IRRB

THE

INTERNATIONAL RED RIVER BOARD

Fifteenth Annual Progress Report

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INTERNATIONAL
RED RIVER BOARD

CONSEIL INTERNATIONAL
DE LA RIVIERE ROUGE

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Commissioners:

The International Red River Board is pleased to submit its Fifteenth Annual Progress Report to the International Joint Commission.

Respectfully submitted,

Mike Renouf
Co-Chair, Canadian Section

Col. Daniel Koprowski
Co-Chair, United States Section

PREFACE

This report documents water quality trends and exceedances of objectives, effluent releases, and control measures for the Red River basin for the 2012 Water Year (October 01, 2012 through September 30, 2013). In addition, this report describes the activities of the International Red River Board during the reporting period October 01, 2013 to September 30, 2014 and identifies several current and future water quality and water quantity issues in the basin.

The units of measure presented in this report are those of the respective agencies contributing to this report.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 SUMMARY

1.01 Water Quantity and Water Quality

Water Quantity in 2013

Stream flows for much of the Red River Basin were at normal (25-75 percentile) levels by the spring of 2014 due to carryover from heavy summer/fall rains the preceding year. A deep frost layer, wet soils in the southern basin, and a near normal snowpack (increasing from south to north) led to spring runoff flooding in the minor to moderate range for most main stem tributaries and moderate to near major flooding on the Red River by May. The spring was followed by an active weather pattern that subsequently produced peaks at or above the spring levels for many stream gages and led to overall conditions in the above normal range (>75 percentile) for most stream gages this summer.

The Red River at Fargo crested on June 23 at 27.84 ft. (provisional), with a discharge of 10,400 cfs, in the upper quartile (21st) for the 114 years of record. The exceedance probability for the spring peak was in the 0.10 to 0.20 range. The Red River at Grand Forks crested on Apr. 13 at 36.24 ft. (provisional) with a peak discharge of 29,000 cfs, the 38th highest peak in 133 years of record. The exceedance probability for the peak was between 0.20 and 0.50. The Red River at Grand Forks passed 3.39 million acre-ft between October 2012 and September 2013, the same period in 2011 produced a record 10.3 million ac-ft. Spring runoff into Devils Lake caused an approximate increase of 1.25 ft. (from a 52.40 ft. winter level to 53.66 ft. on July 1). The lake level has been dropping since the early July high thanks in part to pumping from Devils Lake West End Outlet (250 cfs capacity) and the Devils Lake East End Outlet (350 cfs capacity) which began in late May (interrupted intermittently in June as upper threshold flow limits on the Sheyenne River dictated).

In the Red River Basin, the USGS North Dakota Water Science Center works in cooperation with the U.S. Army Corps of Engineers; U.S. Bureau of Reclamation; International Joint Commission of the U.S. State Department; Manitoba Provincial Government; National Weather Service; North-Central River Forecast Center; Minnesota Department of Natural Resources; North Dakota State Water Commission; North Dakota Department of Health; U.S. Bureau of Indian Affairs; several water resource boards and districts; and other Federal, State and local water resources managers. Data and information shared among the agencies and offices helped in flood mitigation, water regulation, and water resource planning.

Precipitation during the autumn of 2012 was well below normal in most of southern Manitoba and in the North Dakota and Minnesota portions of the Red River Basin. As a result of below normal precipitation, soil moisture was well below normal at freeze-up and significantly less than that experienced in 2010 prior to the widespread 2011 flooding.

However, winter precipitation in southern Manitoba and in the U.S. portion of the Red River basin was near normal to well above normal. Snow water content prior to snowmelt in 2013 was above average and up to 200 per cent of normal for some areas. Significant snow accumulation in March led to the flood outlook for the Red River increasing from "minor to moderate" to "moderate to major". The weather in April was abnormally cold in southern Manitoba with daily mean temperature staying below zero until the end of April. The weather continued to be very dry until the time of freeze-up in autumn 2012 and thus the water levels in the Red River were well below normal. Tributaries contributed very little discharge if any until the spring freshet in 2013.

The Red River peaked later and higher than in normal years due to the combination of above normal winter precipitation and abnormally prolonged cold spring weather. The melt occurred rapidly which caused rapid rises and ice jams on tributaries. The Red River crested at Emerson, Manitoba on May 7, 2013 at a level of 784.2 feet (239.03 metre) and a flow of about 45,200 cubic feet per second (1280 cubic metre per second). The crest occurred about a month later than normal years, which was 7th latest record spring peak since 1912, and was close to higher quartile levels. Also, due to the abnormal spring weather condition and rapid melt, the crest at Ste. Agathe occurred due to locally generated runoff on May 4, 2013, three days earlier than the crest at Emerson. The melt conditions resulted in observed peak flows well below those forecasted in March.

The Red River Floodway was operated from April 29th to June 8th. Winnipeg water levels peaked at 17.21 ft (James Avenue datum). Operation of the Red River Floodway, Portage Diversion and Shellmouth Reservoir reduced the observed peak by 6.3 ft.

Weather conditions remained near normal after the spring snowmelt and Red River levels remained near normal conditions throughout the summer and autumn of 2013.

Water Quality

Several exceedances of the water quality objectives for the Red River at the international boundary recommended by the International Joint Commission (IJC) and approved by the Governments of the U.S. and Canada were observed at the international boundary during the 2012 water year. Dissolved oxygen generally remained well above the objective level of 5.0 mg/L. Exceedances of the water quality objectives, and concentrations approaching the objective level for total dissolved solids (TDS) were observed at the international boundary during the 2012 water year.

Total Dissolved Solids (TDS) remained at or above the objective of 500 mg/L for most of the 2012 water year, with the exception of during the flood stage. The highest observed value of 1248 mg/L occurred in November 2012 when there were higher and sustained releases from Devils Lake coupled with low flow / drought conditions for the majority of the basin.

The chloride objective (100 mg/L) was exceeded in 22.7% of the samples collected during the water year. Monthly values ranged from a minimum of 8 mg/L in May 2013 to a maximum of 186 mg/L in October 2012.

The sulphate objective (250 mg/L) was exceeded in 34 % of the sampled collected 2012 water year. Like the TDS objective, the main reason for such a high increase in sulphate concentrations was likely due to the additional releases from Devils Lake through most of 2012. Sulphate concentrations ranged from a low of 41 mg/L in May 2013 to a high of 461 mg/L in December 2012.

During the 2012 water year, the *Escherichia coli* bacteria objective of 200 colonies/100 ml was not exceeded.

1.02 International Red River Board Activities

As noted in the Preface, this report also describes the activities of the International Red River Board (IRRB) for the period October 01, 2013 - September 30, 2014 which succeeds the 2013 water year. The key activities are highlighted below.

In 2013, the IRRB further revised its 3-year work plan to reflect the status of its activities, and to affirm consistency with the International Watersheds Initiative and the IJC Directive to the IRRB. The work plan priorities include a continued effort to expand the existing scientific knowledge of aquatic ecosystem dynamics and current conditions. The activities encompass discussions on the Phase II Risk Assessment Planning following the completion of the three-year Devils Lake Fish Pathogen/Parasite Sampling Program. Key IRRB activities also include - development and implementation of apportionment/flow targets at the International Boundary including instream flow needs (IFN); continuation of the development of Comprehensive Flood Mitigation Strategy (CFMS) as per the terms of reference of the Committee on Hydrology; LiDAR mapping and hydraulic modeling of the Lower Pembina River Basin which has been completed and submitted to the IJC; and recommendations for setting nutrient objectives for the Red River at the International Boundary. The IJC, in turn, is expected to make recommendations to governments to implement the apportionment/flow targets and nutrient objectives.

An IWI proposal prepared by the Water Quality Committee (WQC) titled, " Red River Stress Response Modelling – Phase 1 Data Identification and Computational Model" has been approved by the Board and submitted to the IJC for funding. The Board also approved the final report from RESPEC Consulting Services titled," Approaches to Setting Nutrient Targets in the Red River of the North". The study was conducted with IWI funds provided by the IJC and was completed in March 2013. The WQC will utilize the recommendations made by RESPEC in its proposed computational model.

The IRRB held its summer bi-annual meeting on September 4-5, 2013 to address select issues in the basin, and the winter bi-annual meeting on January 16-17, 2014 for a more complete review of its responsibilities, activities, and accomplishments. The meetings addressed water quality monitoring and compliance with IJC objectives and established alert levels; and IRRB work plan priorities. The latter included actions to develop and implement water quantity apportionment procedures / instream flow needs (IFN), prioritized flood mitigation plans, and biological monitoring and nutrient management strategies for the basin. The Board in 2012 endorsed the development of a draft *White Paper* on Devils Lake for discussion to make recommendations to the IJC to resolve outstanding issues related to water quantity/flooding, water quality, and nutrients.

The three year pathogens and parasites sampling program was completed in 2008. Three bacteria, one parasite, and several lesions were identified from fish in Devils Lake that were not identified elsewhere in the basin. The fish pathologists concluded that the fish parasites and pathogens in Devils Lake could be transferred from the Lake through the gravel and rock filter currently in place, by birds (often the intermediate or final parasite host), and by unintentional and intentional transfer by people (or their boats). The parasites and bacteria found in Devils Lake were generally widely distributed throughout much of North America. All were opportunistic pathogens that could adversely affect fish health only if fish health was compromised for other reasons. None were foreign parasite or pathogen species. For these reasons, all experts concluded that the risk to downstream fish and fisheries was low from the parasites and pathogens found in Devils Lake, and the potential for causing disease was negligible. The fish experts provided recommendations that would help to ensure that risk of certain pathogens and invasive species entering the Red River basin is reduced and would monitor for the presence of

invasive species in the basin (AEC Qualitative Risk Assessment Report, dated October 2011). For more details, please go to http://www.ijc.org/conseil_board/red_river/irrb_pub.php?language=english#other and click on Devils Lake – Red River Basin Fish Parasite and Pathogen Project, Qualitative Risk Assessment.

1.03 International Red River Board Three-Year Work Plan (2012-2015)

The Board reviewed and updated its three-year work plan in January 2013. Current priorities include:

- Report Water Quality Objectives,
- Phase II Basin-wide Assessment of Invasive Species,
- Comprehensive Flood Mitigation Strategy,
- Water Quantity Apportionment & Instream Flow Needs (IFN),
- Next Steps to Address the Lower Pembina Flooding Issues,
- Strategies to Develop Nutrient Management Objectives,
- Outreach and Engagement, and
- IWI funded Projects.

The current three-year work plan covers the period from October 1, 2012 through September 30, 2015.

2.0 INTRODUCTION

In April 2000, the International Joint Commission (IJC) formally merged its International Red River Pollution Board and International Souris-Red Rivers Engineering Board consolidating the water quality and water quantity responsibilities of the former boards, to form the International Red River Board (IRRB). This consolidation formalized the already emerging cooperative efforts of the former boards toward an integrated approach to transboundary water issues in the basin. Further, in its November 2000 report *Living with the Red*, the IJC recommended that the governments assign certain flood-related tasks to the IJC for implementation by its IRRB. In June 2001, Canada and the United States formally approved a new expanded directive for the IRRB. The directive is included in Appendix A.

In April 2003, the IJC requested further discussion with the IRRB on how to achieve a more ecosystem approach and a capacity to respond to the range of environmental and water-related challenges of the 21st century. In April 2004, the IJC adopted guiding principles aimed at broadening the partnership efforts of its international boards with other watershed entities for a more inclusive approach. The IJC refers to this effort as the International Watersheds Initiative. The various water management organizations in the Red River Basin appear receptive to the Initiative while at the same time recognizing the independent, impartial and objective role of the IJC and its boards in providing advice to governments. In June 2005, the IJC recommended that the governments of Canada and the United States confirm their support for the Initiative. The Red River basin is one of three pilot watersheds recommended by the IJC for implementation of the Initiative and for funding support.

In brief, the IRRB is responsible for assisting the IJC in avoiding and resolving transboundary disputes regarding the waters and aquatic ecosystems of the Red River and its tributaries and aquifers. This is accomplished through the application of best available science and knowledge of the aquatic ecosystems of the basin and an awareness of the needs, expectations and capabilities of residents of the basin. The geographic scope of the Board's mandate is the Red River basin, excluding the Assiniboine and Souris Rivers. The mandate presently includes the Poplar and Big Muddy River basins, previously the responsibility of the International Souris-Red Rivers Engineering Board. The Red River Basin is illustrated in Figure 1.

This report is the fifteenth IRRB annual progress report to the IJC.

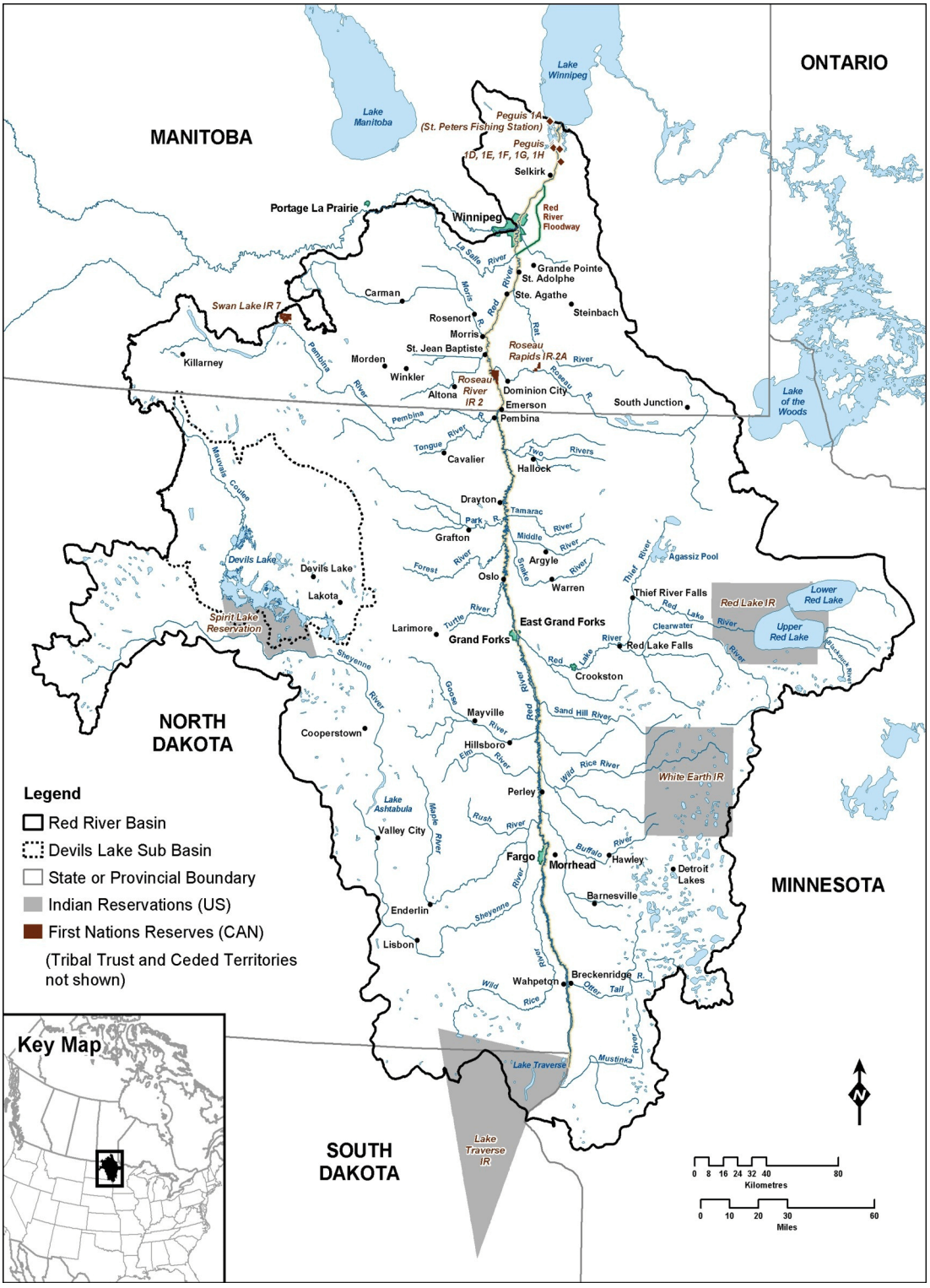

Figure 1: Red River and its Tributaries

3.0 INTERNATIONAL RED RIVER BOARD MEMBERSHIP

In its 1997 report *The IJC and the 21st Century,* the IJC proposed comprehensive international watershed boards as an improved mechanism for avoiding and resolving transboundary disputes. The intent was to broaden the scope of information upon which decisions relating to water and air are being made.

Through the continued integration of its water quality and water quantity responsibilities, and through efforts to increase stakeholder involvement, many of the goals of a comprehensive watersheds approach are being achieved by the International Red River Board. To facilitate these objectives, Board membership has been expanded to include non-government participation.

Colonel Daniel Koprowski, U.S. Army Corps of Engineers; and Mike Renouf, Environment Canada, are the current Co-Chairs of the Board, respectively. Scott Jutila, US Army Corps of Engineers; and Girma Sahlu, Environment Canada, provide secretarial and technical support to the Board.

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4.0 INTERNATIONAL RED RIVER BOARD ACTIVITIES

During the reporting period October 01, 2012 - September 30, 2013, the International Red River Board met with the IJC at the fall and spring semi-annual meetings at which Board priorities, activities and funding requirements were discussed. The Commissioners were apprised of basin developments and their potential transboundary implications.

4.01 Interim and Annual Board Meetings

The IRRB held its summer bi-annual meeting on September 4-5, 2013 to address select issues in the basin, and the winter bi-annual meeting on January 16-17, 2014 for a more complete review of its responsibilities, activities, and accomplishments. The meetings addressed water quality monitoring and compliance with IJC objectives and established alert levels, and IRRB work plan priorities. The latter included actions to develop and implement water quantity apportionment procedures, instream flow needs, prioritized flood mitigation plans, and biological monitoring and nutrient management strategies for the basin.

Except for half-day executive sessions during the September and January bi-annual meeting, both meetings were open to the public in a spirit of information sharing and collaboration. This was undertaken in recognition that there are many local, regional, state/provincial, federal and natural resource management entities operating in the basin with which connective links would be mutually beneficial. In addition to inviting presentations from interested groups, the public audience was invited to share its views. The Board initiated its first public session in conjunction with the Red River Basin Commission (RRBC) Annual Conference. RRBC provided a session in its conference agenda for IRRB Co-Chairs to address conference attendees which provided the opportunity for a larger public dialogue. IRRB will continue to coordinate with RRBC for future public meetings. This would allow the IRRB to reach out to a far larger public audience than it would during its regular open house to the public that is held at the end of its Board meeting.

4.02 IJC International Watersheds Initiative (IWI)

In 2004, the IJC adopted guiding principles aimed at broadening the partnership efforts of its international boards with other watershed entities for a more inclusive approach. The IJC refers to this effort as the 'International Watersheds Initiative'. The aim of the Initiative is to enhance the capabilities of existing IJC international boards while at the same time, strengthening cooperation among the various local entities. Building this capability includes[1]:

- employing a broader, systemic perspective of the watershed;
- expanding outreach and cooperation among organizations with local water-related interests and responsibilities;
- promoting the development of a common vision for the watershed;
- developing a better hydrologic understanding of the water-related resources; and
- creating the conditions for the resolution of specific watershed-related issues.

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1 *A Discussion Paper on the International Watersheds Initiative: Second Report to the governments of Canada and the United States under the Reference of November 19, 1998 with respect to International Watershed Boards, June 2005.*

In 2013, two activities / projects were undertaken by the International Red River Board (IRRB) and its Water Quality Committee (WQC). The first activity was a workshop titled, " Red River Water Quality and Watershed Modelling Meeting" held on April 30, 2013 in Grand Forks, North Dakota. The one-day workshop gathered water quality experts from Canada and the United States and they discussed various water quality models that could be applied in the Red River Basin such as, SPARROW, HSPF, SWAT, BATHTUB, CE_QUAL-W2, and WASP Model. The application of LiDAR GIS was also included in the discussions. The Water Quality Committee hosted the Workshop with no funding from the IJC. However, the IJC provided funding to the second project titled, "Approaches to Setting Nutrient Targets in the Red River of the North". The report was prepared for the IJC by RESPEC Consulting & Services and was completed in March 2013. Furthermore, the WQC has submitted another project proposal to the IJC called, "Red River Stressor Response Modelling – Phase 1 Data Identification and Conceptual Model".

There are many government, non-government, academic, private; and other entities with resource management responsibilities and interests in the Red River basin. Many have expressed support for a watershed approach. The present IRRB membership and Committee structures provide a linkage to key segments of this community with potential to expand the linkages as integrative approaches evolve.

In its June 2005 report to the governments of Canada and the United States[1], the IJC recommended that the governments confirm their support for the Initiative and that funds be made available commensurate with board work plans. The Red River watershed is one of five pilot watersheds recommended by the IJC for implementation of the Initiative and for funding support.

4.03 Improving the Information Base to Address Transboundary Issues

The IRRB monitors water quality at the international boundary; maintains awareness of development activities basin-wide; provides a forum for the identification and resolution of water-related transboundary issues; recommends strategies for water quality, water quantity, and ecosystem health objectives, and; monitors flood preparedness and mitigation activities.

To effectively address this mandate a focused effort through the application of best available science and knowledge of the hydrology and aquatic ecosystems of the basin is required. Hence, in 2001 the Board established two committees, a Committee on Hydrology (COH) and the Aquatic Ecosystem Committee (AEC) under which access to expertise could be consolidated with the capacity to undertake specific investigations and tasks. The COH was re-established in 2006-2007 with a broader agency representation and new members. Specific activities assigned to the committees include establishing natural flow and water usage databases, evaluating current water quality monitoring and reporting protocols, developing biological monitoring strategies, and developing recommendations on an inter-jurisdictional drainage policy for the basin. These efforts are characterized by strengthened coordination with key water-oriented organizations in the watershed; and improved partnerships to develop a knowledge base and a shared understanding of water issues. Most frequently, the interests, objectives, and activities of the Committees intersect. Cross-membership also contributes to an integration of effort. Furthermore, the Board established the Water Quality Committee (WQC) in 2011 to address water quality and nutrient management issues in the Red River Basin.

4.03-1 Water Quality Monitoring at the International Boundary and Red River Basin

During the reporting period, Environment Canada continued to provide water quality monitoring at the international boundary, and provided reports on the status of compliance with established IJC water quality objectives. This was augmented with reports on the presence of pesticides, herbicides and other chemical constituents for which alert levels have been established (see reports summarized in Chapter 5).

IRRB Member agencies also reported on the status of water quality surveillance and water pollution control in their respective portions of the basin. The scope of this work and its significant contribution to the information base is described in Chapters 6 and 7.

In September 2011, Environment Canada announced its plans to reduce the water quality sampling program for the Red River at Emerson. The Board sent a letter to the IJC expressing its concern about the reduction to the water quality sampling program. At the Board meeting held on August 30, 2012 in Detroit Lakes, MN, Environment Canada re-assured the Board its commitment to hire more staff and to re-instate the water quality sampling program on the Red River at the International Boundary.

4.03-2 Water Quality and Ecosystem Health

In 2003, the AEC prepared a conceptual framework to monitor the long-term aquatic ecosystem health of the watershed and an action plan outlining specific activities and resource requirements. The framework and action plan were endorsed by the Board and form the basis of the IRRB work plan. The overarching aquatic ecosystem health goal for the watershed, as articulated by the AEC, is to "assure that water resources of the Red River of the North basin support and maintain a balanced community of organisms with species composition, diversity and functional organization comparable to the natural habitats within the basin without regard to political boundaries".

Devils Lake Outlet Enhanced Monitoring

In early 2005, the North Dakota Devils Lake state outlet was completed and operation of the outlet was imminent. Operation of the outlet connects a closed basin in North Dakota, which is also part of the Hudson Bay drainage system, with the additional potential of transferring fish parasites and pathogens into the Hudson Bay watershed to the detriment of fish populations, especially to commercial and sport fish populations in the Red River and in Lake Winnipeg.

Given the transboundary implications of outlet operations and concerns to Manitoba and Canada regarding potential transfer of foreign organisms, multi-lateral negotiations were launched involving diplomatic levels, federal, state and provincial authorities, and the White House Council on Environmental Quality (CEQ). The negotiations resulted in the installation of a temporary gravel filter at the outlet to act as a barrier against the transfer of fish and some plants into the Red River system. The negotiations also resulted in a three-year sampling program to address issues related to the transfer of invasive species.

In summary, the objectives of the sampling program were to: determine the presence and prevalence of fish parasites and pathogens in resident fish from Devils Lake, the Sheyenne River, Red River, and Lake Winnipeg, and; to address the risks associated with transfer of such parasites and pathogens from the Devils Lake outlet to downstream aquatic ecosystems. A further objective was to use the comprehensive fish survey data to support the overall framework for biological monitoring in the Red River basin as identified in the IRRB work plan.

The three-year program comprising 7 sampling sites and 13 target fish species was initiated in September 2006. A report on the 2006 data collection was to provide the basis for any necessary refinement of the program for the following 2 years. Further, the results of the 3-year sampling program would be used to establish a focused long-term monitoring program for fish parasites and pathogens in the Red River basin, including select tributaries to the Red River and Lake Winnipeg.

The project plan assigned technical and financial responsibility to Canada for the collection and analysis of the biological data in the Canadian portion of the basin, and to the United States for like work carried out in the United States. Consistent methods, as confirmed in a workshop of experts in August 2006, were applied to both streams of work. The project was coordinated and managed by the Canadian and United States Co-Chairs of the AEC, with implementation and technical management of the project assigned to Fisheries & Oceans Canada and U.S. Fish & Wildlife Service. The project design allowed for peer review of the interpretive reports. The three year sampling was completed in 2008.

The results from the 2006 -2008 Pathogen Survey of Devils Lake, the Red and Sheyenne Rivers indicated statistical confidence on six species from Devils Lake. There was no detection of viral agents, which was very significant. Some of the bacterial findings were not unusual for this type of aquatic environment; and the results were repeatable from previous years. The initial sampling results were presented to governments via a conference call on March 10, 2009 (see also Section 1.02 of this report). The final report of the Pathogens and Parasite Study was presented to the IJC at fall 2011 appearance in Ottawa, Canada. Another presentation was also made to the general public at the winter Red River Basin Commission Conference on January 26, 2012 by the Co-Chairs of IRRB. For more information, please go to http://www.ijc.org/conseil_board/red_river/en/irrb_home_accueil.htm, "*publications/other reports".* The Board is currently planning to develop Phase II of the Pathogens and Parasites Study and to explore the possibility of conducting a basin-wide study in the Red River Basin.

4.03-3 Water Quality Committee - Nutrient Management Strategy for the Red River Watershed

The formation of the Water Quality Committee was approved at the September 2011 International Red River Board meeting. The Committee is developing a Nutrient Management Strategy as endorsed by the Board.

The Water Quality Committee currently consists of the following members:
Jim Ziegler, Minnesota Pollution Control Agency (Co-chair)
Nicole Armstrong, Manitoba Conservation and Water Stewardship (Co-chair)
Mike Ell, North Dakota State Department of Health
Leah Thvedt, Red River Basin Commission
Rochelle Nustad, U.S. Geological Survey
Eric Steinhaus, U.S. Environmental Protection Agency
Sharon Reedyk, Agriculture and Agri-Food Canada
Jeff Lewis, Red River Basin Commission
Mike Vavricka, Minnesota Pollution Control Agency
Iris Griffin, Environment Canada
Rob Sip, Minnesota Department of Agriculture
Keith Weston, United States Department of Agriculture
Justin Shead, Manitoba Conservation and Water Stewardship

The WQC has been tasked with developing a nutrient management strategy for the Red River. An important aspect of that strategy, outlined in component 3, is the development of water quality targets and/ or load allocations for nutrients (nitrogen and phosphorus) at the international border and at sub-watershed discharge points in the watershed.

This current project proposal builds on the work of an IWI funded literature review that details the various methods available for setting water quality targets and/or loads for phosphorus and nitrogen. The Water Quality Committee has accepted the final report, "Approaches to Setting Nutrient Targets in the Red River of the North," prepared by RESPEC which includes the recommendation to develop a stressor-response model for the Red River parallel to considering nutrient loading targets for Lake Winnipeg.

The stressor-response model will investigate the relationships among nutrients, suspended sediment, and the biological response in the Red River and involves five steps:

1 Identify data available from multiple jurisdictions and agencies.
2 Develop conceptual model of the Red River.
3 Perform exploratory data analysis to understand relationships among the ecological components of the system, evaluate how human disturbance might impact these relationships, and suggest statistical approaches for stressor-response modeling.
4 Collect additional data needed to fill gaps in stressor-response model development
5 Complete stressor-response modeling using the available dataset and statistical modeling approaches. Identify biological thresholds along a stressor gradient using approaches such as nonparametric change-point analysis.

The Committee's last report to the IRRB was on March 19, 2014; and it has met once since then in June 2014. The activities of Committee are sub-divided into six components.

Component one – *Developing a Nutrient Management Strategy* – The task has been completed.
Component Two - *Develop a Shared Understanding of Jurisdictions' Nutrient Regulatory Frameworks and Identify Current Nutrient Reduction Actions, Activities and Plans for the Red River Watershed*. This task has been completed. The matrix and regulatory framework distributed previously will be updated as required.
Component Three - *Recommend and Implement Nutrient Load Allocation and/or Water Quality Targets for Nutrients* - *International Watersheds Initiative Project – Review of Methods for Developing Water Quality Targets*
The final report for this work was submitted by RESPEC in March, 2013 and approved by the Water Quality Committee in May, 2013. The report was distributed to and approved by the IRRB in July, 2013. It has been posted on the IRRB website at: http://ijc.org/boards/irrb/files/2012/06/Approaches-to-Setting-Nutrient-Targets-in-the-Red-River-of-the-North-FINAL.pdf

Water Quality Modeling

No committee work has been done on this since the last report. Individual jurisdictions have the information they need to begin to use the SPARROW model.

International Watersheds Initiative Proposal – Development of a Stressor-Response Model for the Red River

The RESPEC report mentioned above had a number of recommendations regarding development of a model for determining appropriate water quality targets. The Water Quality Committee developed a proposal for the IWI to do the first two of these recommendations. After discussion with IJC staff and the Board at the January meeting, the Committee revised the proposal. A revised proposal was submitted that included doing all of the work recommended in the RESPEC report with regard to the development of a stressor-response model for the Red River. The funding requested was changed from $30,000 for the earlier proposal (which was intended to be phase 1 of 2 projects) to $100,000 for the current proposal which includes both phases of the project.

IJC staff contacted the WQC with questions about the modified proposal. The WQC co-chairs developed a response to those questions and then had a phone conference with them to discuss the response. The WQC also discussed criteria for selection of the contractor to conduct the work outlined. IJC staff were satisfied with the response and said they would be submitting the proposal to their contracting staff for preparation of the request for proposals (RFP). The Committee has not seen a draft RFP yet.

Component Four – Monitor and Report on Progress towards Meeting Water Quality Targets and Nutrient Load Allocations - Work to assess the comparability of existing water quality monitoring programs and data throughout the watershed is underway and the committee is exploring options for web-based delivery of information on water quality monitoring programs. This work is still ongoing.

