

---

# Table of Contents

Executive Summary .....	E-1
Mission Statement .....	E-1
Brief History .....	E-1
1. Introduction .....	1-1
1.1 District Overview .....	1-1
1.2 District History .....	1-2
1.3 Purpose of the Watershed Management Plan .....	1-3
1.4 District Role in the Red River Watershed Management Board.....	1-4
1.5 Plan Relationship to the Red River Basin Flood Damage Mediation Agreement .....	1-4
1.6 Plan Structure and Function.....	1-6
1.7 Previous Plan Success.....	1-7
1.8 Review of Existing Rules and Permit System .....	1-7
2. Watershed Description .....	2-1
2.1 Setting – Location and Size .....	2-1
2.2 Physical Setting .....	2-1
2.2.1 Geology.....	2-1
2.2.2 Ecoregions .....	2-2
2.2.3 Topography.....	2-2
2.2.4 Soils .....	2-2
2.2.5 Climate .....	2-3
2.2.6 Population .....	2-3
2.2.7 Land Use.....	2-4
2.3 Fish, Wildlife and Natural Resources .....	2-4
2.4 Water Resources.....	2-5
2.4.1 Major Streams and Tributaries .....	2-5
2.4.2 Lakes .....	2-6
2.4.3 Wetlands .....	2-6
2.4.4 Drainage Systems .....	2-7
2.4.5 Water Management Structures.....	2-7
2.4.6 Water Use – Surface Water and Groundwater.....	2-7
2.4.7 Water Use – Inventory of Public Water Suppliers .....	2-8
2.4.8 Water Use – Inventory of Municipal Wastewater Treatment Systems.....	2-8

2.4.9	Groundwater .....	2-8
2.4.10	Impaired Waters and TMDLs.....	2-8
2.5	Economic .....	2-9
2.5.1	Agriculture.....	2-9
2.5.2	Forestry.....	2-9
2.5.3	Industry .....	2-9
2.5.4	Recreation and Tourism.....	2-9
3.	Assessment of Existing and Emerging Resource Management Issues .....	3-1
3.1	Existing District-wide Issues.....	3-1
3.1.1	Data Collection and Management .....	3-1
3.1.1.1	<i>Red River Basin Mapping Initiative (RRBMI)</i> .....	3-1
3.1.1.2	<i>Project Monitoring and Evaluation</i> .....	3-1
3.1.2	Education .....	3-2
3.1.3	Erosion and Sediment Control.....	3-2
3.1.4	Flood Damage Reduction, Rate of Runoff, Volume of Runoff.....	3-2
3.1.5	Long Range Work Planning and Financing .....	3-3
3.1.6	Water Quality .....	3-3
3.2	Emerging Issues .....	3-4
3.2.1	Impaired Waters .....	3-4
3.2.1.1	<i>Overview</i> .....	3-4
3.2.1.2	<i>Roles and Responsibilities</i> .....	3-5
3.2.2	National Pollutant Discharge Elimination System Program .....	3-9
3.2.2.1	<i>Overview</i> .....	3-9
3.2.2.2	<i>Roles and Responsibilities</i> .....	3-9
3.2.3	Wetland Regulations .....	3-10
3.2.3.1	<i>State Wetland Overview</i> .....	3-10
3.2.3.2	<i>Federal Wetland Overview</i> .....	3-10
3.2.3.3	<i>Roles and Responsibilities</i> .....	3-11
3.2.4	Groundwater Planning .....	3-12
3.2.4.1	<i>Overview</i> .....	3-12
3.2.4.2	<i>Roles and Responsibilities</i> .....	3-12
3.2.5	Tile Drainage.....	3-13
3.2.5.1	<i>Overview</i> .....	3-13
3.2.5.2	<i>Roles and Responsibilities</i> .....	3-13
3.2.6	Drought Planning, Irrigation, Ethanol Production, and Increased Water Use .....	3-14
3.2.6.1	<i>Overview</i> .....	3-14
3.2.6.2	<i>Roles and Regulations</i> .....	3-15
3.2.7	Drainage Law Minnesota Statutes 103E.....	3-15
3.2.7.1	<i>Overview</i> .....	3-15
3.2.7.2	<i>Roles and Responsibilities</i> .....	3-16
3.2.8	Land Use Change .....	3-16

