2010

Chisago Lakes Chain of Lakes Watershed Stream Monitoring

Summary

Chisago Soil & Water Conservation District

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Project Objective

The Chisago Lakes Lake Improvement District (LID), the Chisago Soil & Water Conservation District (SWCD) and the Minnesota Pollution Control Agency (MPCA) partnered to collect water quality monitoring data in the Chisago Lakes Chain of Lakes Watershed during 2009 and 2010. Gathering data to help determine the amounts of nutrients and sediment that are entering local lakes from small watersheds and tributaries is necessary for the Total Maximum Daily Load (TMDL) Study that is underway. This data will help the SWCD determine the best management practices and projects to clean up impaired waters and protect unimpaired waters.

Many sites were identified as practical locations for tributary sampling. Some of the sites identified prior to the monitoring season were determined to be either not suitable for sampling due to low water levels or redundant due to the proximity to a lake sampling location. These sites were left out to save both staff and lab costs and to reduce the likelihood of skewed data.

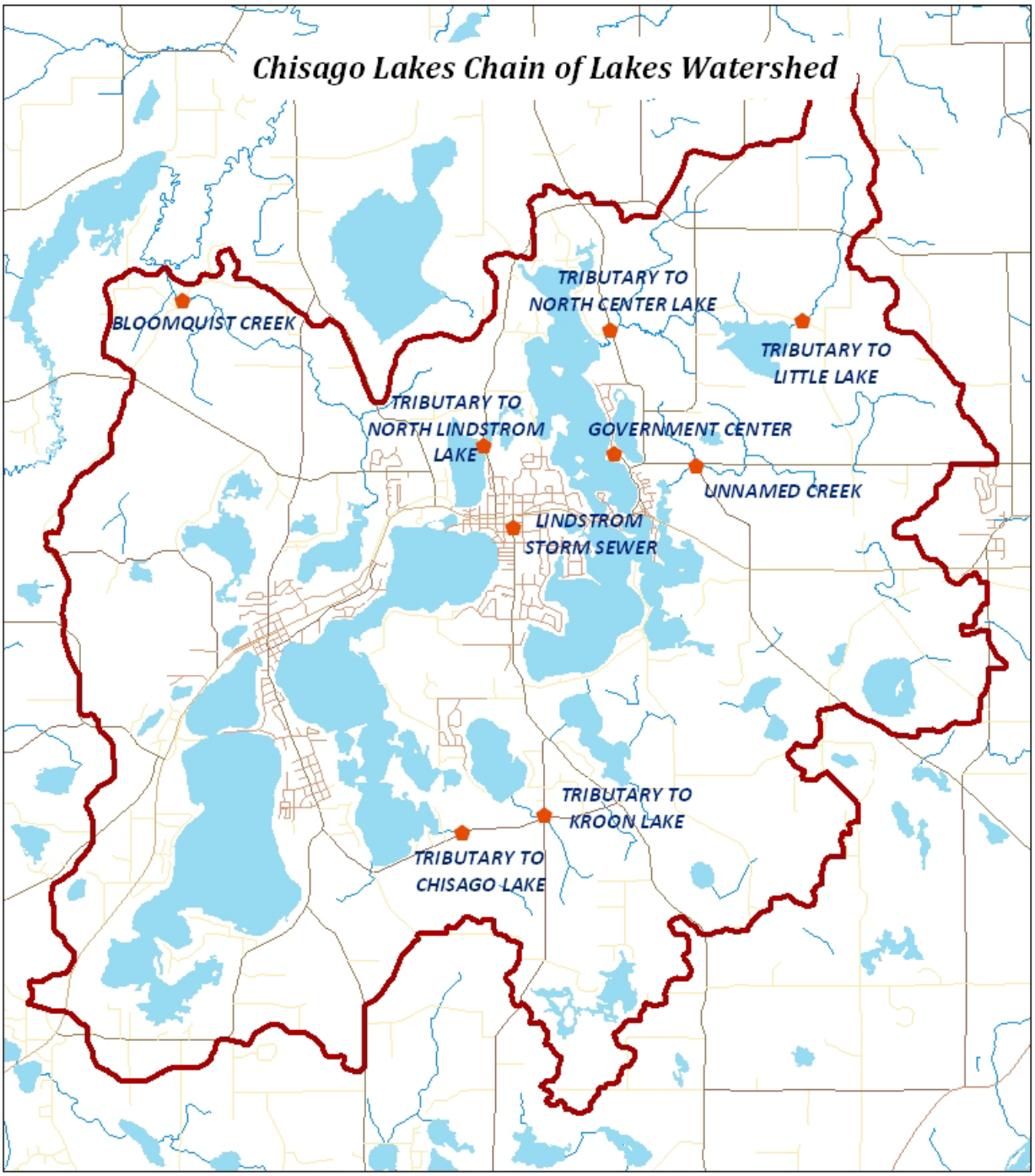
Methods

Twelve parameters were included in the sampling program, although not all parameters were sampled at each stream. When available, the MPCA standards for the North Central Hardwood Forest were used as a benchmark to judge the results by. Standards are not available for all parameters. When there is no established standard, the results are compared to the expected range for Chisago County. In some cases, a parameter has both a standard and an expected range. When this is the case, the standard is a more reliable and meaningful way to rate a stream. Orthophosphate has neither a standard nor an expected range. Orthophosphate was sampled so that the phosphorus source could be determined (inorganic or organic phosphorus). Orthophosphate results typically indicate inorganic phosphorus; therefore, by subtracting the orthophosphate from the total phosphorus, one can compare the organic versus inorganic amounts, which may suggest a source of the phosphorus.

A further explanation of the parameters, including the standards and expected ranges for each parameter, can be found on page 4.

In this report, the averages of stream data are found in a chart below a graph for each parameter on each stream. The average for 2009 includes only data from 2009. The average for 2010 is computed with only 2010 data. The overall average is an average of all data from 2009 and 2010. It is not an average of the averages.

