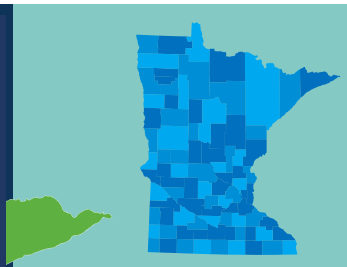
Water Quality Monitoring

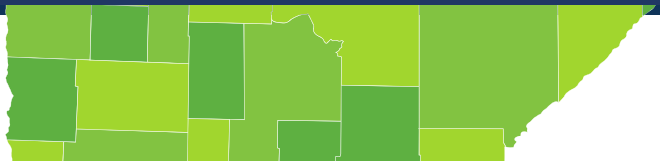
June 2025

Creation of an online, real-time water quality monitoring network in Minnesota

DEPARTMENT OF NATURAL RESOURCES

MINNESOTA POLLUTION CONTROL AGENCY





Legislative charge

Subd. 22. Real-Time Water Quality Network

$100,000 the second year is to study, in coordination with the commissioner of the Pollution Control Agency, the creation of an online real-time water quality monitoring network in Minnesota. The study must include the barriers to implementing this multiagency program, including the design of a website and the cost to deploy stream flow and nitrate monitoring equipment in the state. This is a onetime appropriation. The study must be completed by June 30, 2025, and submitted to the chairs and ranking minority members of the legislative committees with jurisdiction over environment and natural resources.

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Editing and graphic design

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Estimated cost of preparing this report *(as required by Minn. Stat. § 3.197)*

Total staff time: 85 hrs.	$6,700
Production/duplication	$0.00
Total	$6,700

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This report is available in alternative formats upon request.

Contents

Water quality monitoring network status

This report explores the development of an online, real-time water quality monitoring network in Minnesota. It outlines the barriers to implementing this multi-agency initiative, including website design and the costs associated with deploying stream flow and nitrate monitoring equipment across the state. Minnesota agencies follow a coordinated approach guided by the Minnesota's Water Quality Monitoring Strategy 2021 to 2031 (state.mn.us), which provides a framework for tracking stream flow, nitrate levels and other key water quality parameters.

Multiple organizations contribute to this statewide monitoring effort, including the Minnesota Department of Natural Resources (DNR), the Minnesota Pollution Control Agency (MPCA), the Minnesota Department of Agriculture (MDA), the U.S. Geological Survey (USGS), the Metropolitan Council Environmental Services (MCES) and various local partners. Each agency plays a distinct role in the monitoring process. Currently, the MPCA, MDA, USGS and MCES use sensors to continuously monitor nitrate levels. Additional details on each agency's activities are provided in the appendix.

Beyond the state's current plans for flow, data display, and one-time funding for continuous nitrate monitoring, we report recommend operational funding for the nitrate sensor network, website updates, and changes to the nitrate sensor network to support increased capacity.

Overall recommendations

- Ensure stable operational funding and resources (see assumptions for more information).

Nitrate sensor and monitoring recommendations

- The MPCA received $2M in one-time funding to purchase and install the initial continuous nitrate network; it may not be fully spent before expiring. Extending the appropriation funds through fiscal year 2027 avoids leaving sensors unused, creating data gaps, or decommissioning sites due to lack of funding.
- Install additional nitrate sensors in more locations that show increasing concentrations.
- Fund additional staff to extend continuous nitrate monitoring statewide.

Website-based recommendations

- The DNR currently has a $300K upgrade project to improve ease of accessing continuous nitrate data. Additional funding may be needed to complete all website enhancements for a robust and accessible nitrate-focused webpage, including state-wide views of nitrate concentrations.

Network expansion recommendations

- Expand the network to include additional sites at a scale that matches the capacity of staff needed to maintain and process data. For nitrate monitoring, that scale is one staff for 20 sites. The following lists the cost per site and per staff.

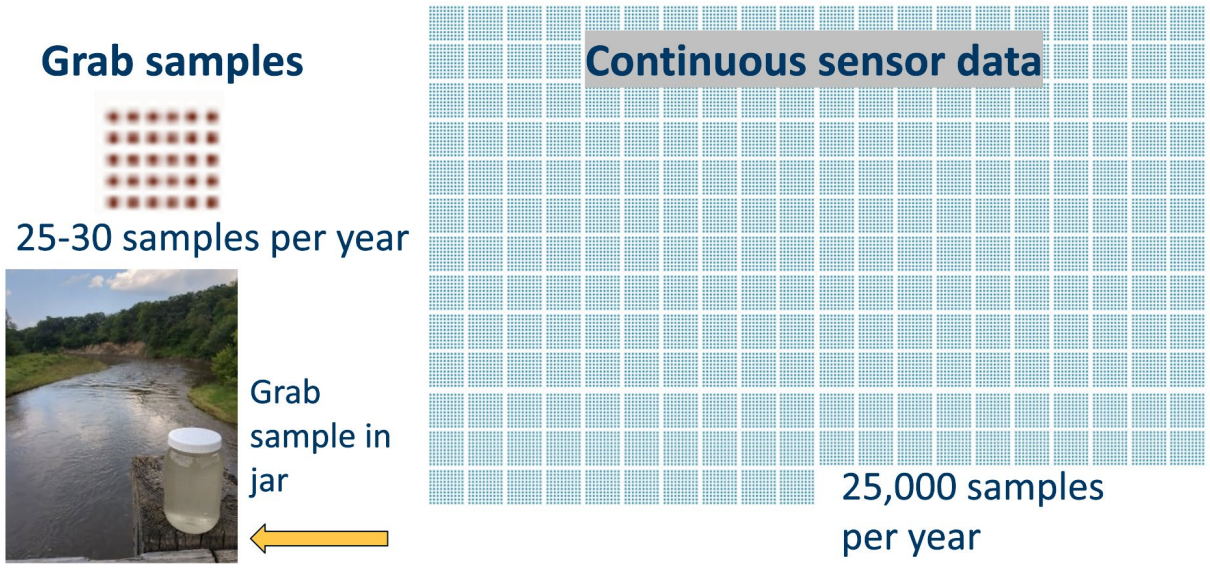
Adding additional continuous nitrate monitoring sites installed by the MPCA

