OVERALL PLAN

Bois de Sioux Watershed District

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EXECUTIVE SUMMARY

The Bois de Sioux Watershed District (District) was established on May 11, 1988, by order of the Minnesota Board of Water and Soil Resources (BWSR) under the provisions of the Minnesota Statutes (MS), Chapter 103D, otherwise referred to as the Minnesota Watershed Act. The District is located in west central Minnesota and includes the entire drainage basin, in Minnesota, of the Bois de Sioux River. The counties included in this area are Traverse, Grant, Wilkin, Stevens, Big Stone and Otter Tail. Cities within the District are Breckenridge, Doran, Campbell, Wendell, Elbow Lake, Norcross, Herman, Donnelly, Graceville, Dumont, Johnson, Wheaton and Tintah. The total area is about 1,412 square miles of which 93 percent is used for agricultural production. The Bois de Sioux River and its source, Lake Traverse, form the boundary between Minnesota and South and North Dakota. The river flows north from Lake Traverse to Breckenridge where it joins with the Otter Tail River to form the Red River of the North. Major tributaries in Minnesota are the Mustinka River and the Rabbit River. Tributaries in North and South Dakota contribute drainage from an additional 549 square miles. The District is a governmental subdivision of the State of Minnesota with authority to comprehensively manage water resources. Minnesota Statutes requires the Watershed District Board of Managers to develop and periodically update a watershed management plan. In accordance with Minnesota Statutes, the District has revised its ten-year, comprehensive watershed plan (Overall Plan).

In developing the Overall Plan, the Board of Managers was assisted by an Advisory Committee. They held a series of public informational meetings throughout the District to gather input directly from residents and natural resource management agencies on specific watershed-wide and subwatershed problems. The meetings served to inform the public on the responsibilities and authorities of the Watershed District and to better acquaint the Board with the area and its residents. The District also followed the guidelines of the Red River Mediation process in addressing both flood damage reduction (FDR) and natural resources enhancement (NRE) opportunities in the development and implementation of watershed projects. The Board recognizes that the majority of damage reduction strategies can significantly improve natural systems if designed and constructed with environmental goals in mind.

This revised overall plan includes a general description of the District and its water resources. It outlines the problems known to exist in the District, potential solutions, and the policies the Board intends to follow. This plan is intended to be a guide for the Board and other local, state and federal agencies for implementing watershed projects and policies within the District. The plan is aimed at identifying problems on a subwatershed basis and developing solutions for implementation. Some of the problems identified include:

- Flooding of agricultural land;
- Flood damages to public and private property;
- Erosion and sedimentation;
- Water quality impairment;
- Loss of fish and wildlife habitat; and
- Limited recreational opportunities.

Some of the potential solutions and implementation items include:

- Impoundments, levees and drainage system modifications;
- Acquisition and relocation of structures;
- Wetland and watercourse restorations;
- Buffer and filter strips;
- Enhanced public education and outreach; and
- Watershed permitting programs.

The overall goal of the Board is to make the wisest possible use and conservation decisions for the District's water and other related resources. This revised overall plan is intended to be the guide for the accomplishment of this goal.

MISSION STATEMENT

To provide coordinated water resource management over the entire hydrologic basin of the Bois de Sioux River lying within the State of Minnesota.

ACKNOWLEDGEMENTS

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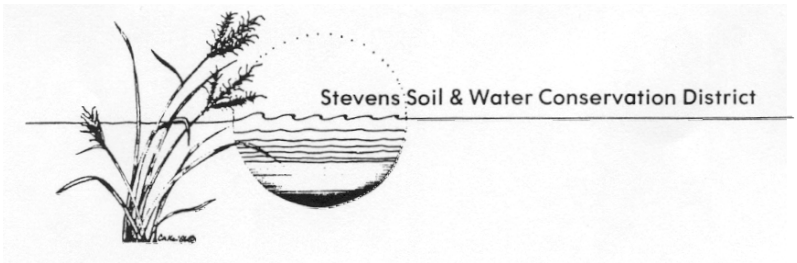

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El Dorado Township
Everglade Township
Grant County
North Ottawa Township
Stevens County
Traverse County Extension
Traverse County Sportsmen
Wilkin County

INTRODUCTION

The District was established on March 11, 1988 by order of the Minnesota BWSR under the provisions of MS, Chapter 103D, otherwise referred to as the Minnesota Watershed Act. The original mission of the District was: "To provide coordinated water resource management over the entire hydrologic basin of the Bois de Sioux River lying within the State of Minnesota." This mission has not changed in the current District plan.

While the District prepared its Overall Plan Revision, counties within the District had state approved and locally adopted comprehensive local water plans (CLWPs) in accordance with MS, Chapter 110B. The information in the CLWPs was in some way incorporated in the Overall Plan. The CLWPs would augment the District's efforts and will provide policy guidance and detailed information regarding the resource base. It was the District's intention to deal with issues addressed in the CLWPs as they pertain to the District's mission. This would, in turn, assist the individual counties in implementing their plans.

PURPOSE AND GENERAL OBJECTIVES

The District was established, and is operated, for the purposes outlined below:

I. To provide coordinated water resource management over the entire hydrologic basin of the Bois de Sioux River lying within the State of Minnesota.

II. For all the purposes provided for in MS 103D as they may apply now and in the future, as follows:

   A. Control or lessen damage by floodwaters.

   B. Improve stream channels for drainage, navigation, and any other public purpose.

   C. Reclaim or fill wet and overflowed lands.

   D. Provide water supply for irrigation.

   E. Regulate the flow of streams and conserve their waters.

   F. Divert or change watercourses in whole or in part.

   G. Provide and conserve water supply for domestic, industrial, recreational, agricultural, or other public use.

   H. Provide for sanitation and public health and regulate the use of streams, ditches, or watercourses for disposal of waste.

I. Repair, improve, relocate, modify, consolidate and abandon, in whole or in part, drainage systems within a watershed district.

J. Impose preventative or remedial measures to control or reduce land and soil erosion and siltation of watercourses or bodies of water affected by erosion.

K. Regulate improvements by riparian landowners of the beds, banks, and shores of lakes, streams, and marshes by permit or otherwise to preserve them for beneficial use.

L. Provide for the generation of hydroelectric power.

M. Protect or enhance the quality of water in watercourses or bodies of water.

N. Protect groundwater and regulate its use to preserve it for beneficial use.

The District has adopted rules and policies to the aforementioned purposes and has a successful history of implementing projects and completing permit reviews that have positively impacted drainage and flooding issues within the District. The current general plan will build on the success of the original plan and will move the District into projects that promote flood damage reduction and natural resource enhancement opportunities in cooperation with local, state and federal natural resource agencies.

A key to future success will hinge on the efforts of the District to follow the principles of the Red River Basin Mediation Agreement of 1998 (copy on file in the Bois de Sioux District Office) and to work within the guidelines of the Red River Flood Damage Reduction Work Group when developing projects. The purpose of the Mediation Agreement process was to reach agreements on long-term solutions for reducing flood damage and for protection and enhancement of natural resources. The focus of the agreements is to balance economic, environmental and social considerations when developing and pursuing flood damage reduction and natural resource enhancement projects. The District developed this overall plan by inviting all of the members of the Flood Damage Reduction Work Group to be “at the table” in an effort to follow the spirit and intent of the mediation process. Members included local, state and federal natural resource agencies; environmental organizations; and citizens. The actions and projects proposed in this overall plan reflect consensus of this diverse work group and the Board.

PART I. DESCRIPTION OF THE DISTRICT

LOCATION AND SIZE

The District is located in west central Minnesota and includes the entire drainage basin in Minnesota, of the Bois de Sioux River. The counties included in this area are Traverse, Grant, Wilkin, Stevens, Big Stone, and Otter Tail. The total watershed area is about 1,412 square miles. The Bois de Sioux River and its source, Lake Traverse, form the boundary between Minnesota and South and North Dakota. The river flows north from Lake Traverse to Breckenridge where it joins with the Otter Tail River to form the Red River of the North. The major tributaries in Minnesota are the Mustinka River and the Rabbit River. Tributaries in North and South Dakota contribute drainage from an additional 549 square miles. A map indicating the legal boundaries of the District is shown in Figure 1 – Political Boundaries Map.

GEOLOGY

The District's area is underlain by bedrock that was formed during the precambrian period of geologic time, approximately 3 billion years ago. These are igneous and metamorphic rocks, predominantly granite and gneiss. A map of bedrock elevational contours is shown in Figure 2 – Precambrian Bedrock Elevations Map. The depth below the surface to the bedrock varies from only 14 feet near Herman to 600 feet near the southwest corner of the District.

Overlying the bedrock, in most of the District, are sediments that were formed when oceans covered parts of the area, during the cretaceous period, about 100 million years ago. These sedimentary deposits include layers of soft shales, sandstones, and limestone. Their thickness varies from zero in the high bedrock areas around Herman to 280 feet in the southwest corner of the District. A map of cretaceous bedrock elevation contours is shown in Figure 3 – Cretaceous Bedrock Elevations Map.

The zone above the cretaceous sediments and up to the ground surface consists of glacially transported materials called glacial drifts that were deposited during the Great Ice Age, from 2,000,000 to 12,000 years ago. Major deposits, referred to as glacial moraines, were built up and remain at the terminal extent of the more recent glaciers. Glacial moraines form the upland regions in the eastern and southern parts of the District.

As the last glacier retreated, meltwater was trapped between the continental divide at the southwest corner of the District near Browns Valley and the ice mass to the north. A huge water body was formed which is referred to as Glacial Lake Agassiz. Wave action at the margins of the lake formed the beach ridges that remain as prominent features of the

FIGURE 1
POLITICAL BOUNDARIES MAP

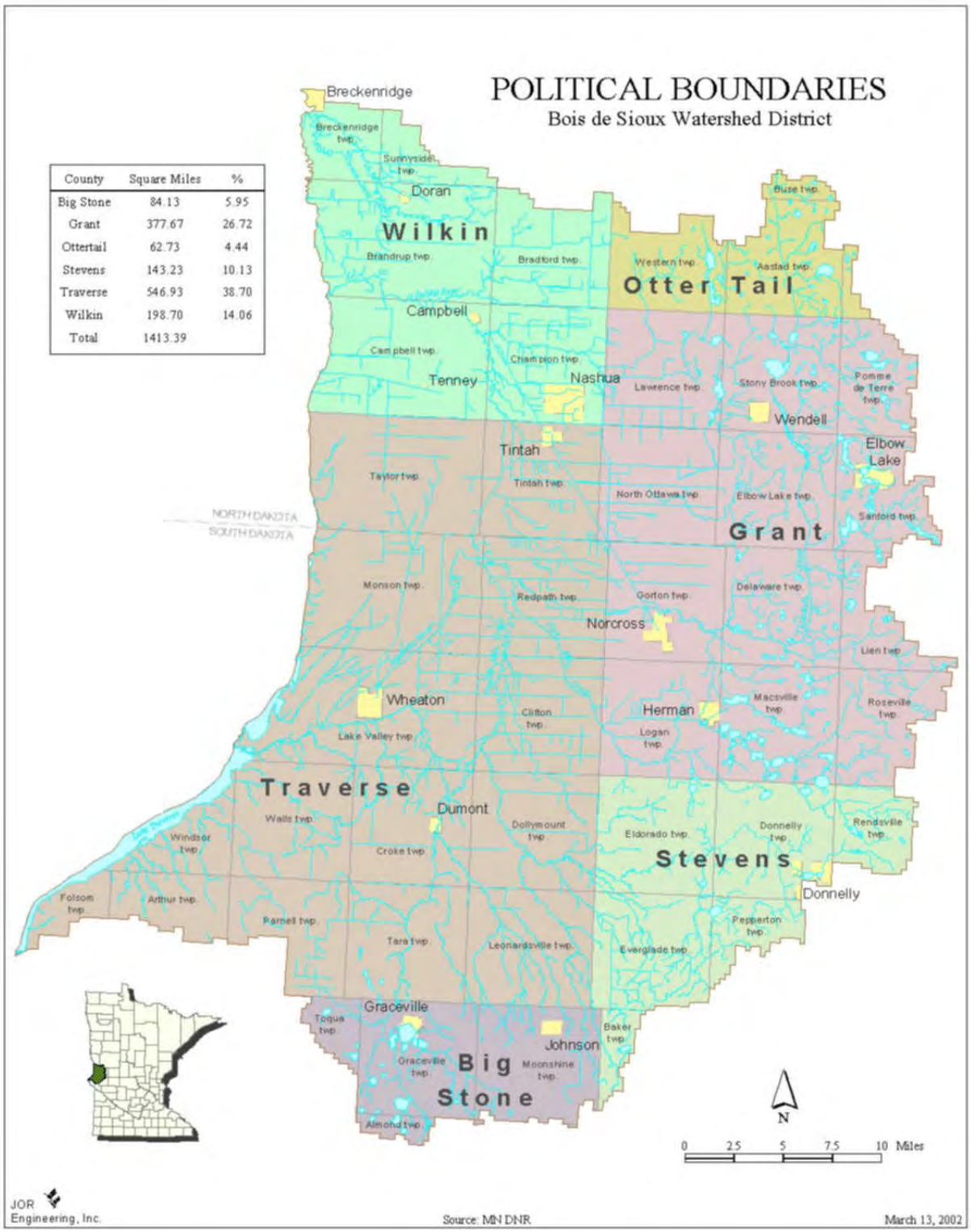


FIGURE 2
PRECAMBRIAN BEDROCK ELEVATIONS MAP

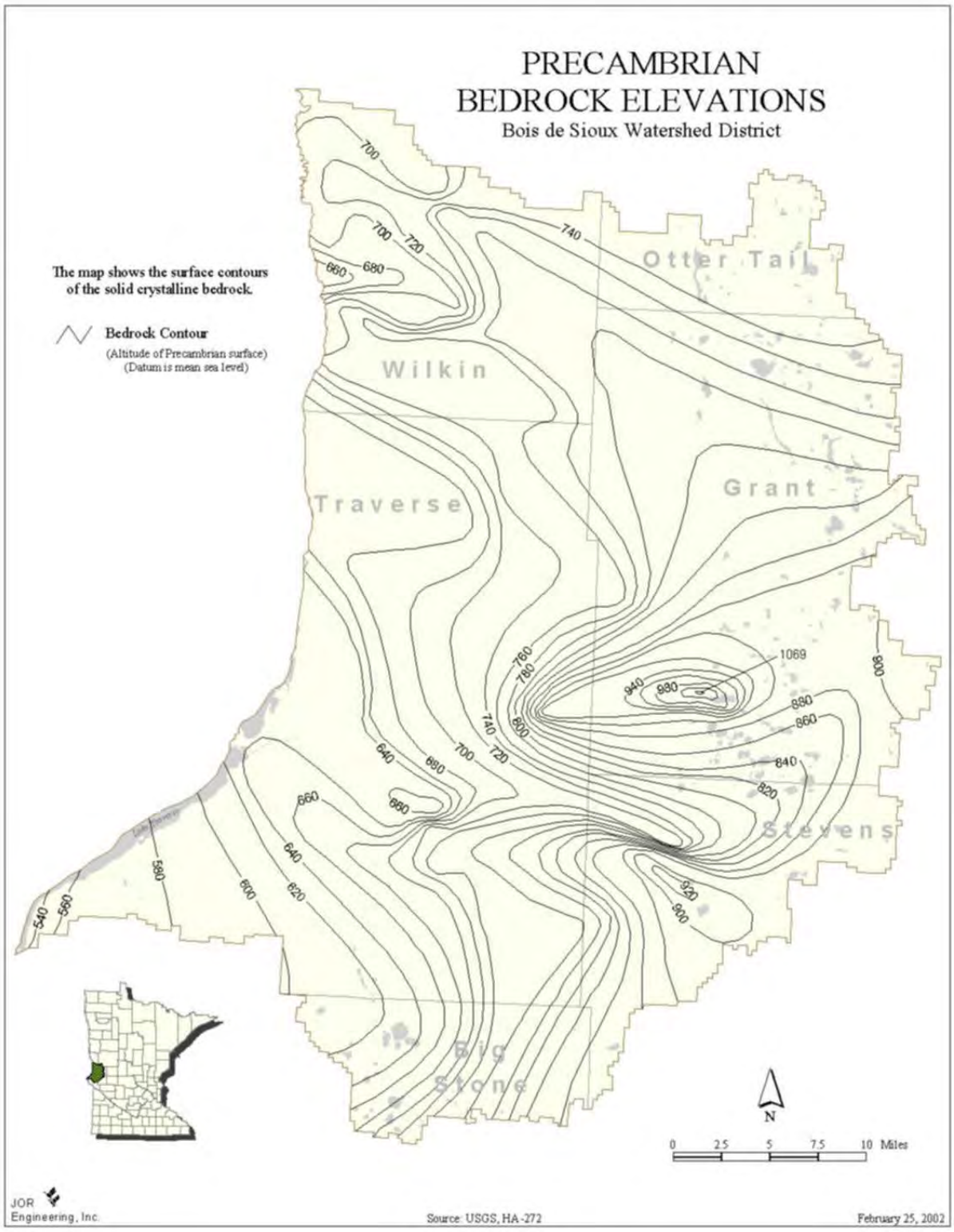
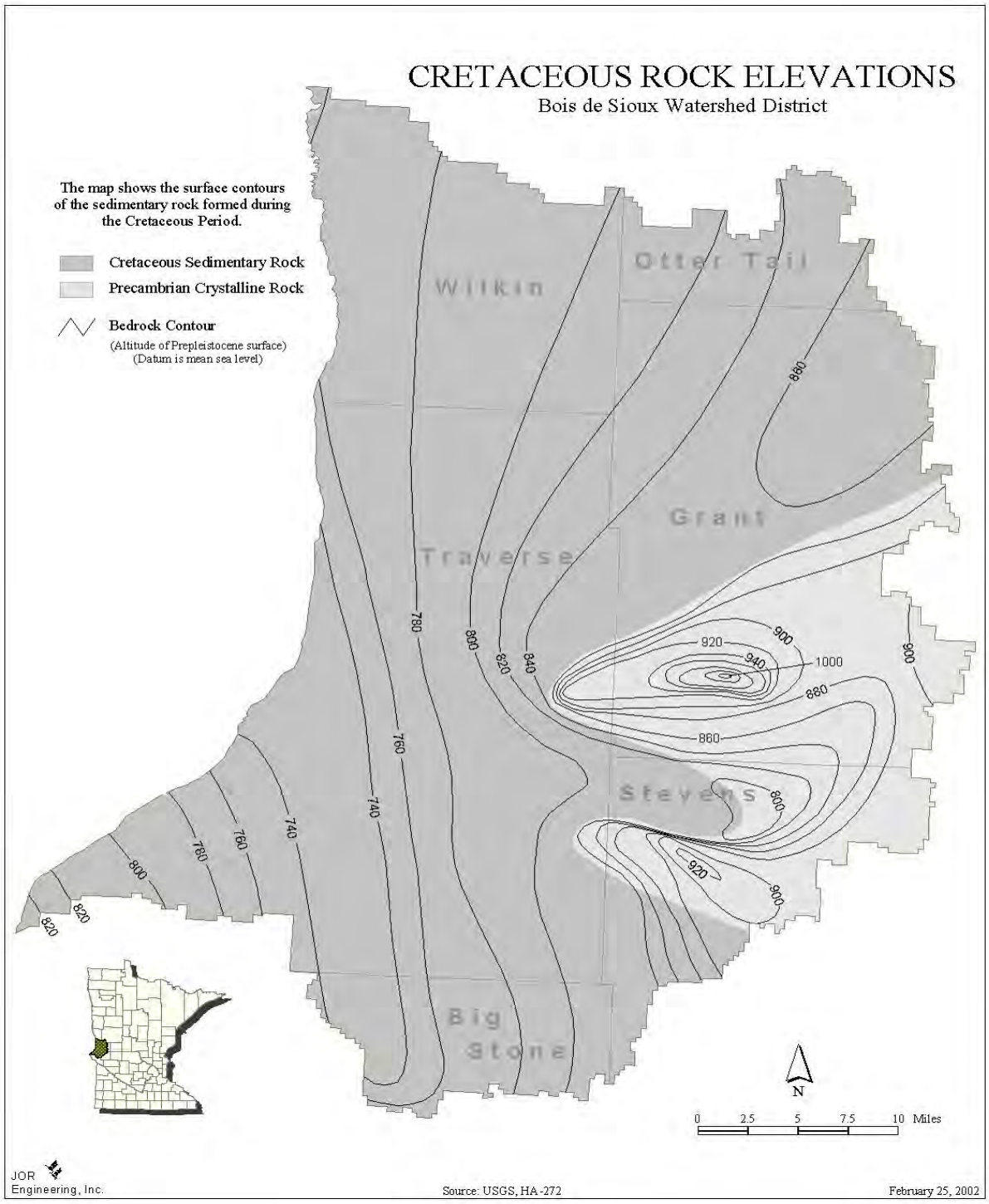


FIGURE 3
CRETACEOUS BEDROCK ELEVATIONS MAP



landscape. In the northwestern area of the District is the broad, flat, glacial lake plain which was the bed of the lake. The locations of the moraine and lake plain areas are shown on the map in Figure 4 – Major Landforms Map.

The thickness of the glacial deposits varies from 14 feet near Herman to 350 feet at Graceville. It is made up of a mix of materials, including clay, silt, sand, gravel, stones, and boulders. In some areas, the materials are very well mixed and are commonly referred to as glacial till. In other areas, they have been worked on and sorted by wind and water and redeposited as sediments of various gradations of particle size.

TOPOGRAPHY

The topography of the District varies from gently rolling with interspersed lakes and wetlands in the morainal areas to very flat and level in the lake plain areas. Land elevations range from 1280 feet above mean sea level northeast of Elbow Lake to 950 feet at Breckenridge. Land slopes of up to 20 percent are found in the morainal areas. In the lake plain, zero slope is not uncommon. A map of the general surface topography is shown in Figure 5 – Elevation Map.

SOILS

The soils of the District are all based in glacial materials. The soil texture differences depend on the sorting processes that wind and water have applied to the glacial deposits. The unsorted glacial till is a mixture of clay, silt, sand, gravel, and rock. The action of running water or waves on the till washed away the smaller particles in some areas, leaving behind the characteristic gravel pit deposits. The clay, silt and sand particles were transported by the water to more quiet areas within the streams or lake area. In general, the fine clay particles were carried farthest and deposited in the depths of the lake. The sands were the first to settle and form deposits in streambeds or near the edges of the lake where wave action further distributed them up and down the shoreline.

Topsoil development may include the addition of windborne deposits and organic remains that accumulate both above ground and within the root zone. Soils of the District have been extensively mapped by the U.S. Department of Agriculture primarily to encourage suitable landuse applications. Detailed soil surveys have been published covering each of the counties. These maps are detailed enough for landuse planning on a small acreage basis.

From a water management viewpoint, soil texture is probably the most important characteristic. Sandy soils have higher water infiltration rates but are more prone to drought and erosion than clay soils. Figure 6 – Soil Texture Map is a generalized soil landscape map of the District showing the soil texture.

FIGURE 4
MAJOR LANDFORMS MAP

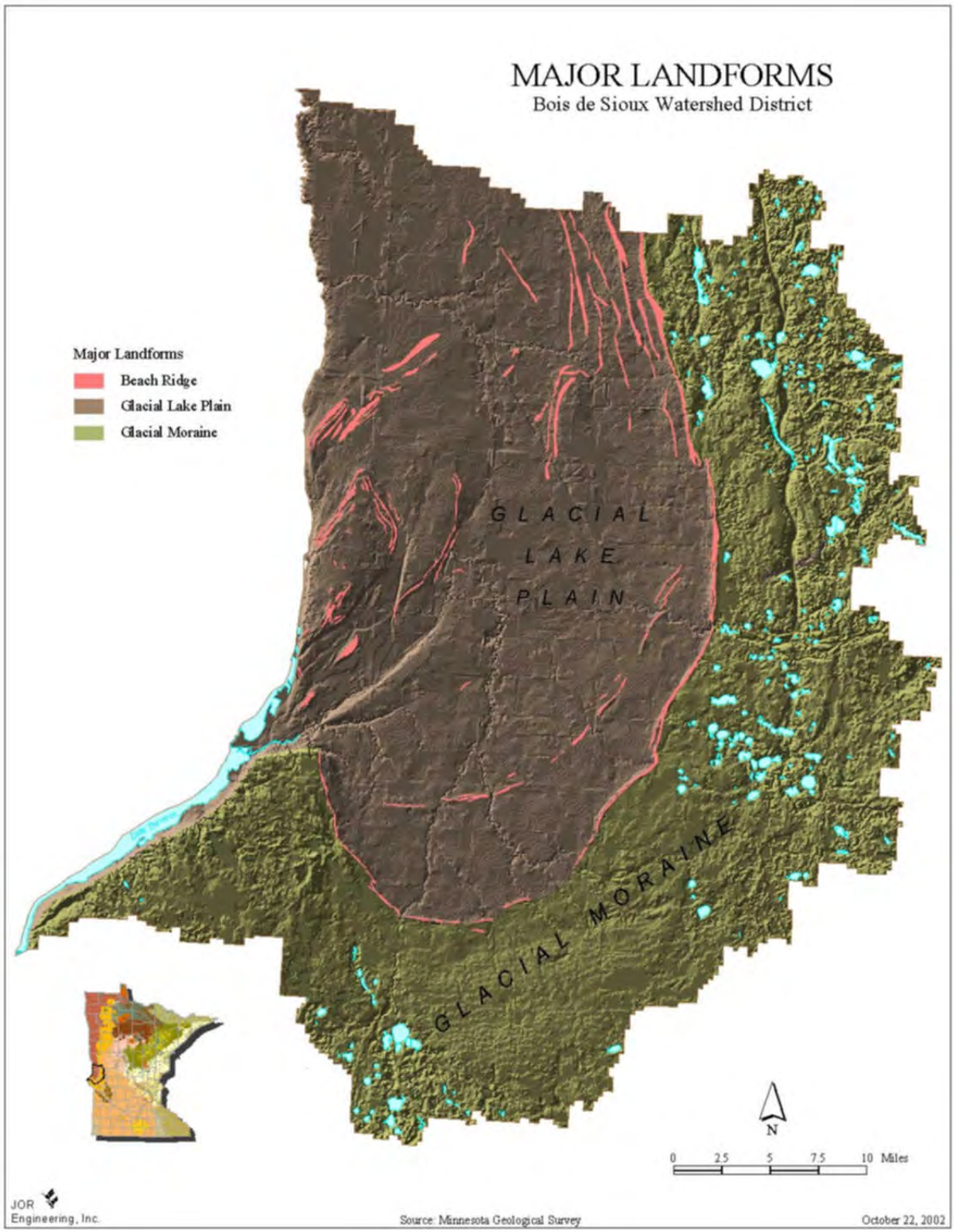


FIGURE 5
ELEVATION MAP

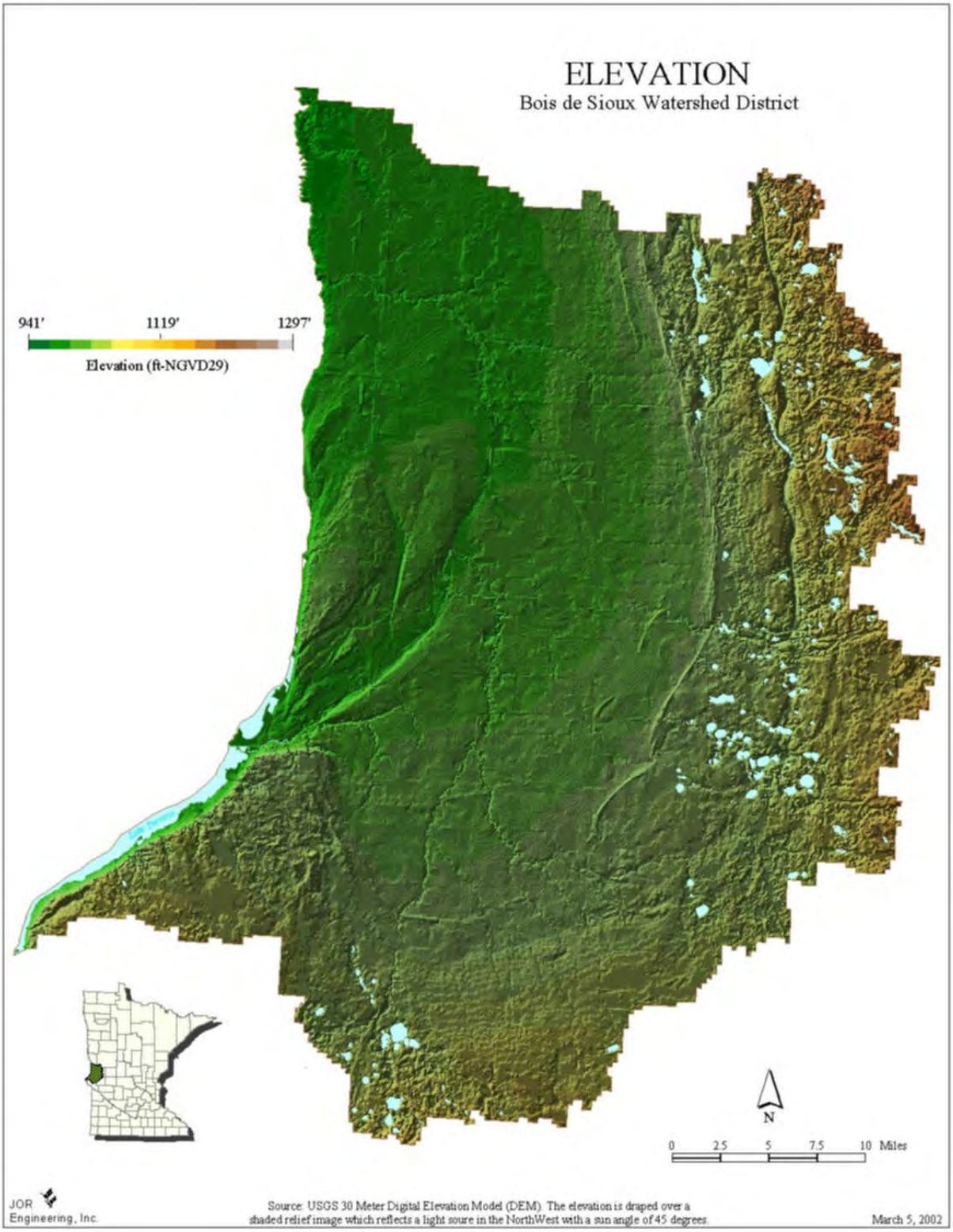
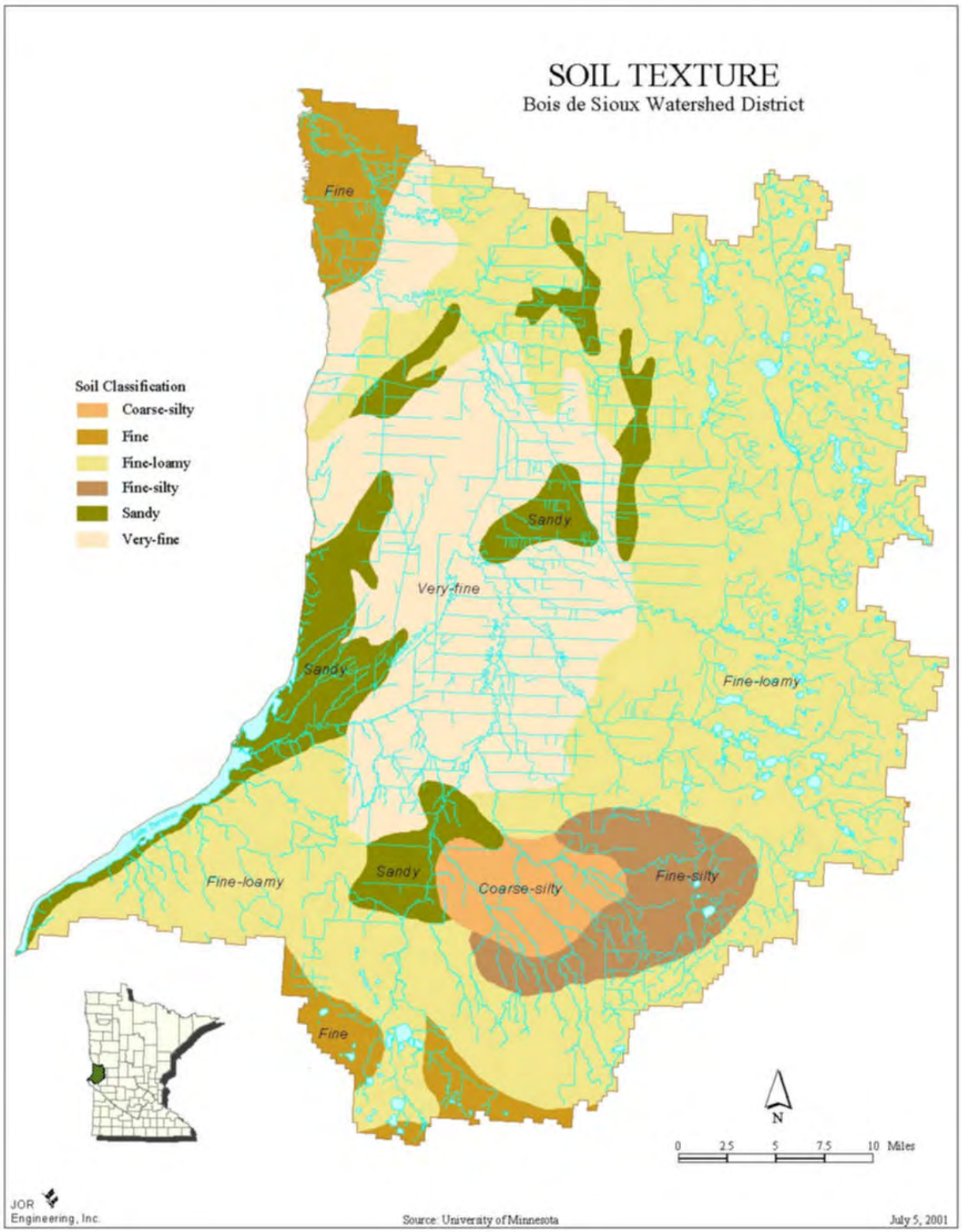


FIGURE 6
SOIL TEXTURE MAP



CLIMATE

The climate of the District is characterized by extreme temperature fluctuations and seasonal precipitation patterns. The average annual temperature is about 44 degrees Fahrenheit and the monthly average ranges from 9 degrees in January to 72 degrees in July. The lowest reported temperature was -45 degrees and the highest has been 114 degrees. The average dates of the last and first hard freeze are May 12 and September 23. The average depth of frost penetration is about 45 inches. The average annual precipitation is about 22.5 inches, ranging from 21 inches in the west to 24 inches in the east. The precipitation is greatest during the summer months with the highest normal monthly rainfall of about 4 inches occurring in June. The lowest normal monthly precipitation occurs in December and is about 0.5 inches. The average annual snowfall is about 40 inches. The average annual evapotranspiration potential in the District is about 27 inches. The average annual evaporation from shallow lakes is about 31 inches. The prevailing winds are from the northwest in the winter and the southeast in the summer and average about 10 miles per hour.

Climatic and hydrologic factors that affect design of water management facilities are primarily storm precipitation, snowmelt, and both normal and extreme runoff.

A 24-hour precipitation of 4.95 inches or more would be expected to occur, on the average, once every 50 years. The average annual runoff is only about 0.75 inches. Most of this occurs in the spring. The largest floods also are most likely to occur in the spring and are typically caused by a combination of rainfall and snowmelt. The 100-year 10-day spring runoff is estimated to be 5.5 inches.

POPULATION

According to information taken from the U.S. Census, the 1990 population of the District was about 17,000. According to more recent census information, the populations of Big Stone, Stevens, Traverse and Wilkin Counties dropped 5-7% from 1990 to 2000. The population of Grant County increased less than 1% and that of Otter Tail by 12% over this same period. However, Otter Tail County makes up a very small portion of the District, so it is likely that the population of the District decreased by approximately 5% from 1990 to 2000. Approximately 55 percent of the residents live on farms. The remaining citizens live in towns, the largest of which is Wheaton with a population of about 1,600. Agriculture and related businesses are the prime sources of income within the District.

LANDUSE

The land of the District is almost entirely devoted to agriculture. About 90% of the area is cropland with a small percentage of pasture, wetland areas (1.3%), and woodlands (1.8%). A variety of crops are produced in the area including corn, wheat, barley, soybeans, alfalfa, and

sugar beets. The long-range trends in agricultural landuse have been increased size of farms and fields and a reduction in livestock. A consequence of these trends has been a reduction in the suitability of landuse relative to landform. For example: Highly erodible, steeply sloping, flood prone, or wetland areas may be included in a field devoted to cropland in order to make farm equipment operations more convenient. Figure 7 – Landuse Map shows the existing landuses within the District.

FISH AND WILDLIFE

Fish and wildlife are important natural resources of the area. Fishing and hunting provide recreation for residents and are also significant to the local economy. Duck, goose, pheasant, Hungarian partridge, fox, and whitetail deer are commonly hunted species. Walleye, northern pike, panfish, bullhead, and roughfish species are fished, both for recreation and commercially.

The District lies along a major flyway for migratory birds. Species that migrate through the area include the bald eagle and peregrine falcon both of which are on the endangered species list. The burrowing owl, which is native to this area, has been put on the endangered species list. It has suffered due to the loss of natural prairie habitat. The U.S. Fish and Wildlife Service (USFWS), the Minnesota Department of Natural Resources (MNDNR), and the U.S. Army Corps of Engineers (USACE) are all involved in wildlife management within the District. Their efforts have been primarily aimed at waterfowl production, although this also tends to benefit upland game and non-game species. Their programs include land acquisition and easements. Private organizations are also involved.

WATER RESOURCES

SURFACE WATERS

Streams

The rivers and streams of the District derive their flow characteristics from their watersheds. In general, watersheds in the lake plain area produce brief periods of high runoff and long periods with little or no flow. Conversely, watersheds in the morainal areas may have their runoff peaks attenuated and flow periods extended by storage in natural lakes and depressional wetland areas. However, all streams in the District are subject to periods of no flow. Figure 8 - Hydrology shows the streams within the District.

