METROPOLITAN COUNCIL

Environmental Services

2016

Stream Water Quality Summary for the Twin Cities Metropolitan Area

This report is a brief technical summary of the 2016 stream monitoring program. In 2016, Metropolitan Council Environmental Services (MCES) collaborated with federal, state, county, city, and watershed organizations to carry out monitoring at 21 sites on 20 streams located in the Minnesota, Mississippi, and St. Croix River basins (Figure 1). Sampling efforts in 2016 resulted in 625 field visits, 2,098 field parameter readings, and over 13,500 laboratory results.

Stream monitoring is an important part of maintaining and understanding the water quality of a region. Streams in the seven-county Twin Cities Metropolitan Area (metro area) flow into and directly impact the Minnesota, Mississippi, and St. Croix Rivers. Streams are also used for a variety of recreational activities such as swimming, camping, fishing, and boating.

The results from the MCES stream monitoring program are used internally and externally to:

- Assess the amount of nonpoint source pollution travelling from tributaries into the Mississippi, Minnesota, and St. Croix Rivers.
- Evaluate how efficient current watershed management practices are at reducing nonpoint source pollution on a watershed scale.
- Aid in the development of management plans to improve water quality of streams and rivers in the metro area.
- Assess long term trends and compare current conditions to Minnesota water quality standards.
- Provide data to be used in Total Maximum Daily Load (TMDL) plans.

Additionally, the monitoring program supports regional policies established in the Metropolitan Council's Thrive MSP 2040 and 2040 Water Resources Policy Plan. This includes assessing the region's lakes, streams, rivers and aquifers to evaluate their impact on regional water resources, and to measure success in achieving regional water goals.