Equipment: $30K/site
Equipment maintenance: $2K/site, annually
Staff: $175K year/20 sites (maintenance and data processing)

Importance of monitoring networks

Access to timely data is essential for informed decision-making. While provisional stream flow data is available in real time, current methods—relying on grab samples and delayed data analysis—do not allow for real-time nitrate monitoring. Implementing a continuous nitrate sensor network would address this gap by providing immediate, ongoing nitrate data.

Currently, there is, on average, a two-year lag in processing and finalizing nitrate and flow monitoring data. In contrast, a sensor network would enable continuous, real-time collection of water quality data, offering significantly greater detail and immediacy than periodic grab sampling (see image below).



This advancement would improve understanding of water quality issues and enable more timely responses—something not possible when relying on data that is already two years old.

This gap was identified in Minnesota's Water Quality Monitoring Strategy 2021 to 2031, section 2.12, to provide continuous data, particularly for nitrate, at more locations. Continuous nitrate sensors support everything from understanding the state of the environment to fate and transport, and they help local water managers enhance restoration and best practices. As nitrate levels rise throughout the state, so does the need for a real-time monitoring network. It could help the state inform drinking water suppliers, track progress of nitrate reduction with more detail, and direct investments with greater precision to help meet Minnesota Nutrient Reduction Strategy goals and collaborate with downstream

states. Real-time nitrate sensors could vastly enhance modeling, data sharing, and development of best management practices (BMPs).

The state of monitoring networks

Continuous flow

The DNR operates 266 stream gages, 121 of which are paired with the MPCA to collect water quality samples for the Watershed Pollutant Load Monitoring Network (WPLMN) (see map in the appendix). The DNR provides flow measurements at key locations during severe drought and flood events, including forecasts and warnings, real-time and historical stream flows, and water levels. The DNR partners with federal agencies to transmit stream gage data through the National Oceanic and Atmospheric Administration (NOAA) satellites to the Cooperative Stream Gaging (CSG) website.

Continuous nitrate sensors

The Minnesota Legislature provided one-time funding from the Clean Water Fund for the MPCA to install a network of continuous nitrate sensors in areas where elevated nitrate was measured. Data and details are available on the MPCA 24-hour nitrate network webpage (https://www.pca.state.mn.us/air-water-land-climate/24-hour-nitrate-network). While excess nitrate can occur anywhere in the state, historically, southern Minnesota has had more elevated nitrate levels in its surface water.

In 2025, the first year of the network's operation, the MPCA expects to install 21 continuous nitrate sensors at monitoring stations (MPCA nitrate sensor locations). The sensors are placed in rivers and streams during the ice-free months, which means the network runs about seven months of the year. Current funding will allow for the purchase of additional sensors, bringing the total to 35. However, the funding expires on June 30, 2026, which will not allow for the placement of these second-phase sensors or sensor operations during the 2026 season.

Resources and collaboration among state and federal agencies are needed to run the network. Each monitoring station has electricity and telemetry equipment to transmit its nitrate level data, which will appear on the webpage throughout the day during the operational months.

Current in-stream nitrate sensor locations:

- Cedar River near Austin, at 540th Ave
- Zumbro River at Kellogg
- Bridge Creek, Crystal Creek, and South Branch Root River sensors in southeastern Minnesota (already installed).

Websites

Continuous flow and nitrate data are available to state agencies and the public through the CSG website, jointly operated and maintained by the DNR and the MPCA. This website is a portal for real-time stream flow data, site photos, water quality information and more.

Examples of available information include:

- Stream flow gage location, site characteristics, reader, type of gage, and drainage area
- Stage/discharge rating curves and equations
- Stream flows
- Flow statistics
- Hourly headwater and tailwater readings
- Flood damage stages

The CSG website includes a filter to show specific nitrate station locations and data (see the appendix for more information).

Projects in development

The DNR and Minnesota IT Services (MNIT) are updating and integrating interagency hydrologic data from the CSG, Cooperative Groundwater Monitoring (CGM), and LakeFinder websites into the WISKI water information system. The overall goal is to provide centralized access to surface and groundwater data. This project will improve real-time data delivery and visualizations, address the timeliness of telemetered datasets, offer an enhanced tool for graphing multiple parameters (like discharge and nitrate, precipitation and water temperature, or multiple stations, etc.), and potentially add tabular or graphical summaries of statistics and trends for sites with adequate data records. The work began in the summer of 2024, and the contract runs through June 2027.