The physical characteristics of the streams are also influenced by the regions through which they pass. In the morainal areas, they tend to have a steeper gradient and more developed channel capacity than in the lake plain areas. Floodplains in the morainal areas tend to be well defined whereas, in the lake plain, the floodplain areas are broad and poorly defined.

FIGURE 7
LANDUSE MAP

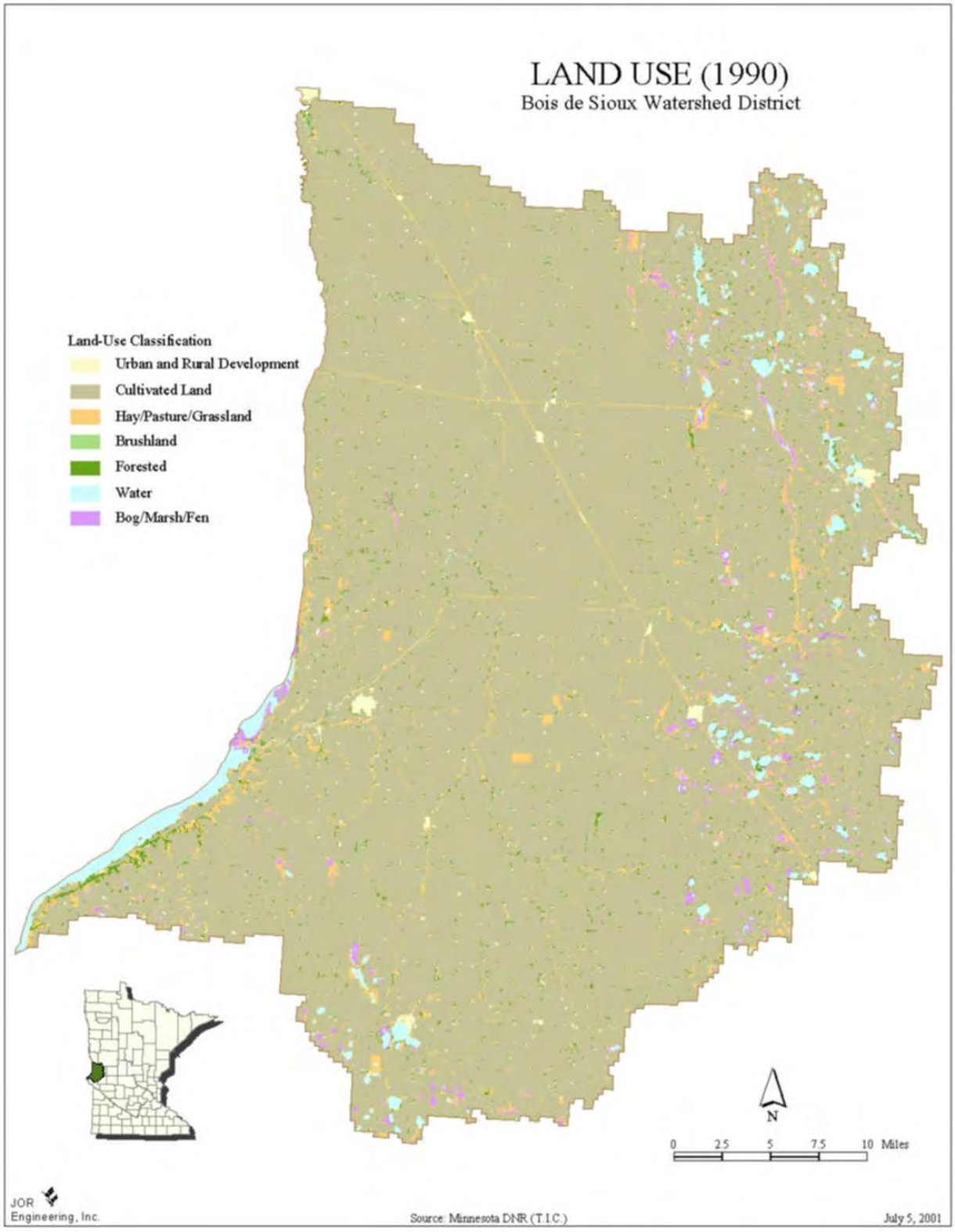
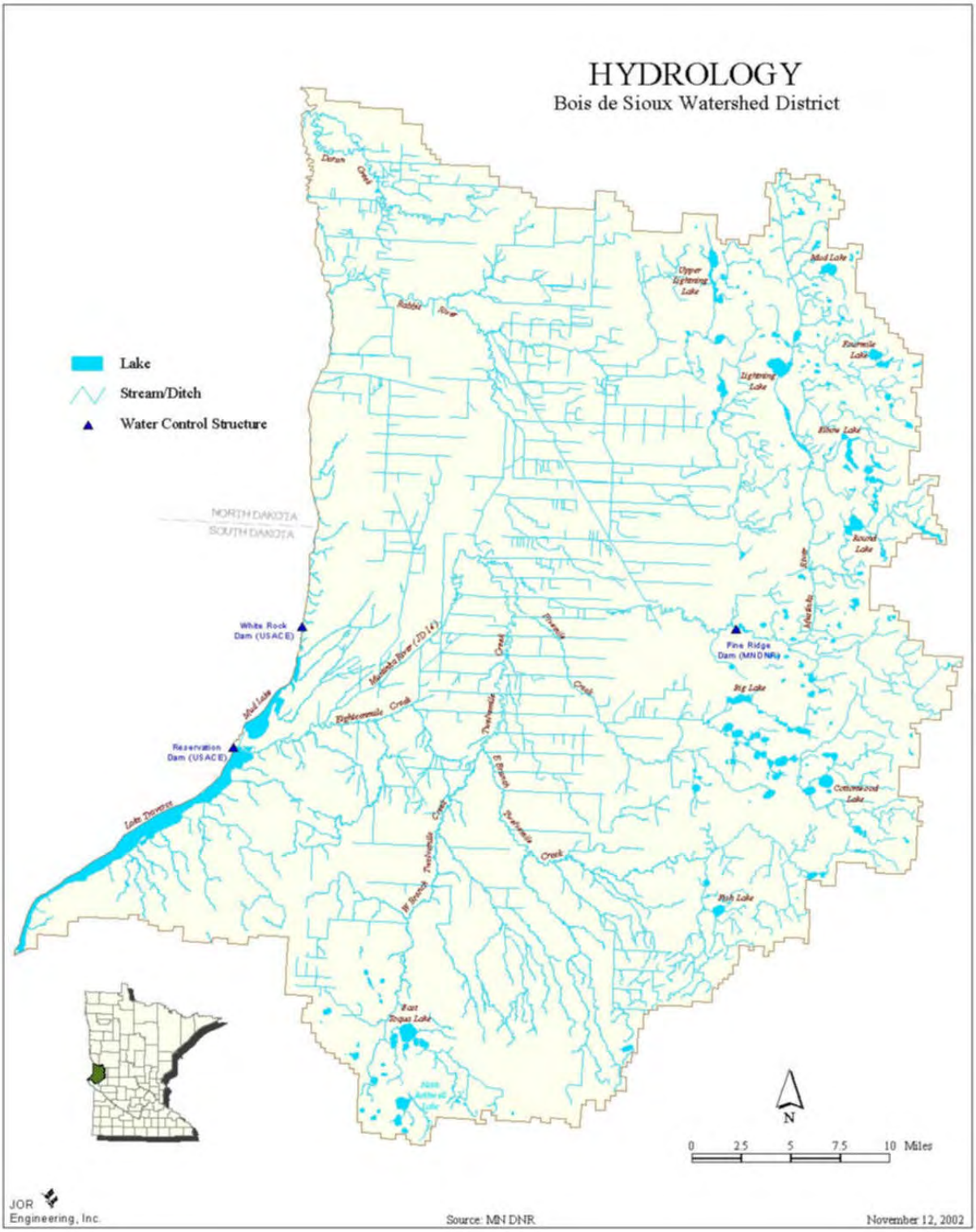


FIGURE 8
HYDROLOGY IN DISTRICT



Because the morainal areas are upstream, they are often blamed for extensive flooding of the lake plain. However, on a drainage area basis, the morainal streams typically produce less peak runoff. In either area, artificial surface drainage and landuse changes may cause dramatically increased runoff rates.

The major rivers of the District are the Bois de Sioux, Rabbit, and Mustinka. The Bois de Sioux River has a drainage area of 1160 square miles at its source and 1984 square miles at its outlet. The average gradient is about 0.6 feet per mile. The Mustinka River has a total drainage area of 860 square miles. Its gradient is only 0.5 feet per mile in the lower 15 miles. Over most of its remaining length, the slope is about 3 feet per mile. The Rabbit River has a total drainage area of 322 square miles. It has a gradient of 0.8 feet per mile in the lower 10 miles and averages 5.25 feet per mile through the upstream reaches.

The Red River of the North serves as the outlet for the area's drainage. The Red River begins in Breckenridge at the confluence of the Bois de Sioux and Otter Tail Rivers. The gradient of the river averages only about 0.5 feet per mile, and it is subject to widespread flooding. At Breckenridge, the gradient is about 1.3 feet per mile. Both Breckenridge and Wahpeton, in North Dakota, are subject to flooding. The average annual mainstem flood damages on the Red River, north to the Canadian border, were estimated by the Corps of Engineers in 1981 at $5,620,000. Figure 9 shows the 1997 FEMA Damage sites.

Lakes

There are about 40 lakes within the District that are larger than 160 acres. A partial listing of these lakes includes the Upper Lightning, Lightning, Elbow, Round, Niemackl, Big, Fish, Cottonwood, East Toqua, and West Toqua. Lake Traverse and Mud Lake, along the South Dakota border, are the largest water bodies, having a combined area of about 14,775 acres. Lake Traverse is a major fishery and recreation area. Figure 8 - Hydrology shows the lakes within the District.

Wetlands

There are approximately 51,692 acres of wetlands in the District based on the National Wetlands Inventory developed by the USFWS. They are broken down by type and acreage as follows:

FIGURE 9
1997 FEMA DAMAGE SITES

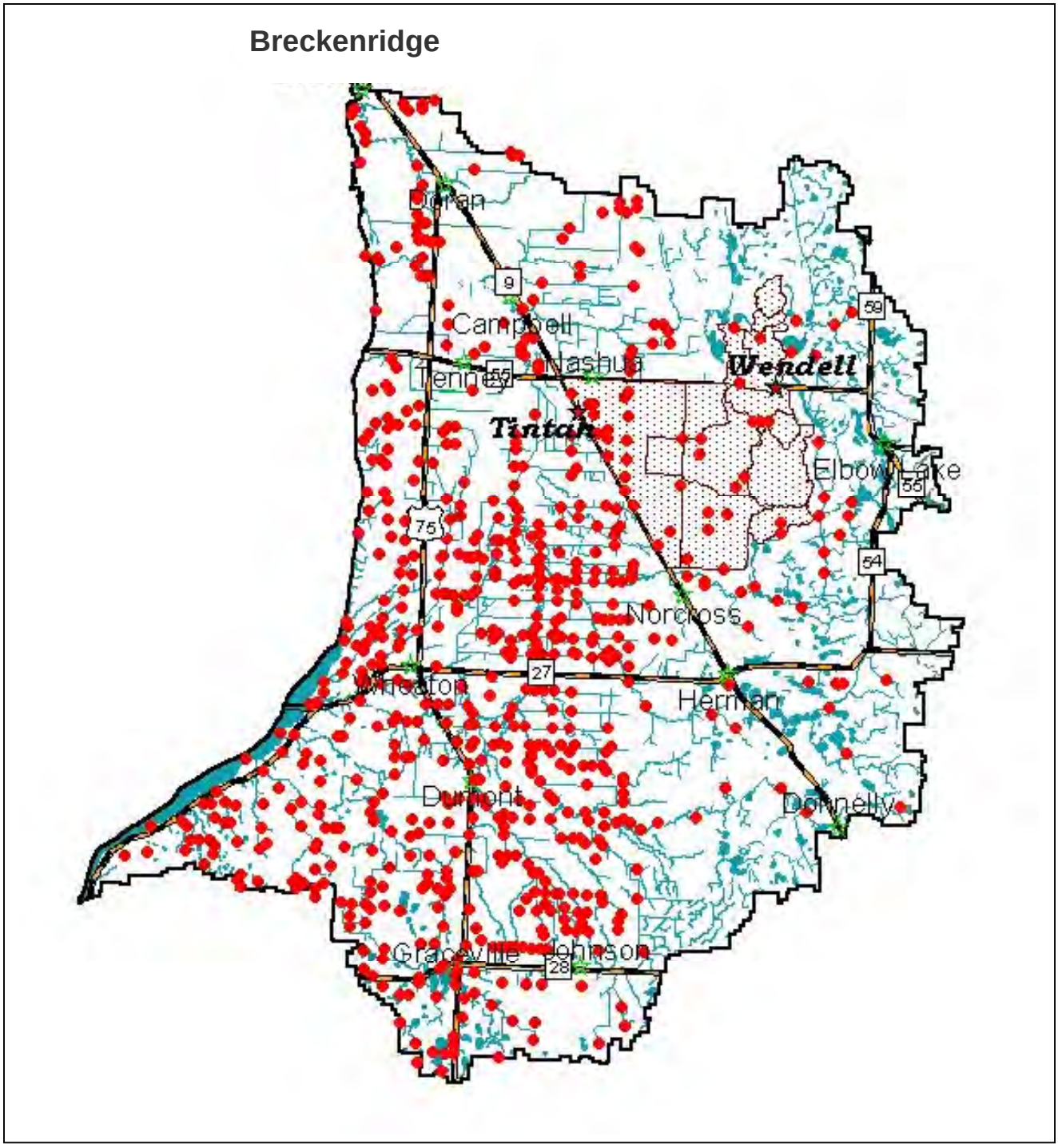


Table 1
Wetlands in the district

WETLAND TYPE – NWI	ACREAGE
Type 1 *Seasonally Flooded*	11,108
Type 2 *Fresh Meadow*	16
Type 3 *Shallow Fresh Marsh*	21,283
Type 4 *Deep Fresh Marsh*	1,412
Type 5 *Open Fresh Water*	16,455
Type 6 *Shrub Swamps*	241
Type 7 *Wooded Swamps*	1,117
Type 8 *Bogs*	60

Figure 10 – National Wetlands Inventory Map shows the locations of existing wetlands within the District.

It is estimated in the December 2002 Minnesota Department of Natural Resources Fisheries Stream Survey Report that there are 100,000 acres of drained wetlands within the District. The USFWS and Ducks Unlimited (DU) have also identified restorable resource areas, which can be found at http://www.midwest.fws.gov and http://www.mnducks.org. The Minnesota Center for Environmental Advocacy (MCEA) has developed a map of potentially restorable resource areas shown in Figure 11 - Restorable Resources Analysis.

Drainage Systems

Legal drainage ditches have been constructed in the Bois de Sioux watershed since about 1870. There are 581 miles of legal ditches as shown in Figure 12 – Legal Ditches. Of these, 414 miles are managed by the District. Most of the existing ditch systems were established during the first quarter of this century. They provide local relief from soil wetness conditions and minor flooding problems. Inadequate drainage based on today's design standards and problems with existing legal and natural drainage systems is a major water management concern. The generally flat topography and predominantly heavy soils of this area do not afford adequate natural drainage for efficient production of agricultural crops. However, when drained the soils are highly productive.

Water Management Structures

The Lake Traverse Bois de Sioux River Project was constructed by the Corps of Engineers in 1941. The project consists of a flood control dam at the outlet of Mud Lake (White Rock

FIGURE 10
NATIONAL WETLAND INVENTORY MAP

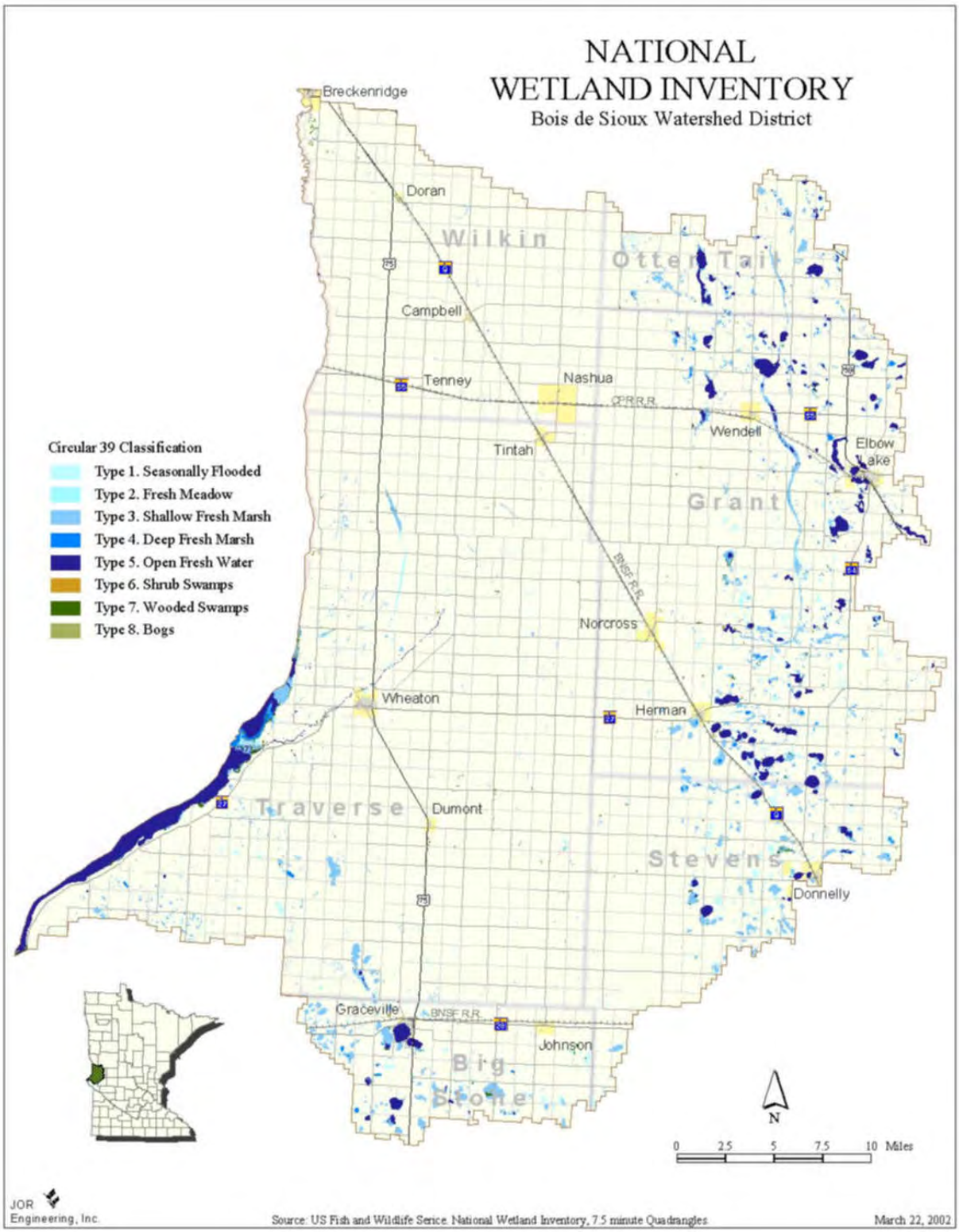


FIGURE 11
RESTORABLE RESOURCES ANALYSIS MAP

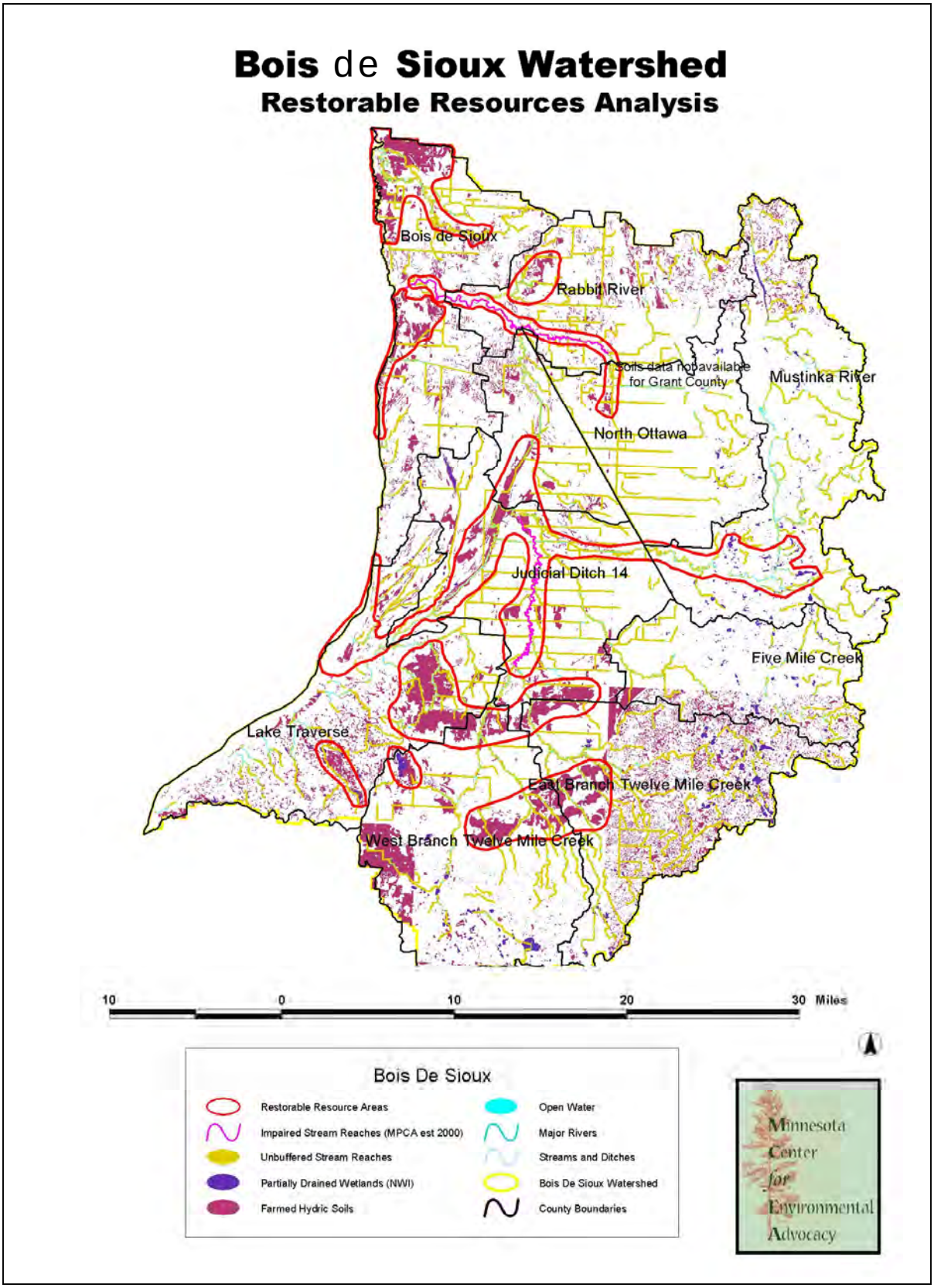
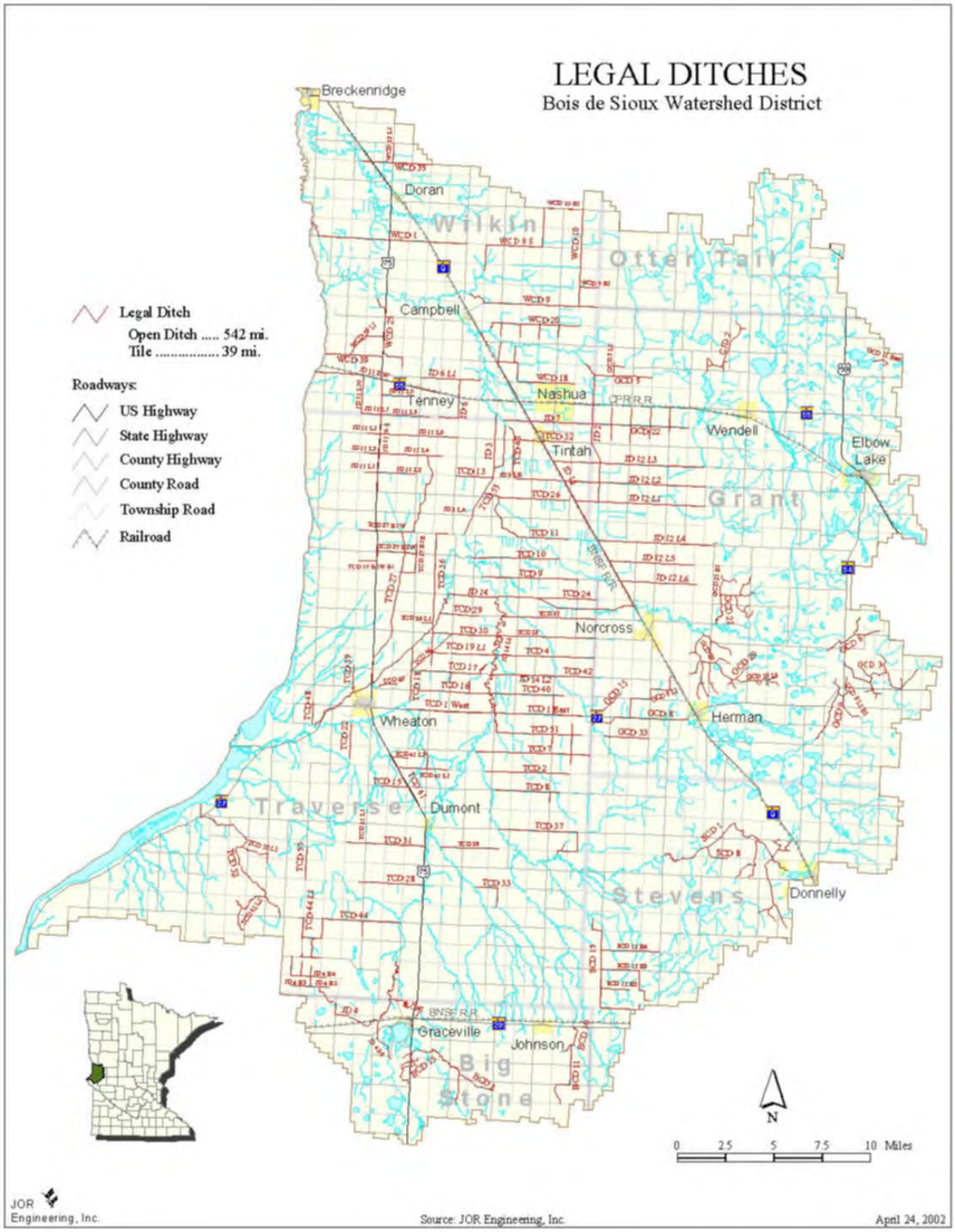


FIGURE 12
LEGAL DITCHES MAP



Dam), a level control dam at the outlet of Lake Traverse (Reservation Dam), a levee at the south end of Lake Traverse (the Browns Valley Dike), and a channel improvement on the Bois de Sioux River extending 24 miles downstream. The project provides 128,520 acre-feet of flood control storage in addition to a conservation pool of 121,280 acre-feet. The flood storage capacity is equivalent to 2.2 inches of runoff from the upstream drainage area.

Normal operation of the dams is to control the level of Lake Traverse at about 976 feet above sea level and Mud Lake at about 972. During minor runoff events, Reservation Dam at the outlet of Lake Traverse is opened to keep the lake below 977. White Rock Dam at the outlet of Mud Lake will be closed if there is flooding potential downstream. During major floods, the level in Mud Lake will rise to equal that in Lake Traverse: the pools will rise together from 977 to 981. When the reservoir reaches 981, White Rock Dam is opened to match the inflow as best it can. In 1997, inflow was higher than outflow and pools raised to 982.25. The release of water at White Rock Dam may impact downstream drinking water due to the presence of high organic carbon (TOC), high sulfate and hardness.

The Mustinka River Project was constructed by the Corps of Engineers in 1957. It consists of 36.1 miles of channel improvement on the Mustinka River, Twelve Mile Creek, and County Ditch 42. This project was then turned over to the Local Government Unit (LGU)-Joint County Board to be managed as a Legal Drainage System under Minnesota Statute MS 103E. Dispute over assessment area was encountered and resolved. The resolution reduced the size of assessment area making it smaller relative to the project drainage area. Maintenance is a problem due to the inability to generate enough money to do the work. It does provide local flood protection. Figure 8 - Hydrology shows the location of the water management structures within the District.

GROUND WATER

Ground water is an extremely important resource of the District. All domestic water supplies, public and private, are drawn from ground water, with the exception of the Breckenridge municipal water supply that uses the Otter Tail River as a backup. Ground water has provided a reliable and relatively high quality source of water for both domestic and livestock consumption. Irrigation has not been a major factor and significant development of irrigation is not anticipated.

In general, ground water recharge occurs normally in the morainal areas and discharge occurs in the lake plain area. This is evidenced by a number of flowing wells in the lake plain and by the numerous springs that feed Lake Traverse. The quality and quantity of ground water available varies depending on the formation in which it is found. Ground water is found in both surficial and buried aquifers within the glacial drift. It is also found in the cretaceous sediments and, to a limited degree, within the bedrock.

Water from aquifers in the glacial drift is generally very hard and high in dissolved solids and iron. Surficial aquifers tend to have lower dissolved solids and iron content. However, they are far more easily contaminated by surface water pollutants. Yields from individual wells typically range from 100 to 500 gpm. Water from aquifers in the cretaceous sediments is high in dissolved solids and iron. The hardness ranges from mild to severe. This water may contain a significant amount of salts that may make it unsuitable for some uses. Yields from individual wells are usually less than 100 gpm.

UNIQUE WATER AND LAND RELATED RESOURCES

Outstanding Resource Value Waters (ORVW)

According to the MN Rules 7050 ORVW, there are no outstanding resource value waters within the District.

Rare and Endangered Species

The District has a listing and maps of rare and endangered species. The District will review the information prior to implementation of watershed projects to avoid adverse impacts.

Critical Vegetated Habitats

Figure 13 – Existing Resources Analysis Map shows areas of existing habitat that are of high priority for natural resources management agencies.

WATER USE

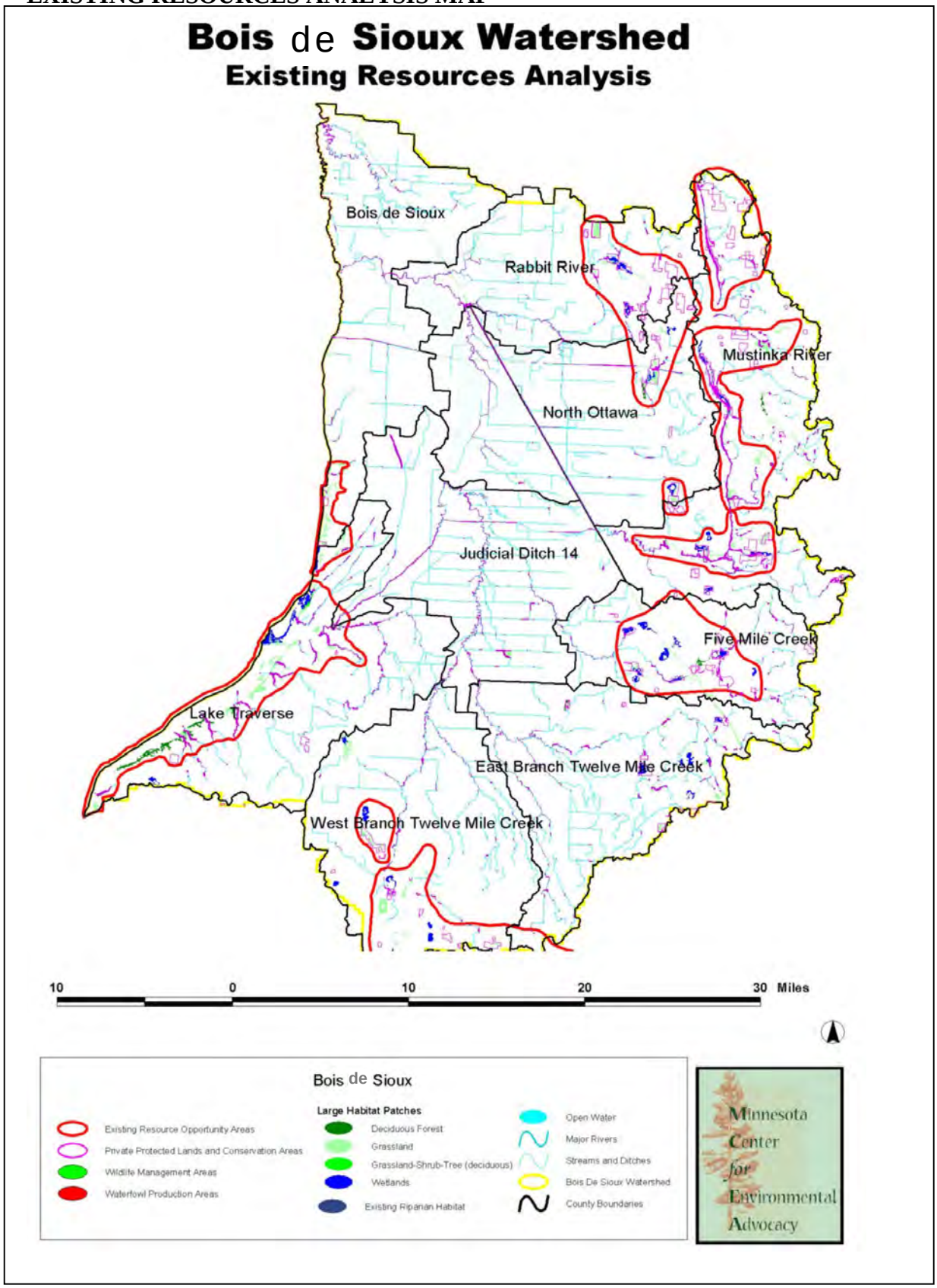
Surface Water

Based on information provided by the MNDNR, there are twelve permitted surface water appropriation installations within the watershed that have a total combined permitted volume of 693.7 million gallons per year (MGY).

Ground Water

Based on information provided by the MNDNR, there are twelve permitted ground water appropriation installations within the watershed that have a total combined permitted volume of 3,792.6 MGY.

FIGURE 13
EXISTING RESOURCES ANALYSIS MAP



Inventory of Public Water Suppliers

Based on information provided by the MNDNR, there are seventeen municipal water suppliers within the District. The total annual volume of water appropriation permitted is 948.4 MGY of which 210 MGY is backup water supply for Breckenridge from the Otter Tail River and 738.4 MGY is from various ground water sources. Three of the cities within the District are required by law to have a Water Supply and Emergency Conservation Plan; they are Breckenridge, Wheaton and Elbow Lake.

Inventory of Municipal Wastewater Treatment Systems

According to the Minnesota Pollution Control Agency (MPCA), there are 8 unsewered communities and over 1,200 individual sewage treatment systems within the District. The MPCA estimates that approximately 75 percent of the homes within the District utilize an individual sewage treatment system. There are 8 permitted waste water treatment plant discharges within the District, including Campbell, Barry, Donnelly, Elbow Lake, Graceville, Herman, Wendell and Wheaton. The combined average daily flows from these facilities is approximately 0.72 million gallons per day of treated waste water.

EXISTING WATER MANAGEMENT PLANS AND PROGRAMS

The Board recognizes the importance of having a comprehensive plan that both captures local vision and is inclusive of the goals and objectives of other natural resources agencies. During the planning process, members of the BWSR, MPCA, MNDNR, USFWS, USACE, County Water Planners, Soil and Water Conservation Districts, County Commissioners and others were invited to participate in the planning process. These individuals were asked to provide input to the District's planning process on the goals, policies and objectives of the following plan areas:

- County Water Management Plans (Appendix 3)
- Soil and Water Conservation District Plans (Appendix 3)
- Natural Resources Agency Plans (Agency input/comments)
- Other Local Government Water Management Plans (Plan input/comments)
- Tillage Transects Summary (Appendix 4)

The District provided numerous opportunities for the respective agencies to provide review and comment on the District's watershed plan. Where possible, the District will try to provide opportunities for the various resource agencies to implement their programs when the District is implementing a flood damage reduction project. These partnership opportunities will be facilitated through the Mediation Process and the established Project Teams (Appendix 10). The results of the interviews with SWCD and County Water Planning Staff, and tillage transect data are contained in Appendices 3 and 4.

PART II. OVERALL WATERSHED GOALS AND OBJECTIVES

OVERALL WATER QUANTITY VISION

Streamflow in the Bois de Sioux Watershed is characterized by high peak flows and low to intermittent base flows. Local citizens and their representative leadership have repeatedly and consistently identified flood control as the highest priority watershed management issue. This is understandable because frequent devastating floods have caused tremendous economic and social hardship. Low flows can be a limiting factor for recreational and economic development opportunities, but is less a problem than flooding in the riverine environment. The water quantity goal of the District is to reduce damaging flood flows and, to the extent practical, convert high peak flows to sustaining beneficial base flows.

Streamflow problems and their solutions are not only local matters. In fact, without a broader focus, it is quite possible to solve problems in one area at the expense of another. It is also possible to solve specific local problems in ways that diminish the practicality of solving broader area or regional problems. These adverse consequences have unfortunately been characteristic of historic water management efforts. Avoiding their perpetuation requires commitment to an overall plan that is based on a comprehensive approach to water management.

Solving the District's streamflow problems seems unlikely to be accomplished by the construction of any one project or at any one point in time. Rather, it is expected to require multiple applications of various techniques, which may take place over a long period of time. Projects may be undertaken by different jurisdictions within government and by private individuals and groups. Other activities within the basin may also potentially affect streamflows or may affect the long-term feasibility of flood control solutions. The importance of this plan is to provide a framework for future water management and related activities to ensure that all of the elements, however and whenever implemented, will fit together in a complimentary way.

Flood damage reduction projects can be constructed with no significant net environmental loss and can be made to enhance natural resources. Involvement of appropriate environmental agencies in the planning and implementation process will help to ensure that adverse environmental impacts are avoided, minimized or mitigated. Flood control projects may provide opportunities for both flood damage reduction and environmental enhancement. These opportunities will be explored with the Flood Damage Reduction Project Team whenever the District begins to implement a project.

