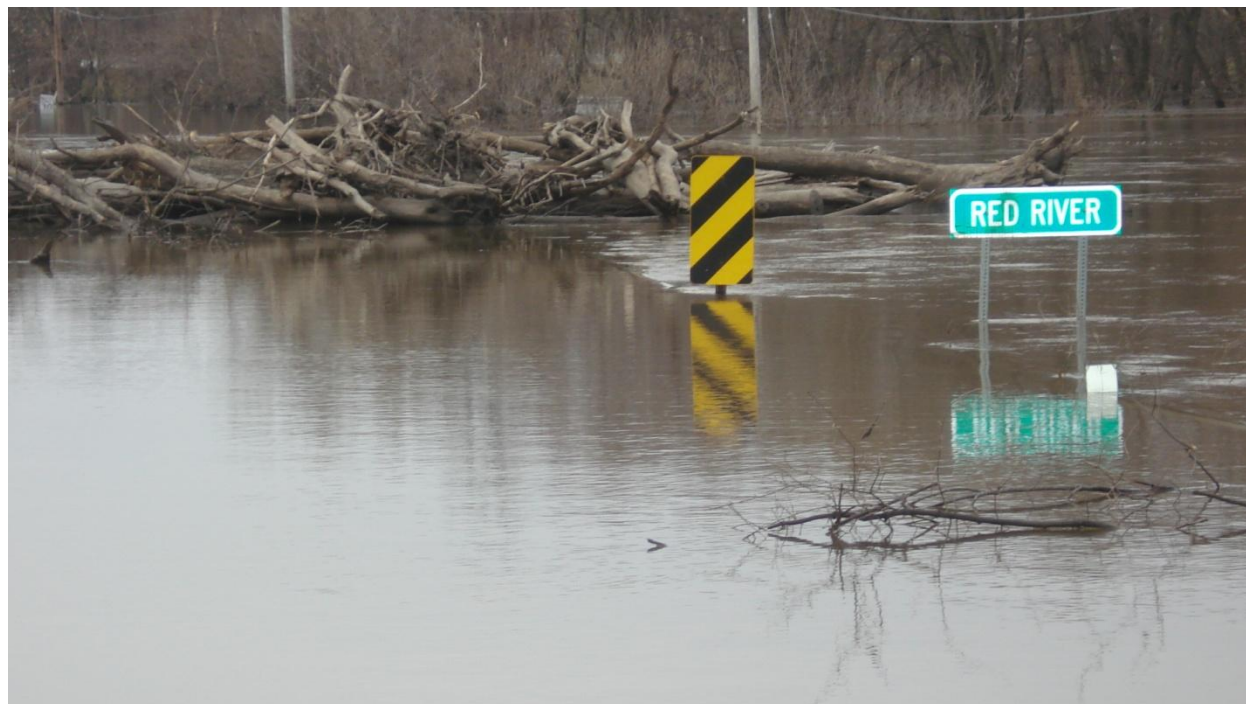


# RED RIVER BASIN COMMISSION

## LONG TERM FLOOD SOLUTIONS



## PROGRESS REPORT TO THE MINNESOTA LEGISLATURE

**January 15, 2010**



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# EXECUTIVE SUMMARY

## LONG TERM FLOOD SOLUTION (LTFS) PROJECT

The 2009 Minnesota Legislature appropriated \$500,000 to the Red River Basin Commission (RRBC) and charged it with developing a comprehensive plan of action to address, mitigate, and respond to flooding and related water quality and land conservation issues in the Red River basin and report progress and outcomes in January (Chapter 93, Art. 2 (4)). The North Dakota Legislature matched Minnesota's funding for the same purpose. RRBC's progress towards this goal to date includes the following:

**Phase I: Information Gathering:** The RRBC is generating first-hand information from basin stakeholders. This will allow for the recommendations being developed for the state to be centered in grass-roots citizen and leader feedback. This information will be analyzed, processed and packaged to identify problems, activities, needs to ensure recommendations are consistent with local activities underway and in the developmental stages. This information is being generated through three strategies.

- The first is public surveys that basin residents are completing providing their views on problems, concerns, and solutions Basin residents can complete it electronically on the RRBC website: [www.redriverbasincommission.org](http://www.redriverbasincommission.org).
- The second through 21 basin public forums that was completed on January 14, 2010. These forums were attended by nearly 1,000 basin residents.
- And finally, damage inventory surveys at the watershed district, city, and county levels are being completed. These extensive surveys have been sent to these governmental units with about half completed and returned. Follow up work is underway for the remaining results and a developmental grid for analysis is under development.

**Leveraging Funds:** The RRBC is leveraging funds towards the state appropriation to efficiently produce results on long term flood solutions by effectively utilizing river flow models and decision making tools that will influence the ability to recommend flood damage reduction strategies based on factual information. RRBC matched the 2009 Minnesota appropriation by securing a \$500,000 appropriation from the state of North Dakota. The RRBC subsequently leveraged new federal funding with this combined \$1 million in state funds through the U.S. Army Corps of Engineers (USACE) Red River Basin-wide Feasibility Study for a one-to-one match.

**Basin Flood Damage Reduction Principles:** The RRBC is leading the way to formulate through consensus basin flood damage reduction principles that will guide basin leaders in identifying flood reduction strategies and locations, in prioritizing projects to maximize available funding, and in keeping a balanced basin-wide comprehensive water management focus.

**Goals for Flows and Levels of Protection:** RRBC is also currently in the process of building consensus on levels of flood protection goals for the basin infrastructure and economic base. These goals once established will help guide future decisions related to funding needs, timelines, and strategies that can help solve the problems.

**Flood Damage Reduction Strategies/Project Identification:** RRBC is developing creative and effective *projects and strategies* to get results. RRBC is working with water managers on the front lines to identify key impediments to implementing projects and developing “outside the box” solutions to overcome them. RRBC is looking at new, innovative funding opportunities for projects. RRBC is addressing other key issues such as the impacts of drainage, on-stream storage, and the mitigation of downstream impacts. RRBC is also developing goals for the reduction in flood flows for each tributary at seven mainstem locations throughout the basin. These goals are essential in determining the locations, size and operation of upstream floodwater storage. RRBC has developed a Red River mainstem unsteady flow model for the purpose of modeling the river and tributary flows to reduce mainstem flows by an agreed-upon percentage (currently 20 percent is being considered). Developing strategies for upstream floodwater storage is a critical component of the comprehensive watershed approach to long term flood solutions. Water storage is essential to reducing flood flows at downstream locations, it is a necessary supplement to local protection measures and will be a component of the plan and recommendations. There will also be recommendations related to the permitting process, and opportunities for multi-use of existing wetlands.

**Phase II:** This phase is in process of contract negotiations with the contractor best positioned to carry out the task. The USACE is able, under its federal authority for the Red River Basin Feasibility, to contract directly with the contractor to accomplish the LTFS Project Phase II Workplan task. Therefore, the USACE, the local co-sponsors (the Minnesota Red River Water Management Board and the North Dakota Joint Water Resource District Board) and the RRBC are all collaboratively working on this project and the recommendations that will emerge. The final outcome will be a product that has local, state, and federal buy-in. The additional benefit of the USACE doing the contract is that it frees up state funds to do more on the modeling which will be extremely beneficial in helping set goals, projecting costs/timelines and in prioritizing. The RRBC Board approved this action at its November 3, 2009 board meeting and contract negotiations are underway and scheduled to be completed in January 2010 so that Phase II can begin. This phase will begin to put together the final report details and recommendations with all supporting information.

**Phase III:** is not a part of this project and will be the implementation of the recommended strategies and projects. RRBC can assist in the implementation phase which will likely be led by current local entities such as Watershed Districts (WD) in Minnesota and Water Resource Districts (WRD) in North Dakota in conjunction with the appropriate state and federal agencies.

## **A. LONG TERM FLOOD SOLUTIONS (LTFS) PROJECT DEVELOPMENT**

Upon notification of the availability of funding from Minnesota (MN) and North Dakota (ND) for the LTFS Project to the Red River Basin Commission (RRBC), the staff and Board of Directors began to plan to implement the project, for when funding became available July 1, 2009. (see Appendix 1 for Legislation). RRBC's 14-member Executive Committee at their monthly meeting in May 2009 began discussing the project and over the next couple of meetings took the following actions. 1) First, it was agreed to call the effort the LTFS Project. 2) Second, the fiscal tracking mechanism was established to handle the funds through a separate RRBC account rather than a project account in the RRBC general fund. 3) Third, a workplan that staff had developed was adopted (see Appendix 2). 4) Fourth, action was taken to establish two working committees to assist the Board and Executive Committee with the project. 5) And lastly, action was taken to begin implementing the first part of the workplan, by developing and RFP for one part and contracts for other parts.

The staff attended the MN Board of Water and Soil Resources (BWSR) meeting at their earliest meeting explaining the workplan and receiving the motion necessary to enter into a contract with BWSR for the funds. The same action occurred with the ND State Water Commission (SWC) at their next meeting.

