Metropolitan Council

Environmental Services

2010

Annual River Water Quality Assessment Report

The Metropolitan Council has a long history of leadership in protecting the quality of water in the seven-county Twin Cities metropolitan area. As the metro area population continues to grow, it is the job of the Council to plan for and oversee the growth while maintaining environmental integrity.

The Council is charged under state law with developing a comprehensive development guide for the metro area that consists of policy statements, goals, standards, programs, and maps prescribing guidance for the orderly and economical development of the region. The development guide consists of the *2030 Regional Development Framework* (Framework) and “system plans” for wastewater, regional recreation and open space, and transportation (including aviation).

The Framework includes a policy that directs the Council to work with local and regional partners to reclaim, conserve, protect and enhance the region’s vital natural resources as well as a regional benchmark specifically for water quality: the water quality leaving the metropolitan area is as good as the water quality entering the metropolitan area and in compliance with federal and state regulations. The *Water Resources Management Policy Plan,* which includes the wastewater system plan, also includes policies and implementation strategies directing staff to measure and assess our lakes, rivers and streams with the goal of measuring our success in meeting the no-adverse-impact benchmark of the Framework.

Minnesota Stat. 103F.721 mandates the Council to assess the metro area waters (rivers, streams and lakes) that have been polluted or that have the potential for pollution. As part of the commitment of Metropolitan Council Environmental Service (MCES) to preserving and protecting water quality, the agency supports several water monitoring programs that collect a variety of data for area rivers, streams, and lakes. Today MCES has an extensive network of lake, stream and river monitoring sites to detect seasonal and annual changes in water quality throughout the metro area. The purpose of this report is to summarize and assess river water quality information collected in 2010 by MCES.

Assessments of the region’s water supply, lake water quality, metropolitan area streams, and other water-related reports can be found on the Council website at:

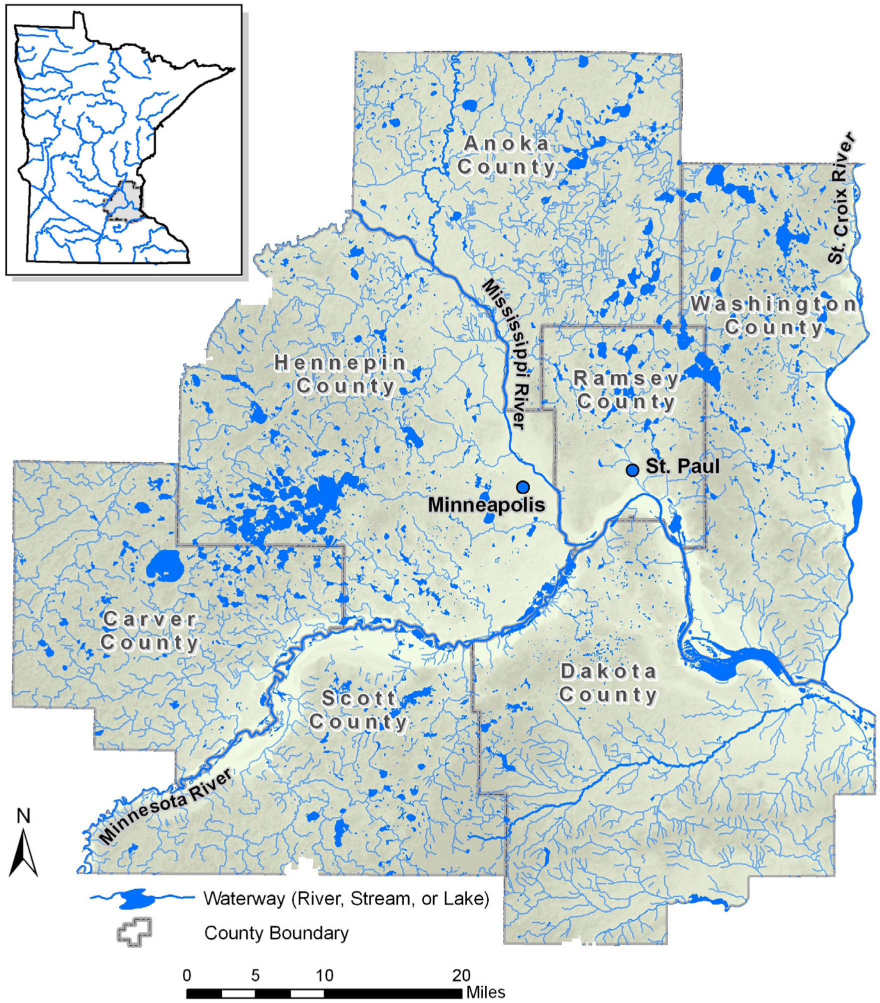
http://www.metrocouncil.org/Reports/water_reports.htm

In this Report:

Figures:

River Water Quality Partnerships and Collaboration

To achieve Metropolitan Council objectives related to river water quality, MCES collaborates with various federal and state agencies to evaluate the health of the rivers. MCES relies on the United States Geological Survey (USGS) and the Corps of Engineers for flow monitoring data used in conjunction with the MCES river water quality information. In addition, MCES relies on the United States Environmental Protection Agency (EPA) and the Minnesota Pollution Control Agency (MPCA) to provide guidance related to federal and state wastewater treatment plant (WWTP) effluent regulations and limits for the Council's seven treatment plants.