Effect of Flood Timing

During major flood events, almost all areas of the watershed contribute floodwater. However, due to location or other characteristics, some areas may consistently contribute more to the peak flow, which is the more damaging portion of a flood hydrograph. The selection and design of appropriate flood damage reduction measures will depend on the timing of an area's floodwater contribution to flooding in other areas of the basin.

For purposes of discussion, we have divided the District into three timing zones as described below and shown on Figure 14 – Generalized Map of Timing Zones. The zones are labeled early, middle, and late, based on when water from each area tends to arrive at the outlet of the District.

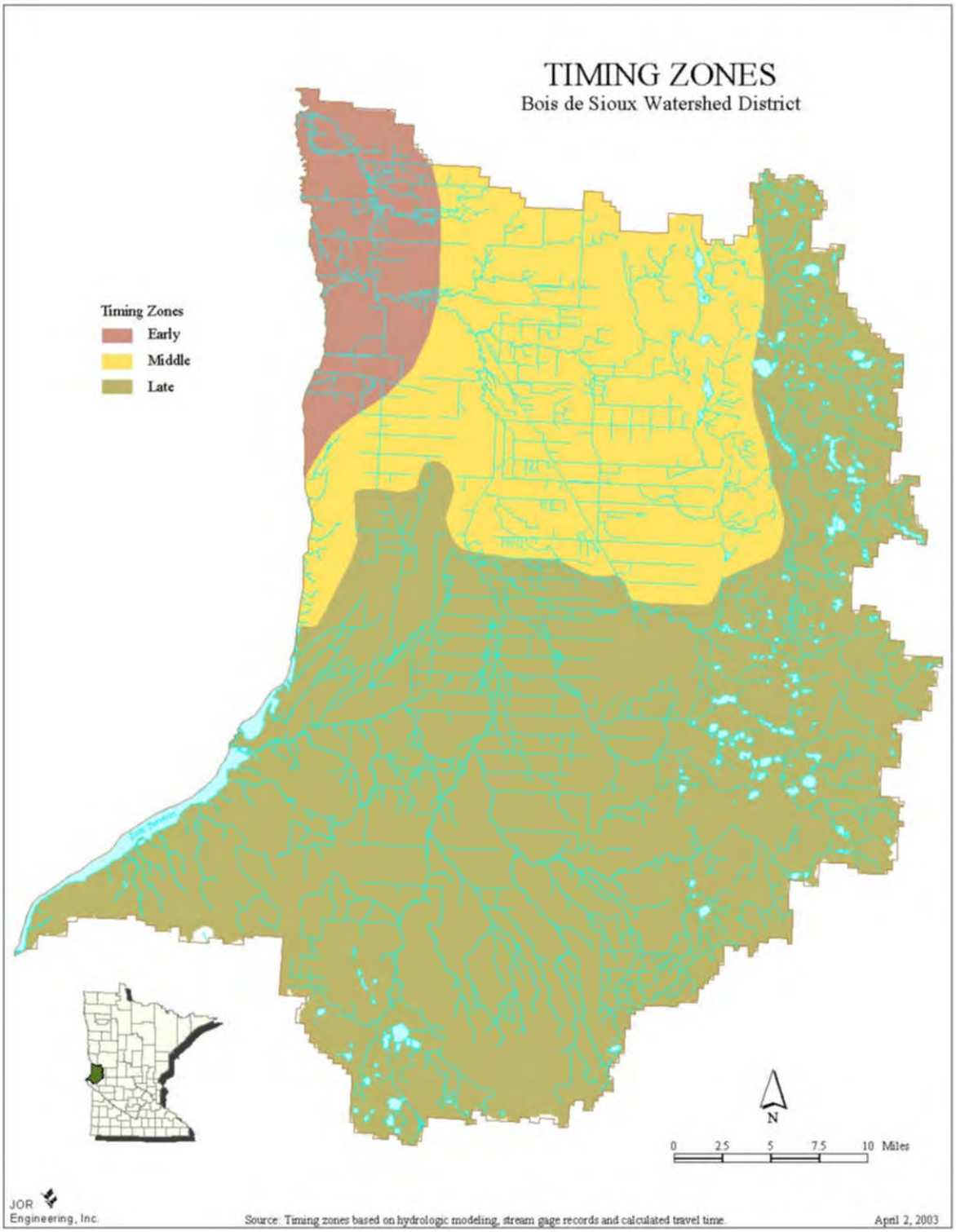
1. Early. Most of the runoff from these areas typically moves through ahead of the major flood flows from other areas of the watershed. Usually, these areas are close to the outlet of the watershed and/or are well drained. Slowing down or storing water from these areas could increase downstream flood damages if water is released during the flood peak. Conversely, speeding up the removal of water from these areas may provide downstream peak flow reduction.

2. Middle. Runoff from these areas typically coincides with the flood peak at the outlet of the watershed. Modification of flows from these areas will potentially provide the greatest flood control benefits. Slowing down or storing water from these areas will be especially beneficial if releases can be delayed until after floodwaters have receded. Speeding up the water could also be beneficial if it would move through before the peak. Ideally, the timing of flows from these areas could be controlled to allow either early or late release.

3. Late. Most of the runoff from these areas typically moves through after the major flood flows from other areas of the watershed. Usually, late areas are the most remote within the watershed, are poorly drained, or their runoff is delayed by existing storage facilities. Slowing down floodwater from these areas will always reduce downstream peak flows and will generally provide the greatest benefit within the watershed. Conversely, speeding up water from these areas will likely increase downstream flood damages.

Note that the timing of an area's floodwater contribution depends on the location of the downstream damage center being considered. Knowledge of the timing of flows within the Bois de Sioux Watershed and the Red River Basin continues to be developed based on gage data from actual flood events and by hydrologic modeling. Therefore, the maps shown lack detail and should not be considered final. However, it is evident that for most floods on the

FIGURE 14
GENERALIZED MAP OF TIMING ZONES



Red River, water from the Bois de Sioux Watershed would be middle or late water. Therefore, from a Red River Basin perspective, flood damage reduction measures that store, slow down, or reduce runoff would be the most appropriate. From a Bois de Sioux Basin perspective, those measures should be located primarily within the middle and late areas of the Bois de Sioux watershed.

Recommended Projects to Reduce Flood Flows

Types of projects that would reduce flood flows are discussed below:

Impoundments

Impoundments are projects that store floodwater. They may be floodwater detention impoundments, which release all of the stored water after the flood, or flood water retention impoundments that retain a portion of the water to be used for other beneficial purposes. Retention impoundments may have permanent pools for wildlife or recreation, or semipermanent pools for water supply or streamflow maintenance. Retention impoundments can be as beneficial for flood control as detention impoundments, if the total storage capacity is increased to compensate for the permanent or semipermanent storage volume. It may be more economical to build retention impoundments since a portion of the cost can be assigned to other benefits and financially supported by other interests.

Impoundments may have gated outlets, which can be operated in response to conditions anywhere in the watershed, or ungated outlets which will automatically release a designed amount of water based on conditions at the reservoir site. Gated outlets can provide greater benefits in that water is normally stored only when necessary or beneficial and is not released until downstream flooding conditions have subsided. The disadvantages of gate control are the cost and problems associated with operation. Other interests may feel better served by an ungated outlet than by a gated one optimized for flood control. However, a gated outlet with an operating plan that has been optimized for other interests as well as flood control will better serve both. Most gated impoundments include ungated outlets to automatically release water before the design capacity of the reservoir is exceeded.

Impoundments may be located on-channel, where all streamflows enter the impoundment, or off-channel, where only a portion of the flow enters the impoundment. Either type can be designed to provide flood control benefits. The advantages of one type or the other are generally site specific. On-channel impoundments are the more traditional type and potential sites are readily recognizable as low lying, river valley, or frequently flooded areas. Off-channel impoundments may be more space efficient or may be less disruptive to the environment. They are likely to be located in non-traditional areas which may be locally controversial.

Impoundments would be most beneficially located in the middle and late contributing areas of the watershed.

The District is the likely implementation agency for most flood control impoundment projects. If federal agencies are involved, the District would likely be the local sponsor. An inventory of potential impoundment sites was developed in 1990 and has been updated on this planning process and have been involved in the subwatershed discussions.

Wetland Restorations

Wetland restorations (also creations or enhancements) are a type of impoundment project, but are listed separately here because they typically have other primary purposes. They can provide substantial flood control if designed to do so. In general, those with no surface outlet or with small piped outlets are most effective.

Due to semi-arid climate in this area, most wetlands are likely to develop a seasonal water deficit. The deficit that exists usually at the beginning of a spring flood event must be filled before any water is released. That volume is totally removed from the flood hydrograph and therefore has great flood control value. Wetlands are most beneficially located in the middle and late contributing areas of the watershed.

Many agencies, organizations and individuals are involved in wetland restoration activities. These activities need to be coordinated to ensure that anticipated flood control benefits are achieved.

Culvert Sizing

Culvert sizing is a flood control technique that incorporates roads and other man-made barriers to provide short-term detention of floodwater and reduce peak flows. It is a widely used form of flood control which can provide benefits throughout the watershed and appeals to a sense of fairness.

Culvert sizing should be based on drainage area and closely matched to channel capacity. When channel capacity is exceeded, the culvert restricts flows and the excess water temporarily impounded upstream. For the method to be safe and effective, the grade must be high enough to prevent overtopping or be designed to overflow without washing out.

The District has routinely included culvert sizing as a mitigation requirement in granting drainage improvement permits. Projects to accelerate widespread implementation of culvert sizing may be a possibility. An inventory of existing culverts, and their respective drainage areas, is needed to evaluate the current status and future potential of this alternative.

The flood control benefits of culvert sizing are greatest when implemented in the middle and late contributing areas of the watershed.

Landuse Change

Cultivated cropland produces a significantly higher volume of runoff from rainfall events than does grassland or forest. Converting from crops to grass or trees will reduce flood volume. The amount of runoff reduction that can be achieved from a conversion during a 100-year, 24-hour storm ranges from 1/4" on fine clay soils to 1½" on coarse sandy soils. The greatest flood flow reduction will be provided by landuse change in sandy soils, typically found in beach ridge areas of the watershed. Targeting flood prone land will also reduce local flood damages.

Other Projects to Reduce Flood Damages

Other measures may be necessary to cope with flooding problems that cannot be adequately controlled by flow reduction methods. The following sections describe the most commonly used methods.

Drainage and Channel Improvements

Drainage and channel improvements have been traditionally applied methods for providing local flood control. Adequate drainage is essential for efficient agricultural production in this area. However, adverse impacts should be avoided or mitigated.

The effect of drainage on downstream flooding conditions is a complicated issue and requires site-specific analysis. If the outflow rates can be controlled, drainage improvements can actually reduce downstream peak flows. This can be accomplished by appropriate culvert sizing, for example. Some drained soils also provide greater absorption capacity. Tile drainage, which slowly draws down subsoil moisture, may be particularly effective in reducing runoff rates.

Levees and Dikes

Levees and dikes can protect property from flooding. The degree of protection depends on the height of the dike. In general, levees are practical where flood heights are relatively low. The effect of levees on flood flows or elevations requires a site-specific evaluation.

However, the general tendency is to reduce floodplain storage and to reduce floodway capacity, thereby increasing both upstream levels and downstream flows.

Municipal levees or dikes have been constructed in many cities within the District. Most provide emergency rather than permanent protection. Low-level dikes (where failure would not be life threatening) are appropriate for protecting developed areas. The use of high dikes to protect low lying or floodway areas should be avoided. Such areas should be evacuated or converted to flood tolerant uses.

Farmstead ring dikes can protect individual farmsteads from flooding. Many farmsteads are located in frequently flooded areas with low probability of adequate future flood control. For these locations, ring dikes may be a recommended alternative. The District is administering a state and regional program to construct farmstead ring dikes in this area.

Agricultural levee systems have evolved in many areas of the District as landowners have installed traps on culverts through road grades and spoil banks. Typically, these are in areas where the existing drainage channels have inadequate capacity. No doubt, the levees have been a practical alternative for the land they protect. Unfortunately, they tend to raise flood levels on unprotected, or less protected, land. Therefore, private agricultural levee systems should be viewed as temporary. Properly designed agricultural levee systems could be developed that would provide both flood protection and flood control. These seemingly conflicting purposes can be easily resolved by carefully setting levee overtopping elevation. The concept is to provide farmland protection for relatively frequent floods up to about the 10-year level. When overtopping occurs during greater floods, land behind the levees would provide timely flood control storage, reducing flows downstream.

Environmental Considerations

Prior to development, the landscape of the District consisted of a mosaic of prairie lands and wetlands with networks of prairie streams coursing throughout. This landscape supported an abundance and diversity of fish and wildlife resources. The landscape throughout the watershed has been extensively altered, primarily to improve agricultural production. While the agricultural lands have been highly productive, much of the natural landscape values once present in the watershed have been replaced with agricultural economic values. Most of the original prairie landscape has been cultivated and many of the original wetlands have been drained. Many of the original streams have been channelized and riparian corridors have been diminished or lost. Settlement and development of this landscape for intensive agricultural production has dramatically reduced the quantity and quality of the natural landscape features. Most of the remaining grassland and wetland are confined to small islands and disconnected strips of habitat within the agricultural landscape. Similarly, waterways have been ditched, straightened, and their hydrographs have been altered while lakes have been drained or their shorelines developed.

The following broad goals, objectives, and strategies will help achieve this vision for natural resources in this watershed. They were developed by natural resource professionals with input from the watershed district and represent their perspective. The District does not have primary responsibility for implementing these natural resource goals, objectives, and strategies. Nevertheless they are expected to support the goals described here when they are implementing projects within the District.

The rivers and streams in the watershed form a network that can provide habitat to support a diversity of aquatic life. The Mustinka River and its tributaries form one network and the Bois de Sioux River and its tributaries form another network. Lake Traverse and Mud Lake hydraulically connect these systems but from a biological viewpoint these systems remain separate.

OVERALL WATERSHED GOALS AND OBJECTIVES

The Bois de Sioux Watershed held numerous meetings of the CAC/TAC to identify FDR and NRE issues and opportunities (see matrices in Appendix 10 and 11). The issues identified by the CAC/TAC were used to develop implementation strategies for subwatershed plans for FDR and for NRE issues for the entire watershed. This type of multiple objective management strategy requires identification and integration of the natural resource goals with the flood management goals.

Multiple objective management strategies require that a watershed and ecological systems approach be used to design and evaluate potential flood control projects since, linked relationships between physical, biological and chemical processes controlling the natural resource environment can be disrupted or enhanced by changes resulting from projects. A systems perspective is necessary to fully address the integration of flood control and natural resource enhancement.

A. Water Quantity

As discussed earlier, given the location of the District within the Red River Basin, flood storage and other forms of flood volume reduction are the most regionally compatible flood damage reduction measures. The amount of storage (or flow reduction) required is highly dependent on the type, design, and location of future projects. Few potential sites have been identified and few of those have developed designs or operating plans. Therefore, an estimate of required storage is somewhat speculative and based on assumptions of what will be possible, practical, and acceptable. Yet, it would be unrealistic to embark on a program of flood storage construction without some quantification of the amount of storage required. For that purpose, a preliminary storage goal of 150,000 acre-feet has been adopted.

Recent major floods in the District provided extensive streamflow data through the District's gaging program. Review of these data are the primary basis for determining appropriate storage goals. The goals reflect two concerns. First is the need to reduce local flooding within subwatersheds of the District. Second is the need to reduce flows at the outlet of the District (Breckenridge) and downstream on the Red River. This second concern is, in large part, beyond the control of the Board because the flows at Breckenridge include major contributions from the Otter Tail River in Minnesota and from the Dakota portion of the Bois de Sioux Watershed. Nevertheless, the Board is committed to providing the Districts share of flood flow reductions, and trusts and encourages other jurisdictions to do the same.

Goal 1: Protect intensively farmed cropland from the 10 year, 24-hour runoff event.

Goal 2: Provide flood protection to cities within the watershed from the 100 year flood event.

Goal 3: Reduce flood flows within and downstream of the watershed to reduce damages to public and private property, municipal services and agricultural land.

Objective 1 Provide an additional 150,000 ac-ft of storage throughout the entire watershed.

Objective 2 Stop or mitigate activities that would otherwise increase peak flow in downstream hydrograph.

Objective 3 Continue to develop an inventory of potential impoundment sites.

Objective 4 Consider the implementation of a USACE Feasibility Study for a multiple purpose project that reduces flood damages.

Goal 4: Prevent damage from critical events while enhancing base flows.

Objective 1 Define, restore and/or create hydrologic areas that are critical for contributing to or sustaining base flows.

Objective 2 Restore wetlands in critical areas in ways that augment base flows.

Objective 3 Restore drained lake basins to augment base flows.

Goal 5: Continue the public drainage system maintenance program.

Objective 1 Develop a public drainage system inventory.

Goal 6: Promote distributive storage across the watershed through culvert sizing criteria.

Objective 1 Conduct an inventory of existing culverts and their respective drainage areas.

Objective 2 Involve road authorities in development of culvert sizing criteria.

B. Water Quality

Numerous water quality benefits can be achieved through effective implementation of activities proposed by the District. Storing flood water during spring runoff events and storm events in impoundments and through other activities will serve to reduce sediment transport by allowing soil particles to settle in the basins prior to water being discharged downstream. Such activities should also allow for the reduction of other nutrients present in the water, such as phosphorus. Controlling water release over a period of time would also reduce stream bank erosion immediately downstream from structures.

Water quality monitoring in the watershed immediately adjacent to project sites is necessary to establish baseline water quality conditions for the area and to document water quality impacts to portions of the watershed downstream of projects after implementation. As an initial implementation activity, the District has linked to the Red River Basin Monitoring Program through its River Watch activities and began monitoring water quality conditions throughout the watershed. Teachers and students from high schools in the watershed assist with monitoring efforts. Monitoring is performed at sites that help characterize conditions of distinct reaches of major waterways and associated tributaries including creeks and major drainage ditches. Site locations, parameters, and sampling frequency are adjusted as needed to compliment other monitoring programs including MPCA, TMDL and Flood Damage Reduction Project monitoring. Sites also correspond to the extensive streamflow gauge network in place throughout the watershed.

The District is also working with the MPCA and other local units of government in establishing water quality monitoring sites for the on-going watershed total maximum daily load (TMDL) project. Sites identified in this process along with those identified as part of

the River Watch project, will enable the District and the MPCA to establish valuable basin wide monitoring sites in the future that will effectively document water quality changes over time.

To date, only limited water quality data exists for the Bois de Sioux River and its subwatersheds. However, data that does exist indicates significant water quality impairments in virtually all portions of the watershed with several headwater areas as possible exceptions. Impacts from agricultural activities and drainage are significant and have lead to concentrations of nutrients and total suspended solids (TSS) that are in excess of what is expected for the ecoregion. Total organic carbon (TOC) may have a major impact upon downstream water users (Fargo and Moorhead) when significant releases, and during some periods of low flow, from White Rock Dam. Algae blooms in Mud Lake and Lake Traverse, promoted by excess nutrients, contribute to objectionable taste and odors in drinking water supplies. Future monitoring in the basin will provide further refinement of water quality assessments for the watershed and will allow for the development of more direct correlations between various landuse activities and water quality. The District anticipates state and federal funding to carry out the monitoring and implementation program.

Goal 1: Assist the MPCA and participating local units of government in the preparation and implementation of TMDL diagnostic studies and implementation strategies.

Objective 1 Participate in the validation of impaired reaches (Appendix 8).

Objective 2 Work with local steering committees to develop TMDL diagnostic studies for the entire Bois de Sioux watershed.

Objective 3 Assist the MPCA and local units of government in initiating TMDL implementation strategies within the watershed that will improve water quality.

Goal 2: Develop or require the development of a monitoring plan, which will qualify the current state of the water in project areas, and track water quality before, during and after projects.

Goal 3: Ensure that the construction and operation of projects do not impair water quality.

Goal 4: **Ensure that water quality benefits to the watershed from construction of proposed impoundments and other associated best management practices (BMPs) are maximized to the greatest degree without jeopardizing the flood damage reduction potential of the projects.**

Objective 1 Construct and operate projects that do not impair water quality.

Objective 2 Ensure that the water quality components of the projects and related activities are coordinated with other water quality programs and projects within the watershed.

Goal 5: **Ensure that the water quality components of projects and other activities are coordinated with other water quality programs and projects within the watershed.**

Goal 6: **Develop water quality monitoring programs with local and state partners to characterize current conditions and assess long-term water quality trends.**

Objective 1 Continue partnership(s) with River Watch program to facilitate on-going collection of baseline physical, chemical and biological data (Appendix 9).

Objective 2 Develop monitoring locations at the outfalls of TMDL subwatersheds. (Evaluation and monitoring strategy will define locations and parameters for monitoring network.)

Goal 7: **Ensure that the monitoring and analysis of water quality data is of such a quality and duration to provide for accurate documentation of water quality changes downstream throughout the life of the watershed projects.**

C. Erosion and Sedimentation

Erosion due to storm runoff is another problem in the subwatershed. The severity depends on the land cover, duration and volume of water. The District will encourage the SWCD to promote agricultural best management practices to improve crop residue, tillage cover and reduce soil erosion. The District will encourage natural resources management agencies to promote shoreline restoration projects and will work with the USACE to stabilize water levels and revise the operations plan.

The landscape throughout the watershed has been extensively altered, primarily to improve agricultural production. While the agricultural land has been highly productive, much of the natural landscape values once present in the subwatershed have been lost. Most of the original prairie landscape has been cultivated and many of the original wetlands have been drained. Many of the original streams have been channelized and riparian corridors have been diminished or lost. In addition to maintaining soil productivity and minimizing crop damage from blowing soil, control of wind erosion and the resulting sediment, has the added benefit of minimizing the clogging of drainage and road ditches.

The following goals and objectives are located in SWCD plans, county water plans and various plans of the natural resources agencies. The District supports the implementation of these goals and objectives by the respective agencies and will cooperate with them when undertaking projects.

Goal 1: Achieve 30 percent reduction of sedimentation to the District's water bodies due to soil erosion.

Objective 1 Accelerate the installation of vegetated buffer strips and participation in retirement programs by establishing buffer strips on 85 percent of shoreland areas and 50 percent of other eligible lands. Conduct mailing to all landowners/operators in the watershed outlining eligible areas for programs on aerial photos. Conduct follow-up calls to landowners and assist them with the development of conservation plans.

Objective 2 Implement agricultural BMPs to reduce erosion and sedimentation.

Objective 3 Achieve a reduction in soil erosion in agricultural areas of the watershed by adding 318,000 acres of conservation tillage adjacent to ditches, waterways and wetlands.

Objective 4 Reduce water erosion by restoring drained/cropped wetlands and upland buffer fringe, using native plant species wherever possible.

A) Assist SWCD and NRCS in restoring 10,000 acres. Restore wetlands in critical areas using local, state and federal restoration programs.

B) Assist the USFWS in achieving their goal to acquire 5,640 acres through fee title(s) and 3,800 acres through easement in the Fergus Falls Wetland Management District.

C) Assist the USFWS in achieving their goal to acquire 1,830 acres through fee title(s) and 2,500 acres through easement in the Morris Wetland Management District.

D) Assist Pheasants Forever acquire 3,000 acres permanent wildlife habitat through fee title(s).

Objective 5 Plant 245 miles of field windbreaks**,** using native plant species wherever possible, in critical areas identified in the SWCD and County Water Plans.

Objective 6 Develop strategies as opportunities arise for integrating public and private marginal land set-aside programs.

Objective 7 Develop a strategy for partnership with the NRCS to utilize conservation programs available from USDA.

D. Fish, Wildlife and Other Natural Resources

The current landscape of the Bois de Sioux presents tremendous opportunities to increase the quantity and quality of habitats that will support diverse and abundant fish and wildlife populations. The future vision of natural resources in this watershed includes blocks of quality grassland and wetland habitats that can sustain diverse populations of wildlife, stable stream and lake habitats that can sustain diverse populations of fish and aquatic life, and functional connections betweens these habitats. The recommended activities listed below should be implemented progressing from upstream to downstream, whenever possible. The following goals and objectives are located in SWCD plans, county water plans and various plans of the natural resources agencies. The District supports the implementation of these goals and objectives by the respective agencies and will cooperate with them when undertaking projects.

Goal 1: Restore drained basins above the beach ridge.

Goal 2: Protect existing wetlands where practical.

Goal 3: Restore grassland and enroll it in perpetual protection programs.

Objective 1 Provide partnership for implementation of the USFWS habitat and population advisory committee goals for native grasslands, prairies and wetlands restoration.

Objective 2 Use existing mapping efforts by resource agencies to identify high priority areas (i.e. USFWS thunderstorm maps, MNDNR mapping efforts).

Objective 3 Establish large blocks of habitat.

Goal 4: Manage impoundments to attenuate flows in the Bois de Sioux River and tributaries, whenever possible, to provide additional fisheries habitat.

Objective 1 Consider culvert design that will permit fish passage during spring.

Goal 5: Manage water levels and vegetation (wetland and upland) within impoundments to provide maximum wildlife habitat value and related public use opportunities within the constraints of flood protection goals and management requirements.

Objective 1 Increase the amount of migratory bird habitat.

Objective 2 Identify and develop migratory waterfowl nesting and resting areas.

Goal 6: Establish riparian corridor areas along all waterways including ditches.

Objective 1 Create or widen riparian corridors on streams and ditches. Support incentives to implement strategies that will stabilize streams.

Objective 2 Use natural channel design principles to re-establish channels.

Goal 7: Develop natural resource enhancement monitoring and assessment programs that define the following data and monitoring needs:

Objective 1 Encourage development of a Soil Survey Geographic Data Base (SSURGO) of soils data throughout the District.

Objective 2 Recommend air photo interpretation for wetlands and riparian corridors to develop strategies to prioritize.

Objective 3 Monitor water quality in the basin.

Objective 4 Track temperature annually on the Bois de Sioux River, Mustinka River, Rabbit River, and Twelve Mile Creek (see subwatershed plans).

Objective 5 Promote the installation of a continuous gage station on Mustinka River.

Objective 6 Track landuse changes in the watershed, particularly the continuous sign-up CRP lands. Including this information in the GIS will enable those changes to be utilized in the hydrologic model.

Objective 7 Update drainage figures (i.e. ditches vs. natural channels) as more detailed data become available.

Objective 8 Survey culverts in the basin (dimensions and slope).

Objective 9 Update longitudinal profiles and slopes.

Objective 10 Conduct a fisheries survey of the Rabbit River as soon as is possible.

Objective 11 Conduct similar surveys of Bois de Sioux streams and their fish populations every five years.

Goal 8: Preserve and protect unique natural resource communities and features in the watershed.

Objective 1 Avoid impacts to unique natural resource communities and features.

Objective 2 Refer to the MNDNR heritage database when implementing District projects.

Objective 3 Where appropriate, establish buffer areas between unique landscape features and adjacent landuse.

Goal 9: Protect, restore, enhance, and manage lakes and streams in the Bois de Sioux Watershed to support sustainable aquatic communities.

Objective 1 Create a more natural hydrograph (lower peaks and less flashy for a given runoff event) in the Mustinka and Bois de Sioux Rivers compared to the current hydrograph.

Identify and manage groundwater recharge areas to augment base flows.

Strategically place and operate storage facilities to attenuate high flows and augment base flows.

Identify, restore and manage wetlands and wet prairies.

Objective 2 Increase the number of miles of functional riparian areas along ditches, streams, wetlands and lakes.

Support incentives to implement strategies that will establish buffers between wetlands, waterways, lakes and the adjacent landuse.

Identify, prioritize and rehabilitate unstable watercourses.

Objective 3 Maintain and improve the quality of Lake Traverse as a natural and recreational resource.

Support the development of additional landuse regulations that protect Lake Traverse.

Support and implement activities that improve the quality of water entering Lake Traverse.

E. Water Based Recreational Activities

Hunting and trapping opportunities exist within the watershed area. Demand for hunting areas (both public and private) is high, focusing mainly on waterfowl, deer and pheasants. Trapping within the watershed is directed at muskrat, mink, raccoon, fox and beaver. The

level of trapping fluctuates with the fur markets. Expanded wetland and grassland acreage would provide additional hunting, trapping and wildlife viewing with associated local economic benefits.

Lake Traverse provides fishing opportunities with fishable populations. Stream fishing is limited to spring when the streamflow is adequate to facilitate fish migration. As stated earlier, the streams in this area are currently intermittent, meaning that they will flow only when there is a significant run off event. The following goals and objectives are located in the various plans of the natural resources agencies. The District supports the implementation of these goals and objectives by the respective agencies and will cooperate with them when undertaking projects.

Goal 1: Increase and promote outdoor recreational activities related to fish, wildlife, and other natural resources in the watershed.

Objective 1 Cooperate with local, state, and federal agencies to expand and manage compatible water based recreational activities to provide local economic benefits.

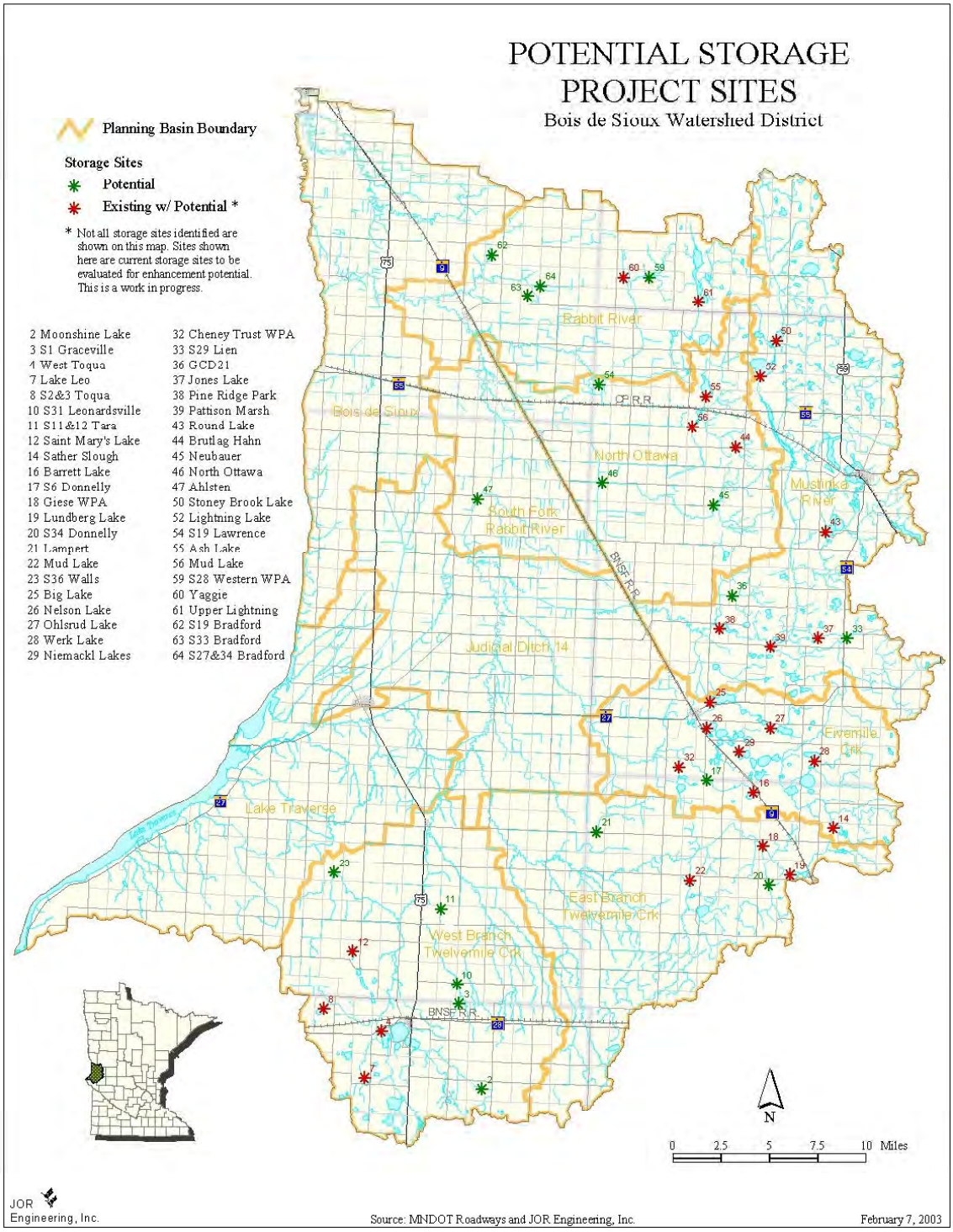
Objective 2 Establish or expand wildlife areas to increase hunting and wildlife viewing opportunities.

Objective 3 Where appropriate permit\encourage recreational facilities on lakes, streams and wetlands (i.e. accesses, boat ramps, docks, etc.).

Objective 4 Participate in the development of a Lake Traverse fisheries plan.

Objective 5 Enhance base flows for recreation.

FIGURE 15
POTENTIAL STORAGE PROJECT SITES



PART III. SUBWATERSHED IMPLEMENTATION PLANS

INTRODUCTION

The purpose of this section is to describe the physical characteristics of each subwatershed in the District, to identify problems related to water management, and to propose solutions in the form of goals and objectives to address those problems (Figure 15 – Potential Storage Project Sites). The District's initial plan, completed in 1990, contained a listing of potential storage sites. This list was reviewed and changed by the watershed planning team to reflect changes that have taken place, such as the mediation process, for inclusion in the plan. The potential storage sites identified in Figure 15 are to be used as a starting point for Project Teams for addressing the District's flooding and natural resources problems. The list is by no means all inclusive or limiting, it is merely a starting point for project discussions in each of the subwatershed plans.

BOIS de SIOUX

DESCRIPTION OF WATERSHED

Watershed Setting

The Bois de Sioux subwatershed is located in both Wilkin and Traverse counties, consisting of 150 square miles as shown in Figure 16. This watershed contains Doran Creek, a portion of the Rabbit River, and other lands that drain directly into the Bois de Sioux River. Surface water management problems within this watershed include: flooding, drainage, erosion, water quality, water supply, wildlife issues and cropland irrigation. Breckenridge and Doran are the major cities within this subwatershed. The land mass is almost 97 percent glacial lake plain. Agriculture dominates the landuse covering almost 95 percent of the land area.

Bois de Sioux NRE Ordinal Rankings

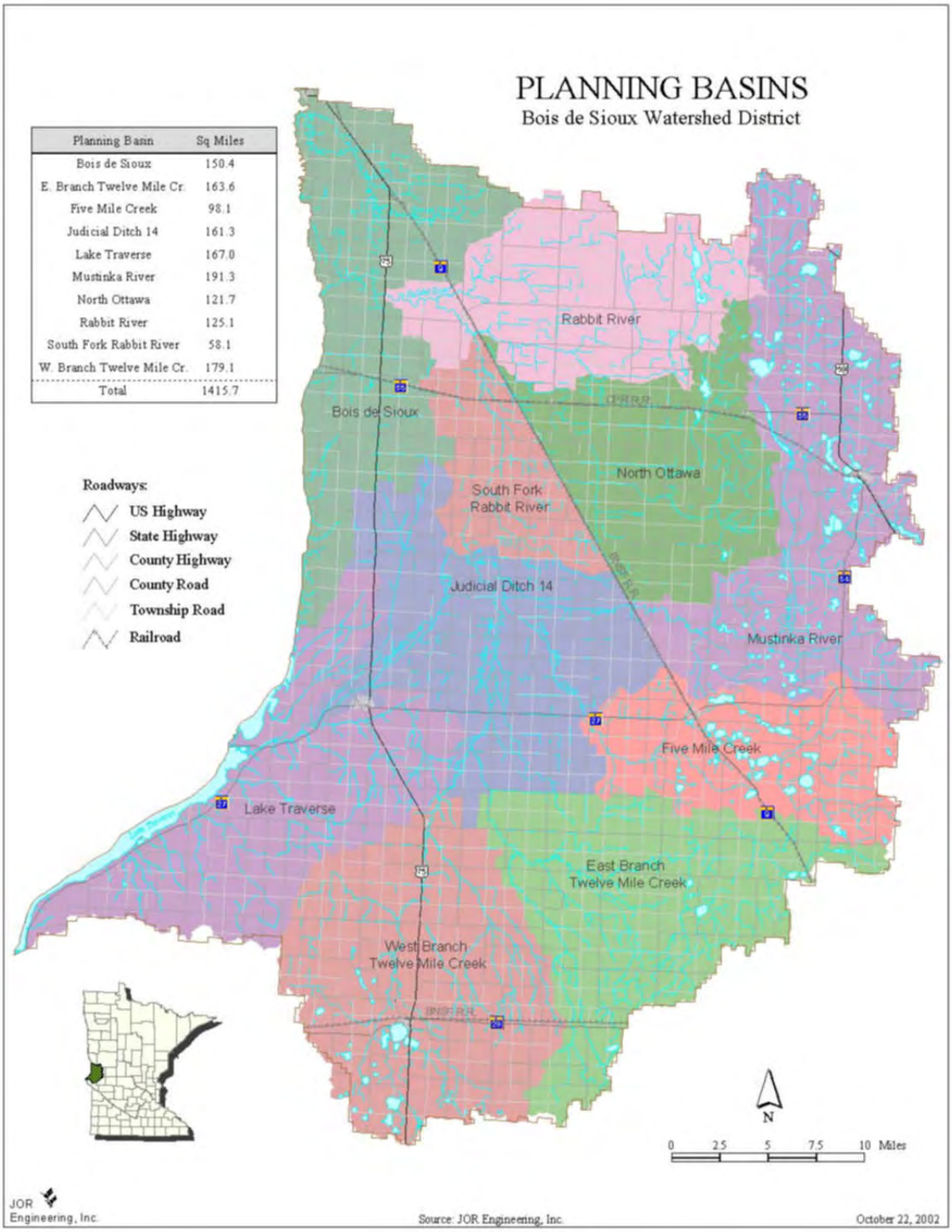
1. Support implementation of projects to improve water quality.
2. Promote implementation of habitat creation.

