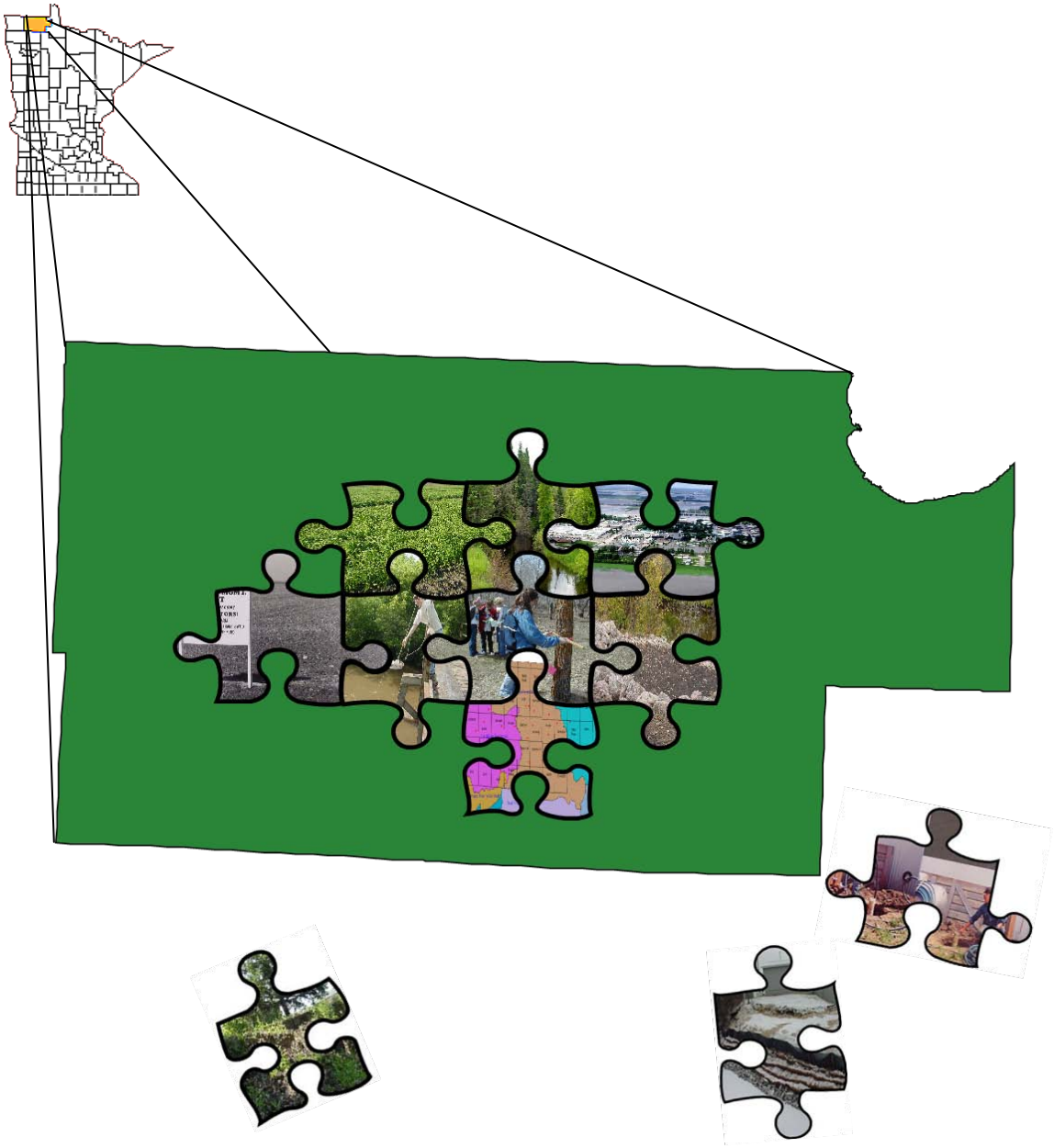
ROSEAU COUNTY

LOCAL WATER MANAGEMENT PLAN

2010-2019



Common Acronyms and Abbreviations:

BMP – Best Management Practice
BWSR – MN Board of Water and Soil Resources
CLWP – Comprehensive Local Water Plan (old system)
CREP – Conservation Reserve Enhancement Program
CRP – Conservation Reserve Program
CSP – Conservation Stewardship Program
DNR – Minnesota Department of Natural Resources
EQIP – Environmental Quality Incentive Program
FDR – Flood Damage Reduction
HEL – Highly Erodible Land
LWMP – Local Water Management Plan
LoW – Lake of the Woods
MDA – Minnesota Department of Agriculture
MDH – Minnesota Department of Health
MPCA – Minnesota Pollution Control Agency
NRCS – Natural Resource Conservation Service
NRE – Natural Resource Enhancement
PWT – Project Work Team
RIM – Re-Invest in Minnesota
RRWD – Roseau River Watershed District
RRWMA – Roseau River Wildlife Management Area
SSTS – Subsurface Sewage Treatment System
SWCD –Soil and Water Conservation District
TMDL – Total Maximum Daily Load
TRWD – Two Rivers Watershed District
WRWD – Warroad River Watershed District
WCA – Wetland Conservation Act

For Copies

Roseau County Local Water Management Plan – contact Roseau County SWCD 218-463-1903 or website at www.nwmnswcd.org; click on Roseau, Plans & Financial Info

Roseau River Overall Plan – contact Roseau River Watershed District – 218-463-0313

Two Rivers Overall Plan – contact Two Rivers Watershed District – 218-843-3333

Warroad River Overall Plan – contact Loren Horner – 218-386-2850

River Watch Information – contact Danni Halvorson – 218-523-6171

Local Government Unit for Local Water Management (LWM): Roseau SWCD

Roseau Co SWCD Board of Supervisors:

			Term expires
Chair	Glenn Darst	Greenbush, MN	2012
Vice-Chair	Jay Estling Jr	Roosevelt, MN	2012
Treasurer	Gary Johnson	Roseau, MN	2010
Secretary	Warren Ulvin	Roseau, MN	2012
Public Relations	John Gaukerud	Badger, MN	2010

County Commissioners:

Alan Johnston	Warroad, MN	District 1
Jack Swanson	Roseau, MN	District 2
Orris Rasmussen	Roseau, MN	District 3
Russell Walker	Warroad, MN	District 4
Mark Foldesi	Greenbush, MN	District 5

Water Resources Advisory Committee:

Loren Horner	WRWD
Chad Severts	BWSR
Watershed Managers	RRWD, TRWD, WRWD
Cary Hernandez	MPCA
Loren Horner	WRWD
Brian Ketring	Roseau County Hwy Dept
Nathan Johnson	Region Ext. Office
Scott Johnson	District Manager
Mark Foldesi	County Commissioner
Gary Bennett	DNR - Waters
Phil Talmage	DNR - Fisheries
Dawn Torrison	DNR - Wildlife
Dan Money	TRWD
Rob Sando	RRWD
Jeff Pelowski	Environmental Services

Office Information:

Roseau County Soil and Water Conservation District
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http://www.nwmnswcd.org/

Water Plan Coordinator:

Janine Lovold
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Executive Summary

Roseau County, located in north-western Minnesota, has the distinction of being part of two ecoregions (Red River Valley and Northern Minnesota Wetlands), two main river basins (Red River and Rainy River), and two biomes (Tallgrass Aspen Parkland and Coniferous Forest). Thus, Roseau County is a transitional region with many interesting and unique characteristics. Roseau County covers a total of 1685.4 square miles (1,078,680 acres) including waterbodies. About 30% of the land is in public ownership and the remaining 70% is privately owned.

Adjacent entities are Kittson County to the west, Marshall County to the south, Beltrami to the southeast, Lake of the Woods County to the east and Manitoba, Canada to the north. Major cities are Badger, Greenbush, Roosevelt, Roseau, Strathcona and Warroad with Salol and Wannaska being minor communities. The City of Roseau is the county seat and is located 10.5 miles south of the Canadian border. Roseau County contains 44 major townships (11 are unorganized) and 11 partial ones (borders Canada and Lake of the Woods; mostly unorganized). According to the US Census Bureau (2000), 91.1% of the 16,388 persons in Roseau County are rural. (The 2008 population estimate is 15,946 residents.) Population density is 9.8/square mile. Principal industries are Polaris, Marvin Windows, Central Boiler and HeatMor. Agriculture and agricultural related businesses are still a major source of income and include production from small grain, oil seed, grass seed, bees, beef cattle, dairy, hogs, sheep and turkey.

The climate can be extreme in Roseau County. The average winter temperature is 4.6° F and the average summer temperature is 63.9° F. Temperature extremes can be lower than -40° F's and higher than 100° F. Temperatures are typically cooler in the east and warmer in the west. Total annual precipitation is 20.52 inches. More precipitation typically falls over the eastern part of the county (can be ~ 30 inches), while the western portion is generally drier (~ teens to 20 inches). Most of the precipitation occurs from June through September. Average snowfall is 35.3 inches. Prevailing winds are from the west and April is typically the windiest month at an average of 10.0 miles/hour. The sun shines 64% of the time in the summer and 49% in the winter.

Soils were developed from calcareous and loamy glacial till. Eastern county soils basically consist of lacustrine silts and clays and also some lacustrine sands on sandbars. The western two thirds of the county are dominated by Percy soils that are loamy till with rock fragments. Organic soils can be found in one third of Roseau County. Because the topography is more or less level with gentle slopes, soils are poorly drained and contain a higher content of organic matter. Soils under the former grassland prairie typically have a higher water holding capacity and are darker in color. Forest soils consist of sands to heavier textured soils where pine and deciduous trees are found, respectively.

The landscape of Roseau County, shaped during the last Ice Age, is level to gently sloping and includes three of the four major beach ridges in northern MN (Norcross, Tintah, & Campbell). The most extensive ridge and sandbars occurs in Beltrami Island State Forest (BISF) in the southeast. The highest point of the county, incidentally, is also located here at 1270 ft. The lowest point is found in northwestern Roseau County. The other two beach ridges are found in southern part of the county, west of State Hwy 89 and from Greenbush through Badger, ending four miles west of Roseau. Drainage principally occurs through three major river systems. Two Rivers drains southwestern Roseau County through three branches that eventually converge and flow into the Red River of the North in Kittson County. Warroad River drains the eastern end of the county through two branches that converge south of Warroad and flows into Lake of

the Woods. The Roseau River drains from the southeastern part of the county in the BISF through two branches that converge in northwestern Malung Township. The river flows in a southeasterly to northwesterly direction and empties into the Red River of the North close to Dominion City, Manitoba, Canada. Two minor watersheds, Tamarac and Thief River, also drain into the Red River of the North. Drainage from all watersheds ultimately flows into Hudson Bay.

Total Maximum Daily Load (TMDL) studies and implementation plans have not been conducted yet for impaired waters in Roseau County. Surface waters identified as impaired, on the Clean Water Act's 303 (d) list, which may require a TMDL include: Sprague Creek for turbidity; Roseau River from Hay Creek to Canadian border for dissolved oxygen (DO) and turbidity; Two Rivers South Branch from unnamed ditch to lateral ditch 2 for fish bioassessments (IBI); and headwaters of north fork Roseau River to main stem Roseau River and Roseau River to Canadian border for the bioaccumulative toxin, mercury. (IBI or index of biotic integrity is a regionally based index used to measure the integrity of rivers and streams, and to determine the level of their biotic impairment. Multiple parameters based on fish community structure and functions are used to evaluate a complex biotic system.) The mercury impairment also includes the man-made Hayes Lake on north fork Roseau River. See page 12 for a map relating to these impairments. Roseau County is also expected to participate in the Lake of the Woods TMDL study for excess nutrients. Willow Creek is anticipated to be added to the Impaired Waters List.

A monitoring study on the Roseau River by the MPCA is tentatively scheduled for 2010 for turbidity and DO. One monitoring study regarding organics, inorganics and field tests was done by the Two Rivers Watershed District and the Roseau and Kittson SWCDs during the years 1991-1993 with a BWSR Challenge Grant. Recommendations from that study included filter strip implementation along all water courses that are tributary to rivers, fencing livestock away from rivers, implementation of tillage and erosion control techniques, and fertilizer and pesticide control chemicals to be used and handled with care. The Roseau SWCD has monitored river and creek sites within the county since 2001 and has incorporated surface monitoring data into the EPA STORET database starting with year 2003. A baseline study of Roseau County surface waters by the SWCD has a timeline of 10 years and will be completed around 2013. The SWCD has been collecting data on turbidity and DO along with conductivity, water temperature, pH, nitrate, total phosphorus, fecal coliform bacteria counts, and now *E. coli*. The Two Rivers Watershed District (TRWD) also has been collecting data for many years on four sites in the Two Rivers watershed portion within Roseau County and for short term around TRWD project sites as needed. The River Watch high school students and Red River Watershed Management Board personnel also have surface water sites that they have been collecting data since year 2000. The Warroad River Watch has not been active for many years, but the Badger – Greenbush River Watch will be starting soon. The Roseau River Watch is active during the school year. Roseau County and its monitoring partners anticipate in working together for TMDL development, implementation, and monitoring regarding impaired waters within the next 10+ years.

Purpose of the Local Water Management Plan

The purpose of the updated Local Water Management Plan for Roseau County is:

1. To actively work on the existing local priority concerns and to identify future potential priority concerns so that our water resources and related land resources are protected, managed and developed.
2. To update and continue the process of developing and applying an action plan to promote sound water and related land resource management in the county.

3. To continue working towards effective environmental protection and management in Roseau County through focusing on priority concerns and recognizing potential priority concerns.
4. This water plan is also recognized as the Roseau County SWCD Comprehensive Plan.

A resident survey and entity survey / concern sheet were employed to obtain information from all watersheds and provide the Water Resources Advisory Committee the opportunity to identify five priority concerns that would be worked on during the next 10 years with an amendment opportunity in the 5th year. Details regarding these concerns can be found in the Priority Concerns Scoping Document in Appendix A.

Description of Roseau County Priority Concerns

Priority Concern 1: Erosion & Sedimentation of Surface Waters, Stormwater Runoff and Wetlands

Although Roseau County is relatively flat, erosion and the resulting sedimentation take place through wind and water since the advent of ground cover removal and drainage for agricultural purposes.

Currently, Roseau County CRP acres are at the 25% cap, but that may change with lands coming out of CRP, especially if CRP becomes a program of the past. All highly erodible lands (HEL) are required to have a conservation plan and ground cover in Roseau County, but even non-HEL's have been observed to have erosion incidences. On most agricultural lands, most producers do not plant a cover crop in the fall, unless they are involved with programs that require such a practice. With rising costs of production, many producers may elect to skip best management practices that are in their best interest. It is also believed that some producers may not realize that production costs can increase due to erosion causing land to become less productive. Even on non-HEL's and particularly during droughts, wind erosion has caused sediments to collect in roadside ditches or settle around structures.

Drainage is essential for agriculture and dwelling in Roseau County. With the efficient use of drainage equipment, run-off occurs at ever increasing rates along with sediment that collects downstream. Best Management Practices, such as filter strips adjacent to all ditch systems, need to be implemented. A list of Best Management Practices can be found in Appendix B for various applications in rural and urban areas. Floods of the past have been the major contributors of erosion and sedimentation. The 2002 flood was observed to scour forested areas, entire fields and roads, carve new channels, and damage ditch systems through erosion and sloughing. Sediments were seen to settle out in the form of sedimentation bars in ditches and stream courses.

Stormwater runoff has supplied to sediment buildup, although in a slower fashion compared to a flood event. Runoff sediments may fill in wetlands and thus reduce floodwater retention and natural filtering capabilities. Most cities in Roseau County are located on a river system and so urban runoff picks up dirt, debris, nutrients and other chemicals, which flow into river systems. Stormwater management is not required for cities under 5,000 people.

Retroactive cleanouts and proactive practices need to be implemented to help alleviate and / or prevent sedimentation, improve navigability, and keep waterways open. Land use and land cover through the use of Best Management Practices (BMP's) are key to keep soil where it belongs.

Objective:

- ► Enhance and improve the quality of surface waters and wetlands through conservation practices, best management practices, restoration, and structures

Water Plan Cost: Staff Time
Watershed Priority Areas: Roseau River, Warroad River, Lake of the Woods, All
Groundwater System: NA

Priority Concern 2: Flood Control and Flood Damage Reduction

Flooding is a problem throughout Roseau County because the topography is generally flat, which impedes timely drainage. Most flooding occurs during the spring with the snow melt, but the less frequent summer and fall floods have been known to occur. Flooding is prevalent primarily from north City of Roseau to Canada where land fall is generally 0.2 feet/mile and stream capacity is not sufficient. Waters may take months to recede and cause considerable structural damages to buildings, roadways, ditches, and agricultural lands. Major floods have shown to cause this type of damage even in areas that typically do not experience such problems, such as those areas to the south and southeast of Roseau County where landfall is more significant. However, the difference is that flood water recedes fairly quickly.

Overbank flooding occurs when river channel capacities are not adequate to sufficiently drain water in a timely matter during rapid snow melt, snow melt with rain, ice jams, or severe rainfall amounts. Overland flooding takes place when snowmelt or severe rainfall is impounded through frozen or blocked culverts and ditches. Overland flooding may also occur during high water conditions where culverts or ditches are running at full capacity and are unable to handle the additional runoff. The water accumulates until it overflows roadways and floods section after section in the down slope direction.

