Minnesota River Assessment Project Report

Executive Summary

Report to the Legislative Commission on Minnesota Resources

January 1994

Minnesota Pollution Control Agency

MINNESOTA RIVER EXECUTIVE SUMMARY

BACKGROUND

In 1989 several federal, state and local agencies began a four-year comprehensive study of the Minnesota River basin. This cooperative effort, the Minnesota River Assessment Project (MRAP), was designed to evaluate how pollution is entering the Minnesota River and how the river is affected by pollution.

The purpose of the study was to examine the water chemistry, the biological communities and the land uses that characterize the Minnesota River Basin.

More than 30 federal, state and local agencies participated in the study, which was funded by the State Legislature as recommended by the Legislative Commission on Minnesota Resources as well as local, state and federal agencies. A list of the cooperators can be found at the back of this summary.

The goals of the study were to:

- Assess water quality and set water quality improvement objectives for individual tributaries and sites along the main stem of the river
- Develop assessment techniques that are transferable to other large basin studies in the state

Resource

The Minnesota River flows 335 miles through some of the state's richest agricultural land from its source at the Minnesota/South Dakota border to its confluence with the Mississippi River at Fort Snelling. The Minnesota River basin drains 16,700 miles of land, which includes all or parts of 37 counties in Minnesota. The Minnesota River is the largest tributary to the Mississippi River in Minnesota.

Problem

The Minnesota River is one of the state's most highly polluted waters, particularly from nonpoint sources of pollution. Some common nonpoint sources of pollution include storm water discharges, septic tank discharges and runoff from roads, parking lots, construction sites, lawns, agricultural fields, feedlots, mining operations and forest harvesting operations.

Minnesota's water quality rules define water quality standards for all state waters based on the goals of the federal Clean Water Act to provide fishable and swimmable waters wherever possible. Nonpoint source pollution entering the Minnesota River contributes to water-quality degradation and violation of standards throughout the basin. Water quality standards most often violated in the Minnesota River are fecal coliform bacteria, turbidity, unionized ammonia and dissolved oxygen.

The volume of suspended sediment carried by the Minnesota River is greater than most other rivers in the state. These fine particles of silt and clay are characteristic of the soils in the Minnesota River basin. Much of the sediment carried by the Minnesota River is transported to the Mississippi River, greatly increasing the Mississippi's pollutant load.

High levels of bacteria in the river also raise health concerns for people who have contact with the river's water.

Pollutants of concern

In the Minnesota River, the pollutants of greatest concern are bacteria, sediments, nutrients, bacteria and oxygen-demanding substances.

Bacteria

High levels of fecal coliform bacteria are often present in the Minnesota River. Sources of this bacteria include wastes from animal feedlots and inadequately treated sewage. These bacteria are often associated with disease-producing organisms that can cause diarrhea, infectious hepatitis, cholera, dysentery, salmonella and typhoid fever. High bacteria levels in the Minnesota River pose health risks for people who have contact with the river's water through activities such as wading, swimming and water skiing.

Sediment

During 13 years of monitoring the Minnesota River at Mankato, the U.S. Geological Survey observed a sediment load of 2700 tons per day. This equals a 10-ton dump truck load approximately every five-and-a-half minutes.

Approximately 90 percent of the sediment carried by the Minnesota River is silt size or smaller. Sediment of this size settles slowly and once suspended is often carried long distances by moving water before settling.

Sediment causes a variety of problems in the river and its tributaries. High amounts of sediment affect biological communities by covering the bottom of the streams and destroying spawning sites and eggs. This condition is termed embeddedness and is widespread throughout the Minnesota River watershed. Sediment on the river bottom limits the oxygen and food that is available to aquatic life.

Sediment is also a problem because many other pollutants attach to sediment particles and are carried into streams along with it.

Nutrients

Phosphorus and nitrogen are the two main nutrients that cause problems in the river. Excess phosphorus and nitrogen are a problem because they increase plant and algae growth in streams.