Existing Conditions, Related Problems and Opportunities

A. Water Quantity

The Bois de Sioux subwatershed experiences frequent flooding throughout the subwatershed with spring flooding being almost an annual occurrence. Damages associated with this type of flood are to public infrastructure, personal property, cropland and public resources (fisheries, wildlife, soils and water quality). Flood problems within this subwatershed primarily originate from upstream areas.

FIGURE 16
PLANNING BASINS MAP



Bois de Sioux FDR Ordinal Rankings
Pursue the implementation of flood damage reduction projects to protect public infrastructure.

FDR Action Item:
The District will pursue the implementation of flood damage reduction projects to protect public infrastructure.

B. Water Quality

The MPCA has identified the river as an impaired water body due to high levels of ammonia. The source of the ammonia problem is unknown at this time and is being investigated. Water quality data is very limited for this area. There could be high levels of total suspended solids, total phosphorus, and other contaminants due to the cultivated agriculture that is prominent within the subwatershed. This correlation is based on the latest USDA Natural Resource Conservation Service Tillage Transect Survey (Table 1) and data gathered from the neighboring Lake Traverse Improvement Project Diagnostic Study.

The TMDL process requires pre- and post-implementation of water quality monitoring in the watershed adjacent to project sites to establish baseline water quality conditions for the area and to document water quality enhancements to portions of the watershed downstream of the projects after implementation. This water quality sampling and data analysis should be coordinated with the TMDL being proposed by the MPCA for the Bois de Sioux River.

Action Item:

1. Develop a monitoring program to qualify and quantify both the current water quality situation and the extent of any water quality problem in the subwatershed. This plan should address three specific areas of work:

    a) Baseline data collection and analysis;
    b) Project specific data collection and analysis; and
    c) Bois de Sioux River TMDL study.

2. Develop a continuous collection of flow regimes, chemical, physical, and biological data. The parameters should be based on the Stream Classification as outlined in Minnesota Rules 7050.0220 and 7050.0221 through 7050.0227.

    Sampling should be conducted at least monthly, for at least one year to assess the current water quality situation. Further sampling should be conducted at least quarterly beyond the first year to build a long-term database. The database should utilize a user-friendly format that can be accessed by all identified stakeholders.

Specific sampling locations and frequencies can be developed here or in a separate monitoring document.

C. Erosion and Sedimentation

Erosion due to storm runoff and wind is another serious problem in the subwatershed. During periods of high runoff, channel erosion causes bank stabilization concerns for Doran Creek. The severity depends on the land cover, duration, and volume of water. Erosion is often worse in the spring due to the lack of vegetative cover on fields. Additionally, wind erosion is of concern in this area, however, it is dependent on conditions.

The landscape throughout the watershed has been extensively altered, primarily to improve agricultural production. While the agricultural land has been highly productive, much of the natural landscape values once present in the subwatershed have been lost. Most of the original prairie landscape has been cultivated and many of the original wetlands have been drained. Many of the original streams have been channelized and riparian corridors have been diminished or lost. In addition to maintaining soil productivity and minimizing crop damage from blowing soil, control of wind erosion and the resulting sediment, has the added benefit of minimizing the clogging of drainage and road ditches.

Management of crop residues during tillage has long been a key component of an erosion control and water management strategy. Thirty percent crop residue after planting, averaged over the crop rotation, is generally recommended as the minimum amount of residue necessary to achieve acceptable soil erosion (a 65 percent reduction in soil erosion). A combination of a hydrologic soil group (soil) and a landuse and treatment class (cover) is used to determine the hydrologic soil-cover complex. The effect of the hydrologic soil-cover complex on the amount of rainfall that runs off is represented by a runoff curve number (CN). Higher curve numbers indicate more runoff. Conversion of cropland to grasslands via land retirement programs will achieve a significant reduction in runoff.

Retired riparian croplands provide the additional benefit of significantly reducing sediment, phosphorus and other pollutants contained within runoff entering the vegetative buffer strip. In addition to considering natural resource enhancements when implementing their projects in this subwatershed, the District will encourage and support natural resource agencies and private landowners to protect and improve the natural resources in this subwatershed.

D. Fish and Wildlife Habitat

Existing Resources: Most of the fish and wildlife habitat in this subwatershed has been lost due to landuse changes, drainage, and channel modifications. Fish habitat is particularly limited by channelization of the Bois de Sioux River and a flow regime characterized by

frequent short periods of high flow and long periods of extremely low flows. The combination of poor habitat conditions and the current flow regime limits the ability of the Bois de Sioux to sustain aquatic life. Wildlife habitat is limited by a lack of grassland and wetland habitat and a loss of connectivity of the habitat that remains. Few large habitat patches and conservation land are present in this subwatershed and most wetlands have been drained (MCEA report can be viewed at the watershed office). The downstream, unchannelized reach of the Bois de Sioux River provides good aquatic habitat and provides an important corridor for wildlife. This area has historically been an important deer wintering area. Some grassland areas (mostly CRP) are located in the upper reaches of this watershed.

Resource Improvement Opportunities: The potential to significantly improve fish and wildlife habitat in this subwatershed is high. In particular, efforts to rehabilitate the Bois de Sioux River and its corridor have the potential to greatly benefit fish and wildlife in this subwatershed. In addition to considering natural resource enhancements when implementing projects in this subwatershed, the watershed district will encourage and support natural resource agencies and private landowners to take the following actions to protect and improve the natural resources in this subwatershed.

NRE Action Items

1. Maintain, improve and expand existing habitats along river, stream, and ditch corridors.

2. Increase grassland and wetland habitats within the river corridors (Lower Rabbit and Bois de Sioux) and other waterway corridors.

3. Increase grassland and wetland habitats adjacent to the river corridors and elsewhere in this subwatershed.

4. Develop rehabilitation plan(s) for channelized river and stream reaches.

5. Work with USACE to review the operating plan for the White Rock Dam and encourage changes to create a healthier flow regime for aquatic life, including downstream water quality improvements for domestic use, if changes could be made that do not affect the ability of Mud Lake to provide quality waterfowl habitat.

6. Consider the downstream impacts upon users of that drinking water in-take, namely Fargo-Moorhead.

E. Water Based Recreational Activities

Fishing was identified as a water based recreational activity for this subwatershed.

EAST BRANCH TWELVE MILE CREEK

DESCRIPTION OF WATERSHED

Watershed Setting

The East Branch Twelve Mile subwatershed is located in Stevens, Big Stone and Traverse counties (Figure 16). This subwatershed has an area of 164 square miles of which 93 percent is in agricultural production. The land mass is approximately 84 percent glacial moraine and 16 percent glacial lake plain. Surface water management problems within this watershed include: flooding, drainage, erosion, water quality, water supply, wildlife issues and cropland irrigation.

East Branch Twelve Mile Creek FDR Ordinal Rankings

1. Create an additional 30,000 acre-feet of storage.
2. Implement a project to address the "county line dispute."
3. Implement projects to address county and state road washout and inundation problems.

East Branch NRE Ordinal Rankings

1. Support projects that reduce erosion.
2. Support projects that reduce nutrient loading.

Existing Conditions, Related Problems and Opportunities

A. Water Quantity

The East Branch Twelve Mile subwatershed experiences frequent flooding throughout the subwatershed with spring flooding being almost an annual occurrence. Damages associated with this type of flood are to public infrastructure, personal property, cropland and public resources (fisheries, wildlife, soils and water quality). The upper reaches of the subwatershed are in the glacial moraine area having rolling topography and depressional wetland areas. Many of the wetlands have been drained by private and public drainage projects.

The East Branch Twelve Mile subwatershed is a headwaters area. Therefore, its flooding problems originate within the subwatershed. This subwatershed is also a major contributor to downstream flooding. It is considered a high opportunity area for flood storage type projects because they would tend to solve both the local and the downstream flooding problems. Similarly, water conserving measures that reduce runoff may be very beneficial in this area.

Because of the topography, including both drained and undrained wetlands, the area would seem to have great potential for multi-purpose flood control and natural resource

enhancement projects. Pursuing such projects should be a high priority within this subwatershed.

There are two areas where serious local conflicts have evolved around county boundaries. In one case, a Big Stone County ditch outlets into a natural waterway just upstream of the Traverse County line. The downstream flooding problems are generally attributed to the county ditch not extending to an adequate outlet. In the second case, two Traverse County ditches extend upstream to just short of the Stevens County line. Land in Stevens County not included in the benefited area and the downstream ditches are not considered adequate to handle improved drainage from land in Stevens County. Outlets into Traverse County are restricted and water from upstream drainage areas causes severe flooding along the county line. In both cases, upstream storage should be considered as a solution having widespread benefits.

FDR Action Items:

1. Pursue projects to create an additional estimated 30,000 acre-feet of flood storage within the East Branch Twelve Mile subwatershed.

2. Work with landowners to address the aforementioned county line disputes.

B. Water Quality

Water quality is poor within this subwatershed due to nutrient and sediment loading. Projects to improve water quality such as easements and landuse best management practices will be encouraged by the District.

C. Erosion and Sedimentation

Erosion due to storm runoff is another serious problem in the subwatershed. During periods of high runoff, channel erosion causes bank stabilization concerns. The severity depends on the land cover, duration, and volume of water. Erosion is often worse in the spring due to the lack of vegetative cover on the fields. The district will support the SWCDs in their efforts to promote agricultural best management practices to improve crop residue, tillage and cover and reduce soil erosion.

The landscape throughout the watershed has been extensively altered, primarily to improve agricultural production. While the agricultural land has been highly productive, much of the natural landscape values once present in the subwatershed have been lost. Most of the original prairie landscape has been cultivated and many of the original wetlands have been drained. Many of the original streams have been channelized and riparian corridors have been diminished or lost. In addition to maintaining soil productivity and minimizing crop

damage from blowing soil, control of wind erosion and the resulting sediment, has the added benefit of minimizing the clogging of drainage and road ditches.

Management of crop residues during tillage has long been a key component of an erosion control and water management strategy. Thirty percent crop residue after planting, averaged over the crop rotation, is generally recommended as the minimum amount of residue necessary to achieve acceptable soil erosion (a 65 percent reduction in soil erosion). A combination of a hydrologic soil group (soil) and a landuse and treatment class (cover) is used to determine the hydrologic soil-cover complex. The effect of the hydrologic soil-cover complex on the amount of rainfall that runs off is represented by a runoff curve number (CN). Higher curve numbers indicate more runoff. Conversion of cropland to grasslands via land retirement programs will achieve a significant reduction in runoff.

Retired riparian croplands provide the additional benefit of significantly reducing sediment, phosphorus and other pollutants contained within runoff entering the vegetative buffer strip. In addition to considering natural resource enhancements when implementing their projects in this subwatershed, the District will encourage and support natural resource agencies and private landowners to take the following actions to protect and improve the natural resources in this subwatershed.

NRE Action Items:

1. Support the efforts of the SWCDs to promote a Red River Valley Conservation Reserve Enhancement Program (CREP) program.

2. Support the efforts of the Stevens SWCD to implement projects that address nutrient and sediment loading.

3. Support the efforts of the Stevens SWCD to implement the following projects to reduce wind erosion over the next 10 years:

    - Install 20 miles of field windbreak.
    - Install 50 acres of farmstead shelterbelts.
    - Create 20 acres of wildlife habitat.
    - Create 40 acres of riparian forest buffers.

D. Fish and Wildlife Habitat

Existing resources: Most of the fish and wildlife habitat in this subwatershed has been lost due to landuse changes, drainage and channel modifications. The CAC/TAC identified the lack of riparian habitat as being an important problem in this subwatershed. Large habitat patches, conservation lands and riparian habitat are very limited in this subwatershed and most wetlands have been drained (MCEA report can be viewed at the watershed office). Streams in this subwatershed may provide some spawning and nursery habitat but hydrologic conditions probably limit these opportunities to a short spring period. An overall lack of grassland and wetland habitats limits pheasant, prairie chickens, and other wildlife populations.

Resource Improvement Opportunities: The potential to significantly improve fish and wildlife habitat in this subwatershed is high. In particular, increasing the grassland and wetland habitats have the potential to significantly increase bird species (including pheasant and prairie chicken populations) and may help sustain streamflows. In addition to considering natural resource enhancements when implementing their projects in this subwatershed, the District will encourage and support natural resource agencies and private landowners to take the following actions to protect and improve the natural resources in this subwatershed.

NRE Action Items:

1. Support the efforts of the Stevens SWCD to promote installation of buffer strips.

2. Increase grassland and wetland habitats near waterways.

3. Increase grassland and wetland habitats adjacent to waterways and elsewhere.

E. Water Based Recreational Activities

Fur bearer trapping, upland game hunting and waterfowl hunting recreational activities were identified for this subwatershed.

FIVE MILE CREEK

DESCRIPTION OF WATERSHED

Watershed Setting

The Five Mile Creek subwatershed is located in Grant, Stevens, and Traverse counties (Figure 16). This subwatershed has an area of 98 square miles of which 84 percent is in agricultural production. The land mass is approximately 82 percent glacial moraine, 16 percent glacial lake plain and 1 percent beach ridge. Surface water management problems within this watershed include: flooding, drainage, erosion, water quality, water supply, wildlife issues and cropland irrigation. A Legislative Commission on Minnesota Resources (LCMR) project lead by MNDNR is currently working to improve conditions on the Niemackl chain of lakes.

Five Mile Creek FDR Ordinal Rankings

1. Create an additional 10,000 acre-feet of storage.
2. Implement a project to improve public drainage systems.
3. Implement a project to address sedimentation south of Highway 27.

Five Mile NRE Ordinal Rankings

1. Support implementation of Niemackl Lake projects.
2. Support implementation of CRP.
3. Support implementation of projects to reduce erosion.

Existing Conditions, Related Problems and Opportunities

A. Water Quantity

The Five Mile Creek subwatershed experiences frequent flooding throughout the subwatershed. Flooding in this area is primarily related to antecedent moisture conditions. During extended wet periods, the lake and wetland water levels are high leaving very little room for flood storage. At the other extreme, during extended dry periods, all of the upstream runoff is absorbed by the lakes and wetlands. Damages associated with flooding are to public infrastructure, personal property, cropland and natural resources (fisheries, wildlife, soils and water quality). The City of Herman, near the downstream end of the subwatershed, has experienced significant flooding. The CAC identified flooding, high lake levels, crop damages and road damages as being high priority problems in this subwatershed.

FDR Action Items:

1. Pursue projects to create an additional 10,000 acre-feet of flood storage within the Five Mile Creek subwatershed. Targeted areas for storage projects are upstream from Herman including Big Lake and Ohlsrud Lake.

2. Work with affected landowners that petition for projects to address problems of inadequate waterway capacity and channel sedimentation.

B. Water Quality

Water quality within this subwatershed is impacted by nutrient and sediment loading including municipal wastewater discharges. Projects to improve water quality such as easements and landuse best management practices will be encouraged by the District.

NRE Action Item:

1. Support the efforts of the SWCDs to implement a project to improve water quality in the Niemackl Lakes project area.

C. Erosion and Sedimentation

Erosion due to storm runoff is another problem in the subwatershed. The severity depends on the land cover, duration and volume of water. Erosion is often worse in the spring due to the lack of vegetative cover on the fields. The district will support the efforts of the SWCDs to promote agricultural best management practices to improve crop residue, tillage and cover and reduce soil erosion.

The landscape throughout the watershed has been extensively altered, primarily to improve agricultural production. While the agricultural land has been highly productive, much of the natural landscape values once present in the subwatershed have been lost. Most of the original prairie landscape has been cultivated and many of the original wetlands have been drained. Many of the original streams have been channelized and riparian corridors have been diminished or lost. In addition to maintaining soil productivity and minimizing crop damage from blowing soil, control of wind erosion and the resulting sediment, has the added benefit of minimizing the clogging of drainage and road ditches.

Management of crop residues during tillage has long been a key component of an erosion control and water management strategy. Thirty percent crop residue after planting, averaged over the crop rotation, is generally recommended as the minimum amount of residue necessary to achieve acceptable soil erosion (a 65 percent reduction in soil erosion). A combination of a hydrologic soil group (soil) and a landuse and treatment class (cover) is used to determine the hydrologic soil-cover complex. The effect of the hydrologic soil-cover complex on the amount of rainfall that runs off is represented by a runoff curve number (CN). Higher curve numbers indicate more runoff. Conversion of cropland to grasslands via land retirement programs will achieve a significant reduction in runoff.

Retired riparian croplands provide the additional benefit of significantly reducing sediment, phosphorus and other pollutants contained within runoff entering the vegetative buffer strip.

In addition to considering natural resource enhancements when implementing their projects in this subwatershed, the District will encourage and support natural resource agencies and private landowners to take the following actions to protect and improve the natural resources in this subwatershed.

NRE Action Items:

1. Support the efforts of the SWCDs to promote a Red River Valley Conservation Reserve Enhancement Program (CREP) program.

2. Support the efforts of the Stevens SWCD to implement projects that address nutrient and sediment loading.

3. Support the efforts of the Stevens SWCD to implement the following projects to reduce wind erosion over the next 10 years:

    - Install 20 miles of field windbreak.
    - Install 50 acres of farmstead shelterbelts.
    - Create 20 acres of wildlife habitat.
    - Create 40 acres of riparian forest buffers.

D. Fish and Wildlife Habitat

Existing resources: Much of the fish and wildlife habitat in this subwatershed has been lost due to landuse changes, drainage, and channel modifications. This subwatershed was identified by the CAC/TAC as having some of the best remaining habitat within the District. Some large habitat patches, conservation lands, and riparian habitat are present in this subwatershed and some wetlands have not been drained (MCEA report can be viewed at the watershed office). Streams in this subwatershed may provide spawning and nursery habitat for some species but hydrologic conditions probably limit these opportunities to a short period during spring. Grassland and wetland habitats support some pheasant populations. Much of this subwatershed was included in the Niemackl Watershed LCMR project led by the MNDNR, an effort to improve water quality through wetland restoration, grass filter strips, conservation easements, septic system upgrades, and rough fish control. There is also the potential for a large habitat loss here and when existing CRP contracts expire.

Resource Improvement Opportunities: The potential to significantly improve fish and wildlife habitat in this subwatershed is high. In particular, increasing the amount of quality grassland and wetland habitats has the potential to significantly increase bird species (including pheasant and prairie chicken populations) and may help sustain streamflows. In addition to considering natural resource enhancements when implementing their projects in this subwatershed, the District will encourage and support natural resource agencies and private landowners to take the following actions to protect and improve the natural resources in this subwatershed.

NRE Action Items:

1. Support the efforts of the SWCDs to identify "at-risk" CRP land and identify alternatives to protecting existing land cover.

2. Support the efforts of the SWCDs and resource agencies to acquire land and easements to create more private and public conservation land in the subwatershed.

3. Support the efforts of the SWCDs and resource agencies to protect existing habitat areas and increase the quantity and quality of wetland and grassland habitats.

E. Water Based Recreational Activities

Water based recreational opportunities for the subwatershed include fishing, swimming and waterfowl hunting. Water based recreational opportunities include fishing potential on Cottonwood Lake, Graham Lake, Big Lake, as well as swimming in Cottonwood Lake and waterfowl hunting throughout the subwatershed. The subwatershed also supports some pheasant populations.

JUDICIAL DITCH 14

DESCRIPTION OF WATERSHED

Watershed Setting

The Judicial Ditch 14 subwatershed is located in Traverse, Grant and Stevens counties, and includes the City of Wheaton (Figure 16). This subwatershed has an area of 161 square miles of which 95 percent is in agricultural production. Located within the glacial lake plain, it is characterized by flat topography and widespread floodplains. Management problems within this watershed include: widespread flooding, inadequate drainage, erosion, poor water quality, extended periods with little or no flow and wildlife issues.

Judicial Ditch 14 FDR Ordinal Rankings

1. Create an additional 5,000 acre-feet of storage.
2. Implement projects to address flooding problems from 18 mile into 12 mile.

Judicial Ditch 14 NRE Ordinal Rankings

1. Support reductions to agricultural land erosion.
2. Support projects that reduce sediment/nutrient loading.

Existing Conditions, Related Problems and Opportunities

A. Water Quantity

Due to its location, flooding in the Judicial Ditch 14 subwatershed is driven by waters from upstream subwatersheds. Damages associated with flooding are to public infrastructure, personal property, cropland and public resources (fisheries, wildlife, soils and water quality). The CAC identified flooding, crop damages and road damages as being high priority problems in this subwatershed.

Judicial Ditch 14 is a channel improvement project constructed by the USACE. It included enlarging and straightening the Mustinka River, clearing and snagging Twelve Mile Creek, and enlargement of Traverse County Ditch 42. This project was turned over to the LGU-Joint County Board to be managed as a Legal Drainage System under MS 103E. Dispute over assessment areas was encountered and resolved. The resolution reduced the size of assessment areas making it smaller relative to the project drainage area. Maintenance is a problem due to the inability to generate enough money to do the work. The channel is unstable and its tendency to meander is causing severe erosion and bank failures.

Legal ditch systems dominate the drainage network in this subwatershed. They are typically a mile apart and have an east-west orientation. Most of the ditches outlet into Twelve Mile Creek. The exception is Traverse County Ditch (TCD) 27 which mostly follows a broad

swale formed by waters exiting Glacial Lake Agassiz. Most of the legal ditches have 2 to 5 year channel capacity, which would be considered marginally adequate.

FDR Action Items:

1. Pursue projects to create an additional 5,000 acre-feet of flood storage within the Judicial Ditch 14 subwatershed. A targeted area is near the upper end of TCD 27.

2. Consider a project to provide controlled transfer of water from Twelve Mile to Eighteen Mile Creek.

B. Water Quality

Water quality is poor within this subwatershed due to nutrient and sediment loading. The City of Herman's wastewater facility was also identified as an item of concern by the TAC. Projects to improve water quality such as easements and landuse best management practices will be encouraged by the District. The District will encourage the City of Herman to pursue improvements to its wastewater treatment system.

C. Erosion and Sedimentation

Erosion due to storm runoff is another problem in the subwatershed. The severity depends on the land cover, duration and volume of water. Erosion is often worse in the spring due to the lack of vegetative cover on the fields. The District will support the efforts of the SWCDs to promote agricultural best management practices to improve crop residue, tillage cover and reduce soil erosion.

The landscape throughout the watershed has been extensively altered, primarily to improve agricultural production. While the agricultural land has been highly productive, much of the natural landscape values once present in the subwatershed have been lost. Most of the original prairie landscape has been cultivated and many of the original wetlands have been drained. Many of the original streams have been channelized and riparian corridors have been diminished or lost. In addition to maintaining soil productivity and minimizing crop damage from blowing soil, control of wind erosion and the resulting sediment, has the added benefit of minimizing the clogging of drainage and road ditches.

Management of crop residues during tillage has long been a key component of an erosion control and water management strategy. Thirty percent crop residue after planting, averaged over the crop rotation, is generally recommended as the minimum amount of residue necessary to achieve acceptable soil erosion (a 65 percent reduction in soil erosion). A combination of a hydrologic soil group (soil) and a landuse and treatment class (cover) is used to determine the hydrologic soil-cover complex. The effect of the hydrologic soil-cover complex on the amount of rainfall that runs off is represented by a runoff curve number

(CN). Higher curve numbers indicate more runoff. Conversion of cropland to grasslands via land retirement programs will achieve a significant reduction in runoff.

Retired riparian croplands provide the additional benefit of significantly reducing sediment, phosphorus and other pollutants contained within runoff entering the vegetative buffer strip. In addition to considering natural resource enhancements when implementing their projects in this subwatershed, the District will encourage and support natural resource agencies and private landowners to take the following actions to protect and improve the natural resources in this subwatershed.

NRE Action Items:

1. The District will support the efforts of the SWCD to:

    - Establish 150 miles of field windbreaks.
    - Annually convert 700 acres of marginal land to native vegetation.
    - Promote 80,000 acres of residue management practices.
    - Install 30 water control structures.

D. Fish and Wildlife Habitat

Existing Resources: Most of the fish and wildlife habitat in this subwatershed has been lost due to landuse changes, drainage and channel modifications. Large habitat patches, conservation lands and riparian habitat are very limited in this subwatershed and most wetlands have been drained (MCEA report can be viewed at the watershed office). A reach of the Mustinka River and the lower reaches of several streams located in this subwatershed may provide spawning and nursery habitat to several fish species. An overall lack of grassland and wetland habitats limits pheasant, prairie chickens and other wildlife populations.

Resource Improvement Opportunities: The potential to significantly improve fish and wildlife habitat in this subwatershed is high. In particular, buffering waterways and increasing the grassland and wetland habitats have the potential to significantly increase bird species (including pheasant and prairie chicken populations) and may help sustain streamflows. Rehabilitating streams and increasing fish passage also have potential to enhance the value of stream resources in this subwatershed. In addition to considering natural resource enhancements when implementing their projects in this subwatershed, the watershed district will encourage and support natural resource agencies and private landowners to take the following actions to protect and improve the natural resources in this subwatershed.

NRE Action Items:

1. Support the efforts of the SWCDs and resource agencies to increase grassland and wetland habitats near waterways.

2. Support the efforts of the SWCDs and resource agencies to increase grassland and wetland habitats adjacent to waterways and elsewhere.

3. Support the efforts of the SWCDs and resource agencies to develop rehabilitation plans for the Mustinka River and other waterways.

E. Water Based Recreational Activities

No water based recreational opportunities were identified in this subwatershed.

LAKE TRAVERSE

DESCRIPTION OF WATERSHED

Watershed Setting

The Lake Traverse subwatershed is located in Traverse County (Figure 16). It is hydrologically dominated by Lake Traverse. Lake Traverse was a reach of the outlet channel from Glacial Lake Agassiz. The lake was formed by post glacial sediment deposition at the outlets of tributary Mustinka and Little Minnesota Rivers. Lake Traverse, and Mud Lake to its north, have been modified by dams constructed and operated by the USACE primarily for downstream flood control.

This subwatershed has an area of 167 square miles of which 82 percent is in agricultural production. The land mass is approximately 52 percent glacial lake plain, 47 percent glacial moraine and 1 percent beach ridge. Management problems within this watershed include: flooding, drainage, erosion, water quality, water supply, and fish and wildlife issues.

Lake Traverse FDR Ordinal Rankings

1. Create an additional 5,000 acre-feet of storage.
2. Work with the USACE to address operational issues associated with high water levels and shoreline erosion on Lake Traverse.

Lake Traverse NRE Ordinal Rankings

1. Support improvement of septic systems.
2. Support projects to reduce erosion.
2. Support projects to improve water quality.

Existing Conditions, Related Problems and Opportunities

A. Water Quantity

Flooding problems are primarily confined to drained pothole and flat land areas on the plateau high above Lake Traverse and to developed shoreland along the lake. Damages associated with flooding are to public infrastructure, personal property, cropland and public resources (fisheries, wildlife, soils and water quality). The CAC identified flooding, high lake levels, crop damages and road damages as being high priority problems in this subwatershed.

The Lake Traverse Project of the USACE consists of two reservoirs. The upper reservoir, which includes Lake Traverse, has a dam at the outlet to control the lake level elevation at 976.8, if possible. The lower reservoir includes Mud Lake. The dam at the outlet is operated

primarily to control downstream flooding. It is also operated to control water levels in the marsh at about elevation 972 during non-flood periods. During large floods the project operates as one reservoir with a maximum design flood pool elevation of 982. Flood control storage to that elevation is 151,500 acre-feet of which is gate controlled storage. In anticipation of severe spring flooding, the USACE may draw Lake Traverse down to 974.5, providing an additional 25,000 acre-feet of available flood control storage. Shoreline erosion and flooding of cabins are problems related to high waters during flood control operation.

FDR Action Items:

1. Pursue projects to create an additional 5,000 acre-feet of flood storage within the Lake Traverse subwatershed. A target area would be along Traverse County Ditch 52.

2. Work with the USACE to address operational issues associated with high water levels and shoreline erosion on Lake Traverse.

B. Water Quality

Water quality is poor within this subwatershed due to nutrient and sediment loading. Shoreline erosion along Lake Traverse has been identified as a major contributor to poor water quality. Failing septic systems along Lake Traverse have been identified by the CAC/TAC as a major contributor to poor water quality in Lake Traverse. Projects to improve water quality such as easements and landuse best management practices will be encouraged by the District. Releases have been associated with degrading downstream water quality, when possible consider water quality impacts on downstream industry. The District will promote the upgrade of septic systems along the lake.

C. Erosion and Sedimentation

Management of crop residues during tillage has long been a key component of an erosion control and water management strategy. Thirty percent crop residue after planting, averaged over the crop rotation, is generally recommended as the minimum amount of residue necessary to achieve acceptable soil erosion (a 65 percent reduction in soil erosion). A combination of a hydrologic soil group (soil) and a landuse and treatment class (cover) is used to determine the hydrologic soil-cover complex. The effect of the hydrologic soil-cover complex on the amount of rainfall that runs off is represented by a runoff curve number (CN). Higher curve numbers indicate more runoff. Conversion of cropland to grasslands via land retirement programs will achieve a significant reduction in runoff.

Retired riparian croplands provide the additional benefit of significantly reducing sediment, phosphorus and other pollutants contained within runoff entering the vegetative buffer strip. In addition to considering natural resource enhancements when implementing their projects in this subwatershed, the District will encourage and support natural resource agencies and

private landowners to take the following actions to protect and improve the natural resources in this subwatershed.

NRE Action Items:

1. The District will support the Traverse County Local Water Planner and the SWCD in their efforts to:

    - Design and install conservation practices for the Traverse Lake Improvement Project:
        - increase conservation tillage by 5,000 acres,
        - create 10 acres of new waterways,
        - create 3 water and sedimentation control basins,
        - establish 5 miles of field windbreaks,
        - establish 10 acres of farmstead shelterbelts,
        - cultivate 5 acres of wildlife plantings,
        - create 100 acres of buffer strips.

2. The District will support the work of the USACE to improve downstream water quality and reduce impacts on downstream industry and municipal water users.

D. Fish and Wildlife Habitat

Existing Resources: Much of the fish and wildlife habitat in this subwatershed has been lost due to landuse changes, drainage and channel modifications. The CAC/TAC identified loss of grassland and wetlands, degraded spawning habitat and botulism problems on Mud Lake as being priority problems. Some large habitat patches, conservation lands and riparian habitat are present in this subwatershed while most wetlands have been drained (MCEA report can be viewed at the watershed office). The portion of the subwatershed along Lake Traverse contains unique habitats in the Bois de Sioux subwatershed. Several sites in this area support hillside prairie tracts with oak and ash woodlands also present. These are important for deer and turkey populations. Lake Traverse supports a quality fishery and Lake Traverse and Mud Lake provides important waterfowl migratory habitat.

Resource Improvement Opportunities: The potential to significantly improve fish and wildlife habitat in this subwatershed is high. In particular, buffering waterways and protecting the habitats along Lake Traverse will ensure the continued existence of these important and unique resources. In addition to considering natural resource enhancements when implementing their projects in this subwatershed, the District will encourage and support natural resource agencies and private landowners to take the following actions to protect and improve the natural resources in this subwatershed.

NRE Action Items:

1. Support the efforts of the SWCD and resource agencies to protect the hillsides and ravines adjacent to Lake Traverse.

2. Support the efforts of the SWCD and resource agencies to improve water quality in Lake Traverse to maintain the value of this area for waterfowl habitat.

3. Support the efforts of the SWCD and resource agencies to acquire land and easements to create more private and public conservation lands in the subwatershed.

4. Support the efforts of the SWCD and resource agencies to protect existing habitat areas and increase the quantity and quality of wetland and grassland habitats.

5. Support the efforts of the MNDNR on the development of a Lake Traverse management plan.

E. Water Based Recreational Activities

The District will review existing recreational use surveys for this area and will promote the opportunities for enhanced recreational opportunities when implementing watershed projects.

MUSTINKA RIVER

DESCRIPTION OF WATERSHED

Watershed Setting

The Mustinka River subwatershed contains the upper reaches of the Mustinka River where it meanders within the valley of a glacial river. The Mustinka River subwatershed has a total drainage area of 191 square miles. Almost 94 percent of the landmass of this subwatershed is glacial moraine. Prior to settlement, the subwatershed was dominated by prairie grassland with a high density of wetlands (15-20 percent land cover) especially above the glacial Lake Agassiz beach ridge. Agricultural development has resulted in diminished wildlife habitat, and over 83 percent of the watershed is cropland. Figure 16 illustrates the location of the Mustinka River subwatershed within the Bois de Sioux Watershed. The Mustinka River subwatershed covers parts of two counties including Grant and Otter Tail. The major city within this area is Elbow Lake. Industry of the area is primarily agricultural. Transportation routes within the area include township, county, state and federal highways and two railroad systems.

This subwatershed has significant management problems including flooding, inadequate drainage, erosion, water quality, water supply and wildlife issues.

Mustinka River FDR Ordinal Rankings

1. Create an additional 20,000 acre-feet of storage.
2. Pursue projects to address flooding at County Roads (CR) # 1, #8, #9 and #11.
3. Implement a FDR project at the Pine Ridge Park Structure.
4. Implement a project to update floodplain maps.

Mustinka River NRE Ordinal Rankings

1. Support wetland restoration.
2. Support planting of buffer strips.

Existing Conditions, Related Problems and Opportunities

A. Water Quantity

Within the Mustinka River subwatershed frequent flooding is a problem. Damages associated with large floods are to infrastructure, personal property, cropland and public resources (i.e. fisheries, wildlife, soils, and water quality).

Flood flows within this watershed are moderated by lakes and depressional wetland areas. They are also greatly attenuated by floodplain storage in the Mustinka River Valley. Culvert

crossings under roads contribute flow control until the roads are overtopped. Future sizing of culverts is critical to maintaining flow control. Additional control could be realized by raising roads that frequently overtop.

Action Items:

1. Pursue the implementation of projects to construct 20,000 acre-feet of storage within this subwatershed.

B. Water Quality

Numerous water quality benefits will be achieved upon the effective implementation of the activities proposed by the Bois de Sioux Project Team within this subwatershed plan. The storage of flood water during spring runoff events and storm events in impoundments and through other activities, will serve to reduce erosion and sediment transport by allowing soil particles to settle in basins prior to discharge. The aforementioned activities should also allow for the reduction of other nutrients present in the water, such as phosphorus. Controlling water release over a period of time would also reduce stream bank erosion immediately downstream from structures.

The TMDL process requires pre- and post-implementation of water quality monitoring in the watershed adjacent to project sites to establish baseline water quality conditions for the area and to document water quality enhancements to portions of the watershed downstream of the projects after implementation. This water quality sampling and data analysis should be coordinated with the TMDL being proposed by the MPCA for select reaches of the Mustinka River. Goals for the Mustinka River Watershed's water quality are below.

FDR Action Items:

1. Develop a monitoring program to qualify and quantify both the current water quality situation and the extent of any water quality problem in the subwatershed. This plan should address three specific areas of work:

    a) Baseline data collection and analysis;
    b) Project specific data collection and analysis; and
    c) Mustinka River TMDL study.

2. Develop a continuous collection of flow regimes, chemical, physical, and biological data. The parameters should be based on the Stream Classification as out lined in Minnesota Rules 7050.0220 and 7050.0221 through 7050.0227.

    Sampling should be conducted at least monthly, for at least one year to assess the current water quality situation. Further sampling should be conducted at least

quarterly beyond the first year to build a long-term database. The database should utilize a user-friendly format that can be accessed by all identified stakeholders. Specific sampling locations and frequencies can be developed here or in a separate monitoring document.

3. Based on the results above, identify solutions to problems and expand the objectives to address said problems.

MPCA Action Items:

1. Assist the MPCA in the development of a TMDL study.

2. Monitor four locations on the Mustinka River for Ammonia, Dissolved Oxygen and other parameters relating to Dissolved Oxygen and Ammonia.

    a) Collect water quality data monthly for one year;
    b) Collect flow data for one year;
    c) Reduce data to provide a total daily load of the above parameters;
    d) Verify the TMDL list using this data;
    e) If there is verification, identify the sources of the load;
    f) Implement activities to correct the problem ; and
    g) Delist the Mustinka River as a TMDL study.

    The MPCA will provide funding ($50,000) and technical assistance to the project sponsor, as they manage the TMDL study.

    The TMDL process can easily fit into a larger subwatershed monitoring plan, as described in B.1, FDR Action Items, above.

C. Erosion and Sedimentation

The landscape throughout the watershed has been extensively altered, primarily to improve agricultural production. While the agricultural land have been highly productive, much of the natural landscape values once present in the subwatershed have been lost. Most of the original prairie landscape has been cultivated and many of the original wetlands have been drained. Many of the original streams have been channelized and riparian corridors have been diminished or lost. In addition to maintaining soil productivity and minimizing crop damage from blowing soil, control of wind erosion and the resulting sediment, has the added benefit of minimizing the clogging of drainage and road ditches.

Management of crop residues during tillage has long been a key component of an erosion control and water management strategy. Thirty percent crop residue after planting, averaged

over the crop rotation, is generally recommended as the minimum amount of residue necessary to achieve acceptable soil erosion (a 65 percent reduction in soil erosion). A combination of a hydrologic soil group (soil) and a landuse and treatment class (cover) is used to determine the hydrologic soil-cover complex. The effect of the hydrologic soil-cover complex on the amount of rainfall that runs off is represented by a runoff curve number (CN). Higher curve numbers indicate more runoff. Conversion of cropland to grasslands via land retirement programs will achieve a significant reduction in runoff.

Retired riparian croplands provide the additional benefit of significantly reducing sediment, phosphorus and other pollutants contained within runoff entering the vegetative buffer strip. In addition to considering natural resource enhancements when implementing their projects in this subwatershed, the District will encourage and support natural resource agencies and private landowners to take the following actions to protect and improve the natural resources in this subwatershed.

OBJECTIVES

1. Encourage and promote the establishment of field windbreaks, using native plant species wherever possible.

2. Consider a project at the Pine Ridge Park structure that focuses on sediment control and removal.

D. Fish, Wildlife, and other Natural Resources

Existing Resources: Much of the fish and wildlife habitat in this subwatershed has been lost due to landuse changes, drainage, and channel modifications. More habitat patches, conservation land, riparian habitats, and wetlands remain in this subwatershed than in any other (MCEA report can be viewed at the watershed office). The Mustinka River and the network of streams in this subwatershed have the potential to provide spawning, nursery, and seasonal habitat for a number of fish species. Extended periods of low flow limit the ability of these streams to support diverse aquatic life year round. This area is also important for grassland bird species and provides nesting and seasonal habitats for migrating birds.