The primary concern of the watershed districts in Roseau County is to reduce flood damages through programs and projects that deal with levees, ring dikes, establishment of impoundments and restoration of wetlands and watercourses, and also at the same time enhance natural resources. The mission of the watershed districts for flood damage reduction is to protect city and rural homesteads, protect agricultural lands, and reduce damage to roads and crossings. A current project in the process of being built is the East Diversion around the City of Roseau by the Army Corps of Engineers. The project is designed to help with flood control in the City of Roseau and not impact downstream lands.

Objectives:

- ► Implementation of practices for flood control and flood damage reduction to reduce flood impacts
- ► Water flow gauge and structure upgrades with additional analytical parameters for data analysis

Water Plan Cost: $200+
Watershed Priority Areas: Roseau River, Two Rivers, Warroad River, All
Groundwater System: NA

Priority Concern 3: Surface Water Protection and Improvement

The current impairments identified by the MPCA are fish IBI (index of biological integrity) for a portion of Two Rivers South Branch in southwestern Roseau County and into Kittson County, dissolved oxygen and turbidity for the Roseau River from convergence of Hay Creek to the Canadian border, and turbidity for Sprague Creek. Agriculture, livestock production, ditch cleanouts also impact surface waters, especially with stormwater runoff or during floods. It is also noteworthy to mention that most of the streams that are classified as impaired have been channelized or modified in the past.

Protection of aquatic and riparian habitats is essential for healthy riverine systems and wildlife populations (aquatic and terrestrial). As work, inventories, or surveys are done on river systems, water segments with adjacent riparian areas that can provide the greatest biological benefit need to be designated as important priority areas for protection. Potential areas also need to be inventoried for restoration and possible protection.

The Roseau River is one of the many recreational opportunities that Roseau County has to offer. Many residents enjoy fishing on this river summer and winter, especially on reaches around the old Roseau Lake to Caribou in Kittson County. Five fish surveys between 1978 and 2000 have found that fish species and population have been consistent on the Roseau River (see Roseau River Overall Plan and Red River Basin Stream Survey Report 2000). With all the modifications and land use changes that have impacted this watershed from the beginning of the late 1800s through the 1900s, it is important to protect and improve the water quality of the Roseau River.

Two Rivers also has many outdoor recreational opportunities of which most occur in Kittson County. Two Rivers South Branch headwaters (aka SD 91, channelized portion) originate south of the City of Badger and eventually flow into Lake Bronson, where people use these waters for swimming and fishing. Many fish are supported by these waters and include northern pike, walleye, perch, sauger, crappie, sunfish, bass, catfish, bullhead, carp, and suckers (TRWD Overall Plan page 13). The Overall Plan also mentions that stream fishery habitat is being degraded due to the unstable watercourse with erosion and sedimentation issues, flashy flows, beaver dam blockages, and loss of upland habitat.

Lake of the Woods is not inside the Roseau District; however, Roseau County does have many ditch systems, Willow Creek and Warroad River, which contribute to Lake of the Woods waters. Lake of the Woods is a major draw for its fishing industry, nationally and internationally and impacts our local economy directly. The impairment for Lake of the Woods is excess nutrients. Algal blooms have been observed in the lake's waters. Another concern listed in the Rainy River Basin Plan (2004) is severe erosion that that has the potential to harm the fishing industry, which in turn impacts the local economy. The Lake of the Woods has an enormous watershed that includes Minnesota, and the provinces of Manitoba and Ontario, Canada.

An additional concern within Roseau County is lack of surface water during drought conditions that impact livestock and fish populations.

Objective:

- ► Protect, improve and monitor the quality of surface waters

Water Plan Cost: $8550+ plus Staff Time
Watershed Priority Areas: All
Groundwater System: NA

Priority Concern 4: Managing Existing Ditch Systems

Drainage systems are critical for agriculture, urban and rural residences in Roseau County and need to be maintained and improved to optimally function. Wet cycles and past floods have deteriorated drainage structures and caused sloughing and erosion. Support for continued maintenance using new technologies to improve water quality during and after repair is needed as it will take many years to inventory and repair the ditches.

Objectives:

- ► Proper care and maintenance of existing ditch systems

Water Plan Cost: ? ($85,000) plus Staff Time
Watershed Priority Areas: All
Groundwater System: NA

Priority Concern 5: Groundwater Protection and Quality

Not much is known about ground water resources or its movement in Roseau County as no hydrological mapping has been done. The limits of aquifers, especially the more deeply buried or less extensive aquifers are not well mapped and the recharge areas are not well defined. The extent of agricultural chemicals that impact groundwater resources have also not been documented. The extent of pollution by factors, other than nitrates and bacteria, has not been well studied. However, the MPCA has conducted a statewide baseline survey between 1992 and 1996 with thirteen factors using fourteen groundwater collection sites in Roseau County (see Appendix E).

Critical areas such as sandy beach ridges and other highly permeable locales are of high concern as percolation rates are greatest in these areas and are at risk for contamination. Rural homesteads are also of concern where groundwater testing is not done on a regular basis. Nearly 95% of rural residents in the U.S. rely on groundwater for their drinking supply according to the US EPA. Most residents in Roseau County are served by surficial drift aquifers of which are recharged by normal precipitation. This type of aquifer is thought to be susceptible to direct access of contaminants from the land surface.

Roseau County is also concerned about low groundwater levels during drought conditions. In 2006, drought conditions returned and many people had to deal with low well water levels for themselves and / or for livestock.

Objectives:

- ► Groundwater protection
- ► Groundwater quality analysis
- ► Update and implementation of ordinances that protect groundwater

Water Plan Cost: $14,475+ plus Staff Time
Watershed Priority Areas: All
Groundwater Systems: All

Consistency with Other Plans

No differences were found in federal, state, watershed or surrounding county plans that were contradictory to the priority concerns selected for this Local Water Management Plan. Federal plans to various local plans included some or most of these concerns so it appears that these concerns are fairly common across boundaries, which may be due to politics and funding tied to these items. This makes partnering with various agencies easier and more efficient.

Recommended Amendments to Other Plans and Official Controls

1) Request State funding to identify potential SSTS projects or areas that have failing SSTS or are an immediate public health threat, assuming that those areas would be brought into compliance with current SSTS regulations when adequate State funding is available
2) Include more environmental education and education for permitting processes
3) Better communication between agencies
4) Need for a one-stop-shop for permitting and a lead agency or coordinator
5) Timely implementation of existing plans and controls
6) Fix regulations that are too little or too much
7) More authority to watershed boards

Priority Concerns

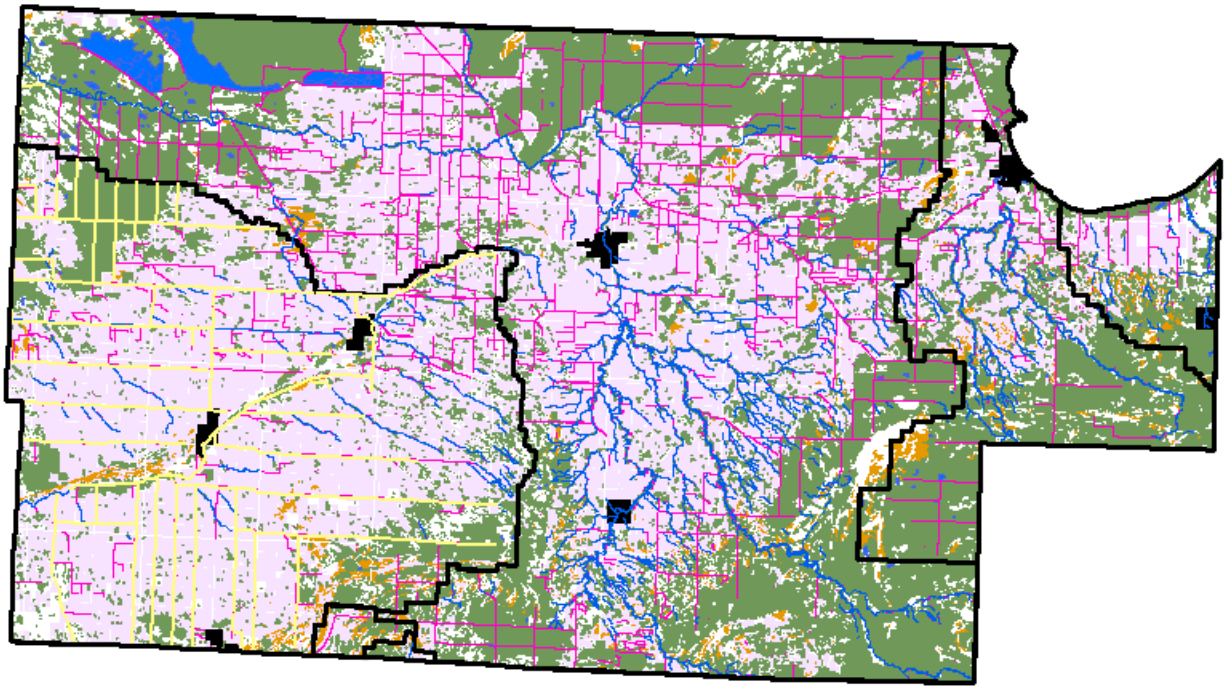
Identification of Priority Concerns

The Priority Concerns that this local water management plan will address are 1) Erosion & Sedimentation of Surface Waters, Stormwater Runoff and Wetlands; 2) Flood Control and Flood Damage Reduction; 3) Surface Water Protection and Improvement; 4) Managing Existing Ditch Systems; and 5) Groundwater Protection and Quality.

Assessment of the Priority Concerns

Assessment

Priority Concern 1: ***Erosion & Sedimentation of Surface Waters, Stormwater Runoff and Wetlands***



Erosion and sedimentation are very important concerns in Roseau County that affect surface water quality, cause problems with the various drainage systems and potentially fill-in wetlands. The Overall Plans of the Two Rivers, Roseau River and Warroad River (also Rainy River Basin Plan 2004) describe erosion and sedimentation plus other surface water problems in the sub-watersheds within Roseau County. These problems include ditch or river bank erosion or failures, field erosion, road & culvert washouts, and sedimentation of agricultural ditches, fields, & pastures, and sedimentation & cattails that cause drainage blockages, to list a few. The Roseau River Overall Plan mentions that the area of high sedimentation occurs from the Hwy 310 bridge to Lake Bottom. Roseau County has had over 10 years of wet to very wet conditions by 2004.

Floods of the past, especially 2002, have caused erosion in fields, drainage systems, and stream systems. The result is sedimentation in water courses that has hindered drainage and navigability. This sedimentation can range from inches up to 3 feet in areas. Persisting siltation from sediment bars in streams continue to impact larger bodies of water such as Lake of the Woods and the Red River of the North, both of which drains into Canadian waters. A total of 35 sediment bars has been counted in the Roseau River during an aerial flight in 2006 by HDR Engineering, Inc., who worked with the Roseau River Watershed District (RRWD) at that time. (This flight only flew the northern part starting from the City of Roseau.) Also, the river passage in Warroad has been dredged partially in the past due to sedimentation and the resulting cattail/reed growth and navigability impediments. This river is currently facing the same problem once again, because of the massive flood in 2002 that scoured the top soil from fields, leveled roads, and channeled new water courses and dropped sediment into the navigation channels in the Warroad River located within the City of Warroad. In addition, sedimentation within wetlands may cause problems such as less temporary water storage during floods, eventual competition with upland plant and animal species, less capacity to filter or store water, and more flooding impacts to upland areas.

Wind erosion has also contributed to sediment loads in many drainage systems, especially in the dry times. Highly erodible lands (HEL) are required to have and maintain cover, but non-HEL's often are left bare after harvest until spring planting. Conservation education and program availability continue to be needed to combat erosion.

Stormwater is another major contributor of erosion and sedimentation. In rural areas, runoff from fields flow from field ditches into ditch systems and then into creeks and rivers. In the urban setting, street runoff carries sediment from spring thaw to freeze up with most of the sediment loading occurring in the spring due to snowmelt carrying sand particulates from winter street sanding.

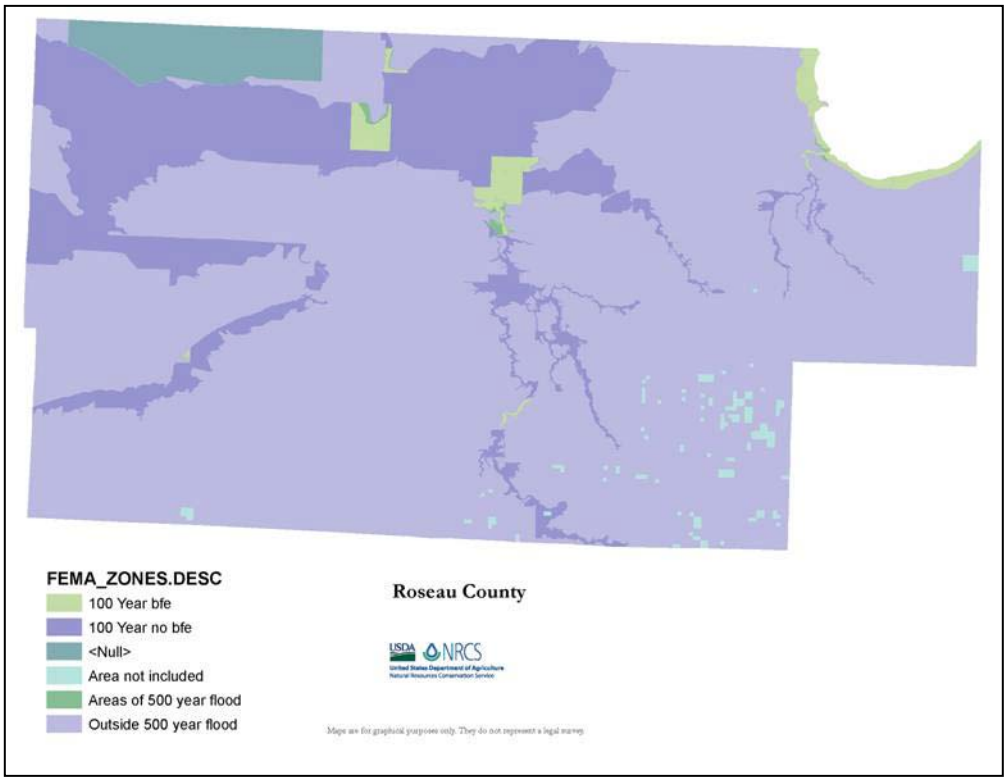
<u>Future Project If Funding Was Available</u>

- Inventory and identify sites county-wide with GPS for side-water inlets needed to control erosion and sedimentation
- Provide cost-share to landowner to put in side-water inlet plus rock weir, rock dams or rip-rap

Assessment

***Priority Concern 2:* Flood Control and Flood Damage Reduction**

FEMA Zone Flood Map of Roseau County



Flood Control and Flood Damage Reduction with Natural Resource Enhancements

Flooding is a major concern for many agricultural and livestock producers and Roseau County residents. Flooding frequency may occur annually in the spring after snowmelt in some sub-watersheds, especially those northern areas between the City of Roseau and the Canadian border. Summer flooding or high waters does take place at times with the last major flooding occurring in 2002. Flooding impacts water quality by the movement of sediment, nutrients and pesticides from the landscape into surface waters. Damage can be quite extensive to public and private lands, infrastructure and other property, such as livestock. For maps on historic heavy rains, please see Appendix C.

The Watershed Districts' Overall Plans list flooding and flood damage problems by subwatershed and also include implementation strategies for flood control and flood damage reduction, respectively. For more information, contact the respective Watershed District to obtain a copy of their Overall Plan (pg ii). Some of the listed problems include insufficient channel capacity, need for ditch cleanout/maintenance, crossover waters from adjacent watersheds, crop loss, overland flooding, water backup, beaver dams, uncontrolled runoff from higher to lower areas, stream bank failures and flashiness of water flow.

LIDAR (light detecting and ranging) is a tool used to obtain topographical data. This remote laser sensor was recently used to map the Red River Basin through the International Water Institute. The County covered the cost for the east side of the county for LIDAR mapping as this area is not part of the Red River Basin.

Future Project If Funding Was Available

- County-wide culvert inventory (excluding TRWD as culvert inventory is completed) with GPS waypoints, flow direction and size
- Beaver and Beaver Dam Removal as mentioned in Watersheds' Overall Plans, District-wide
- Raingarden implementation in strategic areas for stormwater control – $50,000
- Expand / improve gauges in Greenbush, Pelan, and SD #72

Roseau River Watershed Overall Plan

The FDR goals are:

1. Providing 100 year protection for the City of Roseau and rural homesteads in the district,
2. Providing 10 year protection for agriculture lands,
3. Reducing flood damage to roads and crossings,
4. Reducing drought damages, and
5. Preserving ground water supply recharge areas.

The NRE goals are:

1. Protecting, restoring, enhancing and managing lakes and streams in the Roseau River watershed to support sustainable aquatic communities,
2. Managing wetland and upland habitats in the Roseau River watershed to support sustainable wildlife communities,
3. Preserving, protecting and restore unique natural resource communities and other features in the watershed,
4. Increase and promote outdoor recreational activities related to fish, wildlife and other natural resources in the watershed, and
5. Improving water quality in the Roseau River watershed.