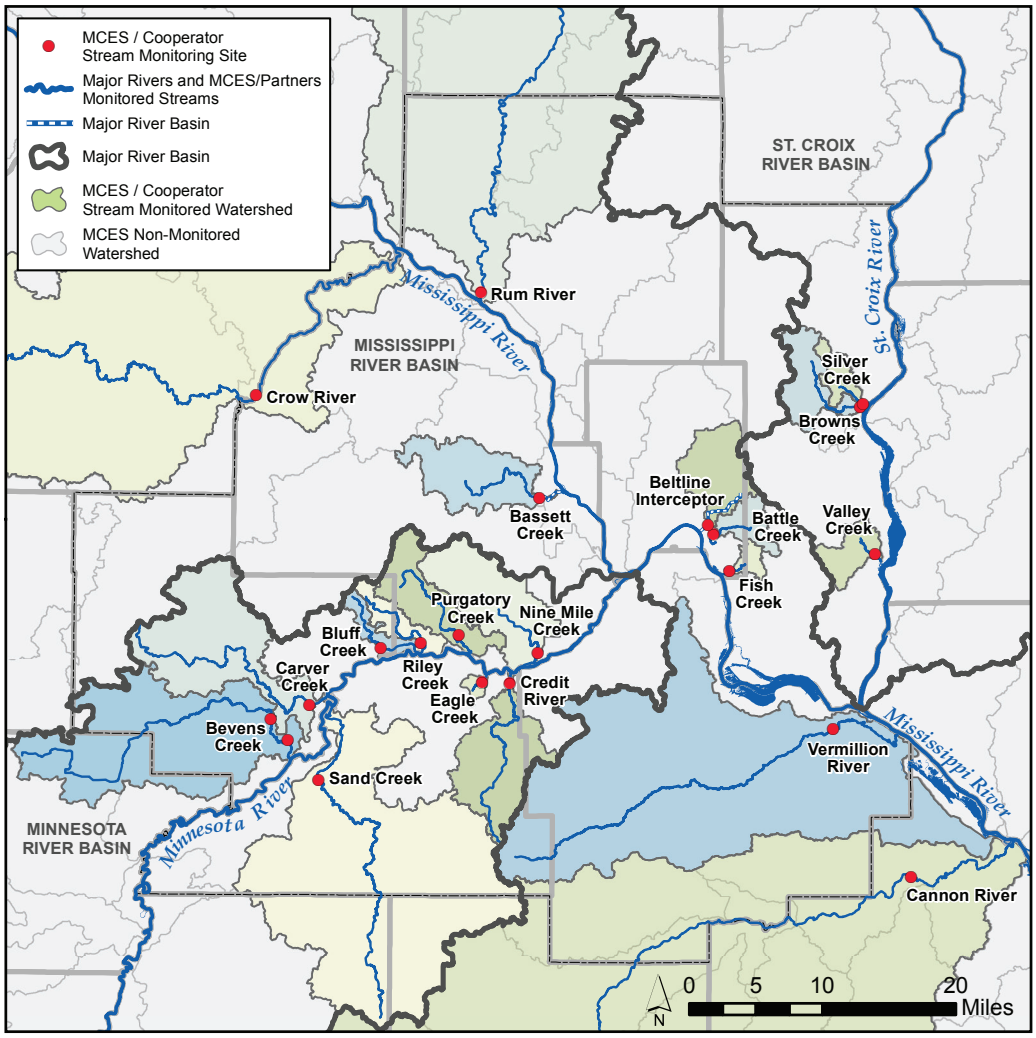


Figure 1: 2016 MCES Stream Monitoring Stations

To summarize 2016 stream water quality, MCES calculated the median of the following key water quality parameters at each stream: chloride, total suspended solids, total phosphorus, and nitrate-nitrogen. These median concentrations include measurements taken from all types of flow conditions (low, normal, and high). Streams may have different water quality due to a combination of factors such as watershed size, land cover, and geology.

MCES compared the 2016 median of each key water quality parameter for each site to 10-year datasets from 2007-2016. Concentrations are highly affected by stream flow and volume which can vary between years. The comparison between 2016 and the previous decade should not be taken as an indication of increasing or decreasing water quality, but rather as a snapshot comparison to conditions of recent years. This summary covers ten years of monitoring data at each site, with the exception of two sites that had gaps in monitoring in 2015 (Bluff Creek and Lower Bevens Creek) and a newly established site (Purgatory Creek, 2014-2016).

Box-and-whisker plots (boxplots) were used to summarize key water quality parameter measurements from the 10-year reference period. Figure 2 shows an explanatory legend of the boxplots used in this report. Note that 50% of the data points fall within the box (also known as the interquartile range), with the centroid delineated by the median line. The outer extents of the whiskers designate the maximum and minimum values. Median values for 2016 measurements are plotted as a red triangle on top of the 10-year boxplot.

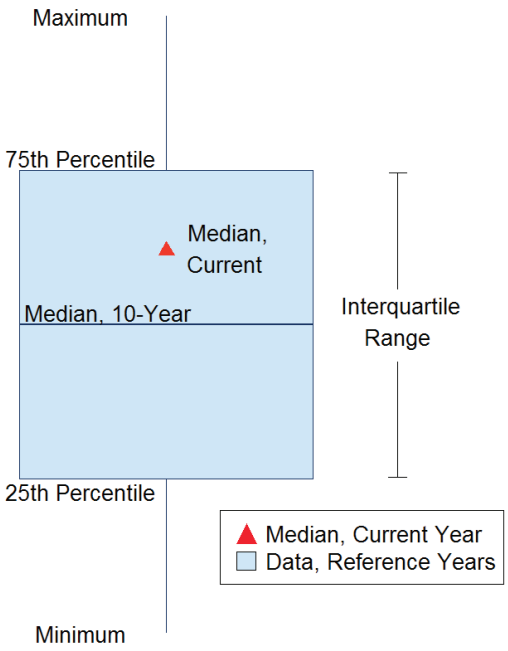


Figure 2: Explanatory legend that demonstrates how information is summarized throughout this report.