Component Five - Facilitate ongoing technical, scientific and methodological dialogue and information sharing - This work is ongoing.

Component Six - Adapt the nutrient management strategy based on progress and ongoing evaluation - This work is ongoing.

Other Updates - The committee had a representative from the US Army Corp at the June 2014 committee meeting to discuss the Comprehensive Watershed Management Plan the Corp is developing with the Red River Basin Commission. The Corp outlined their goals for developing the water quality portion of the plan. The committee agreed that they would allow from 1 to 2 hours per committee meeting for the next 5 or 6 meetings to provide information the Corp can use to develop the Plan.

The final step would be to make recommendations to the IJC and then to Governments for the development and implementation of the nutrient management strategy.

IRRB acknowledges and thanks the IJC for its continued financial support for initiatives carried out by the Board and its committees in the Red River Basin.

4.03-4 Water Quantity Apportionment

As indicated by the historic streamflow records, water supply in the Red River basin is highly variable seasonally, annually, and over longer time periods. Recent forecasts of water demand based on population and economic growth projections further test the adequacy and reliability of these supplies. Scientific opinion with respect to climate change provides added caution regarding future hydrologic trends and the prospect of greater instability in water supply in the region.

The factors noted above and projected increases in water use causing larger departures from the

natural regime to occur, prompt action to set flow targets at the international boundary. The IRRB considers it prudent to consider recommending the establishment of such targets before they are needed. In July 2006, the Committee on Hydrology (COH) was asked to prepare a detailed proposal to establish the 'process' for undertaking development and implementation of apportionment procedures. The proposal is to identify the project elements, participating agencies, related capacity issues, and timelines.

At the January 2008 meeting, the Board approved the Committee on Hydrology's plan for recommending the development and implementation of flow apportionment procedure for the Red River. The Committee noted the establishment of a process for the development and implementation of water quantity apportionment requires an understanding of the natural flow regime on the Red River. Any acceptance of an apportionment procedure will require agreement on the method of computing the natural flow in the Red River Basin and understanding water uses in the Basin. The development of a flow apportionment procedure is likely to be a multi-year process and will require involvement of many partners. Major issues will be differences in water laws between the jurisdictions and consideration of instream flows. To support the development of a flow apportionment procedure three reports have been prepared under the IJC International Watershed Initiative.

The first report, Dr. Rob de Loe's, University of Guelph, reviewed apportionment governance procedures relevant to the Red River basin, and recommended an appropriate model. Dr. de Loe's completed report titled, "Sharing the Waters of the Red River Basin: A Review of options for Transboundary Water Governance" was approved by the IRRB at the September 2009 meeting.

The study was based on an extensive review of two main sources of information: (1) documents and reports relating to water management in the Red River Basin, and (2) the literature of transboundary water management. Two overseas and two International Canada/US case studies were analyzed in detail, with the goal of revealing insights into real-world problems and solutions of transboundary water governance. The overseas case studies were the Orange-Senqu River Basin in southern Africa and the Murray-Darling Basin, in Australia, The two Canada/US case studies were the St. Mary-Milk Rivers and the Souris River basins. The study recommended an apportionment model and approach to transboundary water governance in the Red River Basin that includes the following major elements:

1. A prior appropriation to meet critical human and environmental needs.
2. Rules to apportion remaining natural flows between Canada and the United States based on the principle of equitable sharing.
3. Rules regarding waters that originate in the respective countries' portion of the basin but do not cross the boundary. This model represents a balanced approach that takes account of local circumstances (e.g., the role of the *Boundary Waters Treaty of 1909*, existing management relationships, climatic conditions and the nature of water uses).

The second report, by R. Halliday & Associates, entitled "Determination of Natural Flow for Apportionment of the Red River identified a process for the development and implementation of water quantity apportionment procedures. The report covered the following areas:

- Define and review various methodologies that may be used to determine natural flow.
- Discuss these methods in the context of the Red River basin and recommend a specific method or methods.
- Review the data requirements of the selected method/methods and compare the requirements to the existing databases.
- Identify key data deficiencies and indicate how these could be resolved.

- Identify potential problem areas, such as, availability of structures to deliver minimum flows, different water rights
  appropriation procedures between jurisdictions and information availability.
- Review specific calculation procedures pertaining to international tributaries and recommend an approach.
- Review considerations related to equitable apportionment.

The Project Depletion Method was recommended given the availability of an adequate hydrometric network and a robust system of water permits or licenses in the Basin. Information is provided on how the calculation can be accomplished and several information gaps were identified in the areas of hydrometric and meteorological networks; water allocation; water use: evaporation and apportionment.

The report notes that there are a number of matters that must be resolved before natural flow can be calculated and before an apportionment arrangement can be executed including agreement by the two governments. None of them is incapable of being resolved with good will among the parties. However, as water consumption in the Red River Basin is relatively low compared to that in other apportioned basins in the interior plains, it may be preferable to explore whether an international drought contingency plan may be a productive task to pursue rather than considering a traditional apportionment agreement. As an alternative, careful consideration of minimum flow criteria for the Red River could provide additional insights. Such criteria could well be the only element of an apportionment arrangement that is really required at this time.

The development and implementation of water quantity apportionment procedures for the Red River basin requires an understanding of the aquatic ecosystem to assist in identifying instream flow requirements for the Red River. A report gathered information to support the development of instream flows entitled "Information Available for an Instream Flows Analysis of the Red River for Water Apportionment Purposes" was prepared by William G. Franzin for the Board. Information was gathered with respect to the following five major riverine areas of hydrology; geomorphology; biology; connectivity; and water quality; variables. Because of the large amount of detailed hydrological, hydraulic and modeling data at least a year's effort would be required by a person specializing in hydraulic modelling and GIS would be required to process the data to determine the feasibility of an instream flow study with the available data. If feasible, an Instream flow study of the Red River would be led by a Steering Committee with several Task groups and takes three to five years.

4.04 Comprehensive Flood Mitigation Strategy

In its report *Living with the Red*, the IJC noted that there is no single solution to reduce, mitigate and prevent harm from future flooding, and that comprehensive, integrated, binational approaches must be pursued and implemented. The report follows with a list of recommendations to include, " Governments immediately take steps, on a binational basis, to begin development of a comprehensive flood damage reduction plan for the Red River basin".

In 2003, at the request of the IJC, the IRRB completed a basin-wide survey and analysis of actions taken by governments at all levels in implementing the recommendations contained in *Living with the Red*. The final survey report titled *Flood Preparedness and Mitigation in the Red River Basin - October 2003*, indicated that while considerable progress had been made in increasing preparedness for major floods and in mitigating potential harm from future floods, there was a need for continued

and concerted effort to address those IJC recommendations entailing multiple objectives and inter-jurisdictional cooperation. Further to this report, the IRRB indicated that a comprehensive flood mitigation plan as proposed by the IJC in January 2003 would provide an appropriate mechanism to mobilize the multi-jurisdictional co-operation necessary to assure cohesion on flood management and long-term resiliency in the basin.

In 2005, the document titled *Comprehensive Flood Mitigation Plan* (CFMP) was prepared by the IJC in consultation with the Red River Basin Commission (RRBC) and the IRRB, and advice regarding preferred options for advancing the document to the political level was sought from senior officials in the three jurisdictions (North Dakota, Minnesota, and Manitoba). The proposed CFMP is intended to build on the Memorandum of Understanding for Flood and Drought Mitigation on the Red River that was signed by the governors of North Dakota, Minnesota and South Dakota and the Premier of Manitoba in April 2004. Further, the Plan recognizes current efforts led by the RRBC to develop a Natural Resources Framework Plan (NRFP). The CFMP would contribute to and become an integral part of the NRFP.

Support for the CFMP was discussed further at the IRRB annual meeting in July 2006. It was concluded that while members do not all have the same interpretation of the priorities for flood mitigation in the basin or on follow-up approach, the components under a CFMP, or Flood Mitigation Strategy as the suggested name-change, need to be determined. Integral to this task is a [current] documentation of the accomplishments and the positive benefits that have accrued to the basin and communities. The latter represents an important communications document reflecting the actions and achievement of many agencies, including the IJC and IRRB. This undertaking would also provide insight into how the IRRB and others might support or influence continued preparedness and mitigation activities in the basin.

As agreed at the 2006 annual meeting, the IRRB Co-Chairs prepared a Terms-of-Reference for the Committee on Hydrology Committee (COH) to develop a detailed project proposal that outlines the scope of work required to document the flood mitigation accomplishments to date and to identify the remaining mitigation priorities for the basin. The individual and collective capacity of participating agencies, and options to engage Committee members, IRRB members, and/or independent consultants, to complete the task is to be explored.

The IRRB Co-Chairs reviewed the March 2007 letter they had sent to the COH regarding the IRRB's role in identifying priority flood mitigation activities for the basin. In their letter, the Co-Chairs asked the COH to continue providing a current inventory of improvements and deficiencies based on agency knowledge. The same letter was also discussed with the IJC Commissioners at the April 2007 meeting. Based on the discussion, the Commissioners clarified their position on the Comprehensive Flood Mitigation Strategy (CFMS), previously known as the Comprehensive Flood Mitigation Plan (CFMP), and it was agreed that the IRRB should continue with the development of the CFMS as per the terms of reference provided to the COH. The Co-Chairs have indicated that based on the discussion with the IJC, they would amend their direction to the COH.

Since the 1997 Red River Flood there has been a legacy of accomplishments in the areas of cooperation between jurisdictions, improvements in predictive tools, public involvement and changes in legislation and development of data dissemination tools. However, there are still challenges in improving the predictive tools, maintaining and improving databases, data collection and data dissemination, maintaining flood protection infrastructure and continued review of flood protection policy and legislation.

Based on these accomplishments and challenges the Board felt it was time to update the IJC report "Living with the Red". The COH was instructed to develop a project proposal under the IWI initiative for the publication of a document entitled "How Are We Living with The Red?" In 2008, the IJC approved funding for this project and the COH contracted Halliday & Associates to assess flood preparedness, mitigation and to identify gaps and tasks yet to be undertaken. The intent of the document is to inform the public of accomplishments and challenges regarding flood mitigation in the basin and to supplement IRRB information available via the IJC International Red River web page. The completed project was presented to the Board at its meeting on September 16, 2009 in Gimli, Manitoba.

The study found much has been accomplished, yet some unresolved issues remain. While the communities of the Red River basin are unquestionably more flood resilient than in 1997, it will still take considerable effort to achieve the level of integration and cohesion on flood management that the IJC envisaged. Adoption of binational measures, however, will still be needed before the long-term resiliency of the basin can be assured. Some of the key achievements can be summarized under headings of policy, legislation and institutions; preparedness; mitigation; and environment as follows:

Policies, Legislation and Institutions

- Improvements in policy and legislation have been made in all jurisdictions.
- In 2008 Canada introduced its first national mitigation strategy. That strategy includes a number of priority actions, including an avenue for federal contributions to mitigation measures.
- Changes in data policies by the Canadian federal government and by the Manitoba government have led to much improved access to data.
- Manitoba has introduced a new designated flood area regulation. The associated elevation and inspection requirements for new structures will reduce future flood damages.
- Activities of the United States Army Corps of Engineers are aimed at a more integrated basin-wide consideration of mitigation projects.
- Both North Dakota and Minnesota have implemented new state building codes that include flood-proofing measures.
- Key institutional developments include the formation of the IJC's International Red River Basin Board, the Red River Basin Commission and the International Water Institute.

Preparedness

- All communities in the basin now have up-to date emergency response plans.
- Significant improvements have been made to flood forecasting in both Canada and the US.

Mitigation

- Many structural measures aimed at protecting both rural and urban floodplain residents have been completed or are at advanced stages of development.
- Major levees such as those for Grand Forks and East Grand Forks are essentially complete.
- The increased capacity of the Red River Floodway at Winnipeg is now available although the project will not be complete until 2011.
- Flood protection measures for many other communities, large and small, are in place and thousands of rural residences have been moved, raised or diked.
- Several agencies are collaborating with the Red River Basin Commission and the International Water Institute on the development of complex hydraulic models for the basin.

Environment

- Measures have been introduced to avoid contamination of wells and to remove hazardous chemicals from the floodplain, or improve the storage facilities for chemicals.
- Programs are underway aimed at establishing riparian conservation reserves and developing a greenway on the Red River.

There are some causes for concern nonetheless. The less successful recommendations are those that involve multiple agencies and, perhaps, multiple objectives. These sorts of tasks could be deemed to be more difficult and could naturally be expected to take longer. It may be that public expectations for structural measures supersede all other post-flood pressures and that those expectations need to be met before proceeding with "softer" projects. As well, some structural measures in the upper basin have been delayed by other priorities and because of permitting issues.

4.05 Invasive Species – Zebra Mussels

Zebra mussels, a non-native invasive species, were discovered in the Red River basin for the first time in September 2009. The mussels were found in Pelican Lake in Otter Tail County, Minnesota, which is on the Otter Tail River. Native to Eastern Europe and Western Russia, zebra mussels were first discovered in the Great Lakes in 1988. They entered the Upper Mississippi River system from Lake Michigan via the Illinois River (Chicago Sanitary and Shipping Canal) and spread upriver into Minnesota and Wisconsin via recreation and commercial boat traffic. Heavy infestations can kill native mussels, impact fish populations, interfere with recreation, and increase costs for industry, including power and water supply facilities.

Zebra mussels are adapted to lentic (lakes/reservoir) habitat. They can survive in riverine habitat, but they require an upstream source of healthy zebra mussel populations to continually supply free floating larvae – typically from an upstream reservoir or lake. Zebra mussels are typically spread overland from infected lakes via transient recreational boat traffic and transfers of boat docks or lifts. It is probable that there is an established and reproducing population in Pelican Lake, as evidenced by small and large individuals observed. Based on previous experience on the Upper Mississippi River, it is likely that zebra mussels will colonize the reservoir immediately downstream (Orwell Reservoir) and larvae likely will drift down the Otter Tail River to the Red River. However, the higher energy and flashy nature of the Red River does not provide ideal zebra mussel habitat. Eventual Zebra mussel infestation of the Red River is possible, but surviving population levels are likely to be minimal.

The confluence of the Red River and the Otter Tail River is approximately 550 river miles from Lake Winnipeg. U.S. Army Corps of Engineers experience on the Upper Mississippi River indicates that larval drift ranges from approximately 75 to 125 miles before juveniles settle and attach to hard surfaces. It is highly unlikely that larval juveniles will drift from the Otter Tail to Lake Winnipeg. Infestation of Lake Winnipeg via the Red River would require the establishment of a viable population within closer proximity (a lake or a reservoir which is non-existent at this time). Over land transport by humans from infested waters appears to be a more likely vector for zebra mussels to become established in Lake Winnipeg.

There is little that can be done to address an existing infestation of zebra mussels. Natural resource agencies in the U.S. and Canada are focused on public awareness and education aimed at preventing transportation of mussels on boats, trailers, and docks. Actions include increased signage at infested lakes, watercraft inspections, and monitoring.

In October 2013, Manitoba Conservation and Water Stewardship (MCWS) confirmed zebra mussels have been found in Manitoba waters. Mussels were recently found on the hull of a private boat, probable source of infestation, and a dock at Winnipeg Beach and on some fishing boats dry docked at Gimli (Lake Winnipeg). MCWS implemented a rapid-response protocol to address the issue which included:

- Ensuring staff were on site at Winnipeg Beach, Gimli and Hecla to provide information to watercraft owners and local residents to help identify zebra mussels, collect samples to determine the extent of infestation and advise on steps everyone can follow to help prevent the further spread of this aquatic invasive species. Watercraft inspection teams were available in the Winnipeg Beach and Gimli areas from October until Lake freeze-up.
- Deploying mobile decontamination units for aquatic invasive species where necessary. Teams' locations were changed depending on need and as new information was received.
- Engaging stakeholders to make them aware that zebra mussels have been found in Manitoba and what can be done to deal with the situation.
- Extending the watercraft inspection program to help collect data about this situation.

The public was advised to call 1-877-867-2470 (toll-free) for up-to-date information about the exact daily location of these teams [Source: MCWS-October 17, 2013 -News Release].

4.06 Lower Pembina River Flooding

The IRRB at its January 2008 meeting established the Lower Pembina River Flooding Task Team (LPRFTT). The mandate of this Task Team was to develop a science-based solution(s) to mitigate flooding in the lower Pembina River basin (Figure 2).

A significant milestone for the IRRB was the completion of the Lower Pembina River Flooding Task Team (LPRFTT) Report. The LPRFTT has overseen the completion of a three- phased International Watersheds Initiatives (IWI) study report entitled, "Simulation of Flood Scenarios on the Lower Pembina River Flood Plains with the Telemac 2D Hydrodynamic Model". All three phases of the study were conducted by the National Hydraulic Centre (NRC). Based on the results of the modelling effort, the LPRFTT developed a document titled, "An exploratory analysis of mitigation measures for the lower Pembina River basin". This LPRFTT reports from the three phases were then presented and subsequently accepted by the IJC. The reports, the model and animations have also been made public.

The National Research Council's (NRC) Canadian Hydraulics Centre provided a March 1, 2013 webinar, showing how Blue Kenue can be used as an analysis and visualization tool for hydraulic models.

One of the recommendations provided by the IJC to Governments was to establish a Task Team to work towards a binational solution to help manage the flooding issues in the Pembina Basin. Based on

this recommendation, the Governor of ND and the Premier of Manitoba have each assigned 5 members and have created the Pembina River Task Team. IRRB Co-chairs have also been included as members of the Task Team in addition to the 10 Task Team members. The first meeting was held on 15 October 2013 in Fargo, ND. The meeting was organized by the Red River Basin Commission. Lance Yohe, Executive Director of the RRBC, was the meeting facilitator.

Topics of discussion included:

- Summary of past reports/plans/studies, data, modelling, and transboundary committees;
- Purpose and charge of the committee;
- Role of participants;
- Starting points that Manitoba and North Dakota agree on for what the committee will move forward on;
- Presentation on the Telemac 2D model prepares under the leadership of the Lower Pembina River Basin Task Team from 2008-2012; and
- Primary discussion of possible solutions.

The most recent meeting of the Task Team was held on March 24, 2014 in Fargo, ND.

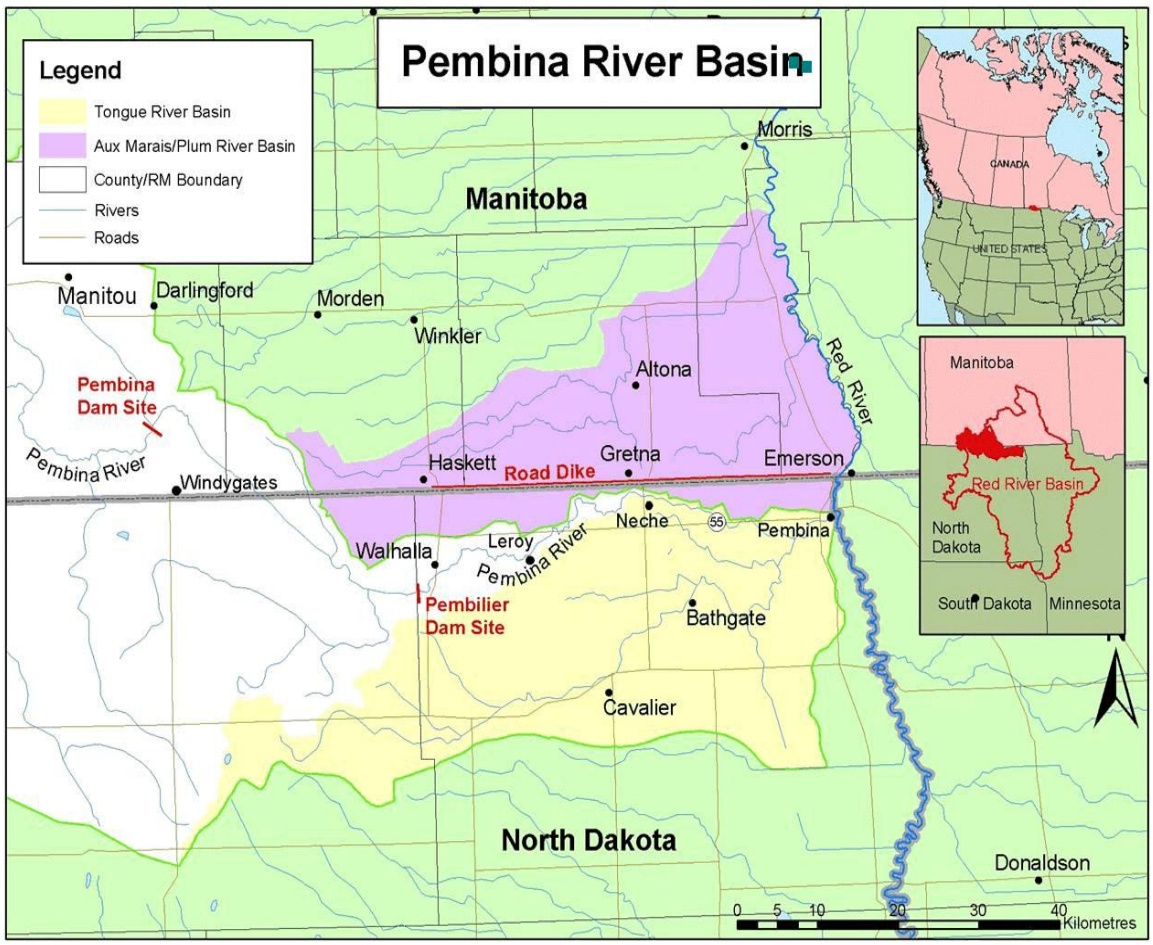


Figure 2: Pembina River Basin. The yellow and white areas comprise the Pembina River Basin.

4.07 Poplar River Basin

The Poplar River forms an international river basin shared by Saskatchewan and Montana. Although not geographically located within the Red River basin, the mandate of the IRRB includes the Poplar River, previously the responsibility of the International Souris-Red Rivers Engineering Board (ISRREB). This responsibility originates with the 1975 IJC instructions to the ISRREB to investigate equitable apportionment alternatives on the East Poplar River in consideration of the thermal power station and cooling reservoir that were being constructed by the Saskatchewan Power Corporation near Coronach, Saskatchewan. In 1976, the ISRREB recommended an apportionment formula to the IJC for the East Poplar River. Subsequently, in 1978, the IJC recommended an apportionment formula to the governments of Canada and the United States.

Environment Canada and the United States Geological Survey (USGS) have been collecting monthly water quality samples for nutrients, major ions and metals since July 1975. However, in 1977, the governments of Canada and the United States referred the issue of water quality to the IJC. The IJC Water Quality Task Force completed its report in 1981, which provided the basis for establishing flow-weighted objectives for numerous water quality parameters, including total dissolved solids (TDS) and boron. The International Air Pollution Advisory Board provided advice to the IJC regarding air pollution potential from the generating station. The Coronach Power Station began operation in 1981. Although Canada and Saskatchewan have not accepted the IJC apportionment formula and water quality objectives, both the formula and objectives have been followed by Saskatchewan throughout the intervening years.

Bilateral Monitoring Committee

The Poplar River Bilateral Monitoring Committee was established in 1980 by the Governments of Canada and the United States, and is composed of government representatives from Canada and the United States, Montana, and Saskatchewan, as well as one public ex-officio member from Canada and one from the United States. The Committee's main responsibility is to oversee monitoring programs designed to evaluate the potential for transboundary impacts from the generating station and its operations. The Committee's current mandate expires in 2017. Under the Committee's purview, surface and ground water quality and quantity data, and air quality data are collected at or near the international boundary. These monitoring programs initially included a quarterly data exchange and an annual data review and report. In September 1991, the Committee agreed that the data exchange was no longer required and that an annual data review and report would suffice.

Compliance with Apportionment and Water Quality Objectives

The water quality report for boron and TDS for 2013 was derived from the daily specific conductance data collected on the East Poplar River at the international boundary. No exceedances of the water quality objectives of the East Poplar River were observed for the 2013 monitoring year.

Based on IJC recommendations, the United States was entitled to an on-demand release of 670 dam^3 (500 acre-feet) from Cookson Reservoir in 2013. A volume of 4,630 dam^3 (3,750 acre-feet) was delivered between May 1 and May 31, 2013. In addition, daily flows during 2013 met or exceeded the minimum recommended by the IJC except for several periods during January and December when daily flows were below the recommended minimum due to ice conditions in the channel.

Starting August 2013, the Poplar River Annual Report will be posted on the IJC website under the International Red River Board using the following link:
http://www.ijc.org/en_/Poplar_Big_Muddy_Rivers_Basin.

5.0 WATER QUALITY AT THE INTERNATIONAL BOUNDARY

The water quality of the Red River at the international boundary, as reported herein, is based on continuous monitoring and instantaneous grab samples obtained during the 2012 water year (October 1, 2012 - September 30, 2013). The collected data, carefully scrutinized, are used to determine compliance with established IJC water quality objectives at the international boundary and in meeting the provisions of the Boundary Waters Treaty of 1909 between Canada and the United States. Detection of exceedances of the objectives serves as a trigger mechanism for agencies to take appropriate action to prevent or to mitigate potential problems, and to minimize the potential for reoccurrence. Environment Canada provides this monitoring service for the IRRB and maintains a permanent water quality and water quantity data collection site at Emerson, Manitoba.

The five parameters recommended by the IJC which Governments have approved objectives are discussed below along with streamflow and *pH* characteristics for a corresponding time period. Water quality characteristics at other locations throughout the basin are referenced in subsequent chapters of this report to provide a more complete spatial representation of water quality and aquatic ecosystem conditions in the Red River basin. During the reporting period, the observed pH and temperature values for the Red River remained within the normal range.

5.01 Water Quality Objectives

As described in Appendix B, the IJC established objectives for a limited number of water quality variables for the Red River at the international boundary. These variables are dissolved oxygen, total dissolved solids, chloride, sulphate, and *Escherichia coli* bacteria. The IRRB is responsible for monitoring and reporting on compliance with these objectives.

As described below, some exceedances of the IJC water quality objectives, and concentrations approaching the objective level for some parameters were observed during the reporting period. However, no intervention action by Governments or participating agencies the IRRB or participating agencies was required.

Dissolved Oxygen
Dissolved oxygen remained above the objective level of 5.0 mg/L throughout the reporting period. The lowest dissolved oxygen concentrations were detected in July, when water temperatures were highest.

Total Dissolved Solids
Total Dissolved Solids (TDS) remained at or above the objective of 500 mg/L for most of the 2012 water year, with the exception of during the flood stage. The highest observed value of 1248 mg/L occurred in November 2012 when there were higher and sustained releases from Devils Lake coupled with low flow / drought conditions for the majority of the basin.

Chloride
The chloride objective (100 mg/L) was exceeded in 22.7% of the samples collected during the water year. Monthly values ranged from a minimum of 8 mg/L in May 2013 to a maximum of 186 mg/L in October 2012.

Sulphate
The sulphate objective (250 mg/L) was exceeded in 34 % of the sampled collected 2012 water year. Like the TDS objective, the main reason for such a high increase in sulphate concentrations was likely due to the additional releases from Devils Lake through most of 2012. Sulphate concentrations ranged from a low of

41 mg/L in May 2013 to a high of 461 mg/L in December 2012.

Bacteriological Characteristics
The bacteriological characteristics of the Red River are assessed on the basis of observed *Escherichia coli* bacteria for which an IJC objective (200 colonies per 100 ml) has been defined. The presence of *Escherichia coli* in water is an indicator of impacts via human and/or animal wastes. During the 2012 water year, the *Escherichia coli* bacteria objective of 200 colonies/100 ml was not exceeded.

5.02 Alert Levels

Ten of the suites of pesticides and herbicides and five of the metals and toxic substances for which alert levels were established by the former International Red River Pollution Board were detected by Environment Canada (Water Quality Monitoring and Surveillance Division) during the reporting period (Table 1).

Pesticides and Herbicides
Based on a total of up to 12 water samples, 9 pesticides and/or herbicides and one metabolite (Desethyl Atrazine) with a total aggregate of 98 alerts (greater than detection concentration) were recorded during the October 1, 2012 - September 30, 2013 reporting period. Five compounds (2,4-D, MCPA, Mecoprop, Atrazine and Desethyl Atrazine) were detected in all samples analysed; however the detection levels were all below the Canadian Guidelines for the Protection of Aquatic Life. Given that the Red River basin is an agriculturally dominated region, the presence of pesticides and herbicides is expected. The detection of banned pesticides (legacy contaminants) is not unusual given the slow bio-degradation rate of these chemicals.

The IRRB recognizes that there is very little scientific information available to assess the implications of long-term exposure to low concentrations of pesticides and herbicides by aquatic organisms and humans. The IRRB continues to closely track the frequency of detection of these parameters with the intention to update its assessment as new scientific information becomes available.

Metals
A total of 44 water samples were collected and analyzed for metals and toxic substances during the reporting period. The highest number of exceedances were detected for iron, manganese and cadmium, with exceedance rates of 95%, 97% and 100%, respectively. Iron and manganese are abundant components in natural soils and can be released into surface waters through groundwater or sediment. Extremely high concentrations of total iron and total were detected on three sampling occasions in May 2013, which may have been associated with high runoff events as the total suspended solids were also somewhat elevated. However, the detection of higher levels of cadmium indicates anthropogenic sources, likely through wastewater treatment plant releases. Exceedances of zinc and arsenic were also detected. However, these occurrences were less frequent, with exceedances in 7% and 11% of the samples, respectively.

Table 1. Exceedances of Alert Levels, Red River at International Boundary October 1, 2012 to September 30, 2013						
Parameter	**Units**	**Alert Level**	**Number of Samples**	**Number of Exceedances**	**Maximum Exceedance Value**	**Canadian Environmental Quality Guideline**
Metals:						
Cadmium	ug/L	Detect	44	**44**	2.59	0. 074 ug/l[1,3]
Chromium	ug/L	50	44	**0**	--	NG
Iron Total	ug/L	300	44	**42**	17200	300 ug/l[1]
Manganese Total	ug/L	50	44	**43**	1990	200 ug/L[2]
Selenium	ug/L	10	44	**0**	--	1 ug/l[1]
Zinc	ug/L	47	44	3	106	30 ug/l[1]
Toxic Substances:						
Arsenic (total)	ug/L	10	44	5	15.3	5 ug/l[1]
Boron (total)	ug/L	500	44	0	--	29 mg/l[1]
Total PCB	ng/L	Detect	12	0	--	NG
Pesticides:						
2,4-D	ng/L	Detect	11	11	126	4000 ng/l[1]
Bromoxynil	ng/L	Detect	11	2	2.84	5000 ng/l[1]
Clopyralid	ng/L	Detect	11	11	60	NG5
Dicamba	ng/L	Detect	11	11	26.6	10000 ng/l[1]
Imazamethabenz-methyl a	ng/L	Detect	11	0	--	NG
Imazamethabenz-methyl b	ng/L	Detect	11	0	--	NG
MCPA	ng/L	Detect	11	11	16.5	2600 ng/l[1]
Mecoprop	ng/L	Detect	11	11	24.5	NG
Picloram	ng/L	Detect	11	8	26	29000 ng/l[1]
Aldrin	ng/L	Detect	12	0	--	NG
g-Benzenehexachloride	ng/L	Detect	12	0	--	NG
Pentachloroanisole	ng/L	Detect	12	0	--	NG
Atrazine	ng/L	Detect	12	12	693	1800 ng/l[1]
Desethyl Atrazine	ng/L	Detect	12	12	155	NG
Metolachlor	ng/L	Detect	12	9	218	7800 ng/l[1]
P,P-DDE	ng/L	Detect	12	0	--	NG
Alpha-Endosulfan	ng/L	Detect	12	0	--	3 ng/l[1,4]
Beta-Endosulfan	ng/L	Detect	12	0	--	3 ng/l[1,4]
Heptachlor Epoxide	ng/L	Detect	12	0	--	NG
Metribuzin	ng/L	Detect	12	0	--	1000 ng/l[1]

Notes:
1. Canadian Water Quality Guidelines for the Protection of Aquatic Life (http://st-ts. ccme. ca/)
2. Canadian Water Quality Guidelines for the Protection of Agriculture (http://st-ts. ccme. ca/)
3. Guideline value corrected for minimum value for hardness (mg/L $CaCO_3$) in the reporting period (http://st-ts. ccme. ca/?lang=en&factsheet=93)
4. Guideline value is for technical grade Endosulfan, which is a mixture of the two biologically active isomers (α and β)
5. NG = No guideline established

6.0 WATER QUALITY SURVEILLANCE PROGRAMS

As described in Chapter 5, data collected at Emerson, Manitoba, are used to determine compliance with established IJC water quality objectives at the international boundary. Chapter 6 contains basin-wide data and information contributed by IRRB member agencies to provide a more complete spatial representation of water quality and aquatic ecosystem health conditions in the Red River basin.