3.2.8.1	Overview.....	3-16
3.2.8.2	Roles and Responsibilities.....	3-16
3.2.9	Floodplain Management .....	3-16
3.2.9.1	Overview.....	3-16
3.2.9.2	Roles and Responsibilities.....	3-17
3.2.10	Shoreland Management.....	3-17
3.2.10.1	Overview.....	3-17
3.2.10.2	Roles and Responsibilities.....	3-17
3.3	Existing and Emerging Planning Region Issues.....	3-18
4.	Guidance of Future Activities .....	4-1
4.1	Principles, Goals, and Policies .....	4-1
4.1.1	Guiding Principles.....	4-1
4.1.1.1	Consistency within the Red River Basin .....	4-1
4.1.1.2	Need for Permitting .....	4-1
4.1.1.3	An Integrated Resource Management Approach.....	4-2
4.1.1.4	An Adaptive Management Approach.....	4-4
4.1.1.5	Land Use Management .....	4-5
4.1.1.6	Balanced Approach.....	4-5
4.1.1.7	Cooperation and Leveraging Resources .....	4-5
4.1.1.8	Regional Assessment Locations and Desired Future Conditions ..	4-5
4.1.2	Goals and Policies.....	4-6
4.2	District Programs.....	4-21
4.2.1	Rules and Permitting .....	4-21
4.2.2	Data Collection and Management .....	4-21
4.2.2.1	Surface Water Hydrology (Stage, flow and runoff volume).....	4-22
4.2.2.2	Surface Water Quality.....	4-23
4.2.2.3	Groundwater Quantity and Quality.....	4-23
4.2.2.4	Natural Resources .....	4-24
4.2.2.5	Survey and Topographic Data.....	4-24
4.2.3	Education and Information .....	4-24
4.2.4	Floodplain Management Program.....	4-26
4.2.5	Natural Resource Enhancement Cost Share .....	4-26
4.2.6	Farmstead Ring Dikes.....	4-26
4.2.7	Drainage System Buffer Strip Cost Share .....	4-27
4.2.8	Wellhead Protection Investigation .....	4-27
4.2.9	Surface Water Quality Enhancement Program .....	4-27
4.3	Desired Future Conditions .....	4-33
5.	Planning Regions and Regional Assessment Locations .....	5-1
5.1	Background .....	5-1
5.2	Existing and Desired Future Conditions.....	5-13
5.2.1	Hydrology.....	5-15

5.2.2	Water Quality .....	5-18
5.2.3	Stream Stability and Geomorphology .....	5-22
5.2.4	Wetland, Forest, and Prairie .....	5-22
6.	Watershed District Administration .....	6-1
6.1	Plan Implementation Procedure .....	6-1
6.1.1	Overview .....	6-1
6.1.2	Role of Guidance Documents .....	6-1
6.1.2.1	<i>General Intent</i> .....	6-1
6.1.2.2	<i>Criteria and Incorporation Process</i> .....	6-2
6.2	Plan Revisions and Amendments .....	6-3
6.2.1	General Approach .....	6-3
6.2.2	Amendments to This Plan.....	6-4
6.2.2.1	<i>Criteria and Format</i> .....	6-4
6.2.2.2	<i>Plan Amendments</i> .....	6-5
6.3	Local Units of Government.....	6-5
6.3.1	Overview .....	6-5
6.3.2	Analysis of Plan Consistency .....	6-7
6.3.2.1	<i>Adjacent Watershed Districts</i> .....	6-7
6.3.2.2	<i>Local Water Management Plans</i> .....	6-7
6.3.2.3	<i>Plans Developed by State and Federal Agencies Non-Profit Entities</i> .....	6-11
6.4	Financing and Funding.....	6-17
6.4.1	Funding Approach and Rationale.....	6-17
6.4.2	Funding the Watershed District .....	6-17
6.4.2.1	<i>Overview</i> .....	6-17
6.4.2.2	<i>Funds Generated by Ad Valorem Tax Levies</i> .....	6-18
6.4.2.3	<i>Funds Generated by Assessment Levies</i> .....	6-19
6.4.2.4	<i>Funds Generated through Bond Sales</i> .....	6-21
6.4.2.5	<i>Funds Generated through Collection of Charges</i> .....	6-21
6.4.2.6	<i>Funds Generated through Collection of Fees</i> .....	6-22
6.4.3	Establishment of MS 103D.729 Water Management Districts.....	6-22
6.4.3.1	<i>Overview</i> .....	6-22
6.4.3.2	<i>Description of the Water Management Districts</i> .....	6-23
6.4.3.3	<i>Annual Charge Amount</i> .....	6-23
6.4.3.4	<i>Method to Determine Charges</i> .....	6-23
6.4.3.5	<i>Duration for Existence of the Water Management Districts</i> .....	6-25
6.4.3.6	<i>Use of Funds</i> .....	6-25
6.4.3.7	<i>Process to be Used to Create Water Management Districts</i> .....	6-26
6.4.4	Financing District Activities.....	6-27
6.4.4.1	<i>Overview</i> .....	6-27
6.4.4.2	<i>Financing District Efforts</i> .....	6-27