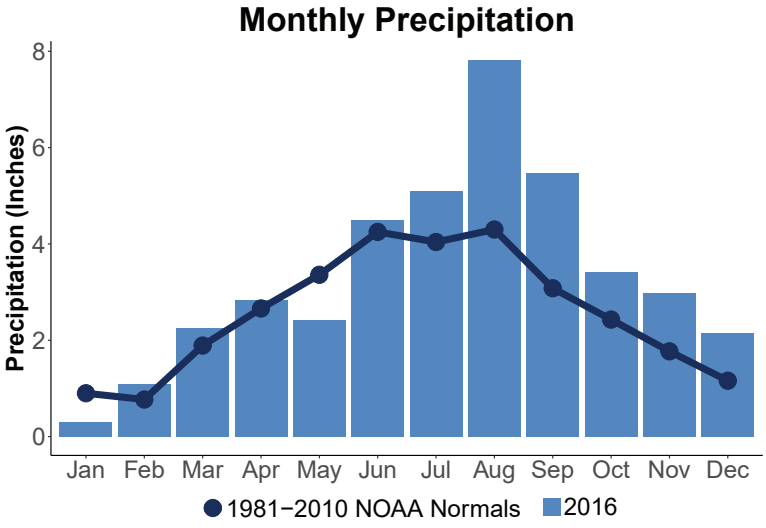
Precipitation

Description

Precipitation is measured at the Minneapolis-St. Paul International Airport, which is a good indicator of significant rainfall events in the metro area because of its central location.

2016 Results

Precipitation in the metro area during 2016 was above the normal precipitation, as defined by NOAA 1981-2010 Climate Normals (a data set updated every 10 years). Total precipitation in 2016 was 40.3 inches, 9.7 inches above normal; it was the wettest year on record for the region since recordings began in 1871. The first half of the year demonstrated fairly typical precipitation, with a deficit of 0.42 inches below normal. The second half of the year was exceptionally wet, with 10.1 inches above normal; it went on record as the wettest second half of the year since 1900.



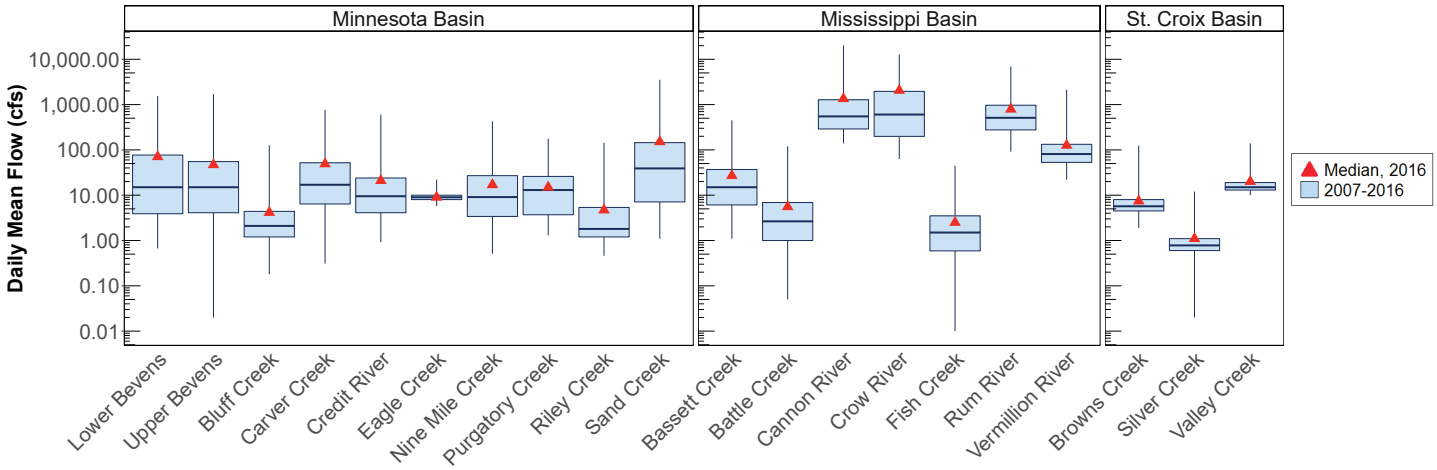
Stream Flow

Description

The rate of water flowing in a stream affects aquatic life, channel geometry, and capacity to carry pollutants. Stream flow is influenced by precipitation and watershed characteristics. During wet periods, nonpoint source pollutants are often carried through storm sewer systems and natural drainage systems to lakes and smaller streams and subsequently to the major rivers. High flows can cause stream bank erosion, habitat destruction, and flooding. During dry periods, low flows can result in more concentrated pollution, increased sediment deposition, and lower habitat quality.