U.S. Water Quality Standards Program

In the United States, the statutory basis for the current Water Quality Standards (WQS) program is the Clean Water Act. Under Section 303 of this Act, the Environmental Protection Agency (EPA) issued a Water Quality Standards Regulation (40 CFR Part 131). This regulation specifies the requirements and procedures for developing, reviewing, revising, and approving WQS by the States and Tribal Nations. EPA has approved WQS programs for the States of North Dakota, South Dakota, and Minnesota. No tribal programs in the Red River basin have yet been approved.

WQS define the water quality goals for a water body or portion thereof, by designating the use or uses to be made of the water, and implementation criteria for protecting each of those uses or areas. Additionally, a WQS program must include an anti-degradation policy to protect water quality that is already better than State standards. Designated uses for water bodies may include:

- Aquatic life - protection of fish and other aquatic organisms;
- Recreation - swimming, wading, boating, and incidental contact;
- Drinking water - protection for downstream public water supply intakes;
- Miscellaneous - industrial or agricultural uses, tribal religious uses, etc.

Water quality standards are designed to protect the beneficial uses associated with the standards. Based on the assessment of the water quality data and other relevant information compared to the standards for a given pollutant or water quality characteristic, the use may be:

- Fully supported
- Partially supported
- Threatened
- Not supported

6.01 Minnesota

Water Quality Surveillance

MPCA's Watershed Approach and WRAPS
A framework for protecting and restoring water quality in Minnesota's watersheds

MPCA's water resource management efforts are tied to the goals of the 1972 Clean Water Act for restoring and protecting the multiple beneficial uses, including recreation, drinking water, fish consumption and ecological integrity of America's waters. The passage of Minnesota's Clean Water Legacy Act in 2006 provided a policy framework and resources to state and local governments to accelerate efforts to monitor, assess, and restore impaired waters, and to protect unimpaired waters.

Watershed Approach spawns process (WRAPS) for restoration/protection

The watershed approach is a 10-year rotation for assessing waters of the state on the level of Minnesota's major watersheds (Figure 3). The primary feature of this approach is a focus on the water resource as the starting point for water quality assessment, planning, and results measures. This approach led to development of a process to identify and address threats to water quality in each major watershed. This process is called WRAPS or the Watershed Restoration and Protection Strategy.

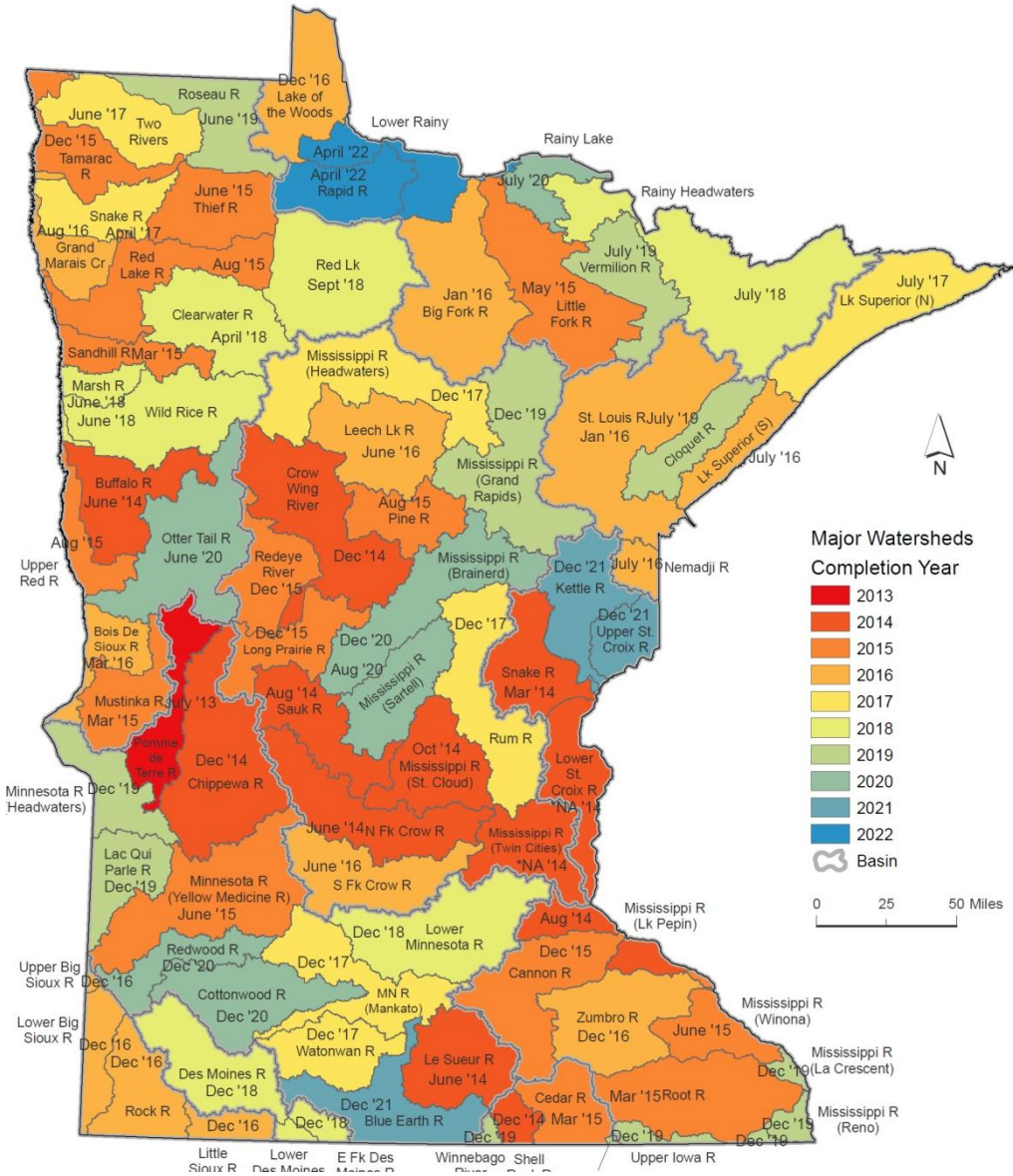


Figure 3: Watershed Approach Spawns Process

Major steps/phases of WRAPS

There are four main overlapping steps of the WRAPS process. The goal is to complete steps 1 through 3 within four years with step 4 beginning in year five.

Step 1 — Monitor and gather data and information

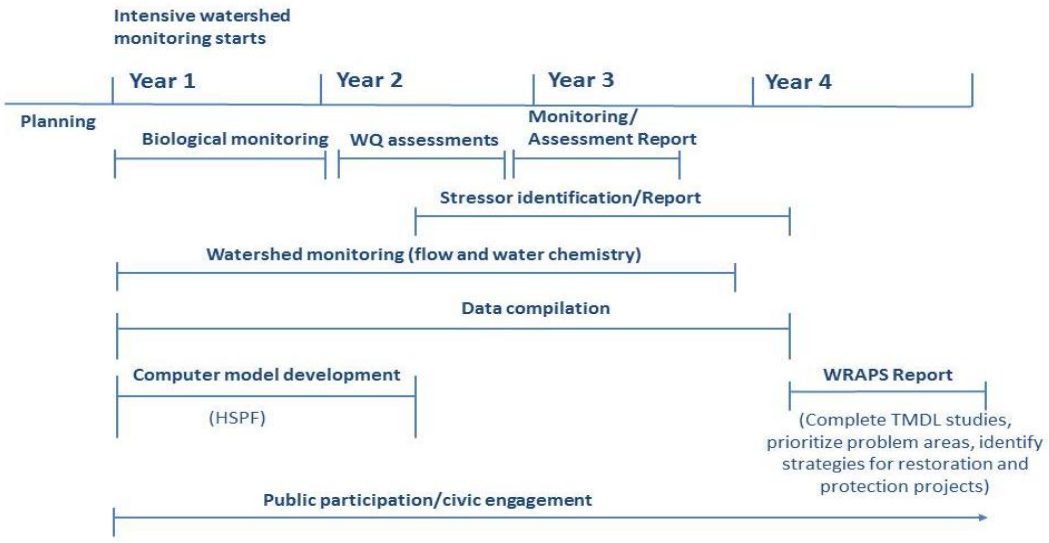
The 10-year monitoring schedule provides intensive monitoring of streams and lakes within each major watershed to determine overall health of the water resources, identify impaired waters, and identify those waters in need of additional protection to prevent future impairments. Data from past and current local water monitoring are included in the process. Information on watershed characteristics, like land use, topography, soils, and pollution sources is also gathered in this step. Outcomes of this step include the creation of a **Monitoring and Assessment Report** and **Biota Stressor Identification Report** for the watershed.

Step 2 — Assess the data
Based on results of intensive watershed monitoring in step one, MPCA staff and our partners conduct a rigorous process to determine whether water resources meet water quality standards and designated uses. Waters that do not meet water quality standards are listed as impaired waters.

Step 3 — Establish implementation strategies to meet standards (TMDL Study/WRAPS Report)
Based on the watershed assessment, a TMDL study and WRAPS Report are completed. Existing local water plans and water body studies are incorporated into the planning process. An overall water quality framework which details strategies and methods for meeting water quality standards is developed for the watershed with input from interested parties. Outcomes of this step include a comprehensive watershed-wide TMDL study and WRAPS Report.

Step 4 — Implement water quality activities
Various local units of government, including watershed districts, municipalities, and soil and water conservation districts, take the lead on developing and carrying out implementation plans based on what is learned during the earlier steps of the process. Civic engagement and public participation are core elements of all steps throughout the process.

The WRAPS Process at a glance



Benefits of the Watershed Approach/WRAPS

The MPCA's improved system for integrating and managing water quality programs will yield considerable benefits in the form of efficiencies and environmental benefits, including:

- An ongoing, predictable cycle for water quality management and evaluation,
- Integrating watershed protection and restoration needs into a single management plan,
- A more efficient approach to addressing impairments,
- A common framework for monitoring, TMDL studies, and implementation strategies,
- Increased stakeholder interest and local support,
- Improved collaboration and innovation, and
- A reduction in the cost of improving the quality of waters.

Red River Pollutant Load Monitoring

The Watershed Pollutant Load Monitoring Network (WPLMN) is designed to obtain spatial and temporal pollutant load information from Minnesota's rivers and streams and track water quality trends. This long-term program utilizes state and federal agencies, universities, local partners, non-profits and Minnesota Pollutant Control Agency (MPCA) staff to collect water quality and flow data to calculate pollutant loads. Monitoring sites span three ranges of scale:

Basin – major river main stem sites along the Mississippi, Minnesota, Rainy, Red and St. Croix Rivers
Major Watershed – tributaries draining to major rivers with an average drainage area of 1350 square miles (8 digit HUC scales)
Subwatershed – major branches or nodes within major watersheds with average drainage areas of approximately 300-500 square miles

Establishment of basin and major watershed sites within the network began in 2007 following the passage of Minnesota's Clean Water Legacy Act with subsequent funding from the Clean Water Land and Legacy Amendment.

Sample collection frequency for load monitoring is 'event-based' where high flow periods are sampled more frequently than low flow periods. Runoff events can be very dynamic and characterizing the high-flow periods is crucial for estimating loads. Sample collection at major watershed outlets and main-stem Red sites occurs throughout the year (estimated annual loads versus seasonal).

Approximately 35 samples are collected from the outlet/basin sites and 25 from the sub-watershed sites. MPCA contractors are utilized to assist in sample collection and load estimation. The International Water Institute has assisted in this event-based effort since the inception of the statewide network. Funding for this program comes from the Minnesota Clean Water Land and Legacy Amendment.

Primary goals for the program are:

- Measuring and comparing regional differences in water quality
- Determining long-term trends
- Using the water quality data to assist with impaired water assessments, watershed modeling efforts, load allocations and long term assessments of protection and restoration plans
- The quality of Lake Winnipeg waters has deteriorated over time, with particular concern arising over the last few decades in response to the effects of accelerated nutrient enrichment. The frequency and intensity of algal blooms in the lake have increased in association with rising phosphorous and nitrogen loading from diffuse and point sources in the Lake Winnipeg watershed (State of Lake Winnipeg: 1999-2007, Executive Summary 2011). The WPLMN monitors nutrient and sediment levels at Red River main-stem sites and inputs from Minnesota's

major tributaries to the Red River in order to quantify the states input to the Red River and ultimately Lake Winnipeg (figures 4, 5, 6, 7 & 8).

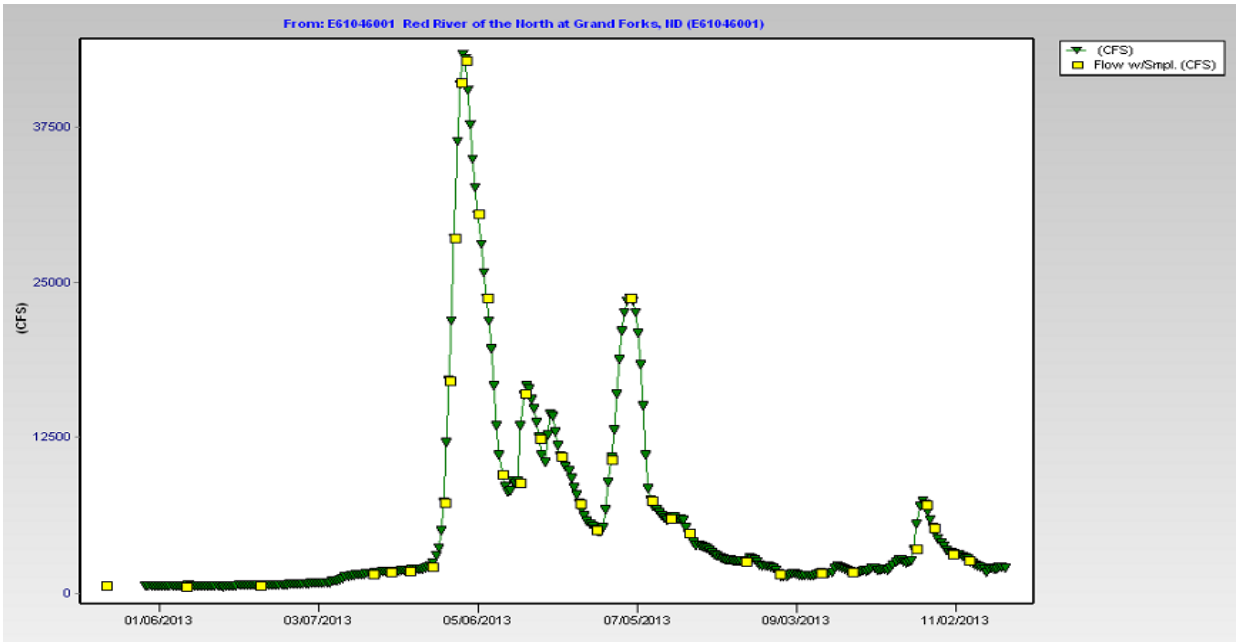


Figure 4: Discharge versus date hydrograph showing 35 load samples collected from the Red River at Grand Forks in 2013. Note: samples collected more frequently during high flow periods.

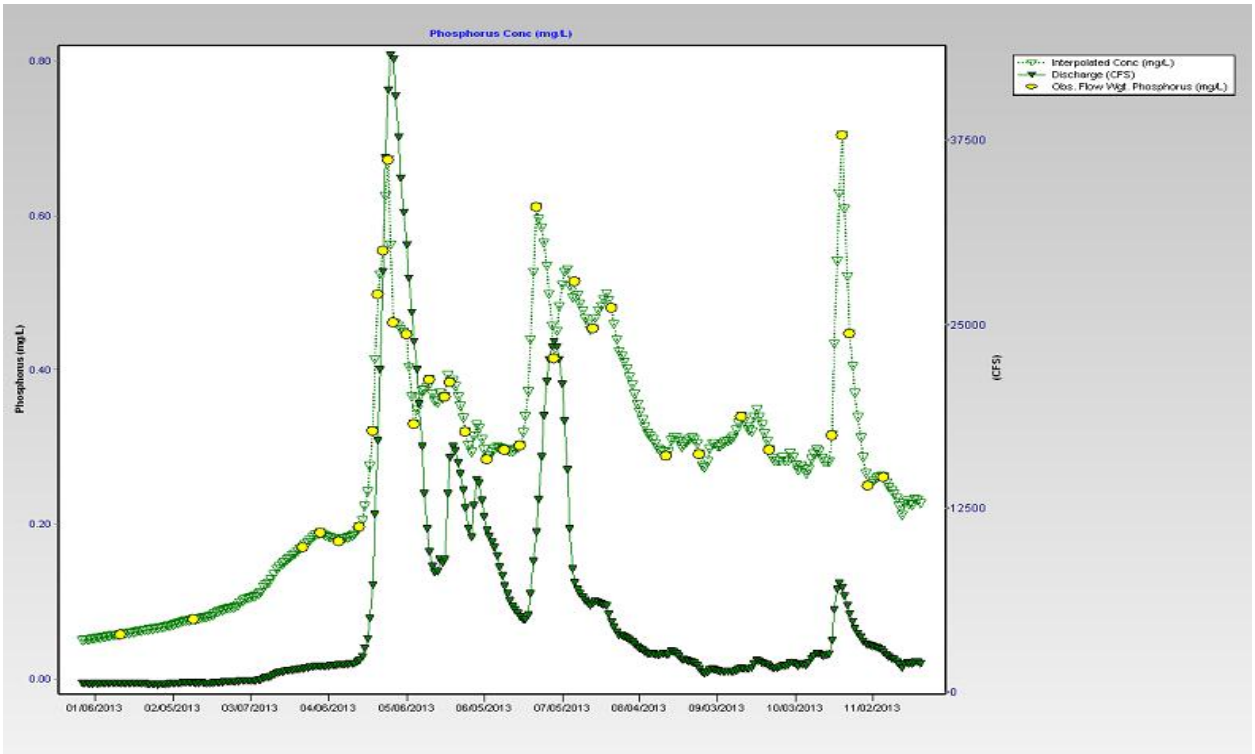


Figure 5: Estimated phosphorus concentrations versus date plotted on daily flow hydrograph – using the Flux32 model for estimating daily and annual pollutant loads.

This hydrograph represents the Red River at Grand Forks for 2013. Note: decreasing phosphorus daily concentrations at peak spring melt and early July events.

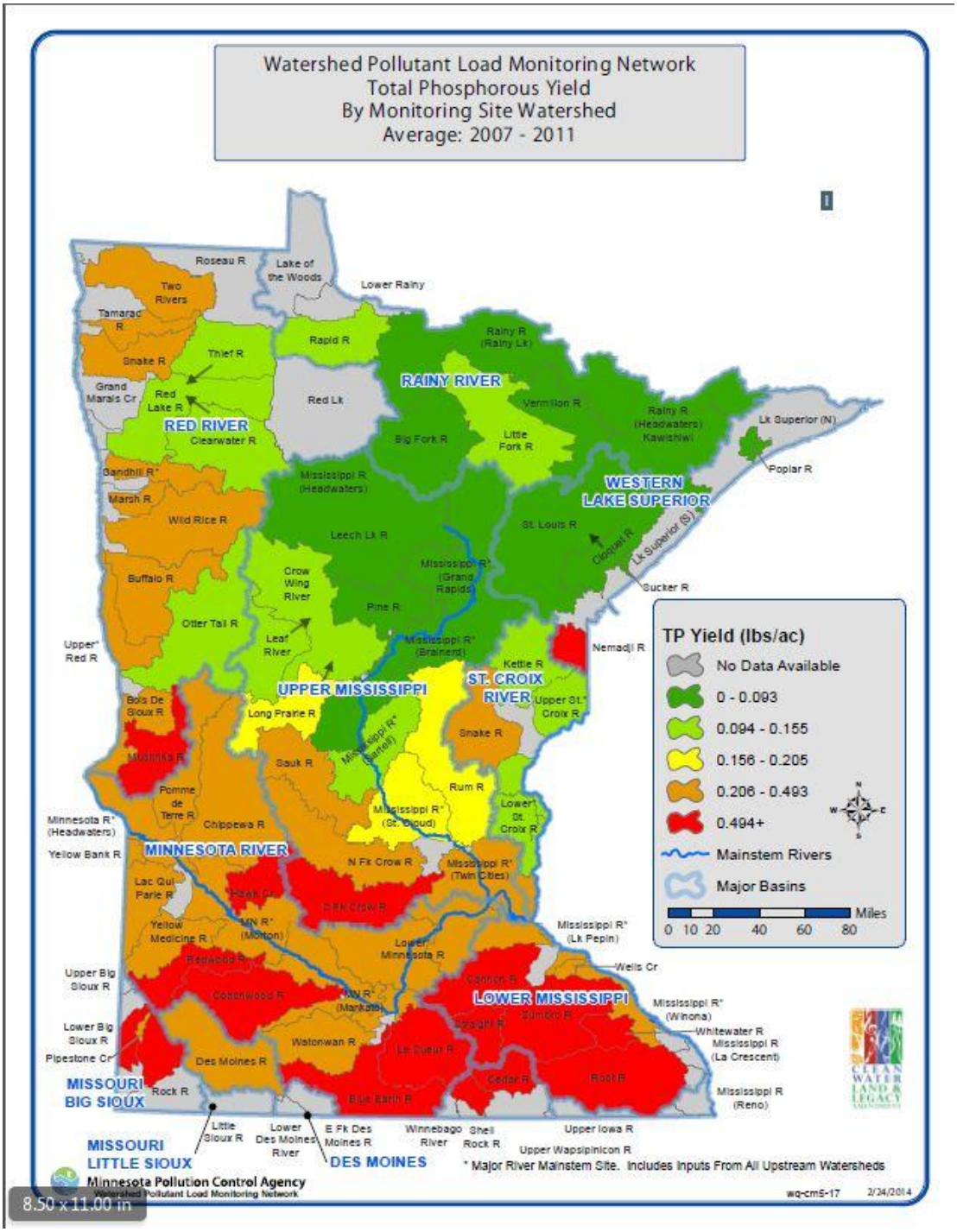


Figure 6: Watershed Pollutant Load Monitoring Network

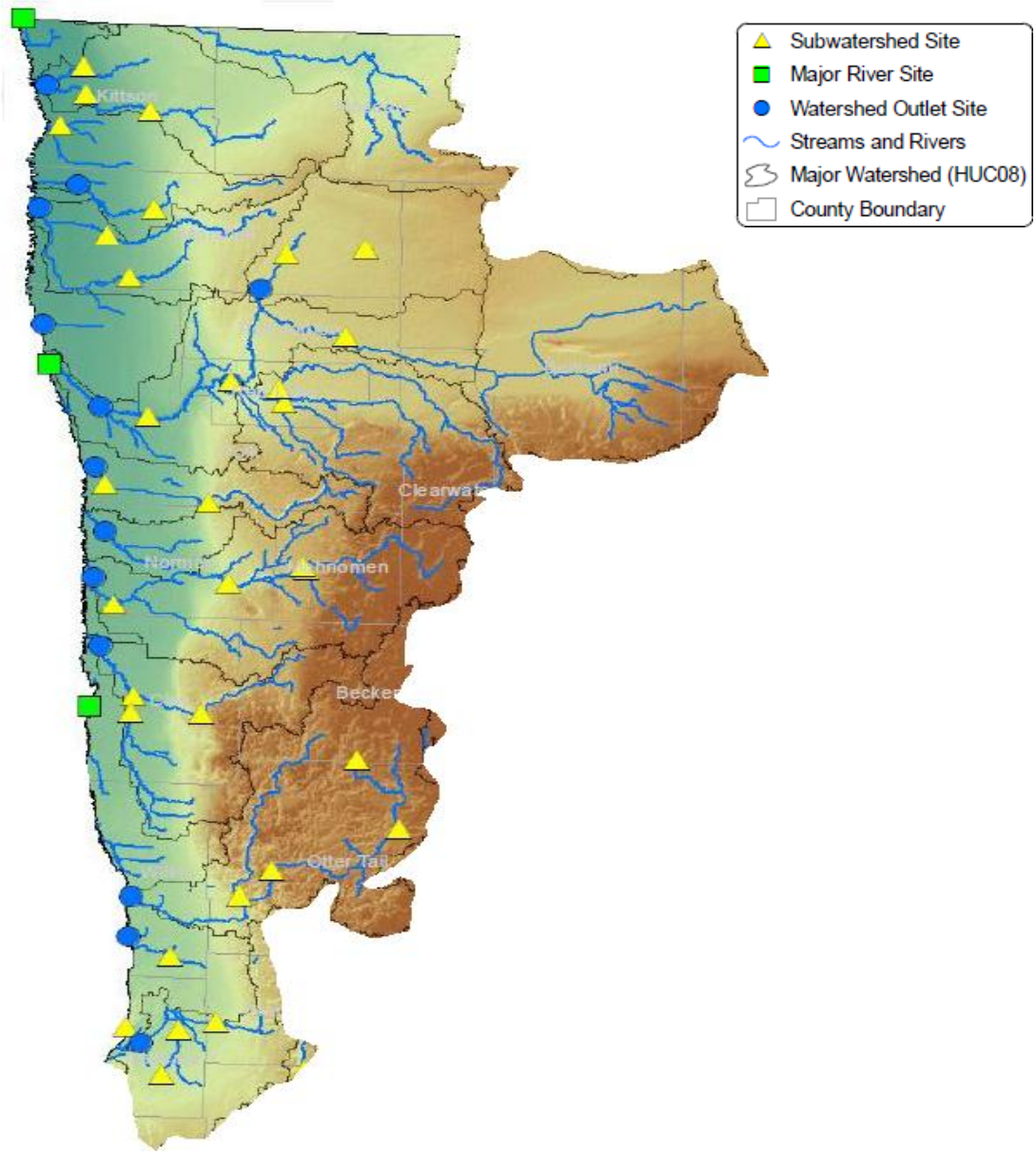


Figure 7: Current Red River of the North watershed pollutant load monitoring sites

Table 2 Current Red River of the North watershed pollutant load monitoring sites

Mustinka River nr Wheaton
Mustinka River nr Norcross
Twelvemile Creek nr Wheaton
Bois de Sioux River nr White Rock
Rabbit River nr Campbell
Bois de Sioux River nr Doran
Otter Tail River at Breckenridge
Otter Tail River nr Elizabeth
Pelican River nr Fergus Falls
Red River of the North River nr Kragnes
Red River at Grand Forks
Red River of the North River at Emerson
Buffalo River nr Hawley
Buffalo River nr Glyndon
S. B. Buffalo River nr Glyndon
Buffalo River nr Georgetown
Wild Rice River nr Mahnomen
Wild Rice River at Twin Valley
S. B. Wild Rice nr Felton
Wild Rice nr Hendrum
Marsh River nr Shelly
Roseau River at Caribou
Sand Hill River nr Fertile
Sand Hill River at Climax
Red Lake River at Highlanding nr Goodridge
Red Lake River at Red Lake Falls
Red Lake River nr Fisher
Lost River nr Brooks
Clearwater River at Plummer
Clearwater River at Red Lake Falls
Mud River nr Grygla
Thief River nr Holt
Thief River nr Thief River Falls
Snake River nr Warren
Snake River nr Big Woods
Middle River at Argyle
Tamarac River nr Florian
Tamarac River nr Robbin
Kittson CD27 nr Kennedy
S. B. Two Rivers at Lake Bronson
N. B. Two Rivers nr Northcote
S. B. Two Rivers at Hallock
Two Rivers nr Hallock

2013 flow weighted mean concentrations (FWMC), annual loads and annual flow volume for the Red River main-stem load sites

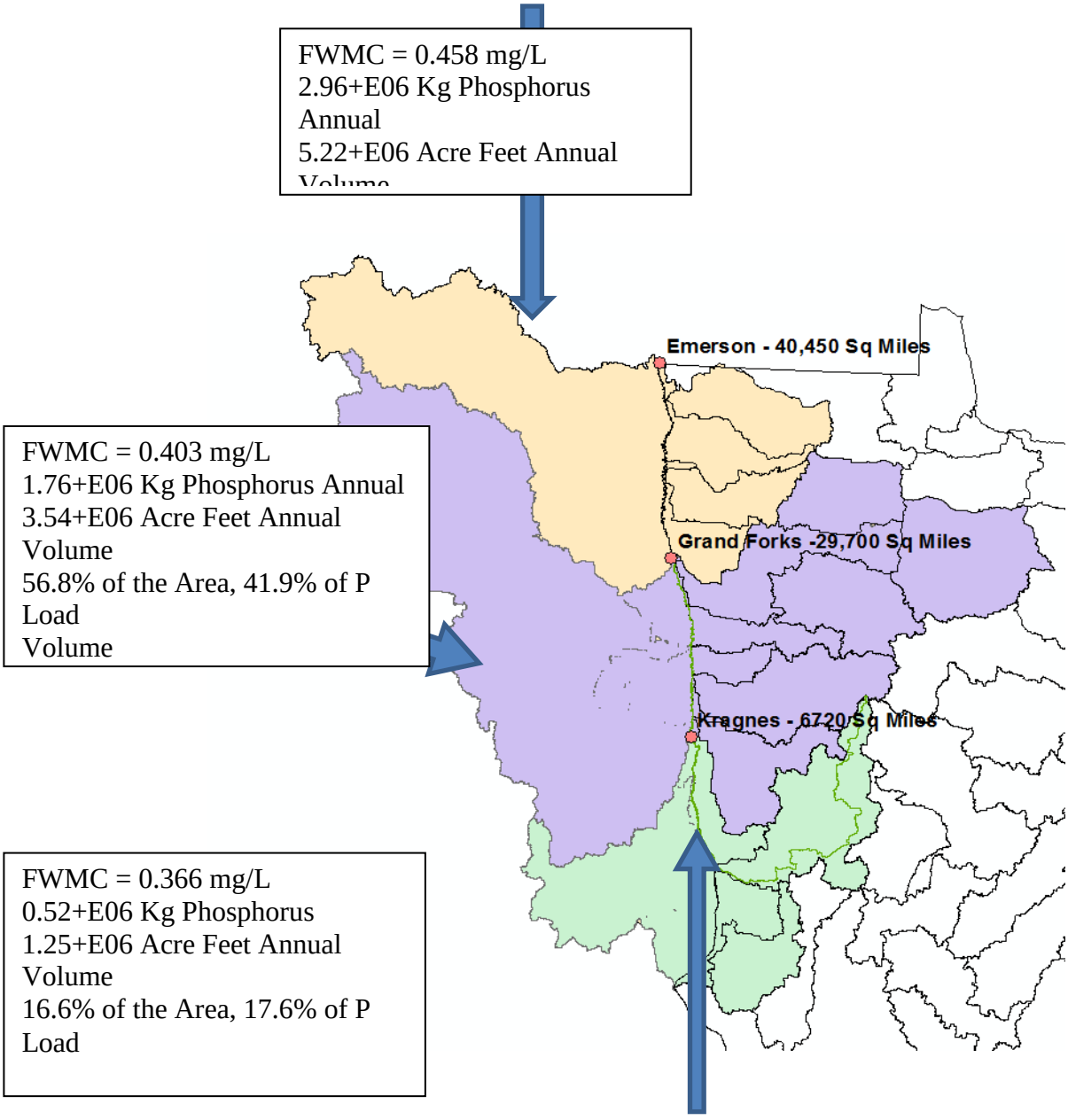


Figure 8: 2013 Flow-weighted Mean Concentrations Annual Loads 7& Annual Flow Volume for Red River

6.02 North Dakota

Ambient Water Quality Monitoring Program

Beginning January 1, 2013, the North Dakota Department of Health (department) began implementation of a revised ambient water quality monitoring program for rivers and streams in the state, including the Red River basin. This revised monitoring program is based on recommendations provided in a recently completed report published by the US Geological Survey's North Dakota Water Science Center (USGS) entitled "Evaluation of water-quality characteristics and sampling design for streams in North Dakota, 1970–2008" (http://pubs.usgs.gov/sir/2012/5216/). In its report the USGS recommended a set of core monitoring sites representing 3 levels of sampling intensification. The highest level of sites, design level 1, consist of a network of 32 basin integrator sites located across the state with 16 level 1 sites located in the Red River basin (Figure 9, Table 3). These sites are sampled 8 times per year, twice in April, once each in May, June, July, August, and October, and one time in the winter (January) under ice. The next level, design level 2, consists of 23 sites with 12 level 2 sites located in the Red River basin (Figure 9, Table 4). These sites are sampled 6 times per year, once each in April, May, June, August and October and once under ice during the winter (January). The lowest level of sites, design level 3, consists of 26 sites. There are 12 level 3 sites located in the Red River basin (Figure 9, Table 5). These sites are only be sampled 4 times per year, once each in April, June, August and October. Under the current design, the USGS samples all of the design level 2 sites (with the exception of the Red River at Harwood which is sampled by the department) and all the design level 3 sites. In the Red River basin the department samples 8 level 1 sites, while the USGS samples 8 sites.

