RED RIVER BASIN COMMISSION'S

LONG TERM FLOOD SOLUTIONS

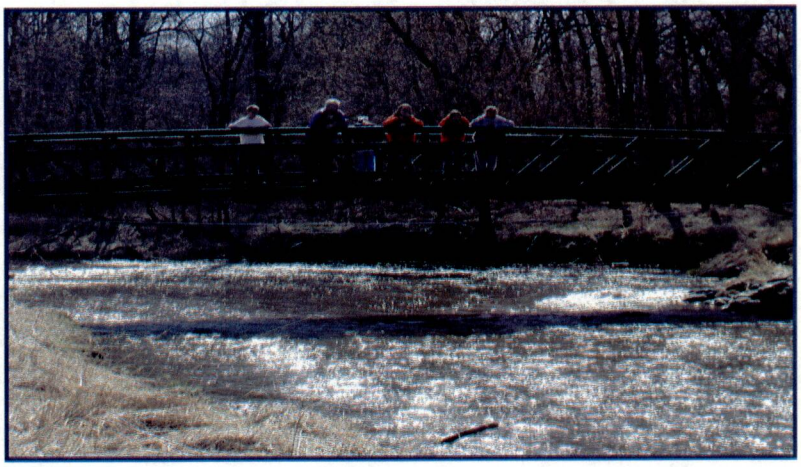
For the Red River Basin

Report Includes:

LTFS Executive Summary

Conclusions and Recommendations for Action

Funding Timeline for Project Implementation Costs: Along the Red River of the North and Tributaries



April, 2012

Red River Basin Commission Offices

Moorhead Office
119 5th St. S., Ste. 209
PO Box 66
Moorhead, MN 56561-0066
218-291-0422
218-291-0438 Fax
1-866-629-4498 Toll Free

Winnipeg Office
410-112 Market Ave.
Winnipeg, MB
R3B 0P4
204-982-7250
204-982-7255 Fax

staff@redriverbasincommission.org
www.redriverbasincommission.org

VISION

A Red River Basin where residents, organizations, and governments work together to achieve basin-wide commitment to comprehensive integrated water stewardship and management.

MISSION

To create a comprehensive integrated basin-wide vision, to build consensus and commitment to the vision, and to speak with a unified voice for the Red River Basin.

Red River Basin Commission's Long Term Flood Solutions

for the Red River Basin

March 2012

THE RED RIVER BASIN is an international, multi-jurisdictional watershed of 45,000 square miles, with 80 percent of the basin lying in the United State and 20 percent in Manitoba, Canada. Eighteen Minnesota counties and 22 North Dakota counties lie wholly or partially in the basin. The economic impact of the basin, from both urban-generated activity and a vibrant agricultural economy, is significant. This basin is home to more than half a million people, and serves as a jobs, education and medical hub, in addition to a world-renowned agricultural producer.

NEED FOR ACTION

The increase in frequency and magnitude of flooding in the Red River basin is unmistakable. The spring flood of 1997 that decimated the metro center of Grand Forks-East Grand Forks and gravely threatened areas throughout the basin introduced a decade of flooding. Since 2000, the basin has experienced damaging flooding in all but two years. Since 1997, most sites along the main stem have seen levels of flooding at or close to 100-year levels, some in more than one flood event. And tributary areas have experienced up to 500-year flood levels during the past decade. We know today that larger floods are both possible and probable.

THE IMPETUS

Before the major flood waters of 2009 had even receded, state legislators in North Dakota and Minnesota asked the Red River

THE PROCESS

The LTFS study process brought together professional and citizen water managers from all levels and from all the reaches of the basin. In addition to hands on involvement from the RRBC Board of Directors, umbrella committees were assembled (Policy, Technical) and specific issue workgroups to dissect the issues and identify solutions. In addition, a number of outside experts and agencies were contracted to develop information and analysis for central questions addressed in the study. Most importantly, the study was a grass-roots effort. It was launched with an extensive public engagement process of 21 public flood forums held in the Minnesota, North Dakota and South Dakota portions of the basin, with more than 1,000 attendees in total. Citizens' experiences, problems and concerns with flooding in the basin were solicited, together with suggestions for solutions. It was this public input that helped shape the study's committees and issues to explore. A second series of public meetings was held in spring of 2011 in order to gather feedback from citizens on the primary directions and conclusions of the study. That feedback helped to guide final conclusions and recommendations. The results of the overall study findings are presented in this report to assist the basin's residents, community leaders, water managers and policy makers.

ASSUMPTIONS FOR FUTURE CONDITIONS

Pertinent to the LTFS plan development

adopted by RRBC Board 2010

Components of the LTFS plan are intended to be developed and implemented over the next 50 years. It is important to understand the assumptions under which this plan was developed. The following describe basic assumptions about several issue areas in the Red River basin that are key to plan development.

Agriculture will continue to be the dominant land use through out the basin. Adequate surface drainage has been and will continue to be integral to maintaining productivity of cropland. Sub-surface drainage is likely to become increasingly popular.

Current development trends will continue into the foreseeable future. The major urban centers and communities will continue in their present locations. Major metro areas will continue to grow. Future development will occur in compliance with floodplain management regulations.

Floods will continue into the future. Floods larger than historically experienced can be expected to occur.

Flood damage reduction will need to be implemented in the basin based primarily on the identified needs of the basin residents and their willingness to provide or seek the funding necessary to implement the measures which they believe are appropriate, effective, and justified. State and federal agencies will support the implementation of the various measures based on their policies, regulations and availability of funding. Flood damage reduction is just one issue that affects the sustainability of the region.

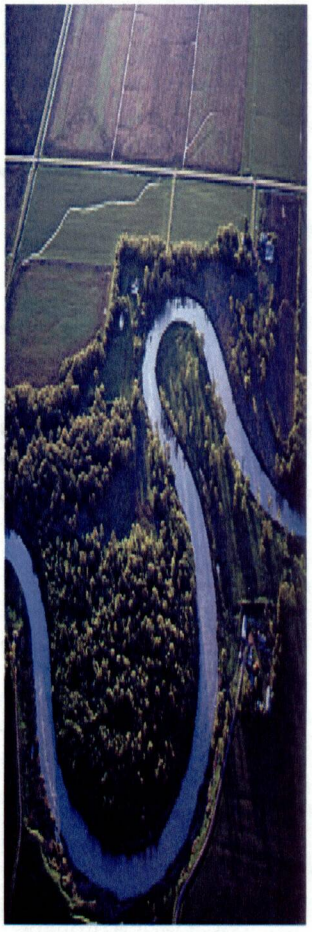
Other key resource issues need to be considered as this plan is developed and implemented, including droughts, water supply, water quality, recreation and other natural resource areas.

Guidelines for Protection in the Basin

Before the LTFS study, the only site protection guideline for levels of protection was the federal (FEMA) requirement that mortgaged structures in 100-year floodplains (or lower) carry flood insurance. The problem with these guidelines for the Red River basin is that 100-year flood levels have been experienced on most reaches of the main stem and far surpassed in some tributary areas. RRBC developed baseline goals for levels of flood protection during the project.

Level of Flood Protection Goals

The LTFS review of current local protection policies and practices revealed that the basin lacks adequate guidelines on levels of protection appropriate for various basin locations. The following goals for levels of protection were developed as part of the study and approved by the RRBC to serve as a guideline for the residents of the Red River basin, its communities, and state/provincial and federal agencies, as they plan and implement future local protection projects (see Appendix D, Table D-3). The intended outcome of the goals is to provide a long-term objective for communities and sites that will cumulatively reduce the risk of flooding and flood damages from potential floods of larger size than the basin has experienced in the recent past. The goals can help move the basin beyond a mode reactive to the last large flood to a proactive mode of using risk and damage assessments to put adequate protection into place to reduce flood risk across the basin.



Level of Flood Protection Goals for the Red River Basin

Area Protected	Estimated Recurrence Interval
Major urban/metropolitan areas (1) (2) (4)	500 year or greater
Critical infrastructure (1) (2)	500 year or greater
Cities/municipalities (1) (2)	200 year or greater
Rural residences & farmsteads (1) (2)	100 year or greater
Agricultural cropland: Summer flood	10 year or greater
Transportation (2) (3) Critical transportation system and emergency service links	200 year or greater

Notes

(1) Protection for urban areas, critical infrastructure, cities, rural residences, and farmsteads should all have appropriate freeboard (i.e., contingency or risk and uncertainty allowance) with any projects designed to provide the specified level of protection.

(2) If a flood of record has occurred which exceeds the specified level of protection goal, the flood of record should be used in place of the specified level of protection goal.

(3) The critical transportation systems should be maintained passable during a flood of the described level of protection to assure safe and reliable transportation and provision of emergency services. The transportation system should not increase flooding problems either upstream or downstream.

(4) Includes Fargo-Moorhead, Grand Forks-East Grand Forks, and Winnipeg.

The Red River Basin Commission (RRBC) is a group of people working together to achieve common goals for water protection and management within the Red River Basin.

119 S. 5th St. PO Box 66 Moorhead, MN 56561 218-291-0422
staff@redriverbasincommission.org

See the full report on our website:
www.redriverbasincommission.org

CURRENT LEVELS OF PROTECTION VERSUS NEEDS IN THE BASIN

Although the strategy of local protection dates back many decades in the basin, the extent of existing site protection is still modest. The following table summarizes the levels of local site protection currently in place at basin communities and then compares that with RRBC's levels of protection goals to identify the gaps and the needs. The table reveals that flood protection for events exceeding the 100 -year level is an exception and that almost a third of the communities, on the average, have no permanent protection. Of those communities having permanent protection, fewer than half are protected to a 100-year level or higher.