2016 Results

United States Geological Survey (USGS) streamflow data were used for the Rum, Cannon, and Crow Rivers. MCES does not monitor flow at these sites to maximize resources without duplicating efforts. Flow at Beltline Interceptor is not available. All other sites were monitored by MCES or partner organizations. Overall, 2016 was an exceptionally wet year with above normal precipitation. Consequently, almost every stream in the monitoring network demonstrated 2016 median streamflow above 10-year median streamflow. This excludes Eagle Creek, a groundwater dominated stream which had a similar median flow in 2016 compared to the 10-year record. The 2016 median flows for Cannon River, Crow River, and Sand Creek exceeded 10-year 75th percentiles. The largest departures of 2016 median flows from 10-year medians were Upper Bevens (405% higher) and Lower Bevens Creeks (370% higher).



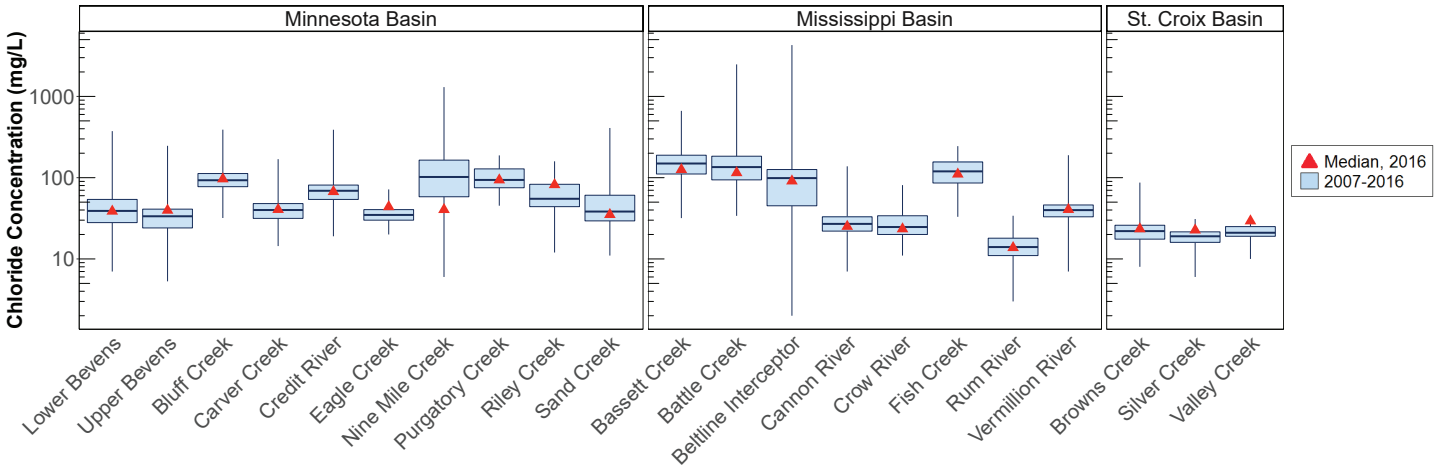
Chloride

Description

Chloride, one component of salt, is typically used for winter maintenance of roads, sidewalks, and parking lots and for home water softening. It can also come from certain types of fertilizers. Excess levels of chloride in the environment can be toxic to aquatic and terrestrial organisms. Chloride is not easily removed after it is introduced to natural waters; there are no processes that naturally cycle chloride through the environment.