Monitoring Locations



2008-2010 Water Quality Monitoring Sites

Monitored by the Chisago SWCD

Tributary Monitoring Sites

Lake

Stream

0 3,000 6,000 12,000 Feet

N

Explanation of Parameters

Parameter	Unit	MPCA Standard-North Central Hardwood Forest	Expected Range Chisago County
Ammonia Nitrogen*	mg/L	Under Development	0.02-0.28 mg/L
*Ammonia nitrogen samples lower than 0.05 are reported as 0.05 mg/L.			
Dissolved Oxygen	mg/L	No more than 50% below 5.0 mg/L	>5.0 mg/L
E. Coli	org/100 mL	Average 126 organisms/100 mL	No Range
Nitrate + Nitrite	mg/L	Under Development	0.01-0.18 mg/L
Orthophosphate	mg/L	No Standard	No Range
pH	mg/L	No more than 50% below 7.0	7.9-8.3
Temperature	°F	The daily average shall not exceed 86.0°F	35.6-69.8
Total Kjedahl Nitrogen	mg/L	Under Development	0.5-3.0 mg/L
Total Phosphorus	mg/L	Under Development	0.06-0.15
Total Suspended Solids	mg/L	Proposed at No more than 10% above 30.0 mg/L	4.8-16.0
Transparency	cm	Average <20 cm	No Range
Turbidity	NTU	Average 25 NTU	3.0-8.5 NTU

Ammonia Nitrogen - An inorganic form of nitrogen contained in fertilizers, septic system effluent, and animal wastes. It is also a product of bacterial decomposition of organic matter. Ammonia nitrogen becomes a concern if high levels of the un-ionized form are present. In this form, it can be toxic to aquatic organisms. The presence of un-ionized ammonia is a function of the ammonia nitrogen concentration, pH, and temperature. Conversion of ammonia nitrogen to nitrite nitrogen by nitrification requires large quantities of oxygen which can kill aquatic organisms due to the lowered dissolved oxygen concentrations in water. Samples are reported in mg/L. The lowest reported amount is 0.05 mg/L; samples less than this amount are reported as 0.05 mg/L.

Dissolved Oxygen (DO) - The concentration of molecular oxygen (O2) dissolved in water. The DO level represents one of the most important measurements of water quality and is a critical indicator of a water body's ability to support healthy ecosystems. Levels above 5 mg/L are considered optimal, and most fish cannot survive for prolonged periods at levels below 3 mg/L. Microbial communities in water use oxygen to breakdown organic materials, such as manure, sewage and decomposing algae. Low levels of dissolved oxygen can be a sign that too much organic material is in a water body. DO is reported as mg/L.