Two Rivers Watershed District

The FDR goals are:

1. Coordinating with other Boards the delivery of flow to the Red River,
2. Maintaining, modifying, constructing or improving properly functioning watercourses to provide protection to agricultural land for a 10 year event, while ensuring that there are no resulting downstream adverse impacts,
3. Reducing the duration, peak and frequency of overland flooding,
4. Reducing damages to and loss of residential area from flooding for a 100 year event (minimum),
5. Minimizing the effects of drought relative to land use practices, and
6. Enhancing and protecting groundwater supplies.

The NRE goals are:

1. Improving and sustaining surface water quality,
2. Reducing erosion and sedimentation,
3. Participating in efforts to enhance, establish and protect stream corridors and riparian areas,
4. Participating in efforts to enhance, provide and protect habitats,
5. Supporting the expansion of water based recreation, and
6. Providing educational and outreach opportunities.

EXCERPT FROM TRWD OVERALL PLAN

GOAL: Reduce the duration, peak, and frequency of overland flooding

PRIORITY ISSUE:

Public Infrastructure:

• Reduce road & culvert damages from flooding.

Agricultural Land:

• Reduce damages to cropland from flooding (delayed planting or destroyed crops).
• Reduce damages to pastures from flooding.

General:

• Address issues associated with crossover flooding from the Roseau River.
• Address beaver dams on ditches and natural watercourses.

STRATEGIES:

1) For Public Infrastructure, expand on the current District culvert sizing policy by implementing a complete culvert sizing project in one or more subwatersheds to effectively size all culverts from upstream to outlet to control the 10 year runoff event. In areas east of U.S. Highway #59, promote land use practices that reduce runoff, promote natural landscape storage activities (wetland & prairie restoration), stream & river rehabilitations to slow down stream flows, incorporation of ag levies where appropriate, install gated storage immediately east of Hwy 59 (in North Branch and Middle Branch subwatersheds) – by doing so in conjunction with other activities the needed acre feet of storage can be reduced. In areas west of U.S. Highway #59, utilize riparian buffers, stream rehabilitation with ag levies, field windbreaks to reduce snow & sediment deposits in drainage systems (will allow ditches to open earlier in spring), immediately west of Hwy 59 utilize off channel gated storage, and emphasize best management practices (conservation tillage & residue management). In areas west of U.S. Hwy 75, investigations regarding the feasibility of improving drainage channels should continue. This type of channel work would be designed to remove local water from the land in advance of the peak of the Red River flooding.

2) For Agricultural Land, utilize the same strategies as stated in #1 above. This should be done by slowing down water from upstream areas with respect to the 10 year runoff event for ag lands. Pasture management plans should be developed which include tolerant seed mixtures, rotational grazing, and livestock exclusion from streams.

3) For the general category, the same strategies as listed above should be considered. Also, partnerships should be created with the Roseau River WD and Canada to identify issues related to crossover flooding and agree upon possible solutions, including impoundments, diversions, and dike building. A watershed district wide beaver control program should be investigated, with incentives for trappers and payments for beavers in widespread areas, not just on legal drainage systems.

PREFERRED OUTCOMES: Significant reduction in damages to residential, public infrastructure, and private property.

POTENTIAL PARTNERS: SWCD, Townships, Counties, County Highway Dept., NRCS, DNR, BWSR, FSA, USACE, Roseau River Watershed District, International Joint Commission, Red River Basin Commission.

GOAL: Reduce damages to and loss of residential areas from flooding for a 100 year event (minimum)

PRIORITY ISSUE: Reduce damages and losses to urban and rural residents from flooding.

STRATEGIES: Discourage building within the 100 year floodplain and other flood prone areas.

Utilize the farmstead ring dike program and other programs to protect farm residences and out-buildings.

Assess each community's flood protection needs, and implement flood damage reduction projects both upstream from and within municipalities.

PREFERRED OUTCOMES: Protection of rural and urban residential areas from a 100 year frequency flow event. By reducing the damages, a reduction in the cost to repair will occur, resulting in less public and private money needed for disaster assistance.

POTENTIAL PARTNERS: Planning & Zoning, Townships, DNR, RRWMB, FEMA, NRCS, Cities, USACE, Counties, MN Department of Public Safety

Warroad River Watershed

Goals

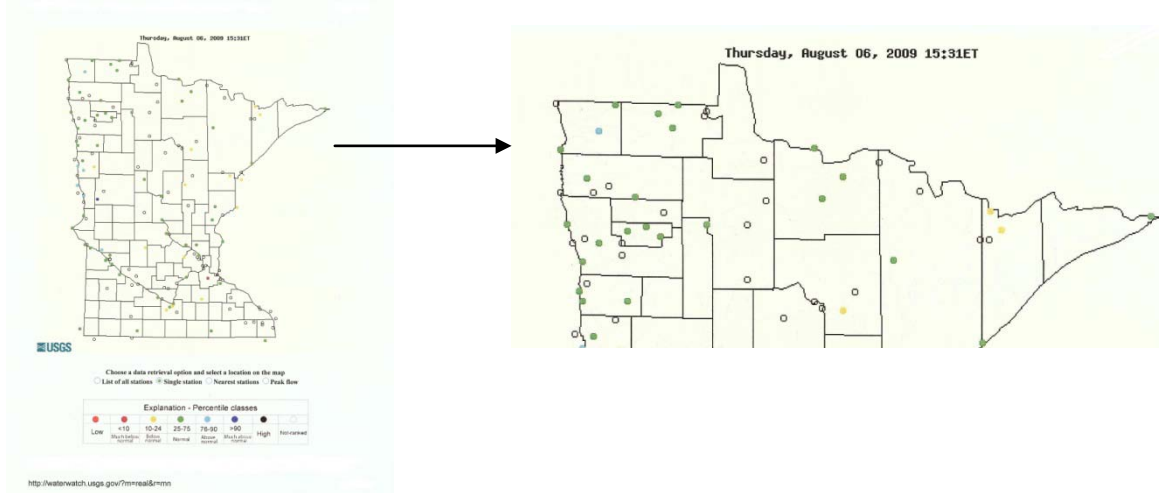
1. Prove leadership and management for the business of the Watershed District
2. Provide information and education to the public
3. Promote good stewardship of the environment
4. Partner with local, state and federal entities
5. Focus on water flow management and water quality

Highest Recorded Peak Stages on Roseau River and Sprague Creek– USGS Gauges

Roseau River below South Fork near Malung		**Roseau River at Ross**	
26.96 ft	6/12/2002	18.89 ft	6/16/2002
23.45 ft	4/20/1996	18.25 ft	5/12/1950
23.37 ft	4/3/1966	17.50 ft	7/1919
22.98 ft	4/6/1997	17.40 ft	5/23/1996

Roseau River below SD 51 near Caribou		**Sprague Creek**	
11.91 ft	6/24/2002	17.08 ft	6/11/2002
11.81 ft	5/19/1950	14.25 ft	5/13/2004
11.13 ft	4/19/1997	13.43 ft	11/9/2000
10.78 ft	5/31/2004	12.53 ft	7/1/2005

USGS Stream flow conditions in Real Time - http://mn.water.usgs.gov/



Two Rivers Flow Network

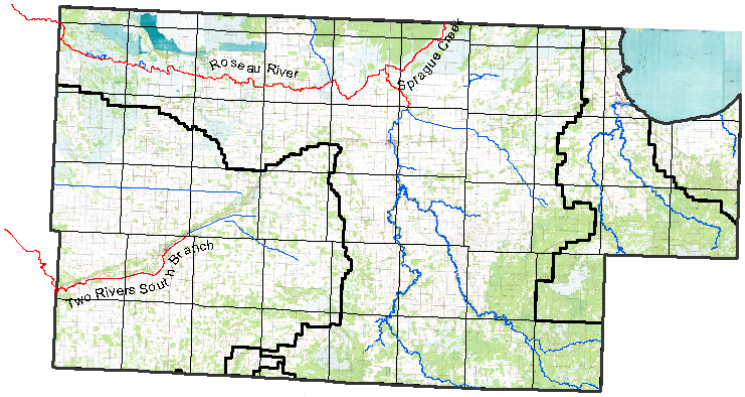
Two Rivers WD also has a network of stream flow monitoring sites. The WD would like to expand / improve gauges in Greenbush, Pelan, and SD # 72 on the county line between Roseau and Kittson Counties.

Assessment

***Priority Concern 3:* Surface Water Protection and Improvement**

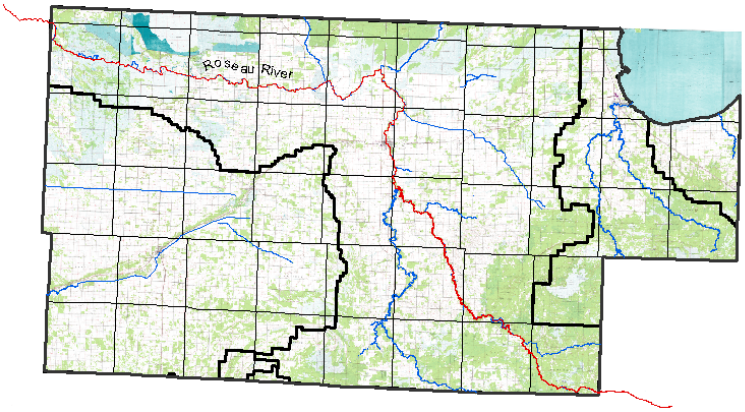
The MPCA has identified impaired waters in Roseau County on the 303(d) list of the Clean Water Act. If this concern is not addressed, waters downstream may be impacted. The impaired waters must be studied to see if the impairments are caused by human activity or by natural conditions and what measures can be taken to improve the condition of Roseau River, Sprague Creek and Two Rivers. The waters are listed as impaired for aquatic life. The impacted waters in Roseau County include three sub-basins, which are Hay Creek/Norland, Lake Bottom and Big Swamp for Roseau River and Sprague Creek. The sub-basins of impacted water regarding Two Rivers South Branch are SD 90, SD 91and SD 95. The many sub-watersheds that comprise each of the basins can be found on page 48 of the Overall Plan of the Roseau River Watershed District and page 23 of the Overall Plan of the Two Rivers Watershed District.

Impaired Waters Affecting Aquatic Life



Two Rivers South Branch – Fish and Invertebrate Index of Biological Integrity
Roseau River – Dissolved Oxygen and Turbidity
Sprague Creek - Turbidity

Bioaccumulative Toxins



Roseau River – Mercury Impairment

Summary of Roseau River Watershed and the Water Quality Data Collected
Roseau River Watershed

The Roseau River originates in Beltrami Island State Forest and empties into the Red River in Manitoba, Canada. Between these two regions, the Roseau River flows through many different land use areas that include forests, agricultural land, cities, peat lands and swamps. Many small tributaries, three large tributaries, State Ditches, Judicial Ditches, laterals, field and township drainages and treated lagoon waters contribute to the waters of the Roseau River. In the early 1900s, the Roseau River was modified from Caribou to north of the City of Roseau to increase the width of the channel and straighten the alignment to increase drainage in order to alleviate flood waters that plagues this watershed. This modification is known as State Ditch 51 and landfall is about 0.2 feet/mile.

Hay Creek is a tributary of the Roseau River whose headwaters start in northwestern Beltrami Island State Forest. This creek meanders predominately through agricultural land before draining into main stem of the Roseau River north of the City of Roseau. Hay Creek has been modified and straightened in the 1900s and even had its convergence into the Roseau River changed.

Most of the Sprague Creek Watershed occurs in Canada and drains down into Roseau County from the north and meanders through the bog in Lost River State Forest before converging with the Roseau River. A small section of Sprague Creek, which lies on U.S. soil, was changed through dredging for Judicial Ditch 61. Many laterals of Judicial Ditch 61 empty into Sprague Creek at various locations. This creek is mainly surrounded by bog forest, peatland and wetlands. Tannins from the tamarack trees stain the waters a tea color. Sprague Creek empties into the Roseau River about seven miles north of the City of Roseau. In 2008, MPCA added Sprague Creek to the 303 (d) list Clean Water Act as impaired waters requiring a TMDL for turbidity.

Another tributary of the Roseau River is Pine Creek, which also was modified and diverted. Part of Pine Creek's waters was diverted to flow into the wildlife pools in the Roseau River Wildlife Management Area before draining into the Roseau River in extreme northwestern Roseau County because of the Canadian diversion. The rest of Pine Creeks waters flows south through some agricultural lands and the old Roseau lakebed to finally empty into the Roseau River.

More detailed information about drainage and the Roseau River can be found in the Overall Plan of the Roseau River Watershed District. However, this summary shows that there is a possibility of many factors that are contributing to the impaired waters of the Roseau River. The slow down of water on State Ditch 51 due to the low fall of land may cause the water to stagnate, especially during drought conditions. The low flow in this area during floods would also cause low dissolved oxygen due to dead plant and animal matter, nutrient loading, and high algae populations. The peatlands and swamps would furnish some acid seepage, which also is known to deplete waters of oxygen. So the combination of natural stagnation, acid seepage and warm water temperatures during summer months may help to contribute to low oxygen conditions. One cannot blame the entire problem on natural causes. Channel modifications from the past, storm water runoff from cities, developments, fields and pastures, floodwaters and sedimentation from channel erosion (modified and unmodified) are all contributors.

The MN DNR - Division of Fisheries has published five fish population surveys between 1971 and 2000 for the Roseau River. Additional surveys for Bemis Hill Creek, Sprague and Bear Creeks and the Palmville outlet near Mickinock Creek have also had fish population assessments in the late 1980's to mid 1990's.

The MPCA has been monitoring the Roseau River (State Ditch 51) since the 1970's and found low dissolved oxygen levels. Most aquatic organisms need to have DO levels to be above 5 mg/L to survive. This study prompted the MPCA to place the Roseau River section from Hay Creek to the Canadian Border onto 303(d) list. In 2008, the MPCA added a turbidity impairment, for the same reach, to the 303 (d) list. Additional monitoring and studies need to be done to pin-point problem areas and find out what can be done to restore water quality.

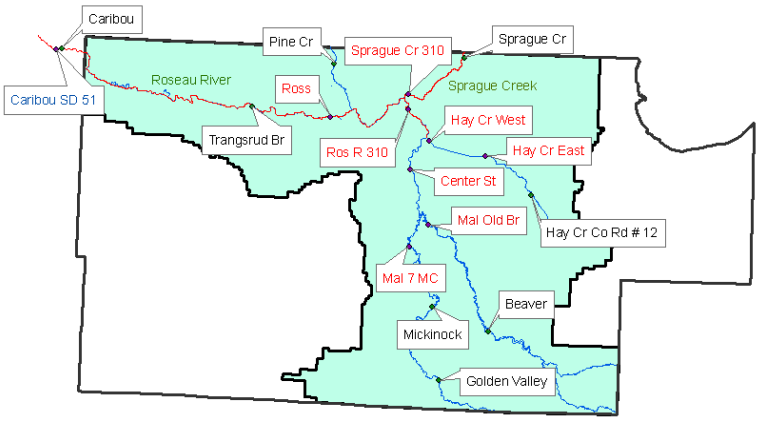
Water monitoring data from 2003 through 2009 by the Roseau SWCD has been entered into the EPA STORET database.

Monitoring

Surface water monitoring currently is being done by the Roseau SWCD, Red River Watershed Management Board, and during the school year, River Watch students (Roseau High). Waters being monitored include the Roseau River, Hay Creek, and Sprague Creek, which have been done since 2001. The Roseau SWCD and River Watch monitors at selected sites once a month to get a "snapshot" of what the water is like at that moment of time. See figure below for locations of water sampling sites.

Roseau River Watershed Water Monitoring Sites

Black – Roseau SWCD
Red – River Watch
Blue – Red River Wd Mgt Bd



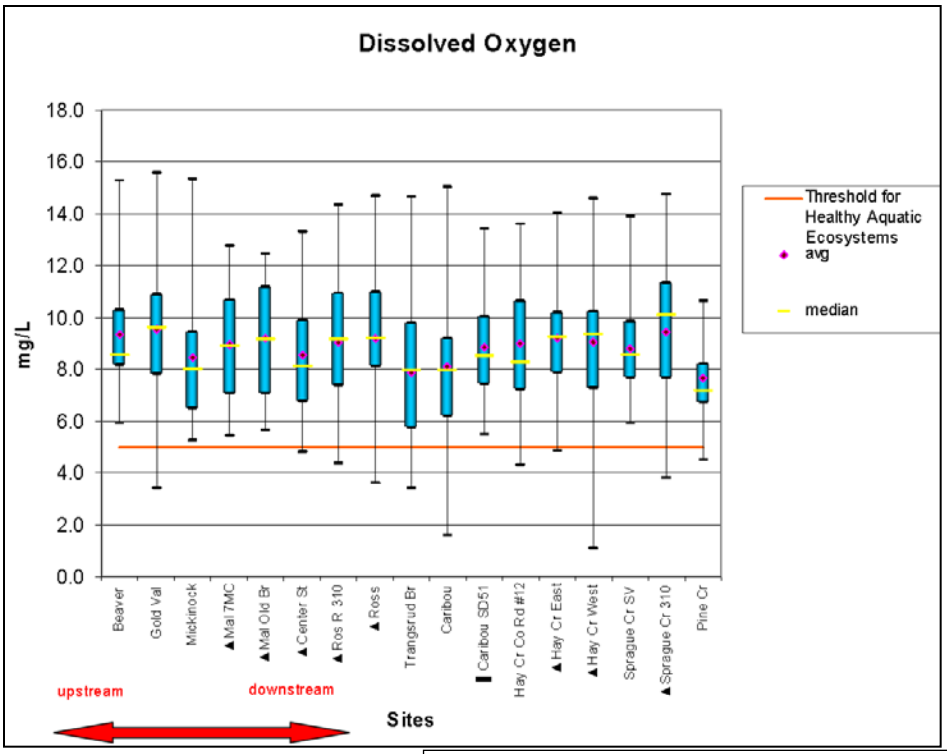
River Watch checks waters for stage level, pH, conductivity, water and air temperatures, dissolved oxygen, turbidity and transparency. The Roseau SWCD parameters for monitoring are stage level, water temperature, pH, conductivity, turbidity, and dissolved oxygen. Water samples are sent to a lab for fecal coliform counts (recently changed to *E. coli* counts), nitrate and total phosphorus.