Comparison of Existing Flood Protection with Recommended Guidelines for Level of Protection

City/Location	RRBC Recommended Guideline for Level of Flood Protection	Existing Level of Protection					Existing Protection meets RRBC Recommended Guideline for Level of Flood Protection?
		500 year	200 year	100 year	Less than 100 year	No Permanent Protection	
Red River Main Stem							
Wahpeton, ND	200 year			X			No
Breckenridge, MN	200 year			X			No
Fargo, ND	500 year				X		No
Moorhead, MN	500 year				X		No
Perley, MN	200 year				X		No
Hendrum, MN	200 year				X		No
Halstad, MN	200 year		X				*Yes*
Nielsville, MN	200 year					X	No
Grand Forks, ND	500 year		X				No
East Grand Forks, MN	500 year		X				No
Oslo, MN	200 year	X					*Yes*
Drayton, ND	200 year				X		No
Pembina, ND	200 year			X			No
St. Vincent, MN	200 year				X		No
Noyes, MN	200 year			X			No
Emerson, MB	200 year			X			No
Morris, MB	200 year			X			No
Winnipeg, MB	500 year	X					*Yes*
Minnesota Tributaries							
Georgetown	200 year				X		No
Ada	200 year				X		No
Shelly	200 year				X		No
Climax	200 year					X	No
Crookston	200 year				X		No
Warren	200 year			X			No
Alvarado	200 year			X			No
Argyle	200 year			X			No
Hallock	200 year				X		No
Roseau	200 year				X		No
North Dakota Tributaries							
Abercrombie	200 year				X		No
Valley City	200 year				X		No
Lisbon	200 year				X		No
Horace	200 year			X			No
West Fargo	500 year	X					*Yes*
Enderlin	200 year			X			No
Casselton	200 year			X			No
Mapleton	200 year			X			No
Harwood	200 year				X		No
Argusville	200 year			X			No
Devils Lake	200 year			X			No
Minnewaukan	200 year					X	No
Grafton	200 year				X		No
Neche	200 year				X		No

Flood Routing Models

Using MIKE 11, a flow routing model, the LTFS study was able to use the modeling information from sub-basins to predict the effect that reduced flows due to additional floodwater storage sites from the tributaries would have on various points on the main stem Red River.

20% Reduction Model	Based on WMC Mike 11 Model and tributary hydrologic models						cla 1/16/2011	
Summary of Tributary Flow Reductions								
1997 Spring Flood								
		Planned by WSDs			Original Allocation			
	Peak Flow Reduction	Peak Flow Reduction	Volume Reduction	Volume Reduction	Peak Flow Reduction	Volume Reduction	Volume Reduction	Reduction Focus
Tributarie Areas	cfs	%	%	acft	%	%	acft	
BdS R @ White Rock	1048	13%	16%	51219	20%	20%	61760	Store early water
Rabbit R @ TH 75 ung	1425	31%	39%	47639	35%	26%	24377	Peak flow reduction
BdS ungaged	0	0%	0%	0	13%	9%	12119	No reduction
Ottertail R @ Orwell	0	0	0	0	0%	0%	0	No reduction
Ottertail ung	500	13%	12%	7217	13%	12%	7217	Peak flow reduction
Wildrice ND @ Abercrombie	3150	32%	6%	23702	35%	17%	57908	Peak flow reduction
Fargo ungaged	3000	13%	13%	30433	13%	13%	30433	Store late water
Sheyenne R @ Harwood	2401	23%	11%	68395	23%	11%	68395	Peak flow reduction
Rush R @ Amenia	508	35%	13%	4324	35%	13%	4324	Peak flow reduction
Buffalo R @ Dilworth	2549	30%	17%	36091	35%	17%	38158	Peak flow reduction
Wild Rice MN @ Hendrum	2315	23%	20%	76545	35%	20%	74385	Peak flow reduction
Halstad ung	7500	13%	13%	81002	13%	13%	81002	Store late water
Goose R @ Hillsboro	2820	35%	16%	35356	35%	16%	35356	Peak flow reduction
Marsh R nr Shelly	135	3%	8%	6819	51%	18%	15247	Peak flow reduction
Sand Hill R @ Climax	43	1%	18%	19184	35%	21%	22161	Peak flow reduction
Red Lake R @ Crookston	5200	18%	8%	74830	35%	13%	119097	Peak flow reduction
RLR ung	1600	12%	10%	11427	12%	10%	11427	Store late water
GF ungaged	4400	12%	10%	32015	12%	10%	32015	Store late water
Turtle R nr Arvilla	90	10%	13%	4615	10%	13%	4615	Store late water
Forest R @ Minto	300	14%	7%	5875	14%	7%	5875	Store late water
Snake R ung	1334	24%	16%	20210	16%	15%	17128	Store late water
Middle R @ Argyle	751	20%	13%	8371	35%	23%	15067	Store late water
Park R @ Grafton	2422	47%	31%	40739	35%	20%	26462	Peak flow reduction
Tamarac R ung	1150	24%	13%	11533	13%	12%	7179	Store late water
Drayton ung	1370	8%	10%	22208	8%	10%	22208	Store late water
S Br Two R @ Lake Bronson	503	12%	26%	21735	27%	14%	15208	Store late water
Tongue R @ Akra	50	7%	4%	1580	7%	4%	1580	Store late water
Pembina R @ Neche	1900	13%	9%	51113	13%	9%	51113	Peak flow reduction
Emerson ung	3000	7%	7%	23364	7%	7%	23364	Store late water
Average/Total		**17%**	**13%**	**817540**	**22%**	**13%**	**885177**	

Summary of Mainstem Flow Reductions							
1997 Spring Flood	Upstream Contributing??? Drainage Area	Peak Flow Reduction	Peak Flow Reduction	Upstream Tributary Volume	Upstream Tributary Volume Reduction	Upstream Tributary Volume Reduction	
Mainstem Locations	sqmi	cfs	%	acft	acft	%	
Wahpeton	4010	2723	21%	801206	106075	13%	
Fargo	6210	5459	19%	1425717	180209	11%	
Halstad	15430	14236	20%	3307686	426566	13%	
Grand Forks	21690	14985	14%	5149686	606198	12%	
Drayton		20679	16%	5912194	719749	12%	
Emerson		25861	20%	6915848	817540	12%	
		Less than allocation or goal					
		Meets allocation or goal					
		Exceeds allocation or goal					
		Hydrologic models not completed					

Potential Retention Projects

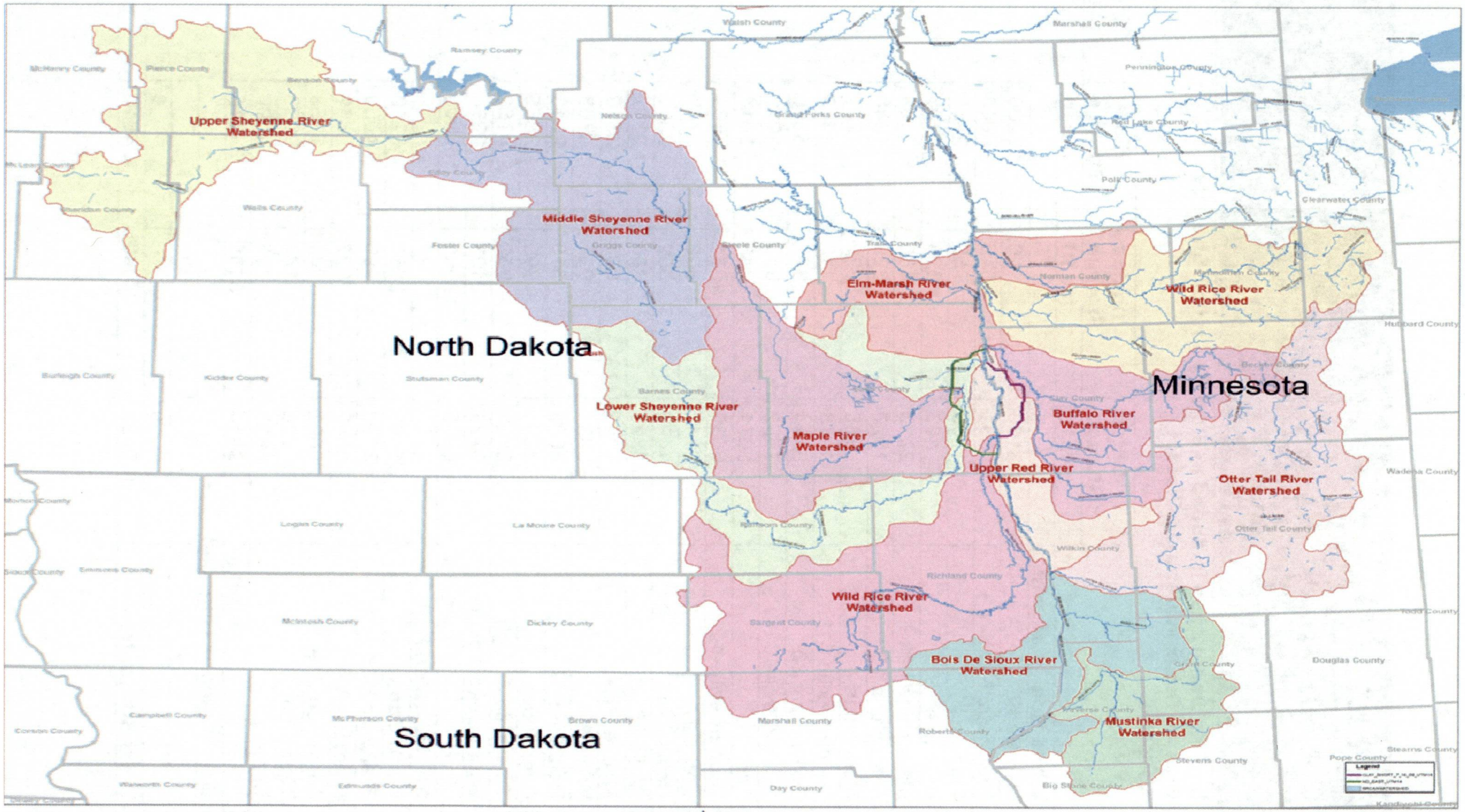
From the Mike 11 modeling, individual watershed district can identify potential sites to achieve their allocation towards the 20 percent reduction on the main stem Red River. Here, Minnesota's Bois de Sioux Watershed District in the very southeast portion of the basin put forth possible projects to be considered that would more than meet a 20 percent reduction.