Escherichia coli (E. coli) - A subgroup of fecal coliform bacteria that is present in the intestinal tracts and feces of warm-blooded animals. It is used as an indicator of the potential presence of pathogens. There are many different strains of E. coli that are classified into more than 170 groups. Although most strains of E. coli are harmless and live in the intestines of healthy humans and animals, the E. coli O157:H7 strain produces a powerful toxin and can cause severe illness. E. coli is reported as the number of organisms per 100 mL sample.

Nitrate + Nitrate - Nitrate (NO3) plus nitrite (NO2) as nitrogen. In lakes, most nitrate/nitrogen is in NO3 form. Elevated levels of nitrates/nitrogen are often caused by over application of fertilizers that leach into waterbodies. It is measured in mg/L.

Orthophosphate - Water-soluble inorganic form of phosphorus in the form PO_4. Primary sources include water treatment facilities, feedlot runoff, failing septic systems. This form of phosphorus is more readily available for algae growth. Orthophosphate is measured in mg/L.

pH - A measure of acidity, with 7 being neutral. Numbers under 7 are acidic and numbers over 7 are alkaline. There is no unit associated with pH.

Temperature - A specific degree of hotness or coldness as indicated on or referred to a standard scale. Lakes in Chisago County meet the standard for temperature if the daily average temperature does not exceed 86.0°F.

Total Kjedahl Nitrogen -The sum of organic nitrogen and ammonia in a water body. Measured in milligrams per liter (mg/L). High measurements of TKN typically results from sewage and manure discharges to water bodies.

Total Phosphorus - A nutrient essential to the growth of organisms and commonly the limiting factor of primary productivity of surface water bodies. Total phosphorus includes the amount of phosphorus in solution (reactive) and in particle form. Agricultural drainage, wastewater, and certain industrial discharges are typical sources of phosphorus and can contribute to the eutrophication of surface water bodies (MPCA). The lower the reading, the clearer the water. Total phosphorus is measured in mg/L.

Total Suspended Solids - Very small particles remaining dispersed in a liquid such as wastewater due to turbulent mixing that can create turbid or cloudy conditions. Total suspended solids cause interference with light penetration, build up of sediment, and potential reduction in aquatic habitat. Solids also carry nutrients that cause algal blooms and other toxic pollutants that are harmful to fish. The lower the reading, the clearer the water.

Transparency Tube - A measure of water clarity in a 100 cm tube with a black and white disk at the bottom. Letting water out of the tube until you can see the disk will give you the transparency reading. The higher the reading, the clearer the water is.

Turbidity - Turbidity in water is caused by suspended matter, such as clay, silt, finely divided organic and inorganic matter, soluble colored organic compounds, and plankton and other microscopic organisms. In streams, a major cause of elevated turbidity is disturbed and eroding soils carried by storm run-off to streams. Once in the stream system, elevated turbidity reduces the depth of photosynthesis and the feeding ability of aquatic organisms. When soils settle out in downstream reaches with slower flow, bed substrate becomes embedded, removing essential habitat for aquatic insects and other organisms. Turbidity is expressed in NTU (Nephelometric Turbidity Units).

Stream S000-997
Bloomquist Creek

BLOOMQUIST CREEK is a small creek that is a direct tributary to the Sunrise River. This creek runs through a very large wetland complex. During high flow situations the creek is the outlet from the Chisago Lakes Chain of Lakes Watershed. Bloomquist Creek also collects water from the Chisago Lakes Joint Sewage Treatment Commission, which is the wastewater treatment facility for the cities of Stacy, Chisago City, Lindstrom, Center City and Wyoming. This is the largest stream within the Chisago Lakes Chain of Lakes Watershed and flows year round. The water in Bloomquist Creek is generally clear. In the summer months when low flows are present, water north of the sampling point is stagnant and is often covered in duckweed.

