10-Year Comprehensive Plan

May 2006

Red Lake Watershed District

HDR

Red Lake Watershed District
10-Year Comprehensive Plan

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List of Acronyms

BMP	Best Management Practice
BWSR	Minnesota Board of Water and Soil Resources
CAC	Citizens Advisory Committee
CLAA	Clearwater Lake Area Association
CRP	Conservation Reserve Program
CREP	Conservation Reserve Enhancement Program
EPA	Environmental Protection Agency
FDR	Flood Damage Reduction
FDRWG	Flood Damage Reduction Work Group
FEMA	Federal Emergency Management Agency
GIS	Geographic Information Systems
HEC	Hydrologic Engineering Center
HMS	Hydrologic Modeling Software
ISTS	Individual Sewage Treatment System
Managers	Red Lake Watershed District Board of Managers
MCEA	Minnesota Center for Environmental Advocacy
MDH	Minnesota Department of Health
MnDNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
NPDES	National Pollution Discharge Elimination System
NRE	Natural Resource Enhancement
NRCS	Natural Resource Conservation Service
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
Overall Plan	RLWD 10-year, Comprehensive Watershed Plan
OVRW	Outstanding Value Resource Waters
PT	Project Team

RIM	Reinvest in Minnesota
RLDNR	Red Lake Department of Natural Resources
RLWD	Red Lake Watershed District
RRBMN	Red River Basin Monitoring Network
RRWMB	Red River Watershed Management Board
STORET	EPA's largest computerized environmental data system (STOrage and RETrieval)
SWCD	Soil and Water Conservation District
TAC	Technical Advisory Committee
TMDL	Total Maximum Daily Load
TSAC	Technical and Scientific Advisory Committee
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USGS	U.S. Geologic Survey
USFWS	U.S. Fish and Wildlife Service
WCA	Wetland Conservation Act
WMA	Wildlife Management Area
WPA	Waterfowl Protection Area
WRP	Wetland Reserve Program
WWTP	Waste Water Treatment Plant

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EXECUTIVE SUMMARY

The Red Lake Watershed District (RLWD) was established on April 2, 1970, by order of the Minnesota Water Resources Board under the provisions of Minnesota Statutes, Chapter 112, otherwise referred to as the Minnesota Watershed Act. The RLWD is located in northwestern Minnesota and includes the entire drainage basin, in Minnesota, of the Red Lake River and tributaries, such as Clearwater River and Thief River. The counties included in this area are Red Lake County and parts of the following counties: Beltrami, Clearwater, Itasca, Koochiching, Mahnomen, Marshall, Pennington, Polk and Roseau. In addition, the RLWD geographically encompasses a major portion of the Red Lake Reservation, which is the homeland of the Red Lake Band of Chippewa Indians. The Red Lake Nation is a sovereign nation, recognized at the federal level, wherein neither the RLWD nor the State of Minnesota has any jurisdiction. Major cities within the RLWD include Thief River Falls, East Grand Forks, Crookston and Red Lake Falls. The total area is about 5,990 square miles, of which 41 percent is used for agricultural production. The Red Lake River, draining Lower and Upper Red lakes, the Clearwater River and the Thief River make up the major drainage areas of the RLWD. The RLWD is a governmental subdivision of the State of Minnesota with authority to comprehensively manage water resources. Minnesota Statutes requires the RLWD Board of Managers (Managers) to develop and periodically update a watershed management plan every 10 years. In accordance with Minnesota Statutes 103D.405, the RLWD has revised its 10-year, comprehensive watershed plan (Overall Plan).

In developing the Overall Plan, the Managers were assisted by the Technical Advisory Committee (TAC) and Citizens Advisory Committee (CAC) (Appendix 10). In addition to conducting a resource inventory and development of a district-wide hydrologic model, the Managers held a series of public informational meetings throughout the RLWD to gather input directly from the 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 RLWD and to better acquaint the Managers with the area and its residents. The RLWD 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 Managers recognize that the majority of FDR strategies can significantly improve natural systems if designed and constructed with environmental goals in mind.

The plan includes a general description of the RLWD and its water resources. It outlines the problems known to exist in the RLWD, potential solutions and the policies the Mangers intend to follow. This plan is intended to be a guide to implementation of watershed projects. 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
- 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
- Watershed permitting programs

The overall goal of the Managers is to make the wisest possible use and conservation of the RLWD's water and related resources. The Overall Plan is intended to be the guide for the accomplishment of this goal.

RED LAKE WATERSHED DISTRICT – MISSION STATEMENT

In the 1988 revision of the RLWD Overall Plan, the Managers did not develop and adopt an overall Mission Statement for the RLWD. In accordance with applicable Minnesota Rules and Statutes, the Managers hereby adopt the following as the Overall Mission Statement for the 2006 Revised RLWD Overall Plan:

"The Mission of the Red Lake Watershed District is to reduce flooding and flood damages, to seek to improve water quality and enhance fish and wildlife habitat through sound water management."

RED LAKE WATERSHED DISTRICT – POLICIES

The Managers will operate under the following policies:

1. The Managers will grant audience to any individual or group seeking information or aid in solving any problem pertaining to the management or use of water and related resources.
2. Petitions pertaining to the management or use of water and related resources will be accepted, studied and evaluated by the Managers in accordance with Minnesota Statutes 103D and 103E.
3. The Managers will not approve any petition for a project unless it meets the following requirements:

    - That it is in conformity with the Overall Plan
    - That the benefits are greater than the total estimated cost
    - That the proposed project is in compliance with the provisions and purposes of the Minnesota Watershed Act
    - That it is in conformity with the policies of the Red River Watershed Management Board (RRWMB)

4. The Managers, on matters of mutual concern, will cooperate with:

    - Adjacent watershed districts' board of managers
    - State Board of Water and Soil Resources
    - State of Minnesota Department of Natural Resources
    - Minnesota Pollution Control Agency
    - Minnesota Department of Agriculture
    - U.S. Department of Agriculture Natural Resource Conservation Service
    - County, state and federal units of government
    - Units of local government, private and public corporations and private individuals

- ❖ Soil and Water Conservation Districts
- ❖ Regional Development Commission
- ❖ Red Lake Band of Chippewa Indians
- ❖ Other affected local, state and federal partners

5. The cost of approved projects which have been properly petitioned for may be paid from assessments upon benefited lands and municipalities or by other means.
6. The Managers shall not permit the use of ditches, streams, rivers or lakes for the disposal of sanitary effluent or other wastes unless the project meets the requirements of and is approved by the Minnesota Pollution Control Agency (MPCA) and other authorized agencies.
7. The Managers shall recommend that the protection of fish, wildlife and other game species and the protection of their habitat be considered as part of proposed projects.
8. The Managers will cooperate with the State of Minnesota and all counties and municipalities within the RLWD in all land, water planning and zoning activities carried on by such public corporations, pursuant to the authority of Minnesota Statutes, Sections 304.21 through 394.27 or any other legislative authority.
9. The Managers shall manage and conserve the surface and undergroundwaters within the RLWD for the beneficial use of all people.
10. The Managers will support and encourage the use of soil and water conserving practices.

1.0 INTRODUCTION

The early European settlers, intent on promulgating agricultural conversion of the land in what is now the lower portions of the RLWD, were immediately confronted with the need for drainage of the land, especially in the flat western Lake Plain and northern Lake-Washed Till Plain. In its historic and natural condition, this area was subject to disastrous spring and summer floods that often ruined crops and destroyed roads, bridges and public utilities.

The drainage was very poor and sluggish, and there were extensive open marshes north of the Red Lakes. There were impassable peat bogs scattered throughout the eastern part of the watershed. Some of these shallow, level peat bogs are underlain by impervious layers of clay, which do not permit percolation. Some wet areas had natural drainage outlets, but they were generally clogged with fallen trees, brush and other debris. Elsewhere, natural drainage meandered through the area with inadequate slope, ineffective outlets or insufficient capacity to accommodate agriculture and settlement activity with the extensive floodplain.

The magnitude of this problem was recognized by the State Government, and in 1893, the State Legislature appropriated $100,000.00 for drainage in the Red River Valley and created a drainage commission called the Red River Valley Drainage Commission. The commission spent $182,500.00 in draining and converting wetlands for agriculture in the Red River Valley.

In 1901, the State Legislature created the State Drainage Commission. The commission ordered ditches surveyed in Beltrami, Marshall and Roseau counties. The Lost River Ditch in Beltrami and Polk counties and the New Solum Ditch in Marshall County were completed in 1902. Additional surveys of ditches in Polk and Red Lake counties were made in 1902. The Grand Marais Ditch in Polk County and the Emardville Ditch in Red Lake County were completed in 1903 and 1904, respectively.

The RLWD was preceded by a governmental unit, known as the Red Lake Drainage and Conservancy District, whose territory included approximately the same land.

The Red Lake Drainage and Conservancy District was ordered by the District Court of the 14th and 15th Judicial Districts on February 13, 1920. Little is known of the activities of the board following the organization. The original Conservancy District board became inactive and no successor board members were named following the original appointments. On January 10, 1946, the District Courts of the 14th and 15th Judicial Districts issued an Order whereby there were directors appointed for the Conservancy District. This reactivation was due to contemplated projects on the Red Lake and Clearwater rivers. Under the Conservancy District, three major projects were completed. They were the dredging of the Clearwater River, the Red Lake River and the Lost River.

After many years of operation, the Board of Directors of the Red Lake Drainage and Conservancy District felt the RLWD could better function under the Minnesota Watershed Act. The board petitioned the District Court for the right to operate under Chapter 112, the Minnesota Watershed Act. A hearing was held in Thief River Falls. On January 25, 1969, the Conservancy District was authorized to operate under and to exercise all the rights and authorities contained in the Minnesota Watershed Act.

The board petitioned the Minnesota Water Resources Board on July 24, 1969, amended January 20, 1970, for a change of name, review of boundary and distribution of managers of the watershed district. A hearing on the matter was held in Thief River Falls on March 31, 1970 and in Kelliher on April 2, 1970. In their Order, the Water Resources Board stated that the principal place of business shall be at Thief River Falls, directed that a description of the land within the RLWD be written, stipulated that the Managers shall have seven members, specified the procedure by which county boards shall appoint subsequent managers and stated the terms of office for the Managers (Appendix 3). The Red Lake Band of Chippewa Indians has no representation on the RLWD Board of Managers.

The Minnesota Watershed Act states that the Managers, together with an Advisory Committee, shall develop an Overall Plan for the management of water and other natural resources of the RLWD. The Overall Plan will guide the Managers in their work and can be amended as the need arises. The success of the Overall Plan will depend on the desire of the citizens in the RLWD to initiate action that will help to solve watershed problems.

2.0 GENERAL DESCRIPTION OF RED LAKE WATERSHED DISTRICT

2.1 LOCATION AND SIZE

The RLWD is located in northwestern Minnesota and includes all of Red Lake County and parts of the following counties: Beltrami, Clearwater, Itasca, Koochiching, Mahnomen, Marshall, Pennington, Polk and Roseau (Figure 1 and Figure 2).

The RLWD extends 140 miles from east to west at its widest extremity and 80 miles from north to south. The area of the watershed is approximately 5,990 square miles. It lies between Range 28 West and Range 50 West and Township 146 North and Township 158 North (Figure 3).

The Red Lake Nation is a sovereign nation, wherein the RLWD has no jurisdiction (Figure 4).

2.2 GEOLOGY

The watershed is divided into seven distinct geomorphic areas, namely, the Agassiz Lacustrian Plain, Red River Valley; Agassiz Lacustrian Plain, Inter-Beach area; Red Lake area; Agassiz Peatlands, Till Plain; Moraine and Bagley Outwash area (Figure 5). The legend in Figure 5 is referenced to the geomorphic area by parenthesis. The historical extent of Lake Agassiz is shown in Figure 6.

2.2.1 Agassiz Lacustrian Plain – Red River Valley (See Lake Agassiz in Figure 5)

The Red River Valley area consists of low, nearly level plain. Lake-laid sediments are commonly 5-10 feet thick. Most common soil types are clay, silty clay and silt loam. Water table depth is normally 5- 10 feet, with runoff slow to very slow. Permeability is low, and the water holding capacity is high.

2.2.2 Agassiz Lacustrian Plain – Inter-Beach Area (See Lake Agassiz in Figure 5)

The Inter-Beach area consists of beaches formed by stages of Glacial Lake Agassiz and has poorly-drained areas between beaches. Ridges are usually 2-15 feet high. Widths are from 150-500 feet. The water table on well-formed beaches is normally 10 feet, but between ridges is usually less than 6 feet. Soils are generally sandy, gravelly and droughty.

2.2.3 Agassiz Lacustrian Plain – Red Lake Area (See Lake Agassiz, Koochiching Lobe and Organic Deposits in Figure 5)

The Red Lake area is nearly level with depressed plains and organic and sandy soils. The water table is normally over 10 feet on drained soils and between surface and 6 feet on poorly-drained soils and contains shallow lacustrian sediments over calcareous loam and clay loam soils.

2.2.4 Bagley Outwash Plain (See Red River Lobe and Koochiching Lobe in Figure 5)

The Bagley Outwash consists of nearly level to gently rolling topography. The water table is normally more than 10 feet on well-drained soils. In lower elevations, the water table is between the surface and 6 feet deep. Soils range from loamy to sandy and in most places includes sand and gravel substrata. Water holding capacity is very low.

2.2.5 Agassiz Peatlands (See Organic Deposits in Figure 5)

The Agassiz Peatlands are low and very poorly-drained plains. About 75 percent of it consists of organic soil generally 7-8 feet deep. Normal water tables are from 0-3 feet deep on organic soils and 6-10 feet deep in mineral soils. Most sandy soils are 2-4 feet thick over loamy glacial till. Organic soils are mostly non-acid (> 5.5). The water holding capacity is very high on the peat soils and low on the sandy soils.

2.2.6 Moraine (See Red River Lobe and Koochiching Lobe Figure 5)

The Moraine consists mainly of calcerous loam till. Glacial stones are fairly common over most of the region. The soils have a high water holding capacity. The water table is generally greater than 10 feet on the upland and surface, to 6 feet in the depressions. The topography of the Moraine area, which occupies the southern part of the watershed, is made up of hills and depressions with local relief up to 150 feet.

2.2.7 Till Plain (See Koochiching Lobe in Figure 5)

Till plain is characterized by gently rolling topography with a few areas of more rolling landscape. Depressions, potholes and small bogs are common. The water table is normally deeper than 10 feet. From the surface to 6 feet deep, the water is on peat bogs and poorly-drained soils. The soils developed on calcareous loam till. Soils, in some places bordering on the Mahnomen Lacustrine Plain, are silty in the upper 12-24 inches.

2.3 TOPOGRAPHY

The altitude of the watershed ranges from 800 feet in the western end, at the confluence of the Red Lake River and Red River of the North, to 1,600 feet mean sea level (msl) in the south-central part (Figure 7 and Figure 8). In general, the southern part of the area, which is made up of northern Clearwater County and a small tract of land in Mahnomen County, has the highest elevation, ranging approximately 1,260-1,600 feet msl. The northern part of the watershed, which is north of the Upper and Lower Red lakes and the Red Lake River, is rather flat, ranging from 1,200 feet on the eastern edge of the watershed to 1,140 feet msl at the western edge of Mud Lake. The Lake Plain in the western edge is also flat, ranging from 920 feet at Gentilly to 800 feet msl at East Grand Forks.

The slope of the Red Lake River above Crookston is about 2 feet per mile, but the slope of the downstream reach is only 1.1 feet per mile.

Figure 1
Red Lake Watershed District

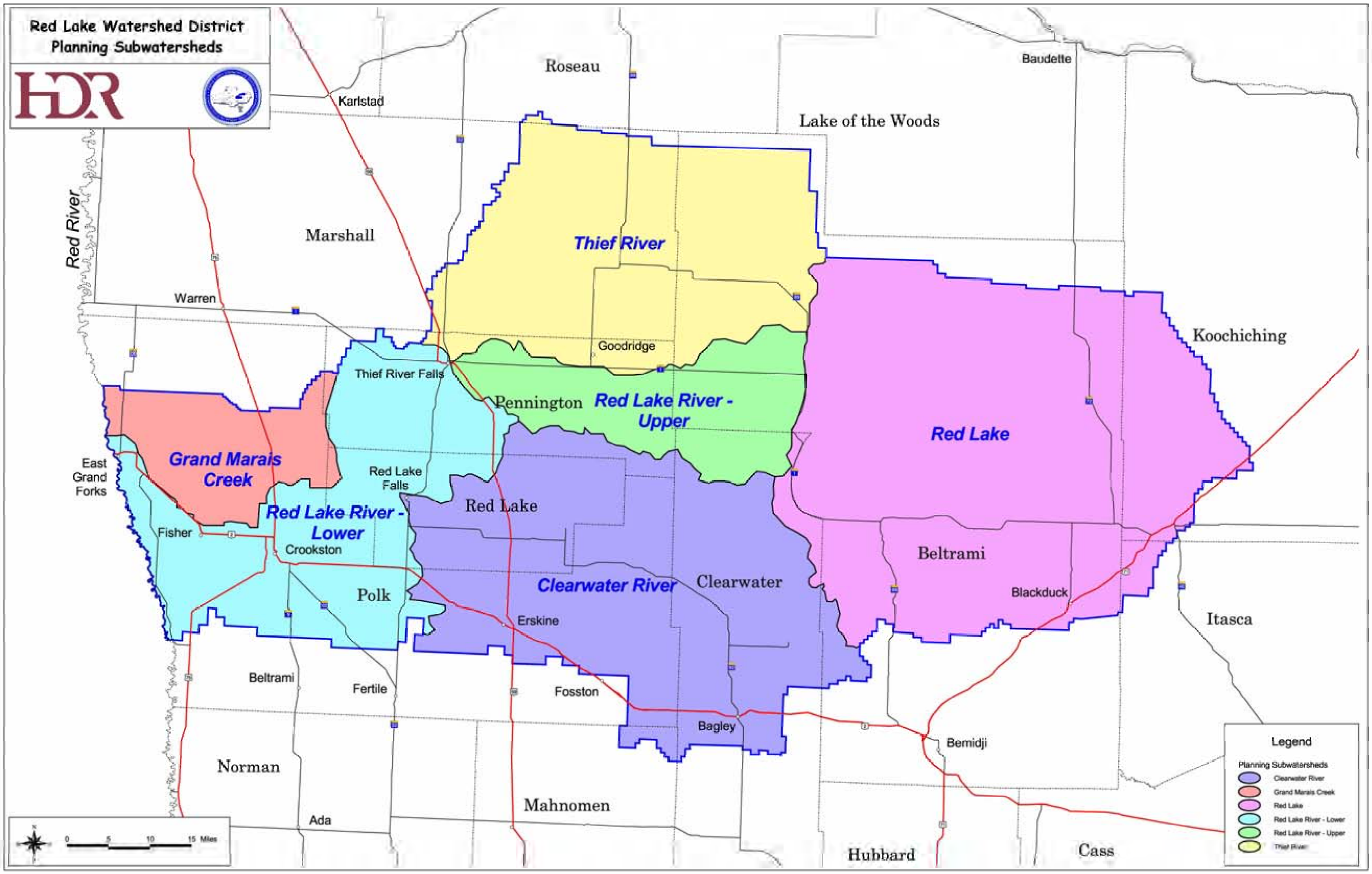


Figure 2
Red Lake Watershed District Counties

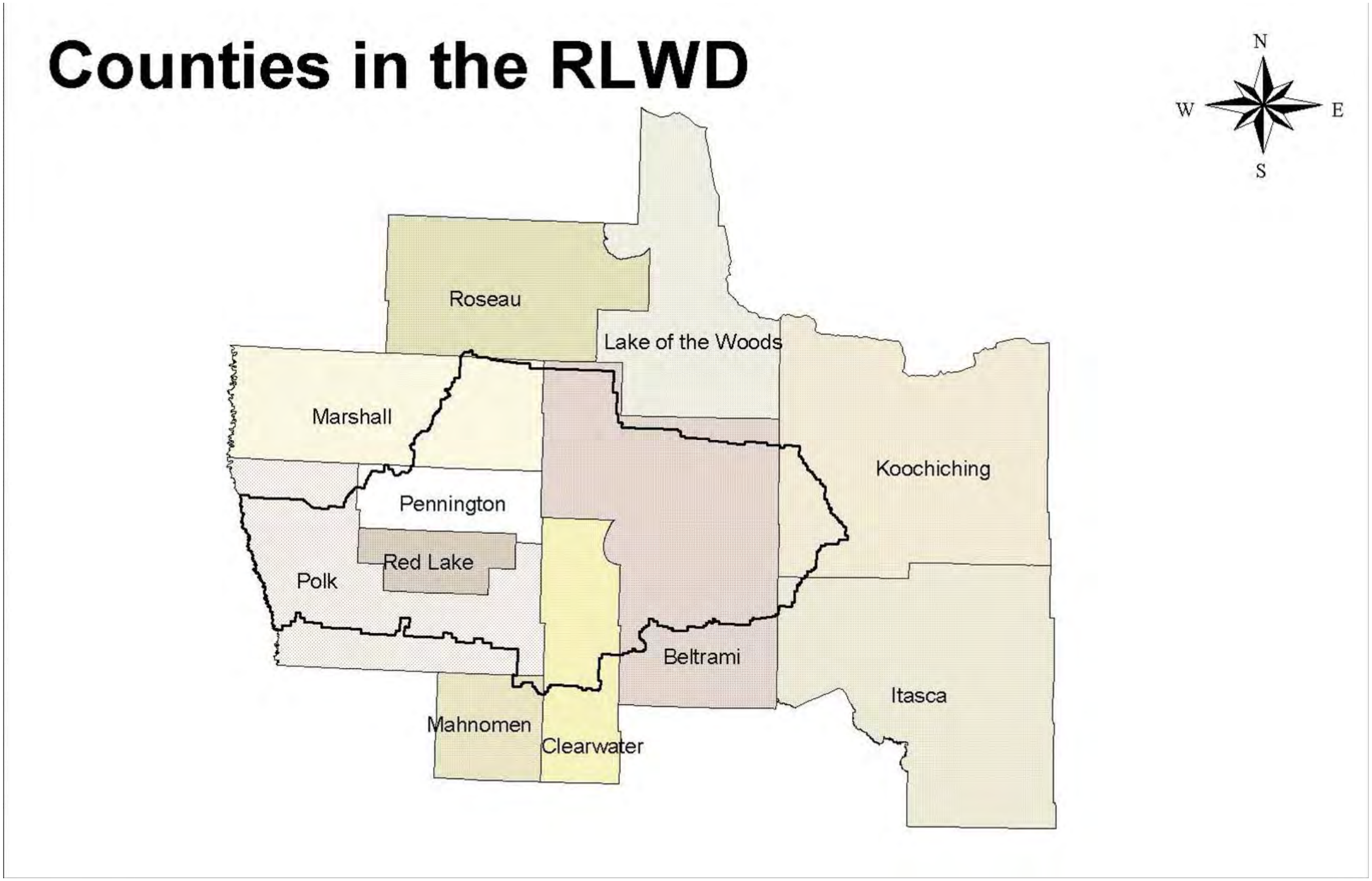


Figure 3
Red Lake Watershed District Features

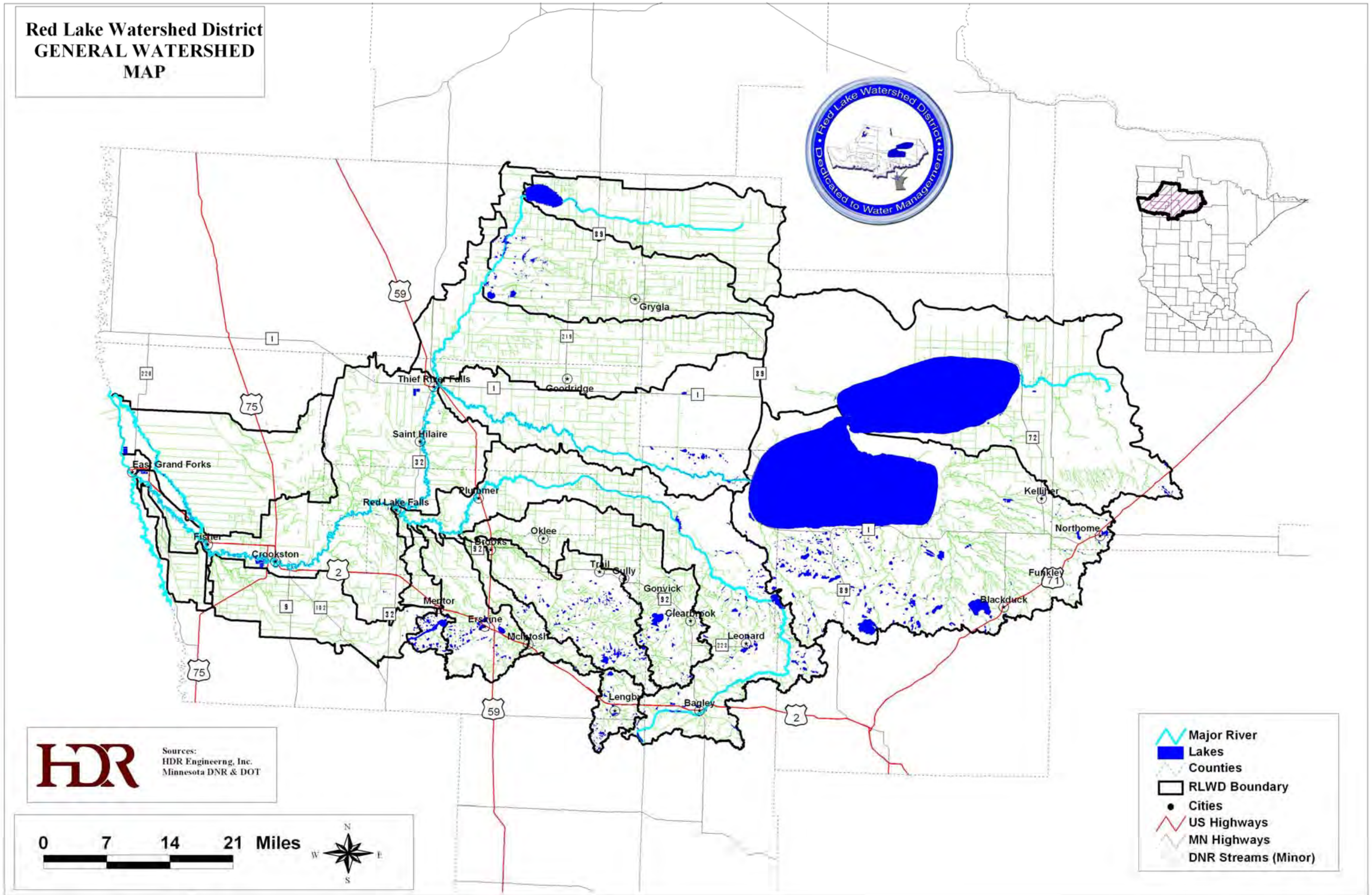


Figure 4
Public and Tribal Lands

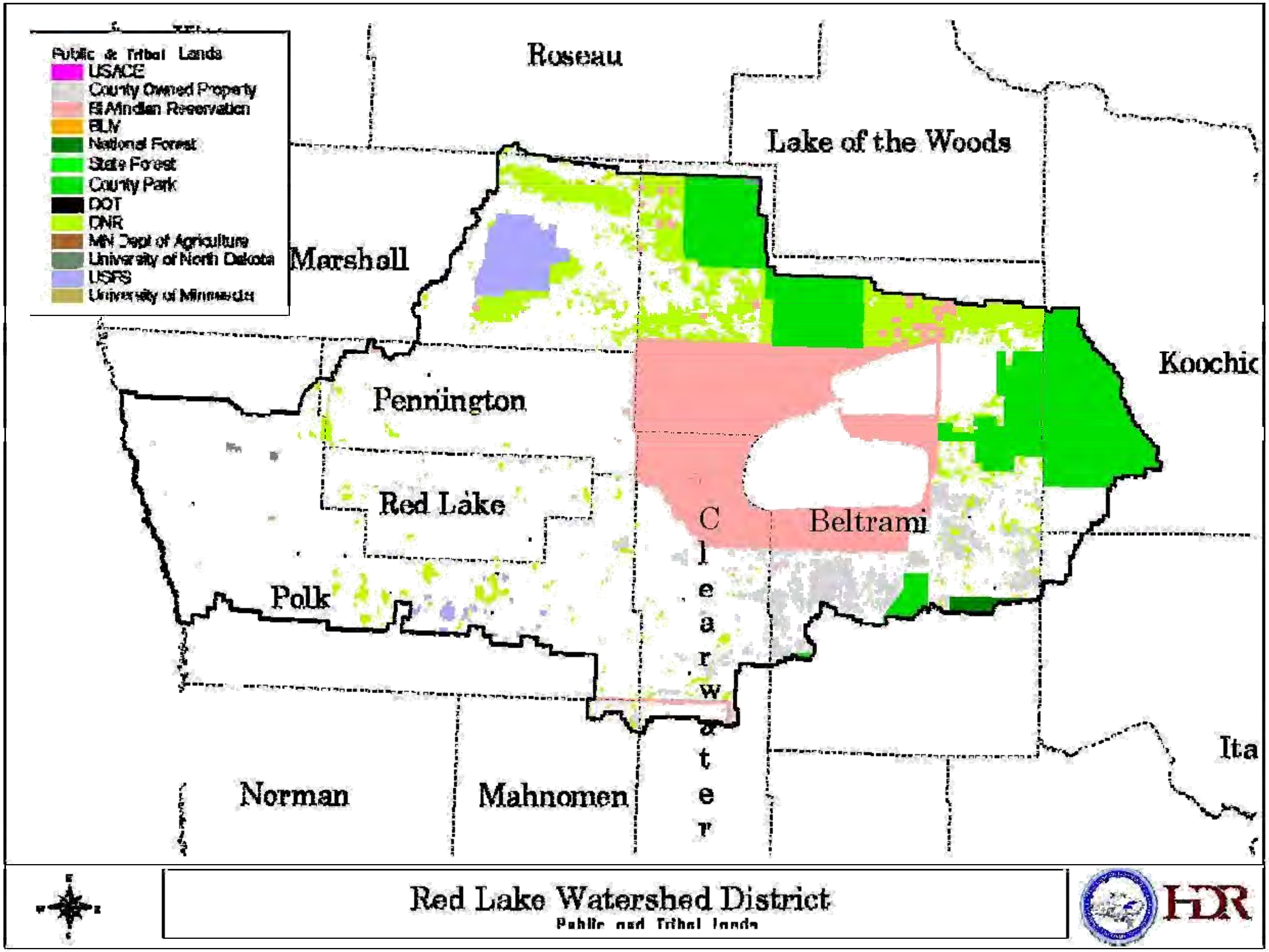


Figure 5
Red Lake River Watershed Geomorphology

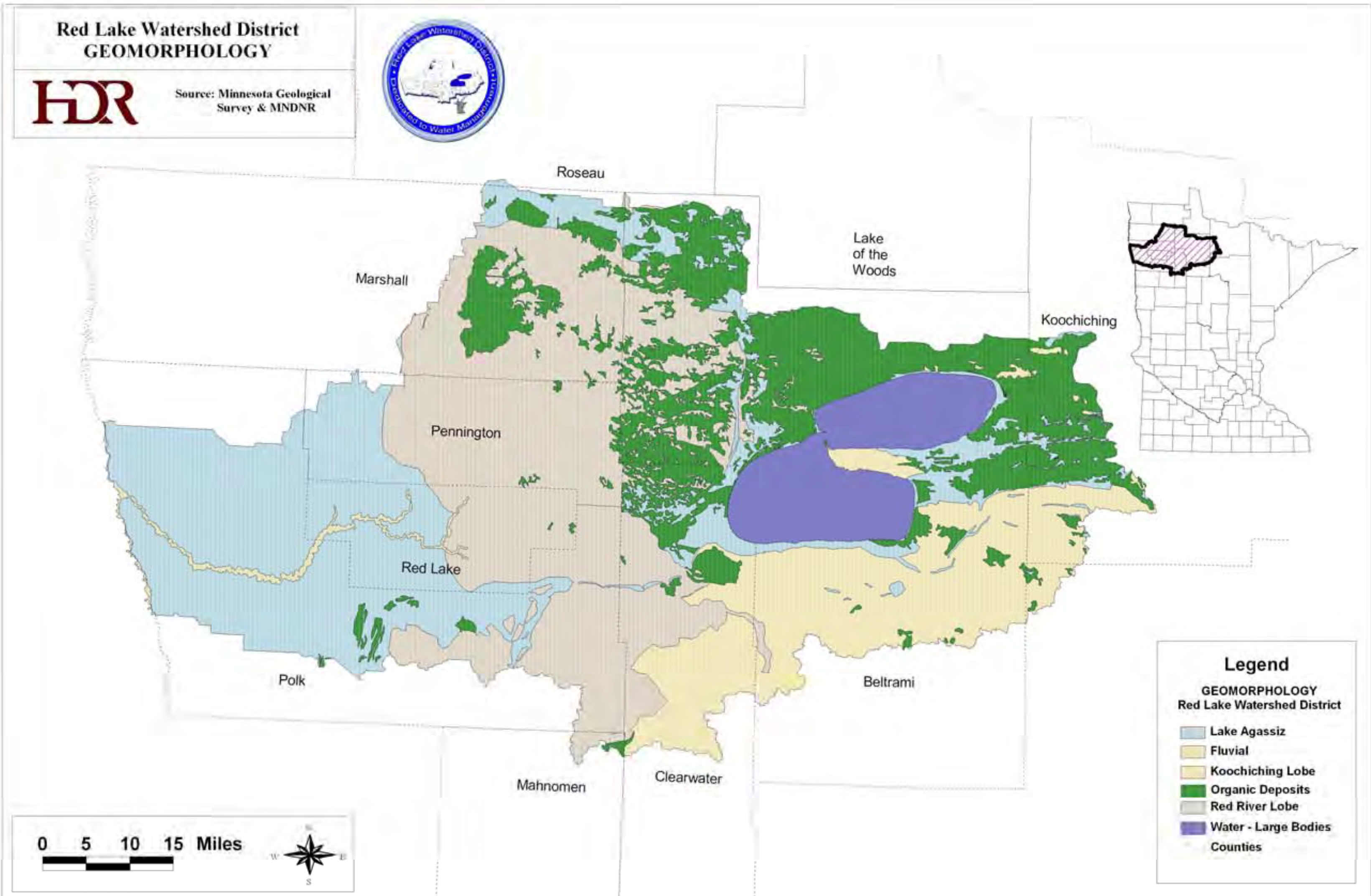


Figure 6
Lake Agassiz

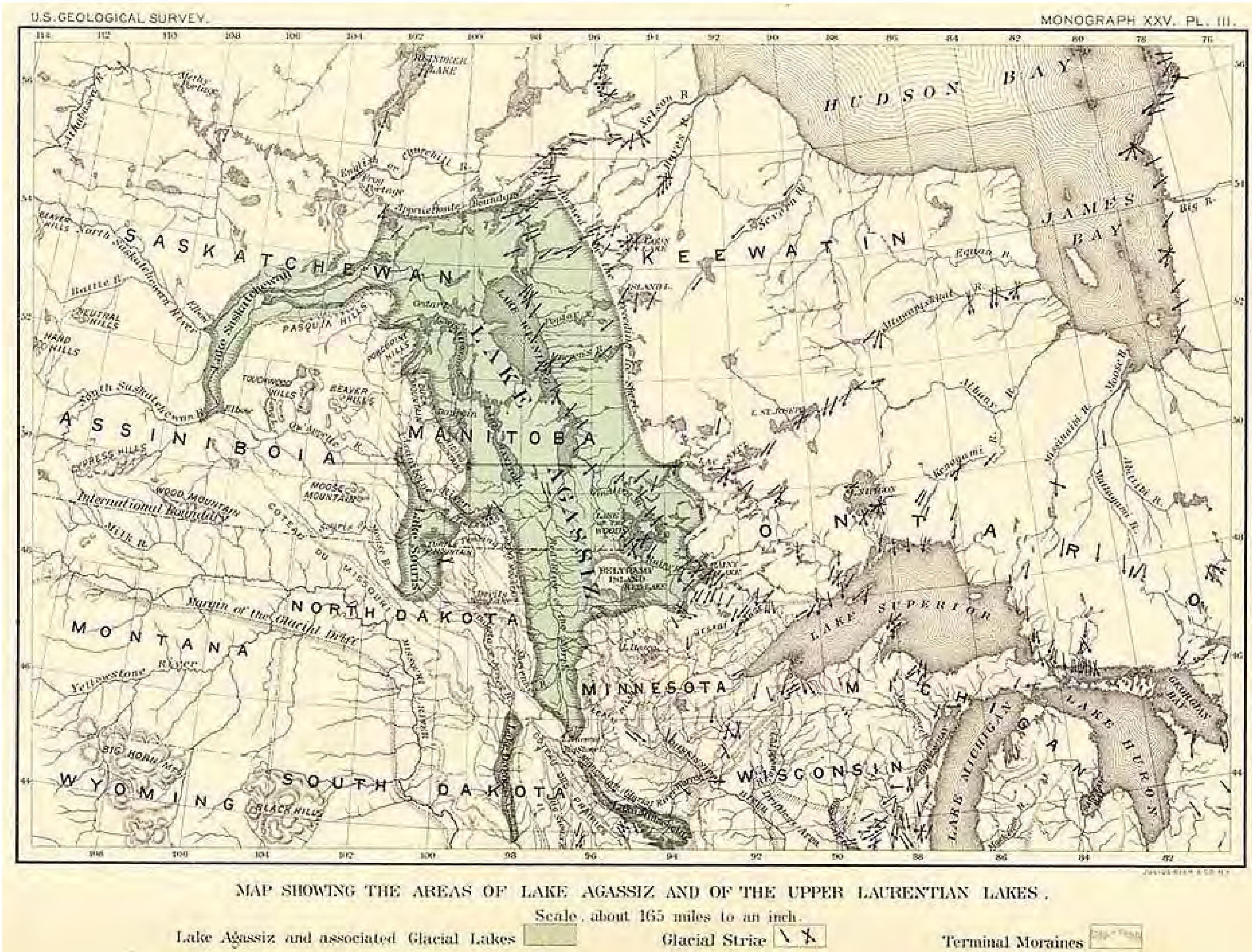


Figure 7
Topography

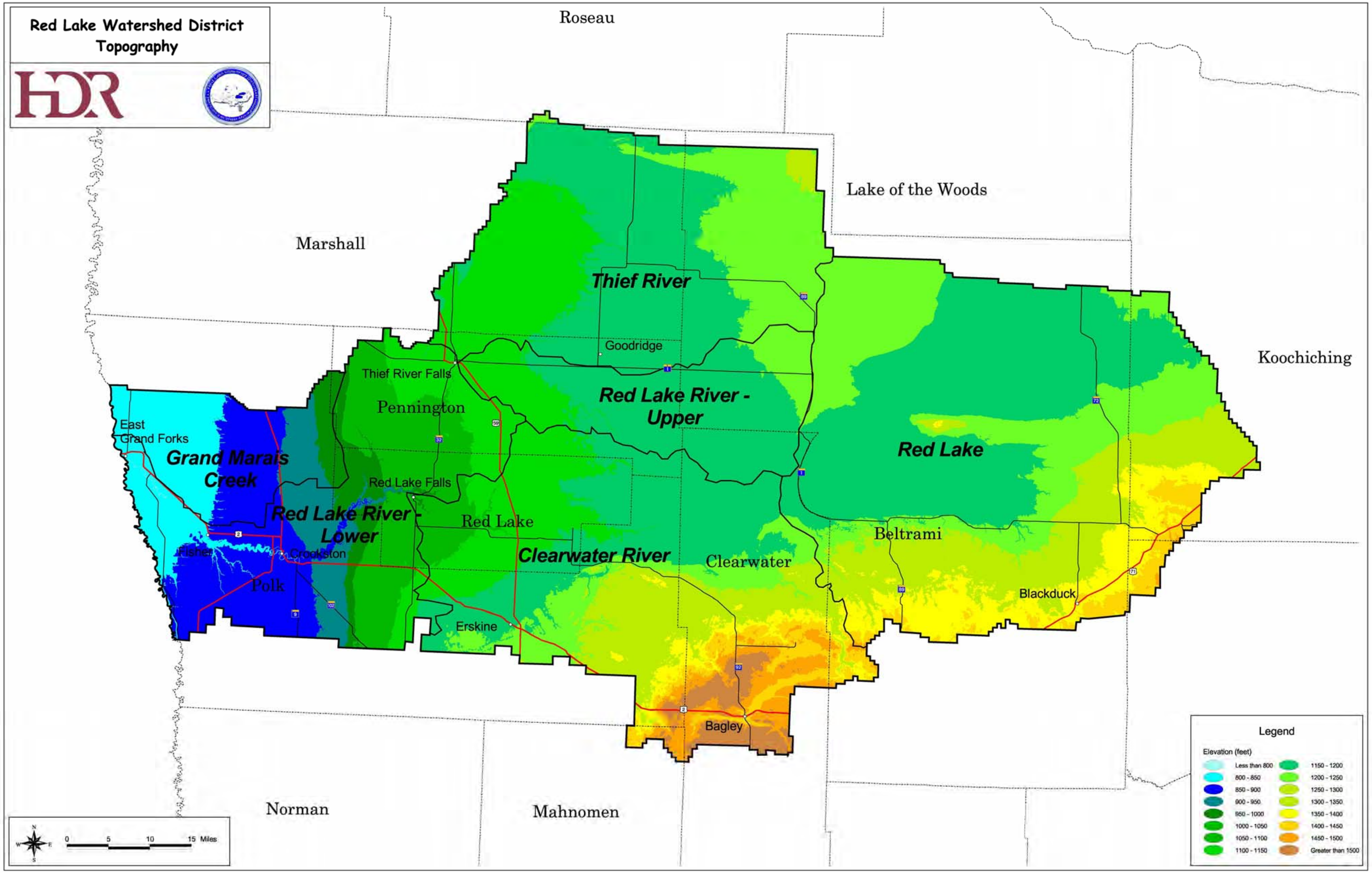
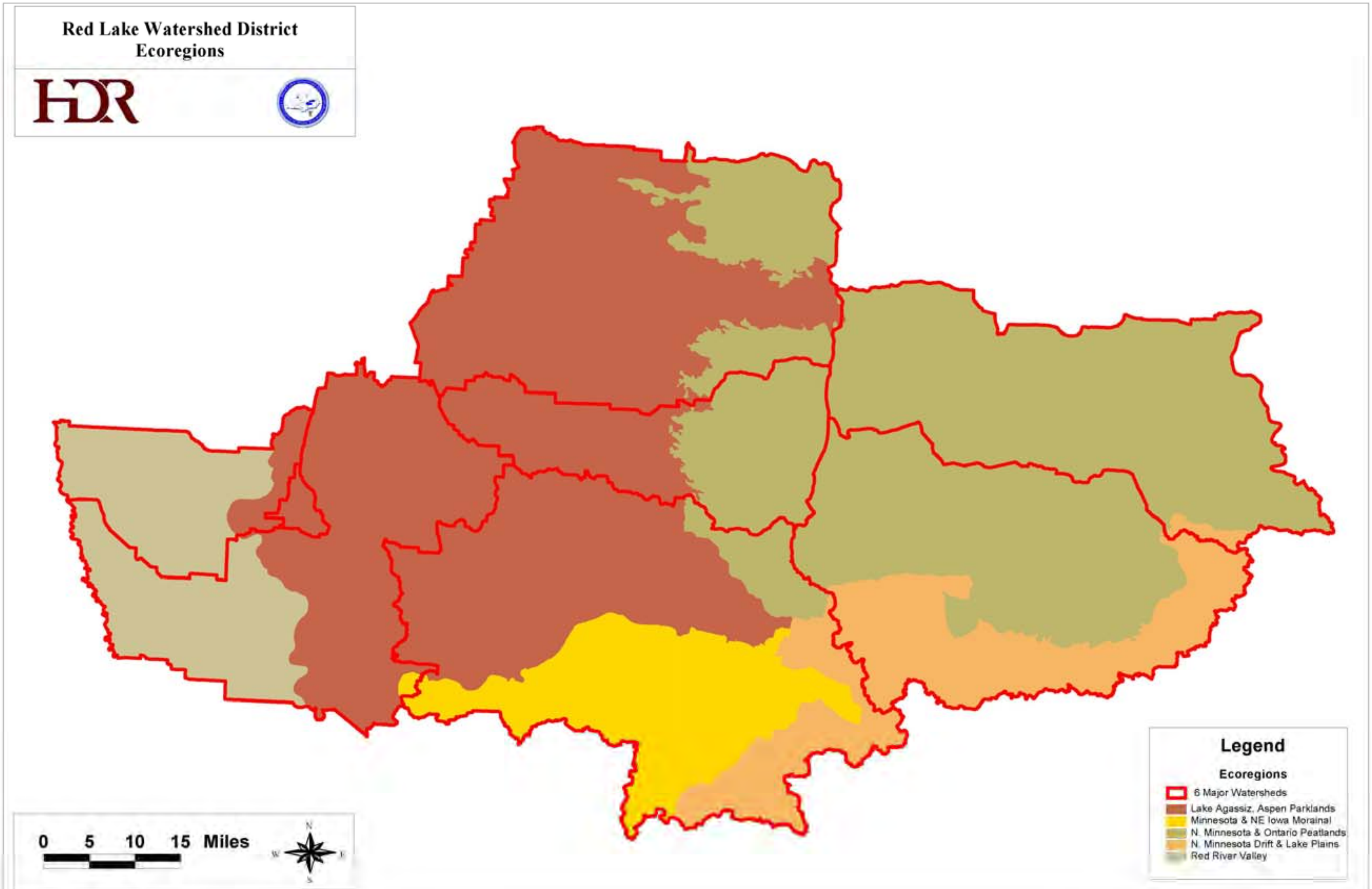


Figure 8
Ecoregions



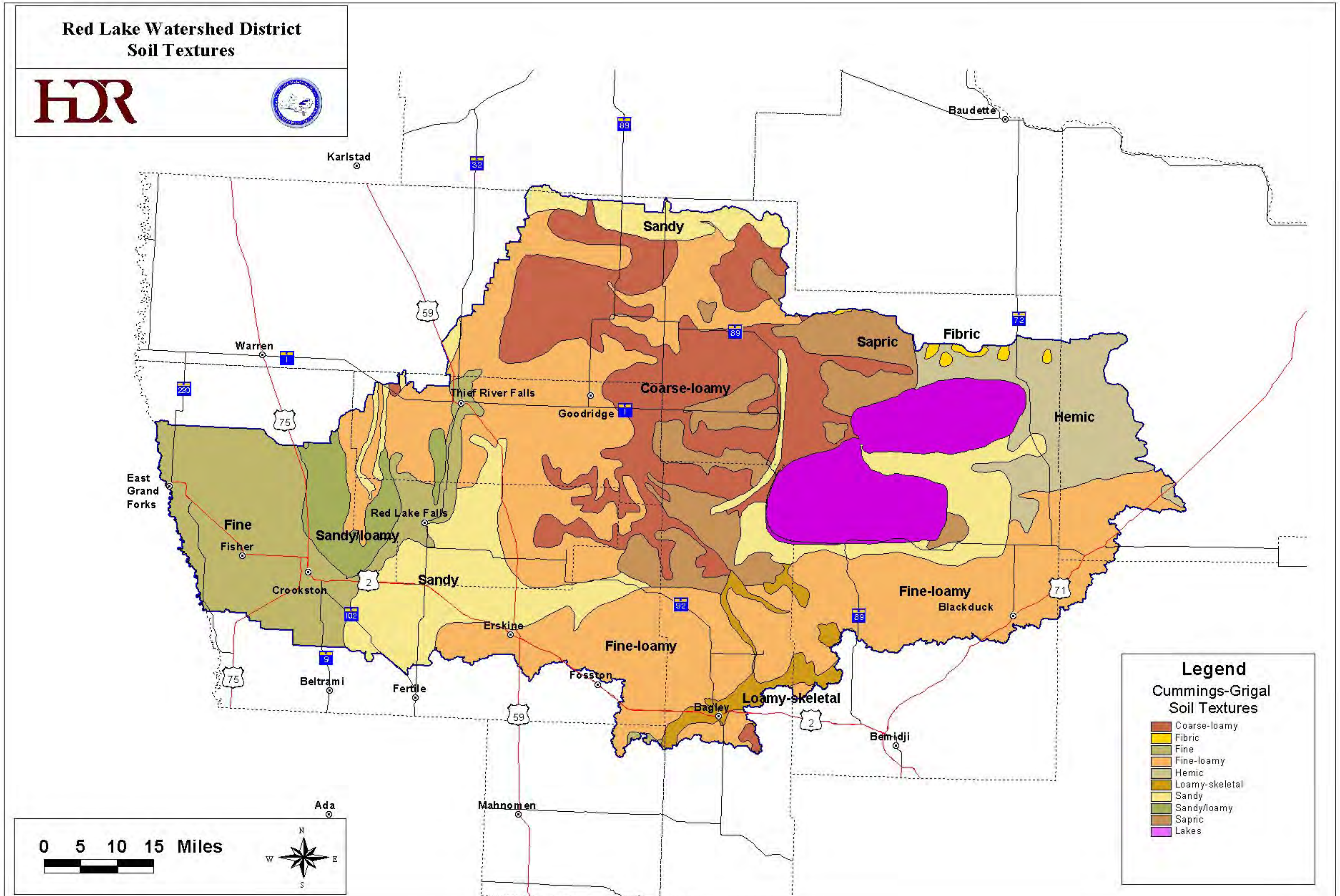
2.4 SOILS

The soils of the RLWD 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 quieter areas within the streams or downstream to a lake area. In general, the fine clay particles were carried furthest 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 RLWD have been extensively mapped by the U.S. Department of Agriculture (USDA) primarily to encourage suitable land use applications. Detailed soil surveys have been published covering each of the counties and are available at local USDA Natural Resource Conservation Service (NRCS) and County Soil and Water Conservation District (SWCD) offices. Unfortunately, however, only a portion of the Red Lake Reservation has been mapped for soils.

A reconnaissance soil survey, published in 1939, is available for Polk, Red Lake and Marshall counties. Generalized soil maps are available for all the counties. Statistical maps are available for the entire watershed. Figure 9 is a generalized soil landscape map of the RLWD showing soil textures.

Figure 9
Soil Textures Map



2.5 CLIMATE

2.5.1 Temperature

The climate of this basin is characterized by cold to arctic winters with numerous winter storms and short summers of moderate temperatures. The mean annual temperature of Crookston in the western basin is 39.7 degrees Fahrenheit (F.), compared to 38.4 degrees F. at the Red Lake Indian Agency in the extreme eastern end. January and February are the coldest months and have mean monthly temperatures of 4.0 degrees F. and 10.1 degrees F., respectively. A record -51 degrees F. at Crookston and -50 degrees F. at the Red Lake Indian Agency have been recorded.

The mean monthly temperatures from April to September vary from 59 degrees F. in the west to 57 degrees F. in the east end of the basin. July and August are the warmest months, averaging 70 degrees F. and 68 degrees F. Temperatures of 100 degrees F. and higher have been recorded 12-15 times during the past 60 years. The frost-free period (32-31 degrees F.) in the western end is 124 days compared to 117 in the eastern edge of the watershed.

2.5.2 Precipitation

The annual precipitation increases from 19 inches in the northwestern corner to 23 inches on the eastern edge of the basin. Approximately 75 percent falls as rain and the remainder as snow. The greatest amount of moisture, 31-33 percent of the total precipitation, is recorded during June and July. The least amount, 1.75 inches, occurs during December, January and February, as snowfall. Much of the winter's snowfall runs off during the spring breakup (Figure 10 and Figure 11).

2.5.3 Rain, Snow and Stream Gage

Since 1978, the RLWD has kept track of rain, snow and stream gage sites covering 4,049 miles. Records are taken by voluntary readers. There are 100 stream gage sites with 51 readers; 21 rain gage sites with 21 readers; and three snow gage sites that are read by the RLWD staff.

Figure 10
Precipitation

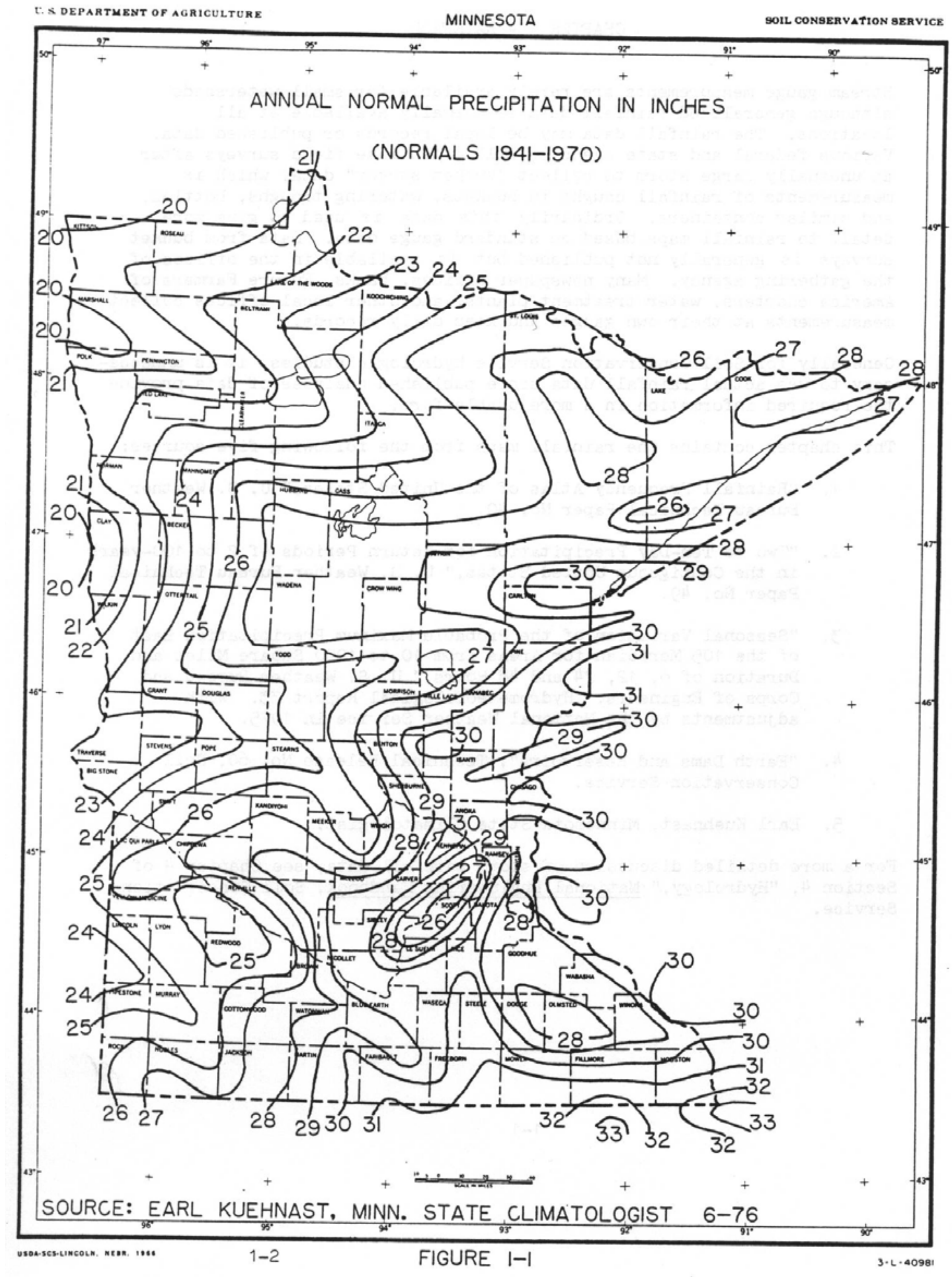
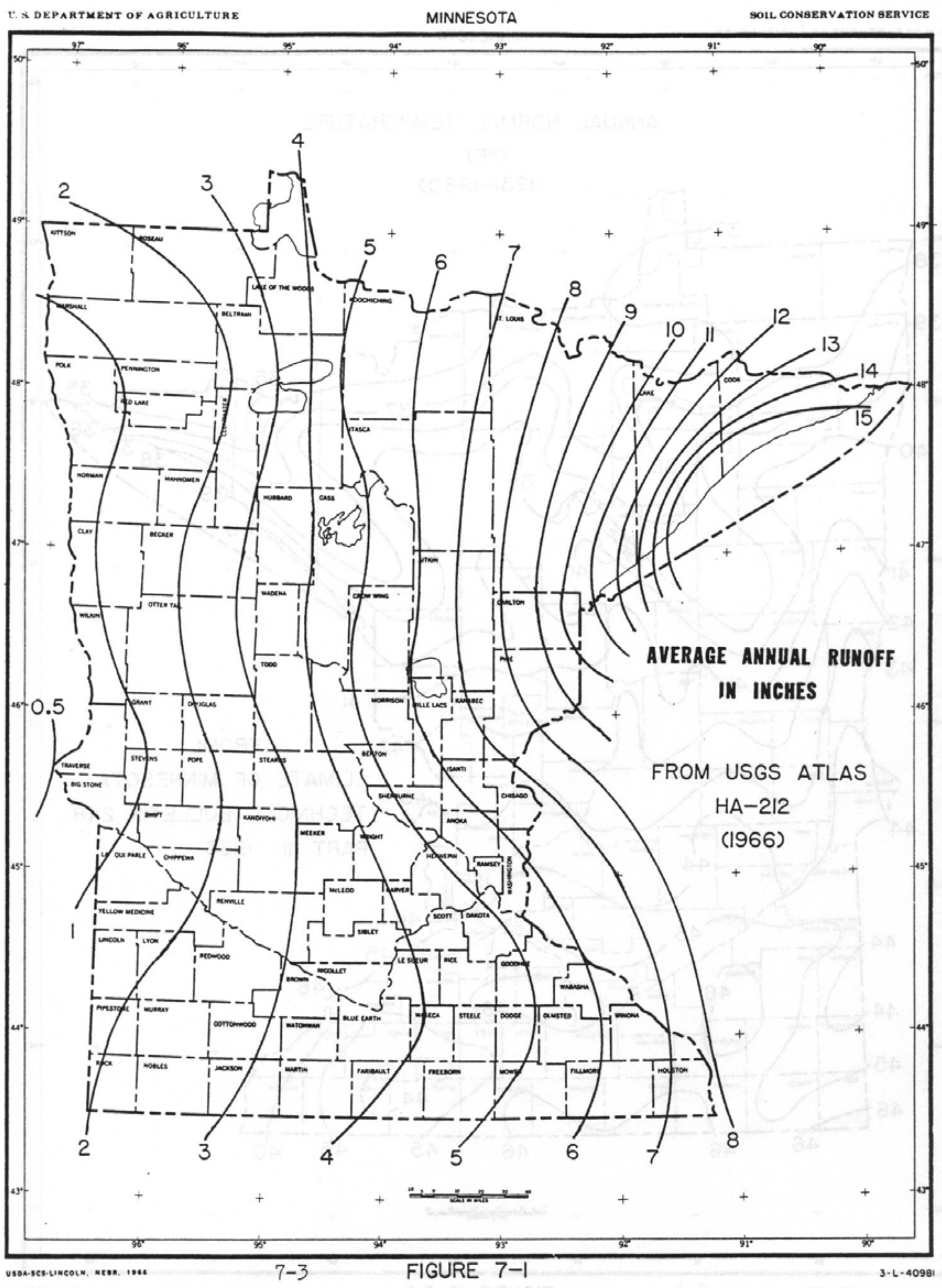


Figure 11
Runoff



2.6 POPULATION

The estimated population of the RLWD, using 2003 census data, is about 74,000. The largest cities within the RLWD are East Grand Forks (population 7,616), Crookston (population 8,104), Thief River Falls (population 8,488) and Red Lake Falls (population 1,601).