High concentrations of nitrates, a form of nitrogen, are hazardous to some infants causing a condition known as methemoglobinemia, commonly known as "blue baby syndrome." Blue baby syndrome disrupts the oxygen-transport capabilities of the blood, resulting in asphyxiation of the baby. Infants whose formula is made with water containing high concentrations of nitrates face the greatest risk. Boiling of water for feedings may increase the risk by concentrating the nitrates. A 10 mg/liter standard for nitrates has been set to protect drinking water.

Unionized ammonia, a form of nitrogen, is toxic to many aquatic organisms, such as fish and aquatic invertebrates.

Oxygen-demanding materials

Dissolved oxygen is necessary for aquatic life . A dissolved-oxygen standard of 5 milligrams/liter has been set to protect such life. Many different pollutants can create an oxygen demand in the river. These include raw manure, feedlot runoff, domestic sewage, storm water runoff and sediment. Significant daily swings in dissolved oxygen can occur due to excessive plant growth.

How nonpoint source pollutants enter the river

During rains, large quantities of organic materials, inorganic solids and nutrients find their way into the tributaries and are eventually transported into the Minnesota River.

A small-watershed stream may change quickly from high-quality water to very low-quality water, filled with sediment and associated pollutants, during runoff. A small stream that looks very clean in dry weather may carry a significant amount of pollution into the main stem of the Minnesota River during an intense but short rainfall.

Rainstorms are more frequent in the eastern or lower portion of the Minnesota River basin where the average runoff is more than six inches a year. By comparison, the average runoff in the western extreme of the basin near South Dakota is less than two inches a year.

STUDY RESULTS AND FINDINGS

The Minnesota River Assessment Project consisted of three interrelated components: physical/chemical assessment, biological/toxicological assessment and land use assessment. To study the river, researchers set up a monitoring network in the Minnesota River Basin from the dam at Lac Qui Parle Reservoir to the confluence with the Mississippi River. The network included 14 sites on the main stem of the river, ground water from 19 separate springs sites and 17 sites throughout the watersheds of the major tributaries. These sites were used for the water quality, biological and toxicological monitoring.

A brief summary of the findings from each of these assessments follow:

Physical/chemical assessment

The objectives of the physical and chemical assessment of the basin were to identify sources and determine loadings of major nutrients, suspended sediment, biochemical oxygen demand and organic carbon in selected reaches of the Minnesota River and its tributaries. Another goal was to measure the movement of sediment and associated pollutants between river reaches. Researchers also examined areas of bank erosion and sediment deposition to determine whether in-stream loading might have a greater effect on river quality than upland sources of pollution.

Findings

- Approximately 90 percent of the sediment in transport is fine particles (silt and clay), which can be transported long distances.

- The majority of sediment transport occurs during rain storms and snow melt when sediment concentrations increase dramatically.

- Sediment delivery from uplands via drainage ditches is virtually all fine material (silt and clay).

- Periods of highest turbidity and highest sediment concentrations are associated with periods of transport of the fine particles as the river rises.

- During periods of stable flow (no runoff), turbidity is primarily caused by abundant algal growth with a lesser contribution from silt and clay.

- Sediment deliveries from single rain storms at various streams during this study have ranged from as little as 10 tons/square mile to more than 100 tons/square mile. The average annual yield for the entire basin upstream from Mankato has been about 74 tons/square mile over the last 25 years. This results in an average transport of just under one million tons of sediment through Mankato each year, ranging from about 200,000 tons to 3.5 million tons per year.

- Samples collected as high flows recede (just after the peak) on the main stem of the Minnesota River, when bank erosion is expected to be at maximum, have relatively low concentrations of sediment. This suggests that bank erosion is not the main cause of high concentrations and turbidity in the main stem. Preliminary results suggest that this is also true in the major tributaries. Bank erosion, nonetheless, was shown to add measurable quantities of sediment to the total sediment load.