The entire workplan is built around a Phase I and a Phase II effort. Phase I is an information gathering phase to ensure that the future recommendations to each state are rooted in the reality of the problem, solutions that are underway, and solutions that still need to be developed. This basis will make it possible to address local needs while at the same time creating a basin strategy.

Phase II of the project will be to take all the information, add to it, and begin to narrow it down and package it so that we end up with a basin plan that has practical solutions to the flooding issue which can be affordably implemented. The final recommendations to the states that emerge after Phase II will provide a clear path of what needs to be done, where it should be done, a general projections of what it will cost, and a projection of how long it will take.

Phase III is not a part of this project and will be the implementation of the recommended strategies and projects. This phase will likely be implemented by current local entities such as Watershed Districts (WD) in MN and Water Resource Districts (WRD) in ND in conjunction with the appropriate state and federal agencies.

## **B. LONG TERM FLOOD SOLUTIONS (LTFS) PROJECT STATUS**

- a. Project Name:** The Long Term Flood Solutions (LTFS) Project was the name given to the project at the May 14, 2009 Executive Committee, reflecting the goal of the project. The Flood Damage Reduction (FDR) recommendations that emerge from the project will be short-term strategies (around 10 years) as well as strategies that are mid-term, (around 20 years) and longer term (out to around 50 years).

- b. **Fiscal Management:** A new bank account at the 1<sup>st</sup> State Bank of Hawley has been established to account for the state funds. These funds will be received after the RRBC has encumbered expenses and put in the account and then distributed to RRBC for expenses incurred. This will keep the state funds for the LTFS Project separate from other RRBC project accounts.
- c. **Workplan:** The workplan has been developed and is continually updated as the project is implemented. This workplan was developed by staff and the RRBC Executive Committee and was Board accepted the workplan when the Board approved the June 18, 2009 Executive Committee minutes and actions at the August 6, 2009 Board meeting.
- d. **LTFS Sub-Committees:** At the May 14, 2009 Executive Committee meeting the announcement was made by staff regarding the states of MN and ND each allocating \$500,000 to RRBC for this project. It was decided to establish two committees to assist in the effort.
  - i. LTFS Oversight Committee: This committee has seven members as follows: MN Board of Water and Soil Resources, John Jaschke; ND State Water Commission, Dale Frink; MN Legislature, Rep. Morrie Lanning; ND Legislature, Senator Tom Fischer; MN member, Jon Evert; ND member, Jake Gust; and Manitoba (MB), Steve Topping. All of these members are also on the RRBC Board of Directors (Lanning is Ex-Officio). This committee met separately for the first several months but now meets with the RRBC Executive Committee monthly, and as needed to provide guidance and oversight to the LTFS Project.

The LTFS Oversight Committee decided to meet independently with the Fargo/Moorhead (F/M) groups working on the F/M Diversion Project including the two cities, the two counties, the local MN watershed district, and the local ND water resource district leaders and other citizen groups. These meetings were to update each group on the LTFS Project and goals as well as to discuss with them how the LTFS Project will mesh with the proposed F/M Diversion Project under consideration and how the LTFS Project might help address other concerns by various landowner and downstream groups. These meetings have all occurred and RRBC is on now the agenda of the meetings of the local F/M Working Group that represents local governments from the area in both states. RRBC is able through this venue to continually communicate with and update the F/M Working Group on the LTFS Project activities. This is especially critical as the LTFS Project recommendations for strategies for FDR could complement and enhance the F/M Diversion if upstream storage can be achieved to lessen the impact of Red River stage elevations by an F/M Diversion.

- ii. LTFS Technical Advisory Committee (TAC): This committee began as a committee linked to the MN Red River Water Management Board (RRWMB) and the ND Joint Water Resource District Board (JWRDB). The initial committee was composed of the two chairs: MN, John Finney; ND, Jim Lyons; the two policy advisors: MN, Ron

Harnack; ND, Tom Fischer; and the two technical advisors: on the Minnesota side, Dan Thul from the DNR; and ND, Randy Gjestvang-SWC. The LTFS TAC has grown to include: RRWMB and JWRDB Board members: MN, Dan Wilkens, and ND, Mark Brodshaug. Representatives of the upstream watersheds from F/M: MN, Bruce Albright—Buffalo Red Watershed District (WD); ND, Rick St. Germain-Houston Engineering; Jon Roeschlein - Bois de Sioux WD; and ND, Jeff Volk- Wild Rice River-Moore Engineering. Representatives from the MN Flood Damage Reduction Working Group: MN, Al Kean-BWSR; MN, Jim Solstad-DNR; MN, Charlie Anderson-JOR Engineering; and MN, and Henry VanOffelen. And a representative from the F/M downstream interest group: MN, Terry Guttormson-farmer. This committee has met several times and is planning to meet more often now that modeling data is available for the Red River mainstem and needs to be analyzed and used in developing recommendations related to basin FDR principles as well as goals related to levels and flows for example. At their January 13, 2010 meeting, the LTFS TAC established working sub-committees: one to deal with technical issues such as mainstem and tributary modeling of flows, establishing flow reduction goals at an ideal percentage. The other sub-committee will address policy issues such as permits, funding, and other impediments to project implementation.

- e. **Contracts:** There were initially contracts that needed to be put in place on several fronts and related to several issues. The RRBC Executive Committee acting on the advice of the LTFS Oversight Committee acted on the following contracts at their July 16, 2009 meeting. Other contracts will be issued as the project moves forward and specific needs are identified.
- i. Administrative and Fiscal Management: It was decided to have RRBC carry out the administrative and fiscal management duties.
  - ii. Policy and Project Coordinator: It was decided to contract with RRBC to provide these services, as they had been contracting with someone capable of providing the effort needed on this project. This person would be hired full time and also act as lead for the project and has been retained.
  - iii. Damage and Project Surveys: It was decided to issue a contract with Barr Engineering to assist in the development and initial compilation strategies for the surveys to be send to MN and ND counties, cities, WDs, and WRDs.
  - iv. Public Meeting Facilitator: It was decided to issue a contract to Karen Nitzkowski, a local public facilitator, to assist with the round of public meeting to gather information. This contract was issued and will be fulfilled by the end of January 2010.
  - v. RFP for Phase I: It was decided that the staff should develop an RFP for Phase I and to advertise it and issue it with LTFS oversight guidance. The RFP was prepared, advertised according to legal timelines, candidates interviewed and on August 6, 2009 Barr Engineering was awarded the Phase II contract.

- f. **State Contracts:** The RRBC Executive Director presented to the ND SWC on June 23, 2009 and at the MN BWSR on June 24, 2009 on the LTFS Project workplan. Both the SWC and BWSR approved entering into contracts. The state contracts are in place and have been developed in a manner to provide consistency for the project, while maintaining the integrity of each state agencies need.
- g. **Phase I:** Phase I has numerous components that are related primarily to gathering information that will be used in Phase I to begin to develop recommendations. Some portions of the final product also began in this phase such as: draft outline of final plan/recommendations, Basin Flood Damage Reduction (FDR) Principles, flow and level goals, and the MN and ND Legislative Report. The Phase I contract was issued to Barr Engineering in August of 2009. This contract includes work assisting with the processing of all information gathered from the public surveys; the public forums; and the surveys to counties, cities, WD, and WRD. In addition facilitation, information gathering, and consensus building at the monthly RRBC Board meetings and November 2009 Board retreat, the RRBC Executive Committee, the LTFS Oversight Committee, and the LTFS TAC. As information is processed and prepared the 41 member RRBC Board representing MB, MN, ND, and SD at local, provincial and state levels will be asked to agree on the project recommendations. On FDR issues this will take significant discussion and effort as there are multiple interests and viewpoints on the RRBC Board just as there are outside of RRBC in the basin. What these components are and their status is listed below.
- i. Leveraging Federal Funds: At the June 18, 2009 RRBC Executive Committee it was decided to send a letter to the U.S. MN and ND Congressional Delegation to see if the U.S. Army Corps of Engineers (ACE) could receive authorization for an addition \$1 million on their Red River Basin Mainstem Feasibility Study so that the MN and ND state funds could be matched. This effort was successful and the workplan for how the two funding sources relate to each other and match activities is now in place and being implemented. It will result in the LTFS Project recommendations being also endorsed by the MN RRWMB, ND JWRDB, and USACE as the basin plan/recommendations for future actions related to FDR activities. It is a major step forward in looking toward the future with a unified voice and plan of action.
  - ii. Public Surveys: The RRBC developed and widely distributed a public survey throughout the basin which has generated hundreds of responses to date. Currently underway, the survey solicits residents' opinions on ideal levels of protection; best approaches to improving flood protection, proposed solutions, and their willingness to financially contribute, among other things. Initially, the results received are displayed on the RRBC web site and illustrate several things including that residents want a comprehensive approach to solutions and are willing to pay for more protection. Complete results will be reported this spring. Basin residents can complete it electronically on the RRBC website: [www.redriverbasincommission.org](http://www.redriverbasincommission.org)
  - iii. Public Forums: In the fall and early winter of 2009 the RRBC sponsored 21 public flood forums around the Red River basin to publicly engage with basin residents to hear their flood stories and solicit ideas and feedback on a comprehensive plan.