6.5 District Operations.....	6-31
6.5.1 Advisory and Related Committees .....	6-31
6.5.2 Long Range Work Plan .....	6-32
6.5.3 Annual Work Plan and Budget .....	6-33
6.5.4 Annual Report.....	6-34
6.5.5 Annual Audit.....	6-34
6.5.6 Self Assessment Process .....	6-34
6.5.6.1 Policy Implementation.....	6-38
6.5.6.2 Collaborative Efforts.....	6-38
6.5.6.3 Project Activity .....	6-39
6.5.7 Administration of the Legal Boundary .....	6-39
6.5.8 Rules and Permitting .....	6-39
6.5.9 Responsibilities under Drainage Law (MS 103E).....	6-40
6.5.10 Process for Project Implementation.....	6-40
6.6 Project Implementation Process .....	6-40
6.6.1 Overview .....	6-40
6.6.2 Project Implementation Process.....	6-42
6.6.3 Determining the Least Environmentally Damaging Practicable Alt. ....	6-42
6.6.3.1 General Approach.....	6-42
7. Summary and Analysis of Previous District Data Collection and Modeling Analyses .....	7-1
7.1 Water Quality .....	7-1
7.1.1 General Water Quality Characteristics.....	7-1
7.1.2 Section 319 Sedimentation Project Summary.....	7-2
7.1.3 Summary of River Watch Data.....	7-2
7.2 Hydrology .....	7-3
7.2.1 Modeling Analysis.....	7-3
7.2.1.1 Peak Flows at Regional Assessment Locations .....	7-4
7.2.1.2 Stacked Hydrograph Analysis .....	7-6
7.2.1.3 Distributed Runoff Reduction (Storage) Analysis.....	7-8
7.2.1.4 Runoff Timing Analysis and TSAC Paper No. 11.....	7-9
7.2.1.5 Agriculture to Grassland Conversion Analysis .....	7-15
7.2.2 Hydrology Frequency Analysis .....	7-17
7.2.2.1 Flood Frequency Analysis at the USGS Gaging Stations .....	7-17
7.2.2.2 Rainfall Depth Frequency Relationships.....	7-20
7.2.2.3 Storm Event Specific Rainfall Depth .....	7-22
7.3 Hydraulics.....	7-23
7.3.1 Existing Hydraulic Models.....	7-23
7.4 Overall Modeling Conclusions .....	7-24
7.4.1 Summary of Hydrologic and Hydraulic Model Results.....	7-24
7.4.2.1 Proposed Peak Flow and Runoff Volume Reductions Goals.....	7-24

7.5 High Resolution Topographic Data.....	7-25
7.5.1 Extent and Description of Available Data .....	7-25
7.5.2 Additional Data Needs.....	7-26
7.6 Internet / Web Resources.....	7-26
7.6.1 BRRWD Interactive Mapper / Web Page.....	7-26
7.6.2 Flood Forecast Display Tool .....	7-27