In general, census statistics indicate that the northwestern region of the state continues to slowly decline in population and that the population is continuing to age. The continued shifting of population out of the watershed and the region may lead to improvements in water quality due to lower human impacts. However, it is very difficult to measure these impacts and they would only be implied. It may be possible for the district to statistically compare population trends to land use and water quality to see if a linkage between human population and water quality exists.

Agriculture and related businesses are the prime sources of income within the RLWD. Major industrial employers include Digi-Key Corporation and Arctic Cat, Incorporated. In general, household mean and median incomes tend to be below the state-wide average. Job-Z and other economic development incentive programs have been created in an attempt to introduce more jobs within the region.

Table 1
Total Population by County for Northwestern Minnesota

COUNTY	2000 TOTAL POPULATION	2010 POPULATION ESTIMATE	PERCENT CHANGE	2000 URBAN POPULATION	2000 RURAL POPULATION
Beltrami	39,650	45,040	12.0	12,492	27,158
Clearwater	8,423	8,810	4.0	0	8,423
Itasca	43,992	47,590	7.5	8,530	35,462
Koochiching	14,355	13,570	-5.8	7,790	6,565
Mahnomen	5,190	5,360	3.0	0	5,190
Marshall	10,155	9,500	-6.9	0	10,155
Pennington	13,584	14,000	3.0	9,164	4,420
Polk	31,369	30,830	-1.7	15,385	15,984
Red Lake	4,299	4,310	0.0	0	4,299

Minnesota Department of Administration, Land Management Information Center, 2000 Census Information

2.7 LAND USE

Exclusive of Red Lake Nation lands, a large portion of the land of the RLWD is devoted to agriculture. The Red Lake Nation manages its lands predominantly for fish and wildlife habitat and timber production. Most of the area is cropland with a small percentage of pasture, wetland areas and woodlands. A variety of crops are produced in the area including corn, wheat, barley, soybeans, alfalfa, wild rice and sugar beets. The long-range trends in agricultural land use 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 land use 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 12 shows the existing land uses within the RLWD. Figure 4 shows public land ownership and Red Lake Band of Chippewa lands within the RLWD. Table 2 and Table 3 show land areas within the RLWD.

Figure 12
Existing Land Use Map

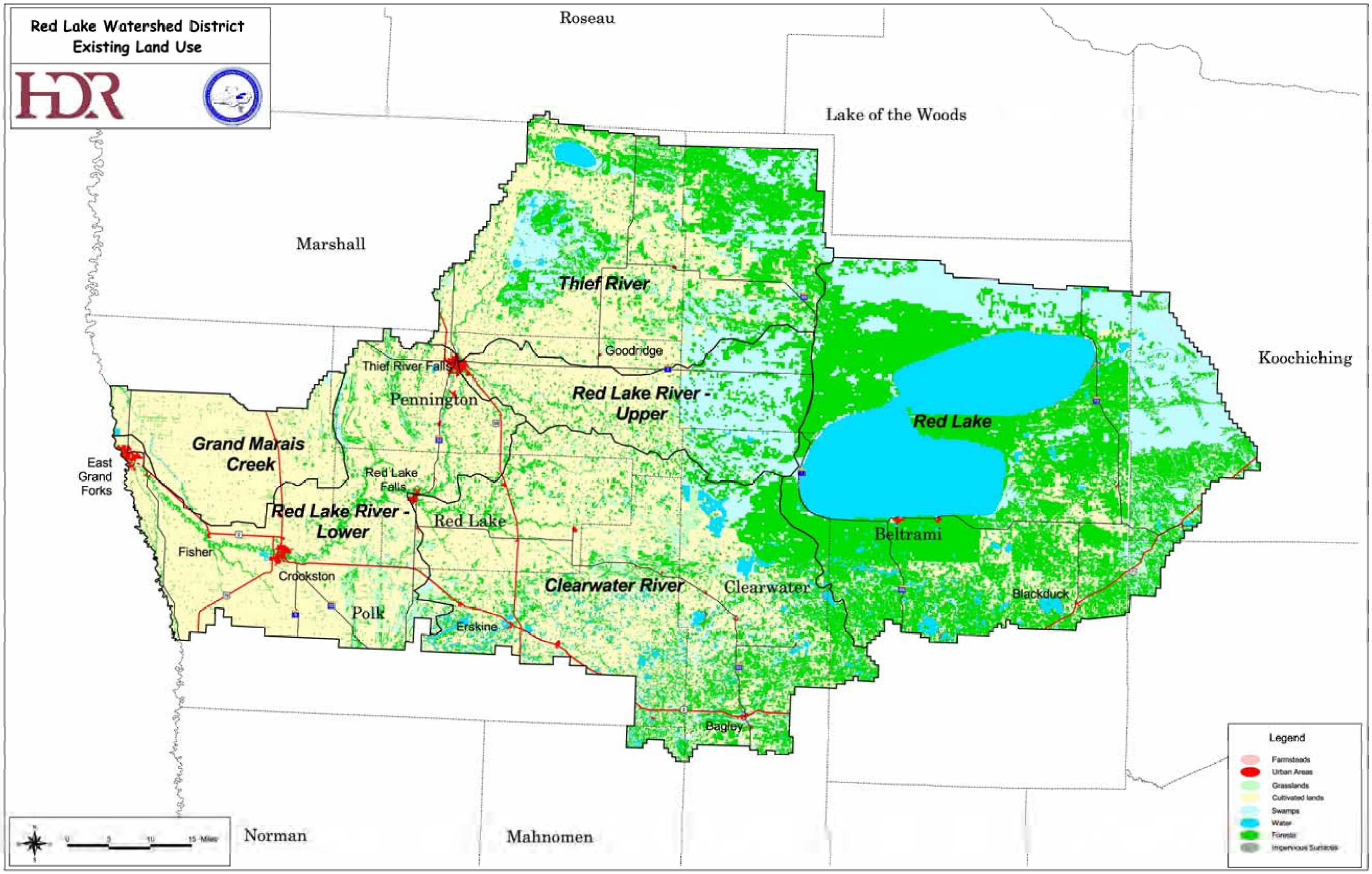


Table 2
Planning Basin Characteristics Area

Planning Basins	Clearwater	Grand Marais	Lower Red Lake River	Upper Red Lake River	Red Lakes	Thief	Total RLWD
Basin Area (sqmi)	1,362	317	874	457	1,929	1,068	6,020
Basin Area (acres)	871,387	202,663	559,091	292,443	1,234,747	683,408	3,852,739
Wetland Area - NWI (acres)							
Mn wetland Type	144,460	3,236	34,994	153,118	855,675	349,665	1,541,147
1	2,324	264	1,430	929	3,878	3,450	12,275
2	40,319	1,173	18,205	86,007	28,221	79,077	253,003
3	25,968	1,121	5,350	1,099	22,087	37,816	93,441
4	1,820	22	138	1,979	2,416	5,218	11,593
5	19,663	37	932	1,706	299,716	9,563	331,617
6	36,740	194	3,979	23,554	139,141	106,567	310,176
7	9,660	424	4,940	32,379	60,323	93,398	201,124
8	7,965	-	20	5,465	299,894	14,574	327,919
Lakes/Rivers (acres)	23,454	1,947	4,556	2,844	302,962	10,133	345,896
EcoRegions of RLWD (Acres)							
Lake Agassiz, Aspen Parklands	384,431	44,472	356,727	139,242	704	513,680	1,439,256
Minnesota & NE Iowa Morainal	304,853	-	3,358	-	-	-	308,212
N. Minnesota & Ontario Peatlands	55,386	-	-	153,201	988,851	169,728	1,367,167
N. Minnesota Drift & Lake Plains	126,687	-	-	-	254,191	-	380,879
Red River Valley	29	165,553	190,598	-	-	-	356,180
Landuse (Acres)							
Cultivated Land	471,450	191,980	456,095	117,023	62,972	294,904	1,594,424
Forest land	245,555	4,395	40,927	62,290	610,310	185,103	1,148,580
Grass/Brush land	60,435	3,163	39,168	11,440	21,819	60,241	196,266
Mines	1,078	58	1,901	40	172	185	3,434
Water	24,738	780	4,331	1,815	304,735	11,515	347,914
Developed land	7,101	1,355	7,744	1,140	3,579	813	21,732
Wetlands	60,944	930	8,882	98,695	240,160	130,599	540,210
Other	86	-	43	-	-	50	179

Table 3
Planning Basin Characteristics Percent of Area

Planning Basins	Clearwater	Grand Marais	Lower Red Lake River	Upper Red Lake River	Red Lakes	Thief	Total RLWD
Wetland Area - NWI (%)	16.58%	1.60%	6.26%	52.36%	69.30%	51.16%	40.00%
Mn wetland Type							
1	0.27%	0.13%	0.26%	0.32%	0.31%	0.50%	0.32%
2	4.63%	0.58%	3.26%	29.41%	2.29%	11.57%	6.57%
3	2.98%	0.55%	0.96%	0.38%	1.79%	5.53%	2.43%
4	0.21%	0.01%	0.02%	0.68%	0.20%	0.76%	0.30%
5	2.26%	0.02%	0.17%	0.58%	24.27%	1.40%	8.61%
6	4.22%	0.10%	0.71%	8.05%	11.27%	15.59%	8.05%
7	1.11%	0.21%	0.88%	11.07%	4.89%	13.67%	5.22%
8	0.91%	0.00%	0.00%	1.87%	24.29%	2.13%	8.51%
Lakes/Rivers (%)	2.69%	0.96%	0.81%	0.97%	24.54%	1.48%	8.98%
Total Wetlands/Lakes/Rivers	19.27%	2.56%	7.07%	53.33%	93.84%	52.65%	48.98%
EcoRegions of RLWD (%)							
Lake Agassiz, Aspen Parklands	44.12%	21.94%	63.80%	47.61%	0.06%	75.16%	37.36%
Minnesota & NE Iowa Morainal	34.98%	0.00%	0.60%	0.00%	0.00%	0.00%	8.00%
N. Minnesota & Ontario Peatlands	6.36%	0.00%	0.00%	52.39%	80.09%	24.84%	35.49%
N. Minnesota Drift & Lake Plains	14.54%	0.00%	0.00%	0.00%	20.59%	0.00%	9.89%
Red River Valley	0.00%	81.69%	34.09%	0.00%	0.00%	0.00%	9.24%
Landuse (%)							
Cultivated Land	54.10%	94.73%	81.58%	40.02%	5.10%	43.15%	41.38%
Forest land	28.18%	2.17%	7.32%	21.30%	49.43%	27.09%	29.81%
Grass/Brush land	6.94%	1.56%	7.01%	3.91%	1.77%	8.81%	5.09%
Mines	0.12%	0.03%	0.34%	0.01%	0.01%	0.03%	0.09%
Water	2.84%	0.38%	0.77%	0.62%	24.68%	1.68%	9.03%
Developed land	0.81%	0.67%	1.39%	0.39%	0.29%	0.12%	0.56%
Wetlands	6.99%	0.46%	1.59%	33.75%	19.45%	19.11%	14.02%
Other	0.01%	0.00%	0.01%	0.00%	0.00%	0.01%	0.00%

2.8 FISH AND WILDLIFE

Fish and wildlife are important resources of the area. Hunting, fishing, trapping and wildlife viewing provide recreation for area residents and bring in people from outside the area, with significant benefits to the local economy. Waterfowl, ruffed and sharp-tailed grouse, white-tailed deer and snowshoe hare are commonly hunted species. Walleye, northern pike, crappie, channel catfish, smallmouth bass, bullhead and rough fish are all important recreational fisheries. Lake sturgeon were once abundant in the Red River Basin and there are historical accounts of them being present upstream into the Upper and Lower Red lakes. The deep scour hole located at the confluence of Clearwater River and Red Lake River was reported to be the largest lake sturgeon spawning location in the Red River Basin. However, by the mid-1900's, lake sturgeon had effectively been extirpated from the basin as a result of over exploitation, dam construction and declines in water and habitat quality. The Minnesota Departmnet of Natural Resources (MnDNR) currently stocks lake sturgeon fry in the above-mentioned scour hole as part of a cooperative lake sturgeon restoration plan. The Upper and Lower Red lakes are the largest walleye lakes in Minnesota. The Upper and Lower Red lakes have been identified as unique resources for their size and their history. The RLWD will seek to actively work with the Red Lake Band of Chippewa Indians and the MnDNR in the management of the lakes and their outlet.

The RLWD lies along a major flyway for migratory birds. Species that migrate through and stay in the area include the bald eagle, burrowing owl and peregrine falcon. Federally, bald eagles are listed as threatened. Gray wolves present in the area are listed as threatened. Burrowning owls are are not listed federally, but are listed by Minnesota as endangered. Minnesota lists bald eagles as a species of spectial concern and peregrine falcons as threatened. Agassiz National Wildlife Refuge (NWR) is home to the largest nesting colony of Franklin's gulls in North America. The U.S. Fish and Wildlife Service (USFWS), the MnDNR and the U.S. Army Corps of Engineers (USACE) are involved in wildlife management within the RLWD. Their efforts have been primarily aimed at waterfowl production, migration habitat, resident deer, grouse, elk and numerous other upland game and non-game species. Wildlife management efforts are focused on maintaining a variety of habitats, which include a variety of wetlands, brushlands, timbered areas and prairies and savannahs to benefit a variety of resident and migratory wildlife. Their programs include land acquisition and easements. The Red Lake Band of Chippewa Indians and a number of private organizations are also involved.

The Minnesota Center for Environmental Advocacy (MCEA) completed a detailed assessment of natural resources within the RLWD as a part of the Overall Plan update. A copy of the assessment report is available for review at the RLWD offices.

3.0 WATER RESOURCES

3.1 MAJOR STREAMS AND TRIBUTARIES

The Red Lake River originates at the dam at the outlet of Lower Red Lake and flows in a westerly direction approximately 196 river miles to its confluence with the Red River of the North at East Grand Forks (Figure 13).

There are two main tributaries to Red Lake River. One is Thief River, which drains the northern part of the RLWD. This watershed is approximately 1,090 square miles in size. Thief River joins the Red Lake River at Thief River Falls. The second tributary is the Clearwater River, which drains the area south of the Red Lake River. There are about 1,347 square miles in this watershed. Clearwater River empties into Red Lake River at Red Lake Falls. The Lost, Hill and Poplar rivers are minor tributaries to the Clearwater River. The Grand Marais Creek is another significant stream in the RLWD, but it outlets into the Red River of the North, north of East Grand Forks. The Grand Marais Creek subwatershed consists of approximately 317 square miles and is almost entirely agricultural in nature.

There are a number of tributaries of the Upper and Lower Red lakes. These include: Battle Creek, Blackduck River, Cormorant River, Dorrigans Creek, Mud River, Shotley Brook, Tamarac River and several smaller streams.

There are wide variations in the flow of the Red Lake River and its tributaries. The peak periods occur in April and May, depending on the spring breakup and snow melt, and again in May, June or July when heavy spring or summer rains occur. A low flow period generally occurs in the late summer or early fall because of low precipitation. During the winter months, when the rivers and lakes are frozen over, another low flow occurs (Figure 14).

Figure 13
Major Streams and Tributaries Map

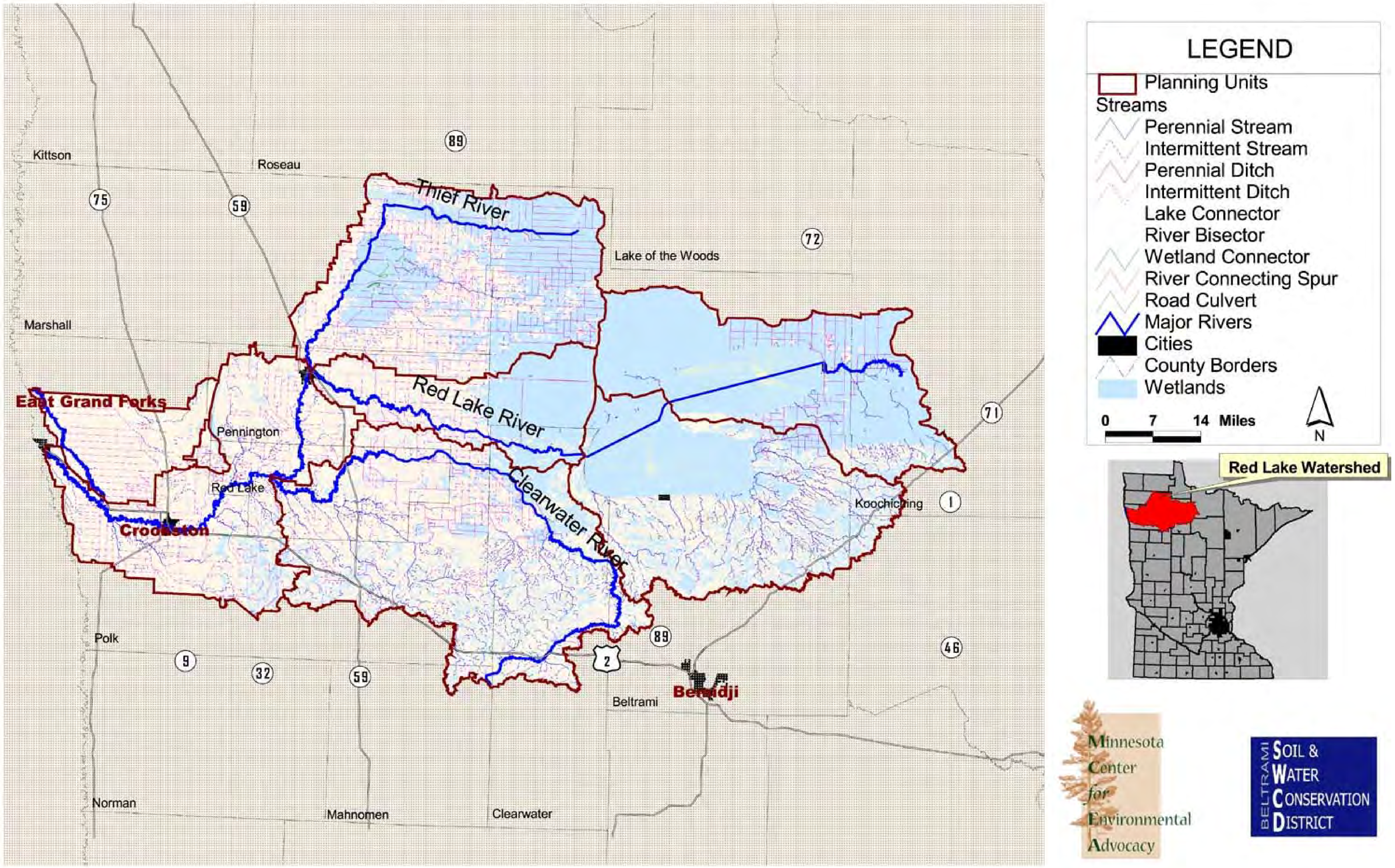
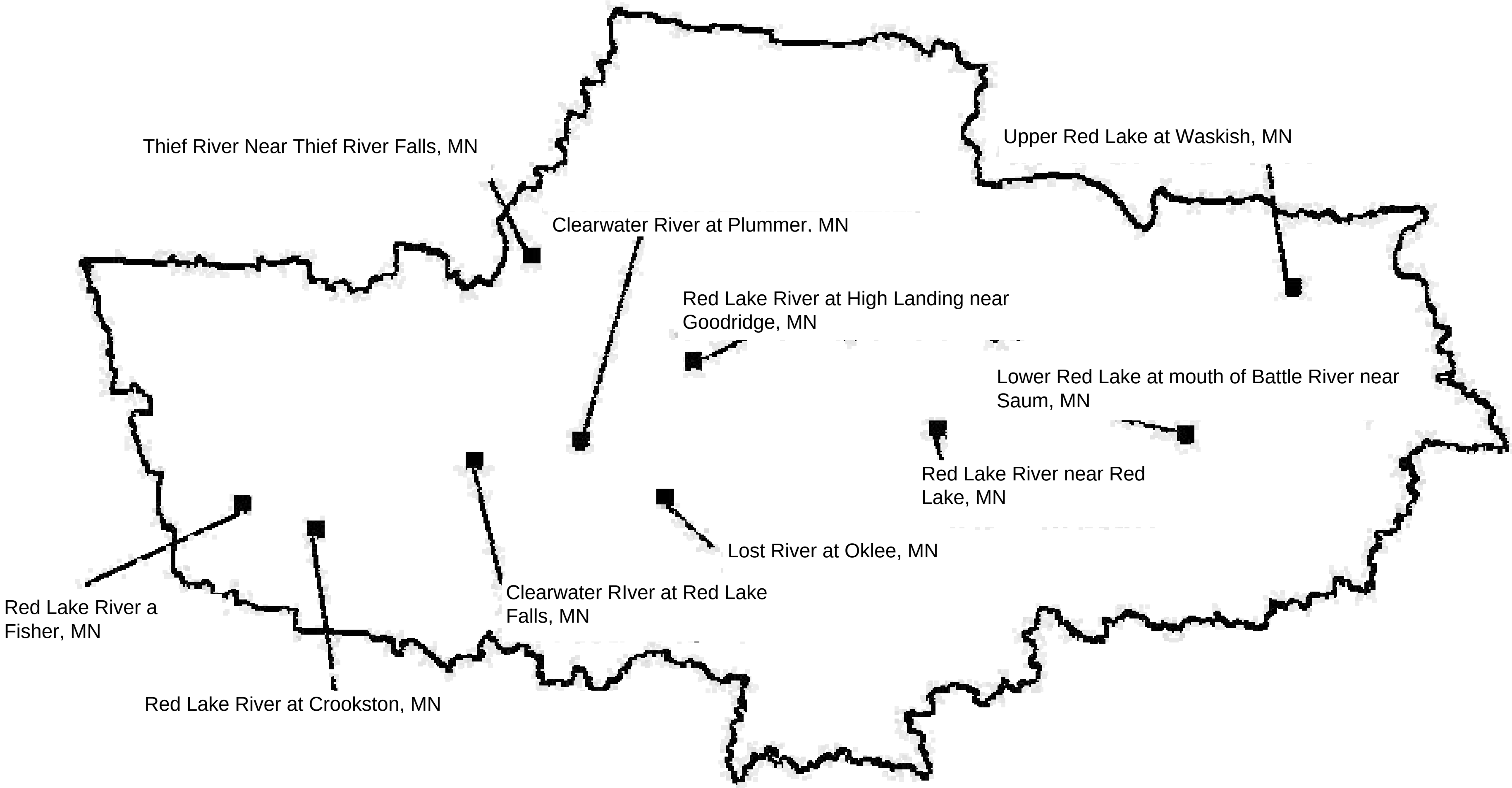


Figure 14
Stream Gages Site Location Map



3.2 LAKES

The largest lakes are the Upper and Lower Red lakes, which comprise an area of 265,040 acres. Lower Red Lake and 60 percent of Upper Red Lake are within the Red Lake Reservation and are fished, for subsistence and commercial purposes, solely by members of the Red Lake Band of Chippewa Indians.

The remainder of Upper Red Lake lies outside of the Reservation and is managed by the Minnesota DNR. A cooperative effort between the Red Lake Band of Chippewa Indians and the MnDNR is currently underway to restore the walleye fishery in the Red Lakes, which collapsed in the mid-1990's.

There are numerous smaller lakes in the RLWD, such as Badger, Cable, Cameron, Cross, Puposky, Poplar, Turtle, Whitefish and many others. Blackduck Lake and Balm Lake have favorable shorelines with sand bottoms. Pine, Clearwater and Maple lakes have a mixture of sand and muck bottoms. Maple Lake is located close to Crookston, East Grand Forks and Grand Forks in Polk County.

Total lake area in the RLWD is estimated at 314,800 acres. There are approximately 190 smaller lakes, most of which are in the moraine area south of the Upper and Lower Red lakes.

3.2.1 Wetlands

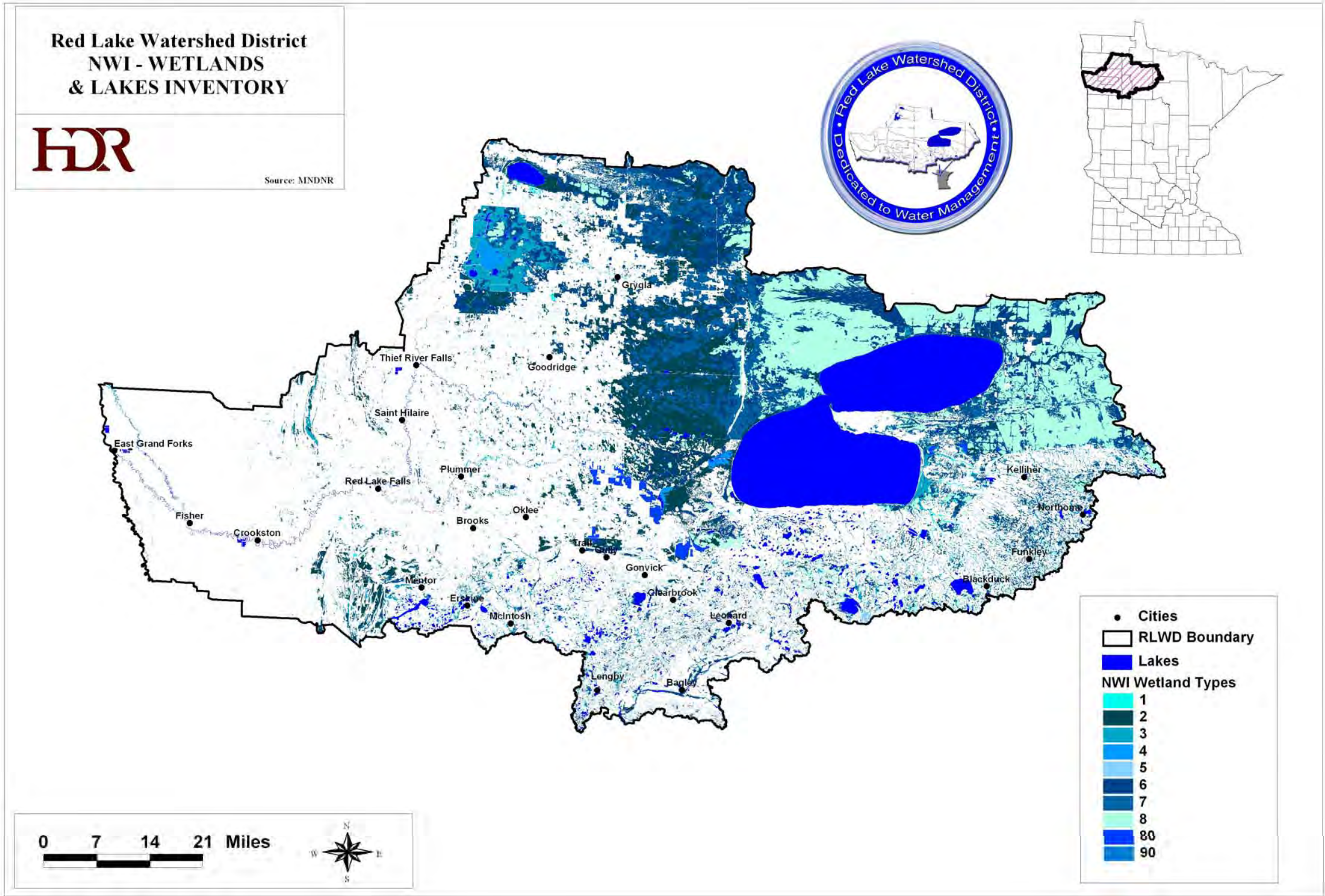
There are 1,541,147 acres of wetlands in the RLWD based upon the National Wetlands Inventory (NWI). They are broken down by type and acreage as follows:

Table 4
Wetlands in the Red Lake Watershed District

WETLAND TYPE - NWI	ACREAGE
Type 1	12,275
Type 2	253,003
Type 3	93,441
Type 4	11,593
Type 5	331,617
Type 6	310,176
Type 7	201,124
Type 8	327,919

Figure 15 shows the locations of existing wetlands within the RLWD.

Figure 15
National Wetlands Inventory Map



3.2.2 Drainage Systems

The cumulative affects of drainage are the focus of much discussion and debate. Section 6.0 addresses FDR principles and the role that drainage plays in the overall approach to water management. Legal drainage ditches have been constructed in the watershed since about 1870. Figure 3 shows most of the public ditch systems placed in a grid-like fashion across mainly the western portion of the RLWD. There are 271 miles of legal ditches managed by the RLWD. Most of the existing ditch systems were established during the first quarter of the 1900's. 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 natural drainage adequate for efficient production of agricultural crops. However, when drained, the soils are highly productive. The RLWD has obtained Minnesota Board of Water and Soil Resources (BWSR) challenge grant funds to update the RLWD ditch inventory with better mapping and identification of benefited areas (Figure 16).

3.2.3 Water Management Structures

The Red Lake outlet was constructed by the USACE. The project consists of a flood control dam at the outlet of Lower Red Lake. The project provides 1 million acre-feet (ac-ft) of flood control storage. Figure 17 depicts the water management projects within the boundaries of the RLWD. Some of these projects, such as the Kiwosay, are managed for purposes other than flood control. Appendix 4 details specific project information.

The RLWD is a partner in over 23 different water retention facilities of varying size and purpose. These projects have significant cumulative NRE values associated with land use that is inherent with water management facilities.

Figure 16
Legal Ditches Map

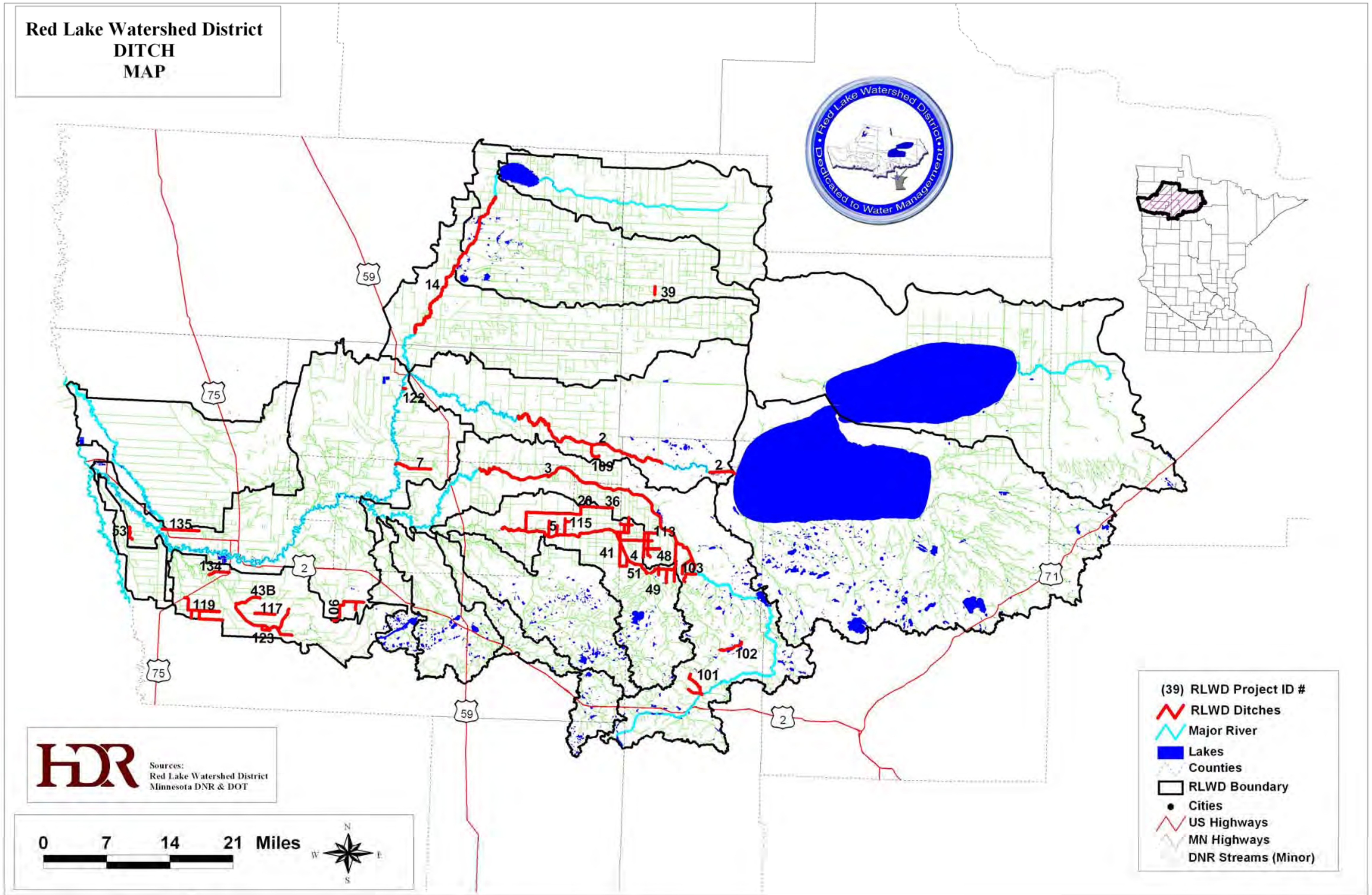


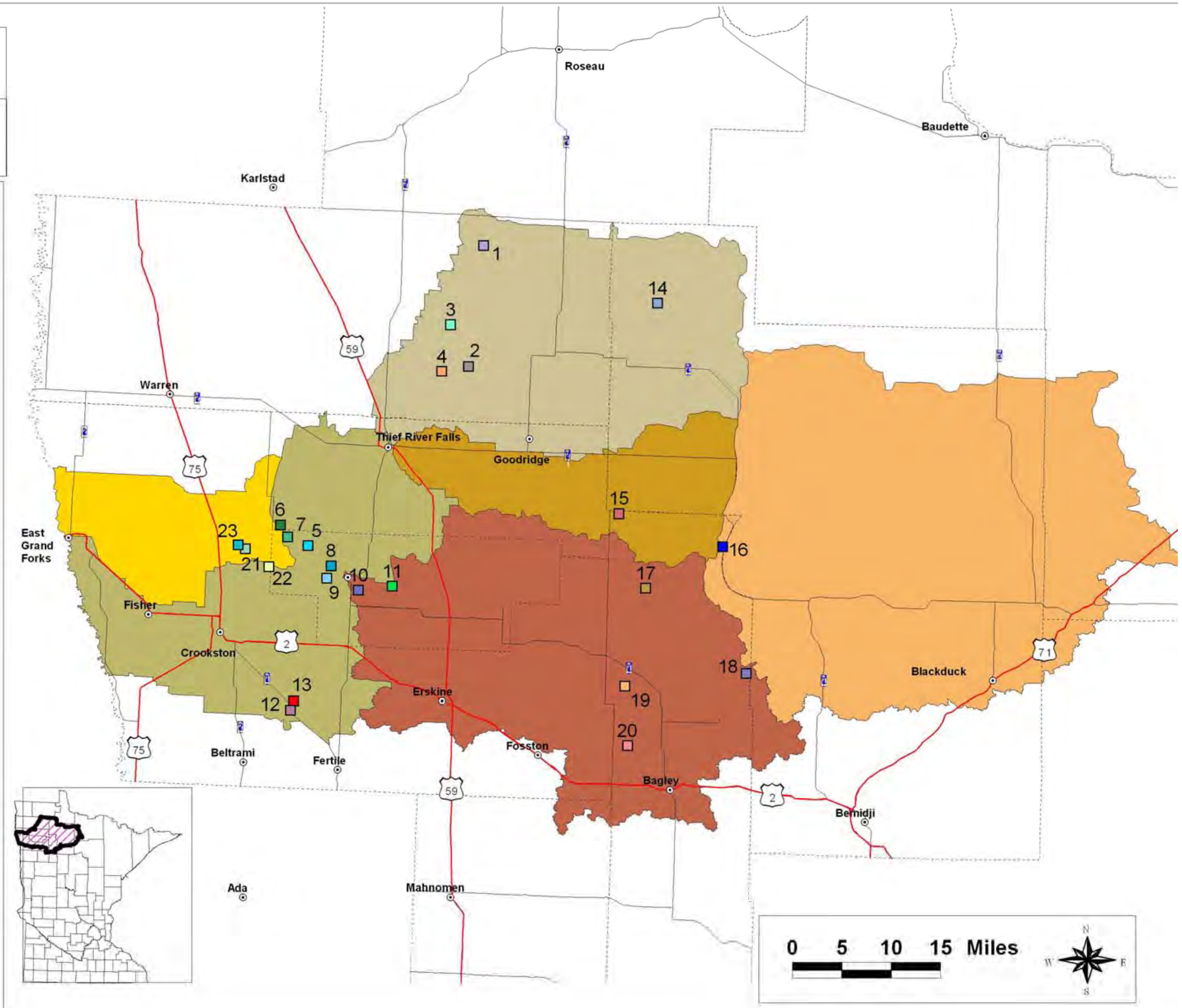
Figure 17
Water Management Projects

Water Management Projects within Red Lake Watershed District

HDR

RLWD Projects

Project Name	Project ID	Storage (acre-ft)	Drainage Area (sq. miles)
Abraham	20	66	0.3
Agassiz	3	45,000	387
BR-6	13	1,023	8
Baird-Beyer	7	400	7
Black River	5	4,700	108
Clearwater Lake	18	4,200	162
Elm Lake	4	7,500	63
FSE Sites 1 & 2	23	590	3.1
Good Lake	15	10,100	72
Goose Lake	6	5,500	16
Kiwosay	17	12,000	36
Knutson	10	42	3
Lost River Pool	2	4,500	54
Louisville-Parnell	22	360	5.1
Miller	11	123	4
Moose River	14	36,250	125
Odney Flaat	12	36	7
Parnell	21	3,600	25
Pine Lake	19	6,080	45
Red Lakes Dam	16	1,000,000	1730
Seeger Dam	9	266	6
Thibert	8	6	1
Thief Lake	1	45,000	222



3.3 WATER SUPPLY

Groundwater aquifers in the glacial drift and underlying fractured bedrock surface are an important source of water supply for small communities, farms and ranch populations. Large industries, such as power generating plants, sugar and potato processing plants, rely on the rivers for their water supply.

In the eastern two-thirds of the watershed, adequate water can be obtained from wells less than 150 feet deep. In the western part of the RLWD, well depths may exceed 300 feet and may be drawing groundwater from the sand and gravel glacial till deposits or the Precambrian bedrock surface.

The four largest cities in the RLWD are Thief River Falls, Crookston, East Grand Forks and Red Lake Falls. Thief River Falls and East Grand Forks obtain their water from the Red Lake River. The intake for the City of Thief River Falls is downstream of the confluence of the Thief River. The City of Grand Forks, North Dakota, also uses the Red Lake River as a drinking water source. Crookston has recently completed drilling two new wells in addition to their four existing wells. The six wells are located in two separate well fields. Crookston wells range in depth from 56 feet to 164 feet. Red Lake Falls has two deep wells (303 and 307 feet). The remaining towns and villages have from one to three wells, depending on population and local industry. Wells depths vary 56-307 feet deep throughout the watershed district. More detailed information on the public water supplies can be found in the source water assessment for each system provided by the Minnesota Department of Health (MDH).

There is relatively little recharge of underground aquifers from the average annual precipitation of 22 inches. Evapotranspiration results in a loss of approximately 19.4 inches, and the remaining 2.6 inches are lost in runoff.

3.3.1 Drinking Water

The smaller communities and farm population obtain their water supply from wells. This water is usually of good quality and suitable for domestic and livestock needs. The MDH tests all public water supplies systems for a variety of constituents. The testing is completed on "finished" water after any treatment processes.

The two communities of Thief River Falls and East Grand Forks obtain their water exclusively from the Red Lake River. It is necessary to filter and disinfect all river water used for municipal and industrial purposes. During high spring runoff, water purification problems are increased. Both communities participated in preparing a source water assessment and included the following as issues of importance: naturally occurring organics, sediment, micro-organisms and turbidity.

3.3.2 Water Use

3.3.2.1 Surface Water and Groundwater

Based on information provided by the MnDNR, there are hundreds of permitted surface water and groundwater appropriation installations within the watershed. Figure 18 shows the MnDNR permitted active water use locations.

3.3.2.2 Inventory of Public Water Suppliers

Based on information provided by the MDH, there are 17 municipal water suppliers within the RLWD. Four of the cities within the RLWD (Thief River Falls, East Grand Forks, Crookston and Red Lake Falls) are required by law to have a MnDNR Water Supply and Emergency Conservation Plan.

In addition, each community already has or will be preparing a wellhead protection plan. Wellhead protection planning includes delineating a capture zone for each public water supply well and managing potential contaminant sources within that designated wellhead protection area. Communities with completed plans in the RLWD include: Red Lake Falls, Oklee and St. Hilaire. Communities where plans are underway include: Crookston, Bagley and Blackduck. Other communities in the RLWD will develop plans in the future.

3.3.3 Water Quality Monitoring Plan

The RLWD's Water Quality Project has been ongoing since 1984. The RLWD's commitment to this project reflects the heightened awareness and increased concern for water quality from the public and agencies alike. Fifty-five sites located throughout the RLWD were sampled seasonally, beginning in 1984. Sampling was reduced to 30 sites in 1990. The RLWD currently monitors over 30 sites four times per year. Sampling sites are located in all major subwatersheds within the RLWD. Although a core set of long-term monitoring sites [i.e. those sites associated with U.S. Geologic Survey (USGS) gauges] will continue to be monitored, some site locations may be adapted to changing project needs and assessment strategies. The RLWD long-term monitoring program collects data for dissolved oxygen, water temperature, conductivity, pH, total phosphorus, orthophosphorus, total suspended solids (TSS), total dissolved solids, total Kjeldahl nitrogen, ammonia nitrogen, nitrates and nitrites, fecal coliform and chemical oxygen demand. Water quality samples will be analyzed for Escherichia (E.) coli bacteria from May of 2005 forward due to impending MPCA standards for this parameter. Also beginning in 2005, long-term monitoring program samples will no longer be analyzed for chemical oxygen demand (Figure 19).

Figure 18
Water Use

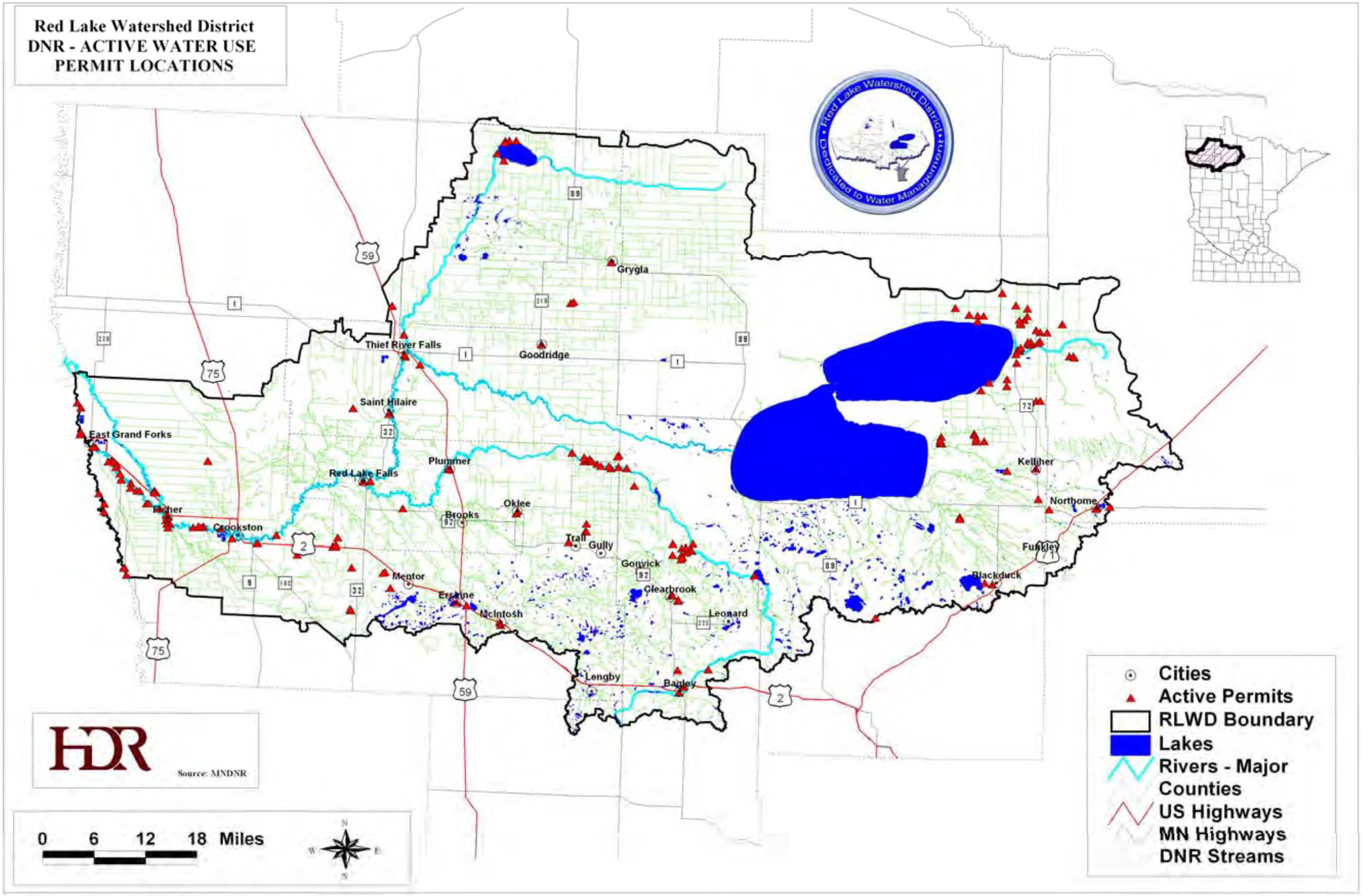
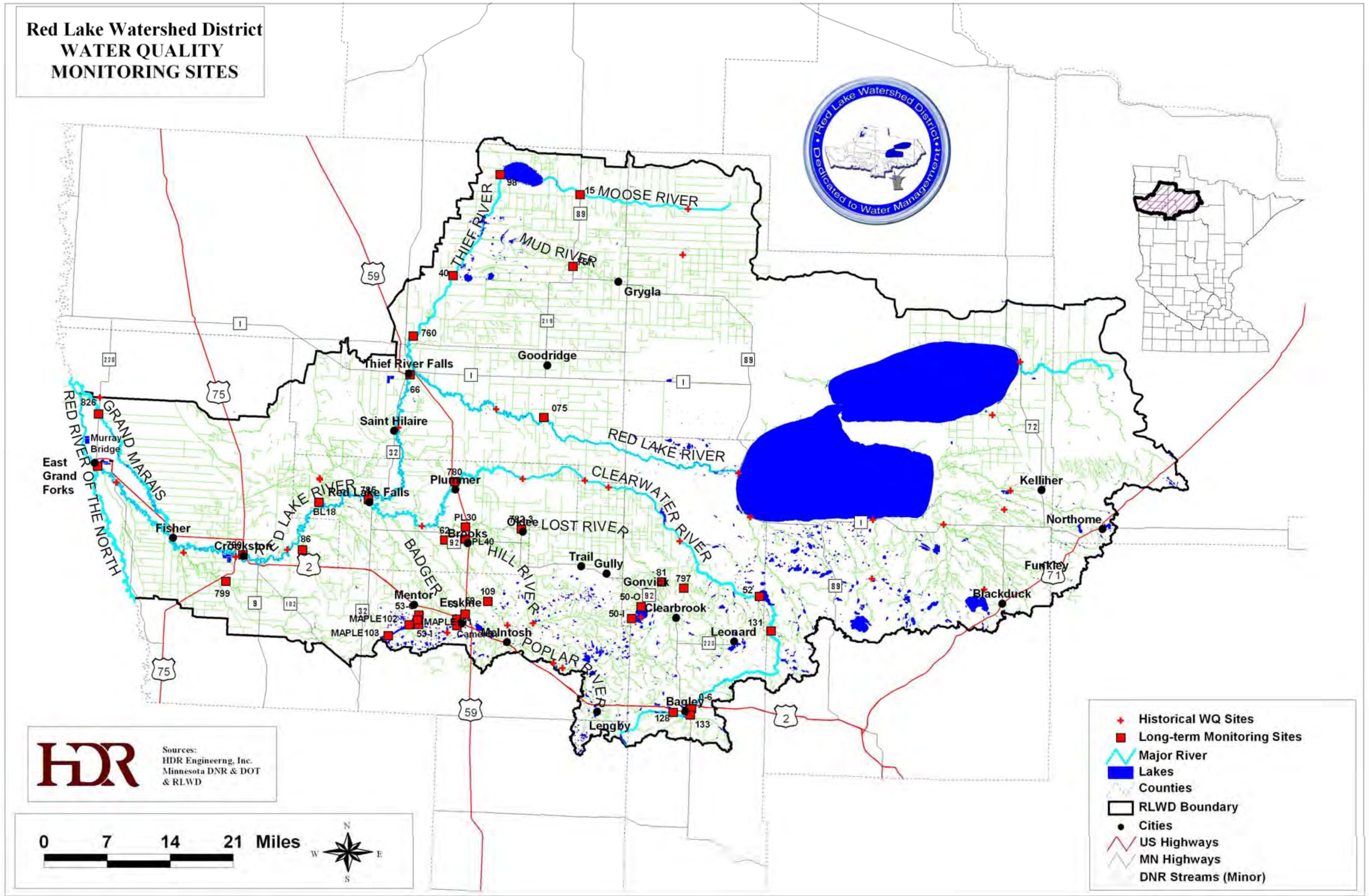


Figure 19
Water Quality Monitoring Sites



The RLWD long-term monitoring program is undergoing changes that will increase its efficiency and the usability of the data collected without greatly increasing costs. Data will be collected on a schedule that is more suitable for assessments. Data will regularly be entered into the Environmental Protection Agency's (EPA) national water quality database STORET. Analysis for two parameters for which data is not used may be discontinued. Site location will continue to be based on the locations of USGS gauges, position within a watershed, project locations, locations of other agencies' monitoring sites and the locations of impaired reaches. Flow measurements will be collected at sites that lack rating curves. The RLWD has spent an average of $41,000 per year on its water quality program since it began. The amount spent varies each year, based upon the amount of time spent on other water quality projects.

Water quality varies throughout the RLWD. The Red Lakes subwatershed, Upper Red Lake River subwatershed and the Upper Clearwater River subwatershed, in the eastern part of the RLWD, are characterized by good water quality. Some streams within these areas have even seen improvement in recent years. As the rivers travel further west into the Red River Valley, however, they encounter lower gradients, increased drainage and channelization. These factors and others negatively affect water quality and biotic integrity. The Thief River, which joins the Red Lake River from the north, has relatively good water quality during normal flow conditions, particularly during summer months. However, during bank-full flows as well as low-flow situations, water quality can become impaired. Dissolved oxygen levels plummet, while total dissolved solids and conductivity levels increase during winter occurrences of low-flow. TSS and phosphorus levels greatly increase during occurrences of high flow, whether this high flow is from runoff, the release of water from Agassiz NWR, or both. On the Lower Red Lake River and on Grand Marais Creek, high turbidity and TSS levels are a regular occurrence. A summary of water quality findings, including impaired waters as identified by the MPCA, is found in Appendix 6 and Appendix 7.

3.3.3.1 Outstanding Resource Value Waters

According to Minnesota Rules Chapter 7050.0180, there are seven calcareous fens classified as Outstanding Value Resource Waters (OVRW) within the RLWD. The ORVWs are listed as follows:

<u>**Calcareous Fens**</u>

Clearwater County:

(1) Clearbrook fen, 61 (T.149, R.37, S.17)

Pennington County:

(2) Sanders east fen, 65 (T.153, R.44, S.7)
(3) Sanders east fen, 74 (T.153, R.44, S.7)
(4) Sanders fen, 64 (T.153, R.44, S.18, 19)

Polk County:

(5) Tympanuchus prairie fen, 26 (T.149, R.45, S.17)
(6) Tympanuchus prairie fen, 38 (T.149, R.45, S.16)
(7) Gully fen (T.150, R.39W, S.14)

In addition, the Pembina Trail Reserve in Polk County is classified as an ORVW.

3.3.3.2 Rare and Endangered Species

The RLWD has the MnDNR Natural Heritage Program listing and maps of rare and endangered species on file. The RLWD will review this information prior to implementation of watershed projects to avoid adverse impacts.

3.3.4 Inventory of Municipal Wastewater Treatment Systems

The wastewater treatment facilities in the RLWD appear in Table 5.

Table 5
RLWD Wastewater Treatment Facilities

Facility Name	ID Number	County	Watershed Name	Facility flow (mgd)
Bagley WWTP	MN0022691	Clearwater	Clearwater River	0.14
Clearbrook WWTP	MN0020931	Clearwater	Clearwater River	0.125
Erskine WWTP	MN0022527	Polk	Clearwater River	0.101
Gonvick WWTP	MN0020541	Clearwater	Clearwater River	0.1
McIntosh WWTP	MNG580031	Polk	Clearwater River	0.105
Oklee WWTP	MNG580038	Red Lake	Clearwater River	0.058
Plummer WWTP	MN0024520	Red Lake	Clearwater River	0.037
7 Clans Casino Stabilization Ponds	MN0063452	Pennington	Red Lake River	0.0135
American Crystal Sugar - Crookston	MN0001929	Polk	Red Lake River	5
American Crystal Sugar - E Grand Forks	MN0001937	Polk	Red Lake River	10
Crookston WWTP	MN0021423	Polk	Red Lake River	1.4
Fisher WWTP	MN0023426	Polk	Red Lake River	0.0375
Goodridge WWTP	MNG580022	Pennington	Red Lake River	0.026
Red Lake Falls WWTP	MN0020613	Red Lake	Red Lake River	0.16
St Hilaire WWTP	MN0024741	Pennington	Red Lake River	0.025
Thief River Falls Power Plant	MNG250058	Pennington	Red Lake River	0.002
Thief River Falls Regional Airport	MN0044415	Pennington	Red Lake River	0.00675
Thief River Falls WWTP	MN0021431	Pennington	Red Lake River	2.14
East Grand Forks WWTP	MN0021814	Polk	Red River of the North - Grand Marais	1.4
Oslo WWTP	MN0024431	Marshall	Red River of the North - Grand Marais	0.102
Grygla WWTP	MN0040771	Marshall	Thief River	0.032
Blackduck WWTP	MN0052302	Beltrami	Upper and Lower Red Lakes	0.1255
Kelliher WWTP	MNG580068	Beltrami	Upper and Lower Red Lakes	0.0365

3.3.5 Relationship to Existing Water Management Plans and Programs

The Managers recognize 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 MPCA, MnDNR, USFWS, USACE, County Water Planners, SWCDs, County Commissioners and others were invited to participate in the planning process. These individuals were asked to provide input to the RLWD's planning process on the goals, policies and objectives of the following plan areas:

- County Water Management Plans
- Soil and Water Conservation District Plans
- Natural Resources Agency Plans
- Other Local Government Water Management Plans
- MPCA Regional Groundwater Plan

The RLWD provided numerous opportunities for the respective agencies to provide review and comment on the RLWD's Overall Plan. Where possible, the RLWD will try to provide opportunities for the various resource agencies to implement their programs when the RLWD is implementing a FDR project. These partnership opportunities will be facilitated through the mediation process and the established project teams (PTs).

In addition to the input the various agencies had in the development of the overall watershed plan, each agency administers programs that impact water resources management. The programs with the greatest potential to impact water resources management by the RLWD are summarized in Table 6. The agencies should be contacted directly for a complete program description.

The Flood Damage Reduction Mediation Agreement of 1998 was developed and intended to be the framework for a collaborative approach to implement both FDR and natural areas protection and enhancement in the Red River Basin on chronic, flood-prone areas identified by local watershed organizations.

3.3.6 Groundwater Quality

The role of the RLWD in this area will be to review data gathered by other agencies and data compiled by the RLWD. New water quality information in the RLWD is being accumulated by the MDH, MPCA, USGS, MnDNR and the SWCD with their analysis of public water supplies. The RLWD will strive for coordination of a groundwater data management program. The

RLWD's role will involve an annual review of the data gathered by other agencies during the current year and assisting industry and agriculture people in siting new facilities. The aforementioned activities are not intended to supersede the authority or responsibility of other agencies, but to deal with locally sensitive projects before they are extensively developed.

Table 6
Programs that Impact Water Resources Management

Agency	Program	Synopsis
MnDNR	Land Use Management (shoreland, flood plain)	State-wide land use management standards, implemented by cities and counties. Impact setback, density, ISTS, water quality, etc.
MnDNR	Protected Waters and Wetlands Permitting Program	Issues permits for activities that alter course, current or cross-section of protected waters. Coordinated with other local, state and federal permits.
MPCA	Total Maximum Daily Loads	Data collection, monitoring and analysis. Will result in capitol projects to improve water quality. Opportunity for partnership with RLWD.
MPCA	NPDES Program	Permitting program for construction and land disturbing activities. Self monitoring program for implementation of BMPs to reduce erosion and sedimentation.
BWSR	Wetland Conservation Act	State wetland protection program designed to protect wetlands not regulated by MnDNR or USACE. Coordinated with other local, state and federal actions.
BWSR	Grant and funding programs [Conservation reserve enhancement program (CREP), Wetland Reserve Program]	Programs to idle sensitive agricultural lands and restore wetlands and associated habitat to improve water quality.
USACE	Section 401 and 10 Permits	Water resources permitting programs that regulated fill and excavation in waters of the U.S. and navigable waters. Coordinated with local and state efforts.

3.3.7 Annual Report on Water Quality

An annual water quality report will be prepared by the RLWD staff for the RLWD annual report. A biannual comprehensive water quality report will also be produced beginning in 2004. This report will include the statistical analysis and water quality modeling conducted using RLWD long-term monitoring data. Without this type of accounting and compilation of data, it is unlikely the abatement plan would be dynamic and adaptable. The report will summarize, specifically, the five major areas of the abatement plan, the planning for the subsequent years and will describe changes needed to fine tune the Overall Plan, based on the data and conclusions of the previous year's work. Reports will also be produced for any special water quality projects, including intensive monitoring, erosion control projects and any studies conducted by the RLWD. Copies of all reports are available at the RLWD office and posted on the RLWD website (www.redlakewatershed.org).