These forums were held around the basin in MN, MB, and ND including the following MN communities: Cormorant Township, Dilworth, Georgetown, Halstad, Moorhead, Oslo, Red Lake Falls, and Roseau. Almost 1,000 attendees participated and voiced their opinions on last year's flood, chronic flooding experiences, concerns for future flooding, and suggestions and ideas for solutions. The last meeting was just completed January 14, 2010. RRBC will generate a report in the next month on all the information gleaned. (See appendix 2 for details and information from the forums that has been processed to date).

iv. Damage and Project Surveys:

RRBC is gathering a comprehensive inventory of flood damages during the 2009 flood and previous recent floods from watershed districts and flood-prone cities, and their proposals on potential solutions. Respondents are reporting on flood damages such as the number of residences



damaged, miles of roads washed out, and steps towards proposed solutions such as flood damage reduction strategies. Once the responses are complete, RRBC will report its findings this spring. RRBC developed and sent damage inventory requests to the flood-prone cities in the basin and Minnesota watershed districts to get a complete picture of past flood damages and what their obstacles are in completing any flood damage reduction plans, such as permitting or funding. About half of those surveys have been completed, the remainder delayed by the wet fall that delayed harvest well into winter. The remaining completed surveys are expected before spring.

- v. USACE Red River Basin Feasibility Study: The RRBC is *leveraging funds* in the basin to expand the resources to efficiently get results on long term flood solutions. The ACE has federal funding for a Basin Feasibility Study. There are several components that have been underway that will assist the LTFS Project. These are: the Basin LiDAR (Digital Elevation Data) collected at North Dakota State University by the International Water Institute with local, state, and federal funding. Mainstem Modeling has also been ongoing through RRBC and the development of the Mike 11 Mainstem Model from Lake Traverse in SD to Lake Winnipeg in MB. This project has recently been completed and has been used to generate mainstem flow reductions of 20 percent (see Appendix 4).

1. This collaborative study will expand Mainstem Modeling compatibilities with the RRBC's Mike 11 Model and the USACE's HEC-RAS model that allows one to perform one-dimensional steady flow, unsteady flow, sediment

- transport/mobile bed computations, and water temperature modeling. This will provide valuable flow information for the Red River and its tributaries.
2. The study will also utilize the International Water Institute's (IWI) collection of digital elevation data, and development of a decision support system. The primary focus of this work will be to develop, coordinate and document basin-wide goals pertaining to runoff for each of the sub-watersheds in the Red River Basin. In addition to flood damage reduction, other objectives to be incorporated in this multi-beneficial project will be: improved water quality, ecosystem restoration, and water supply.
  3. At the direction of RRBC, the USACE also will be updating existing or developing new Hydrologic Model System (HMS) models, a physically-based distributed-parameter model system, for all Minnesota and North Dakota sub-watersheds.
- vi. Pilot Project/s: The RRBC Board discussed the concept of a pilot project/s to help identify problems that continually emerge as projects for FDR are developed. The Board and Committees listened to concepts and a proposal and eventually determined it was best to have the LTFS TAC work with these issues. The LTFS TAC at their January 13, 2010 meeting began addressing these issues through the formation of a policy sub-committee. This sub-committee will explore the key issues and report back to the TAC with a recommendation on either proceeding with the sub-committee, RRBC staff, or outside contract work. The following items will be further studied and reported upon:
1. Assess at least six prior water projects (a minimum of three projects in North Dakota and a minimum of three projects in Minnesota) and drawing from previous experiences of relevant sources throughout the basin, develop a comprehensive list of impediments to timely project identification and completion and provide a corresponding set of recommendations for reducing or eliminating such impediments for the RRBC and the local project sponsor. Analyze and report in detail on the identified specific impediments.
  2. Analyze and report in detail on access to funding for projects that identifies all current, available funding sources, the process to access them, and any relevant timelines. Included in this report shall be: local funding options; state funding options including: (state agencies, legislative appropriations and funding, cost share formulas, and etc.); federal funding options including: (new funding sources, grant appropriations, legislation, cost shares, and etc.); and basin funding opportunities including: (international options, new funding sources, and options for the creation or modification of existing organizations to best secure funding for water projects, and etc.)
  3. Convening and engaging key sources throughout the basin, prepare findings on how such a water storage pilot project may interface with the following key issues in the basin: drainage, on-stream storage, mitigation of downstream impacts, opportunities for storage utilizing existing wetlands, permitting

process with relevant state agencies and the U.S. Army Corps of Engineers, and resistance to land use conversions, among others.

4. Using the above findings, develop an additional list of recommendations for improved or enhanced joint project support and/or collaboration across geopolitical boundaries and/or between existing water management agencies.
5. Using the recommendations formulated from the processes described above, and in cooperation with the RRBC administration, preparation of a set of recommendations for inclusion in the draft Water Management and Flood Damage Reduction strategy/framework for the Red River Basin.
6. Subsequent to or concurrent with above items, assist the RRBC in the selection of one or two “Pilot” projects in North Dakota and/or Minnesota in the upper basin, based on readiness and compatibility with the goals of the local project sponsor(s), to establish processes to condense project implementation that will result in shortened timelines and reduced costs.

**h. Economic Analysis:** The RRBC Board has determined and economic information related to the Red River Basin will be useful in the final FDR recommendations to weigh costs of projects against the economic benefits of the basin. In order to provide policy makers, decision leaders, basin residents, and MN and ND taxpayers with an idea of the economic impact of the Red River Basin and why investing in flood protection is a worthwhile endeavor, the RRBC requested economic data from the University of Minnesota Crookston EDA Center. Directed by Jack Geller, formerly from the Minnesota Center for Rural Policy and Development, the EDA Center has already completed a report on seven of the 18 Minnesota counties in the Red River Basin to quantify this economic impact. Initial results illustrate that the basin region is a significant net exporter of goods and services, producing many economic benefits for Minnesota, the region and the country. The remaining counties will be analyzed over the next months so that there is a complete picture of the value of the basin.

**i. Basin Flood Damage Reduction Principles:** The RRBC is leading the way to formulate FDR Principles that will guide basin leaders through this project and into the future on basin-wide, comprehensive water management. Consent among the basin’s key players, represented on RRBC’s board and committees, is an investment that takes time, but will pay dividends.

Among the proposed principles are commitments that the proposed solutions are comprehensive, basin-wide in nature, and address issues such as floodplain regulations and zoning for future development, the role of upstream floodwater storage in mitigating downstream flood flows, and that solutions be multi-purpose. Additional components of the principles suggest cross-jurisdictional partnerships must be facilitated, ongoing evaluation and prioritization occur, and that responsibility and accountability be shared among all levels of government. The Long Term Flood Solutions Plan will build upon, supplement, and expand upon the Red River Basin Commission’s Natural Resource

Framework Plan, and the Basin Commission's current overall Guiding Principles. RRBC has developed a Red River Basin Natural Resource Framework Plan (NRFP) that has 13 basin Goals identified, nine of which relate to land and water resource management, protection, and improvement. Goal six in the NRFP is to reduce flood damages on the mainstem and its tributaries. The LTFS Project offers the perfect opportunity to develop principles, goals, strategies for projects and recommendations to solve flood problems in the basin and to provide a road map for doing the same on the other NRFP goals.

The current proposed principles the RRBC is discussing and continuing to develop next week at its annual conference are as follows:

➤ **Principle 1:** The **Comprehensive Long Term Flood Solutions plan** developed by the Red River Basin Commission, in partnership with the (Minnesota) Red River Water Management Board (RRWMB), the (North Dakota) Red River Valley Joint Water Resource District Board (RRVJWRDB), and Manitoba interests, should be the framework for federal, state and local agencies and jurisdictions to implement those components of the plan that fall within their authorities, jurisdictions and capabilities. The plan will consider both existing and potential future development needs throughout the basin.

➤ **Principle 2:** **Levels of Flood Protection goals** for the Red River Basin are essential to a coherent and comprehensive strategy for reducing the risk of flooding and flood damages throughout the Red River Basin with the objective of providing a more reliable, safe and secure place for basin residents to live and contribute to the economic well-being of the region, North Dakota, South Dakota, Minnesota, Manitoba, the United States and Canada. The Level of Flood Protection goals may not be initially achievable due to a variety of factors, including the cost of implementation, however they provide a long term vision of what is needed for the basin.

➤ **Principle 3:** A comprehensive **Basin Approach** is critical to long-term success in reducing flood damages throughout the basin. The basin approach uses all appropriate measures to reduce or prevent flood damages including levees, diversions, upstream storage, floodplain regulations and zoning, flood insurance, buyouts and other structural and non-structural measures.