- Nitrate-nitrogen levels seldom exceeded 10 milligrams/liter in the main stem of the river upstream of Mankato, but frequently exceeded this level at Mankato and downstream.

- Main stem concentrations of *chlorophyll a* indicate high levels of algae.

- Phosphorus concentrations increase two- to five-fold in streams throughout the basin when there is runoff.

- High bacteria counts occurred during both low and high flow conditions, suggesting that some bacterial inputs are constant, such as inadequate municipal treatment plants, septic systems or directly discharging feedlots.

- The instances of elevated oxygen demand during the summer months in the basin upstream of Henderson coincided with highly elevated algal productivity.

- Concentrations of sediments and phosphorus rise dramatically in the tributaries and main stem of the river during runoff. Concentrations fall rapidly as overland runoff ceases. Bacteria, oxygen demand and nitrate are important exceptions in that they can also be high during non-runoff, steady-flow conditions.

- The hydrology of the watershed has been altered in the past century due to extensive ditching and tiling. Formerly landlocked areas are now connected to surface waters, resulting in downstream delivery of pollutants.

Biological/Toxics Assessment

The primary objective for the biological/toxics studies was to help define existing conditions in the Minnesota River and its tributaries. One of the Minnesota River Assessment Project goals was to use these results to help define "attainable conditions" in the basin so that target improvement recommendations can be set for the cleanup activities that are scheduled to follow this project. When developing indices for attainable conditions, researchers took into account the agricultural nature of the Minnesota River watershed.

As part of this assessment, researchers examined habitat, toxicity of water and sediments and the health of fish and macroinvertebrate communities in the Minnesota River and its tributaries.

Fish, macroinvertebrates (stoneflies, caddisflies, freshwater mussels, etc.) and algal communities are commonly measured in watershed investigations. Their composition is directly influenced by environmental factors such as water and sediment chemistry and habitat conditions. Healthy communities are distinguished by diverse and stable populations. In streams where environmental quality is degraded, pollution-sensitive populations decline and are replaced by more pollution tolerant forms.

The Minnesota River basin provides important recreational opportunities for anglers from southern Minnesota, South Dakota, Iowa and Nebraska. Walleye, northern pike and channel catfish are found in the major rivers throughout the basin, Flathead catfish and sauger are found on the main stem of the Minnesota River downstream of Granite Falls. Smallmouth bass are fished in the main stem of the Minnesota River and in tributaries such as the Cottonwood River and Blue Earth River. There are also about 20 spring-fed trout streams within the basin.

Past Minnesota Department of Natural Resources fisheries investigations and surveys of local resource managers (MPCA, 1991) have suggested that nonpoint source pollution has impaired the fishery in many stream and river segments.

Findings

- Habitat was evaluated in the upper watershed areas of the Minnesota River basin. Habitat quality was found to be generally poor, riparian zones adjacent to the streams were absent and stream beds were covered by sediments.

- The toxicity of the water and sediments to organisms at the bottom of the food chain was measured for the Minnesota River and its tributaries. No surface water toxicity was found.

- Analysis of the sediments showed some chronic toxicity to these organisms. Elevated sediment toxicity was found at Fort Snelling, Henderson and the reservoirs at Rapidan and Lac Qui Parle. Lac Qui Parle Reservoir showed the most toxicity. In general, greater toxicity can be predicted at reservoirs because of the settling of sediments and higher nutrient concentrations.

- Toxicity in the sediments was believed to be caused by ammonia nitrogen.

- Aquatic macroinvertebrates that live in and on bottom sediments are considered to be important indicators of water quality. Macroinvertebrate communities were assessed at approximately 40 sites along the main stem of the Minnesota River, its major tributaries, and small-watershed streams. Most sites sampled had been adversely affected by pollution, and had fewer species than would be desirable.

- All macroinvertebrate communities at the sites studied on the main stem of the Minnesota River would be judged as moderately to severely affected by pollution. The main stem sites at Henderson and Lac Qui Parle were the most severely affected.