Impoundment sites included in Flow Reduction Strategy
Bois de Sioux Watershed District
4/19/2009

	Gated Storage (ac ft)	Ungated Storage (ac ft)	Total Storage (ac ft)	RRBC 20% plan Reduction (ac ft)
White Rock watershed				
Red Path	13100	3100	16200	
Red Path West	5501	545	6046	
Eldorodo 7	1700	755	2455	
Big Lake	463	1325	1788	
Moonshine Lake	2723	686	3409	
Moonshine 13	1520	328	1848	
Moonshine 4	885	322	1207	
Leonardsville 31E	1046	413	1459	
Dollymount 30	5484	872	6356	
Leonardsville 31W	1592	350	1942	
Tara 12	3071	843	3914	
Leonardsville 12	6630	1031	7661	
Croke 17	2142	605	2747	
Dollymount 24	1499	552	2051	
Walls 36	1897	850	2747	
Moose Head	1622	896	2518	
Walls 30	3831	937	4768	
Delaware 17	1695	518	2213	
Everglades	1965	890	2855	
Township Slough	3802	950	4752	
South Dakota site(s)	8771	2193	10964	
Subtotal	**70939**	**18961**	**89900**	**61760**
Rabbit watershed				
North Ottawa	16160	2050	18210	
Brandrup S23	3020	980	4000	
Bradford S34	3042	627	3669	
Lawrence S19	5892	1061	6953	
Tintah S34	833	160	993	
Daniels	867	223	1090	
Subtotal	**29814**	**5101**	**34915**	**24377**
Bois de Sioux Ungaged				
Subtotal	0	0	0	**12119**
Total BdS watershed	**100753**	**24062**	**124815**	**98256**

Status of New Hydrologic Model Development (HMS) Using LIDAR Data

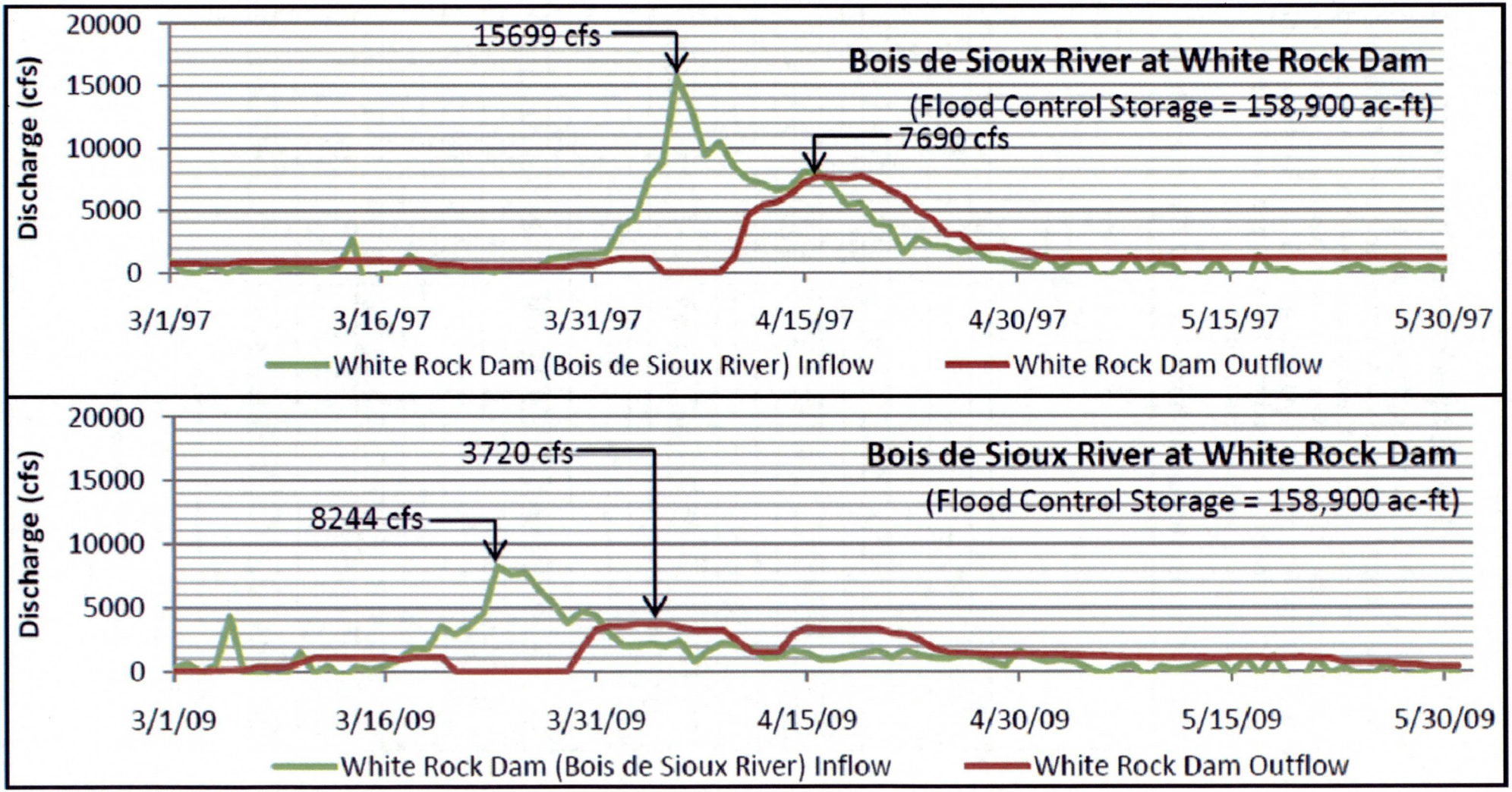
(all colored watersheds are underway)



Red River Watershed
North Dakota/Minnesota

moore engineering, inc.
Consulting Engineering • Land Surveying
West Fargo • Fergus Falls

Uncertainty of Storage
Discharges Along The Red River of the North at White Rock Dam for the 1997 and 2009 Floods



Potential Effects of Storage on Cities

The potential effects of flow reduction were evaluated in several ways. In the following table, the approximate potential flow and stage reductions from the 1997 flood are computed for each of six points on the main stem using the proposed reduction allocations and proposed storage for subbasins upstream of each of the six sites (see Appendix D, Table D-17). The resulting flow reductions range from 17% at Grand Forks-East Grand Forks to 24% at Emerson. The resulting stage reductions for the 1997 flood would have ranged from 1.3 feet near the border at Emerson to 2.8 feet at Grand Forks-East Grand Forks.

Effects of Potential Additional Storage on 1997 Flood Peak Stages

Upstream/Tributary Drainage Areas	Total Volume of 1997 Flood (Mike 11 Model)	Peak Flow of 1997 Flood (Mike 11 Model)	Proposed Storage in Watershed	Modified Peak Flow with Proposed Storage	Peak Flow Reduction of Proposed Storage	Peak Flow Reduction of Proposed Storage	Approx. Peak Stage Reduction of Proposed Storage
	ac-ft	cfs	ac-ft	cfs	cfs	%	ft
Bois de Sioux @ White Rock Dam		7,820	78,900	6,780	1,050	13%	
Rabbit River @ TH 75 ungaged		4,570	34,900	3,140	1,430	31%	
Bois de Sioux ungaged		8,540	*0*	8,540	0	0%	
Otter Tail River @ Orwell Dam		1,500	*0*	1,500	0	0%	
Otter Tail River ungaged		3,800	*11,000*	3,300	500	13%	
Wahpeton/Breckridge	**742,000**	**12,890**	**124,800**	**10,170**	**2,720**	**21%**	**2.4**
Wild Rice River @ Abercrombie		9,930	75,500	6,780	3,150	32%	
Fargo ungaged		23,000	*42,000*	20,000	3,000	13%	
Fargo/Moorhead	**1,450,000**	**28,570**	**242,300**	**23,110**	**5,460**	**19%**	**2.3**
Sheyenne River @ Harwood		10,300	*120,000*	7,900	2,400	23%	
Rush River @ Amenia		1,450	14,900	940	510	35%	
Buffalo River @ Dilworth		8,370	63,000	5,820	2,550	30%	
Wild Rice River @ Hendrum		10,150	*118,000*	7,840	2,310	23%	
Halstad Ungaged (includes Elm River)		57,000	*142,000*	49,500	7,500	13%	
Halstad	**3,310,000**	**71,390**	**700,200**	**57,160**	**14,200**	**20%**	**1.7**
Goose River @ Hillsboro		8,060	*62,000*	5,240	2,820	35%	
Marsh River near Shelly		4,070	*0*	3,930	140	3%	
Sand Hill River @ Climax		4,370	*39,000*	4,320	50	1%	
Red Lake River @ Crookston		28,980	270,000	23,780	9,400	32%	
Red Lake River ungaged		13,600	*20,000*	12,000	1,600	12%	
Grand Forks ungaged		36,400	*56,000*	32,000	4,400	12%	
Grand Forks/East Grand Forks	**5,130,000**	**110,750**	**1,147,200**	**95,770**	**19,000**	**17%**	**2.8**
Turtle River near Arvilla		930	11,500	840	90	10%	
Forest River @ Minto		2,100	*10,000*	1,800	300	14%	
Snake River ungaged		5,510	*30,000*	4,180	1,330	24%	
Middle River @ Argyle		3,710	*26,000*	2,960	750	20%	
Park River @ Grafton		5,110	50,300	2,690	2,420	47%	
Tamarac River ungaged		4,820	*13,000*	3,670	1,150	24%	
Drayton ungaged		17,170	*39,000*	15,800	1,370	8%	
Drayton	**5,820,000**	**128,320**	**1,327,000**	**107,640**	**26,000**	**20%**	**1.7**
South Branch Two Rivers @ Lake Bronson		4,060	*27,000*	3,560	500	12%	
Tongue River @ Akra		680	*3,000*	630	50	7%	
Pembina River @ Neche		14,300	*90,000*	12,400	1,900	13%	
Emerson ungaged		42,000	*41,000*	39,000	3,000	7%	
Emerson	**6,740,000**	**129,800**	**1,488,000**	**103,940**	**31,000**	**24%**	**1.3**