At all level 1, 2 and 3 sites field measurements are taken for temperature, dissolved oxygen, pH and specific conductance. Sampling and analysis at all level 1, 2 and 3 sites consist of general chemistry, dissolved trace elements, and total and dissolved nutrients (Table 6). In addition to these water quality parameters, total organic carbon (TOC), dissolved organic carbon (DOC), total suspended solids (TSS), and E. coli bacteria are sampled and analyzed for at all level 1 sites (Table 4). E. coli bacteria are only be sampled during the recreation season (May-September). In addition to sampling for these analytes, the Red River at Fargo, the Red River at Grand Forks, and the Red River at Pembina are sampled for total suspended sediment. The analysis of the total suspended sediment samples is conducted by the USGS Iowa Sediment Laboratory. All chemical analysis of samples is performed by the department's Laboratory Services Division.

Table 3. Level 1 North Dakota Ambient Water Quality Monitoring Sites in the Red River Basin.

USGS Site ID	NDDoH Site ID	Site Name	Latitude	Longitude	Design Level	Responsible Agency
05051300	385055	Bois de Sioux River near Doran, MN	46.1522	-96.5789	1	NDDH
05051510	380083	Red River at Brushville, MN	46.3695	-96.6568	1	NDDH
05053000	380031	Wild Rice River near Abercrombie, ND	46.4680	-96.7837	1	NDDH
05054000	385414	Red River at Fargo, ND	46.8611	-96.7837	1	USGS-GF
05057000	380009	Sheyenne River near Cooperstown, ND	47.4328	-98.0276	1	NDDH
05058000	380153	Sheyenne River below Baldhill Dam, ND	47.0339	-98.0837	1	NDDH
05058700	385168	Sheyenne River at Lisbon, ND	46.4469	-97.6793	1	NDDH
05059000	385001	Sheyenne River near Kindred, ND	46.6316	-97.0006	1	NDDH
05060100	384155	Maple River below Mapleton, ND	46.9052	-97.0526	1	NDDH
05066500	380156	Goose River at Hillsboro, ND	47.4094	-97.0612	1	USGS-GF
05082500	384156	Red River at Grand Forks, ND	47.9275	-97.0281	1	USGS-GF
05083000	380037	Turtle River at Manvel, ND	48.0786	-97.1845	1	USGS-GF
05085000	380039	Forest River at Minto, ND	48.2858	-97.3681	1	USGS-GF
05090000	380157	Park River at Grafton, ND	48.4247	-97.4120	1	USGS-GF
05100000	380158	Pembina River at Neche, ND	48.9897	-97.5570	1	USGS-GF
05102490	384157	Red River at Pembina, ND	48.9769	-97.2376	1	USGS-GF

Table 4. Level 2 North Dakota Ambient Water Quality Monitoring Sites in the Red River Basin.

USGS Site ID	NDDoH Site ID	Site Name	Latitude	Longitude	Design Level	Responsible Agency
05051522	NA	Red River at Hickson, ND	46.6597	-96.7959	2	USGS-GF
05051600	385573	Wild Rice River near Rutland, ND	46.0222	-97.5115	2	USGS-GF
05054200	385040	Red River at Harwood, ND	46.9770	-96.8203	2	NDDH
05055300	385505	Sheyenne R above DL Outlet nr Flora, ND	47.9078	-99.4162	2	SWC
05056000	385345	Sheyenne River near Warwick, ND	47.8056	-98.7162	2	USGS-GF
05057200	384126	Baldhill Creek near Dazey, ND	47.2292	-98.1248	2	USGS-GF
05059700	385351	Maple River near Enderlin, ND	46.6216	-97.5740	2	USGS-GF
05064500	NA	Red River at Halstad, MN	47.3519	-96.8437	2	USGS-GF
05065500	NA	Goose River nr Portland, ND	47.5389	-97.4556	2	USGS-GF
05082625	385370	Turtle River at State Park near Arvilla, ND	47.9319	-97.5145	2	USGS-GF
05084000	NA	Forest River near Fordville, ND	48.1972	-97.7306	2	USGS-GF
05092000	380004	Red River at Drayton, ND	48.5722	-97.1476	2	USGS-GF

Table 5. Level 3 North Dakota Ambient Water Quality Monitoring Sites in the Red River Basin.

USGS Site ID	NDDoH Site ID	Site Name	Latitude	Longitude	Design Level	Responsible Agency
05052500	385232	Antelope Creek at Dwight, ND	46.3113	-96.7345	3	USGS-GF
05054500	380135	Sheyenne River above Harvey, ND	47.7028	-99.9490	3	USGS-Bis
05056060	385089	Mauvais Coulee Trib #3 nr Cando, ND	48.4575	-99.2243	3	USGS-GF
05056100	380207	Mauvais Coulee nr Cando	48.4481	-99.1026	3	USGS-GF
05056200	385092	Edmore Coulee nr Edmore	48.3367	-98.6604	3	USGS-GF
05056215	385093	Edmore Coulee Trib nr Webster	48.2664	-98.6809	3	USGS-GF
05056239	385091	Starkweather Coulee nr Webster, ND	48.3206	-98.9407	3	USGS-GF
05056340	380213	Little Coulee nr Leeds, ND	48.2433	-99.3729	3	USGS-GF
05060500	385302	Rush River at Amenia, ND	47.0166	-97.2143	3	USGS-GF
05099400	385287	Little South Pembina near Walhalla, ND	48.8653	-98.0059	3	USGS-GF
05101000	381279	Tongue River at Akra, ND	48.7783	-97.7468	3	USGS-GF

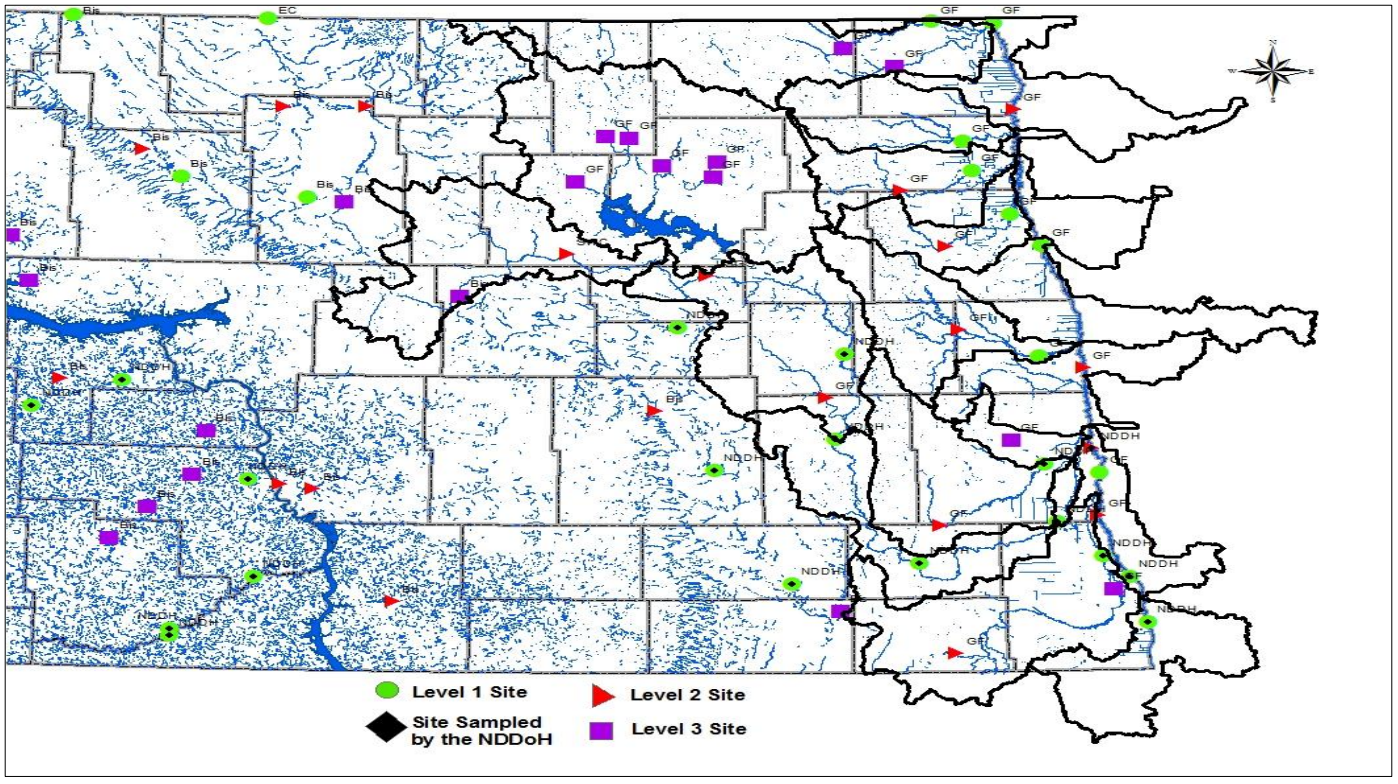


Figure 9: North Dakota Ambient Water Quality Monitoring Sites in the Red River Basin.

Table 6. North Dakota Ambient Water Quality Monitoring Parameters

Field Measurements	Laboratory Analysis			
	General Chemistry	Trace Elements	Nutrients	Biological
Temperature	Sodium[1,2]	Aluminum[1,2]	Ammonia (Total)[2]	E. coli[3]
pH	Magnesium[1,2]	Antimony[1,2]	Nitrate-nitrite (Total)[2]	
Dissolved Oxygen	Potassium[1,2]	Arsenic[1,2]	Total Kjeldahl Nitrogen[2]	
Specific Conductance	Calcium[1,2]	Barium[1,2]	Total Nitrogen[2]	
	Manganese[1,2]	Beryllium[1,2]	Total Phosphorus[2]	
	Iron[1,2]	Boron[1,2]	Total Organic Carbon[3]	
	Chloride[1,2]	Cadmium[1,2]	Ammonia (Dissolved)[2]	
	Fluoride[1,2]	Chromium[1,2]	Nitrate-nitrite (Dissolved)[2]	
	Sulfate[1,2]	Copper[1,2]	Total Kjeldahl Nitrogen (Dissolved)[2]	
	Carbonate[2]	Lead[1,2]	Total Nitrogen (Dissolved)[2]	
	Bicarbonate[2]	Nickel[1,2]	Total Phosphorus (Dissolved)[2]	
	Hydroxide[2]	Silica[1,2]	Dissolved Organic Carbon[3]	
	Alkalinity[2]	Silver[1,2]		
	Hardness[2]	Selenium[1,2]		
	Total Dissolved Solids[3]	Thallium[1,2]		
	Total Suspended Solids[1]	Zinc[1,2]		

[1]Analyzed as dissolved.

[2]Sampled and analyzed at level 1, 2 and 3 sites.

[3]Sampled and analyzed at level 1 sites.

North Dakota Department of Agriculture Pesticide Monitoring Program

As a compliment to North Dakota's revised ambient water quality monitoring program, in 2013 the department and the USGS cooperated with the North Dakota Department of Agriculture (NDDA) in a state pesticide monitoring program. Through this cooperative pesticide monitoring program, the department and the USGS collected pesticide samples at all of the level 1 water quality monitoring sites in the state, while the NDDA provided sample analysis through a contract with Montana State University's Agriculture Experiment Station Analytical Laboratory. Through this program 6 to 7 samples were collected at each site in 2013. In general, samples collected in the Red River basin were collected in late April, mid May, late May, mid June, mid-late July, late August, and in mid-late October. A final report detailing the results of the 2013 monitoring program, including the results from samples collected in the Red River basin can be found at http://www.nd.gov/ndda/files/resource/2013SWReport_Final.pdf

6.03 Manitoba

Surface Water Quality Monitoring

Water quality continues to be monitored monthly at two sites on the Red River within Manitoba by Manitoba Conservation and Water Stewardship. These sites are located upstream and downstream of the City of Winnipeg (Floodway control structure and Selkirk, respectively) (Figure 10). Variables measured include physical parameters, general chemistry, suspended sediment, bacteria, industrial organics, pharmaceuticals, trace elements, nutrients, and agricultural chemicals. Long-term variables monitored by Manitoba Conservation and Water Stewardship are shown in Table 7. In addition, benthic macroinvertebrates were collected from the Red River at Emerson and Selkirk in September 2013.

Routine monitoring is also conducted on five tributary streams to the Red River by Manitoba Conservation and Water Stewardship (Figure 10). Samples are collected at minimum four times per year and analyzed for a wide range of variables including physical, general chemistry, suspended sediment, bacteria, industrial organics, trace elements, nutrients, and agricultural chemicals.

Red River – Main Stem

During this reporting period, water quality in the Manitoba reach of the Red River main stem remained generally similar to previous years. Dissolved oxygen concentrations were relatively high with an average concentration of 8.35 mg/L upstream of the City of Winnipeg and 8.4 mg/L downstream of the City of Winnipeg. The lowest value recorded (less than 0.1 mg/L in May of 2013, downstream of the City of Winnipeg) was likely result of sampling error. The next lowest dissolved oxygen concentration excluding the November was 5.0 mg/L in February 2013 upstream of the City of Winnipeg.

Densities of *Escherichia coli* bacteria downstream of the City of Winnipeg were comparable to the previous reporting period. Average density downstream of the City of Winnipeg was 58 organisms / 100 mL (geomean), compared to 72 organisms / 100 mL in the previous reporting period. In comparison, the average density of *E. coli* bacteria in the upstream reach was 13 organisms / 100 mL (geomean), comparable to the previous year (11 organisms / 100 mL). Densities of *E. coli* bacteria did not exceed the Manitoba Water Quality Standards, Objectives, and Guideline for the protection of recreation of 200 organisms / 100 mL upstream of the City of Winnipeg. Meanwhile the exceedance rate of the Manitoba Water Quality Standards, Objectives, and Guidelines for the protection of recreation was 17 per cent downstream of the City of Winnipeg, compared with 18 per cent in the previous reporting period.

During this reporting period, two samples were analyzed for pesticides upstream of the City of Winnipeg. Twelve pesticides out of the 63 monitored were detected, compared to nine in the previous reporting period. Five pesticides were detected during both sampling periods (June and July): 2,4-D, AMPA, atrazine, dicamba, and glyphosate. Pesticides detected in only one sample included atrazine desethyl, bromacil, bromoxynil, chlorothalonil, diuron, MCPA, and triclopyr.

In July 2013, the concentration of bromacil upstream of the City of Winnipeg (0.21 µg/L) exceeded the guideline developed by the Canadian Council of Ministers of the Environment for protection of irrigation uses, of 0.20 µg/L. In both June and July 2013, concentrations of dicamba (0.0231 µg/L; 0.131 µg/L) exceeded the guideline developed by the Canadian Council of Ministers of the Environment for protection of irrigation uses of 0.006 µg/L. MCPA also was detected in a concentration exceeding the Canadian Council of Ministers of the Environment guideline for protection of irrigation of 0.025 µg/L, in July 2013 (0.095 µg/L). None of the detections of pesticides upstream of Winnipeg exceeded water quality guidelines

(where available) for the protection of surface water used as sources of drinking water supply, habitat for aquatic life and wildlife, or livestock uses.

Eleven pesticides out of the 63 monitored were detected downstream of the City of Winnipeg, versus ten detections in the previous reporting year. A total of four samples were analyzed for pesticides, taken in May (two samples), June, and July. Glyphosate and AMPA were the most commonly detected pesticide, detected in four of the four samples. 2,4-D, atrazine desethyl, atrazine, bromoxynil, chlorothalonil, dicamba, imazamethabenz methyl, MCPA, and tribenuron methyl were also detected, at lower frequencies.

None of the detections of pesticides downstream of Winnipeg exceeded water quality guidelines (where available) for the protection of surface water used as sources of drinking water supply or livestock uses. However, the concentration of Chlorothalonil on May 29, 2013 (0.618 µg/L) exceeded the water quality guideline for the protection of aquatic life developed by the Canadian Council of Ministers of the Environment, of 0.18 µg/L. The guidelines developed by the Canadian Council of Ministers of the Environment for protection of irrigation uses were exceeded by MCPA (guideline 0.025 µg/L; 0.101 µg/L detected in July 2013) and dicamba (guideline 0.006 µg/L; 0.0265 µg/L detected in June 2013; 0.0955 µg/L detected in July 2013).

Red River - Tributary Streams

During this reporting period, six sampling stations in five tributaries (Boyne, La Salle, Rat, Roseau, and Seine Rivers) were sampled between four and seven times. Most water quality parameters in these tributaries to the Red River main stem remained relatively comparable to past years. Average dissolved oxygen concentrations were similar to the previous reporting period, ranging from 6.8 to 8.2 mg/L. Dissolved oxygen concentrations were usually above the Manitoba Water Quality Objective at the tributaries monitored in the reporting year. The lowest dissolved oxygen concentrations was measured in the Boyne River in December 2012 (2.1 mg/L), which was the only tributary sample below the minimum instantaneous Water Quality Objective of 3.0 mg/L. Densities of *E. coli* bacteria in the Boyne River in May 2013 were reported as greater than 9990 organisms / 100 mL, which was likely due to sample contamination or mishandling. At all other Red River tributaries sampled in the reporting year, densities of *E. coli* bacteria met the Manitoba Water Quality Objective for recreation of 200 organisms / 100 mL.

Pesticides in the five tributaries were analysed from July 2013 samples. Nine pesticides were detected out of the 63 monitored, compared with twelve in the previous reporting period when sampling was more frequent. Glyphosate was the most commonly detected pesticide, found in six of six samples. Other pesticides detected at lower frequencies included 2,4-D, AMPA, bromoxynil, dicamba, imazamethabenz methyl, MCPA, thifensulfuron methyl, and tribenuron methyl.

Eight of these pesticides (all but 2,4-D) were detected in the La Salle River. Four pesticides were detected in the Seine River at the Perimeter highway including 2,4-D, AMPA, dicamba and glyphosate. Only one pesticide, glyphosate, was detected in the Boyne, Rat, and Roseau Rivers, and the Seine River at Ste. Anne. The guidelines developed by the Canadian Council of Ministers of the Environment for protection of irrigation uses were exceeded for dicamba (guideline 0.006 µg/L) in the La Salle and Seine Rivers, and for MCPA (guideline 0.025 µg/L) in the La Salle River. None of the detections of pesticides in Red River tributaries exceeded water quality guidelines (where available) for the protection of surface water used as sources of drinking water supply, habitat for aquatic life and wildlife, or livestock uses (Table 7).

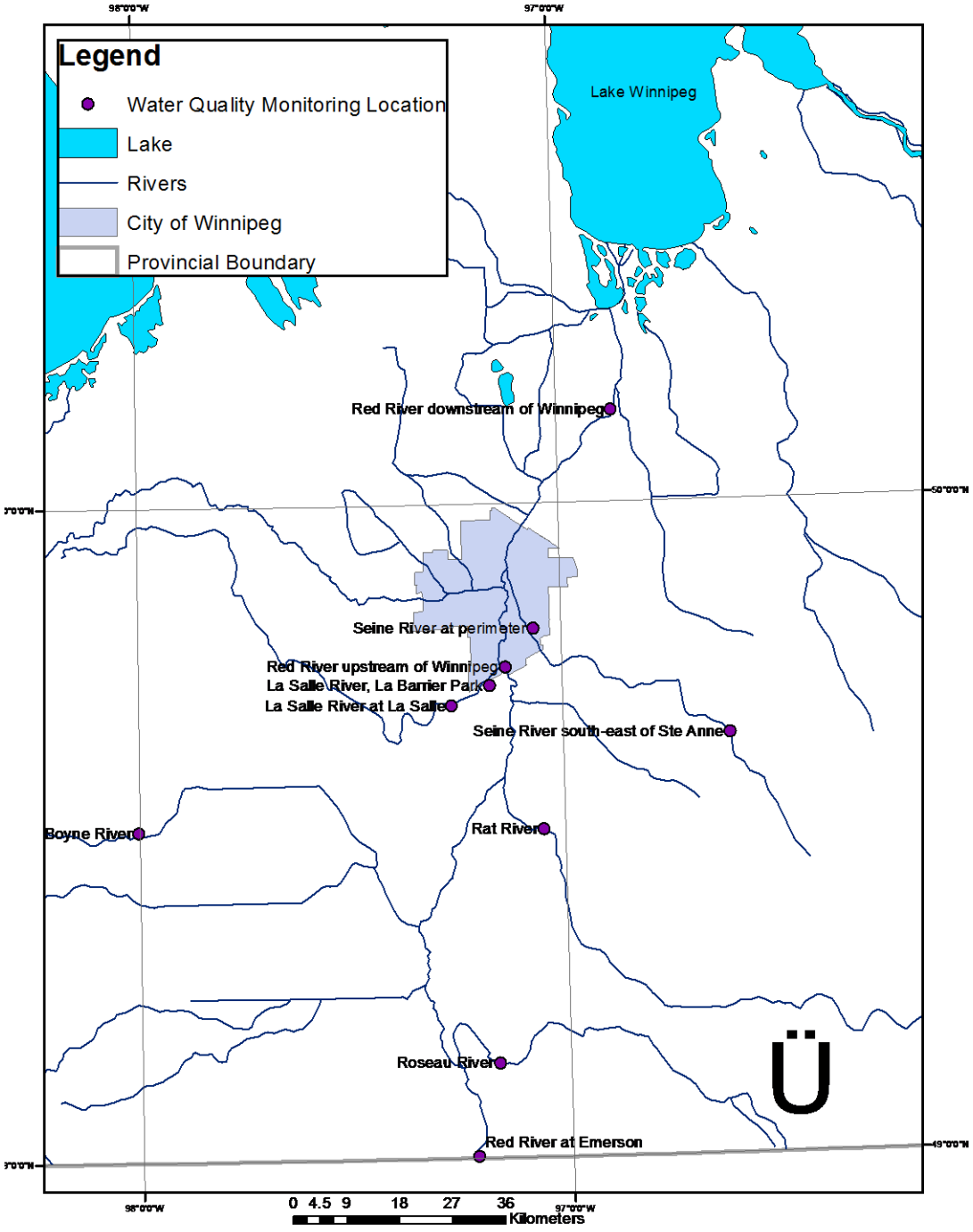


Figure 10: Locations of water quality and benthic invertebrate sample sites in the Red River watershed (Manitoba).

Table 7. Routine surface water quality monitoring variables sampled by Manitoba Conservation and Water Stewardship on the Red River and tributaries within Manitoba, Canada.

Variables	Units
2,4,5-TP	ug/L
2,4-DB	ug/L
2,4-D	ug/L
ALACHLOR	ug/L
ALKALINITY CO3	mg/L
ALKALINITY OH	mg/L
ALKALINITY TOTAL CACO3	mg/L
ALKALINITY TOTAL HCO3	mg/L
ALUMINUM DISSOLVED	mg/L
ALUMINUM TOTAL	mg/L
AMMONIA DISSOLVED	mg/L
AMPA(AMINOMETHYLPHOSPHONIC ACID)	ug/L
ANTIMONY TOTAL	mg/L
ARSENIC TOTAL	mg/L
ATRAZINE DESETHYL	ug/L
ATRAZINE	ug/L
AZINPHOS METHYL	ug/L
BARIUM TOTAL	mg/L
BENOMYL	ug/L
BERYLLIUM TOTAL	mg/L
BISMUTH TOTAL	mg/L
BORON TOTAL	mg/L
BROMACIL	ug/L
BROMOXYNIL	ug/L
CADMIUM TOTAL	mg/L
CALCIUM TOTAL	mg/L
CAPTAN	ug/L
CARBOFURAN	ug/L
CARBON TOTAL INORGANIC	mg/L
CARBON TOTAL ORGANIC (TOC)	mg/L
CARBON TOTAL	mg/L
CARBOXIN (CARBATHIN)	ug/L
CESIUM TOTAL	mg/L
CHLORDANE-CIS	ug/L
CHLORDANE-TRANS	ug/L
CHLORIDE DISSOLVED	mg/L
CHLOROPHYLL A	ug/L
CHLOROTHALONIL	ug/L
CHLORPYRIFOS-ETHYL (DURSBAN)	ug/L
CHROMIUM HEXAVALENT DISSOLVED	mg/L
CHROMIUM TOTAL (CR)	mg/L
COBALT TOTAL	mg/L
COLOUR TRUE	CU
CONDUCTIVITY (AT 25C)	uS/cm
COPPER TOTAL (CU)	mg/L
CYANAZINE	ug/L
DELTAMETHRIN	ug/L
DIAZINON	ug/L
DICAMBA (BANVEL)	ug/L
DICHLOROPROP(2,4-DP)	ug/L
DICLOFOP-METHYL	ug/L

Table 7. Continued….

Variables	Units
DIMETHOATE (CYGON)	ug/L
DINOSEB	ug/L
DIURON (DCMBU)	ug/L
DIURON	ug/L
EPTAM	ug/L
ESCHERICHIA, COLI	CFU/100 mL
ETHALFLURALIN (EDGE)	ug/L
FENOXAPROP	ug/L
GAMMA-BENZENEHEXACHLORIDE (LINDANE)	ug/L
GLYPHOSATE (ROUNDUP)	ug/L
HARDNESS TOTAL CACO3	mg/L
IMAZAMETHABENZ-ME	ng/L
IMAZAMETHABENZ-METHYL	ug/L
IRON TOTAL (FE)	mg/L
LEAD TOTAL	mg/L
LITHIUM TOTAL	mg/L
MAGNESIUM TOTAL	mg/L
MALATHION	ug/L
MANGANESE TOTAL (MN)	mg/L
MCPA	ug/L
MCPP (MECOPROP)	ug/L
METASULFURON-ME	ng/L
METHOXYCHLOR (P,P'-METHOXYCHLOR)_	ug/L
METRIBUZIN	ug/L
METSULFURON-METHYL	ug/L
MOLYBDENUM TOTAL	mg/L
NICKEL TOTAL	mg/L
NITROGEN DISSOLVED NO3 & NO2	mg/L
NITROGEN TOTAL KJELDAHL (TKN)	mg/L
OXYGEN BIOCHEMICAL DEMAND	mg/L
OXYGEN DISSOLVED	mg/L
PARATHION ETHYL	ug/L
PARATHION METHYL	ug/L
PENTACHLOROPHENOL	ug/L
PHEOPHYTIN A	ug/L
PHOSPHOROUS-ACID HYDROLYZABLE	mg/L
PHOSPHOROUS-TOTAL-ORTHO	mg/L
PHOSPHORUS DISSOLVED ORTHO	mg/L
PHOSPHORUS PARTICULATE	mg/L
PHOSPHORUS TOTAL (METALS SCAN)	mg/L
PHOSPHORUS TOTAL (P)	mg/L
PHOSPHORUS TOTAL DISSOLVED	mg/L
PHOSPHORUS TOTAL INORGANIC	mg/L
pH	pH units
PICLORAM (TORDON)	ug/L
POTASSIUM TOTAL	mg/L
PROPACHLOR	ug/L
PROPANIL	ug/L
PROPOXUR	ug/L

Table 7. Continued….

Variables	Units
QUIZALOFOP	ug/L
RUBIDIUM TOTAL	mg/L
SELENIUM TOTAL	mg/L
SETHOXYDIM	ug/L
SETHOXYDIM	ug/L
SILICON TOTAL	mg/L
SILVER TOTAL	mg/L
SIMAZINE	ug/L
SODIUM TOTAL	mg/L
SULPHATE DISSOLVED	mg/L
TEBUTHIURON	ug/L
TELLURIUM TOTAL	mg/L
TERBUFOS	ug/L
THALLIUM TOTAL	mg/L
THIFENSULFURON METHYL	ug/L
THIFENSULFURON-ME	ng/L
THORIUM TOTAL	mg/L
TIN TOTAL	mg/L
TITANIUM TOTAL	mg/L
TOTAL DISSOLVED SOLIDS	mg/L @180C
TOTAL SUSPENDED SOLIDS	mg/L
TRALKOXYDIM	ug/L
TRALKOXYDIM	ug/L
TRIALLATE (AVADEXBW)	ug/L
TRIBENURON	ng/L
TRICLOPYR	ug/L
TRIFLURALIN(TREFLAN)	ug/L
TUNGSTEN TOTAL	mg/L
TURBIDITY	Ntu
URANIUM TOTAL	mg/L
VANADIUM TOTAL	mg/L
ZINC TOTAL (ZN)	mg/L
ZIRCONIUM TOTAL	mg/L

7.0 WATER POLLUTION CONTROL

7.01 Contingency Plan

In January 1981 a contingency plan was developed by the former International Red River Pollution Board. The purpose of the plan, which had been adopted by the IRRB, is to ensure that positive coordinated action is taken to minimize public health hazards and environmental damage in the event of a spill. This plan does not supersede any local or national contingency plans in existence but rather serves to coordinate these activities. The plan becomes effective wherever the discharge of a pollutant within the Red River basin has the potential to adversely impact the Red River. The plan also becomes effective at any time when exceedances of either water quality objectives or alert levels as described in Chapter 5 are observed at the international boundary. A current list of contacts and telephone numbers associated with the contingency plan is included in Appendix C.