- Macroinvertebrate communities in the larger tributaries were considered moderately affected by pollution. The Chippewa River was the most affected tributary.

- For the small to intermediate streams, physical characteristics and composition of bottom-dwelling communities varied greatly. Most of these sites are moderately affected and some severely affected by pollution.

- Habitat modification and excessive amounts of organic material were factors affecting macroinvertebrate communities.

- Fish communities were evaluated at 116 sites. Information from historical records and the least impacted sites were used to develop a ranking system for Minnesota River fish communities. This ranking system is called an Index of Biotic Integrity. Six percent of the sites tested had excellent fish community health, 21 percent good fish community health, 35 percent fair, 26 percent poor, and 10 percent very poor using this ranking system.

- Poorer fish community quality was noted in the Blue Earth tributaries.

- Higher fish community quality was found in the larger streams.

- Habitat degradation due to ditching and sedimentation were the most obvious factors impairing the fish communities.

Land Use Assessment

Assessing land use is very important to understanding the types and magnitude of pollutant sources entering a system. In the Minnesota River system, there are 1208 minor watersheds which make up the surface water flow to the system. Because it was not practical to assess all 1208 watersheds, a number of minor watersheds were selected and assessed using four different methods of land use assessment. These four methods, called Levels I-IV, are described below. Findings and a comparison of the costs and usefulness of each of the methods follows the descriptions.

The Level I land use study, conducted by Mankato State University, was undertaken to determine if existing data and modeling methods could be used to predict water chemistry in the Minnesota River. Level I used a model based on ecoregions to try to predict the potential for nonpoint source pollution from each of the 1208 minor watersheds. The model used data from the Land Management Information Center, which included land use, soil texture, slope and water orientation data.

The Level II assessment's goal was to identify, analyze and recommend the most cost-effective group of best management practices that would improve the quality of the water that leaves agricultural lands. The USDA Soil Conservation Service (SCS) conducted the work on 10 minor watersheds located in the Blue Earth, Le Sueur and Watonwan watersheds. The 10 minor watersheds evaluated by this method are a subset of the 37 minor watersheds assessed in the third land-use study.

The primary pollutants studied in the Level II assessment were sediment and nutrients (nitrogen and phosphorus). Cropland fields were analyzed using Soil and Water Conservation District inventories and the use of various computer models. Watershed and field level management alternatives were established and then modeled to determine the impacts on water quality.

The third method of land use assessment was developed as a means of assessing cropland fields and nonpoint sources such as septic systems, tile inlets, wells, dumps and feedlots. The Level III approach included five steps: walking the watershed, interviewing landowner/operators, developing land use maps, developing databases and estimating costs to implement the assessment. Soil and Water Conservation District staff conducted this assessment in 37 minor watersheds.

The fourth method of land-use assessment involved the use of large-scale infrared aerial photography to obtain land cover/land use information, which can be used to assess point source and nonpoint source pollution in the minor watershed study areas. The same 10 minor watersheds assessed in Level II were selected as study sites for the Level IV assessment.

Findings

<u>Evaluation of best management practices—SCS Level II assessment</u>

- An estimated 200,000 tons per year of soil is eroded from cropland from the 10 sub-watersheds studied in the Level II assessment. An estimated 19 percent (38,000 tons) of the soil that eroded from cropland was washed out of the watersheds into the river system.

- The majority of the cropland in the 10 sub-watersheds is eroding at five tons per acre or less. The five-ton level is what is known as the tolerable level (T), above which crop productivity can be affected. Even though soil loss levels were below T, water quality problems were found in the system. This confirms the observation that a small amount of pollutant loss per acre multiplied by millions of acres can significantly affect water quality.

- Sediment and nutrient management strategies would lead to significant reductions in pollutant loadings. Models showed that the following reductions at the outlet of a watershed could be made: sediment by 45 percent, phosphorus by 65 percent and nitrogen by 15 percent.