Indicates that Flow Reduction Goals were exceeded

Indicates that Flow Reduction Goals were met

Indicates that Flow Reduction Goals were not met

Results of Complementary Floodplain Management Approaches

Reducing flood risk in the Red River basin requires the working together of the three complementary approaches of floodplain management: 1) nonstructural attention to the physical floodplain and land use practices, both urban and rural, together with participation in federal programs such as NFIP; 2) local site protection for vulnerable damage sites such as communities, urban centers and, as possible, agricultural lands; and 3) reduction of peak flood flows through a basin-wide effort.

Level of Protection at Cities along the Red River

	Level of Protection							
City/Location	RRBC Recommended Guideline	Current Conditions	Meets RRBC Recommended Guideline?	Future Conditions including Planned Upgrades	Meets RRBC Recommended Guideline?	Future Conditions including Planned Upgrades plus Proposed Upstream Flood Storage	Meets RRBC Recommended Guideline?	Additional Measures Needed to Meet RRBC Recommended Guideline?
Red River Main Stem								
Wahpeton, ND	200 yr	100-125 yr	No	100-125 yr	No	< 200 yr	No	Yes
Breckenridge, MN	200 yr	100-125 yr	No	100-125 yr	No	< 200 yr	No	Yes
Fargo, ND	500 yr	< 100 yr	No	> 200 yr	No	> 200 yr	No	Yes
Moorhead, MN	500 yr	< 100 yr	No	> 200 yr	No	> 200 yr	No	Yes
Georgetown, MN	200 yr	< 100 yr	No	100 yr	No	> 200 yr	Yes	No
Perley, MN	200 yr	< 100 yr	No	100 yr	No	> 200 yr	Yes	No
Hendrum, MN	200 yr	< 100 yr	No	100 yr	No	> 200 yr	Yes	No
Halstad, MN	200 yr	250 yr	Yes	250 yr	Yes	> 250 yr	Yes	No
Shelly, MN	200 yr	< 100 yr	No	100 yr	No	> 200 yr	Yes	No
Nielsville, MN	200 yr	no permanent protection	No	100 yr	No	> 100 yr	No	Yes
Climax, MN	200 yr	no permanent protection	No	100 yr	No	> 100 yr	No	Yes
Grand Forks, ND	500 yr	250 yr	No	250 yr	No	> 500 yr	Yes	No
East Grand Forks, MN	500 yr	250 yr	No	250 yr	No	> 500 yr	Yes	No
Oslo, MN	200 yr	> 200 yr	Yes	> 200 yr	Yes	> 200 yr	Yes	No
Drayton, ND	200 yr	< 100 yr	No	< 100 yr	No	< 100 yr	No	Yes
Pembina, ND	200 yr	100 yr	No	100 yr	No	> 100 yr	No	Yes
St. Vincent, MN	200 yr	< 100 yr	No	>100 yr	No	200 yr	Yes	No
Noyes, MN	200 yr	100 yr	No	100 yr	No	> 100 yr	No	Yes

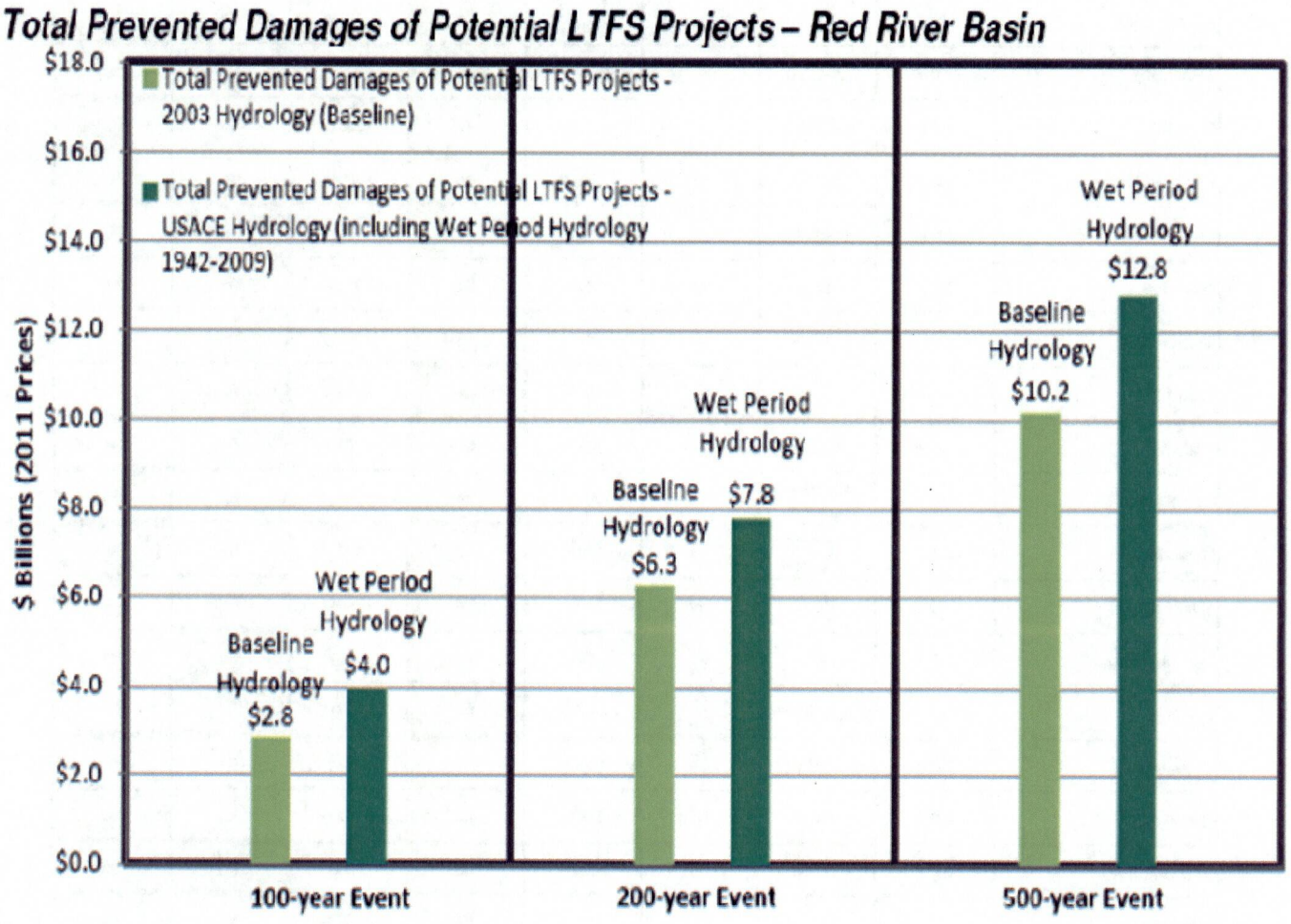
Summary of Damages Prevented by Potential LTFS Projects

The following figure summarizes the estimated damages prevented by the potential LTFS local protection projects, combined with a 20% flow reduction on the Red River main stem. Prevented damages are estimated for 100-year, 200-year and 500-year floods.

Prevented damages are computed for both 1) baseline hydrology, or that currently used by the USACE and 2) wet period hydrology, or that recommended by the current USACE feasibility study for Fargo-Moorhead flood protection.

Depending on the hydrology used, damages prevented by the potential LTFS projects will range from about $3 to 4 billion for a single 100-year flood, from $6.5 to 8 billion for a single 200-year flood, and from $10 to 13 billion for a single 500-year flood.

Working together with sound, proactive floodplain management, the potential LTFS projects can make a profound, measureable difference far into the future for the Red River basin.



PART IV: MOVING AHEAD WITH INTEGRATED ACTION

10
Conclusions and Recommendations for Action

The basin of the Red River of the North, historically subject to widespread chronic flooding, regularly sustains millions of dollars in economic damages for each flood event. The **Red River Basin Commission** (RRBC) identified the following conclusions on structural and nonstructural strategies needed for permanent flood solutions in the basin and recommendations for action for states (individually and collectively) and the federal government to consider as they fund and implement Long Term Flood Solutions (LTFS) for the Red River Basin in Minnesota and North Dakota. These recommendations are built around the basin-wide LTFS Level of Protection Goals" adopted by the RRBC in 2010 together with related flood risk reduction needs. The recommendations aim to move basin leaders from the usual response of reacting to the most recent major flood experience to a proactive, long-term plan with appropriate protection levels basin wide. If implemented, these recommendations will significantly reduce the risk of flood damages, and minimize disruption and economic loss and thus facilitate and expedite recovery after spring and summer floods.