Hydrologic Network within the Metro Area

Potential Sources of Water Pollution

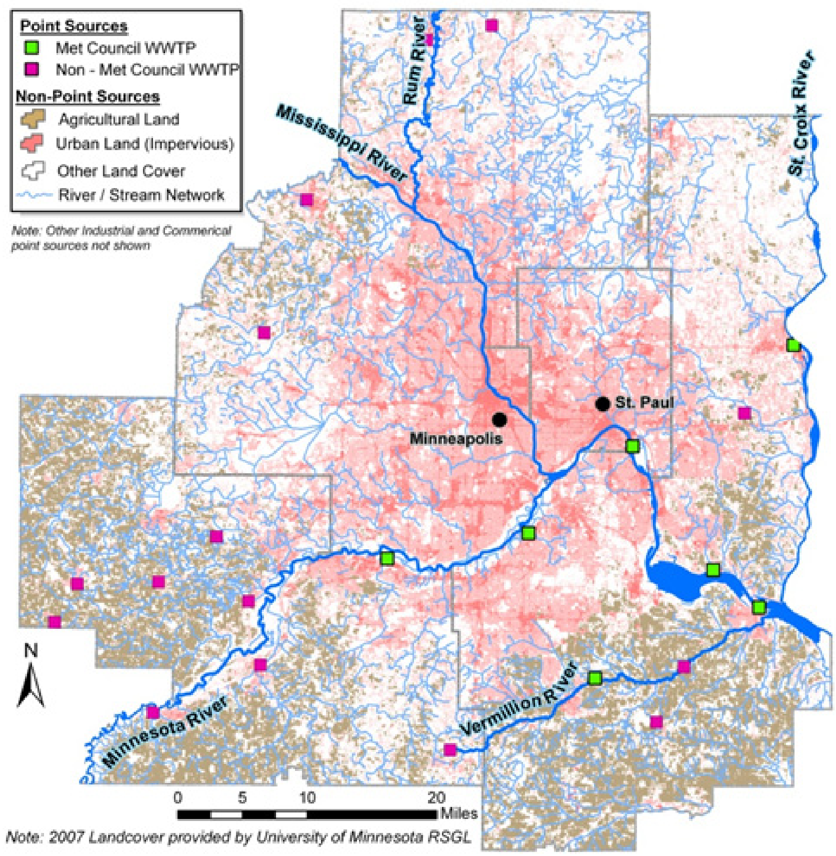
Sources of water quality pollution vary throughout the metro area. For regulatory purposes as defined by the federal Clean Water Act, the source of water pollution is categorized as point or nonpoint.

Point-source Pollution

Point-source pollution originates from an identifiable end-of-pipe source, typically treated or untreated wastewater, called effluent, from wastewater treatment plants or industrial facilities. MCES owns and operates the region's seven largest treatment plants, which discharge treated effluent into the Mississippi, Minnesota and St. Croix rivers. Additionally, there are approximately 200 other MPCA-permitted point sources such as industrial facilities and small municipal WWTPs throughout the metro area.

Nonpoint source (NPS) Pollution

NPS pollution is the transport of pollutants across the landscape via runoff into waterways. NPS pollution begins with the alteration of the landscape caused by agricultural production and urban development. NPS pollution can originate from diffuse sources such as stormwater runoff from parking lots and lawns, and erosion from farm fields, construction areas, and highways.



Point Sources (Wastewater Treatment Effluent) and Nonpoint Sources within the Metro Area

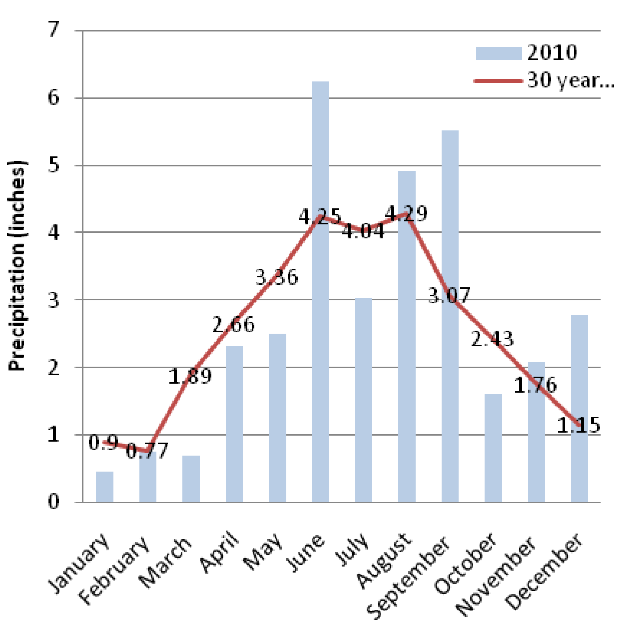
Factors Affecting Water Quality in 2010

The origins of water pollution are dependent on multiple variables including precipitation, topography, land management and population throughout the region.

Precipitation

The transport of pollutants to rivers and streams is mainly driven by precipitation. The amount, intensity and timing of precipitation influences water quality. For example, heavy rainfall or rapid snowmelt events increase the risk of water pollution from agricultural and urban runoff. During dry years, river and stream flows decline and water quality deterioration may occur when nutrients and contaminants become more concentrated in reduced volumes.