Some of the data analysis conducted for this report includes the creation of histograms and time series plots using Microsoft Excel, data censoring by simple substitution and the calculation of annual loads by the Flux modeling program. Comparisons are made among sites based on mean concentrations, EPA standards and minimally impacted values. Water quality data is interpreted for the identification of problems, impacts, trends and patterns. The RLWD water quality program will produce biannual comprehensive reports of results from its long-term monitoring program. Additional information on water quality is found in Appendix 7.

3.3.8 Impaired Waters and Total Maximum Daily Loads

The MPCA is the state agency responsible for protecting Minnesota's water quality. Every two years an updated list of impaired streams and lakes is published. This list can be found on the MPCA website at http://www.pca.state.mn.us/water/tmdl/index.html.

There are a number of rivers, streams and lakes within the RLWD that are listed on the MPCA Clean Water Act Section 303(d) List of Impaired Waters. Most of these impairments are discussed within the subwatershed sections of this Overall Plan (Section 7.0). These "impaired" waters do no meet water quality standards and pose risks to people, aquatic life and recreation. They contain too much sediment, bacteria, mercury, phosphorus and other contaminants. There will need to be a continued effort from local, state and federal interests to meet the challenge of addressing these impaired waters. Appendix 6 is included as an example for development of total maximum daily loads (TMDLs) in the Red River Basin.

3.3.9 Water Quality Improvement Projects

In addition to monitoring water quality, the RLWD will pursue the implementation of projects that will improve water quality, habitat and provide other natural resource enhancements. Studying the rivers and lakes is essential for understanding the locations and sources of water quality problems. However, studies and monitoring programs should be balanced with implementation of projects that will actually create improvements in water quality, habitat, etc. The Clearwater Nonpoint Study and other studies have recommended various projects for improving and protecting water quality. Cost-share funding through state, federal and non-profit grants will be sought for these projects. These projects could include streambank stabilization, grade stabilization, riparian buffer, wetland restoration, public education, stream restoration and Best Management Practice (BMP) implementation projects. Special studies (by the RLWD as well as other agencies) and the RLWD long-term monitoring program will be used to target priority areas and needs for water quality improvement project implementation.

4.0 Economic Development

4.1 LAND USE

The largest acreage of cropland is in the Grand Marais subwatershed. Clearwater River subwatershed contains the largest acreage of pasture land and the largest forest acreage is in the Red Lake River subwatershed. The area in lakes is rather large, occupying approximately 8.2 percent of the RLWD. Table 2 gives a breakdown of the various land uses within the RLWD. The U.S. Census Bureau and State of Minnesota Department of Employment and Economic Development have a wealth of statistics related to population, employment, income and activities within the RLWD (Appendix 9).

4.2 AGRICULTURE

Agricultural production plays an extremely important role in the RLWD. Approximately 41 percent of the RLWD is in cultivation. Due to geomorphology, the predominance of agricultural production lessens from west to east within the RLWD. Important crops produced include wild rice, beans, corn, wheat and some livestock production (Figure 12).

4.3 FORESTRY

Forestry is another important industry within the RLWD, ranking close behind agriculture and industry in importance. Approximately 30 percent of the RLWD's land cover is forested and the alignment of forested land tends to be inverse to cultivated land. (Figure 12).

4.4 INDUSTRY

Major industrial employers within the RLWD include Artic Cat, Digi-Key and American Crystal Sugar. There are also numerous other small business located within the RLWD including grocery and retail, commercial and other light industrial activities.

4.5 RECREATION AND TOURISM

The RLWD offers great opportunities for many kinds of recreation including fishing, camping, hunting, wildlife viewing, canoeing, tubing, cycling, water sports and winter sports. Waskish, on Upper Red Lake, is the center for some of the best crappie and recovering walleye fishing in the nation. A state forest campground, with public access to Upper Red Lake, is located there. Good fishing at the other lakes also attracts many tourists.

Parts of three state forests, Beltrami Island, Pine Island and Koochiching, are located in the RLWD and provide habitat for moose, elk, deer, bear, wolves, coyotes and small game birds. In the fall, the northern and eastern parts of the RLWD become a mecca for a large number of hunters. The Thief Lake Wildlife Management Area (WMA) and the Agassiz NWR provide ideal habitat for the production of migratory waterfowl. Many different species of birds and other wildlife live in these management areas. Both areas are open to controlled deer hunting and Thief Lake is open to controlled hunting of waterfowl in the fall.

There are some resorts on the lakes in the RLWD that provide swimming, boating, water skiing and other facilities. In the communities along the Red Lake River are groups concerned with the quality and accessibility of the river. These groups are focusing on cleaning and improvement of the access, safety, trails and shoreline.

4.6 WILDLIFE REFUGE AND MANAGEMENT AREAS

4.6.1 Agassiz National Wildlife Refuge

Agassiz NWR was established in 1937 as Mud Lake NWR. The Refuge was renamed in 1961 for the shallow depressional lake plains formed by Glacial Lake Agassiz. The NWR lies in the aspen parkland transition zone between the coniferous forest to the north and east and the tallgrass prairie to the south and west. The original focus of the Refuge was on waterfowl. Over the years other migratory birds and year-round resident wildlife have received an increasing emphasis in NWR management.

Agassiz NWR is located in the eastern Red River Valley, an area of relatively flat terrain and a gentle gradient averaging 1.5 feet per mile, sloping east to west across the NWR. The major threat of flooding at Agassiz NWR is the result of spring runoff following wet winters and spring rains. Flooding is one of the key issues affecting the NWR's habitat and facilities. Sedimentation deposition from erosion off adjacent farm lands and ditch systems discharging into the NWR are other factors affecting the NWR pools, wildlife habitat and water quality.

Agassiz's 61,500 acres includes 26 impoundments and three lakes. These diverse habitats provide a haven for many wildlife species. The refuge supports over 280 species of birds, 49 species of mammals, 12 species of amphibians and nine species of reptiles.

The NWR is administered by the USFWS, a branch of the Department of the Interior. The goal of the USFWS is to conserve and enhance the nation's fish and wildlife populations and their habitats.

The refuge is located in northeastern Marshall County, 23 miles northeast of Thief River Falls.

4.6.2 Thief Lake Wildlife Management Area

The Thief Lake WMA covers 55,000 acres and encompasses a variety of habitat types. The WMA includes MnDNR Division of Fish and Wildlife acquired lands, dedicated consolidated conservation lands and trust fund lands.

Thief Lake, located 38 miles northeast of Thief River Falls, is located in northeastern Marshall County. The lake covers 7,100 acres at normal pool level and is approximately 5 miles long and 3 miles wide. The average water depth is 3 feet. Approximately 3,000 acres of the lake is in a sanctuary, while the remainder is open to the public, with four major boat launches and camping areas. The Moose River enters the lake from the east, and the Thief River is the outlet to the west. A dam at the outlet controls the water level, and the normal summer pool is 1158.5 feet msl.

The MnDNR's Division of Fish and Wildlife manages this WMA, as well as the Eckvoll and Elm Lake WMAs discussed below.

4.6.3 Eckvoll Wildlife Management Area

The Eckvoll WMA is in eastern Marshall County, 31 miles northeast of Thief River Falls, and nine miles west of Grygla. It is adjacent to the Agassiz NWR. Bisected by the main stem of Judicial Ditch 11, the area consists of 6,440 acres of mostly tax-forfeited land.

Approximately 50 percent of the area is open, primarily wetland, consisting of cattail, cane and sedges. Brush, largely willow and aspen, make up the bulk of the remaining cover types. An estimated 300 acres of open water type marsh is located on the north side of Judicial Ditch 11.

This management area produces and supports a high wildlife population, including such major species as moose, deer, ruffed grouse, sharp-tailed grouse and waterfowl. Many other mammals and birds make use of the area for at least a portion of the year. The area will be managed both as a wildlife production and staging area, as well as for public hunting and wildlife viewing.

4.6.4 Elm Lake Wildlife Management Area

The Elm Lake WMA is in eastern Marshall County, 9 miles northeast of Thief River Falls. The area consists of 15,543 acres. It adjoins the south boundary of Agassiz NWR.

Approximately 75 percent of the area is open wetland consisting of marsh vegetation. The higher land is mainly brush with some open areas of grass, legumes and scattered woodlands.

This WMA produces and supports a high wildlife population including such major species as moose, deer, ruffed grouse, sharp-tailed grouse and waterfowl. Fur-bearing animals are common in the area.

Farmes Pool Impoundment, which lies within Elm Lake WMA, was designed to help with flood control, drainage and wildlife benefits, with funding of up to $1.5 million, funded by Ducks Unlimited, to be used toward the establishment of this project.

4.7 RED LAKE INDIAN RESERVATION

The RLWD maintains a cooperative working relationship with the Red Lake Band of Chippewa Indians. As the RLWD moves forward with projects, it will make every effort necessary to involve the Red Lake Band of Chippewa Indians very early in the planning effort, including in the creation of PTs, for any project involving potential effects to, or in the vicinity of, Red Lake Nation lands.

5.0 Historic Flood Problems

Since early European settlement, flooding has been the principal water resource problem in the Red River of the North Basin. The basin is particularly susceptible to severe flooding due to its flat topography and the northward flow direction of the Red River. When the river overtops its channel banks, vast areas of flat adjacent land become inundated. During spring snowmelt, the thaw generally begins in the southern reaches. The northern reaches of the river, normally frozen for a longer period, inhibit the northward flow and can thus aggravate the flooding problem.

The catastrophic flood damages over the years represent a substantial burden to the local, regional and national economy. In view of this flooding problem, in 1976 the Minnesota State Legislature passed legislation allowing the existing watershed districts to join together in a common effort under a Joint Powers Agreement. The Red River Watershed Management Board (RRWMB) was formed to plan, develop and manage the water resources to reduce damages from flooding.

The Watershed Law in Minnesota (Chapter 103D) was comprehensive enough to embody the intent and purpose without amendment. Therefore, the watershed districts were the logical choice among existing governmental units to initiate the task of flood flow and damage reduction.

Presently, RRWMB's members consist of the following eight watershed districts:

- Bois de Sioux Watershed District
- Joe River Watershed District
- Middle River-Snake River Watershed District
- Red Lake Watershed District
- Roseau River Watershed District
- Sandhill River Watershed District
- Two Rivers Watershed District
- Wild Rice Watershed District

The Red River of the North is the only major North American river flowing north. This fact, combined with other regional characteristics of its 23 tributaries in both Minnesota and North Dakota, makes flooding in this river basin a very complex phenomenon with a high frequency.

Past efforts in dealing with the flooding problem concentrated solely on the effects of single projects on local areas or sub-basins, but neglected the overall basin-wide objective. USACE, SWCDs and others have constructed impoundments, dams, levees, channels and other flood control structures in an attempt to alleviate the flooding problem. Unfortunately, these efforts are developed for a specific area and can result in inadequate consideration of the basin-wide effect of these structures on FDR. As a result, it is likely that certain areas may not realize the full potential of FDR, which might otherwise be attainable had it been possible to coordinate them under a management plan. The process of seeking prompt solutions to meet the water resources needs is also hampered by the fact that the basin crosses several political boundaries.

The RRWMB acts as a central coordinating and funding agency for members of the eight watershed districts in the Red River of the North Basin in Minnesota. The RRWMB assumes a leadership role necessary for the proper and efficient water resources planning, development and management.

5.1 HISTORIC FLOODS

The major flood of 1950 at Crookston was caused by runoff from snowmelt followed by a prolonged rainfall. A peak flow of 20,400 cubic feet per second (cfs) was reached on April 23, 1950. The stream flow receded to 11,000 cfs and increased again following moderately heavy precipitation. The river crested on May 7, 1950 with a peak discharge of 27,400 cfs. The volume of flow at Crookston in excess of the channel capacity was 406,700 ac-ft, equivalent to nearly 3 inches of runoff from the 2,550 square miles of drainage area below the Upper and Lower Red lakes. In Crookston, the low-lying residential areas were flooded. Most of the business district did not sustain flood damage due to a higher elevation of the area.

The flood in April 1965 was caused by heavy rainfall on frozen soil. It produced a crest stage at Crookston exceeding the 1950 flood peak stage. Urban flood damage at Crookston and East Grand Forks was lessened by successful emergency protective measures and levees constructed following the 1950 flood.

In 1966, a severe blizzard occurred in early March depositing a thick blanket of snow with a high water content over most of the Red River Basin. At Crookston, the peak flow of 21,500 cfs occurred on April 3, 1996 and a peak stage only 1.3 feet lower than the record 1950 flood resulted. A sudden siege of freezing weather during the peak runoff period, together with the massive emergency protective measures, which included raising and strengthening existing levees and blasting a large ice jam, prevented catastrophic damages at Crookston.

Flooding of the Red Lake River happened again in the spring of 1967. The snowmelt produced a peak flow of 18,300 cfs at Crookston. Sandbagging low areas and other emergency measures resulted in only minor urban damages at Crookston and the communities along the Red River.

Another flood occurred in April 1969. An inch of rain fell after the melting snow, which contained an average water equivalent of 5 inches. The Red Lake River crested at 1.5 feet above the 1965 previous high stage at Crookston. The peak flow was 28,400 cfs (provisional) on April 12, 1969

The situation at Crookston was extremely critical, as the high flood stage was not forecast until two days prior to the time of the flood crest. Thus, the city had only two days to raise the existing flood barriers, primarily with sandbags, to prevent inundation of one-half of the residential area. Through tremendous local efforts by hundreds of volunteers, about $3.6 million in damages were prevented.

In 1969, serious flood losses were experienced along the Red Lake River and its tributaries. The very large flood volume from the Red Lake River contributed substantially to the 1969 record flood of the century on the Red River at Grand Forks, East Grand Forks and the extensive farming area further downstream.

Other damaging floods at Crookston occurred in 1897, 1919 and 1962. There was also flooding in 1974, when a reading of 15,000 cfs occurred. In 1978, the flood record shows a reading of 15,300 cfs, and in 1979, a reading of 20,500 cfs was recorded. There have been other floods in the 1980s and early 1990s and then the historic flood of 1997 (25,000-27,000 cfs) which fundamentally changed the landscape of many cities within the entire Red River Valley.

The 1997 spring flooding along the Red Lake River and the Red River of the North broke most existing flood records in Minnesota. The Federal Emergency Management Agency's (FEMA) estimate of public infrastructure damage in Minnesota from the flood was approximately $300 million. Total flood damages and associated economic impacts were estimated to be as high as $2 billion.

5.1.1 Contributing Climatic Conditions to 1997 Flood

❖ Heavy autumn precipitation.

Much of Minnesota received 6 or more inches in late October and November, 1996.

Many areas received 4 or more inches above normal.

Most of Minnesota was in the 95th percentile (a one in 20 year event).

❖ Extraordinary winter snowfall.

Much of Red River and upper Minnesota River basins received over 6 feet of snowfall.

- Some areas had over 8 feet of snowfall.
- Many areas received two to three times the average snowfall.

Over 40 percent of Red River Basin (Minnesota portion) and uppermost reaches of Minnesota Basin were in 99th percentile (near or exceeding record snowfall).

- Two-thirds of the Red River reach was in the 99th percentile.
- Historically, no greater area of the Red River Basin has ever been in the record snowfall category in any past season. 1996-97 snowfall exceeded 1896-97 (severe Red River flooding a century ago) snowfall by 25-50 percent in much of the Red River Basin (Minnesota portion).
- Less than 10 percent of the basin was covered by the record snowfall in 1896-97.

❖ Less than ideal snowmelt scenario.

There were few mid- and late winter melting days.

Large temperature fluctuations occurred in early April.

- Up to 10 degrees above normal in first week of month.
- Up to 20 degrees below normal in second week of month.

❖ Heavy early spring precipitation

Two or more inches of precipitation (rain and snow) fell in western Minnesota April 5-6, 1997.

Normal monthly April precipitation amounts to approximately two inches for the region.

5.2 EXISTING MEASURES FOR FLOOD DAMAGE REDUCTION

The cities of Crookston and East Grand Forks are in the process of having federal flood control projects constructed by the USACE. In addition, in response to the historic floods of 1997, many farmstead ring dikes, acquisition and relocations and small community flood control projects have been constructed and implemented in an effort to clear floodplains and reduce flood damage potential. In accordance with the mediation agreement, all future FDR projects will be developed by a PT with an eye for multiple objectives and benefits.

6.0 Resource Management Strategies

FDR 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 FDR and environmental enhancement. These opportunities will be explored with the Mediation Agreement related PT whenever the RLWD begins to implement a project.

A key component of the planning process and future project development will involve utilizing a watershed-wide hydrologic model to assess and develop alternatives and solutions to water management problems in the RLWD.

The RLWD held numerous meetings of the TAC/CAC to identify FDR and NRE issues and opportunities. The tables in Appendix 1 and Appendix 2 represent a compilation of the top ranked (1, 2 and sometimes 3) priority action items for FDR, water quality, erosion and natural resources from an overall watershed perspective and by subwatershed. These action items represent some of the top priorities for the RLWD to address in the upcoming decade. The complete rankings are found in Appendix 5.

Stream flow in the lower and middle portions of the RLWD are 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 are a less noticeable problem affecting the riverine environment and limiting related recreational and economic development opportunities. The water quantity goal of the RLWD is to reduce damaging flood flows and, to the extent practical, convert high peak flows to sustaining base flows.

Stream flow 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 been all too common characteristics of historic water management efforts. Avoiding their perpetuation requires commitment to an overall plan that is based on a comprehensive approach to water management.

Solution of the RLWD's stream flow problems is 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 stream flows 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.

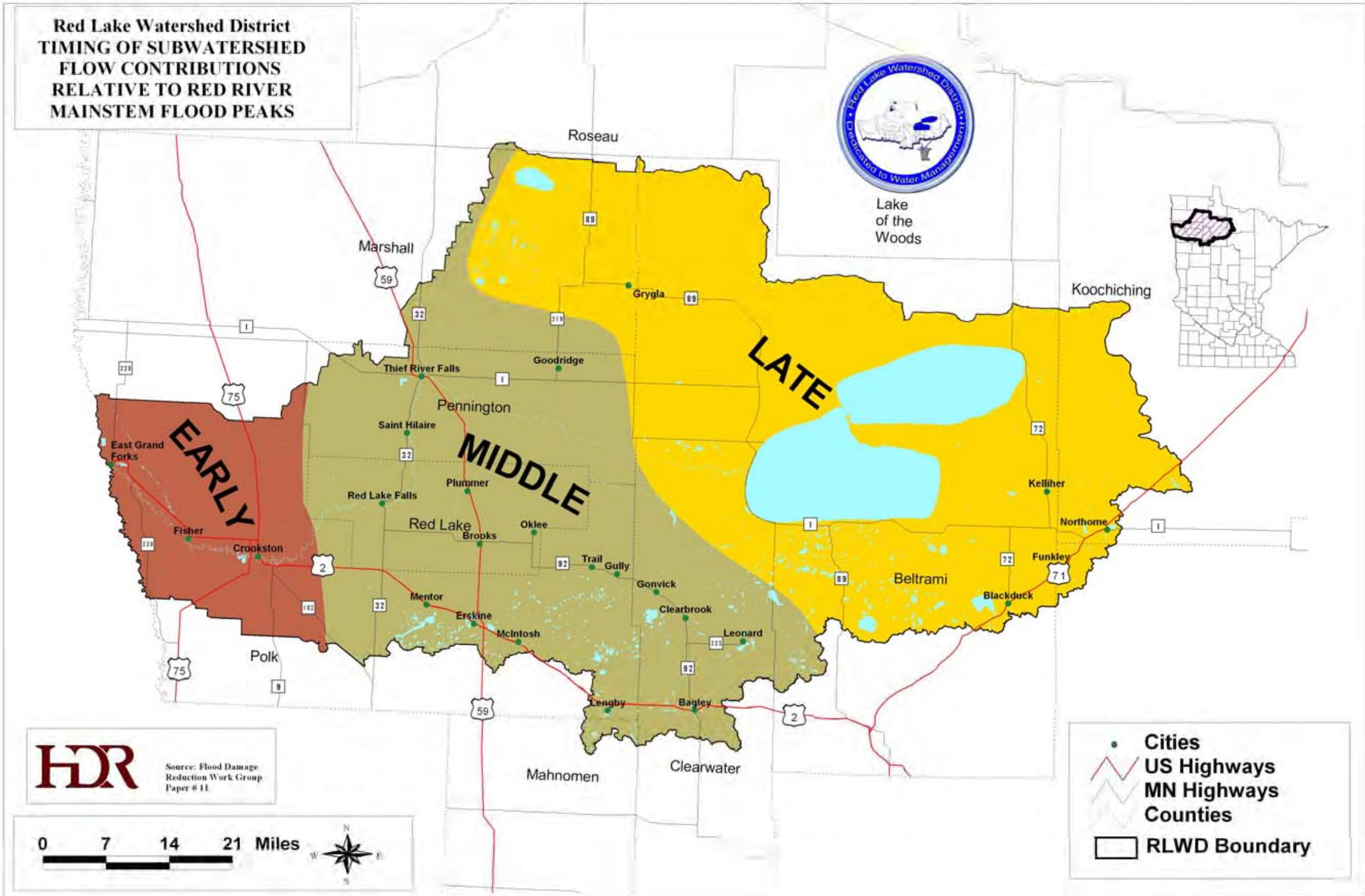
6.1 EFFECT OF FLOOD TIMING

During major flood events, almost all areas of the watershed contribute flood water. 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 FDR measures will depend on the timing of an area's flood water contribution to flooding in other areas of the basin.

For purposes of discussion, we have divided the RLWD into three timing zones shown on the generalized map in Figure 20 and described below. The zones are labeled early, middle and late, based on when water from each area tends to arrive at the outlet of the RLWD.

1. <u>Early</u>. 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. <u>Middle</u>. 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 ahead of the peak. Ideally the timing of flows from these areas could be controlled to allow either early or late release.
3. <u>Late</u>. 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 flood water 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.

Figure 20
Three Timing Zones



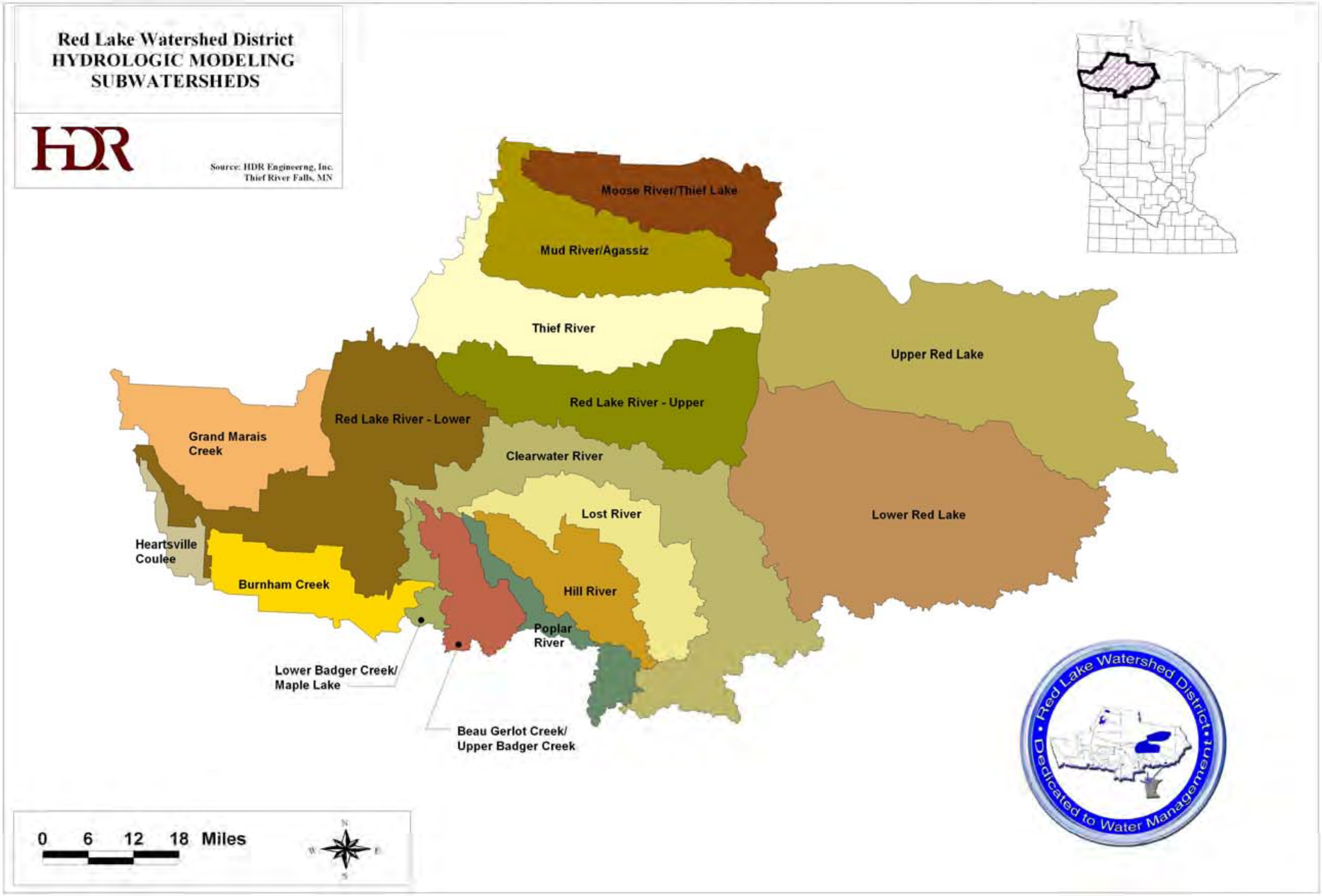
Note that the timing of an area's flood water contribution depends on the location of the downstream damage center being considered. Knowledge of the timing of flows within the RLWD and the Red River Basin continues to be developed based on gage data from actual flood events and by hydrologic modeling. Therefore, the maps shown lack detail and should not be considered final. However, it is evident that for most floods on the Red River, water from the RLWD would be middle or late water. Therefore, from a Red River Basin perspective, FDR measures that store, slow down, or reduce runoff would be the most appropriate. These runoff reduction measures should be located primarily within the middle and late areas of the RLWD.

6.2 HYDROLOGIC MODEL

A hydrologic model has been developed for the entire RLWD as part of the overall watershed planning process. The model will be used to evaluate and investigate possible solutions to RLWD water problems. This model will be used to predict stream flows at a number of predetermined points within each subwatershed for various rainfall events and intensities.

This tool will be extremely useful to the RLWD when analyzing the runoff characteristics of water that originates from snowmelt and rainfall events. The model will be used in flood forecasting, planning and locating sites for impoundments, studying subwatershed areas for the potential to store water in wetlands, analyzing a watershed for culvert sizing, water quality studies and time of travel analysis, sediment loading analysis, analysis of how in place and proposed ditching affects the runoff and many other applications (Figure 21).

Figure 21
Modeling Subwatersheds



6.3 DATA COLLECTION / GIS

Geographic Information Systems (GIS) technology was used where possible, for the collection of data and presentation in an effort to facilitate the plan update process and provide a working tool for future watershed management.

Existing layers of GIS data were used as base data. The accuracy of this data is not always precise, thus it is considered as planning level quality. This existing information is available statewide. Additional data specific to the RLWD was collected and added to the database. This information includes:

- Hydrologic Curve Numbers
- Legal Ditch Systems – All Jurisdictions
- Rain Gage Monitoring Locations
- Protected Waters
- Stream Gage Monitoring Locations
- Soils
- Sub-watershed Delineations
- Climatic Data
- Water Quality

6.4 RLWD HEC-GEOHMS HYDROLOGIC MODEL CALIBRATION

There are 16 separate subwatersheds and 14 separate HMS subwatershed models. The Mud, Moose and Thief River subwatersheds were combined into one HMS model. In order to run the models for the entire watershed district, a Visual Basic application was developed to interactively and systematically run each subwatershed, starting upstream and moving downstream for any particular system analysis, in a Windows environment.

All parameters within the HMS models were developed using publicly available GIS data in Arcview and exported to HMS. Thus, the parameters and how they were developed are consistent at a minimum. All of the models can be run, either individually or as a system. The final piece of the project was to calibrate the model(s), via adjustment of the Clark Method's R value (basin storage). Within the models, this value was arbitrarily set at two, which is regionally appropriate, but should be adjusted accordingly. This is the area where calibration efforts were focused.

The calibration process was as follows:

Select a significant recent rainfall event(s) to calibrate against. Two significant and similar events are May 12-15, 1998 and May 7-10, 1999. The spatial and temporal distributions were different, but the resulting mainstem flows were similar. The 1999 event was chosen as an event to evaluate and compare.

Choose two subwatersheds (and tributary subwatersheds) with a USGS gage near the outlet to calibrate: Mud-Moose-Thief and Clearwater. Clearwater was selected.

Develop the Theissen rain gage weighting ratios for each calibration run. The Theissen polygon method was used to identify where to put our "rain gages," and then determine the gage weighting ratios to apply to each sub-basin in the HMS model. The actual model gage input would be generated from the NEXRAD data in terms of rain depth and temporal distribution.

Based upon these exercises, adjust subwatershed R values in both calibrated and similar non-calibrated subwatersheds as appropriate.

Calibrate the entire system to compare to the Red Lake River flows at Crookston for the stated events.

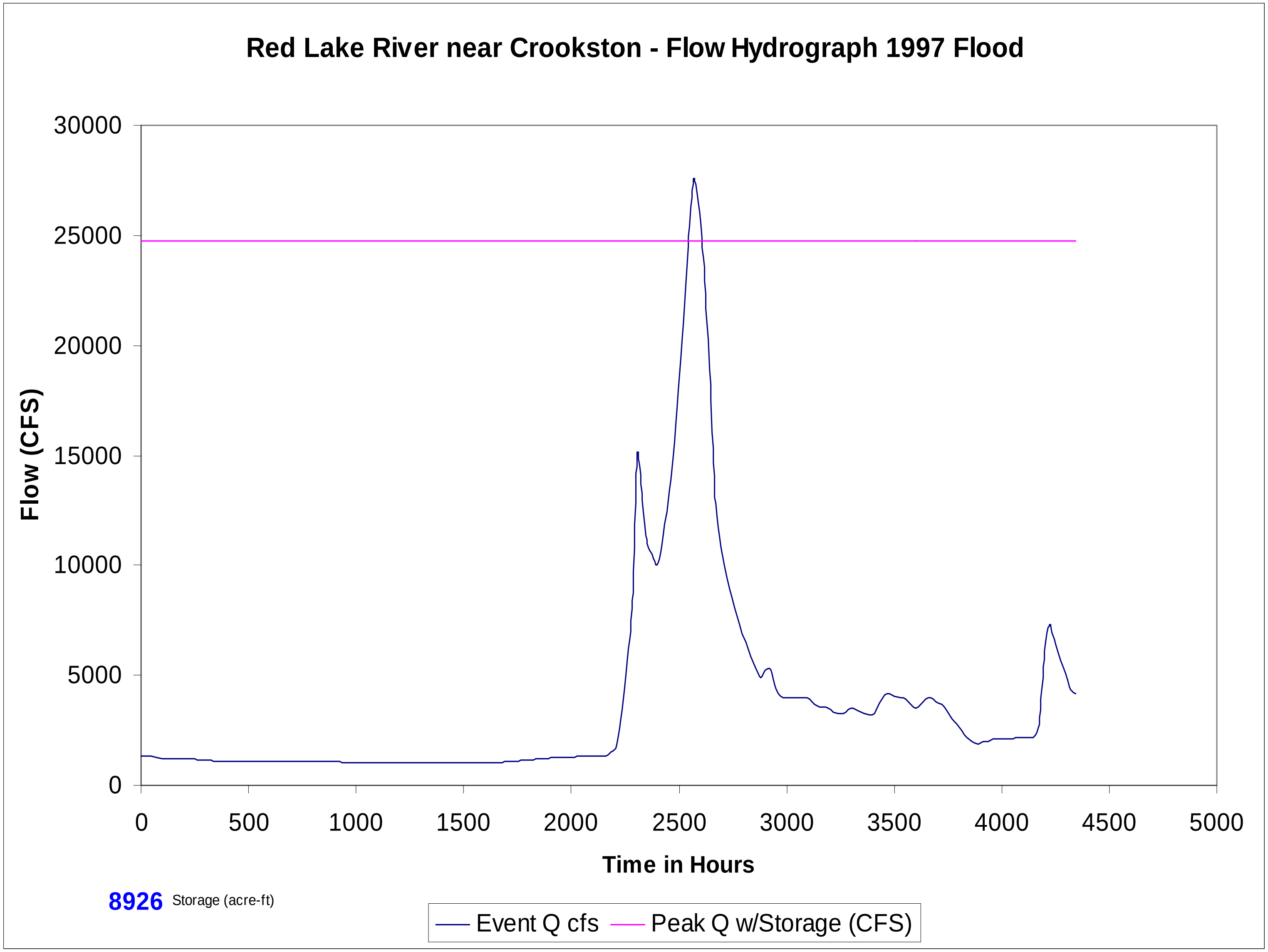
6.5 MODEL RESULTS

In the visioning phase of the planning process, a "reasonable" goal of peak flow reduction on the Red Lake River in Crookston was set at 10 percent. Crookston was selected, as opposed to East Grand Forks, since the USGS gage is located in Crookston. This peak flow reduction goal would be attained by reducing runoff volume using any one of the FDR methods available such as land use changes, impoundments, wetland restorations, etc.

As an example, the 1997 flood hydrograph for the Red Lake River in Crookston (Figure 22) was evaluated by theoretically reducing the peak flow volume by 10 percent. The volume of water in excess of this flow equated to approximately 9,000 ac-ft. Assuming an ideal volume reduction effectiveness factor of three, the resulting volume reduction in the upstream contributing watershed would need to be about 30,000 ac-ft. This increase is due to the limitations of targeting volume reduction/storage to occur exactly at the right time of the proposed peak reductions, much like turning off a faucet. Because this is not realistic, planners must anticipate additional volume reductions are required to achieve specific peak flow reductions. A factor of three is attainable with volume reductions placed in the critical middle contributing areas.

The watershed was modeled as a network of sub-basins, reaches and reservoirs, which are subdivided depending on land use, soils and topography. Additional sub-basins have been or will be developed for areas that have potential projects identified, or for critical damage sites.

Figure 22
1997 Flood Hydrograph



6.5.1 Flood Damage Reduction

Flooding is a major problem within much of the RLWD. This problem is primarily related to geology, topography, weather and land use. The Flood Damage Reduction Work Group (FDRWG) in Minnesota seeks to provide PTs and others with science-based and consensus-based tools to enable more effective FDR within the basin.

A fundamental premise is that FDR along the main stem of the Red River and the lower reaches of its major tributaries (glacial lakebed region) is substantially dependent on the types and locations of FDR and related measures implemented upstream. Flooding in the glacial lakebed region of the basin is substantially affected by runoff timing and volume from upstream areas. Runoff timing and volume are, in turn, substantially affected by the topography, soils, precipitation and land use within different regions of the basin, as well as by the types and locations of FDR and NRE measures that may be implemented. A basin-wide FDR framework is outlined in FDRWG Technical and Scientific Advisory Committee (TSAC) Paper #11, which will better enable a coordinated approach to integrate various FDR and associated NRE measures that are most effective for achieving the overall goals envisioned by the Red River Basin Mediation Agreement adopted in December 1998.

The goal of this framework identified in TSAC Paper #11 is to implement various types of FDR measures individually, or in concert, at locations for which they are best suited to achieve FDR benefits locally and in the watershed, while also contributing to reduction of main stem flooding risk. This framework includes FDR measures that are also NRE measures and promotes multi-purpose projects as outlined below.

There are critical concepts about runoff timing and volume in relation to flood peaks on the main stem of the Red River and facts about variations in topography, soils, precipitation and evaporation within the Minnesota portion of the basin, as foundations for defining the expected peak flow reduction effects of implementing various FDR measures within different areas of the RLWD. Available geologic, topographic, meteorologic and historical flood data, as well as computed runoff travel times, are used to illustrate these concepts and to define “early,” “middle,” and “late” runoff areas within the RLWD.

A wide array of alternative FDR measures are identified, categorized and discussed, including pros, cons and general recommendations for the best areas in which to implement these measures to optimize overall FDR benefits. A summary table is presented for the identified array of FDR measures with ratings of potential for peak flow reduction on the main stem when these measures are implemented in early, middle, or late runoff areas relative to the main stem. It should be noted that there are a number of measures, such as abandonment of flood-prone areas and the retirement of flood-prone lands, that can be implemented within these areas. Such measures should be given careful consideration when evaluating the overall effectiveness of proposed solutions.

6.5.2 Summary of Flood Damage Reduction Measures

FDR measures can be grouped into the four general categories outlined below. These categories and measures are listed here and discussed in more detail in subsequent sections.

- Reduce Flood Volume

  Restore or create wetlands (providing infiltration and evapotranspiration)

  Use cropland best management practices (BMPs) to increase infiltration and evapotranspiration

  Convert cropland to prairie or other types of perennial grassland (e.g., Conservation Reserve Program (CRP) and Reinvest in Minnesota (RIM), to increase infiltration and evapotranspiration)

  Convert land use to forest (forested areas generally have the lowest runoff coefficients, due to high interception and evapotranspiration)

  Other beneficial uses of stored runoff

- Increase Conveyance Capacity

  Channelization (increasing the flow capacity of existing channels or flowages)

  Drainage (creating new or improved conveyance capacity)

  Diversions (of flood waters around a current damage area)

  Setting back existing levees (to restore floodway capacity)

  Increasing road crossing capacity

- Increase Temporary Flood Storage

  Impoundments (with or without a normal pool, to detain water in excess of downstream channel capacity)

  Restored or created wetlands (functioning as impoundments)

  Drainage (to lower surface water and groundwater levels, which increases infiltration and temporary storage in the upper soil horizons)

Culvert sizing (to increase temporary storage by widespread metering of runoff close to its source)

Setting back existing levees (to restore floodplain storage areas)

Overtopping levees (to utilize diked floodplain storage capacity when critically needed)

- Protection/Avoidance

  Urban levees

  Farmstead levees

  Agricultural levees

  Evacuation of the floodplain (removing people and flood-prone facilities and converting to more flood-compatible land uses)

  Floodproofing

  Flood warning and emergency response planning

Many projects will combine two or more of these methods. Specific application of each method is dependent on design and location.

- Reducing runoff volume is always beneficial, especially if done in the middle and upper parts of a watershed.
- Increasing flood storage is most beneficial in the middle and upper parts of a watershed.
- Increasing conveyance is most beneficially done in the lower parts of a watershed.
- Protection measures are most beneficially applied in the middle and lower parts of a watershed.

Many of these methods have been used extensively throughout the RLWD. Most still have application as part of future FDR projects. The challenge for watershed district managers is to develop projects containing one or more of these methods while adhering to the flood damage and natural resource protection goals and principles established by the working group. Similarly, the challenge for natural resource managers, especially in the Red River Basin, is to incorporate FDR goals to the greatest extent possible in their development and operational plans.

6.5.3 Flood Damage Reduction Strategies

Accomplishing the broad FDR described above will require consideration of a full range of structural and non-structural strategies. Specialized strategies such as adequate flood warning systems and ring dikes will help prevent loss of human life and damage to farm structure, homes and communities. Meeting other goals will require strategies that reduce overland flooding, provide storage and/or maintain or provide adequate conveyance. The work group agreed that a combination of strategies may be needed to maximize the effectiveness of any particular strategy. These strategies potentially include:

- Wet Dams

  A dam constructed to maintain a permanent pool of water while providing temporary storage of stream flows for flood control. It may also provide wildlife habitat and recreation.

  Can be designed with gated or automatic draw-down control outlet structures.

  A constant source of inflow is needed for pool maintenance.

  A management plan incorporating downstream predicted peak-flows is essential to maximize FDR potential.

- Dry Dams

  A dam constructed for temporary storage of stream flows during flood events.

  Can be designed with gated or automatic draw-down control outlet structures.

  Duration of designed storage depends on downstream channel capacity.

  A management plan incorporating downstream predicted peak-flows is essential to maximize FDR potential.

- On-stream Storage

  A structure placed across the cross-section of a stream's topography causing flood flows to form a pool.

  Utilizes existing landscape features to maximize control capability.

  May cause alterations to pre-project plant communities in a summer storm event.

  Allows for control of flows from entire watershed above the point of construction.

- Off-stream Storage

  A storage structure placed adjacent to a water course to receive diverted flood flows.

  Potential for construction and effectiveness dependent on the area topography.

  Allows for maintaining a free-flowing stream in non-flood flow conditions and can ensure a stream flow during flood events.

  Duration of storage can be extended to ensure maximum downstream benefits.

  Allows for control of flows from entire watershed above the point of construction.

Note: On/off stream storage can have either gated or un-gated outlet controls. With gated storage the project's management plan can adapt to future conditions. With fixed draw-down features, the release of stored water is pre-determined.

- Flood Storage Wetlands

  An outlet control structure is constructed on previously drained wetland which may contain a permanent pool.

  Some natural wetland functions can be restored and maintained.

  Can reduce the runoff from a watershed's contributing area in direct relation to the size of the temporary pool created thereby reducing downstream discharges.

  Secondary goals may be wildlife enhancement, water quality improvement, stream flow stabilization, provide infiltration for groundwater recharge and reduce erosion.

- ❖ Wetland Restoration

  Wetlands restored to pre-drainage hydrology and appropriate native vegetation.

  May provide flood storage benefits based on hydrologic setting, outlet configuration and antecedent moisture conditions.

- ❖ River Corridor Restoration

  The area adjacent to a stream is restricted to non-rotational farming practices or within a city is designated as a green belt and zoned against building activity.

  Effectiveness based on degree of flow control accomplished.

  Can be effective in reducing streambank erosion and downstream sediment deposition.

  Provide a haven and travel route for wildlife.

  Reduces downstream flow velocities and allows for restoration of natural ecosystem.

  May provide additional floodplain storage during flood events.

- ❖ Setback Levees

  Levees (dikes) are built parallel to and a reasonable distance (e.g., meander belt width) away from water courses to contain flows and increase riparian storage of above-bank flows.

  Can prevent flooding of adjacent land and resulting cross-country sheet-flooding.

  May increase downstream flows by removing traditional routing and storage.

  May create an impediment to drainage of adjacent land and minor watershed outlets.

- ❖ Riparian Buffer Strips

  The land adjacent to streams is permanently seeded/planted to appropriate vegetation.

  Reduces erosion and filter runoff from affected land.

  Reduces cropland losses by taking land out of annual production.

  Provides a haven/travel corridor for wildlife and access for stream maintenance.

- Dredging and Channelization

  Channel modification or removal of accumulated sediment to increase channel capacity.

  May increase downstream flows.

  May reduce flooding due to increased channel flow efficiency and timing of discharge.

  Disrupts stream ecology and equilibrium and may cause downstream erosion and sedimentation.

- Storage Easement

  Compensation is paid to landowners for the public or private benefit of storing water on their land.

  Offsets lost land value do to required land use change.

  Provides and incentive for project development where needed.

- Retirement of Land

  Converts land from agricultural production to permanent vegetation.

  Reduces surface runoff during and/or after precipitation storm events.

  Significantly reduces erosion of soil from affected area.

  Provides for wildlife habitat.

- Land Use

  Land use changes may alter downstream flows.

  Increased areas of intensively cultivated crops may increase storm event runoff.

  Land use changes are influenced by economics and federal, state and local policy.

  Flood plain land uses compatible with periodic flooding may accomplish FDR.

- Best Management Practices

  A practice or combination of practices that are determined to be the most effective and practicable means of treating a resource problem at levels compatible with environmental quality goals.

- ❖ Gating Ditches

  Adjustable controls are placed on culverts in channels to regulate stream flow.

  Topography of the affected area determines the technically appropriate control used.

- ❖ Culvert Sizing

  Graduated sizing of culverts within a ditch system to provide a degree of control.

  Equity is an important consideration.

  The smaller the drainage area is, the more effective culvert sizing can be in accomplishing meaningful, effective control.

- ❖ Drainage

  Modification of the hydrology of the land by providing drainage-ways to convey surface or subsurface water from cultivated or occupied areas.

  Water conveyed by drainage of agricultural land in the higher elevation areas of a watershed may increase downstream flows.

In Table 7, FDR measures are rated in terms of appropriateness for local and downstream FDR, based on location in the watershed in relation to timing of runoff to the main stem. A plus sign (+) indicates application of a particular FDR measure would normally have a positive effect downstream on the main stem of the Red River or the lower reaches of its major tributaries (i.e., it would result in a reduction in downstream peak flows). A minus sign (-) indicates a likely negative effect on downstream flooding, and a zero (0) indicates a likely insignificant effect on downstream flooding. Double plus signs (++) and double negative signs (--) indicate more substantial positive or negative effects on downstream flooding.

Table 7
Expected Peak Flow Reduction Effects on the Red River Main Stem of FDR Measures Applied in Early, Middle and Late Areas Upstream

Flood Damage Reduction Measure	Early* Upstream Area	Middle* Upstream Area	Late* Upstream Area
1) Reduce Flood Volume	+	++	++
a) Wetlands	+	+	++
b) Cropland BMPs	+	++	++
c) Conversion to grassland	+	++	++
d) Conversion to forest	+	++	++
e) Other beneficial uses of stored water	+	++	++
2) Increase Conveyance Capacity	+	-	--
a) Channelization	+	-	--
b) Drainage	+	-	--
c) Diversion	+	Variable	-
d) Setting back existing levees (to increase conveyance capacity)	+	-	--
e) Increasing bridge capacity	+	-	-
3) Increase Temporary Flood Storage	Variable	++	+
a) Gated impoundments	+	++	++
b) Ungated impoundments	-	+	+
c) Restored or created wetlands	-	+	+
d) Drainage	-	+	++
e) Culvert sizing	-	+	+
f) Setting back existing levees (to increase floodplain storage)	+	++	+
g) Overtopping levees	++	+	Variable
4) Protection/Avoidance	Variable	Variable	Variable
a) Urban levees	-	-	-
b) Farmstead levees	-	-	-
c) Agricultural levees	-	-	-
d) Evacuation of the floodplain	-	-	-
e) Floodproofing	-	-	-
f) Warning and emergency response	-	-	-

**Location of FDR measure relative to the Red River main stem at the international border*

In order to achieve this peak flow reduction of 10 percent, each subwatershed was assigned a portion of the goal to achieve the net result downstream. In accordance with the hydrologic model, the following subwatersheds were evaluated using these volume reductions in order to achieve the goals.

- Thief River: 10,000 ac-ft
- Clearwater River: 10,000 ac-ft
- Red Lakes: 0 ac-ft (currently gate controlled)
- Upper Red Lake River: 5,000 ac-ft
- Lower Red Lake River: 5,000 ac-ft
- Grand Marais: 5,000 ac-ft (does not contribute to Crookston)

6.5.4 Environmental Considerations

A range of environmental issues should be considered when investigating FDR projects. The types of projects outlined previously in this section can have negative and beneficial effects on natural resources. In general, projects at sites that displace or eliminate quality habitats should be avoided in favor of projects at sites that include features that connect, restore and/or rehabilitate quality habitats. Projects at sites that offer multipurpose opportunities for both FDR and NRE are most likely to be permitted and funded. Several existing impoundments within the RLWD are good examples of multipurpose projects that provide both FDR and NRE (e.g., Thief Lake WMA, Agassiz NWR, Moose River). The Red River Basin FDRWG Technical and Scientific Advisory Committee has produced several reference documents to consider when investigating FDR projects (See Technical Paper 11, Technical Paper 13, and "A Users Guide to Natural Resources Efforts in the Red River Basin" in particular).

As a part of prioritizing issues for overall watershed implementation, the CAC compared the various FDR and NRE categories to each other with the categories receiving the most points being perceived as the highest priority for the RLWD to address. The overall FDR and NRE rankings are as follows:

Table 8
Flood Damage Reduction Rankings

Overall Watershed Flood Damage Reduction Rankings (Total Points)	
Flood Damages	14
Flooding	12
Drainage	10
Stream Flows	8
Lake Levels	6
Groundwater	4
Other Flood Damage Issues	2
Drought	0

Table 9
Natural Resource Enhancements Rankings

Overall Watershed Natural Resource Enhancements Rankings (Total Points)	
Erosion and Sedimentation	10
Water Quality	8
Fish and Wildlife Habitat	6
Water Based Recreational Activities	4
Unique Water/Land Related Issues	1
Other Natural Resource Issues	1

A multiple objective management strategy additionally 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 must 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 a project. A systems perspective is consequently imperative to address fully the integration of flood control and NRE.

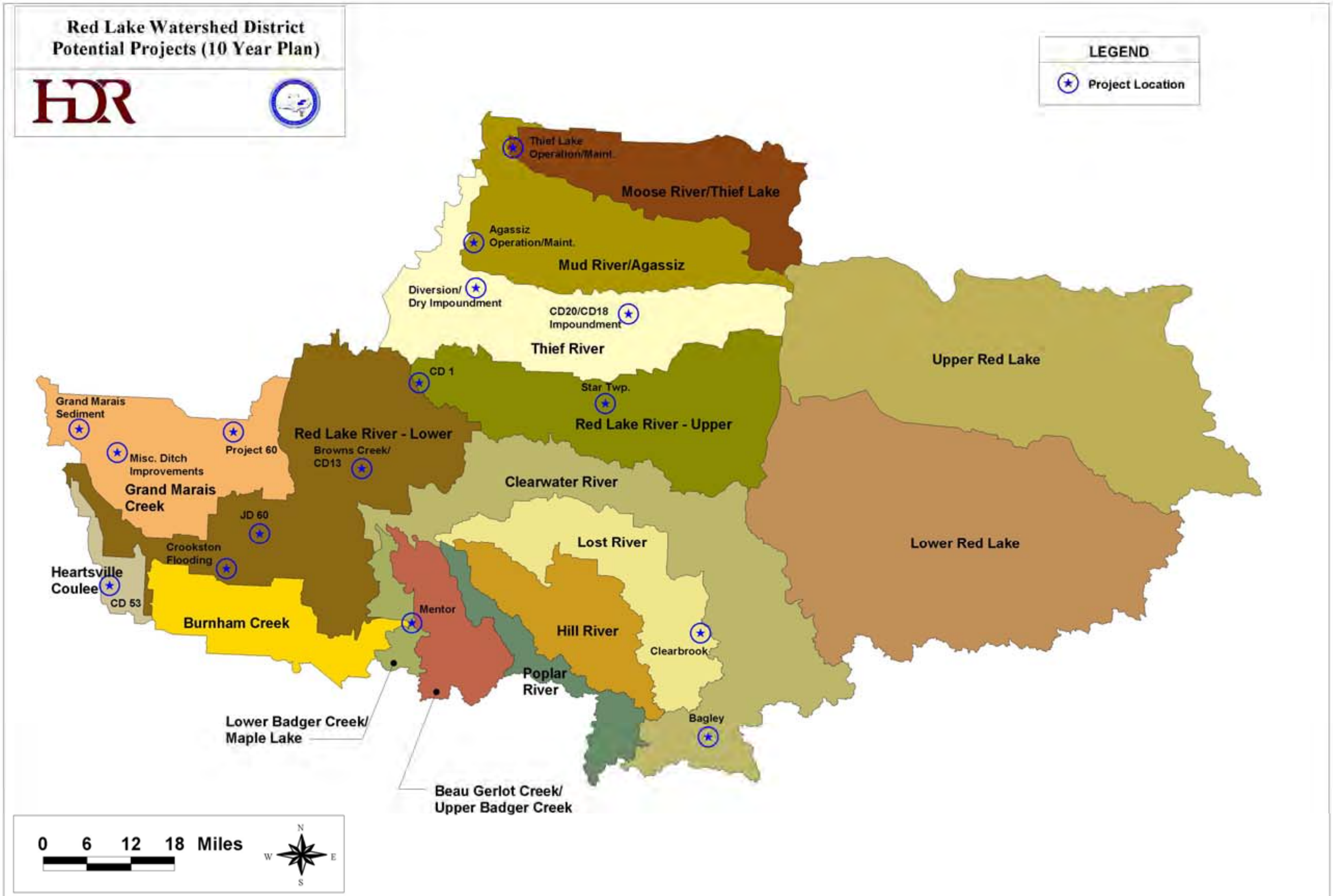
6.6 OVERALL WATERSHED FDR AND NRE VISION, GOALS AND OBJECTIVES

Any flood mitigation program first requires a clear and quantitative definition of the flooding problem. Identification of where, when, how long and extent of the flood impacts are basic to beginning the development of a flood control program within the given watershed. The RLWD held numerous meetings of the TAC/CAC to identify FDR and NRE issues and opportunities (Appendix 1 and Appendix 2). The issues identified by the TAC/CAC were used to develop implementation strategies for the plan subwatersheds for FDR and for the entire watershed for NRE issues. A multiple objective management strategy additionally 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 must 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 a project. A systems perspective is consequently imperative to address fully the integration of flood control and NRE.

Based on these goals, the potential projects that have been identified for FDR appear in Figure 23. The project locations shown in Figure 23 are conceptual in nature and not intended to describe a specific project location.

Figure 23
Potential Projects



6.7 VISIONING WORKSHOP RESULTS

To develop a greater sense of watershed purpose, agency and community buy-in, the RLWD conducted a series of workshops to establish an overall mission statement for the watershed and then developed specific visioning statements for each of the major areas of concern including water quantity and quality, erosion and natural resources. The vision statements were intended to reflect the consensus of the joint TAC/CAC as to the desired future condition for the watershed in each specific area of outcome. Workshop results are presented for each of four issue areas: 1) Water Quality, 2) Water Quantity, 3) Erosion and 4) Natural Resources, separately below. Some groups developed ideas in addition to vision and goals, and the natural resources group developed subwatershed specific goals. The additional ideas and subwatershed goals are all presented below. <u>The visions and goals will be used as the basis for determining the final visions and policies in the watershed plan.</u> The various additional ideas will also be considered in the formation of objectives, policies, strategies and actions of the plan (Appendix 8).

6.7.1 Water Quantity

The science and engineering behind FDR projects has evolved greatly over the last several decades and especially since the original formation of the RLWD. It is now widely recognized and accepted that FDR 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 FDR and environmental enhancement. These opportunities will be explored with the FDR PT whenever the RLWD begins to find a solution in a problem area. To this end, the Water Quantity Subcommittee recommended the following vision statement be adopted by the RLWD to address water quantity:

6.7.1.1 The Vision: We envision a reduction in flood damages with active cooperation and education of constituents and public partners.

Goal 1: Reduce peak flows from the Red Lake River at East Grand Forks and Crookston by 10 percent, and reduce corresponding flood stages by approximately 1 foot.

Goal 2: Reduce runoff volume contributing to peak flows by 30,000 ac-ft.

Goal 3: Special projects – Actively seek and identify projects to implement based upon problems identified by stakeholders.

Goal 4: Educate **–** Develop an outreach program that promotes an understanding of the policies and activities of the RLWD.

***Goal 5*:** Floodplain – participate in floodplain management programs affecting urban and agricultural areas.

6.7.2 Water Quality

The goals of the RLWD water quality program include the evaluation of water quality, identification of pollution sources, water quality improvement and public education. The means of achieving these goals may vary depending upon the purpose of the monitoring being conducted. The RLWD monitoring program consists of a long-term monitoring program, special studies and investigative monitoring. Other organizations within the RLWD are also collecting water quality data. These include high schools involved in the River Watch program, the Red Lake MnDNR, the MPCA and Soil and Water Conservation Districts. The RLWD intends to work closely with other natural resource professionals in order to coordinate monitoring efforts and share information. The Red River Basin Monitoring Advisory Committee and the Red River Basin Water Quality Team are two groups that facilitate this cooperation among agencies. To this end, the Water Quality Subcommittee recommended the following Vision Statement be adopted by the RLWD to address water quality:

6.7.2.1 The Vision: We envision that there will be measured improvement in water quality in the majority of district water bodies through increased knowledge in location and sources of problems with the RLWD, improved public education, interagency cooperation and project implementation.

Goal 1: Increased knowledge of sources that cause water quality problems

<u>Potential Policies, Objectives, Strategies and Actions:</u>

Increased knowledge: Intensive, major subwatershed-based water quality studies (like the Clearwater Nonpoint)

Lower Red Lake River

Thief River

Increase investigative monitoring

All the RLWD

Increased number of long-term monitoring sites and increased frequency (monthly vs. quarterly)

Improved lake water quality data

Studies (Maple, Pine, Cameron, Bartlett)

TMDL studies, involvement in Best Professional Judgment groups

Timely submission and sharing of data and results

Begin new tile drainage studies

Goal 2: Improve Public Education

Potential Policies, Objectives, Strategies and Actions:

Renew and expand river watch project

Improve the RLWD's website

Develop educational materials (phosphorus, etc.)

Updates

Conduct more outreach and workshops

Lake associations

Water quality monitoring

Improve the quality of RLWD reports

Understandable

Annual/Bi-Annual

Encourage organization of lake associations

Encourage RLWD coalition of lake associations

Find more opportunities to educate groups

Goal 3: Improve Interagency Cooperation

Potential Policies, Objectives, Strategies and Actions:

RRWMB Water Quality Team

RRWMB Monitoring Advisory Committee

TMDL studies

Increase involvement in the state's assessment of waters (every two years)

Increase involvement in TMDL study committee

Promote improved sharing of data

Coordinate monitoring networks

Continue to actively promote FDR workgroups

Work together/cost share on specific projects

Work with other agencies and groups to create educational opportunities

Goal 4: Improve Project Implementation

Potential Policies, Objectives, Strategies and Actions:

- Complete Phase II of Clearwater Nonpoint Study (Clearwater Watershed Initiative)
- Identify funding for water quality improvement projects
- TMDL projects/implementation
- Lake Management Plan creation
- Implement recommendations of water quality studies
- Specific projects
- Erosion control on rivers and lakes
- Address dissolved oxygen/sediment/phosphorus reduction projects in Thief River subwatershed
- Maple Lake phosphorus reduction
- Riparian buffer strips/BMPs
- Lake restoration projects
  - Cameron
  - Bartlett
- Stream bank/corridor restoration

6.7.3 Erosion

Throughout the identification of issues, the RLWD TAC/CAC identified sedimentation as a major issue facing the RLWD. The sources of sediment are many and include bank erosion and wind and water erosion from agricultural lands. The agricultural erosion appears to be an "easier" problem to solve through education and implementation of BMPs, such as filter strips and no-till residue management. The RLWD hopes to achieve a reduction in erosion and sedimentation through a partnership with local, state and federal funding agencies.

The other larger part of the sedimentation problem is bank erosion. The RLWD recognizes the importance of this problem and that this is actually a more costly problem that will take many years to "fix." The magnitude of the bank erosion problem is beyond the financial and technical capabilities of the RLWD to address individually and will require local, state and federal partners. To this end, the Erosion and Sedimentation Planning Subcommittee recommend the following vision statement be adopted by the RLWD to address erosion and sedimentation.