These recommendations cannot be successful without the dedicated local, state and federal participation in funding and commitment to implement.

Immediate Needs/Critical Risks: Fargo-Moorhead, Devils Lake

- Under current conditions, the Fargo-Moorhead metropolitan area could get, in a major 500-year level flood, **$9 to $10 billion or more in basin damages,** according to the USACE.
- **Current levels of protection for Fargo-Moorhead are inadequate**. Protection should be increased to enable a successful 500-year flood fight.
- Protection measures for Fargo-Moorhead should be **economically viable** and provide the **least level of adverse impacts** to others.
- A **diversion** of the Red River around Fargo-Moorhead would provide the protection needed to endure a successful 500-year flood fight if it were supplemented by retention and other available options to achieve the RRBC's proposed LTFS level of protection goals.
- **Retention** to achieve the potential 20 percent flow reduction on the main stem should be aggressively pursued upstream of Fargo-Moorhead to decrease the duration, scope, and level of floods in the Fargo-Moorhead area, downstream communities, and rural areas.

Recommendation for Action 1.1

The **flood protection trajectory** that has increased protection in the Fargo-Moorhead metro area since the 2009 flood should continue. State and federal funds, with local government cost share, should continue supporting ongoing dike construction, property acquisitions, flowage easements, and flood infrastructure projects to be able to fight at least a 100-year flood, and upwards of a 500-year flood in the long term.

Recommendation for Action 1.2

Progress towards the proposed $1.77 billion **diversion should be continued** utilizing local, state, and federal funds so that, combined with current flood protection strategies, this community will have the capacity within 10 years to wage a successful flood fight equal to or greater than the LTFS 500-year flood.

Recommendation for Action 1.3

Retention upstream of the Hickson and Abercrombie stream gage for a flow reduction of 20 percent (minimum) should be advanced with shared funding by the F-M flood Diversion Authority working with local and joint water boards, using city, local, state, and federal funds.

Recommendation for Action 1.4

Leaders in state government in North Dakota and Minnesota, along with key local government officials and with input from the Diversion Authority and federal agencies, should convene by early 2012 to determine the **non-federal cost share formula for the Locally Preferred Plan ($1.77 billion) diversion**, and related $3.5 million operational estimates.

- **Rising levels of water in the Devils Lake** region have increased the potential for a natural overflow that could discharge approximately 14,000 cubic feet per second (cfs) of water into the Sheyenne River, triggering prolonged flooding and catastrophic downstream water quantity and quality problems in the Sheyenne and Red Rivers. This crisis should continue to be addressed with immediate local, state and federal action.

Recommendation for Action 1.5

The recommendations developed by **the Devils Lake Executive Committee** through the work of the Devils Lake Collaborative Working Group should continue to be supported by the state of North Dakota, local authorities, and federal and tribal governments to guard against critical risks.

Recommendation for Action 1.6

The RRBC and IRRB should distribute information with downstream interests and jurisdictions providing **progress and timelines** on Devils Lake activities.

Recommendation for Action 1.7

A comprehensive model using real-time data to determine the effects of **releases of Devils Lake water** via the various outlet channels on the Sheyenne and Red Rivers should be examined by local leaders and state and federal agencies to determine needs and related costs. The examination should include the integration of various models already in use by the USGS, the NWS, the NDSWC, and the USACE and be facilitated by the RRBC.

Cornerstone Solutions: Floodplain Management

2A Floodplain Management – Nonstructural Strategies
2B Floodplain Management – Raising Levels of Protection
2C Floodplain Management – Retention

2A Floodplain Management – Nonstructural Strategies

- A majority of the basin population lives adjacent to the Red River main stem and its tributaries at the lowest geographic elevation subject to flooding with **no comprehensive, basin-wide approach to floodplain management** , nor is there a mechanism to align the variations in local, state, and federal rules, regulations, and approaches.
- **Nonstructural floodplain management strategies** should be an integral component of reducing flood damage risks in the basin.
- The most effective overall technique for living with floods is for basin citizens to take **personal responsibility for their own flood risk** and for the sustainability of our natural resources.
- Minnesota and North Dakota should fund and administer **flood mitigation policy** consistently throughout the Red River basin so that a flood event in excess of the 100-year becomes the benchmark for managing the risk of flooding, regulating development in the floodplain, and for developing flood risk reduction projects around existing and newly developed areas.

Recommendation for Action 2A.1

State floodplain regulations and local zoning ordinances should contain criteria for **new residential, commercial, industrial, and agri-business development** that requires the largest of the following protection standards:

- 100-year flood plus three feet
- 200-year flood plus one foot
- flood of record plus one foot

Recommendation for Action 2A.2

Buildings located in at-risk areas where structural measures cannot accomplish the recommended flood protection levels or are not economically feasible should be publicly acquired and removed over the next three to five years.

Recommendation for Action 2A.3

Local governments in the basin should **update floodplain ordinances** in the next three years, **not permit new development in areas of high risk of flooding** immediately adjacent to the Red River and tributaries, **and minimize the use of variances**, unless protected by elevation or another acceptable FEMA strategy.

Recommendation for Action 2A.4

A review of basic **floodplain regulations and programs** should be undertaken by appropriate agencies and stakeholders of local, state and federal standards, to include:

2A.4.1 An evaluation of the appropriate **standards and regulations for development** throughout the basin, including the adequacy of the 100-year regulatory minimum standard (to include FIRMS) and the consideration of future standards to reduce losses;

2A.4.2 An analysis of community and state compliance with the **flood insurance** program, to include an analysis of proposed mandatory flood insurance for structures protected by dikes, identification of impediments to, and potential tools and

resources for, participation in FEMA's community Rating System, determination of the feasibility of insurance development, and a strategy to prompt a basin-wide reduction in flood insurance rates;

2A.4.3 An analysis of the use of **variances by local governments**; the reasons for and consequences of using variances for individuals, communities, and state; and most effective way(s) to track and document the use of variances.

Recommendation for Action 2A.5

Every community and county in the basin should work toward joining or improving their rating through the national FEMA **Community Rating System** to achieve lower flood insurance premiums for their residents (40-45 percent discounts) by 2015 as part of their mitigation plan update.

Recommendation for Action 2A.6

A **Floodplain Bill of Rights**, to include a floodplain map and flooding history, should be developed by RRBC with local government, realtors, builders, developers, FEMA, and state agency participation (2012).

Recommendation for Action 2A.7

RRBC should develop **education materials** on the floodplain related to the floodplain, insurance, personal decisions, and the Floodplain Bill of Rights, to be distributed to the public, realtors, lenders, and others (2012).

Recommendation for Action 2A.8

The USACE nonstructural assessment of identified structures has been completed for the F-M diversion project along the main stem in six counties deemed economically feasible for **nonstructural mitigation.**

2A.8.1 The USACE should **expand its assessment** along the entire main stem.

2A.8.2 A **local sponsor** should be identified to provide the non-federal cost share of 35 percent and implement the mitigation in the next three to five years.

2A.8.3 Congress should **authorize such a project and appropriate approximately $12 million** in funding for the 65 percent federal cost share to mitigate.

Recommendation for Action 2A.9

Minnesota and North Dakota should use their respective state Silver Jackets (Flood and Hazard Mitigation) teams to regularly communicate issues regarding flood mitigation efforts in the Red River Basin. Silver Jackets team members from Minnesota and North Dakota should contribute to a **collaborative interstate strategy for flood recovery and projects for mitigation efforts** for the Red River of the North basin, to be coordinated with the RRBC and others as deemed appropriate.

2B Floodplain Management - Raising Levels of Protection

- Comprehensive and strategic level of protection goals are needed for the entire basin. To this point, existing levels of protection have been based most often on the most recent flood experience, political will, and funding availability.

- The Minnesota and North Dakota legislatures should use the RRBC *Level of Flood Protection Goals* as a guide to future basin flood risk reduction strategies. *(See Level of Flood Protection Goals" adopted by the RRBC Board (2010) in LTFS Report, Ch. 8. Analysis assumes required freeboard.*

Major Urban/Metropolitan Areas

- **Fargo-Moorhead** (see Section 1. Biggest Risks).
- **Grand Forks-East Grand Forks.** Over the next 20 to 25 years, Minnesota and North Dakota should support increasing protection to a **500-year flood level for Grand Forks-East Grand Forks** by improving the cities' current 200- to 250-year protection with upstream retention that achieves the potential minimum 20 percent flow reduction on the Red River main stem at Grand Forks.
- **Winnipeg** has elevated its level of protection to 700 years by recent expansion of their diversion following the 1997 flood. Since its construction and subsequent first use in 1969, the floodway has operated over 20 times and prevented more than $10 billion in flood damages. This model shows the importance of long range planning to realize the protection required from potential large floods.

Recommendation for Action 2B.1

Grand Forks and East Grand Forks should each request the **500-year or greater level of protection** through the appropriate state and federal legislative avenues. Planning should recognize the degree to which the strategy of retention can assist in achieving this level of protection for the two cities.

Recommendation for Action 2B.2

The RRBC shall facilitate an exchange between officials in **Winnipeg, Manitoba,** and Fargo-Moorhead local government officials, the F-M Diversion Authority, and the public for the purpose of **sharing Winnipeg's experiences and expertise on the development and expansion of that city's diversion**, including engineering, construction, and operation and maintenance of the Red River Floodway.