➤ **Principle 4:** **Floodplain Regulations and zoning** for future developments should use the same level of flood protection criteria (Level of Flood Protection Goals). Uniform, consistent, and enforceable regulations should be adopted for the Red River basin and should be implemented at the State and local levels.

➤ **Principle 5:** **Goals for the reduction in flood flows** throughout the basin are essential to determining the locations, size and operation of upstream floodwater storage. *(Flow reduction goals will be adopted by the Red River Basin Commission, in conjunction with the RRWMB, the RRVJWRDB, and Manitoba interests.)*

➤ **Principle 6:** Upstream **Floodwater** storage is a critical component of the comprehensive basin approach to Long Term Flood Solutions. Upstream storage is essential to reducing flood flows at downstream locations, is a necessary supplement to local protection measures, can be used to offset loss of floodplain storage due to local protection projects such as levees, and should be a component of any plan. *(Guidelines for Upstream Floodwater storage for each sub-basin will be adopted by the Red River Basin Commission, in conjunction with the RRWMB, the RRVJWRDB and Manitoba interests.)*

- **Principle 7:** Components of the Long Term Flood Solutions plan will incorporate **Multiple Purposes** whenever possible consistent with the objectives of the Red River Basin Commission's Natural Resources Framework Plan, including water quality, water supply, and fish and wildlife resources.
- **Principle 8: Cost Effectiveness** is an important measure of the value of the components of an overall Long Term Flood Solutions plan. However, cost-effectiveness is only one of many considerations in judging the overall merits of a plan.
- **Principle 9:** The Red River Basin Commission will **facilitate the implementation of cross-jurisdictional partnerships** for the implementation of the Long Term Flood Solutions plan and will also assist in the resolution of conflicts associated with the plan.
- **Principle 10: Evaluation and prioritization** of projects and components of the Long Term Flood Solutions plan will be facilitated by the Red River Basin Commission in conjunction with the RRWMB, the RRVJWRDB and State of MN and ND and Manitoba interests. *(Evaluation criteria and a prioritization process are to be determined.)*
- **Principle 11:** An **evaluation** of the progress on plan implementation will be conducted annually by the Red River Basin Commission and modifications to the implementation process will be made as necessary.
- **Principle 12:** The Long Term Flood Solutions plan will recognize that a **shared responsibility, commitment and accountability at the local, state and federal levels** will be necessary for successful implementation of the plan.

**j. Basin Goals:** In addition to Basin FDR Principles, RRBC is developing goals that reflect flow reduction percentages (see Appendix 4) for the mainstem and tributaries and levels of protection where discussions will be enhanced by the modeling information. These goals are under discussion to build basin wide consensus on them and will be part of the RRBC Annual Summit Conference public small group discussion on January 20, 2010. Levels of flood protection goals for the Red River Basin are essential to a coherent and comprehensive strategy for providing a reliable, safe and secure place for basin residents to live and contribute to the economic well-being of the region. Basin leaders are developing goals to guide what is sufficient for each metropolitan area and community, for example, local leaders in Fargo-Moorhead have a goal of 500-year protection for the metropolitan area.

**RRBC: Level of Flood Protection Goals**  
***(proposed only: under current discussion)***  
*(Draft Strawman) January 15, 2010*

Why Level of Flood Protection Goals? Level of Flood Protection goals provides a long term objective to reduce the risk of flooding and flood damages throughout the Red River Basin. These goals may not be initially achievable for a variety of reasons including the costs of implementation, but will provide a basis for potential future action as resources to implement these goals become available. Once a level of flood protection goal is defined, the flood stage reduction, flood flow reduction, or other actions needed to achieve that goal can be defined.

	Estimated Recurrence <u>Interval</u>	Chance of Being Equaled or Exceeded <u>in any Given Year</u>
Major Urban/Metropolitan Areas: (1) (2) (4) (same level of protection as Winnipeg's)	700 year	0.14%
Critical Infrastructure: (1) (2) <i>(water and wastewater treatment facilities; airports; hospitals; regional communication facilities; chemical storage facilities; etc)</i>	700 year	0.14%
Cities/Municipalities: (1) (2)	250 year	0.4 %
Rural Residences & Farmsteads(1) (2)	100 year	1.0%
Agricultural Cropland:	minimum of 10 year summer flood	10%
Transportation: (2) (3) Critical Transportation System and Emergency Service Links:	250 year	0.4%

**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.

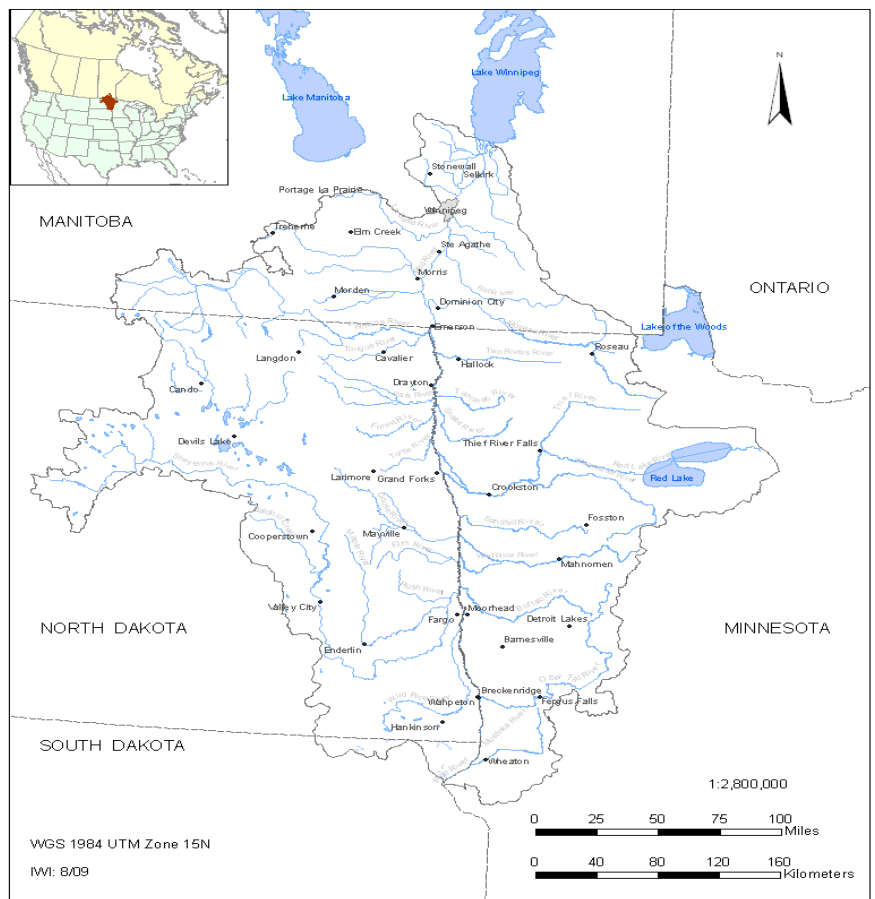
**k. Modeling:** Goals for the reduction in flood flows for each tributary at seven mainstem locations throughout the basin are essential to determining the locations, size and operation of upstream floodwater storage. RRBC has initiated a Red River mainstem unsteady flow model for the purpose of reducing mainstem flows by an agreed-upon percentage (currently 20 percent is being considered). Guidelines for upstream floodwater storage is a critical component of the comprehensive watershed approach to long term flood solutions. Water storage is essential to reducing flood flows at downstream locations, is a necessary supplement to local protection measures, and should be a component of any plan. RRBC will utilize the HMS sub-watershed models that the USACE is now developing and link them to the Mike 11 Mainstem Model for mainstem flow reductions that result directly from upstream sub-watershed storage strategies.

**l. Phase II:** This phase is in process of contract negotiations with the contract best positioned to carry out the task. The USACE is able under its federal authority for the Red River Basin Feasibility to contract directly with the contractor to accomplish the LTFS Project Phase II workplan task. This means that the USACE, the local co-sponsors the MN RRWMB and the ND JWRDB and the RRBC are all collaboratively working on this project and the recommendations that will emerge. The final outcome will be a product that has local, state, and federal buy-in. The additional benefit of the USACE doing the contract is that it frees up state funds to do more on the modeling which will be extremely beneficial in helping set goals, projecting costs/timelines and in prioritizing. The RRBC Board approved this action at its November 3, 2009 Board meeting and contract negotiations are underway and scheduled to be completed in January 2010 so that Phase II can begin. This phase will begin to put together the final report details and recommendations will all supporting information.