6.7.3.1 The Vision: We envision a RLWD that will have a reduction in the delivery of sediment to district water bodies and drainage systems through enhanced interagency cooperation and public education on erosion causes and effects.

Goal 1: Reduced agricultural erosion

Goal 2: Decreased sediment to lakes, streams, rivers, drainage systems

Goal 3: Increased use of agricultural BMPs

Goal 4: Increased public understanding

Goal 5: Increased interagency cooperation

Goal 6: To be cost effective and to leverage to the extent practical limited resources.

<u>Potential Policies, Objectives, Strategies and Actions:</u>

Identify sediment sources as bank or field erosion

Support erosion reduction activities of other entities

Coordinate sediment reduction efforts of those in watershed

Educate about causes and effects of erosion leading to sedimentation

Implementation of sediment reducing practices

At some point, break down by region

Additional Erosion Issues and Discussion Points:

- No ditch authority over last mile on systems that outlet into natural draws that deliver sediment to river.
- Sedimentation is the watershed's major concern (not the source).
- The sources of this sediment are many. Some sources (bank erosion) are costly to correct.
- Bank erosion progression worsens moving west across the RLWD.

6.7.4 Natural Resources

Prior to development, the landscape of the RLWD contained as diverse a mix of habitat as any in the Red River Basin. This landscape included a mosaic of prairie, wetlands, peatlands, woodlands and shrublands, with networks of streams coursing throughout that supported an abundance and diversity of fish and wildlife resources. Much of this landscape throughout the watershed has been extensively altered through conversion of native vegetation to agricultural production and through extensive drainage. Drainage activities have created some highly productive agricultural land, but in those areas that are still extensively drained, many of the natural landscape values once present have been lost.

In western portions of the watershed, on the flat lake plain, almost all of the original prairie landscape has been cultivated, and most of the original wetlands have been drained. In central portions of the RLWD, those beach ridge and inter beach ridge areas, many wetlands were drained, and many of the prairie, shrublands and woodlands were converted to cropland in the early and middle 1900s. In many of these areas, land use has once again changed during the past 20 years, and numerous acres of cropland have been converted back to perennial vegetation including prairie, wetlands and woodlands leaving a diverse mix of habitats. In eastern portions of the watershed district, wetlands, shrublands and woodlands and peatlands still dominate the landscape in many areas.

A diverse network of watercourses also exists in the RLWD. The Red Lake River serves as the primary backbone for an entire system of tributary waterways that extend throughout the watershed. These watercourses provide a variety of habitats and conditions that support diverse aquatic communities. In western portions of the watershed, the Red Lake River and its tributaries are low gradient habitats with pools and runs. In central portions of the RLWD, watercourses are relatively high gradient and provide diverse habitats that are particularly important for species like walleye. In eastern portions of the watershed, watercourses range from low gradient headwater streams running through bogs to moderate gradient streams similar to those in the beach ridge area. These watercourse have changed substantially over the years. Some have been channelized, some have lost their riparian corridors, some have been impounded and others remain relatively undisturbed.

The hydrology of all watercourses has also changed due to land use and drainage. This has contributed to channel instability, high peak flows and extended periods of low or no base flow. Numerous fish and wildlife lakes are also present in the RLWD.

Among these lake resources, land use changes, including agriculture and commercial/residential development and the resulting increased potential for eutrophication, have become an issue of concern.

The current landscape of the RLWD presents tremendous opportunities to maintain and enhance the quantity and quality of terrestrial and aquatic habitats that will continue to support diverse and abundant fish and wildlife populations on public and private lands. The vision for the future of the natural resources in this watershed includes blocks of quality grassland, wetland, shrubland and woodland habitats that can sustain diverse populations of wildlife. It includes stable reaches of diverse stream habitats and lake habitats that can sustain diverse populations of fish and aquatic life, and it includes functional connections between many of these habitats.

The following goals, objectives and strategies will help achieve this vision. <u>In most cases, natural resource agencies and private landowners in cooperation with natural resource agencies will be responsible for achieving these watershed goals.</u> The RLWD is expected to support the recommendations described here when they are implementing projects within the RLWD. Agencies encourage the RLWD to reference the natural resource maps in this plan as they implement watershed projects.

6.7.4.1 The Vision: We envision a RLWD with a quantity and quality of habitats that function to sustain diverse and healthy fish and wildlife populations and provide abundant recreational opportunities.

With this vision in mind, special attention should be given to the unique natural resource characteristics and opportunities in this large watershed with a mix of public and private lands with diverse habitats, numerous watercourses and Minnesota's largest lakes. Cooperation among the diverse range of users and managers is essential to maintaining and enhancing these resources.

Goal 1: Maintain existing quality habitats (watercourses, wetlands, lakes, grasslands, brushlands)

Goal 2: Enhance the quality of existing habitats (watercourses, wetlands, lakes, grasslands, brushlands)

Goal 3: Increase the quantity of quality habitats

Goal 4: Educate folks on the functions and value of existing fish and wildlife habitat with inference to how it can be compatible with FDR.

Goal 5: Support recreational use of resources, subwatershed goals

7.0 Management Framework

This section presents the management philosophy and framework for the RLWD. The framework is organized into six distinct planning subwatersheds for implementation purposes (Figure 1). Basic characteristics of the subwatersheds are described in Table 10.

Table 10
Planning Subwatershed Characteristics

Subwatershed	Area (Sq Mi)	Primary Land Uses Characteristcs	Other Characteristics
Upper Red Lake River	457	Consists of a mix of agricultural land, forest, wetlands, urban and grassland.	No lakes. Wetland areas are scattered throughout the area.
Lower Red Lake River	874	Consists largely of agricultural land, but is also made up of forest, wetlands, urban and grassland	No lakes. Wetland areas are scattered throughout the area
Thief River	1068	Consists of a mix of agricultural lands, forest lands and wetlands, with very little grasslands, lakes or developed urban land	Contains seven named lakes. All lakes are shallow. Wetlands throughout.
Grand Marais	317	Consists largely of agricultural land (94 percent), but is also made up forest, wetlands, urban and grassland	There are no lakes in this subwatershed. Wetland areas are scattered throughout the area.
Clearwater River	1362	Consists largely of agricultural and forest land, but is also made up of wetland, urban and grassland	Contains many lakes. 28 are larger than 100 acres and 107 lakes are smaller than 100 acres.
Upper and Lower Red Lake	1,929	Consists largely of forest land, lakes and wetlands, with very little agricultural or developed land.	Contains 86 lakes, 18 of which are over 100 acres

Management priorities, actions, roles and responsibilities are presented separately for each planning subwatershed in the following subsections. This was done for two primary reasons:

1. To make the document easier to use
2. Because of the watershed's overall size and complexity

Appropriate management approaches vary across the watershed because of variations in such things as setting, topography and land use. For example, the northern part of the watershed, north of the Upper and Lower Red Lake and the Red Lake River and the western regions of the RLWD, are rather flat, while other areas have much greater variations in topography. Having a subwatershed planning framework also allows management actions to focus on local basin characteristics, while allowing resources managers and interested parties to quickly find applicable portions of the plan.

There are also significant differences in land use across the RLWD, with the western half being intensively farmed, while the eastern half is primarily grassland, swamps, forests and lake surfaces. The broad soil classifications also vary significantly across the RLWD in a west-to-east direction due to historic glacial activity and the location of glacial Lake Agassiz.

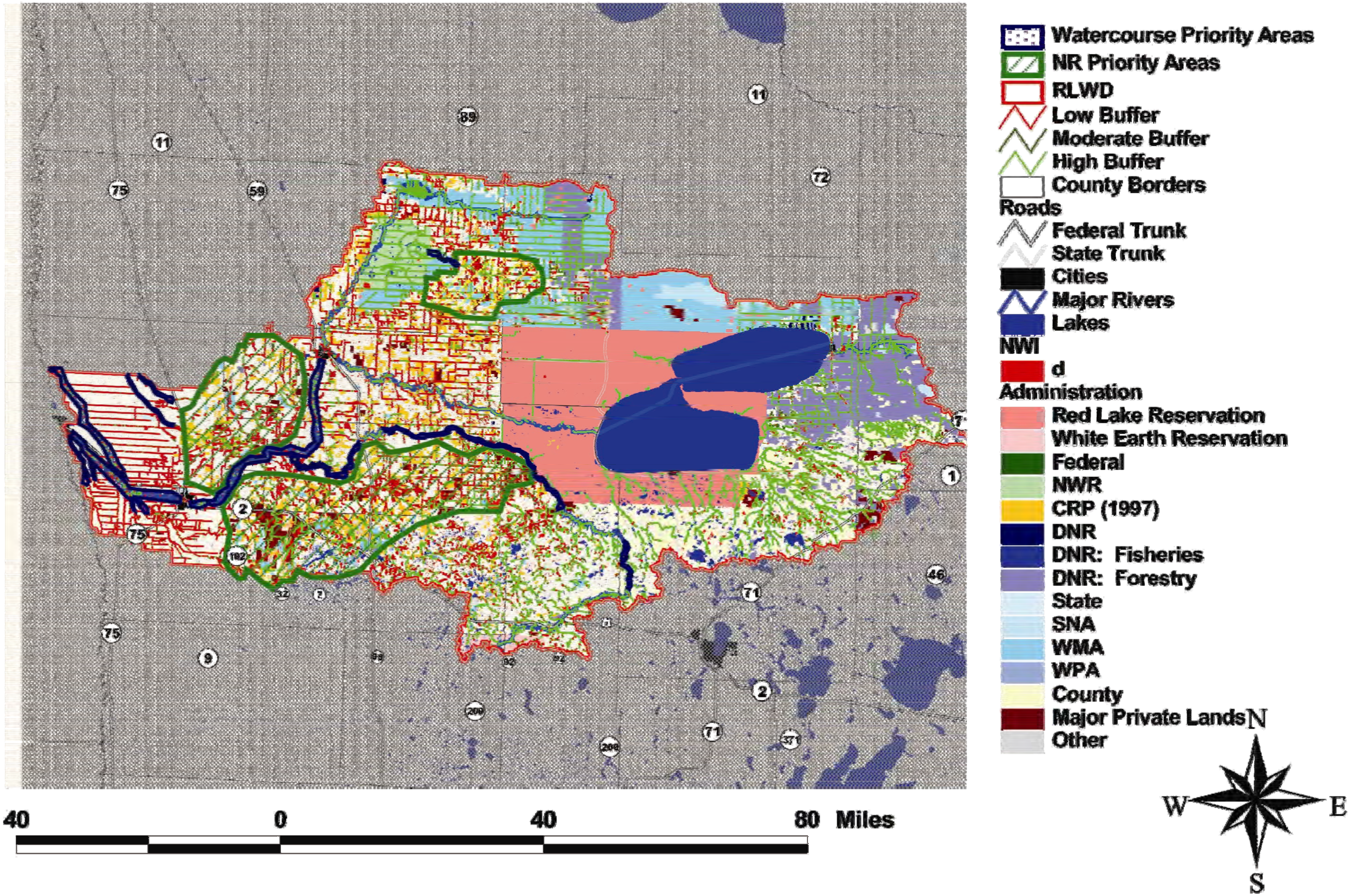
Flood damages and FDR also varies on a sub-basin level. Flooding in the glacial lakebed region of the basin is substantially affected by runoff timing and volume from upstream areas. Runoff timing and volume are, in turn, substantially affected by the topography, soils, precipitation and land use within different regions of the basin, as well as by the types and locations of FDR and NRE measures that may be implemented. A basin-wide FDR framework will better enable a coordinated approach to integrate various FDR and associated NRE measures that are most effective for achieving the overall goals envisioned by the Red River Basin Mediation Agreement adopted in December 1998. In addition, the hydrologic model (described in Section 6.0) uses subwatersheds so that results can be presented and implementation planning completed on a subwatershed basis.

The goal of this framework is to implement various types of FDR measures individually, or in concert, at locations for which they are best suited to achieve FDR benefits locally and in the watershed, while also contributing to reduction of main stem flooding risk. This framework includes FDR measures that are also NRE measures, and promotes multi-purpose projects.

As was discussed in Section 6.0 of the plan, there are critical concepts about runoff timing and volume in relation to flood peaks on the main stem of the Red River, and facts about variations in topography, soils, precipitation and evaporation within the Minnesota portion of the basin, as foundations for defining the expected peak flow reduction effects of implementing various FDR measures within different areas of the RLWD. Available geologic, topographic, meteorologic and historical flood data, as well as computed runoff travel times, are used to illustrate these concepts and to define “early,” “middle,” and “late” runoff areas within the RLWD. This difference in the timing of the delivery of water also is reflected in the identification of the six planning subwatersheds.

In summary, for these and other similar differences in features across the RLWD, it was decided that the implementation activities portion of the plan would be best addressed both in general at a watershed scale and for specifics at a subwatershed scale. The action items and management priorities in the following subwatershed sections reflect a “walk before you run” approach. <u>This means that the subwatershed plans focus on priority issues. These issues and priorities were identified through numerous meetings of the TAC/CAC.</u> The tables in Appendix 1 and Appendix 2 represent a compilation of the top ranked (i.e., numbers 1, 2 and sometimes 3) priority action items for FDR, water quality, erosion and natural resources from an overall watershed perspective and by subwatershed (Figure 24). These action items represent some of the top priorities for the RLWD to address in the upcoming decade. Project and activity implementation tables are found in Appendix 1 and Appendix 2. The complete priority rankings of the TAC/CAC are found in Appendix 5.

Figure 24
Red Lake River Watershed District Priority Natural Resource Areas



7.1 UPPER RED LAKE RIVER SUBWATERSHED PLAN

7.1.1 Introduction

This section presents the implementation plan for the Upper Red Lake River subwatershed (Figure 25). The plan is organized by first presenting a summary of important physical characteristics of the subwatershed. More detailed information is available in Sections 2.0-5.0 and in Appendix 7. The section also identifies the problems related to water management in the subwatershed and describes the proposed solutions in the form of goals and objectives to address these problems.

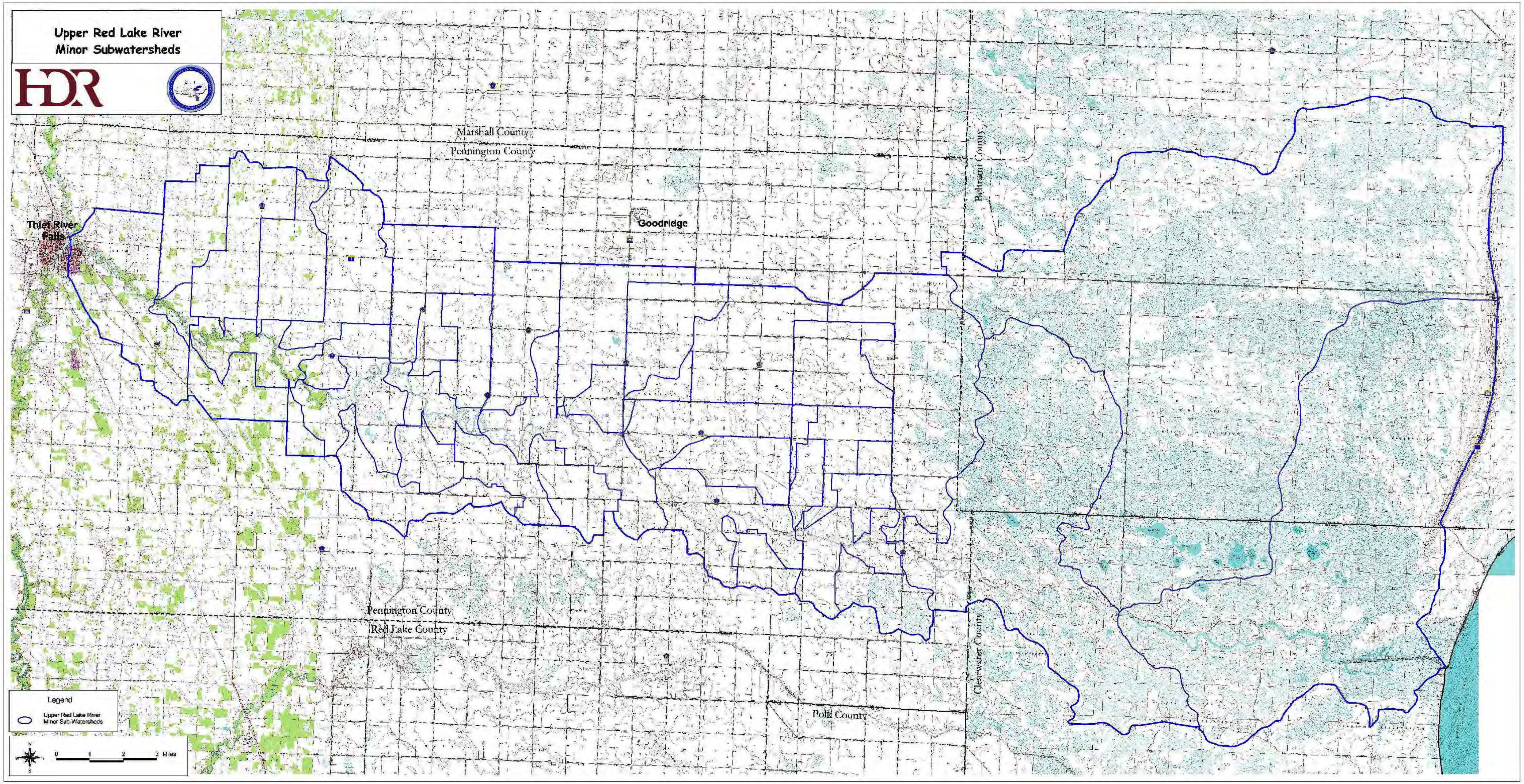
7.1.2 General Physical Characteristics

The Upper Red Lake River watershed consists of an approximately 457 square mile area. The watershed outlets into the Lower Red Lake River at Thief River Falls, and begins at the Lower Red Lake outlet control structure. The watershed is located entirely within the Glacial Lake Agassiz/Aspen Parklands and the Northern Minnesota Peatlands ecoregions. Soil textures range from fine loam in the western portion to coarse loam/sapric in the eastern portion of the watershed. The area consists of a mix of agricultural land, forest, wetlands, urban and grassland.

Table 11
Land Use Characteristics of the Upper Red Lake River Subwatershed

CHARACTERISTIC	AREA
Basin Area (sq mi.)	457
Basin Area (acres)	292,443
Wetland Area NWI (acres)	153,118
MINNESOTA WETLAND TYPE	
1	929
2	86,007
3	1,099
4	1,979
5	1,706
6	23,554
7	32,379
8	5,465
Lakes/Rivers (acres)	2,844
ECOREGIONS OF RLWD (ACRES)	
Lake Agassiz, Aspen Parklands	139,242
Minnesota & NE Iowa Morainal	--
N. Minnesota & Ontario Peatlands	153,201
N. Minnesota Drift & Lake Plains	--
Red River Valley	--
LAND USE (ACRES)	
Cultivated Land	117,023
Forest Land	62,290
Grass/Brushland	11,440
Mines	40
Water	1,815
Developed Land	1,140
Wetlands	98,695
Other	--

Figure 25
Upper Red River Lake Watershed Map



7.1.3 Surface Water Summary

The Upper Red Lake River subwatershed is bordered along its north side by the Thief River subwatershed. All of the drainage from within the smaller subwatersheds ends up in the Red Lake River at various points along the river.

There are no lakes in this subwatershed. Wetland areas are scattered throughout the area. The wetland areas are very dense in the eastern portion of the subwatershed, generally east of the Pennington/Clearwater county line. Many of the wetlands in west portion of this watershed have been altered by drainage for the purposes of agricultural production. The majority of the eastern wetlands have been left untouched. Remaining wetlands have been estimated to be 2-43 percent of pre-settlement extent.

Drainage systems in this subwatershed are a complex network of natural streams and legal ditch systems developed for agriculture. Generally, the ditch systems are under the administration of the county in which they reside or the RLWD. One notable exception within this watershed is the existing multi-purpose Good Lake project which is capable of storing 10,000 acre feet of water. The Good Lake project is sited on Red Lake Nation lands and is under the jurisdiction of the Red Lake Band of Chippewa Indians.

7.1.4 Groundwater Summary

The subwatershed is located in the Lake-Washed Till Plain physiographic area of the Red Lake River Watershed District. The surficial geology of the area is dominated by the lake-washed till. The till is described as a sandy, clay-silt loam containing fine to medium gravel with a scattering of boulders. The till is covered in areas to the west by very-fine to fine-grained, uniform glacial lake sand generally less than 20 feet in thickness. In the eastern portion of the subwatershed, the till is overlain by a thin covering of peat (only a few feet thick) that results from the water table being close to or at land surface, paired with poor drainage in the area. Localized peat deposits are also present in many closed depressions within the till.

Glacial sediment aquifers in the region provide very moderate amounts of groundwater. Suitable yields of 5 gallons per minute (gpm), or more for domestic use, can be found in sand lenses within the till. These lenses are often localized and yields can vary. The aquifer may accommodate municipal or industrial uses, possibly up to 250 gpm in some rare instances. Hardness of the groundwater is commonly greater than 180 milligrams per liter (mg/l).

Paleozoic sediments, consisting of shales and limestones, are discontinuous and underlie the glacial lake deposits along the western side of the subwatershed. Precambrian crystalline rocks underlie the glacial sediments, forming the base of the groundwater reservoir for most of the watershed. The fractured surface of crystalline rocks may provide an adequate supply of groundwater for limited domestic use.

Information regarding the individual city wells, water quality analysis results and the aquifers that serve as the water supply can be obtained from the individual cities and the Minnesota Geological Survey.

7.1.5 Natural Resources Implementation Plan

The Upper Red Lake River subwatershed includes the lands adjacent to the Red Lake River from Thief River Falls to the outlet of lower Red Lake. The western and central portions of this watershed have diverse habitats including agriculture, grasslands, wetlands, brushlands and woodlands. The eastern portion of this watershed, located in the Red Lake Reservation, is dominated by wetlands. Public lands are not common in this subwatershed. Throughout the central and western portion of this watershed CRP lands account for a substantial amount of the habitat. These lands provide a mix of grasslands, wetlands and brushlands and provide seasonal and permanent habitats to a variety of species including game species such as white-tailed deer, waterfowl and sharp-tail grouse. Habitats in the eastern portion of this subwatershed also support moose and bear populations. The areas adjacent to the Red Lake River also provide a habitat corridor with a mix of woodlands, wetlands and pasture.

The Red Lake River is a great stream resource that provides a variety of habitats for many fish species. However, a large portion of this subwatershed has been channelized and the quality of this instream habitat has been substantially reduced. MnDNR fish sampling within the Upper Red Lake River subwatershed yielded a “fair” biotic integrity classification near Highlanding. Downstream dams reduce the productivity and recreational use of this river reach.

Natural resource problems and issues were identified using a questionnaire with resource agencies. Results of this questionnaire and the resource inventory were considered by a natural resources subcommittee. The Upper Red Lake River was identified as an important resource within the region that needs to be recognized and protected. Recreational activities including hunting, fishing, tubing, swimming etc. were all identified as being popular activities. The following are the major goals and actions recommended by the natural resources subcommittee.

7.1.5.1 Natural Resources Problems

- The dam at Thief River Falls eliminates fish passage to the 56 miles of river upstream.
- Stream bank erosion and a lack of buffers along tributary waterways limit habitat in these waterways and increases sediment loading to the Red Lake River.
- The Red Lake River is somewhat limited by its flashy hydrology, extended periods of low flow and sediment loading.
- Excessive snagging and clearing on the Red Lake River can reduce in-stream habitat. Woody debris provides habitat diversity for a variety of species.

7.1.5.2 Improve Fish Habitat in the Red Lake River and its Tributaries

- Support activities that reduce the flashiness and enhance base flows
- Stabilize stream banks in areas of accelerated erosion
- Provide fish passage at Thief River Falls
- Reduce sediment load in streams
- Buffer all watercourses
- Increase the amount of woody fish cover
- Implement agricultural BMPs to reduce wind and water erosion throughout the subwatershed
- Other strategies include improved ditches with side inlets, buffer and grassed waterways, residue management, tree plantings and reduce farming into road ditches

7.1.5.3 Maintain and Improve Wildlife Habitat (indicators could be land base statistics or prairie chicken and sharp-tail population levels)

- Re-establish habitat corridors along the Red Lake River
- Connect existing corridor woodland habitats
- Protect existing grassland habitats
- Identify and protect existing tracts of prairie
- Retain, increase, or implement CRP, Conservation Reserve Enhancement Program (CREP), Wetland Reserve Program (WRP) and CRP acres
- See MnDNR land management plan for some good targets and strategies

- Enhance existing grassland habitats
- Encourage active vegetation management that maintains grassland quality (prescribed burning, weed control, etc)
- Target CRP to increase number of large blocks of grassland habitats
- Protect existing wetland habitats
- Support efforts to retain WRP acres
- Support Wetland Conservation Act (WCA) enforcement
- Enhance existing wetland habitats
- Target wetland restorations in areas near existing restorations
- Encourage active vegetation management that maintains wetland quality (moist soil management, prescribed burning, weed control, etc)

7.1.5.4 Increase Recreational Opportunities

- Support efforts of the Red Lake River corridor project to raise awareness and increase recreational opportunities
- Partner with other groups to highlight existing opportunities
- Wildlife viewing/birding, hunting, trails

The Natural Resource Committee's recommendations were used by the RLWD to develop the following natural resource goals, objectives and specific action items are presented in Table 12.

7.1.6 Water Quantity Implementation Plan

Due to terrain, draining of wetlands for cropland and other land use changes, the Upper Red Lake River subwatershed experiences frequent flooding throughout the subwatershed. Damages associated with this type of flood are to public infrastructure, personal property, cropland and public resources (fisheries, wildlife, soils and water quality). Agricultural flooding and rural, residential damages were identified as the highest priority flooding issues. In addition to projects shown in Figure 23, it is the RLWD's goal to address the following issues with the Upper Red Lake River subwatershed:

7.1.6.1 Upper Red Lake River FDR Rankings

- ❖ Agricultural crop damages.
- ❖ Inadequate agricultural drainage.
- ❖ Residential flooding in spring from Smiley Bridge to Thief River Falls.
- ❖ High landing flooding.
- ❖ City of Thief River Falls water supply.

7.1.6.2 FDR Action Items

1. The RLWD will pursue projects to create additional flood volume reduction and storage projects within the eastern portions of this subwatershed to reduce agricultural and residential flooding.
2. The RLWD will pursue projects that reduce bank erosion and still provide adequate agricultural drainage.
3. The RLWD will respond to petitions and other requests for the ditches that are actively managed by the RLWD. The RLWD will seek partnerships with the county and private landowners to improve the overall coordination and management of the public and private ditch system.
4. The RLWD will partner with member communities to promote projects that protect public water supplies. Table 12 provides a summary list of specific implementation actions for the subwatershed.
5. The RLWD will partner with local, state and federal agencies to implement 5,000 ac-ft of flood volume reduction projects within this subwatershed.

7.1.7 Water Quality Implementation Plan

A number of monitoring sites are located in the subwatershed. These include: a site at the Red Lake Dam, a site at Highlanding Bridge and a site at First Street Bridge in Thief River Falls. The RLWD also coordinates data gathering with other organizations. The RLWD currently coordinates sampling efforts with the MPCA, SWCDs, Red Lake MnDNR, the RRWMB and the Red River Basin Institute.

Water quality monitoring has been done by the RLWD at two sites associated with streams within the subwatershed. Monitoring has been done since as early as 1980 for several parameters, including field measurements for dissolved oxygen, pH, temperature, turbidity, transparency and conductivity. Laboratory analysis is performed on stream samples for fecal coliform, TSS, total dissolved solids, chemical oxygen demand, total phosphorus, orthophosphorus, nitrates and nitrites, ammonia, total Kjeldahl nitrogen, alkalinity, dissolved oxygen, pH, temperature, turbidity, transparency and conductivity. Major locations for sampling include the Red Lake Dam Outlet and the Highlanding Bridge. The RLWD periodically prepares a water quality report, and results are available upon request in the RLWD office. There are no impaired stream reaches, as identified by the MPCA, in this subwatershed.

It is the RLWD's goal to address the following issues with the Upper Red Lake River subwatershed:

The planning process resulted in the following water quality rankings and action items.

7.1.7.1 Upper Red Lake River Water Quality Rankings

- ❖ Need for filter strips along the river and ditches.
- ❖ Turbidity and 303D impairment.
- ❖ Water Quality Assessment and concerns for development.
- ❖ Pasture lands along river and needs for alternate water sources.

7.1.7.2 Water Quality Action Items

1. The RLWD will actively partner with the MnDNR, USFWS, Red Lake Band of Chippewa Indians, USDA NRCS, USACE, MPCA and the SWCDs to seek to implement projects that reduce agricultural and bank erosion and improve water quality.
2. The RLWD will support the efforts of municipalities to identify and protect recharge areas and to improve surface water quality.
3. The RLWD will develop a TMDL implementation program in cooperation with other local, state and federal agencies.

Table 12 provides a summary list of specific implementation actions for the subwatershed.

7.1.8 Erosion and Sedimentation Implementation Plan

Erosion due to storm runoff is a serious problem in the subwatershed. During periods of high runoff, channel erosion causes bank stabilization concerns for this 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. It is the RLWD's goal to address the following issues within the Upper Red Lake River subwatershed:

7.1.8.1 Upper Red Lake River Erosion and Sedimentation Rankings

- River and ditch bank failures.
- Ditches and tributary outlets to channels.

7.1.8.2 Erosion and Sedimentation Action Items

1. The RLWD will seek partnerships with landowners, SWCD and USDA NRCS to implement BMPs that reduce agricultural erosion and slow water down.
2. The RLWD will seek out grant opportunities to conduct an erosion assessment on the entire course of the Red Lake River from the Red Lake outlet on the reservation to the Red River.

Table 12 provides a summary list of specific implementation actions for the subwatershed.

7.1.9 Summary and Conclusions

This section presents an overall watershed management plan and overview of the Upper Red Lake River subwatershed. Goals and objectives for the subwatershed are presented above for the following plan elements: 1) Natural Resources, 2) Water Quantity, 3) Water Quality and 4) Erosion and Sedimentation. Table 12 provides a summary list of specific implementation actions organized by these same plan elements.

Table 12
Upper Red Lake River Subwatershed Implementation Actions

ACTION/GOAL	PLAN ELEMENT	SCHEDULE	CONCEPTUAL COST
Create additional flood storage within eastern portions of subwatershed to reduce agricultural and residential flooding	Water Quantity Action Item	Years 1-5	$5,000,000
Reduce bank erosion and provide adequate agricultural drainage	Water Quantity Action Item	Years 6-10	$300,000
Respond to petitions and other requests for ditches actively managed by RLWD	Water Quantity Action Item	Ongoing	$50,000
RLWD will partner with USDA NRCS USACE MPCA and SWCDs to implement projects to reduce agricultural and bank erosion and improve water quality	Water Quality Action Item	Years 1-5	$100,000
RLWD will support efforts of municipalities to identify and protect recharge areas and to improve surface water quality	Water Quality Action Item	Years 5-10	$10,000
RLWD will seek partnerships with landowners, SWCD and USDA NRCS to implement BMPs to reduce agricultural erosion and slow water down	Erosion and Sedimentation Action Item	Years 1-5	$25,000
RLWD will seek out grant opportunities to conduct an erosion assessment on the entire Red Lake River from the Red Lake outlet on the reservation to the Red River	Erosion and Sedimentation Action Item	Years 5-10	$25,000
Increase number of water quality monitoring sites	Watershed-wide Activity	Ongoing	$5,000
Develop TMDL diagnostic studies	Watershed-wide Activity	Ongoing	$10,000
Initiate TMDL implementation strategies	Watershed-wide Activity	Ongoing	$5,000
Improve District website and education programs	Watershed-wide Activity	Ongoing	$5,000
Reduce streambank erosion	Natural Resource Action Item	Ongoing	$5,000
Install vegetative buffer strips	Natural Resource Action Item	Ongoing	$30,000

7.2 LOWER RED LAKE RIVER SUBWATERSHED PLAN

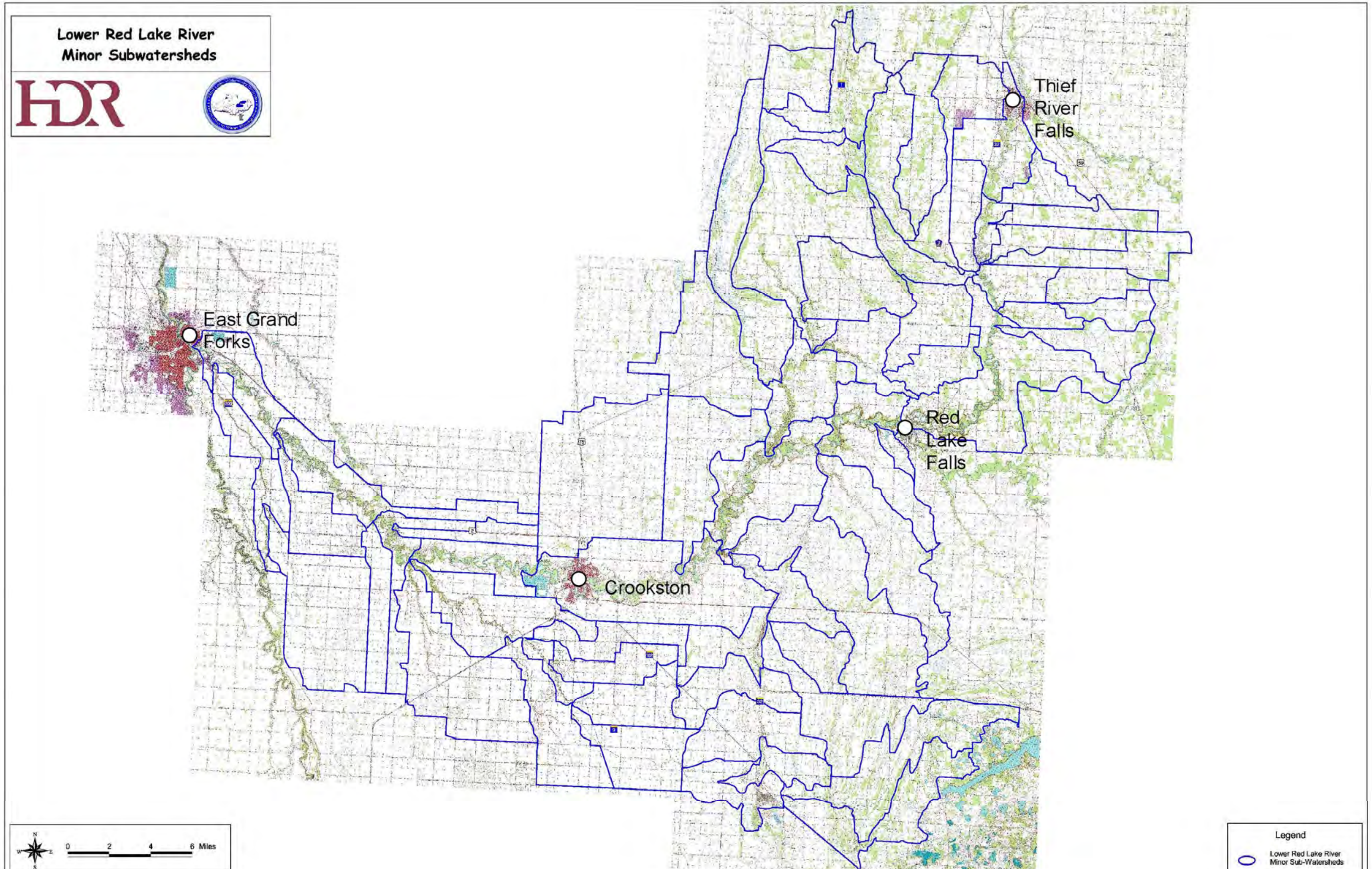
7.2.1 Introduction

This section presents the implementation plan for the Lower Red Lake River subwatershed. The plan is organized by first presenting a summary of important physical characteristics of the subwatershed (Figure 26). More detailed information on the subwatershed is available in Sections 2.0-5.0 and in Appendix 7. This section also identifies the problems related to water management in the subwatershed and describes the proposed solutions in the form of goals and objectives to address those problems.

The Lower Red Lake River planning basin includes the Heartsville Coulee, Burnham Creek and Lower Red Lake River minor subwatersheds. The Heartsville Coulee and most of the Burnham Creek watershed areas are dominated by lands in agricultural production. Small patches of woodland and grassland habitat exist near waterways and along the Red River. These areas provide limited habitat to some species including game species such as white tailed deer. The Lower Red Lake River watershed (generally east of U.S. Highway 9) and eastern portions of the Burnham Creek watershed have more diverse habitats including agriculture, grasslands, wetlands, brushlands and woodlands. Include in these areas are numerous WMAs, waterfowl protection areas (WPAs) and the Nature Conservancy Glacial Ridge project area (~24,000 acres). CRP lands are also common along State Highway 102 (until about 8 miles west of U.S. Highway 9) and in areas along and east of U.S. Highway 9. These lands provide seasonal and permanent habitats to a variety of species including game species such as white-tailed deer, sandhill crane, waterfowl, prairie chicken and sharp-tail grouse. The prairie chicken population has increased dramatically in recent years.

Burnham Creek and Heartsville Coulee provide some seasonal habitat for fish. The Lower Red Lake River provides a diversity of habitats year round. Many tributaries to these streams (natural and ditches) are unstable with large amounts of active erosion. Dams on the Red Lake River at Crookston and Thief River Falls limit fish passage and the potential for this watershed to produce fish. An important historical lake sturgeon spawning bed is located at the confluence of the Lower Red Lake and Clearwater rivers.

Figure 26
Lower Red Lake River Subwatershed Map



7.2.2 General Physical Characteristics

The Lower Red Lake River watershed consists of an approximately 874 square mile area. The watershed outlets into the Red River of the North at East Grand Forks, and begins just downstream of the dam in Thief River Falls. The watershed is located mainly within the Red River Valley and Glacial Lake Agassiz/Aspen Parklands ecoregions. Soil textures range from fine in the western portion of the watershed to sandy loam in the east portion of the watershed. There are two sand ridges west of Thief River Falls along what is commonly termed the Pembina Trail. The area consists largely of agricultural land, but is also made up of forest, wetlands, urban and grassland (Table 13). The following presents a general summary of surface water and groundwater in the subwatershed. The summary is followed by a discussion of the problems, goals and policies and the implementation actions for each of the four plan elements: 1) Natural Resources, 2) Water Quality, 3) Water Quantity and 4) Erosion and Sedimentation.

7.2.3 Surface Water Summary

This subwatershed is also comprised of two minor subwatersheds which outlet into the Red Lake River. They are the Heartsville Coulee and Burnham Creek minor subwatersheds. The Lower Red Lake River subwatershed is bordered along its north side by the Grand Marais subwatershed. The drainage from within the smaller minor subwatersheds ends up in the Red Lake River in the western half of the watershed. The Thief River and Upper Red Lake River subwatersheds are tributaries to the Lower Red Lake River subwatershed in Thief River Falls. The Clearwater River subwatershed is a tributary to the Lower Red Lake River in Red Lake Falls.

Table 13
Land Use Characteristics of the Lower Red Lake River Subwatershed

CHARACTERISTIC	AREA
Basin Area (sq mi.)	874
Basin Area (acres)	559,091
Wetland Area NWI (acres)	349,994
MINNESOTA WETLAND TYPE	
1	1,430
2	18,205
3	5,350
4	138
5	932
6	3,979
7	4,940
8	20
Lakes/Rivers (acres)	4,556
ECOREGIONS OF RLWD (ACRES)	
Lake Agassiz, Aspen Parklands	356,727
Minnesota & NE Iowa Morainal	3,358
N. Minnesota & Ontario Peatlands	--
N. Minnesota Drift & Lake Plains	--
Red River Valley	190,598
LAND USE (ACRES)	
Cultivated Land	456,095
Forest Land	40,927
Grass/Brushland	39,168
Mines	1,901
Water	4,331
Developed Land	7,744
Wetlands	8,882
Other	43

There are no lakes in this subwatershed. Wetland areas are scattered throughout the area. These wetland areas are somewhat denser in the extreme southeastern portion of the subwatershed, generally south of U.S. Highway 2 and east of State Highway 102. Many of the wetlands in this watershed have been altered by farm drainage for the purpose of agricultural production.

Drainage systems in this subwatershed are a complex network of natural streams and legal ditch systems. Generally the ditch systems are under the administration of the county or watershed district in which they reside.

7.2.4 Groundwater Summary

The subwatershed is located in the Lake Plain physiographic area of the RLWD. The surficial geology of the area consists of mainly clay with small regions of silt, sand, sand and gravel ridges and lake-washed till. Clay deposits dominate the Lower Red Lake River subwatershed and are characterized as being very dense, uniform and of low permeability. Thicknesses can range from a few feet in the eastern part of the watershed to more than 120 feet in the western portions. Nearly level topography in this region also relates to poor drainage. Sand and gravel ridges, known as beach ridges from Glacial Lake Agassiz, occur in mainly north-south trending ridges that range in thickness from a few feet to 30 feet in some areas. Drainage is good within the ridges, but can be poor in the inter-ridge areas where deposits of peat are evident. The fine sand or silt deposits in the area are fairly uniform and are underlain by till and clay. Thicknesses for both deposits are generally less than 20 feet. Lake-washed till deposits are described as sandy, clay-silt loam that contains fine to medium gravel with a scattering of boulders. The deposits are generally not well drained.

Glacial aquifers in the region only provide moderate amounts of groundwater. Suitable yields of 5 gpm, or more for domestic use, are mainly found in sand and gravel deposits in the till. Beach ridge deposits are limited in aerial extent and saturation is limited to a few bottom feet. Groundwater supplies from the smaller beach deposits are unreliable due to periods of limited precipitation. Groundwater supply for industrial use and irrigation is generally poor. Quantities and quality for such uses are inadequate. Hardness of the groundwater is commonly greater than 180 mg/l.

Paleozoic sediments consisting of shales and limestones are discontinuous and underlie the glacial lake deposits along the western side of the subwatershed. The western tip of the subwatershed near East Grand Forks contains Paleozoic limestone and sandstone that is thin and discontinuous. Paleozoic deposits contain highly saline groundwater. Precambrian crystalline rocks underlie most of the subwatershed, forming the base of the groundwater reservoir for most of the watershed. The fractured surface of crystalline rocks may provide an adequate supply of groundwater for limited domestic use.

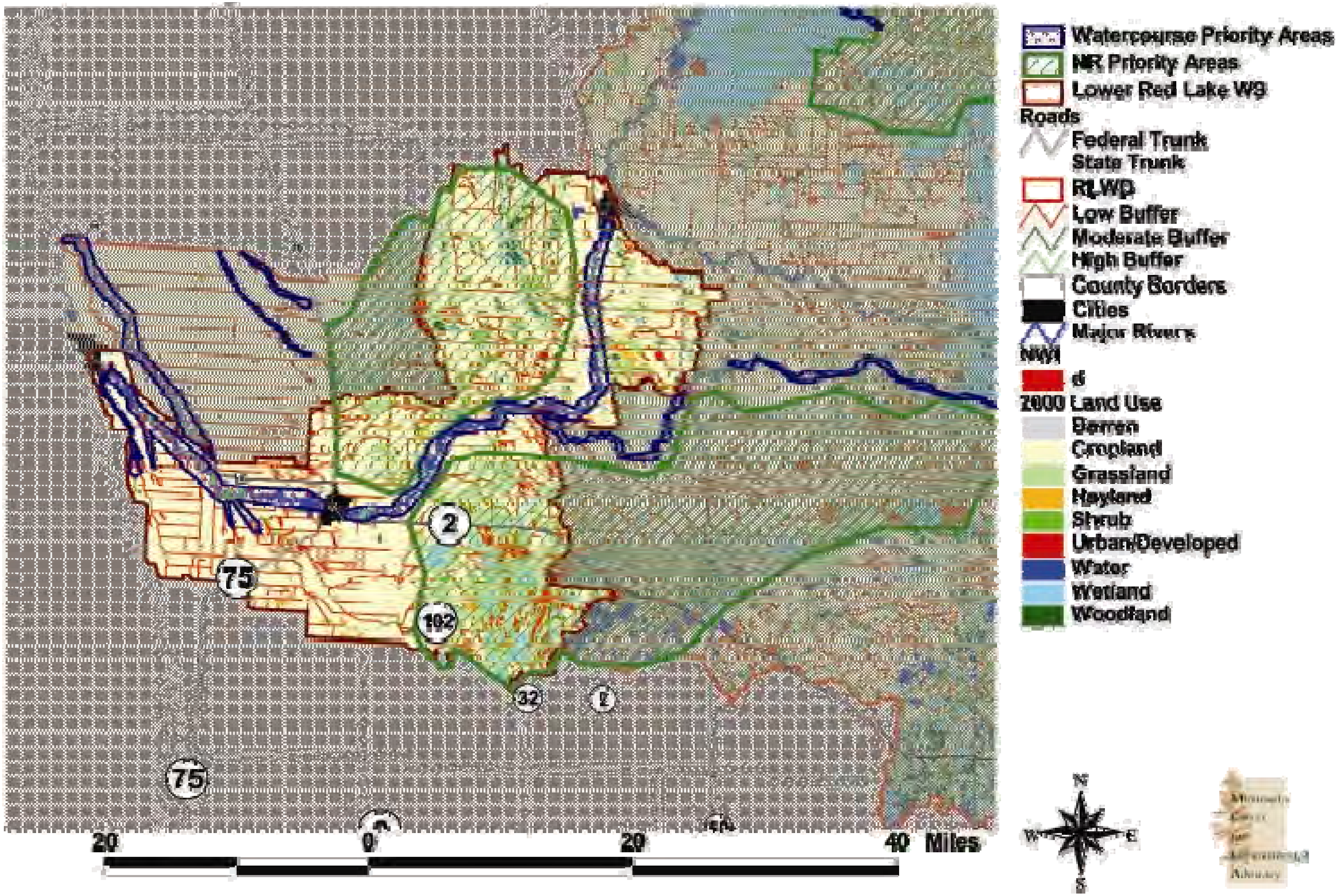
Information regarding the individual city wells, water quality analysis results and the aquifers that serve as the water supply can be obtained from the individual cities and the Minnesota Geological Survey.

7.2.5 Natural Resources Implementation Plan

Natural resource problems and issues were identified using a questionnaire with resource agencies. Results of this questionnaire and the resource inventory were considered by a natural resources subcommittee. The following are the major goals and actions recommended by the Natural Resources Subcommittee.

The Lower Red Lake River was identified as an important resource within the region, a resource that needs to be recognized and protected (see Figure 27). Recreational activities, including hunting, fishing, tubing and swimming, were all identified as being popular activities. The following are the major goals and actions recommended by the Natural Resources Subcommittee.

Figure 27
Lower Red Lake River Priority Natural Resource Areas



7.2.5.1 Maintain and Improve Wildlife Habitat (indicators could be land base statistics or prairie chicken and sharp-tail population levels)

- Re-establish habitat corridors along all major waterways
- Identify key areas and connect existing habitats along the corridors by promoting land use changes. Particularly Heartsville Coulee, Burnham Creek and the Red Lake River
- Connect existing corridor woodland habitats
- Protect existing grassland habitats
- Identify and protect existing tracts of prairie
- Retain or increase CRP acres in those areas that already have considerable amounts of CRP
- See MnDNR land management plan for some good targets and strategies
- Enhance existing grassland habitats
- Encourage active vegetation management that maintains grassland quality (prescribed burning, weed control, etc)
- Target CRP to increase number of large blocks of grassland habitats
- Protect existing wetland habitats
- Support WCA enforcement
- Enhance existing wetland habitats
- Support efforts at Glacial Ridge
- Target wetland restorations in areas near existing restorations. Particularly the high density of existing resources east of U.S. Highway 75.
- Encourage active vegetation management that maintains wetland quality (moist soil management, prescribed burning, weed control, etc)
- Support continuation of WRP

7.2.5.2 *Increase Recreational Opportunities*

- Support efforts of the Red Lake River Corridor project
- Partner with other groups to highlight existing opportunities
- Wildlife viewing/birding, Hunting, Trails
- Increased recreational opportunities near Glacial Ridge NWR and the numerous state lands in the eastern portion of this watershed

7.2.5.3 *Lower Red Lake River Watershed Natural Resource Goals and Objectives*

1. Improve existing riverine habitat conditions
   - Reduce the flashiness of stream flows
   - Stabilize stream banks in areas of accelerated erosion
2. Re-establish habitat corridors
   - Red River
   - Heartsville Coulee, Burnham Creek, Red Lake River
   - Connect existing corridor woodland habitats
3. Reduce erosion and resulting sedimentation in watercourses
   - Implement agricultural BMPs to reduce wind and water erosion throughout the Heartsville Coulee subwatershed, in western portions of the Burnham Creek subwatershed (west of State Highway 102) and in portions of the Lower Red Lake River subwatershed west of State Highway 32
   - Implement agricultural BMPs and land use changes in the eastern portion of the watershed and along the upper reaches of the Red Lake River
   - Stabilize the stream bed and banks on Heartsville Coulee and Burnham Creek, particularly in the lower reaches of these waterways where ditch outlets have accelerated erosion and deposition
4. Protect and enhance existing grassland habitats such as CRP
   - Protect existing tracts of prairie
   - Retain or increase CRP acres in those areas that already have considerable amounts of CRP
   - See MnDNR land management plan for some good targets and strategies

- ❖ Active vegetation management
- ❖ Maintain prairie chicken population

5. Wetland protection and enhancement
   - ❖ East of U.S. Highway 75 (complexes)
6. Protect existing high quality natural resource features
   - ❖ Beach ridge and inter-beach ridge areas
   - ❖ Protect existing tracts of prairie (e.g., Malberg Prairie)
   - ❖ Protect existing wetland complexes
   - ❖ Natural watercourses
7. Improve water quality
8. Increase recreational opportunities
   - ❖ See Red Lake River Corridor project
   - ❖ See Glacial Ridge plan

7.2.6 Water Quantity Implementation Plan

Due to terrain, draining of wetlands for cropland and/or under-designed structures, the Lower Red Lake River subwatershed experiences frequent flooding throughout the subwatershed. Spring flooding is almost an annual occurrence in this watershed. Damages associated with this type of flood are to public infrastructure, personal property, cropland and public resources (fisheries, wildlife, soils and water quality). Agricultural flooding and damages in the City of Crookston were identified as the highest priority flooding issues. In addition to projects shown in Figure 23, it is the RLWD's goal to address the following top priority issues within the Lower Red Lake River subwatershed:

7.2.6.1 Lower Red Lake River FDR Rankings

- ❖ Agricultural crop damages
- ❖ Residential flooding in the North East part of Crookston
- ❖ Bank sloughing in Crookston and Red Lake Falls
- ❖ Judicial Ditch 60 and lateral 4 of Judicial Ditch 60 flooding

- ❖ Overland flooding near Red Lake County Ditch 13
- ❖ Inadequate east-west ditches in the western half of the Lower Red Lake River subwatershed

7.2.6.2 FDR Action Items

1. The RLWD will pursue projects to create additional flood storage within the eastern portions of this subwatershed to reduce agricultural and residential flooding.
2. The RLWD will pursue projects that reduce bank erosion and still provide agricultural drainage.
3. The RLWD will respond to petitions and other requests for the ditches that are actively managed by the RLWD. The RLWD will seek partnerships with the County and private landowners to improve the overall coordination and management of the public and private ditch system.
4. The RLWD will partner with local, state and federal agencies to implement 5,000 ac-ft of flood volume reduction projects within this subwatershed.

Table 14 provides a summary list of specific implementation actions recommended by the TAC/CAC for the subwatershed.

7.2.7 Water Quality Implementation Plan

There are two impaired stream reaches as identified by the MPCA in this subwatershed as of 2004. They include:

- ❖ Red Lake River, Burnham Creek to Unnamed Creek (near East Grand Forks)
- ❖ Red Lake River, Unnamed Creek to Red River

Water quality monitoring has been done by the RLWD at six sites associated with streams within the subwatershed. Monitoring has been done since as early as 1984 for several parameters, including field measurements for dissolved oxygen, pH, temperature, turbidity, transparency and conductivity. Laboratory analysis is performed on stream samples for fecal coliform, TSS, total dissolved solids, chemical oxygen demand, total phosphorus, orthophosphorus, nitrates and nitrites, ammonia, total Kjeldahl nitrogen, alkalinity, dissolved oxygen, pH, temperature, turbidity, transparency, alkalinity and conductivity. The RLWD periodically prepares a water quality report and results are available upon request in the RLWD office.

The MPCA has identified the Lower Red Lake River as an impaired water body due to high levels of turbidity. The watershed will continue to assess the problem and the data available for the next 303D assessment will likely extend the impairment upstream through Crookston. It is the RLWD's goal to address the following issues with the Lower Red Lake River subwatershed:

7.2.7.1 Lower Red Lake River Water Quality Rankings

- ❖ Turbidity and 303D impairment.
- ❖ Source water protection (East Grand Forks).

7.2.7.2 Water Quality Action Items

1. The RLWD will actively partner with the USDA NRCS, USACE, MPCA and the SWCDs to seek to implement projects that reduce agricultural and bank erosion and improve water quality.
2. The RLWD will support the efforts of municipalities to identify and protect recharge areas and to improve surface water quality.

Table 14 provides a summary list of specific implementation actions for the subwatershed.

7.2.8 Erosion and Sedimentation Implementation Plan

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 this 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. Additionally, wind erosion is of concern in this area; however, it is dependent on conditions. It is the RLWD's goal to address the following issues with the Lower Red Lake River subwatershed:

7.2.8.1 Lower Red Lake River Erosion and Sedimentation Rankings

- ❖ Tributary bank instability at the outlets into the river.
- ❖ Erosion on Judicial Ditch 60 south of CR 11.
- ❖ Bank sloughing in Crookston and Red Lake Falls.
- ❖ Erosion on the last mile of Polk County Ditch 1 west of Crookston.
- ❖ Ditches outletting into natural streams and contributing sediment.

7.2.8.2 Erosion and Sedimentation Action Items

1. The RLWD will seek partnerships with landowners, SWCD and USDA NRCS to implement BMPs that reduce agricultural erosion and slow water down. Landowners will be discouraged from farming in ditches.
2. The RLWD will seek out grant opportunities to conduct an erosion assessment on the entire course of the Red Lake River from the Red Lake outlet on the reservation to the Red River.

Table 14 provides a summary list of specific implementation actions for the subwatershed.

7.2.9 Summary and Conclusions

This section of the overall watershed management plan presents an overview of the Upper and Lower Red Lake subwatershed. Goals and objectives for the subwatershed are presented above for the following plan elements: 1) Natural Resources, 2) Water Quantity, 3) Water Quality and 4) Erosion and Sedimentation. Table 14 provides a summary list of specific implementation actions organized by these same plan elements.

Table 14
Lower Red Lake River Subwatershed Implementation Actions

Action/Goal	Plan Element	Schedule	Conceptual Cost
Improve existing riverine habitat conditions	Natural Resource Action Item	Ongoing	$30,000
Re-establish habitat corridors	Natural Resource Action Item	Ongoing	$20,000
Reduce erosion and sedimentation in watercourses	Natural Resource Action Item	Years 1-5	$100,000
Create additional flood storage within eastern portions of subwatershed to reduce agricultural and residential flooding	Water Quantity Action Item	Years 1-5	$5,000,000
Respond to petitions and other requests for the ditches actively managed by RLWD. Seek partnerships with County and private landowners to improve the overall coordination and management of the public and private ditch systems	Water Quantity Action Item	Ongoing	$100,000
Partner with the USDA NRCS, USACE, MPCA and SWCDs to implement projects that reduce agricultural and bank erosion and improve water quality	Water Quality Action Item	Years 1-5	$100,000
Partner with the USDA NRCS, USACE, MPCA and SWCDs to implement projects that reduce agricultural and bank erosion and slow water down	Erosion and Sedimentation Action Item	Years 1-5	$100,000
Seek grant opportunities to conduct erosion assessment on the entire course of the Red Lake River from Red Lake outlet on the reservation to the Red River	Erosion and Sedimentation Action Item	Years 5-10	$25,000

7.3 THIEF RIVER SUBWATERSHED PLAN

7.3.1 Introduction

This section presents the implementation plan for the Thief River subwatershed (Figure 28). The plan is organized by first presenting a summary of important physical characteristics of the Thief River subwatershed. More detailed information on the subwatershed is available in Sections 2.0-5.0 and in Appendix 7. The section also identifies the problems related to water management in the subwatershed and describes proposed solutions in the form of goals and objectives to address those problems.

The Thief River planning watershed includes the Moose River, Mud River and Thief River minor subwatersheds (Figure 28). Public lands in the eastern and western portion are dominant natural resource features in this subwatershed. The central portion of this subwatershed is primarily private lands used for agriculture. All these lands provide a large area of diverse habitats. Public lands include state wildlife management areas and acres of state forest lands (Table 15). Prominent public land resource features include: Thief Lake WMA (7,000-acre basin, +WMA), Moose River Impoundment, the Randen Ridge area, Agassiz NWR and Elm Lake WMA.