Resource Improvement Opportunities: The potential to significantly improve fish and wildlife habitat in this subwatershed is high. In particular, more grassland and wetland habitats should be developed near existing habitats and along the Mustinka River. In addition to considering natural resource enhancements when implementing their projects in this subwatershed, the District will encourage and support natural resource agencies and

private landowners to take the following actions to protect and improve the natural resources in this subwatershed.

NRE Action Items

1. Protect all existing wetlands in the subwatershed.

2. Support other agency programs to restore, enhance and/or protect additional wetlands.

3. Manage impoundments to attenuate flows in the Mustinka River and tributaries whenever possible.

4. Reduce in stream sediment loads through implementation of BMPs to reduce soil erosion and runoff.

5. Integrate water level manipulations in impoundments to encourage use as a feeding and resting area by migratory birds, both game and non-game species.

6. Manage water levels and vegetation (wetland and upland) within impoundments, to provide maximum wildlife habitat value and related public use opportunities within the constraints of flood protection goals and management requirements.

E. Water Based Recreational Activities

This subwatershed was identified as having some of the better remaining habitat blocks and recreational opportunities within the District. However, adverse impacts to water quality and draining of wetlands have contributed to a decline in recreational opportunities such as fishing, swimming and hunting.

RABBIT RIVER

DESCRIPTION OF WATERSHED

Watershed Setting

The Rabbit River subwatershed covers parts of three counties including Grant, Otter Tail and Wilkin. The cities within this area include Nashua and Campbell. The total drainage area is 126 square miles. Figure 16 illustrates the location of the Rabbit River subwatershed within the Bois de Sioux Watershed. The upper reaches are in the glacial moraine area which constitutes 25 percent of the subwatershed. Sixty-eight percent is lake plain and 7 percent is beach ridge.

Industry of the area is primarily agricultural. Agricultural development has resulted in diminished wildlife habitat, and channelization of natural watercourses has converted over 75 percent of the riparian habitat in the watershed to cropland. Over 92 percent of the land within this subwatershed is in agricultural production. The Rabbit River subwatershed has significant surface water management problems (i.e. flooding, drainage, erosion, water quality, water supply, and fish and wildlife issues).

Rabbit River FDR Ordinal Rankings

1. Create an additional 20,000 acre-feet of storage.

Rabbit River NRE Ordinal Rankings

1. Support planting of buffer strips.
2. Support projects that reduce erosion.
3. Support a project to reduce Upper Lightning Lake erosion.

Existing Conditions, Related Problems and Opportunities

A. Water Quantity

Within the Rabbit River subwatershed frequent flooding is a problem. A spring flood is almost an annual occurrence. Damages associated with flooding are infrastructure, personal property, cropland, and public resources (i.e. fisheries, wildlife, soils, and water quality).

Flood flows from the glacial moraine area are attenuated by lakes and depressional wetlands. Runoff from the west slopes of the beach ridges is very fast and causes problems when it runs out onto the flat lake plain area. Ditches constructed to carry these flows include Grant County Ditch #5 (GCD) and Wilkin County Ditches 8, 9, and 10 (WCD). The WCD have inadequate capacity resulting in frequent flooding. These ditches empty into the Rabbit River which frequently floods over a wide area. Storage in the upper reaches is the preferred

solution to flooding in the Rabbit River subwatershed. This includes storage in the upstream North Ottawa and South Fork Rabbit River subwatersheds.

1. The District intends to pursue the development of approximately 20,000 acre-feet of storage within this subwatershed. Targeted areas are along WCDs 8, 9, 10, and GCD 5.

B. Water Quality

The MPCA has identified the Rabbit River as an impaired water body due to high levels of ammonia and turbidity. The source of the ammonia problem is unknown at this time and is being investigated. Water Quality data is very limited for this area. Due to the prominence of cultivated land within the subwatershed, high levels of total suspended solids, total phosphorus, and other contaminants are suspected by the Bois de Sioux Project team. This correlation is based on the latest USDA Natural Resource Conservation Service Tillage Transect Survey.

The TMDL process requires pre- and post-implementation of water quality monitoring in the watershed adjacent to project sites to establish baseline water quality conditions for the area and to document water quality enhancements to portions of the watershed downstream of the projects after implementation. This water quality sampling and data analysis should be coordinated with the TMDL being proposed by the MPCA for the Rabbit River.

Action Item:

1. Develop a monitoring program to qualify and quantify both the current water quality situation and the extent of any water quality problem in the subwatershed. This plan should address three specific areas of work:

    a) Baseline data collection and analysis;
    b) Project specific data collection and analysis; and
    c) Rabbit River TMDL study.

2. Develop a continuous collection of flow regimes, chemical, physical, and biological data. The parameters should be based on the Stream Classification as out lined in Minnesota Rules 7050.0220 and 7050.0221 through 7050.0227.

    Sampling should be conducted at least monthly, for at least one year to assess the current water quality situation. Further sampling should be conducted at least quarterly beyond the first year to build a long-term database. The database should utilize a user-friendly format that can be accessed by all identified stakeholders.

Specific sampling locations and frequencies can be developed here or in a separate monitoring document.

C. Erosion and Sedimentation

Erosion due to storm water runoff and wind is another serious problem in the subwatershed. During periods of sedimentation, channel erosion causes bank stabilization concerns for Upper Lightning Lake. The severity depends on the land cover, duration, and volume of water. Erosion is often worse in the spring due to the lack of vegetative cover on the fields and snow blocked ditches that force flood flows to go overland.

In addition to considering natural resource enhancements when implementing their projects in this subwatershed, the watershed district will encourage and support natural resource agencies and private landowners to take the following actions to protect and improve the natural resources in this subwatershed.

The landscape throughout the watershed has been extensively altered, primarily to improve agricultural production. While the agricultural land has been highly productive, much of the natural landscape values once present in the subwatershed have been lost. Most of the original prairie landscape has been cultivated and many of the original wetlands have been drained. Many of the original streams have been channelized and riparian corridors have been diminished or lost. In addition to maintaining soil productivity and minimizing crop damage from blowing soil, control of wind erosion and the resulting sediment, has the added benefit of minimizing the clogging of drainage and road ditches.

Management of crop residues during tillage has long been a key component of an erosion control and water management strategy. Thirty percent crop residue after planting, averaged over the crop rotation, is generally recommended as the minimum amount of residue necessary to achieve acceptable soil erosion (a 65 percent reduction in soil erosion). A combination of a hydrologic soil group (soil) and a landuse and treatment class (cover) is used to determine the hydrologic soil-cover complex. The effect of the hydrologic soil-cover complex on the amount of rainfall that runs off is represented by a runoff curve number (CN). Higher curve numbers indicate more runoff. Conversion of cropland to grasslands via land retirement programs will achieve a significant reduction in runoff.

Retired riparian croplands provide the additional benefit of significantly reducing sediment, phosphorus and other pollutants contained within runoff entering the vegetative buffer strip. In addition to considering natural resource enhancements when implementing their projects in this subwatershed, the District will encourage and support natural resource agencies and private landowners to take the following actions to protect and improve the natural resources in this subwatershed.

NRE Action Items:

1. Support the efforts of the counties to promote practices that reduce gully erosion in field waterways.

2. The District will support the SWCD's efforts to promote the planting of buffer strips and the construction of 80-120 water and sediment control structures.

3. Increase cropland acreage using conservation tillage by 30 percent.

4. Accelerate the installation of vegetative buffer strips and participation in retirement programs by establishing buffer strips on 85 percent of shoreland areas and 50 percent of other eligible lands by 2006. Conduct mailing to all landowners and operators in the watershed highlighting areas eligible for program buffers on aerial photos. Conduct follow-up calls to landowners and assist with the development of CRP plans.

5. Restore 4 wetland basins per year, totaling 320 acres of wetland habitat and another 100 acres of upland buffer habitat.

D. Fish and Wildlife Habitat

Existing Resources: Most of the fish and wildlife habitat in this subwatershed has been lost due to landuse changes, drainage, and channel modifications. Some large habitat patches, conservation lands, and riparian habitat are present in this subwatershed and some wetlands have not been drained (MCEA report). The Rabbit River and numerous tributary streams located in this subwatershed may provide spawning and nursery habitat for several fish species but channel modifications and hydrologic conditions probably limit these opportunities to a short period during spring. An overall lack of grassland and wetland habitats limits pheasant, prairie chickens, and other wildlife populations.

Resource Improvement Opportunities: The potential to significantly improve fish and wildlife habitat in this subwatershed is high. In particular, buffering waterways and increasing the grassland and wetland habitats have the potential to significantly increase bird species (including pheasant and prairie chicken populations) and may help sustain streamflows. In addition to considering natural resource enhancements when implementing their projects in this subwatershed, the watershed district will encourage and support natural resource agencies and private landowners to take the following actions to protect and improve the natural resources in this subwatershed.

NRE Action Items:

1. Support the Grant County Comprehensive Local Water Plan (CLWP) and SWCD in their efforts to implement projects that improve habitat.

2. Maintain and improve existing grassland and wetland habitats.

3. Increase grassland and wetland habitats near waterways.

4. Increase grassland and wetland habitats adjacent to waterways and elsewhere.

5. Develop rehabilitation plan for the waterways.

E. Water Based Recreational Activities

Upper Lightning Lake was identified as having decreased duck hunting opportunities.

SOUTH FORK RABBIT RIVER

DESCRIPTION OF WATERSHED

Watershed Setting

The South Fork Rabbit River subwatershed is located in both Wilkin and Traverse counties (Figure 16). This subwatershed has an area of 58 square miles of which 97 percent is in agricultural production. The land mass is approximately 99 percent glacial lake plain. Management problems within this watershed include: flooding, drainage, erosion, water quality, wildlife issues.

The subwatershed is in an interbeach area of the glacial lake plain. The low area between the beaches has a very gradual northerly slope. Drainage of this subwatershed is provided by a densely constructed network of legal drainage ditches. Most of these ditches have inadequate to marginal capacity. The outlet is into the Rabbit River.

South Fork Rabbit River Creek FDR Ordinal Rankings

1. Create an additional 5,000 acre-feet of storage.
2. Implement a drainage improvement project at Traverse County Ditch (TCD) #53.

South Fork Rabbit River Ordinal Rankings

1. Support planting of buffer strips.
2. Implements projects to reduce stream bank erosion.

Existing Conditions, Related Problems and Opportunities

A. Water Quantity

The South Fork Rabbit River subwatershed experiences frequent flooding throughout the subwatershed. Spring flooding is almost an annual occurrence. Damages associated with flooding are to public infrastructure, personal property, cropland and public resources (fisheries, wildlife, soils and water quality). The CAC identified crop damages and road damages as being high priority problems in this subwatershed.

FDR Action Items:

1. Pursue projects to create an additional 5,000 acre-feet of flood storage within the subwatershed. Target areas are upstream of TCD #53. The District will cooperate with landowner initiatives that improve drainage on TCD #53.

B. Water Quality

Water quality is poor within this subwatershed due to nutrient and sediment loading. Projects to improve water quality such as easements and landuse best management practices will be encouraged by the District.

The TMDL process requires pre- and post-implementation of water quality monitoring in the watershed adjacent to project sites to establish baseline water quality conditions for the area and to document water quality enhancements to portions of the watershed downstream of the projects after implementation.

C. Erosion and Sedimentation

Erosion due to storm water runoff is another problem in the subwatershed. The severity depends on the land cover, duration and volume of water. Erosion is often worse in the spring due to the lack of vegetative cover on the fields. The District will encourage the SWCDs to promote agricultural best management practices to improve crop residue, tillage and cover and reduce soil erosion.

The landscape throughout the watershed has been extensively altered, primarily to improve agricultural production. While the agricultural land has been highly productive, much of the natural landscape values once present in the subwatershed have been lost. Most of the original prairie landscape has been cultivated and many of the original wetlands have been drained. Many of the original streams have been channelized and riparian corridors have been diminished or lost. In addition to maintaining soil productivity and minimizing crop damage from blowing soil, control of wind erosion and the resulting sediment, has the added benefit of minimizing the clogging of drainage and road ditches.

Management of crop residues during tillage has long been a key component of an erosion control and water management strategy. Thirty percent crop residue after planting, averaged over the crop rotation, is generally recommended as the minimum amount of residue necessary to achieve acceptable soil erosion (a 65 percent reduction in soil erosion). A combination of a hydrologic soil group (soil) and a landuse and treatment class (cover) is used to determine the hydrologic soil-cover complex. The effect of the hydrologic soil-cover complex on the amount of rainfall that runs off is represented by a runoff curve number (CN). Higher curve numbers indicate more runoff. Conversion of cropland to grasslands via land retirement programs will achieve a significant reduction in runoff.

Retired riparian croplands provide the additional benefit of significantly reducing sediment, phosphorus and other pollutants contained within runoff entering the vegetative buffer strip. In addition to considering natural resource enhancements when implementing their projects

in this subwatershed, the District will encourage and support natural resource agencies and private landowners to protect and improve the natural resources in this subwatershed.

D. Fish and Wildlife Habitat

Existing Resources: Most of the fish and wildlife habitat in this subwatershed has been lost due to landuse changes, drainage and channel modifications. The CAC/TAC identified the lack of wetlands and upland cover as being important problems in this subwatershed. Large habitat patches, conservation lands and riparian habitat are very limited in this subwatershed and most wetlands have been drained (MCEA report can be viewed in the watershed office). Tributary waterways located in this subwatershed may provide spawning and nursery habitat for several fish species but hydrologic conditions probably limit these opportunities to a short period during spring. An overall lack of grassland and wetland habitats limits pheasant, prairie chickens and other wildlife populations.

Resource Improvement Opportunities: The potential to significantly improve fish and wildlife habitat in this subwatershed is high. In particular, buffering waterways, increasing the grassland and wetland habitats have the potential to significantly increase bird species (including pheasant and prairie chicken populations) and may help sustain streamflows. In addition to considering natural resource enhancements when implementing their projects in this subwatershed, the watershed district will encourage and support natural resource agencies and private landowners to take the following actions to protect and improve the natural resources in this subwatershed:

NRE Action Items:

1. Maintain and improve existing grassland and wetland habitats.

2. Increase grassland and wetland habitats near waterways.

3. Increase grassland and wetland habitats adjacent to waterways and elsewhere.

4. Develop rehabilitation plan for waterways in this subwatershed.

5. Support the efforts of others to protect and improve the natural resources in the subwatershed.

E. Water Based Recreational Activities

No water based recreational opportunities were identified in this subwatershed.

WEST BRANCH TWELVE MILE

DESCRIPTION OF WATERSHED

Watershed Setting

The West Branch Twelve Mile subwatershed is located in both Big Stone and Traverse counties (Figure 16). Dumont and Graceville are cities within this subwatershed. This subwatershed has an area of 179 square miles of which 92 percent is in agricultural production. The land mass is approximately 81 percent glacial moraine and 19 percent glacial lake plain. Surface water management problems within this watershed include: flooding, drainage, erosion, water quality, and wildlife issues.

West Branch Twelve Mile Creek FDR Ordinal Rankings

1. Create an additional 30,000 acre-feet of storage.
2. Address Judicial Ditch #4 concerns when the opportunity exists.
3. Implement urban flood damage reduction projects.

West Bank Twelve Mile NRE Ordinal Rankings

1. Support projects that reduce erosion and sedimentation.
2. Support projects to improve East Toqua Lake.

Existing Conditions, Related Problems and Opportunities

A. Water Quantity

The West Branch Twelve Mile subwatershed experiences frequent flooding throughout the subwatershed. Spring flooding is almost an annual occurrence. Damages associated with flooding are to public infrastructure, personal property, cropland and public resources (fisheries, wildlife, soils and water quality). This subwatershed has been identified as a major contributor to downstream flooding.

The moraine area is characterized by lakes and depressional wetland basins. Many of them are landlocked basins, or were prior to construction of public and private ditch systems. Flood flows in the moraine area are relatively slow due to storage on lake and wetland areas. The City of Graceville, located on the banks of East Toqua Lake, is subject to flooding due to occasionally high lake levels. Storage is the preferred solution to flooding in this part of the District. Opportunities exist to restore many of the previously drained basins which would provide natural resource benefits along with flood control. One such project is under way with the planned restoration of Moonshine Lake which had been drained by Big Stone County Ditch 8.

In contrast, the upper lake plain area is characterized by relatively steep sloping lands. Rapid runoff from steep slopes combined with the fan shape of the watershed lead to flash flood conditions in the area around and including the City of Dumont. Due to the flooding problems downstream, storage is the preferred solution in this area also. Reservoirs will have to be built through the construction of dikes, since there are few natural storage areas.

FDR Action Items:

1. Pursue projects to create an additional 30,000 acre-feet of flood storage within the West Branch Twelve Mile subwatershed.

2. Implement a project to address the "county line dispute."

3. Work with the Minnesota Department of Transportation (MnDOT) to eliminate the road washout and inundation problems with Highway 75.

4. Implement the Moonshine Lake project.

B. Water Quality

Water quality is poor within this subwatershed due to nutrient and sediment loading. Projects to improve water quality such as easements and landuse best management practices will be encouraged by the District.

C. Erosion and Sedimentation

Erosion due to storm runoff is another serious problem in the subwatershed. During periods of high runoff, channel erosion causes bank stabilization concerns. The severity depends on the land cover, duration and volume of water. Erosion is often worse in the spring due to the lack of vegetative cover on the fields. The District will promote agricultural best management practices to improve crop residue, tillage and cover and reduce soil erosion.

The landscape throughout the watershed has been extensively altered, primarily to improve agricultural production. While the agricultural land has been highly productive, much of the natural landscape values once present in the subwatershed have been lost. Most of the original prairie landscape has been cultivated and many of the original wetlands have been drained. Many of the original streams have been channelized and riparian corridors have been diminished or lost. In addition to maintaining soil productivity and minimizing crop damage from blowing soil, control of wind erosion and the resulting sediment, has the added benefit of minimizing the clogging of drainage and road ditches.

Management of crop residues during tillage has long been a key component of an erosion control and water management strategy. Thirty percent crop residue after planting, averaged

over the crop rotation, is generally recommended as the minimum amount of residue necessary to achieve acceptable soil erosion (a 65 percent reduction in soil erosion). A combination of a hydrologic soil group (soil) and a landuse and treatment class (cover) is used to determine the hydrologic soil-cover complex. The effect of the hydrologic soil-cover complex on the amount of rainfall that runs off is represented by a runoff curve number (CN). Higher curve numbers indicate more runoff. Conversion of cropland to grasslands via land retirement programs will achieve a significant reduction in runoff.

Retired riparian croplands provide the additional benefit of significantly reducing sediment, phosphorus and other pollutants contained within runoff entering the vegetative buffer strip. In addition to considering natural resource enhancements when implementing their projects in this subwatershed, the District will encourage and support natural resource agencies and private landowners to take the following actions to protect and improve the natural resources in this subwatershed.

NRE Action Items:

1. Support the efforts of the SWCDs to implement a buffer strip program to reduce erosion and sedimentation.

2. Manage closed basins to reduce erosion in during flash events.

D. Fish and Wildlife Habitat

Existing Resources: Much of the fish and wildlife habitat in this subwatershed has been lost due to landuse changes, drainage and channel modifications. The CAC/TAC identified the lack of wetlands and upland cover as being important problems in this subwatershed. Some large habitat blocks, public and private conservation land, and riparian habitat are present in this subwatershed and some wetlands have not been drained (MCEA report can be viewed at the watershed office). The numerous waterways in this subwatershed may provide spawning and nursery habitat for several fish species but channel modifications and hydrologic conditions probably limit these opportunities to a short period during spring. An overall lack of grassland and wetland habitats limits pheasant, prairie chickens and other wildlife populations.

Resource Improvement Opportunities: The potential to significantly improve fish and wildlife habitat in this subwatershed is high. In particular, buffering waterways and increasing grassland and wetland habitats have the potential to significantly increase bird species (including pheasant and prairie chicken populations) and may help sustain streamflows. In addition to considering natural resource enhancements when implementing their projects in this subwatershed, the watershed district will encourage and support natural resource agencies and private landowners to take the following actions to protect and improve the natural resources in this subwatershed.

NRE Action Items:

1. Maintain and improve existing grassland and wetland habitats.

2. Increase grassland and wetland habitats near waterways.

3. Increase grassland and wetland habitats adjacent to waterways and elsewhere.

E. Water Based Recreational Activities

Poor water quality in East Toqua Lake has been identified as the only recreational problem. The District will pursue projects to improve water quality and create opportunities for contact recreation within this subwatershed.

NORTH OTTAWA

DESCRIPTION OF WATERSHED

Watershed Setting

The North Ottawa subwatershed is a component of the Rabbit River watershed located in Grant, Wilkin, Otter Tail and Traverse counties of west central Minnesota. The Rabbit River watershed within the District has significant surface water management problems (i.e. flooding, drainage, erosion, water quality, water supply, wildlife issues, cropland irrigation and others). It is located in Minnesota between the Otter Tail River basin to the north and the Mustinka River basin to the east and south. It is bordered on the west side by the Bois de Sioux River which is its outlet.

The Rabbit River has a total drainage area of 320 square miles. Figure 16 illustrates the location of the North Ottawa Subwatershed as it relates to the Red River Basin in Minnesota and the Bois de Sioux Watershed. The Rabbit River Subwatershed covers parts of four counties including Traverse, Grant, Otter Tail and Wilkin. The cities with this area are Doran, Campbell, Wendell, Tintah, and the largest, Breckenridge. Industry of the area is primarily agricultural. In the city of Wahpeton, ND, there are two sugar processing plants. One processes sugar beets and one processes corn. These two plants are significant users of water from the Red River. Transportation routes within the area include township, county, state and federal highways and two railroad systems.

The North Ottawa subwatershed consists of 120 square miles as shown in Figure 16. Industry in the area is primarily agriculture. Prior to settlement the subwatershed was dominated by prairie grassland with a high density of wetlands (15-20 percent land cover) especially above the glacial Lake Agassiz beach ridge. Agricultural development has resulted in diminished wildlife habitat, and channelization of natural watercourses has converted over 75 percent of the riparian habitat in the watershed to cropland.

Existing Conditions, Related Problems and Opportunities

A. Water Quantity

Within the North Ottawa subwatershed frequent flooding is a problem. A spring flood is almost an annual occurrence. Damages associated with this type of flood are to infrastructure, personal property, and cropland; public resources i.e. fisheries, wildlife, soils, and water quality. The City of Tintah, located in the downstream portion of this subwatershed, has a significant potential for flood damage.

In the western one third of the subwatershed, in the area east of Tintah, frequent summer floods occur and cause substantial crop losses. This is primarily due to the topography of the subwatershed where the water flows off the beach ridge to the east and spreads out on this flat area southeast of Tintah. Attempts to alleviate this problem have had limited success. The primary method was to develop drainage channels to move the water downstream. The first attempt in this area was to construct State Ditch #18 which carried flows west. The second attempt was with Judicial Ditch # 2 which carried flows to the North into the Rabbit River and the third attempt was with Judicial Ditch #12 and six laterals which carry water to the north and west into the Rabbit River, just south of Campbell.

In the eastern (above the beach ridge) part of the subwatershed, there exist numerous wetland and low-lying basins, some drained and some not. Drained basins of 10 acres or larger constitute about 1200 acres of the total.

B. Water Quality

The MPCA has identified the Rabbit River as an impaired water body due to high levels of ammonia. The source of the ammonia problem is unknown at this time and is being investigated. Water Quality data is very limited for this area. The NOPT feels that there could be high levels of total suspended solids, total phosphorus, and other contaminants due to the cultivated agriculture that is prominent within the subwatershed. This correlation is based on the latest USDA Natural Resource Conservation Service Tillage Transect Survey and data gathered from the neighboring Lake Traverse Improvement Project Diagnostic Study

C. Erosion and Sedimentation

Erosion is another serious problem in the subwatershed. During periods of high runoff, overland flooding causes significant sheet, rill and gully erosion. The severity depends on the land cover, duration, and volume of water. Erosion is often worse in the spring due to the lack of vegetative cover on the fields. Wind erosion is a problem in this area, depending on conditions.

The most severe water erosion occurs in the sloping area west of the beach ridge. Laterals of Judicial Ditch 12 are the primary channels through this area. However, these channels and associated culvert crossings, are small with less than a quarter (1/4) the recommended capacity in some reaches based on standard engineering design principles for drainage projects. This causes excess flows to leave the channels and run cross-country resulting in extensive gully erosion through the cultivated fields.

D. Fish and Wildlife Habitat

Existing Resources: Much of the fish and wildlife habitat in this subwatershed has been lost due to landuse changes, drainage and channel modifications. Some large habitat blocks, conservation lands, and riparian habitat are present in this subwatershed and some wetlands have not been drained (MCEA report can be viewed in the watershed office). The numerous waterways in this subwatershed may provide spawning and nursery habitat for several fish species but channel modifications and hydrologic conditions probably limit these opportunities to a short period during spring. An overall lack of grassland and wetland habitats limits pheasant, prairie chickens and other wildlife populations. The North Ottawa project will provide much needed wildlife habitat in this subwatershed.

Resource Improvement Opportunities: The potential to significantly improve fish and wildlife habitat in this subwatershed is high. In particular, buffering waterways and increasing the grassland and wetland habitats have the potential to significantly increase bird species (including pheasant and prairie chicken populations) and may help sustain streamflows. In addition to considering natural resource enhancements when implementing their projects in this subwatershed, the watershed district will encourage and support natural resource agencies and private landowners to take the following actions to protect and improve the natural resources in this subwatershed.

NRE Action Items:

1. Maintain and improve existing grassland and wetland habitats.

2. Increase grassland and wetland habitats near waterways.

3. Increase grassland and wetland habitats adjacent to waterways, the North Ottawa project and elsewhere.

4. Develop rehabilitation plan for waterways.

E. Water Based Recreational Activities

Hunting and trapping opportunities exist within the subwatershed area. Demand for hunting areas (both public and private) is high, focusing mainly on waterfowl, deer, and pheasants. Trapping within the subwatershed is directed at muskrat, mink, raccoon, fox, and beaver. The level of trapping fluctuates with the fur markets. Expanded wetland and grassland acreage would provide additional hunting, trapping and wildlife viewing with associated local economic benefits.

Fishing is limited to spring when the streamflow is adequate to facilitate fish migration. As stated earlier, the streams in this area are currently intermittent, meaning that they will flow only when there is a significant run off event.

Watershed Goals, Objectives and Desired Outcomes

A. Water Quantity

Water quantity goals for this area include providing approximately 18,000 to 20,000 acre feet of gate controlled storage and approximately 6,000 acre feet of ungated storage or a combination thereof. The following objectives have been discussed and accepted on a consensus basis by the North Ottawa Project Team.

Goal 1: Protect intensively farmed cropland from the 10 year, 24-hour runoff event.

Goal 2: Provide flood protection to the City of Tintah from the 100 year flood event

Goal 3: Reduce the effects, within and downstream of this subwatershed, of damages to public and private property, municipal services and agricultural land.

Objective 1 Construct the North Ottawa Project Impoundment to provide approximately 16,000 ac-ft of gated flood storage and 1,200 ac-ft of ungated flood storage.

Objective 2 Restore approximately 600 acres of the drained basins, above the beach ridge providing approximately 1,200 ac-ft of primarily ungated flood storage.

Objective 3 Investigate the feasibility of constructing a reservoir in the vicinity of Sections 30 and 19 of Elbow Lake Township to provide approximately three to five thousand (3,000-5,000) ac-ft of flood storage.

Objective 4 Reduce the runoff from a 10-year summer event by:

- 80 ac-ft by installing 1,500 acres of buffer strips (using native plant species wherever possible).
- 40 ac-ft by increasing conservation tillage by 15 percent

Objective 5 Assess the operating plans on existing publicly controlled gated structures and enhance those operations as much as possible to maximize flood control benefits where compatible with other management objectives.

Objective 6 Inventory existing culverts, structures and implement culvert sizing, control gates, etc. on existing drainage systems where temporary flood storage is practical or feasible.

Objective 7 Obtain baseline data regarding low flows on the Rabbit River mainstem and its tributaries.

Objective 8 Improve and manage existing drainage facilities to reduce future flooding and erosion problems.

B. Water Quality

Numerous water quality benefits will be achieved upon the effective implementation of the activities proposed by the Bois de Sioux Project Team within this subwatershed plan. The storage of flood water during spring runoff events and storm events, in impoundments and through other activities, will serve to reduce sediment transport by allowing soil particles to settle in the basins prior to their discharge and reduce erosion in the first place. Such activities should also allow for the reduction of other nutrients present in the water such as phosphorus. Controlling water release over a period of time would also reduce stream bank erosion immediately downstream from structures.

Pre and post implementation water quality monitoring in the watershed adjacent to the project sites is necessary to establish baseline water quality conditions for the area and to document water quality enhancements to portions of the watershed downstream of the projects after implementation. This water quality sampling and data analysis should be coordinated with the TMDL being proposed by the MPCA for select reaches of the Rabbit River.

Goal 1: Ensure that the water quality benefits to the watershed from the construction of the proposed impoundments and other associated BMPs are maximized to the greatest degree without jeopardizing the flood damage reduction potential of the project.

Goal 2: Insure that the construction and operation of the projects do not impair water quality.

Goal 3: **Insure that the water quality components of the projects and other activities are coordinated with other water quality programs and projects within the watershed.**

Goal 4: **Insure that the monitoring and analysis of water quality data is of such a quality and duration to provide for accurate documentation of water quality changes downstream throughout the life of the watershed projects.**

Objective 1 Develop a monitoring program to qualify and quantify the current water quality situation and the extent any water quality problem in the subwatershed. This plan should address three specific areas of work:

a) Baseline data collection and analysis of the Rabbit River
b) Project specific data collection and analysis
c) Rabbit River TMDL study

Baseline water quality data collection:

Develop a continuous collection of flow regimes, chemical, physical, and biological data for the Rabbit River and North Ottawa subwatershed. The parameters should be based on the Stream Classification as out lined in Minnesota Rules 7050.0220 and 7050.0221 through 7050.0227.

Sampling should be conducted at least monthly, for at least one year to assess the current water quality situation. Further sampling should be conducted at least quarterly beyond the first year to build a long-term database. The database should utilize a user-friendly format that can be accessible to all identified stakeholders. Specific sampling locations and frequencies can be developed here or in a separate monitoring document.

Project specific water quality data collection:

For the North Ottawa Project and all other projects, which may follow, the District should develop a monitoring plan, which will qualify the current state of the water in the project area, and track that water quality before, during, and after the project.

This monitoring plan should ideally be an expansion or modification of a) above. It should focus on that reach of the Rabbit river which will be most

affected by the project. In the case of the North Ottawa project, there is also considerable opportunity to monitor the newly created impoundment for a variety of physical, chemical, and biological water quality indicators.

Objective 2 Based on the results above, identify solutions to the problem and expand on the objectives to address said problems.

Objective 3 Partner in TMDL study with the MPCA.

Possible TMDL Outline:

- Monitor four locations on the Rabbit River for Ammonia, Dissolved Oxygen and other parameters relating to Dissolved Oxygen and Ammonia.
- Collect water quality data monthly for one year.
- Collect flow data for one year.
- Reduce data to provide a total maximum daily load of the above parameters.
- Verify the TMDL list using this data.
- If there is verification, identify the sources of the load.
- Implement activities to correct the problem.
- Delist the Rabbit River as a TMDL study.

The MPCA will provide funding ($50,000) and technical assistance to the project sponsor as they manage the TMDL work.

The TMDL process can easily fit into a larger subwatershed monitoring plan, as described in B.1 above.

C. Erosion and Sedimentation

The landscape throughout the watershed has been extensively altered, primarily to improve agricultural production. While the agricultural lands have been highly productive, much of the natural landscape values once present in the watershed have been lost. Most of the original prairie landscape has been cultivated; many of the original wetlands have been

drained. Many of the original streams have been channelized and riparian corridors have been diminished or lost.

In addition to maintaining soil productivity and minimizing crop damage from blowing soil, control of wind erosion and the resulting sediment has the added benefit of minimizing the clogging of drainage and road ditches.

Management of crop residues during tillage has long been a key component of an erosion control and water management strategy. Thirty percent residue after planting, averaged over the crop rotation, is generally recommended as the minimum amount of residue necessary to achieve acceptable soil erosion (a 65 percent reduction in soil erosion). A combination of a hydrologic soil group (soil) and a landuse and treatment class (cover) is used to determine the hydrologic soil-cover complex. The effect of the hydrologic soil-cover complex on the amount of rainfall that runs off is represented by a runoff curve number (CN). Higher curve numbers indicate more runoff. Conversion of cropland to grasslands through land retirement programs will achieve a significant reduction in runoff.

Retired riparian cropland provides the additional benefit of significantly reducing the sediment, phosphorus and other pollutants contained within runoff entering the vegetative buffer strip.

Objective 1 Reduce water erosion by more than 3,100 tons/year by installing 1,500 acres of buffer strips, using native plant species wherever possible.

Objective 2 Reduce water erosion by increasing conservation tillage practices by 15 percent.

Objective 3 Reduce water erosion by restoring 600 acres of drained and cropped wetlands and upland buffer fringe, using native plant species wherever possible.

Objective 4 Encourage and promote the establishment of field windbreaks, using native plant species wherever possible.

D. Fish, Wildlife and other Natural Resources

Fish habitat is limited in this subwatershed as a result of channelization/ditching, fish barriers, and a lack of continuous flow. Fisheries managers would like to maximize the secondary/incidental benefits of flood reduction activities to restore, improve or create fish habitat. Wildlife managers indicate that because of the location geographically to the major

migratory flyways, this area is important to waterfowl production, and feeding and resting for migratory birds. It is their goal to maximize the wildlife production in the area in a way that compliments the other goals of this plan.

Objective 1 Restore approximately 600 acres of the drained basins above the beach ridge.

Objective 2 Protect all existing wetlands in the subwatershed.

Objective 3 Restore 6,000 acres of grassland and enroll them in perpetual protection programs.

Objective 4 Support other agency programs to restore, enhance and/or protect additional wetlands.

Objective 5 Manage impoundments to attenuate the flows in the Rabbit River and tributaries, whenever possible, to provide additional fisheries habitat.

Objective 6 Reduce in stream sediment loads through implementation of BMPs to reduce soil erosion and runoff.

Objective 7 Integrate water level manipulations in the North Ottawa impoundment to encourage use as a feeding and resting area by migratory birds, both game and non-game species.

Objective 8 Manage water levels and vegetation (wetland and upland) within impoundments, particularly the North Ottawa Project Impoundment, to provide maximum wildlife habitat value and related public use opportunities within the constraints of flood protection goals and management requirements.

PART IV. ANNUAL MONITORING AND EVALUATION PROGRAM

Any watershed management plan requires an annual monitoring and evaluation program to review activities that were completed and, if necessary, to reprioritize implementation activities in the watershed to meet local needs or to capitalize on funding opportunities from other programs. To accomplish this, the District will develop an annual activity report which is compliant with MS Section 103D.

PART V. PROJECTS

A. PETITIONED PROJECTS

Petitioned Watershed Projects

The public may petition the District for projects pursuant to MS 103D.705. All petitions must meet the statutory requirements and be accompanied by a $2,000 or suitable bond. After reviewing the Petition and the Board approves, the project will be assigned a name and number and will further direct their Engineer to proceed with surveying, maps, etc. If the Engineer's Report determines that the project is feasible they prepare a plan. If the report is unfavorable, the board must hold a hearing on the report within thirty-five (35) days. A favorable report is sent to the Commissioner of MNDNR and BWSR who will file an advisory report. Appraisers/Viewers are appointed. The Viewers Report is examined by the Board and can be returned to the Viewers' if felt inadequate. Once all of the above and advisory reports are completed, the Board will notice a final hearing. Notice of pendancy must be filed with the County Recorders where ownership of real estate is acquired. If a positive order comes out of the final hearing, bids are called for and construction begins.

Petitions For Drainage Projects

The public may petition the District for drainage projects pursuant to MS 103E. Most petitions under MS 103E require a bond or cash deposit of $10,000. Minnesota law requires that all drainage projects closely follow the detailed requirements of MS 103E. The public needs to be aware that new drainage projects and improving existing drainage systems require a board finding of an adequate outlet before approval. This is a difficult requirement to meet in our area, where flooded waterways are commonplace. Therefore, the District encourages potential petitioners to consider including water retention in such projects.

It is recommended that any interested petitioner seek legal advice when assembling a petition for said projects.

B. OTHER PROJECT IDEAS

Individuals will be invited to bring project ideas to the Board for review and discussion. After preliminary review by the board, they may direct the engineer to review further in order to gather additional information and report back. Then the board will decide if they wish to establish the proposed project by resolution of the board, if they should require a petition for the project, or if they should dismiss it altogether. If the board does not dismiss the project at this point and until it is established as a project by resolution or petition, the project will be placed on the list of potential projects (Project Inventory List) for future review and potential establishment. This list will be reviewed annually and updated as necessary. Projects may also be removed from the list at that time.

PART VI. DISTRICT POLICIES

The present policies and positions of the District regarding water management issues are set forth herein. The District is an evolving entity and its policies will naturally change as experience is gained and projects are completed. The purpose of this section is to provide a basis for making consistent policy decisions and to present as clear a picture as possible of the District's position on water management issues.

I. The **OVERALL GOAL** of the Board is to make the wisest possible use and conservation decisions for the District's water and other related resources. To further this general goal, the Board will:

A. Educate themselves on a wide range of topics so as to understand as best they can all matters related to the District's resource management. The educational process shall include the following:

1. The District will belong to the Minnesota Association of Watershed Districts and actively participate in other organizations that are of benefit to the District.

2. Contact and information exchanges will be made with members from other watershed districts and associations dealing with similar subjects.

3. Each Manager shall seek the opinions and input of residents within the Watershed District.

4. All Board Managers shall listen with attentive and open minds to all individuals and entities wishing to express opinions or views as to any matter relevant to the District's management of resources.