Graphs (pages 16, 17) were created for dissolved oxygen and turbidity as these are of primary concern. Ecoregions are defined by land use, land-surface form, potential natural vegetation and soil characteristics (Fandrei et al, 1988; MPCA). Water quality is interrelated to ecoregion physical characteristics and this information can be used to determine water characteristics for that region (Fandrei et al, 1988; MPCA).

The ecoregions in Roseau County are the Northern Minnesota Wetlands, which include Roseau River watershed and Lake of the Woods watershed, and Red River Valley, which includes the Two Rivers watershed. Since the Roseau River watershed has characteristics of the Red River Valley and Northern Minnesota Wetlands Ecoregions, the graphs show both ecoregion ranges for the water sites for the Roseau River Watershed. (The Red River Valley ecoregion annual mean includes at least fours year of data between years 1979-1992 and the Northern MN Wetlands annual mean includes at least four years of data between years 1970-1992.) The water sample sites means are compared against the ecoregions' annual means. The MPCA

uses the 25% and 75% quartiles to establish the typical ranges for streams in Minnesota according to ecoregion.

Dissolved Oxygen



Note: Roseau SWCD DO data – 2003-2008 (2001 & 2002 data not used as DO was measured using a different instrument)

River Watch DO data – 2001-2008

Dissolved Oxygen

	Site	min	25th%	median	75th%	max	avg	# of samples
1	Beaver	5.91	8.15	8.57	10.27	15.28	9.36	38
2	Gold Val	3.43	7.83	9.59	10.87	15.58	9.57	27
3	Mickinock	5.23	6.48	7.99	9.45	15.33	8.48	37
4	▲Mal 7MC	5.46	7.05	8.88	10.66	12.77	8.96	33
5	▲Mal Old Br	5.65	7.05	9.13	11.19	12.48	9.20	35
6	▲Center St	4.80	6.80	8.10	9.88	13.30	8.56	31
7	▲Ros R 310	4.37	7.35	9.15	10.93	14.33	9.05	32
8	▲Ross	3.63	8.11	9.20	11.00	14.67	9.20	23
9	Trangsrud Br	3.39	5.75	7.95	9.81	14.66	7.88	30
10	Caribou	1.60	6.19	7.94	9.22	15.05	8.10	30
11	Caribou SD51	5.48	7.41	8.50	10.05	13.38	8.83	26
12	Hay Cr Co Rd #12	4.28	7.22	8.24	10.66	13.59	9.00	27
13	▲Hay Cr East	4.84	7.85	9.27	10.20	14.06	9.20	46
14	▲Hay Cr West	1.07	7.27	9.34	10.25	14.60	9.03	53
15	Sprague Cr SV	5.91	7.64	8.56	9.84	13.90	8.82	24
16	▲Sprague Cr 310	3.81	7.68	10.07	11.32	14.73	9.42	27
17	Pine Cr	4.49	6.72	7.16	8.23	10.65	7.67	17

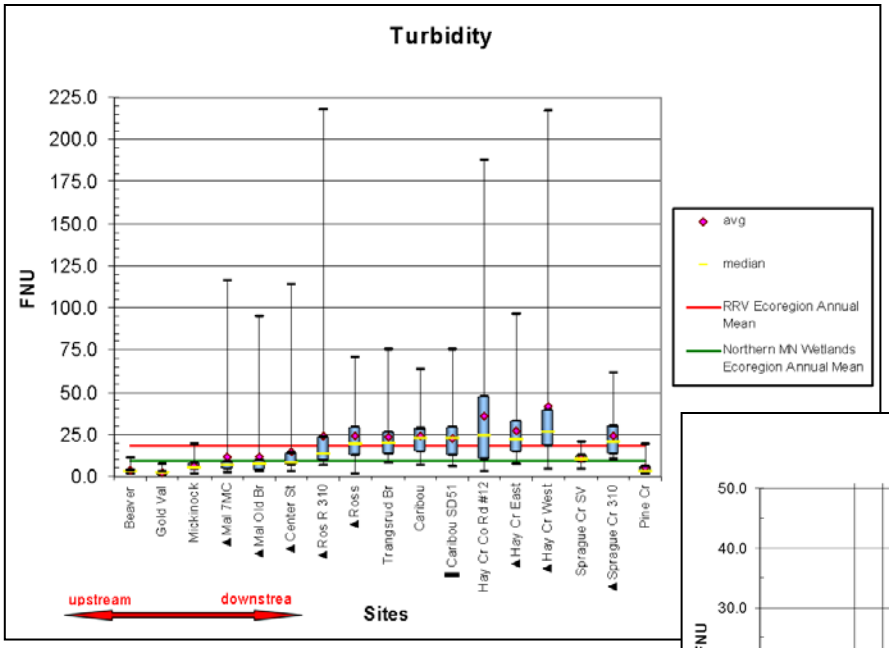
Most of the time, sites show dissolved oxygen to be consistently above the 5 mg/L threshold. Low spikes below the threshold were found at eleven sites. Even though the other six sites show the minimum dissolved oxygen concentration to be above 5 mg/L, the minimums were low enough during the day that one could assume the dissolved oxygen may have dipped below the threshold later in the day or night. In dissolved oxygen studies, samples need to be taken before 9:00 am or a continuous probe needs to be placed to get the most accurate readings and obtain readings during the early morning hours. Most of the readings were not done during the

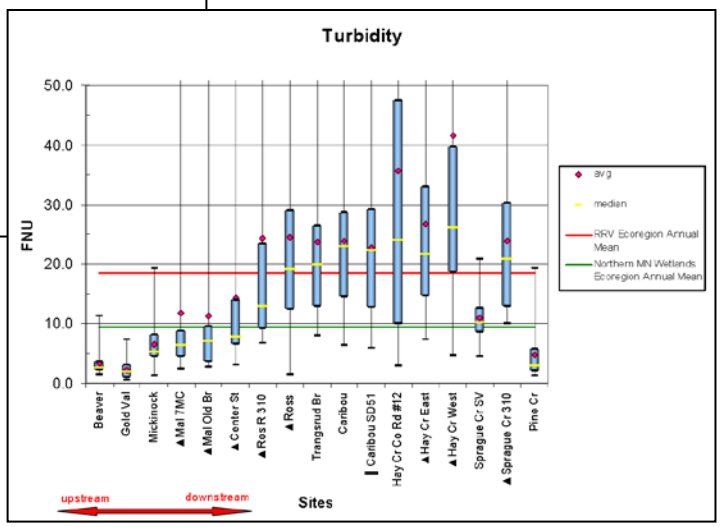
recommended time as this is difficult to accomplish and would require many days to check all sites.

The means or averages averaged from 7.67 to 9.57 mg/L. The higher means are found at sites in the upper reaches of the watershed or in the forest. The dissolved oxygen means lower as the sites progress through agricultural lands and peatlands.

Low dissolved oxygen concentrations were generally found almost every site during low water flow conditions with warm summer temperatures, summer stagnant waters (no flow), and times of flooding, especially at those sites where flood waters always slowly dissipate (north of the City of Roseau).

Turbidity





RRV Ecoregion Annual Mean = 18.5 mg/L

RRV Stream Range = 6-23 NTU

Northern MN Wetlands Ecoregion Annual Mean = 9.4 mg/L

Northern MN Wetlands Stream Range = 4.1 – 10 NTU

NTU – nephelometric turbidity units – ecogregion measurements
FNU – formazine nephelometric units – SWCD measurements – sites without symbols – years 2003-2008
NTRU – nephelometric turbidity ratio units – River Watch, RRV WMB – all sites with symbols – years 2001-2008

Note: The turbidity units are <u>not</u> interchangeable. At this time, no formula exists to convert units. The Roseau SWCD turbidity meter measures in FNU's. The River Watch / RRV WMB turbidity meter measures in NTRU's. The MPCA turbidity studies involving ecoregions uses NTU's.

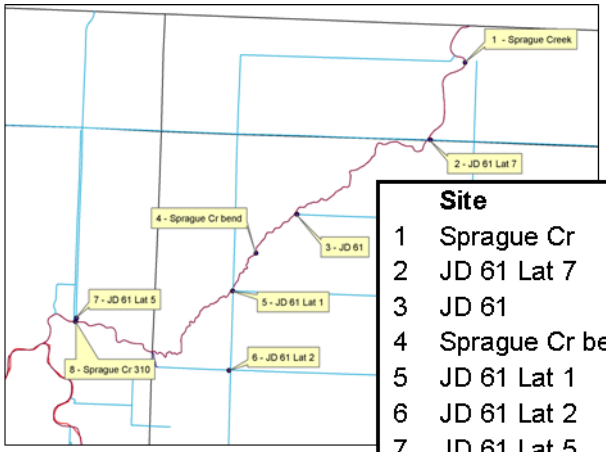
Even though the turbidity measurements are not convertible at this time, a graph (page 17) was constructed to show what is currently happening in the Roseau River watershed. The second graph is just a close up of the first graph. Sites going through low impact forested areas in the upper-watershed have the lowest turbidity on average (Beaver and Golden Valley). As the water flows through higher impacted areas such as agriculture and incoming ditches, turbidity increases. Highest turbidity measurements were found after a significant rainfall, cattle or other animals in the stream upstream from monitoring site, fast flow, construction, converging muddy ditches, and flood / eroding conditions.

Turbidity

	Site	min	25th%	median	75th%	max	avg	# of samples
1	Beaver	1.5	2.2	2.6	3.7	11.3	3.4	31
2	Gold Val	0.5	1.0	1.9	3.0	7.3	2.2	27
3	Mickinock	1.3	4.4	5.3	8.2	19.2	6.5	30
4	▲Mal 7MC	2.4	4.5	6.3	8.7	116.0	11.8	22
5	▲Mal Old Br	2.8	3.6	7.0	9.6	94.8	11.3	23
6	▲Center St	3.1	6.5	7.8	14.0	114.0	14.4	21
7	▲Ros R 310	6.7	9.2	12.9	23.4	218.0	24.4	24
8	▲Ross	1.4	12.4	19.1	29.1	71.0	24.5	16
9	Trangsrud Br	8.0	12.9	20.0	26.5	75.0	23.7	30
10	Caribou	6.3	14.5	23.0	28.7	63.7	23.9	30
11	Caribou SD51	5.8	12.7	22.3	29.1	75.6	22.7	26
12	Hay Cr Co Rd #12	2.8	10.0	24.1	47.5	188.0	35.6	28
13	▲Hay Cr East	7.4	14.6	21.7	33.0	96.5	26.7	29
14	▲Hay Cr West	4.6	18.6	26.1	39.7	217.0	41.5	34
15	Sprague Cr SV	4.5	8.6	10.2	12.6	20.8	10.9	24
16	▲Sprague Cr 310	10.0	12.9	20.8	30.3	61.6	23.9	21
17	Pine Cr	1.2	2.1	2.8	5.7	19.2	4.8	18

Turbidity on Sprague Creek

A turbidity check was done once in May 2009 at seven sites to get a general idea of what was happening in the Sprague Creek watershed since the creek has been listed for turbidity impairment. The highest turbidity measurement occurred on Site 6, JD 61 Lat 2. This lateral converges with Sprague Creek a little more than a mile downstream. This ditch had a muddy appearance and upon closer inspection of an atlas, flows on the north side of agricultural lands and has other lateral and branches that converge upstream. The other laterals flow through forested areas. Obviously, more measurements need to be done to fully understand what is happening between the first and last sites.



	Site	FNU
1	Sprague Cr	7.7
2	JD 61 Lat 7	2.8
3	JD 61	2.8
4	Sprague Cr bend	12.5
5	JD 61 Lat 1	2.2
6	JD 61 Lat 2	18.5
7	JD 61 Lat 5	--
8	Sprague Cr 310	5.6

Summary of Two Rivers Watershed and the Water Quality Data Collected

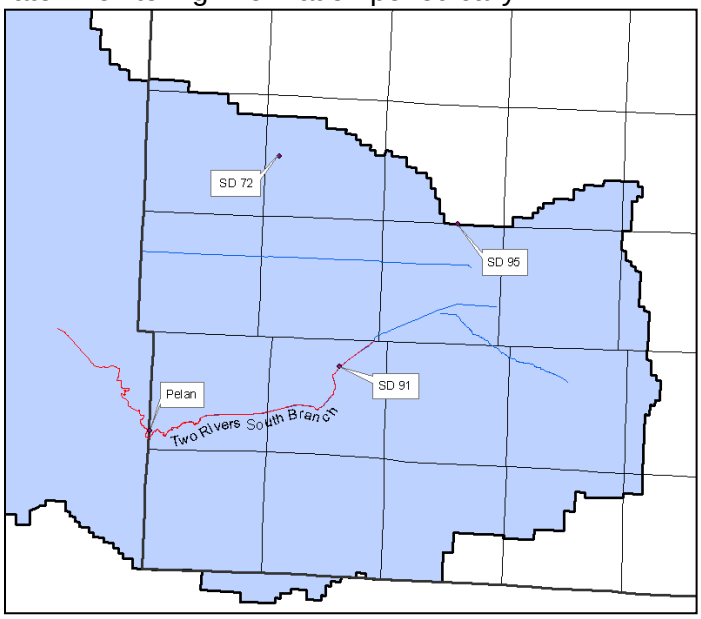
Two Rivers Watershed

The Two Rivers has three branches, into which waters from western Roseau County empties. The South Branch originates south of Badger, flows through Greenbush and exits Roseau County in Dewey Twp. Most of the South Branch in Roseau County is known as SD 91. The branches and laterals of SD 91 along with the CD 4 empties into the South Branch system. Waters from SD 95 (branches & laterals) in Barto and Polonia Twps flow westerly and eventually enter into Middle Branch. Badger Creek and Skunk Creek waters were diverted in the past from entering into the Roseau River system and now flow into SD 95. State and Judicial Ditches in Soler and Juneberry Twps contribute waters that flow into the North Branch of Two Rivers.

The MN DNR - Division of Fisheries has published five fish population surveys between 1986 and 2003 for the Two Rivers system.

Monitoring

Surface water monitoring has been done by the TRWD and the sites are shown on the map below. The Badger-Greenbush High School students will be starting the River Watch program. Currently the sites that they will be visiting are unknown at this point. The TRWD publishes a summary of surface water monitoring information periodically.



TRWD current surface water monitoring sites

Two Rivers Watershed Water Quality Summary

By Danni Halvorson, RRBMP, 2004

The following is an overview of the River Watch, Watershed District, and Water Plan monitoring on the Two Rivers for 1991 thru 2003 as performed by the Red River Basin Monitoring Program (RRBMP), the Two Rivers Watershed District (TRWD), and the Kittson County Water Plan (KCWP).

The data was analyzed by site, ecoregion, and water course. Omernik's ecoregion framework from Fandrei, et al. (1988) was used for spatial division of the watershed. A map of Omernik's ecoregions is provided in the appendix, all but one of the sites used in this analysis fall within the Red River Valley (RRV) ecoregion. Mean values for selected variables were calculated for and compared to the annual ecoregion range from the 25th to 75th percentile also known as the interquartile (IQ) range taken from the

work of McCollor and Heiskary (1993) in an attempt to characterize the baseline water quality of the watershed. This IQ range is used as a range of "typical values" that would be expected for "least impacted" streams in the RRV ecoregion.

Site data was also analyzed using the "Guidance Manual for Assessing the Quality of Minnesota Surface Waters, for the Determination of Impairment" (MPCA 2003). This was done to assess the potential of the sites to exceed the Total Maximum Daily Load standards. This process is often referred to as the, Impaired Waters Assessment.

