather Creek and the East Branch. Both basins achieved their goals that CRWP partners set for them in 1999 for total phosphorous and total suspended solids.

Some sites did not support the decreasing trend in 2003. The Upper Mainstem and Middle Mainstem Chippewa Rivers had issues with high concentrations of total phosphorous and Ortho phosphorous. Shakopee Creek and Dry Weather Creek had problematic levels of nitrate-nitrite nitrogen.

All basins expressed above the standard levels of fecal coliform during the summer swimming months. No basin was found to be fully supportive of swimming.

Special Thanks

Thanks to the Minnesota Pollution Control Agency's Clean Water Partnership Program for their funding and assistance in carrying out the monitoring and analysis. Thanks to Chippewa River Watershed Project's many partners for their continued support and participation.

CRWP Cooperating Partners:

Montevideo Wastewater Treatment Plant, Benson Wastewater Treatment Plant, Chippewa County Commissioners, Chippewa County Land and Resource Management, Chippewa Soil & Water Conservation District, Douglas County Commissioners, Douglas County Land and Resource Management, Douglas Soil & Water Conservation District, Grant Soil & Water Conservation District, Kandiyohi County Commissioners, Kandiyohi County Water Plan, Kandiyohi Soil & Water Conservation District, Land Stewardship Project, Minnesota Department of Natural Resources-Divisions of Forestry, Fisheries, and Water, Natural Resources Conservation Service, Prairie Country RC&D, Pope County Commissioners, Pope County Environmental Services, Pope Soil & Water Conservation District, Stevens Soil & Water Conservation District, Swift County Commissioners, Swift County Environmental Services, Swift Soil & Water Conservation District, WesMin RC&D