5. The Board, individually and collectively, shall make a conscientious effort to keep abreast of the activities of all other public agencies and private organizations that have any involvement in water management or related subjects.

6. The Board, individually and collectively, shall diligently seek out and study all scientific or other data that is relevant to the District's management of its water and related resources.

7. Each Manager shall diligently strive to become personally acquainted with the physical features and areas of concern of the entire District through personal inspection.

8. The Board, through similar methods, will endeavor to keep fully informed on all water management issues and activities which affect the water and related resources of the District.

B. Conscientiously endeavor to keep the public fully informed of the Board's activities and scrupulously endeavor to conduct all meetings in full compliance with the letter and spirit of the Minnesota Open Meeting Law (MS Chapter 13D).

C. Endeavor to work with all other public agencies and private organizations to achieve common or compatible goals.

D. Maintain a broad perspective and be receptive to the input of all individuals and entities and give equitable and fair consideration to the concerns and positions of the entire Watershed District.

E. Seek to actively inform and educate the public as to the information they themselves learn relative to wise use and conservation of the District's water and related resources.

F. Seek to develop wise use and conservation of the District's water and related resources through the development of feasible projects involving the cooperation of multiple groups and resources, combined with fair and equitable regulation.

G. Endeavor to give due consideration to the historical background when considering projects within the District. Strive to respect both the legal and equitable rights of individuals to the extent possible, which shall include scrupulous adherence to the constitutional principle that no private right shall be taken or adversely affected without just compensation.

H. The Board accepts the responsibility for making decisions on all issues that come before it, based upon the collective judgment of its members.

II. DRAINAGE is essential to efficient agricultural production which is very important to the economy of this area. On the other hand, drainage can increase flooding and erosion and decrease water quality and valuable wildlife habitat. These adverse impacts may be reduced or eliminated by proper design of drainage systems. The District, therefore, intends to encourage and facilitate proper drainage practices and to discourage and control improper drainage practices.

A. The District will endeavor to install new drainage systems and improve existing legal drainage systems when petitioned to do so in accordance with state statutes.

1. Ditch systems will be designed to avoid increasing downstream flooding.

a) Design capacity will not exceed the relative capacity of the outlet(s) downstream. Measures will be included to control discharge rates.

b) During minor runoff events, drainage flows will be provided adequate outlets. During major runoff events, water may be held back in order to avoid overloading drainage systems.

2. Ditch systems will be designed to minimize erosion.

a) Side inlet structures will be provided, when needed.

b) Grade control structures will be included in the channel, where needed.

c) Channel side slopes will be designed to provide adequate bank stability depending on the soils encountered.

d) Permanent cover will be maintained in the channel and up to the crest of the spoil bank on either side, or where there is no spoil bank, for an adequate distance beyond the edge of the channel.

3. Ditch systems should be maintained as near as practical to the design condition.

B. The District will take over any legal drainage system, when directed by the County Board or Joint County Board to do so, together with the right to repair and maintain it. The transfer may be initiated by the County or Joint County Board or by a petition from any person interested in the drainage system or by the Board.

1. Drainage systems turned over to the District will be maintained and administered according to the provisions of MS Chapter 103E, which is commonly referred to as the Drainage Code and is also used by the County and Joint County Ditch Boards.

2. Inadequate drainage systems or systems which cause erosion, sedimentation, or flooding problems should be improved, where necessary. In many cases, the existing design is so old that it no longer reflects either the current use or current environmental values. The District intends to encourage improvement of outdated drainage systems under its jurisdiction.

a) Drainage systems taken over will be surveyed, if necessary, to determine existing conditions.

b) An evaluation will be made of the system based on both design and existing conditions.

(1) Areas requiring repairs will be identified.

(2) Areas requiring improvements in order to function properly will be identified.

c) Maintenance procedures should not be implemented if it is reasonably clear that damages will result to the system or to other properties. In this case, the necessary improvements will be recommended.

C. The District will prepare and maintain an inventory of existing legal drainage systems. The inventory will include the following:

1. Design and construction information;

2. Benefited area; and

3. Any known deficiencies of the system.

D. The District will maintain rules and regulations, guidelines, or other procedures to control or influence private drainage activities.

1. The District will not interfere with private efforts to drain agricultural lands provided that the legal right to drain exists and adequate measures are taken to protect the receiving waters and other landowners.

2. The District will develop standard recommended practices or assist landowners in developing suitable practices for private drainage.

3. The District may require permits for drainage activities which have the potential to adversely affect the environment or other landowners.

III. **FLOOD CONTROL** is a major need within the District as well as downstream along the Red River of the North. Retention of flood water is seen as the most appropriate flood control measure since it can reduce both local and regional flooding problems.

A. The District will analyze the flooding situation to determine an appropriate course of action.

1. Streamflow and rainfall monitoring programs will be implemented to assist in analyzing the flooding problem.

2. The District intends to use hydrologic models to evaluate flood control alternatives.

3. The District intends to develop a flood water management plan.

4. The District, where appropriate, may pursue the maintenance of natural watercourses.

B. Control of runoff from agricultural and other developed lands is essential to reduce damages caused by flooding and erosion/sedimentation.

1. The District will encourage private individuals to control runoff from their lands.

2. Rules requiring runoff controls as a condition for drainage will be considered.

3. Economic incentives will be considered.

C. The District will actively work toward the construction of water retention structures (impoundments).

1. An inventory of potential impoundment sites will be maintained.

2. The District will endeavor to install impoundments when petitioned to do so.

3. The District may implement impoundment projects by Board resolution.

D. The District will attempt to provide funding for flood control projects.

1. The District will use its general taxing authority to make funds available for runoff control projects.

2. The District will work with all existing agencies and will pursue outside funding of projects from state and federal agencies as well as from private organizations.

E. The District will work with road authorities to provide runoff control.

1. Multipurpose projects to provide flood control at road crossings will be encouraged and supported.

2. Uniform culvert sizing recommendations may be developed.

3. Landowners will be encouraged to work with road authorities where road crossings can be modified, to provide runoff control from small drainage areas.

F. The District will work with wildlife agencies to develop multi -purpose flood control and wildlife management projects.

G. The District will work with lake associations or other local groups to develop multipurpose projects to provide lake level and flood control and water quality.

H. The use of non-structural flood damage reduction measures such as floodplain zoning and building regulations will be encouraged.

I. The District will follow the policies of the mediation process when implementing projects.

IV. **WATER QUALITY** is recognized as a major water management issue. The District also recognizes the authority and existing programs of other agencies dealing with water quality issues. The District intends to find its role in water quality management by supporting and assisting those other agencies and by addressing those aspects which may not be adequately addressed by others.

A. The District strongly supports all efforts to reduce point source pollution.

1. The District will investigate pollution problems, which may arise, and attempt to identify the source.

2. The District will assist appropriate pollution control agencies in applying abatement measures.

3. The District will encourage the installation and proper operation of wastewater collection and treatment systems.

B. The greatest water quality problems in the District are probably caused by non-point source pollution. Because of its diverse nature, it is difficult to control and there has been a lack of effective programs to deal with this problem. Fortunately, this appears to be changing. The District will work with other agencies and support their efforts in reducing non-point pollution.

1. The District will initially target its efforts toward reducing soil erosion. This is because soil erosion is closely related to the flooding and drainage problems which the District must also address.

a. Landowners will be encouraged to implement practices to reduce the volume of runoff which will result in less erosion and reduced flood flows. The goal is to increase infiltration into the soil where it can be utilized by the crop or other vegetation, or go to replenish the groundwater. This can be achieved by maintaining good soil cover and condition.

b. Landowners will be encouraged to protect the soil from erosion. This can be accomplished by implementing soil conservation practices such as grassed waterways, grade

control structures, crop residue management, cover crops, shelter belts, and by re-establishing permanent vegetation in critical areas.

c. Landowners will be encouraged to provide settling or filtering facilities to remove suspended particles. This can be accomplished by routing the runoff through ponds, marshes, or other permanently vegetated areas. It will result in reduced sedimentation in downstream lakes and drainageways.

2. Landowners should be as free as possible to choose the methods that work best for them. However, the District may mandate compliance, if necessary.

C. Groundwater contamination is usually caused by dissolved substances in the water which eventually seep into the aquifers. Excessive use of fertilizers and potentially hazardous chemicals is the greatest concern in this area. Groundwater protection strategies are currently being considered at the state level. The role of watershed districts has not yet been defined. However, the District is ready to accept any role within its financial capabilities.

D. The District will work with lake associations and other local groups to improve water quality.

E. The District will install pollution abatement projects when petitioned to do so, according to state statutes.

F. All work of the District has the potential to affect water quality.

1. The potential impacts on water quality will be considered prior to implementing any project or program.

2. If water quality enhancement features can be included in a project, the District will endeavor to include such features and to obtain any additional funding required.

G. Most water quality and related environmental issues are not local in nature. The District does not intend to solve its problems by transporting them to another place or time. However, it also recognizes that certain problems may be most effectively handled on a regional or larger basis. The District expects to do its share in finding solutions to these larger problems.

APPENDICES

The following appendices contain information and raw data from numerous public meetings that were held in the development of this watershed plan. They contain Ordinal Rankings of problems identified by citizen groups, specific goals and objectives from SWCDs and County Water Plans, present District Rules and Permit Checklist, a list of Acronyms used in this plan, a placeholder for a TMDL program, and data analyses from the River Watch Program and project Implementation Matrices that detail specific project partners and their roles, both financial and non-financial, in carrying out the policies and positions of the District regarding water management issues. The District is an evolving entity and these features of the plan will naturally change as experience is gained and projects are completed. The purpose of this section is to provide the basis, in part, of how the plan was developed and approved by the Board. The intent of this plan is to provide consistent policy in decision-making and to present as clear a picture as possible of the District's position on water management issues.

APPENDIX 1

Subwatershed Table 1
Ordinal Rankings by Subwatershed – FDR or NRE

Appendix 1
SUBWATERSHED TABLE 1

Subwatershed	Flooding	Flood Damages	Drainage	Drought	Streamflows	Lake Levels	Ground water	Other Flood Damage Issues
BOIS de SIOUX	Main stem agricultural flooding HIGH	Crop losses – prevented planting HIGH	Drainage – inadequate for agricultural needs – does infer "bigger is better" MODERATE TO HIGH	Drought ~ sandy soils MODERATE TO LOW	Intermittent streamflows LOW		Ground water – aquifer lowering	Other flood damage – Urban development US of Breckenridge LOW
	Homestead flooding MODERATE	Flood damage ~ public infrastructure HIGH						
	Dam Safety – White Rock Dam MODERATE (Public perception)	Flood damage ~ Personal property MODERATE TO HIGH						
	Flooding of grass land for hay – Beaver dams MODERATE	Flood damage ~ public access LOW						

Subwatershed	Flooding	Flood Damages	Drainage	Drought	Streamflows	Lake Levels	Ground water	Other Flood Damage Issues
RABBIT RIVER	Small outlet – water backs up annually MODERATE	Road washouts MODERATE TO HIGH	Drainage ~ WCD #10 and other legal systems HIGH	Drought ~ High fluctuation LOW		Lakeshore erosion due to high Upper Lightning Lake Levels MODERATE		
	Cropland – overland flooding HIGH	Crop damages MODERATE	Channelization appears to contribute to flood problems – Grant Co. comment					
	Flooding – farmstead MODERATE							
MUSTINKA RIVER	Depressional area flooding LOW	Township and county roads washouts - #9, #8, #1 (across Mustinka Valley) and #11 from Pine Ridge Grant Co. Suggests a MODERATE TO HIGH	Poorly designed public and private drainage systems LOW TO MODERATE	Light soils - Wind erosion This is a priority in the Grant SWCD plan for the western part of county. LOW	Intermittent streamflows – fish movement, livestock watering LOW	Natural fluctuations of lake levels – public perceptions LOW TO MODERATE		

Subwatershed	Flooding	Flood Damages	Drainage	Drought	Streamflows	Lake Levels	Ground water	Other Flood Damage Issues
MUSTINKA RIVER	Mustinka River Valley flooding From Pine Ridge and DS MODERATE to HIGH	Pine Ridge Park structure problems – Sedimentation problems of reservoir. MODERATE			Flashy streamflows – erosion damage LOW			
	Inadequate/non-existent Floodplain Mapping – W half Grant Co. All subs in Grant Co.	Livestock losses during floods MODERATE						
		Crop losses MODERATE						
S. FORK RABBIT RIVER	Cropland – overland flooding HIGH	Road damages HIGH	Drainage ~ legal system – TCD #53 and others HIGH	Drought ~ high fluctuation LOW			Ground water ~ contamination of wells from flooding LOW	
	Mustinka overflows MODERATE	Crop damages MODERATE						

Subwatershed	Flooding	Flood Damages	Drainage	Drought	Streamflows	Lake Levels	Ground water	Other Flood Damage Issues
JUDICIAL DITCH 14	Diverted water from 18 Mile into 12 Mile – adds to flooding on 12 Mile HIGH	Road washouts HIGH (major transportation route)	Previous diversion – legal ditches (doesn't work very well) HIGH		Flows exceeding capacity during runoff events HIGH		Ground water – contaminated wells MODERATE	
	Overland flooding - flat ground with steep approaching slopes HIGH	Crop losses HIGH	Legal drainage systems – outdated design MODERATE					
	Flooding - Ice and snow blockage HIGH	Flood damage to personal property - homes HIGH						
FIVE MILE CREEK	Spring flooding Herman and west HIGH	Spring events Herman and west HIGH	Less than 10 year capacity on 2 public drainage systems MODERATE to HIGH	Wind erosion MODERATE	Streamflows ~ long duration out of bank flows western half of subwatershed MODERATE	Lake levels are uncontrolled and tend to be "unbalanced" in their storage and releases. MODERATE		

Subwatershed	Flooding	Flood Damages	Drainage	Drought	Streamflows	Lake Levels	Ground water	Other Flood Damage Issues
FIVE MILE CREEK	Summer flooding Herman and west HIGH (when it happens)	Summer events Herman and west HIGH	Sedimentation in the Five Miles south of Hwy 27 MODERATE to HIGH		Streamflows ~ upper watershed area (E half) is flashy in some locations MODERATE	High lake levels contribute to over-wintering rough fish and destroying wetland vegetation HIGH (NRE opportunity)		
LAKE TRAVERSE	High levels LT – spring HIGH (lakeshore, cabins)		Inadequate pothole drainage capacity LOW	Drought ~ hilltops burn off LOW	Streamflows ~ flashy, sporadic spring and summer LOW		Ground water ~ active springs LOW	Inflow from Little Minnesota River Less than LOW
	Road washouts HIGH	Road damages MODERATE		Drought ~ Crop losses – dries out fast HIGH	Flashy streamflows LOW		Ground water ~ arsenic LOW	
	Overflow from 12 mile creek subwatershed – 1) Sec 11 in Croke; 2) breakout flows from TCD #31; and 3) overflow south of Dumont MODERATE	Damage to crop land Pothole flooding LOW TO MODERATE	Seepage below ridge – High water table MODERATE TO HIGH	Drought ~ prone to wind erosion when dry HIGH – when dry				

Subwatershed	Flooding	Flood Damages	Drainage	Drought	Streamflows	Lake Levels	Ground water	Other Flood Damage Issues
LAKE TRAVERSE	Flooding problems along Hwy 75 north of Dumont MODERATE	Damage to CD #52 MODERATE						
	Flooding along Mustinka HIGH	Inadequate outlets for agricultural drainage MODERATE						
		Road washouts – erosion of shoulders HIGH (major transportation route)						
		Crop losses LOW						
		Damage to personal property – homes and businesses MODERATE						
E. BRANCH TWELVE MILE CREEK	Overland flooding – steep slopes (beach ridge area) and depressional areas HIGH	Road washouts and inundation – major transportation road HIGH	County line dispute HIGH		Flows exceeding capacity during runoff events, flashy in US reaches HIGH	Lake Levels ~High water levels – above DS OHW LOW TO MODERATE		

Subwatershed	Flooding	Flood Damages	Drainage	Drought	Streamflows	Lake Levels	Ground water	Other Flood Damage Issues
E. BRANCH TWELVE MILE CREEK	Ice and snow blockage HIGH	Crop losses HIGH	Natural Streams – sedimentation problems, widening naturally MODERATE					
	Major ??? Contributor to downstream flooding HIGH	Flood damage to personal property – farmsteads MODERATE	Pumping stations needed for drainage LOW					
			Drainage has "popped" (P.W.) drained many basins/ game lake (Note: Stevens Co. has inventory) HIGH					
WEST BRANCH TWELVE MILE CREEK	Overland flooding – steep slopes and depressional areas HIGH	Road washouts and inundation HIGH (major transportation route)	Drainage ~ county line dispute HIGH		Streamflows ~ flows exceeding capacity during runoff events, flashy in DS reaches HIGH	Lake Levels ~High water levels – above DS OHW LOW TO MODERATE		Major ??? Contributor to downstream flooding HIGH

Subwatershed	Flooding	Flood Damages	Drainage	Drought	Streamflows	Lake Levels	Ground water	Other Flood Damage Issues
WEST BRANCH TWELVE MILE CREEK	Diverted water from this watershed into 18 Mile subwatershed Note: Major?? contributor to Ds flooding HIGH	Crop losses HIGH	Natural Streams – downcutting – deepening and widening naturally MODERATE TO HIGH			Lake Levels ~low water levels MODERATE		
		Flood damage to personal property – farmsteads MODERATE	Drainage has "popped" (P.W.) drained many basins/ game lake Note: adverse affect on fisheries – potential winter kill in East Toqua Lake HIGH					
		Urban flood damages HIGH						

APPENDIX 2

Subwatershed Table 2
Ordinal Rankings by Subwatershed – FDR or NRE

Appendix 2
SUBWATERSHED TABLE 2

Subwatershed	Erosion and Sedimentation	Water Quality	Fish and Wildlife Habitat	Water-based recreational Activities	Unique water/Land Related Resources	Other Natural Resource Issues
BOIS de SIOUX	Bank Stability Doran Creek MODERATE	Turbid water, high nutrients HIGH	Intermittent flows block fish HIGH		Goose predation of crops HIGH	Unusual landscape – unnatural aesthetics MODERATE
	Wind Erosion MODERATE	DS drinking water supply taste and odor HIGH	Lack of habitat HIGH			
	Farming intermittent stream HIGH					
RABBIT RIVER	Erosion- Ridge overtopping from North Fork MODERATE to HIGH	Rabbit River TMDL HIGH	Preservation and maintenance of existing habitat LOW to MODERATE		Goose predation of crops HIGH	Lack of buffer strips HIGH
	Gully erosion in field waterways MODERATE to HIGH	Probability of failing septics LOW to MODERATE		Decreased duck hunting possibilities (Less ducks in Upper Lightning Lake) MODERATE		

Subwatershed	Erosion and Sedimentation	Water Quality	Fish and Wildlife Habitat	Water-based recreational Activities	Unique water/Land Related Resources	Other Natural Resource Issues
RABBIT RIVER	Upper Lightning Lake erosion MODERATE to HIGH	Potential pond system problems LOW				
MUSTINKA RIVER	Field erosion MODERATE	Livestock use of streams MODERATE	Historic Loss of wetlands and uplands HIGH	Poor water quality for swimming MODERATE to HIGH	Goose predation of crops HIGH	
	Channel erosion MODERATE	Lakes are eutrophic HIGH	Rough fish infestation MODERATE			
	Light soils subject to wind erosion LOW to MODERATE	Lack of buffer strips HIGH	Lightning lake freeze out LOW			
	Lightning Lake shoreline erosion HIGH					
S. FORK RABBIT RIVER	Gully erosion in field waterways LOW	Rabbit River TMDL list MODERATE			Goose predation of crops HIGH	Lack of buffer strips HIGH

Subwatershed	Erosion and Sedimentation	Water Quality	Fish and Wildlife Habitat	Water-based recreational Activities	Unique water/Land Related Resources	Other Natural Resource Issues
S. FORK RABBIT RIVER	Stream Bank Erosion HIGH	Septic system design and inundation LOW	Lack of habitat MODERATE	Intermittent flows limit recreation LOW	Goose predation of crops HIGH	Loss of grass and water habitat LOW
JUDICIAL DITCH 14	Ag land and channel erosion HIGH	Nutrient and sediment loading HIGH	Fish use MODERATE			Burrowing Owl LOW
	Mud Lake Sedimentation HIGH	Feedlot problems LOW				
FIVE MILE CREEK	Sedimentation in flatter western portions of the WS HIGH	City of Herman Wastewater HIGH	Potential to enhance good habitat area - Niemackl Lakes Project Area HIGH		Goose predation of crops HIGH	
	Bank Erosion HIGH	Niemackl lakes Project Area Water quality issues HIGH	Land Cover losses at expiration of CRP – should be watershed wide HIGH			
	Gully Erosion HIGH		Loss of fisheries habitat due to sedimentation MODERATE to HIGH			

Subwatershed	Erosion and Sedimentation	Water Quality	Fish and Wildlife Habitat	Water-based recreational Activities	Unique water/Land Related Resources	Other Natural Resource Issues
LAKE TRAVERSE	Severe Stream bank erosion HIGH	Degraded water quality LOW	Lack of fish and wildlife habitat MODERATE	Overuse by motorized watercraft MODERATE	No alternative opportunities for birding HIGH to MODERATE	Loss of grass and water habitat LOW
	Ag land sheet erosion MODERATE	Failing Septic Systems HIGH	Fish use diminished due to loss of marshes MODERATE	Not enough hunting habitat HIGH	Goose predation of crops HIGH	
	South Half of Lake Traverse shore erosion HIGH	Lake Eutrophication – Hyper-eutrophic HIGH	Grass and wetlands HIGH	No recreation trails MODERATE to HIGH		
	Steer Creek HIGH	Nutrient and sediment loading MODERATE	Degraded spawning habitat HIGH			
	Ag related gully erosion HIGH	Poor water quality for DS users HIGH	Botulism on Mud Lake MODERATE			
	CD52 erosion and lake sedimentation HIGH					
	Sedimentation into Mud Lake MODERATE					

Subwatershed	Erosion and Sedimentation	Water Quality	Fish and Wildlife Habitat	Water-based recreational Activities	Unique water/Land Related Resources	Other Natural Resource Issues
E. BRANCH TWELVE MILE CREEK	Natural stream sedimentation and aggradation HIGH	Septic system design and inundation LOW	Loss of wetlands and upland cover MODERATE		Goose predation of crops HIGH	Loss of grass and water habitat LOW
	Ag land and channel erosion MODERATE to HIGH	Nutrient and sediment loading HIGH	Diminished use by Fish MODERATE			Lack of Buffer Strips MODERATE
	Mud Lake/Lake Traverse Sedimentation HIGH	Turbidity HIGH	Lack of Functional Riparian Areas MODERATE			
		Potential for feedlot problems MODERATE				
WEST BRANCH TWELVE MILE CREEK	Ag land and channel erosion HIGH	Septic system design and inundation LOW	Loss of wetlands and upland cover MODERATE	Poor water quality for swimming, E. Toqua Lake HIGH	Goose predation of crops HIGH	Lack of Buffer Strips MODERATE
	Sedimentation in adjacent flood plain LOW to MODERATE	Nutrient and sediment loading HIGH	Diminished fish use MODERATE			

Subwatershed	Erosion and Sedimentation	Water Quality	Fish and Wildlife Habitat	Water-based recreational Activities	Unique water/Land Related Resources	Other Natural Resource Issues
WEST BRANCH TWELVE MILE CREEK	Closed Basin Bank Erosion due to High Water MODERATE	Potential for feedlot problems MODERATE				
		Storm water from Graceville to Toqua Lake HIGH				

APPENDIX 3

Local County Water Management Plans and SWCD Plans

Appendix 3
Local County Water Management Plans and SWCD Plans

June 25, 2002, at the Bois de Sioux Watershed District (BdWSD) Plan Update meeting, the 'dovetailing' of Big Stone, Stevens, Grant, Traverse, Otter Tail and Wilkin Counties Comprehensive Local Water Plan (CLWP) and Soil and Water Conservation District (SWCD) action items with the District Plan updated action items were discussed.

BIG STONE COUNTY

July 22, 2002, the Flood Damage Reduction (FDR) and Natural Resource Enhancements (NRE) ordinal rankings for the West Branch Twelve Mile Creek subwatershed were presented and discussed with Gary Hoffman, Big Stone SWCD Manager; Darren Wilke, Big Stone CLWP Manager; Jon Roeschlein, District Administrator; and Richard Lane, Big Stone County Commissioner.

When asked if there was agreement with the FDR high priority issues, or if anything was missed; there was consensus regarding the priorities of the issues with the following comments:

- Flooding issues concern of "diverted water" into 18 Mile subwatershed from this subwatershed. Note: Contributor to downstream flooding and let the hydro modeling quantify watershed-wide.
- Flood damages issue concern of "road washouts and inundation" should specify Highway 75.
- Flood damages issue concern of "urban flood damages" stated "Graceville's taken care of."
- Drainage issue concern of "drainage-county line dispute" should specify Judicial Ditch (JD) # 4.

When asked if there was agreement with these NRE high priority issues, or if anything was missed; there was consensus regarding the priorities of the issues, with the following comments:

- Erosion and sedimentation issue add the concern of "closed basin bank erosion due to high water- moderate priority".
- Water quality issue concern specific to Graceville's storm water begged the question of other cities' storm water systems within the entire watershed.
- Other natural resource issues should have a concern regarding lack of buffers as a high priority.

The following goals and actions were developed for a ten-year period within Big Stone County portion of the District.

Big Stone County CLWP and SWCD will work with the District on the Traverse Lake Improvement Project by designing and installing the following conservation practices:

- 5,000 acre increase in conservation tillage,
- 6 acres of new waterways,
- 2 water and sedimentation control basins,
- 3 miles of field windbreaks,
- 8 acres of farmstead shelterbelts,
- 5 acres of wildlife plantings,
- 100 acres of buffer strips,
- Restore Moonshine Lake and an additional 50 acres of wetland, and
- Control runoff from the feedlots located within the District portion of Big Stone County (used 1997 Level I Feedlot inventory to estimate there are to be 12 operations, of which 3 are within 1000 feet of water on MNDNR's protected waters list).

Big Stone County personnel has started updating the CLWP. This information/process will improve the watershed context and define common goals/objectives/actions.

The general feel of the meeting was good and the need and advantage of dovetailing the plans was discussed and understood by all.

GRANT COUNTY

Present were Joe Montonye, Grant SWCD Manager; Odell Christenson, SWCD Supervisor; Charlie Foss, County Commissioner; Jon Roeschlein, District Administrator and Pete Waller, BWSR.

July 25, 2002, the FDR and NRE ordinal rankings for the Rabbit, Mustinka Twelve Mile Creek and Five Mile Creek subwatersheds were presented.

When asked if there was agreement with these FDR high priority issues or if anything was missed, there was consensus regarding the priorities of the issues with the following comments:

- Need "adequate" floodplain mapping watershed-wide, specifically wanted within Grant County.

- Channelization of waterways/streams/rivers increasing slope, velocities resulting in flood damages a high priority in the Rabbit River, Twelve Mile Creek and Mustinka River subwatershed as flooding, flood damage or drainage issue.
- Within the Mustinka River subwatershed the flood damage issue of "township and county roads washout" should be changed to a high priority from a moderate to high.
- Within the Mustinka River subwatershed flood damages issue of "Pine Ridge Park structure problems" specify sediment control and removal.
- Within the Mustinka River subwatershed expand the light soils-wind erosion beyond a drought issue to reflect the sedimentation within channels reducing channel capacity resulting in out of channel flows as a high priority. Actually wind and water erosion are an issue.

When asked if there was agreement with these NRE high priority issues, or if anything was missed; there was consensus regarding the priorities of the issues, with the following comments:

- A RRV Conservation Reserve Enhancement Program (CREP) should allow existing priority practices such as CP-21 and Conservation Reserve Program (CRP) to be enrolled into long-term easement.
- The high priority issue "land cover losses at expiration of CRP" within the Five Mile Creek should be a high priority issue watershed-wide.
- Move "goose predation of crops" to unique water or land related resources from water-based recreation watershed-wide.
- Within the Mustinka River subwatershed, add lack of buffers as high priority. It is also a water quality issue-watershed-wide.
- Within the Mustinka River subwatershed, water-based recreational activities strike "moderately" from poor water quality for swimming.
- Within the Five Mile Creek subwatershed add the Niemackl Lakes Project area. Currently this is a high priority for Grant SWCD/CLWP.

The following goals and actions were developed for the Bois de Sioux and Mustinka River subwatersheds (different than planning basins):

Annual	10-Year Total	Description
1,500 ac	15,000 ac	critical area seeding on CRP, RIM, WRP land
20,000 ac	200,000 ac	conservation tillage
7	70	water and sedimentation control structures
2 ac	20 ac	grassed waterways
1,500 ac	150,000 ac	wildlife upland habitat management
250 ac	2,500 ac	wildlife wetlands habitat management
10	100	water control structures for wildlife
1,000 ac	10,000 ac	conservation Buffer Strips
1,250 ac	12,500 ac	nutrient management plans
5 miles	50 miles	field windbreaks
2.5 ac	25 ac	farmstead windbreaks
35 ac	350 ac	wildlife tree plantings

General feel of the meeting was good and the need and advantage of dovetailing the plans was discussed and everyone could 'live with it'.

OTTER TAIL COUNTY

July 22, 2002, the FDR and NRE ordinal rankings for the Rabbit River and Mustinka River subwatersheds were presented and discussed with Brad Mergens, CLWP-West Otter Tail SWCD Manager; Jon Roeschlein, District Administrator; Don Davenport, Watershed Manager, and Dennis Mosher, Otter Tail County Commissioner.

When asked if there was agreement with these FDR high priority issues within the Rabbit River and Mustinka River subwatersheds, or if anything was missed; there was consensus regarding the priorities of the issues with the following exception:

- Cropland-overland flooding within the Rabbit River subwatershed should specify "spring events" and its priority remain high.

When asked if there was agreement with these NRE high priority issues within the Rabbit River and Mustinka River subwatersheds, or has anything been missed; there was consensus regarding the priorities of the issues, with the following comments:

- A RRV CREP should allow existing priority practices such as CP-21 and Continuous Conservation Reserve Program (CCRP) to be enrolled into long-term easement.
- Add "lack of buffers- high priority" as other natural resource issue for both subwatersheds. (Note the differential from Otter Tail to Grant and Wilkin in USDA's Soil Rental Rates as major implementation impediment.)
- In the Rabbit River subwatershed erosion and sedimentation issue, change priority ranking of "gully erosion in field waterways" from moderate to high.
- In the Rabbit River water-based recreational activities, specify Upper Lightning Lake as having decreased duck hunting possibilities.
- In the Mustinka River fish and wildlife habitat issue, reflect the historic loss or the fact that most all "loss of wetlands, uplands, and habitats" has taken place.

The following actions were developed for a ten-year period for the District portion of Otter Tail County:

Water erosion is defined as a high priority problem within the West Otter Tail SWCD when it occurs at a rate of more than two tons per acre per year.

- Construct 80-120 water and sediment control structures.
- Increase cropland acreage using conservation tillage by 30 percent.
- Accelerate the installation of vegetative buffer strips and participation in retirement programs by establishing buffer strips on 85 percent of shoreland areas and 50 percent of other eligible lands by 2006. Conduct mailing to all landowners or operators in the watershed outlining areas eligible for programs buffers highlighted on an aerial photo. Conduct follow-up calls to landowners and assist with the development of CCRP plans.
- Restore 4 wetland basins per year totaling 320 acres wetland habitat and another 100 acres of upland buffer habitat.

General feel of the meeting was good and the need and advantage of dovetailing the plans was discussed and understood by all.

STEVENS COUNTY

July 22, 2002, the FDR and NRE ordinal rankings for the East Branch Twelve Mile Creek subwatershed were presented and discussed with Bill Kliendl, Stevens CLWP Manager; Dave Jungst, Stevens SWCD Manager; Jon Roeschlein, District Administrator; Jack Lampert Watershed Manager and Herb Kloos, Stevens County Commissioner.

When asked if there was agreement with these FDR high priority issues, or if anything was missed; there was consensus regarding the priorities of the issues with the following comments:

- Flooding issue concern of "overland flooding- steep slopes and depressional areas" does the steep slopes mean the beach ridge area?
- Flooding issue concern of "ice and snow blockage" should specify in man-made channels.
- Flooding issue concern of "major contributor to downstream flooding" remove major-let the hydro modeling quantify watershed wide.
- Flood damages concern "road washouts and inundation- major transportation road" no state roads were mentioned only county roads.
- Drainage issue concern of "county line dispute" specify judge's ruling.

When asked if there was agreement with these NRE high priority issues or if anything was missed; there was consensus regarding the priorities of the issues, with the following comments:

- A RRV CREP should allow existing priority practices such as CP-21 and CRP to be enrolled into long-term easement.
- Erosion and sedimentation issue concern of "agricultural land and channel erosion" change the priority ranking of high to moderate-high.
- Water quality issue concern "nutrient and sediment loading" address specific to Lake Traverse and Mud Lake.
- Other natural resource issues should have a concern regarding lack of buffers as a moderate priority.

The following ten-year period goals and actions within the Stevens County portion of the District were developed:

OBJECTIVE**:** Maintain and improve water quality and quantity in Stevens County.

- Install ten water and sedimentation structures.
- Install ten grassed waterways.
- Restore 150 acres of wetland, including upland buffer.
- Assist with the Lake Traverse Watershed Improvement Project.
- Goal: Accelerate the installation of vegetative buffer strips and participation in the CCRP and Reinvest in Minnesota (RIM) Programs. Establish buffers strips on 85 percent of shoreland areas and on 50 percent of other eligible lands. Conduct mailing to all landowners and operators in the watershed outlining areas eligible for CCRP buffers highlighted on an aerial photo. Conduct follow-up calls to landowners and assist with the development of CCRP plans. Numbers from SWCD annual would reflect an annual acreage goal of 25 and 125 for easements and CCRP respectfully.
- Increase the use of conservation tillage by percent or acreage. Example: 20 percent or 15,000 acres
- Conduct tillage transect survey to access adoption rates of conservation tillage.

OBJECTIVE**:** Reduce wind erosion.

- Install 20 miles field windbreak.
- 50 acres of farmstead shelterbelts.
- 20 acres wildlife habitat.
- 40 acres of riparian forest buffers.

It was pointed out that Stevens County will soon start updating the CLWP and this information/process will improve the watershed context and he looks forward to common goals/objectives/actions.

General feel of the meeting was good and the need and advantage of dovetailing the plans was discussed and understood by all.

TRAVERSE COUNTY

July 15, 2002, the FDR and NRE ordinal rankings for the Bois de Sioux Main Stem, South Fork of Rabbit River, Judicial Ditch #14, Five Mile Creek, Lake Traverse, East Branch Twelve Mile Creek, and West Branch Twelve Mile Creek subwatersheds were presented and discussed with Don Otto, Traverse SWCD Manager; Jon Roeschlein, District Administrator; and Bill Gibson, Traverse County Commissioner.

When asked if there was agreement with these FDR high priority issues, or was anything missed; there was consensus regarding the priorities of the issues with the following exception:

- "Damage to crop land" within the Lake Traverse subwatershed should specify "basins or pot-holes" and priority changed from a low to moderate to a moderate.

When asked if there was agreement with these NRE high priority issues or if anything was missed; there was consensus regarding the priorities of the issues, with the following comments:

- A RRV CREP should allow existing priority practices such as CP-21 and CRP to be enrolled into long-term easement.
- The high priority issue "land cover losses at expiration of CRP" within the Five Mile Creek should be a high priority issue watershed-wide.
- "South Half of Lake Traverse shoreland erosion" issue possibly addressed in CLWP update action item "shoreland ordinance update".
- Judicial Ditch 14, East Branch Twelve Mile Creek, West Branch Twelve Mile Creek and Five Mile Creek "sediment and nutrient loading" should specify which downstream resources (Lake Traverse and/or Mud Lake) are being impacted. Does the Traverse Lake D/F Study quantify loadings per subwatershed?
- East Branch Twelve Mile Creek "potential for feedlot problems" should be a moderate issue to be contestant with "potential for feedlot loading" moderate ranking within the West Branch Twelve Mile Creek.

General feel of the meeting was good and the need and advantage of dovetailing the plans was discussed and understood by all.

The following goals and actions (ten years) within the Traverse County portion of the District were developed:

Soil and water conservation problem – wind erosion.

OBJECTIVE: To reduce soil erosion to "T" on 150,000 acres.

- Establish 150 miles of field windbreaks to protect 12,000 acres from wind erosion.
- Make 1,000 personal contacts with landowners to promote field windbreaks.

OBJECTIVE: Annually change the landuse on 700 acres of marginal agricultural land from cropland to native vegetation.

- Make 600 personal contacts of landowners with marginal agricultural land.

OBJECTIVE: To increase the amount of residue management practices in the SWCD by 100,000 acres.

- Provide no-till drill to landowners to seed 15,000 acres.
- Protect 85,000 acres by providing technical/educational assistance to 1,000 via personal contacts regarding residue management/conservation tillage.

SOIL and WATER CONSERVATION PROBLEM----WATER EROSION

OBJECTIVE: To reduce soil loss from wind and water erosion to 'T' on 150,000 acres.

- Establish 150 miles of field windbreaks.
- Protect 95,000 acres by providing technical/educational assistance to 1,100 via personal contacts regarding residue management/conservation tillage.
- Establish buffer strips on 12,000 acres. The following wording was suggested for Wilkin and Otter Tail: *"Accelerate the installation of vegetative buffer strips and participation in retirement programs by establishing buffer strips on 85 percent of shoreland areas and 50 percent of other eligible lands by 2006. Conduct mailing to all landowners/operators in the watershed outlining areas eligible for programs buffers highlighted on an aerial photo. Conduct follow-up calls to landowners and assist with the development of CCRP plans."*
- Install 30 water control structures to improve water quality via 100 personal contacts.
- Restore 80 drained wetlands and maintain 50 existing wetlands.
- Reduce phosphorus entering surface waters by installing 10 animal waste management systems.