SITES, SAMPLE SCHEDULES, AND WATER QUALITY VARIABLES

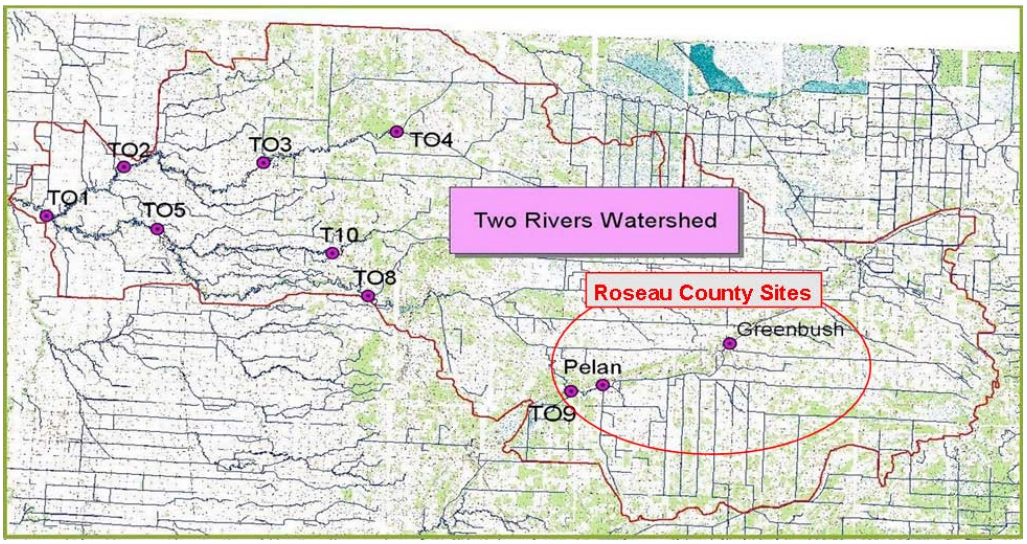
Sampling was conducted on a monthly basis when possible and took place randomly from April to November for each of the years 1991 thru 2003. Sampling occurred at as many as 27 sites in the TRWD from1991 thru 2003, however only the sites on the Two Rivers with more than 10 sample events were used in this analysis. Thus, the analysis focuses on ten core sites; 3 on the North Branch, 5 on the South Branch, 1 on the Middle Branch, and 1 site after the confluence of the North and South Branches of the Two Rivers. The sites mentioned are shown on the map on page 2 below.

The monitoring included field collection and lab analysis. The RRBMP, TRWD, and KCWP generally sampled four to five sites from the different rivers and/or tributaries in the locale. Monitoring of physical and chemical conditions involved monthly collection of samples from April through November for the following parameters: turbidity, pH, conductivity, dissolved oxygen, total phosphorus, ortho-phosphorus, nitrate/nitrite nitrogen, TKN, TSS, fecals, and air and water temperature.

Lab analysis was conducted by MVTL Labs, Inc in New Ulm, MN for the years 1991 - 1998 and at RMB Lab in Detroit Lakes, MN for 1999 - 2003. Lab analysis was also conducted by the schools involved in River Watch for the years 1999 – 2001. This data because of its potential for error was not used in preparing this report.

For the purposes of this report analysis of the nutrient content, TSS, and fecals will be based solely on certified lab data. Nutrient content analysis is further refined by focusing on total phosphorus and nitrate/nitrite nitrogen because they have corresponding ecoregion IQ ranges. And, analysis of turbidity, pH, conductivity, and dissolved oxygen will be based on all the available data collected from 1991 thru 2003. A brief explanation of selected water quality parameters and a table of the raw data used in the following analysis are provided in the appendix.

WATER QUALITY SITES USED IN ANALYSIS



(For reference, Roseau County Sites diagram was added)

ECOREGION – DATA ANALYSIS

Table 1 below shows a conglomeration of all the data as it compares to the RRV ecoregion and is broken into 3 parts. Part 1 shows mean nutrient, fecal, and sediment data from the certified labs MVTL and RMB, part 2 shows mean field data collected at each site, and part 3 shows the IQ data from McCollor and Heiskary (1993). In each case the number of events/samples that the data is based on is given as ***N****. Mean values in each part of the table are highlighted in yellow if they exceed the upper IQ value (75th percentile).*

Table 1 Ecoregion Data Comparisons

1991 -2003 Ecoregion Means (MVTL and RMB Labs)								
Site	**TP**	**N**	**NO2NO3**	**N**	**TSS**	**N**	**Fecals**	**N**
Greenbush								
Pelan	0.071	5	0.028	5	6	5		
T01	0.173	43	0.193	23	60	49	61	19
T02	0.126	29	0.048	12	19	36	24	23
T03	0.090	23	0.088	5	9	29	58	17
T04	0.128	29	0.019	12	7	31	50	27
T05	0.134	30	0.067	11	29	36	63	27
T08	0.148	30	0.088	9	8	31	31	21
T09	0.083	20	0.023	6	16	26	65	23
T10	0.095	27	0.020	11	9	35	43	24
1991 through 2003 Ecoregion Means (All Field Data)								
Site	**Turbidity**	**N**	**Conductivity**	**N**	**pH**	**N**	**DO**	**N**
Greenbush	6.82	12	631	15	8.01	15	10.23	14
Pelan	7.84	10	488	10	8.20	10	8.86	10
T01	79.43	33	681	33	8.08	59	8.90	77
T02	25.38	28	600	26	7.94	55	7.86	74
T03	7.16	27	540	26	8.01	54	8.73	74
T04	3.66	29	596	28	7.71	56	8.01	76
T05	20.86	18	552	18	8.07	44	9.01	63
T08	4.63	23	486	23	8.07	50	9.98	70
T09	8.22	5	506	5	7.94	51	9.00	52
T10	6.84	13	447	14	7.87	41	9.32	62

(Roseau County Sites in RED)

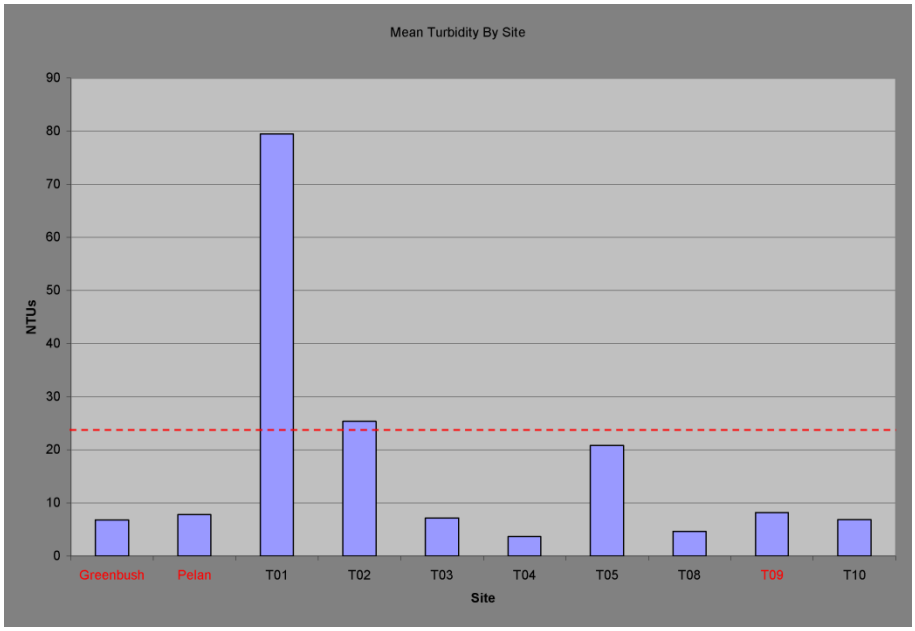
Ecoregion study annual data 1979-1992, 25th to 75th percentile range.

Ecoregion	TP=	NO3NO2=	TSS=	Turbidity=	Conductivity=	pH=
RRV	.11-.30	.01-.21	11-59	6-23	440-640	8-8.4
N=	321	198	322	139	322	187
Units	**mg/l**	**mg/l**	**mg/l**	**NTUs**	**Us/cm**	

****Values that are in yellow exceed the ecoregion study's 75th percentile value*
****Units for watershed parameters are the same as indicated for Ecoregion study.*
****Ecoregion values for dissolved oxygen and fecals are not set. State standards of 5 mg/l dissolved oxygen and 220 colonies/100 ml for fecals apply.*

When looking at the mean values across the watershed there does not appear to be any problems with nutrient levels, fecals, or dissolved oxygen. However, mean turbidity at sites T01 and T02 does exceed the upper IQ value of 23 NTUs for the RRV ecoregion. TSS at site T01 also exceeds the upper IQ value of 59 mg/l. Graph 1 below further illustrates how sites T01 and T02 exceed the ecoregion expected value for turbidity. The ecoregion expected value is shown as the red dashed line. The data shows that sediment is an issue at site T01 and that T02 mean turbidity is also above the expected value however only slight.

Graph 1 Mean Turbidity



IMPAIRED WATERS ASSESSMENT

The following additional assessment is based on the levels of use support defined by the U.S. EPA and MPCA for listing waters as impaired for the State 303(b) report and 303(d) List (TMDL). These categories listed in Table 2 are: Fully Supporting, Partially Supporting, and Not Supported as per the guideline for conventional pollutants and water quality characteristics in the table. Results are reported at sites where there was a minimum of 10 data points within the most recent 10 years as required for impaired waters assessments.

Water quality standards are benchmarks by which the qualities of surface waters are measured. The Clean Water Act requires all surface waters be assessed to determine their condition and ability to support their designated uses. In the case of the surface waters of the Two River watershed, designated uses relate to aquatic life and recreation.

Measurement of various parameters provides guidance as to the extent that surface waters are meeting their designated uses. The information presented in Table 3 provides an overview of the status of water quality conditions based on turbidity (25 NTUs), dissolved oxygen (5mg/l), and fecal counts (220 col/100ml) at sampling sites distributed throughout the Two River watershed. The table shows the number of samples the analysis is based on followed by the percent of the samples that did not meet the assessment guidelines. Percent values are shaded or not shaded according to their level of use support.

Table 2 Levels of Use Support

Summary of Data Requirements and Exceedance Thresholds for Assessment of Conventional Pollutants and Water Quality Characteristics.					
Impairment Assessment for	*Period of Record*	*Minimum No. of Data Points*	*Use Support or Listing Category Based on Chronic Standard Exceedances*		
Chronic Standards Exceedances Thresholds:			*< or =10%*	*10-25%*	*>25%*
305(b) Report	*Most recent 10 years*	*10**	*Fully Supporting*	*Partially Supporting*	*Not Supporting*
303 (d) List (TMDL)	*Most recent 10 years*	*10**	*Not Listed*	*Listed*	*Listed*

**Minimum of 20 data points for turbidity based on TSS.*

Table 3 Levels of Use Support Percent Exceedance

Sample Site	Number of DO samples	D.O. < 5 mg/l		Number of Turb samples	Turb > 25 NTU		Number of Fecal samples	Fecals > 200 orgs/100ml
T01	77	5		33	75		19	5
T02	74	12		28	43		23	0
T03	74	0		27	0		17	0
T04	76	16		29	0		27	0
T05	63	2		18	28		27	4
T08	70	0		23	0		21	0
T09	52	6		5	0		23	9
T10	62	3		13	8		24	0
Greenbush	14	14		12	8			
Pelan	10	10		10	0			

No shade	Fully Supporting (< or = 10% of sample events exceeding)
	Partially Supporting (10-25% of sample events exceeding)
	Not Supporting (> 25% of sample events exceeding)

The impaired water assessment further shows excessive turbidity at site T01 and T02 with site T05 showing up also as having too many sample events with turbidity levels greater than 25 NTUs. The high levels of turbidity at these sites are most likely associated with erosion from wind, agricultural practices, and stream instability caused from previous high water damage to the main channel and upstream tributaries (e.g. local drainage and field ditches).

At times, dissolved oxygen content also appears to be a problem at sites T02, T04, Greenbush, and Pelan. The low dissolved oxygen readings at T04 may be and most likely are associated with the vast wetland areas directly upstream of the site. The Pelan site located near the large ridge between the cities of Karlstad and Greenbush may also be receiving significant ground water flow especially during low water levels that may be causing the dissolved oxygen content to fall below the desired level. However, the remaining sites T02 and Greenbush appear to be receiving most of their flow from surrounding agricultural land. It appears that forces other than ground water interaction may be causing the low dissolved oxygen readings at these sites.

SUMMARY AND RECOMMENDATIONS

From the data used in this investigation, it looks like the biggest concerns in the watershed are dissolved oxygen and sediment levels. In particular, to point the finger at the one site with the most problems it appears that the TO2 site is in the worst shape having both high sediment and low dissolved oxygen readings. T01 also has significant sediment based on TSS and Turbidity but the dissolved oxygen readings have been to date all greater than the desired 5 mg/l level.

It is important to note that the values listed in this analysis are concentrations only and do not account for flow or loadings. At a minimum, the data warrants further investigation on the problem areas indicated above. Further investigation should include flow data collection in conjunction with the chemical analysis for TSS and field measurements of turbidity so sediment loads coming from the flagged sites can be estimated and a TSS/turbidity correlation can be developed. Further investigation into the sites flagged for low dissolved oxygen is also warranted. Site T02 in particular which is located in the lower 1/3 of the watershed should have enough flow to keep dissolved oxygen levels above the 5 mg/l threshold. It appears that a flow blockage maybe the Hill Dam just downstream of the site or other obstacle is affecting the flow during low water levels and possibly the dissolved oxygen levels at the site

REFERENCE

Fandrei, G., S.A. Heiskary, and S. McCollor. 1988. Descriptive Characteristics of the Seven Ecoregions in Minnesota. Minnesota Pollution Control Agency.

Heiskary, Steven, and S. McCollor. 1993. Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions, Addendum to: Descriptive Characteristics of the Seven Ecoregions in Minnesota. Minnesota Pollution Control Agency.

Minnesota Pollution Control Agency. 2003. Guidance Manual for Assessing the Quality of Minnesota Surface Waters. For the Determination of Impairment. 305(b) Report and 303(d) List.

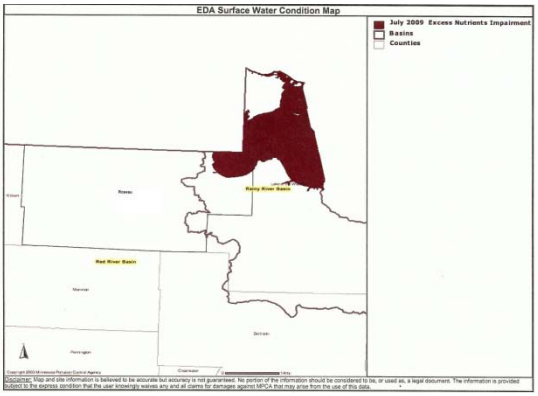
Summary of Lake of the Woods/Warroad Watersheds and the Water Quality Data Collected

LOW/Warroad Watersheds

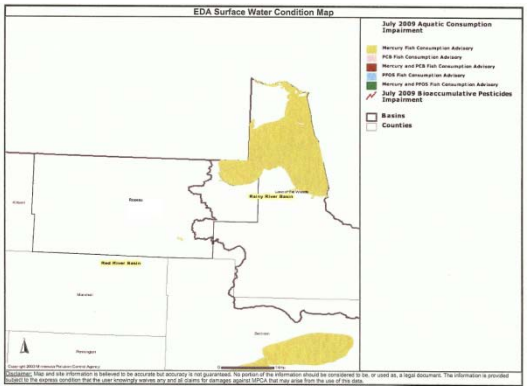
The Warroad River has two branches, into which waters from eastern Roseau County empties. Both branches arise in BISF and converge in northern Moranville Township before flowing into Lake of the Woods in the City of Warroad. Bulldog Run, Clausner Creek and CD 6 empty into the West Branch Warroad River. Other ditch systems that converge with the Warroad River system or flow directly into Lake of the Woods are CD 6, 9, 10, 20, 25, 26 and JD 22 and 62. Willow Creek flows into the Lake of the Woods in North Laona Township.

These watersheds, which are part of the Rain River Basin, are different compared to the rest of the Rainy River watersheds in that they resemble more like watersheds in the Red River Basin in topography, wetlands and erosive soils according to the Rainy River Basin Plan.

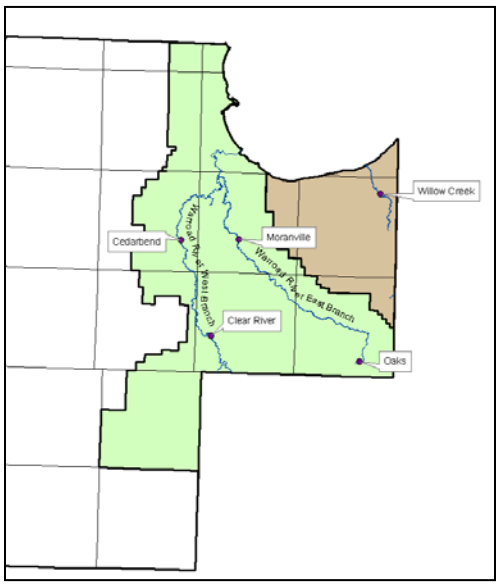
No surface waters are listed as impaired in the Warroad River or Lake of the Woods watersheds in Roseau County. Nolan Baratono, MPCA (Water and Basin Planner for the Rainy River Basin), indicated that Lake of the Woods is on the impaired waters list for excess nutrients and mercury (not in Roseau County) and that Willow Creek (in Roseau County) is up to be on the impaired waters list. A TMDL study will be underway in the next few years. As the Warroad River, Willow Creek and numerous ditches empty into Muskeg Bay of Lake of the Woods, Roseau County and its partners will be asked to fill TMDL study roles. The Roseau SWCD would like to continue its role in monitoring surface waters in this area of the county and add monitoring sites on the various ditch systems in order to collect data of what is going into Lake of the Woods from Roseau County. The main ideas are to reduce phosphorus loading and make sure no new sources of phosphorus are getting into the lake. Warroad River will be set up as a pour point and have a station set up for flow monitoring during this study.