Critical Infrastructure:

- **Critical infrastructure needs to be protected from flooding to the greatest levels practical.** If adversely affected by flooding, infrastructure such as water and waste water facilities, airports, hospitals, transportation, regional communications facilities, or chemical storage sites can experience major disruptions, resulting in harm to the people, economy, and environment of the basin.

Recommendation for Action 2B.3

Over the next three to five years, state emergency management officers shall facilitate the identification and documentation of **at-risk critical basin infrastructure** and report to the state legislatures in the annual LTFS update.

Small Cities and Municipalities:

- By 2015, cities in Minnesota and North Dakota on the main stem, tributaries, and in other flood prone areas should achieve protection to the **100-year level or three feet of freeboard the largest flood in their area plus three feet of freeboard**, whichever is greater.

- Once cities have achieved this level of protection, additional protection should be pursued towards achieving greater than **200-year flood protection** using upstream retention. Flood flow reduction from upstream retention can further complement the current levees and other strategies underway or contemplated.

Recommendation for Action 2B.4

Community structural projects in collaboration with the RRWMB and RRJWRD should be funded in the next state funding cycle for each respective state. *See attached funding timeline table D-31 and Level of Protection Appendix D, D-3.1, p. 12 with state, local and federal funding.*

Rural Residences and Farmsteads

Funding ring dikes or elevating of buildings for **rural residents and farmsteads** in flood prone areas should protect to three feet above the 100-year level or three feet above the largest flood in their area, whichever is greater.

Recommendation for Action 2B.5

Structural projects identified in collaboration with the RRWMB and RRJWRD for **rural areas, including ring dikes and rural property acquisitions**, should be funded beginning in the next state funding cycle through 2015 for each respective state. For those projects that become necessary only after future floods, funding shall become available in subsequent funding cycles. *See attached funding table D-31 and Level of Protection Appendix D, D-3.1, p. 12.*

Agricultural Cropland

- **Agriculture is an economic mainstay** of the basin, with basin farms experiencing composite net returns of $3 billion or more annually.
- **Adequate drainage**, whether surface or tile, is crucial to crop production in the basin.
- Studies such as the **timing analysis study** suggest that improvements to drainage systems in areas that contribute consistently to the rising side of the Red River flood hydrograph (early water) have the potential to help reduce Red River flood peaks if they can move runoff through the system ahead of flood peaks. *(Minnesota Flood Damage Reduction Workgroup Technical Paper No. 11)*
- At this time, no comprehensive, systematic approach exists to **coordinate the release of water in the current drainage system** based upon this timing analysis. Recent improvements in modeling, flow data, and elevation data can be utilized to better manage water to reduce flooding on the Red River.
- The **strategies that slow water** or hold it on the land slightly longer (while allowing for timely movement in the drainage system) are best implemented through land use and easement programs that take into account landowner impacts, as well as benefits to the local area the main stem .
- Potential exists to appropriate **new federal funding for land management** to the basin through the next U.S. Farm Bill that will assist landowners in reducing runoff, reducing erosion, and improving water quality. This effort will come through programs administered by the Natural Resource Conservation Service or its designee.

Recommendation for Action 2B.6

The RRRA, RRWMB, and RRJWRD, with appropriate state agencies, local government, and commodity group participation and support, should **develop a multipurpose drainage strategy** for agricultural land that evaluates the following:

2.10.1 Designed and engineered for both private benefits and public water management objectives.
2.10.2 Temporary detention (slowing down of water) by land management practices and land use changes.
2.10.3 Side inlet controls for all ditches.
2.10.4 Use of drainage for peak flow reductions and erosion control.
2.10.5 Rate and volume of water related to field and drain capacity.
2.10.6 Timing and movement of water in an equitable manner.
2.10.7 Landowner incentives and needs.
2.10.8 Adding drainage components to hydrologic models.
2.10.9 Need for studies, strategies, moratoriums, and additional information.

Recommendation for Action 2B.7

River channel maintenance such as snagging and clearing of trees, including the removal of trees that have or are at risk of falling into rivers and waterways, should be continued as necessary to maintain open waterways systems. The two states should continue to fund this effort: under current policies, North Dakota at its level of about $1 to $2 million, and Minnesota to restore its historic level of $150,000 per year.

Recommendation for Action 2B.8

For purposes of achieving long-term flood retention and other benefits, Minnesota should provide state funding through bonding of $10 million a biennium for the Red River basin through the Board of Water and Soil Resources for **Reinvest In Minnesota** (RIM) easements to **match or supplement federal USDA conservation funding** such as the Wetland Reserve Program, Conservation Reserve Program, EWP, and Environmental Quality Assurance Programs to achieve long term flood retention to leverage federal funding in the next five-year farm bill and for other benefits.

Recommendation for Action 2B.9

A basin **wetland bank** whereby farmers/landowners can purchase and exchange wetland credits should be developed by Minnesota, North Dakota, and South Dakota in partnership with NRCS and the local joint water resource districts in North Dakota and joint watershed districts in Minnesota.

Recommendation for Action 2B.10

The following **pilot projects, demonstrations, and studies** should be authorized and funded:

2B.10.1 Drainage as a Flood Reduction Tool Analysis: The RRRA, with appropriate state agency support, shall initiate an analysis of how to better utilize the **surface drainage system** to lower spring flood hydrographs by removing water on the rising side of the hydrograph consistent with the early, middle, and late zones.
2B.10.2 Culvert Inventory: An analysis outlining the advantages, disadvantages, benefits, and costs of a **basin-wide culvert inventory** gathered at the local water board level should be completed by RRBC and presented to the appropriate local and state entities with recommended funding from local, state, and federal sources (2012).
2B.10.3 Culvert Size Demonstration Project: A demonstration project in partnership with NRCS and affected local water boards should be implemented to analyze the flow

reduction benefits of **small distributed and culvert-sizing retention.** The project, estimated to cost about $1.5 million, should be 75/25 percent federal/non-federal cost shared (2012).

2B.10.4 Ag Damage Report: The 1980 and 2002 basin **agriculture flood damage reports** should be updated and documented in a continuously updated data base, with federal funds provided through USDA to provide local project benefit/cost information to assist in local impoundment strategies at the local landowner and water board level.

2B.10.5 Wetland Water Level Management Pilot Project: Within the next two years, a pilot project should be funded by NRCS in cooperation with the RRRA and other appropriate state and federal agencies to **draw down wetlands in the autumn enabling spring storage** and determining benefits and impacts for habitat and retention.

2B.10.6 Multi-Purpose Pilot Project: A demonstration project with funding and participation from farm and commodity groups and other interested parties should be developed and implemented in 2012, with RRBC assistance, to gather data on the timing and impacts on flooding from the following: **tile drainage, surface drainage, wetland restoration, early water ditch drainage, and culvert sizing.**

2B.10.7 Tile Drainage Study: A **tile drainage analysis** by the RRRA through the Basin Technical and Scientific Advisory Committee under the staff direction of the International Water Institute should be funded by the RRWMB and RRJWRD and completed in 2012.

2B.10.8 Buffer Strip: Buffer strips should be established and enforced at the local level for all natural, altered, and man-made waterways to a minimum of 16.5 feet (1 rod) and a maximum of 50 feet or more with incentives provided to landowners to reduce sediment for water quality and maintenance cost benefits and to slow the flow of water into the waterways.

Recommendation for Action 2B.11

The **rural flood control systems** that protect agricultural productivity and the economy from spring and summer floods should continue to be implemented throughout the basin. The goal is to reduce crop loss and to reduce planting delays by moving water off of land by mid-May in the spring and maximize flood control designs for peak run off for a 24-hour summer rainfall event with a 10 year reoccurrence interval.

Critical Transportation System and Emergency Services

- The **Red River basin** covers approximately 45,000 square miles or 28 million acres, a majority directly in active agricultural production, with an extensive system of highways, roads, and bridges that provide for the movement of goods and people to enhance the economic output of the region.
- The RRBC should facilitate discussions with regional organizations, state and federal departments of transportation, and EMOs, to identify a strategy **for critical transportation preservation** including potential road elevations during 100-, 200-, and 500-year flood levels compatible with the LTFS level of protection goals.
- **Critical transportation and emergency services** throughout the basin are inconsistent with each other and fail to operate effectively for a typical flood event.

Recommendation for Action 2B.16

Minnesota and North Dakota should each explore the issues surrounding **dedicating a portion of state aid for highway funding for culvert sizing and related road modifications** that benefit basin flood damage reduction strategies and introduce legislation to change state law if necessary. The RRBC shall assist with facilitation the discussion and analysis, by the end of 2013.

Recommendation for Action 2B.17

An analysis of planned and proposed **road elevations** for 100-, 200-, and 500-year flood protection at township, county and state levels for emergency, population sustainability, and agricultural and economic production needs shall be developed. Engineering expertise funded and directed by the RRWMB, RRJWRD, and appropriate state agencies should identify needs by location and hydrologic impacts on flooding by change of flows, elevation of the flood stage, and other related impacts using the new LiDAR data.

Recommendation for Action 2B.18

Minnesota and North Dakota should develop through their Departments of Transportation, a state and local funding **strategy to assist in county and township flood-related road repairs** and implement additional flood mitigation efforts once the protection goals are achieved and federal emergency aid under a disaster declaration is less likely.

Recommendation for Action 2B.19

The RRBC should facilitate discussions with relevant regional organizations, state and federal departments of transportation, and emergency management offices to identify a **strategy for critical transportation preservation,** including potential road elevations during the 100-, 200-, and 500-year flood levels, and to identify state and federal funding needs.