SOIL and WATER CONSERVATION PROBLEM----WATER EROSION and FLOOD DAMAGES

- Increase infiltration by changing tillage practices to no-till on 15,000 acres via 150 personal contacts regarding residue management/conservation tillage.
- Establish buffer strips on 12,000 acres.
- Restore 80 drained wetlands and maintain 50 existing wetlands via 150 personal contacts to promote programs.

SOIL and WATER CONSERVATION PROBLEM----WILDLIFE HABITAT

Establish 34,000 acres of upland and wetland habitat by establishing 12,000 acres of buffer strips and restoring 80 drained wetland basins.

July 1, 2002 following the Wilkin CLWP Task Force meeting, the high priority FDR and NRE ordinal rankings for the Bois de Sioux Main Stem, Rabbit River and South Fork Rabbit River subwatersheds were presented and discussed with Bruce Poppel, Wilkin County Environmental Officer; Steve Cole, DC NRCS; Don Bajumpaa, Wilkin SWCD Manager, Jon Roeschlein, District; Stephanie Miranowski, Wilkin County Commissioner; Gerald Nordick, Citizen Wilkin County Environmental Advisory Committee; and Bob Westfall, Citizen Wilkin County Environmental Advisory Committee.

When asked if there was agreement with these FDR high priority, or if anything was missed; there was consensus the issues were high priority and did not feel the need to add to the rankings.

When asked if there was agreement with these NRE high priority, or if anything was missed; there was consensus the issues were high priority and did not feel the need to add to the rankings.

When asked, what implementation actions are in the draft Wilkin CLWP and the SWCD plan which would impact these high priority rankings; these answers were given:

- Wilkins's CLWP has buffers.
- Investigation of local soil loss ordinance by 2005.
- Unsewered communities and incompliant ISTS within the shoreland area as a high priority action.

General feel of the meeting and the rational for it was understood by all.

The following annual goals/actions within the Wilkin County portion of the District were developed:

OBJECTIVE: Reduce wind erosion on agricultural farmland in Wilkin County.

- Promote the parturition of 400 acres in CCRP and 640 in WRP.
- Plant 2 miles of field windbreaks, 3 farmstead shelterbelts and 1 wildlife habitat area.

- Assist with tree maintenance (weed badgering and laying tree fabric) on 14 sites and spraying 23 miles of windbreaks, shelterbelts, and wildlife plantings.
- In cooperation with NRCS, through farm planning, the SWCD will promote the use of conservation tillage on 1,300 acres.
- Work with the Wilkin CLWP staff to help reach the goal of reducing wind erosion, which exceeds 2 tons per year on all soils.
- Assist landowners with no-till on 700 acres.

OBJECTIVE: Increase awareness of water quality concerns in Wilkin County.

- Promote the installation of 400 acres of conservation practices (buffer strips) along perennial streams, lakes, and rivers through the promotion of land retirement programs.
- Provide a septic system design service and design 7 systems.
- Provide a septic system inspection service and inspect 7 systems.

OBJECTIVE: To reduce water erosion on agricultural farmland.

- Through farm planning, the District will promote the use of conservation tillage on 1,330 acres in Wilkin County.
- Assist landowners with no-till on 660 acres in Wilkin County.

OBJECTIVE: Increase awareness of grassland management.

- Promote EQIP to help improve grasslands on 70 acres.

OBJECTIVE: Increase wildlife habitat in Wilkin County by providing improved shelter and food resources.

- Promote landowner participation in programs to provide wildlife habitat on 400 acres.

OBJECTIVE: Accelerate the installation of vegetative buffer strips and participation in the CRP and RIM programs.

GOAL: Establish buffers strips on 85 percent of shoreland areas by 2006.

GOAL: Establish buffers strips on 50 percent of other eligible lands. Conduct mailing to all landowners and operators in the watershed (Rabbit River watershed completed) outlining areas eligible for CRP buffers highlighted on an aerial photo. Conduct follow-up calls to landowners and assist with the development of CRP plans.

LANDUSE with in Bois de Sioux Major Watershed		
	Acres	**% of Total**
Total Watershed Area	**127,961**	
Urban/Rural Development	1,525	1.2%
Cultivated Land	122,199	95.5%
Hay, Pasture, Grassland	2,060	1.6%
Brushland	202	0.2%
Forested	1,553	1.2%
Water	376	0.3%
Bog/Marsh/Fen	38	0.0%
Mining	8	0.0%

Wilkin County Landuse Summary 100ft. Stream/Ditch Buffer		
	Acres	**% of Total**
Total Buffer Area	**23,164**	
Urban/Rural Development	298	1.3%
Cultivated Land	17979	77.6%
Hay, Pasture, Grassland	2775	12.0%
Brushland	298	1.3%
Forested	906	3.9%
Water	656	2.8%
Bog/Marsh/Fen	245	1.1%
Mining	7	0.0%

APPENDIX 4

Tillage Transects

Appendix 4
TILLAGE TRANSECTS

The landscape throughout the watershed has been extensively altered, primarily to improve agricultural production. While the agricultural lands have been highly productive, much of the natural landscape values once present in the watershed have been lost. Most of the original prairie landscape has been cultivated; many of the original wetlands have been drained. Many of the original streams have been channelized and riparian corridors have been diminished or lost.

In addition to maintaining soil productivity and minimizing crop damage, control of erosion has the added benefit of reduced drainage and road ditches maintenance.

Management of crop residues during tillage has long been a key component of an erosion control and water management strategy. Thirty percent residue after planting, averaged over the crop rotation, is generally recommended as the minimum amount of residue necessary to reduce soil erosion to an acceptable level (an estimated 65 percent reduction in soil erosion).

The following table provides an indication of conventional tillage and conservation tillage with the related total soil loss.

Number of Acres and Total Soil Loss for Indicated Tillage Systems

	Bois de Sioux Subwatershed		Mustinka River Subwatershed	
	Conventional Tillage	Conservation Tillage	Conventional Tillage	Conservation Tillage
Grant County				
Acres	311,336	15,068	428,953	50,187
Total Soil Loss (in tons)	158,820	6,404	484,073	41,111
Traverse County				
Acres	340,296	143,534	610,566	251,978
Total Soil Loss (in tons)	119,465	15,493	205,638	33,291
Big Stone County				
Acres	N/A	N/A	77,047	67,112
Total Soil Loss (in tons)	N/A	N/A	99,598	35,779
Stevens County				
Acres	N/A	N/A	72,843	96,693
Total Soil Loss (in tons)	N/A	N/A	83,318	49,902
Total of Acres				
Acres	651,632	158,602	1,189,409	465,970
Total Soil Loss (in tons)	278,285	21,897	872,627	160,083

The following tables provide an indication of tillage methods on different slopes with the related soil loss per acre.

BOIS de SIOUX RIVER WATERSHED
Number of Acres and Soil Loss with indicated Slope Percent

Grant Co Tillage System	Slope Percent									
	0-2%		3-4%		5-7%		8-10%		>10%	
	Acres	Tons/ Acre	Acres	Tons/ Acre	Acres	Tons/ Acre	Acres	Tons/ Acre	Acres	Tons/ Acre
Conventional	227,233	0.7	15,284	1.6	3,167	4.3	0	-	0	-
Mulch-till	7,392	0.5	0	-	0	-	0	-	0	-
No-till	4,933	0.4	0	-	448	1.5	0	-	0	-
Ridge-till	536	-	0	-	0	-	0	-	0	-
Traverse Co Tillage System	**Slope Percent**									
	0-2%		3-4%		5-7%		8-10%		>10%	
	Acres	Tons/ Acre	Acres	Tons/ Acre	Acres	Tons/ Acre	Acres	Tons/ Acre	Acres	Tons/ Acre
Conventional	145,614	0.8	13,291	2.0	0	-	0	-	0	-
Mulch-till	35,921	0.4	3,336	0.9	0	-	0	-	0	-
No-till	2,652	0.2	0	-	0	-	0	-	0	-
Ridge-till	0	-	0	-	0	-	0	-	0	-

MUSTINKA RIVER WATERSHED
Number of Acres and Soil Loss with indicated Slope Percent

Grant Co Tillage System	Slope Percent									
	0-2%		3-4%		5-7%		8-10%		>10%	
	Acres	Tons/ Acre	Acres	Tons/ Acre	Acres	Tons/ Acre	Acres	Tons/ Acre	Acres	Tons/ Acre
Conventional	222,257	0.9	85,230	1.7	29,470	5.4	748	4.5	1,272	17.6
Mulch-till	15,655	0.6	5,649	1.2	2,169	2.7	0	-	0	-
No-till	8,085	0.4	1,794	0.7	897	1.6	0	-	536	-
Ridge-till	0	-	0	-	0	-	0	-	0	-

Traverse Co Tillage System	Slope Percent									
	0-2%		3-4%		5-7%		8-10%		>10%	
	Acres	Tons/ Acre	Acres	Tons/ Acre	Acres	Tons/ Acre	Acres	Tons/ Acre	Acres	Tons/ Acre
Conventional	251,340	0.8	1,991	2.6	0	-	1,330	-	0	-
Mulch-till	83,788	0.4	669	1.1	0	-	0	-	0	-
No-till	2,660	0.2	0	-	0	-	0	-	0	-
Ridge-till	669	0.2	0	-	0	-	0	-	0	-

Big Stone Co Tillage System	Slope Percent									
	0-2%		3-4%		5-7%		8-10%		>10%	
	Acres	Tons/ Acre	Acres	Tons/ Acre	Acres	Tons/ Acre	Acres	Tons/ Acre	Acres	Tons/ Acre
Conventional	58,743	1.3	25,239	2.1	11,631	3.0	3,984	8.0	0	-
Mulch-till	16,866	0.6	6,846	1.0	632	1.4	0	-	0	-
No-till	2,917	0.6	346	0.3	0	-	0	-	0	-
Ridge-till	1,760	0.8	6,413	1.2	0	-	0	-	0	-

Stevens Co Tillage System	Slope Percent									
	0-2%		3-4%		5-7%		8-10%		>10%	
	Acres	Tons/ Acre	Acres	Tons/ Acre	Acres	Tons/ Acre	Acres	Tons/ Acre	Acres	Tons/ Acre
Conventional	69,619	1.3	3,225	2.8	0	-	0	-	0	-
Mulch-till	77,591	1.0	11,632	1.6	1,298		0	-	0	-
No-till	1,288	0.5	0	-	0	-	0	-	0	-
Ridge-till	3,235	0.9	649	1.2	0	-	0	-	0	-

A combination of a hydrologic soil group (soil) and a landuse and treatment class (cover) is used to determine the hydrologic soil-cover complex. The effect of the hydrologic soil-cover complex on the amount of rainfall that runs off is represented by a runoff curve number (CN). Higher curve numbers indicate more runoff. Conversion of cropland to grasslands via land retirement programs will achieve a significant reduction in runoff. Conversion of cropland to grasslands also provides the additional benefit of significantly reducing the sediment (80 percent erosion reduction of area retired and 65 percent entrapment of sheet flow from upland) and phosphorus in runoff passing through the vegetation. The Traverse SWCD 2000 annual report documented the following accomplishments for buffer strip:

- 573.6 acres enrolled (385 ac in CCRP and 188.6 ac in RIM)
- Annual Soil Saved=7,121 tons
- Annual Net Sedimentation Reduction= 1,424 tons
- Annual Phosphorus Reduction= 1,764 pounds

The following table provides an indication of the landuse within 120-feet of a stream, ditch, wetland or lake by county.

Landuse (by County) within the Bois de Sioux Watershed which is Located 120' From a Hydrologic Source						
Landuse	**Big Stone Co.**	**Grant Co.**	**Otter Tail Co.**	**Stevens Co.**	**Traverse Co.**	**Wilkin Co.**
Cultivated	2,000	10,287	1,442	5,117	16,906	7,073
Deciduous Forest	144	546	62	221	1,009	385
Deciduous Shrubbed Grassland	6	139	11	17	194	140
Exposed Soils	0	0	0	0	11	2
Farmstead	7	79	3	25	161	74
Grassland	200	2,502	278	460	2,975	828
Gravel Pits	0	0	0	0	1	0
Open Water	188	710	266	0	480	348
Other Rural Development	0	10	1	77	32	7
Out of State/County	0	0	0	0	7	3
Rural Residential Development	4	0	0	3	31	3
Transitional Ag	80	300	11	65	295	13
Urban Industrial	10	67	0	2	32	12
Wetland	112	1,340	289	345	376	25
Coniferous Shrubbed Grassland	0	0	0	0	3	0

Goal 1: Reduce soil erosion due to wind and water.

Objective 1 Promote implementation of agricultural BMPs to reduce erosion and sedimentation, and facilitate natural channel evolution to a stable condition.

Objective 2 Achieve a 65 percent reduction in soil erosion in the agricultural areas of the watershed by encouraging the SWCDs to add 250,000 acres of conservation tillage *on steeper slopes* adjacent to ditches, waterways and wetlands.

APPENDIX 5

Revised 1999 Rules of Bois de Sioux Watershed District

Appendix 5
Revised 1999 Rules of Bois de Sioux Watershed District

Section 1. Introduction and General Policy.

The rules of the Bois de Sioux District are to effectuate the purposes of Minnesota Statutes, Section 103D, and the authority of the Managers therein prescribed. These rules are deemed necessary to implement and make more specific the law administered by them.

If any part of these rules is for any reason held to be invalid, such decision shall not affect the validity of the remaining portion of these rules.

Changes to these rules may be made by the Managers. Any interested person may petition the Managers for a change in these rules.

If any rule is inconsistent with the provisions of Minnesota Statute, Section 103D, or other applicable law, the provisions of said Section 103D or other applicable law shall govern.

The Managers accept the responsibilities with which they are charged as a governing body. While there is no intention to usurp the authority or responsibilities of other agencies or governing bodies, neither will they shirk their responsibilities. They will cooperate to the fullest extent feasible with persons, groups, state and federal agencies and other governing bodies.

It is the intention of the Managers that no person shall be deprived or divested if any previously established beneficial use or right, by any rule of the District, without due process of law, and that all rules of the District shall be construed according to said intention.

It is the intention of the Managers to promote the use of the waters and related resources within the District in a provident and orderly manner so as to improve the general welfare and public health for the benefit of its present and future residents.

Section 2. Amendment or Rules.

The Managers shall comply with the following steps in amending rules:

A. A copy of any proposed amendment to the rules shall be submitted to each Manager at least thirty (30) days before its adoption by the Managers.

B. An amendment to the rules shall be adopted by a majority vote of the Managers.

C. The original copy of the rules and any amendments to the rules shall be kept in the files of the Managers, and in addition, copies shall be prepared for distribution to the County Auditors, County Commissioners, Soil and Water Conservation Districts, Farm Service Agencies, and Township Board Chairmen in the District, and any other interested persons requesting the same.

D. Every rule and amendment thereof adopted by the Managers shall have the force and effect of the law.

Section 3. Definitions.

For the purpose of these rules, certain words and terms are herein defined as follows:

A. District means the Bois de Sioux Watershed District.

B. Managers means the District Board of Managers.

C. Person means an individual, firm, partnership, association, or corporation, but does not include public or political subdivisions. It specifically includes, but is not limited to, landowners, occupants, contractors or equipment operators.

D. Public Corporation means a county, town, school district, or a political division or subdivision of the state or federal government.

E. Public Health includes any act or thing tending to improve the general sanitary conditions of the District.

F. General Welfare includes any act or thing tending to improve or benefit or contribute to the safety or well being of the general public or benefit the inhabitants of the District.

G. Work or Works means any construction, maintenance, repairs or improvements.

H. The word "shall" is mandatory, not permissive.

I. Drainageway means a natural or artificial channel or tile which provides a course for water flowing continuously or intermittently.

J. Legal drainage system means a watershed, county or joint county drainage system.

K. A plan is a map or drawing and supporting data for proposed works.

L. Maintenance, as referred to for dikes, drainage ditches and sewers, shall mean restoring the system as near as practicable to its original condition or as subsequently improved.

M. Normal high water mark means a mark delineating the highest water level which has been maintained for a sufficient period of time to leave evidence upon the landscape. Commonly, it is that point where the natural vegetation changes from predominantly aquatic to predominantly terrestrial.

Section 4. Permits.

The requirement for a permit from the Managers for certain uses of water or works within the District is not intended to delay or inhibit development. Rather, the permits are needed so that the Managers are kept informed of planned projects, can advise and in some cases provide assistance, and to insure that developments of the natural resources are orderly and in accordance with the Overall Plan for the District.

A. All permits, when issued shall be signed by the President **or** Secretary of the Board of Managers, or their designates.

B. No works or use requiring a permit shall be commenced prior to the issuance of the permit.

In addition to the remedies provided in Minnesota Statute 103D.545 and Section 8, infra, in those instances where work has been done before a permit is granted, the Board may require that the property be returned to its original condition before considering the permit; and

The Board shall require applicant pay an "After-The-Fact" permit fee in the amount of $100, plus the actual engineering and attorneys fees incurred by the Board in dealing with the "After-The-Fact" permit application, as a condition to granting the permit.

C. Unless specified in the permit, works for which a permit is given must be completed within one (1) year. The Managers further require, as a condition of all permits, that they be notified when an improvement is completed by returning a "COMPLETION REPORT" card.

D. If a permit application is refused or granted subject to conditions, the Board shall, within forty-five (45) days, hold a hearing on the permit application.

E. Any applicant or other person or public corporation dissatisfied with the Board's decision on any permit application must appeal the Board's decision to the District Courts of the State of Minnesota within ninety (90) days from and after the issuance of the Board's decision or said Board decision shall become final.

F. No fee shall be charged for a permit application except the "After-The-Fact" permit fee hereinabove described.

G. Applications for a permit may be filed personally or mailed to:

Bois de Sioux Watershed District
1002 Broadway, Wheaton, Minnesota 56296
(320) 563-4185/P
(320) 563-4987/F

H. A plat or drawing shall accompany the application, and the Managers may request additional information.

I. The Board may issue district wide permits on an annual basis for specific classes of projects where a standard design has been approved by the Board and where the Board is satisfied construction of such projects will be adequately supervised.

1. Each district wide permit shall be subject to such specific requirements as the Board may establish.

2. A hearing shall be held before any district wide permit is issued or renewed.

Section 5. Flood Control and Drainage.

(1) General Rules for the Disposal of Surface Water.

A. Every person shall use his land reasonably in disposing of surface water and may turn into a natural Drainage way all the surface water that would naturally drain there, but he may not burden a lower landowner with more water than reasonable under the circumstances.

B. Surface water shall not be artificially removed from the upper land to and across lower land without adequate provision being made on the lower land for its passage.

C. In order to reduce sediment transport, where feasible drainage shall be discharged through marsh lands, swamps, retention basins or other treatment facilities prior to release into the receiving bodies of public waters. Maximum utilization will be made of temporary storage areas or retention basins scattered throughout developing areas to maximize upstream storage and to reduce peak flows, erosion damage and drainage facility construction costs. Open drainage ditches shall make maximum use of vegetation to reduce channel erosion.

D. To control and alleviate erosion and the situation of the watercourses of the District:

1. All watercourses therein shall be constructed with a side slope, as determined by proper engineering practice, so as to reasonably minimize land and soil erosion, giving due consideration to the intended capacity of the watercourse, its depth, width and elevation, and the character of the soils through which the drain passes.

2. Water inlets, culvert openings and bridge approaches shall have adequate shoulder and bank protection in order to minimize land and soil erosion.

E. Any person who allows dirt to blow from his lands into a drainage is responsible for the removal of same.

F. Flood Control and Drainage (2, E. & F.) are interpreted so that ponds created solely by excavation are not reservoirs nor is the creation thereof reshaping of the surface topography. Therefore, the creating of ponds solely by excavation shall not require a watershed permit.

(2) A permit must be obtained from the Watershed District prior to any work being commenced for the following:

A. Any landowner, occupant, contractor or equipment operator shall be responsible to ascertain that a permit has been obtained before undertaking any of the work hereinafter described requiring a permit from the Board of Managers.

B. No person or public corporation shall cut an artificial Drainage way across a subwatershed and thereby deliver water into another subwatershed without a permit from the Managers.

C. No person or public corporation shall undertake to construct or improve any drainage way without a permit from the Board of Managers. A permit is required for any deepening or enlarging of existing drainage ways. Any existing Drainage way may be cleaned of debris, cattails, and blown in or washed in sediment without a permit; but any cleaning that involves removing clay or virgin soils or changing the alignment, depth, or cross-section of the Drainage way requires a permit.

D. No person or public corporation shall construct, alter, or remove any dike without a permit from the Board of Managers.

E. No person or public corporation shall undertake the construction, removal or abandonment of any reservoir for the impoundment of water without a permit from the Managers; nor shall any works be done which would alter the effectiveness of a reservoir without a permit from the Managers.

F. No person or public corporation shall undertake the practice of land forming, which is the reshaping of the surface topography but which does not induce the common farming practice of land leveling, on a given tract of land without a permit from the Managers.

G. No Wetland types 3, 4, 5 and 8, as described by Circular 39, Wetlands of the United States, published by the United States Department of the Interior, shall be drained without a permit from the Managers.

H. Construction of new drainage ditches or improvements to existing public drainage ditches shall be administered by the Managers. Plans and specifications for such projects shall be filed with the Watershed District. Maintenance and repair of public drainage systems as permitted by Chapter 103E, Minnesota State Statutes, may be made by ditch authorities without a permit, provided the Board of Managers have

been given copies of the plans and specifications for said ditch. The Board of Managers shall be notified of the proposed work prior to the commencement thereof.

I. No person or public corporation shall install or alter any drainage structure which will change the elevation and/or capacity of the structure without obtaining a permit from the Board of Managers.

Section 6. Related Ordinances.

The Managers will cooperate with public corporations and state and federal agencies in the application of ordinances and rules concerning water and related resources within the District.

A. Copies of proposed county, municipal and town ordinances relating to surface water drainage, land use zoning, shore land use and flood plain zoning, as applied to changes within the flood plain, shall be submitted to the Manager thirty (30) days prior to the first public hearing date for review and comment.

B. Ordinances relating to surface water drainage, land use zoning, shore land use and flood plain zoning shall be submitted to the Managers within forty-five (45) days after passage.

Section 7. Alteration of Natural Drainage Way, Lakes and Wetland.

Management of natural drainage ways, lakes, wetlands and their abutting land should be done in such a way so as to reduce their deterioration and to maximize their value for the general welfare of the District.

A. No change may be made in the bed, banks or shores of natural drainage ways, lakes or wetlands without a permit from the Managers.

Section 8. Enforcement.

Any provision of these Rules or an order or stipulation agreement made, or any permit issued, by the Board of Managers of this Watershed District, may be enforced by criminal prosecution, injunction pursuant to Section 103D.545, of the Minnesota Statutes, action to compel performance, restoration, abatement, and other appropriate action.

A violation of these Rules or any order or stipulation agreement made, or a permit issued by the Board of Managers of this Watershed District, is a misdemeanor in accordance with Section 103D.545 of the Minnesota Statutes.

Adopted by the Board of Managers of the Bois de Sioux Watershed District this 21st day of October, 1999.

Frank Davison, Secretary

Bois de Sioux Watershed District PERMIT REQUIREMENTS

A permit must be obtained from the Bois de Sioux Watershed District PRIOR to any work being commenced including, but not limited to, the following activities:

1) Transfer of water from one subwatershed to another.
2) Construction of new drainage ditches.
3) Improvement of existing drainage ditches. (See rules for definition of improvement, Section 4, item (2), paragraph C)
4) Construction, alteration, or removal of any dike.
5) Any work involving a reservoir.
6) Land forming (not land leveling).
7) Wetland alterations (drain, fill, restore, create, etc.).
8) Installation or alteration of drainage structures which result in a change in capacity.
9) Work in the beds, banks, or shores of any lakes, natural drainageways, or wetlands.

Please refer to a copy of the rules and regulations for more detail definitions and/or call the Bois de Sioux Watershed District at 320-563-4185.

APPENDIX 6

Permitting Checklist

Appendix 6
Permitting Checklist

The following agencies may require a permit for any projects/activities involving water, either surface or otherwise. **You are advised to contact these agencies prior to doing any work within their jurisdiction.** This list is being provided to you in an effort to coordinate the permitting activities and make it easier for you, the applicant, to know what you need to do and where you need to go for permits.

Shoreland/Zoning Offices

- Grant County – 218-685-4967
- Traverse County – 320-563-4411
- Big Stone County – 320-839-3136
- Stevens County – 320-589-7417
- Otter Tail County – 218-739-2271
- Wilkin County – 218-643-5815

Road Authorities – For work in road right-of-way

- County Highway Department
- Grant County – 218-685-4481
- Traverse County – 320-563-4848
- Big Stone County – 320-839-2594
- Stevens County – 320-589-7430
- Otter Tail County – 218-739-2271
- Wilkin County – 218-643-4772
- Township Road Authority – Township Board Members
- Minnesota Department of Transportation
  - – Morris – 320-589-7300
  - – Detroit Lakes – 218-847-1587

Wetland Conservation Act (WCA) – Local Government Units (LGU)

- Grant County – 218-685-4967
- Traverse County – 320-563-8218
- Big Stone County – 320-839-6149
- Stevens County– 320-589-7420
- Otter Tail County – 218-739-2271
- Wilkin County– 24018-643-5815

Swampbuster – Natural Resource Conservation Service (NRCS)

- Grant County – 218-685-5341
- Traverse County – 320-563-8218
- Big Stone County – 320-839-6149
- Stevens County – 320-589-2266
- Otter Tail County – 218-739-5247
- Wilkin County – 218-643-3051

Minnesota Department of Natural Resources (MNDNR)

- Otter Tail, Wilkin, Traverse, Stevens and Grant Counties – 218-739-7576
- Big Stone – 320-796-6272

Bois de Sioux Watershed District

- Administrator – 320-563-4185

U.S. Army Corps of Engineers

- Regulatory Department – 651-290-5372

APPENDIX 7

Definition of Acronyms

Appendix 7
Definition of Acronyms

BdWSD - Bois de Sioux Watershed District

BSC – Big Stone County

BWSR – Minnesota Board of Water and Soil Resources

CCRP – Continuous Conservation Reserve Program

CRP – Conservation Reserve Program

CREP – Conservation Reserve Enhancement Program

CLWP – County Local Water Plan

DOW – Division of Waters

DU – Ducks Unlimited

FDR – Flood Damage Reduction

GC – Grant County

GSWCD – Grant Soil and Water Conservation District

LCMR - Legislative Commission on Minnesota Resources

MPCA – Minnesota Pollution Control Agency

MNDNR – Minnesota Department of Natural Resources

MnDOT – Minnesota Department of Transportation

NOT – North Ottawa Township

NRE – Natural Resource Enhancements

NRCS – United States Department of Agriculture Natural Resource Conservation Service

RIM – Reinvest in Minnesota

RRBC – Red River Basin Commission

SC – Stevens County

SSURGO – Soil Survey Geographic Data Base

SC – Stevens Country

TC – Traverse County

USACE – US Army Corps of Engineers

USFWS – US Department of the Interior Fish and Wildlife Service

WC – Wilkin County

WCA – Wetland Conservation Act

WRP – Wetland Reserve Program

WSWCD – Wilkin County Soil and Water Conservation District

Others

CAC – Citizens Advisory Committee

CN – Curve Number

LTAC – Lake Traverse Association Corporation

LTSTF – Lake Traverse Special Task Force

PT – Project Team

RRBFDRWG – Red River Basin Flood Damage Reduction Work Group – Mediation Group

RRWMB – Red River Watershed Management Board

RUSLE – Russell Universal Soil Loss Equation

TAC – Technical Advisory Committee

TMDL – Total Maximum Daily Load

USLE – Universal Soil Loss Equation

APPENDIX 8

Newly Developed TMDLs

APPENDIX 9

Bois de Sioux Summary of Water Quality
2002 Preliminary Analysis

Appendix 9
Bois de Sioux Summary of Water Quality

2002 Preliminary Analysis

Following is a preliminary overview of monitoring in the Bois de Sioux Watershed in 2002 as performed by the Red River Basin Monitoring Program (RRBMP). Results for nutrient analysis were not back from the Environmental Protection Agency (EPA) lab as of the preparation of this report. A final report will be prepared when results are back and discussion has occurred with resource managers in the watershed. The final report will also include discussion of other water quality and associated monitoring such as flow, stage levels, transparency tube, rainfall, and other measures recorded by volunteers and resource managers in the watershed. Additional detailed water quality data will also be included from detailed monitoring being performed by the USGS at several sites associated with TMDL assessments being done in the Bois de Sioux Watershed.

The Red River Basin Monitoring Program, through its River Watch activities, began monitoring water quality conditions in the Bois de Sioux Watershed in 2002. Teachers and students from high schools based in Graceville, Wheaton, Herman, Campbell, and Breckenridge assisted with monitoring efforts. Sites were selected to characterize conditions of distinct segments of major waterways in the Bois de Sioux Watershed and associated tributaries including creeks and major drainage ditches. Sites were also selected to correspond with the extensive staff gage network in place throughout the watershed. Rating curves, established at these sites, will be used to determine flow and loading estimates for the sample events in 2002.

Sampling via the River Watch program is normally performed on a monthly basis. However, as schools were just beginning in the program this frequency was not obtained in 2002. Also, several of the sites in the southern portion of the Bois de Sioux Watershed could not be sampled during the latter portion of 2002 due to low to no flow conditions which is expected to be a common occurrence at these sites at the latter end of a typical sampling season. Thus, based on the limited data available at this time, only general observations can be made with further monitoring needed to discern any statistically valid results.

Based on sampling that was accomplished in 2002 the following preliminary observations are presented. Results will be compared to Red River Valley ecoregion values for analysis. Conductivity levels at nearly all sampling sites consistently exceeded ecoregion values, often double the ecoregion expectation. The Red River at Breckenridge and one site on the Rabbit River were the only sites with results below the ecoregion value. Conductivity levels are generally higher when groundwater comprises a good share of streamflow which was the

situation for much of the year as a relatively dry year was experienced throughout much of the Bois de Sioux Watershed.

Dissolved oxygen levels were generally good at most sites monitored in the Bois de Sioux Watershed with the exception of dissolved oxygen dropping below the desired level of 5 mg/l at several sampling sites in the mid-reaches of the Twelve Mile Creek subwatershed. These low oxygen levels were found during the summer months of June and July when water temperatures are highest and conversely, dissolved oxygen levels tend to be lowest. These results also tend to be associated with low flow conditions at segments of streams with low gradients, hence little physical mixing is occurring within the stream.

Turbidity levels were generally highest on the Bois de Sioux River with the downstream segment of the Mustinka River also exhibiting some of the highest turbidity levels in the watershed. Turbidity levels were also quite high during the two sample events that were recorded at the ditch entering West Toqua Lake which was serving as an outlet for drawing down of North Rothwell Lake during a portion of the year in 2002.

Until more data is received from the EPA lab to provide a complete season of results for nutrients and solids, only limited analysis and reporting of these parameters will be made at this time. Based on the very limited data available however, the East Branch of 12 Mile Creek exhibited the highest phosphorus and nitrate levels within the District.

Data from other sources need to be assessed for a more complete analysis of watershed and subwatershed conditions. Due to TMDL exceedances in the watershed, the MPCA has contracted with the USGS to carry out a detailed monitoring study of three sites on the Rabbit River and two sites on the Mustinka River which began in late 2001 and will continue into 2003. These TMDL study results will be included in a final summary of results for 2002. The Bois de Sioux Watershed District has also collected samples following rain events in 2002 associated with the proposed Moonshine and North Ottawa Flood Damage Reduction projects as well as monitoring associated with a buffer strip initiative in the watershed.

Prior to the 2003 sampling season, the number and location of sampling sites, parameters being monitored, and frequency of monitoring in the Bois de Sioux Watershed will be reviewed. Adjustments will be made as needed to provide a coordinated monitoring effort in the basin which will provide useful results to all resource managers.

Site ID	Lat	Long	Water Body	County	Site Description
BdS 01	45.86529	-96.04797	Mustinka R	Grant	From Herman 3/4 mile E.-MN 27; 3 miles N-CR 11; 4 miles E-CR 34; 0.3 mile N-CR 13
BdS 02	45.9051	-96.04004	Mustinka R	Grant	From Herman 3/4 mile E. on MN 27; 5 miles N on CR 11; 5.3 miles E and N on CR 8
BdS 11	45.80348	-96.21326	Grant CD 8	Grant	Approx. 3.4 miles W of Herman on MN 27
BdS 13	45.6873	-96.2434	12 Mile CrEBr	Stevens	2 miles S. of Dumont; 8.2 miles E
BdS 15			12 Mile CrEBr-WFk	Traverse	3 miles S. of Dumont; 4.7 miles E
BdS 15B			12 Mile CrEBr-WFk	Traverse	Co. Rd 8 crossing approx. 1 mile downstream of BdS15--alt. due to muddy road
BdS 16			12 Mile CrEBr	Traverse	Approx. 3.4 miles E. of Dumont on CR 6
BdS 18			12 Mile CrWBr-EFk	Traverse	2 miles S. of Dumont; 1.8 miles E
BdS 19	45.6867	-96.4216	12 Mile CrWBr	Traverse	2 miles S. of Dumont; 0.2 miles E
BdS 20	45.5727	-96.4654	12 Mile CrWBr	Big Stone	1.7 miles W. of Graceville
BdS 20B			12 Mile CrWBr	Big Stone	CR13 crossing approx.1 mile downstream of BdS20--alt. due to safety
BdS 23	45.80326	-96.25893	5 Mile Cr	Traverse	Approx. 5.7 miles W. of Herman on MN 27
BdS 26	46.05118	-96.56644	Bois de Sioux R	Wilkin	Bois de Sioux. Hwy 55 crossing 2 miles E. of Fairmount, ND
BdS 27 -TMDL3.2	46.09526	-96.41051	Rabbit R	Wilkin	Rabbit River at Campbell. T146, R46, Sec 2, SE corner (CoRd 4)
BdS 28	46.26041	-96.21324	Rabbit R	Wilkin	Rabbit R. 1.5 miles N of Campbell on MN 9. Sec 35, SW 1/4
BdS 30	46.01015	-96.31836	JD12	Traverse	JD 12 at Tintah. Sec. 3. 2nd St. Bridge
BdS 32 -TMDL1.1			Mustinka R	Traverse	1.2 miles N of Wheaton on US 75
BdS 33	45.87256	-96.11992	Mustinka R	Grant	From Herman E. on MN 27 3/4 mile; N on CR 11-4 miles; E 0.5 mile
BdS 34			12 Mile CrWBr	Traverse	Approx. 0.25 mile E. of Dumont on CR 6
BdS 49 -TMDL3.3	46.11177	-96.49296	Rabbit R	Wilkin	Rabbit River. U.S. Hwy 75 crossing. 4 miles W and 1.2 mile N of Campbell
BdS 5			12 Mile CrMS	Traverse	Approx. 7.4 miles NE of Wheaton on CR 14
BdS 51	46.03582	-96.26620	JD 2	Wilkin	JD 2 Crossing of Hwy 55 2 miles east of Nashua
BdS 53 -TMDL1.2			Mustinka R	Grant	Approx. 1.7 miles NW of Norcross on MN (6.6 miles NW of Herman)
BdS LkTr	45.7691	-96.6392	Lake Traverse	Traverse	MN 117 crossing at Reservoir Dam outlet(approx 8 miles SW of Wheaton)
BdSWRockN			Bois de Sioux R	Traverse	8 miles N of Wheaton and 4 miles W on CR 16
BdSWRock			Bois de Sioux R	Traverse	4 miles N of Wheaton and 4 miles W on CR 10
Moon CD8			BigStone CD 8	Big Stone	3 miles S. of Graceville; 3.1 miles E
Moon CD8-2			BigStone CD 8	Big Stone	2 miles S. of Graceville; 1.6 miles E
Tyler	46.1519	-96.5798	Bois de Sioux R	Wilkin	One mile S and E of Breckenridge on US 75; S 7.2 miles on CR 9; W .2 mile on CR 6
WToqCR52	45.5433	-96.4554	Rothwell Ditch	Big Stone	2 miles S. of Graceville; 1.2 miles W
Red210By			Red R	Wilkin	Red River crossing of MN Hwy 210 bypass-N.edge of Breckenridge
BdSCo12			Bois de Sioux R	Wilkin	RR crossing of Bois de Sioux R. just above confluence with Otter Tail
TCD27			Traverse CD27	Traverse	just before TCD27 enters Mustinka River at site BdS 32