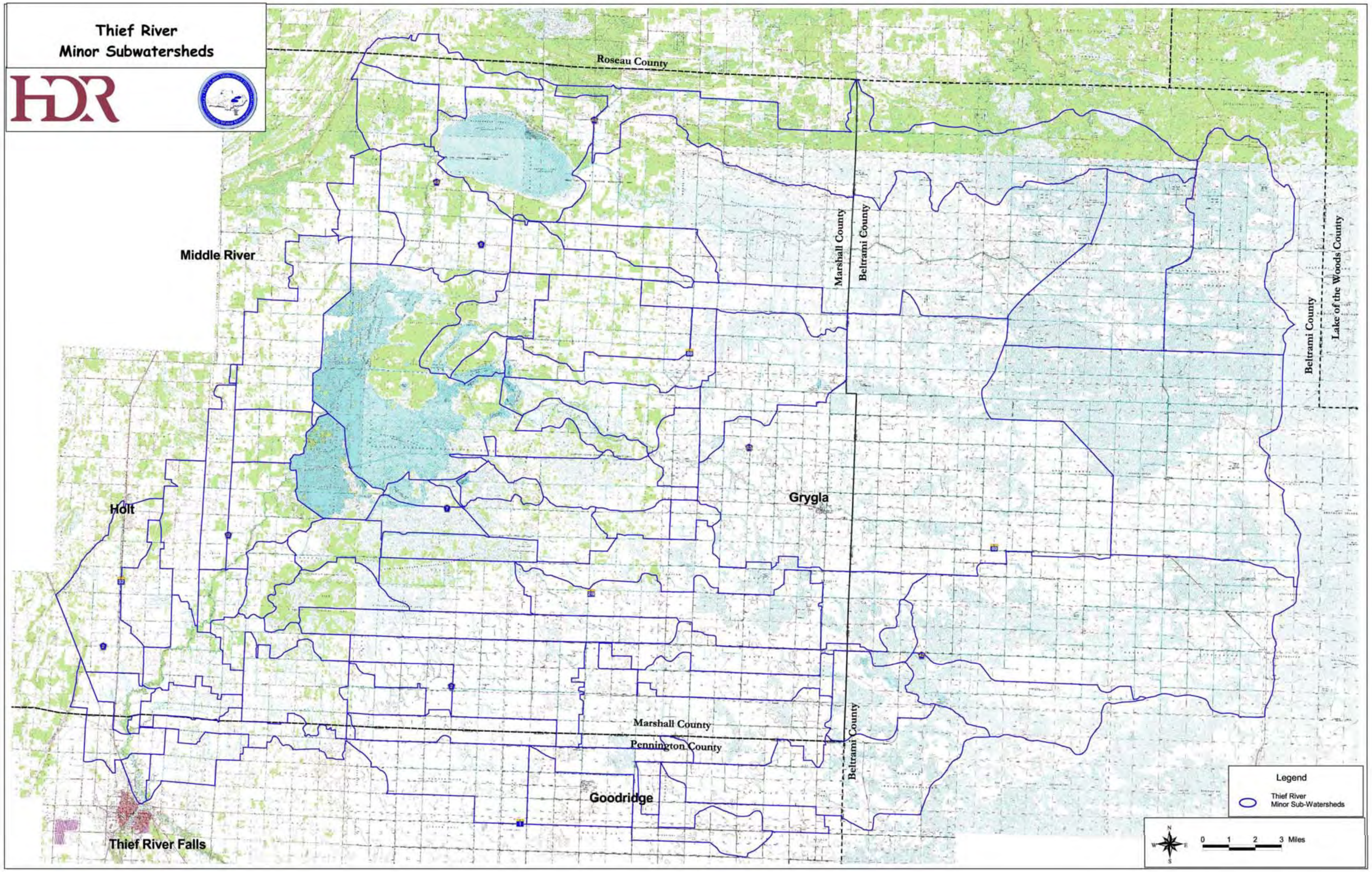
Quality habitats in this subwatershed primarily include forestlands, brushlands and wetlands (Figure 29). Type 6 and 7 wetlands are particularly abundant. Grasslands are of relatively less importance compared to some other planning basins. These habitats provide seasonal and permanent homes to a variety of species including game species such as white-tailed deer, moose, bear, waterfowl and sharp-tail grouse. Some areas provide important winter habitat for deer and migratory and breeding habitat for waterfowl and other birds (e.g., Thief Lake WMA, Agassiz NWR). One of Minnesota's two elk herds is also found in this subwatershed. Prime sharp-tail habitat is located near Grygla extending about 6 miles to the east and 10 to 15 miles west of Beltrami/Marshall county line. CRP lands, common throughout the central portion of the subwatershed, provide some quality habitats and also provide a habitat connection between public lands to the east and west. These lands are of particular importance because they contain a mix of relatively undisturbed areas of grassland, brushland and wetland. East and west of this area the habitat becomes more wooded or wet and less desirable for sharp-tail.

The Moose River, Thief River and Mud River are the primary waterways in this subwatershed. Portions of all of these rivers have been channelized. Dams at impoundment outlets and other impassable areas (e.g., culverts) fragment these stream systems. A network of drainage systems and a few natural waterways are tributaries to these waterways. The hydrology of these waterways has also been modified due to land use changes (flashy flows extended periods of low flow). All these changes have greatly reduced the potential of these waterways to support quality fish populations. The Thief River does provide some quality habitat for some species.

7.3.2 General Physical Characteristics

The Thief River subwatershed consists of an approximately 1,068 square mile area. The watershed outlets into the Red Lake River in Thief River Falls. The watershed is located mostly within the Lake Agassiz ecoregion with the extreme northeastern and southeastern areas fringing on the Northern Minnesota Peatlands ecoregion. Soil textures range from fine-loamy in the west to coarse-loamy in the east, with a strip of sandy soils along the northern boundary of the watershed. The area consists of a mix of agricultural lands, forest lands and wetlands, with very little grasslands, lakes or developed urban land (Table 15). The following presents a general summary of surface water and groundwater characteristics in the subwatershed. The summary is followed by a discussion of the problems, goals and policies and implementation actions for each of the four plan elements: 1) Natural Resources, 2) Water Quantity, 3) Water Quality and 4) Erosion and Sedimentation.

Figure 28
Thief River Subwatershed Map



7.3.3 Surface Water Summary

The Thief River subwatershed is also comprised of two smaller subwatersheds which outlet into the Thief River. They are the Moose River and Mud River/Agassiz subwatersheds. The Thief River subwatershed is the northernmost reach of the RLWD. All of the drainage from within the smaller subwatersheds flows into the Thief River and eventually outlets into the Red Lake River at Thief River Falls.

There are seven named lakes in the Thief River subwatershed. Major lakes for limited-use recreation include Thief Lake and Mud Lake/Agassiz. All lakes within this watershed typically support only waterfowl as they are too shallow to support a recreational fishery. Shoreline is typically undeveloped on the lakes.

Wetland areas are scattered throughout the area. These wetland areas are somewhat denser in the eastern portion of the subwatershed, especially east of the Beltrami county line. Many of the wetlands in the western portion of this watershed have been altered by farm drainage for agricultural production. Remaining wetlands in the eastern portion have been estimated to be 2-43 percent of pre-settlement extent.

Drainage systems in this subwatershed are a complex network of natural streams and legal ditch systems developed for agriculture. Generally, the ditch systems are under the administration of the county in which they reside or of the watershed district. Notable existing water management projects within this watershed include Thief Lake, Agassiz NWR, Elm Lake, Lost River Pool and the Moose River Impoundment, which collectively can store up to 138,000 acre feet of water.

Table 15
Thief River Subwatershed Characteristics

CHARACTERISTIC	AREA
Basin Area (sq mi.)	1,068
Basin Area (acres)	683,408
Wetland Area NWI (acres)	349,665
MINNESOTA WETLAND TYPE	
1	3,450
2	79,077
3	37,816
4	5,218
5	9,563
6	106,567
7	93,398
8	14,574
Lakes/Rivers (acres)	10,133
ECOREGIONS OF RLWD (ACRES)	
Lake Agassiz, Aspen Parklands	513,680
Minnesota & NE Iowa Morainal	-
N. Minnesota & Ontario Peatlands	169,728
N. Minnesota Drift & Lake Plains	-
Red River Valley	-
LAND USE (ACRES)	
Cultivated Land	294,904
Forest Land	185,103
Grass/Brushland	60,241
Mines	185
Water	11,515
Developed Land	813
Wetlands	130,599
Other	50

(Sources: EIS, Soil Survey, GIS information, reports, studies)

7.3.4 Groundwater Summary

The subwatershed is located in the Lake-Washed Till Plain physiographic area of the RLWD. The surficial geology of the area is dominated by the lake-washed till. The till is described as a sandy, clay-silt loam containing fine to medium gravel with a scattering of boulders. The till is covered in areas by a very-fine to fine-grained, uniform glacial lake sand generally less than 20 feet in thickness. Throughout the subwatershed, the till is overlain by a thin covering of peat (only a few feet thick) that results from the water table being close to or at land surface, paired with poor drainage in the area. Localized peat deposits are also present in many closed depressions within the till.

Glacial sediment aquifers in the region provide very moderate amounts of groundwater. Suitable yields of 5 gpm, or more for domestic use, can be found in sand lenses within the till. These lenses are often localized, and yields can vary. The aquifer may accommodate municipal or industrial uses, possibly up to 250 gpm in some rare instances. Hardness of the groundwater is commonly greater than 180 mg/l.

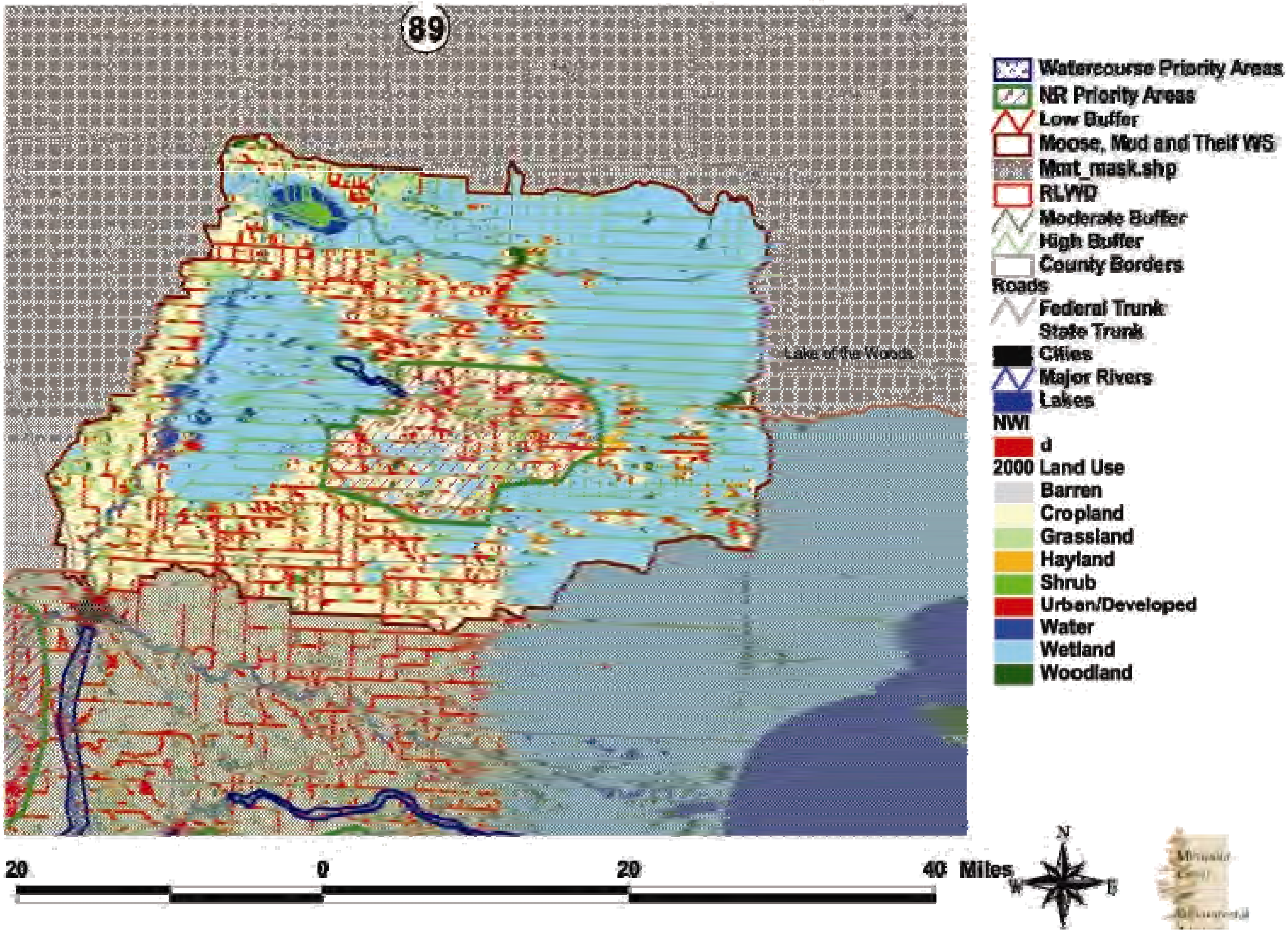
Paleozoic sediments consisting of shales and limestones are discontinuous and underlie the glacial lake deposits along the western side of the subwatershed. Precambrian crystalline rocks underlie the glacial sediments, forming the base of the groundwater reservoir for most of the watershed. The fractured surface of crystalline rocks may provide an adequate supply of groundwater for limited domestic use.

7.3.5 Natural Resources Implementation Plan

The Thief River was identified as an important resource within the region that needs to be recognized and protected. Recreational activities including hunting, fishing, tubing, swimming etc. were all identified as being popular activities. The following are the major goals and actions recommended by the Natural Resources Subcommittee. Figure 29 shows the Thief River Priority Natural Resource Areas.

Natural resource problems and issues were identified using a questionnaire with resource agencies. Results of this questionnaire and the resource inventory were considered by a Natural Resources Subcommittee. The following are the major goals and actions recommended by the Natural Resources Subcommittee.

Figure 29
Thief River Priority Natural Resource Areas



7.3.5.1 Improve Fish Habitat in the Mud, Moose and Thief Rivers and their Tributaries

- Support activities that reduce the flashiness and enhance base flows
- Stabilize stream banks in areas of accelerated erosion
- Rehabilitate the Mud River at the eastern edge of Agassiz and in the Eckvoll WMA where it is a ditch
- Reduce sediment load in streams
- Buffer all watercourses
- Active erosion has been of particular concern on the Moose River in Sections 1-6 of Northwood Township and Sections 1-12 of Whiteford Township (between MC 54 and bridge on Moose River Road). These areas are listed as local priority areas for the Environmental Quality Incentives Program funding
- Active erosion also south of the outlet of the Moose River impoundment (Sprucegrove Township)
- Reduce continual sloughing on ditch 20 and erosion on laterals
- Large deltas are forming on the east end of Thief Lake and in Agassiz NWR. This sediment has been contributed from the lands in the watershed above the lake
- Implement agricultural BMPs to reduce wind and water erosion throughout the subwatershed
- Other strategies include improved ditches with side inlets, buffer and grassed waterways, residue management, tree plantings, reduce farming into road ditches

7.3.5.2 Maintain and Improve Wildlife Habitat (indicators could be land base statistics or sharp-tail population levels)

- Re-establish habitat corridors along all major waterways
- Identify key areas and connect existing habitats along the corridors by promoting land use changes
- Where practical, create habitat corridors along some of the major east/west ditch systems such as ditch 20 and 200
- Connect existing corridor woodland habitats
- Protect and enhance existing brushland habitats
- Protect existing tracts of brushlands

- Manage vegetation actively to maintain brushlands and diversity
- Retain or increase CRP acres in those areas that already have considerable amounts of CRP
- Protect existing grassland habitats
- Encourage active vegetation management that maintains grassland quality (prescribed burning, weed control, etc)
- Target CRP to increase number of large blocks of grassland habitats
- Protect existing wetland habitats
- Support efforts to retain WRP acres
- Support WCA enforcement
- Enhance existing wetland habitats
- Target wetland restorations
- Encourage active vegetation management that maintains wetland quality (moist soil management, prescribed burning, weed control, etc)
- Reduce flows or change timing into Agassiz and Thief Lake to help optimize management of these waters for wildlife production and recreation
- Work with USFWS and MnDNR to identify concerns and develop potential strategies
- Reduce flows or change timing at Moose River to actively control vegetation within the impoundment

7.3.5.3 Increase Recreational Opportunities

- Partner with other groups to highlight existing opportunities
- Wildlife viewing/birding, hunting, trails

Due to terrain, draining of wetlands for cropland and/or under-designed structures, the Thief River subwatershed experiences frequent flooding throughout the subwatershed. Spring flooding is almost an annual occurrence in this watershed. Damages associated with this type of flood are to public infrastructure, personal property, cropland and public resources (fisheries, wildlife, soils and water quality). Agricultural flooding and damages in the City of Goodridge were identified as the highest priority flooding issues. In addition to projects shown in Figure 23, it is the RLWD's goal to address the following issues within the Thief River subwatershed:

7.3.5.4 Thief River FDR Rankings

- Agricultural crop damages.
- Overland flooding in Goodridge.
- Farmstead flooding.
- Flooding along ditch 20 and 200.

FDR Action Items

1. The RLWD, in partnership with local, state and federal agencies, will pursue projects to create an additional 10,000 ac-ft of flood volume reduction within the eastern portions of this subwatershed to reduce agricultural and residential flooding. Storage projects must carefully consider water management, timing of releases and adequacy of downstream outlets.
2. The RLWD will pursue projects that reduce bank erosion and still provide agricultural drainage.
3. The RLWD will respond to petitions and other requests for the ditches that are actively managed by the RLWD. The petitions will be evaluated thoroughly with respect to FDR principles, natural resource affects and upstream and downstream impacts. The RLWD will seek partnerships with the county and private landowners to improve the overall coordination and management of the public and private ditch systems. Ditches will be re-sloped, closed or abandoned, if petitioned for, and identified as appropriate considering all factors.
4. The RLWD will continue to actively promote the farmstead ringdike program.

7.3.6 Objectives and Conceptual Plan

In addition to the activities identified by the planning process, the RLWD formed a special team to look at this subwatershed. The Thief River Project Work Team was formed in March 1999 to address the flooding problems in the Thief River sub-basin in accordance with the provisions of the Red River Basin FDRWG's December 1998 Mediation Agreement. Although the Thief River Project Work Team's scope encompassed the entire Thief River sub-basin, one key focal point was the RLWD's efforts to resolve a conflict between:

- ❖ The desire of landowners along the State Ditch (SD) 83 portion of the Thief River to have State Ditch 83 repaired for FDR purposes and
- ❖ The interest of other natural resource-related agencies (e.g., MPCA) and special interest groups (e.g., Audubon Society) in finding environmentally-friendly alternatives to the proposed State Ditch 83 clean-out.

Therefore, the Thief River Project Work Team attempted to develop a sub-basin-wide conceptual framework that would meet or exceed the FDR performance of the proposed State Ditch 83 clean out, in a manner compatible with the broad FDR and NRE goals of the Mediation Agreement. Those FDR goals include natural resources enhancements, protection against a 100-year flood for urban areas (specifically the City of Thief River Falls) and protection against a 10-year summer storm event for intensively farmed rural areas.

7.3.6.1 Conceptual Plan

The Thief River Project Work Team 's conceptual plan includes four basic features:

- ❖ A diversion channel south from Elm Lake/Agassiz Natural Wildlife Refuge (NWR), routing around the east side of State Ditch 83's low-flow-capacity reach, and joining the Thief River four miles north of Thief River Falls. This diversion channel would be gated to keep flows in concert with downstream flow capacity. A wetland restoration project would be incorporated with the diversion feature along with timely drawdown of existing impoundments adding NRE aspects.
- ❖ Floodwater storage throughout the Thief River sub-basin. Particular attention would be paid to off-channel dry impoundments along C.D. 20. Releases would be timed to be compatible with downstream flow capacity. Storage sites, whether dry or wet, would provide NRE benefits to shorebirds, migratory waterfowl and native game and nongame species.
- ❖ Land use changes throughout the Thief River sub-basin. Incentives and education would be used to encourage land use changes intended to reduce the acreage of floodprone crops and to allow cropping in short-term storage sites. In some cases, alternate crops such as hybrid trees or wild rice would not only be flood tolerant, they would also increase evapotranspiration and, therefore, reduce runoff and storage requirements. In other cases, lands now in row crops might be retired or converted to pasture or natural grasslands. These land use changes would provide excellent habitat gains for resident wildlife. The relative cost effectiveness of ring levees, raising or relocations will have to be weighed in deciding the best solution for farmsteads and residences in floodprone areas.

- Spot cleaning of State Ditch 83 would be made where sedimentation or snags are major flow restrictions or deflect flows into riverbanks and cause serious erosion threats to roads, farmland or important ecosystem features, e.g., spawning areas or nesting cover and trees.

The above package of measures provides a balance of FDR and NRE benefits and the package is consistent with the Mediation Agreement.

Table 17 provides a summary list of specific implementation actions for the subwatershed.

7.3.7 Water Quality Implementation Plan

RLWD monitoring data has identified the Thief River as an impaired water body due to high levels of turbidity during high flows and low dissolved oxygen during periods of low flow. The watershed will continue to assess the problem and the data available for the next 303D assessment.

Water quality monitoring has been conducted by the RLWD at five sites associated with streams within the subwatershed. Monitoring has been done since as early as 1980 for several parameters, including field measurements for dissolved oxygen, pH, temperature, turbidity, transparency and conductivity. Laboratory analysis is performed on stream samples for fecal coliform, TSS, total dissolved solids, chemical oxygen demand, total phosphorus, orthophosphorus, nitrates and nitrites, ammonia, total Kjeldahl nitrogen and alkalinity. Major locations for sampling include the Hillyer Bridge and two sites on the Moose and Mud Rivers. Other organizations also complete monitoring in the subwatershed as described in Table 16.

The MPCA's 2005 assessment of the state's waters was the first assessment that used data from the RLWD's long-term monitoring program. This was the first year that any data was available to assess waters in the Thief River watershed. The 2006 Draft 303 (d) List of Impaired Waters (based upon the 2005 assessment) identifies several impaired reaches on the Thief and Moose Rivers. No impairments were found on the Mud River.

- Thief River from Agassiz Pool to the Red Lake River
  - Impaired by low dissolved oxygen
  - Impaired by high turbidity

- Thief River from Thief Lake to Agassiz Pool
  - Impaired by high un-ionized ammonia (This is a questionable impairment as it is based upon only two occasions where the standard was exceeded and the standard has not been exceeded for several years.)
  - There is enough exceedance rate in turbidity data (through 2005) to list this reach as being impaired by turbidity. However, it is not included on the Draft 303(d) List of Impaired Waters. The percent exceedance level is borderline and no exceedances of the state standard (25 NTU) have been recorded since 1997
- Moose River from Headwaters to Thief Lake
  - Impaired by low dissolved oxygen

Table 16
Thief River Subwatershed Monitoring

Watershed Name	Thief River – Moose River – Mud River
Impaired Waters	Currently none – reach between Agassiz NWR and TRF most likely will be one
Number of Stream Sampling Sites	
RLWD	5
SWCDs	8
River Watch	4
MPCA	1
Field Parameters	dissolved oxygen, pH, water temperature, turbidity, transparency, conductivity
Laboratory Parameters	Total phosphorus, orthophosphorus, TSS, total dissolved solids, total Kjeldahl nitrogen, ammonia nitrogen, nitrates plus nitrates, fecal coliform and E. coli
Earliest Sampling Data	1980
Key Sampling Locations	Hillyer Bridge (USGS gauge GS-05-0760), Moose R. and Mud R.
Other Notes	The Hillyer Bridge monitoring site is also monitored by the MPCA. Noted problems with High TSS and Low Dissolved Oxygen between Agassiz and TRF

It is the RLWD's goal to address the following issues with the Thief River subwatershed:

7.3.7.1 Thief River Water Quality Rankings

- ❖ Turbidity during high flows and low dissolved oxygen 303D impairments.

7.3.7.2 Water Quality Action Items

1. The RLWD will actively partner with the MnDNR, USFWS, USDA NRCS, USACE, MPCA, Marshall County Water Planner and the SWCDs to seek to implement projects that reduce agricultural and bank erosion and improve water quality.

Table 17 provides a summary list of specific implementation actions for the subwatershed.

7.3.8 Erosion and Sedimentation Implementation Plan

Erosion due to storm runoff is another serious problem in the subwatershed. During periods of high runoff, channel erosion causes bank stabilization concerns for this 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. It is the RLWD's goal to address the following issues with the Thief River subwatershed:

7.3.8.1 Thief River Erosion and Sedimentation Rankings

- ❖ Tributary bank instability at the outlets into the river.
- ❖ Erosion on State Ditch 83.
- ❖ Channel and streambank erosion.
- ❖ Ditches outletting into natural streams and contributing sediment.

7.3.8.2 Erosion and Sedimentation Action Items

1. The RLWD will seek partnerships with landowners, SWCD and USDA NRCS to implement BMPs that reduce agricultural erosion and slow water down. Landowners will be discouraged from farming ditches.
2. The RLWD will seek out grant opportunities to conduct an erosion and water quality assessment on the entire course of the Thief River.

Table 17 provides a summary list of specific implementation actions for the subwatershed.

7.3.9 Summary and Conclusions

This section of the overall watershed management plan presents an overview of the Thief River subwatershed. Goals and objectives for the subwatershed are presented above for the following plan elements: 1) Natural Resources, 2) Water Quantity, 3) Water Quality and 4) Erosion and Sedimentation. Table 17 presents a summary list of specific implementation actions organized by these same plan elements.

Table 17
Thief River Watershed Implementation Actions

ACTION/GOAL	PLAN ELEMENT	SCHEDULE	CONCEPTUAL COST
Create additional 10,000 acre-ft of flood volume reduction within eastern portion of subwatershed	Water Quantity Action Item	Years 1-5	$10,000,000
Reduce bank erosion and provide adequate agricultural drainage	Water Quantity Action Item	Ongoing	$20,000/yr
Promote farmstead ringdike program	Water Quantity Action Item	Ongoing	$50,000/yr
Partner with USDA NRCS, USACE, MPCA and SWCDs to reduce agricultural and bank erosion and improve water quality	Water Quality Action Item	Ongoing	$10,000/yr
Seek grant opportunities to conduct erosion and water quality assessment on the entire course of the Thief River	Erosion and Sedimentation Action Item	Years 1-3	$15,000/yr
Improve fish habitat	Natural Resource Action Item	Ongoing	$10,000/yr
Install vegetative buffer strips	Natural Resource Action Item	Ongoing	$20,000

7.4 GRAND MARAIS

7.4.1 Introduction

The Grand Marais watershed is dominated by private lands in agricultural production and a series of ditches that drain into the Grand Marais Creek. The portion of this watershed west of U.S. Highway 75 is almost 100 percent agricultural land. West of U.S. Highway 75, narrow bands of natural lands are found along the Red River and along the Grand Marais Creek. East of U.S. Highway 75, there is a mix of grasslands and agricultural lands with some wetlands. Two WMAs in this area also provide some quality habitats; however, CRP lands provide the majority of grassland and wetland habitats. This area east of U.S. Highway 75 lies along the Campbell Beach Ridge.

Quality habitats in the western portion of this subwatershed are limited to the areas adjacent to Grand Marais Creek and the Red River. These habitats provide seasonal and permanent homes to a variety of species including game species such as white-tailed deer and waterfowl. Quality habitats in the eastern portion of the subwatershed include grasslands, wetlands and some brushlands. (Figure 31). These areas provide seasonal and permanent habitats to a variety of species including game species such as white-tailed deer, prairie chicken and sharp-tail grouse. The prairie chicken population has increased dramatically in recent years.

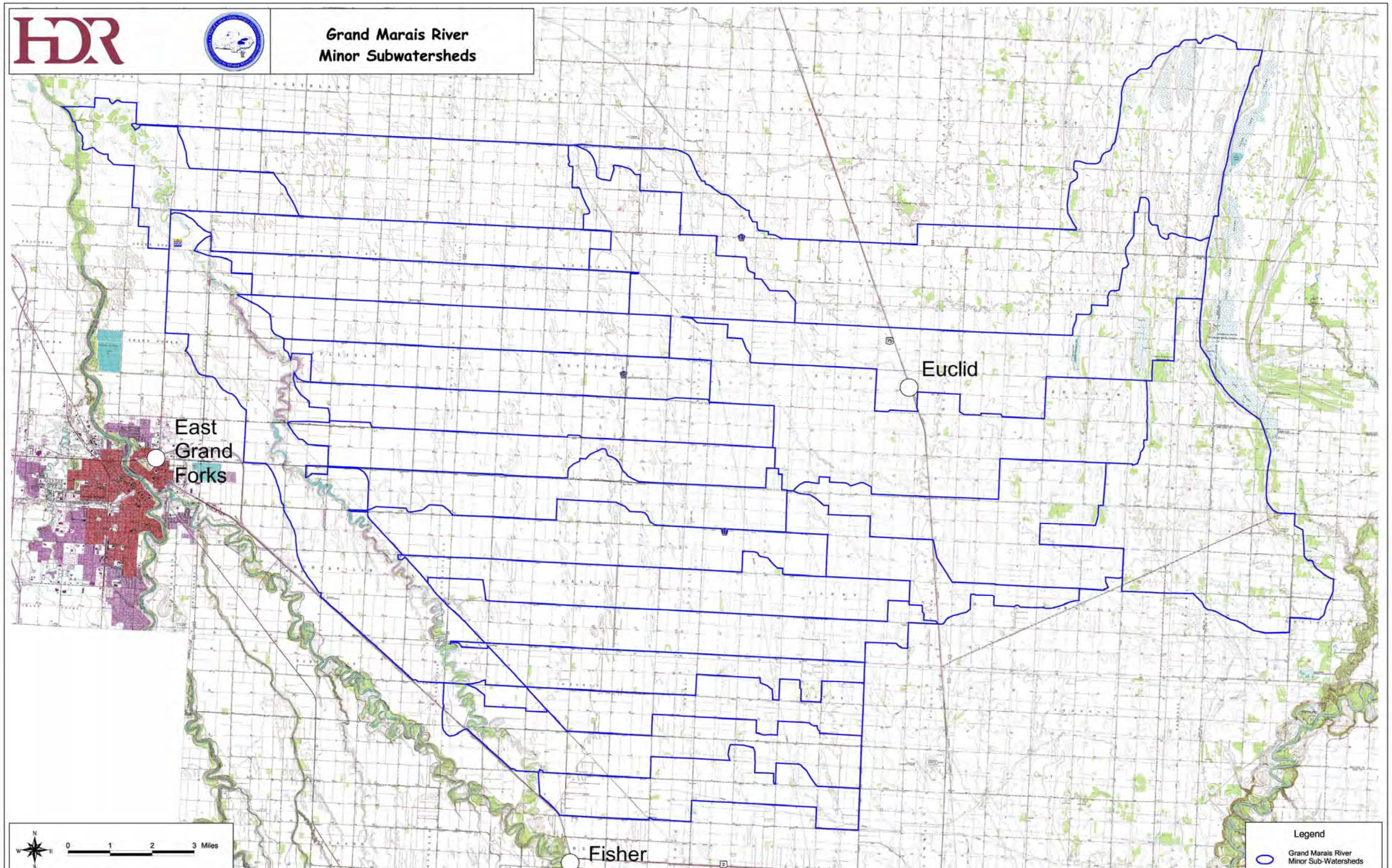
The Grand Marais Creek is the primary waterway in this subwatershed. The waterway provides limited seasonal habitat to a few fish species. The alignment of most of this creek has not been significantly changed but adjacent land use and its hydrology has significantly changed. Large drainage system ditches outlet directly into the Grand Marais at almost every mile and roads cross the waterway almost every mile. The natural outlet of the Grand Marais was bypassed and the waterway now flows straight west to the Red River. This outlet is unstable and has likely altered fish passage between the Red River and the Creek. The hydrology of this subwatershed has been modified due to drainage and land use changes (flashy flows extended periods of low flow). Historically, there is anecdotal evidence that the waterway and its corridor provided quality habitats for waterfowl nesting and production.

7.4.2 General Physical Characteristics

This section presents the implementation plan for the Grand Marais subwatershed (Figure 30). The plan is organized by first presenting a summary of important physical characteristics of the Grand Marais subwatershed. More detailed information on the subwatershed is available in Sections 2.0-5.0 and in Appendix 7. The section also identifies the problems related to water management in the subwatershed and describes the proposed solutions in the form of goals and objectives to address these problems.

The Grand Marais subwatershed consists of an approximately 317 square mile area. The watershed outlets into the Red River approximately nine miles north of East Grand Forks and begins just west of the Goose Lake Swamp area. The watershed is located mainly within the Red River Valley ecoregion with the extreme eastern potion entering the Glacial Lake Agassiz/Aspen Parklands ecoregion. Soil textures range from fine in the western two-thirds of the watershed to sandy-loam/fine-loam in the eastern third of the watershed. The area consists largely of agricultural land (94 percent), but is also made up forest, wetlands, urban and grassland. Elevations range from 1,000 mean sea level (msl) in the east to 800 feet msl along the Red River of the North (Table 18). The following presents a general summary of surface water and groundwater in the subwatershed. The summary is followed by a discussion of the problems, goals and policies and implementation actions for each of the four plan elements: 1) Natural Resources, 2) Water Quantity, 3) Water Quality and 4) Erosion and Sedimentation.

Figure 30
Grand Marais Subwatershed Map



7.4.3 Surface Waters Summary

The Grand Marais subwatershed is bordered along its north side by the Middle River Snake River Watershed District and by the Lower Red Lake River subwatershed on the south and east sides. There are 41 minor subwatersheds within the Grand Marais and each generally represents a legal ditch system. Overland flooding is common each spring.

There are no lakes in this subwatershed. Wetland areas are scattered throughout the area. These wetland areas are somewhat denser in the extreme eastern portion of the subwatershed, generally east of U.S. Highway 75. Many of the wetlands in this watershed have been altered by farm drainage, and many wetlands have been drained for the purposes of agricultural production, especially those in the western two-thirds of the subwatershed.

Drainage systems in this subwatershed are a complex network of legal ditch systems located at 1-2-mile intervals that drain east to west into natural streams. Generally, the ditch systems are under the administration of Polk County or the RLWD. One notable storage project within this watershed is the Parnell impoundment, which is capable of storing 3,600 ac-ft of water. Other impoundments include the Louisville –Parnell Impoundment and Flood Storage Easement Sites 1 and 2 (Figure 17).

The subwatershed is located in the Lake Plain physiographic area of the Red Lake River Watershed District. The surficial geology of the area consists of mainly clay with small regions of silt, sand, sand and gravel ridges and lake-washed till. Clay deposits dominate the Grand Marais Creek subwatershed and are characterized as being very dense, uniform and having low permeability. Thicknesses can range from a few feet in the eastern part of the watershed to more than 120 feet in the western portions. Nearly level topography in this region also relates to poor drainage. Sand and gravel ridges, known as beach ridges from Glacial Lake Agassiz, are located along the eastern portion of the subwatershed. They occur in mainly north-south trending ridges that range in thickness from a few feet to 30 feet in some areas. Drainage is good within the ridges, but can be poor in the inter-ridge areas where deposits of peat are evident. The fine sand or silt deposits in the area are fairly uniform and underlain by till and clay deposits. Thicknesses for both deposits are generally less than 20 feet. Lake-washed till deposits are described as sandy, clay-silt loam that contains fine to medium gravel with a scattering of boulders. The deposits are generally not well drained.

Table 18
Land Use Characteristics of the Grand Marais Subwatershed

CHARACTERISTIC	AREA
Basin Area (sq mi.)	317
Basin Area (acres)	202,663
Wetland Area NWI (acres)	3,236
MINNESOTA WETLAND TYPE	
1	264
2	1,173
3	1,121
4	22
5	37
6	194
7	424
8	-
Lakes/Rivers (acres)	1,947
ECOREGIONS OF RLWD (ACRES)	
Lake Agassiz, Aspen Parklands	44,472
Minnesota & NE Iowa Morainal	-
N. Minnesota & Ontario Peatlands	-
N. Minnesota Drift & Lake Plains	-
Red River Valley	165,553
LAND USE (ACRES)	
Cultivated Land	191,980
Forest Land	4,395
Grass/Brushland	3,163
Mines	58
Water	780
Developed Land	1,355
Wetlands	930
Other	-

7.4.4 Groundwater Summary

Glacial sediment aquifers in the region only provide moderate amounts of groundwater. Suitable yields of 5 gpm or more, for domestic use, are mainly found in sand lenses in the till or in beach ridge deposits. The extent of beach ridge deposits is limited, and sand lenses are often localized. Beach ridges are typically saturated in the lower few feet. Yields of more than 20 gpm can be obtained from the larger ridges, but supplies from the smaller ridges are unreliable and can dry up in late summer to fall. Groundwater supply for industrial use and irrigation is generally poor. Quantities and quality for such uses are inadequate. Hardness of the groundwater is commonly greater than 180 mg/l.

Paleozoic sediments consisting of shales and limestones are discontinuous and underlie the glacial sediments along the western side of the subwatershed. Precambrian crystalline rocks underlie glacial sediments in most of the watershed. The fractured surface of crystalline rocks may provide an adequate supply of groundwater for localized domestic use but are not a good commercial or municipal source of groundwater.

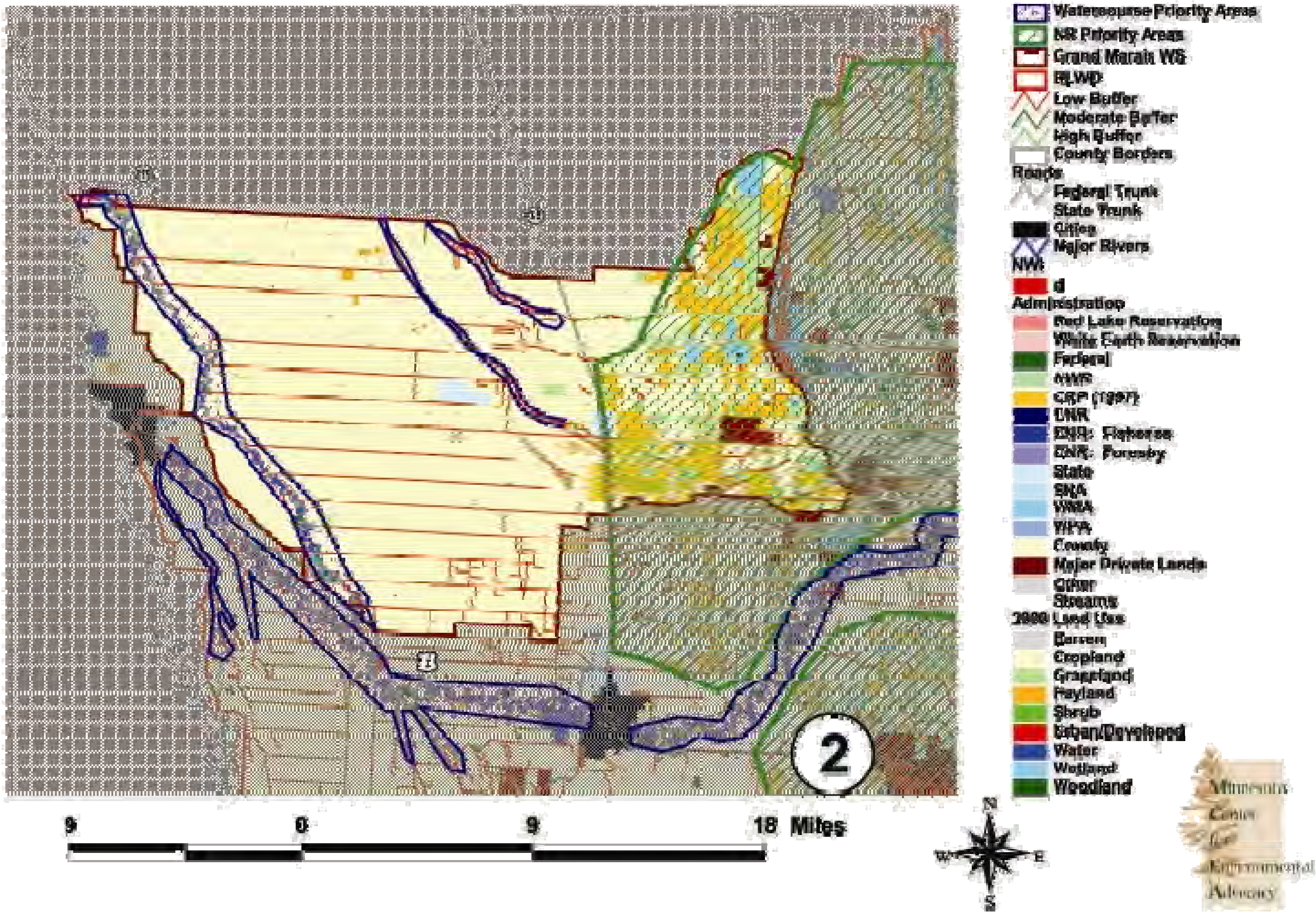
Information regarding the individual city wells, water quality analysis results and the aquifers that serve as the water supply can be obtained from the individual cities and the Minnesota Geological Survey.

7.4.5 Natural Resources Implementation Plan

The Grand Marais Creek subwatershed was identified as an important resource within the region that needs to be recognized and protected. Identified recreational activities were minimal due to highly intensive agriculture.

Natural Resources problems and issues were identified using a questionnaire with resource agencies. Results of this questionnaire and the natural resource inventory were considered by a Natural Resources Subcommittee. The Natural Resource Committee's recommendations were used by the RLWD to develop the following Natural Resource goals and objectives. Specific action items are presented in Table 20. The following are the major goals and actions recommended by the Natural Resources Subcommittee.

Figure 31
Grand Marais Priority Natural Resource Areas



7.4.5.1 Improve Fish Habitat in the Grand Marais Creek and its Tributary Ditches

- Implement activities that reduce the flashiness of the hydrograph
- Implement activities that enhance base flows
- Provide a stable outlet for the Grand Marais Creek
- Restore the natural outlet with the existing outlet improved and used as a high flow diversion
- Stabilize the existing outlet and provide for fish passage during most flow conditions
- Reduce sediment load in streams
- West of U.S. Highway 75, implement agricultural BMPs
- East of U.S. Highway 75, implement agricultural BMPs and land use changes. (Farm the west wisely and preserve the east). Strategies include improved ditches with side inlets, Polk County plan to buffer and grassed waterways, residue management, tree plantings, reduce farming into road ditches

7.4.5.2 Maintain and Improve Wildlife Habitat

- Re-establish a habitat corridor along Grand Marais Creek
- Re-establish the habitat corridor along the Red River
- Participate in Greenway along the Red project
- Maintain existing grassland and wetland areas east of U.S. Highway 75
- Support continuation of CRP, WRP and other programs
- Partner with SWCDs and USDA NRCS to target areas
- Identify and protect existing tracts of native prairie
- See MnDNR land management plan for some good targets and strategies
- Increase the number and size of grassland areas east of U.S. Highway 75
- Encourage active vegetation management that maintains grassland quality (prescribed burning, weed control, etc)
- Create managed impoundments for migratory bird habitat

7.4.5.3 Provide Recreational Opportunities

- Partner to highlight existing opportunities
- Wildlife viewing/birding, hunting, fishing

7.4.6 Water Quantity Implementation Plan

Due to terrain, draining of wetlands for cropland and/or under-designed structures, the Grand Marais subwatershed experiences frequent flooding throughout the subwatershed. Spring flooding is almost an annual occurrence in this watershed. Damages associated with this type of flood are to public infrastructure, personal property, cropland and public resources (fisheries, wildlife, soils and water quality). Agricultural flooding and damages in the City of Euclid were identified as the highest priority flooding issues. In addition to projects shown in Figure 23, it is the RLWD's goal to address the following issues within the Grand Marais subwatershed:

7.4.6.1 Grand Marais Flood Damage Reduction Rankings

- Grand Marais Flood Damage Reduction Project – Project 60
- Overall flooding section by section
- Flooding along County Ditch 2, County Ditch 66, County Ditch 126, Judicial Ditch 60, County Ditch 39 and County Ditch 25.
- Residential flooding.
- Flooding of infrastructure and roads.

7.4.6.2 FDR Action Items

1. The RLWD will also pursue projects to add buffers, farmland dikes and other restoration types of projects to slow down the delivery of water and lengthen the hydrographs to reduce flooding.
2. The RLWD will pursue projects that reduce bank erosion and still provide adequate agricultural drainage.
3. The RLWD will respond to petitions and other requests for the ditches that are actively managed by the RLWD. The RLWD will seek partnerships with the county and private landowners to improve the overall coordination and management of the public and private ditch system.
4. The RLWD's runoff volume reduction goal for the Grand Marais subwatershed is 5,000 acre-ft.

7.4.6.3 Grand Marais Creek Flood Reduction Project (Project 60)

In addition to the priorities established by the TAC/CAC, the RLWD has been actively pursuing the implementation of an FDR project within this subwatershed. This project is one of two identified in the Red River Valley. The Grand Marais Creek Flood Reduction Project builds off the flood damage efforts that are an outgrowth of a mediation agreement reached between the state and local governments in the Red River Valley. Selection of this project acknowledges that Governor Pawlenty's administration has placed a priority on FDR efforts. The project won't involve the state forcing or directing new regulations or efforts on locals. Instead, the state will work in concert with local governments and private partners.

The project costs are expected to be $5.2 million for the Brand and Euclid East impoundments, $2.6 million for ditch improvements (funded through local levies) and $2.2 million for the channel reconstruction project with USACE and other funding sources to be determined. Construction of the impoundments is scheduled to begin in 2006 (Figure 30).

Project area: The project area is located east of East Grand Forks, north of Crookston, south of Warren and west of Thief River Falls. Covering 300 square miles, the area has some of the most fertile farmland in the Red River Valley, yet is often flooded.

A system of ditches running east to west was constructed every mile around the early 1900s to settle and farm the area. Most of these ditches are undersized for their respective drainage areas and the farmland that was opened up over the last century. A typical ditch draining into the Grand Marais Creek has the capacity to handle runoff from a 1-2 year frequency event (2 inches in 24 hours). Because of the low capacity, flooding and crop losses occur on an almost annual basis.

7.4.6.4 Project objectives and benefits:

- ❖ Enhance fish and wildlife habitat through the implementation of 1,000 acres of wetland and prairie restorations.
- ❖ Protect more than 40 square miles of flood-prone farmland in the Polk County Ditch 2 drainage area, as well as roads and structures, from a 10-year frequency storm event (3.5 inches in 24 hours) through the development of 6,000 ac-ft of flood storage with the construction of the Brandt Impoundment, Euclid East Impoundment and ditch improvements.
- ❖ Improve the capacity of County Ditch 2 and County Ditch 66 (21 miles of public ditches) to a 5-year frequency storm event capacity (3 inches in 24 hours).

- ❖ Prevent erosion damages to land, reduce turbidity downstream and increase fish and wildlife habitat by reconstructing/restoring six miles of channel and the County Ditch 2 outlet that flows into the Grand Marais Creek.
- ❖ Reduce sediment loading by 20 percent from County Ditch 2 and County Ditch 66 through the installation of buffer strips and the implementation of agricultural BMPs over 50 percent of County Ditch 2, County Ditch 66 and Brand Channel drainage areas.

7.4.7 Water Quality Implementation Plan

RLWD monitoring data has found that the Grand Marais Creek has high levels of turbidity, total suspended solids TSS, nitrates and nitrites and low levels of dissolved oxygen. Officially, the MPCA's Draft 2006 303(d) List of Impaired Waters lists the Grand Marais Creek as being impaired by high turbidity and low dissolved oxygen from the headwaters to County Ditch 2 based upon RLWD monitoring data. This list also identifies a turbidity impairment from County Ditch 2 to the Red River that is based upon Red River Basin Monitoring Network (RRBMN) data.

Water quality monitoring has been done by the RLWD at one site associated with streams within the subwatershed, on the Grand Marais Creek at State Highway 220. Monitoring has been done since 1985 for several parameters, including field measurements for dissolved oxygen, pH, temperature, turbidity, transparency and conductivity. Laboratory analysis is performed on stream samples for fecal coliform, TSS, total dissolved solids, chemical oxygen demand, total phosphorus, orthophosphorus, nitrates and nitrites, ammonia, total Kjeldahl nitrogen, alkalinity, dissolved oxygen, pH, temperature, turbidity, transparency, alkalinity and conductivity. Additional monitoring sites are operated by the MPCA and River Watch (Table 19).

Site 826 is the current RLWD long-term monitoring site on Grand Marais Creek, a tributary of the Red River of the North. The site is located at the State Highway 220 crossing. There is a primary monitoring site for the RRBMN located downstream of Site 826 that is monitored by the MPCA.

Water quality is very poor in Grand Marais Creek. In fact, it is normally one of the worst water quality sites within the RLWD. This muddy-looking river frequently has high conductivity, high total dissolved solids, high TSS and low dissolved oxygen readings. A predominately agricultural watershed and highly modified hydrology have had an adverse impact on water quality in the river. The altered hydrology consists of a high concentration of drainage ditches entering the river from the east and an actively eroding ditch downstream of Site 826 that diverts water from Grand Marais Creek's natural ditch. Although there are farming operations within the watershed that maintain windbreaks, buffers and other BMPs to minimize erosion, there are many that do not. This is highly evident in the winter when fields are barren and the ditches next to fields without windbreaks are filled with soil from wind erosion while fields with windbreaks, cover crops or crop residue have little erosion. The high turbidity and low transparency of the water prevents the passage of light, so vegetation next to the river is killed whenever the river rises over its banks.

Table 19
Grand Marais Water Quality Monitoring Sites Summary

WATERSHED NAME	Grand Marais
IMPAIRED WATERS	Currently none, but the Grand Marais is likely to be on the next impaired waters list
NUMBER OF STREAM SAMPLING SITES	
RLWD	1
SWCDS	0
RIVER WATCH	3
MPCA	1
FIELD PARAMETERS	dissolved oxygen, pH, water temperature, turbidity, transparency, conductivity
LABORATORY PARAMETERS	Total phosphorus, orthophosphorus, TSS, total dissolved solids, total Kjeldahl nitrogen, ammonia nitrogen, nitrates plus nitrates, fecal coliform and E. coli
EARLIEST SAMPLING DATA	1985
KEY SAMPLING LOCATIONS	Grand Marais Creek at State Highway 220
OTHER NOTES	The MPCA monitors at the last road crossing before the Grand Marais. Some of the ditches flowing into the Grand Marais and the Grand Marais itself. Very high turbidity and TSS levels, low dissolved oxygen as well.

7.4.7.1 Grand Marais Water Quality Rankings

- Turbidity, low dissolved oxygen and 303D impairments.

7.4.7.2 Water Quality Action Items

1. The RLWD will actively partner with the USDA NRCS, USACE, MPCA and the SWCDs to seek to implement projects that reduce agricultural and bank erosion and improve water quality.
2. The RLWD will support the efforts of municipalities to identify and protect recharge areas and to improve surface water quality.
3. The RLWD will actively promote the sharing of data amongst the RLWD, RRWMB, MPCA and River Watch to improve water quality and project funding.

Table 20 provides a summary list of specific information actions for the subwatershed.

7.4.8 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 this 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. Additionally, wind erosion is of concern in this area, especially during the winter. It is the RLWD's goal to address the following top priority issues with the Grand Marais subwatershed:

7.4.8.1 Grand Marais Erosion and Sedimentation Rankings

- Bank failures on County Ditch 2
- Wind and water erosion
- Loss of windbreaks
- Conservation tillage
- Extreme erosion in the ditched portion where the river is diverted directly into the Red River

7.4.8.2 Erosion and Sedimentation Action Items

1. The RLWD will seek partnerships with landowners, SWCD and USDA NRCS to implement BMPs that reduce agricultural erosion and slow water down.
2. The RLWD will seek out grant opportunities to conduct an erosion assessment on the entire course of the Grand Marais.
3. The RLWD will pursue projects in the eastern portions of the overall watershed that retain and slow down the delivery of water.

Table 20 provides a summary list of specific implementation actions for the subwatershed.

7.4.9 Summary and Conclusions

This section of the overall watershed management plan presents an overview of the Grand Marais subwatershed. Goals and objectives for the subwatershed are presented above for the following plan elements: 1) Natural Resources, 2) Water Quantity, 3) Water Quality and 4) Erosion and Sedimentation. Table 20 presents a summary list of specific implementation actions organized by these same plan elements.

Table 20
Grand Marais Subwatershed Implementation Actions

ACTION/GOAL	PLAN ELEMENT	SCHEDULE	CONCEPTUAL COST
Create additional 5,000 ac-ft of flood storage volume reduction within eastern portion of subwatershed to reduce agricultural and residential flooding (Project 60)	Water Quantity Action Item	Years 1-5	$5,000,000
Add buffers, farmland dikes and other restoration projects to slow delivery of water and lengthen hydrographs to reduce flooding	Water Quantity Action Item	Years 5-10	$100,000

Action/Goal	Plan Element	Schedule	Conceptual Cost
Partner with USDA NRCS, USACE, MPCA and SWCDs to implement projects that reduce agricultural and bank erosion and improve water quality	Water Quality Action Item	Ongoing	$25,000/year
Promote sharing data amongst the RLWD, RRWMB, MPCA and River Watch to improve water quality and project funding	Water Quality Action Item	Ongoing	$10,000/year
Seek partnerships with landowners, SWCD and USDA NRCS to implement BMPs to reduce erosion and slow water down	Erosion and Sedimentation Action Item	Ongoing	$5,000/year
Seek out grant opportunities to conduct erosion assessment on entire course of the Grand Marais	Erosion and Sedimentation Action Item	Ongoing	$5,000/year
Retain grasslands east of U.S. Highway 75	Natural Resource Action Item	Years 1-5	$125,000

7.5 Clearwater River Subwatershed Plan

7.5.1 Introduction

This section presents the implementation plan for the Clearwater River subwatershed (Figure 32). The plan is organized by first presenting a summary of important physical characteristics of the Clearwater River subwatershed. More detailed information on the subwatershed is available in Sections 2.0-5.0 and in Appendix 7. The section also identifies the problems related to water management in the subwatershed and describes the proposed solutions in the form of goals and objectives to address those problems.

The Clearwater planning basin includes Upper and Lower Badger creeks, Clearwater River, Hill River, Lost River and Poplar River minor subwatersheds. The landscapes in these subwatersheds provide a diversity of habitats with farmlands, grasslands, woodlands, wetlands, riparian areas and lakes. Public lands with quality habitats include numerous WMAs, WPAs and Rydell NWR. The majority of these lands are in the beach ridge areas. These include a mix of uplands and wetlands with some woodland areas. These lands provide seasonal and permanent habitats to a variety of species including game species such as white-tailed deer, sandhill crane, waterfowl, prairie chicken and sharp-tail grouse. CRP lands are present throughout the watershed with a concentrated band running east to west generally along the southeast border of Red Lake County (along a beach ridge area). These CRP lands are primarily grasslands. Several wild rice operations also provide some migratory wildlife habitat.

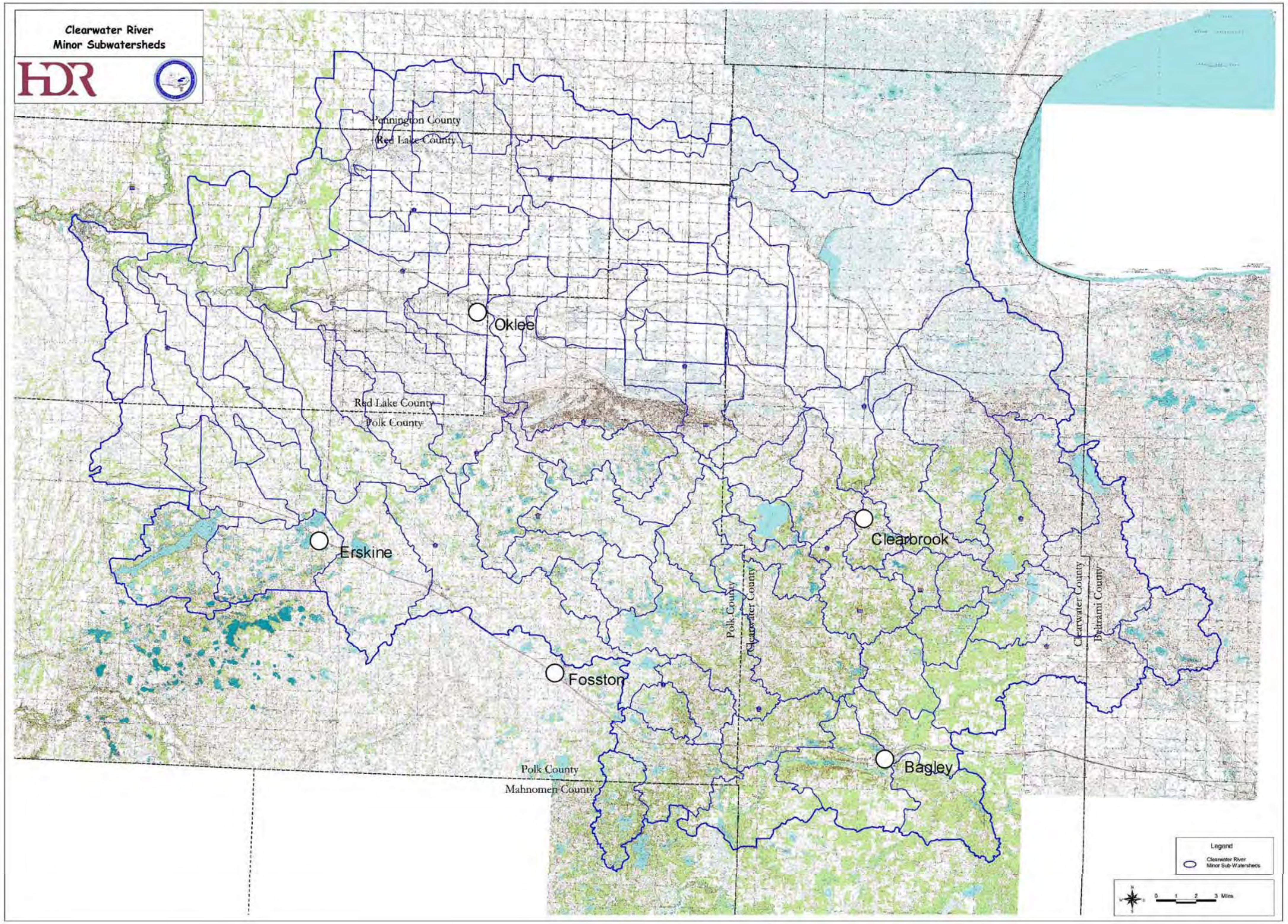
Lakes are prominent and important resources in this watershed. In particular, a number of small lakes are found throughout the southern half of the watershed. These include a mix of fishing and natural environment lakes that provide seasonal and migratory habitat for a variety of species.

Six natural waterways and their tributary networks are also important natural resource features of this watershed. These streams provide a variety of permanent and seasonal habitats for a variety of fish species. The Clearwater River is a trout stream from Clearwater Lake to the east Clearwater county line. The stream is somewhat degraded upstream from this area. From lake to confluence with ruffy brook the stream is in good shape. Pasture and woodlands form its corridor. Some wild rice production is present near its confluence with Ruffy Brook and there is an ongoing USACE project in the reach from Ruffy Brook to about five miles east of Plummer. The Poplar River, Hill River, Lost River and Upper and Lower Badger Creek are smaller systems than the Clearwater and primarily provide spawning and rearing habitat for fish. In most areas they have intact corridors that include some pasture areas. Portions of some streams have been dredged in the past but have become naturalized (e.g., Lost River between Oklee and Gully).

7.5.2 General Physical Characteristics

The Clearwater River subwatershed consists of an approximately 1,362 square mile area. The watershed outlets into the Red Lake River at Sportsman's Park in Red Lake Falls, MN. The Lost, Hill and Poplar rivers are minor tributaries to the Clearwater River. The watershed is located mainly within the Glacial Lake Agassiz/Aspen Parklands and Glacial Moraine ecoregions, but is bordered by the Northern Minnesota Drift and Lake Plains ecoregion. Soil textures range from loamy-skeletal in the southeastern portion of the watershed to sandy in the west portion of the watershed. The area consists largely of agricultural and forest land, but is also made up of wetland, urban and grassland (Table 21). The following presents a general summary of surface water and groundwater in the subwatershed. The summary is followed by a discussion of the problems, goals, policies and implementation actions for each of the four plan elements: 1) Natural Resources, 2) Water Quantity, 3) Water Quality and 4) Erosion and Sedimentation.