The MPCA received a grant to redesign three of its surface water quality data services (listed below) into one solution to create a more public-friendly product with real-time surface water quality data, the MPCA Volunteer Water Monitoring Program (VWMP) data, and the MPCA partner data from local watershed districts, counties, and soil and water conservation districts.

- Volunteer Water Monitoring Program
- MPCA Water Quality Dashboard
- Surface Water

Components:

1.1: Evaluation of current web services and data sources – 04/01/2025

1.2: Design and write requirements of new web service and data source mapping – 10/01/2025

1.3: Build, test and implement new services – 07/01/2026

Assumptions

The following assumptions underpin the estimated resources required to establish an online, real-time water quality monitoring network in Minnesota:

- Continued operational funding to support the existing DNR stream flow network.
- The CSG website will serve as the foundation for the new platform, providing real-time stream flow and water chemistry data.

- The current stream flow monitoring network is sufficient to support the expanded water quality monitoring system.
- Existing partnerships and agreements between state agencies, federal entities and local partners will remain in place, including:
    - The National Oceanic and Atmospheric Administration (NOAA) will continue to provide satellite telemetry services to state websites at no cost.
    - The U.S. Geological Survey (USGS) will maintain its contract with the DNR to collect data at 30 stream gage locations.
    - Local partners will continue contracting with the Minnesota Pollution Control Agency (MPCA) to collect water quality samples at stream gage sites.

Barriers and constraints

The following are barriers and constraints to expanding Minnesota's current real-time stream flow and nitrate network.

- The one-time funding for nitrate sensors will expire on June 30, 2026, halting the installation and operation of second-phase sensors during the 2026 season. A new appropriation is required starting July 1, 2026, to complete installation and support uninterrupted network operation.
- Current appropriation language (excerpt below) directs installations to areas of elevated nitrate. Nitrate concentrations are, however, increasing in other parts of Minnesota that would also benefit from continuous monitoring.
    - "…to purchase and install nitrate sensors to develop a continuous nitrate-monitoring network to monitor watershed and basin pour points where elevated loads of nitrate have been measured historically." Chapter 106 of Minnesota Laws
- Sustained funding is essential, to maintain both the functionality and integrity of the monitoring network. Annual budgets must account for inflation and rising operational costs—otherwise, they effectively result in reduced resources. Adequate funding must also support both staffing and non-staffing needs. Maintaining flow and nitrate sensors requires skilled personnel to service sites regularly and perform calibration measurements. In addition to field staff, robust support is needed across contracting, procurement and IT functions. Data processing and analysis is another critical area that depends on trained professionals to ensure accuracy and usability.
- Technology plays a critical role in enabling an online, real-time water quality monitoring network. To become effective, the system must keep pace with ongoing changes in IT infrastructure and technological advancements. The speed of these changes, however, often outpaces the availability of resources needed for development and implementation.
- The complexity of monitoring equipment presents challenges. Ensuring accurate, reliable data that meets the needs of Minnesotans requires that all components—such as data loggers and sensors for flow and nitrate—work seamlessly together. Equipment must be appropriately matched to both the site conditions and the specifications of the data to be collected.

Equipment continuity is also important; adapting to new or incompatible products (e.g., different sensors or telemetry systems) can drive up costs.

- Not all locations are suitable for continuous monitoring. Some sites may be limited by geological conditions, such as unstable or rapidly changing stream channels, restricted access or safety hazards. These factors can prevent the successful deployment of flow or nitrate sensors.
- Minnesota's water quality monitoring efforts rely heavily on partnerships with local governments, Tribal nations and federal agencies. These collaborations are interdependent and critical to the network's success. Any disruption in these relationships could significantly impact operations. The cost estimates in this document assume ongoing strong partnerships, particularly with federal agencies. For example, NOAA currently provides satellite telemetry at no cost; if this support ends, the state would incur new expenses for private satellite or cellular telemetry. Similarly, the DNR contracts with the USGS to help fund 30 stream gages used by the MPCA for water quality sampling. If USGS funding were reduced or eliminated, the state would need to assume those costs to maintain operations.

Monitoring Costs

Flow Monitoring

Estimated costs by the State of Minnesota

Installation costs for a new flow monitoring site include:

- $15,000 to $25,000 for equipment and installation, depending on the site-specific set-up.
- $175,000/year in staff and operations; one staff can cover approximately 10 to 15 stream flow stations (installation, maintenance, field measurements, data work, etc.).
- $1,000 to $10,000, for average annual equipment repair and maintenance, depending on the site's specific needs.

Estimated costs by USGS contract

Based on the current DNR and USGS contract, the operation, maintenance, and data processing costs per flow site would likely range from $8,000 to $20,000 per site. This does not include costs for the initial equipment and installation for a new site.

Nitrate Monitoring

Estimated costs by the State of Minnesota

The following costs are for nitrate sensors that capture the range of 0.05 to 50mg/L. For lower-level nitrate concentrations, equipment costs would increase by approximately three times. The minimum at

159 of the WPLMN sites is lower than 0.05mg/L and the median of 23 of the sites is lower than 0.05 mg/L.