Excess Nutrient Impairment



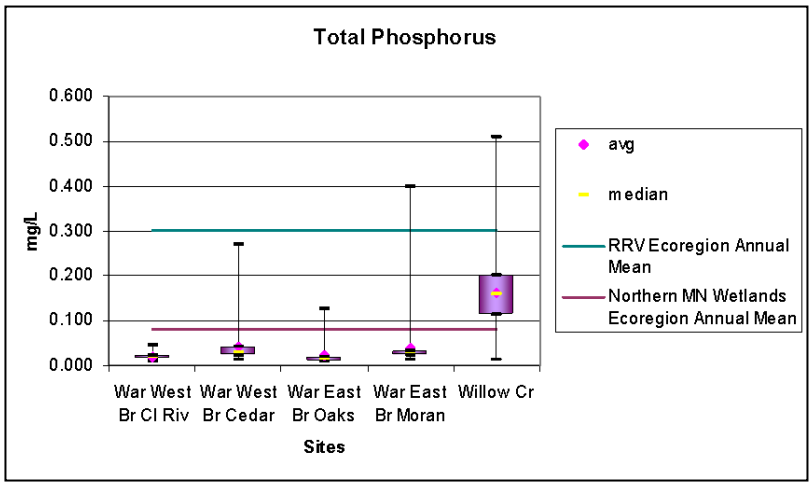
Mercury Impairment



Monitoring

Surface water monitoring has been done Roseau SWCD since 2001 and the sites are shown on the map below. Data from years 2003- 2009 have been recorded in the STORET database. Data from 2001 and 2002 were gathered using different equipment and so were not included in the database. The Warroad High School River Watch was active only in year 2001.

Because Lake of the Woods has been listed for excess nutrients, nitrate and phosphorus data and graphs are shown below. Other graphs with pH, DO, temperature, fecal coliform counts, specific conductivity and turbidity may be found in Appendix D.

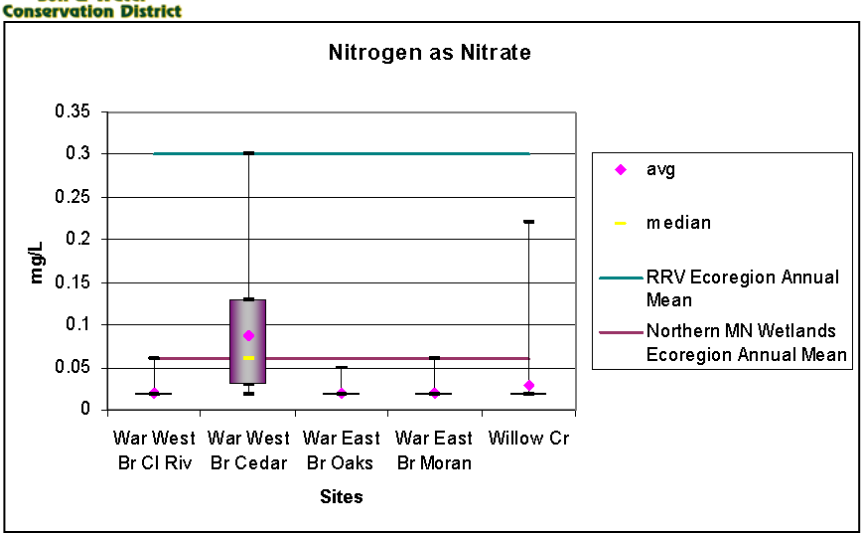


Total Phosphorus

Most of the time, phosphorus does not seem to be an issue for the Warroad River. Willow Creek is consistently above the northern MN wetlands ecoregion annual mean of 0.08 mg/L. Willow Creek runs through a few pastures and geese have been known to use these waters in the summer, according to a local landowner. This creek can dry down to little or no flows during summer and into fall. The Clear River and Oaks sites are located in BISF and show the least amounts of total phosphorus and have means below the ecoregion annual mean. The Cedarbend and Moranville sites are located in more agricultural areas and also have means below ecogion mean, although higher spikes of total phosphorus have been recorded.

Total Phosphorus

Site	min	25th%	median	75th%	max	avg	# of samples
War West Br Clear River	0.011	0.015	0.019	0.022	0.044	0.020	34
War West Br Cedarbend	0.014	0.023	0.029	0.042	0.270	0.042	36
War East Br Oaks	0.009	0.011	0.016	0.021	0.127	0.022	34
War East Br Moranville	0.012	0.023	0.029	0.034	0.400	0.039	34
Willow Creek	0.013	0.115	0.155	0.202	0.510	0.161	31



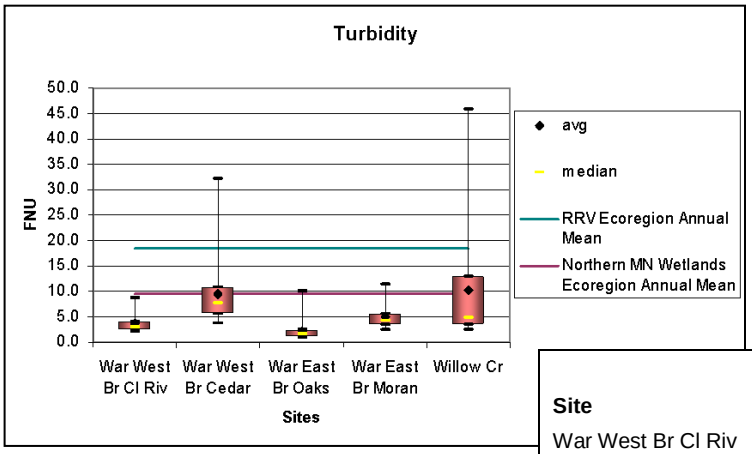
Nitrates

Nitrates do not seem to be an issue, except for the Cedarbend site, where on average, nitrate means are above the northern MN wetlands ecoregion annual mean of 0.06 mg/L. At this time, it is unknown why nitrates are consistently higher at this location compared to any other site in the Warroad or LOW watersheds. One other potential monitoring site exists between this site and the Clear River site to possibly narrow down the source. Nitrate spikes for three sites are right at the ecoregion mean with the two other sites being at or lower than the Red River ecoregion mean.

Nitrate

Site	min	25th%	median	75th%	max	avg	# of samples
War West Br Clear River	0.02	0.02	0.02	0.02	0.06	0.02	34
War West Br Cedarbend	0.02	0.03	0.06	0.13	0.30	0.09	36
War East Br Oaks	0.02	0.02	0.02	0.02	0.05	0.02	34
War East Br Moranville	0.02	0.02	0.02	0.02	0.06	0.02	34
Willow Creek	0.02	0.02	0.02	0.02	0.22	0.03	31

Turbidity



Northern MN Wetlands Ecoregion Annual Mean = 9.4 NTU

Northern MN Wetlands Stream Range = 4.1 – 10 NTU

RRV Ecoregion Annual Mean = 18.5 NTU

RRV Stream Range = 6-23 NTU

Turbidity (FNU)

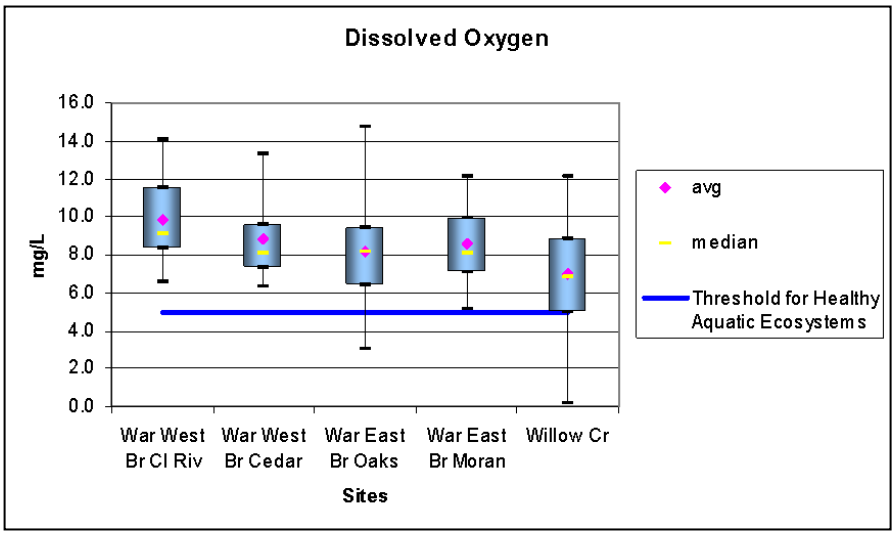
Site	min	25th%	median	75th%	max	avg	count
War West Br Cl Riv	2.1	2.4	2.9	4.1	8.7	3.7	31
War West Br Cedar	3.8	5.5	7.7	10.7	32.2	9.3	33
War East Br Oaks	0.8	1.1	1.7	2.5	10.0	2.2	30
War East Br Moran	2.4	3.5	4.3	5.5	11.4	4.9	34
Willow Cr	2.4	3.3	4.8	13.0	45.7	10.3	28

NTU – nephelometric turbidity units, ecogregion measurements
FNU – formazine nephelometric units, SWCD measurements

(Note: The turbidity units are not interchangeable. At this time, no formula exists to convert units. The Roseau SWCD turbidity meter measures in FNU's. The MPCA turbidity studies involving ecoregions uses NTU's.)

As mentioned earlier, turbidity units are not convertible at this time. A graph was constructed to show which sites have greatest variability and show how landuse can affect surface waters. Cedarbend and Willow Creek have the most variability for turbidity and the highest recorded spikes.

Dissolved Oxygen



All sites have dissolved oxygen (DO) means above the threshold of 5 mg/L. Minimums show that two sites, Oaks and Willow Creek, have had recorded minimums of 3.0 and 0.2 mg/L DO, respectively. The other sites have minimums close enough to the threshold where DO may have dipped below 5 mg/L later in the day or night. Most of the time where DO has been low, it has been due to low flows, high summer temperatures warming surface waters, and/or stagnation.

Dissolved Oxygen

Site	min	25th%	median	75th%	max	avg	count
War West Br Cl Riv	6.6	8.3	9.1	11.5	14.1	9.8	26
War West Br Cedar	6.3	7.3	8.1	9.6	13.3	8.8	32
War East Br Oaks	3.0	6.4	8.2	9.4	14.8	8.2	29
War East Br Moran	5.1	7.1	8.1	10.0	12.1	8.6	30
Willow Cr	0.2	5.0	6.8	8.9	12.1	7.0	27

Future Roseau County TMDL Studies

Local water monitoring partners anticipate involvement with the monitoring and assessment of surface water impairments, TMDL studies and implementation plans in Roseau County. Expected TMDL studies include the dissolved oxygen impairment on the Roseau River, turbidity impairment on Sprague Creek and Roseau River, fish bioassessments (IBI) on Two Rivers South Branch and nutrient monitoring in Warroad River, Willow Creek and various ditches in WR/LOW watersheds (for LOW TMDL). Effectiveness monitoring will be supported and addressed as needed. The mercury studies on Roseau River will also be supported when it comes up. Despite the target start as indicated on the TMDL list below, no studies have been started.

2008 TMDL List - Final 6-10-2008

Reach	Description	Yr[12]	River ID#[4]	Prev ID#[13]	Lake or wetland ID#[6]	Affected use	Pollutant or stressor[3]	Target start[1]	Target completion[1]	Cate-gory[14]
RED RIVER BASIN										
Roseau River	Headwaters to S Fk Roseau R	98	09020314-504			Aquatic consumption	Mercury in fish tissue	1998	2011	5C
Roseau River	S Fk Roseau R to Hay Cr	98	09020314-502			Aquatic consumption	Mercury in fish tissue	1998	2011	5C
Roseau River	Hay Cr to MN/Canada Border	96	09020314-501			Aquatic life	Oxygen, Dissolved[2,5]	2007	2010	5A
Roseau River	Hay Cr to MN/Canada Border	98	09020314-501			Aquatic consumption	Mercury in fish tissue	1998	2011	5A
Roseau River	Hay Cr to MN/Canada Border	08	09020314-501			Aquatic Life	Turbidity	2011	2014	5A
Sprague Creek	MN/Canada border to Roseau R	08	09020314-508			Aquatic Life	Turbidity	2011	2014	5C
Two River, South Branch	Unnamed ditch to Lateral Ditch 2	02	09020312-506			Aquatic life	Fish bioassessments	2010	2013	5C

Category 5 – at least one use is impaired and a TMDL is required.
5A – Impaired by multiple pollutants and no TMDL study plans are approved by EPA
5C – Impaired by one pollutant and no TMDL study is approved by EPA

The TMDL Process

Assess the state's waters
↓
List those that do not meet standards
↓
Identify sources and reductions needed
↓
Implement restoration activities (Implementation Plan)
↓
Evaluate water quality

Links

MPCA Impaired Waters – http://www.pca.state.mn.us/water/tmdl/index.html

BWSR Clean Water Legacy – http://www.bwsr.state.mn.us/CWL/index.html

MN USGS Waters – http://mn.water.usgs.gov/

DNR Watershed Map of MN – http://dnr.state.mn.us/watersheds/map.html

EPA TMDL Website – http://www.epa.gov/owow/tmdl/

Other

For information on statistical data 2003-2008, surface water monitoring graphs 2003-2008, Guide to Typical Minnesota Water Quality Conditions, permitted waste water discharges, normal annual precipitation, normal precipitation May – September, rainfall monitoring network, and Roseau SWCD river monitoring locations, see Appendix D. For information on examples of Best Management Practices, feedlots, feedlot delegated county map, land ownership, topography, TB management zones, general land use, and wetland type information, see Appendix B.

Future Projects If Funding Was Available

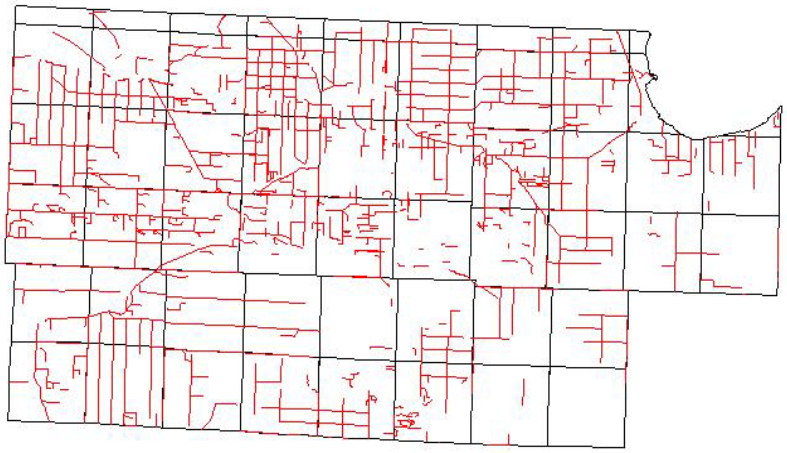
- Additional surface monitoring sites (up to possible 10) for Warroad River/Lake of the Woods watersheds with lab parameters including chlorophyll – a, total suspended solids (TSS), nitrate – nitrite, and total phosphorus
- Additional lab parameters for already established sites (5 sites) for chlorophyll – a and TSS for Lake of the Woods and Warroad River monitoring sites
- Additional lab parameter for Sprague Creek for TSS with additional monitoring sites (up to 6) for TMDL study
- Update river monitoring equipment (sonde unit, Van Dorn sampler)

Assessment

Priority Concern 4: ***Managing Existing Ditch Systems***

Roseau County's ditch system is quite extensive. Drainage started back in the 1800's and as the county was settled; more ditches were dug and or modified to accommodate agriculture, livestock, industrial and residential needs. Cost-share was even provided to private landowners to encourage more drainage and therefore, allow more land to be put into production. Most of the surface lateral ditches on agricultural land have been maintained through private landowners. Other drainage is completed through Roseau County, watershed districts, and the Minnesota Drainage Commission.

Roseau County Ditch Systems



Older drainage systems (county, judicial, state, watershed) included in the 927 miles of ditches are in need of maintenance so that the entire system may function correctly from impacts due to sloughing, erosion and sedimentation as past floods and storm waters have deteriorated this drainage structure. Ditch cleaning issues can arise in the form of landowner(s) denying access for ditch system cleanout leaving that length unrepaired. Many inventory records regarding the ditch systems are currently located at a restoration facility because of floodwater damage from 2002.

The policy of Roseau County is to maintain the drainage system to minimize flooding and adverse impacts that might occur when cleaning a drainage system. Roseau County and the watershed districts will continue to try and maintain the existing drainage systems within the county and to use updated best management practices with new technologies to reduce impacts on water quality when maintenance is performed. About 200+ "As-Built" miles of ditches have been inventoried and gone through maintenance so far with more being done in future years. Funding continues to be critical for inventorying ditches and digitizing records.