Water Body	Sample Site	Sample Date	Sample Time	Temp Air-C	Temp H2O-C	Stage (Ft-md)	Turb NTUs	Cond uS/cm	pH	DO mg/l	DO %Sat	TP mg/l	NO3 mg/l	TSS mg/l
12 Mile CrMS	BdS 5	05/17/2002	10:30	10	11.6	5.7	30.1	1500	8.19	9.77	92	0.099	1.57	41
12 Mile CrMS	BdS 5	06/26/2002	9:35	24	25.8	20.3	65.6	1190	7.82	5.55	68	0.648	0.41	66
12 Mile CrMS	BdS 5	07/24/2002	10:17	22	20.48	20.9	28.2	1208	7.76	8.22	92	0.38	0.24	30
12 Mile CrMS	BdS 5	09/17/2002	10:22	22.2	17.2	21.7	23.8	1350	8.21	8.04	84			
12 Mile CrMS	BdS 5	10/08/2002	14:37	11	9.19	21.8	13.2	1367	8.50	11.74	103			
12 Mile CrEBr	BdS 16	05/17/2002	11:30	11	11.8	6.4	7.6	1790	8.10	10.84	102	0.084	0.84	11
12 Mile CrEBr	BdS 16	06/26/2002	10:10	26	25.6	13.3	43.5	1140	7.53	3.04	37	0.903	1.48	56
12 Mile CrEBr	BdS 16	07/24/2002	11:02	24	19.4	12.0	97.7	1568	7.76	6.65	73	0.989	0.28	100
12 Mile CrEBr	BdS 13	06/26/2002	12:00	27	26.1	3.8	59.7	1936	8.21	11.63	144	0.992	0.08	72
12 Mile CrEBr	BdS 13	07/24/2002	12:42	22	20.6	3.0	69.9	1559	7.86	6.59	72	0.546	0.08	81
12 Mile CrEBr-WFk	BdS 15	06/26/2002	11:40	27	25.9	0.1	0.8	1067	7.54	2.74	34	0.635	0.33	<1
12 Mile CrEBr-WFk	BdS 15B	07/24/2002	13:05	21	19.27	5.5	10.7	1846	7.60	4.07	44	1.18	0.2	16
12 Mile CrWBr	BdS 34	05/17/2002	12:00	13	12.6	1.6	2.0	1079	8.06	9.85	95	0.066	1.24	5
12 Mile CrWBr	BdS 34	06/26/2002	10:30	26	24.2	10.1	11.8	1077	7.57	3.78	45	0.584	0.08	13
12 Mile CrWBr	BdS 34	07/24/2002	11:24	22.5	21.05	10.5	23.0	1090	7.96	8.88	100	1	0.48	30
12 Mile CrWBr-EFk	BdS 18	06/26/2002	11:10	26	25.5	5.5	2.4	1382	7.44	1.58	19	0.597	2.83	<1
12 Mile CrWBr-EFk	BdS 18	07/24/2002	12:06	23	21.25	6	11.9	741	7.74	5.11	58	0.699	0.06	16
12 Mile CrWBr-EFk	BdS 18	09/16/2002	10:10	23	16.2	7.1	25.4	766	8.13	5.10	52			
12 Mile CrWBr	BdS 19	06/26/2002	10:50	25	24.8	3.6	6.5	1023	7.56	3.09	37	0.533	0.16	8
12 Mile CrWBr	BdS 19	07/24/2002	11:44	23	21.1	4.0	31.6	1649	7.82	5.41	61	1.35	0.13	34
12 Mile CrWBr	BdS 19	09/16/2002	9:45	22	15.8	5.4	10.1	1541	8.19	4.71	48			
12 Mile CrWBr	BdS 20	06/26/2002	19:45	27.8	30.08	na	63.6	953	8.43	6.96	92	0.648	0.29	39
12 Mile CrWBr	BdS 20	07/24/2002	18:20	24	23.3	na	37.0	801	8.40	10.66	125	0.852	<.02	26
12 Mile CrWBr	BdS 20B	09/16/2002	9:20	19	12.6	6.1	45.3	1880	7.78	2.92	28			
5 Mile Cr	BdS 23	05/20/2002	10:25	13.5	12.3	2.1	12.2	1370	8.17	10.10	96	0.105	<.02	19
5 Mile Cr	BdS 23	06/20/2002	10:43	21	21.1	8.8	40.9	1421	8.38	9.60	108	0.316	0.03	7
5 Mile Cr	BdS 23	07/25/2002	10:15	22	20.5	2.3sg	37.3	1139	7.62	6.19	69	0.328	0.14	53
5 Mile Cr	BdS 23	09/16/2002	14:05	27.2	19.85	8.6	6.3	1341	8.47	12.03	133			
5 Mile Cr	BdS 23	10/09/2002	10:20	5.5	4.33		9.4	1330	8.13	11.80	91			
Grant CD8	BdS 11	05/20/2002	10:50	16.5	12.3	2.0	6.4	1370	8.32	11.67	111	0.096	<.02	15
Grant CD8	BdS 11	06/20/2002	10:58	21.5	21.1	6.5	5.4	1423	8.43	14.44	163	0.163	0.03	41
Grant CD8	BdS 11	07/25/2002	10:35	22	20.6	2.2sg	19.7	1129	7.66	6.47	72	0.29	0.12	25
Grant CD8	BdS 11	09/16/2002	14:20	32.2	21.31	7.1	10.1	1334	8.83	12.92	146			

Water Body	Sample Site	Sample Date	Sample Time	Temp Air-C	Temp H2O-C	Stage (Ft-md)	Turb NTUs	Cond uS/cm	pH	DO mg/l	DO %Sat	TP mg/l	NO3 mg/l	TSS mg/l
Lake Traverse	BdS LkTr	05/17/2002	17:20	12	13.2	72.2sg	16.2	1174	8.28	9.60	93	0.178	0.28	22
Bois de Sioux R	BdS WRock	05/17/2002	16:20	14	14.3		57.6	1285	8.33	10.50	105	0.156	0.90	72
Bois de Sioux R	BdS WRock	06/26/2002	14:10	30	30.4	20.7	113.0	1277	8.09	6.51	87	0.775	0.10	92
Bois de Sioux R	BdSWRock N	09/17/2002	9:30	21.1	17.43	20.8	142.0	1382	8.28	5.30	56			
Bois de Sioux R	BdSWRock N	10/08/2002	13:49	10	9.27	20.42	44.3	1162	8.40	10.35	90			
Bois de Sioux R	BdS 26	06/20/2002	15:00	26.0	26.5	21.0	48.0	1444	8.44	11.99	149	0.380	0.02	56
Bois de Sioux R	BdS 26	09/17/2002	13:30	30	21.89	21.4	46.6	1357	8.77	11.08	127			
Bois de Sioux R	BdS 26	10/09/2002	13:15	11	9.17	21.1	17.5	1228	8.60	12.54	110			
Bois de Sioux R	Tyler	05/13/2002	13:05	14.5	12.2	16.6	101.0	1287	8.26	9.72	93	0.444	1.19	124
Bois de Sioux R	Tyler	06/27/2002	9:40	26.7	24.7	21.0	28.5	1255	8.29	6.20	75	0.269	0.03	26
Bois de Sioux R	Tyler	09/17/2002	14:13	31	19.01	21.3	43.7	1478	8.67	16.06	174			
Bois de Sioux R	Tyler	10/09/2002	12:35	10	8.25	20.9	12.2	1537	8.68	12.70	108			
Mustinka R	BdS 02	05/20/2002	11:45	16	12.2	3.8	19.0	867	7.70	7.70	82	0.117	0.14	47
Mustinka R	BdS 02	06/20/2002	9:00	19	17.9	4.4	64.1	1625	7.57	5.77	61	0.482	0.28	83
Mustinka R	BdS 02	07/25/2002	9:15	19	20.48	5.8sg	1.9	1241	7.83	2.13	24	0.242	0.09	3
Mustinka R	BdS 02	09/16/2002	12:50	24.4	16.81	3.8	4.6	1377	7.74	8.27	86			
Mustinka R	BdS 02	10/09/2002	8:55	5	5.64	4.2	3.8	1597	7.82	9.97	80			
Mustinka R	BdS 01	05/20/2002	11:30	19	12.0	3.2	25.9	1620	7.95	9.13	86	0.143	0.29	64
Mustinka R	BdS 01	06/20/2002	9:25	16.5	17.5	12.1	92.9	1669	7.52	6.79	71	0.469	0.50	110
Mustinka R	BdS 01	07/25/2002	9:35	20	20.2	5.65sg	4.9	1252	7.53	2.73	30	0.288	0.14	11
Mustinka R	BdS 01	09/16/2002	13:14	24.4	17.36	10.5	7.0	1405	7.95	10.61	111			
Mustinka R	BdS 01	10/09/2002	9:15	5.5	5.5	8.9	7.1	1637	7.85	10.18	81			
Mustinka R	BdS 33	05/20/2002	9:15	14	13.4	14.4	16.1	1640	8.30	11.68	115	0.087	0.59	17
Mustinka R	BdS 33	06/20/2002	9:55	18	21.3	na	25.1	1607	8.19	5.01	57	0.265	0.04	34
Mustinka R	BdS 33	07/25/2002	9:50	21	20.69	14.9sg	9.3	1254	7.61	5.54	62	0.38	0.15	10
Mustinka R	BdS 33	09/16/2002	13:37	25.6	19.95		19.7	1368	8.35	7.94	88			
Mustinka R	BdS 33	10/09/2002	9:40	5.8	8.62		23.0	1387	8.66	11.28	97			
Mustinka R	BdS 53	05/20/2002	9:55	13.5	13.8	1.7	63.1	1660	8.34	9.90	95	0.166	0.72	75
Mustinka R	BdS 53	06/20/2002	10:15	19.5	20.4	12.9	70.3	1631	7.93	7.17	80	0.329	0.32	69
Mustinka R	BdS 32	05/17/2002	9:15	10	12.1	4.6	58.2	1580	8.22	9.01	86	0.145	1.84	75
Mustinka R	BdS 32	06/26/2002	8:55	27	26.3	21.4	45.2	1440	8.06	6.89	86	0.291	0.02	46
Mustinka R	BdS 32	07/24/2002	9:38	22.5	21.3	20.2	60.1	1217	7.74	7.34	83			
Mustinka R	BdS 32	09/17/2002	10:52	25	18.45	21.85	41.3	1371	8.60	10.15	109			

Water Body	Sample Site	Sample Date	Sample Time	Temp Air-C	Temp H2O-C	Stage (Ft-md)	Turb NTUs	Cond uS/cm	pH	DO mg/l	DO %Sat	TP mg/l	NO3 mg/l	TSS mg/l
Red R	Red210By	05/13/2002	13:57	14.5	11.1		22.3	762	8.50	10.37	97	0.107	0.57	51
Red R	Red210By	06/27/2002	11:05	28.9	25.9	22.7	47.1	447	8.30	7.74	95	0.203	0.16	83
Red R	Red210By	09/17/2002	16:13	30	21.01	23.25	34.7	419	8.48	8.54	96			
Red R	Red210By	10/09/2002	14:40	9	9.5	23.5	8.2	484	8.63	11.76	103			
Rabbit R	BdS 27	06/20/2002	13:05	23.5	22.2	20.6	29.3	1908	8.01	7.21	83	0.367	0.14	34
Rabbit R	BdS 27	10/09/2002	13:47	14.0	8.6	20.5	3.5	1554	8.11	8.49	74			
Rabbit R	BdS 28	06/20/2002	13:45	27.0	22.2	6.3	30.5	545	7.81	5.26	61	0.533	0.81	17
Rabbit R	BdS 28	07/24/2002	20:57	20	20.77	6.75	7.2	625	7.85	3.04	34	0.589	0.12	6
Rabbit R	BdS 49	06/20/2002	14:20	27.0	26.5	22.1	55.8	1395	8.09	9.43	118	0.699	0.11	50
JD 2	BdS 51	06/20/2002	12:30	21.5	23.6	11.3	96.7	2582	8.12	9.18	109	0.329	0.09	64
JD 2	BdS 51	07/24/2002	20:25	21	22.4	10.6	21.3	1037	8.34	9.12	106	0.355	0.13	30
JD12	BdS 30	06/20/2002	11:45	22.0	22.2	9.9	48.5	3886	7.85	6.53	76	0.329	0.14	68
JD12	BdS 30	07/24/2002	19:59	22	22.45	9.6	67.8	1783	8.16	7.80	91	0.431	<.02	74
BigStone CD 8	MoonCD8	06/26/2002	17:35	27.8	30.4	3.8	15.3	1039	8.25	8.70	116	0.686	0.08	15
BigStone CD 8	MoonCD8	07/24/2002	16:33	23.5	23.2	4.2	1.8	778	8.33	9.26	108	0.181	<.02	1
BigStone CD 8	MoonCD8-2	06/26/2002	18:25	27.8	29.46	8.7	21.9	1204	8.18	8.47	111			
Rothwell Ditch	WToqCR52	06/26/2002	19:10	27.8	28.08	2.6	96.5	650	9.05	7.31	94	0.495	0.11	156
Rothwell Ditch	WToqCR52	07/24/2002	17:15	25	24.74	2.81	110.0	683	8.77	8.63	104	0.762	0.3	9
Bois de Sioux R	BdSCo12	06/27/2002	11:55	31.1	26.7	15.0	33.0	762	8.25	7.27	91	0.234	0.13	35
Traverse CD27	TCD27	05/17/2002	9:15	10	10.2		3.8	1185	8.57	13.37	122			

Red River Valley Ecoregion 1970-92 Annual Median (75th percentile)					21.0		23.0	640	8.40	5.00		0.30	0.21	59
Northern Glaciated Plains Ecoregion 1970-92 Annual Median (75th percentile)					22.0		23.5	1100	8.30	5.00		0.25	0.51	63

*All sites are in the RRV ecoregion except BdS20, WToqCR52, and MoonCD8 which are in NGP ecoregion

*Results that exceed ecoregion comparative values are shaded--all sites are being compared to the RRV ecoregion values.

*No ecoregion value exists for dissolved oxygen. Levels below 5.0 mg/l are considered to be deficient.

*pH values either greater or less than 10 percent of the ecoregion value are shaded.

	Sample	Sample	Sample	Temp	Temp	Stage	Turb	Cond	pH	DO	DO	TP	NO3	TSS
Water Body	Site	Date	Time	Air-C	H2O-C	(Ft-md)	NTUs	uS/cm		mg/l	%Sat	mg/l	mg/l	mg/l
Mustinka R	BdS 02	5/20/2002	11:45	16	12.2	3.8	19.0	867	7.70	7.70	82	0.117	0.14	47
Mustinka R	BdS 02	6/20/2002	9:00	19	17.9	4.4	64.1	1625	7.57	5.77	61	0.482	0.28	83
Mustinka R	BdS 02	7/25/2002	9:15	19	20.48	5.8sg	1.9	1241	7.83	2.13	24	0.242	0.09	3
Mustinka R	BdS 02	9/16/2002	12:50	24.4	16.81	3.8	4.6	1377	7.74	8.27	86			
Mustinka R	BdS 02	10/9/2002	8:55	5	5.64	4.2	3.8	1597	7.82	9.97	80			
Mustinka R	BdS 01	5/20/2002	11:30	19	12.0	3.2	25.9	1620	7.95	9.13	86	0.143	0.29	64
Mustinka R	BdS 01	6/20/2002	9:25	16.5	17.5	12.1	92.9	1669	7.52	6.79	71	0.469	0.50	110
Mustinka R	BdS 01	7/25/2002	9:35	20	20.2	5.65sg	4.9	1252	7.53	2.73	30	0.288	0.14	11
Mustinka R	BdS 01	9/16/2002	13:14	24.4	17.36	10.5	7.0	1405	7.95	10.61	111			
Mustinka R	BdS 01	10/9/2002	9:15	5.5	5.5	8.9	7.1	1637	7.85	10.18	81			
Mustinka R	BdS 33	5/20/2002	9:15	14	13.4	14.4	16.1	1640	8.30	11.68	115	0.087	0.59	17
Mustinka R	BdS 33	6/20/2002	9:55	18	21.3	na	25.1	1607	8.19	5.01	57	0.265	0.04	34
Mustinka R	BdS 33	7/25/2002	9:50	21	20.69	14.9sg	9.3	1254	7.61	5.54	62	0.38	0.15	10
Mustinka R	BdS 33	9/16/2002	13:37	25.6	19.95		19.7	1368	8.35	7.94	88			
Mustinka R	BdS 33	10/9/2002	9:40	5.8	8.62		23.0	1387	8.66	11.28	97			
Mustinka R	BdS 53	5/20/2002	9:55	13.5	13.8	1.7	63.1	1660	8.34	9.90	95	0.166	0.72	75
Mustinka R	BdS 53	6/20/2002	10:15	19.5	20.4	12.9	70.3	1631	7.93	7.17	80	0.329	0.32	69
Mustinka R	BdS 32	5/17/2002	9:15	10	12.1	4.6	58.2	1580	8.22	9.01	86	0.145	1.84	75
Mustinka R	BdS 32	6/26/2002	8:55	27	26.3	21.4	45.2	1440	8.06	6.89	86	0.291	0.02	46
Mustinka R	BdS 32	7/24/2002	9:38	22.5	21.3	20.2	60.1	1217	7.74	7.34	83			
Mustinka R	BdS 32	9/17/2002	10:52	25	18.45	21.85	41.3	1371	8.60	10.15	109			
Red R	Red210By	5/13/2002	13:57	14.5	11.1		22.3	762	8.50	10.37	97	0.107	0.57	51
Red R	Red210By	6/27/2002	11:05	28.9	25.9	22.7	47.1	447	8.30	7.74	95	0.203	0.16	83
Red R	Red210By	9/17/2002	16:13	30	21.01	23.25	34.7	419	8.48	8.54	96			
Red R	Red210By	10/9/2002	14:40	9	9.5	23.5	8.2	484	8.63	11.76	103			
Rabbit R	BdS 27	6/20/2002	13:05	23.5	22.2	20.6	29.3	1908	8.01	7.21	83	0.367	0.14	34
Rabbit R	BdS 27	10/9/2002	13:47	14.0	8.6	20.5	3.5	1554	8.11	8.49	74			
Rabbit R	BdS 28	6/20/2002	13:45	27.0	22.2	6.3	30.5	545	7.81	5.26	61	0.533	0.81	17
Rabbit R	BdS 28	7/24/2002	20:57	20	20.77	6.75	7.2	625	7.85	3.04	34	0.589	0.12	6
Rabbit R	BdS 49	6/20/2002	14:20	27.0	26.5	22.1	55.8	1395	8.09	9.43	118	0.699	0.11	50
JD 2	BdS 51	6/20/2002	12:30	21.5	23.6	11.3	96.7	2582	8.12	9.18	109	0.329	0.09	64
JD 2	BdS 51	7/24/2002	20:25	21	22.4	10.6	21.3	1037	8.34	9.12	106	0.355	0.13	30
JD12	BdS 30	6/20/2002	11:45	22.0	22.2	9.9	48.5	3886	7.85	6.53	76	0.329	0.14	68
JD12	BdS 30	7/24/2002	19:59	22	22.45	9.6	67.8	1783	8.16	7.80	91	0.431	<.02	74
BigStone CD 8	MoonCD8	6/26/2002	17:35	27.8	30.4	3.8	15.3	1039	8.25	8.70	116	0.686	0.08	15
BigStone CD 8	MoonCD8	7/24/2002	16:33	23.5	23.2	4.2	1.8	778	8.33	9.26	108	0.181	<.02	1
BigStone CD 8	MoonCD8-2	6/26/2002	18:25	27.8	29.46	8.7	21.9	1204	8.18	8.47	111			
Rothwell Ditch	WToqCR52	6/26/2002	19:10	27.8	28.08	2.6	96.5	650	9.05	7.31	94	0.495	0.11	156
Rothwell Ditch	WToqCR52	7/24/2002	17:15	25	24.74	2.81	110.0	683	8.77	8.63	104	0.762	0.3	9
Bois de Sioux R	BdSCo12	6/27/2002	11:55	31.1	26.7	15.0	33.0	762	8.25	7.27	91	0.234	0.13	35
Traverse CD27	TCD27	5/17/2002	9:15	10	10.2		3.8	1185	8.57	13.37	122			
Red River Valley Ecoregion 1970-92 Annual Median (75th percenti					21.0		23.0	640	8.40	5.00		0.30	0.21	59
Northern Glaciated Plains Ecoregion 1970-92 Annual Median (75th					22.0		23.5	1100	8.30	5.00		0.25	0.51	63
*All sites are in the RRV ecoregion except BdS20, WToqCR52, and MoonCD8 which are in NGP ecoregion														
*Results that exceed ecoregion comparative values are shaded--all sites are being compared to the RRV ecoregion values.														
*No ecoregion value exists for dissolved oxyen. Levels below 5.0 mg/l are considered to be deficient.														
*pH values either greater or less than 10 % of the ecoregion value are shaded.														

APPENDIX 10
FDR Issues

Appendix 10
FDR ISSUES

PROPOSED FDR Water Quantity Activities and Potential Agency Roles

Proposed Action (specific tasks/items)	Objective Action Reference (see legend)	Proposed Year of Activity (H/M/L/O)	Roles BdWSD	Roles DNR	Roles MPCA	Roles BWSR	Roles USACE	Roles USFWS	Roles FEMA	Roles NRCS	Roles SWCD/ CWP	Roles Cities	Constraints to partnering and possible action to resolve
1 150,000 ac-ft storage	WW, A.3.1	**H**	**PC**	**PC**	**SIK**	**PC**	**PC**	**PC**	**V**	**SIK**	**SIK**	**PIK**	
2 Mitigate increasing peaks	WW, A.3.2	**O**	**PC**	**PIK**	**SIK**	**PC**	**PIK**	**SIK**	**V**	**SIK**	**SIK**	**SIK**	
3 Potential impoundment sites	WW, A.3.3	**O**	**PC**	**PIK**	**SIK**	**PC**	**PC**	**PIK**	**V**	**PIK**	**SIK**	**SIK**	
4 USACE Feasibility Study	WW, A.3.4	**L**	**PC**	**PC**	**SIK**	**PC**	**PC**	**PIK**	**V**	**PIK**	**SIK**	**SIK**	
5 Sustaining Base Flows	WW, A.4.1	**M**	**SIK**	**PIK**	**SIK**	**PC**	**PC**	**PC**	**V**	**PIK**	**SIK**	**V**	
6 Restore Wetlands	WW, A.4.2	**O**	**SIK**	**PC**	**SIK**	**PC**	**PC**	**PC**	**V**	**PC**	**SIK**	**V**	
7 Restore Lake Basins	WW, A.4.3	**M**	**SIK**	**PC**	**SIK**	**PC**	**PIK**	**PC**	**V**	**PIK**	**SIK**	**SIK**	
8 Drainage System Inventory	WW, A.5.1	**M**	**PC**	**PC**	**SIK**	**PC**	**V**	**V**	**V**	**V**	**SIK**	**V**	
9 Culvert Inventory	WW, A.6.1	**O**	**PC**	**PC**	**SIK**	**PC**	**V**	**V**	**V**	**V**	**SIK**	**V**	
10 Culvert Sizing Criteria	WW, A.6.2	**M**	**PIK**	**PIK**	**SIK**	**PIK**	**SIK**	**V**	**V**	**SIK**	**SIK**	**SIK**	
11 Protect Public Infrastructure	BdS, A	**O**	**PC**	**PC**	**SIK**	**PIK**	**PC**	**V**	**PC**	**SIK**	**SIK**	**PC**	
12 30,000 ac-ft flood storage	EBTM, A.1	**H**	**PC**	**PC**	**SIK**	**PC**	**SIK**	**PC**	**V**	**SIK**	**SIK**	**PIK**	
13 County line disputes	EBTM, A.2	**M**	**PIK**	**SIK**	**SIK**	**PIK**	**SIK**	**V**	**V**	**SIK**	**SIK**	**V**	
14 10,000 ac-ft flood storage	FMC, A.1	**L**	**PC**	**PC**	**SIK**	**PC**	**PC**	**PC**	**V**	**SIK**	**SIK**	**PIK**	
15 Waterway capacity and channel sedimentation	FMC, A.2	**L**	**PIK**	**PC**	**SIK**	**PC**	**SIK**	**PC**	**SIK**	**PC**	**SIK**	**V**	
16 5,000 ac-ft flood storage	JD14, A.1	**M**	**PC**	**PC**	**SIK**	**PC**	**PC**	**PC**	**V**	**SIK**	**SIK**	**PIK**	
17 Controlled water transfer	JD14, A.2	**L**	**PIK**	**PIK**	**SIK**	**PIK**	**SIK**	**PIK**	**V**	**SIK**	**SIK**	**V**	
18 5,000 ac-ft flood storage	LT, A.1	**L**	**PC**	**PC**	**SIK**	**PC**	**PC**	**PC**	**V**	**SIK**	**SIK**	**PIK**	

PROPOSED FDR Water Quantity Activities and Potential Agency Roles

Proposed Action (specific tasks/items)	Objective Action Reference (see legend)	Proposed Year of Activity (H/M/L/O)	Roles BdWSD	Roles DNR	Roles MPCA	Roles BWSR	Roles USACE	Roles USFWS	Roles FEMA	Roles NRCS	Roles SWCD/CWP	Roles Cities	Constraints to partnering and possible action to resolve
19 High water and erosion	LT, A.2	L	PIK	SIK	SIK	PC	PIK	PIK	V	PC	SIK	V	
20 20,000 ac-ft storage	MR, A.1	H, M	PC	PC	SIK	PC	PC	PC	V	SIK	SIK	PIK	
21 20,000 ac-ft storage	RR, A.1	L	PC	PC	SIK	PC	PC	PC	V	SIK	SIK	PIK	
22 5,000 ac-ft flood storage	SFRR, A.1	L	PC	PC	SIK	PC	PC	PC	V	SIK	SIK	PIK	
23 30,000 ac-ft flood storage	WBTM, A.1	H	PC	PC	SIK	PC	PC	PC	V	SIK	SIK	PIK	
24 County line disputes	WBTM, A.2	L	PIK	SIK	SIK	PIK	SIK	SIK	V	SIK	SIK	V	
25 Road washout	WBTM, A.3	M	PIK	SIK	SIK	SIK	SIK	SIK	V	SIK	SIK	PC	
26 Moonshine Lake project	WBTM, A.4	H	PC	PC	SIK	PC	PIK	PC	V	PIK	SIK	PIK	
27 Flood storage	NO, A.3.1	H	PC	PC	SIK	PC	PIK	PC	V	PIK	SIK	PC	
28 Restore drained basins	NO, A.3.2	O	SIK	PC	SIK	PC	SIK	PC	V	PC	SIK	V	
29 Reservoir construction	NO, A.3.3	L	SIK	PC	SIK	PIK	PC	SIK	V	SIK	SIK	PIK	
30 Reduce 10-yr summer runoff	NO, A.3.4	O	PC	SIK	SIK	PIK	PIK	SIK	V	PIK	SIK	SIK	
31 Maximize flood control	NO, A.3.5	L	PC	PC	SIK	PIK	PC	SIK	V	PC	SIK	PIK	
32 Existing drainage systems	NO, A.3.6	L	PC	PIK	SIK	PIK	PIK	SIK	V	SIK	SIK	V	
33 Baseline data on RR	NO, A.3.7	H	SIK	PC	PC	PC	PC	PC	PC	SIK	SIK	SIK	
34 Improve and manage existing facilities	NO, A.3.8	L	PC	SIK	SIK	PC	PC	PC	V	PC	SIK	PC	

Legend:

Proposed Year of Activity:
H = 1-3 years
M = 4-6 years
L = 7-10 years
O = ongoing

Objectives:
WW – Watershed Wide
BdS – Bois de Sioux
EBTM – East Branch 12 Mile Creek
FMC – Five Mile Creek
JD14 – Judicial Ditch 14
LT – Lake Traverse
MR – Mustinka River
NO – North Ottawa
RR – Rabbit River
SFRR – South Fork Rabbit River

Proposed Roles:
$PC = Primary Sponsor using Cash,
$PIK = Primary Sponsor using In kind Services
$SC = Secondary Supporter using Cash
$SIK = Secondary Supporter using In kind Services
$V = Volunteer/Other Services

APPENDIX 11
NRE Issues

Appendix 11
NRE ISSUES

PROPOSED NRE Water Quality Activities and Potential Agency Roles

Proposed Action (specific tasks/items)	Objective Action Reference (see legend)	Proposed Year of Activity (H/M/L/O)	Roles BdWSD	Roles DNR	Roles MPCA	Roles BWSR	Roles USACE	Roles USFWS	Roles FEMA	Roles NRCS	Roles SWCD/CWP	Roles Cities	Constraints to partnering and possible action to resolve
1 Validate impaired reaches	WW, B.1.1	**M**	**SIK**	**PIK**	**PC**	**PIK**	**V**	**SIK**	**V**	**V**	**SIK**	**V**	
2 Develop TMDL diagnostic Studies	WW, B.1.2	**M**	**SIK**	**PIK**	**PC**	**PIK**	**V**	**SIK**	**V**	**V**	**SIK**	**V**	
3 Initiate TMDL implementation strategies	WW, B.1.3	**M**	**SIK**	**PIK**	**PC**	**PIK**	**V**	**SIK**	**V**	**V**	**SIK**	**V**	
4 Construct/operate non-impairing projects	WW, B.2.1	**H**	**PIK**	**PC**	**PC**	**PC**	**V**	**SIK**	**V**	**V**	**SIK**	**V**	
5 Coordinate water quality project components	WW, B.2.2	**H**	**PIK**	**PIK**	**PC**	**PIK**	**V**	**SIK**	**V**	**V**	**SIK**	**V**	
6 Continue River Watch Program	WW, B.3.1	**M**	**PIK**	**PIK**	**PC**	**PIK**	**V**	**SIK**	**V**	**V**	**SIK**	**V**	
7 Develop monitoring locations (TMDL)	WW, B.3.2	**M**	**SIK**	**PIK**	**PC**	**PIK**	**V**	**SIK**	**V**	**V**	**SIK**	**V**	
8 Install vegetative buffer strips	WW, C.1.1	**M**	**SIK**	**PC**	**SIK**	**PC**	**V**	**PC**	**V**	**V**	**SIK**	**V**	
9 Agricultural BMPs	WW, C.1.2	**H**	**SIK**	**PIK**	**SIK**	**PC**	**V**	**PIK**	**V**	**PC**	**SIK**	**V**	
10 Reduce soil erosion	WW, C.1.3	**H**	**PIK**	**PIK**	**SIK**	**PC**	**V**	**PIK**	**V**	**PC**	**SIK**	**V**	
11 Restore wetlands	WW, C.1.4.a	**H**	**SIK**	**PC**	**SIK**	**PC**	**PIK**	**PC**	**V**	**PC**	**SIK**	**V**	
12 Acquire land -Fergus Falls	WW, C.1.4.b	**M**	**V**	**PIK**	**V**	**SIK**	**V**	**PC**	**V**	**PIK**	**SIK**	**V**	
13 Acquire land -Morris	WW, C.1.4.c	**M**	**V**	**PIK**	**V**	**SIK**	**V**	**PC**	**V**	**PIK**	**SIK**	**V**	
14 Acquire land for wildlife management area	WW, C.1.4.d	**M**	**SIK**	**PC**	**SIK**	**PIK**	**V**	**PC**	**V**	**PIK**	**SIK**	**V**	
15 Restore drained basins	WW, D.1	**H**	**SIK**	**PC**	**SIK**	**PC**	**V**	**PC**	**V**	**PIK**	**SIK**	**V**	
16 Protect existing wetlands	WW, D.2	**H**	**PIK**	**PIK**	**PIK**	**PIK**	**PIK**	**PC**	**V**	**PIK**	**SIK**	**V**	
17 Restore grassland	WW, D.3	**H**	**SIK**	**PC**	**SIK**	**PC**	**V**	**PC**	**V**	**PIK**	**SIK**	**V**	
18 Support other agency programs on wetlands	WW, D.4	**H**	**PIK**	**PIK**	**PIK**	**PC**	**PIK**	**PIK**	**V**	**PIK**	**SIK**	**PIK**	
19 Expand compatible recreation for local economy	WW, E.1.1	**M**	**V**	**PC**	**SIK**	**SIK**	**PC**	**SIK**	**V**	**SIK**	**SIK**	**PC**	
20 Establish/expand wildlife areas	WW, E.1.2	**M**	**SIK**	**PC**	**SIK**	**SIK**	**V**	**PC**	**V**	**SIK**	**SIK**	**V**	
21 Permit recreational facilities on water	WW, E.1.3	**M**	**PIK**	**PIK**	**PIK**	**PIK**	**PIK**	**V**	**V**	**V**	**SIK**	**V**	
22 Develop Lake Traverse fisheries	WW, E.1.4	**M**	**V**	**PC**	**SIK**	**SIK**	**PIK**	**PC**	**V**	**SIK**	**SIK**	**V**	
23 Enhance base flows	WW, E.1.5	**M**	**SIK**	**PC**	**SIK**	**PIK**	**PIK**	**PC**	**V**	**SIK**	**SIK**	**V**	

PROPOSED NRE Water Quality Activities and Potential Agency Roles

Proposed Action (specific tasks/items)	Objective Action Reference (see legend)	Proposed Year of Activity (H/M/L/O)	Roles BdWSD	Roles DNR	Roles MPCA	Roles BWSR	Roles USACE	Roles USFWS	Roles FEMA	Roles NRCS	Roles SWCD/ CWP	Roles Cities	Constraints to partnering and possible action to resolve
24 Maintain/improve habitats	BdS, D.1	H	SIK	PIK	PIK	PC	PIK	PC	V	PIK	SIK	V	
25 Increase grassland/ wetland habitats RR and BdS	BdS, D.2	H	SIK	PC	SIK	PC	V	PC	V	PC	SIK	V	
26 Increase grassland/ wetland habitats elsewhere	BdS, D.3	H	SIK	PC	SIK	PC	V	PC	V	PC	SIK	V	
27 Rehabilitation plan for channeled waterways	BdS, D.4	M	PIK	PC	SIK	PC	PIK	PC	V	PIK	SIK	V	
28 Review White Rock Dam operating plan	BdS, D.5	M	PIK	PIK	SIK	SIK	PC	SIK	V	SIK	SIK	V	
29 Promote Red River Valley CREP	EBTM, C.1	M	SIK	PIK	PIK	PC	PIK	PIK	V	PC	SIK	V	
30 Address nutrient/sediment loading	EBTM, C.2	H	SIK	PIK	PC	PC	V	SIK	V	PIK	SIK	V	
31 Reduce wind erosion	EBTM, C.3	M	SIK	PIK	SIK	PC	V	PIK	V	PC	SIK	V	
32 Install buffer strips	EBTM, D.1	M	SIK	PC	SIK	PC	V	PC	V	PC	SIK	V	
33 Increase grassland/ wetland near waterways	EBTM, D.2	M	SIK	PC	SIK	PC	V	PC	V	PC	SIK	V	
34 Increase grassland/ wetland near waterways elsewhere	EBTM, D.3	M	SIK	PC	SIK	PC	V	PC	V	PC	SIK	V	
35 Improve water quality in Niemackl Lakes area	FMC, B.1	H	SIK	PC	PC	PC	V	PC	V	PIK	SIK	V	
36 Identify “at-risk” CRP land	FMC, D.1	H	SIK	PIK	SIK	PC	V	PC	V	PC	SIK	V	
37 Create conservation lands	FMC, D.2	H	SIK	PC	SIK	PIK	V	PC	V	PIK	SIK	V	
38 Protect/increase grassland /wetland habitats	FMC, D.3	H	PIK	PC	SIK	PC	PIK	PC	V	PIK	SIK	V	
39 Support the efforts of the SWCD	JD14, C.1	M	PIK	PIK	SIK	PC	V	SIK	V	PIK	SIK	V	
40 Restore/maintain wetlands	JD14, D.1	M	PIK	PC	SIK	PC	V	PC	V	PIK	SIK	V	
41 Establish 34,000 ac upland/wetland habitat	JD14, D.2	M	PIK	PC	SIK	PC	V	PC	V	PC	SIK	V	
42 Increase grassland/ wetland habitat by waterways	JD14, D.3	L	PIK	PC	SIK	PC	V	PC	V	PC	SIK	V	
43 Increase grassland/ wetland habitat by waterways elsewhere	JD14, D.4	L	PIK	PC	SIK	PC	V	PC	V	PIK	SIK	V	
44 Develop plans for Mustinka River	JD14, D.5	M	PIK	PC	PC	PC	V	SIK	V	PIK	SIK	V	
45 Protect hillsides/ravines	LT, D.1	H	SIK	SIK	SIK	PC	V	PC	V	PC	SIK	V	
46 Create conservation lands	LT, D.3	H	SIK	PC	SIK	PC	V	PC	V	PC	SIK	V	

PROPOSED NRE Water Quality Activities and Potential Agency Roles

Proposed Action (specific tasks/items)	Objective Action Reference (see legend)	Proposed Year of Activity (H/M/L/O)	Roles BdWSD	Roles DNR	Roles MPCA	Roles BWSR	Roles USACE	Roles USFWS	Roles FEMA	Roles NRCS	Roles SWCD/CWP	Roles Cities	Constraints to partnering and possible action to resolve
47 Protect/increase grassland /wetland habitats	LT, D.4	H	PIK	PC	SIK	PC	V	PC	V	PC	SIK	V	
48 Develop management plan	LT, D.5	H	SIK	PIK	V	V	PC	PIK	V	V	SIK	V	
49 Support the efforts of MPCA in TMDL study	MR, B.4.3	M	SIK	PIK	PC	PIK	V	PIK	V	PIK	SIK	V	
50 Install buffers strips	MR, C.1	H	SIK	PIK	SIK	PC	V	PIK	V	PC	SIK	V	
51 Increase conservation tillage	MR, C.2	M	SIK	PIK	SIK	PC	V	PIK	V	PC	SIK	V	
52 Restore drained/cropped wetlands and upland buffers	MR, C.3	H	SIK	PC	SIK	PC	V	PC	V	PC	SIK	V	
53 Restore drained basins	MR, D.1	H	SIK	PC	SIK	PC	V	PC	V	PC	SIK	V	
54 Restore/protect grassland	MR, D.3	M	SIK	PIK	SIK	PC	V	PC	V	PC	SIK	V	
55 Promote buffer strips	RR, C.2	H	SIK	PIK	SIK	PC	V	PC	V	PC	SIK	V	
56 Increase conservation tillage	RR, C.3	M	SIK	PIK	SIK	PC	V	PIK	V	PC	SIK	V	
57 Implement improvement projects	RR, D.1	M	SIK	PC	PC	PC	PIK	PC	V	PC	SIK	V	
58 Maintain/improve grassland /wetland habitats	SFRR, D.1	H	SIK	PC	SIK	PC	V	PC	V	PC	SIK	V	
59 Implement buffer strip program	WBTM, C.1	M	SIK	PIK	SIK	PC	V	PC	V	PC	SIK	V	
60 Maintain/improve grassland /wetland habitats	WBTM, D.1	M	SIK	PC	SIK	PC	V	PC	V	PC	SIK	V	
61 Support the efforts of MPCA in TMDL study	NO, B.4.3	M	SIK	PIK	PC	PIK	V	PIK	V	V	SIK	V	

Legend:

Proposed Year of Activity:
H = 1-3 years
M = 4-6 years
L = 7-10 years
O = ongoing

Note: The BdS will encourage the implementation of NRE activities and cooperate with NRE agencies but will not undertake NRE projects directly.

Objectives:
WW – Watershed Wide
BdS – Bois de Sioux
EBTM – East Branch 12 Mile Creek
FMC – Five Mile Creek
JD14 – Judicial Ditch 14
LT – Lake Traverse
MR – Mustinka River
NO – North Ottawa
RR – Rabbit River
SFRR – South Fork Rabbit River

Proposed Roles:
$PC = Primary Sponsor using Cash,
$PIK = Primary Sponsor using In kind Services
$SC = Secondary Supporter using Cash
$SIK = Secondary Supporter using In kind Services
$V = Volunteer/Other Services