Summary of Stream

Parameter	Overall Average	Standard	Meets Average	Standard Range	Within Expected Range
Dissolved oxygen	6.4 mg/L	No more than 50% below 5.0 mg/L	Yes	Over 5.0 mg/L	Yes
Temperature	56.3 ˚F	Daily average not above 86.0 ˚F	Yes	35.6-69.8 ˚F	Yes
Ammonia Nitrogen	2.78 mg/L	N/A	N/A	0.02-0.28 mg/L	No
Nitrate + Nitrite	0.21 mg/L	N/A	N/A	0.01-0.18 mg/L	No
Total Kjedahl Nitrogen	3.9 mg/L	N/A	N/A	0.5-3.0 mg/L	No
pH	7.6	No more than 50% below 7.0	Yes	7.9-8.3	No (Below)
Total Phosphorus	0.67 mg/L	N/A	N/A	0.06-0.15 mg/L	No
Orthophosphate	0.61 mg/L	N/A	N/A	N/A	N/A
E. coli	142 org/100 ml	<126 organisms/100 ml	No	N/A	N/A
Total Suspended Solids	10.1 mg/L	No more than 10% above 30.0 mg/L	Yes	4.8-16.0 mg/L	Yes
Transparency	89.2 cm	>20.0 cm	Yes	N/A	N/A
Turbidity	12.9 NTU	<25.0 NTU	Yes	3.0-8.5 NTU	No

TRIBUTARY TO CHISAGO LAKE is a small tributary that enters the south end of Chisago Lake. This creek has a small rural watershed and therefore, does not have a large amount of flow. Often, this creek appears rust-colored from large amounts of tannins. Tannin is an indication of breaking down organic matter (leaves, grass and peat) in the watershed and the water. This can make the phosphorus and nitrogen levels high. Samples were only taken when the water was flowing which was generally after rain events, therefore, most of the readings are higher than baseline numbers.

Summary of Stream

Parameter	Overall Average	Standard	Meets Average	Standard Range	Within Expected Range
Dissolved oxygen	6.4 mg/L	No more than 50% below 5.0 mg/L	Yes	Over 5.0 mg/L	Yes
Temperature	52.9 ˚F	Daily average not above 86.0 ˚F	Yes	35.6-69.8 ˚F	Yes
Ammonia Nitrogen	0.09 mg/L	N/A	N/A	0.02-0.28 mg/L	Yes
pH	7.1	No more than 50% below 7.0	Yes	7.9-8.3	No (Below)
Total Phosphorus	0.27 mg/L	N/A	N/A	0.06-0.15 mg/L	No
Orthophosphate	0.10 mg/L	N/A	N/A	N/A	N/A
Total Suspended Solids	61.2 mg/L	No more than 10% above 30.0 mg/L	No	4.8-16.0 mg/L	No
Transparency	65.0 cm	>20.0 cm	Yes	N/A	N/A
Turbidity	11.5 NTU	<25.0 NTU	Yes	3.0-8.5 NTU	No

Stream S001-457
Tributary to Kroon Lake

Tributary to Kroon Lake is a small tributary draining a rural area of Chisago Lakes Township. The stream is often red or rusty colored, meaning that there are a lot of tannins in the water column. Tannin is an indication of breaking down organic matter (leaves, grass and peat) in the watershed and the water. This can make the phosphorus and nitrogen levels high. The small tributary is the outlet from Boo Lake to Kroon Lake. Boo Lake is a large open water wetland with large amounts of vegetation. It is possible that Boo Lake collects pollutants during low water years and flushes out pollutants in higher water situations. Samples were only taken when the water was flowing which was generally after rain events, therefore, most of the readings are higher than baseline numbers.

Summary of Stream

Parameter	Overall Average	Standard	Meets Average	Standard Range	Within Expected Range
Dissolved oxygen	5.3 mg/L	No more than 50% below 5.0 mg/L	Yes	Over 5.0 mg/L	Yes
Temperature	52.3 ˚F	Daily average not above 86.0 ˚F	Yes	35.6-69.8 ˚F	Yes
Ammonia Nitrogen	0.09 mg/L	N/A	N/A	0.02-0.28 mg/L	Yes
pH	7.1	No more than 50% below 7.0	Yes	7.9-8.3	No (Below)
Total Phosphorus	0.96 mg/L	N/A	N/A	0.06-0.15 mg/L	No
Orthophosphate	0.20 mg/L	N/A	N/A	N/A	N/A
Total Suspended Solids	49.2 mg/L	No more than 10% above 30.0 mg/L	No	4.8-16.0 mg/L	No
Transparency	50.0 cm	>20.0 cm	Yes	N/A	N/A
Turbidity	28.2 NTU	<25.0 NTU	No	3.0-8.5 NTU	No