7.02 Spills and Releases

Minnesota

The spills information covers the period from January 1, 2013 to January 1, 2014. The year was fairly normal for the number of spills compared to the long term record.

There were roughly 160 spills reported to us for MPCA Region III through the State Duty Officer. They are received by emergency response (ER) staff and responded to by ER staff or triaged by ER to the specific MPCA program that deals with that industry. They could be generally categorized as follows:

1) 17 Residential heating oil spills, (a homeowners fuel tank spilled to their property either inside or just outside of their home).
2) 18 Reports of releases from process activities at American Crystal Sugar at East Grand Forks, Crookston or Moorhead. These incidents most commonly consist of high BOD process water/product which spills into the enclosed ditch/treatment system at the facility. The facilities have their own storm water systems, which are designed to prevent flow of product/spills off of their property.
3) 8 pipeline releases. Most were releases of crude oil at a pump station or discovery of historic contamination at a facility or along the line.
4) 21 Vehicle fuel releases. These are commonly over-the-road trucking incidents where the fuel line was compromised, leaking fuel to the roadway or ditch.
5) There were 21 reported unauthorized wastewater releases at 18 facilities. Quantities ranged from 30 to 50,000 gallons and 85 – 1800 gallons per minute, and with varying causes including rain events and equipment failures. (This data is for the state fiscal year, July 1, 2013 to June 30, 2014).
6) Feedlot basin bypass, overflow and/or liquid manure application incident. These are not numerous, but they may contribute a high nutrient loaded discharge to the basin.

The largest spill incidents dealt with over in recent years have involved derailments of railcars. The largest in 2013 was a spill of 30,000 gallons of pygas from CP Rail near Plummer. Pygas is a toxic additive used during fuel production and has very high levels of benzene, toluene and styrenes. The product spilled to the road ditch (Hwy 59) where it was contained. Cleanup consisted of free product recovery and soil excavation. Hwy 59 was closed near the site for a month during cleanup. It did not enter the river to the north of Plummer.
The majority of fuel spills that occur in the basin do not impact surface waters to a great extent. The events which most often have negative effects on surface water in the basin are runoff from industry waste water or process water spills and bypasses from municipal waste water systems. Because the road system and pipelines cross all major drainages in Minnesota, there is always a chance that a large fuel spill will impact surface waters in a significant way. Companies that transport fuels in large amounts are required to have spill plans (MN Statute 115E) which are designed to help them respond quickly and thoroughly to any incident. The ER program is working with those industries to make sure those plans are complete and workable.

Municipal and Industrial Wastewater

Twelve municipal/industrial permits were issued in fiscal year 2014, 11 of these were reissuances, one was new. They are:

Fosston WWTP
Detroit Lakes WWTP

Bemidji Bituminous Inc.
Consolidated Equipment Group
Fosston Industrial Facility
Underwood WWTP
Viking WWTP
Brunswick Boat Group New York Mills Operations
BNSF RR - Dilworth
Fergus Power Pump Inc
Shelly WWTP
Spring Prairie Hutterite Colony WWTP – New

The MPCA is reviewing and considering phosphorus limits for NPDES permit holders in the Red River Basin. A two tiered approach is being considered based on facility size and other factors. The MPCA has also been communicating with regional partners in North Dakota, EPA Regions 5 and 8, and Canadian Governments on this issue.

Manitoba

Three municipalities with populations greater than 1,000 discharge treated effluents directly to the Red River within Manitoba. The Town of Morris discharges for a short period of time each spring and fall, while the City of Winnipeg's South End and North End Water Pollution Control Centres and the Town of Selkirk discharge continuously. Volumes and quality of effluent have not changed significantly from previous years. In addition to the two major wastewater treatment facilities within the City of Winnipeg, discharges also occur from 21 private wastewater treatment plants, 79 combined sewer outfalls, and 90 major land drainage outfalls. Most tributary streams also receive treated wastewater effluents from nearby communities.

Notification Regarding Intensive Livestock Operations

During the reporting period, Manitoba was not notified of any intensive livestock operations proposing to locate near the international border on the North Dakota or Minnesota side. Similarly, in Manitoba, no intensive livestock proposals were proposed near the international border.

North Dakota

The North Dakota Pollutant Discharge Elimination System (NDPDES) program requires all permitted facilities (industrial and municipal) to report wastewater spills and by-passes. During this reporting period (October 1, 2012 through September 30, 2013), there were 19 releases reported to the department in the Red River basin in North Dakota. The releases were related to pipe break/mechanical failure and lift station problems (overflows/bypasses) due to localized flooding and excessive precipitation. The facilities followed the reporting requirements of their permit. The spills/releases were followed up by department staff and all actions were resolved. Formal enforcement was not required based on the findings of the department.

7.03 Pollution Abatement and Advisories

Point Source Control Program

The department regulates the release of wastewater and stormwater from point sources into waters of the state through permits issued through the NDPDES Program. Permitted municipal and industrial point

source dischargers must meet technology or water quality based effluent limits. In addition, all major municipal and industrial permittees must monitor their discharge for whole effluent toxicity (WET) on a regular basis.

Toxic pollutants in wastewater discharges are regulated through the industrial pre-treatment program which is administered by the NDPDES Program. The cities of Grand Forks, Fargo, and West Fargo all have approved pre-treatment programs within the Red River basin in North Dakota.

There are presently 150 facilities with a NDPDES Program permit in the Red River basin. Of these, there are 29 industrial wastewater permits and 121 domestic/municipal wastewater permits. A majority of the domestic/municipal wastewater permits are for small lagoon systems which typically discharge 2-3 times a year for a period of a few days to a few weeks.

Stormwater

The NDPDES Program permits stormwater discharges from industrial sites, construction sites and larger municipalities (termed MS4s). The cities of Grand Forks, Fargo, West Fargo and their urbanized area continue to implement their MS4 permits within the Red River basin in North Dakota.

A majority of the construction stormwater permitting in North Dakota is now in the western part of the state. There are approximately 1011 stormwater permits for construction activity and 178 industrial stormwater permits in the Red River basin in North Dakota.

Animal Feeding Operations (AFOs)

The NDPDES Program continues to regulate animal feeding operations (AFOs) in the North Dakota. All large (>1000 animal units) permitted confined animal feeding operations (CAFOs) are inspected annually; whereas medium and small AFOs are inspected on an as-needed basis. There are 213AFOs permitted by the department in the Red River basin. Of these, there are 28 designated as large CAFOs.

Nonpoint Source Pollution Management Program

The Division of Water Quality is responsible for administering the Clean Water Act Section 319 Nonpoint Source Pollution Management Program (NPS Program) in North Dakota. Section 319 of the Clean Water Act and guidance provided by EPA defines the scope of the NPS Program, while the department administers the program with input from the North Dakota Nonpoint Source Pollution Task Force. The task force is comprised of representatives from state and federal natural resource agencies, commodity/producer groups, tribal councils and private wildlife/natural resource organizations.

Each year, federal funds are appropriated by the U.S. Congress to EPA for NPS pollution management. These Section 319 funds are then made available to individual states based on an allocation formula. In North Dakota, funds are awarded to project sponsors (e.g., soil conservation districts, water resource boards, cities, state agencies, universities, resource conservation and development councils, nonprofit organizations) to implement a variety of NPS pollution education, assessment and NPS pollution abatement projects. Approved local projects receive 60 percent federal funds with a 40 percent local match requirement.

Through the NPS Program, the department is currently cost-sharing a variety of NPS watershed assessment and NPS pollution abatement projects in the Red River basin. A map depicting the location of these projects in the Red River basin is provided in Figure 11. The following is a short summary of these projects.

- The Richland County SCD received Section 319 funding for Phase II of the Antelope Creek

Watershed and Wild Rice Riparian Corridor project in July 2011. The SCD was also awarded Outdoor Heritage Funds in 2013 to supplement the Section 319 funding committed for the implementation of best management practices (BMPs). The Outdoor Heritage Funds are state funds generated through oil tax revenues. The primary goal of the project is to restore the recreational uses of the impaired reaches of Antelope Creek and the Wild Rice River in Richland County. As a secondary goal, the project will protect and enhance aquatic life uses of Antelope Creek and the Wild Rice River through targeted implementation of BMPs within or immediately adjacent to the riparian corridor. These goals will be accomplished through one-on-one conservation planning; implementation of agricultural BMP; septic system renovation; and public education.

- The Barnes County SCD received Phase II Section 319 funding for a NPS pollution abatement project on the Sheyenne River below Baldhill Dam (Lake Ashtabula) in April 2010. Outdoor Heritage Funds were also allocated to the project in 2013 to support the installation of BMP identified in the project implementation plan. The Barnes County Sheyenne River Watershed - Phase II Project is designed to provide technical, financial and educational assistance to agriculture producers and landowners with riparian acreage in the Sheyenne River watershed in Barnes County. The goal of the project is to restore and maintain the recreational and aquatic life uses of the Sheyenne River and its tributaries. Project sponsors will: 1) provide technical and financial assistance to producers and landowners within ½ mile of the Sheyenne River and its tributaries as well as to priority locations outside this corridor; 2) assist with BMPs that protect/enhance our riparian areas; 3) develop educational programs to heighten public awareness of NPS pollution impacts and solutions; and 4) develop working partnerships in the local community to benefit natural resources.

- The Ransom County SCD is in the fifth year of a watershed restoration and NPS pollution abatement project focused on Dead Colt Creek Dam reservoir. The main goal of this project is to restore the recreational and aquatic life uses of the reservoir through the implementation of the nutrient, sediment and dissolved oxygen TMDLs developed for Dead Colt Creek Dam. Restoration of the recreational and aquatic life uses will focus on the reduction of sediment and nutrient loadings associated with priority crop, pasture and rangeland acres in the watershed. Specific emphasis will be placed on the reduction of the in-lake mean annual total phosphorus concentrations. The project goals will be accomplished by providing financial and technical assistance for conservation planning and BMP implementation within the targeted acres in the watershed. In addition to the longstanding USDA programs, Section 319 and Outdoor Heritage Funds are also being used to support BMP implementation.

- The Cass County SCD has been utilizing Section 319 funding the past 5 years to support the implementation of the Rush River and Brewer Lake Watershed project. The focus of the Cass County SCD is the implementation of agricultural BMPs that will improve the designated uses of Rush River and Brewer Lake. These beneficial uses include fish and other aquatic biota, and recreation. To restore or maintain these uses, the project goal is to achieve measurable reductions in the mean annual concentrations of total nitrogen and phosphorus as well as E. coli bacteria throughout the watershed.

- The Cass County SCD was also awarded Section 319 funding for the Maple River Watershed project in April 2010. The SCD is using the funding to promote and implement BMPs that will restore the impaired beneficial uses of Maple River. These degraded uses include fish

and other aquatic biota, and recreation. To restore the beneficial uses, the SCD's land management improvement efforts will focus on the reduction of the mean annual concentrations of total nitrogen, phosphorus and E. coli bacteria in the river. The project will provide technical and financial support for conservation planning, agricultural BMP implementation, and septic system renovation. To the extent possible, BMPs supported by the project will be targeted toward the highest priority sub-watersheds, in terms of NPS pollution loadings, in the Maple River watershed.

- Phase IV of the Red River Riparian Project received Section 319 funding in 2008 to restore degraded streambanks and riparian areas along priority tributaries to the Red River in northeastern ND. These priority rivers/areas include the: Little South Pembina River; Tongue River; Park River (South & North Branches); Turtle River; Fordville Dam; and the Middle Sheyenne River in Nelson County. The project's restoration goals will be accomplished through the delivery of financial and technical assistance to agricultural producers and private landowners interested in installing BMP. The project will also assist with the development of riparian forest management plans and provide recommendations for proper riparian management to private individuals and local resource managers. The project also conducts public outreach events annually to disseminate information on riparian management and restoration techniques. The target audiences for the educational efforts include the general public and landowners as well as communities, water resource districts, and soil conservation districts.

- The Grand Forks County SCD is utilizing Section 319 funding to implement the revised Turtle River Watershed project. The updated project goals are to identify management needs in the watershed and strengthen landowner support for future water quality improvement efforts. The focus of the revised project will be to deliver an educational program targeting landowners, educators, youth, and the general public. The main purpose of the educational program is to inform participants of different alternative land management practices that can be used successfully in the watershed to protect and/or improve water quality. As a second goal, the watershed is also being reassessed to better define beneficial use conditions; determine pollutant sources and causes; establish priority areas; and identify BMPs needed to address identified water quality impairments. Restoration goals and objectives for subsequent implementation plans will be based on this assessment information. Tentative plans are to solicit continued Section 319 financial support in 2014 for a project focused on the redefined priority areas.

- The Wild Rice SCD has continued to use Section 319 funds to implement the Wild Rice River Restoration and Riparian project in Sargent County. The priority areas for the project include the lands immediately adjacent to 303(d) listed waterbodies and the major subwatersheds within Sargent County. The SCD's primary goal is to promote and implement agricultural BMPs that will reduce or prevent sediment and nutrient loadings to the Wild Rice River and its tributaries. The watershed project is providing technical and financial support for conservation planning, BMP implementation and the development of riparian easements in the priority areas.

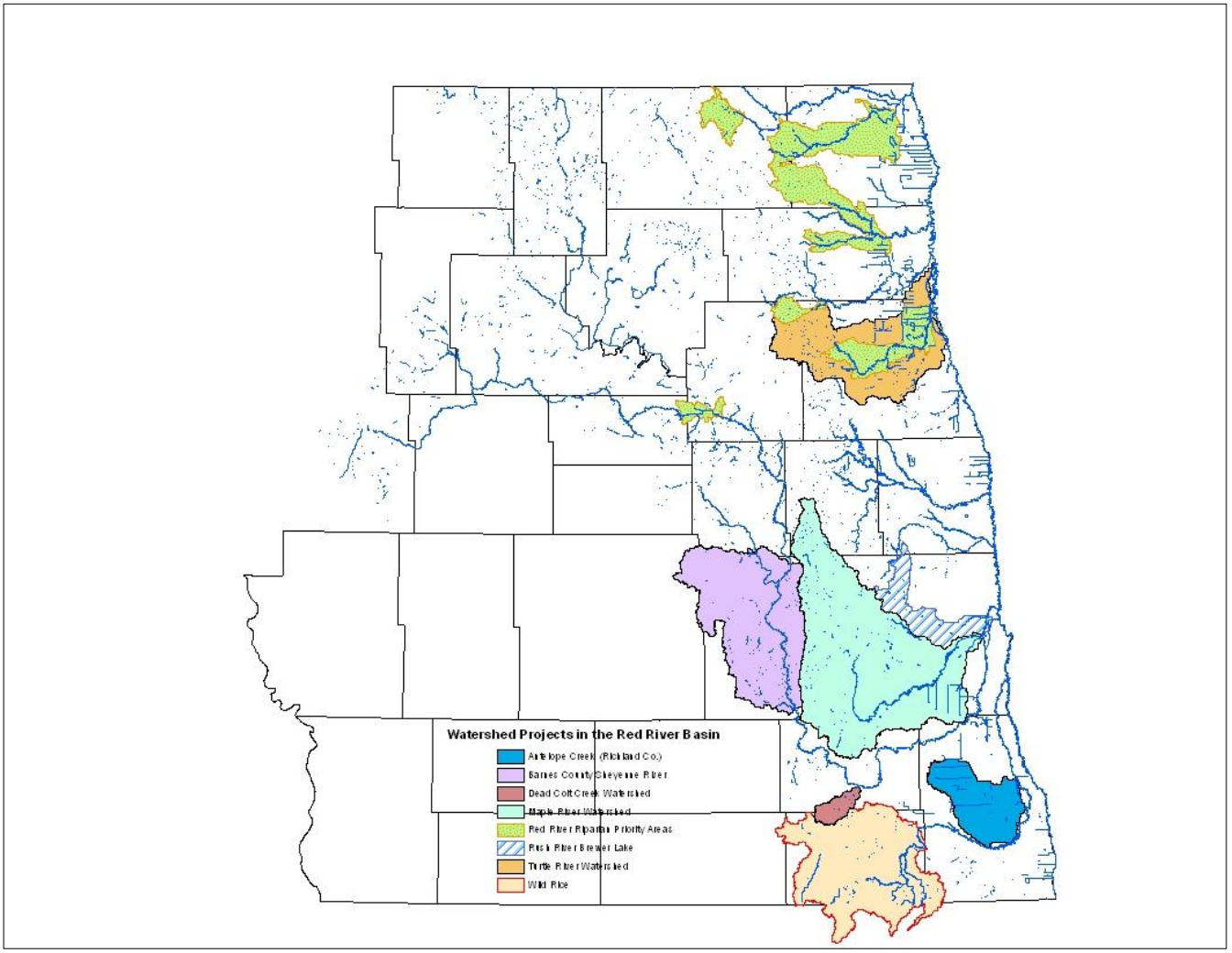


Figure 11: Watershed Restoration and Abatement Project in the Red River Basin, North Dakota

Pollution Abatement

<u>Manitoba</u>

Manitoba Water Quality Standards, Objectives, and Guidelines are applicable to streams within the Red River basin. Water uses protected in the Red River include domestic water supply source, habitat for aquatic life and wildlife, industrial uses, irrigation, livestock watering, and water-related recreation.

Treated municipal effluents discharged to the Red River and tributary streams in Manitoba are licensed under Manitoba's *Environment Act*. Disinfection with ultra-violet light technology has been installed and is operational at the City of Winnipeg's South and North End Water Pollution Control Centres. In August 2004, the City of Winnipeg introduced a web-based system to inform the public whenever there is likely to be a sewer overflow into the Red or Assiniboine Rivers (http://winnipeg.ca/waterandwaste/sewage/overflow/previous24.stm).

Manitoba continues to work to understand sources of nutrients to Lake Winnipeg, to monitor the impacts of excess nutrients and to reduce nutrient loading to meet a 50 % reduction in phosphorus in Lake Winnipeg.

In June 2013, Manitoba introduced the Lake Friendly Accord and the Lake Friendly Stewards Alliance as a way of coordinating action toward a common goal of improving water quality by reducing nutrients through the engagement of all (www.manitoba.ca/lakefriendlyaccord). Manitoba partnered with the Mayors and Reeves of the south basin of Lake Winnipeg to build on the success of the existing "Lake Friendly" awareness program to ensure that this Accord will engage all sectors of society in action to protect our lakes and rivers. The Lake Friendly Accord is a pledge, with signatories supporting a common goal to reduce nutrient loading to waterways by working collaboratively, developing specific commitments, and reporting annually on plans, progress and actions.

The Accord will provide a framework for all stakeholders including governments and non-government agencies to identify actions that they can take to reduce nutrient loading and to improve water quality. The Accord will not duplicate but will build on existing transboundary mechanisms and agreements such as through the International Joint Commission and the Red River Basin Commission.

The Lake Friendly Accord was signed by the governments of Canada and Manitoba, and the South Basin Mayors and Reeves in March 2014. Manitoba is working to engage other signatories from across the Lake Winnipeg basin.

In Manitoba, action to reduce the nitrogen and phosphorus load to Lake Winnipeg and its watershed has been summarized in a document called Lake Friendly in 50 Ways which is available here http://www.gov.mb.ca/conservation/waterstewardship/water_quality/lake_winnipeg/pdf/lake_friendly_50_ways.pdf. Some highlights of Manitoba's action to reduce nutrients include:

- Nutrient Management Regulation
    - Work continues to implement the Nutrient Management Regulation which was enacted in March 2008. The Nutrient Management Regulation applies to the application of nutrients to land from all sources including livestock manure, inorganic fertilizer, cosmetic fertilizers, and biosolids/sludge.
    - More information on the Nutrient Management Regulation under *The Water Protection Act* is available at http://www.gov.mb.ca/waterstewardship/wqmz/index.html.
- Under Manitoba's *Environment Act* and its regulations, all livestock operations regardless of size are prohibited from applying manure to land in the winter (November 10th to April 10th). All operations regardless of size were required to comply by November 10, 2013.
- Manitoba is implementing *The Save Lake Winnipeg Act* which introduced restrictions on the expansion of hog operations, improved protection of wetlands on crown lands, strengthened nutrient removal requirements for the City of Winnipeg's wastewater treatment facility, and introduced a moratorium on the issuance of permits or leases for peat and peat moss.
- A surface water management strategy has been developed for Manitoba through an extensive stakeholder consultation process (http://www.gov.mb.ca/conservation/waterstewardship/questionnaires/surface_water_management/index.html). The surface water management strategy includes 50 actions to be implemented by 2020 including:
    - no net loss of wetland benefits – drainage licenses will be generally unavailable for permanent, semi-permanent and seasonal wetlands, and where they must be drained with no alternative, there must be mitigation to more than compensate for the loss of wetland benefits;
    - run-off retention pond network – research by the University of Manitoba will lead to proven

retention pond models that will manage wet period run-off;
    - terminal basin management – lakes with no natural outlet will be better managed with watershed-based solutions including incoming drainage controls, adjusting land use where available and water diversion only when human health and residences are threatened;
    - more protected areas for wetland benefits – additional protected areas in agro Manitoba will hold more water on the land in natural grasslands and wetlands;
    - green infrastructure – storm water will be better managed by such options as porous pavement, green roofs, rainwater harvesting and urban retention works;
    - new Water Management Directorate – provincial government action will be co-ordinated by a new cross departmental management structure; and
    - new Interagency Surface Water Advisory Team – conservation districts, planning districts, municipalities and representatives of landowners will be invited to co-operatively plan surface water management within provincial watersheds.
- Under the Surface Water Management Strategy, a proposed new approach for drainage and water retention in Manitoba has been announced for public consultation (http://www.gov.mb.ca/conservation/waterstewardship/licensing/drainage/index.html). Key stakeholders developed the risk-based approach to drainage licensing which moves the focus of regulation from oversight of routine drainage and water retention to those projects with potentially serious environmental impacts. Routine drainage and water retention works would have clear minimum standards, reduced wait times and associated costs. Seasonal and permanent wetland benefits would be protected and breaches would be caught through spot audits and improved enforcement.

- Wastewater Treatment:
    - The Manitoba Water Quality Standards, Objectives and Guidelines were enshrined in a regulation under Part Two of *The Water Protection Act* (http://www.gov.mb.ca/waterstewardship/water_quality/quality/website_notice_mwqsog_2011.html). The regulation was registered on November 28, 2011.
    - The Manitoba Water Quality Standards include province-wide standards for phosphorus in wastewater effluent (1 mg/L) and where site-specific conditions warrant, nitrogen (15 mg/L). Under the province-wide nutrient standards, a 1 mg/L phosphorus limit applies immediately for all new, expanding or modified wastewater treatment facilities. Small wastewater treatment facilities discharging more than 820 kilograms of phosphorus per year (serving less than 2,000 people or equivalent) have the option of implementing a demonstrated nutrient reduction strategy (for example, a constructed wetland, effluent irrigation, etc) or the 1 mg/L phosphorus limit. Existing wastewater treatment facilities discharging more than 820 kilograms of phosphorus per year (serving more than 2,000 people or equivalent due to industrial contributions) will be required to meet a 1 mg/L phosphorus limit by January 1, 2016. Facilities were required to submit a phosphorus compliance plan by January 1, 2013 that demonstrates the actions taken and proposed to be taken to meet the 1 mg/L phosphorus limit by January 1, 2016.
    - Nutrient removal has already been implemented at a number of wastewater treatment facilities across the province including in Brandon, Winnipeg's West End Water Pollution Control Centre, Headingley, Neepawa and Gimli. In addition, all wastewater treatment facilities in provincial parks are required to remove phosphorus to 1 mg/L.

- Integrated Watershed Management Planning:
    - Work on integrated watershed management planning under *The Water Protection Act* also continued and included plans in several Red River tributary watersheds: Cooks Creek and Devils Creek. Integrated watershed management plans for the Rat Marsh River, Seine

River, La Salle River, Pembina River and the Grassmere-Netley Creek watershed are complete. Integrated watershed management plans are compiled by local water planning authorities with stakeholder input and are to be implemented, monitored and updated regularly (every ten years) by these authorities. Water planning authorities are designated under *The Water Protection Act* and the development of integrated watershed management planning is guided by specifications in *the Act*. Manitoba provides financial, planning and technical assistance to the process. The integrated watershed management plans include a report on current science knowledge of the watershed environment as well as initiatives to monitor, maintain, and improve environmental conditions in the watershed.

- Education:
    - Manitoba Conservation and Water Stewardship continues to provide support to the South Basin Mayors and Reeves to help Manitobans learn more about being Lake Friendly. More information is available at www.lakefriendly.ca.

8.0 BIOLOGICAL MONITORING IN THE RED RIVER BASIN

8.01 Macorinvertebrates of the Red River in Manitoba

Biological Information

Benthic macroinvertebrates were collected at two locations on the Red River in September 2013: Emerson and Selkirk (Table 8). At each location, one transect of five dredge grab samples were collected by using a petit Ponar dredge. Starting at the east bank, samples were collected at five equidistant sample sites across the width of the river. Each Ponar dredge covered an area of 0.023 m^2. For each transect, 0.115 m^2 of sediment was collected. The dredge samples were washed through 500 µm Nitex nylon nets. River water was used to remove organisms and sediment from the nylon net into a 500 µm mesh sieve. Remaining sediment and all organisms were then placed in labelled 500 mL glass jars with 70 % ethyl alcohol preservative. Macroinvertebrates were subsequently identified to the lowest possible taxonomic level, typically genus and species, by ALS Environmental, Winnipeg, Manitoba.

Table 8. Geographic coordinates for the benthic macroinvertebrates sampling stations at Emerson and Selkirk on the Red River, Manitoba in September 2013.

Transect	Latitude	Longitude
Emerson	49°00'13.6"	97°13'16.2"
Selkirk	50°08'55.7"	96°51'24.8"

In 2013 at Emerson, 21 organisms were collected. To calculate organisms per square metre, the number of organisms at each transect was multiplied by a factor of 8.70 yielding 183 organisms/m^2 (Table 9). At Emerson, the organisms in greatest abundance were from the order Trichoptera (Family Hydropsychidae), a relatively pollution-tolerant net spinning caddis fly larvae.

In the Red River at Selkirk, Manitoba, 357 organisms were collected. To calculate organisms per square metre, the number of organisms at each transect was multiplied by a factor of 8.70 yielding 3104 organisms/m^2 (Table 10). The species of greatest abundance at Selkirk was a copepod (Class Crustacea, Order Copepoda, Family Calanoida).

Similar to 2012, the Red River at Selkirk location had the greatest diversity in benthic macroinvertebrates. The Red River near Selkirk also had a higher number of total organisms due to a few subsamples that included a large number of Tubificidae worms and copepods. Tubificidae are typically tolerant to organic pollutants.

Table 9. Summary of macroinvertebrates collected per transect and calculated total per metre squared in pooled Ponar © dredge samples from the Red River at Emerson, Manitoba in September 2013.

Class	Order	Family	Genus	Species	Number per transect
Annelida	Oligochaeta	Tubificidae			2
Crustacea	Ostracoda				1
Insecta	Coleoptera	Gyrinidae	*Gyrinus*		1
Insecta	Diptera	Ceratopogonidae	*Palpomyia/Bezzia*		1
Insecta	Diptera	Chironomidae	*Cryptochironomus*		3
Insecta	Diptera	Chironomidae			1
Insecta	Diptera	Empididae	*Hemerodromia*		1
Insecta	Ephemeroptera	Ephemeridae	*Hexagenia*	*limbata*	1
Insecta	Trichoptera	Hydropsychidae	*Potamyia*	*flava*	7
Nematoda					3
			Total number of organisms per m2		21
			Total number of taxa		10

Table 10. Summary of macroinvertebrates collected per transect and calculated total per metre squared in pooled Ponar © dredge samples on the Red River at Selkirk, Manitoba in September 2013.

Class	Order	Family	Genus	Species	Number per Transect
Annelida	Oligochaeta	Tubificidae			109
Annelida	Oligochaeta	Tubificidae	*Branchiura*	*sowerbyi*	2
Crustacea	Cladocera				1
Crustacea	Copepoda	Calanoida			120
Crustacea	Ostracoda				12
Gastropoda	Neotaenioglossa	Hydrobiidae	*Amnicola*	*limosa*	3
Gastropoda	Prosobranchia	Valvatidae	*Valvata*	*sincera*	4
Insecta	Diptera	Ceratopogonidae	*Palpomyia/Bezzia*		1
Insecta	Diptera	Chironomidae	*Ablabesmyia*		8
Insecta	Diptera	Chironomidae	*Chironomus*		21
Insecta	Diptera	Chironomidae	*Cryptochironomus*		2
Insecta	Diptera	Chironomidae	*Cryptotendipes*		5
Insecta	Diptera	Chironomidae	*Procladius*		18
Insecta	Ephemeroptera	Ephemeridae	*Hexagenia*	*limbata*	31
Insecta	Ephemeroptera	Ephemeridae	*Hexagenia*	*rigida*	1
Nematoda					2
Pelecypoda	Veneroida	Pisiidae	*Sphaerium*		4
Pelecypoda	Veneroida	Pisiidae			13
			Total number of organisms per m^2		357
			Total number of taxa		18

8.02 *Escherichia coli* and Algal Bloom Monitoring in Lake Winnipeg

Manitoba monitored eighteen recreational beaches within the south basin of Lake Winnipeg for levels of *Escherichia coli* during 2013 (Table 11). Sampling began at the end of May and continued weekly until the beginning of September. Two beaches were monitored every other day. Bathing water near the shoreline was collected for densities of *E. coli*.

While some beaches occasionally exceeded Manitoba's recreational water quality guideline for fecal indicator bacteria, typically recreational water quality is excellent at Lake Winnipeg beaches. All beaches have a blue coloured "Clean Beaches" sign that provides information to bathers about *E. coli* and identifies precautions on how the bathing public can reduce risk of exposure to pathogens. For beaches that had *E. coli* densities above the guideline and that have a history of elevated densities, additional yellow coloured "Beach Advisory" signs were posted. Results of DNA ribotyping from 2002 to 2007 indicated that approximately 34 per cent of *E. coli* from all samples could be attributed to shorebirds and geese, while less than 5 per cent of the samples could be attributed to human sources. Thirty seven per cent of the *E. coli* samples could not be matched to a particular animal source.