The costs of a nitrate site include:

- $20,700 to $29,900 for equipment and installation, depending on the site-specific set-up.
- $175,000/year in staff and operations; one staff can cover approximately 20 sites. Each site is $17,500 in staff time per year (installation, maintenance, data work, etc.).
- $1,700 to $2,200, for average annual equipment maintenance and electricity, depending on the site's specific needs. Does not include replacement in case of damage/failure.
    1. Box upgrades/equipment upgrades.
    2. Annual replacement costs (for example, a $10,000 sensor is expected to last 5 years = $2,000 per year).

Estimated costs by USGS contract

Based on USGS estimates, nitrate sensor installation, including the sensor itself and associated infrastructure and components, typically ranges from $30,000 to $50,000. Annual operational and maintenance costs can vary, depending on the frequency and extent of data collection, analysis and reporting. A general estimate for ongoing costs, including data approval and publication, is approximately $30,000 to $50,000 per year.

Website costs

The CSG website (https://www.dnr.state.mn.us/waters/csg/index.html) is the primary location for the public to access stream flow data collected across the state. It includes a map that displays monitoring sites and site-specific webpages with relevant metadata and interactive data graphs. In its current configuration, the CSG delivers water quality data, like real-time nitrate concentration, to the public, but this functionality requires additional development. It was a quick-fix solution in the fall of 2024 to address the legislation's directive on continuous nitrate monitoring. Planned future work includes map displays of all stations measuring nitrate, with the most recent conditions, enhanced interpretation and analysis. The DNR has $300,000 available until the end of fiscal year 2027 to address the real-time display of nitrate data, along with numerous additional water monitoring enhancements. The DNR initiated the project analysis and planning in the fall of 2024, but the project was put on hold in the spring of 2025 to address higher priorities in the department's IT portfolio. Work on this project is expected to resume when resources become available. The project is in caution status until the project is re-prioritized and becomes active.

Beyond the larger website enhancement project, all websites like CSG require annual maintenance and occasional upgrades to keep up with changes in technology, security needs and software updates. We anticipate $20,000 annually for continued maintenance of these IT applications. A lack of IT developers and business analysts could be a limitation.

Final recommendations and future considerations

To ensure the continued success and potential expansion of Minnesota's online, real-time water quality monitoring network, ongoing investment is essential. This includes funding for equipment maintenance, skilled staffing, IT infrastructure and interagency collaboration. The following recommendations outline key priorities:

1. Expand the Nitrate Sensor Network

- Extend sensor coverage to areas with elevated nitrate loads and locations where concentrations are statistically increasing—even if loads are lower.
- Prioritize sites with unexpectedly high nitrate levels compared to adjacent watersheds, particularly where future land use changes may contribute to rising concentrations.
- A broader nitrate sensor network will enhance early warning capabilities, support surface water drinking water suppliers, and improve understanding of watershed dynamics and surface water-groundwater interactions.

2. Maintain and Support the Existing Flow Monitoring Network

- Preserve the current stream flow monitoring stations operated by multiple state agencies.
- Secure long-term funding to sustain these operations, considering future needs and the importance of continued data availability.

3. Secure Sustainable Funding

- Both maintenance of the current network and any expansion will require reliable, recurring funding.
- Annual budgets must reflect inflation, rising operational costs, and the growing need for both staff and non-staff resources.
- Skilled personnel are essential for equipment upkeep, calibration, data collection and analysis. They also require administrative and IT support, including contracting and procurement services.
- Without adequate funding to match the pace of technological advances and maintenance needs, network performance and future expansion could be compromised.

4. Invest in Technology and Accessibility

- The success of the network depends heavily on up-to-date IT systems. Keeping pace with technological change is essential for reliable operation, security and public access.
- A more robust and user-friendly nitrate data webpage is recommended. Features such as interactive maps with site-specific nitrate concentrations—accessible by hovering over color-coded markers—would improve transparency and public engagement.