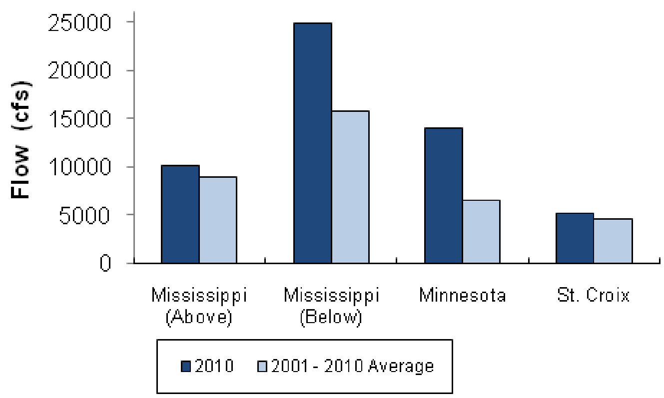
2010 and Average (1981-2010) Monthly Precipitation at Minneapolis St. Paul International Airport



Regional precipitation is measured at the Minneapolis-St. Paul International Airport (MSP), and is a good indicator of significant runoff events because of its central location, even though actual precipitation varies throughout the metro area. In 2010, the metro area experienced slightly above-normal annual precipitation, with 32.89 inches recorded at MSP, compared to the 30-year (1981-2010) annual average of 30.57 inches. 2010 started out with a dry spring and above-normal temperatures, earlier-than-normal snowmelt and ice-out, and low precipitation. Summer was characterized by large storms which produced most of the precipitation. June and August had higher-than-normal precipitation while May and July had lower-than-normal precipitation. Fall 2010 was one of the wettest on record with much-higher-than-normal precipitation in September and December. The largest flood event to hit southern Minnesota began in the early afternoon of September 22 and tapered off during the evening of September 23. More than four inches of rain fell in nearly all southern Minnesota communities, while six or more inches of rain fell in several locations. In the metro area, the Mississippi River rose above flood stage (14 feet) at St. Paul on September 29. This is the first time that the Mississippi River has reached above flood stage in the fall. Overall the warm season precipitation total was higher than normal. Precipitation totals were above the 30-year averages for the months of June, August, September, November and December.

Precipitation results in runoff, which carries nonpoint-source pollution from urban and agricultural areas to metro area rivers. It also increases river flow, which may affect the fate and impact of pollutants in the river system. During wet periods, nonpoint-source pollutants are carried to rivers, and higher flows can also cause stream-bank erosion, habitat destruction and flooding. During dry periods, flows may be too low to sufficiently dilute pollution, sediment deposition increases, and habitat quality may be adversely affected. Like precipitation, flows for 2010 were above average. Flows were high in early spring due to the high temperatures and fast snowmelt, then low in late spring and early summer, and then high throughout late summer and fall. The ground was saturated going into fall; consequently, much of the precipitation received became runoff, especially in the Minnesota and Mississippi River basins. Near record high flows were experienced in November and December.

2010 Flow Compared with Average Flow (2001-2010)



Topography

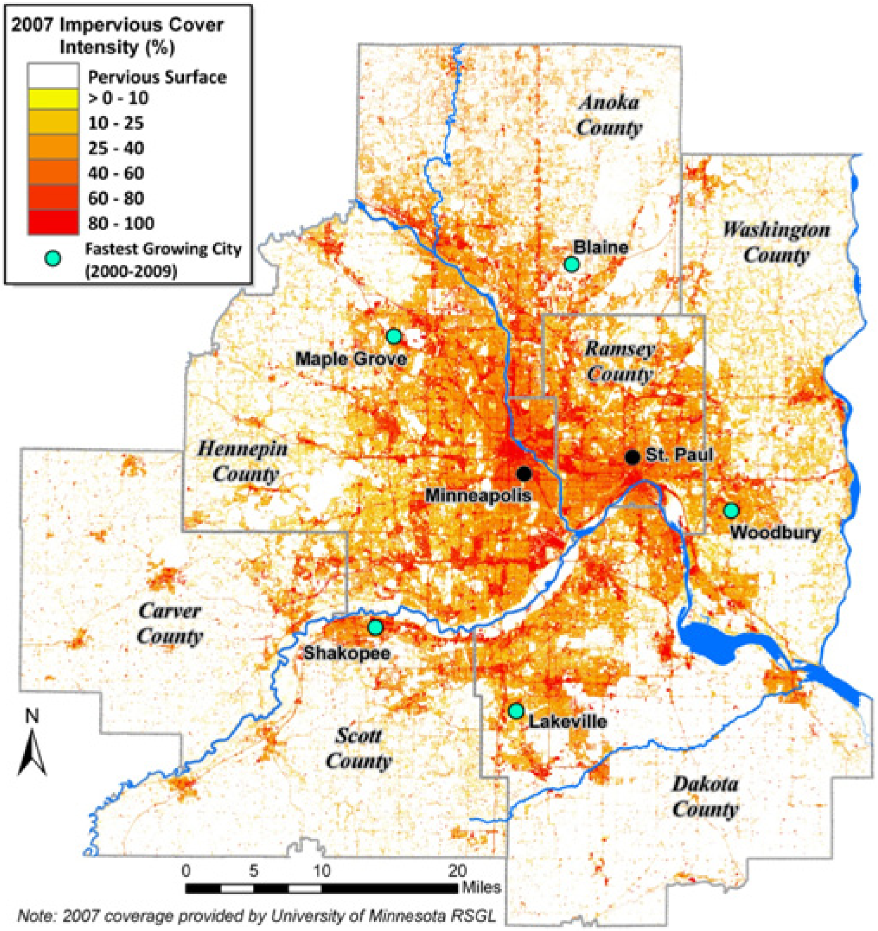
Increased slopes can lead to greater runoff and erosion potential because water can travel more quickly down a steeper slope. When coupled with an impervious land surface such as a street, the amount of runoff entering streams and rivers increases, as does erosion along the stream and river banks. Within the metro area, steep gradients can be found within the major river valleys as well as within stream sections prior to entering the major rivers.