As part of the 2013 beach monitoring program, Manitoba Conservation and Water Stewardship continued to monitor beaches on Lake Winnipeg for the presence of algal blooms. On Lake Winnipeg, West Grand Main Beach, West Grand Beach Lagoon and Victoria Beach at Connaught Road were posted with the first level of algae advisory indicating the number of blue-green algae cells exceeded the Manitoba recreational water quality objective of 100,000 cells per mL. The first level of algae advisory lets bathers know that algae blooms have been observed at the beach and provides some additional advice regarding avoiding contact with the water when algae blooms are present. The second level of advisory or algae toxin advisory is posted when the concentration of microcystin exceeds the Manitoba recreational water quality objective of 20 ug/L. The advisory indicates that drinking, swimming or other contact with the water is not recommended. In 2013 there were no beaches on Lake Winnipeg posted with second level algae advisory signs.

Table 11. Recreational beaches in Lake Winnipeg south basin monitored in 2013.

Locations	*Escherichia coli* in bathing water
Victoria Beach (2 sites)	Weekly
Hillside Beach	Weekly
Albert Beach	Weekly
Lester Beach	Weekly
East Grand Beach	Weekly
West Grand Beach	Every other day
Patricia Beach	Weekly
Gull Harbour	Weekly
Black Point	Weekly
Grindstone Beach	Weekly
Sandy Bar Beach	Weekly
Hnasau Park Beach	Weekly
Spruce Sands Beach	Weekly
Gimli Beach	Every other day
Sandy Hook Beach	Weekly
Winnipeg Beach	Weekly
Matlock Beach	Weekly

8.03 Fisheries of the Red River in Manitoba

Biological Information

A total of 67 fish species have been recorded in the Manitoba's portion of the Red River (Table 12). Presently, Bigmouth Buffalo (*Ictiobus cyprinellus)*, Chestnut Lamprey (*Ichtyomyzon unicuspis*) and Silver Chub (*Macrhboposis storeriana*) are designated as Special Concern under *The Species at Risk Act*. In 2005, Lake Sturgeon (*Acipenser fulvescens)* were recommended for listing as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). This species may be listed under the Species at Risk Act in 2013/2014.

Known aquatic invasive species that have been introduced in the Manitoba portion of the Red River include the Common Carp (*Cyprinus carpio)*, White Bass (*Morone chrysops)*, Rainbow Smelt (*Osmerus mordax)* and Asian Carp Tapeworm (*Bothriocephalus acheilognathi)*. Other recent introductions into the Manitoba portion of the Red River include Feral Gold Fish (*Carassius auratus)*, Smallmouth Bass *(Micropterus dolomieu)* and Largemouth Bass *(Micropterus salmoides).*

In 2010 and 2011, zebra mussel veligers (*Dreissena polymorpha*) were confirmed from the Red River near Wahpeton, North Dakota. This follows the discovery of zebra mussels in 2009 from Pelican Lake, Minnesota. Pelican Lake forms part of an upstream chain of connected waterways within the Red River watershed and this discovery was the first occurrence of this aquatic invader in the Red River watershed. Consequently, Conservation and Water Stewardship in cooperation with Environment Canada continued to collect weekly water samples during the spring, summer and fall of 2012 for the presence of zebra mussel veligers (larval zebra mussels) in the Red River at Emerson. No veligers have been found to date.

In 2010, a number of new initiatives were put into place by the Aquatic Invasive Species Task Group under the Canada-Manitoba Fisheries Advisory Board with the goal of establishing collaborative programs for preventing aquatic invasive species from entering Manitoba. These preventative measures were aimed at popular fishing and boating destinations including the Red River corridor. Inspections of trailered watercraft at the international border crossings of Emerson and Sprague were conducted during the period. Navigational buoys and supporting equipment deployed in the Red River were inspected for aquatic invasive species in the fall of 2013 with none being found.

Zebra mussels were identified at five harbour locations in Lake Winnipeg in 2013, including Silver/Arnes, Gimli, Willow Point, Winnipeg Beach/Boundary Bay and Balsam Bay. Densities were low, approximately 2 to 3 per m^2 and all collected individuals were less than one year of age, indicating an early stage of infestation. The distribution of mussels within Lake Winnipeg, and the failure to find either zebra mussel veligers or adults in the Red River, was indicative of introduction of zebra mussels via an infested watercraft, likely at Gimli or Winnipeg Beach harbour, and not as a result of downstream drift of veligers in the Red River. A Rapid Response protocol was immediately implemented and a Science Advisory Committee with federal, provincial and external zebra mussel experts struck to consider the best response to the invasion. The Committee recommended potash (100 ppm potassium chloride) treatment of the affected harbours to reduce the probability that these sites would serve as vectors for further spread of zebra mussels in 2014 and to reduce the overall population of mussels. Treatments of the harbours (excluding Willow Point, which was confirmed to have frozen to the bottom in during the winter of 2013/2014) were successfully concluded in May and June 2014. An intensive monitoring program is being implemented in 2014 to assess whether there is a viable offshore population of zebra mussels and to monitor any further spread of zebra mussels to other locations in Lake Winnipeg. Manitoba is also enhancing its boat inspection and decontamination capacity in 2014. Further control and containment options await results of the monitoring data.

An instream flow study has been undertaken on the Assiniboine River (a major tributary of the Red River). The objective of this study is to develop appropriate instream flow recommendations to ensure healthy and sustainable aquatic ecosystem functions. A final report draft is expected in 2014/15.

The Instream Flow program within Manitoba Fisheries Branch continued coordination efforts on some of its activities with a committee from Fisheries and Oceans Canada. The intention of this collaboration was to seek intellectual partnerships that could promote the development of instream flow needs assessments within Manitoba. One project coming out of this collaboration concerned the International Joint Commission which had requested instream flow work to commence on the Red River through the International Red River Board. This request sought to understand the environmental impacts of apportionment agreements for the Red River. Up until this point, work had begun on the hydrology of the system but it had not been clear how these hydrological assessments would be linked to the environmental impact of the river's changed hydrology over time. As such, the Provincial Instream Flow Biologist was consulted to explain conceptual and methodological linkages between the hydrology and the other aspects of the instream flow needs approach as a method for determining "environmental flows". Currently, work on the Red River has remained focused on understanding its hydrology, after which it is proposed that linkages to other instream flow needs aspects will commence.

Recreational Angling - Value

The Manitoba portion of the Red River has become internationally known for the high quality of angling the fishery supports. Based on Manitoba's 2005 Angler Survey, Manitobans and visitors to the province fished a total of 2.6 million days of which 10% were spent on the Red River making it the most heavily fished area in the province. It is estimated that anglers fishing the Red River contribute $15-20 million annually on goods and services directly/indirectly related to angling. In 2010, Manitoba again participated in a National Recreational Angling Survey. These surveys remain the only source of harvest information related to recreational fishing in Canada. Further economic information is available in a 2012 Travel Manitoba report "Economic Evaluation of Manitoba's Hinting and Fishing Industry".

The fishery attracts nonresidents to trophy walleye and channel catfish angling opportunities. Furthermore, the diverse fish species composition appeals to residents of all ages. From an angling perspective, the fishery is managed to: 1) ensure sustainability of the recreational fishery for future generations, 2) encourage angler participation and development of the recreational fishing potential of the river, and 3) maximize economic returns to angling interests who rely on the fishery for their livelihood.

The majority of angling effort occurs between the floodway gate structure at St. Norbert to the mouth of the river at Lake Winnipeg during the open water season. Angling is especially concentrated from the dam at Lockport downstream to Netley Creek and within the City of Winnipeg.

Angling in Winnipeg has become more popular with anglers over the past 10 years due to the work conducted by Winnipeg's Urban Angling Partnership (UAP - private sector and government partnership). There are a number of issues that have affected users of this fishery and the UAP has been working towards addressing as many as possible. These include, but not restricted to, water quality concerns, fish consumption (i.e., safety) and access to the fishery due to fluctuating water levels, particularly in within the City of Winnipeg.

Manitoba Conservation and Water Stewardship, Fisheries Branch has been collaborating with researchers from the University of Nebraska for 2011 to 2014 on a series of projects to understand and improve management of the valuable Red River channel catfish fishery. Demographic information is being collected

and stable isoptope evaluation of the food web is being conducted to facilitate description of energy flow through to channel catfish. A ongoing catfish tagging program began in August of 2012 and will estimate population size, mortality, and physical extent of the population. More than 4000 channel catfish have been tagged with externally visible orange Floy tags to date. In 2014 tagging activities extended to locations south of the City of Winnipeg, including the Red River at the International Boundary.

Table 12. Fish species of the Red River in Manitoba.

Common Name	Genus	Species	Presence	Common Name	Genus	Species	Presence
Banded Killifish	Fundulus	diaphanus	Rare	Largemouth Bass +	Micropterus	salmoides	Uncommon
Bigmouth Buffalo *	Ictiobus	cyprinellus	Common	Logperch	Percina	caprodes	Common
Bigmouth Shiner	Notropis	dorsalis	Unknown	Longnose Dace	Rhinichthys	cataractae	Unknown
Black Bullhead	Ameiurus	melas	Common	Longnose Sucker	Catostomus	catostomus	Common
Black Crappie	Pomoxis	nigromaculatus	Common	Mimic Shiner	Notropis	volucellus	Unknown
Blackchin Shiner	Notropis	heterodon	Unknown	Mooneye	Hiodon	tergisus	Rare
Blacknose Shiner	Notropis	heterolepis	Unknown	Ninespine Stickleback	Pungitius	pungitius	Common
Blackside Darter	Percina	maculata	Unknown	Northern Pike	Esox	lucius	Common
Bluntnose Minnow	Pimephales	notatus	Unknown	Pearl Dace	Margariscus	margarita	Unknown
Brassy Minnow	Hybognathus	hankinsoni	Unknown	Quillback	Carpiodes	cyprinus	Uncommon
Brook Stickleback	Culaea	inconstans	Common	Rainbow Smelt +	Osmerus	mordax	Uncommon
Brown Bullhead	Ameiurus	nebulosus	Common	River Darter	Percina	shumardi	Common
Burbot	Lota	Lota	Common	River Shiner	Notropis	blennius	Unknown
Central Mudminnow	Umbra	Limi	Common	Rock Bass	Ambloplites	rupestris	Common
Channel Catfish	Ictalurus	punctatus	Common	Rosyface Shiner	Notropis	rubellus	Unknown
Chestnut Lamprey *	Ichthyomyzon	castaneus	Unknown	Sand Shiner	Notropis	stramineus	Uncommon
Cisco	Coregonus	artedi	Common	Sauger	Sander	canadensis	Common
Common Carp +	Cyprinus	carpio	Common	Shorthead Redhorse	Moxostoma	macrolepidotum	Common
Common Shiner	Luxilus	cornutus	Rare	Silver Chub *	Macrhybopsis	storeriana	Common
Creek Chub	Semotilus	atromaculatus	Unknown	Silver Lamprey	Ichthyomyzon	unicuspis	Unknown
Emerald Shiner	Notropis	atherinoides	Abundant	Silver Redhorse	Moxostoma	anisurum	Common
Fathead Minnow	Pimephales	promelas	Common	Smallmouth Bass +	Micropterus	dolomieu	Unknown
Flathead Chub	Platygobio	gracilis	Unknown	Spotfin Shiner	Cyprinella	spiloptera	Unknown
Freshwater Drum	Aplodinotus	grunniens	Abundant	Spottail Shiner	Notropis	hudsonius	Common
Golden Redhorse	Moxostoma	erythrurum	Rare	Stonecat	Noturus	flavus	Unknown
Golden Shiner	Notemigonus	crysoleucas	Unknown	Tadpole Madtom	Noturus	gyrinus	Common
Goldeye	Hiodon	alosoides	Common	Troutperch	Percopsis	omiscomaycus	Common
Goldfish +	Carassius	auratus	Unknown	Walleye	Sander	vitreus	Common
Hornyhead Chub	Nocomis	biguttatus	Unknown	Western Blacknose Dace	Rhinichthys	obtusus	Unknown
Iowa Darter	Etheostoma	exile	Common	White Bass +	Morone	chrysops	Common
Johnny Darter	Etheostoma	nigrum	Common	White Crappie	Pomoxis	annularis	Unknown
Lake Chub	Couesius	plumbeus	Rare	White Sucker	Catostomus	commersoni	Common
Lake Whitefish	Coregonus	clupeaformis	Uncommon	Yellow Perch	Perca	flavescens	Common
Lake Sturgeon *	Acipenser	fulvescens	Rare				

Note: * = indicates species at risk, + = indicates introduced species

9.0 ADDITIONAL ACTIVITIES IN THE RED RIVER BASIN

As outlined in Appendix A – International Red Rive Board Directive, the duties of the Board include maintaining an awareness of other agencies in the basin, of developments and conditions that may affect water levels and flows, water quality and ecosystem health of the Red River and its transboundary tributaries, and activities that contribute to a better understanding of the aquatic ecosystems. Chapter 9 provides an overview of a number of relevant activities and developments in the basin.

9.01 Garrison Diversion Project - Dakota Water Resources Act

The Dakota Water Resources Act (DWRA) of December 2000 amended authorizing legislation for the Garrison Diversion Project. The legislation outlines a program to meet Indian and non-Indian water supply needs in North Dakota and authorizes water uses including municipal, rural and industrial, fish and wildlife, recreation, irrigation, flood control, stream flow augmentation, and ground water recharge.

Red River Valley Water Supply Project

In December 2007 a final Environmental Impact Statement (EIS) was completed which identified a preferred alternative for delivery of Missouri River water, via existing and new facilities, to meet both short- and long-term water needs in the Red River Valley in North Dakota and Minnesota. The Bureau of Reclamation has completed the DWRA required NEPA analyses.

Secretary of the Interior Kempthorne signed a formal determination on January 13, 2009, finding that the EIS' proposed water treatment for the importation of Missouri River water for the Red River Valley project was adequate under applicable federal law and treaty provisions. The selected approach to water treatment was developed in close consultation with U.S. EPA and the U.S. Department of State, as required by DWRA. The preferred biota treatment alternative identified in the final EIS meets or exceeds treatment goals proposed by the Province of Manitoba.

Secretary Kempthorne deferred signing a Record of Decision (ROD) concluding it would be more appropriate to defer a ROD until Congress has authorized construction of the project features identified in the EIS. If and when authorized by subsequent legislation, as DWRA requires for such an importation project, the Department of the Interior would then review the authorized project to determine whether any additional National Environmental Policy Act (NEPA) is required or appropriate.

An extensive amount of engineering and environmental work had previously been completed using an approach to obtain a federal Record of Decision and federal implementation. Because the Secretary of Interior has not signed the Record of Decision, the Lake Agassiz Water Authority (LAWA) and Garrison Diversion Conservancy District (GDCD) had their consultants develop a proposed alternative route concept and project configuration for State and local implementation. The ND State Water Commission (NDSWC) obtained the services of CH2M HILL to perform an independent value engineering analysis of the proposed alternative and other alternative routes. Various questions about the potential for the RRVWSP to be implemented as a State and local project were also to be addressed.

The primary goal of the study is to help the State select the alignment that provides the best opportunity to complete the Red River Water Supply Project.

The main study objectives are to:

1. Assess various pipeline alignments previously identified, and to identify and assess additional alignments that should be considered
2. Assess the overall technical and permitting feasibility of a Missouri River intake and delivery of water to identified end users
3. Assess the estimated project costs

The following 25 alternatives were evaluated:

- 12 alignments, each with one of two intake types (total of 24 alternatives)
    - A bank filtration system (BFS), consisting of several horizontal collector wells
    - A conventional river bank diversion intake system
- Preferred Alternative described in the Final Environmental Impact Statement, Red River Valley Water Supply Project (FEIS) (Bureau of Reclamation, 2007)

Project stakeholders developed the following criteria, in order of importance, to select the best alternative:

- Criteria A – Timely Construction Start. Federal permitting requirements, existing easement options, and how to leverage work already completed was evaluated to for a State and local project to be implemented in the shortest period of time.

- Criteria B – Sustainable Project for Users. The project would need to meet the long term needs of user. Various delivery systems (stream channel versus pipeline) and the use of Lake Ashtabula.

- Criteria C – Robustness. This criterion reflects the desire to deliver water to Lake Ashtabula to take advantage of storage on the east side of the Continental Divide and measures the relative cost to add more users.

- Criteria D – Benefits/Impacts to Lake Ashtabula and Instream Flows. This reflects the desire to maintain previous environmental commitments made during the federal process. A distinction exists among the alternatives regarding their potential to enhance conditions for aquatic life and habitat in the Sheyenne River and, in some cases, the Red River. That benefit occurs due to providing higher instream flows when the project water is delivered within these rivers to Fargo or Grand Forks.

The Washburn to Baldhill Creek pipeline alignment (Alternative 13, also known as Option 1 or Plan B) is the apparent best alternative because it best meets the developed criteria (Figure 12). Further discussion is ongoing.

The North Dakota State Water Commission (NDSWC) issued a request for engineering proposals for a hydro-geologic investigation and conceptual Bank Filtration System (BFS) design on the Missouri River. The team of CH2MHill/AE2S working in conjunction with Layne Ranney was selected for this contract. The purpose of the project is to categorize the potential for subsurface water intakes along the Missouri River primarily to investigate the feasibility of a BFS comprised of Horizontal Collector Wells (HCW) intake option for a potential Red River Valley Water Supply Project as well as potential subsurface intake locations for other uses. The scope of work will include review of existing data, geophysical exploration, soil borings, aquifer pumping tests and conceptual design of an intake along with estimate of probable costs. The study is expected to be completed by January 2015.

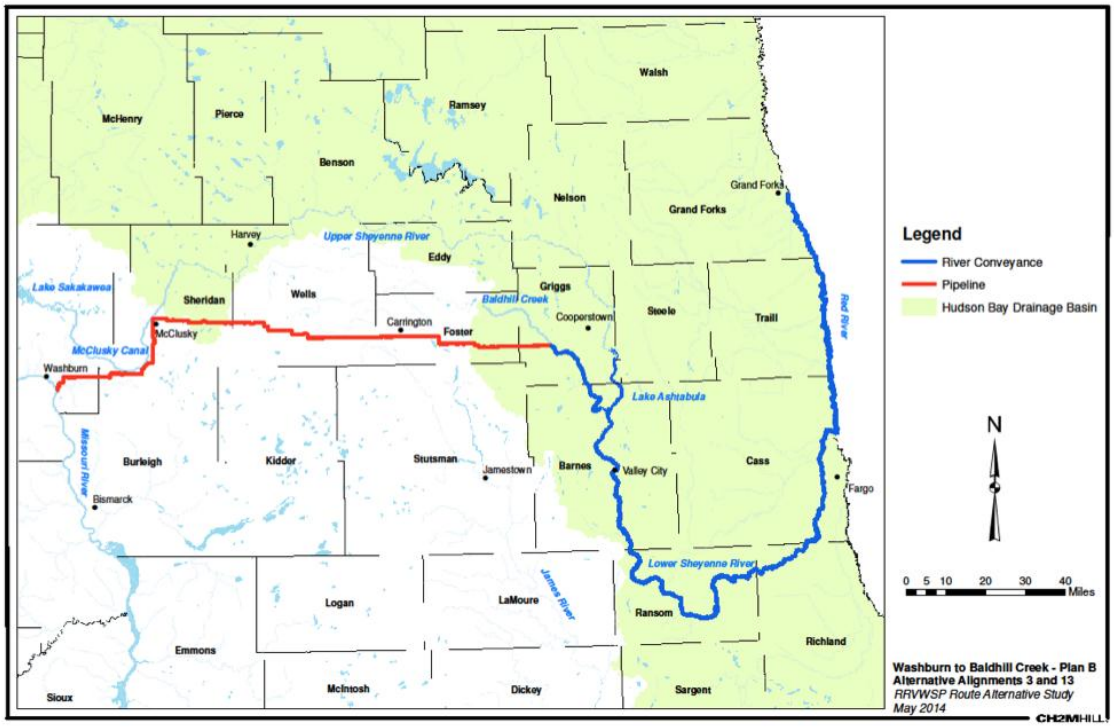


Figure ES-1 – Alternative 13 – Washburn to Baldhill Creek (Plan B; Option 1)

Red River Valley Water Supply Project Alternative Route Engineering Study ES-3

Figure 12: Alternative 13- RRVWSS – Washburn to Baldhill Creek

Northwest Area Water Supply (NAWS) – The Bureau of Reclamation has continued to work on the Supplemental Environmental Impact Statement (SEIS). The draft SEIS evaluates the estimated future water needs of the area through 2060, develops a full range of reasonable alternatives to meet this future need, and evaluates the potential environmental effects of the proposed alternatives.

The NAWS Draft EIS went out for public review on June 20. A public hearing was held on the draft SEIS on July 23, in Minot, ND. The purpose of the hearing is to seek public comment on the draft SEIS. Public comments can be received through September 10, 2014.

Watershed Detention Strategies – With the exception of the Park River and Pembina River, detention studies are now complete in all watersheds in the Red River basin of ND. (Updated hydrologic models will soon be completed for the Park River and Pembina River watersheds. When they are available, detention studies will proceed for each of these watersheds.) The studies located potential temporary storage sites, for the purpose of flood damage reduction, within each subbasin. Criteria used included the requirement that each site had a drainage area of at least 20 square miles, that it was capable of temporarily holding at least 3 inches of runoff, and that off-channel sites be analyzed except for the upper portion of the tributaries. The newly completed hydrology models were used to develop hydrographs for various events and to compare the change in hydrograph if each potential site were in place. The volume of water removed from the flood

hydrograph within each subbasin was compared to the amount described in the RRBC LTFS study, to determine if each subbasin was capable of obtaining the storage described in that report.

A similar effort is ongoing on the MN side of the Red River watershed.

Possible impacts to the flood hydrograph on the Red River mainstem have been determined for the southern portion of the watershed (to Halstad). Further development of the hydraulic model is underway so that a similar analysis can be continued to the border.

Red River Retention Authority - The Red River Retention Authority (RRRA), formed in 2010, is comprised of members of the Red River Joint Water Resource District, a North Dakota political subdivision, and the Red River Watershed Management Board, a Minnesota political subdivision. The primary objective of the Red River Retention Authority is to ensure joint, comprehensive, and strategic coordination of retention projects in the Red River of the North watershed and facilitating implementation and construction of temporary retention in the Red River Watershed for the purpose of flood damage reduction. Several entities are involved as partners in this process.

The RRRA and its members have been aggressively pursuing federal dollars to off-set local costs for retention projects, and will serve as an advocate for local projects in the federal regulatory process. The U.S. Department of Agriculture has included the Red River Basin in the Prairie Grasslands Region Critical Conservation Area. This provides an opportunity for the RRRA to apply for funding through the Regional Conservation Partnership Program, which is included in the 2014 farm bill. The application process is underway at this time.

The goal of the RRRA is to reduce the severe flood flows on the Red River by 20 percent. To achieve that, retention projects in the basin need to temporarily store about 1.5 million acre-feet of water. Using the data provided in the detention studies, and detailed discussion with each individual member of the RRJWRD in ND and the RRWMB in MN, a list of potential projects has been prepared. The projects are in various stages of development; with some close to construction, some in various stages of study/design, and some just getting underway.

While the main purpose of the projects is for flood damage reduction, water retention on agricultural lands could also help to improve water quality in the basin.

9.02 Devils Lake Sub-Basin

DEVILS LAKE UPDATE

Devils Lake

Hydrology:

The water surface elevation on January 1, 2014 was 1452.3 msl. The level of Devils Lake continued to increase during the spring of 2014, with an apparent peak of 1453.46 msl on June 29. This is an increase of 1.2 feet from the beginning of 2014. This increase adds 13,881 acres to the size of the lake, and about 240,000 acre-feet of additional storage. This 2014 peak elevation is also only 0.8 feet lower than the modern period record high of 1454.30 established on June 27, 2011. The lake elevation on July 23, 2014 was 1453.2 msl, about 0.2 feet lower than the apparent peak for 2014 (Table 13). Annual inflow for 2013 was about 420,000 acre-feet, the 4th highest recorded.

Table 13. Devils Lake Annual inflow for 2013

Date	Elevation (msl)	Area (acres)	Volume (acre-feet)
Jan. 16, 2010	1449.92	162,100	3.36 Million
June 27, 2010	1452.05	182,800	3.73 Million
Nov. 20, 2010	1451.26	175,000	3.59 Million
Jan. 16, 2011	1451.62	178,600	3.66 Million
June 27, 2011	1454.30	208,500	4.19 Million
January 21, 2012	1453.3	197,000	4.00 Million
May 7, 2012	1453.6	200,057	4.03 Million
Jan. 1, 2013	1451.4	176,000	3.62 million
June 27, 2013	1454.0	204,852	4.11 million
Jan. 1, 2014	1452.3	185,000	3.77 million
June 29, 2014	1453.5	198,881	4.01 million
July 23, 2014	1453.2	195,401	3.95 million

State Emergency Outlet Project Update:

Operation:

West Devils Lake Outlet:

Due to high flows on the Sheyenne River and other rivers further downstream (and repairs on the riser pipes) discharge from the west outlet did not start until May 20, ranging from 50 cfs to 130 cfs for the rest of May. The pumps were shut down on June 2 due to high flows occurring further downstream. Limited discharge of about 125 cfs started again on June 13. The pumps were again shut down on June 28, due to high downstream flows and potential change of precipitation. The pumps resumed at a rate of about 140 cfs after a couple days of that time. The rate of discharge increased to full capacity of 250 cfs on July 16.

East Devils Lake Outlet:

High downstream flow conditions also delayed the start of pumping from the east outlet. The pumps started to discharge at a reduced rate on May 12. Due to high flow conditions downstream, the discharge rate was limited to about 150 cfs for the rest of May. Pumps had to be shut down on June 2, due to heavy rain received further downstream. The pumps were again started at a rate around 140 cfs on June 17. They were shut down again for a couple days around June 28, before continuing at a rate of about 140 cfs. Discharge was increased to about 350 cfs on July 16 (Table 14).

Table 14. Summary of the extent of discharge from the outlets for a portion of 2014

Month	Days Discharge Occurred		Average Discharge (cfs)		Monthly Volume (acre-feet)	
	West	East	West	East	West	East
May	12	20	79	141	1,874	5,581
June	19	15	82	68	4,884	4,061
July						
August						
Sept.						
Oct.						
Nov. 2014						
TOTAL					6,758	9,642

Table 15. Summary of the volume and inches of water removed from the Lake since pumping was started in 2005

Year	Volume Removed (acre-ft.)	Inches Removed (inches)
2005	38	0.0
2006	0	0.0
2007	298	0.02
2008	1,241	0.1
2009	27,653	2.0
2010	62,977	4.2
2011	46,911	2.7
2012	157,542	9.5
2013	141,783	10.0
TOTAL	438,443	28.52

Water Quality:

Water quality testing has been ongoing at several locations along the Sheyenne River and Red River. Data from June 2014 is shown in Figure 13.

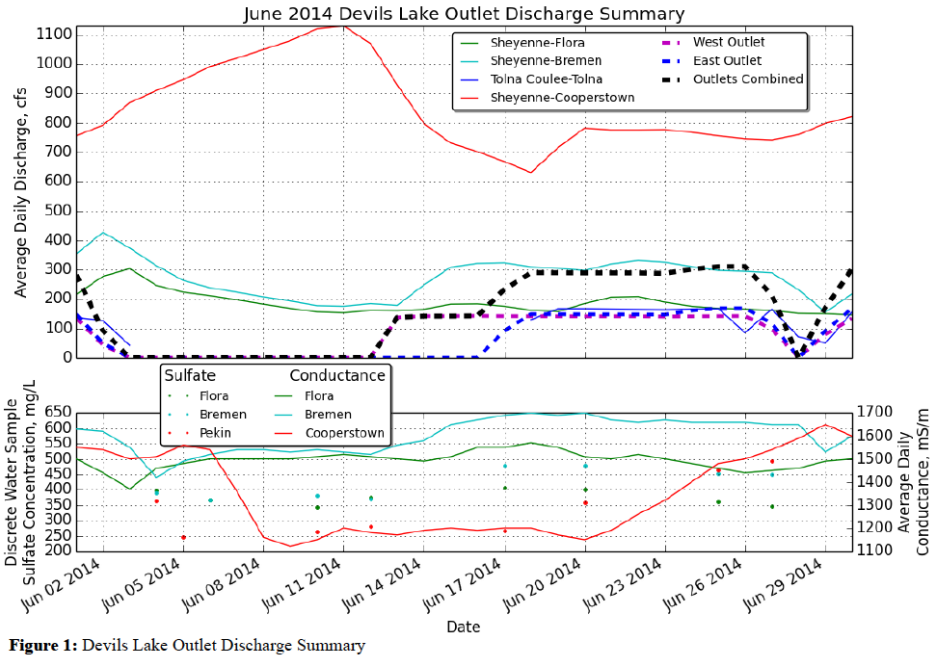


Figure 1: Devils Lake Outlet Discharge Summary

Figure 13: Devils Lake Outlet – Water Quality & Discharge Summary

Devils Lake Outlet Committee:

The Devils Lake Outlets Management Advisory Committee met on May 14, 2014 in Carrington, ND. The committee includes a representative from Manitoba and Minnesota.

Tolna Coulee Control Structure:

The operating plan for the structure requires that prior to a natural overflow the stop log elevation remain between 1 foot and 2 feet below the water surface of the lake.

Emergency Gravity Water Transfer Channel:

The proposed gravity flow channel would provide an outlet from Stump Lake, extending south to Tolna Coulee. The control elevation at the bottom of the channel is proposed at 1452 msl. The channel would include stop logs to control releases based on downstream conditions. The channel would have a capacity of

100 cfs when Stump Lake is at an elevation of 1454 msl, if the stop logs were not in place. The channel would be operated to maintain downstream water quality uses. An operating committee is being proposed for the project.

The Devils Lake Joint Water Resource Board is the local sponsor for this project. They have indicated that they are withdrawing as the lead agency of the gravity outlet. The project is tabled at this time.

Upstream Storage:

The State Water Commission (SWC) is committed to a three-pronged approach to flooding in the Devils Lake basin, of which upper basin water management is an integral part. Several programs exist to store water, including the Extended Storage Acreage Program (ESAP), and projects by the ND Natural Resources Trust (Trust), and the U.S. Fish and Wildlife Service. The new Devils Lake Executive Committee action plan has reinforced and placed emphasis on the need to increase upper basin storage where possible.

The Trust is pursuing a plan to acquire privately held land for a multipurpose, multi-wetland restoration project in northeastern Ramsey County. SWC staff has estimated that this project will store approximately 631 acre-feet of additional water over existing conditions. The project requires commitments from multiple funding sources, including the Wetland Reserve Program (WRP), the North American Wetlands Conservation Act, ND Game and Fish, and the Trust. The project will put the land under a 30-year WRP easement with the ND Game and Fish taking title to the land for use as a public access wildlife conservation area. Total project cost is estimated at $2,048,000, and would result in long term water storage on land available for public use. The Trust has requested water storage funding from the SWC in the amount of $125,000. If approved, the SWC will develop a seven-year contract for water storage at the Johnson Farms site. Annual inspections will be conducted to ensure water storage at the site for the duration of the agreement. This expenditure equates to about $30.00/acre-foot per year of storage for the duration of the contract, which is comparable to the rates paid for existing ESAP temporary storage easements. The acquisition plan developed by the Trust involves several partners and as a result has several contingencies.