- Significant reductions in sediment and nutrients could be achieved using existing technology for residue and tillage management. Practices leaving approximately 30 to 40 percent crop residue on the surface after planting were evaluated. Models predicted that by treating 16 percent of the land, a 25 percent reduction in deliverable sediment could be achieved, and by treating 79 percent of the cropland, a 45 percent reduction in sediment could be achieved.

Comparison of the four levels of assessment

- Level I is a broad-scale computer modeling approach using statewide minor watershed data. Its strength is the inclusion of the whole basin. This a theoretical approach that involves computer-trained personnel and models. Cost is minimal, about $20,000 for all 1208 watersheds. This model did not accurately predict the nonpoint source potential of the different watersheds studied, perhaps because it did not take in account land use management. The long-term goal is to refine the model so it could be used as a screening tool to prioritize each of the 1208 minor watersheds for assessment and implementation of best management practices.

- The SCS Level II system uses modeling to trace the water from where it falls to the outlet of a watershed. Use of these models requires a large amount of site-specific data usually obtained from the SCS and SWCDs. Its greatest strength is the ability to model the impacts of various practices, such as crop residue management, and to predict the water quality output. Its greatest drawback is the cost, $40,000 for the initial set-up of the model. However, the modeling processes and/or outputs could be transferred to similar watersheds, which could substantially reduce the cost. If the 1208 minor watersheds in the basin could be classified into Level II categories, this would be a useful planning tool.

- Level III is a local methodology tracing water back from where it enters a body of water. It has the advantage of involving landowners throughout the process. It has proven to be extremely successful in providing accurate and sensitive information for inventories of the 37 minor watersheds studied. The drawbacks of this method are its labor-intensive approach and the inability to check the accuracy of landowner information. The cost of this method is more than $10,000 per minor watershed. Information from these assessments was used directly in Level II, and the methodology is being used in many MPCA Clean Water Partnership projects.

- Level IV is a technical methodology using aerial photography interpretation and analysis. It does not involve participation by landowners. It can provide the most accurate data for geographical information systems. The cost of $1,000 per minor watershed is reasonable, but for enhanced analysis several flights may be needed. Of all the methods used, this one has the best potential for trend documentation because of its capability for measuring at specific points in time.

CONCLUSIONS

- Large amounts of sediment and nutrients are carried into the Minnesota River during rain fall and snow melt. A certain type of sediment—fine particles of silt and clay—is causing serious problems in the Minnesota River watershed. These fine particles of silt and clay are characteristic of the soils found in the watershed. Fine sediments, which can be transported long distances, cause an increase in turbidity or cloudiness of the water. They can also cause aesthetic problems and carry nutrients and other pollutants that can cause low levels of dissolved oxygen in the river.

- Biological communities (fish, algae and invertebrates) are adversely affected by pollution throughout the Minnesota River and its tributaries. Siltation and excessive amounts of organic pollutants (e.g. manure, septic system runoff, antifreeze) are affecting the health and stability of aquatic communities.

- Levels of *chlorophyll a* indicate the presence of large amounts of algae in the river. This condition is pronounced under summer low-flow conditions.

- Levels of phosphorus in the basin are high enough to produce nuisance growth of algae. These concentrations often increase two- to five-fold in streams throughout the watershed when there is runoff.

- Nitrate levels in the Minnesota River and its tributaries were elevated but did not exceed 10 milligrams/liter nitrate-nitrogen above Mankato. At Mankato and downstream, nitrate levels often exceed 10 milligrams/liter nitrate-nitrogen. The level of 10 milligrams/liter nitrate-nitrogen is set by the federal government to protect drinking water. None of the cities at Mankato or downstream draw their drinking water directly from the river or its tributaries. However, these high nitrate levels are of particular concern to the City of Mankato. Under certain conditions, water from the Blue Earth River moves into the shallow aquifer that is used as the source of Mankato's drinking water.