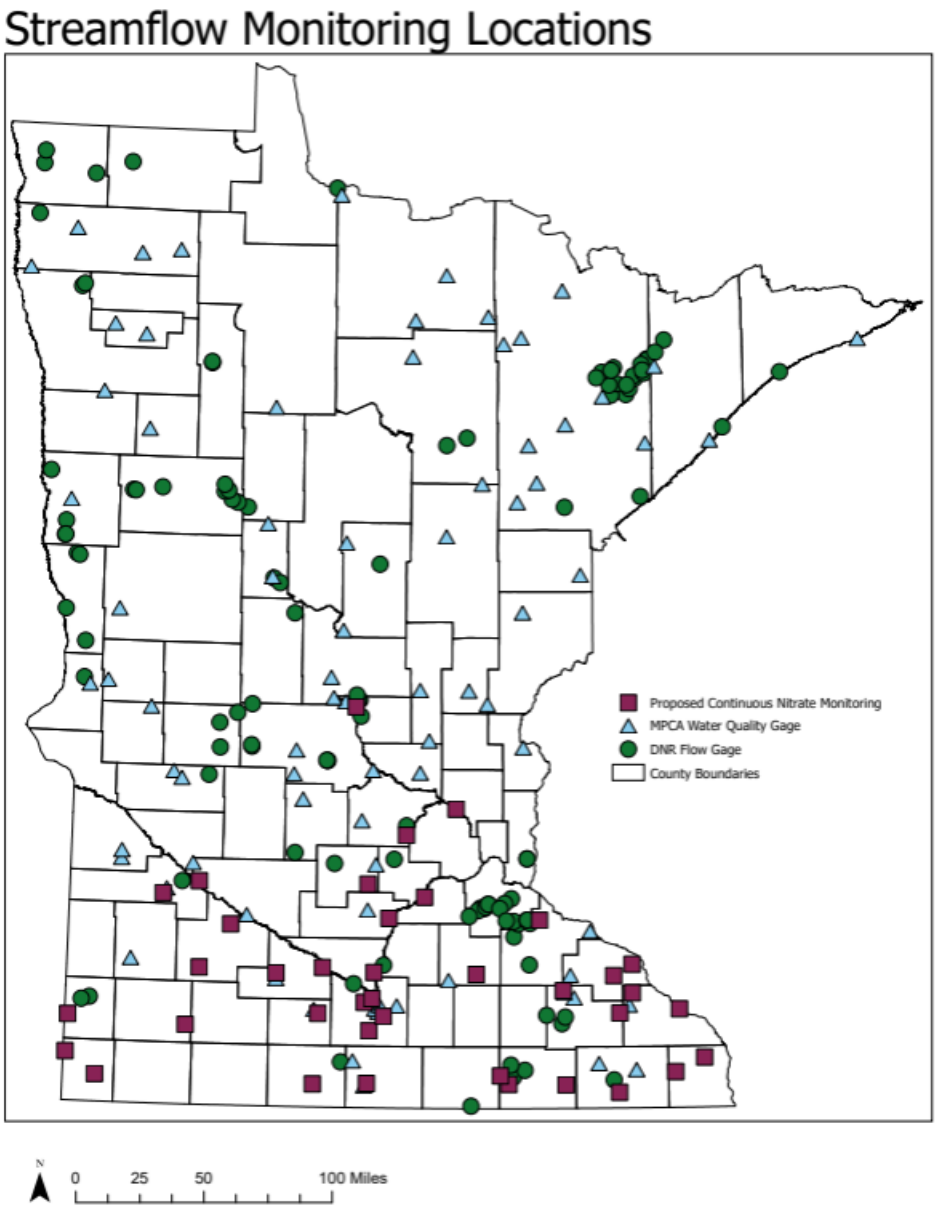
5. Strengthen and Sustain Partnerships

- The state relies on strong relationships with local partners, Tribal nations and federal agencies to keep the network operational.
- Changes to these partnerships could significantly impact network functionality. If any entity is unable to fulfill its role, additional state funding may be required, to maintain coverage or fill critical gaps.
- For example, NOAA currently provides satellite telemetry free of charge. Should that support end, the state would need to fund alternative telemetry options. Similarly, USGS contracts supporting 30 flow monitoring sites would require state funding, if federal support is reduced.

Conclusion:

Ongoing and expanded funding is critical to maintain and grow Minnesota's real-time water quality monitoring network. This includes supporting existing infrastructure, adding new nitrate sensors, keeping up with IT and cybersecurity needs, and preparing for potential changes in interagency partnerships. A sustained commitment will ensure the state continues to deliver accurate, accessible and actionable water quality data to other state and federal agencies, local governments, businesses and residents.

Appendix



This map shows active stream gaging locations. All points represent the DNR streamflow quantity monitoring network. The blue triangles are sites where MPCA also collects water quality samples. The red squares show the locations where MPCA collects water quality samples and has or will be installing continuous nitrate sensors using the one-time appropriated funds from the FY24 legislative session.

Flow monitoring

DNR

The DNR's Ecological and Water Resources (EWR) group collects and shares stream flow information in Minnesota, to support the DNR's statutory responsibilities and water management programs.

The stream gaging data help the DNR evaluate trends in stream base flow conditions, determine the frequency and magnitude of floods and low flows, and assist in assessing watershed condition changes due to land use or climate changes. The DNR also uses the data to develop hydrologic models to evaluate surface water and groundwater interaction problems and make decisions about suspending water appropriation permits.

At most of these stream gages, the DNR also provides continuous water level and discharge, mean daily discharge, water temperature, and precipitation data. Staff hydrologists compile and distribute these data via the CSG website. Primary clientele includes DNR staff who use stream flow information to make permitting decisions and monitor flooding; The MPCA staff who use stream flow data to help calculate pollutant loads for total maximum daily load (TMDL) studies and other uses; private consultants and engineering firms; the National Weather Service (NWS) for flood forecasting and response; staff throughout various state agencies and local governments; and researchers and members of the public making water planning and management decisions.

USGS

The USGS independently collects and maintains stream gaging data at over 220 sites across Minnesota. Primary data products include continuous water level and discharge, mean daily discharge, and annual peak stage and discharge. Selected gages also have continuous water-quality monitoring sensors that may include water temperature, specific conductance, pH, turbidity, and dissolved oxygen.

General data users include emergency managers and responders, water managers, environmental and transportation agencies, non-profits, universities and researchers, utilities, recreational enthusiasts, private consultants, insurers, and legal firms.