Land Use

The pressure of population growth and economic development on the metro area's landscape influences runoff, wastewater effluent volumes, and ultimately the pollution loads entering the rivers and streams. The modification of the landscape to accommodate city streets, new subdivisions and tilled agricultural land can change the hydrologic balance. Rain that falls onto grassland or forests infiltrates into the ground and contributes to the groundwater supply. Infiltration is less prevalent on tilled, agricultural lands or in urban areas with impervious surfaces such as traditional parking lots or roofs. The runoff water from agricultural and impervious lands concentrates and carries a large number of pollutants that would otherwise remain on the landscape if the rainwater were able to infiltrate into the ground.

Based on 2007 satellite imagery processed by the University of Minnesota, the metro area is influenced by an impervious, urbanized landscape (33% of the region) and agriculture (20% of the region). The remaining land is generally characterized as grassland, forests, wetlands and open water. As an indicator of landscape changes, recently released 2010 Census Bureau information indicates that the population of the metro area increased by 207,505 people from 2000 to 2010 and the number of households increased by 96,293. The communities that have experienced the greatest population growth during the past 10 years include Shakopee, Woodbury, Lakeville, Blaine and Maple Grove. Around 90% of the new growth occurred in the developing suburbs, the second- and third-ring suburbs.

Impervious Cover Percentage and Population Growth within the Metro Area



Note: 2007 coverage provided by University of Minnesota RSGL

MCES River Water Quality Data

The river monitoring program began in 1927 after the Mississippi River was declared a public health hazard. Today the river monitoring program serves a wide array of needs, including:

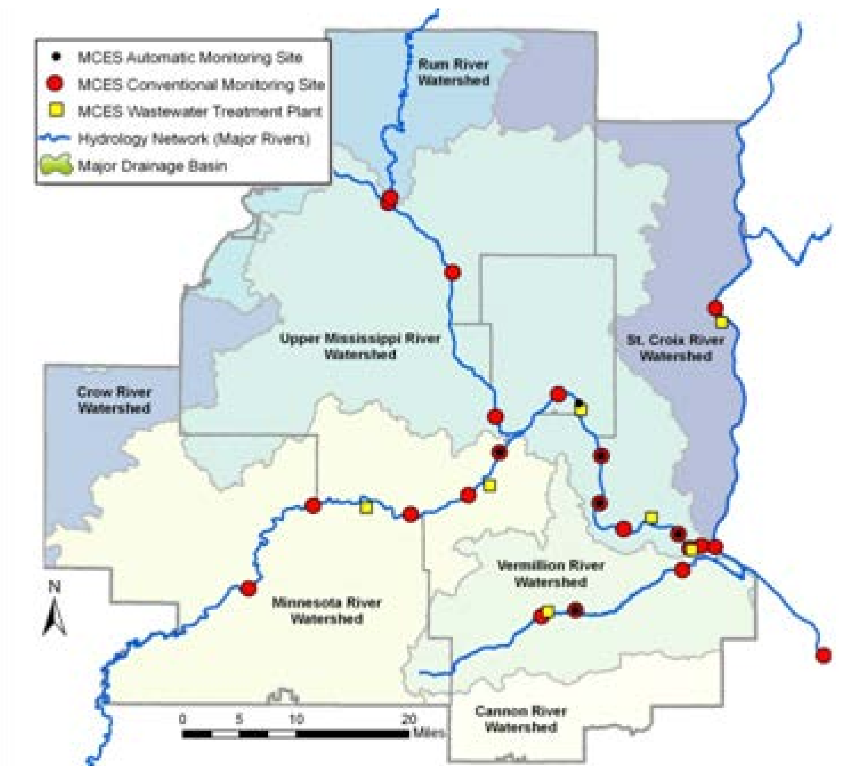
- Collection of water quality data to meet National Pollutant Discharge Elimination System (NPDES) permit requirements for MCES treatment plants
- Assessment of the performance and effectiveness of MCES treatment plants
- Measurement of compliance with state water quality standards and criteria
- Determination of the biological health of large river ecosystems
- Documentation of long-term trends and changes in water quality

Today MCES monitors more than 150 river miles on five rivers: the Minnesota, the Mississippi, the St. Croix, the Rum and the Vermillion. The river monitoring sites are placed at locations where the major rivers converge, enter and exit the metro area, as well as upstream and downstream of the MCES treatment plants. In 2010, the health of these rivers was evaluated through automatic water quality monitoring at six sites and collection of conventional water quality samples at 22 sites.