**C. BACKGROUND: RED RIVER BASIN**

**a) The Red River and its Basin:**

The origin of the Red River of the North is at the confluence of the Otter Tail and Bois de Sioux rivers near Breckenridge, Minnesota in Wilkin County and runs north about 550 miles long. The Red River Basin or drainage area, encompasses more than 45,000 square miles across the corner of northeastern South Dakota, eastern North



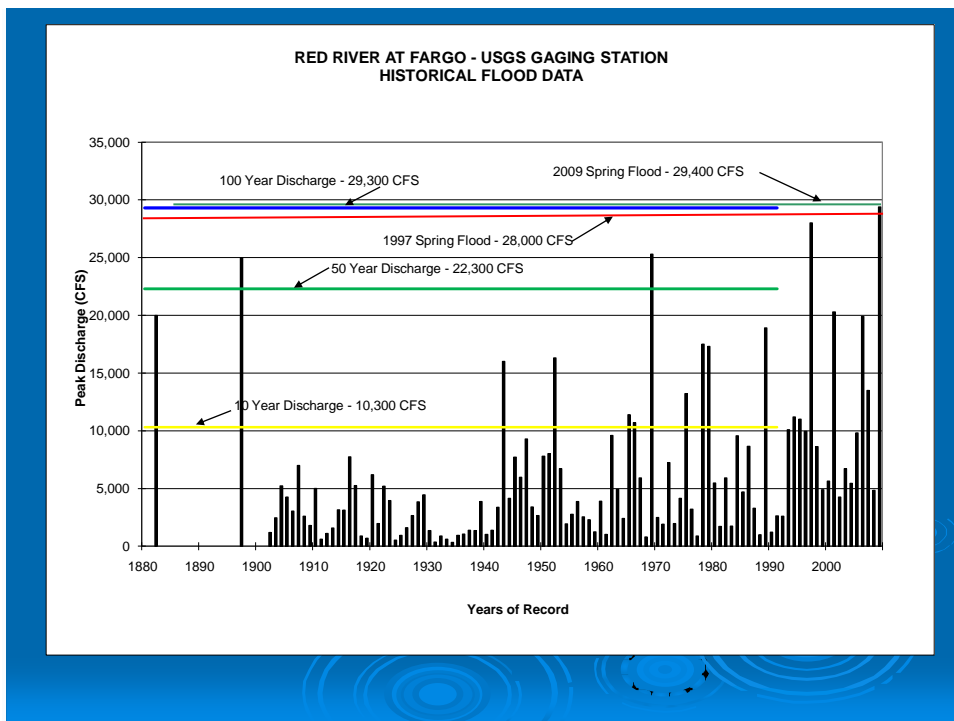
Dakota, Northwestern Minnesota and southern Manitoba, Canada. The Red River flows across the flat lakebed of the enormous, glacial Lake Agassiz. As the glacier melted, its waters formed the lake, and over thousands of years sediments settled to the bottom of the lakebed, leaving behind some of the most fertile soil in the world. The Red River itself is relatively young; it began only after Lake Agassiz drained, about 9,500 years ago.

While the Red River essentially drains the region, it did not create a “valley” wider than a few hundred feet, contrary to popular perception. The much-wider floodplain is the expansive bed of the glacial lake shown in the illustration above. It is flat; from its southern origin and onward north to the international border near Emerson, Manitoba, its gradient is only about 1:5000, or approximately 1 foot per mile.

Because of its flatness, high water has essentially nowhere to go, except to spread across the lakebed in "overland flooding". Heavy snows or rains, on saturated or still frozen soil especially in early spring, has caused a number of major floods, which often are made worse by the fact that snowmelt starts in the warmer south, and waters flowing northward are often dammed or slowed by ice. Major floods in historic times include those of 1826, 1897, 1950, 1997, and the most recent 2009 flood.

b) **Flooding:** Flooding is a major issue in the Red River Basin and continues to negatively impact the economy year after year. The first graph below shows the history of Red River flooding since 1880. It shows the pattern of increased floods in recent years and also the largest floods of recent record. The other piece in this section shows highlights the 2009 flood.

i) Flooding History





## ii) 2009 Flood

The 2009 Red River flood along the Red River of the North in Minnesota and North Dakota in the United States and Manitoba in Canada brought record flood levels not only to the Fargo-Moorhead metropolitan area, but widespread throughout the basin. In Fargo-Moorhead, after more than a week-long sandbagging effort, and emergency dikes and levees were instituted, the river crested at 40.82 feet on March 28, 2009.

Emergency dikes were constructed in Grafton, Harwood, and Richland County. The Georgetown levee was raised another two feet. Soccer fields in Fargo-Moorhead were dug up to get quick access to clay for the emergency levees, and sand was hauled in to meet the need for over 3.5 million sandbags. Thousands of volunteers rushed from surrounding communities, the Twin Cities, and around the country.

The next several months residents and communities spent tearing down emergency structures and clearing and cleaning debris and damage. Many roads remain in disrepair. Cities and communities continue to revise their emergency plans and institute upgrades to their infrastructure in the hopes that they are more prepared for future floods.



## **D. BACKGROUND: RED RIVER BASIN COMMISSION (RRBC)**

The RRBC was formed in 2002 to address land and water issues in a basin-wide context. The RRBC was formed as a result of a merger between the Red River Basin Board, the International Coalition, and the Red River Water Resources Council. The RRBC is a chartered, not-for-profit corporation in the United States operating in Minnesota, North Dakota and South Dakota and a charity in Canada operating in Manitoba. RRBC has offices in Moorhead, Minnesota, and Winnipeg, Manitoba, and is dedicated to innovation in the management of the Red River Basin's water resources.

The RRBC has a 41-member Board of Directors. These directors represent: local governments such as cities, counties, municipalities, watershed districts, and water resource districts; First Nations; environmental groups; and at-large citizen members. The Governors of Minnesota, North Dakota, and South Dakota and the Premier of Manitoba also appoint members to the Board. In Minnesota, the Governor's appointments are: Department of Natural Resources Commissioner Mark Holsten, Minnesota Pollution Control Agency Commissioner Paul Eger, and Minnesota Board of Water and Soil Resources Executive Director John Jaschke.

The RRBC has adopted a vision, a mission statement and a set of Guiding Principles, based on input provided by basin residents, to guide its activities. These basic documents provide the foundation to develop reasonably specific goals and objectives for water management in the basin. These goals and objectives, along with the mission statement and the Guiding Principles, provide a framework for the Board.

## a. RRBC Board of Directors

<b>RED RIVER BASIN COMMISSION BOARD 2010</b>			
	<b>Minnesota – 12</b>	<b>North Dakota - 12</b>	<b>South Dakota - 2</b>
<b>Counties</b>	Jon Evert, Clay Jerry Dahl, Mahnomen	Joe Belford, Ramsey Hetty Walker, Pembina	
<b>Cities</b>	Hank Ludtke, Frazee Betty Pikop, Stephen Mark Voxland, Moorhead	Shane Walock, Horace Fred Bott, Devils Lake Kevin Burg, Hillsboro	
<b>Watersheds</b>	John Finney, Joe River Dan Wilkins, Sand Hill	Tom Fischer, SE Cass Ben Varnson, Red River Joint Water Resources Board	
<b>State</b>	Paul Eger, MPCA John Jaschke, BWSR Mark Holsten, DNR	Dale Frink, State Water Commission Dale Glatt, Department of Health Terry Steinwand, Game and Fish	
<b>Environmental</b>	Henry Van Offoelen, MN Center for Environmental Advocacy	Genevieve Thompson, National Audubon Society	
<b>At-Large</b>	Warren Seykora	Jake Gust	Roger Navratil, Roberts County
<b>MANITOBA - 12</b>			
<b>Municipalities</b>	Herm Martens, R.M. of Morris John Falk, R.M. of Rhineland Marvin Magnusson, R.M. of Bifrost Kurtiss Krasnesky, R.M. of St. Andrews		
<b>Cities</b>	Jeff Browaty, Winnipeg R.S. "Bud" Oliver, Selkirk		
<b>Water Co-Op</b>	Sam Schellenberg, Pembina Valley Water Coop		
<b>Environmental</b>	Joy MacLean, Lake Winnipeg Research Consortium		
<b>Provincial</b>	Steve Topping, Manitoba Water Stewardship Dwight Williamson, Manitoba Water Stewardship Muriel Smith, Winnipeg		
<b>At-Large</b>	Bill Paulishyn, R.M. Springfield		
<b>FIRST NATIONS/TRIBAL - 3</b>			
Melissa Hotain, Assembly Manitoba Chiefs			
Allen Pemberton, Red Lake Band of Chippewa Indians, Red Lake, MN			
<i>Vacant</i>			

## b. RRBC Vision and Mission

**Vision:** The Red River Basin Commission's vision is: A Red River Basin where residents, organizations and governments work together to achieve basin-wide commitment to comprehensive integrated watershed stewardship and management.

**Mission:** The Red River Basin Commission's mission is: To develop Red River Basin integrated natural resources framework plan; to achieve commitment to implement the framework plan; and to work toward a unified voice for the Red River Basin.