Stream S005-120
Tributary to North Center Lake

TRIBUTARY TO NORTH CENTER LAKE is a small creek that drains the area between Little Lake and North Center Lake. This stream always flows; however, during low flow the water is only an inch deep or less. This low water level makes it hard to take accurate samples without getting stream substrate in the sample bottle. Directly upstream from this monitoring location is a wetland complex. Further upstream in the watershed, the stream runs through a wooded buffer. Overall, the water is clear with a tint of rust from breaking down tannins, likely from large amounts of leaf litter in the watershed.

Summary of Stream

Parameter	Overall Average	Standard	Meets Average	Standard Range	Within Expected Range
Dissolved oxygen	5.9 mg/L	No more than 50% below 5.0 mg/L	Yes (Barely)	Over 5.0 mg/L	Yes
Temperature	59.4 ˚F	Daily average not above 86.0 ˚F	Yes	35.6-69.8 ˚F	Yes
Ammonia Nitrogen	0.08 mg/L	N/A	N/A	0.02-0.28 mg/L	Yes
pH	6.8	No more than 50% below 7.0	No	7.9-8.3	No (Below)
Total Phosphorus	0.45 mg/L	N/A	N/A	0.06-0.15 mg/L	No
Orthophosphate	0.33 mg/L	N/A	N/A	N/A	N/A
Total Suspended Solids	5.9 mg/L	No more than 10% above 30.0 mg/L	Yes	4.8-16.0 mg/L	Yes
Transparency	74.0 cm	>20.0 cm	Yes	N/A	N/A
Turbidity	15.5 NTU	<25.0 NTU	Yes	3.0-8.5 NTU	No

Stream S005-121
Tributary to Little Lake

Tributary to Little Lake is a small creek that drains into Little Lake in the northeast portion of the Chisago Lakes Chain of Lakes Watershed. This creek's watershed is rural with both animal and cropland agriculture. There is also a large wetlands complex in the upper portion of the watershed. The large wetland complex could be flushing out the phosphorus that it collected during the low flow times of 2007-2009 during the higher flows of 2010.

Summary of Stream

Parameter	Overall Average	Standard	Meets Average	Standard Range	Within Expected Range
Dissolved oxygen	7.0 mg/L	No more than 50% below 5.0 mg/L	Yes	Over 5.0 mg/L	Yes
Temperature	60.3 ˚F	Daily average not above 86.0 ˚F	Yes	35.6-69.8 ˚F	Yes
Ammonia Nitrogen	0.11 mg/L	N/A	N/A	0.02-0.28 mg/L	Yes
pH	6.9	No more than 50% below 7.0	No	7.9-8.3	No (Below)
Total Phosphorus	0.80 mg/L	N/A	N/A	0.06-0.15 mg/L	No
Orthophosphate	0.65 mg/L	N/A	N/A	N/A	N/A
Total Suspended Solids	13.1 mg/L	No more than 10% above 30.0 mg/L	Yes	4.8-16.0 mg/L	Yes
Transparency	56.0 cm	>20.0 cm	Yes	N/A	N/A
Turbidity	14.0 NTU	<25.0 NTU	Yes	3.0-8.5 NTU	No

Stream S005-122
Unnamed Creek to South Center Lake

UNNAMED CREEK is a small creek that is a tributary to the backwaters of South Center Lake. The creek runs through a rural watershed. At this sampling point, the water was extremely low in 2008 and 2009 which allowed the stream bed to grow large amounts of vegetation. This vegetation and the low water levels could have made more organic matter present in the water column than would have been present if higher flows were present more often.