Surface Water Stressors

In a diverse urbanized area such as the Twin Cities area, there are many different stressors that can impact the health, use and enjoyment of our rivers and streams. The EPA and MPCA are responsible for enforcing water quality standards for these stressors to ensure that designated beneficial uses are met, such as drinking water, aquatic life and human recreation. The standards for water bodies vary based on their uses, sizes, locations and depths. For example, a lake is regulated differently from a river or a stream and a shallow stream is regulated differently than a major river. The metro area rivers monitored by MCES are generally classified as:

MCES River Monitoring Stations within the Metro Area



- St. Croix River: (1C)Drinking water, (2Bd)aquatic life and recreation, and (3C)industrial use and cooling
- Mississippi River (above the confluence with the Minnesota River): (1C)Drinking water, (2Bd)aquatic life and recreation, and (3C)industrial use and cooling
- Mississippi River (below the confluence with the Minnesota River): (2C)Aquatic life and recreation and (3C)industrial use and cooling
- Minnesota River: (2C)Aquatic life and recreation and (3C)industrial use and cooling

To help determine whether metro area rivers meet water quality standards (Table 1), the following parameters were evaluated by MCES in 2010.

Turbidity/Total Suspended Solids

Elevated total suspended solids (TSS) concentrations within surface waters can decrease water clarity, transport excess nutrients such as phosphorus, deplete oxygen levels and decrease biotic diversity. Suspended solids can come from various sources on the landscape including construction sites, lawns, agricultural fields, gullies, ravines and stream banks. Total suspended solids impairment is regulated by turbidity, but is also commonly measured as TSS. The Minnesota turbidity chronic (long-term concentration) standard for class 2A (coldwater fisheries) waters is 10 nephelometric turbidity units (NTU), while the standard for class 2Bd (cool or warm water fisheries) waters is 25 NTU.

Dissolved Oxygen

Dissolved oxygen (DO) in the water is necessary to support aquatic life. The two main sources of oxygen in surface water are the atmosphere and aquatic plants. Factors such as high temperature, low flow, increased pollution, or a muddy channel bottom can decrease DO levels. A daily DO concentration greater than 5 mg/L meets the current Minnesota standard.

Nutrients

Nitrate nitrogen and phosphorus are nutrients that are necessary for aquatic growth; however, excessive nutrient contributions can accelerate plant growth in our rivers and streams, leading to over-enrichment or eutrophication. Eutrophication can lead to algal blooms, decreased oxygen levels, and fish kills. Currently there are no numeric standards for phosphorus and nitrate in rivers and streams; however, numeric phosphorus limits do exist for most WWTP effluents. Nutrients are currently managed through a watershed assessment approach, which aims to quantify and limit nutrients entering the surface waters.

Pathogens

Pathogens are organisms found in human or animal fecal matter. Sources can include failing septic tanks, untreated wastewater, livestock, pets and wildlife. The pathogen that is commonly measured is Escherichia coli (E. coli) bacteria, and an average monthly *E. coli* count greater than 126 organisms per 100ml exceeds the regulatory standard between April 1 and October 31.

Chloride

Elevated concentrations in rivers and streams can be toxic to aquatic and terrestrial organisms. The main sources of chloride – road deicing and water softeners – are typically found in the urban environment. A Minnesota stream is deemed impaired if the chronic (four-day average) chloride concentration is greater than 230 mg/L and/or the instantaneous one-hour average concentration is greater than 860 mg/L, the levels that are toxic to aquatic life.

Table 1: State Numeric Water Quality Standards for Evaluated Parameters within Rivers & Streams

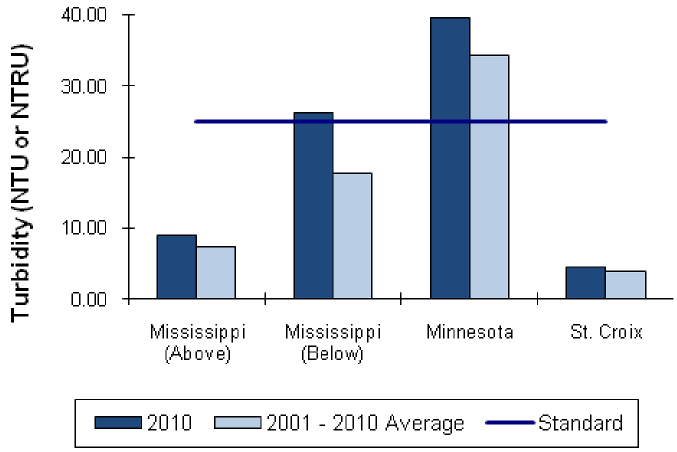
Parameter	Numeric Limit
Total Phosphorus	No 2010 River Standard (proposed standard under development) MCES Wastewater Treatment Plant (WWTP) Permit Limit 1 mg/L
Nitrate-Nitrogen	No 2010 River Standard (proposed standard under development) No 2010 MCES WWTP Permit Limit Surface waters used for drinking water cannot exceed 10 mg/L
Dissolved Oxygen	2010 River Standard 5 mg/L daily average MCES WWTP Permit Limit 6 - 9 mg/L depending on flow conditions
E. Coli Bacteria	2010 River Standard 10% of monthly samples cannot exceed 1,260 organisms/100mL MCES WWTP Permit Limit average monthly count of 200 organisms/100mL
Turbidity	10 NTU (Class 2A waters) , 25 NTU (Class 2Bd waters) daily maximum MCES WWTP Permit Limit 25 NTU daily maximum
Total Suspended Solids	No 2010 River Standard (proposed standard under development) No 2010 MCES WWTP Permit Limit
Chloride	2010 Chronic River Standard 230 mg/L (four-day average concentration) No 2010 MCES WWTP Permit Limit