Ditch Systems

County Controlled Ditches

County						
5	6	7	9	10	11	13
17	18	20	21	23	24	25
26						
Judicial						
19	33	61	62	63		
State						
20	69	72	91	95		

TRWD Ditch Jurisdiction - CD #4, Soler #4 and Dewey #5

RRWD Ditch Jurisdiction - #1, #3, CD #8, CD #16, SD #51, JD #62

EXCERPT FROM TRWD OVERALL PLAN

GOAL: Maintain, modify, construct, or improve properly functioning watercourses to provide protection to agricultural land for a 10 - year event, while ensuring that there are no resulting downstream adverse impacts.

PRIORITY ISSUE:

Legal (Public) Systems:

- Reduce the number of drainage systems with outlets that are in disrepair.
- Address beaver dams on ditches and natural watercourses.
- Address problem of debris in river channels.
- Address blockages in drainage systems from sediment, vegetation, and other causes.
- Reduce "flashiness" of the hydrograph related to ditches and natural watercourses.
- Reduce damages to legal ditch systems by preventing or correcting slope failures.

Natural Systems:

- Reduce the number of drainage systems with outlets that are in disrepair.
- Address beaver dams on ditches and natural coulees.
- Address problem of debris in river channels.
- Address blockages in drainage systems from sediment, vegetation, and other causes.
- Reduce the "flashiness" of the hydrograph related to ditches and natural watercourses.
- Reduce damages to natural systems by preventing or correcting slope failures.

Private Systems:

- Reduce the number of drainage systems with outlets that are in disrepair.
- Address beaver dams on ditches and natural coulees.
- Address blockages in drainage systems from sediment, vegetation, and other causes.
- Reduce the "flashiness" of the hydrograph related to ditches and natural watercourses.
- Follow all necessary permitting procedures
- Ensure proper construction to prevent erosion problems such as gullies, side slope failures, and washouts.

Road Ditches:

- Reduce the number of drainage systems with outlets that are in disrepair.
- Address beaver dams on ditches and natural coulees.
- Address blockages in drainage systems from sediment, vegetation, and other causes.
- Reduce the "flashiness" of the hydrograph related to ditches and natural watercourses.
- Reduce damages to legal ditch systems by preventing or correcting slope failures.

STRATEGIES:

1) For legal ditch systems, an annual inspection should be done on each system, which identifies the general ditch condition and specific problems, including any restrictions, condition of outlets, bank and bed failures, sedimentation issues, water quality issues, fish & wildlife issues, and any other issues. A ditch operations and maintenance plan should be written for each ditch system and should address annual cattail spraying, beaver dams and maintenance of them, removal of woody vegetation and debris, cover crops on adjacent fields, riparian buffer strips, CRP, wetland restorations, funding needed for maintenance, and other issues deemed appropriate. For systems that have chronic problems, investigate the feasibility of establishing a storm water management unit or water management district and set up of a storm water utility.

2) For natural systems, an inventory should be completed similar to a ditch inventory & once complete work with DNR to investigate delegating permitting authority. Clean outs of sediment should be done as necessary, and water flow from ditches into natural systems should be controlled by utilizing side pipe inlets or other means. Other maintenance should

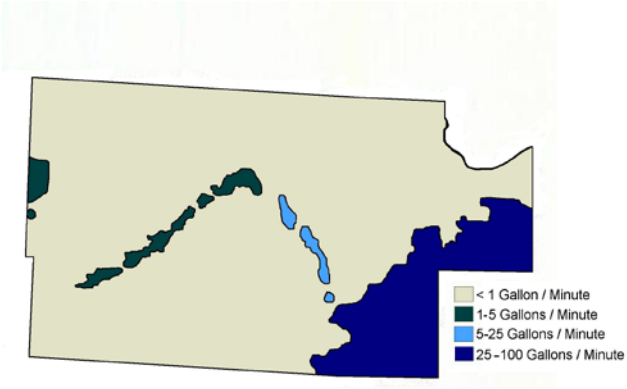
include brush management, prescribed burning to control vegetation, no farming up to waterway edges, and perpetual easements through programs such as EWP, RIM, & CREP.
3) For private systems, the *Rules of the Two Rivers Watershed District* should be reviewed and adjusted if necessary. Also, an inventory of sites should be completed and an effort made to identify who is responsible for maintenance, and work with them to do the maintenance. Other strategies include encouraging farmers not to farm to bottoms of ditches and watercourses, cost share on side pipe inlets, riparian buffer strips, sediment traps, fencing to eliminate cattle in ditches, and grassed waterways.
4) For road ditches, the TRWD should work with road authorities (MNDOT, County Highway Dept., & Townships) to identify trouble spots (i.e. where field ditches outlet into road ditches), develop a corrective action plan, and a policy agreement to address capacity of future road construction and maintenance activities. Also, road ditches could be included as a part of (lateral to) legal drainage systems in order to facilitate maintenance. In addition, upstream projects should be incorporated that address timing of flows such as stream restorations and gated storage. Measures should be taken to address sedimentation of ditches due to erosion from adjacent fields resulting from poor tillage practices or lack of cover crop. Maintenance issues include roadside mowing, buffer strips, elimination of the practice of farming ditch bottoms, incorporating wetland projects, and eliminating livestock in ditch systems.

PREFERRED OUTCOMES: All systems within the District should eventually have capacity to carry a 10 year frequency storm event (3.5 – 4 inches runoff in 24 hrs). Reduction of erosion and sedimentation, leading to less complaints and less ditch cleaning, reducing maintenance costs.

POTENTIAL PARTNERS: Soil & Water Conservation Districts, County Commissioners, County Highway Departments, Townships, DNR, BWSR, FSA, NRCS

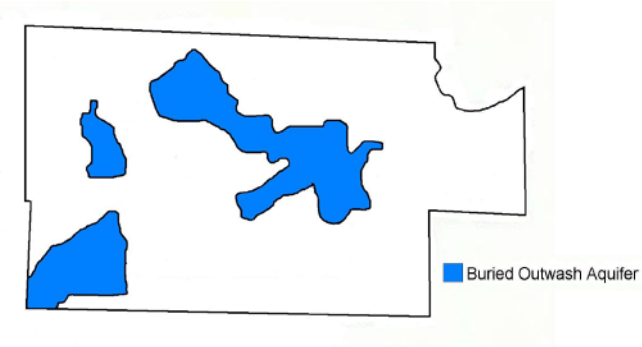
Priority Concern 5: ***Groundwater Protection and Quality***
Groundwater Systems in Roseau County

Unconsolidated Glacial Drift Aquifers



Surficial Drift Aquifers

Most residents in Roseau County are served by surficial drift aquifers of which are recharged by normal precipitation. This type of aquifer is susceptible to direct access of contaminants from the land surface. The water quality in these aquifers is generally believed to be good quality. This water may contain large concentrations of iron and manganese. Hardness can range from 200-400 mg/L. Nitrate contamination is present is some areas. The dominant water type is calcium magnesium bicarbonate.

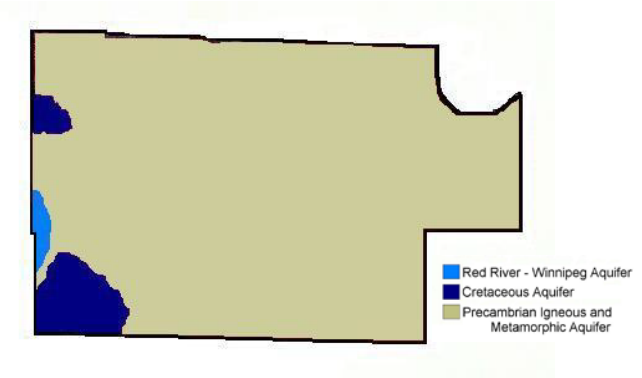


Buried Drift Aquifers

Water from buried drift aquifers are also found in Roseau County, which also provides good drinking water. It is also believed that these waters are also of good quality. Hardness may range from 300-1200 mg/L. Iron concentration may be high. Dominant water type is calcium magnesium bicarbonate. Where Cretaceous rock underlies buried aquifers, calcium magnesium bicarbonate sulfate and calcium magnesium chloride water types are present.

Bedrock Aquifers

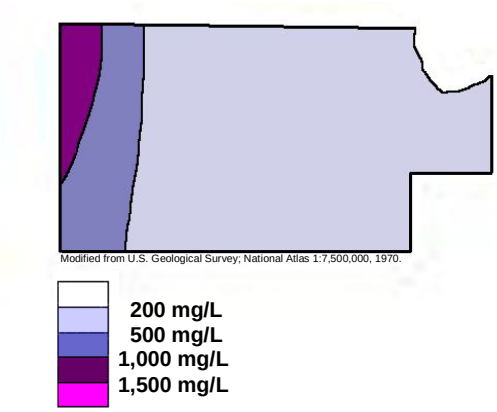
Other aquifers in Roseau County include Cretaceous and Red River-Winnipeg aquifers, which are sedimentary bedrock aquifers, and a crystalline bedrock aquifer. Cretaceous and Red River-Winnipeg aquifers are found in small areas on the west side of the county.



Bedrock Aquifers

The Cretaceous aquifer is usually only used when drift aquifers are not present, but may be used for rural domestic and livestock supplies. Water is commonly hard with high sulfate, chloride and dissolved solids concentrations. The Red River–Winnipeg aquifer is highly mineralized with dissolved solids concentrations ranging from 3000 – 60,000 mg/L. Large iron, sodium and chloride concentrations are also present. This water is seldom used. Crystalline bedrock aquifers (Precambrian) underlie the unconsolidated and sedimentary materials in Roseau County.

Dissolved-Solids Concentration in Water from the Crystalline-Rock Aquifer



This bedrock is composed of igneous and metamorphic rocks. Cretaceous aquifers may contribute mineralized water to the crystalline aquifer in the western most part of the county. Crystalline bedrock aquifers consist of granite, greenstone and slate rocks where water collects in fractures, faults and weatherized zones. Dissolved solids concentrations are generally less than 300 mg/L. The common water type is calcium magnesium bicarbonate. Yields may be limited, but may supply water to rural domestic and livestock wells. This aquifer is not considered an aquifer for most of the state of Minnesota.

Groundwater Recharge

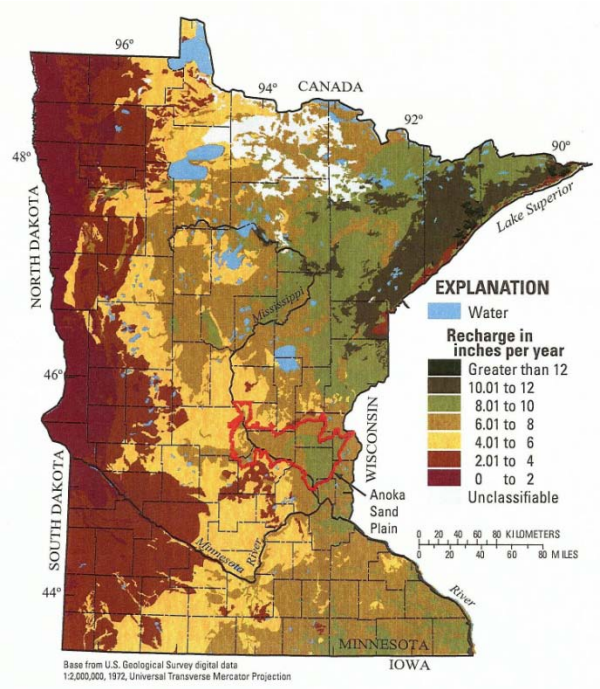


Figure Average annual recharge rate to surficial materials in Minnesota (1971–2000) estimated on the basis on the regional regression recharge method (modified from Lorenz and Delin, 2007).

Groundwater recharge estimates for Roseau County ranges from 0 - 2 inches in the west to 4 - 6 inches in the east (see left map).

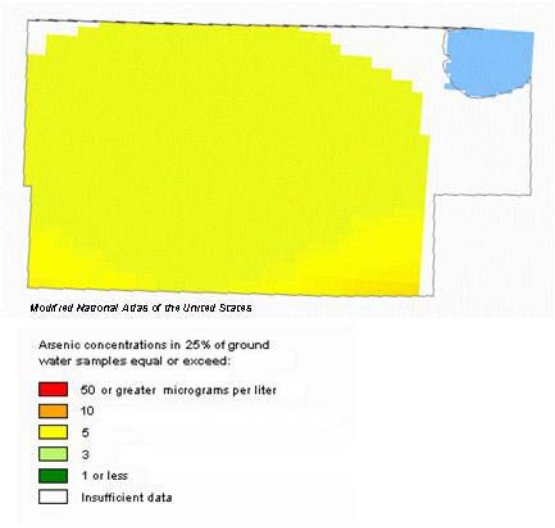
According the USGS, most of Minnesota's groundwater is replenished during the spring and fall when precipitation/snowmelt is prevalent and plant transpiration is lower (USGS, 2007). Most of the precipitation that falls on Minnesota is returned to the atmosphere through evaporation and transpiration with only a fraction ending up in groundwater systems. Recharge rates vary across Minnesota in response to differences in soils, land cover and use, landscape, confining layers, precipitation rate, snowmelt rate, evaporation and transpiration. After groundwater is recharged, much of the water flows through groundwater systems and empties into wetlands, streams and lakes. The rest of the recharged groundwater may flow to deeper confined aquifers, may be taken up by plants, or may be withdrawn through wells for many purposes.

Groundwater recharge is not equivalent to infiltration of water at the land surface, not equated to the process of percolation, to be confused with aquifer yield, or the same as sustainable yield (January 2007. Ground-Water Recharge in Minnesota. Fact Sheet 2007-3002, US Dept of the Interior and US Geological Survey).

Groundwater Studies

The groundwater systems in Roseau County are not well understood and there have been no extensive groundwater studies done to date except for a Baseline Study and a Salol Landfill Analysis by the MPCA and routine private drinking well tests for nitrate and bacteria. The Minnesota DNR, USGS, and Minnesota Department of Agriculture have no observation wells located in Roseau County.) The MPCA has conducted a Baseline Study of Groundwater in of 15 wells located throughout Roseau County (see appendix F for the results of this study). Most wells were private drinking water wells. Analyses that were published to maps include beryllium, boron, calcium, chloride, iron, manganese, nitrate, sodium, sulfate, total dissolved solids, total organic carbon and volatile organic compounds. The arsenic study used 32 wells to test groundwater. The Salol landfill wells were analyzed for many different chemicals. This analysis is useful for localized information, but is not comprehensive to what is going on in the rest of the county. No known pesticide studies have been done regarding Roseau County's groundwater.

A report regarding the MPCA baseline groundwater study was published (Baseline Water Quality of Minnesota's Principal Aquifers - Northwest Region, 1999). Water quality was observed from a water chemistry standpoint rather than consumption. Water was sampled from surficial aquifers (two each for unconfined and water table) and eleven buried aquifers in Roseau County. (No well water samples were taken from the Cretaceous aquifer located in Roseau County.) Results were combined with 18 other counties in the northwest region.



The conclusion of this study was that arsenic was the primary chemical of concern for buried drift aquifers. Other chemicals that were thought to be a concern were iron, sodium, and where buried drift aquifers are underlain by Cretaceous bedrock, chloride, boron, sulfate, and sodium. In Cretaceous aquifers, chemicals of concern are boron, sulfate, sodium, molybdenum, fluoride, and iron. Health-based drinking standards were exceeded for manganese, nitrate, selenium, arsenic, barium, boron, and molybdenum and for the non-health based standards, iron, aluminum chloride, fluoride sodium and sulfate. Volatile organic compounds were found in a low percentage of wells (4.9%). (One of these wells is located in eastern Roseau County.)

For information on groundwater appropriation, source water assessment, groundwater provinces, open dump and landfill inventory sites, registered underground storage tank list, underground storage tank leak list, and a list of hazardous waste generators, see Appendix E.

Roseau SWCD Ground Water Data

The Roseau SWCD has used nitrate equipment to test groundwater in the past. Between 2002 and 2005, ninety nine well water samples, twelve water brands, and one city water sample were tested for nitrates using the Minnesota Department of Agriculture nitrate testing equipment. Thirty-two samples tested positive to presence of nitrate. Twenty nine out of the thirty two samples were below 10 ppm (parts per million) and 86% of those were 1 or less than 1 ppm. Three samples were greater than 10 ppm and had the results of 11, 17, and 24 ppm. The

highest sample was taken from an older farm near a mobile home park. The State of Minnesota established that nitrate levels be less than 10 ppm for drinking water purposes.

The various brands of brand drinking water tested for nitrate included Dasani®, Kandiyohi® (5 gallon distilled water), Aquafina®, Crystal Glen®, & Culligan® – 0 ppm, Roseau City Water – 0.2 ppm, Ice Mountain® – 0.6 ppm, Evian® Natural Spring Water – 0.7 ppm, Chippewa Spring Water Sport® – 3.2 ppm, Klarbrunn® – 4.1 ppm, Henry's Natural Spring Water® – 4.2 ppm, Holiday Pantry® Natural Spring Water– 4.3 ppm, and Kandiyohi® Purified Water – 4.7 ppm. All were below the State standard of 10 ppm, but 61.5% did have nitrate present.