## APPENDIX 1 MN AND ND LEGISLATION

The Minnesota Legislature appropriated \$500,000 from the general fund to the Red River Basin Commission, available July 1, 2009, in the Capital Investment Finance Bill (2009 Chapter 93) through the Board of Water and Soil Resources (BWSR). Specifically the funding is for:

*Minnesota legislative guidance:*

Subd.4/ Red River Basin Commission Grant \$500,000

(a) From the general fund for grants, contracts, or agreements with the Red River Basin Commission or its members to develop, in consultation and cooperation with all boards and commissions involved with water management and flood prevention and control in the Red River basin, a comprehensive plan of action to address, mitigate, and respond to flooding and related water quality and land conservation issues in the Red River watershed. The plan must take into account previous federal, state, provincial, regional, and local assessments and make specific recommendations for floodplain management goals and outcomes for the Red River basin including structural and nonstructural measures, wetland restoration, water storage allocations by major watershed, and designation of roles and responsibilities and time frames for implementation. The commission shall report progress on goals and outcomes to the legislature by 15 January 2010.

(b) Any remaining money may be used to implement the plan. Up to five percent of this appropriation may be used by the board for technical and administrative oversight.

(c) This appropriation is contingent on the state of North Dakota contributing at least an equal amount in a grant to the Red River Basin Commission.

*North Dakota legislative guidance:*

HB 1020, Sec. 9. Legislative Intent – State Water Commission Projects. It is the intent of the sixty-first legislative assembly that of the funds appropriated in the water and atmospheric resources line item in section 1 of this Act, the state water commission provide funding for the following projects, for the biennium beginning July 1, 2009, and ending June 30, 2011: (among others) Evaluate, in conjunction with state, local and federal officials and entities, long-term flood control solutions in the Red River valley - \$500,000

Minnesota BWSR approved this funding on June 24, 2009 at its meeting in St. Paul, and the North Dakota State Water Commission on June 23, 2009 also approved the pass through of this funding based on RRBC's proposed plan submitted to them.

**APPENDIX 2**  
**LTFS WORKPLAN**  
**July 1, 2009 - June 30, 2011**

**Goal:** Develop a comprehensive plan for long-term solutions for flooding, water quality and land conservation in the Red River Basin in the United States.

The study shall address, and the final report shall include: structural and non-structural measures; wetland restoration for water storage/water quality enhancement; projected costs by component; and implementation schedule by component.

Procedure: Since Minnesota specifically mentions the Red River Basin Commission (RRBC), they will provide overall management and coordination for the funds from both states. Most of the specific tasks will be completed through a contract with those best able to complete the task: whether a government entity, a consultant, a university, and etc. Potential leads are identified for the solutions or specific tasks in the attached tables. The selected contractors must have the appropriate expertise to complete tasks thoroughly and in the shortest possible time.

Development of a workplan (ND and MN):

The following is a draft outline for a work that is to be completed during the July 1, 2009 through June 30, 2011 timeframe. The workplan is patterned after the Minnesota legislation since it is more specific.

The workplan will have two phases 1) Phase I and 2) Phase II. There will be management and coordination to support these phases as well as support activities to build support for the recommendations that will emerge from the Final Phase II Report.

Each of the solutions or tasks will require guidance including a list of specific work to be completed and/or answers required. In Phase I this will take the form of a planning report document that will provide uniformity in reporting and what to report on. These planning reports will be developed by the SWC, BWSR, RRBC and others that deem useful in providing assistance. The planning report documents will describe the work to be accomplished with consideration given to prevent overlap in work on the other solutions or indicate where coordination will be required.

While the Red River Basin Commission's area of interest includes the Canadian portion of the Red River basin, the work to be completed in this effort is to be focused on the United States portion of the basin. Flood control methods etc. that have been adopted in Canada should be considered as optional solution concepts for consideration in this effort. The effort should include a discussion of cumulative benefits from multiple solution concepts that might be collectively implemented.

Some portion of the funds provided to the RRBC may be used or passed through to the COE, USDA, or FEMA as non-federal cost-share (in-kind or cash match). The COE will be analyzing many of the proposed solutions or tasks as part of one of their authorized studies: Fargo-Moorhead Metro Feasibility Study, F/M Upstream Feasibility Study, Wild Rice MN Feasibility Study, Watershed Feasibility Study, and Pembina River Feasibility Study. The USDA- Agricultural Watershed Enhancement Project (AWEP) may also produce projects that funds could be utilized as match. In addition FEMA is considering funds that would also link to these tasks and may need match of in-kind. The Commission would retain funds for the tasks that may not be part of the COE's study such as flood water retention, regulatory review, ring dike/pedestal implementation, riparian restorations,

and greenway outside the metro area as examples. This could be determined through consultation with the COE staff assigned to their feasibility study.

LONG TERM RED RIVER FLOOD CONTROL SOLUTIONS									
WORK PLAN Task	Who	Deliverable	COE	Matches AWEP	FEMA \$'s?				
<b>MINGMT/COORD</b>	RRBC		50% Yes	\$5 M/Yr Yes	Yes				
<b>PHASE I</b>		Report							
A number of reports will be generated from Phase I, guided by uniform standard request (planning forms) to each WRD/WD in the basin. These reports will include all projects that currently are under consideration or could be considered. These reports will include all structural and non-structural projects as listed below.									
Damage Center Review	Local Review re Problems and Solutions All 2009 Damage Centers		FEMA/RRBC Yes		Yes				
Explore All Possibilities 1-12 & 14	Contracts To Provide Information Each WRD/WD Guidelines for Gathering Information	Local Eng. Firms Water/Soil COE/USDA/FEMA Local/State Universities	Yes	Yes	Yes				
<b>PHASE II</b>		Final Report							
The report from Phase II will be compiled by an independent outside consultant (or group) that will evaluate and access all the possibilities. As this report is compiled it will be reviewed regularly at RRBC Board and public meetings, as well as by state/federal agencies. This report will include a prioritization, cost, timelines and other relevant information for decision making and a unified basin approach to flood solutions.									
Narrow Down Possibilities 1-12 & 14	Evaluate/Assess/Final Report Process All Above Information Project Recommendations Costs/Timelines/Policy RRBC Board/Public Interaction	Independent Contractor Eng. Firm	Yes	Yes	Yes				
<b>SUPPORT</b>									
Facilitation	At regular (increased #) RRBC Board Mtgs. Federal Inter-Agency Task Force All Levels of Government--RRBC Brd Mtg Public @ RRBC Brd Mtg State/Federal -- Elected/Agency Governor Offices Regulatory Issues, S, Cooperation Public Meetings/Materials Annual Summit Conference Media	Consultant/RRBC	Yes	Yes	Yes				
Legislative/Policy 13, 15		RRBC							
Communication		Jnt Water Brds COE/USDA RRBC	Yes	Yes					
Modeling Coordination Development		COE/FEMA/RRBC WD/WRD/Eng Firm	Yes	Yes	Yes				
<b>PHASE III</b>									
Implementation	Prioritization/Funding/Permits	F/S/L Government							

This table contains solutions or tasks that have, in many cases, been considered or studied in the past and that should be revisited and assessed in this effort. (This is an initial list to be discussed and modified. Extent and limits of work to be accomplished for each solution concept will be detailed in the Workplan i.e. Greenway development is to be considered along the river mainstem only.)

<b>No.</b>	<b>Solution or Task</b>	<b>Proposed Lead(s)</b>	<b>Expected Outcome</b>	<b>Project Type</b>
1	Retention Dams - including permanent reservoirs, dry dams, and off-channel storage embankments	ND/MN/COE	Flood Control	Structural
2	Wetland Creation/Restoration	ND/MN	Flood Control and Water Quality Enhancement	Structural
3	Natural Lake and Existing Reservoir Increased Storage	ND/MN	Flood Control and Water Quality Enhancement	Structural
4	Floodplain Management	ND/MN/FEMA	Updated, Digitized, and expanded Maps	Non-structural
5	Waffle Plan Implementation	ND/MN/EERC	Flood Control and Water Quality Enhancement	Structural
6	Urban Levees	COE/MN/ND/Cities	Flood Control	Structural
7	Land Management – Cover Crops – example Winter Wheat, Grass Cover Restoration	ND/MN/USDA	Flood Control and Water Quality Enhancement	Non-structural
8	Land Management – Grassed Waterways	ND/MN/USDA	Flood Control and Water Quality Enhancement	Non-structural

9	Land Management – Erosion Control Structures to Reduce Channel Slopes	ND/MN/USDA	Flood Control and Water Quality Enhancement	Structural
10	Regulatory Modification to Improved Water Control/Water Quality	ND/MN	Flood Control and Water Quality	Non-structural
11	Ring Dike/Pedestal Protection	ND/MN/Local Water Managers	Flood Damage Reduction	Structural
12	Greenway establishment	ND/MN/County/ Township/City	Flood Damage Reduction and Water Quality	Structural and Non-structural
13	State and Local funding mechanisms/policies/commitment	ND/MN/County/ City	Flood Control and Water Quality	Structural and Non-structural
14	Riparian Area Restorations	ND/MN/USDA/ Counties/Townships	Flood Damage Reduction and Water Quality	Structural and Non-structural
15	City/Township Zoning Regulation Modifications	Cities/Townships	Flood Damage Reduction and Water Quality	Non-structural
16	Hydrologic Model coordination and development	ND/MN/COE	Flood Control and Water Quality	Non-structural