Metro Area 2010 River Water Quality Compared to State Standards

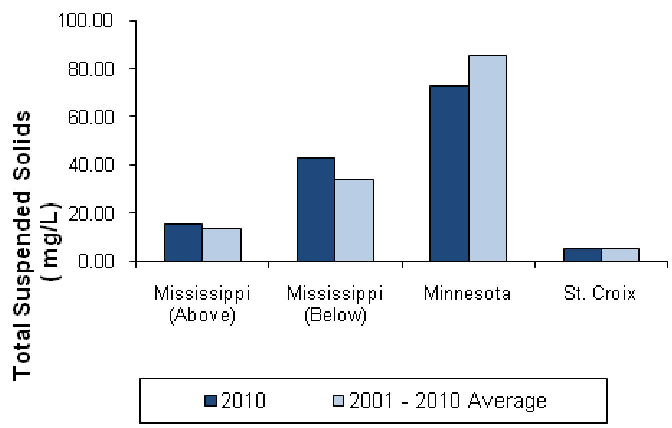
The results shown below are indicative of the 2010 and 10-year average (2001-2010) concentrations of several water quality variables within four separate river reaches (Mississippi River above Minnesota River confluence, Mississippi River below Minnesota River confluence, Minnesota River and St. Croix River). Concentrations of these variables can be compared to state numeric water quality standards where applicable. The variables examined include total suspended solids, turbidity, dissolved oxygen, total phosphorus, nitrate-nitrogen, *E. coli* bacteria, and chloride. Although annual and long-term average concentrations of these variables are presented, extreme conditions (e.g., storm events or droughts) can cause concentrations to fluctuate greatly. A summary of the results can be found in Table 2.

Turbidity and Total Suspended Solids (TSS)

Particulate matter in the water may harm aquatic life by decreasing light available for plant growth, increasing water temperature, clogging gills of aquatic inhabitants and covering habitat. Suspended solids can also negatively affect user perception of water quality and decrease swimmability. Particulate matter in the water can be from a variety of sources, including sediment which has eroded from stream banks or been carried into a river with urban or agricultural runoff. It can also be organic particulate such as decaying matter or algae. The amount of particulate matter in a river can be measured by calculating the amount of light scattered by the particles or by calculating the dry weight of matter left on a filter after a sample of water has been passed through the filter. The first method measures turbidity. The second method measures TSS. Turbidity is an easier measurement but can be influenced by the presence of dissolved matter, temperature, and the shape of the particles. TSS is a more accurate measurement of the particulate matter, but currently no standards for TSS exist. The 2010 average daily turbidity levels within the four river reaches monitored were above the 10-year average level. Both the Minnesota River and the Mississippi River after the confluence with the Minnesota River exceeded the daily turbidity water quality standard of 25 NTU. The average daily TSS concentrations were lower than the 10-year average for the Minnesota and St. Croix rivers and above average for both reaches of the Mississippi River. The Minnesota River is the primary TSS contributor within the metro area.

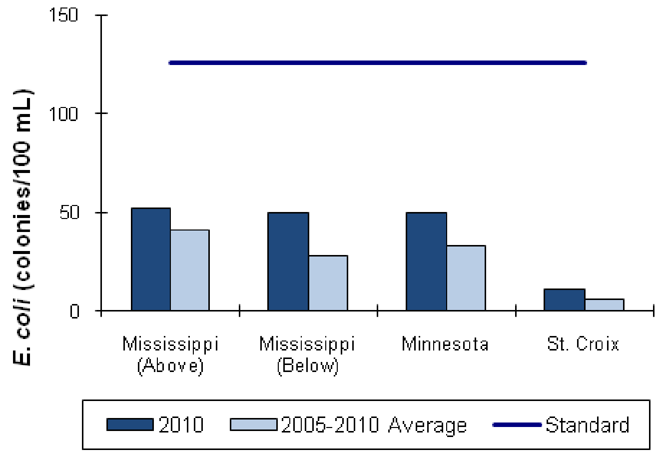


The Mississippi (Above) and the St. Croix have turbidity levels below the standard. The Mississippi (Below) and the Minnesota have turbidity levels over the allowable level set by the standard.