Known state-agency users include the EWR for water appropriation permits and drought management, Mississippi River low-flow plan for hydropower operators, river restoration, invasive fish and other aquatic species monitoring, fisheries assessments, and Minnesota state water trails; the MPCA for water quality sampling and TMDL load calculations, wastewater treatment plant effluent permits; the MNDOT for flood-frequency assessments and trends used in bridge and culvert design and populating updates to the USGS StreamStats application used by many engineering firms and other agencies throughout Minnesota and the nation; the MDA for pesticide and agricultural chemical monitoring at approximately 20 gages; the Minnesota Department of Health; the Minnesota Homeland Security and Emergency Management, Minnesota Public Safety, the Minnesota Board of Water & Soil Resources, and the Minnesota Environmental Quality Board.

Selected other governmental agencies regularly using USGS gage data include Environment Canada Climate Change and Water Survey of Canada for international agreements; the U.S. NWS for forecasting and warning of floods and hydrologic events; the U.S. Army Corps of Engineers for water control, navigation, and channel maintenance; the International Joint Commission for international agreements; U.S. Forest Service; U.S. Fish and Wildlife Service; U.S. Environmental Protection Agency (EPA); Federal Energy Regulatory Commission; U.S. Department of Transportation; Metropolitan Council Environmental Services for water quality sampling and pollutant load calculations at 13 gages; Metropolitan Mosquito Control District for planning applications; Red River Watershed Management Board for flood and water control; Red River Basin Commission, many watershed districts and watershed management outlets for water resources and soil conservation projects and monitoring; many Tribal communities for wild rice, natural resource and flood monitoring; and many local counties and municipalities for many of the uses listed.

In Minnesota, the USGS stream gage network is funded cooperatively by USGS and more than 40 federal, state, regional, watershed, Tribal, county and municipal agencies, and select private entities. While each gage may have originally been installed for a specific purpose, users and uses of stream flow data change over time. General data uses include planning, forecasting, and warning for floods and droughts; managing water rights, appropriations, and effluent permits; managing transboundary water issues, compacts and treaties; managing hydropower production and navigation; assessing water quality and aquatic habitat impairments; describing effects of changes to land, climate, and water use on stream flow; designing roads, culverts, bridges, reservoirs, water-supply and wastewater facilities; and assessing recreational activity safety.

MPCA

The MPCA collects data and provides information on stream flows in Minnesota for multiple purposes. Its monitoring coordinators install, calibrate and upgrade the equipment as needed, and collect, compile, analyze and distribute the hydrologic data for the respective gaging stations. Stream flow information helps:

- Support stressor identification
- Calculate TMDL
- Calibrate large and smaller scale sub-watershed models
- Evaluate BMP effectiveness
- Assist decision-making for some local government projects
- Provide context to climate changes across the long-term biological monitoring network

MDA

The MDA has several programs that collect hydrologic and water quality data to improve understanding of the impacts of pesticides and fertilizers on water resources. They include the Discovery Farms Minnesota, Goodhue County Paired Cover Crop Demonstration, Nicollet County Drainage Demonstration, Red River Valley Drainage Water Management, Root River Field to Stream Partnership, and the St. Peter Drinking Water Supply Management Area (available on the MDA near-real-time website).

These projects often combine water quantity, water quality, and agronomic decisions to better understand the range of water, nutrient, and sediment exports from each field or small watershed and use a paired watershed approach to assess BMP effectiveness. Additionally, as part of the pesticide water quality monitoring program, the MDA has installed equipment at several stream locations to monitor water level, rainfall and other water quality parameters. The MDA has contracted the DNR to collect stream flow measurements at several of these locations, and they are integrated into the CSG website.

Metropolitan Council

The Metropolitan Council (Met Council) partners with the USGS on providing cost-sharing funds for flow monitoring along the St. Croix River at Stillwater, Minnesota, and Prescott, Wisconsin. For its Minnesota and Mississippi River water quality monitoring stations, the council utilizes multiple USGS station flow records across the metro area to compute pollutant loads and flow-weighted concentration trends. This information supports evaluations of the region's water planning and the effectiveness of local wastewater systems.

The Met Council's tributary monitoring program conducts flow monitoring on 14 tributary rivers and streams in the metro area. This monitoring increases the understanding of the contributions of nonpoint pollution in the metro area. These stations monitor continuous stage, conductivity and temperature with cellular telemetry for real-time data access. Eight of those 14 stations are part of the Met Council's Watershed Outlet Monitoring Program (WOMP), which partners with local water organizations and communities to conduct fieldwork. For WOMP streams, local organizations perform most of the fieldwork and Met Council coordinates tasks for flow measurements, equipment programming and event sampling. There are two additional tributary river and stream stations that utilize USGS flow data (the Cannon and Rum rivers). Like the large rivers program, this flow information is used to calculate pollutant loads and water quality trends, which are then shared with local partners to target implementation and measure the success of watershed management projects over time.

Local partners

There are a handful of watershed districts and Soil and Watershed Conservation Districts (SWCD) that also collect flow data for various purposes and different lengths of time. For example, the Sauk River Watershed District collects flow measurements and stage, and then sends the data to the MPCA for work-up in WISKI; the Lake of the Woods SWCD has also done so in past years. Also, there are watershed districts and groups in the metro area that monitor flow and input to local partner internal databases.