2016 Results

The Mississippi River basin had streams with the highest (Bassett Creek) and lowest (Rum River) 2016 median chloride concentrations. The three streams in the St. Croix River basin (Browns, Silver, and Valley Creeks) traditionally have had low median chloride concentrations, and this was true again in 2016. Overall in 2016, MCES streams did not show large departures of median chloride concentrations from 10-year medians. The largest departures of 2016 median chloride concentrations from 10-year medians were Nine Mile Creek (60% lower), Riley Creek (49% higher), and Valley Creek (40% higher). Nine Mile Creek typically demonstrates a fast rainfall-response. Problems with equipment in 2016 caused no storm event samples to be collected during winter or spring months. Without storm event samples, a bias for low chloride concentrations could have occurred and resulted in a low median concentration for 2016.



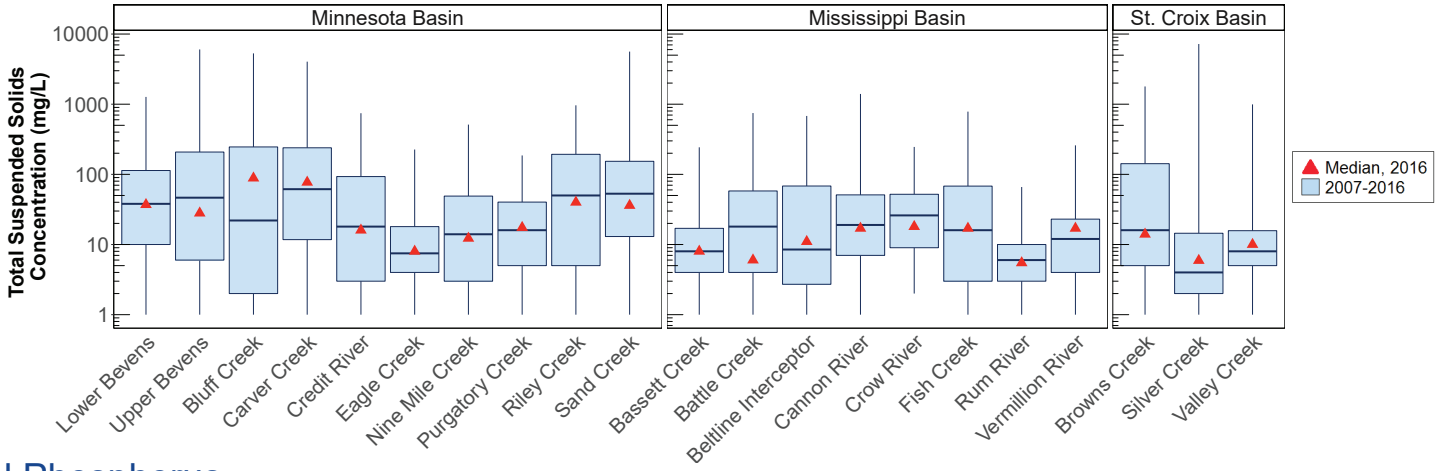
Total Suspended Solids

Description

Total suspended solids are any material suspended in water which can be removed with a filter. There are a variety of sources including eroded sediment from stream banks, lawns, construction sites, and agricultural fields as well as organic particulates such as decaying matter and algae. High levels of total suspended solids in rivers may harm aquatic life by decreasing the light available for plant growth, increasing water temperature, clogging gills of aquatic inhabitants, and covering habitat. High levels can also affect recreational use by decreasing water clarity and creating unfavorable swimming conditions.

2016 Results

The highest 2016 median total suspended solids concentrations were observed in streams of the Minnesota River basin (Bluff, Carver, Riley, Sand, and Upper and Lower Bevens Creeks); the Minnesota River basin has younger geology and sandy glacial deposits that make it more susceptible to erosion than the Mississippi and St. Croix River basins. At all stream monitoring sites, 2016 median total suspended solids concentrations fell between the 10-year 25th and 75th percentiles. The largest departures of 2016 median total suspended solids concentrations from 10-year median concentrations were at Bluff Creek (277% higher) and Battle Creek (67% lower). In 2016, Bluff Creek was sampled solely by baseflow sampling due to relocation and reconstruction of monitoring equipment. As a flashier stream, sampling bias could have been introduced through missed storm event sampling; this could be a possible explanation for the large departure from the median concentration at Bluff Creek.