## **APPENDIX 3 PUBLIC FORUM FEEDBACK**

### **General issues and themes that regularly surfaced throughout the series of public meetings include the following:**

- Every flood is different
- Funding concerns exist at every level
- Residents consider flood predictions as very mysterious
- Water quantity and quality
  - Concern about water quality, sediments, sulfates
  - Concerns about saturation and ground water issues
  - There are lake issues associated with high water ranging geographically from Devils Lake, ND to the Minnesota lakes east of the Red River
  - Overland flooding has increased and/or is occurring in new areas
  - Concerns are abundant about perceived increasing drainage
- Impact on people
  - Flooding is chronic, people are tiring, ready to “throw in the towel”
  - The cost to fight floods is financially and emotionally high
- Damages
  - Road damages are extensive and the cost of repairs is high
  - The increasing lack of trees, the move away from conservation has made flooding worse
  - Agricultural ditching: some blame, others want to know the impact. Producers wonder where they can put water to be able to produce
  - Agricultural concerns over summer flooding
  - Recovery struggles: Many FEMA practices counterproductive, requirements out of touch; flood insurance is costly and covers very little

### **2009 Flood and Why it was Different**

- The volume of water was unprecedented
- Duration of the flood was long, 4-10 weeks, with two crests
- Rural areas, impassable roads for weeks during flood events, clean up and repair finally coming to a close now, many months later
- Smaller communities braced themselves and were isolated for weeks, big concern for emergencies
- Courage and help from the Army National Guard, U.S. Army Corps of Engineers, and student population-was excellent.
- Fear in 2009 escalated and remains high for this spring 2010

### **Why Residents Still Live in the Basin**

- Agriculture: Most fertile, productive soil in the world; sugar beets, spring wheat, canola, soybeans, flax and hay production is high
- Economic impact of the region is significant: jobs, renewable energy development, and manufacturing. Red River basin is a net exporter.
- Great education, school facilities, quality higher education
- Important city infrastructure – hospitals, airports, shopping, churches, highways
- Recreation and tourism
- Quality of the people: honest, pitch in to help; people put others first; work ethic is high
- Generations, family came from here, farms in families for many generations
- Great and safe place to raise children, family

## Solutions

- Communication
  - Must be basin-wide approach working together
  - Leadership and teamwork
  - Keep the local in decision-making
  - Priorities should be protected: keeping people, farmland, economic development
  - USACE's benefit-cost ratio is unrealistic, should instead focus on cumulative impacts and cost effectiveness. Agriculture damages are not considered.
  - Work with agencies (FEMA, USACE, DNR, MnDOT, etc.) to develop flexibility and solutions
- Flood Protection
  - Use strategies to hold water back close to the place it falls
  - Slow the water down
  - Compensation: Public has much interest and willingness in retaining water if property owners compensated fairly
  - Concern over impact of Fargo-Moorhead's project from both downstream and upstream communities and residents
  - Drainage must be addressed
  - Overland flooding, need to be able to control ditches
  - Ditches need cleaning
  - Rivers need removal of debris, trees, etc. perhaps dredging
  - Part of solution must consider if current wet cycle ends, how to prepare for drought: water storage during wet times used for supply during dry times
  - Conservation and wetland restoration should be a priority
  - Nonstructural considerations should be made such as land use controls
  - Waffle plans, and culvert sizing projects should be considered as new options
- Strategies to help
  - Need better and more data – put data behind potential solutions
  - More flow gauges needed, new laser LiDAR technology is key
  - More and better modeling is necessary

## APPENDIX 4

### MIKE 11 MAINSTEM MODEL: 20 PERCENT FLOW REDUCTIONS

Charles L. Anderson, PE, JOR Engineering  
January 12, 2010

#### **Basin Wide Flood Flow Reduction Strategy**

Flood damage reduction efforts have often focused on individual communities or interests and taken the form of a protection strategy. Commonly implemented protection measures include levees and diversion channels. While these measures are effective and can be implemented in a relatively short time frame, they do little to reduce the overall flood problem. In fact, they simply move excess flood water from one area of the basin to another. This forces basin planners to allocate protection on some basis of need. Determining in essence whether it is ok to protect large communities at the expense of small communities; small communities at the expense of farmsteads; farmsteads at the expense of farmland; and farmland at the expense of natural land (or vice versa).

The primary alternative to a protection strategy is a flood flow reduction strategy. This strategy reduces flows on the mainstem by altering the hydrology of the contributing watersheds as a basin wide effort. The benefits of reduced flooding would be distributed along the entire length of the Red River, not just too targeted communities. Equally important, the benefits would extend far upstream into the tributary watersheds. Implementing this strategy requires allocating the necessary flow reductions to each contributing watershed.

To assist in the flow reduction allocation process, the Red River Basin Commission developed a Red River Mainstem model. The model was based on Mike 11 software developed by DHI Water and Environment Inc, Denmark. It has been calibrated to simulate the 1997 spring flood. Physical features of the Red River and its flood plain are represented in the model as cross-section data. Hydrologic inputs are the measured flows from the main tributaries and derived flows from the ungaged tributary areas. This model can now be used to simulate the mainstem response to reduced flows from tributary areas.

As a preliminary exercise, the tributary flows were reduced in the model to meet a flow reduction goal of 20% along the entire length of the Red River Mainstem. A factor in selecting 20% reduction as an initial goal was the effect it would have had at Grand Forks in 1997. That amount would have reduced the flood to a level that the (then existing) levees would have been expected to withstand. The modeled results are shown on the attached figures. The flow reduction required from each sub watershed is illustrated as the difference between the existing and altered tributary hydrographs.

Tributary reduction strategies were based on timing, by targeting waters contributing the most to mainstem peaks. Other factors considered include tributary damage reduction and the practicality of achieving specific flow reductions. Tributary peak flow reductions ranged from 0 to 50%. Peak flow reductions on strategic tributaries averaged about 35%. The combined flow reduction on all tributaries upstream from Emerson totaled 885,000 acre-feet, which is about 16% of the total 1997 flood volume at Emerson.

The amount of constructed storage required to achieve a 20% reduction would likely be greater than 885,000 acre-feet depending on the quality (efficiency) of storage provided. Flow reduction can be achieved by implementing a wide variety of measures including on-channel or off-channel impoundments; culvert sizing or waffle storage; wetland restoration or land use change. Gate controlled flood storage impoundments are the most efficient measure to reduce flood flows. Strategically located and precisely operated, they may have close to 100% efficiency in meeting the flow reduction goal. That is, the amount of constructed storage required to meet the 20% reduction goal would not be much greater than 885,000 acre-feet. On the other hand, flood specific factors such as variability in runoff will likely leave some constructed storage underutilized. Other measures, such as culvert sizing, provide only short term storage. Short term storage, in the right location, can reduce peak flows, but in the wrong location, it can actually increase peak flows. A mix of measures may be the best approach. The combined efficiency of the mix in meeting the tributary flood flow reduction goal would have to be determined locally.

The modified tributary hydrographs from the 1997 flow reduction model will serve as a starting point for an allocation process. The allocation goal should be to distribute to each watershed a fair share of the responsibility to manage its flood flows and the local benefits provided by doing so. Each watershed would determine, through the use of its own models, what would be required to modify its outflow hydrograph to approximate the flow reduction shown. They would be encouraged to do so in ways that also meet local flood control goals, so the resulting reduced outflow hydrographs may vary more or less from that originally allocated and thus result in more or less benefits on the mainstem. Some watershed areas may be unwilling or unable to meet their allocation goal. Their share would then need to be reallocated to another area. The model could then be used to determine the most effective ways to reallocate tributary flow reductions to achieve the mainstem goal.