Nitrate sensor monitoring

MPCA

For almost 10 years, the MPCA has maintained continuous nitrate sensors on the Cedar River, near Austin, and the Zumbro River, near Kellogg. The monitoring setups have guided staff evaluation of planned technology for future sites. As a result of the 2024 legislative session, the MPCA was tasked with

"developing a continuous nitrate monitoring network to monitor watershed and basin pour points where elevated loads of nitrate have been measured historically." Chapter 106 of Minnesota Laws. The MPCA has initiated this network by hiring a network coordinator and monitoring specialist. It is in the process of confirming station locations, setup, and equipment needed. As of June 2025, sensor purchasing is in process.

Additional information about the nitrate network and links to the CSG by station can be found on the MPCA 24-hour nitrate network webpage (https://www.pca.state.mn.us/air-water-land-climate/24-hour-nitrate-network).

A map of locations is available here: Continuous Nitrate Sensor Locations

Current MPCA stream nitrate sensors are located at:

- Cedar River near Austin, 540th Ave
- Zumbro River at Kellogg, MN

The MPCA also assists the MDA on the Root River Field to Stream Partnership nitrate sensor stations, which are listed in the MDA section.

Additional locations

The Sentinel Spring collaboration between the MPCA, the DNR, the MDA, and the Olmsted and Fillmore county SWCDs focuses on monitoring continuous nitrate in springs. Monitoring locations measure spring level, water temperature, nitrate concentration, and flow. It was originally a two-year pilot project starting in 2016, entailing spring monitoring at Sentinel Springs to collect data on aquifer recharge and aquifer characteristics following precipitation and snowmelt events. The MPCA's role is to deploy continuous nitrate probes in five springs (Bear and Engle springs, the Lanesboro Hatchery and Peterson Hatchery Main springs, and Crystal Springs Hatchery), along with collecting anion samples and assisting with flow measurements as needed. All three hatcheries are displayed in near-real time on the MDA website (https://mda.onerain.com/map/?view=0c6ef2dd-887e-4728-8117-4a11627cff50).

MDA

In addition to the stream sensors that MDA partners on with the MPCA and the DNR, the MDA also has continuous nitrate sensors in artificial tile drainage systems, cave drips, ponds, springs, intermittent streams, and wells. The projects with these sensors include Discovery Farms Minnesota (13 sensors), Goodhue County Paired Cover Crop Demonstration (two sensors), Root River Field to Stream Partnership (three sensors), the St. Peter Drinking Water Supply Management Area (four sensors), and other projects (four sensors). These data are available on the MDA near-real time website (https://mda.onerain.com/map/?view=0c6ef2dd-887e-4728-8117-4a11627cff50).

Current MDA stream nitrate sensors are located at:

- Bridge Creek near Houston, John Deere Dr
- Crystal Creek near Harmony, TWP315
- South Branch Root River near Grand Meadow, 760th Ave

Data

The DNR/MDA/MPCA interagency WISKI database

Continuous time-series water quantity and quality data are managed in a proprietary, relational database and data processing software package called WISKI. Time-series surface water, flow, groundwater, continuous water quality, and climate data are stored, managed and made available to agency staff in WISKI. The MPCA and the DNR partner in operating and maintaining WISKI, where the MDA also stores time-series data. Some of the data (primarily stream flow) is currently available to the public through the CSG website (https://www.dnr.state.mn.us/waters/csg/index.html).

Efforts are underway to expand public access to more data. The MCES uses its own version of WISKI for data management and quality control processes. Discrete water chemistry data, along with real-time, continuous data, are shared on the MCES Electronic Information Management System. The MCES is working to offer approved chemistry data to the EPA's Water Quality Exchange system, where it can be easily accessed by the MPCA for assessments.

Data visualizations

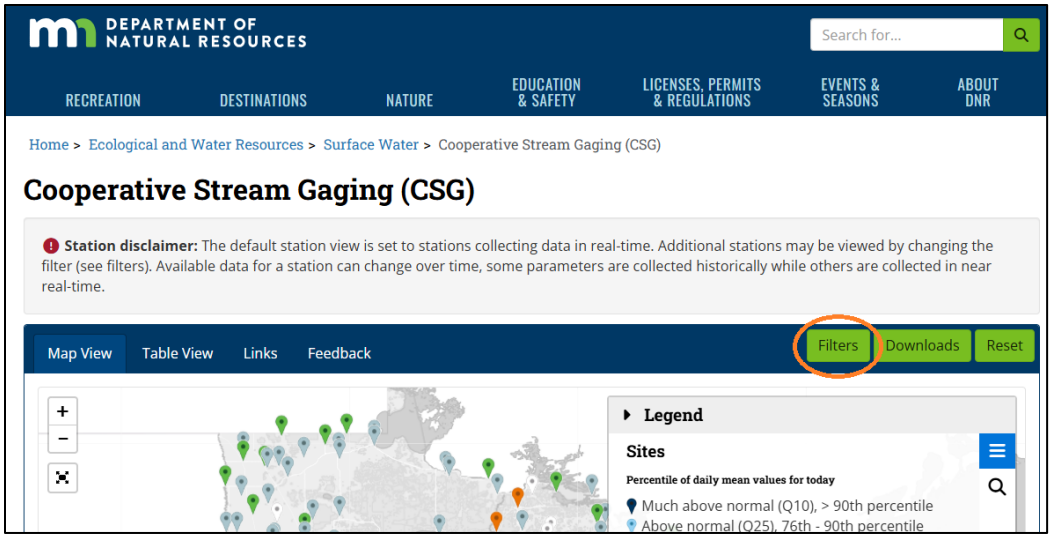
The continuous flow and nitrate data are available to state agencies and the public via the CSG website, also jointly operated and maintained by the DNR and the MPCA. The CSG website (https://www.dnr.state.mn.us/waters/csg/index.html) provides a portal for state agencies and the public to access real-time stream flow data, site photos, water quality information and other information.