2C Floodplain Management - Retention

- No **comprehensive, basin-wide strategy** exists to implement the LTFS minimum 20 percent flow reduction goal for the main stem while achieving local tributary flood damage reduction.
- The impacts of retention are often dependant **on timing** and location. Not all sites are equally beneficial for local tributary and basin main stem flood damage reduction.
- Flow reduction through retention as demonstrated by **modeling** can reduce flows and stages on the Red River main stem as well as provide local benefits on tributaries. However, due to the variability of flood events, retention must be used in conjunction with other structural and non-structural measures to achieve the LTFS goals that will result in basin-wide improved levels of protection.
- The minimum goal for flow reduction on the Red River main stem at the **international boundary** for a 100-year flood equates to around 1.5 million acre feet of storage upstream accounting for timing of flow and costing approximately $1.5 billion.
- Retention using the minimum **20 percent flow reduction goal basin-wide** can be achieved over the next 20 years if local, state, and federal funds are leveraged to provide comprehensive local, tributary and main stem benefits for residents, property, and the environment.
- **Retention** that will cumulatively achieve the basin minimum 20 percent flow reductions over the next 20 to 25 years should be managed to improve flood control, improve water

quality, include natural resource enhancement opportunities, and provide potential water supply during extended droughts.

- Numerous small, aged PL 83-566 **flood control dams** throughout the basin could provide additional capacity for flood storage retention with refurbishment.

Recommendation for Action 2C.1

Federal funding should be provided for retention at $25 million per year or $500 million over the next 20 years, with Minnesota, North Dakota, and local governments providing cost share funding for retention to achieve a minimum 20 percent reduction in peak flows on the Red River.

Recommendation for Action 2C.2

Cost for retention projects should be shared among federal (50 to75 percent), states of Minnesota and North Dakota (25 to 35 percent), and the RRWMB, RRJWRD and local water boards (10 to 25 percent) over a period of 20 years staying within the current local joint board two mil levy.

Recommendation for Action 2C.3

A **review of federally operated reservoirs**, identifying the potential for increased storage during flood events, should be conducted by USACE and state agencies, and Wildlife Management Areas by the USFWS, reporting to relevant state agencies and the RRRA.

Recommendation for Action 2C.4

The newly formed RRRA should work with each water management board to **plan, design, and implement retention,** to achieve 25 percent of the retention goal every five years for their respective areas, with the goal of achieving the minimum 20 percent flow reduction for the Red River main stem over 20-25 years.

Recommendation for Action 2C.5

A **project prioritization methodology** for the use of federal funds reflecting local and main stem needs and benefits should be developed by the RRRA by 2012.

Recommendation for Action 2C.6

The **permitting process** for water retention projects should be coordinated by the RRRA and a federal agency liaison in the basin working with appropriate state and federal agencies to help streamline the process to decrease timelines for project implementation, allow a one-stop permitting process, and provide general permits for certain projects.

Recommendation for Action 2C.7

NRCS and/or the states of Minnesota and North Dakota should provide $400,000 to **expand the Project Planning and Permit Evaluation demonstration project** to the entire Red River basin through the International Water Institute as part of the USACE Basin Watershed Feasibility Study.

Recommendation for Action 2C.8

Public outreach on retention programs and a survey to determine landowner interest in storing water on their land should be completed in two years by the RRWMB and RRJWRD (or

the RRRA) to assist in future planning for retention projects and determine achievable timelines and cost expectations that correspond to local participation.

Recommendation for Action 2C.9

Regarding the ongoing USACE Red River Basin-wide Feasibility Study:

2C.9.1 The current ongoing **study shall be continued with federal funding at $1 million per year** and corresponding $1 million non-federal match.

2C.9.2 The updating of HMS (hydrologic modeling system) of the remaining major watersheds should be completed by the end of 2012. This modeling will provide the tools necessary to **identify retention projects** on tributaries that provide local benefits and cumulatively benefit the basin.

2C.9.3 Modeling of the remaining **main stem** Hydrologic Engineering Centers River Analysis System **HEC-RAS** reach to the Canadian border presently underway, including the work needed to tie all the main stem reaches together into one model from White Rock, South Dakota, to the Canadian border, should be completed by the end of 2012.

2C.9.4 The HEC-RAS main stem model, in conjunction with the new watershed HMS models, should be finalized in such a way that they can be utilized to provide the basis for a RRRA **"Project Prioritization Process"** needed for evaluating proposed projects, their effectiveness, and downstream impacts in contributing to the RRBC's flow reduction goals on the major tributaries and Red River main stem.

Recommendation for Action 2C.10

NRCS, in conjunction the RRRA, shall **evaluate PL 83-566 and other dams that have flood control capacity in the basin to determine the feasibility of restoration** for the purpose of adding potential flood water retention storage, including the identification of specific structures for rehabilitation, specific strategies and funding necessary, and proposed timelines. NRCS shall issue its findings to the RRRA by September 30, 2012. Federal funding of up to $6 million is needed for the evaluation and an additional estimated $10-$15 million for refurbishment.

Information and Tools for Maximizing Efforts Going Forward

- The Red River Basin, a vast geographic area of three states and one Canadian province, **has great need for cooperation** across boundaries for uniform data and information gathering efforts, an understanding of our differences, and a shared vision of what needs to be accomplished.
- The current local, state, and federal partnership in comprehensive flood risk reduction strategies is **disjointed and operates in a piecemeal fashion.**
- **Each flood varies**, creating unique issues regarding preparation and protection needs.
- **Levels of protection** recommended by RRBC for the LTFS Report will provide the safety net needed and allow for variations in floods, weather, and forecasting.
- **Further improvements in flood forecasting** such as new data sets, modeling improvements, and real time information to account for variables related to precipitation and temperature are needed to build upon those instituted after the 1997 flood.
- **Additional efforts and information** are needed as a guide for the future as updated needs become evident.

Recommendation for Action 3.1

The RRBC shall, for the next 10 years, conduct an **annual evaluation of flood mitigation progress towards the implementation of the LTFS Report Recommendations.** This evaluation shall be submitted to Minnesota, North Dakota, South Dakota, and Manitoba.

Recommendation for Action 3.2

Jurisdictional Multi-Boundary Coordination should be implemented wherever possible through the RRBC.

3.2.1 The Minnesota, North Dakota, and South Dakota governors and the Manitoba Premier should meet at least once every two years, along with the relevant legislative committee chairs of the state and provincial governments, to receive an **update on progress towards the LTFS recommendations** on flood reduction strategies, water quality, water quantity, and other relevant natural resource issues.

3.2.2 With the assistance of RRBC, the **International Legislators Forum** among Manitoba, Minnesota, North Dakota, and South Dakota legislators should be continued to discuss current topics, including flood risk reduction strategies.

3.2.3 Minnesota should coordinate through the Board of Water and Soil Resources and the state legislature the **inclusion of all subwatersheds** on the Minnesota side as Watershed Districts (Ottertail) and membership in the RRWMB (Ottertail and Buffalo-Red Watershed District).

3.2.4 Federal agencies should utilize their **regional structures in innovative new ways** to accommodate Red River basin hydrologic boundaries.

3.2.5 When necessary, RRBC shall coordinate a **jurisdictional meeting** of heads of state, legislative leaders, and key agency officials to prompt dialogue and development of unified action on such issues.

Recommendation for Action 3.3

LTFS should be expanded to include the entire Red River basin:

3.3.1 Manitoba should continue funding RRBC's efforts to model the 20 percent **flow reduction strategy in Manitoba** and also continue and accelerate the gathering of Light Detection and Ranging (LIDAR) data, at $70,000 through 2012.

3.3.2 **South Dakota** and local leadership should determine the feasibility of establishing watershed organizations in Roberts and Marshall counties through the International Legislators Forum within the next two years.

Recommendation for Action 3.4

RRBC should coordinate development of a basin-wide strategy and identification of funding sources for **improving flood forecasting** during 2012 among local, state, provincial, and federal agencies.

3.4.1 The generation of **relevant time appropriate data** (real time rain and snowmelt, soil moisture, frost depth information, and other information) and improved modeling through a volunteer network and the development of a real time network shall be addressed.

3.4.2 The feasibility of establishing an **on-site decision support service** to the region during spring and summer flood events by hosting a US National Weather Service

hydrologist in the basin shall be considered, as well as identifying a funding source for such an effort.

Recommendation for Action 3.5

The USGS, RRWMB, RRJWRD, and their member water boards, NDSWC, MNDNR, and other key stakeholders, should **develop a stream gage strategy** by 2012 with associated costs and funders for the basin for the main stem Red River and its tributaries that will support the new hydrologic and hydraulic models that will provide a long term record for accurate, timely, and consistent flow data for model development, aid in flood reduction strategies, and include water quality modeling needs in the next two years.

Recommendation for Action 3.6

RRBC should **update the LTFS Report in 2021** with the inclusion of Manitoba and South Dakota and shared funding from the four jurisdictions.

Resources to Implement

- Minnesota and North Dakota, cost sharing with local, state, and federal funds, should implement actions consistent with the LTFS to maintain the basin's social, economic, and environmental welfare and protection from future large floods, as this investment over the next 10 years will significantly **reduce the risk of $11-13 billion in losses** from a large flood and protect the economic output of the basin.

Recommendations for Action 4.1

The states of Minnesota and North Dakota, cost sharing with local and federal partners, should make a **financial investment** of about $3.54 billion over the next 10 years to immediately address flooding in the basin with a structural approach.

4.1 **Funding in Minnesota** needed for the next 10 years is $270.9 million, from local and state sources.

4.2 **Funding in North Dakota** needed for the next 10 years is $536.4 million from local and state sources.

4.3 **Local funding** at the RRWMB and RRJWRD levels should be increased and maintained at a two mil levy.