Well Survey 2000 (Certified Lab)
wells – 41
Coliform Bacteria– 6 positive
E coli – 1 positive
Nitrate – 2 greater than 10 ppm; 2 less than 10 ppm, rest below detection limit
Lead – 6 positives; ranges 1.4 – 13.6 ppb; 1 greater than 5 ppb; 1 greater than 10 ppb, rest below detection limit

Well Survey 2001(Certified Lab)
wells – 16
E coli – 1 positive
Coliform Bacteria – 5 positives
Nitrate Nitrite Nitrogen – 3 less than 10 ppm, rest below detection limit
Lead – 6 positives; ranges from 1.1 to 6.5 ppb, rest below detection limit

Year 2002 (Certified Lab)
wells – 1
E coli – negative
Coliform Bacteria – negative
Nitrate Nitrogen – below detection limit

Well Survey 2005 (Certified Lab)
wells – 87
E coli – 1 positive
Coliform Bacteria – 11 positive
Nitrate – 10 less than 10 ppm, rest below detection limit

Future Project If Funding Was Available

- Establish a 50% cost-share program for septic systems (mounds and regular)

Goals and Objectives

Priority Concern 1: Erosion & Sedimentation of Surface Waters, Stormwater Runoff and Wetlands

Objective A: Enhance and improve the quality of surface waters and wetlands through conservation practices, restoration, and structures

1. **Encourage the use of best management / conservation practices in rural areas to reduce erosion**

    - Examples of land use practices include having a cover on highly erodible land, planting windbreaks, planting buffers and riparian strips adjacent to waterways, not farming to edge of ditch or in the ditch, residue management on fields (not just the erosion prone ones), erosion and sedimentation management on new developments and road construction, planting cover strips on tilled fields in the fall, grade stabilization structures in gully forming areas, and streambank stabilization on bank sloughs. These types of practices will maintain and enhance water quality and keep the soil where it is supposed to be. All watersheds priority.

2. **Promote and support Warroad River restoration**

    - The Warroad River in sections 29 and 30 needs to be dredged and cleaned for navigability into Lake of the Woods.

3. **Promote and support the east stormwater control and sediment basin for City of Roseau**

    - The City of Roseau needs to construct a stormwater control and sediment basin for the east side of the city in order to manage stormwater runoff and collect sediment before the water is released into the Roseau River. Raingardens could also be implemented in reducing stormwater runoff and aid in recharging groundwater.

Priority Concern 2: Flood Control and Flood Damage Reduction

Objective A: Flood control and flood damage reduction practices to decrease flood impacts

1. **Participation in Project Work Teams (PWT) of Watershed Districts to support on-going flood reduction efforts and identify natural resource enhancement opportunities**

    - Each Watershed District has a Project Work Team that is active in the District to help with projects that are related to goals of the District. RRWD current projects include the Malung Impoundment, Roseau Lake Bottom, Palmville, Roseau WMA, Hay Creek – Norland, and ring dike program. TRWD current projects in Roseau County are Ross 7 and Big Swamp.

    - Support sensible, potential projects in Beltrami Island State Forest that provide flood damage reduction and natural resource enhancement.

2. **Support for beaver and beaver dam removal as mentioned in the sub-watershed sections of the Watersheds' Overall Plans**

    - Sub-watersheds of RRWD with mentioned beaver problems – South Branch, North Branch, Stafford, Big Swamp; Sub-watersheds of TRWD within Roseau County with mentioned beaver problems – SD 90, Middle Branch, Badger and Skunk Creek

Diversion, SD 95, SD 91; Areas within WRWD with mentioned beaver problems – Moranville Twp (eight sections), CD 10 and laterals, Bulldog Run starting at Rd 136, District-wide.

3. **Promote and support stormwater control for City of Warroad**

- The City of Warroad needs stormwater control to manage stormwater runoff that overwhelms stormwater drains within the city and causes street flooding. Possible solutions per WRWD Overall Plan (2007) include a stormwater project, maintaining waterways & ditches, new drainage systems, and culvert size review/resizing. Raingardens have been shown to be effective in ground water recharge and stormwater runoff control for homes and businesses.

4. **Support the update of the Floodplain Management Ordinance – pending due to DNR, FEMA restudy**

Objective B: Water flow gauge and structure upgrade with additional analytical parameters for data analysis

1. **Acquire additional water flow gauges, some with additional parameters to gather more data**

- The RRWD would like to get more river information than the currently water flow gauge measures for projects and to assess the state of the waters on a daily basis. Emergency Services would like additional flow monitoring gauges (Wannaska, and near Hayes Lake State Forest). TRWD would like to expand their gauge sites and improve gauges.

Priority Concern 3: Surface Water Protection and Improvement

Objective A: Protect, improve and monitor the quality of surface waters

1. **Continue surface water quality monitoring efforts for baseline study and later for TMDL studies**

- Water quality monitoring and analysis will continue on the Roseau River, Warroad River, Sprague Creek, Pine Creek and Willow Creek. Highest priority is given to the impaired reaches on the Roseau River and Sprague Creek in the Roseau River Watershed. TRWD currently monitors waters of the Two Rivers watershed in the western part of the county.

2. **Continue to support the rainfall monitoring network**

- Currently 37 people and agencies, located throughout the county participate in recording rain amounts that can be used for flood forecasts and crop disaster programs. All watersheds are priority.

3. **Test surface waters for ag chemical(s)**
4. **Partner and work on TMDL Plan(s) and Implementation for impaired waters**

- Partner with the Kittson County, TRWD, Kittson SWCD, RRWMB and MPCA to work on and implement TMDL plans for fish IBI on Two Rivers South Branch located in southwestern Roseau County and flowing into Kittson County. Partner with the Roseau County, RRWD, MPCA, and RRWMB to work on and implement TMDL plan for DO and turbidity on the Roseau River from Hay Creek to the Canadian border. Partner with LoW County, LoW SWCD, WRWD, MPCA to work on and implement TMDL plans for excess nutrients on Lake of the Woods of which some surface waters of Roseau County empty into; and Willow Creek (when officially listed as impaired). Roseau Lake Bottom

restoration is a Roseau River Watershed District potential project any may be a future Priority Concern.

5. **Protection of quality habitat in aquatic and adjacent riparian areas along streams**
6. **Promote nutrient / manure management plans**
    - NRCS writes nutrient and pest management plans for producers in EQIP
    - SWCD/NRCS can design nutrient management systems and Best Management Practices for livestock producers regarding water quality
7. **Promote ag chemical education and their impacts**
    - The SWCD as the Ag Inspector for Roseau County provides certified testing for chemical applicators in multiple categories
8. **Promote soil and water stewardship/education**
    - Provide support for students environmental activities such as the Envirothon, River Watch and Conservation Camp
    - Provide support for area churches during stewardship week
    - Educate through newsletters and fairbooth

Priority Concern 4: Managing Existing Ditch Systems

Objective A: Proper care and maintenance of existing ditch systems

1. **Continue the ditch system inventory**
2. **Continue routine ditch maintenance as funded with proper side slopes and sediment structures & matting**
3. **Partner with the DNR for rock structures that are adequate and effective**
4. **Partner with watershed districts, Highway Department and Minnesota Conservation Corps for culvert inventory/study**
    - High priority for all watersheds, except Two Rivers because their inventory has been completed
5. **Digitization of ditch records for information access**
6. **Implement new technologies in ditch systems and maintenance as they come available**

Priority Concern 5: Groundwater Protection and Quality

Objective A: Groundwater protection

1. **Offer Ag BMP low interest loans for replacing failing septic systems**
2. **Offer cost-share for well sealing for wells not covered by State Cost Share Program**
3. **Promote waste water treatment systems solutions in cluster developments**
4. **Promote educational material for groundwater supply, drinking water, septic systems and abandoned wells**
5. **Participate on wellhead protection teams as requested for cities wanting wellhead protection plans**
6. **Assist Cities with wellhead protection plan implementation as opportunities arise**

Objective B: Groundwater quality analysis

1. **Continue to have well water test kits on hand**
2. **Establish monitoring wells for routine water quality testing**
3. **Offer well water testing for critical areas such as sand ridges (nitrate, coliform bacteria, arsenic)**
4. **Begin a groundwater quality study for nitrates, coliform bacteria and arsenic**
5. **Begin a groundwater quality study for atrazine**
6. **Provide a well water testing clinic for nitrate and coliform bacteria every 2 years for 100 people**

Objective C: Update and implementation of ordinances that protect groundwater

1. **Update the county-wide SSTS ordinance beginning in 2010**
2. **Update of Solid Waste Management ordinance beginning in 2012**
3. **Update of Shoreland ordinance beginning in 2011**

Implementation Schedule for Priority Concerns

Priority 1

Objective A: Enhance and improve the quality of surface waters and wetlands through conservation practices, restoration, and structures

			Cooperators	WP Cost	Potential funding sources	Duration	Watershed	Groundwater systems
Actions	**1**	Encourage the use of best management / conservation practices in rural areas to reduce erosion	SWCD, NRCS, Hwy Dept, WD's	0	Grants, EQIP, Federal, County	continuous	All	NA
	2	Promote and support Warroad River restoration	ACOE, NRCS, DNR, WD, Hwy Dept, SWCD	Staff time?	Grants, Federal, State, Local	1-2 months?	All	NA
	3	Promote and support the east stormwater control and sediment basin for City of Roseau	City of Roseau, DNR, MPCA, ACOE, SWCD	0	Grants, Federal, State, Local	1-2 years	RR	NA

Priority 2

Objective A: Flood control and flood damage reduction practices to decrease flood impacts

			Cooperators	WP Cost	Potential funding sources	Duration	Watershed	Groundwater systems
Actions	**1**	Participation in Project Work Teams (PWT) of Watershed Districts to support on-going flood reduction efforts and identify natural resource enhancement opportunities	All agencies and interested groups	$200/yr	Local	continuous	RR, TR	NA
	2	Support for beaver and beaver dam removal as mentioned in the sub-watershed sections of the Watershed Districts' Overall Plans	WDs, County, SWCD	Staff time	State, Grants, WD, County	1x every 8-10 yrs	RR, TR, WR	NA
	3	Promote and support stormwater control for City of Warroad	City of Warroad, Twp, WRWD, Hwy Dept, SWCD	Staff time	WD, County, Grant	continuous	WR	NA
	4	Update the Floodplain Management Ordinance – pending due to DNR, FEMA restudy	County, Environmental Office	0	County, Grant	pending	All	NA

Objective B: Water flow gauge and structure upgrade with additional analytical parameters for data analysis

Actions	**1**	Acquire additional water flow gauges, some with additional parameters to gather more data	RRWD, TRWD, Emergency Mgmt, USGS, SWCD	?	Federal, State, Grants	continuous / short time	RR, TR	NA

Priority 3

Objective A: Protect, improve and monitor the quality of surface waters

			Cooperators	WP Cost	Potential funding sources	Duration	Watershed	Groundwater systems
Actions	**1**	Continue surface water quality monitoring efforts for baseline study and later for TMDL studies	SWCD	$3500-4500/yr	State, WD, Grant	About 4 more years/ ? for TMDL studies	RR, LoW, WR	N/A
	2	Continue to support the rainfall monitoring network	SWCD, NRCS	$200/yr	Local, Grant, DNR	continuous	All	N/A
	3	Test surface waters for ag chemical(s)	SWCD	$600-$2500	State, Grant, WD	2 mo/yr	RR, LoW, TR,WR	N/A
	4	Partner and work on TMDL Plan(s) and Implementation for impaired waters	County, WD's, MPCA, SWCD	unknown	County, WD, MPCA, State, Grant	3 yrs per project?	TR, RR, WR, LoW	N/A
	5	Protection of quality habitat for aquatic and adjacent riparian areas along streams	County, WD's, DNR, SWCD	Staff time	DNR, Grant, State	continuous	TR, RR, WR, LoW	N/A
	6	Promote nutrient / manure management plans / design nutrient management systems and Best Management Practices for water quality	MPCA, MDA, NRCS, SWCD	Staff time	NRCS	0	All	N/A
	7	Promote ag chemical education and their impacts	SWCD, County	Staff time	County, Grant	continuous	All	N/A
	8	Promote soil and water stewardship/education	SWCD, WD, RRWMB	$1350/yr	Grant, County, WD's, SWCD, RRWMB, NRCS	continuous	All	N/A

Priority 4

Objective A: Proper care and maintenance of existing ditch systems

			Cooperators	WP Cost	Potential funding sources	Duration	Watershed	Groundwater systems
Actions	**1**	Continue the ditch system inventory	County, Hwy Dept, WD's	0	County, Grant, State	>10 years	All	N/A
	2	Continue routine ditch maintenance as funded with proper side slopes and sediment structures & matting	Hwy Dept, WD's	0	County, Grant, State	>10 years	All	N/A
	3	Partner with the DNR for rock structures that are adequate and effective	Hwy Dept, DNR	0	County, State, DNR	>10 years	All	N/A
	4	Partner with watershed districts, Minnesota Conservation Corps and Hwy Dept for culvert inventory/study	WD, MCC, Hwy Dept, County, SWCD	0 or ?	County, State, WD, Grant	1 month WRW/LoWW, 5 months RRW ?	All, except TR	N/A
	5	Digitization of ditch records for information access	Hwy Dept, WD's, County	0	County, Grant, State	>10 years	All	N/A
	6	Implement new technologies in ditch systems and maintenance as they come available	Hwy Dept, WD's, MDA, MPCA	0	County, State	>10 years	All	N/A

Priority 5								
Objective A: Groundwater protection								
			Cooperators	**WP Cost**	**Potential funding sources**	**Duration**	**Watershed**	**Groundwater systems**
Actions	**1**	Offer Ag BMP low interest loans for replacing failing septic systems	SWCD, Banks, Farm Credit Services	0	Multi-lender, State	1x every 2-3 yrs	All	All
	2	Offer cost-share for well sealing for wells not covered by State Cost Share Program	SWCD	$1000/yr	State Grant	continuous	All	All
	3	Promote waste water treatment systems solutions in cluster developments	County, Watersheds, Townships, Environmental Office, SWCD, MPCA	Staff time	State, Federal, County, Staff time	continuous	All	All
	4	Promote educational material for groundwater supply, drinking water, septic systems and abandoned wells	SWCD, MDA, MDH MPCA,	Staff time	Grants, Staff time	2007-2010	All	All
	5	Participate on wellhead protection teams as requested for cities wanting wellhead protection plans	SWCD, MDH, Cities	Staff time	Local, Staff time	As needed	RR, TR, WR	All
	6	Assist Cities with wellhead protection plan implementation as opportunities arise	SWCD, MDH, Cities	Staff time	Local, Staff time	As needed	RR, TR, WR	All
Objective B: Groundwater quality analysis								
Actions	**1**	Continue to have well water test kits on hand	SWCD, MDH	0	Grants, Local, Staff time	12 mo/year	All	All
	2	Establish monitoring wells for routine water quality testing	SWCD, MDH, DNR, MPCA	?	Grants, Local, Staff time	6 mo/yr	All	All
	3	Offer well water testing for critical areas such as sand ridges (nitrate, coliform bacteria, arsenic)	SWCD, MDH, MDA	$10,450 + shipping	Grant, Local, Staff time	1week/year for 4yrs for about 180 people	All	All
	4	Begin a groundwater quality study for nitrates, coliform bacteria and arsenic	SWCD, MDH, MDA	$1375 plus shipping	Grant, Local, Staff time	25/yr	All	All
	5	Begin a groundwater quality study for atrazine	SWCD, MDH, MDA	$350-$1500	Grant, Local, Staff time	25/yr	All	All
	6	Provide a well water testing clinic for nitrate and coliform bacteria every 2 years for 100 people	SWCD, MDA	$150	Grant, Local, Staff time	Every 2-3 yrs	All	All
Objective C: Update and implementation of ordinances that protect groundwater								
Actions	**1**	Update SSTS ordinance beginning in 2010	County, MPCA, Environmental Office	0	County, MPCA, Grant	Continuous	All	All
	2	Update of Solid Waste Management ordinance beginning in 2012	County, MPCA, Environmental Office	0	County, MPCA, Grant	1-2 years	All	All
	3	Update of Shoreland ordinance beginning in 2011	County, DNR, Environmental Office	0	County, DNR, Grant	1-2 years	All	All

Implementation Schedule for Ongoing Programs

Implementation Plan – Ongoing Programs					
Programs	**Agency**	**Cost or as funded per year (as of year 2010)**	**Existing Funding Sources**	**Watershed**	**Groundwater Systems**
Ag BMP Loan Program	SWCD	$50,000 or Revolving (3-7 applications yr for tillage equipment @ $50,000 each	State, Staff time	All	All
CRP	FSA	Ongoing	Federal	All	All
County Ag Inspector	SWCD	$6,875 +Grant	County, State Grant	All	All
EQIP	NRCS	Ongoing	Federal	All	All
SSTS	Environmental Services	$9931 + county $ or as funded; Need for $30,000	State Grant, County	All	All
LWM	SWCD	$20,719 + county levy or as funded; will decrease 2011	Grants, Staff time	All	All
Shoreland Management	Environmental Services	$3,073 + county $ match or as funded	State Grant, County	WR / LoW	All
State Cost Share	SWCD	$17,716 or as funded; will decrease 2011	State Grant, Staff time	All	All
WCA	SWCD	$27,619 + match or as funded	State Grant, Staff time	All	All
CSP	FSA, NRCS, SWCD	Ongoing	Federal	All	All
CCRP	FSA, NRCS	Ongoing	Federal	All	All
Tree Program	SWCD	$32,000	District	All	All