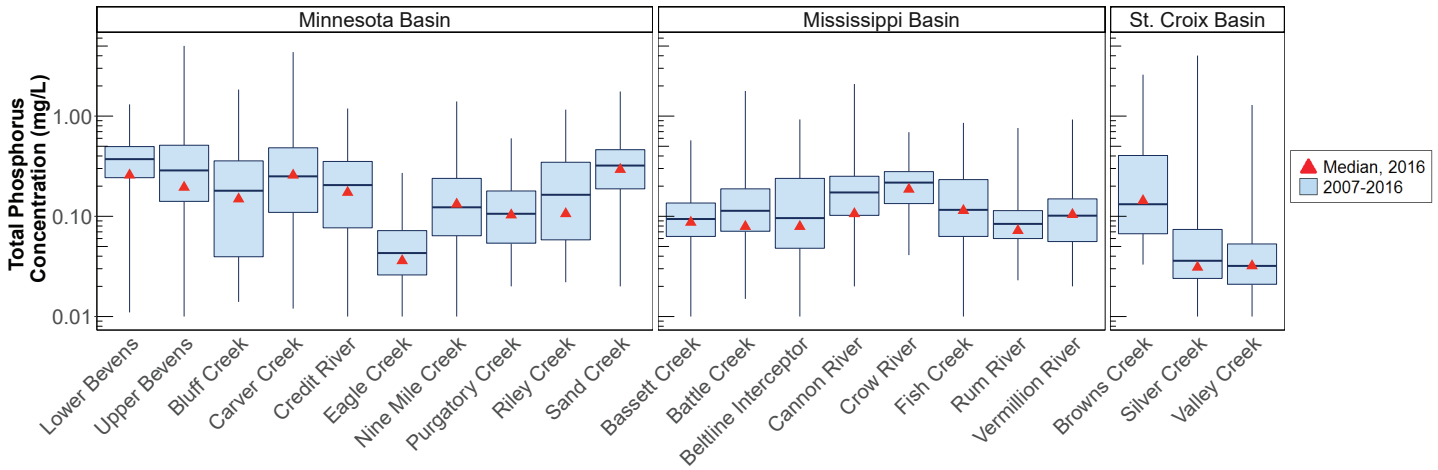
Total Phosphorus

Description

Phosphorus is an essential nutrient necessary for the growth of aquatic organisms. Nutrients cycle naturally in the environment, but elevated levels of phosphorus in rivers can be caused by lawn or agricultural fertilizers, malfunctioning septic systems, manure, and pet wastes. High levels of phosphorus can stimulate excess growth of aquatic plants, causing algae blooms which reduce oxygen levels in the water. This creates uninhabitable conditions for most aquatic life and generally makes the water unusable for recreational activities. Phosphorus tends to bind to sediments and particulates; patterns of total phosphorus concentrations are often similar to patterns of total suspended solids concentrations.

2016 Results

The 2016 phosphorus results generally mirrored the 2016 total suspended solids results, meaning relative to the other monitored streams, those with higher phosphorus also had higher suspended solids (e.g. Carver, Sand, and Bevens Creeks) and those with lower phosphorus also had lower suspended solids (e.g. Silver and Eagle Creeks). The Minnesota River basin contained streams with the highest 2016 median concentrations. This could be due to the geologic age of the Minnesota basin that make it more susceptible to erosion than the Mississippi and St. Croix basins. All 2016 median phosphorus concentrations fell between 10-year 25th and 75th percentiles and did not show large departures from 10-year medians.