- High fecal coliform bacteria counts have been found throughout the river basin. These high levels of bacteria, which can be associated with other disease-causing bacteria, are a health concern for people who have contact with the river water. For example, people who swim, wade or water ski in the river can get sick from contact with the water.

- Although some of the tributaries have higher concentrations of specific pollutants, no single tributary is controlling the overall water quality of the river.

- The effects of pollution from municipal and industrial treatment facilities as well as pollution from septic tanks and feedlots with direct discharges are more pronounced during low flow conditions where there is less dilution.

- Traditionally, erosion limits are expressed as soil loss tolerances ("T") which are the maximum levels of erosion that can take place while maintaining high agricultural productivity. Because of a predominance of gentle slopes and fine-textured soils within much of the Minnesota River Basin, soil losses rarely exceed "T." The difficulty with this type of erosion standard is that it looks only at field-scale needs and does not address downstream water quality considerations. The water quality problems of the Minnesota River with respect to sediment may indeed be a case of a delivery of sediment from watersheds over a very large area even though erosion rates are low.

RECOMMENDATIONS

- Establish phosphorus standards for the Minnesota River basin. The state's standard-setting process is participatory involving affected parties.

- Implement soil erosion control practices on all land, including transportation, construction, agricultural and urban areas.

- Help people recognize that fine-textured soil lost from gentle slopes contributes to water quality problems.

- Control erosion of cropland currently not using soil management best management practices. Follow a three-phase approach to bring cropland to at least 30 percent residue after planting, or provide equivalent soil protection, in the following order:

    1. treat cropland currently exceeding soil loss tolerance (T) levels; then

    2. treat cropland in riparian areas and other areas where sediment delivery is highest; and then

    3. treat the remaining cropland acres.

- All communities should develop and implement plans to manage urban storm water.

- The amount of nutrients (phosphorus and nitrogen) must be reduced through urban and agricultural fertilizer best management practices, control of feedlot runoff, septic system upgrades and control of inadequately treated point sources.

- Vegetated buffers should be established alongside ditches and rivers in the basin.

- Additional stream bank assessments are needed to target areas that need protection.

- Wetland restoration is needed in carefully selected locations to settle solids, remove nutrients and reduce peak flows, thereby protecting stream banks.

- Long-term trend monitoring of the entire Minnesota River basin is needed.

- Stream channelization and river clearing and snagging should be limited. When necessary, these activities should be carefully implemented, considering downstream consequences. These actions adversely affect stream habitat.

- Land treatment goals should be established. These should be reasonable and cost effective and shown to significantly reduce nonpoint source pollution.

- Long-term trend monitoring should be refined to increase our understanding of toxics throughout the Minnesota River basin.

- Strategies and recommendations should be set to meet a 10-year goal for addressing pollution problems in the basin. Watersheds in the basin should be prioritized so that resources can be directed to address critical problems first.

MRAP PROJECT REPORTS

Volume I—LCMR Work Plan and Project Summary

Legislative Commission on Minnesota Resources Project Work Plan. Minnesota Pollution Control Agency.

MRAP Project Summary. Minnesota Pollution Control Agency.

Volume II—Physical and Chemical Assessment

Selected Basin Characteristics and Water-Quality Data for the Minnesota River Basin—U.S. Geological Survey Open-File Report 93-164. Thomas A. Winterstein et al.*

Sources and Transport of Sediment, Nutrients and Oxygen-Demanding Substances in the Minnesota River Basin, 1989-92. United States Geological Interpretive Report. Greg Payne.

The Minnesota River Basin: A Hydrollogic Overview and Assessment of Spring Resurgence. Joseph A. Magner and Scott Alexander.

Wetland Water Quality Functions: Literature Review and Considerations for Wetland Restoration/Creation in the Minnesota River Basin. Brendan J. Cain and Joseph A. Magner.

Selected Water Quality and Flow Data from Minor Watersheds in the Blue Earth River Basin. Gregory D. Johnson.