See attached funding timeline table D-31 and Level of Protection Appendix D, D-3.1, p. 12 with state, local and federal funds.

Table D-31 Funding Timeline for Project Implementation Costs along the Red River of the North and Tributaries(6)(7)

All costs in millions and are estimated at 2011 price levels

The best available information as of September 2011 is presented in this table. However it is not complete as much of the information has yet to be developed. These costs will change as additional information is developed.

		Total Project Cost	Remaining Project Costs 1st Ten Years (Starts 1 July 2011)					Remaining Funding for Future (After 2021)	Notes
			Total Funding	Federal Funding	Non-Federal Funding (1)	Non-Federal Funding in Minnesota	Non-Federal Funding in North Dakota		
Local Protection Projects									
Red River Main Stem									
Red	Farmstead and Rural Residence Ring Dikes	$17.0	$3.2	$1.8		$0.4	$1.0	TBD	(8)
Red	Minnesota Rural Area Buyouts	$12.0	$12.0			$12.0		TBD	
Red	North Dakota Rural Area Buyouts	$7.0	$7.0	$3.6			$3.4	$0.0	
Red	Stanley Township, Cass County, ND Levees	$4.0	$4.0				$4.0	$0.0	
Red	Breckenridge, MN	$41.0	$0.7			$0.7		$0.0	
Red	Oxbow, ND	$0.4						$0.0	
Red	Fargo/Moorhead Diversion Project	$1,770.0	$1,770.0	$785.0	$985.0			$0.0	(1, 6)
Red	Fargo, ND - Other Non-Diversion Projects	$200.0	$200.0				$200.0	$0.0	
Red	Moorhead, MN - Other Non-Diversion Projects	$70.0	$25.0			$25.0		$0.0	
Red	Oakport Twp, MN	$33.0	$8.7			$8.7		$0.0	
Red/ Buffalo	Georgetown, MN	$3.2	$3.2			$3.2		$0.0	
Red	Perley, MN	$2.7	$0.3			$0.3		$0.0	
Red	Hendrum, MN	$2.5	$0.3			$0.3		$0.0	
Red/ Marsh	Shelly, MN	$3.0	$2.0			$2.0		$0.0	
Red	Nielsville, MN	$3.0	$1.8			$1.8		$0.0	
Red/ Sand Hill	Climax, MN	$3.0	$2.3			$2.3		$0.0	
Red	Oslo, MN	$9.0	$9.0			$9.0		$0.0	
Red	Drayton, ND	TBD							
Red	Pembina, ND	$0.1						$0.0	
Red	St. Vincent, MN	$2.9	$2.9			$2.9		$0.0	
Tributaries									
Sheyenne/Maple/Rush Rivers (ND)									
Sheyenne	Valley City, ND	$60.0	$60.0	$39.0			$21.0	$0.0	
Sheyenne	Fort Ransom, ND	TBD							
Sheyenne	Lisbon, ND	$10.0	$10.0					$0.0	
Sheyenne	Kindred, ND	$3.0	$3.0					$0.0	
Sheyenne	Horace, ND							$0.0	(2)
Sheyenne	West Fargo, ND							$0.0	(2)
Sheyenne	Reile's Acres, ND							$0.0	(2)
Maple	Enderlin, ND	$0.3						$0.0	
Maple	Mapleton, ND	$0.1						$0.0	
Rush	Amenia, ND	TBD							
Sheyenne	Harwood, ND							$0.0	(2)
Sheyenne	Reed Township, Cass County, ND	$4.5	$4.5	$1.8			$2.7	$0.0	

Table D-31 Funding Timeline for Project Implementation Costs along the Red River of the North and Tributaries[6][7]

All costs in millions and are estimated at 2011 price levels

The best available information as of September 2011 is presented in this table. However it is not complete as much of the information has yet to be developed. These costs will change as additional information is developed.

		Total Project Cost	Remaining Project Costs 1st Ten Years (Starts 1 July 2011)					Remaining Funding for Future (After 2021)	Notes
			Total Funding	Federal Funding	Non-Federal Funding[1]	Non-Federal Funding in Minnesota	Non-Federal Funding in North Dakota		
Wild Rice River (MN)									
Marsh	Ada, MN	$9.4	$6.0			$6.0		$0.0	
Felton Ditch	Felton, MN	$2.7	$2.7			$2.7		$0.0	
Wild Rice	Buyouts	$1.5	$0.3			$0.3		$0.0	
Red Lake River (MN)									
Cty Ditch 1	Thief River Falls, MN	$1.0						$0.0	
Red Lake	Crookston, MN	$40.0	$6.0			$6.0		$0.0	
Middle/Snake Rivers (MN)									
Snake	Alvarado, MN	$3.0	$3.0			$3.0		$0.0	
Middle	Argyle, MN	$0.8	$0.3			$0.3		$0.0	
Park River (ND)									
Park	Grafton, ND	$42.1	$41.0	$31.6			$9.4	$0.0	
Pembina River (ND)									
Pembina	Neche, ND	$3.0	$3.0	$1.9			$1.1	$0.0	
Roseau River (MN)									
Roseau	Roseau, MN	$40.0	$20.0	$14.0		$6.0		$0.0	
Devils Lake (ND)									
Devils Lake	Devils Lake, ND (City of)	$150.0						$0.0	
Devils Lake	Minnewaukan, ND	$10.5						$0.0	
Devils Lake	Fort Totten, ND	$120.0	$120.0	$120.0				$0.0	
Devils Lake	Tolna Coulee - Control Structure	$14.0	$13.4	$9.9			$3.5	$0.0	(3)
	West End Outlet	TBD						$0.0	(6)
	East End Outlet	$85.0	$85.0				$85.0	$0.0	
	Gravity Outlet	$17.0	$17.0				$17.0	$0.0	
	Buyouts	TBD						$0.0	
	Raise federal aid roads	$190.0	$190.0	$190.0				$0.0	
	Raise township roads	TBD						$0.0	
	Raise railroads	$97.0	$97.0	$64.7			$32.3	$0.0	(4)
	Increase Upper Basin Storage	$75.0	$75.0	$75.0				$0.0	
Subtotal - Local Protection - In United States		***$3,163.5***	***$2,809.6***	***$1,338.2***	***$985.0***	***$92.9***	***$380.4***	***$0.0***	

Table D-31 Funding Timeline for Project Implementation Costs along the Red River of the North and Tributaries[6][7]

All costs in millions and are estimated at 2011 price levels

The best available information as of September 2011 is presented in this table. However it is not complete as much of the information has yet to be developed. These costs will change as additional information is developed.

		Total Project Cost	Remaining Project Costs 1st Ten Years (Starts 1 July 2011)					Remaining Funding for Future (After 2021)	Notes
			Total Funding	Federal Funding	Non-Federal Funding [1]	Non-Federal Funding in Minnesota	Non-Federal Funding in North Dakota		
Upstream Storage Projects									
	Potential Upstream Storage Projects	***$1,463.0***	***$700.0***	***$350.0***		***$175.0***	***$175.0***	***$763.0***	(5)
Other Flood Related Activities									
	Pilot Projects	$10.0	$5.0	$2.5		$1.3	$1.3	$5.0	
	Decision Support Network	$4.0	$4.0	$2.0		$1.0	$1.0	$0.15/yr	
	Forecasting	$2.0	$2.0	$1.0		$0.5	$0.5	$0.15/yr	
	FEMA Flood Plain Mapping with LiDAR data	TBD							
	Transportation Upgrades	TBD							
	404 Retention Permitting Coordination	$1.0	$1.0	$0.5		$0.3	$0.3	$1.0	
	Drainage	TBD							
	Conservation Program Funding	TBD							
Subtotal - Other Flood Related Activities		***$17.0***	***$12.0***	***$6.0***	***$0.0***	***$3.0***	***$3.0***	***$6.0***	
TOTAL FOR UNITED STATES IN RED RIVER BASIN		**$4,643.5**	**$3,521.6**	**$1,694.2**	**$985.0**	**$270.9**	**$558.4**	**$769.0**	

TBD To be determined

Notes:

(1) The estimated amounts of the Federal and non-Federal Fargo/Moorhead LPP Diversion project total costs are based on the Fargo-Moorhead Metropolitan Area Flood Risk Management project Supplemental Draft Feasibility Report and Environmental Impact Statement, April 2011. Final cost sharing amounts between the non-Federal partners have not yet been determined.

(2) Additional local protection included as a part of the Fargo-Moorhead LPP North Dakota diversion project cost listed under Fargo and Moorhead at the top of this table.

(3) Tolna Coulee cost includes $14 million for the control structure to prevent significant erosion in case of a natural overflow.

(4) Cost sharing for raising railroad embankment at Devils Lake estimated to be one-third cost shared by Burlington Northern Santa Fe Railway, one-third by Amtrak, and one-third by the North Dakota Department of Transportation through a US Department of Transportation grant.

(5) Federal participation in potential upstream storage projects is assumed to be available through future U.S. Farm Bill at approximately 50 percent cost sharing; however, actual Federal funding availability and cost sharing amounts is uncertain. Also, implementation of projects in each state is assumed to be at comparable levels, however this will depend on project implementation schedules by each state.

(6) Operation and maintainance (O&M) costs of projects are not included in this tabulation, eventhough in some cases the O&M costs may be substantial. O&M costs are typically a non-Federal or local responsibility and should also be considered in the implementation decision for a project.

(7) Information on specific projects at individual communities can be found on the City Assessment tables in Appendix C.

(8) Funding for farmstead and rural ring dikes depend on the number of landowners requesting assistance. A rough estimate based on funding from recent years is included.