E. coli Bacteria

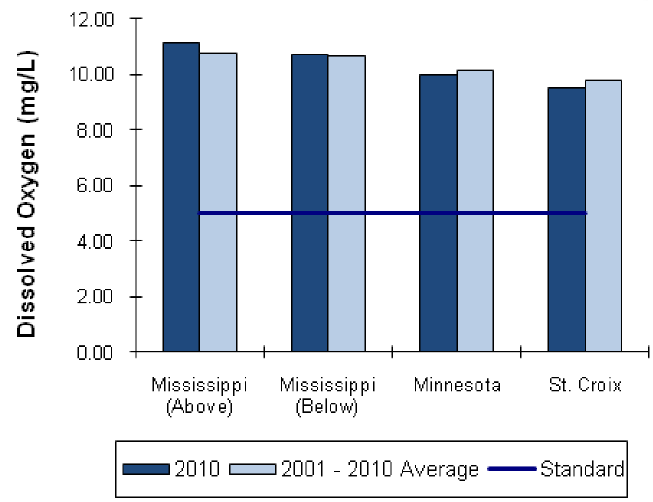
One measure of a river's recreational value is its suitability for swimming. One of the factors that determines suitability for recreation is the level of *E. coli* bacteria. High *E. coli* levels can indicate the presence of potentially dangerous pathogens such as typhoid fever, hepatitis and dysentery. Sources can include failing septic tanks, untreated wastewater, livestock, pets and wildlife. An average monthly *E. coli* count greater than 126 organisms per 100mL or more than 10% of all samples in a month above 1,260 organisms/100 mL exceeds the regulatory standard between April 1 and October 31. Average monthly 2010 concentrations of *E. coli* were well below the average monthly water quality standard (although monthly values are typically based on four rather than five samples), indicating favorable conditions for recreational use at these locations. Of the 606 samples collected in 2010, eight samples exceeded 1,260 organisms/100 mL. Five of these were on the Minnesota River and three were on the Mississippi River. All of these high levels occurred after large precipitation events on the previous day or two.



All four rivers have *E. coli* levels below the standard.

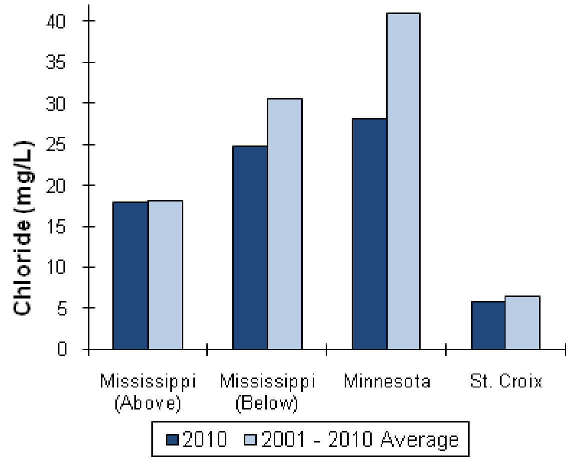
Dissolved Oxygen (DO)

Living organisms need oxygen to survive so the amount of dissolved oxygen in a river determines whether it can support aquatic life. Dissolved oxygen can come into an aquatic system from the atmosphere but it is also produced in aquatic systems through photosynthesis. Dissolved oxygen concentrations can be reduced through high temperatures, low flow, increased pollution, and the decomposition of organic material in the water. Dissolved oxygen levels of 5 mg/L and greater are generally adequate to support aquatic life. However, fish consumption advisories may exist due to other contaminants (mainly PCBs and mercury). Annual average dissolved oxygen levels in all three rivers were higher than the water quality standard of 5 mg/L in 2010 and were comparable to the 10-year average levels. High oxygen levels provide healthy conditions for a diverse fish population, indicating fishable conditions. No daily dissolved oxygen measurements in 2010 were below the 5 mg/L threshold.

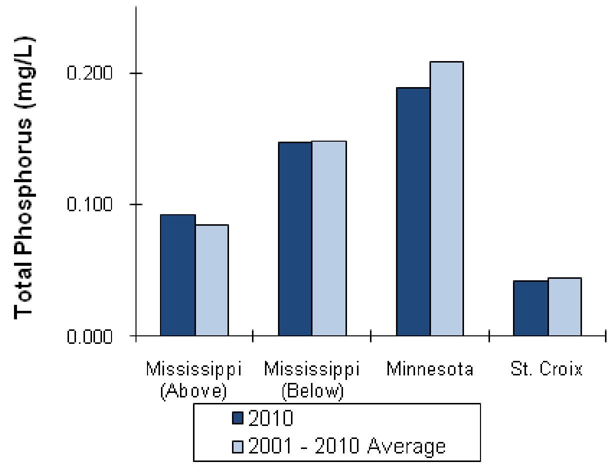


All four rivers have dissolved oxygen levels above the minimum required by the standard.