Water Quality Analysis of the Lower Minnesota River and Selected Tributaries: River (1976-1991) and Nonpoint Source (1989-1992) Monitoring. Metropolitan Waste Control Commission.

Volume III—Biological and Toxicological Assessment

Diatom Assemblage Structure as an Indicator of Stream Habitat Condition in the Minnesota River Watershed. Carl Richards and Franz J. Kutka.

Characterization of Sediments, Settleable Solids and Water Quality of Stormwater Runoff in the Minnesota River Watershed. Beth Proctor.

Ambient Toxicity Assessments in the Minnesota River Basin. John W. Arthur , Jo A. Thompson, Charles T. Walbridge and Harry W. Read.

* will be printed separately

Assessment of Organic Pollutants on Fish in the Minnesota River Watershed by HepaticAminopyrine N-Demethylase Activity. Steve D. Mercurio et al.

Analysis of Benthic Macroinvertebrate Communities in the Minnesota River Watershed. James A. Zischke, Gerald Erickson, Diane Waller and Robert Bellig.

A Fish Community Analysis of the Minnesota River Basin. Patricia A. Bailey, John W. Enblom, Steven R. Hanson, Paul A. Renard and Konrad Schmidt.

Volume IV—Land Use Assessment

Nonpoint Source Pollution Potential Model of the Minnesota River Basin Watershed MRAP Level I—Land Use. Charles V. Peterson and Henry W. Quade.

An Atlas of Nonpoint Source Pollution Potential in the Minnesota River Basin. Charles V. Peterson and Henry W. Quade.*

MRAP Level II Assessment—USDA Soil Conservation Service. Tim Koehler, Peter Cooper et al.

SWCD Methodology of Land Use Assessment—MRAP Level III. Mary Mueller and Gary Wehrenberg.

MRAP Level III Database and Database Documentation for Minnesota River Assessment Project—Land Use Assessment Questionnaire. Julie A. Doherty.*

MRAP Land Use Level IV Aerial Photography Methodology. Cis Berg.

* will be printed separately

REPORT DISTRIBUTION

The results of the Minnesota River Assessment Project are compiled into four volumes, each containing several individual reports. A limited number of the full report sets were printed because of the size of the reports and budget constraints. The full reports are available for review at the Minnesota Pollution Control Agency's central office in St. Paul and regional offices in Marshall and Rochester. Copies are also available at county soil and watershed conservation districts in the basin and at major libraries in the basin.

MRAP COOPERATORS

Minnesota Pollution Control Agency
U.S. Department of the Interior, U.S. Geological Survey
U.S. Environmental Protection Agency, Environmental Research Laboratory, Duluth
U.S. Department of Agriculture, Soil Conservation Service
Mankato State University
Metropolitan Council
Metropolitan Waste Control Commission
Minnesota Department of Agriculture
Minnesota Board of Water and Soil Resources
Minnesota Department of Natural Resources
Minnesota Land Management Information Center
Gustavus Adolphus College
St. Olaf College
South Central Minnesota Counties Water Planning Project
Natural Resources Research Institute
University of Minnesota
University of Wisconsin-Madison
U.S. Department of the Interior, U.S. Fish and Wildlife Service
Blue Earth County Soil and Water Conservation District
Brown Soil and Water Conservation District
Chippewa Soil and Water Conservation District
Cottonwood Soil and Water Conservation District
Faribault County Soil and Water Conservation District
Kandiyohi Soil and Water Conservation District
Lincoln Soil and Water Conservation District
Lyon Soil and Water Conservation District
Martin Soil and Water Conservation District
Murray Soil and Water Conservation District
Nicollet Soil and Water Conservation District
Redwood Soil and Water Conservation District
Renville County Soil and Water Conservation District
Sibley Soil and Water Conservation District
Swift County Soil and Water Conservation District
Watonwan Soil and Water Conservation District
Yellow Medicine Soil and Water Conservation District