Figure 32
Clearwater River Subwatershed Map



7.5.3 Surface Water Summary

This subwatershed is also comprised of five smaller subwatersheds which outlet into the Clearwater River. These five subwatersheds include the Beau Gerlot Creek, Badger Creek, Hill River, Lost River and Poplar River subwatersheds. The Clearwater River subwatershed is bordered along its north side by the Upper Red Lake River subwatershed. All of the drainage from within the smaller subwatersheds ends up in the Clearwater River. All of the water comes together in the Clearwater River and outlets at the confluence with the Red Lake River in Red Lake Falls.

There are many lakes in the Clearwater River subwatershed. There are 28 lakes larger than 100 acres and 107 lakes smaller than 100 acres. Major lakes for recreation include Maple, Cameron, Badger, Clearwater, Pine, Oak, Cross, Turtle, Buzzel and Whitefish. The larger lakes typically support a fishery, with the majority of smaller lakes only supporting waterfowl hunting as a recreation. Much of the shoreline is developed on the larger lakes, and the majority of small lakeshores are undeveloped.

Wetland areas are scattered throughout the area. These wetland areas are considerably denser in the extreme northeastern portion of the subwatershed, especially within the Red Lake Reservation, where the original wetlands are intact. Many of the wetlands have been altered by farm drainage, and many wetlands have been drained for the purposes of agricultural production.

Table 21
Land Use Characteristics for the Clearwater River Subwatershed

CHARACTERISTIC	AREA
Basin Area (sq mi.)	1,362
Basin Area (acres)	871,387
Wetland Area NWI (acres)	144,460
MINNESOTA WETLAND TYPE	
1	2,324
2	40,319
3	25,968
4	1,820
5	19,663
6	36,740
7	9,660
8	7,965
Lakes/Rivers (acres)	23,454
Total Wetlands/Lakes/Rivers	167,914
ECOREGIONS OF RLWD (ACRES)	
Lake Agassiz, Aspen Parklands	384,431
Minnesota & NE Iowa Morainal	304,853
N. Minnesota & Ontario Peatlands	55,386
N. Minnesota Drift & Lake Plains	126,687
Red River Valley	29
LAND USE (ACRES)	
Cultivated Land	471,450
Forest Land	245,555
Grass/Brushland	60,435
Mines	1,078
Water	24,738
Developed Land	7,101
Wetlands	60,944
Other	86

7.5.4 Groundwater Summary

The subwatershed is located in parts of the Lake-Washed Till Plain and Moraine physiographic area of the RLWD. The surficial geology of the area consists of mainly glacial tills to the south, peat to the northeast, lake-washed till to the northwest and sand to the southwest. The glacial till deposits consist of sandy, clay-silt loam containing fine to medium gravel with a scattering of boulders. The peat deposits are generally only a few feet thick, accompanied by the poor drainage and the water table at or near the land surface. Sand deposits are described as being very-fine to fine and commonly less than 20 feet thick. The lake-washed till deposits have a composition similar to the glacial till and are overlain in many local low areas by thin deposits of clay, silt, sand and peat. In the southern section of the subwatershed, just north of Bagley (and other small regions to the north), deposits of sand and gravel from outwash and ice contact features are present. The deposits consist of fine sand to medium gravel, with thicknesses ranging from a few feet to almost 100 feet. Local topography is generally hilly, with improved drainage over other areas in the watershed.

Glacial sediment aquifers in the region provide moderate amounts of groundwater. Suitable yields of 5 gpm or more for domestic use can be found in sand lenses within the till. These lenses are often localized and yields can vary and may accommodate municipal or industrial uses. Outwash and ice-contact sand and gravel aquifers are the best source in the watershed for a large groundwater supply. Yields can reach several hundred gpm. The areal extent of the aquifer is fairly large, and water quality is adequate for municipal, industrial, domestic and irrigation use. Hardness is generally greater than 180 mg/l, and iron content may be high.

Paleozoic sediments consisting of shales and limestones are discontinuous and underlie the glacial sediments along the western side of the subwatershed. Precambrian crystalline rocks underlie glacial sediments in most of the watershed. The fractured surface of crystalline rocks may provide an adequate supply of groundwater for localized domestic use but are not a good commercial or municipal source of groundwater.

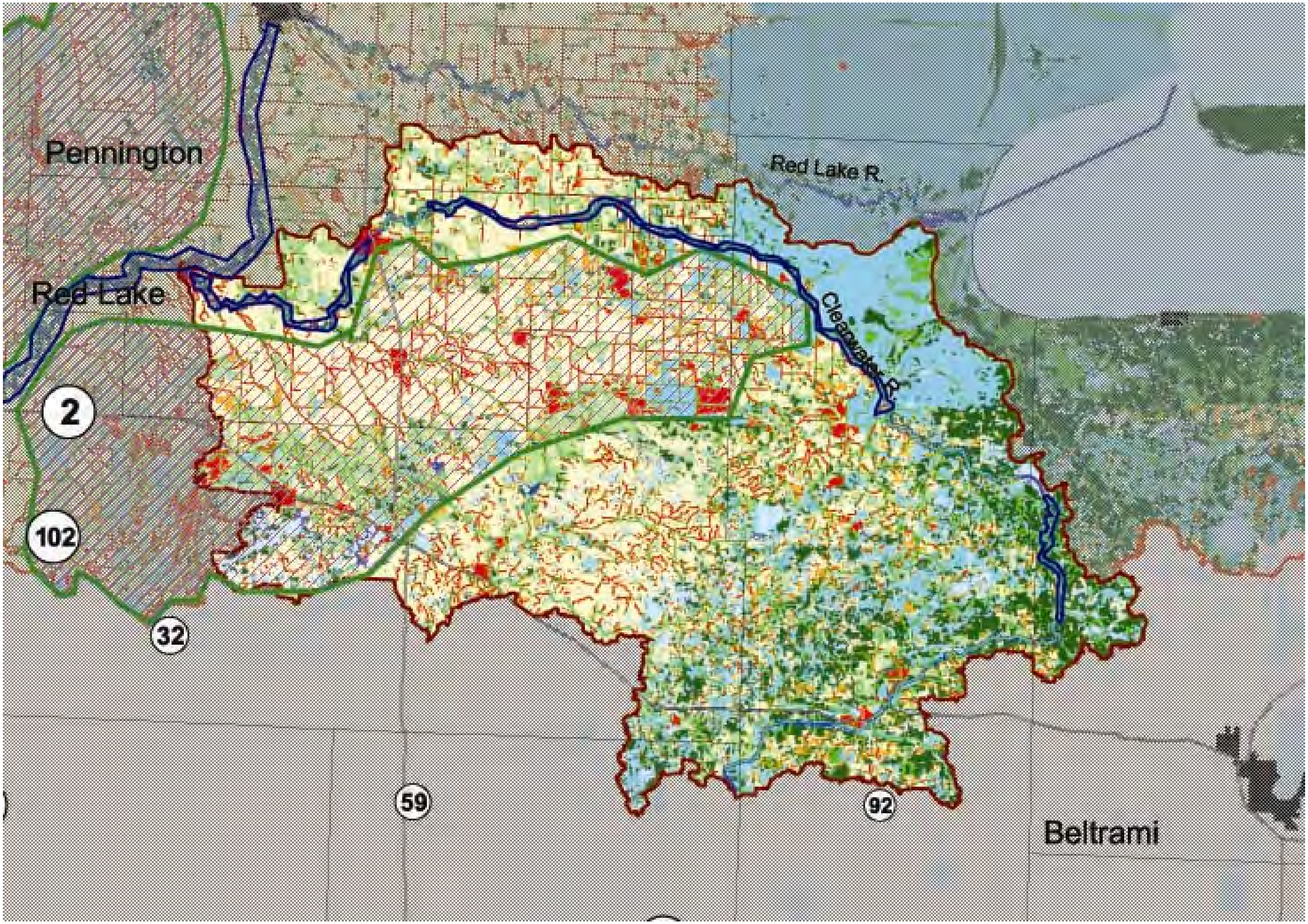
Information regarding the individual city wells, water quality analysis results and the aquifers that serve as the water supply can be obtained from the individual cities and the Minnesota Geological Survey.

7.5.5 Natural Resources Implementation Plan

The Clearwater River was identified as an important resource within the region that needs to be recognized and protected. Recreational activities, including hunting, fishing, tubing and swimming, were all identified as being popular activities. It is important to note that a large portion of the Clearwater River has been channelized and instream habitat quality and channel stability have been substantially reduced, both within and downstream of the channelized segment.

Natural resources problems and issues were identified using a questionnaire with resource agencies. Results of this questionnaire as the resource inventory were considered by a National Resources subcommittee. Priority natural resource areas are shown in Figure 33. The following are the major goals and actions recommended by the Natural Resources subcommittee.

Figure 33
Clearwater Priority Natural Resources Areas



7.5.5.1 *Improve Fish Habitat in the Clearwater River and its Tributaries*

- Support activities that reduce the flashiness and enhance base flows
- Maintain smallmouth bass fishing in the lower portion of the Clearwater and downstream segments of Lost and Poplar rivers
- Maintain stream connectivity. Sampling efforts before and after the modification of the Crookston dam has demonstrated a substantial increase in channel catfish in the Red Lake River. It is likely that channel catfish will move into streams within the Clearwater River subwatershed and establish a fishery
- Stabilize stream banks in areas of accelerated erosion
- Buffer corridors
- Increased habitat complexity, especially within channelized stream segments
- Reduce sediment load in streams
- Strategies include improved ditches with side inlets, buffer and grassed waterways, residue management, tree plantings, reduce farming into road ditches

7.5.5.2 *Maintain and Improve Existing Lake Quality*

- Implement consistent shoreland zoning
- Develop lake watershed plans
- Participate in shoreland development planning
- Improve stormwater planning in lake watersheds

7.5.5.3 *Maintain and Improve Wildlife Habitat (indicators could be land base statistics or prairie chicken and sharp-tail population levels)*

- Re-establish habitat corridors along all major waterways
- Identify key areas and connect existing habitats along the corridors by promoting land use changes
- Protect existing grassland habitats
- Identify and protect existing tracts of prairie
- Retain or increase CRP acres in those areas that already have considerable amounts of CRP. Care must be taken to reduce fire risk associated with uncontrolled burning of peat fires
- See MnDNR land management plan for some good targets and strategies
- Enhance existing grassland habitats

- ❖ Encourage active vegetation management that maintains grassland quality (prescribed burning, weed control, etc)
- ❖ Target CRP to increase number of large blocks of grassland habitats
- ❖ Protect existing wetland habitats
- ❖ Support efforts to retain WRP acres
- ❖ Support WCA enforcement
- ❖ Enhance existing wetland habitats
- ❖ Target wetland restorations in areas near existing restorations
- ❖ Encourage active vegetation management that maintains wetland quality (moist soil management, prescribed burning, weed control, etc)
- ❖ Target CRP and WRP to increase number of wetland complexes

7.5.5.4 Increase Recreational Opportunities

- ❖ Partner to highlight existing opportunities
- ❖ Wildlife viewing/birding, hunting and trails
- ❖ Increased recreational opportunities in the area around Maple Lake and Rydell NWR

The Natural Resources Committee's recommendations were used by the RLWD to follow the following Natural Resources goals, objectives and specific action items are presented in Table 23 at the end of the section.

7.5.6 Water Quantity Implementation Plan

Due to terrain, draining of wetlands for cropland and/or under-designed structures, the Clearwater River subwatershed experiences frequent flooding throughout the subwatershed. Spring flooding is almost an annual occurrence in this watershed. Damages associated with this type of flood are to public infrastructure, personal property, cropland and public resources (fisheries, wildlife, soils and water quality). Agricultural flooding and damages in the cities of Bagley, Clearbrook and Mentor were identified as the highest priority flooding issues. In addition to projects shown in Figure 23, it is the RLWD's goal to address the following issues within the Clearwater River subwatershed:

7.5.6.1 Clearwater River FDR Rankings

- Agricultural crop damages.
- Overland flooding in Clearbrook, Bagley and Mentor.
- Farmstead flooding.

7.5.6.2 FDR Action Items

1. The RLWD will partner with the Red Lake Band of Chippewa Indians, local, state and federal agencies to implement 10,000 ac-ft of flood volume reduction projects within this subwatershed. Care will be taken to avoid impacts to the environment in the Red Lake Nation.
2. The RLWD will coordinate with wild rice producers to determine a mutually beneficial approach to utilizing rice paddy storage volume for FDR downstream.
3. The RLWD will pursue projects that reduce bank erosion and still provide adequate agricultural drainage.
4. The RLWD will respond to petitions and other requests for the ditches that are actively managed by the RLWD. The RLWD will seek partnerships with the county and private landowners to improve the overall coordination and management of the public and private ditch system.
5. The RLWD will continue to actively promote the farmstead ringdike program.
6. The RLWD will work with the cities of Bagley, Clearbrook and Mentor to secure grant funding to implement projects and address overland flood problems.

7.5.7 Water Quality Implementation Plan

The MPCA has identified the Clearwater River as an impaired water body due to high levels of turbidity, TSS, fecal coliforms and low dissolved oxygen during periods of low flow.

Water quality monitoring has been done by the RLWD at 19 sites associated with streams since 1984 and more recently at four other sites on lakes within the subwatershed. Lakes being monitored include Clearwater Lake (1993), Cameron Lake (2003) and Maple Lake (2004). The parameters measured included field measurements for dissolved oxygen, pH, temperature, turbidity, transparency and conductivity. Laboratory analysis is performed on stream samples for fecal coliform, orthophosphorus, nitrates and nitrites, ammonia, total Kjeldahl nitrogen and alkalinity. Lakes monitoring data includes Secchi depth readings, as well as total phosphorus and chlorophyll-a analysis. The RLWD periodically prepares a water quality report. Results are available upon request in the RLWD office.

The MPCA 2006 Draft List of Impaired Waters identifies aquatic life or aquatic recreation. Since mercury impairments (aquatic consumption impairments) were found throughout the entire RLWD and are not something that can be managed at the local level, they are excluded from this list.

- Clearwater River
  - Headwaters to T148 R36W S36 east line (Beltrami/Clearwater County Border)
    - Low dissolved oxygen
  - Ruffy Brook to Lost River
    - Fecal coliform
    - Low dissolved oxygen
  - Lower Badger Creek to Red Lake River
    - Turbidity
- County Ditch 57
  - Low dissolved oxygen
- Lost River
  - Anderson Lake to Hill River
    - Fecal coliform
  - T148 R38W S17 south line to Pine Lake
    - Low dissolved oxygen
- Poplar River
  - Spring Lake to U.S. Highway 59
    - Low dissolved oxygen
- Poplar River Diversion
  - Unnamed ditch to Badger Lake
    - Low dissolved oxygen
- Silver Creek
  - Headwaters to Anderson Lake
    - Fecal coliform
- Unnamed Creek – Eighteen Lake to Bee Lake
    - Low dissolved oxygen
- Unnamed Creek – Mitchell Lake to Badger Lake
    - Low dissolved oxygen
- Walker Brook
  - Walker Brook Lake to Clearwater River
    - Low dissolved oxygen

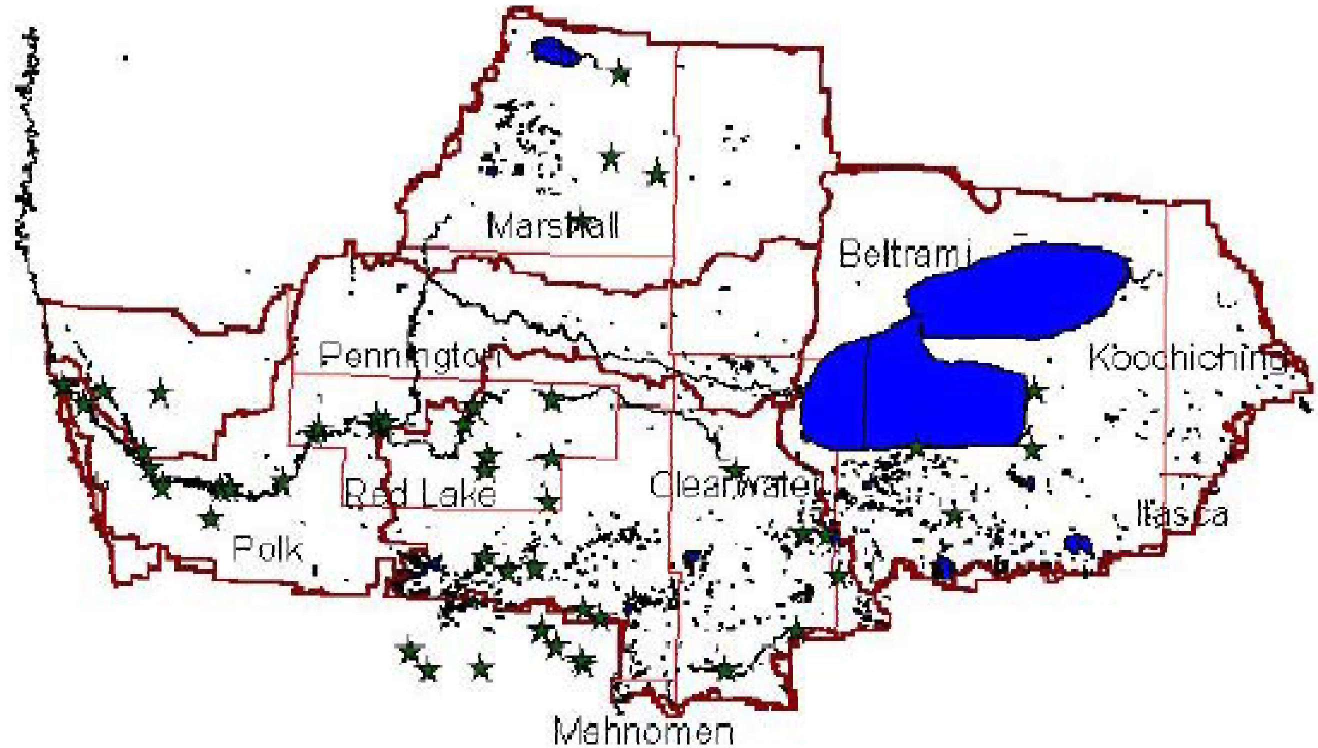
Clearwater Lake straddles the Clearwater County and Beltrami County border along the path of the Clearwater River. The water quality within this lake is normally quite good. High algae blooms and a sharp increase in the trophic state of the lake in 1997 increased local concern over the water quality of the lake. These water quality problems were most likely caused by high flows in the watershed and untreated wastewater bypassed by the overloaded Bagley wastewater treatment facility. In 2003, the Clearwater Lake Water Quality Model Study and the Clearwater Lake Management Plan were completed. The study found that the water quality within the lake has recovered since 1997, and the average trophic state levels are at a desirable level within the mesotrophic range. After 1997, there was a weed problem on the lake. The amount of floating vegetation has decreased since then, but the amount of rooted vegetation has increased in recent years, making access to the lake difficult from some docks and nearly blocking entrance to the southeast bay of the lake. This increased growth in vegetation may be due to phosphorus that has settled to the bottom of the lake. Clearwater Lake is monitored by the RLWD in cooperation with the Clearwater Lake Area Association (CLAA) and is also monitored once every three years by the Clearwater SWCD. The Clearwater Lake Management Plan sets goals for protecting and improving water quality within the lake.

The RLWD also sponsors River Watch programs for nine schools. The goals of the program are to develop baseline water quality data, provide hands on "real world" science opportunities for students and promote greater citizen awareness and understanding of watersheds and the role of watershed districts. Senior high students from participating schools perform the monitoring, including field collection and lab analysis. Field measurements of dissolved oxygen, water temperature, pH, conductivity, transparency, turbidity, stage, water depth and stream width are collected at each site along with appearance and recreational suitability observations. Each school collects data at least once per month. River Watch groups prepare reports based upon monitoring results. These reports are then presented at area River Watch forums. In addition to the schools listed below, Bagley started a River Watch program in 2004. Some schools plan on adding or changing monitoring sites as well.

Table 22
River Watch Sites (2004)

	SITE NAME	RIVER
Clearbrook/Gonvick	CG 40	Clearwater River
Clearbrook/Gonvick	CG 20	Clearwater River
Clearbrook/Gonvick	CG 50	Clearwater River
Clearbrook/Gonvick	CG 30	Clearwater River
Clearbrook/Gonvick	CG 35	Clearwater Lake outlet
Clearbrook/Gonvick	CG 10	Clearwater River
Red Lake County Central	OK 10	Clearwater River
Red Lake County Central	PL 10	Clearwater River
Red Lake County Central	PL 20	Clearwater River
Red Lake Falls	CL 10	Clearwater River

Figure 34
River Watch Sites within the Red Lake Watershed District



7.5.7.1 SWCD Monitoring Locations

Several SWCDs within the RLWD conduct monitoring programs of their own. The Pennington and Red Lake SWCDs all conduct stream monitoring. The Clearwater SWCD conducts their own lake monitoring programs and has assisted the RLWD with stream monitoring for special studies.

The list of past and present RLWD special projects includes the Clearwater River Intensive Low Flow Monitoring, Cross Lake and Turtle Lake Water Quality Study, Beaver Pond Water Quality Study, TMDLs on the Clearwater River, Clearwater Lake monitoring, Maple Lake monitoring and Clearwater Lake Water Quality Model projects.

Current special studies include the Red River Basin Buffer Initiative, Maple Lake Monitoring and the Clearwater River Small Cities Stormwater Project. The Red River Basin Buffer Strip Initiative project involves monthly monitoring at the Silver Creek long-term monitoring site (#81). The extra monitoring at this site is conducted as part of a cost share agreement between the RLWD and the Red River Basin Commission.

The watershed will continue to assess the problem and the data available for the next 303D assessment. It is the RLWD's goal to address the following issues with the Clearwater River subwatershed.

7.5.7.2 Clearwater River Water Quality Rankings

- Turbidity, TSS, fecal coliform and low dissolved oxygen 303D impairment.
- Potential impacts of TMDLs on wild rice operations.
- Maple Lake water quality.

7.5.7.3 Water Quality Action Items

1. The RLWD will actively partner with the USDA NRCS, USACE, MPCA and the SWCDs to seek to implement projects that reduce agricultural and bank erosion and improve water quality.

The Clearwater River Small Cities Stormwater Project is being conducted in order to determine the need for stormwater retention in the cities of Clearbrook and Gonvick. Stormwater modeling will be conducted to determine the ideal size and location of stormwater retention ponds in the cities. The sediment and nutrient reduction estimates will be compared to monitoring results.

The RLWD is currently participating in a TMDL study on two impaired reaches within the Clearwater River watershed. The trout stream portion of the Clearwater River is listed as impaired for fecal coliform. Walker Brook, a tributary that enters the Clearwater River near Bagley, is impaired for dissolved oxygen. Both listings were based upon data collected for the Clearwater Nonpoint Study in 1992 and 1993. The Clearwater River was monitored intensively once again in 2002 for the Clearwater Lake Water Quality Model Project. The Clearwater SWCD also collected fecal coliform samples in late summer and fall of 2002. The new data shows that the reach is no longer impaired for fecal coliform. Only one set of samples exceeded the standard of 200 coliforms/100 ml. These samples were collected during a large rainfall and runoff event. The results of the study will recommend that the trout stream reach of the Clearwater River be de-listed. The Walker Brook impairment, on the other hand, is still impaired by low dissolved oxygen levels. Ancient, oxygen depleted groundwater is a major source of water for this stream. The stream also flows through organic soils and fens. The decomposition occurring in these depletes oxygen further.

Table 23 provides a summary list of specific implementation actions for the subwatershed.

7.5.8 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 for this 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. It is the RLWD's goal to address the following issues with the Clearwater River subwatershed:

7.5.8.1 Clearwater River Erosion and Sedimentation Rankings

- ❖ Tributary bank instability at the outlets into the river.
- ❖ Lost River channel and streambank erosion.
- ❖ Ditches outletting into natural streams and contributing sediment.

7.5.8.2 Erosion and Sedimentation Action Items

1. The RLWD will seek partnerships with landowners, SWCD and USDA NRCS to implement BMPs that reduce agricultural erosion and slow water down.
2. The RLWD will seek out grant opportunities to conduct an erosion assessment on the entire course of the Clearwater River.

Table 23 provides a summary list of specific implementation actions for the subwatershed.

7.5.9 Summary and Conclusions

This section of the overall watershed management plan presents an overview of the Clearwater River subwatershed. Goals and objectives for the subwatershed are presented above for the following plan elements: 1) Natural Resources, 2) Water Quantity, 3) Water Quality and 4) Erosion and Sedimentation. Table 23 provides a summary list of specific implementation actions organized by these same plan elements.

Table 23
Clearwater River Subwatershed Implementation Actions

Action/Goal	Plan Element	Schedule	Conceptual Cost
Partner with the USDA NRCS, USACE, MPCA and the SWCDs to seek to implement projects that reduce agricultural and bank erosion and improve water quality	Water Quality Action Item	Years 1-5	$25,000
Seek partnerships with landowners, SWCD and USDA NRCS to implement BMPs that reduce agricultural erosion and slow water down	Erosion and Sedimentation Action Item	Years 1-5	$10,000
Seek grant opportunities to conduct an erosion assessment on the entire course of the Clearwater River	Erosion and Sedimentation Action Item	Ongoing	$25,000
Retain or Increase CRP acres	Natural Resource Action Item	Ongoing	$50,000
Pursue 10,000 ac-ft of flood volume reduction, including use of rice paddies	Water Quantity Action Item	Years 1-10	$10,000,000
Improve District website and education programs	Watershed-wide Activity	Ongoing	$10,000
Continue/expand River Watch program	Watershed-wide Activity	Ongoing	$10,000
Develop monitoring locations (TMDL)	Watershed-wide Activity	Ongoing	$20,00
Implement lake restoration projects	Watershed-wide Activity	Ongoing	$250,000
Promote comprehensive ditch management strategies	Watershed-wide Activity	Ongoing	$25,000

7.6 RED LAKES – UPPER AND LOWER

7.6.1 Introduction

This section presents the implementation plan for the Upper and Lower Red lakes subwatershed (Figure 35). The plan is organized by first presenting a summary of the important physical characteristics of the Upper and Lower Red lakes subwatershed. More detailed information on the subwatershed is available in Sections 2.0-5.0 and in Appendix 7.

The Red Lakes are the most significant natural resource feature in this subwatershed. These lakes historically have provide a tremendous walleye fishery. Current plans being implemented to rehabilitate this fishery appear on course. The current crappie fishery and northern pike fishery are outstanding. Tributary streams to the lakes provide spawning habitat. Some of these streams have erosion issues. Rice farms on Tamarac River and Shotley Brook, peatlands north of Red Lake and bog areas are also prominent aquatic features.

The remaining landscape in this planning basin is dominated by wetlands including peatlands, bogs and shrublands. These areas provide habitat for a diversity of species. Public lands are common and most of this area is within the boundary of the Red Lake Indian Reservation.

7.6.2 General Physical Characteristics

The Red Lakes watershed consists of an approximately 1,929 square mile area. The watershed outlets into the Red Lake River at the Red Lake Dam. The watershed is located entirely within the Northern Minnesota Peatlands and the Northern Minnesota Drift and Lake Plains ecoregions. Soil textures range from fine-loamy in the southern portion of the watershed to hemic/sapric in the northern portion of the watershed with a buffer strip of sandy soils around Lower Red Lake. The area consists largely of forest land, lakes and wetlands, with very little agricultural or developed land (Table 24).

The following presents a general summary of surface water and groundwater in the subwatershed. The summary is followed by a discussion of the problems, goals, policies and implementation actions for each of the four plan elements: 1) Natural Resources, 2) Water Quantity, 3) Water Quality and 4) Erosion and Sedimentation.

Figure 35
Red Lakes Subwatershed Map

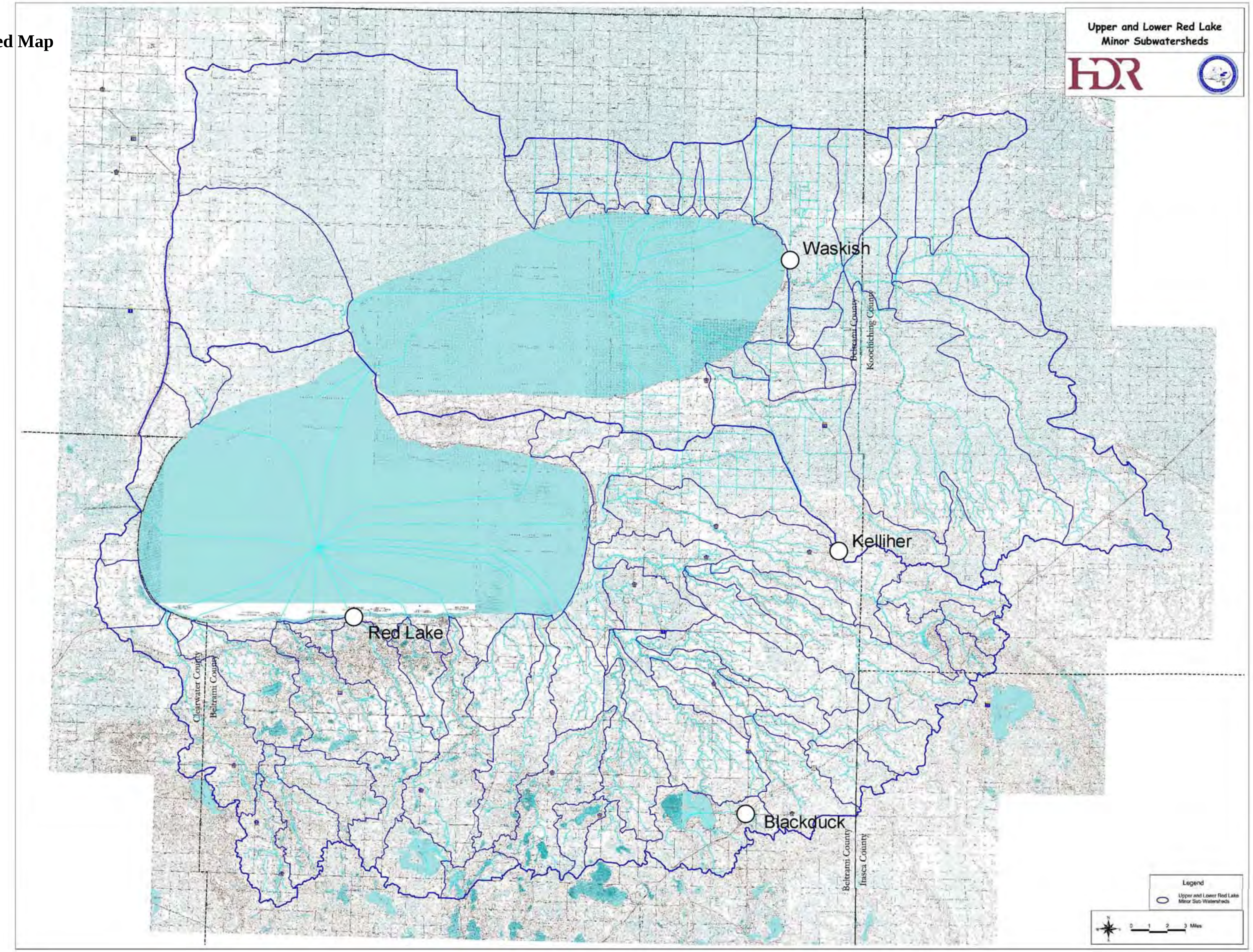


Table 24
Land Use Characteristics for the Upper and Lower Red Lakes Subwatershed

CHARACTERISTIC	AREA
Basin Area (sq mi.)	1,929
Basin Area (acres)	1,234,747
Wetland Area NWI (acres)	855,675
MINNESOTA WETLAND TYPE	
1	3,878
2	28,221
3	22,087
4	2,416
5	299,716
6	139,141
7	60,323
8	299,894
Lakes/Rivers (acres)	302,962
Total Wetlands/Lakes/Rivers	1,158,637
ECOREGIONS OF RLWD (ACRES)	
Lake Agassiz, Aspen Parklands	704
Minnesota & NE Iowa Morainal	-
N. Minnesota & Ontario Peatlands	988,851
N. Minnesota Drift & Lake Plains	254,191
Red River Valley	-
LAND USE (ACRES)	
Cultivated Land	62,972
Forest Land	610,310
Grass/Brushland	21,819
Mines	172
Water	304,735
Developed Land	3,579
Wetlands	240,160
Other	-

7.6.3 Surface Water Summary

The Red Lakes subwatershed is the uppermost reach of the RLWD. All of the drainage from within the smaller subwatersheds ends up in the Red Lakes and eventually outlets into the Red Lake River at the Red Lake Dam. Dam outflows are controlled by the USACE.

There are 86 named lakes in the Red Lakes subwatershed, of which 18 are over 100 acres. Major lakes for recreation include: the controlled eastern portion of the Upper Red Lake Basin, Bass, Blackduck, Julia, Medicine, Island, Puposky, Sandy and White Fish Lakes. The larger lakes typically support a fishery, with the majority of smaller lakes only supporting waterfowl.

Wetland areas are scattered throughout the area. These wetland areas are somewhat denser in the northern and eastern portions of the subwatershed, especially within the Red Lake Reservation. The majority of the northern and eastern wetlands have been left untouched. Remaining wetlands have been estimated to be 53-95 percent of pre-settlement extent. Much of the northern and eastern areas of this watershed have been devoted to wildlife management areas.
Drainage systems in this subwatershed are a complex network of natural streams with a few legal ditch systems. Generally, the ditch systems are under the administration of the county in which they reside or of the Red Lake Band of Chippewa Indians.

Although there are not currently any monitoring locations within this subwatershed, the RLWD has past data available at one site associated with a stream from 1989 to 2002. The Red Lake Band of Chippewa Indians and MnDNR now monitor all major streams that enter the lakes as well as the lakes themselves within the subwatershed. The parameters measured included field measurements for dissolved oxygen, pH, temperature, turbidity, transparency and conductivity. Laboratory analysis is performed on stream samples for fecal coliform, TSS, total dissolved solids, chemical oxygen demand, total phosphorus, orthophosphorus, nitrates and nitrites, ammonia, total Kjeldahl nitrogen and alkalinity. Lakes monitoring data includes Secchi depth readings, as well as total phosphorous and chlorophyll-a analysis. The RLWD has past data available, but current data can be obtained from the Red Lake Department of Natural Resources (RLDNR). There are no impaired stream reaches as identified by the MPCA in this subwatershed.

7.6.4 Groundwater Summary

The subwatershed is located in the Moraine physiographic area of the Red Lake River Watershed District. The surficial geology of the area consists of mainly glacial tills in the southern region of the watershed and glacial sands and peat lands surrounding the Upper and Lower Red lakes to the north. The glacial till deposits consist of sandy, clay-silt loam containing fine to medium gravel with a scattering of boulders. The peat deposits are generally only a few feet thick, caused by the poor drainage and the water table at or near the land surface. Peat deposits also occur locally within closed depressions found in the moraine. Sand deposits are described as being very-fine to fine and commonly less than 20 feet thick. Drainage is improved over areas containing clays and silts. Deposits of both sand and peat are underlain by till in most places.

Glacial sediment aquifers in the region provide very moderate amounts of groundwater. Suitable yields of 5 gpm or more, for domestic use, can be found in sand lenses within the till. These lenses are often localized, and yields can vary and may accommodate municipal or industrial uses. Hardness of the groundwater is commonly greater than 180 mg/l.

Precambrian crystalline rocks underlie the glacial deposits throughout the watershed. The crystalline rocks do not provide an adequate supply of groundwater due to the few, localized, interconnected fractures in the bedrock.

Information regarding the individual city wells, water quality analysis results and the aquifers that serve as the water supply can be obtained from the individual cities and the Minnesota Geological Survey.

7.6.5 Natural Resources Implementation Plan

The Red River Flood Damage Reduction Mediation Agreement requires the protection and enhancement of natural resources be considered and incorporated into the next generation of watershed plans. To fill this gap in natural resource data, the BWSR contracted with the MCEA to provide natural resource assessments of the RLWD. The following subsection summarizes this natural resource assessment and incorporates the information into the subwatershed plan.

The Upper and Lower Red lakes were identified as being truly unique and significant natural resources. It was widely recognized that the RLWD, local, state and federal agencies and the Red Lake Band need to work together to ensure the long-term health and sustainability of this resource.

Natural resource problems and issues were identified using the questionnaire with resources agencies. Results of this questionnaire and the resource inventory were considered by a Natural Resources Subcommittee. The following are the major goals and actions recommended by the Natural Resources Subcommittee.

7.6.5.1 Support Active Management of Red Lake Fish Populations

See Recovery Plan for Red Lakes Walleye Stocks (MnDNR, Red Lake Band of Chippewa Indians).

7.6.5.2 *Improve Fish Habitat in Red Lake Tributaries*

- Manage water appropriation and discharge methods in a manner that is compatible with fish spawning and early life stage requirements
- Stabilize stream banks in areas of accelerated erosion
- Reduce sediment load in streams
- Buffer all watercourses
- Reduce sediment input into the Red Lakes
- Implement agricultural BMPs to reduce wind and water erosion throughout the subwatershed
- Other strategies include improved ditches with side inlets, buffer and grassed waterways, residue management, tree plantings, reduce farming into road ditches
- Maintain and improve wildlife habitat (indicators could be land base statistics or sharp-tail or deer or moose population levels)
- Maintain habitat corridors along all major waterways
- Identify key areas and connect existing habitats along the corridors by promoting land use changes
- Connect existing corridor woodland and wetland habitats
- Protect and enhance existing brushland habitats
- Protect existing tracts of brushlands
- Manage vegetation actively to maintain brushlands and diversity
- Retain or increase CRP acres in those areas that already have considerable amounts of CRP
- See MnDNR land management plan for some good targets and strategies
- Protect existing woodland habitats
- See MnDNR land management plan for some good targets and strategies
- Enhance existing woodland habitats
- Protect existing wetland habitats
- Support efforts to retain WRP acres
- Support WCA enforcement
- Enhance existing wetland habitats

- ❖ Target wetland restorations in areas near existing restorations
- ❖ Encourage active vegetation management that maintains wetland quality (moist soil management, prescribed burning, weed control, etc)

7.6.5.3 Increase Recreational Opportunities

- ❖ Partner with other groups to highlight existing opportunities
- ❖ Wildlife viewing/birding, hunting and trails

The Natural Resource Committee's recommendations were used by the RLWD to develop the following natural resource goals, objectives and specific action items are presented in Table 27.

7.6.6 Water Quantity Implementation Plan

The Red Lakes subwatershed is unique in that a large portion of the land is controlled by tribal interests and the outlet of the lake is controlled by the USACE. The discussions of water quantity centered on the outlet and the impacts on downstream interests. It is the RLWD's goal to address the following issues with the Red Lakes subwatershed:

7.6.6.1 Red Lakes FDR Rankings

- ❖ Cabin flooding.
- ❖ USACE operations of the outlet.
- ❖ Water release impacts to downstream Red Lake River.

7.6.6.2 FDR Action Items

1. The RLWD will seek to partner with the Red Lake Band of Chippewa Indians, MnDNR, Waskish Township, Upper Red Lake Area Association and the USACE to manage the outlet of Red Lake in a way that reduces flood damages and protects the resources of Upper and Lower Red lakes.

Table 27 provides a summary list of specific implementation actions for the subwatershed.

7.6.7 Water Quality Implementation Plan

There are no impaired stream reaches as identified by the MPCA in this subwatershed. Efforts, therefore, focus on monitoring to identify trends. The RLWD's Water Quality Project has been ongoing since 1984. The RLWD's commitment to this project reflects the recently heightened awareness and increased concern for water quality from the public and agencies alike.

Although not currently monitoring any locations within this subwatershed, the RLWD has available at one site past data associated with a stream from 1989 to 2002. The Red Lake MnDNR now monitors all major streams that enter the lakes as well as the lakes themselves within the subwatershed. The parameters measured include field measurements for dissolved oxygen, pH, temperature, turbidity, transparency and conductivity. Laboratory analysis is performed on stream samples for fecal coliform, TSS, total dissolved solids, chemical oxygen demand, total phosphorus, orthophosphorus, nitrates and nitrites, ammonia, total Kjeldahl nitrogen and alkalinity. Lakes monitoring data includes Secchi depth readings, as well as total phosphorous and chlorophyll-a analysis. The RLWD has past data available, but current data can be obtained from the RLDNR.

Table 25
Upper and Lower Red Lakes Water Quality Monitoring Sites Summary

WATERSHED NAME	Upper and Lower Red Lakes
IMPAIRED WATERS	None
NUMBER OF STREAM SAMPLING SITES	9 historical sites, 1 monitored through 2002
RLWD	0
RLDNR	at least 10
RIVER WATCH	4
MPCA	0
FIELD PARAMETERS	dissolved oxygen, pH, water temperature, turbidity, transparency, conductivity, total dissolved solids, stage
LABORATORY PARAMETERS	**Total phosphorus, orthophosphorus, TSS, total dissolved solids, total Kjeldahl nitrogen, ammonia nitrogen, nitrates plus nitrates, fecal coliform and E. coli**
EARLIEST SAMPLING DATA	1989
KEY SAMPLING LOCATIONS	Mud Creek in Redby
OTHER NOTES	The Red Lake Department of Natural Resources monitors all the main streams that inlet to the lake, as well as the Red Lakes themselves

It is not RLWD's intent to duplicate other testing programs within the district but to complement them. Since the RLDNR currently monitors sites within this subwatershed, this plan does not call for the RLWD to duplicate that effort, but instead to coordinate with the RLDNR and use their data.

Standard methods have been created and are used from monitoring program to monitoring program to ensure that data is comparable. In 2002, the RLWD and RLDNR learned that both organizations had been monitoring the same sites for over 10 years. These sites were NEB-2 and the Lower Red Lake Dam (#740 on the Red Lake River) monitoring site. Site NEB-2 is in the City of Redby, at the crossing of State Highway 89/1 and Mud Creek. This site was monitored through 2002 by the RLWD. It was dropped for the 2003 sampling year because of duplication of sampling efforts between the RLWD and the RLDNR, a hazardous site location (narrow bridge) and a lack of water quality programs in the area. There is a fish hatchery downstream, and it has good dissolved oxygen levels.

The RLDNR also monitors water quality at all the inlets to the Upper and Lower Red lakes, as well as the Red Lake Dam. Below is a chart listing the portion of the RLDNR sites that are part of the EPA STORET database.

Table 26
RLDNR Monitoring Sites from STORET

STATION ID	DESCRIPTION
RLI001	BATTLE R AT PONEMAH RD 0.2 MI UPST OF THE MOUTH
RLI002	BIG STONE LK AT SH-1, 300' UPST LOWER RED LAKE
RLI003	BLACKDUCK R AT PONEMAH RD 7 MILES E REDBY
RLI004	RED LAKE R AT LOWER RED LAKE OUTLET DAM
RLI005	SANDY R AT SH-1 10 MILES W OF RED LAKE
RLI006	SANDY R AT I.S.#6, 3/4 MI UPST FROM SH-1
RLI007	SHOTLEY BK 100 FEET UPST MOUTH AT UPPER RED LK
RLI008	TAMARAC R UPST OF SH-72 AT WASHKISH
RLI009	MAHNOMIN (sic) R 1/4 MI UPST MOUTH AT UPPER RED LAKE
RLI010	PIKE CK AT I.S.#12 2 MI SE OF RED LAKE
RLI011	PIKE CK 100' UPST MOUTH IN RED LAKE
RLI012	PIKE CK S OF BIA MAINT. BLDG IN RED LAKE
RLI013	MUD R 100 FT UPST LOWER RED LAKE AT REDBY
RLI014	L ROCK CK 100 FT UPST LOWER RED LAKE 4 MI W RED
RLI015	CLEARWATER R AT KIWOSAY INLLET DITCH ROAD
RLI016	CLEARWATER R AT KIWOSAY WILD. AREA ACCESS RD.

The water quality of the Upper and Lower Red lakes is relatively good. The need to implement BMPs on tributaries to the lakes was identified as the chief water quality concern. It is the RLWD's goal to address the following issues with the Red Lakes subwatershed:

7.6.7.1 Red Lakes Water Quality Rankings

- ❖ Need for filter strips along tributary rivers, creeks and ditches.
- ❖ Long shore drift clogging rivers.
- ❖ Pasture lands along river and needs for alternate water sources.

7.6.7.2 Water Quality Action Items

1. The RLWD will actively partner with the Red Lake Band, USDA NRCS, USACE, MPCA and the SWCDs to seek to implement projects that reduce agricultural and bank erosion and improve water quality. Coburn Creek has been identified by MnDNR fisheries as a potential source for significant impairment.

Table 27 provides a summary list of specific implementation actions for the subwatershed.

7.6.8 Erosion and Sedimentation

Erosion due to storm runoff is a serious problem in the subwatershed. During periods of high runoff, channel erosion causes bank stabilization concerns for this subwatershed. The severity depends on the land cover, duration and volume of water. It is the RLWD's goal to address the following issues with the Red Lakes subwatershed:

7.6.8.1 Red Lakes Erosion and Sedimentation Rankings

- ❖ River, creek and ditch bank failures.
- ❖ Ditches and tributary outlets to lakes.

7.6.8.2 Erosion and Sedimentation Action Items

1. The RLWD will seek partnerships with landowners, SWCD and USDA NRCS to implement BMPs that reduce agricultural erosion and slow water down.
2. The RLWD will seek out grant opportunities to conduct an erosion assessment and to provide alternate sources of water for livestock.

Table 27 provides a summary list of specific implementation actions for the subwatershed.

7.6.9 Summary and Conclusions

This section of the overall watershed management plan presents an overview of the Upper and Lower Red lakes subwatershed. Goals and objectives for the subwatershed are presented above for the following plan elements: 1) Natural Resources, 2) Water Quality, 3) Water Quantity and 4) Erosion and Sedimentation. Table 27 provides a summary list of specific implementation actions organized by these same plan elements.

Table 27
Upper and Lower Red Lake Subwatershed Implementation Actions

ACTION/GOAL	PLAN ELEMENT	SCHEDULE	CONCEPTUAL COST
Re-establish functional habitat corridors along all watercourses	Natural Resources Action Item	Ongoing	$20,000/year
Protect existing high quality natural resource features	Natural Resources Action Item	Ongoing	$10,000/year
Partner with Red Lake Band and USACE to manage outlet of Red Lake to reduce flood damages and protect resources of Upper and Lower Red Lakes	Water Quantity Action Item	Years 1-3	$25,000
Partner with the Red Lake Band, USDA NRCS, USACE, MPCA and SWCDs to implement projects that reduce agricultural and bank erosion and improve water quality	Water Quality Action Item	Years 1-3	$50,000
Seek grant opportunities to conduct an erosion assessment and to provide alternate sources of water for livestock.	Erosion and Sedimentation Action Item	Ongoing	$5,000/year

8.0 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 RLWD will develop an annual activity report which contains the following information:

- Board / Advisory Committee Member Information

  A list of the RLWD's board members, advisory committee members and board member vacancies at the end of the reporting year, including the names of designated officers and members and information on how members can be contacted, and indicating the county that each board member is appointed by

- District Employee / Consultant Contact Information

  A list of District employees and consultants, including mailing addresses and telephone numbers

- Previous Year's Annual Work Plan Assessment

  An assessment of the previous year's annual work plan that indicates whether the stated goals and objectives were achieved and, if they were not achieved, indicates why they could not be achieved

- Projected Work Plan for the Coming Year

  A projected work plan for the next year indicating the desired goals and objectives

- Permit / Variance Summary

  A summary of the permits or variances issued or denied under ordinances or rules required by the RLWD or local plan and any enforcement actions initiated by either the RLWD or its local units of government

- Water Quality Monitoring Summary

  A summary of water quality monitoring data collected by the RLWD or its local units of government

- Local Plan Evaluation

  An evaluation of the status of local plan adoption and implementation based on a review of the local unit of governments' activities by the RLWD during the past year

- ❖ Relevant District Service Activities

  The RLWD's activities related to the biennial solicitations for interest proposals for legal, professional or technical consultant services

- ❖ Fund Balance Assessment

  An assessment of changes in fund balances, including a description of the costs of each program element with respect to the overall annual budget

- ❖ Status of Wetland Banking Program

  The status of any locally adopted wetland banking program

This annual monitoring and evaluation report will be presented to the residents of the RLWD at one of the regular monthly Managers meetings.

8.1 PERMITS AND RULES PROGRAM

The RLWD requires a permit application to be submitted for the following activities:

- ❖ Water is to be diverted from one watershed to another
- ❖ Water is to be drained into a legal ditch
- ❖ A ditch is to be repaired
- ❖ A marsh is to be drained
- ❖ A dike is to be constructed or altered
- ❖ A reservoir is to be drained or constructed
- ❖ A bridge, culvert or drain is to be installed or changed
- ❖ A natural waterway, lake or marsh is to be changed
- ❖ Construction is to be done near a waterway, lake or marsh

According to the RLWD's annual report, the RLWD received 147 permit applications and approved 140 permits. The RLWD has received over 2,300 permit applications since 1987 and since the year 2000 averages about 140 applications per year. The RLWD inspects each permit site for compliance with permit conditions.

The intent of the permit program is to effectively manage and protect the resources of the RLWD while allowing for reasonable use. The RLWD feels that it has been effective in accomplishing these missions and will continue to work with the other natural resource management agencies to further these goals.

9.0 PROJECTS

9.1 PETITIONED PROJECTS

The RLWD will accept petitions from the public for projects to be constructed under Minnesota Satute 103D.705. That petition must meet the requirements of the statute and also be submitted with the required bond. When considering a petitioned project, the Managers will consider not only the statutory requirements, but also will consider whether the proposed project is in keeping with the RLWD's goals, policies and objectives, as well as the Red River Mediation Agreement and other considerations. The Managers may direct staff to develop a decision matrix for use when evaluating petitioned projects.

After reviewing the petition and the Managers approve, the Managers will assign the project 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 Managers must hold a hearing on this report within 35 days. A favorable report is sent to the Director of MnDNR Waters and the BWSR, who file an advisory report. After the filing of the Engineer's Report, the Mangers will appoint three landowners as neutral appraisers/viewers. The Viewers' Report is examined by the Managers and can be returned to the viewers if felt inadequate. Once all of the above and advisory reports are completed, the Managers 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.

9.2 OTHER PROJECT IDEAS

Individuals will be invited to bring project ideas to the Managers for review and discussion. After preliminary review by the Managers, they may direct the engineer to review further in order to gather additional information and report back. Then the Managers will decide if they wish to establish this proposed project by resolution of the Managers, if they should require a petition for the project or if they should dismiss it altogether. If the Managers do 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 be removed from the list at this time also.

As an action item to address Sections 9.1 and 9.2, the Managers will develop guiding principles and a procedure for evaluating proposed projects in accordance with all applicable Minnesota Rules, Minnesota Statutes and the mediation agreement.

10.0 CONFLICT BETWEEN EXISTING PROGRAMS AND POLICIES OF OTHER JURISDICTIONS

10.1 SOIL AND WATER CONSERVATION DISTRICTS

The RLWD will coordinate its programs with those of the Beltrami, Clearwater, Itasca, Koochiching, Marshall, Mahnomen, Pennington, Polk, Red Lake and Roseau County SWCDs. The RLWD will collaborate with these agencies when possible to prevent overlap in planning activities and reduce any duplication of efforts. Cooperation will also allow for shared funding while implementing conservation activities.

10.2 COUNTY COMPREHENSIVE LOCAL WATER PLANS

It is the intent of the RLWD to coordinate water management efforts with the Comprehensive Local Water Plans of the counties included within each district. This will help to improve the sharing of resources and to ensure that each district and county are moving towards the same FDR and NRE goals.

10.3 STATE AND FEDERAL AGENCIES

The RLWD will involve state and federal agencies through the Mediation Agreement Project Work Teams to review proposed projects. District staff work closely with state and federal staff during the day to day operations of each district and will continue to do so on a regular basis.

10.4 COUNTY DITCH SYSTEMS

The RLWD will work with and cooperate with each of the counties within the districts to coordinate water management efforts with regard to flood control and ditch systems. This is essential because of the vast network of ditches and their interrelation with water management activities.

10.5 RED LAKE BAND OF CHIPPEWA INDIANS

The Red Lake Band of Chippewa Indians maintains jurisdiction over more than 846,500 acres of land. Over 664,602 acres of Red Lake Nation lands are situated within the geographic extent of the RLWD, constituting 18 percent of the land within the geographic scope of the RLWD. The Red Lake Band resides on land it has held since prior to the establishment of the U.S. and the subsequent establishment of the State of Minnesota, and exerts sole jurisdiction over its lands. While the lands of the Red Lake Band are held in common by the entirety of the Red Lake Band membership, with no individual property ownership, the lands of the Red Lake Band are not public lands in the same sense as other public lands in the U.S. or the State of Minnesota. In essence, the lands of the Red Lake Band constitute foreign soil to non-Red Lake Band residents of the U.S. The major focus of land management on the Red Lake Reservation is for fisheries and wildlife habitat and cultural purposes.