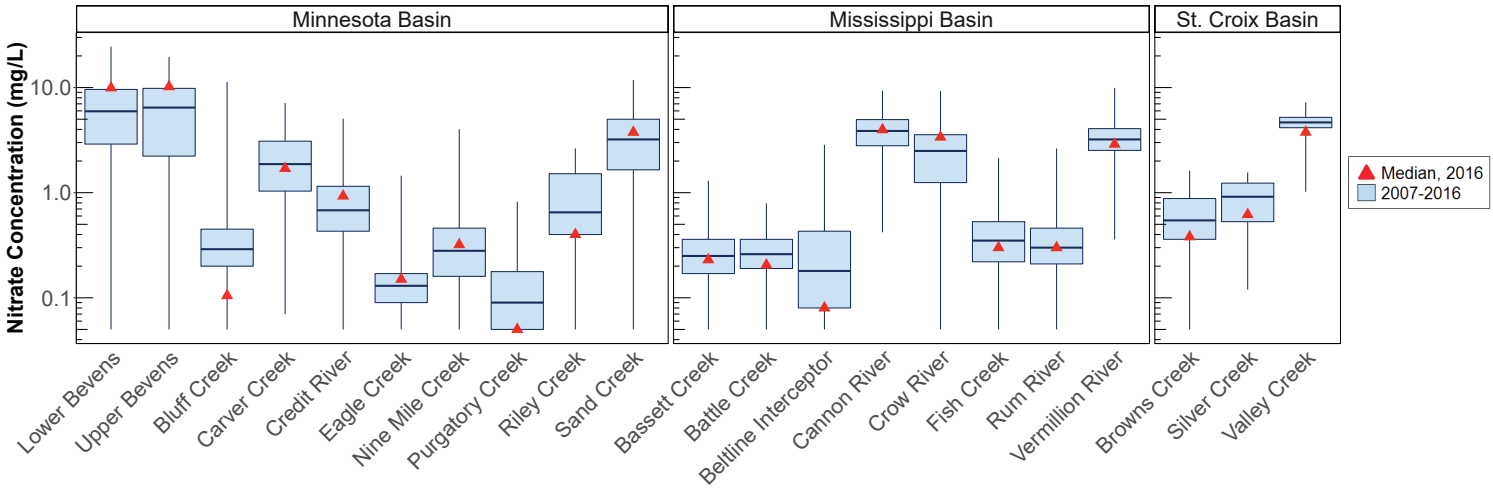
Nitrate – Nitrogen

Description

Nitrate-nitrogen is an essential nutrient necessary for the growth of aquatic organisms. Aside from natural processes, common sources of nitrate include fertilizers, plant debris, leaking septic tanks, and municipal wastewater treatment systems. High nitrate levels can cause the same problems associated with high phosphorus concentrations and if consumed can lead to methemoglobinemia, a blood condition typically affecting infants which impairs the ability of red blood cells to efficiently transport oxygen throughout the body.

2016 Results

The Minnesota River basin contained the streams with the highest (Upper Bevens Creek) and lowest (Eagle Creek) 2016 median nitrate concentrations. The highest 2016 nitrate concentrations occurred in streams in agriculturally dominated areas (e.g. Bevens and Sand Creeks, and Cannon, Vermillion, and Crow Rivers). The groundwater fed Valley Creek was the exception to this observation. The current land use around Valley Creek is not as agricultural as it once was, but it is believed the past use of fertilizer on farm lands infiltrated into the groundwater which now feeds the creek. The largest departures of 2016 median nitrate concentrations from 10-year median concentrations were at Bluff Creek (54% lower), Upper Bevens Creek (60% higher), Lower Bevens Creek (58% higher), and Beltline Interceptor (56% lower). The departure at Bluff Creek could be from potential sampling bias due to a lack of storm event sampling in 2016, as described in the total suspended solids results section. Purgatory Creek experienced extremely low concentrations of nitrate in 2016; the median concentration of 0.05 mg/L is equal to the reporting limit for nitrate in the MCES lab. This may appear to be a large departure from the median for the period of record, but the values are both quite low and the log-scale y-axis makes the change appear to be larger than it is. Additionally, Purgatory Creek was established in 2014, so the boxplot displays only 3 years of data.



For More Information

MCES will continue to coordinate and conduct water quality and hydrologic monitoring across the stream program network, and will release reports to summarize data.

Past monitoring reports and monitoring data can be found in the Metropolitan Council's Environmental Information Management System (EIMS) at https://eims.metc.state.mn.us/.

For questions or comments about this summary, please contact Erik Herberg at erik.herberg@metc.state.mn.us or at 651-602-1473.

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