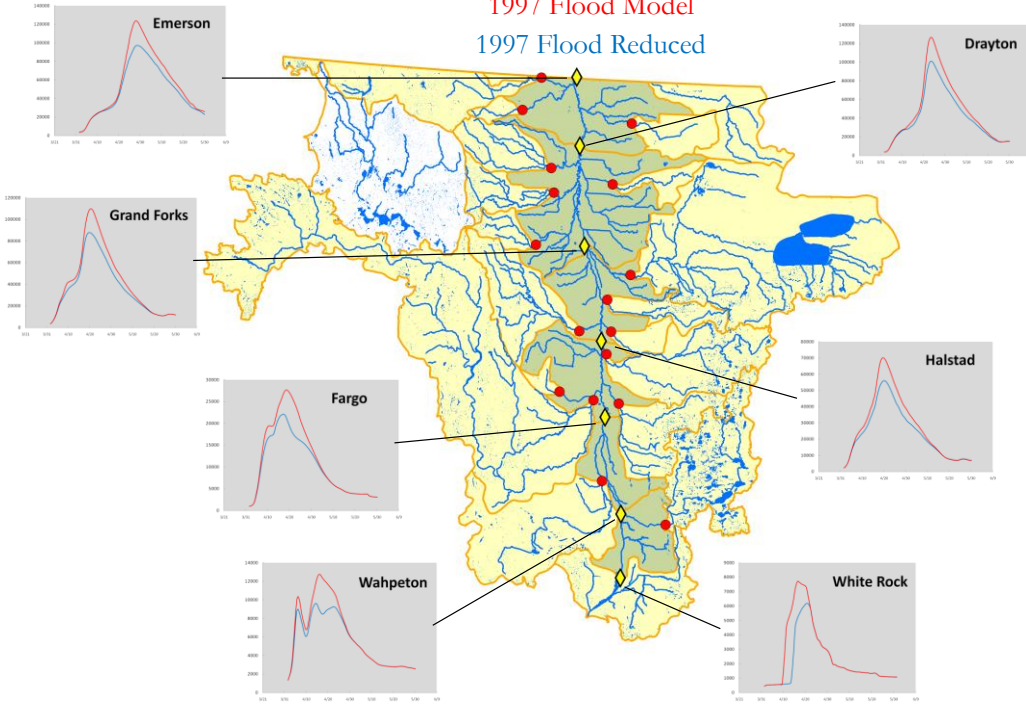
Implementing flood flow reduction will require significant investments over a relatively long time frame. The cost of gate controlled flood storage has recently been about \$1,000 per acre-foot. At that price, 1 million acre-feet of gate controlled storage would cost about \$1 billion. The most cost effective projects tend to get constructed first, so it is probable that the costs of later projects will be higher. This, along with inflation, will likely increase the final cost of implementation. Flood flow reduction projects can present great opportunities for multipurpose benefits such as water supply, water quality and other water related natural resources. Including these benefits will add to the overall costs. Those additional costs should not be allocated to flood damage reduction, but they do need to be considered in estimating the total amount of public investment (and benefit) that may be desired. Although the time frame for implementation is highly dependent on the availability of funding, it is also influenced by public acceptance and resolve. Historic construction rates of about 10,000 acre-feet per year have not been particularly difficult to maintain. At that rate it would take 100 years to construct 1,000,000 acre-feet. Given a very high priority of support, it could possibly be accomplished within 25 years.

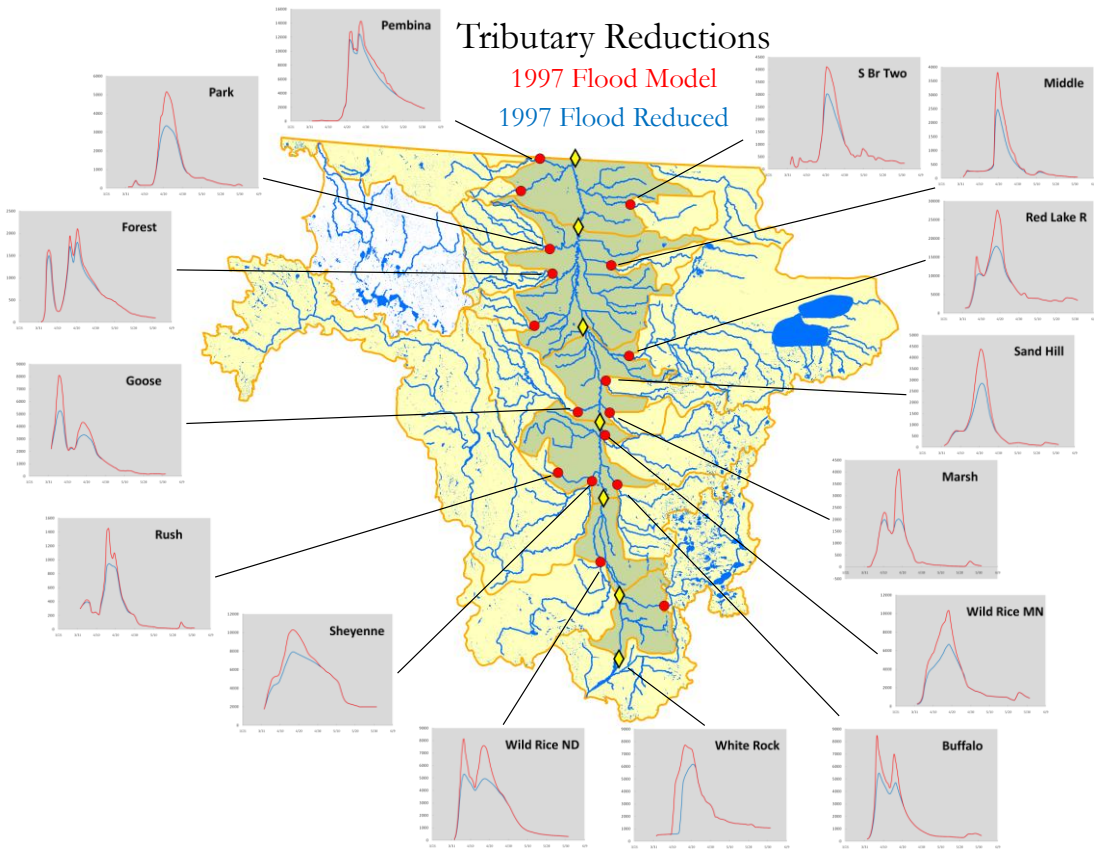
Unlike quick fix strategies, flood flow reduction will provide a long term solution to the persistent and widespread flooding problems that plague the entire Red River Basin.

# Mainstem Results

1997 Flood Model

1997 Flood Reduced





<b>20% Reduction Model</b>					1/12/2010
<b>Summary of Tributary Flow Reductions</b>					cla
<b>1997 Spring Flood</b>					
	Peak	Peak			
	Flow	Flow	Volume	Volume	Reduction Focus
	Reduction	Reduction	Reduction	Reduction	
<b>Gaged Tributaries</b>	%	cfs	%	acft	
<b>Ottertail R @ Orwell</b>	0	0	0	0	None
<b>BdS R @ White Rock</b>	20%	1542	20%	61760	Store early water
<b>Wildrice ND @ Abercrombie</b>	35%	2854	17%	57908	Peak flow reduction
<b>Sheyenne R @ Harwood</b>	23%	2401	11%	68395	Peak flow reduction
<b>Rush R @ Amenia</b>	35%	508	13%	4324	Peak flow reduction
<b>Buffalo R @ Dilworth</b>	35%	2930	17%	38158	Peak flow reduction
<b>Wild Rice MN @ Hendrum</b>	35%	3610	20%	74385	Peak flow reduction
<b>Goose R @ Hillsboro</b>	35%	2820	16%	35356	Peak flow reduction
<b>Marsh R nr Shelly</b>	51%	2100	18%	15247	Peak flow reduction
<b>Sand Hill R @ Climax</b>	35%	1510	21%	22161	Peak flow reduction
<b>Red Lake R @ Crookston</b>	35%	9600	13%	119097	Peak flow reduction
<b>Turtle R nr Arvilla</b>	10%	90	13%	4615	Store late water
<b>Forest R @ Minto</b>	14%	300	7%	5875	Store late water
<b>Middle R @ Argyle</b>	35%	1330	23%	15067	Store late water
<b>Park R @ Grafton</b>	35%	1800	20%	26462	Peak flow reduction
<b>S Br Two R @ Lake Bronson</b>	27%	1100	14%	15208	Store late water
<b>Tongue R @ Akra</b>	7%	50	4%	1580	Store late water
<b>Pembina R @ Neche</b>	13%	1900	9%	51113	Peak flow reduction
<b>Average/Total</b>	<b>22%</b>		<b>13%</b>	<b>616709</b>	
<b>Ungaged Areas</b>	%	cfs	%	acft	
<b>Rabbit R @ TH 75 ung</b>	35%	2108	26%	24377	Peak flow reduction
<b>Ottertail ung</b>	13%	500	12%	7217	Peak flow reduction
<b>BdS ungaged</b>	13%	1135	9%	12119	Peak flow reduction
<b>Fargo ungaged</b>	13%	3000	13%	30433	Store late water
<b>Halstad ung</b>	13%	7500	13%	81002	Store late water
<b>RLR ung</b>	12%	1600	10%	11427	Store late water
<b>GF ungaged</b>	12%	4400	10%	32015	Store late water
<b>Snake R ung</b>	16%	1367	15%	17128	Store late water
<b>Tamarac R ung</b>	13%	563	12%	7179	Store late water
<b>Drayton ung</b>	8%	1370	10%	22208	Store late water
<b>Emerson ung</b>	7%	3000	7%	23364	Store late water
<b>Average/Total</b>	<b>14%</b>		<b>12%</b>	<b>268468</b>	
<b>Total volume of flow reduction on the tributaries</b>			<b>885177</b>	<b>acre-feet</b>	

# **Report to the Minnesota Legislature: A Progress Report on a Comprehensive Long Term Flood Solutions Plan for the Red River Basin**

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**For more information, contact:**

## **Red River Basin Commission**

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Upon request, this material will be made available in an alternative format such as large print