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Appendix 1
Subwatershed Table 1

Potential 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 RLWD	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 10 % reduction in peak flows	WW	H	PC	PC	SIK	SC	PC	PC	V	SIK	SIK	PIK	
2 Reduce runoff volume by 20,000 acre-feet	WW	O	PC	PIK	SIK	SC	PIK	SIK	V	SIK	SIK	SIK	
3 Identify Potential impoundment sites	WW	O	PC	PIK	SIK	SC	PC	PIK	V	PIK	SIK	SIK	
4 Seek out special projects	WW	O	PC	PC	SIK	SC	PC	PIK	V	PIK	SIK	SIK	
5 Sustaining Base Flows	WW	M	SIK	PIK	SIK	SC	PC	PC	V	PIK	SIK	V	
6 Restore Wetlands	WW	O	SIK	PC	SIK	SC	PC	PC	V	PC	SIK	V	
7 Improve education program	WW	H	SIK	PC	SIK	SC	PIK	PC	V	PIK	SIK	SIK	
8 Drainage System Inventory	WW	H	PC	PC	SIK	SC	V	V	V	V	SIK	V	
9 Participate in Floodplain Management programs	WW	O	PC	PC	SIK	SC	V	V	V	V	SIK	V	
10 Reduce flooding in Clearbrook	CR	H	PIK	PIK	SIK	SC	SIK	V	V	SIK	SIK	SIK	
11 Reduce flooding in Bagley	CR	H	PC	PC	SIK	SC	PC	V	PC	SIK	SIK	PC	
12 Reduce flooding in Mentor	CR	H	PC	PC	SIK	SC	SIK	PC	V	SIK	SIK	PIK	
13 Improve quality of data for Maple Lake	CR	M	PIK	SIK	SIK	SC	SIK	V	V	SIK	SIK	V	
14 Develop/improve stage/flow data	CR	M	PC	PC	SIK	SC	PC	PC	V	SIK	SIK	PIK	
15 Reduce overland flooding section by section	GM	H	PIK	PC	SIK	SC	SIK	PC	SIK	PC	SIK	V	
16 Address flooding at CDs 2, 66, 126, 60, 39, 25	GM	H	PC	PC	SIK	SC	PC	PC	V	SIK	SIK	PIK	
17 Implement a project to inventory provate ditching	GM	M	PIK	PIK	SIK	SC	SIK	PIK	V	SIK	SIK	V	
18 Implement projects to reduce crop damages	GM	L	PC	PC	SIK	SC	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 Reduce agricultural damages	LRLR	H	PIK	SIK	SIK	SC	PIK	PIK	V	PC	SIK	V	
20 Reduce overland, residential flooding in Crookston	LRLR	H	PC	PC	SIK	SC	PC	PC	V	SIK	SIK	PIK	
21 Reduce Bank Sloughing	LRLR	H	PC	PC	SIK	SC	PC	PC	V	SIK	SIK	PIK	
22 JD 60 flooding	LRLR	L	PC	PC	SIK	SC	PC	PC	V	SIK	SIK	PIK	
23 Reduce Cabin Flooding	RL	H	PC	PC	SIK	SC	PC	PC	V	SIK	SIK	PIK	
24 Review/update Corps operating plan	RL	H	PIK	SIK	SIK	SC	SIK	SIK	V	SIK	SIK	V	
25 Reduce farmstead flooding	TR	H	PIK	SIK	SIK	SC	SIK	SIK	V	SIK	SIK	PC	
26 Reduce flooding in Goodridge	TR	H	PC	PC	SIK	SC	PIK	PC	V	PIK	SIK	PIK	
27 Reduce Ag-land flooding	TR	H	PC	PC	SIK	SC	PIK	PC	V	PIK	SIK	PC	
28 Reduce Ag-land flooding	URLR	H	SIK	PC	SIK	SC	SIK	PC	V	PC	SIK	V	
29 Address agricultural drainage	URLR	H	SIK	PC	SIK	SC	PC	SIK	V	SIK	SIK	PIK	
30 Address County ditch problems	URLR	L	PC	SIK	SIK	SC	PIK	SIK	V	PIK	SIK	SIK	

Legend:

Proposed Year of Activity:

H = 1-3 years

M = 4-6 years
L = 7-10 years
O = ongoing

Objectives:
WW – Watershed Wide
CR – Clearwater River
GM– Grand Marais Creek
LRLR – Lower Red Lake River
RL – Red Lakes
URLR – Upper Red Lake River
TR – Thief 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 Service

Appendix 2
Subwatershed Table 2

Potential NRE Activities and Potential Agency Roles

Proposed Action (specific tasks/items)	Objective Action Reference (see legend)	Proposed Year of Activity (H/M/L/O)	Roles RLWD	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 Increase number of monitoring WQ sites	WW	**H**	**PC**	**PIK**	**PC**	**SC**	**V**	**SIK**	**V**	**V**	**SIK**	**V**	
2 Develop TMDL diagnostic Studies	WW	**H**	**PC**	**PIK**	**PC**	**SC**	**V**	**SIK**	**V**	**V**	**SIK**	**V**	
3 Initiate TMDL implementation strategies	WW	**M**	**PC**	**PIK**	**PC**	**SC**	**V**	**SIK**	**V**	**V**	**SIK**	**V**	
4 Improve District Website and education programs	WW	**H**	**PC**	**PIK**	**PIK**	**SC**	**V**	**SIK**	**V**	**V**	**SIK**	**V**	
5 Coordinate water quality project components	WW	**H**	**PC**	**PIK**	**PC**	**SC**	**V**	**SIK**	**V**	**V**	**SIK**	**V**	
6 Continue/Expand River Watch Program	WW	**H**	**PC**	**PIK**	**PC**	**SC**	**V**	**SIK**	**V**	**V**	**SIK**	**V**	
7 Develop monitoring locations (TMDL)	WW	**M**	**PC**	**PIK**	**PC**	**SC**	**V**	**SIK**	**V**	**V**	**SIK**	**V**	
8 Install vegetative buffer strips	WW	**M**	**SIK**	**PC**	**SIK**	**SC**	**V**	**PC**	**V**	**V**	**PC**	**V**	
9 Promote Agricultural BMPs	WW	**H**	**SIK**	**PIK**	**SIK**	**SC**	**V**	**PIK**	**V**	**PC**	**PC**	**V**	
10 Reduce soil erosion (ag, lakes, rivers)	WW	**H**	**PIK**	**PIK**	**SIK**	**SC**	**V**	**PIK**	**V**	**PC**	**SIK**	**V**	
11 Restore wetlands	WW	**M**	**SIK**	**PC**	**SIK**	**SC**	**PIK**	**PC**	**V**	**PC**	**SIK**	**V**	
12 Implement Lake Restoration Projects	WW	**M**	**PIK**	**PIK**	**PC**	**SC**	**V**	**PC**	**V**	**PIK**	**SIK**	**V**	
13 Promote comprehensive ditch management strategies	WW	**H**	**V**	**PIK**	**V**	**SC**	**V**	**PC**	**V**	**PIK**	**SIK**	**V**	
14 Acquire land for wildlife management area	WW	**M**	**SIK**	**PC**	**SIK**	**SC**	**V**	**PC**	**V**	**PIK**	**SIK**	**V**	
15 Restore grasslands	WW	**M**	**SIK**	**PC**	**SIK**	**SC**	**V**	**PC**	**V**	**PIK**	**SIK**	**V**	
16 Protect existing wetlands	WW	**H**	**PIK**	**PIK**	**PIK**	**SC**	**PIK**	**PC**	**V**	**PIK**	**SIK**	**V**	
17 Expand compatible recreation for local economy	WW	**M**	**SIK**	**PC**	**SIK**	**SC**	**V**	**PC**	**V**	**PIK**	**SIK**	**V**	
18 Support other agency programs on wetlands	WW	**H**	**PIK**	**PIK**	**PIK**	**SC**	**PIK**	**PIK**	**V**	**PIK**	**SIK**	**PIK**	
19 Project to address Clearwater River and Ruffy Brook	CR	**H**	**PC**	**PC**	**SIK**	**SC**	**SIK**	**SIK**	**V**	**SIK**	**SIK**	**PC**	
20 Review development at Walker Brook Lake	CR	**M**	**PIK**	**PIK**	**SIK**	**SC**	**V**	**SIK**	**V**	**SIK**	**SIK**	**PIK**	
21 Reduce lake shoreline erosion	CR	**M**	**PIK**	**PIK**	**PIK**	**SC**	**PIK**	**V**	**V**	**V**	**SIK**	**V**	
22 Improve Maple Lake water quality	CR	**M**	**PC**	**PC**	**PC**	**SC**	**PIK**	**SIK**	**V**	**SIK**	**SIK**	**V**	
23 Address water quality on Cameron, Badger and	CR	**M**	**PC**	**PC**	**PC**	**SC**	**SIK**	**SIK**	**V**	**SIK**	**PIK**	**V**	

Potential NRE Activities and Potential Agency Roles

Proposed Action (specific tasks/items)	Objective Action Reference (see legend)	Proposed Year of Activity (H/M/L/O)	Roles RLWD	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
Mitchell Lakes													
24 Assess ISTS compliance on lakes	CR	**H**	**PIK**	**PIK**	**PC**	**SC**	**PIK**	**V**	**V**	**V**	**SIK**	**PIK**	
25 Complete Clearwater River Initiative phase II	CR	**H**	**PC**	**PIK**	**PC**	**SC**	**V**	**V**	**V**	**V**	**PIK**	**V**	
26 Address bank failures on CD 2, JD 60 and Grand Marais	GM	**H**	**PC**	**PC**	**SIK**	**SC**	**V**	**PC**	**V**	**PC**	**SIK**	**V**	
27 Address wind and water erosion	GM	**M**	**SIK**	**SIK**	**SIK**	**SC**	**V**	**SIK**	**V**	**PC**	**PIK**	**V**	
28 Restore and add windbreaks	GM	**M**	**SIK**	**PC**	**SIK**	**SC**	**V**	**SIK**	**V**	**PC**	**PIK**	**V**	
29 Promote Conservation tillage	GM	**M**	**SIK**	**PIK**	**SIK**	**SC**	**V**	**SIK**	**V**	**PC**	**PIK**	**V**	
30 Address erosion at confluence with Red River	GM	**H**	**PC**	**PIK**	**PIK**	**SC**	**V**	**SIK**	**V**	**PC**	**PIK**	**V**	
31 Implement TMDL workplan	GM	**H**	**PC**	**PIK**	**PC**	**SC**	**V**	**V**	**V**	**V**	**PIK**	**V**	
32 Reduce flashy hydrograph	GM	**M**	**PC**	**PC**	**PC**	**SC**	**V**	**V**	**V**	**V**	**SIK**	**V**	
33 Address tributary bank instability at outlets	LRLR	**M**	**PC**	**PC**	**PC**	**SC**	**V**	**V**	**V**	**V**	**SIK**		
34 Bank failure on JD 60 south of CR11	LRLR	**H**	**PC**	**PC**	**PC**	**SC**	**V**	**V**	**V**	**V**	**SIK**	**V**	
35 Bank sloughing in Crookston and Red Lake Falls	LRLR	**M**	**PC**	**PC**	**PC**	**SC**	**V**	**V**	**V**	**V**	**SIK**	**V**	
36 Bank failure on Polk CD 1, last mile	LRLR	**H**	**PC**	**PC**	**PC**	**SC**	**V**	**V**	**V**	**V**	**SIK**	**V**	
37 Sedimentation from ditches into natural streams	LRLR	**H**	**SIK**	**PIK**	**SIK**	**SC**	**V**	**PC**	**V**	**PC**	**SIK**	**V**	
38 Conduct comprehensive erosion assessment from outlet to Red River	LRLR	**H**	**PC**	**SIK**	**SIK**	**SC**	**SIK**	**PIK**	**V**	**PIK**	**PIK**	**V**	
39 Coordination with Red Lakes Nation	RL	**H**	**PIK**	**PIK**	**PIK**	**SC**	**PIK**	**PIK**	**PIK**	**PIK**	**PIK**	**V**	
40 Coordination for Red Lakes	RL	**H**	**PIK**	**PIK**	**PIK**	**SC**	**PIK**	**PIK**	**PIK**	**PIK**	**PIK**	**V**	
41 Erosion on Battle Creek	RL	**M**	**PIK**	**PC**	**PC**	**SC**	**V**	**V**	**V**	**PC**	**PIK**	**V**	
42 Sedimentation from ditch systems	RL	**M**	**PIK**	**PC**	**PC**	**SC**	**V**	**V**	**V**	**PC**	**PIK**	**V**	
43 Address river and ditch bank failures	TR	**H**	**PC**	**PC**	**PC**	**SC**	**V**	**V**	**V**	**PIK**	**PIK**	**V**	
44 Address erosion on Ditch 20 and laterals	TR	**H**	**PC**	**PC**	**PC**	**SC**	**V**	**V**	**V**	**PIK**	**PIK**	**V**	
45 Address ditch erosion	TR	**H**	**PC**	**PC**	**PC**	**SC**	**V**	**V**	**V**	**PIK**	**PIK**	**V**	

Potential NRE Activities and Potential Agency Roles

Proposed Action (specific tasks/items)	Objective Action Reference (see legend)	Proposed Year of Activity (H/M/L/O)	Roles RLWD	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
46 SD 83 sedimentation and bank erosion	TR	H	PC	PC	PC	SC	V	V	V	PC	PIK	V	
47 TMDL implementation plan	TR	H	PC	PIK	PC	SC	V	V	V	V	SIK	V	
48 Promote installation of filter strips on ditches	URLR	H	PIK	PC	PC	SC	V	PC	V	PC	SIK	V	
49 Address river and ditch bank failures	URLR	H	PC	PC	PC	SC	V	PIK	V	V	PIK	V	
50 Address erosion on ditches and outlets	URLR	H	PC	PIK	PC	SC	V	PIK	V	PIK	SIK	V	
51 Develop TMDL implementation Plan	URLR	H	PC	PIK	PC	SC	V	V	V	V	SIK	V	

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

<u>Objectives:</u>

WW – Watershed Wide
CR – Clearwater River
GM– Grand Marais Creek
LRLR – Lower Red Lake River
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TR – Thief River

<u>Proposed Roles:</u>
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Appendix 3
Watershed Rules

PERMIT AND DRAINAGE RULES OF THE RED LAKE WATERSHED DISTRICT

Section 1. INTRODUCTION

The Rules of the Red Lake Watershed District shall be in compliance with Minnesota Statutes, Chapter 103D, and the rules adopted by the Board shall be consistent with the provisions of these statutes and shall have the full force of law.

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 Statutes, Chapter 103D, or other applicable law, the provisions of said Chapter 103D or other applicable law shall govern.

Section 2. GENERAL POLICY

The Managers accept the responsibilities with which they are charged as a governing body. While there is no intention to infringe upon or interfere with the authority or responsibilities of other agencies or governing bodies, the manager will not ignore 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 of 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 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 3. DEFINITIONS

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

A) District means the Red Lake Watershed District.

B) Managers means the Red Lake Watershed District Board of Managers.

C) Person means individual, firm, partnership, association, or corporation but does not include public or political subdivision.

D) Public corporation means county, town, city, school district a political division or subdivision of the state, or a duly authorized agency of the federal government.

E) Public health involves any actions or issues tending to improve the general sanitary conditions of the District.

F) General welfare includes any action or issues 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 an artificial or natural channel which provides a course for water flowing continuously or intermittently.

J) Legal drainage system means a watershed, county or judicial drainage system, or a state drainage system now taken over as a judicial or county drainage system.

K) Private drainage system means an individual or mutual drainage system.

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

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.

N) Domestic purposes refers to the use of water for the common household and farm uses. The number of individual people served at any time is limited to twenty-five (25).

O) Administrator means the Administrator of the Red Lake Watershed District.

P) District Engineer means the Engineer of the Red Lake Watershed District.

Section 4. WORKS PAID BY ASSESSMENT

Revoked by Board of Managers May 12, 1977.

Section 5. PERMITS

The requirements for a permit from the Managers for certain uses of water or work 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 ensure that developments of the natural resources are orderly and in accordance with the overall plan for the District.

A) All permits issued by the District shall be signed by the President or the Administrator or such other officers designated by the Board of Managers. No permit shall be issued until there has been consultation with the District Engineer and the Manager representing that part of the District where the work is to be done.

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

C) Unless specified in the permit, work for which a permit is given must be completed within one year. The Managers further require as a condition of all permits that they be notified when said improvement is completed.

D) If a permit application is refused or granted subject to conditions, the applicant may within thirty (30) days demand a hearing on the application before the Board of Managers.

E) Obtaining a permit from the Managers does not relieve the applicant from the responsibility of obtaining any other additional authorization or permits required by law.

F) All applications for permits shall be filed with the Administrator at the District Office in Thief River Falls, Minnesota. Upon receipt and within thirty (30) days of filing, the permit shall be acted upon.

G) H) and I) Revoked by Board of Managers December 14, 1978.

J) A plan supporting the data should accompany the application.

K) If additional information is required by the Managers or District Engineer to act upon a permit, such information must be returned to the District within thirty (30) days of request or the permit application will become void. If further review is needed in the opinion of a Manager or District Engineer, a permit application may be presented at a scheduled meeting of the Managers. If deemed necessary, the Managers may schedule a formal hearing on the permit in question.

All applications shall require the following information:

APPLICATION FOR PERMIT

Name ______________________
Telephone No. ______________________
Address ______________________
Project location ______________________
Type of work proposed (attach all necessary reports, maps, drawings, etc. to support permit application) ______________
Permit requested for ______________________
Description of work to be done ______________
Work is necessary because ______________
Signature ______________________
Date ______________________

Section 6. FLOOD CONTROL AND DRAINAGE

All persons shall use their land reasonably in disposing of surface water and may turn into a natural drainageway all the surface water that would naturally drain there, but they may not burden a lower landowner with more water than is reasonable under the circumstances.

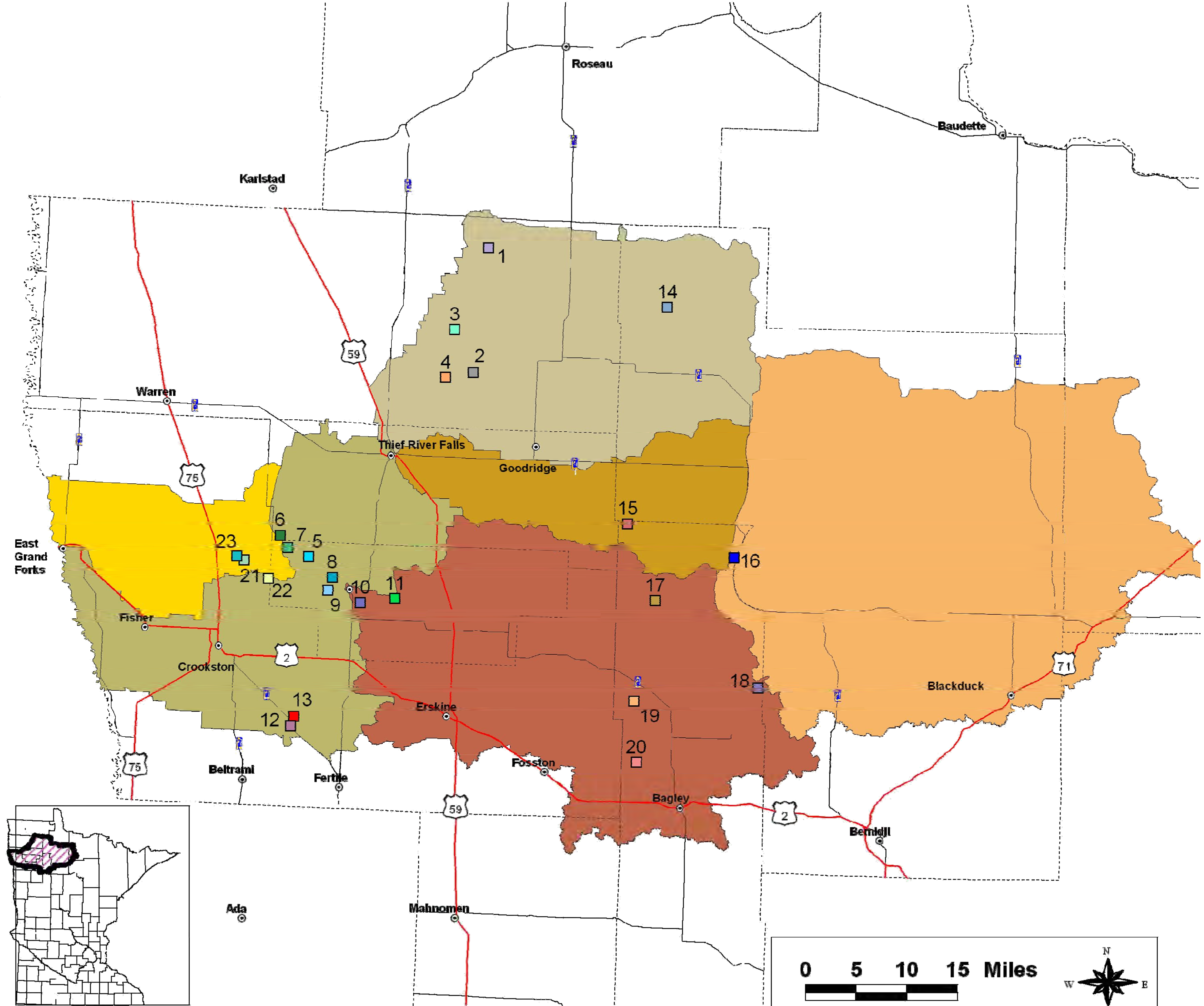
Surface water shall not be artificially removed from upper land to and across lower land without adequate provision being made on the lower land for its passage, nor shall the natural flow of surface water be obstructed so as to cause an overflow onto the property of others.

Appendix 4
Water Management Projects

Water Management Projects within Red Lake Watershed District

RLWD Projects

Project Name	Project ID	Storage (acre-ft)	Drainage Area (sq. miles)
Abraham	20	66	0.3
Agassiz	3	45,000	387
BR-6	13	1,023	8
Baird-Beyer	7	400	7
Black River	5	4,700	108
Clearwater Lake	18	4,200	162
Elm Lake	4	7,500	63
FSE Sites 1 & 2	23	590	3.1
Good Lake	15	10,100	72
Goose Lake	6	5,500	16
Kiwosay	17	12,000	36
Knutson	10	42	3
Lost River Pool	2	4,500	54
Louisville-Parnell	22	360	5.1
Miller	11	123	4
Moose River	14	36,250	125
Odney Flaat	12	36	7
Parnell	21	3,600	25
Pine Lake	19	6,080	45
Red Lakes Dam	16	1,000,000	1730
Seeger Dam	9	266	6
Thibert	8	6	1
Thief Lake	1	45,000	222



Moose River Impoundment Project

GENERAL

The project, which is a two pool design, was a cooperative effort of the Red Lake Watershed District and the Mn department of Natural Resources for flood control and wildlife management. Flood damages will be reduced by impounding floodwaters in the upper reaches of the watershed. Wildlife and associated recreational benefits will be enhanced by water retained in the two pools. The project is constructed on lands managed by and the Mn department of Natural Resources.

LOCATION

The project is located at the headwaters of the Moose and Mud Rivers in northwestern Beltrami County, approximately 15 miles northeast of Grygla, MN.

PURPOSE

Multi-purpose – designed to provide flood control, streamflow maintenance, increase wildlife values, and benefit fire control

PROJECT COMPONENTS

North Pool: The North Pool outlets into the Moose River (JD #21). The major components of the north pool are: 5 miles of diversion ditch, 4 miles of earthen dike with a top elevation of 1218.0, one gated outlet structure, one rock lined emergency spillway at an elevation of 1216.0. Approximately 1/3 (41.7 sq. mi.) of the total project drainage area (125.0 sq. mi.) drains to the Moose River.

South Pool: The South Pool outlets into the Mud River (JD #11). The major components of the south pool are: 3 miles of diversion ditch, 9 miles of earthen dike with a top elevation of 1220.0, 4 miles of earthen dike between the north and south pools, one gated outlet structure, two rock lined emergency spillways at an elevation of 1218.0. Included between the pools is an interpool structure which may be used to pass water between the pools. Approximately 2/3 (83.3 sq. mi.) of the total project drainage area (125.0 sq. mi.) drains to the Mud River.

Moose River Impoundment Project

FUNCTIONAL DESIGN DATA

	North Pool	South Pool	Total
Top of Dam Elev. (ft.–msl)	1218.0	1220.0	
Freeboard Flood Elev. (ft.–msl)	1217.2	1219.3	
Freeboard Flood Storage (ac.ft)	16,250	38,250	54,500
Emer. Spillway Elev. (ft.–msl)	1216.0	1218.0	
Emer. Spillway Storage (ac.ft.)	12,000	24,250	36,250
Gated Pool Elev. (ft.-msl)	1215.3	1217.4	
Gated Pool Storage (ac.ft.)	9,750	19,750	29,500
Typical Summer Elev. (ft.-msl)	1211.7	1213.6	
Typical Summer Storage (ac.ft.)	2,000	4,000	6,000
Typical Winter Elev. (ft.-msl)	1210.5	1212.4	
Typical Winter Storage (ac.ft.)	800	1,800	2,600
Max No-Flood Elev. (ft.-msl)	1212.5	1214.5	
Max No-Flood Storage (ac.ft.)	3,000	6,000	9,000
Project Drainage Area (sq. mi.)	41.7	83.3	125.0

OPERATION & MAINTENANCE

Operation of the floodgates is the responsibility of the Red Lake Watershed District. A local person monitors and records the pool elevations and streamgages and operates the floodgates as directed by the Red Lake Watershed District. Outflows from the pools are coordinated with Agassiz National Wildlife Refuge and Thief Lake Wildlife Management Area.

Maintenance items are the responsibility of the Red Lake Watershed District and the State.

COST

The total project cost was approximately $3.4 million. Funding was provided by the following:

State of Minnesota	$1,690,000
Red Lake Watershed District	$ 612,000
Red R. Watershed Management Board	$ 1,126,000

OPERATIONAL

1988

Lost River Impoundment Project

GENERAL

In approximately the mid 1970's, the project was constructed by the Mn Department of Natural Resources to improve waterfowl habitat. On December 14, 1978 the Red Lake Watershed District entered into a formal agreement with the Mn Depatrment of Natural Resources to modify the original impoundment by raising the elevation of the dike and emergency spillway. Four (4) 48 in. diameter gated pipes and a spillway from ditch 200 of JD #11 supply water to the impoundment which is an "off channel" reservoir.

LOCATION

Marshall County, Grand Plain Township, approximately 20 miles northeast of Thief River Falls. The drainage area above the impoundment is 53 square miles.

PURPOSE

Multi-purpose – designed to increase wildlife values, and provide flood control

PROJECT COMPONENTS

Approximately 10 miles of earthen embankment, an outlet control structure, and an emergency spillway into Ditch 200.

FUNCTIONAL DESIGN DATA

	Elev. (ft. – msl)	Storage (ac. – ft.)
Top of Dam	1150.2	14,600
Emergency Spillway	1148.2	10,000
Typical Summer	1146.2	5,500
Typical Winter	1145.2	3,700

Drainage Area – 53.0 sq. mi.

OPERATION & MAINTENANCE

Operation and maintenance is the responsibility of the State.

COST

To modify approximately - $109,000

OPERATIONAL

1978

Elm Lake Project
(Farmes Pool)

GENERAL

Elm Lake was drained in about 1920 by the construction of Branch #200 of Judicial Ditch #11. The Elm Lake project is a cooperative effort of the U.S. Fish and Wildlife Service, Mn Department of Natural Resources, Red Lake Watershed District, and Ducks Unlimited. Majority of funding for the project was provided by Ducks Unlimited, Inc. At the time, this was the largest Ducks Unlimited project in the lower 48 states.

LOCATION

Marshall County, approximately 17 miles northeast of Thief River Falls. The drainage area of ditch 200 above Elm Lake is 63 square miles.

PURPOSE

Multi-purpose – designed to meet three major objectives: Flood control, Increase wildlife values, and upstream drainage improvement

PROJECT COMPONENTS

Approximately 9 miles of earthen embankment, an outlet control structure, rock lined emergency spillway, and an enlargement of a portion of Ditch 200.

FUNCTIONAL DESIGN DATA

	Elev. (ft. – msl)	Storage (ac. – ft.)
Top of Dam	1145.0	19,700
Emergency Spillway	1142.0	11,000
Max Summer	1141.0	7,500
Typical Summer	1140.0	5,500
Typical Winter	1139.0	3,500

Drainage Area – 63.0 sq. mi.

OPERATION & MAINTENANCE

During significant flood events the Red Lake Watershed District will determine the need to install additional stop-logs to provide downstream flood control. Operation of the outlet structure is the responsibility of Agassiz National Wildlife Refuge.
Various maintenance items are the responsibility of either the U.S. Fish and Wildlife Service, State of Minnesota, or Red Lake Watershed District.

COST

Approximately - $2 million

OPERATIONAL

1991

SCHIRRICK DAM #25
RED LAKE WATERSHED DISTRICT

LOCATION: Black River, T152N, R45W

DRAINAGE AREA: 107.7 square miles

FLOOD POOL:

Gated Storage	Temporary Storage	Total Storage
4000 ac.ft. Elev. 962 - 987	800 ac.ft. Elev. 987 - 989.3	4800 ac.ft (.8")

DESCRIPTION:

The Schirrick Dam was constructed in 1984. The primary purpose of the project is to provide flood relief on the Red Lake River and the Red River of the North by controlling the flow contribution from the Black River. A small permanent pool is also provided.

The dam consists of the following components: An earthen embankment and reservoir with capacity to detain up to 4,800 acre-feet of water and a gated outlet control structure.

The operable components of the dam are the stoplog bays and the flood control gates. The stoplog bays control the elevation of the permanent pool. The floodgates control the flow contribution of the Black River during floods. The outlet structure has large enough flow capacity to pass Black River flood flows with minimal waste of storage. The gates will normally be open, and will only be closed in the event of severe mainstem flooding. The flood gates will be closed 24 hours in advance of a predicted stage of 26 feet in Crookston, or 60 hours in advance of a predicted stage of 46 feet in Grand Forks.

COST: $1,019,000

OPERATIONAL DATE: January 1985

FACT SHEET

RED LAKE DAM

GENERAL: The U.S. Army Corps of Engineers operates the dam at the outlet of the Red lakes. The dam was completed in 1951. Operation of the dam provides major flood control and stream flow maintenance benefits.

LOCATION: The dam is located in Clearwater County on the western shore of Lower Red Lake. Trunk Highway 89 crosses the dam approximately 12 miles northwest of the village of Red Lake and 42 miles southeast of Thief River Falls.

RESERVOIR INFORMATION: Upper and Lower Red Lake comprise the largest lake area wholly contained within Minnesota. The Red Lakes have a surface area of approximately 290,000 acres (453 square miles). With over 1 million acre-feet of flood storage, Red Lake is by far the largest reservoir in the Red River Valley.

DISCHARGE CAPACITY: The discharge capacity of the dam is very small in relation to the size of the drainage area (and reservoir); therefore control efforts to release high water can take years. The current outflow capacity of approximately 1000 cfs can lower the lake level only .2 foot per month (assuming no inflow).

DAM OPERATION: The dam is manually operated in relation to stages in the lake and downstream on the Red Lake River at Highlanding.

a. Problem: When the lake is above target levels, water is discharged at the capacity of the downstream channel. Rainfall events, combined with high discharges from the dam, often cause flooding of ag lands along the Red Lake River. The flow travel time of 1.5 days from the dam to Highlanding, and the dam operators living off-site at Winnibigoshish, Leech, or Pokegama Dams, cause a lag in response time and contribute to the problem.

b. Solutions: One possible solution involves modification of operations to include: remote sensing of lake and river stages, and precipitation; and remote control capabilities of the dam. These modifications are presently being considered, and could lessen the lag time between hydrologic occurrences and gate operations at the dam.

6/92

FACT SHEET

GOOD LAKE PROJECT

INTRODUCTION: The Good Lake Project is a cooperative effort of the Red Lake Band of Chippewa Indians, and the Red Lake Watershed District to provide wetland habitat, flood water retention, and a potential irrigation water supply.

LOCATION: The project area lies entirely within the Red Lake Indian Reservation. The site is approximately 30 miles east of Thief River Falls, within Clearwater and Beltrami Counties.

PROJECT COMPONENTS: The project includes the following main components: approximately 9 miles of dike at elevation 1178.5, 7.5 miles of inlet channels, a reinforced concrete outlet structure, and 2 miles of outlet channel and access road.

FISH AND WILDLIFE: The project will provide expanded and enhanced wetland habitat for waterfowl, furbearers, and other wetland species. The normal water level of Good Lake will be increased approximately 3 feet, which will expand the water surface area from the existing 84 acres to 1800 acres. The reservoir will also have potential to be used for seasonal rearing of northern pike.

FLOOD CONTROL: The project will reduce flood peaks on both the Red Lake River and the Red River of the North. The dam will store runoff from the 82 square mile drainage area. Spring storage capacity is 11,300 ac.ft., equal to approximately 2.6 inches of runoff from the drainage area. The project will also reduce flooding on approximately 4000 acres of private land immediately west of the project, by intercepting overland flows.

WATER SUPPLY: The reservoir may be used as a water supply for irrigation of wildrice paddies. Paddies have not been built, but there is a potential for paddy development in adjacent areas.

COST: The total project cost is $2,129,000. Project funding or in-kind contributions were provided by the following:

Red Lake Band of Chippewa Indians
Red Lake Watershed District
Red River Watershed Management Board
State of Minnesota

10/96

BR-6
BURNHAM CREEK DAM

INTRODUCTION:

This dam was constructed as part of an overall PL-566 project in the Burnham Creek Watershed. The dam was completed in 1988. The project was designed and built by the U.S.D.A. Soil Conservation Service. Local sponsors were the East and West Polk Soil and Water Conservation Districts and the Red Lake Watershed District.

LOCATION:

The dam is located in Polk County approximately 14 miles southeast of Crookston. The dam is built on the downstream side of a beach-ridge of glacial Lake Agassiz. Water is stored in parts of Sections 1, 2, 11, and 12 of Onstad Township (T148N, R45W).

PROJECT COMPONENTS:

The dam includes an earthen embankment approximately 1.8 miles long, with a maximum height of 18 feet. The outlet structure consists of a two-stage riser with a five foot diameter outlet pipe. Two pools were created by the project: a permanent wildlife pool consisting of a restored wetland, and a temporary flood pool.

WILDLIFE HABITAT:

A 62 acre permanent wildlife pool was created in the upper part of the impoundment by restoring a drained wetland. Over 130 bird species have been identified on the site with 60 species nesting here. The area is used heavily by migrating waterfowl including flocks of up to 5000 Sandhill Cranes. The area is managed by the Minnesota Department of Natural Resources as a waterfowl refuge.

FLOOD CONTROL:

The flood control goal of the project is to reduce flooding of agricultural lands downstream. The pool has a flood storage volume of 1023 ac.ft. and will store approximately two inches of runoff from the 8.1 square miles that drains into the dam. The dam is located in the headwater area of County Ditch 140. County Ditch 140 routinely overflowed into the Burnham Creek Watershed downstream of the dam--adding to the flood damages along Burnham Creek. The dam provides benefits to areas downstream along County Ditch 140 and Burnham Creek.

COST:

The dam cost $1,127,000. The unit flood storage cost was $1100/acre-foot.

Funding was provided by the following agencies:

Federal PL-566 Funds	$919,553
Red River Watershed Management Board	105,825
Red Lake Watershed District	101,363

Burnham Creek Impoundment, Red Lake Watershed District Proj. No. 43, BR 6 Structure

Location: Section 2, T148N, R45W
Drainage Area: 8.1 square miles

Flood Pool:
- Area-212 acres
- Volume-1,023 acre-feet

Permanent Pool:
- Area-95 acres
- Volume-108 acre-feet

Description: The flood retention structure BR-6 is part of an overall PL 566 project sponsored by Polk County and by the East and West Polk Soil and Water Conservation Districts. The project is an earthfill dam.
Cost: $1,126,741 = $1,101/A.F.

Funding:		
	Federal PL 566 Funds	$919,553
	Red River Watershed Management Board	$105,825
	Red Lake Watershed District	$101,363

Burnham Creek Channel, Red Lake Watershed District Proj. 43B

The channel work will involve enlargement and realignment of 12.5 miles of man-made ditch or previously modified channel and 1.9 miles of unmodified well-defined natural channel.
Area: 104,000 acres in Polk County
Cost: $2,166,175

Funding:		
	Public Law 566 Funds	$1,772,238
	Local Assessment	$ 393,937

Red Lake Watershed District Project #121
Louisville/Parnell Impoundment and Wetland Bank
Project Summary

Background

The project was petitioned for by the project landowner, Mr. Paul Hoff. Mr. Hoff requested that the RLWD Board consider construction of a water impoundment and wetland restoration on the project site. In August of 1996, the Board appointed HDR Engineering, Inc. as the project engineers.

Technical Information

The project has a tributary area of approximately 5 square miles. The project site receives "break-out" flows from legal drainage systems during extreme rainfall events. The flows cause significant erosion and crop loss for several miles downstream. The project is designed to control runoff from the 25-year 30 hour summer storm event. The project consists of 5 pools. One primary pool for flood control and 4 pools for wetland restoration and banking purposes. The total flood storage available is 400 acre feet. Approximately 39 acres of wetland bank are anticipated. The total project site is 480 acres.

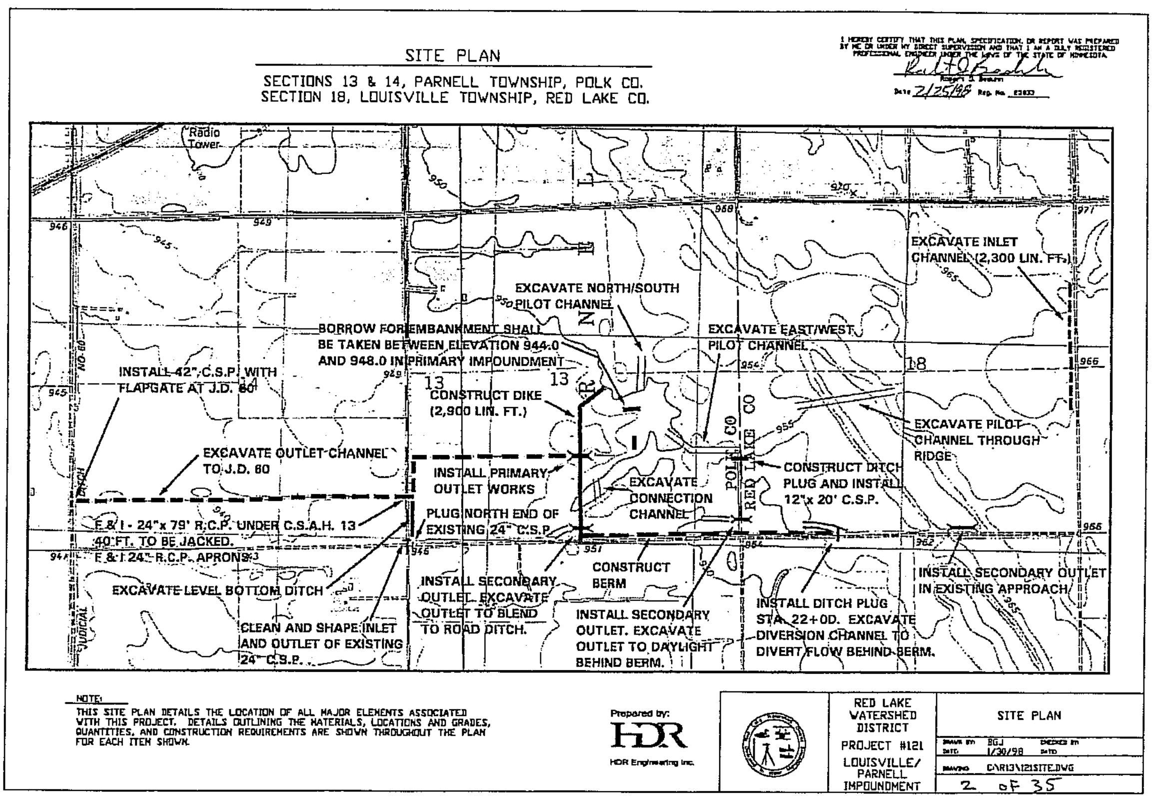
Project Cooperators

The project is sponsored by the Red Lake Watershed District. Other sponsors include:

•Red River Watershed Management Board - Flood Control
•MN/DNR Flood Damage Mitigation Grant Program - Flood Control
•Minnesota Department of Transportation - Wetland Banking
•Farm Service Agency - CRP areas for agricultural wetland restoration (10 and 15 year CRP Contracts)

Technical services have been provided by:

•RLWD Engineering and Surveying Technicians
•HDR Engineering Inc. - Project Engineer
•Widseth Smith Nolting - Surveying and Construction Observation
•Midwest Testing - Soils Testing



SITE	Thief Lake(Existing)		# 2
LOCATION	Section 21, T158N, R41W, Marshall County Source of the Thief River		
DRAINAGE AREA (sq. mi.)	About 200		
PERMANENT POOL	Normal	Drawn Down	Drawn Down
ELEVATION (feet MSL)	1158.5	1157	1157
AREA (acres)	7000	5800	5800
Volume (acre-feet)	18,000	8,000	8,000
FLOOD POOL	Full Pool	Full Pool	Maximum
ELEVATION (feet MSL)	1161	1161	1163
AREA (acres)	7500	7500	11,500
Volume (acre-feet)	35,000	35,000	54,000
FLOOD CAPACITY			
VOLUME (acre-feet)	17,000	27,000	46,000
RUNOFF (inches)	1.6	2.5	4.3
1975 High	1161.12		
INITIAL COST ($)			

COMMENTS:

This existing impoundment is operated by the DNR for wildlife management. The pool is normally drawn down over the winter to 1157 feet to help control spring runoff.
1163 feet is the maximum legal elevation.

SITE	Agassiz National Wildlife Refuge (Existing)	# 3
LOCATION	T156N, R42W, Marshall County At the junction of Mud and Thief Rivers	
DRAINAGE AREA (sq. mi.)	615.of which ____sq.mi. are not controled by the impoundments. Thief Lake and the Moose River are upstream.	
PERMANENT POOL	Normal	Draw Down
ELEVATION (feet MSL)	Approved 1976 Elevations	
AREA (acres)	23,100	19,500
Volume (acre-feet)	38,400	25,700
FLOOD POOL		
ELEVATION (feet MSL)	See note below	
AREA (acres)		
Volume (acre-feet)	70,000	70,000
FLOOD CAPACITY	See note below	
VOLUME (acre-feet)	31,600	44,300
RUNOFF (inches)	1.0	1.4
AGASSIZ POOL		
Normal	1140.5	
1975 High	1142.0	
1979 High	1142.5	

INITIAL COST ($)

Note: The gates are operated with regard to downstream, as well as, refuge flood conditions. Greater volumes than those indicated can be stored, and have been in the past. The amount represents what can reasonably be stored, with the existing facilities, without considerable damages on the refuge. Run-off control listed is based on the uncontrolled drainage area.

COMMENTS:

Agassiz National Wildlife Refuge is operated by the U.S. Fish and Wildlife Service primarily for the benefit of waterfowl. The total refuge area is 61,660 acres, or about 96 square miles. About 23,000 acres are normally under water.

The impoundment area includes 15 seperate pools. The data listed is a summary of all the pools.

Agassiz Pool is the largest and includes the original Mud Lake. This pool is normally drawn down about 1 1/2 feet in the fall.

SITE	Clearwater Lake	# 14
LOCATION	T149N, R35-36W, Beltrami and Clearwater Counties	
DRAINAGE AREA(sq.mi.)	153	
PERMANENT POOL	Existing lake	
ELEVATION (feet MSL)	1273	
AREA (acres)	990	
VOLUME (acres/feet)		
FLOOD POOL	Existing Dam	Drawn Down
ELEVATION (feet MSL)	1277	1270
AREA (acres)	1120	890
VOLUME (acres/feet)		
FLOOD CAPACITY	Existing Dam	Drawn Down
VOLUME (acres/feet)	4180(1)	2820(2)
RUNOFF (inches)	0.5	0.3
INITIAL COST ($)		

COMMENTS:

(1) Storage capacity above normal lake level.
(2) Storage capacity below normal lake level if drawn down.

The existing dam was constructed by the Minnesota Department of Game and Fish in 1931. Stop logs are provided to adjust lake levels above and below normal.

SITE	Pine Lake	# 19(35)	
LOCATION	T149N, R38W, Pine Lake Twp., Clearwater County. On the Lost River.		
			Proposed
DRAINAGE AREA (sq.mi.)	44.7		8.2
PERMANENT POOL	Summer Level	Drawn Down	
ELEVATION (feet MSL)	1283.5	1282.5	1283.5
AREA (acres)	1310	1190	1310
VOLUME (acres/feet)	10300	8900	10300
FLOOD POOL (100 year)			
ELEVATION (feet MSL)	1285.7	1287.3	1284.5
AREA (acres)	1620	1890	1400
VOLUME (acres/feet)	13800	16600	2910
FLOOD CAPACITY	Summer Flood	Spring Flood	
VOLUME (acres/feet)	3500	7700	1400
RUNOFF (inches)	1.5	3.2	3.2
INITIAL COST (1981)	$70,000.00 ??		

COMMENTS:

There is considerable shoreline development.

Potential Impoundment Sites No. #19 and #28 are upstream.

SITE	Baird-Beyer Dam (Existing) # 25(16)
LOCATION	Section 3. T151N, R45W, Louisville Twp., Red Lake County. On the Little Black River, a small tributary of the Black River, upstream from Huot.
DRAINAGE AREA (sq.mi.)	22.6 total
PERMANENT POOL	
ELEVATION (feet MSL)	962
AREA (acres)	24
VOLUME (acres/feet)	70
FLOOD POOL	
ELEVATION (feet MSL)	972
AREA (acres)	37
VOLUME (acres/feet)	330
FLOOD CAPACITY	
VOLUME (acres/feet)	260
RUNOFF (inches)	0.7
INITIAL COST ($)	???

COMMENTS:

Goose Lake Flood Stage is 5500 feet. Drainage Area is 15.6. Runoff is 6.6".

SITE	Abraham Dam (Existing) # 32
LOCATION	Northeast 1/4 Section 32, T148N, R38W.
DRAINAGE AREA (sq.mi.)	0.3
PERMANENT POOL	
ELEVATION (feet MSL)	76
AREA (acres)	7
VOLUME (acres/feet)	30
FLOOD POOL	
ELEVATION (feet MSL)	82
AREA (acres)	15
VOLUME (acres/feet)	96
FLOOD CAPACITY	
VOLUME (acres/feet)	66
RUNOFF (inches)	4.1
INITIAL COST ($)	???

COMMENTS:

SITE	Odney Flaat Dam (Existing)	# 33
LOCATION	Section 9, Onstad Township	
DRAINAGE AREA (sq.mi.)	7.1	
PERMANENT POOL		
ELEVATION (feet MSL)	1002.0	
AREA (acres)		
VOLUME (acres/feet)		
FLOOD POOL		
ELEVATION (feet MSL)	1004.0	
AREA (acres)		
VOLUME (acres/feet)		
FLOOD CAPACITY		
VOLUME (acres/feet)	35.9	
RUNOFF (inches)	0.1	
INITIAL COST ($)	$25,000.00	

COMMENTS:

SITE	Ke-Wa-Sa	# 34
LOCATION	Greenwood Township	
DRAINAGE AREA (sq.mi.)	35.6	
PERMANENT POOL		
ELEVATION (feet MSL)	1175.0	
AREA (acres)	2579	
VOLUME (acres/feet)	5615	
FLOOD POOL		
ELEVATION (feet MSL)	1177	
AREA (acres)	4580	
VOLUME (acres/feet)	12,610	
FLOOD CAPACITY		
VOLUME (acres/feet)	6995	
RUNOFF (inches)	6.3	
INITIAL COST ($)		

COMMENTS:

SITE	Goose Lake (Existing)	# 35
LOCATION	Polk Center Township	
DRAINAGE AREA (sq.mi.)	15.6	
PERMANENT POOL		
ELEVATION (feet MSL)	995	
AREA (acres)		
VOLUME (acres/feet)		
FLOOD POOL		
ELEVATION (feet MSL)	996	
AREA (acres)		
VOLUME (acres/feet)		
FLOOD CAPACITY		
VOLUME (acres/feet)	5,500	
RUNOFF (inches)	6.6	
INITIAL COST ($)		

COMMENTS:

SITE	Knutson (Existing)	# 37
LOCATION	Section 26, T151N, R44W Red Lake County	
DRAINAGE AREA (sq.mi.)	2.71	
PERMANENT POOL		
ELEVATION (feet MSL)	1030.0	
AREA (acres)	2.7	
VOLUME (acres/feet)	12.6	
FLOOD POOL		
ELEVATION (feet MSL)	1039.2	
AREA (acres)	9.4	
VOLUME (acres/feet)	55	
FLOOD CAPACITY		
VOLUME (acres/feet)	42.4	
RUNOFF (inches)	.29	
INITIAL COST ($)		

<u>COMMENTS:</u>

SITE	Thibert (Existing)	# 38
LOCATION	Section 17, T151N, R44W Red Lake County	
DRAINAGE AREA(sq.mi.)	1.02	
PERMANENT POOL		Raised
ELEVATION (feet MSL)	1005	1009
AREA (acres)	.83	1.8
VOLUME (acres/feet)	4.3	9
FLOOD POOL		
ELEVATION (feet MSL)	1008	1012
AREA (acres)	1.4	3
VOLUME (acres/feet)	7.7	15
FLOOD CAPACITY		
VOLUME (acres/feet)	3.4	6
RUNOFF (inches)	.06	.11
INITIAL COST ($)		

COMMENTS:

SITE	Seeper Dam (Existing) # 39
LOCATION	North 1/2 Section 29, T151N, R44W
DRAINAGE AREA (sq.mi.)	6.4
PERMANENT POOL	
ELEVATION (feet MSL)	1004
AREA (acres)	25
VOLUME (acres/feet)	220
FLOOD POOL	
ELEVATION (feet MSL)	1011
AREA (acres)	40
VOLUME (acres/feet)	450
FLOOD CAPACITY	
VOLUME (acres/feet)	230
RUNOFF (inches)	.7
INITIAL COST ($)	

COMMENTS:

SITE	Miller (Existing)	# 40
LOCATION	West 1/2 Section 26, T151N, R43W	
DRAINAGE AREA (sq.mi.)	4.4	
PERMANENT POOL		
ELEVATION (feet MSL)	1076.5	
AREA (acres)	11	
VOLUME (acres/feet)	32	
FLOOD POOL		
ELEVATION (feet MSL)	1082.7	
AREA (acres)	30	
VOLUME (acres/feet)	155	
FLOOD CAPACITY		
VOLUME (acres/feet)	123	
RUNOFF (inches)	0.5	
INITIAL COST ($)		

COMMENTS:

Appendix 5
Ranking of Issues

Upper Red Lake River Subwatershed
Natural Resources Enhancement Issues Ranking

Order	Issue	Severity	Ranking (1=high / 12=low)	Comments
A	River and ditch bank failures	high	1	
B	Ditches and tributary outlets to channels	high	1	
C	Filter strips along river; ditches and ag pipes	high	1	
E	Water quality is relatively good on the RLR within this subwatershed	low	2	
F	TMDL for turbidity; from lake to confluence of Thief River	moderate	2	
G	TMDLs, concerns for development issues	high	2	
H	Pasture lands along oxbows; fencing; need to create alternate water source	moderate	3	
J	Fish passage at Red Lake Dam at outlet to river	moderate	4	
L	Influenced by water level: USACE operating plan and climate conditions; ag vs. rec	moderate	5	
K	Need more recreational opportunities, Red Lake river corridor project	moderate	6	
I	Beaver damage	moderate	7	
D	Ag land tiling	moderate	8	
M	Patterned peatlands	low	9	
N	Numerous wetlands in eastern area (reservation)	low	9	

Upper Red Lake River Subwatershed Flood Damage Issues Ranking

Order	Issue	Severity	Ranking (1=high / 12=low)	Comments
A	Agricultural	high	1	
F	Inadequate ag drainage	high	1	
G	County ditch problems	low	1	
D	Smiley Bridge west to Thief River Falls on Red Lake River, residential flooding in spring	high	2	
E	Sherwood forest, spring flooding	high	2	
C	High landing flooding	moderate	3	
H	City of Thief River Falls water supply, source is Red Lake River	low	3	m
I	Red Lake River long periods of high flow	moderate	3	m
K	Flow controlled by USACE	high	3	j,k
L	Alternate supplies study? GW	moderate	4	
B	Good Lake impoundment, excess water	moderate	5	
J	Lack of flow/stage information at Kratka Bridge	low	6	
N	More info concerning ag land tiling	low	7	
M	High water tables in eastern parts	low	8	

Lower Red Lake River Subwatershed
Natural Resources Enhancements Issues Ranking

Order	Issue	Severity	Ranking (1=high / 12=low)	Comments
B	Tributary bank instability at outlets into rivers	moderate	1	
C	JD 60, south of CR11, Ricards buildings about to fail	high	1	
D	Bank sloughing in Crookston and Red Lake Falls	high	1	
E	Polk CD 1 outlet, last mile, west of Crookston	high	1	
F	Ditches outletting into natural streams, filling outlet streams with sediment	high	1	
A	Erosion assessment from reservation to Red; map eroded areas; applied for LCMR grant	high	2	
G	Turbidity: LRLR is impaired Water: cost of treating water is expensive; Burnham Crk to Red; the data available for the next assessment will extend impairment upstream through Crookston (303D)	high	3	
I	Source water protection	moderate	4	
K	Source water protection	moderate	4	
O	Low water: tubing	moderate	5	
P	Red Lake Corridor Group: need to investigate their work (Paige)	moderate	5	
Q	Fishing is important in LRLR	moderate	5	
N	Ottertail Dam, east of Crookston, fish passage in lower flows	moderate	6	
R	Safety near dams, especially above Crookston	moderate	6	
L	Wellhead protection plans Crookston, Red Lake Falls, Thief River Falls	moderate	7	
S	Wayside State Park at Huot	moderate	8	
T	Prairie remnants	moderate	8	
U	LRLR is a unique resource that needs to be recognized	moderate	8	
V	Old Treaty crossing at Huot	moderate	8	

Lower Red Lake River Subwatershed Natural Resources Enhancements Issues Ranking

H	Outlet of Schirrik Dam, feedlot in Black River	low	9	
M	DNR to provide info: Beach Ridges, prairie grouse, deer	low	10	
J	Flowing well protection in Huot	low	11	

Lower Red Lake River Subwatershed Flood Damage Issues Ranking

Order	Issue	Severity	Ranking (1=high / 12=low)	Comments
A	Agricultural	high	1	
B	Overland flooding in Crookston: city dikes in poor condition	high	2	
E	Residential flooding in NE part of Crookston	high	2	
J	Bank sloughing in Crookston and Red Lake Falls	high	3	
G	JD 60 flooding	high	4	
H	Lateral 4 (2) of JD 60	high	5	
C	Overland flooding near RLC CD 13, Browns CR	high	6	
F	Inadequate E-W ditches in western half of subwatershed	high	7	
K	Public water supply in EGF and TRF	low	8	
O	Source water protection plans and wellhead protection plans need to be done or followed up on	moderate	9	
L	Flashy hydrograph (53)	moderate	10	
M	Groundwater not adequate for municipal supplies	low	11	
N	Gravel pit contamination of aquifers	low	12	
I	Surface water irrigators	low	13	
D	Huot Dam: 1946 (BC not positive) Today, Section 205 high flow cutoffs	moderate	14	practical

Thief River Subwatershed Natural Resources Enhancement Issues Ranking

Order	Issue	Severity	Ranking (1=high / 12=low)	Comments
A	River and ditch bank failures	high	1	
C	Ditch 20 sloughing and erosion on laterals	high	1	
D	Active erosion Section 1 Northwood Twp; MC TH 54 and bridge on Moose River	high	1	
F	Ditch erosion	high	1	
G	Overall sloughing and sedimentation	high	1	
H	SD 83 sedimentation, bank erosion	high	1	
J	CD18/30 bank sloughing	high	1	
K	Sedimentation deltas Thief Lake, Agassiz, Elm Lake	high	1	
M	Channel and streambank erosion	high	1	
N	High total suspended soils and dissolved solids on the Mud River	moderate	1	
O	High fecal coliform at Thief Lake outlet; low DO from Agassiz NWR outlet to TRF; high TSS and TDS from Agassiz NWR outlet to TRF; high conductivity near TRF	high	2	
P	Low DO on the Moose River	moderate	2	
Q	Hydrogen Sulfide in TRF	moderate	2	
R	Generally poor water quality coming from impoundments	moderate	2	
U	Low flows	moderate	3	
X	Flashy hydrographs	moderate	3	
W	2002 Agassiz operation sediment releases	moderate	4	
AA	Agassiz update CCP	moderate	4	
BB	Thief Lake management plan update	moderate	4	
CC	Review Moose River impoundment operations	moderate	4	
T	Thief, Mud, Moose River Corridors	moderate	5	
V	Thief River Section 19, lost river channel rehab	moderate	5	
Y	Restore channelized Mud River	moderate	5	
EE	ATV corridors	moderate	6	
FF	Boat ramps	moderate	6	

Thief River Subwatershed Natural Resources Enhancement Issues Ranking

GG	Preserve hunting	moderate	6	
JJ	Canoeing	moderate	6	
HH	Protection of fens	moderate	7	
II	Natural heritage elements	moderate	7	
L	Ag land tiling	moderate	8	
S	Beaver damage	low	9	
Z	Preserve Elm Lake deer wintering area	low	10	
DD	Grassland/brushland habitat maintenance	low	10	

Thief River Subwatershed Flood Damage Issues Ranking

Order	Issue	Severity	Ranking (1=high / 12=low)	Comments
B	Farmstead flooding	high	1	l
L	Farmstead ringdikes	high	1	b
M	Goodridge flooding	high	1	
A	Ag land flooding	high	2	c
C	Overland flooding	high	2	a
E	Ditch 20 system problems (maintenance)	high	3	f
F	Ditch 20 to 200	high	4	e
G	Flooding adjacent to Agassiz	moderate	5	g,j,o,s,u
J	Adjacent to Agassiz	moderate	5	g,j,o,s,u
O	Debris Agassiz	moderate	5	g,j,o,s,u
S	Thief River flows into Agassiz	high	5	g,j,o,s,u
U	Extended periods of high flow in Thief River (SD # 83); extended periods of low flow in TR; flashiness in flow from Agassiz to NWR	high	5	g,j,o,s,u
K	Downstream of Elm Lake	moderate	6	a,u
D	Inadequate outlets	moderate	7	e,f,a
N	Whole length of 200	moderate	8	
P	Better maintenance on public systems; extensive ditch systems draining non-productive lands	high	8	
Q	Beaver problems	high	8	
R	Channel maintenance on natural reaches	moderate	8	
T	Outlet of SD 83	moderate	9	
I	Impoundments: refer to URLR	low	10	p
H	Subwatershed has more control structures	low	11	
V	More info concerning ag land tiling	low	12	

Grand Marais Subwatershed Natural Resources Enhancement Issues Ranking

Order	Issue	Severity	Ranking (1=high / 12=low)	Comments
A	Bank failures on CD 2, JD 60; Grand Marais is silted in	high	1	ext. erosion
B	Wind and water erosion: worst wind erosion in winter	high	1	c,d
C	Loss of windbreaks	high	1	b,d
D	Conservation tillage	high	1	b,c
E	Extreme erosion in the ditched portion where the river is diverted directly to the Red River	high	1	a
F	Turbidity and TSS under periods of high flow and low DO under low flow	high	2	g
G	River will be listed on next MPCA List of Impaired Waters (TMDL)	high	2	f
L	Flashy hydrograph hinders waterfowl production along the Grand Marais	moderate	3	
H	Degraded fish and wildlife habitat, especially along the Grand Marais	high - west of 75 low - east of 75	4	j
J	Waterfowl and furbearer habitat could be more productive	moderate	4	h
K	Vegetation in flood plain is killed during high flows	moderate	4	j,h
Q	Native prairie	high	5	r
R	Calcareous fens	high	5	q
I	Prairie chicken and sharp tail grouse populations are on the rise	moderate	6	east 75
S	Small wetlands are missing (DU Study)	high	7	
M	Minimal opportunities for fishing, waterfowl hunting, canoeing, wildlife viewing	low	8	n,o
N	Waterfowl hunting is on the rise	low	8	m,o
O	Riparian corridor hunting is quite good	low	8	m,n
P	Limited trail systems	low	8	
T	Important non-game avian corridor	high	9	

Grand Marais Subwatershed Flood Damage Issues Ranking

Order	Issue	Severity	Ranking (1=high / 12=low)	Comments
A	Overall flooding, section by section	high	1	i
H	CD2, CD 66, CD 126, JD 60, CD 39, CD 25	high	1	a
I	Additional private ditching	moderate	1	a
L	Crop damage	low	1	a
B	Residential and ag flooding along the Grand Marais	high	2	d,g
D	Residential and ag flooding west of the Grand Marais east of #220	high	2	b,g
G	Residential flooding north of EGF, west of #220	high	2	b,d
P	City of Euclid	high	2	b
E	Roads and ag lands and bridges	high	3	
C	Emergency services cannot reach patients	high	4	
F	Lack of detailed mapping of flood damaged areas	moderate	5	FEMA working on
N	Sedimentation	high	6	m
M	Flashy hydrographs (high peaks)	high	7	n
O	Flow information	moderate	8	linkage to A easy to implement
K	Subsurface drainage (tiling)	low	9	
J	Benefited areas are much smaller than drainage areas	low	10	areas not paying benefits

Clearwater Subwatershed Natural Resources Enhancement Issues Ranking

Order	Issue	Severity	Ranking (1=high / 12=low)	Comments
B	Channelized reach of the Clearwater River and Ruffy Brook (seeking new channel); USACE project cut		1	
F	New development of homes at Walker Brook Lake		2	low priority in this category
G	Maple Lake and other lakes erosion of shoreline		2	g, j, t, u, v
J	Maple Lake suffers from poor water quality	high	2	
Q	Other Lakes: Cameron, historic sewage effluent; Badger and Mitchell, fish kills	high	2	g, j, t, u, v
S	ISTS compliance on area lakes		2	
T	Clearwater Lake mesotrophic now after going eutrophic in 1997 due to sewage, need to prevent future problems		2	g, j, t, u, v
U	Oak Lake is not able to sustain a viable fishery: water levels, excess nutrients		2	
w	Hill River Lake: fish kills		2	
A	Bank stabilization and erosion (e.g. Lost River, Greenwood) - RLWD to provide report		3	d
C	Sand/sediment transport; impacts wild rice pump intakes; spring; no sampling during flooding		3	a,d
D	Ditch bank sloughing and stabilization		3	a
E	Sediment from commercial wild rice production		4	
H	Ag erosion western half		4	i
I	Wind erosion on beach ridges		4	h
K	RLC Ditch 57 has low D.O.		5	
L	Citizens are concerned about TMDL regulations and their effect on wild rice and all other farming operations		5	o, p
O	Walker Brook and Walker Brook Creek naturally occurring TMDL		5	low priority in this category

Clearwater Subwatershed Natural Resources Enhancement Issues Ranking

P	Delisting of Clearwater for Fecal TMDL denied by MPCA, need to revisit		5	low priority in this category
M	Very high percentage of subsurface drainage; possible positive impacts on water quality (TSS, TP, less tillage, reduced runoff, increased infiltration); possible adverse N impacts		6	
N	Tiling has changed ag practices to no-till or near it		6	
R	Poplar Diversion: JD 73 outlets to Maple Lake, sediment plume; east and west flows in 73		7	
v	Upper Clearwater is a designated trout stream		8	

Clearwater Subwatershed Flood Damage Reduction Issues Ranking

Order	Issue	Severity	Ranking (1=high / 12=low)	Comments
A	City of Clearbrook Flooding		1	
B	City of Bagley, some homes on East end	low to moderate	1	
I	City of Mentor, flooding from Maple Lake outflow; also CD 14 sedimentation. All issues seem to be related		1	
G	Perceived lack of flow/ WQ data in Maple Lake area		2	
H	More stage/flow data		2	
C	Beavers plugging ditches, culverts and waterways	entire subwatershed	3	
D	Lack of maintenance of aging public ditch system	entire subwatershed	3	
E	Ditches by Anderson Lake		3	
L	Badger Creek flooding		3	
F	Wild rice paddies struggle for supply in some years with low water		4	Need to recognize: store floods in high years, struggle in dry years. How to help?
M	Clearwater Lake: outlet structure; potential for damages to road; N side of dam, discharge near wingwall		5	
J	Many wildlife lakes here; need to examine primary use: wildlife vs fisheries		6	
K	Crookston: 2 new wells in this area; need awareness of this		7	

Red Lakes Subwatershed Natural Resources Enhancement Issues Ranking

Order	Issue	Severity	Ranking (1=high / 12=low)	Comments
O	Red Lakes themselves	high	1	
P	Red Lake Nation coordination	high	1a	
A	Some erosion/runoff on Battle Creek	high	2	
B	Sedimentation and vegetative growth in ditch systems	high	2	
C	Long shore drift clogs rivers, impedes access	high	2	
D	Erosion problems on tributaries to Red Lakes	high	2	
F	Shotley Brook Dam failure	high	2	
G	Fish spawning impacted	high	2	
K	Fish cribs	moderate	3	
L	Good fishing on lakes	moderate	3	
M	Waterskiing	moderate	3	
E	Bartlett Lake eutrophication	high	4	
I	Brushland/grassland habitat	low	5	
J	Need for controlled burning	low	5	
N	Bog state recreation area	moderate	6	
Q	Trout stream	moderate	6	
H	Fish escapement	low	7	

Red Lakes Subwatershed Flood Damage Issues Ranking

Order	Issue	Severity	Ranking (1=high / 12=low)	Comments
A	Cabin flooding	high	1	
B	Corps operations	high	1	
K	Operation of dam	high	1	
O	Water release impacts to downstream Red River	high	1	a
G	Poor drainage high water table	moderate	2	
H	Impacts to wild rice	moderate	2	
L	Beaver problems	high	2	
I	Access to lakes from cabins	moderate	3	
J	Need for DNR dredging permits for lake access	moderate	3	
C	Shotley Brook Dam	moderate	4	
D	Tamarac River Dam	moderate	4	
N	Shotley Brook plugged frequently	moderate	4	
E	Ditch 10	low	5	f
F	Ditch abandonment	low	5	e
M	WCA issues of mitigation with so many wetlands	low	6	

Natural Resource Enhancements Issues Ranking

Categories, Issue Number and Ranking	Erosion and Sedimentation 1	Water Quality 2	Fish and Wildlife Habitat 3	Water-based Recreational Activities 4	Unique Water/ Land Related Resources 5	Other Natural Resource Issues 6
Erosion and Sedimentation 1		1	1	1	1	1
Water Quality 2	1		2	2	2	2
Fish and Wildlife Habitat 3	1	2		3	3	3
Water-based Recreational Activities 4	1	2	3		4	4
Unique Water/ Land Related Resources 5	1	2	3	4		5
Other Natural Resource Issues 6	1	2	3	4	6	

Flood Damage Reduction Rankings

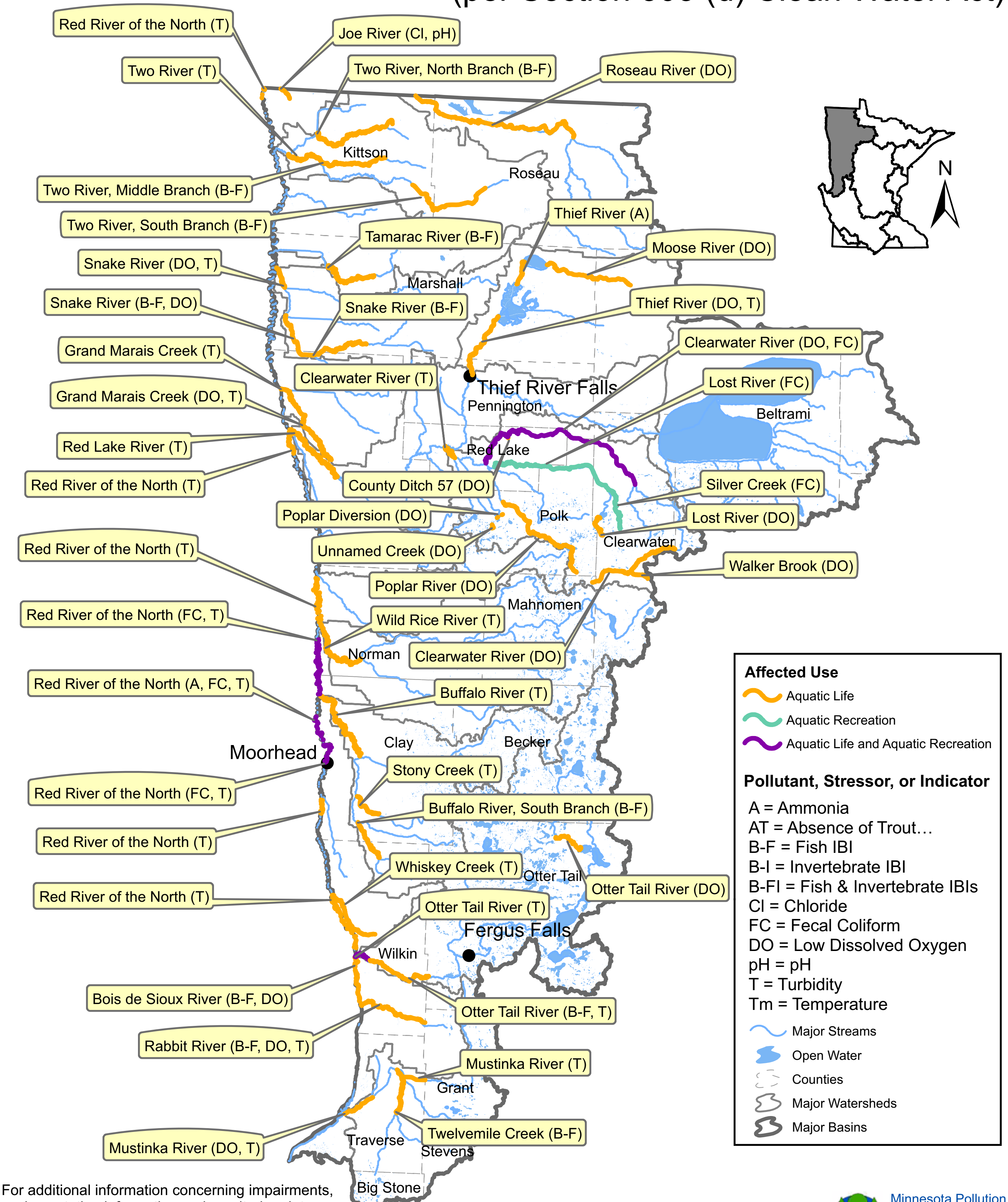
Categories, Issue Number and Ranking	Flooding 1	Flood Damages 2	Drainage 3	Drought 4	Steam Flows 5	Lake Levels 6	Groundwater 7	Other Flood Damage Issues 8
Flooding 1		2	1	1	1	1	1	1
Flood Damages 2	2		2	2	2	2	2	2
Drainage 3	1	2		3	3	3	3	3
Drought 4	1	2	3		5	6	7	8
Steam Flows 5	1	2	3	5		5	5	5
Lake Levels 6	1	2	3	6	5		6	6
Groundwater 7	1	2	3	7	5	6		7
Other Flood Damage Issues 8	1	2	3	8	5	6	7	

Appendix 6
Newly Developed Total Maximum Daily Loads

Red River Basin: Conventional Parameters

2006 Impaired Waters Requiring a TMDL (per Section 303 (d) Clean Water Act)

Draft until approved by US EPA



For additional information concerning impairments, such as station information and monitoring data, see the MPCA Environmental Data Access System. http://www.pca.state.mn.us/data/edaWater

Minnesota Pollution Control Agency
October, 2005

Red River Basin Pollution Reduction Program
Management Framework for Local Implementation

The #### Subwatershed Example

Chapter 1: Introduction

Preface: As defined by the 1997 Federal list of impaired waters the #### River Subwatershed within the RLWD is imparted for turbidity/D.O./Ammonia. To determine the presence and level of impairment the MN PCA has undergone a detailed monitoring program to determine the extent of the problem. The results of the detailed monitoring appraisal will be available the summer 2002

This document defines a framework for local implementation of pollution reduction activities in areas with impaired waters. The process developed below combines existing local management efforts of the RLWD, local water planners and soil and water conservation district to foster a high level of landowner participation in a small number of priority subwatersheds.