Outlet Mitigation Plan:

Beginning in 1993, as Devils Lake began its historically unprecedented rise, the State Water Commission (SWC) has been at the forefront of efforts to combat flooding in the basin. The lake level has now risen 30 feet expanding from about 49,000 acres to over 200,000 acres. At its overflow elevation of 1458 feet msl, where it naturally spills into the Sheyenne River, Devils Lake will cover more than 261,000 acres. To combat the growing flooding problem, local, state, and federal authorities adopted a three-pronged approach in the mid 1990s: infrastructure protection for roads, levees, and relocations; upper basin water management, including water storage in the upper basin; and discharge of flood water through an emergency west-end outlet to the Sheyenne River. This approach was designed with the interests of both Devils Lake basin and downstream residents in mind. The principal concept has been to manage water and flood damage within the Devils Lake basin, while attempting to prevent a potentially catastrophic natural overflow through Tolna Coulee to the Sheyenne River.

The 2011 Devils Lake Outlet Mitigation plan developed by SWC staff with input from stakeholders, including the Devils Lake Outlet Advisory Committee, provides important direction in addressing problems that could arise downstream from emergency measures taken at Devils Lake to protect the safety and general welfare of both basin and downstream residents. The draft plan has two key components; construction of emergency outlets to remove floodwater from Devils Lake and a course of action to address

downstream issues along the Sheyenne River that may result from operating the emergency outlet projects.

Refer to Figures 14 and 15 for Devils Lake historic water surface elevations for Devils Lake water surface elevations near Devils Lake for the period 2010-2014.

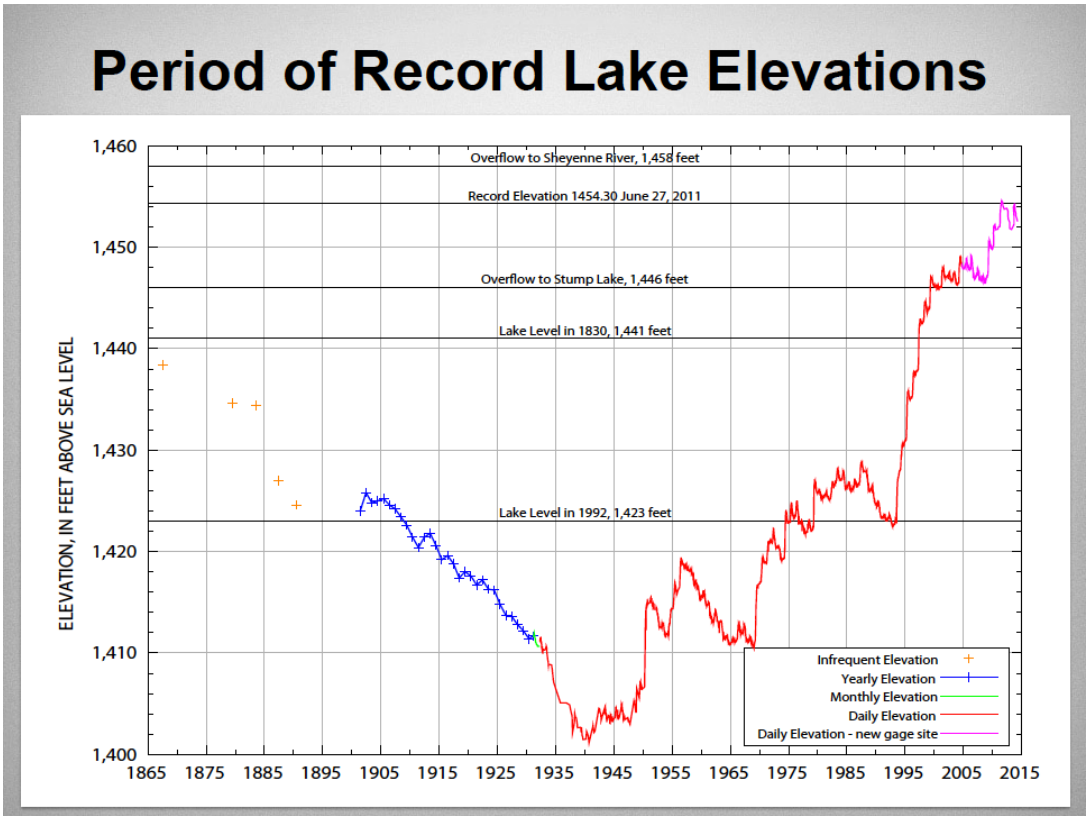


Figure 14: Devils Lake Historic Water Surface Elevations

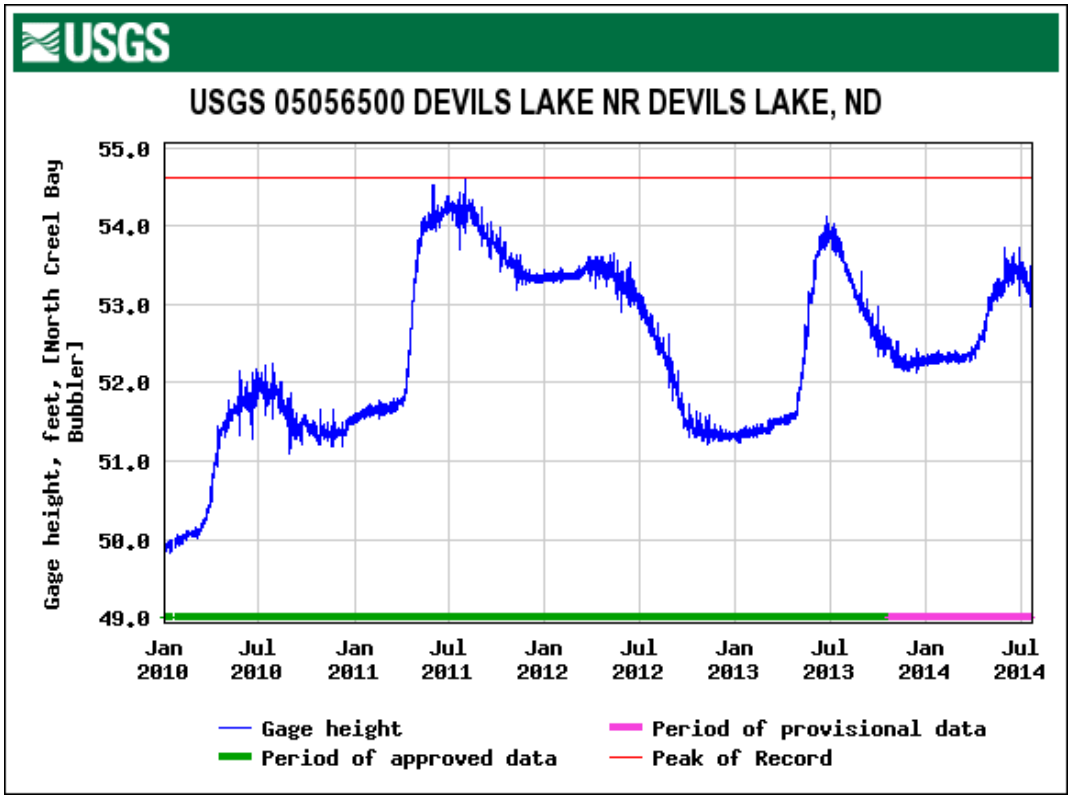


Figure 15: Devils Lake near Devils Lake Water Surface Elevations - 2010-2014

9.03 U.S. Army Corps of Engineers Flood Control Activities

Introduction

The Corps of Engineers has a long history of involvement in water resource issues in the Red River of the North basin. Current Corps activities in the basin include operating flood control and multipurpose reservoirs, conducting flood risk management and ecosystem restoration studies, constructing flood risk management and ecosystem restoration projects, conducting and participating in special studies and initiatives, regulating work in navigable waters and other waters of the United States, and providing emergency assistance and disaster response. The Corps cooperates and collaborates with other Federal and State agencies, local watershed districts, environmental groups, and local communities to address water resource problems and opportunities in the basin. For completed projects, damages prevented are reported through 2012 in nominal dollars, not adjusted for inflation.

Construction Projects

Breckenridge, Minnesota, and Wahpeton, North Dakota

Wahpeton and Breckenridge are at the confluence of the Bois de Sioux and Otter Tail Rivers, the beginning of the Red River of the North. The flood risk management projects for these cities are treated as two separate, but dependent, projects. The levee portions of both projects must be initiated together to avoid adverse impact on the city on the other side of the river.

The Breckenridge project consists of a high-flow diversion channel north of the Otter Tail River and two separable permanent levee reaches that provide 100-year level of flood protection for the city of Breckenridge. Construction of the diversion was completed in 2005. The diversion channel sustained damaged in 2010 and 2011, due to high extended flows in the channel causing erosion and sedimentation at the channel. The repair work for the diversion channel is expected to be completed in 2014. The total estimated cost for the Breckenridge project is $41.1 million. Damages prevented are $60.1 million.

The Wahpeton project, authorized under the Corps' Section 205 Continuing Authority Program, consists of a permanent levee system and flood easements. Construction of the Wahpeton project began in 2003 with interior flood control features, which are complete. The first of three stages of levee construction began in June 2008. A slurry trench is scheduled to be completed in 2014 marking the substantial completion of the construction phase. Additional work on existing levees will be incorporated as needed for compliance with levee standards. The total estimated cost for the Wahpeton project is $21 million. Damages prevented are $72.6 million.

Crookston, Minnesota

Construction of a flood risk management project for the Thorndale, Woods, and Downtown/Riverside neighborhoods was essentially completed in November 2004. Two rock berms protecting the upstream side of two cutoff channels were damaged from ice flows in April 2005, and repairs were completed in 2013. The project is scheduled to be transitioned to the sponsor in 2014. Damages prevented are $37.4 million.

Devils Lake Embankment, North Dakota

Devils Lake is subject to extreme variations in lake levels, depending on the climate change. Spring of 2013 again saw significant spring run-off with the lake rising over 2 and one-half feet to a peak elevation of 1,453.96. The current elevation (November 4, 2013) is 1,452.35. In June of 2011, the lake hit a record elevation of 1454.3. The embankments are being raised in three phases to protect the City of Devils Lake.

Phase 1 was awarded in October 2009, and is essentially complete. Phase 2 was split into two contracts; Phase 2a was awarded in November 2010 and is essentially complete. Phase 3 was awarded in April 2011, and Phase 2b was awarded in May 2011. Phases 2b and 3 are nearing completion with minor work to be completed in the spring of 2014. Once construction is complete, the city will be protected from the maximum lake elevation that could occur. The cost to complete the raise to elevation 1466 was approximately $167.8 million. Damages prevented are $157.5 million.

Emergency Operations

During flood events in the Red River basin, the Corps' St. Paul District provides emergency assistance as part of a large force made up of local, State and Federal responders as well as volunteers. In 2013 the Corps' St. Paul District provided emergency operations support to local and state efforts with moderate to major flooding in the Red and Park River basins.

Fort Abercrombie, North Dakota

A Section 14 Emergency Streambank Protection study began in September 2008. Erosion along the Red River of the North was threatening the historic Fort Abercrombie site. A project to stabilize the bank was initiated with the signing of a Project Partnership Agreement in October 2011. Construction of the streambank protection at Ft. Abercrombie was completed in 2013. The total cost for the Fort Abercrombie project was $1.2 million

Grafton, North Dakota

A flood risk management project for the city of Grafton, North Dakota, was authorized in the Water Resources Development Act of 1986. The authorized project includes a diversion channel, road raises, 3 new railroad bridges, a new Highway 81 bridge and roughly an 8 mile tieback levee. The current estimated project cost is $45.2 million. Federal funding is not currently available to proceed with design, but the St. Paul District is working with the local sponsors to determine a path forward.

Grand Forks, North Dakota, and East Grand Forks, Minnesota

Construction of the flood risk management project for the cities of Grand Forks and East Grand Forks is essentially complete. The project has been certified as providing a 100-year level of flood protection in accordance with the Federal Emergency Management Agency's national flood insurance program. The levee construction to a 250-year level of protection was completed in 2013. The design level of protection is equivalent to the peak discharge experienced during the 1997 flood. Total estimated project cost is $386 million. Damages prevented are approximately $1 billion.

North Dakota Environmental Infrastructure Program (Section 594)

The Corps is assisting communities and rural areas in North Dakota under the North Dakota Environmental Infrastructure Program. The Corps provides design and construction assistance for wastewater treatment and related facilities; combined sewer overflow; water supply, storage, treatment, and related facilities; environmental restoration; and surface water resource protection and development. Projects were funded in 2008, 2009, 2011, and 2012. No new funds were provided in 2013. The projects in Minnewaukan, Trail Rural Water District, and Minot are the only projects remaining to be completed.

Roseau, Minnesota

A flood risk management project for the city of Roseau, Minnesota, was authorized in the Water Resources Development Act of 2007. The project will include a 4.5 mile long diversion channel with associated recreation features. The current estimated project cost is $41.8 million. Construction of the diversion channel's outlet and downstream most 1.25 miles was completed in August 2011. The second construction contract completed 2.25 miles of channel in November 2013. The third construction contract for 0.25 miles of channel was awarded in November 2013. Plans and specifications for the remaining portion of the

project are complete and ready for construction contract solicitation pending increased authority and the availability of funds.

Sheyenne River, West Fargo, North Dakota

Construction of the West Fargo project was essentially completed in 1994. Construction to repair 6,000 feet of the diversion channel that was damaged by erosion and sloughing in 2005 was completed in October 2012. Topsoil and seeding operations were completed in June 2013. The project was transitioned to the non-Federal Sponsor in September 2013. Total estimated project cost is $52 million. Damages prevented are $379.6 million.

Tolna Coulee, North Dakota

Tolna Coulee is located on the southwest corner of Stump Lake in Nelson County, North Dakota. The continued rise of Devils Lake has increased the potential for a catastrophic overflow of Devils Lake through Tolna Coulee. The Tolna Coulee Advance Measures project will prevent a catastrophic flow of water through Tolna Coulee, while also allowing for the gradual lowering of Devils Lake if natural erosion occurs. Construction of the project, an 800-foot long sheet pile sill with a control structure that includes removable concrete stop logs, was completed in May 2012 at a total project cost of $8.98 million. The structure is operated by the North Dakota State Water Commission.

Studies

Drayton Dam Fish Passage Mitigation Project, Drayton, North Dakota

A Section 206 aquatic ecosystem restoration feasibility study of the Drayton Dam began in July 2008. The study assessed ways to provide fish passage and eliminate dangerous hydraulic conditions at the dam while maintaining the pool for water supply and bank stability. The project is currently in the Pre-construction Engineering and Design phase to be implemented as mitigation for impacts to fish passage associated with the Fargo-Moorhead Metropolitan project.

Fargo-Moorhead Metropolitan Area, North Dakota and Minnesota

The feasibility study was completed in December 2011. The Report of the Chief of Engineers was signed in December 2011 and the Record of Decision was signed in April 2012. Modifications to the plan were presented in a supplemental environmental assessment, and a Finding of No Significant Impact was signed in September 2013. The federally recommended plan is the North Dakota 20,000 cubic feet per second (cfs) diversion with upstream staging. The plan includes a 30-mile long diversion channel, a 6-mile long connecting channel, 12 miles of tie-back embankments, 4 miles of overflow embankment, levee/floodwall features in Fargo and Moorhead, control structures on the Red and Wild Rice (ND) rivers, aqueducts on the Sheyenne and Maple Rivers, and ring levees around the communities of Comstock, MN and Oxbow/Hickson/Bakke, ND. The project is currently in the Preconstruction Engineering and Design phase. The project was authorized in the Water Resources Reform and Development Act (WRRDA) on 14 June 2014. Congressional authorization and funding is needed before federal construction can begin.

Fargo-Moorhead and Upstream Area, North Dakota, South Dakota and Minnesota

This feasibility study was looking for opportunities to reduce flood damages and restore aquatic ecosystems in the entire watershed upstream of Fargo-Moorhead. The study began in August 2004. Phase 1a was completed in June 2005. It concluded that a system of impoundments could reduce the 1-percent-chance flood stage in Fargo-Moorhead up to 1.6 feet, but the system was not likely to be economically justified based on economic benefits alone. Phase 1b began in April 2008 to develop hydrologic and hydraulic models of the Wild Rice River in North Dakota to assess specific potential storage sites. The study was terminated in 2013. Efforts pertaining to storage and modeling within the upper Red River basin are being pursued as part of the Red River Basin Wide Study.

Red River Basin Watershed Study

The Corps began a basin-wide watershed study in June 2008. The first phase of study used LiDAR to collect detailed topographic information and develop a digital elevation model of the entire watershed in cooperation with the International Water Institute (IWI). Subsequent phases include developing basin-wide hydrologic models, updating the Red River Basin Decision Information Network, and developing a Comprehensive Watershed Management Plan. Hydrologic modeling of the entire Red River was completed in 2012. The Red River Basin Commission issued a report to State and Federal officials on a comprehensive plan for long-term flood solutions in December 2011. The Corps has contracted with the IWI to update the Red River Basin Decision Information Network website (www.rrbdin.org). Data from the LiDAR collection, the hydrologic models and other watershed planning tools are being linked to the site. Training and public education efforts on use of the refurbished website will continue into 2014. The RRBDIN website will continue to be updated as additional information and tools become available. The following efforts are components of the overall study:

Red River Basin Nonstructural Feasibility Study

A study examining the feasibility of implementing non-structural Federal project in the Red River basin has been undertaken as part of the larger Red River basin study. This study will be complete in early 2014. The results are still pending.

Halstad Upstream Retention Study

As part of the Red River Basin Watershed Study, the HUR study was carried out by the Red River Basin Commission (RRBC) to identify potential floodwater retention sites necessary to reduce peak 100-year flows by 20-percent on the Red River main stem at Fargo. The study modeled one runoff scenario and identified 97 conceptual retention sites throughout the Red River Basin upstream of Halstad, ND. The 97 sites could provide approximately 580,000 acre-feet of flood storage on 108,000 acres of land.

Comprehensive Watershed Management Plan

A collateral effort between the RRBC and the Corps will begin in 2014, with the RRBC updating their Natural Resources Framework Plan, and the Corps beginning development of a Comprehensive Watershed Management Plan, which will be used to inform future Federal investment in the Red River basin.

Valley City, North Dakota Flood Risk Management Feasibility Study

A feasibility study was initiated in April 2012 to investigate opportunities to manage flood risk in Valley City. Initial study efforts focused on developing hydrologic and hydraulic models and investigating a range of alternatives. The preliminary analyses showed that Federal support for structural alternatives such as levees and floodwalls was unlikely. The study was terminated in February 2013.

Silver Jackets

Silver Jackets teams are collaborative State-led interagency teams, continuously working together to reduce flood risk at the state level. Through the Silver Jackets program, the U.S. Army Corps of Engineers, the Federal Emergency Management Agency, additional Federal, State and sometimes local and tribal agencies provide a unified approach to addressing a State's priorities. The North Dakota Flood Risk Management Silver Jackets team has been active since 2009, and formally adopted a charter in 2010 (under revision).

The North Dakota Silver Jackets team currently has two pilot projects in North Dakota and three shared with Minnesota in the Red River of the North basin. The projects include Souris River System Wide Improvement Framework study to determine interim risk reduction measures for Minot and vicinity, Souris basin hydrometeorological instrumentation analysis to recommend placement of new flow and precipitation gages, emergency action plan guidebook template in MN and ND, Red River Valley pre-flood information packages, and a nonstructural flood risk reduction measures owner's manual for residents in the Red River

Valley. Team actions have also been instrumental in successful support of response to and recovery from recent flood events, especially in the James River, Red River Valley, and Devils Lake basins.

Planning Assistance to States

A HEC-RAS Unsteady Flow model has been developed for the Red River from Halstad, Minnesota, to Pembina, North Dakota under the Section 22 Planning Assistance to States Program. The model has been calibrated and verified to the 2006 and 2009 floods. The North Dakota State Water Commission has developed a separate HEC-RAS Unsteady Flow model of the 2006 flood on the Pembina River from Walhalla to Pembina. The two models are being combined. Other tributaries could be added if funds allow it.

Operations

The Corps of Engineers maintains several stream gages and operates five reservoir projects within the Red River basin: Homme Dam and Lake, Baldhill Dam, Orwell Dam, Lake Traverse, and Red Lake Dam.

Stream Gaging

The Corps provides funding to support stream gaging in the Red River. The Corps maintains gages at several locations including Wahpeton and Valley City North Dakota. These gages provide critical information related to reservoir operation, flood forecasting, drought management and the overall health of the watersheds.

Homme Dam and Lake

Homme Dam and Lake is on the South Branch of the Park River 2 miles west of the city of Park River, North Dakota, on North Dakota State Highway 17. Homme Dam was built for water supply purposes and flood benefits. Damages prevented are $2 million.

Baldhill Dam (Lake Ashtabula)

Baldhill Dam is in eastern North Dakota 60 miles west of Fargo and 9 miles northwest of Valley City, North Dakota. The dam is on the Sheyenne River, 271 river miles upstream from its confluence with the Red River of the North. The dam provides flood risk reduction for urban areas along the Sheyenne River. It also provides substantial water supply and pollution abatement for the Sheyenne River and the Red River of the North. Damages prevented are $422.7 million.

Orwell Dam

Orwell Dam is on the Otter Tail River, 6 miles southwest of Fergus Falls, Minnesota, on County Road 15. Project purposes are flood control, water supply, and pollution abatement. During periods of low flow in the Red River basin, discharges from Orwell Dam comprise the majority of the stream flows in the Red River. The Minnesota Department of Natural Resources leases 1,985 acres of the project for wildlife management purposes, of which 660 acres are a wildlife sanctuary. Hunting and fishing are permitted in some project areas, but not in the wildlife sanctuary. Damages prevented are $706 million.

Lake Traverse

Lake Traverse is located at the border between northeastern South Dakota and western Minnesota. The primary purposes of the project are flood control along the Bois de Sioux River and in the lower Red River Valley and water conservation for frequent periods of drought. The project includes two dams, two lakes, and the Browns Valley dike at the southern end of the project. The Browns Valley dike lies directly on the continental divide. White Rock Dam, which forms Mud Lake, is at the extreme north end of the project and

controls water flowing north on the Bois de Sioux River. Reservation Dam controls the pool level at Lake Traverse and the water flow north into Mud Lake; it also serves as a levee that separates the two lakes. Damages prevented are $4.4 billion.

Red Lake Dam

Red Lake Dam is on the Red Lake River at the outlet of Lower Red Lake. The project is operated for water supply, pollution abatement, flood reduction, water conservation, recreation, and fish and wildlife enhancement. Construction of a fish passage structure at the dam began in 2007 and was completed on August 11th, 2011. Damages prevented are $19.3 million.

Regulatory Programs

The Corps of Engineers Regulatory Programs include permitting authorities under Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act. The St. Paul District has jurisdiction in Minnesota; Omaha District has jurisdiction in North Dakota and South Dakota. Under Section 10, a Corps permit is required to do any work in, over or under a navigable water of the United States. Water bodies have been designated as navigable waters of the United States based on their past, present, or potential use for transportation for interstate commerce. Under Section 404, a Corps permit is required for the discharge of dredged or fill material into waters of the United States.

Project Modification Reviews: Section 408

U.S.C. 408 (Section 408) authorizes the Secretary of the Army to permit others to alter and modify an existing Corps project in certain circumstances. Proposals submitted for Section 408 review and approval undergo a rigorous engineering, policy and environmental review by the Corps and, if required, independent external peer review. Within the Red River Valley, major levee modifications were approved at Oslo, Minnesota in 2012 and Alvarado, Minnesota in 2013. Proposed levee and floodwall modifications at Pembina, North Dakota are under final review. Pre-review discussions are underway with the Bois de Sioux Watershed District on a proposed retention project on the Mustinka River in Minnesota.

Contact Person

The St. Paul District, Corps of Engineers, point-of-contact for planning and studies in Red River of the North Basin is Aaron Snyder, Project Management Branch (PM-B). Telephone: (651) 290-5489
Email: **Aaron.M.Snyder@usace.army.mil**

Project information sheets with details on all St. Paul District projects can be found on the St. Paul District, Corps of Engineers, Internet homepage at: **www.mvp.usace.army.mil**

9.04 USGS Water Resource Investigations and Activities

Determination of the Distribution, Transport, and Load of Sediment in the Red River of the North and its Tributaries near Fargo

Natural resource agencies were concerned about possible geomorphic impacts of the proposed diversion projects in the Fargo-Moorhead area. Site-specific information available on sediment transport and riverine geomorphic processes were very limited and prohibited accurate geomorphic modeling to address the concerns. The existing Horace-West Fargo diversion represents a good field scale example of what could happen to the sediment transport and distribution if the proposed ND Diversion Channel is constructed. The USGS, in cooperation with the US Army Corps of Engineers, collected suspended-sediment, bed-load, and bed-material samples at 9 sites on the Red, Sheyenne, Maple, Wild Rice, Rush, Lower Rush, and Buffalo Rivers in the Fargo area during the 2010-2012 spring high-flow periods from March through May and during rainfall-runoff events and baseflow conditions from June through November in 2011 and 2012. The data provide information to describe the distribution and transport of sediment near the Fargo-Moorhead area. The methods and results of the 2010 and 2011 data collection were compiled in 3 USGS Scientific Investigations Reports: (http://pubs.usgs.gov/sir/2011/5064/), (http://pubs.usgs.gov/sir/2011/5134/), and (http://pubs.usgs.gov/sir/2012/5111/)

Interactive map for Accessing Water Quality Data in the Red River Basin

An interactive map service was developed as a result of a binational effort to map the locations of water quality sampling sites in the Red River Basin with greater than 10 years of record. This service was developed in cooperation with the International Joint Commission (IJC) at the request of the Water Quality Committee and its International Red River Board (IRRB) and the Red River Basin Commission (RRBC) to provide a single platform to view multi-jurisdictional and sustained water quality sampling sites. The map service is a first step towards a bi-national multi-agency water-quality decision support tool for the Basin. The map can be accessed at: http://gis.ijc.org/javascript/7c_RED_WQ/map/#.UeaiQue-qzn

APPENDIX A

DIRECTIVES TO THE INTERNATIONAL RED RIVER BOARD

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DIRECTIVE TO THE
INTERNATIONAL RED RIVER BOARD

1. Pursuant to the Boundary Waters Treaty of 1909, responsibilities have been conferred on the Commission under a 1948 Reference from the governments of Canada and the United States with respect to the use and apportionment of the waters along, across, or in the vicinity of the international boundary from the eastern boundary of the Milk River drainage basin on the west up to and including the drainage basin of the Red River on the east, and under the May 1969 authorization from the governments to establish continuous supervision over the quality of the waters crossing the boundary in the Red River and to recommend amendments or additions to the objectives when considered warranted by the International Joint Commission.

2. This directive replaces previous directives and instructions provided by the International Joint Commission to the International Souris-Red Rivers Engineering Board, and in the February 8, 1995 Directive to the International Red River Pollution Board. This Directive consolidates the functions of those two former boards into one board, to be known as the International Red River Board (Board).

3. The Board's mandate is to assist the Commission in preventing and resolving transboundary disputes regarding the waters and aquatic ecosystem of the Red River and its tributaries and aquifers. This will be accomplished through the application of best available science and knowledge of the aquatic ecosystem of the basin and an awareness of the needs, expectations and capabilities of residents of the Red River basin.

4. The geographical scope of the Board's mandate shall be the Red River basin, excluding the Assiniboine and Souris Rivers. The Board's activities shall focus on those factors which affect the Red River's water quality, water quantity, levels and aquatic ecological integrity.

5. The Board's duties shall be to:

   A. Maintain an awareness of basin-wide development activities and conditions that may affect water levels and flows, water quality and the ecosystem health of the Red River and its transboundary tributaries and inform the Commission about transboundary issues.

   B. Provide a continuing forum for the identification, discussion and resolution of existing and water-related issues relevant to the Red River basin.

   C. Recommend appropriate strategies to the Commission concerning water quality, quantity and aquatic ecosystem health objectives in the basin.

   D. Maintain continuing surveillance and perform inspections, evaluations and assessments, as necessary, to determine compliance with objectives agreed to by governments for water quality, levels and quantity in the Red River basin.

   E. Encourage the appropriate regulatory and enforcement agencies to take steps to ensure that agreed objectives are met.

   F. Encourage the appropriate authorities, such as resource and emergency planning agencies, to establish and maintain contingency plans, including early warning procedures, for appropriate reporting and action on accidental discharges or spills, floods and droughts.

G. Monitor and report on flood preparedness and mitigation activities in the Red River basin and their potential effects on the transboundary aquatic ecosystems, and encourage and facilitate the development and maintenance of flood-related data information systems and flood forecasting and hydrodynamic models. In carrying out this responsibility, the Board shall:

   i. Monitor progress by the governments (federal, state, provincial, municipal) in implementing the recommendations of the Commission's report on the Red River basin flooding, and in maintaining and advancing the work of the Task Force's legacy projects, and to this end provide opportunities for the public to comment on the adequacy of such progress.

   ii. Encourage governments to develop and promote a culture of flood preparedness in the Red River valley.

   iii. Encourage government efforts to develop and implement a long-term strategy for flood mitigation emergency preparedness.

   iv. Encourage the sharing of accurate and timely transboundary information to support the development of improved flood forecasting techniques and procedures for early flood warnings and to improve communication of flood forecasts.

   v. Provide through the activities of the Board a forum for the exchange of best practices and for other flood-related information on preparedness, mitigation, response and recovery to assist in transboundary problem solving.

   vi. Promote the application of innovative technologies for supporting flood modeling and mapping.

   vii. Monitor the adequacy of data and information collection networks (meteorological, hydrometric, water quality) for flood preparedness, forecasting and mitigation, within the larger context of overall water management needs in the basin.

   viii. Monitor potential transboundary effects of flood mitigation and other works in the basin, and encourage cooperative studies necessary to examine these effects.

   ix. Encourage governments to integrate floodplain management activities in watershed and basin management.

   x. Interact with all levels of government to help decision-makers become aware of transboundary flood-related and associated water management issues.

   xi. Assist in facilitating a consultative process for resolution of the lower Pembina River Flooding issue.

H. Involve the public in the work of the Board, facilitate provision of timely and 'pertinent information within the basin in the most appropriate manner', including electronic information networks; and conduct an annual public meeting in the Red River basin.

I. Provide an annual report to the Commission, plus other reports as the Commission may request or the Board may feel appropriate in keeping with this Directive.

J. Maintain an awareness of the activities of other agencies and institutions, in the Red River basin.

6. The Board shall continue to report on the non-Red River geographic areas under the responsibility of the former International Souris-Red Rivers Engineering Board, including the Popular and Big Muddy basins, but excluding the Souris River basin until the Commission determines otherwise.

7. The Board shall have an equal number of members from each country. The Commission shall normally appoint each member for a three-year term. Members may serve for more than one term. Members shall act in their personal and professional capacity, and not as representatives of their countries, agencies or institutions. The Commission shall appoint one member from each country to serve as co-chairs of the Board. An alternate member may not act as a co-chair.

8. At the request of any members, the Commission may appoint an alternate member to act in the place of such member whenever the said member, for any reason, is not available to perform such duties as are required of the member.
9. The co-chairs of the Board shall be responsible for maintaining proper liaison between the Board and the Commission, and among the Board members. Chairs shall ensure that all members of the Board are informed of all instructions, inquiries, and authorizations received from the Commission and also activities undertaken by or on behalf of the Board, progress made, and any developments affecting such progress.