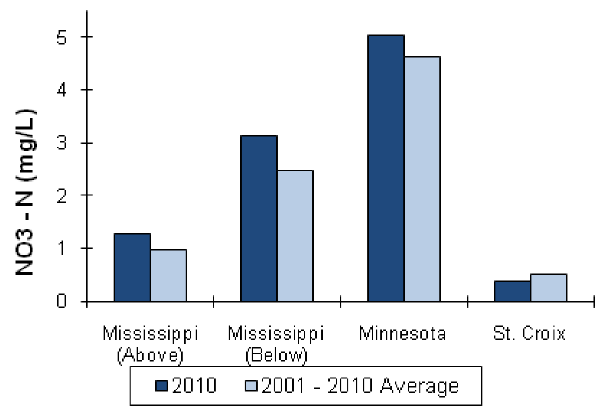
Chloride



Elevated concentrations in rivers and streams can be toxic to aquatic and terrestrial organisms. The main sources of chloride – road deicing and water softeners – are typically found in the urban environment. A Minnesota stream is deemed impaired if the chronic (four-day average) chloride concentration is greater than 230 mg/L and/or the instantaneous one-hour average concentration is greater than 860 mg/L, the levels that are toxic to aquatic life. Average daily 2010 chloride concentrations were below the 10-year average daily concentration. Both the 2010 and 10-year average chloride concentrations are well below 230 mg/L. Although monitoring is done weekly and not consecutively over four days, the highest one-day chloride concentration measured on any of the three rivers was 64 mg/L. Lower chloride concentrations could be due to high flow, more conscientious application practices, or a dry spring.



Nutrients – Total Phosphorus and Nitrate - Nitrogen



Aquatic plants provide food, oxygen and habitat for river organisms. However, an excess of plant growth can lead to unsightly algae blooms, and oxygen depletion and odor upon decaying, making the water unpleasant for recreational activities and unsuitable for aquatic life. In addition to creating poor water quality in Minnesota, excess nutrients entering the Mississippi River in the upper Midwest are blamed for the "dead zone" in the Gulf of Mexico. Nitrogen and phosphorus are essential nutrients for plant growth, and individually or combined, are often the limiting nutrient(s) in aquatic systems. Nitrogen and phosphorus are common components of wastewater treatment plant discharges and urban and agricultural runoff. They can stimulate excessive plant growth when levels in rivers are too high. The average 2010 total phosphorus concentrations for the Mississippi and St. Croix rivers are about the same as the 10-year average. The most notable change is a decrease in the total phosphorus concentration in the Minnesota River compared to the 10-year average. Phosphorus is often transported with particles so this reduction may be due in part to the lower TSS values measured in the Minnesota River. An overall river water quality standard for total phosphorus does not exist. Nitrate-nitrogen concentrations were higher in 2010 in the Mississippi and Minnesota rivers compared to the 10-year average. Only in the St. Croix River did nitrate-nitrogen levels decrease in 2010. An overall river water quality standard for nitrate-nitrogen does not exist. However, the Mississippi River above the confluence with the Minnesota River and the St. Croix River are used directly for drinking water. Therefore, the nitrate-nitrogen concentration must not exceed 10 mg/L to protect human health. Both rivers are in compliance.

Table 2: Summary of 2010 Water Quality Compared with the 10-year Average (2001–2010)

	Flow	Turbidity	TSS	*E.coli**	DO	Chloride	Phosphorus	Nitrate - N
Mississippi (Above)	Higher	Higher	Higher	Higher	Higher	Same	Higher	Higher
Mississippi (Below)	Higher	Higher	Higher	Higher	Same	Lower	Same	Higher
Minnesota	Higher	Higher	Lower	Higher	Same	Lower	Lower	Higher
St. Croix	Higher	Higher	Same	Higher	Lower	Lower	Lower	Lower

Turbidity levels exceed the allowable level set by the standard.

*Average is based on data from 2005 - 2010

Upcoming MCES Water Resource Reports

The MCES Water Resources Assessment Section plans to release several additional water quality reports and assessments during 2011. These include:

- Historic annual pollutant loads dataset for rivers (1980 – Present)
- Historic annual pollutant loads dataset for streams (Site Inception – Present)
- Summary report on annual stream water quality
- 2011 Twin Cities Metropolitan Area Stream Trends Assessment

Report Data Sources

The 2010 Annual River Water Quality Assessment Report relied on several information sources. Monitoring data, including flow and water chemistry, originated from MCES and the USGS. Information related to water quality and standards was provided by the EPA and MPCA. Information related to data and the analysis methodology used in development of this report can be obtained from MCES Water Resources Assessment Section Manager Judy Sventek (judy.sventek@metc.state.mn.us).

About the Metropolitan Council

The Metropolitan Council was established by the Minnesota Legislature in 1967 to provide policy for regional growth for the seven-county Minneapolis-St. Paul metro area. The mission of the Metropolitan Council is to develop, in cooperation with local communities, a comprehensive regional planning framework, focusing on wastewater, transportation, parks and aviation systems, that guides the efficient growth of the metro area. The Council operates wastewater and transit services, and administers housing and other grant programs.

The Metropolitan Council consists of a chair and 16 members appointed by the Minnesota governor representing 16 geographic districts:

Susan Haigh	Chair
Roxanne Smith	District 1
Lona Schreiber	District 2
Jennifer Munt	District 3
Gary Van Eyll	District 4
Steven Elkins	District 5
James Brimeyer	District 6
Gary Cunningham	District 7
Adam Duininck	District 8
Edward Reynoso	District 9
John Đoàn	District 10
Sandra Rummel	District 11
Harry Melander	District 12
Richard Kramer	District 13
Jon Commers	District 14
Steven T. Chávez	District 15
Wendy Wulff	District 16

Visit www.metrocouncil.org for more information about the Council.

Metropolitan Council

390 Robert Street North
St. Paul, MN 55101-1805
(651) 602-1000

Publication Number 32-11-050