Examples of information available from the CGS website include:

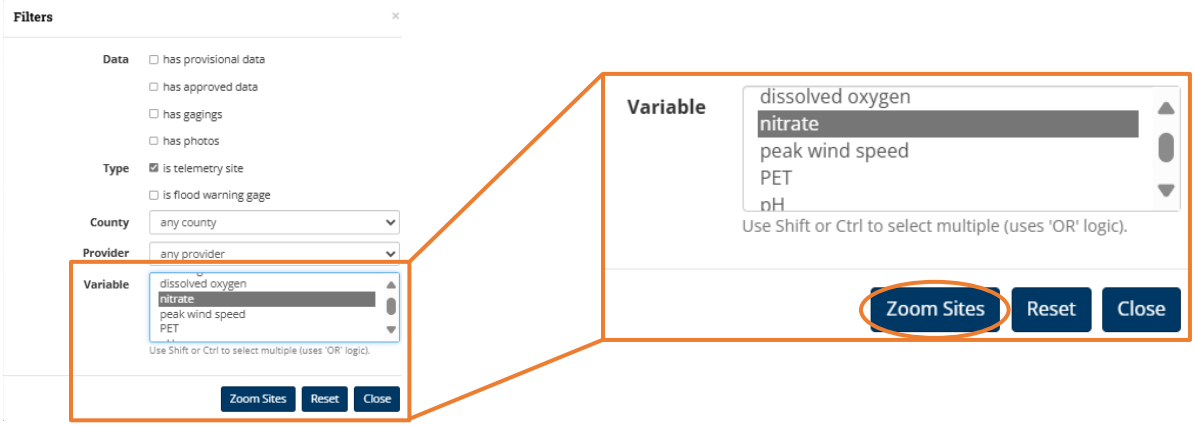
- Stream flow gage location, site characteristics, reader, type of gage, and drainage area
- Stage/discharge rating curves and equations
- Stream flows
- Hourly headwater and tailwater readings
- Flow statistics
- Flood damage stages
- Continuous water quality

On the CSG website, use the filter to display the location of nitrate stations and their data.

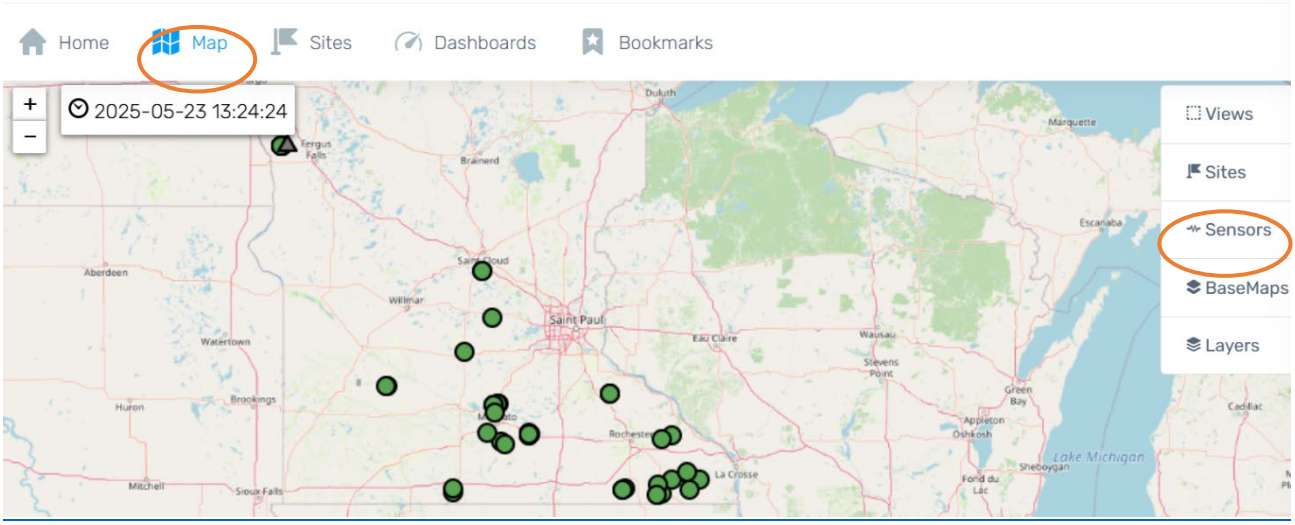
- Click the green *Filters* button on the upper right of the page (circled in orange).



- Choose *Nitrate* from the variable box, click the blue *Zoom Sites* button at the bottom; only nitrate sites will show on the map.



- The locations of continuous nitrate stations supported by the MDA are also available on its website (https://mda.onerain.com/). Click on the map icon at the top of the page, then choose *Sensors* on the right of the page to open a dialog box.



- In the dialog box, scroll down to *Nitrate-N Concentration* and select it to view those locations. It will include all MDA-supported nitrate sensors in streams, springs, and wells.