10. Each chair, after consulting the members of the Board, may appoint a secretary. Under the general supervision of the chair(s), the secretary(ies) shall carry out such duties as are assigned by the chairs or the Board as a whole.

11. The Board may establish such committees and working groups as may be required to discharge its responsibilities effectively. The Commission shall be kept informed of the duties and composition of any committee of working group. Unless other arrangements are made, members of the Board, committees or working groups will make their own arrangements for reimbursement of necessary expenditures.

12. The Commission should also be informed of the Board's plans and progress and of any developments or cost impediments, actual or anticipated, which are likely to affect carrying out the Board's responsibilities.

13. The Commission shall be informed, in advance, of plans for any public meetings or public involvement in the Board deliberations. The Board shall report in a timely manner, to the Commission on these meetings, including representations made to the board.

14. The Board shall provide the text of media releases and other public information materials to the Secretaries of the Commission for review by the Commission's Public Information Officers, prior to their release.

15. Reports, including annual reports and correspondence of the Board shall, normally, remain privileged and be available only to the Commission and to members of the Board and its committees until their release has been authorized by the Commission.

16. If, in the opinion of the Board or of any member, any instruction, directive, or authorization received from the Commission lacks clarity or precision, the matter shall be referred promptly to the Commission for appropriate action.

17. In the event of any unresolved disagreement among the members of the Board, the Board shall refer the matter forthwith to the Commission for decision.

18. The Commission may amend existing instructions or issue new instruction to the Board at any time.

APPENDIX B

B.1 WATER QUALITY OBJECTIVES

B.2 WATER QUALITY ALERT LEVELS

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B.1 WATER QUALITY OBJECTIVES

The purpose of the water quality objectives and alert levels is to restore and maintain the chemical, physical, and biological integrity of the waters of the Red River. Five specific objectives were adopted for the Red River at the international boundary by the IJC in 1969.

Water quality objectives are used when necessary to secure government commitment to pollution abatement action. Compliance with the objectives is the primary means by which the International Red River Board identifies major water quality issues to the IJC.

The term >exceedance is used to describe a situation where an objective is not met. A situation is classified as an exceedance if an individual instantaneous sample, obtained from the continuous auto-monitor, or through a grab sample, is equal to or greater than the corresponding water quality objective (except for dissolved oxygen, which must be observed to be equal to or less than the objective). The five specific parameters and corresponding objective are listed below.

E. Coli	200 colonies/100 ml
Chloride	100 mg/L
Sulphate	250 mg/L
Total Dissolved Solids	500 mg/L
Dissolved Oxygen	5 mg/L

B.2 WATER QUALITY ALERT LEVELS

Water quality alert levels are used to complement water quality objectives. If exceeded, alert levels will trigger investigative action on the part of the IRRB or its representatives. The exceedance is addressed in terms of its magnitude, implications to water uses and possible resolutions. On the basis of alert level exceedances and subsequent investigations, the IRRB may advance proposals for additional objectives.

Water quality alert levels, for a wide range of parameters, in addition to the five specific parameters noted above, were developed by a working group in 1985. These alert levels were approved by the predecessor International Red River Pollution Board in January 1986. The alert levels that are currently in effect are listed in the following table. Further, the table provides a comparison of alert levels with the North Dakota and Minnesota Water Quality Standards, and with the Manitoba Water Quality Objectives as of 1990. The table has not been updated to reflect recent state and provincial revisions. The IRRB Aquatic Ecosystem Committee established by the IRRB in June 2001 will be reviewing the issue of objectives and alert levels with respect to monitoring requirements, analytical methodologies, and reporting protocols.

Parameter	Minnesota Standards	North Dakota Standards	Manitoba Objectives	Red River Pollution Board Objectives	Origin/ Rational

COMPARISON OF WATER QUALITY ALERT LEVEL STANDARDS AND OBJECTIVES - August 20, 1990

Parameter	Minnesota Standards	North Dakota Standards	Manitoba Objectives	Red River Pollution Board Objectives	Origin/ Rational
Fecal Coliform	200/100 ml geometric mean 10% of samples not to exceed 2,000 based on a minimum of 5 samples in a 30 day period from Mar. 1 – Oct. 31. HH*	200 fecal coliforms per 100 ml. This standard shall apply only during the recreation season, May 1 to September 30. HH	100/100 ml. At least 90% of samples in any consecutive 30 day period should have a fecal coliform density of less than 100 per 100 ml. HH	200/100 ml geometric mean with 10% of samples not to exceed 400 based on min. 5 samples – 30 day period – May 1 – Oct. 31 and for the balance of year not to exceed 1000/100 ml. Current IJC objective.	Minnesota and North Dakota based on primary body contact recreation.
Chloride	100 mg/l (total) ID	100 mg/l (total) ID	100 mg/l (soluble) ID	100 mg/l (dissolved) Current IJC Objective	All agencies based on industrial consumption.
Sulfate	250 mg/l (total) DW	250 mg/l (total) DW	250 mg/l (dissolved) DW	250 mg/l (total) Current IJC Objective	All agencies based on domestic consumption.
TDS	500 mg/l DW	None	500 mg/l DW	500 mg/l Current IJC Objective	All agencies, excluding North Dakota based on domestic consumption.
Dissolved Oxygen	5 mg/l (minimum)	5 mg/l (minimum)	47% saturation or more.	5 mg/l (minimum) Current IJC Objective	All agencies for the protection of aquatic life.
Chemical Characteristics					

- DW – Drinking Water
- HH – Human Health
- AL – Aquatic Life
- ID – Industrial Consumption
- IR - Irrigation

Parameter	Minnesota Standards	North Dakota Standards	Manitoba Objectives	Red River Pollution Board Objectives	Origin/ Rational
pH	6.5 - 9.0 AL	7.0 - 9.0 AL	6.5 – 9.0 AL	6.5 - 9.0	All agencies based on protection of aquatic life.
Dissolved Gas					
Ammonia-N	.04 mg/l as N unionized (warm water) Al	Unionized as N (dissolved). Calculation from standards. See page 8-10. AL	Variable, ranging from 0.0184 to 0.050 mg/l ammonia as NH_3.*		Minnesota and North Dakota for the protection of aquatic life.
Metals (Total)					
Aluminum	Total 125 µg/l AL	None	None	None	Minnesota for the protection of aquatic life.
Cadmium	Total The chronic standard shall not exceed: $_e$ [0.7852 {ln (total hardness mg/l)} – 3.49]. For hardness values greater than 400 mg/l, 400 mg/l shall be used in the calculation of the standard. Cadmium standards in µg/l at various hardness values: 50 mg/l hardness = 0.66 µg/l, 100 mg/l hardness = 1.1 µg/l, 200 mg/l hardness = 2.0 µg/l AL	Total The one-hour average, concentration in µg/l cannot exceed the numerical value given by $_e$ [1.128{ln(hardness as mg/l)} –3.828] more than once every 3 years on the average. AL The four day average concentration in µg/l cannot exceed the numerical value given by $_e$ [.7852{ln(hardness as mg/l)} –3.490] more than once every 3 years on the average.	$_e$ [0.7852 {ln(hardness as mg/l)} –3.49], where hardness is expressed in mg/l $CaCO_3$ and the resultant objective is expressed in µg/l. (e.g.) 50 mg/l $CaCO_3$ = 0.66 µg/l, 100 mg/l $CaCO_3$ = 1.1µg/l, 200 mg/l $CaCO_3$ = 2.0 µg/l. AL	Less than detection.	Minnesota and Manitoba for the protection of aquatic life and wildlife.
Chromium	None	Total 50 µg/l DW	$_e$ [0.8190 {ln (hardness)} +1.561],	50 µg/l	North Dakota based on domestic consumption.

Parameter	Minnesota Standards	North Dakota Standards	Manitoba Objectives	Red River Pollution Board Objectives	Origin/ Rational
			where hardness is expressed in mg/l $CaCO_3$ and the resultant objectives is expressed in µg/l. (e.g.) 50 mg/l $CaCO_3$ = 120 µg/l, 100 mg/l $CaCO_3$ = 210 µg/l, 200 mg/l $CaCO_3$ = 370 µg/l.		
Chromium, Trivalent	Total The chronic standard shall not exceed: exp. [0.819{ln (total hardness mg/l}+ 1.561]. For hardness values greater than 400 mg/l, 400 mg/l shall be used in the calculation of the standard. Chromium +3 standards in µg/l at various hardness values: 50 mg/l hardness = 117 µg/l, 100 mg/l hardness = 207 µg/l, 200 mg/l hardness = 365 µg/l. AL	None	$_e$ [0.8190 {ln (hardness)} +1.561], where hardness is expressed in mg/l $CaCO_3$ and the resultant objectives is expressed in µg/l. (e.g.) 50 mg/l $CaCO_3$ = 120 µg/l, 100 mg/l $CaCO_3$ = 210 µg/l, 200 mg/l $CaCO_3$ = 370 µg/l.. AL	None	Manitoba and Minnesota for the protection of aquatic life.
Chromium, Hexavalent	Total The chronic standard is 11 µg/l AL	None	11 µg/l AL	None	Manitoba and Minnesota for the protection of aquatic life.

Parameter	Minnesota Standards	North Dakota Standards	Manitoba Objectives	Red River Pollution Board Objectives	Origin/ Rational
Copper	Total The chronic standard shall not exceed: exp. [0.62 {ln (total hardness mg/l}) -0.57]. For hardness values greater than 400 mg/l, 400 mg/l shall be used in the calculation of the standard. Copper standards in µg/l at various harness values: 50 mg/l hardness = 6.4 µg/l, 100 mg/l hardness = 9.8 µg/l, 200 mg/l hardness = 15 µg/l . AL	Total The one-hour average concentration in µg/l cannot exceed the numerical value given by $_{e}$[.9422{1n (hardness as mg/l})-1.464] more than once every 3 years on the average. The four-day average concentration in µg/l cannot exceed the numerical value given by $_{e}$ [8545{ln (hardness as mg/l)} –1.465] more than once every 3 years on the average. AL	$_{e}$[0.8545{ln(hardness)}-1.465], where hardness is expressed in mg/l $CaCO_3$ and the resultant objective is expressed in µg/l. (e.g.) 50 mg/l $CaCO_3$ = 6.5 µg/l., 100 mg/l $CaCO_3$ = 12 µg/l, 200 mg/l $CaCO_3$ = 21 µg/l.		Minnesota and Manitoba for the protection of aquatic life.
Iron	300 µg/l DW	None	300 µg/l DW	300 µg/l	Minnesota, Manitoba based on domestic consumption.
Lead	Total The chronic standard shall not exceed: exp. [1.273{ln (total hardness mg/l)}-4.705]. For hardness values greater than 400 mg/l, 400 mg/l shall be used in the calculation of the standard. Lead standards in µg/l at various hardness values: 50 mg/l hardness = 1.3 µg/l 100 mg/l hardness = 3.2 µg/l 200 mg/l hardness = 7.7 µg/l AL	Total The one-hour average concentration in µg/l cannot exceed the numerical value given by $_{e}$ [1.266{In (hardness as mg/l) - 1.416] more than once every 3 years on the average. The four-day average concentration in µg/l cannot exceed the numerical value given by $_{e}$ (1.266{ln (hardness as mg/l) - 4.661) more than once every 3 years on the average. AL	$_{e}$ [1.273{ln (hardness)} - 4.705], where hardness is expressed in µg/l $CaCO_3$ and the resultant objective is expressed in µg/l. (e.g.) 50 mg/l $CaCO_3$ = 1.3 µg/l, 100 mg/l $CaCO_3$ = 3.2 µg/l, 200 mg/l $CaCO_3$ = 7.7 µg/l,		Manitoba, Minnesota and North Dakota for the protection of aquatic life and wildlife.
Manganese	50 µg/l DW	None	50 µg/l DW	50 µg/l	Minnesota and Manitoba based on domestic consumption.

Parameter	Minnesota Standards	North Dakota Standards	Manitoba Objectives	Red River Pollution Board Objectives	Origin/ Rational
Mercury	Total 0.0069 µg/l AL	Total Acute 2.4 µg/l Chronic 0.012 µg/l AL	Acid soluble mercury 0.006 µg/l	Less than detection in water. 0.5 micrograms per gram in fish fillets.	Minnesota, North Dakota and Manitoba for protection of aquatic life, animal life and humans as a result of bioconcentrations in tissue in the food chain.
Nickel	Total The chronic standard (CS) shall not exceed the human health-based criterion of 88 µg/l. For waters with total hardness values less than 50 mg/l, the CS shall not exceed: exp. [0.846{ln(total hardness mg/l)} + 1.1645]. AL and HH	None	$_{e}$ [0.76{ln(hardness)} None +1.06], where hardness is expressed in mg/l) $CaCO_3$ and the resultant objective is expressed in µg/l (e.g.) 50 mg/l $CaCO_3$ = 56 µg/l, 100 mg/l $CaCO_3$ = 96 µg/l, 200 mg/l $CaCO_3$ = 160 µg/l, AL	None	Minnesota for the protection of aquatic life and human health. Manitoba for the protection of aquatic life.
Selenium	Total 5 µg/l AL	10 µg/l DW	10 µg/l DW	10 µg/l	Manitoba and North Dakota based on domestic consumption. Minnesota for the protection of aquatic life.
Silver	Total The chronic standard shall not exceed 1.0 µg/l. AL	The one-hour average concentration in µg/l cannot exceed the numerical value given by $_{e}$ [1.72{ln(hardness)} as mg/l)}-6.52] more than once every three years on the average. AL	0.1 µg/l AL	None	Manitoba, Minnesota and North Dakota for protection of aquatic life.

Parameter	Minnesota Standards	North Dakota Standards	Manitoba Objectives	Red River Pollution Board Objectives	Origin/ Rational
Zinc	Total The chronic standard shall not exceed: exp. [0.8473{ln(total hardness mg/l)} + 0.7615], For hardness values greater than 400 mg/l, 400 mg/l shall be used in the calculation of the standard. Zinc standards in µg/l at various hardness values: 50 mg/l hardness = 59 µg/l 100 mg/l hardness = 106 µg/l 200 mg/l hardness = 191 µg/l AL	Total The one-hour average concentration in µg/l cannot exceed the numerical value given by e [.8473{ln(hardness as mg/l)} +.8604] more than one every 3 years on the average. The four-day average concentration in µg/l cannot exceed the numerical value given by e [.8473 {ln(hardness as mg/l})+.7614] more than once every 3 years on the average. AL	47 µg/l AL	47 µg/l	Minnesota, North Dakota and Manitoba for the protection of aquatic life.
Nutrients					
Nitrates (N)	Total 10 mg/l DW	Dissolved 1.0 mg/l DW	Total 10 mg/l DW	Total 10 mg/l	Minnesota and Manitoba based on domestic consumption.
Toxic Substances					
Arsenic	Total 50 µg/l DW and AL	Total 50 µg/l DW	Acid soluble arsenic 50 µg/l DW	Total 10 µg/l (under review)	Minnesota based on domestic consumption and for protection of aquatic life.
Boron	500 µg/l IR	750 µg/l IR	500 µg/l IR	Total 500 µg/l	Minnesota, Manitoba based on irrigation water.
Chlorine	Total residual 6 µg/l	None	None	None	Minnesota for protection of aquatic life.
Cyanide	Free cyanide 5.2 µg/l AL	Total 5 µg/l AL	Free cyanide 5.2 µg/l cyanide AL	Total 5 µg/l	Minnesota and North Dakota for protection of aquatic life.

Parameter	Minnesota Standards	North Dakota Standards	Manitoba Objectives	Red River Pollution Board Objectives	Origin/ Rational
Dioxin	None	None	None	Not detectable in any media analyzing to parts per trillion.	Task Force
PCBs	Total 0.000029 µg/l AL and HH	Total Acute 2.0 µg/l Chronic 0.014 µg/l AL	.014 µg/l AL	Not detectable in water, in fish total PCBs not exceeding 2 micrograms per gram in fillets.	Body burden: Manitoba, North Dakota and Minnesota for protection of aquatic life, animal life and human life.
Phenolics	None	None	1 µg/l DW	10 µg/l	North Dakota to protect against taste and odor in water and fish.
Phenol	123 µg/l AL	Total 10 µg/l DW	1.0 µg/l 2.0 AL	None	North Dakota to protect against taste and odor in water and fish.
Pentachlorophenol	The chronic standard shall not exceed: exp.[1.005{pH} – 5 .290]. Pentachlorophenol standards in µg/l at, various pH values: pH 7.0 = 5.7 µg/l, pH 7.5 = 9.5 µg/l, pH 8.0 = 16 µg/l. AL	Acute 20.0 µg/l Chronic 13.0 µg/l AL	0.06 mg/l DW	None	Minnesota and North Dakota for the protection of aquatic life. Manitoba based on domestic consumption.
Pesticides and Volatile Hydrocarbons	Acenapthene 12 µg/l Acrylonitrile 0.38 µg/l Anthracene 0.029 µg/l Benzene 6.9 µg/l Bromoform 128 µg/l	Aldrin (total) Acute 3.0 µg/l Chlordane (total) Acute 2.4 µg/l Chronic 0.0043 µg/l	Aldicarb 0.009 mg/l Aldrin + Dieldrin 0.0007 mg/l Atrazine	Not detectable in water**	All agencies for the protection of aquatic life, animal life domestic consumption and human health.

** Limits in fish tissue are being researched by the Task Force.
Tissue samples have been collected by North Dakota and Manitoba.

Parameter	Minnesota Standards	North Dakota Standards	Manitoba Objectives	Red River Pollution Board Objectives	Origin/ Rational
	Carbon Tetrachloride 1.9 µg/l Chlordane 0.00029 µg/l Chlorobenzene 10 µg/l Chloroform 55 µg/l Chlorpyrifos 0.041 µg/l DDT 0.0017 µg/l 1,2-Dichloroethane 3.8 µg/l Dieldrin 0.000026 µg/l Di-2-Ethylhexyl phthalate 1.9 µg/l Di-n-Octyl phthalate 30 µg/l Endosulfan 0.15 µg/l Endrin 0.016 µg/l Ethylbenzene 68 µg/l Fluoranthene 4.1 µg/l Heptachlor 0.00039 µg/l Heptachlor epoxide 0.00048 µg/l Hexachlorobenzene 0.00022 µg/l Lindane 0.032 µg/l Methylene chloride 46 µg/l Parathion 0.013 µg/l Phenanthrene 2.1 µg/l 1,1,2,2-Tetrachloroethane 1.54 µg/l Tetrachloroethylene 3.8 µg/l 1,1,1-Trichloroethane 263µg/l 1,1,2-Trichloroethylene25µg/l 2,4,6-Trichlorophenol 2.0µg/l Toluene 253 µg/l Toxaphene 0.0013 µg/l	Dieldrin (total) Acute 2.5 µg/l Chronic .002 µg/l Endosulfan (total) Acute .22 µg/l Chronic .06 µg/l (continued) Endrin (total) Acute .18 µg/l Chronic .0023 µg/l Heptachlor (total) Acute .52 µg/l Chronic .004 µg/l Lindane (Hexachlorocyclohexane) Acute 2.0 µg/l Chronic .06 µg/l Toxaphene (total) Acute .73 µg/l Chronic .0002 µg/l AL	0.06 mg/l Azinphos-methyl 0.02 mg/l Bendiocarb 0.04 mg/l Benzene 0.005 mg/l Benzo (a) pyrene 0.00001 mg/l Bromoxynil 0.005 mg/l Carbaryl 0.09 mg/l Carbofuran 0.09 mg/l Carbon tetrachloride 0.005 mg/l Chlordane 0.0043 µg/l Chlorpyrifos 0.09 mg/l Cyanazine 0.01 mg/l Diazinon 0.02 mg/l Dicamba 0.12 mg/l 1,2-Dichlorobenzene 0.2 mg/l 1,4-Dichlorobenzene 0.005 mg/l DDT and metabolites 0.001 µg/l 1,2-Dichloroethane		

Parameter	Minnesota Standards	North Dakota Standards	Manitoba Objectives	Red River Pollution Board Objectives	Origin/ Rational
	Vinyl Chloride 0.15 µg/l Xylene(total m, p and o) 166 µg/l		0.005 mg/l Dichloromethane 0.05 mg/l 2,4-Dichlorophenol 0.9 mg/l 2,4-D – 0.9 mg/l (continued) Diclofop-methyl 0.009 mg/l Dieldrin – 0.0019 µg/l Dimethoate – 0.02 mg/l Diquat – 0.07 mg/l Diuron – 0.15 mg/l Endosulfan – 0.056 µg/l Endrin – 0.0023 µg/l Glyphosate – 0.18 mg/l Heptachlor and heptachlor epoxides – 0.0038 µg/l Hexachlorobutadiene 0.1 µg/l Lindane – 0.080 µg/l Malathion – 0.19 mg/l Methoxychlor – 0.9 mg/l Metribuzin – 0.08 mg/l Monochlorobenzene 0.08 mg/l Nitrilotriacetic acid 0.05 mg/l Paraquat – 0.01 mg/l Parathion – 0.05 mg/l Phthalic acid esters: Dibutylphthalate–4.0 µg/l Dii-(2-ethylhexyl) phthalate 0.6 µg/l other phthalates –0.2 µg/l Phorate – 0.002 mg/l Picloram – 0.19 mg/l Polychlorinated biphenyls 0.014 µg/l		

Parameter	Minnesota Standards	North Dakota Standards	Manitoba Objectives	Red River Pollution Board Objectives	Origin/ Rational
			Simazine – 0.01 mg/l Temephos – 0.28 mg/l Terbufos – 0.001 mg/l (continued) 2,3,4,6- Tetrachlorophenol 0.1mg/l Toxaphene – 0.013 µg/l Triallate – 0.23 mg/l Trichloroethylene 0.05 mg/l 2,4,6-Trichlorophenol 0.005 mg/l 2,4,5-T – 0.28 mg/l Trifluralin – 0.045 mg/l Trihalomethanes 0.35 mg/l DW and AL		
Oil and Grease	500 µg/l HH	No visible film or sheen upon the waters.	Free from oil and grease residues which cause a visible film or sheen upon the waters or any discolouration of the surface of adjoining shorelines, or cause a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines.	No visible sheen on the surface.	All agencies based on aesthetics, taste and odor in water and fish, and bathing.

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APPENDIX C

WATER POLLUTION CONTROL CONTINGENCY

PLAN LIST OF CONTACTS

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Notification List
For D.O. Depletions, Non-toxic, Oil, and Toxic Spills

United States:

Minnesota Pollution Control Agency – Detroit Lakes, MN

Jim Ziegler
(218) 856-0730 office
(218) 846-0719 Fax
1-800-422-0798 (24hr)

Molly MacGregor
(218) 846-0494 office
(218) 846-0719 Fax
1-800-422-0798

Minnesota Department of Natural Resources – Bemiji, MN (Fisheries)

Keith Mykleseth
(208) 755-3959 office
1-800- 422-0798 (24hr)

North Dakota Health Department – Bismarck, ND

Mike Ell (temporary – to replace Dennis Fewless)
(701) 328-5210 office
(701) 328-5200 fax
1-800-472-2121 (24hr in-state-ask for REACT Officer)
(701) 328-9921 (24hr out-of-state – ask for REACT Officer)

Environmental Protection Agency – Denver, CO

Bert Garcia
(303) 312-6670 office
(303) 312-7206 fax
1-800-424- 8802 (24hr National Response Center)

Canada:

Manitoba Stewardship & Water Conservation – Winnipeg, MB

Nicole Armstrong
(204) 945-3991 office
(204) 948-2357 fax
(204) 944-4888 (24hr telephone service emergency number)

Environment Canada – Winnipeg, MB

Kristina Farmer
(204) 983-4932 office
(204) 294-5128 cell

APPENDIX D

HYDROLOGY COMMITTEE, AQUATIC ECOSYSTEM COMMITTEE, AND WATER QUALITY COMMITTEE MEMBERSHIP LIST

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International Red River Board
Hydrology Committee
Membership:

Name	Organization	Phone	E-mail
Mark Lee (Chair) Steve Topping (Alt.)	Manitoba Water Stewardship, Winnipeg	(204) 945-5606 (204) 945-6398	Mark.Lee@gov.mb.ca stopping@gov.mb.ca
Steve Robinson (Chair) Gregg Wiche (Alt.)	USGS, Bismarck	(701) 775-7221 (701) 250-7400	Smrobins@usgs.gov gjwiche@usgs.gov
Girma A. Sahlu	Environment Canada, Secretary IRRB, Regina, SK	(306) 780-6425	Girma.Sahlu@EC.GC.CA
Scott Jutila	Corps of Engineers, Secretary IRRB, St. Paul, MN	(651) 290-5631	Scott.A.Jutila@usace.army.mil
Randy Gjestvang	N.D. State Water Commission, West Fargo	(701) 282-2318	rgjest@water.swc.state.nd.us
Haitham Ghamry	Dept. of Fisheries & Oceans Canada	(204) 983-5206	Ghamry.Haitham@dfo-mpo.gc.ca
Vacant	Minnesota DNR, Bemidji		

lnternational Red River Board
Aquatic Ecosystem Committee
Membership:

Name	Organization	Phone	E-mail
Mike Ell	NDHD/Bismarck	(701) 328-5214	mell@nd.gov
Wayne Berkas	USGS/Bismarck	(701) 250-7429	wrberkas@usgs.gov
Mike Vavricka	MPCA/Detroit Lakes	(218) 846-8137	michael.vavricka@state.mn.us
Lance Yohe	RRBC/Moorhead	(218) 291-0422	lancer2b2@corpcomm.net
Patricia Ramlal (Co-Chair)	Fisheries and Oceans Canada	(204) 983-8838	Patricia.Ramlal@dfo-mpo.gc.ca
Megan Estep (Co-Chair)	US FWS	303-236-4491	meg_estep@fws.gov
Nicole Armstrong	MB Conservations & Water Stewardship	(204) 945-3991	Nicole.Armstrong@gov.mb.ca
Kristina Farmer	Environment Canada	204-983-4932	Kristina.Famer@ec.gc.ca

International Red River Board
Water Quality Committee
Membership:

Name	Organization	Phone	E-mail
Jim Ziegler, (Co-chair)	Minnesota Pollution Control Agency		Jim.Ziegler@state.mn.us
Nicole Armstrong, (Co-Chair)	Manitoba Conservation and Water Stewardship	(204) 945-3991	nicole.armstrong@gov.mb.ca
Mike Ell	North Dakota State Department of Health	(701) 328-5214	mell@nd.gov
Dennis Fewless	North Dakota State Department of Health		dfewless@nd.gov
Mike Vavricka	MPCA/Detroit Lakes	(218) 846-8137	michael.vavricka@state.mn.us
Leah Thvedt	RRBC/Moorhead	(218) 291-0422	leah@redriverbasincommission.org
Rochelle Nustad	USGS	(701) 231-9747	
Eric Steinhaus	US EPA	(303) 312-6837	Steinhaus.Eric@epa.gov
Sharon Reedyk	Agriculture and Agri-Food Canada		
Jeff Lewis	RRBC		Jeff@redriverbasincommission.org
Mike Vavricka	MPCA/Detroit Lakes	(218) 846-8137	michael.vavricka@state.mn.us
Iris Griffin	Environment Canada	204-984-5694	iris.griffin@ec.gc.ca
Rob Sip	MN Dept. of Agriculture		
Keith Weston	US Dept. of Agriculture		
Justin Shead	MB Conservation & Water Stewardship		

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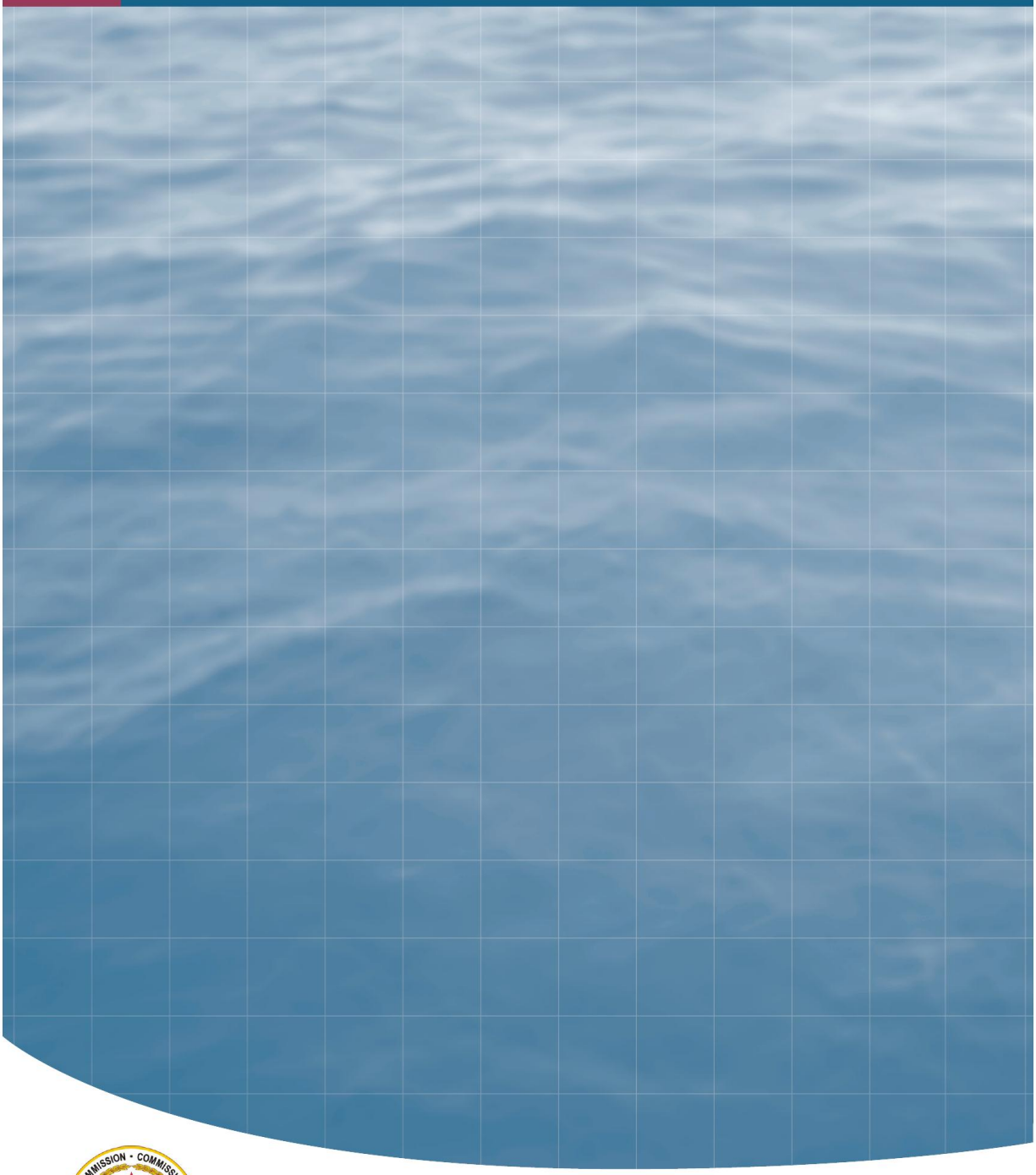


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