List of Tables

1.1 Counties Comprising Buffalo-Red River Watershed District.....	1-2
1.2 Composition of the Buffalo-Red River Watershed District Board Of Managers .....	1-2
1.3 Assessment of Progress toward Accomplishing Goals Identified in the Previous Watershed Management Plan .....	1-9
2.1 Population Projection Estimates for Counties in the BRRWD .....	2-4
3.1 Impaired Waters within the BRRWD Based on the MPCA 303(d) List .....	3-7
4.1 General Characteristics of Lakes in the BRRWD .....	4-31
4.2 Management Classification Matrix.....	4-32
5.1 Regional Assessment Locations in the BRRWD.....	5-2
5.2 Parameters Evaluated at Regional Assessment Locations .....	5-7
5.3 Runoff Volume Reduction Goals .....	5-16
5.4 Existing and Desired Future Conditions Peak Discharges .....	5-17
5.5 Water Quality Standards for Lakes.....	5-19
5.6 State Standards for Class 2B and 2C Waters .....	5-20
5.7 Total Annual Sediment Load (U.S. Tons) .....	5-21
5.8 Total Annual Sediment Yield (U.S. Tons per Acre) .....	5-22
5.9 Existing and Desired Future Condition for Permanent Cover.....	5-23
6.1 Summary of Local Water Management Plans in the BRRWD .....	6-8
6.2 Summary of Some Programs and Initiatives Related to the BRRWD.....	6-12
6.3 Probable Total Revenue by Water Management District if set up by Planning Region .....	6-23
6.4 Summary of Watershed District Programs and Activities and the Probable Primary Funding Sources .....	6-28
6.5 Annual Evaluation Tool for Assessing the Success of District Activities and Programs.....	6-35
6.6 PRAP Greater MN Watershed District Performance Standard Checklist..	6-37
6.7 Criteria Established by the BRRWD for Completing 404(b)(1) .....	6-41
7.1 Peak Flows and Runoff Volumes at Regional Assessment Locations.....	7-4
7.2 Peak Discharges at Red River Regional Assessment Locations .....	7-6
7.3 Expected Peak Flow Reduction Efforts on the Red River Main Stem Of FDR Measures Applied in Early, Middle, and Late Areas Upstream ....	7-14
7.4 Runoff Volume Reduction per Square Mile Converted (A-F/sq. mile).....	7-15

7.5	Effects of Restoring Permanent Cover within the Buffalo River Basin Volume Reduction Result Table .....	7-17
7.6	Rainfall Depths for Various Duration Events.....	7-22
7.7	Runoff Reduction goals within the BRRWD.....	7-25

List of Figures

1.1	Site Map	
1.2	Planning Region Locations	
2.1	BRRWD Base Map	
2.2	Geomorphology	
2.3	Ecoregions	
2.4	Topography	
2.5	Soils	
2.6	Wind Susceptibility	
2.7	Prime Farmland	
2.8	Existing Resources – Priority Resource Areas	
2.9	Existing Resources – Species in Greatest Conservation Needs (SGCN)	
2.10	Existing Resources – Key Habitats	
2.11	Wellhead Protection Areas	
2.12	Groundwater Resources	
3.1	Impaired Waters	
3.2	Water Quality Monitoring	
4.1	Priority Lakes	
5.1	Regional Assessment Locations	
6.1	Buffalo-Red River Watershed District Project Review and Approval Process	
7.1	Buffalo River 100-year, 96-hour Stacked Hydrograph at the Dilworth Gaging Station	
7.2	Effects of Distributed Storage on Peak Discharge	
7.3	Early, Middle, and Late Runoff Timing Zones in the Red River Basin	
7.4	Early, Middle, and Late Runoff Timing Zones in the Red River Basin	
7.5	Hydrograph Effects of Restoring Permanent Cover	
7.6	Flood Frequency Analysis for the Dilworth Gaging Station	
7.7	Flood Frequency Analysis for the Sabin Gaging Station	
7.8	Flood Frequency Analysis for the Hawley Gaging Station	
7.9	Rainfall Depth Map – 100-year, 24-hour	
7.10	June 28-29, 1975 Rainfall Isohyetal Map	
7.11	July 15-16, 1993 Rainfall Isohyetal Map	
7.12	BRRWD MapMaker Website	

## List of Appendices

- A Western Planning Region Planning Summary
- B Lakes Planning Region Planning Summary
- C Moorhead Planning Region Planning Summary
- D Northern Planning Region Planning Summary
- E Southern Planning Region Planning Summary
- F Central Planning Region Planning Summary
- G Mainstem Planning Region Planning Summary
- H Rules
- I Buffalo River Watershed (HUC-09020196) Pilot Program Workplan
- J City of Moorhead Source Water Assessment
- K BRRWD Projects
- L BRRWD Red River Basin Stream Survey Report (2001)
- M Red River Basin Flood Damage Reduction Work Group Agreement
- N Buffalo-Red River Watershed District Natural Resources Assessment
- O Rapid Watershed Assessment: Buffalo Watershed (MN) HUC: 09020106
- P Rapid Watershed Assessment: Upper Red River Watershed (MN/ND) HUC: 09020104