The goal of the program is to incorporate the necessary management framework into the ongoing local watershed management plans to allow for effective implementation towards predicted TMDL source load reduction targets.

The template process below defines how BMP eligibility criteria for pollutant sources could be established to achieve target reduction levels in the #### River Subwatershed. Success of this process relies on establishment of a strong interagency technical advisory committee responsible of the developed of goals and project eligibility.

Chapter 2: Water Quality

[*Summary of TMDL monitoring results and other applicable local and state water quality information.]

The streams of the #### River Subwatershed are not reaching their designated use due to pollution from nonpoint sources. Eroding croplands and streambanks and the lack of nutrient management programs are the major source of nonpoint pollution in the watershed.
Responsibility: Completion of local monitoring grant programs.

Chapter 3: Estimated Pollutant by Source

Using existing data from the County SWCD, County Water Plan, and WD Overall Plan estimate (using only best available information) the amount of pollution from agricultural lands, and streambanks in the watershed. Using preliminary data determine amount of phosphorus [organic] carried in runoff from agricultural land to a receiving stream. The amount of sediment reaching streams from eroding agricultural lands and streambanks was also estimated.

In the #### River Subwatershed, about [* #] percent of the sediment deposited in streams annually is derived from agricultural upland erosion. [* Number] percent of the sediment reaching streams originates from streambank erosion. [*Approximately [* #] percent of the total sediment is contributed from shoreline erosion.

The following is a summary of specific ***estimated*** pollutant sources:

Feedlot Runoff

[* Number] feedlots in subwatershed.

These feedlots were found to contribute [*] pounds of phosphorus. [organic] to surface waters, annually.

Streambank Erosion

[* Number] stream miles in Subwatershed.

[* Number] tons of sediment reach streams from eroding sites.

There are [* #] miles of eroding sites.

Shoreline Erosion

[* Number] miles of reservoir or lake shoreline were found to have severe, moderate, or mild erosion from eroding sites.

[* Number] tons of sediment are delivered to the reservoir, annually.

[* Number] landowners have mild, moderate, or severe erosion sites.

Upland Sediment

[* Number] tons of sediment are delivered to streams.
[* Number] percent from cropland.
[* Number] percent from grazed woodlots and woodlots.
[* Number] percent from pastures.

Urban

Responsibility: LWP/WD/SWCD modeling, data and analysis by technical advisory committees for local plans.

Chapter 4: Project Pollutant Reduction Objectives

<u>Sediment Objective</u>

As estimated by integrating the preliminary water quality monitoring results with the estimated pollutant by source, the WD planning TAC and CAC has recommended a [* #] percent reduction in overall sediment delivered in Subwatershed. To meet this pollutant reduction objective, the following reductions are needed:

<u>Optional objectives</u>

[* Number] percent reduction in sediment reaching streams from agricultural uplands in subwatershed.

[* Number] percent reduction in streambank sediment delivered to all streams and a [* #] percent overall repair of streambank habitat in subwatershed.

[* Number] percent reduction in shoreline sediment delivered to the reservoir.

<u>Phosphorus Objective</u>

Recommended a [* #] percent reduction in overall phosphorus delivered in Subwatershed. To meet this pollutant reduction objective, the following reductions are needed:

<u>Optional objectives:</u>

Reduce overall phosphorus [organic] load by [* #] percent.

[* Number] percent reduction in phosphorous [organic] pollutants from feedlots in subwatershed.

[* Number] percent reduction in phosphorous [organic] pollutants from manure spread on unsuitable acres in subwatershed.

Achieve the sediment objective above.

In addition, the TAC /CAC has set an objective of restoration of [* 10] percent of degraded or prior converted wetlands.

Urban Objectives

Responsibility: Technical advisory committee of local planning programs.

Chapter 5: Eligibility Criteria – Determining if landowner in subwatershed is eligible for program funding.

Cost-share funds for installing pollutant control measures will be targeted at operations, which contribute the greatest amounts of pollutants. Cost-share funds will be available through a combination of County SWCDs, TMDL implementation, County Water Planning /NRBG, FDR, ACOE, MDH, and non-governmental organization conservation funds. These BMP cost-share rates will range from 70 to 100 percent. The County SWCD and RLWD will assist landowners in applying BMPs.

The RLWD and SWCD will contact all landowners who are eligible to receive cost-share funds during the implementation phase. Specific sites or areas within the subwatershed will be designated as either "eligible," or ineligible. Eligible sites need not control every eligible source to receive cost-share assistance.

The following is a brief description of significant pollutant sources and project eligibility criteria:

<u>Agricultural Lands</u>

All agricultural lands contributing sediment to streams at a rate greater than [* #] tons per acre per year will be classified as eligible for implementation and be brought down to a rate of [* #] tons per acre per year. This involves an estimated [* #] acres of cropland.

The BMPs identified by the RLWD/SWCD in the Overall Plan will emphasize both improving farm management and controlling pollutants. Cost share rates are listed below and include both a local /regional and state/federal component.

<u>Feedlots</u>

The objective for feedlot runoff control is to reduce COD loading to streams by a total of [%.] Based on past experience, sites contributing a COD load greater than [*#] pounds on an annual basis will be designated as eligible for cost-share. All eligible landowners need to divert the clean upland water and roof runoff away from the animal lot.

<u>Manure Spreading</u>

All operations in the subwatershed are eligible for cost-sharing for nutrient management planning. RLWD/SWCD/County staff will direct efforts toward operations having a greater potential need for nutrient management planning and little suitable land for spreading. A nutrient management plan may identify the need for winter storage of manure because of limitations of winter spreading on steep slopes and on fields near water.

<u>Streambanks</u>

Sites with a lateral recession of greater than [* 0.5] feet per year will be Eligible.
There will be an emphasis on controlling bank erosion and improving fish and wildlife habitat in subwatershed, to enhance water quality and habitat conditions.

<u>Shoreline</u>

Eligible sites are those with moderate or mild erosion. Moderate sites are defined as having streambanks less than [* three] feet in height, with a lateral recession rate of greater than [* 0.1] feet per year. Mild erosion sites are defined as having bank heights of [* 3.0] feet, with lateral recession rates greater than [* 0.05] feet per year. See tables in chapter two for a summary of eligibility criteria.
Responsibility: Technical advisory committee

Chapter 6: Project Implementation

Project implementation is scheduled to begin in [* year]. Cost-share agreements can be signed from [**year** –year*], all practices must be installed with [*years]. Landowners must maintain practices for at least ten years from the installation of the final practice on the agreement. BMPs can be installed as soon as a landowner signs a cost-share agreement with the RLWD].

Information and Education

The MPCA will provide [* $] to the RLWD for conducting an information and education program in the #### River Subwatershed. The activities will include BMP demonstrations, tours, newsletters and public meetings.

Funds Needed for Cost Sharing, Staffing, and Educational Activities

The MPCA will award grants to RLWD for cost sharing, staff support and educational activities. Table [*] includes estimates of the financial assistance needed to implement activities necessary to achieve predicted target TMDL pollutant reductions.

Cost Estimates for the #### River Management- table

	Total Cost and Financial Responsibility	Implementation Responsibility
Cost Sharing		RLWD, SWCD, County
Local	_______% from State C/S program	
Watershed	_______% from project funds	
Regional	_______% from Red Board mediation funds	
State	_______% from BWSR spec. project or challenge Grant, or MDH source water program.	
Federal	_______% from MPCA 319/TMDL	
Other	_______%NGO or non-profit	
Educational Activities	Potential sources above with local in-kind	RLWD, SWCD, County
Administration	_________ from MPCA to match in-kind.	RLWD, SWCD, County

Chapter 7: Project Evaluation and Monitoring

The evaluation strategy will involve collecting, analyzing and reporting information to track progress in two areas:

1. Administrative: Progress in providing technical and financial assistance to eligible landowners, and carrying out education activities identified.

2. Pollutant Reduction Levels: The RLWD in partnership with County SWCDs and County water Planners will calculate the reductions in pollutant loadings and report findings at annual meetings.

Chapter 8: Execution of Interagency Agreement

The signatories below agree to uphold their responsibility to implement the workplan as defined above.

____

____

____

____

Summary Table of Actions and Responsibilities

Action	Description	Responsible Party
Water Quality Monitoring	Determine level of impairment	MPCA support of local monitoring efforts
Estimate Pollutants by Source	Rough estimate using best available information of the "breakdown" of the source of pollutants- feedlot, streambank, shoreline upland or other.	Watershed District TAC including strong involvement from SWCD, local water planners and MPCA and other state agencies.
Project Pollutant Reduction Objectives	Reduction objective for sediment and Phosphorus and optional reduction for each source listed above.	MPCA will present TMDL reduction objective for impaired waters to Watershed District TAC. The local Plan, with advice from TAC, will modify TMDL goal if monitoring or field data indicates objective is unachievable.
Eligibility Criteria for cost share and other funding	Targeting operations/ sites for cost share and other incentives that contribute greatest amount of pollutants. *Example:* Sites that deliver 2 tons /acres/yr. sediment or 50 pounds of 50 P delivered according to FLEVAL.	Partnership of SWCDs, Watershed District and local water planner with involvement from state agencies.
Project Implementation	Enrolling eligible landowners to install practices to achieve objectives. Program administration and education are also components.	A committed fund should be established to ensure a consistent level of local implementation. The level of financial responsibility of the various sources (federal/ state/ regional/ local and NGO's) for administration and project implementation /cost sharing has yet to be determined.
Project Evaluation	Regular monitoring and analysis to determine progress toward objectives.	Component of local administrative program.

Appendix 7
RLWD Summary of Water Quality

Water quality monitoring has been conducted since 1984 by the District at nineteen sites associated with streams and has commenced more recently at four other sites on lakes within the sub-watershed. Lakes being monitored include Clearwater Lake (1993), Cameron Lake (2003), Maple Lake (2004), and Badger Lake (2004). The parameters measured included field measurements for dissolved oxygen, pH, temperature, turbidity, transparency, conductivity, etc. Laboratory analysis is performed on stream samples for fecal coliform, total suspended solids, total dissolved solids, chemical oxygen demand, total phosphorus, orthophosphorous, nitrates and nitrites, ammonia, total kjeldahl nitrogen, and alkalinity. Lakes monitoring data includes Secchi depth readings, as well as total phosphorous and chlorophyll-a analysis. The District periodically prepares a water quality report, and results are available upon request in the District office. There are six impaired stream reaches as identified by the Minnesota Pollution Control Agency in this sub-watershed. They include;

- Clearwater River, Ruffy Brook to Poplar River
- Clearwater River, Clearwater Co. Line to Clearwater Lake
- Walker Brook, from Walker Brook Lake to Clearwater River
- Poplar River, from Spring Lake to Hwy 59
- Lost River, from Silver Creek to Hill River
- CD57, from confluence with Clearwater River to approx. 2 miles upstream
- MPCA monitoring sites 1
- Riverwatch monitoring sites 19
- SWCD monitoring sites 2

Watershed Name	Thief River - Moose River - Mud River	
Impaired Waters	Currently none - reach between Agassiz NWR and TRF most likely will be on 2006 list	
Number of Stream Sampling Sites	RLWD	5
	SWCDs	8
	Riverwatch	4
	MPCA	1
Field Parameters	dissolved oxygen, pH, water temperature, turbidity, transparency, conductivity, total dissolved solids, stage	
Laboratory Parameters	fecal coliform, total suspended solids, total dissolved solids, chemical oxygen demand, total phosphorus, orthophosphorous, nitrates and nitrites, ammonia, total kjeldahl nitrogen, and alkalinity	
Earliest Sampling Date	1980	
Key Sampling Locations	Hillyer Bridge (USGS gauge GS-05-0760), Moose R. and Mud R.	
Other Notes	The Hillyer Bridge monitoring site is also monitored by the MPCA	
	Noted Problems with High TSS and Low Dissolved Oxygen between Agassiz and TRF	

Watershed Name	Upper Red Lake River	
Impaired Waters	None currently, none expected on 2006 list	
Number of Stream Sampling Sites	RLWD	2
	SWCDs	2
	Riverwatch	0
Field Parameters	dissolved oxygen, pH, water temperature, turbidity, transparency, conductivity, total dissolved solids, stage	
Laboratory Parameters	fecal coliform, total suspended solids, total dissolved solids, chemical oxygen demand, total phosphorus, orthophosphorous, nitrates and nitrites, ammonia, total kjeldahl nitrogen, and alkalinity	
Earliest Sampling Date	1980	
Key Sampling Locations	Red Lake Dam Outlet (GS-05-0740), Highlanding Bridge	
Other Notes	We are dropping the RL Dam starting in 2004 due to avoid duplication of monitoring efforts with the RLDNR, it will continue to be monitored by the RLDNR.	

Watershed Name	Lower Red Lake River
Impaired Waters	2 reaches Red Lake River; Burnham Creek to Unnamed Creek (East Grand Forks) Red Lake River; Unnamed Creek to Red River
Number of Stream Sampling Sites	RLWD 6 SWCDs 7 Riverwatch 15 MPCA 1
Field Parameters	dissolved oxygen, pH, water temperature, turbidity, transparency, conductivity, total dissolved solids, stage
Laboratory Parameters	fecal coliform, total suspended solids, total dissolved solids, chemical oxygen demand, total phosphorus, orthophosphorous, nitrates and nitrites, ammonia, total kjeldahl nitrogen, and alkalinity
Earliest Sampling Date	1984
Key Sampling Locations	1st Street Bridge in Thief River Falls, Sampson Bridge in Crookston (GS-05-790), Murray Bridge in EGF, Burnham Creek, Black River
Other Notes	The turbidity impairment on the RLR should extend upstream to at least Crookston on the 2006 impaired waters list based upon our data Our monitoring site in Thief River Falls shows no impairments.

Watershed Name	Upper and Lower Red Lakes
Impaired Waters	None
Number of Stream Sampling Sites	RLWD 0 9 historical sites, 1 site that was monitored through 2002 RLDNR At least 10 Riverwatch 4
Field Parameters	dissolved oxygen, pH, water temperature, turbidity, transparency, conductivity, total dissolved solids, stage
Laboratory Parameters	fecal coliform, total suspended solids, total dissolved solids, chemical oxygen demand, total phosphorus, orthophosphorous, nitrates and nitrites, ammonia, total kjeldahl nitrogen, and alkalinity
Earliest Sampling Date	1989
Key Sampling Locations	Mud Creek in Redby
Other Notes	The Red Lake Department of Natural Resources monitors all the main streams that inlet to the lake, as well as the Red Lakes themselves

Watershed Name	Grand Marais Creek	
Impaired Waters	Currently none, the Grand Marais will likely be on the next impaired waters list	
Number of Stream Sampling Sites	RLWD	1
	SWCDs	0
	Riverwatch	3
	MPCA	1
Field Parameters	dissolved oxygen, pH, water temperature, turbidity, transparency, conductivity, total dissolved solids, stage	
Laboratory Parameters	fecal coliform, total suspended solids, total dissolved solids, chemical oxygen demand, total phosphorus, orthophosphorous, nitrates and nitrites, ammonia, total kjeldahl nitrogen, and alkalinity	
Earliest Sampling Date	1985	
Key Sampling Locations	Grand Marais River @ Hwy 220	
Other Notes	The MPCA monitors at the last road crossing before the Grand Marais enters the Red River	
	Some of the ditches flowing into the Grand Marais and the Grand Marais itself are monitored by high school students through the Riverwatch program	
	Very high turbidity and TSS levels, low dissolved oxygen as well	

Appendix 8
Goal Planning Workshop Results

RED LAKE WATERSHED DISTRICT WATER QUANTITY GOAL PLANNING WORKSHEET

UPPER RED LAKE

Goal Statement	Priority Issues (What is this goal addressing?)		Strategies	Partners
	Area	Subwatershed		
Reduce peak flows from the RLRC EGF and GM by 10 percent		Ag flooding	Set back levees along ditch systems and Red Lake River, redefine channel via channel restoration	
Reduce runoff volume contributing to peak flows by 20,000 ac-ft.				
Special projects – Actively seek and identify projects to implement based upon problems identified by stakeholders.		Review county ditches specifically CD#1, CD#38, 54 (Star)	Ditch improvements culvert sizing work with county ditch authorities to aid them in the legal process	RLWD counties
Educate – Develop an outreach program that promotes an understanding of the policies and activities of the RLWD.				
Floodplain – participate in floodplain management programs affecting urban and agricultural areas.		Smiley Bridge; Sherwood Forest; (CSP) Conservation Program or other	Flood-proofing levee system; restore wetlands buffer strip	DNR, RLWD, landowners, NRCS, RLWD

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
- Subwatershed = Grand Marais Creek / Lower Red Lake River / Clearwater River / Thief River / Upper Red Lake River / Red Lakes

RED LAKE WATERSHED WATER QUALITY GOAL PLANNING WORKSHEET

UPPER RED LAKE

Goal Statement	Priority Issues (What is this goal addressing?)		Strategies	Partners
	Area	Subwatershed		
Increased knowledge of sources that cause water quality problems.				
Improve Public Education		Filter strips	Improve education and outreach programs; promote conservation security program; CREP; EQIP; Riverwatch – maintain and expand existing program	BWSR; SWCD; NRCS Schools
Improve Interagency Cooperation		Water quality is good	Improve inter-agency cooperation; look for opportunities to jointly fund and participate in projects	DNR; BWSR; MPCA; USACE
Improve Project Implementation				

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
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RED LAKE WATERSHED EROSION GOAL PLANNING WORKSHEET

UPPER RED LAKE RIVER

Goal Statement	Priority Issues (What is this goal addressing?)		Strategies	Partners
	Area	Subwatershed		
Reduced agricultural erosion.		Upper Red Lake River		
Decreased sediment to lakes, streams, rivers, drainage systems.		Upper Red Lake River	Buffer strips; BMPs; assisting in reducing bounce that may affect river and ditch bank failures	NRCS; SWCD; RLWD
Increased use of agricultural Best Management Practices.				
Increased public understanding.			Review operating plan for dam at outlet of Red Lakes	USACE; County Board; Tribe; MnDNR; RLWD
Increased interagency cooperation.		Upper Red River		
To be cost effective and to leverage to the extent practical limited resources.				

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
- Subwatershed = Grand Marais Creek / Lower Red Lake River / Clearwater River / Thief River / Upper Red Lake River / Red Lakes

RED LAKE WATERSHED NATURAL RESOURCES GOAL PLANNING WORKSHEET

Goal Statement	Priority Issues (What is this goal addressing?)		Strategies	Partners
	Area	Subwatershed		
Maintain existing quality habitats (watercourses, wetlands, lakes, grasslands, brushlands)				
Enhance the quality of existing habitats (watercourses, wetlands, lakes, grasslands, brushlands)		Upper Red Lake River	Fish ladder, etc. at outlet of Red Lake * see Recreation section	USACE; RLWD; Tribe; USFW; DNR
Increase the quantity of quality habitats				
Educate folks on the functions and value of existing fish and wildlife habitat with inference to how it can be compatible with FDR.				
Support recreational use of resources.		Upper Red Lake – Active participation of the Red River Corridor folks & assisting them in studies and endeavors	Review operating plan of COE for outflows of water to Red Lake River via dam at Red Lake	USACE' Tribe; RLRCE

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
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RED LAKE WATERSHED WATER QUANTITY GOAL PLANNING WORKSHEET

Goal Statement	Priority Issues (*What is this goal addressing?*)		Strategies	Partners
	Area	Subwatershed		
Reduce peak flows from the RLRC EGF and GM by 10 percent	Crookston Flooding		1 – Upstream storage 2 – Land use change 3 – Investigate influence of tiling	
Reduce peak flows from the RLRC EGF and GM by 10 percent	Browns Creek		Investigate options – clean out with sediment control in upper WS	
Reduce runoff volume contributing to peak flows by 20,000 ac-ft.				
Special projects – Actively seek and identify projects to implement based upon problems identified by stakeholders.				
Educate – Develop an outreach program that promotes an understanding of the policies and activities of the RLWD.				
Floodplain – participate in floodplain management programs affecting urban and agricultural areas.				
Widespread flooding throughout no large discrete area				

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
- Subwatershed = Grand Marais Creek / Lower Red Lake River / Clearwater River / Thief River / Upper Red Lake River / Red Lakes

RED LAKE WATERSHED WATER QUALITY GOAL PLANNING WORKSHEET

Goal Statement	Priority Issues (What is this goal addressing?)		Strategies	Partners
	Area	Subwatershed		
Increased knowledge of sources that cause water quality problems.		LRLR	Develop & implement WQ monitoring/continue existing; Evaluate existing WQ monitoring	Counties, RRWMB, PCA
Improve Public Education		LRLR	Continue Riverwatch	
Improve WQ		LRLR		
Improve Interagency Cooperation		LRLR	Host annual RLWD water quality summit	
Improve Project Implementation		LRLR		
Reduce H2S input from Thief		LRLR		
Test for other constituents			Get state Dept. of Ag. to test for pest/herb/fungicide	
			Support tile water quality monitoring research	

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
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The WQ goals for LRLR align well with overall watershed. Specific goals and activities.

Please talk with Beth regarding source water protection issues, so that this can be included in the narrative/introduction.

Recognize cities that have completed ore are developing wellhead protection plans.

Support Farm Security program.

RED LAKE WATERSHED EROSION GOAL PLANNING WORKSHEET

Goal Statement	Priority Issues *(What is this goal addressing?)*		Strategies	Partners
	Area	Subwatershed		
Reduced agricultural erosion.	Bank sloughing		improve all ditch systems (side inlets, buffers/filterstrip, windbreaks); consider tile vs. surface drainage; get back from river (bank sloughing)	
Decreased sediment to lakes, streams, rivers, drainage systems.			refer to county plans for specific areas of erosion have erosion be part of WQ summit; stabilize stream banks and beds	
Increased use of agricultural Best Management Practices.				
Increased public understanding.			educate and support CSP	
Increased interagency cooperation.				
To be cost effective and to leverage to the extent practical limited resources.				

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
- Subwatershed = Grand Marais Creek / Lower Red Lake River / Clearwater River / Thief River / Upper Red Lake River / Red Lakes

RED LAKE WATERSHED NATURAL RESOURCES GOAL PLANNING WORKSHEET

Goal Statement	Priority Issues *(What is this goal addressing?)*		Strategies	Partners
	Area	Subwatershed		
Maintain existing quality habitats (watercourses, wetlands, lakes, grasslands, brushlands)				
Enhance the quality of existing habitats (watercourses, wetlands, lakes, grasslands, brushlands)				
Increase the quantity of quality habitats				
Educate folks on the functions and value of existing fish and wildlife habitat with inference to how it can be compatible with FDR.				
Support recreational use of resources.				

The stuff is okay in the worksheet on Page 9.

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
- Subwatershed = Grand Marais Creek / Lower Red Lake River / Clearwater River / Thief River / Upper Red Lake River / Red Lakes

RED LAKE WATERSHED WATER QUANTITY GOAL PLANNING WORKSHEET

Goal Statement	Priority Issues *(What is this goal addressing?)* Area	Subwatershed	Strategies	Partners
Reduce peak flows from the RLRC EGF and GM by 10 percent	Covers both	Thief River	Ditch maintenance, dry impoundments, controlled diversions, land use	"Everyone gets along"
Reduce runoff volume contributing to peak flows by 20,000 ac-ft.				
Special projects – Actively seek and identify projects to implement based upon problems identified by stakeholders.		Thief River	Back to first page	
Educate – Develop an outreach program that promotes an understanding of the policies and activities of the RLWD.		Thief River	RLWD newsletter (in conjunction with Extension?)/Informational meeting?	
Floodplain – participate in floodplain management programs affecting urban and agricultural areas.				

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
- Subwatershed = Grand Marais Creek / Lower Red Lake River / Clearwater River / Thief River / Upper Red Lake River / Red Lakes

RED LAKE WATERSHED WATER QUALITY GOAL PLANNING WORKSHEET

Goal Statement	Priority Issues *(What is this goal addressing?)*		Strategies	Partners
	Area	Subwatershed		
Increased knowledge of sources that cause water quality problems.	Low D.O. (Agassiz, Thief Lake, Moose River, etc.)	Thief River	Further studies to follow up on earlier studies (Brent Johnson's original)	US Fish, DNR, RLWD, Marshall, Beltrami, SWCD, City of TRF, Marshall County
Improve Public Education	All tributaries to river and major ditches	Thief River	Workshops for awareness, septic tank, farm runoff, local feed lot inventory, educate on buffer strips	River Watch, M-B SWCD, NRCS, RLWD, Extension svc, MN assoc. of TWP, Marshall Co. Water Plan
Improve Interagency Cooperation		Thief River	Soil and Water District working more closely with other agencies (watershed)	All agencies
Improve Project Implementation		Thief River	Controls on major ditches, stabilize banks, settling ponds	RLWD, County, NRCS, Soil and Water Districts

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
- Subwatershed = Grand Marais Creek / Lower Red Lake River / Clearwater River / Thief River / Upper Red Lake River / Red Lakes

RED LAKE WATERSHED EROSION GOAL PLANNING WORKSHEET

Goal Statement	Priority Issues *(What is this goal addressing?)*		Strategies	Partners
	Area	Subwatershed		
Reduced agricultural erosion.		Thief River	Permanent buffer strips	SWC FSA watershed district
Decreased sediment to lakes, streams, rivers, drainage systems.			Same	Study to see impact
Increased use of agricultural Best Management Practices.			Unused ditches closed vs. better drainage	
Increased public understanding.				
Increased interagency cooperation.				
To be cost effective and to leverage to the extent practical limited resources.				

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
- Subwatershed = Grand Marais Creek / Lower Red Lake River / Clearwater River / Thief River / Upper Red Lake River / Red Lakes

RED LAKE WATERSHED NATURAL RESOURCES GOAL PLANNING WORKSHEET

Goal Statement	Priority Issues (What is this goal addressing?)		Strategies	Partners
	Area	Subwatershed		
Maintain existing quality habitats (watercourses, wetlands, lakes, grasslands, brushlands)		Thief River		
Enhance the quality of existing habitats (watercourses, wetlands, lakes, grasslands, brushlands)				
Increase the quantity of quality habitats				
Educate folks on the functions and value of existing fish and wildlife habitat with inference to how it can be compatible with FDR.				
Support recreational use of resources.				

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
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RED LAKE WATERSHED WATER QUANTITY GOAL PLANNING WORKSHEET
GRAND MARAIS CREEK

Goal Statement	Priority Issues (What is this goal addressing?)		Strategies	Partners
	Area	Subwatershed		
Reduce peak flows from the RLRC EGF and GM by 10 percent		Overall flooding GM subwatershed	Ditch maintenance – make sure they are working; Project 60	
Reduce runoff volume contributing to peak flows by 20,000 ac-ft.		Grand Marais	Project 60	
Special projects – Actively seek and identify projects to implement based upon problems identified by stakeholders.		Grand Marais	Residential flooding along Grand Marais; Establish the Grand Marais as a legal system. Restore sinuosity	
Educate – Develop an outreach program that promotes an understanding of the policies and activities of the RLWD.				
Floodplain – participate in floodplain management programs affecting urban and agricultural areas.				

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
- Subwatershed = Grand Marais Creek / Lower Red Lake River / Clearwater River / Thief River / Upper Red Lake River / Red Lakes

RED LAKE WATERSHED WATER QUALITY GOAL PLANNING WORKSHEET

Goal Statement	Priority Issues *(What is this goal addressing?)*		Strategies	Partners
	Area	Subwatershed		
Increased knowledge of sources that cause water quality problems.		River will be listed on next MPCA List of Impaired waters	- continue monitoring; - conduct 7MDL study; - seek funding for special studies to determine causes of WG problems and projects to improve water quality	
Improve Public Education			- Public education about the benefits of buffer strips and other BMPs	
Improve Interagency Cooperation		TMDL listing	- Shaping of data among the RLWD, RRBMN, and Riverwatch; - Make sure all agencies are involved in TMDL (or other) studies	
Improve Project Implementation		Turbidity and TSS under periods of high flow and low DD under low flow	Buffer strips along ditches and the river; - Create control structures at drainage outlets; - Windbreaks to reduce wind erosion; - Agricultural Drainage Management Study	

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
- Subwatershed = Grand Marais Creek / Lower Red Lake River / Clearwater River / Thief River / Upper Red Lake River / Red Lakes

RED LAKE WATERSHED EROSION GOAL PLANNING WORKSHEET

Goal Statement	Priority Issues *(What is this goal addressing?)*		Strategies	Partners
	Area	Subwatershed		
Reduced agricultural erosion.		Loss of windbreaks Conservation tillage	- Find incentives for installation of windbreaks - Project	
Decreased sediment to lakes, streams, rivers, drainage systems.		Bank failures on CD2, JD60, Grand Marais is silted in; - Extreme erosion in diverted portion of the river	- Make sure ditches have correct slopes and buffers - Project 60	
Increased use of agricultural Best Management Practices.		Loss of windbreaks Conservation tillage	- Project 60	
Increased public understanding.			- Increase landowner knowledge of available incentives for best management practices	
Increased interagency cooperation.			- Project 60	
To be cost effective and to leverage to the extent practical limited resources.				

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
- Subwatershed = Grand Marais Creek / Lower Red Lake River / Clearwater River / Thief River / Upper Red Lake River / Red Lakes

RED LAKE WATERSHED NATURAL RESOURCES GOAL PLANNING WORKSHEET

Goal Statement	Priority Issues (What is this goal addressing?)		Strategies	Partners
	Area	Subwatershed		
Maintain existing quality habitats (watercourses, wetlands, lakes, grasslands, brushlands)		Grand Marais	WREP wetland restoration and habitat	MRCS, SWCD, RLWD
Enhance the quality of existing habitats (watercourses, wetlands, lakes, grasslands, brushlands)		Flashy hydrographs hinder waterfowl production Vegetation killed in flood plain	Project 60 (impoundments) - moderate flow and reduce turbidity (buffers and windbreaks)	
Increase the quantity of quality habitats		Degraded fish and wildlife habitat Native Prairie	Project 60 (wetland and prairie restoration)	
Educate folks on the functions and value of existing fish and wildlife habitat with inference to how it can be compatible with FDR.				
Support recreational use of resources.				

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
- Subwatershed = Grand Marais Creek / Lower Red Lake River / Clearwater River / Thief River / Upper Red Lake River / Red Lakes

RED LAKE WATERSHED WATER QUANTITY GOAL PLANNING WORKSHEET

Goal Statement	Priority Issues *(What is this goal addressing?)*		Strategies	Partners
	Area	Subwatershed		
Reduce peak flows from the RLRC EGF and GM by 10 percent				
Reduce runoff volume contributing to peak flows by 20,000 ac-ft.				
Special projects – Actively seek and identify projects to implement based upon problems identified by stakeholders.	Clearbrook flooding; City of Bagley; City of Mentor (6)	Clearwater	1. Hydrological study 2. Possibly reduce culvert size to slow flow 3. Possible storage easements 4. Onsteam storage 5. Levy construction Ditch cleaning in Mentor	1. Private owners 2. SWCD 3. County engineer
Educate – Develop an outreach program that promotes an understanding of the policies and activities of the RLWD.				
Floodplain – participate in floodplain management programs affecting urban and agricultural areas.				

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
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RED LAKE WATERSHED WATER QUALITY GOAL PLANNING WORKSHEET

CLEARWATER RIVER

Goal Statement	Priority Issues (What is this goal addressing?)		Strategies	Partners
	Area	Subwatershed		
Increased knowledge of sources that cause water quality problems.	Clearwater Lake – New development homes at Walkerbrook Lake	Clearwater	Continue Riverwatch and current monitoring program	SWCD Clearwater Lake Cabin Owners Association
Improve Public Education	ISTS compliance on area lakes	Clearwater		County Environmental Service offices
Improve Interagency Cooperation				
Improve Project Implementation	Maple Lake suffers from poor water quality Cameron Lake	Clearwater Clearwater	Septic compliance – moderate flow of JD 73 Septic compliance – stormwater drainage from Erskine	RLWD; Maple Lake District; Polk SWCD RLWD; Polk SWCD

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
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RED LAKE WATERSHED EROSION GOAL PLANNING WORKSHEET

Goal Statement	Priority Issues (What is this goal addressing?)		Strategies	Partners
	Area	Subwatershed		
Reduced agricultural erosion.				
Decreased sediment to lakes, streams, rivers, drainage systems.	Bank stabilization and erosion on Lost River Restore channelized reach of the Clearwater River	Clearwater	Get funding for USACE project	RLWD Clearwater SWCD
Increased use of agricultural Best Management Practices.				
Increased public understanding.				
Increased interagency cooperation.				
To be cost effective and to leverage to the extent practical limited resources.				

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
- Subwatershed = Grand Marais Creek / Lower Red Lake River / Clearwater River / Thief River / Upper Red Lake River / Red Lakes

RED LAKE WATERSHED NATURAL RESOURCES GOAL PLANNING WORKSHEET

Goal Statement	Priority Issues (What is this goal addressing?)		Strategies	Partners
	Area	Subwatershed		
Maintain existing quality habitats (watercourses, wetlands, lakes, grasslands, brushlands)	Upper Clearwater River trout stream	Clearwater	Continue Riverwatch program. Encourage buffer strips in pasture land and cropland.	
Enhance the quality of existing habitats (watercourses, wetlands, lakes, grasslands, brushlands)				
Increase the quantity of quality habitats				
Educate folks on the functions and value of existing fish and wildlife habitat with inference to how it can be compatible with FDR.				
Support recreational use of resources.				

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
- Subwatershed = Grand Marais Creek / Lower Red Lake River / Clearwater River / Thief River / Upper Red Lake River / Red Lakes

RED LAKE WATERSHED WATER QUANTITY GOAL PLANNING WORKSHEET

Goal Statement	Priority Issues (What is this goal addressing?)		Strategies	Partners
	Area	Subwatershed		
Reduce peak flows from the RLRC EGF and GM by 10 percent		Red Lake	Dam op. but impacts would be so *negative* – to NR-cultural-social – should not consider	
Reduce runoff volume contributing to peak flows by 20,000 ac-ft.		see above		
Special projects – Actively seek and identify projects to implement based upon problems identified by stakeholders.				
Educate – Develop an outreach program that promotes an understanding of the policies and activities of the RLWD.				
Floodplain – participate in floodplain management programs affecting urban and agricultural areas.				

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
- Subwatershed = Grand Marais Creek / Lower Red Lake River / Clearwater River / Thief River / Upper Red Lake River / Red Lakes

RED LAKE WATERSHED WATER QUALITY GOAL PLANNING WORKSHEET

Goal Statement	Priority Issues (What is this goal addressing?)		Strategies	Partners
	Area	Subwatershed		
Increased knowledge of sources that cause water quality problems.	Black Duck; Shotley, Battle; Cormorant Rivers		Increase monitoring	RDLK DNR, PCA, SWCD, EPA
Improve Public Education			RDLK DNR doing education stuff now so continue and coordinate with them	RDLK DNR, EPA, PCA, NRCS
Improve Interagency Cooperation				
Improve Project Implementation				
Improve Quality	Tributaries to Lower Red Lake		Implement agricultural BMPs, including livestock exclusion, by promotion and assistances to increase c/s opportunities	NRCS; SWCD, Rd Lk DNR, EPA

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
- Subwatershed = Grand Marais Creek / Lower Red Lake River / Clearwater River / Thief River / Upper Red Lake River / Red Lakes

RED LAKE WATERSHED EROSION GOAL PLANNING WORKSHEET

Goal Statement	Priority Issues *(What is this goal addressing?)*		Strategies	Partners
	Area	Subwatershed		
Reduced agricultural erosion.			No issue on the reservation. Apply ag BMPs in tributaries to Lower Red	
Decreased sediment to lakes, streams, rivers, drainage systems.				
Increased use of agricultural Best Management Practices.				
Increased public understanding.				
Increased interagency cooperation.				
To be cost effective and to leverage to the extent practical limited resources.				

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
- Subwatershed = Grand Marais Creek / Lower Red Lake River / Clearwater River / Thief River / Upper Red Lake River / Red Lakes

RED LAKE WATERSHED NATURAL RESOURCES GOAL PLANNING WORKSHEET

Goal Statement	Priority Issues (What is this goal addressing?)		Strategies	Partners
	Area	Subwatershed		
Maintain existing quality habitats (watercourses, wetlands, lakes, grasslands, brushlands)		Red Lake Nation	Integrated resource management plan needs to be updated (do themselves)	
Enhance the quality of existing habitats (watercourses, wetlands, lakes, grasslands, brushlands)		Red Lake Nation	Wild rice stand rehab (for waterfowl feeding and resting)" Natural, not fake wild rice	USFSWS; NAFWS*; do LCMR, MWA
Increase the quantity of quality habitats		Red Lake Nation	Message to WD; more actively involved in NRE activities that impact the lakes, particularly Lower Red Lake (Fish and River Corridor) Habitat	SWCD; NRCS; Tribe; USFWS
Educate folks on the functions and value of existing fish and wildlife habitat with inference to how it can be compatible with FDR.		Red Lake Nation		
Support recreational use of resources.		Red Lake Nation		
Fish – Resource		Red Lake Nation	Do not pursue dam operation that allows fish escapement; dam operation that neg. impacts in lake spawning	
Fish – Resource		Red Lake Nation	Improve water quality in feeder river to Lower Red Lake to assure fish spawning in these rivers	

- FDR Issue Areas = Flooding / Flood Damages / Drainage / Drought / Stream Flows / Groundwater / Other Flood Damage Issues
- NRE Issue Areas = Erosion & Sedimentation / Water Quality / Fish & Wildlife Habitat / Water-based Recreational Activities / Unique Land & Water Resources / Other NR Issues
- Subwatershed = Grand Marais Creek / Lower Red Lake River / Clearwater River / Thief River / Upper Red Lake River / Red Lake

Appendix 9
County Census Information

2000 Census At-a-glance

2000 CENSUS: COUNTY-AT-A-GLANCE

	Beltrami County
Population	
2000 Population*	39,650
1990 Population*	34,384
Percent change from 1990 population*	15.3
2003 population estimate***	41,607
2010 population projection***	45,040
2000 Total minority population*	9,407
Urban population**	12,492
Rural population**	27,158
Median age*	31.5
Population by Age	
Population under 18 years*	11,379
Population 18 years and over*	28,271
Population 65 years and over*	4,622
Household	
Number of households*	14,337
Number of families*	9,752
Income	
1999 Median household income**	$33,392
1999 Median family income**	$40,345
Population below poverty level**	6,662
Percent of population below poverty level**	17.6

Housing	
Number of housing units*	16,989
Number of owner-occupied housing units*	10,684
Number of renter-occupied housing units*	3,653
Median housing value**	$74,300
Median contract rent**	$369
Average travel time to work (minutes)**	19.4

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2000 Census At-a-glance

2000 CENSUS: COUNTY-AT-A-GLANCE

	Clearwater County
Population	
2000 Population*	8,423
1990 Population*	8,309
Percent change from 1990 population*	1.4
2003 population estimate***	8,390
2010 population projection***	8,810
2000 Total minority population*	916
Urban population**	0
Rural population**	8,423
Median age*	39.7
Population by Age	
Population under 18 years*	2,193
Population 18 years and over*	6,230
Population 65 years and over*	1,472
Household	
Number of households*	3,330
Number of families*	2,288
Income	
1999 Median household income**	$30,517
1999 Median family income**	$39,698
Population below poverty level**	1,248
Percent of population below poverty level**	15.1

Housing	
Number of housing units*	4,114
Number of owner-occupied housing units*	2,718
Number of renter-occupied housing units*	612
Median housing value**	$61,800
Median contract rent**	$268
Average travel time to work (minutes)**	23.9

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Clearwater County

Minnesota Land Use and Cover Statistics

Description	Acreage	Percent of Total
Urban and rural development	9,986	1.5
Cultivated land	128,657	19.5
Hay/pasture/grassland	3	0.0
Brushland	64,876	9.8
Forested	315,238	47.8
Water	29,895	4.5
Bog/marsh/fen	109,484	16.6
Mining	871	0.1
Total	659,010	100.0

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2000 Census At-a-glance

2000 CENSUS: COUNTY-AT-A-GLANCE

	Itasca County
Population	
2000 Population*	43,992
1990 Population*	40,863
Percent change from 1990 population*	7.7
2003 population estimate***	44,198
2010 population projection***	47,590
2000 Total minority population*	2,498
Urban population**	8,530
Rural population**	35,462
Median age*	41.1
Population by Age	
Population under 18 years*	10,729
Population 18 years and over*	33,263
Population 65 years and over*	7,387
Household	
Number of households*	17,789
Number of families*	12,385
Income	
1999 Median household income**	$36,234
1999 Median family income**	$44,025
Population below poverty level**	4,576
Percent of population below poverty level**	10.6

Housing	
Number of housing units*	24,528
Number of owner-occupied housing units*	14,768
Number of renter-occupied housing units*	3,021
Median housing value**	$79,100
Median contract rent**	$357
Average travel time to work (minutes)**	22

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Itasca County

Minnesota Land Use and Cover Statistics

Description	Acreage	Percent of Total
Urban and rural development	15,977	0.9
Cultivated land	2,500	0.1
Hay/pasture/grassland	121,826	6.5
Brushland	68,908	3.7
Forested	989,509	52.8
Water	189,409	10.1
Bog/marsh/fen	461,942	24.7
Mining	22,266	1.2
Total	1,872,337	100.0

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2000 Census At-a-glance

2000 CENSUS: COUNTY-AT-A-GLANCE

	Koochiching County
Population	
2000 Population*	14,355
1990 Population*	16,299
Percent change from 1990 population*	-11.9
2003 population estimate***	13,986
2010 population projection***	13,570
2000 Total minority population*	611
Urban population**	7,790
Rural population**	6,565
Median age*	41.5
Population by Age	
Population under 18 years*	3,425
Population 18 years and over*	10,930
Population 65 years and over*	2,577
Household	
Number of households*	6,040
Number of families*	3,962
Income	
1999 Median household income**	$36,262
1999 Median family income**	$43,608
Population below poverty level**	1,694

Percent of population below poverty level**	12.1
Housing	
Number of housing units*	7,719
Number of owner-occupied housing units*	4,858
Number of renter-occupied housing units*	1,182
Median housing value**	$63,700
Median contract rent**	$296
Average travel time to work (minutes)**	15.5

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Koochiching County

Minnesota Land Use and Cover Statistics

Description	Acreage	Percent of Total
Urban and rural development	6,086	0.3
Cultivated land	1,976	0.1
Hay/pasture/grassland	108,353	5.4
Brushland	75,677	3.8
Forested	840,070	41.6
Water	45,124	2.2
Bog/marsh/fen	939,167	46.6
Mining	573	0.0
Total	2,017,026	100.0

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2000 CENSUS: COUNTY-AT-A-GLANCE

	Mahnomen County
Population	
2000 Population*	5,190
1990 Population*	5,044
Percent change from 1990 population*	2.9
2003 population estimate***	5,108
2010 population projection***	5,360
2000 Total minority population*	1,938
Urban population**	0
Rural population**	5,190
Median age*	38.2
Population by Age	
Population under 18 years*	1,515
Population 18 years and over*	3,675
Population 65 years and over*	867
Household	
Number of households*	1,969
Number of families*	1,367
Income	
1999 Median household income**	$30,053
1999 Median family income**	$35,500
Population below poverty level**	854

Percent of population below poverty level**	16.7
Housing	
Number of housing units*	2,700
Number of owner-occupied housing units*	1,521
Number of renter-occupied housing units*	448
Median housing value**	$61,900
Median contract rent**	$238
Average travel time to work (minutes)**	21.5

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Mahnomen County

Minnesota Land Use and Cover Statistics

Description	Acreage	Percent of Total
Urban and rural development	3,678	1.0
Cultivated land	175,256	46.9
Hay/pasture/grassland	38,897	10.4
Brushland	10,083	2.7
Forested	105,778	28.3
Water	17,175	4.6
Bog/marsh/fen	22,504	6.0
Mining	147	0.0
Total	373,518	100.0

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2000 CENSUS: COUNTY-AT-A-GLANCE

	Marshall County
Population	
2000 Population*	10,155
1990 Population*	10,993
Percent change from 1990 population*	-7.6
2003 population estimate***	9,979
2010 population projection***	9,500
2000 Total minority population*	405
Urban population**	0
Rural population**	10,155
Median age*	40.5
Population by Age	
Population under 18 years*	2,583
Population 18 years and over*	7,572
Population 65 years and over*	1,881
Household	
Number of households*	4,101
Number of families*	2,836
Income	
1999 Median household income**	$34,804
1999 Median family income**	$41,908
Population below poverty level**	979
Percent of population below poverty level**	9.8

Housing	
Number of housing units*	4,791
Number of owner-occupied housing units*	3,427
Number of renter-occupied housing units*	674
Median housing value**	$52,600
Median contract rent**	$246
Average travel time to work (minutes)**	23.2

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Marshall County

Minnesota Land Use and Cover Statistics

Description	Acreage	Percent of Total
Urban and rural development	10,029	0.9
Cultivated land	811,622	69.9
Hay/pasture/grassland	64,662	5.6
Brushland	62,201	5.4
Forested	126,660	10.9
Water	13,067	1.1
Bog/marsh/fen	71,434	6.2
Mining	1,382	0.1
Total	1,161,057	100.0

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2000 Census At-a-glance

2000 CENSUS: COUNTY-AT-A-GLANCE

	Pennington County
Population	
2000 Population*	13,584
1990 Population*	13,306
Percent change from 1990 population*	2.1
2003 population estimate***	13,654
2010 population projection***	14,000
2000 Total minority population*	489
Urban population**	9,164
Rural population**	4,420
Median age*	37.9
Population by Age	
Population under 18 years*	3,330
Population 18 years and over*	10,254
Population 65 years and over*	2,145
Household	
Number of households*	5,525
Number of families*	3,555
Income	
1999 Median household income**	$34,216
1999 Median family income**	$43,936
Population below poverty level**	1,467

Percent of population below poverty level**	11.1
Housing	
Number of housing units*	6,033
Number of owner-occupied housing units*	4,113
Number of renter-occupied housing units*	1,412
Median housing value**	$60,700
Median contract rent**	$301
Average travel time to work (minutes)**	14.9

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Pennington County

Minnesota Land Use and Cover Statistics

Description	Acreage	Percent of Total
Urban and rural development	7,836	2.0
Cultivated land	310,966	78.6
Hay/pasture/grassland	29,474	7.5
Brushland	9,023	2.3
Forested	30,606	7.7
Water	1,958	0.5
Bog/marsh/fen	5,113	1.3
Mining	646	0.2
Total	395,622	100.0

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2000 Census At-a-glance

2000 CENSUS: COUNTY-AT-A-GLANCE

	Polk County
Population	
2000 Population*	31,369
1990 Population*	32,498
Percent change from 1990 population*	-3.5
2003 population estimate***	31,025
2010 population projection***	30,830
2000 Total minority population*	2,375
Urban population**	15,385
Rural population**	15,984
Median age*	38.2
Population by Age	
Population under 18 years*	8,128
Population 18 years and over*	23,241
Population 65 years and over*	5,463
Household	
Number of households*	12,070
Number of families*	8,045
Income	
1999 Median household income**	$35,105
1999 Median family income**	$44,310
Population below poverty level**	3,284
Percent of population below poverty level**	10.9

Housing	
Number of housing units*	14,008
Number of owner-occupied housing units*	8,949
Number of renter-occupied housing units*	3,121
Median housing value**	$72,700
Median contract rent**	$344
Average travel time to work (minutes)**	16.5

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Polk County

Minnesota Land Use and Cover Statistics

Description	Acreage	Percent of Total
Urban and rural development	18,277	1.4
Cultivated land	1,012,189	79.1
Hay/pasture/grassland	94,087	7.4
Brushland	16,440	1.3
Forested	85,851	6.7
Water	22,450	1.8
Bog/marsh/fen	28,803	2.3
Mining	1,358	0.1
Total	1,279,455	100.0

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2000 Census At-a-glance

2000 CENSUS: COUNTY-AT-A-GLANCE

	Roseau County
Population	
2000 Population*	16,338
1990 Population*	15,026
Percent change from 1990 population*	8.7
2003 population estimate***	16,323
2010 population projection***	17,360
2000 Total minority population*	713
Urban population**	2,699
Rural population**	13,639
Median age*	35.3
Population by Age	
Population under 18 years*	4,867
Population 18 years and over*	11,471
Population 65 years and over*	2,055
Household	
Number of households*	6,190
Number of families*	4,439
Income	
1999 Median household income**	$39,852
1999 Median family income**	$46,185
Population below poverty level**	1,054
Percent of population below poverty level**	6.6

Housing	
Number of housing units*	7,101
Number of owner-occupied housing units*	5,188
Number of renter-occupied housing units*	1,002
Median housing value**	$69,500
Median contract rent**	$380
Average travel time to work (minutes)**	17.5

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Roseau County

Minnesota Land Use and Cover Statistics

Description	Acreage	Percent of Total
Urban and rural development	11,006	1.0
Cultivated land	541,133	50.4
Hay/pasture/grassland	89,280	8.3
Brushland	128,577	12.0
Forested	215,560	20.1
Water	3,492	0.3
Bog/marsh/fen	84,048	7.8
Mining	1,039	0.1
Total	1,074,135	100.0

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Appendix 10
RLWD TAC/CAC Rosters

RLWD Technical Advisory Committee

Tanya Hanson	Red Lake SWCD
Doug Thompson	Clearwater SWCD
Wally Byklum	Marshall-Beltrami SWCD
Gary Lee	East Polk SWCD
Paige Guetter	West Polk SWCD
Randy Huelskamp	Natural Resource Conservation Service
John Braastad	U.S. Fish and Wildlife Service-Agassiz
Maggie Anderson	U.S. Fish and Wildlife Service-Agassiz
Paul Telander	DNR - Thief Lake WMA
Joel Hunder	DNR - Thief Lake WMA
Chad Konickson	DNR
Tom Groshens	DNR
Brian Dwight	BWSR
Michael Lukes	National Weather Service
Roger Hille	MnDOT
Richard Sanders	Polk County Highway Department
Mike Flaagan	Pennington County Highway Department
Jeff Langan	Marshall County Highway Department
Dan Sauve	Clearwater County Highway Department
Mike Vavricka	MPCA-Detroit Lakes Office
Craig Evans	U.S. Army Corps of Engineers
Tom Raster	U.S. Army Corps of Engineers
Arlo Rude	City of Thief River Falls
Perry Hart	City of Crookston
Zach Fore	University of Minnesota-Extension
Jody Horntvedt	University of Minnesota-Extension
Hans Kandel	University of Minnesota-Extension
Chuck Meyer	Red Lake DNR
Henry VanOffelen	MCEA
Beth Kluthe	Minnesota Department of Health
Doug Thorson	Maple Lake Improvement District

RLWD Citizen Advisory Committee

Joyce Kalbakdalen	City of Red Lake Falls
Don Barron	City of Thief River Falls
Eugene L. Mattson	Polk County Commissioner
Delray Larson	Marshall County Commissioner
Charles Naplin	Pennington County Commissioner
Tom Anderson	Clearwater County Commissioner
Todd Stanley	Landowner (appointed by Lowell Smeby)
Loiell Dryud	Landowner (appointed by LeRoy Ose)
John Gunvalson	Landowner (appointed by Vernon Johnson)
Rick Quirk	Landowner
Kameron Harstad	Landowner