Summary of Stream

Parameter	Overall Average	Standard	Meets Average	Standard Range	Within Expected Range
Dissolved oxygen	3.5 mg/L	No more than 50% below 5.0 mg/L	No	Over 5.0 mg/L	No
Temperature	59.7 ˚F	Daily average not above 86.0 ˚F	Yes	35.6-69.8 ˚F	Yes
Ammonia Nitrogen	0.08 mg/L	N/A	N/A	0.02-0.28 mg/L	Yes
pH	6.9	No more than 50% below 7.0	No	7.9-8.3	No (Below)
Total Phosphorus	1.02 mg/L	N/A	N/A	0.06-0.15 mg/L	No
Orthophosphate	0.55 mg/L	N/A	N/A	N/A	N/A
Total Suspended Solids	7.4 mg/L	No more than 10% above 30.0 mg/L	Yes	4.8-16.0 mg/L	Yes
Transparency	65.0 cm	>20.0 cm	Yes	N/A	N/A
Turbidity	11.1 NTU	<25.0 NTU	Yes	3.0-8.5 NTU	No

LINDSTROM STORM SEWER is in downtown Lindstrom and collects stormwater from the Lindstrom City Hall to Olinda Trail in an open ditch. At Olinda Trail, the stormwater travels through a large stormwater pipe to South Lindstrom Lake. This pipe is a problem for landowners near where it outlets. The majority of the time, this stormwater ditch is stagnant. Sampling was not done often, due to the lack of flow.

Summary of Stream

Parameter	Overall Average	Standard	Meets Average	Standard Range	Within Expected Range
Dissolved oxygen	3.8 mg/L	No more than 50% below 5.0 mg/L	No	Over 5.0 mg/L	No
Temperature	59.9 ˚F	Daily average not above 86.0 ˚F	Yes	35.6-69.8 ˚F	Yes
Ammonia Nitrogen	0.21 mg/L	N/A	N/A	0.02-0.28 mg/L	Yes
pH	7.1	No more than 50% below 7.0	Yes	7.9-8.3	No (Below)
Total Phosphorus	0.30 mg/L	N/A	N/A	0.06-0.15 mg/L	No
Orthophosphate	0.10 mg/L	N/A	N/A	N/A	N/A
Total Suspended Solids	34.7 mg/L	No more than 10% above 30.0 mg/L	No	4.8-16.0 mg/L	No
Transparency	55.0 cm	>20.0 cm	Yes	N/A	N/A
Turbidity	16.0 NTU	<25.0 NTU	Yes	3.0-8.5 NTU	No

Stormwater Runoff from the Chisago County Government Center Parking Areas was sampled a few times. This was to view data coming off the road and parking areas in a highly impervious area. Runoff from the Government Center enters North Center Lake in several locations. Stormwater runoff carries many pollutants directly and quickly to lakes. The main concern of stormwater runoff is generally sediment which is easily carried by moving water. This data shows that pollutants are transported by stormwater.

Summary of Stream

Parameter	Overall Average	Standard	Meets Average	Standard Range	Within Expected Range
Ammonia Nitrogen	0.10 mg/L	N/A	N/A	0.02-0.28 mg/L	Yes
Total Phosphorus	0.17 mg/L	N/A	N/A	0.06-0.15 mg/L	No
Orthophosphate	0.08 mg/L	N/A	N/A	N/A	N/A
Total Suspended Solids	79.0 mg/L	No more than 10% above 30.0 mg/L	No	4.8-16.0 mg/L	No
Transparency	14.0 cm	>20.0 cm	Yes	N/A	N/A

Stream S005-128
Tributary from North Center Lake

THE TRIBUTARY FROM NORTH CENTER LAKE connects North Center Lake to North Lindstrom Lake through a channel that has been maintained a few times in the past, but not recently. This channel was so low during the sampling seasons that very few readings were taken. The few baseline samples that were taken will need to be compared to the readings in North Center Lake and North Lindstrom Lake. If higher water levels occur, more sampling could be done to determine the water quality connections between North Center and North Lindstrom Lakes.

Summary of Stream

Parameter	Overall Average	Standard	Meets Average	Standard Range	Within Expected Range
Total Phosphorus	0.05 mg/L	N/A	N/A	0.06-0.15 mg/L	No (Below)
Orthophosphate	0.01 mg/L	N/A	N/A	N/A	N/A
Total Suspended Solids	6.6 mg/L	No more than 10% above 30.0 mg/L	Yes	4.8-16.0 mg/L	Yes
Transparency	80.0 cm	>20.0 cm	Yes	N/A	N/A

Chisago
SWCD